Gas Resource Management

Issue Paper

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1 Introduction

Gas resources continue to be a critical component of the resource fleet, supporting grid reliability while enabling the integration of greater numbers of renewable resources. The Gas Resource Management (GRM) policy initiative considers gas resource participation and cost recovery in the markets operated by the California Independent System Operator (ISO).

Over the past decade, the ISO and its stakeholders have made certain incremental changes to the ISO's market rules to add bidding flexibility and enhance cost recovery for gas resources through market bids. The ISO has also implemented broader policy changes to better adapt the market to the rapidly evolving resource fleet. A suite of tools and processes are in place today to enhance gas-electric market coordination and improve situational awareness for both gas and electric market operators.

To continue to better adapt the participation of gas resources in the wholesale electricity market, a series of working groups were held between the ISO and interested stakeholders to understand what is working and what are the on-going or emerging friction points between gas and electricity systems, operations, and trading in the West. Identifying and addressing these issues is essential for the ISO and its market participants to create a more efficient and coordinated gas and electric system under an expanded and increasingly integrated electric grid.

The purpose of this issue paper is to give stakeholders a roadmap of existing market functionality, identify emerging issues and issues to resolve, and ensure diverse market participant perspectives are effectively represented and considered in the final policy design.

2 Executive Summary

This issue paper explores problem statements and provides history and context on policy questions associated with gas resource participation in ISO-operated wholesale electric markets. The energy markets the ISO operates are designed to produce physically feasible schedules, dispatches, and prices that reflect the costs and characteristics of resources participating in the markets. Supply resources are able to submit bids for their marginal energy separately from their start-up, minimum load, and transition costs. Gas fired resources reflect the cost of fuel in their bid components to ensure that if dispatched or committed by the markets, market revenues adequately cover their fuel costs. Because gas procurement can be challenging based on gas system operations, fuel prices volatility, and gas limitations, the energy markets are constructed to provide sufficient flexibility to reflect uncertainty around the fuel costs that are incorporated within each cost based bids.

In those instances in which the resources must rely on cost based bids, it is important that the bid components have sufficient flexibility to allow entities to incorporate the costs they face. At the same time, because how these costs are reflected can result in the exercise of market power, it is important to ensure there are measures that protect the market from such behavior. In this initiative, we set out to determine what parts of the market design may limit the ability for gas resources participating in the

Western Energy Imbalance Market (WEIM) today, and the Extended Day Ahead Market (EDAM) in the future, to accurately reflect their gas costs and availability.

The stakeholder working group on this initiative focused on the cost-based components of gas resource bids used in the market clearing prices, referred to as reference levels. When the ISO mitigates or limits resource-submitted bids to protect against market power, the ISO may use reference level calculations to proxy resource costs in the market. This practice ensures the market can optimally commit resources to meet demand at least cost, even in uncompetitive situations.

The ISO and its stakeholders have evolved the design of reference levels as policy goals have been informed by experience over the past decade. Policy today reflects a need to accommodate gas price volatility, gas system limitations, and diverse supply arrangements. Stakeholders discussed these challenges as part of two most recent gas policy stakeholder initiatives: Aliso Canyon Gas Electric Coordination[1] and Commitment Costs and Default Energy Bid Enhancements (CCDEBE).[2] [3]

The principles established through these gas policy initiatives apply across all of the ISO markets, including the Western Energy Imbalance Market (WEIM) and the Extended Day-Ahead Market (EDAM) when it becomes operational. However, these measures and market rules were developed primarily taking into consideration the gas system serving resources within the CAISO balancing area footprint, and the needs of real-time only regional market participants.

As the WEIM footprint has evolved and day-ahead participation expands to regional participants, it is important to consider whether the market rules require enhancements to consider the unique characteristics of the gas markets and systems that serve resources in the WEIM and EDAM.

Regional market participants experience volatility, illiquidity, and constrained conditions[4] [5] leading to greater risk that ISO calculated reference levels do not completely capture a gas resource's actual or expected fuel costs. Regional market participants cite other differences in regional gas systems that may expose them to risk that they can't purchase fuel at prevailing commodity market prices. For example,

[1] Aliso Canyon gas electric coordination stakeholder initiative page: California ISO - Aliso Canyon gas-electric coordination (caiso.com)

[2] Commitment costs and default energy bid enhancements stakeholder initiative: California ISO - Commitment costs and default energy bid enhancements (caiso.com)

[3] Through these efforts, the ISO and stakeholders have sought to balance trade-offs between administrative complexity and efficiency. Bidding flexibility is a simple solution to ensuring resources have the opportunity to provide correct cost information to the ISO but flexibility must be balanced with market power protection. While administratively burdensome, efforts to improve reference level accuracy reduce the need for bidding flexibility.

[4] Differences in regional gas conditions are illustrated in Gas Conditions and CAISO Markets February 6, 2023: Gas-Conditions-and-CAISO-Markets-Report-for-Dec2022-Jan2023.pdf

[5] The ISO and stakeholders discussed increasing volatility and different gas regional gas market conditions in the January 25, 2024 working group: https://stakeholdercenter.caiso.com/InitiativeDocuments/Presentation-GasResourceManagement-Jan25-2024.pdf

resources with relatively less gas storage infrastructure are generally more exposed to gas price volatility.

Extending market participation from the WEIM – a real time market – to the Extended Day Ahead Market (EDAM), which covers both day-ahead and real-time market participation, changes the nature of market participation as regional resources also now are offered into the day-ahead market and manage gas procurement to support day-ahead and real-time market awards. The ISO's EDAM is designed to ensure the system can deliver reliable and efficient market outcomes not only during critical events but consistently, even as grid conditions shift and evolve. However, WEIM-only participants today determine their own base schedules as part of their day-ahead operating plan and during the working group discussions have shaped identification of problem statements associated with full economic market participation through the day-ahead market.

During preliminary GRM working group meetings, working group participants conveyed that they expect to face more risk from price uncertainty than market participants can feasibly manage themselves, and have identified four major areas where existing policy might be further enhanced:

1. Informing Fuel Procurement
2. Accommodating Gas Cost Variation in Reference Levels
3. Accessibility of the Reference Level Change Request Process
4. Managing Gas Burn Limitations

While these topics have previously been identified and addressed through policy, in response to stakeholder requests the ISO is now reconsidering questions associated with these policy areas in a regional and day-ahead context.

3 Reader's Guide

This section summarizes the GRM working group perspectives on the topic areas discussed in this paper, identifies the relevant sections of this paper where these issues are discussed in more detail, and introduces next steps for policy development based on stakeholder feedback.

This section is organized as follows:

- **3.1 Gas Electric Market Timeline:** This sub-section establishes short-hand and serves as a reference for key terms and concepts that appear throughout this issue paper.
- **3.2 Fuel Procurement Decisions**: In anticipation of uncertain procurement targets and the attendant impact on intra-day gas prices, stakeholders identified a need for more accurate information to support fuel procurement decisions as the highest priority need coming out of the working group process.
- **3.3 Cost Recovery Risk**: Stakeholders identified scenarios where they face potentially high risk that fuel costs could exceed prices assumed when obtaining their electric market schedules.

- **3.4 Gas System Limitations**: In-so-far as daily gas burn limitations do not pose an immediate reliability concern, stakeholders recommend exploring new tools to more efficiently manage gas burn limits.

Each of the subsequent Sections 4-7 responds to stakeholder recommendations by reviewing the principles and policy goals motivating policy design as it exists today and highlighting salient stakeholder proposed problem statements in that context. Each section identifies opportunities or practical considerations associated with stakeholder recommendations.

➔ Each section includes specific prompts where the ISO is seeking specific stakeholder input to inform next steps. Stakeholders can use these prompts to guide comments and discussion.

3.1 Gas Electric Market Timelines

During the GRM working group discussions, stakeholders identified three main challenges that arise due to the mismatch between gas and electric market timelines:

1. The most liquid gas trading cycle, the Timely nomination cycle open during the next day gas day, ends before the ISO publishes financially binding day-ahead awards. Gas resources must choose to make procurement decisions based on uncertain procurement targets.

2. Because the next day gas price does not fully settle until after day-ahead bids are due, gas resources may not have sufficient, or accurate, information to precisely inform cost adjustments when necessary prior to the close of the day-ahead market.

3. The ISO uses a single gas price index to represent the market price of fuel over the full 24 hours of the real-time electric trade day, but gas resources procure fuel for the electric day during different trading cycles with separate average price indices.

These challenges illustrate different sources of risk inherent to the structure of the electric markets and thematic of stakeholder identified problem statements discussed in this issue paper.

This section defines key terms and shorthand used throughout this issue paper. Tables 1-3 summarize key terms and processes, and Figure 1 combines these concepts in a timeline.

Table 1 Electric Market timeline and processes

Electric Market timeline and processes	
HE1-24: Hours ending in 1-24	For example, HE10 is the 9-10am trade window.
Day-Ahead Market	Supply offers are due by 10am, and market results are typically posted around 1pm.
DA2: Two days before the real-time electric trade day	The day-ahead market process on DA2 produces non-binding advisory results for RT
DA1: One day before the real-time electric trade day	The day-ahead market run on DA1 produces financially binding market awards for RT
RT: Real-time electric trade-day	The real-time trade-day covers HE1-24

Table 2 Gas Market Timeline: gas days and index used in real-time electric market operations

Gas Market Timeline				
	Opens	Closes	Delivery	Used for
GD1 Next day gas day 1	11:00am DA3*	11:00am DA2	7:00am DA1	RT HE1-7
GD2 Next day gas day 2	11:00am DA2	11:00am DA1	7:00am RT	RT HE8-24
GPI Gas Price Index	The ISO uses an early estimate of the GPI for GD2 in the day-ahead market		The ISO uses the final settled GPI for GD2 for RT HE1 – 24	

Table 3 Gas Market Trading Cycles and descriptions

Gas Market Trading Cycles			
	Deadline	**Delivery**	
Timely Nomination Cycle	11:00am DA1	7:00am RT	The timely nomination cycle is the most liquid gas trading cycle during which most fuel is procured.
Evening Nomination Cycle	4:00pm DA1	7:00am RT	Resources can nominate additional gas flows effective the next day, similar to the Timely Cycle. However, nominations compete for available capacity, and trades are not included in the GPI.
Intra-day 1	8:00am RT	12:00pm RT	Intra-day cycles are intended to provide gas resources with an opportunity to modify previously scheduled quantities after gas flow has commenced for the gas day. The ISO understands that some resources use intra-day 3 on DA1 to ensure sufficient supply for RT HE1-7
Intra-day 2	12:30pm RT	3:30pm RT	
Intra-day 3	5:00pm RT	8:00pm RT	

Table 3 above lists and describes the Timely, Evening, and Intra-day gas cycles. Of those, only the Timely nomination cycle is part of the next day gas days described in Table 2. The ISO only uses gas trade data from the next day gas day to inform ISO operations, like reference levels, on a regular basis.

Figure 1 below illustrates the timing of gas procurement relative to the day-ahead and real-time electric market timelines. Gas resources procure gas during the Timely gas nomination cycle on the next day gas day beginning on DA2 (the top row of Figure 1) and ending at HE11 on DA1 (the middle row of Figure 1) for fuel delivery HE07 in RT (the bottom row of Figure 1).

The day-ahead market process on DA2 publishes advisory information in time to inform gas trading during the rest of GD2.

- **Section 4** discusses the market processes and resulting advisory information intended to inform fuel procurement, and stakeholder recommended improvements.

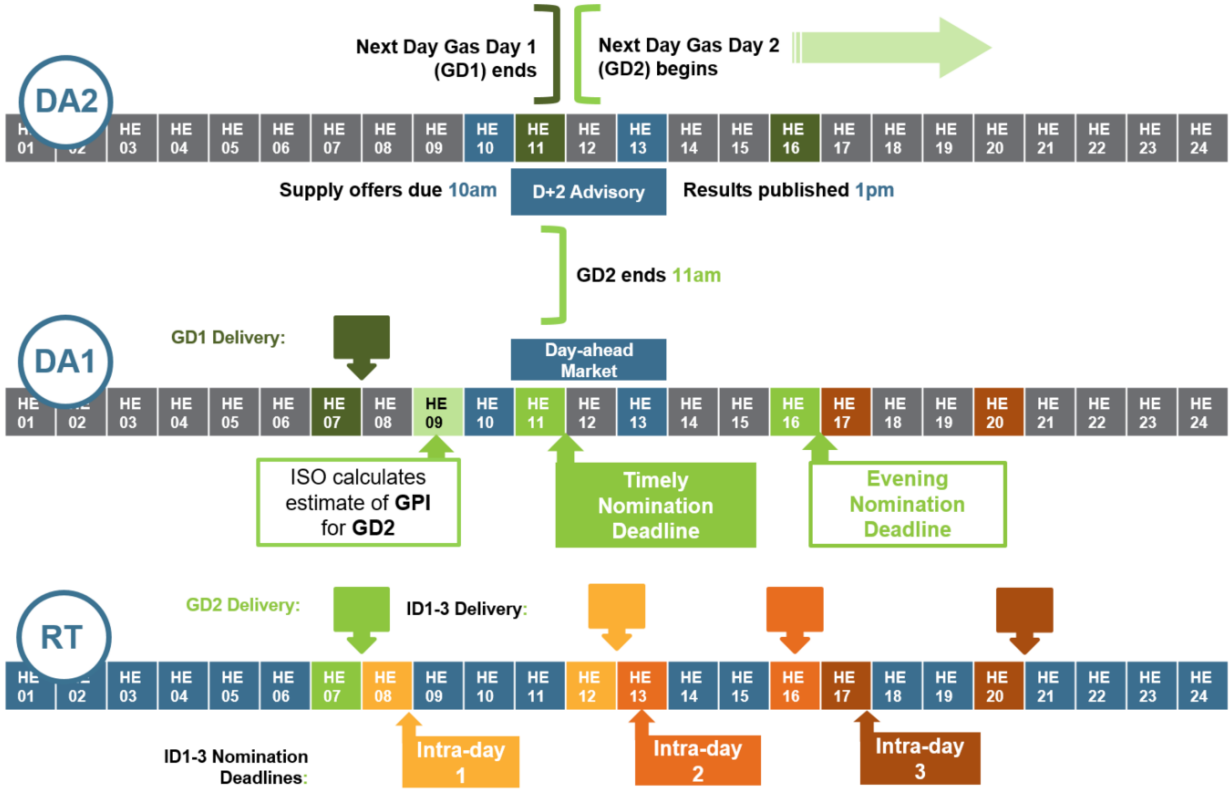
Because the index price for GD2 does not settle until after 11am when the day-ahead market gas already closed, the ISO calculates an estimate of the gas price index for GD2 based on trades cleared by around 8:00am for use in day-ahead market processes on DA1.

- **Section 5.2** discusses the ISO's procedures for identifying relevant commodity prices to use in reference levels in greater detail.

The real-time electric trade-day, RT, includes two different flow days—GD1 and GD2—but uses the GD2 price index for real-time reference levels. Gas flow from GD1 is active at 7am (HE07) on DA1 until 7am (HE07) in RT. Gas flow from GD2 is active 7am (HE07) in RT.

- **Section 5.3.2** discusses how resources may manage risk from day-over-day price changes within the context of observed market conditions, and compares outcomes today to stakeholder suggestions from the working group process.

Figure 1 Gas and Electric Market Timelines



3.2 Fuel Procurement Decisions

The day-ahead market process provides a resource plan for the following day. Suppliers can lock in some financial certainty, reducing the cost-risk from intra-day gas price volatility and real-time changes in demand, while the ISO is assured that resources are committed to meet next day needs. Absent a day-ahead market, a real-time only market locks in prices for a short amount of time, providing market participants with less flexibility to make financial and fuel procurement decisions which (at best) reduces market efficiency.

Because of the timing of the electric day-ahead market relative to the gas day, gas resources must choose to make procurement decisions without knowing procurement targets or expected revenue. Intra-day gas trading is intended to provide gas resources with additional flexibility to adjust their gas

nominations and respond to real-time changes in load.[6] However, intra-day fuel procurement may have more costly premiums related to just-in-time procurement, and transactional risks due to gas supply illiquidity. Gas resources afforded more bidding flexibility can better manage their cost exposure from procuring incremental fuel supply.

Today, intra-day trading represents a fraction of what is procured during the Timely cycle, but GRM working group participants expect that this will change. To the extent that gas resources systematically rely on intra-day gas cycles to meet larger proportions of their day-ahead commitments, more buyers than sellers participating intra-day may exacerbate already illiquid gas market conditions and increase resource's reliance on cost-adjustments.

Flexibility to manage intra-day deviations is not a substitute for day-ahead predictability. To manage procurement cost risk associated with meeting day-ahead commitments, gas resources either need more certainty before the day-ahead market or better insurance in real-time. Supporting market participation through real-time cost-adjustments can increase market prices while not addressing the root cause.

Areas of focus for policy development will need to balance solutions to improve market participants' confidence in information the ISO provides to inform day-ahead fuel procurement with more targeted solutions that address the unique challenges facing regional market participants.

Section 4 provides background on the role of information in support of fuel procurement ahead of real time, discusses how the ISO supports fuel procurement today and will support fuel procurement with enhancements under development for EDAM. The ISO is seeking stakeholder feedback on whether planned or other potential enhancements may improve confidence in non-binding advisory information provided in advance of the day-ahead market.

3.3 Cost Recovery Risk

Gas resources face cost recovery risk if reference levels do not represent a resource's costs with sufficient accuracy. The reference level change request process and after-market cost recovery processes provide resources with opportunities to resolve this risk, but these processes are not intended for regular use. During the GRM working groups, stakeholders suggested that they currently, or expect to, routinely incur costs that are not sufficiently captured by the calculated reference level methodology the ISO uses today. Stakeholders cited challenges reflecting and managing volatility and changing gas market conditions.

Stakeholders described two scenarios in which cost recovery risk from inaccurate reference levels does, or is expected to, materialize:

[6] FERC Order No. 809

(1) Marginal units face the most day-ahead uncertainty and highest cost recovery risk if default energy bids are inaccurate. When the ISO detects uncompetitive conditions and marginal bids exceed the competitive price[7], a marginal resource may rely on its DEB to accurately represent its costs in the market.

(2) When intra-day prices are volatile and trading is illiquid, commitment costs fixed at a day-ahead market price may not be a durable representation of actual costs.[8] In order to manage exposure to gas price volatility, resources may try to submit commitment cost bids that include a cost margin accounting for risk or uncertainty but may not have sufficient flexibility to do so due to the commitment cost cap.

Stakeholder problem statements focus on ensuring reference levels can accommodate volatility and changing gas market conditions. Problem statements identify three potential sources of inaccurate reference levels: inaccurate gas price information, insufficient flexibility to manage gas price volatility, and limited opportunities to reflect unique supply arrangements. Stakeholder recommended solutions include using more up to date gas price indices in reference levels by default, and increasing bidding flexibility built into reference level calculations.

Problem statements and stakeholder recommended next steps are discussed in greater detail in sections 5 and 6.

Section 5 describes how reference levels and reference level adjustment opportunities are intended to accommodate gas price volatility and highlights enhancements made in recent years (e.g. eliminating the lag in gas price index used for the day-ahead market) to minimize the potential for systematic inaccuracies. This section provides examples of analytical methods that the ISO, stakeholders, and regulators have used to assess these tools as they are designed today. These examples can serve as a baseline for stakeholders to evaluate and provide input on the appropriateness of existing policy within the context of regional gas market conditions today.

➔ The ISO is seeking stakeholder feedback on which tools described in this section, if any, are appropriate solutions to the problems described, how to best assess these tools, and how these tools could be improved.

Cost adjustment opportunities are not intended to correct systematic inaccuracies, and market participants should not have to rely on cost adjustments regularly. For this reason, Section 5 captures

[7] GRM working group participants initially identified bid mitigation during periods of gas price volatility as a scope item for problem statement formation, citing heightened mitigation risk during periods of gas market volatility or when using incremental energy bids to economically manage gas burn limitations.
[8] Resources committed day ahead may not rebid their commitment costs in real-time. This policy ensures resources have an incentive to reflect their costs accurately in the market and protects against the potential for manipulation. Resources not committed day-ahead may also be exposed to intra-day fuel cost uncertainty but can minimize the associated risk in so far as they can update their costs until they are committed.

problem statements identifying challenges stakeholders experience, or expect to experience, regularly while Section 6 captures problem statements specifically related to critical events:

Section 6 discusses the accessibility of the reference level change request process. Cost adjustment opportunities should be accessible in a timely manner in the event that a resource's costs diverge significantly from ISO calculated values on a temporary basis. Section 6 provides detailed guidance on supporting valid requests, and navigating the expected timeline and submission process for stakeholder identified use-cases.

➔ The ISO is seeking stakeholder feedback on stakeholder identified use-cases and recommended process improvements described in this section to better inform policy development prioritization.[9]

3.4 Gas System Limitations

Gas pipeline policy and operating procedures for gas electric generators to manage gas system limitations differ across western gas pipelines. A gas pipeline operator might issue operational flow orders (OFOs), emergency flow orders (EFOs), or curtailments to maintain operational pressure on the system. The ISO understands that the notifications issued by regional gas companies vary in terms of the frequency of notification based on the unique conditions and structure of the gas system, associated penalty structure, implied reliability risk, and expected resource behavior as a result.

The ISO coordinates with gas pipeline companies so that pipeline companies can send gas electric generators the appropriate signals to manage gas pipeline imbalances. With limited exceptions, these gas resources are expected to manage gas system notifications and limitations through their incremental energy bids. Because these notifications support gas pipeline reliability, ISO policies seek to ensure resources do not have a disincentive to follow gas pipeline instructions.

During the GRM working group, stakeholders described regular gas system constraints leading to more frequent OFOs and on different gas systems across the West, and described a limited set of options due to differences in access to gas storage and atypical pipeline conditions. Some stakeholders describe receiving daily or hourly imbalance notifications that they manage economically, and manage imbalances during critical events the same way or by securing off system fuel delivery.

Stakeholders requested background and discussion of how the ISO manages gas burn limitations today, and consideration of how to reflect gas burn limitations in the optimization to help manage the efficiency of resources given daily or hourly limitations. Working group participants recommended developing functionality to model gas constraints for individual resources, grouping constraints, hourly and daily gas burn limits to manage resources more efficiently.

[9] In an initial survey, GRM working group participants generally ranked problem statements in Section 6 as low priority for policy development.

Section 7 identifies the technical, practical, and legal complexities with managing gas system constraints through the electric market optimization. This section provides background on gas nomogram constraints as they exist today, and identifies issues that previously precluded the ISO and stakeholders from proceeding with alternative models.

4 Informing Fuel Procurement

GRM working group participants identified the need for information prior to the day-ahead market to support fuel procurement as the highest priority scope item coming out of the working group process. The ISO does provide data ahead of the day-ahead market, advisory results from the 48 hour residual unit commitment (RUC) market run, in support of fuel procurement decisions. Working group feedback on this existing solution included concerns around timing and forecasting accuracy, and a general "lack of confidence" using this information to inform fuel procurement decisions.

The 48 hour RUC process was initially developed as a market operator tool to support efficient gas resource commitment, minimize cycling costs between electric trade days, and support reliability. During the Aliso Canyon Gas-Electric Coordination effort in 2016, the ISO and stakeholders developed a measure to share the RUC advisory results with scheduling coordinators (SCs) of gas resources given the low implementation cost of doing so. However, at that time, stakeholders observed that these advisory schedules would not be complete predictors of day-ahead market results and may have limited value to the SCs making fuel procurement decisions.

The ISO acknowledges the renewed importance of this issue to market participants today. To that end, the ISO has already begun a process to supplant RUC advisory schedules with a new source of data from a separate D+2 market run that serves as a direct indicator of the next day's day-ahead market.

This section lays out existing procedures to support reliability and fuel procurement decisions, seeks stakeholder engagement in ongoing improvements, and offers a path forward for further developing stakeholder recommended enhancements:

- **Section 4.1 Issue Definition** contextualizes the distinct problem statements and value proposition of GRM working group recommendations against prior policy efforts to provide more certainty around fuel procurement ahead of the day-ahead market run.

- **Section 4.2 Market Operator Tools for Reliability** reviews existing market operator tools intended to support real-time operational needs.

- **Section 4.3 Residual Unit Commitment and 48 Hour RUC Advisory** describes the residual unit commitment advisory information the ISO provides to SCs today to inform gas procurement.

- **Section 4.4 D+2 Advisory today and in EDAM** focuses on improving information to inform gas procurement decisions in EDAM.

4.1 Stakeholder perspectives on efforts to increase access to information prior to the day-ahead market

During the 2016 Aliso Canyon gas coordination policy initiative, stakeholders identified three distinct avenues for policy development: 1) access to information prior to the day-ahead market, 2) bidding flexibility for resources to accurately reflect real-time gas costs in reference levels, and 3) the accuracy of the gas price index used to calculate reference levels. Ultimately, at that time, the ISO and stakeholders found that the incremental benefits of informing fuel procurement prior to the day-ahead market would be limited relative to the value of bidding flexibility enhancements for CAISO BA and WEIM only market participants. Stakeholders noted that more information may not meaningfully impact how much fuel these resource procure ahead of time, but instead that bidding flexibility would help gas resources manage their exposure to risk that actual costs could exceed day-ahead awards.

During the more recent CCDEBE policy initiative, the ISO observed systematic differences in gas procurement strategies. The ISO observed gas resources that can better predict their procurement targets will attempt to procure fuel up-to, but typically not over, what they expect to need to meet their day-ahead commitments[10]. The ISO further observed that gas resources facing relatively less certainty tend to wait for their day-ahead market awards to inform a greater portion of their fuel procurement. In either case, day-ahead uncertainty drives reliance on intra-day fuel procurement.

Gas resources located in the CAISO balancing area have established operational experience in the day-ahead market and strategies for managing fuel procurement to meet day-ahead market awards. This is due in part to the continued evolution of market design over the years which has introduced new tools and features that help gas resource operators inform gas procurement and manage associated cost uncertainty.

In the GRM stakeholder working groups, stakeholders noted that new market participants in the day-ahead market, compared to their participation today only in the real time market through the WEIM, may not have established operational experience and may face additional risk when procuring gas to meet their day-ahead market awards. They may, for example, take more conservative strategies to gas procurement to avoid overshooting procurement targets.

Gas resources within potential EDAM BAs may resolve differences between fuel procured during the Timely gas cycle and day-ahead procurement targets by relying more heavily on intra-day gas nomination cycles:

> *Stakeholder Problem Statement 1: Market participants may rely on evening or intra-day gas cycles because they do not have their day ahead schedules in time to inform exact procurement during the more liquid timely nomination cycle. At this time market participants do not have confidence in the*

[10] Commitment Costs and Default Energy Bid Enhancements (CCDEBE) Issue Paper, November 18, 2016. https://stakeholdercenter.caiso.com/InitiativeDocuments/IssuePaper_CommitmentCost_DefaultEnergyBidEnhancements.pdf

accuracy of information provided in the two-day ahead advisory information intended to help inform gas procurement.

Stakeholders expect that illiquidity and volatility in intra-day trading cycles could be exacerbated by "everyone moving in the same direction" to meet day-ahead commitments. Problem statement 1 is expected to exacerbate fuel cost uncertainty and cost recovery risk associated with managing real-time changes in demand for gas generation:

Stakeholder Problem Statement 2: Market participants are expected to hedge the risk of, and be responsive to, unexpected changes in real-time demand. Due to issues described in PS 1, market participants may face additional risk going into real-time if they must rely on intra-day gas cycles just to meet their DA schedules. This is expected to exacerbate intra-day gas market illiquidity and uncertainty around cost recovery, and may impose more risk on market participants than they are willing to assume in real-time.

Flexibility to reflect costs above indexed prices, included in day-ahead reference level calculations, is intended to give resources a way to hedge risk that they could have to pay more for gas than they expected when bidding into the day-ahead market, or than a cost-based day-ahead offer otherwise would have covered. In considering day-ahead market participation, regional market participants are concerned that high, and highly correlated, demand for gas intra-day will systematically expose them to price spikes outside the 'normal' range. Additional flexibility to reflect cost expectations day-ahead helps but does not directly address this problem. More certainty around procurement targets could reduce the risk of this occurring and the degree of impact.

Stakeholders recommend developing enhancements to existing advisory market runs or creating additional advisory market runs to improve certainty for fuel procurement during the Timely gas trading cycle to meet day-ahead commitments.

4.2 Market Operator Tools for Reliability

By coordinating multiple days out, the ISO can support gas pipeline management during the next day gas day when generators have the most flexibility to manage their nominations and day-ahead economic offers. The ISO has observed that gas imbalances show up in next day gas day prices, which allows generators to more efficiently manage their nominations.

Several processes and tools exist today to inform fuel procurement expectations ahead of the day-ahead and real-time markets, and to ensure gas pipeline reliability regardless of when market participants purchase fuel to meet their commitments. For these purposes the ISO uses two separate and distinct sources of information: the residual unit commitment (RUC) look-ahead advisory and the D+2 market run. The two day ahead RUC process and D+2 market process both occur two days before the relevant real-time trade day but are designed for different purposes, use somewhat different inputs, and provide somewhat different information. The main differences between these market processes are summarized in Table 4 (differences in timing are illustrated in Table 5 in Section 4.4).

Only the RUC information may be shared with market participants today, and only with entities currently participating in the day-ahead market. [11] The ISO is currently developing enhancements to the D+2 market run, and plans to begin sharing information from that market process with day-ahead market participants at the onset of EDAM.

The two day ahead RUC advisory results are an indicator of real-time system reliability needs two days out, while the D+2 serves as an indicator of the next day's day-ahead market results. RUC is a reliability focused market run that looks beyond the 24 hours of the day-ahead market to account for anticipated unit commitment needs two days ahead (or more). A reliability function of the integrated forward market (IFM), the RUC process uses RUC bids which signal availability to meet forecasted demand.

After the IFM concludes, the ISO runs the D+2 which is a separate market process whose advisory results the ISO primarily uses internally to prepare for the next day's day-ahead market process. For example, the ISO may use these results to inform exceptional dispatch multiple days out.

[11] See California ISO Tariff Section 6.5.2.2.3 "Advisory Day-Ahead Market Results", and BPM for Market Instruments Section 10.1 "Scope of CMRI Reports Available to SCs"

Table 4 Comparison of 48-hour RUC and D+2 market processes today

		48-Hour RUC	D+2
Inputs	**Bids**	• Economic bids for the IFM two days prior to the relevant real-time trade-day • RUC bids for the relevant trade-day where available and historic bids where economic bids have not been submitted yet	Economic bids from 7 days prior
	Load Forecast	Forecast of CAISO demand	Forecast of CAISO demand
Results	**Purpose**	• Advisory Results indicate real-time system reliability needs two days out. • Provide reliability unit commitment indication where appropriate	• Advisory Results indicate day-ahead commitments for the next day's IFM. • Provide binding reliability unit commitment indication as backstop to 48 hour RUC[12]
	External use	Resource-specific schedules are provided to SCs through CMRI to inform fuel procurement two days out. Gas burn reports are available to gas pipeline companies through CMRI to manage system operations. The ISO provides gas burn data in MMcf on an hourly and 15 minute basis, and summary data based on the gas company, service area, forecast zone, transmission zone, and gas meter.	D+2 ancillary service requirements are posted to OASIS.
	Internal use	Used by the market operator to inform extremely long start commitment	Used by the market operator to inform exceptional dispatch up to three days out. Used by Operations Engineers for outage study purposes.

4.3 Residual Unit Commitment (RUC) and 48-Hour RUC Advisory

The RUC look-ahead process was specifically designed to ensure reliability by efficiently committing gas resources. In particular, RUC facilitates the efficient commitment of long start units that require start up instructions outside the real-time market optimization horizon, and can reduce cycling costs between market runs. Today, the ISO market operators use the RUC look ahead advisory to inform resource commitment with long start up times.

During the Aliso Canyon policy initiative, the ISO proposed providing advisory information from its RUC market run to help resources manage their imbalances between day-ahead gas procurement and real-time gas burn. Today, the ISO may provide SCs representing resources participating in the day-ahead

[12] Extremely Long Start Commitment (ELC) is a backstop manual process to the RUC commitment process looking 48 hours ahead. This requires a bid for the DAM to already be in the system, but the market operator can call and inform the SC to place a bid for the indicated amount to cover the minimum up time.

with these advisory results to inform availability needs two days in advance of the relevant real-time market. The ISO also provides a gas burn report to gas pipeline companies.

Importantly, this information is not designed to directly indicate day-ahead procurement targets but instead indicates available capacity needed to meet real-time reliability needs. The 48-hour RUC uses the IFM from the same market process (two days before real-time) as a proxy for the next day's dispatch and forecasts 24 hours after that based on RUC bids. Different from economic bids, RUC bids indicate a willingness to be available in real-time. RUC advisory schedules do not reflect reliability needs as a separate economic signal, and drivers of RUC procurement may not be transparent to market participants.[13] As a result, gas resources may not have enough information to determine how much, if any, of a RUC award may receive a financially binding day-ahead award.

Load conformance can increase the RUC procurement targets significantly beyond what would be committed through economic dispatch alone. Market operators use load conformance, effectively an increase in the RUC procurement target, to ensure the RUC process procures for a) reliability concerns for which no market product exists, or b) potential uncertainty in day-ahead VER and load forecast. However, the ISO posts load adjustments in RUC to OASIS.

4.4 D+2 Advisory Today and in EDAM

Following the conclusion of the day-ahead market processes, the ISO runs the D+2 market to inform the set-up, and increase the accuracy, of the next day's day-ahead market. The D+2 uses information as close as possible to the next day's day-ahead market.

While today there are no tariff requirements around the process or external provision of information from the D+2, the ISO will begin providing SCs with D+2 information instead of 48-hour RUC advisory information in EDAM. The D+2 is a direct and more complete indicator of day-ahead market results than the 48-hour RUC, and as such more directly responds to the GRM working group problem statements. Similar to the advisory schedules the ISO provides today, advisory market results from the D+2 would not be financially or operationally binding.

Some GRM working group participants recommend and support an additional non-binding market run between the existing D+2 and Day-Ahead market runs, denoted as "D+1.5," in Table 5 below. Stakeholders suggested a new market run would improve the accuracy of advisory information by capturing the benefit of more recent and new information that may become available after the D+2. Stakeholders suggested results by 4am prior to the day-ahead market could give market participants sufficient time to adjust their positions in the remainder of the next day gas day and submit or revise bids into the day-ahead market.

[13] For example, a CAISO BA resource with a Resource Adequacy (RA) contract is expected to submit a $0/MWh RUC bid which indicates that it is willing to be available at no incremental cost to its economic offer; the requirement to submit a $0/MWh rule changes upon the implementation of EDAM and the day-ahead market enhancements.

Table 5 below illustrates the relationship between the 48-hour RUC, the D+2, and a suggested solution coming out of the GRM working group.

Table 5 Timing of today's day-ahead market process, D+2 market run, and stakeholder recommendation

Time of Publication		Day-Ahead Market Process		D-2 Market Run	Stakeholder Recommendation
TD-2	1pm	**IFM +** 24 Hour RUC	48 Hour RUC		
	6pm			D+2	D+2
TD-1	4am	Real-Time (12am – 12am)			D+1.5
	1pm			**IFM**	**IFM**
Trade-day			Forecasted Real-time	Real-time	Real-time

Shown above, the ISO runs a day-ahead market and D+2 two days before the trade-day (TD-2). The 48 hour RUC, run concurrently with the IFM, produces advisory schedules that indicate both economic and reliability needs for the real-time Trade-day, labeled "Forecasted Real-time" above. The D+2 on TD-2 begins after the day-ahead market is complete, and provides advisory schedules for the IFM on TD-1.

The relative benefit of the suggested D+1.5 compared to the existing D+2 would come from new information that was not available in time for the D+2 on TD-2 but becomes available and accessible to the ISO by 1am (in order to publish D1+1.5 results by 4am) on TD-1. For example, SCs may submit new or updated bids, informed by the next day gas day trading activity, into the day-ahead market to inform the D+1.5. However, the ISO would need to establish a new process[14] to collect gas trading data and approximate a GPI based on the first half of the trading day.

New information at 1am might be used to improve forecasting but the ISO's processes to update and publish forecasts are optimized for the timing of the day-ahead market. The ISO receives hourly day-ahead VER forecasts from forecast service providers at 5:30am and 8:45am to support the accuracy of the day-ahead market run. Without running new forecasts,[15] the suggested D+1.5 run would rely on the same forecasting information, published the morning of TD-2, already used by the market processes on TD-2. Adding new forecasting services would increase vendor cost, in addition to personnel costs to monitor and maintain the new forecasting suite.

The prospective value of a new market run must be weighed against the cost of gathering new information, running the optimization, and validating a new stream of market results made available to market participants. The ISO is open to considering an additional market run but proposes, as a preliminary step, to focus policy development on the D+2 to maximize the use of, and more clearly identify the limits of, planned improvements.

[14] This would likely be a manual process, same as the ISO's early approximation of the GD2 GPI for the day-ahead market run. An additional manual process would increase costs and process time.
[15] Moving the publication of these forecasts, instead of running new ones, would reduce their accuracy and reduce the accuracy of the day-ahead market results.

4.4.1 Planned EDAM Enhancements to Improve D+2 Coordination

As part of the EDAM stakeholder process, the ISO and stakeholders developed a number of enhancements for EDAM that should improve the accuracy of D+1 and D+2 results and/or reduce the impact of variability on thermal generator commitment.

Relevant to GRM, imbalance reserves, which are planned for implementation concurrent with the EDAM, are designed to directly procure to cover uncertainty within the day-ahead market optimization providing additional transparency on pricing. A biddable product, imbalance reserves allow resources to directly represent costs related to real-time availability through bids which produced a transparent price signal. The ISO expects the imbalance reserves product will result in the day-ahead market producing more accurate information for the purposes of gas procurement.

4.4.2 Alignment with Gas Procurement

The ISO recognizes the need for a more meaningful and coordinated D+2 to provide better quality information going into EDAM, and looks forward to stakeholders' early engagement on this topic. The ISO will be seeking stakeholder feedback to consider modeling assumptions, develop an analysis of the accuracy of the D+2 and its inputs, and ensure market results provide meaningful information for the purpose of fuel procurement.

Assessing the accuracy of the D+2 in scheduling thermal resources: Stakeholders requested the ISO illustrate how accurate the D+2 is. As a preliminary step, the ISO can provide data on the accuracy of inputs being used in the market run.

➔ The ISO will be seeking stakeholder feedback on what additional metrics would be helpful, if and how to incorporate differences between historical data and potential EDAM operations like expected changes in market participation, in a more holistic assessment.

Inputs and modeling assumptions: The market will use the same co-optimization, underlying network model, and planned constraints enforcements. The ISO will use the following inputs:

- Bids: Where available, the ISO will use bids already submitted for the next day's market run for energy, AS, and imbalance reserves as well as RUC. For bids not yet submitted, the ISO may use a copy of the D+1 bids or same day bids[16].
- Forecasts: BAA VER, load forecasts
- Uncertainty requirements for imbalance reserves (IRU/IRD)
- Applicable network outages the ISO is aware of
- AS: BAA AS requirements. If an EDAM BAA has not yet submitted its AS requirements, the ISO will use the latest day's AS requirement and self-provision or same-day AS requirement self-provision of the BAA

[16] Extended Day Ahead Market Business Requirements Specifications v1.3 (Draft): https://stakeholdercenter.caiso.com/Comments/AllComments/81d799cf-9c05-4ddc-aa65-3a250e1c2363

- Estimations of expected dispatch and network topology for non-EDAM or RC West participating BAAs

Market data representation: The ISO releases resource-specific MWh schedules to SCs that participate in the day-ahead market, and gas burn advisory reports in MMcf directly to gas companies.

Stakeholders have commented that the RUC 48 advisory results as they're published today do not provide the right information to support decision making. Some stakeholders have recommended the ISO publish resource-specific gas burn information in MMBtus[17] in addition to MWh schedules. Because MMBtu is not a native output of the market process, the ISO would need to convert each resource's MWh schedules into MMBtus using information stored in the Masterfile. While this is a service the ISO may be able to provide, the approximation would necessarily be less accurate than what a SC or resource manager can back out of MWh advisory schedules using precise resource parameters, and could be a misleading indicator of procurement targets associated with the MWh schedule provided by the ISO.

Impact of Imbalance Reserves: In EDAM, the ISO will calculate net-demand forecast uncertainty to inform imbalance reserves procurement. This information can signal the potential for deviations between Day-Ahead net-load binding forecasts and current day FMM forecasts for deviations.[18] For example, running the D+2 using a base, high forecast uncertainty (97.5th percentile) and low forecast uncertainty (2.5th forecast uncertainty) with results for full imbalance reserve deployment would provide guidance on forecast variations to help guide potential gas resource unit commitment impacts.

Stakeholders have noted that understanding the accuracy of market results can help inform procurement decisions. Uncertainty can be inferred today but advisory results don't provide an explicit metric of uncertainty needs to inform market participant decision making.

➔ The ISO is seeking stakeholder feedback on how imbalance reserves may be used as an indicator of uncertainty to support fuel procurement decision-making, and input on what additional information the ISO can provide to inform stakeholders' understanding of the new D+2 advisory results and support gas procurement decisions.

5 Accommodating Gas Cost Variation in Reference Levels

To the extent practicable, resource costs should be accurately reflected in the market clearing process to ensure the market can optimally commit resources to meet demand at least cost. In competitive

[17] Today, the ISO shares gas burn data with gas pipeline companies in MMcf as pipeline companies usually meter gas based on volume.

[18] Uncertainty requirements will be published on OASIS with the implementation of the day-ahead market enhancements (DAME).

conditions, market-based (resource submitted as opposed to ISO calculated) bids are an efficient way to reflect resource costs in the market.

To ensure sufficient protections against market power are in place should uncompetitive conditions arise, the ISO may mitigate or limit resource-submitted bids to a value no lower than a resource's specific reference levels. When the ISO uses reference level calculations to proxy resource costs in the market, these reference levels must provide resources with certainty that they will recover their costs. At the same time, reference levels are intended to preserve efficient market outcomes by mirroring a resource's competitive (or cost-based) offer into the market.

Default values—default energy bids (DEBs) and default commitment costs—are designed to serve as a reasonable benchmark for a resource's cost-based offers. Cost-based offers cover the cost of providing incremental energy, starting up, or remaining at min load. Cost-based offers do not include costs such as premiums or a margin for uncertainty.

Reference level calculations use indexed price data and resources' verified operational characteristics. A market-based fuel cost index reinforces competitive incentives and behaviors in line with industry best practices, and serves as a reasonable approximation of most resources' competitive offers.

Reasonable and durable gas resource reference level calculations are predicated on two key assumptions:

1) Next day gas commodity prices correlate with most resources' procurement costs. Resources can manage their own risk exposure from cost deviations around the average, but an average price index reflects regular, prudent and reasonable practices and provides the right incentives for gas procurement and bidding.

2) Gas prices are a reasonable indicator of gas market conditions. Price indices are sufficiently liquid to serve as an indicator of demand and system constraints. Resources with unique supply arrangements, like access to multiple sources of fuel, can seek out the most economic fuel option available to them.

Policy designed to accommodate scenarios when these assumptions to do not hold falls into two distinct approaches: pre-market validation of either temporary cost adjustments or customized reference level modifications, or flexibility to cover variation and uncertainty.

Validating costs pre-market when these assumptions do not hold can be challenging for the ISO and market participants because more precise information may be burdensome (if not infeasible) for both the ISO and market participants to collect and report. Still, efforts to improve accuracy are appropriate where the ISO has observed wide-spread or systematic sources of inaccuracy.

Adding more bidding flexibility into reference level calculations can reduce the effort required to validate costs, but when conditions are uncompetitive bidding flexibility can also increase the market's

exposure to market power exercise. Resources may be afforded more flexibility when cost deviations are more difficult to systematically predict and correct for.

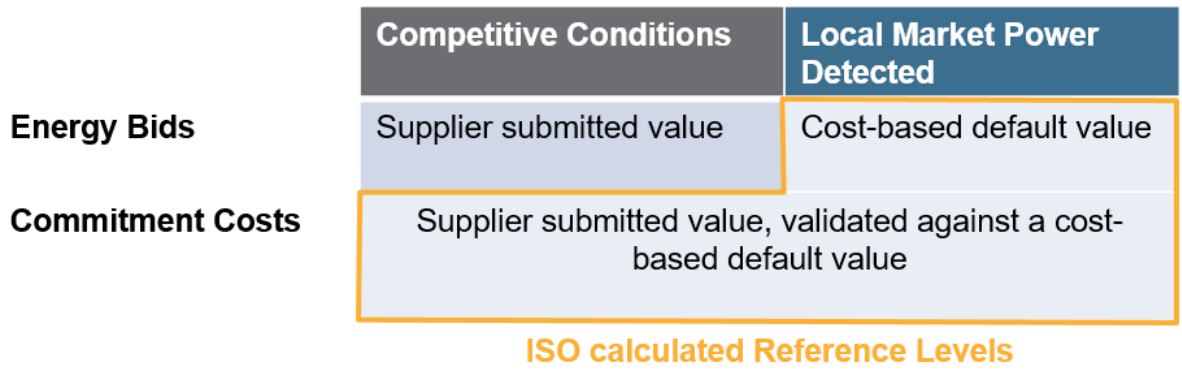
The standard resource-specific costs used to calculate reference levels do no, and cannot practically, perfectly reflect the actual costs incurred by generators. Therefore, the ISO and stakeholders have developed a suite of tools to accommodate unique situations and provide opportunities for resources to request reference level adjustments.

Section 5 is organized as follows:

- **5.1 Summary of Reference level Calculations** provides an overview of reference level policy—principles, problem statements, and mechanics.
- **5.2 Gas Commodity Price Accuracy** discusses the ISO's process for determining the gas price index used in reference level calculations, and identifies the exceptional circumstances in which the ISO may modify the index price used in some resource's reference levels.
- **5.3 Policy Considerations for Scalar Modifications** explains the current methodology for evaluating the efficacy of scalars on default values and the reasonableness threshold to balance bidding flexibility with market power protection.
- **5.4 Unique Fuel Supply Arrangements** provides an overview of existing functionality and processes resources can use to manage unique supply arrangements, like multiple fuel hubs or transportation options. This section also identifies some opportunities and challenges with expanding or modifying today's functionality.
- **5.5 Prior Proposals to Transition to Market-Based Commitment Costs** discusses policies previously proposed to support market-based commitment cost bidding.

5.1 Summary of reference level calculations and related provisions to manage fuel cost uncertainty

Reference levels refer to certain bid cost components that the ISO validates and calculates pre-market. Default energy bids (DEBs) serve as resources' mitigation floor when the ISO detects conditions in which market participants are able to exercise market power. A proxy commitment cost calculation is used to validate the commitment cost or min load cost component of a resource's submitted bid for which market price signals may be insufficient to enforce competitive bidding.



Reference levels are fairly static—calculated once per 24 hour period for day-ahead and real-time—but designed to correlate with most resources costs such that resources do not experience systematic losses.

Gas resource reference levels include a market-based fuel cost index which serves as a benchmark to reinforce competitive incentives and behaviors in line with industry best practices. The ISO calculated gas price index (GPI) for each resource's specific fuel region serves as a cost basis for default energy bids and commitment costs, and the reasonableness threshold.

The ISO applies a multiplier, or "incidental scalar", to default reference level calculations (see Table 6) to represent a margin of error between what the ISO knows/is able to account for and a resource's ultimate costs. This scalar is a safe harbor to accommodate cost variation that occurs as a normal course of business, and has the potential to impact most resources to an equal extent. While originally intended to only cover normal commodity price variation around the GPI, the added flexibility from the incidental scalar can account for variation around a resource's operational characteristics or other reference level parameters.[19]

The reasonableness threshold is based on default cost calculations but includes an additional fuel volatility scalar applied directly to the GPI. The reasonableness threshold facilitates automated cost adjustment requests through the RLCR process. Table 6 below summarizes the relationship between a resource's GPI, default calculations, and the reasonableness threshold.

For each trade-day, the ISO calculates day-ahead and real-time reference levels for gas resources based on indexed fuel cost information and each resources' verified operational characteristics. The ISO calculates each value once and it is used for all 24 hours of applicable—day-ahead or real-time—trade-

[19] Commitment Cost Enhancements Draft Final Proposal, August 12, 2014, P 9. draftfinalproposalcommitmentcostenhancements.pdf (caiso.com)

day. Resources may effectuate different hourly[20] DEB values and commitment costs if not yet committed by requesting hourly adjustments through the automated RLCR process.

The intended usefulness of the RLCR process is predicated on the assumption that the GPI used in reference level calculations correlates with most resources' costs, but acknowledges and provides redress should that correlation be weaker for some resources under specific conditions.

Table 6 Summary of reference levels, multipliers, and GPI relationship

	ISO Calculated Gas Price Index (GPI)		Resource Requested Fuel Cost
	Default Calculations *incidental risk*	**Reasonableness Threshold** *volatility and illiquidity*	The ISO recalculates all reference levels, default calculations and the reasonableness threshold, using approved fuel costs
Energy Bids	Default Energy Bid (DEB) includes **110% multiplier**	Caps DEB adjustment requests at **125% of GPI** (135% of DEB value)	
Commitment Costs	Default Commitment Cost cap includes a **125% multiplier**	Caps adjustments: - **110% of GPI** (135% of proxy cost) on days with a published gas price index - **125% of GPI** (150% of proxy cost) on days with out a published gas price index	
		Automated RLCR Process	**Manual RLCR Process**

5.1.1 Default Energy Bids

Most of the time, competitive conditions prevail and market-based energy bids represent resource costs in the market. The default energy bid may replace a resource's energy bid when resources are subject to market power mitigation. Effectively serving as a mitigation floor, the DEB ensures a resource's bid will not be mitigated to a value lower than its cost-based offer.[21]

By default, resources are afforded relatively less flexibility in their DEBs compared to their commitment costs. That said, resources can request access to additional headroom through the RLCR process. Resources may negotiate DEB values, an opportunity not similarly available for commitment costs.

[20] The automated process will validate any requested value within a certain range, and accepted values with apply to the requested trade-hour.

[21] When the ISO detects the potential for market participants to exercise market power, bids identified as uncompetitive are mitigated to the higher of the competitive LMP and the resource's DEB. Bids below the competitive LMP would not be changed. For more on this topic, see BPM for Market Operations Section 6.5 on Market Power Mitigation.

In CCDEBE, cost recovery risk for gas resources at the margin was determined to be within the normal range.[22] This is in part because many marginal units committed day-ahead to offer incremental capacity in real-time are Resource Adequacy (RA) resources with must offer obligations, whose contracts have the ability to consider fuel cost uncertainty from incremental, real-time fuel procurement.

5.1.2 Default Commitment Costs

The ISO protects the market against market power exercise through commitment cost bidding by validating resource submitted commitment cost bids against a threshold value, the default commitment cost calculation. The commitment cost multiplier applied to this calculation provides a range above the cost-based calculation within which resource submitted values will be validated and sent to market. Resource submitted values in excess of the threshold are capped at the resource-specific default commitment cost value.

Resources broadly face more risk due to intra-day volatility associated with commitment costs than with DEBs. Because of that, by default, resources have relatively more bidding flexibility compared to the incidental scalar applied to DEBs.

In CCDEBE, the ISO did not see evidence that commitment cost flexibility posed a significant issue for regional market participants given the characteristics of market participation at the time. Effectively, non-CAISO day ahead market participants self-schedule as part of their day-ahead operating plan and participate in a real-time imbalance market on an hourly basis through base schedules; this process can limit a resource's exposure to uncertainty.

5.1.3 Reasonableness Threshold

Fuel price volatility can sometimes cause a resource's costs to exceed the headroom afforded by the incidental scalar. Unlike incidental variation, volatility impacts some resources more than others and to varying degrees. Trying to capture all price volatility through the incidental scalar may serve to inflate costs, can reduce price sensitivity and incentives to act competitively or prudently, and can create a greater monitoring burden.

Instead of accommodating the full range of expected volatility by default, the ISO provides resources with flexibility to reflect fuel volatility ex ante through the automated RLCR process. Resources are expected to retain documentation in support of automated requests but do not have to wait for the ISO's review. The automated process instantly verifies or caps requests by comparing requested values to a reasonableness threshold.

[22] The CCDEBE issue paper states, "We understand from stakeholders that they willingly assume price risks on market awards based on their submitted prices and incur profits or losses as a normal course of business. As a result, we posit that the main issue for discussion is whether market enhancements should be pursued that would provide greater flexibility to submit and clear commitment cost offers at suppliers' valuation of the asset and that would ensure mitigated prices are reasonable reflections of suppliers' cost expectations."

The reasonableness threshold sets an upper bound on what the ISO considers is a verifiable cost-adjustment request based on the ISO calculated gas price index for that day.[23] The reasonableness threshold is based on the default variable cost calculation but includes an additional fuel volatility scalar applied directly to the gas price index.[24]

This intentional design choice creates a check-point to facilitate after-the-fact validation of accepted requests, and to mitigate the potential for market distortions by rejecting requests that exceed the specified range. In the latter case, resources are eligible for after-the-fact cost recovery for any requested amount in excess of what was verified pre-market.

5.2 Gas Commodity Price Accuracy

A GPI that correlates with most resource's costs yield sufficiently accurate reference levels for most resources most of the time, and will enforce competitive incentives by providing a competitive benchmark.

In order to meet intended policy objectives, the GPI should have the following characteristics:

1. Market-based, well informed: A market based valuation of the cost of fuel that captures the average of many complete transactions correlates with most costs and supports competitive incentives. By contrast, an illiquid[25] index may reflect asset valuation driven by factors other than current market conditions.

2. Timely: Gas price information that more closely reflects prevailing gas commodity costs enhances the day-ahead market's ability to dispatch resources efficiently, ensures resources will be compensated based on accurate fuel prices, and can reflect constrained gas conditions more dynamically. The ISO allows the use of non-standard products, products that reflect trades over a different period of time than the next day and same day gas cycles, where a sufficiently liquid, market-based index is unavailable[26], i.e. on Mondays.

[23] Resources can request cost adjustments in excess of the reasonableness threshold through the manual RLCR process with the additional requirement of manual cost verification. The manual RLCR process is an important backstop to support market efficiency but is not designed to give resources the ability to dynamically manage differences between their position and the index price. Section 6 discusses the different intended use cases for the automated and manual processes.

[24] The exact reasonableness threshold calculations are unknown to SCs due to concerns of artificial price submissions.

[25] The ISO's liquidity criteria mirrors FERC policy, "Policy on Price Index Formation and Transparency, and Indices Referenced in Natural Gas and Electric Tariffs" (April 2022). PL20-3-000 | Federal Energy Regulatory Commission (ferc.gov)

[26] Market participants may use indices from non-standard products to support reference level change requests in certain circumstances.

3. Sufficiently monitored and transparent: Today, the ISO relies on indices published by vendors—Intercontinental Exchange (ICE), SNL Energy, NGI, and Platts—that publish trading activity and gas commodity price indices during the next day gas trading window. The ISO uses these indices as a proxy for delivered gas costs in reference level calculations.

For most purposes, the ISO uses the index price for the next day gas day, the 24 hour trading period covering the Timely gas trading and nomination cycle. The next day gas price index is a volume weighted average of fixed price physical, consummated trades cleared through, or reported to, vendors during the most liquid trading and nomination cycle for physical gas that flows beginning at 7am the next day. The next day gas price index is the most recent gas commodity price information available that is well-informed and sufficiently monitored.

GRM working groups observed that these indices may not capture all fuel procurement costs that a specific resource may incur:

> *Stakeholder Problem Statement: Reference levels may not precisely represent resource costs as they are based on an index. Index prices, by design, do not account for the spread of prices for all cleared transactions in gas markets or for premiums paid through fixed price contracts.*

The ISO does not have transparency into all gas transactions, like those through a secondary market, to capture them in default reference levels. The ISO's business process to get index information from vendors today is manual, and expanding the scope of what is included would require additional manual processes. Today, resources can request reference level adjustments based on fuel purchases or trades not captured by these indices as long as the transaction occurs within the appropriate timeframe and reflects prudent procurement practices.

Reference levels do not include costs related to a resource's own asset management strategy, like contract premiums, which can create opportunities for strategic bidding. This is standard practice for determining cost-based offers in other ISOs/RTOs.

The ISO uses different procedures, detailed below, to determine the GPI for reference level calculations in the day-ahead and real-time market processes, Mondays, and in exceptional circumstances.

5.2.1 Day-ahead GPI

The information the ISO uses to represent gas procurement costs in day-ahead market process must be available by 9am to ensure the ISO and market participants have enough time to reflect reference level updates in their respective systems and supply offers before the day-ahead market bid window closes at 10am pacific standard time.

Prior to 2016, there was a one day lag between flow date of the operating day and the flow date of the index used to inform the day-ahead market for that operating day. The next day gas day 2 (GD2), in which gas resources nominate flows active at 7am on the real-time electric day, does not close and fully settle until after the ISO must calculate reference levels that will be used in the day-ahead market. Instead, the ISO used to use the gas price index from next day gas day 1 (GD1) to proxy the prevailing

gas price for both gas days in the day-ahead market. The GD1 index reflects the weighted average gas price for the flow day beginning 7am the day before the real-time market (DA1) and ending 7am on the real-time operating day. In other words, GD1 is the right GPI for purchased gas flows over HE01-HE07, or one third of the real-time electric trade day.

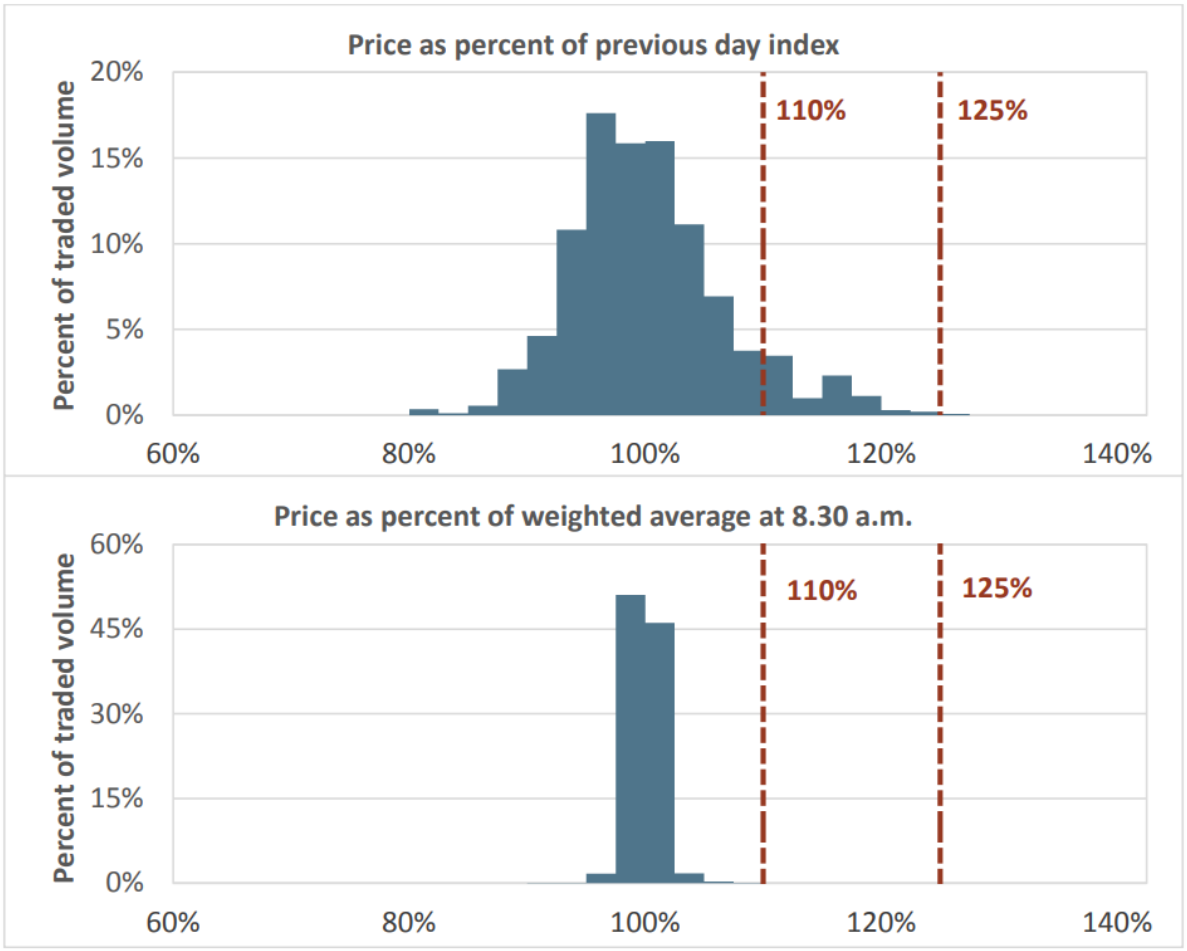
While less accurate than GD2, GD1 was still considered a reasonable proxy for fuel costs for the full real-time electric day because day-over-day gas prices are generally highly correlated. Under normal conditions, the incidental scalar should be sufficient to cover most day-over-day variation. However, GD1 would fail to reflect sudden changes to system conditions that could cause systematically higher prices in GD2.

Today, the ISO takes an approximation of GD2 using trade information from ICE between 8:00-9:00am to inform reference levels in the day-ahead market. Prices reported by ICE at this time reflect trading activity during the GD2 trading window, and the ISO understands that by 9am PT the weighted average is generally a good representation of the eventual settled index price. GD2 is the right GPI for two thirds of the hours in which purchased gas flows are active during the real-time trade day.

Stakeholders almost universally supported this updated procedure to improve the accuracy of gas reference levels. The Department of Market Monitoring (DMM) supported this change with analysis of ICE data going back several years, which can be seen in Figure 2 below, that shows next day trades varied significantly relative to the lagged index price compared to variation observed around the right index price.[27]

[27] Department of Market Monitoring Comments on Commitment Costs and Default Energy Bids Enhancements (November 29, 2016): DMMComments-CommitmentCostsandDefaultEnergyBidEnhancementsIssuePaper.pdf (caiso.com)

Figure 2 DMM Analysis for CCDEBE Issue Paper: Next day trade prices at SoCal CItygate, June through October 2016



The DMM explained "this change should ensure that virtually all gas purchased in the next day market is at a price within the normal headroom provided under current market rules (10 percent for default energy bids and 25 percent for commitment costs)". [28]

➔ GRM working group problem statements and comments suggest that the difference between when gas prices are fixed and what the ISO uses in the market may be problematic. The analysis conducted by the ISO and the DMM to date have not identified a systemic issue related to the usage of the approximated GPI. The ISO requests stakeholders clarify potential market design issues arising from the GPI used in the day-ahead market (the approximated GPI), and what further analysis would support identified issues.

[28] Department of Market Monitoring Comments on Commitment Costs and Default Energy Bids Enhancements (November 29, 2016): DMMComments-CommitmentCostsandDefaultEnergyBidEnhancementsIssuePaper.pdf (caiso.com)

5.2.2 Real-time GPI

The ISO uses settled, published indices for GD2 to inform real-time reference levels. The ISO calculates the GPI for reference levels using at least one price index from at least one of the publishing vendors. Gas price vendors publish final index prices for GD2 by 7:00pm the evening before the real-time electric trade day, and the ISO updates the GPI used in reference levels for the real-time market between 7:00pm and 10:00pm PT.[29]

Stakeholders in the GRM working groups noted that the timing of gas price information being used in real-time reference level calculations continues to be a source of concern:

> *Stakeholder Problem Statement: Gas prices within the energy market today, based on the gas market hubs, used to calculate commitment costs and default energy bids for hours ending (HE) 1 through 7 do not reflect the latest gas price indices for this time period due to the mismatch between the gas and electric day timelines.*

The only trading information applicable to HE01-HE07 more recent than GD1 would come from Intra-day 3 (ID3), the gas trading cycle in which gas resources can revise GD1 nominations for gas flow.[30] Incremental nominations are due at 5pm the evening before real-time and delivered at 8pm that evening. This gas flow is active until 7am on the real-time trade-day when gas purchased through GD2 is delivered.

The ISO does not use gas trading information from the Evening or Intra-day gas trading cycles to inform reference levels regularly primarily because the business process to do so would be manual. Updating reference levels to reflect these prices would require manual processes, require additional process time, and incur business costs.

In addition, intra-day gas price information may not meet the same standards as the next day gas day GPI as a widely applicable benchmark for fuel costs. The ISO understands that these gas cycles support only a fraction of what is traded during the timely gas nomination cycle today,[31] and are notoriously volatile and illiquid. Prices during these trading cycles typically carry premiums relative to the standard published next day gas price index and can be relatively illiquid. Each trading period is short and may not reflect consistent cost drivers.

Therefore, resources can reflect the cost of fuel purchased through evening and intra-day trading as well as purchases from outside the centralized exchanges by request. For example, resources can request cost adjustments for HE01-HE07 through the automated process. This process allows resources to request cost adjustments based on expected costs, like intra-day gas purchases, within a range based on

[29] Gas resource SCs will receive dated reference level calculations the night before the real-time market through CMRI.

[30] The ISO understands that fuel valuation in ID3 is driven by factors besides fuel procurement for HE1-7. For example, the ISO understands that gas resources may procure incremental fuel supply during ID3 to meet changes in the evening peak demand and manage gas pipeline imbalances.

[31] In 2015, DMM found that intra-day trading averages less than 1 percent of trades compared to next day.

the GD2 GPI. In exceptional circumstances, the ISO will update the reasonableness threshold based on observed real-time gas price information to provide resources with greater flexibility to reflect intra-day gas costs as described in Section 5.2.4.

5.2.3 Non-standard indices for Weekends and Mondays

The ISO uses a different process on Mondays than the rest of the week because there is no next day gas day index for trades over the weekend. ICE has two gas products that covers trades for gas deliveries on Mondays: the weekend gas package and the Monday-Only gas product. The ISO uses the Monday-Only gas index for the day-ahead market when ICE reports it in time, and will otherwise use the weekend gas package.

The Monday-Only gas product is a better indicator of the market's expectation of prices specific to the Monday power day because it reflects trading activity for delivery on Monday only. The Weekend gas package is effectively a three day average of gas procurement costs, covering gas deliveries for the Saturday, Sunday, and Monday power days. The ISO understands the latter option is often a poor indicator of the price of procuring Monday-only gas, and stakeholders have raised the issue that intra-day gas prices on Mondays often trade at a significant premium to the weekend package.

In comments and through discussion, GRM working group participants have noted that increasing volatility and illiquidity reduce the availability of an accurate index for Mondays. Some stakeholders suggested the ISO use other non-standard products, like Balance of the Month, that are better informed. Currently, the ISO does not use any other non-standard products to calculate gas costs.[32]

➔ The ISO is open to stakeholder proposals for alternative conventions for Mondays, and is seeking stakeholder feedback on viability, assessment and prioritization of this topic.

5.2.4 Exceptional Circumstances

When resources request cost adjustments through the automated RLCR process, these requests are limited by the reasonableness threshold to limit the potential impact of unsupported costs being used in market dispatch. The reasonableness threshold, defined using a set multiplier on the GPI, cannot practically account for a complete range of costs all the time, and especially in exceptional circumstances. However, the manual option requires recently available information that may not be available in time to submit the request, a concern raised in the GRM working groups:

> *Stakeholder Problem Statement: Stakeholders may not have the actual gas cost information necessary to submit a manual reference level change request by the 8am deadline for the day-ahead market run.*

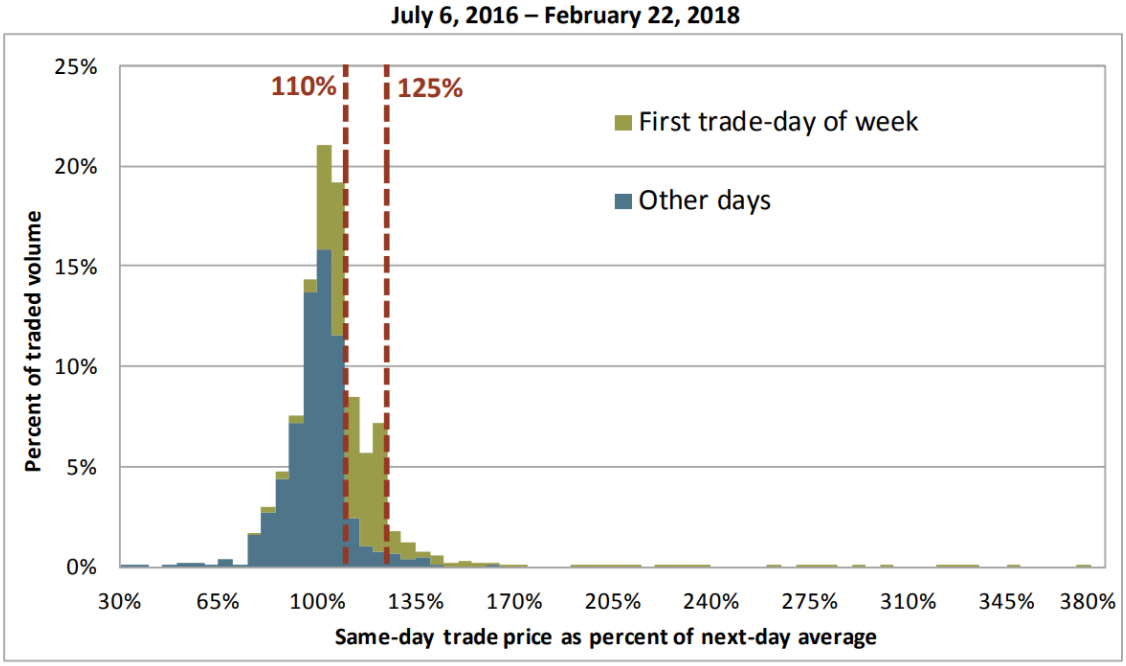
To date, the ISO and stakeholders have identified a number of scenarios when the reasonableness threshold may not be sufficient to cover actual costs and have developed procedures to increase the

[32] The ISO understands these non-standard products reflect value not directly related to the cost of fuel delivered on a given day.

reasonableness threshold based on certain observable triggers: same-day gas price updates, multiple manual RLCRs, and resource specific persistent conditions.

- Same-day gas price updates.[33] The ISO will recalculate the reasonableness threshold using the same-day gas price information when the ISO observes prices during intra-day gas cycle 1 on ICE between 8:00 and 9:00am are 10% greater than the gas price index used for reference levels in the real-time market.

Figure 3 DMM analysis for CCDEBE revised draft final proposal: Price of all same-day gas trades reported on ICE compared to next-day gas index price used by ISO for bid caps used in real-time market mitigation (SCE Citygate)



The DMM analysis above shows the distribution of all same day gas trades for SCE Citygate reported on ICE compared to the next day ICE index price used in reference level calculations.[34] Excluding the first trade-day of the week, DMM observed that about 91 percent of gas volume was purchased at a price within 10 percent of the next day gas price index and 96 percent of gas purchased was within 25 percent.

- Multiple manual RLCRs[35]: If the ISO receives and is able to verify three or more manual RLCRs in the same fuel region in real-time, the ISO infers from this pattern a broader problem with fuel availability, i.e. an unexpected gas pipeline outage, and updates the reasonableness threshold

[33] See BPM for Market Instruments Attachment O.1.2.4.1 Same-day Gas Price Updates
[34] Department of Market Monitoring comments on Commitment Costs and Default Energy Bids Revised Draft Final Proposal (February 2018) P. 4: dmmcomments-commitmentcostsanddefaultenergybidenhancementsreviseddraftfinalproposal.pdf (caiso.com)
[35] See BPM for Market Instruments Attachment O.1.2.4.2 Multiple Manual Reference Level Change Request Updates

for all resources mapped to that fuel region. Individual resources would still have to submit a request to receive an adjusted DEB or commitment cost value, but could do so through the automated process.

- Resource specific persistent conditions[36]: The ISO may adjust a particular resource's reasonableness threshold by applying an additional multiplier on the resource's GPI temporarily. This is a temporary measure based on conditions the ISO observes in the after-market cost recovery process.

A fourth exceptional circumstance triggers changes applied directly to the DEB:

- Frequently mitigated unit (FMU) bid adder[37]: The ISO calculate a monthly bid based on observed data over a rolling 12 month period. A resource is eligible for an FMU adder if the ISO observes the resource is mitigated in over 80% of run hours.

All four of the adjustments described in this section are triggered and informed by observed conditions, and the ISO makes changes through a manual process. The ISO does not make these adjustments in anticipation of issues that may arise.

➔ The ISO is seeking clarity on what specific scenarios stakeholders are concerned about in the problem statement above. The ISO is also seeking stakeholder input on what, if any, predictive methods might be used to make changes to accommodate exceptional circumstances more proactively.

5.3 Policy Considerations for Scalar Modifications

Today's policy gives resources the flexibility to reflect costs, actual or expected, above a resource's calculated costs through scalars incorporated into reference levels. Resources have some flexibility by default through the incidental scalar, and incremental flexibility by request through the fuel volatility scalar in the reasonableness threshold calculation. Resources can reflect costs within the range of these scalars automatically, i.e. without requiring the ISO to validate precise cost information pre-market (as the ISO does for manual cost adjustments).

In order to define the range above a resource's calculated cost within which it's reasonable to expect a resource's actual costs might fall, scalar values are based on actual gas price data and designed to cover most aggregate trade volume save for some outliers. This methodology, illustrated in more detail in appendix A, is designed to balance a trade-off between flexibility and market power protection.

[36] See BPM for Market Instruments Attachment O.1.2.5 Adjustments for Persistent Conditions
[37] See BPM for Market Instruments Attachment D.5.6 FMU Bid Adder

In GRM working groups, stakeholders broadly supported more bidding flexibility to better reflect cost expectations in the market,[38] and in particular expressed support for considering modifications to the reasonableness threshold to accommodate increasing gas price volatility. Stakeholders anecdotally described volatility in various contexts. For example, some stakeholders noted that regional gas hubs generally exhibit more volatility regularly than PG&E Citygate or SoCal Citygate, and some stakeholders identified scenarios in which real-time volatility might cause gas prices to spike intra-day.

The analysis in sections 5.3.2 and 5.3.3 below illustrates how different types of volatility indicate different impacts on reference levels, and different outcomes associated with stakeholder recommended solutions.

The ISO and stakeholders considered an analysis of price movement at regional gas hubs[39] to provide stakeholders with an early opportunity to provide feedback. A snapshot of gas price information includes a non-volatile period and three volatile periods—one summer event and two winter events—summarized in Table 7. The ISO defined volatile periods by considering both high prices and system conditions.[40] Stakeholders identified some potential limitations of the analysis, requested additional context around the volatile days identified, and requested the ISO provide an interpretation of the data.

Table 7 Summary of time periods the ISO identified for preliminary GRM analysis discussion

Time period	Context
July 11 – 14, 2023 (Figure 4)	"non-volatile" period for comparison
September 1 – 9, 2022 (Figure 5)	Gas prices are higher than usual across the west.
December 10 – 22, 2022 (Figure 6)	Gas prices are higher than usual, and higher than the summer period identified, across the west.
February 12 – 19 2021 (Figure 7)	Significantly higher gas prices, especially in the southwest, driven in part by winter storm conditions and gas shortages.

[38] During GRM working groups, stakeholders did not specify whether the recommendation applies to just commitment costs or both DEBs and commitment costs. Stakeholders should consider if and how modifications to bidding flexibility might need to be assessed differently for DEBs and commitment costs.

[39] Gas Resource Management working group meeting, January 25, 2024: https://stakeholdercenter.caiso.com/InitiativeDocuments/Presentation-GasResourceManagement-Jan25-2024.pdf

[40] The ISO does not have detailed information or full transparency into factors that drive trends in gas markets. Generally, the ISO has observed greater volatility when gas prices are higher. Conditions during each of the periods identified are generally consistent across days identified.

The discrete time periods discussed in this analysis may not offer inferential value about broader trends in price movement[41] but are useful to illustrate regional differences and the trade-offs associated with different stakeholder recommended solutions.

Sections 5.3.2 and 5.3.3 each identify a particular type of volatility – day-over-day volatility and price dispersion around the index—and characterizes the potential impact of observed gas price movement on reference level accuracy. Each section describes how policy today intends to resolve identified issues, and examines how stakeholder recommended policy changes—modifications to the reasonableness threshold and changes to the ISO's procedure for updating the GPI in reference level calculations—could have impacted outcomes.

5.3.1 Normal Conditions

Policy today is intended to ensure most random variation from volatility or otherwise falls within the range of the incidental scalar. There are two flavors of gas price movement that can impact reference level accuracy:

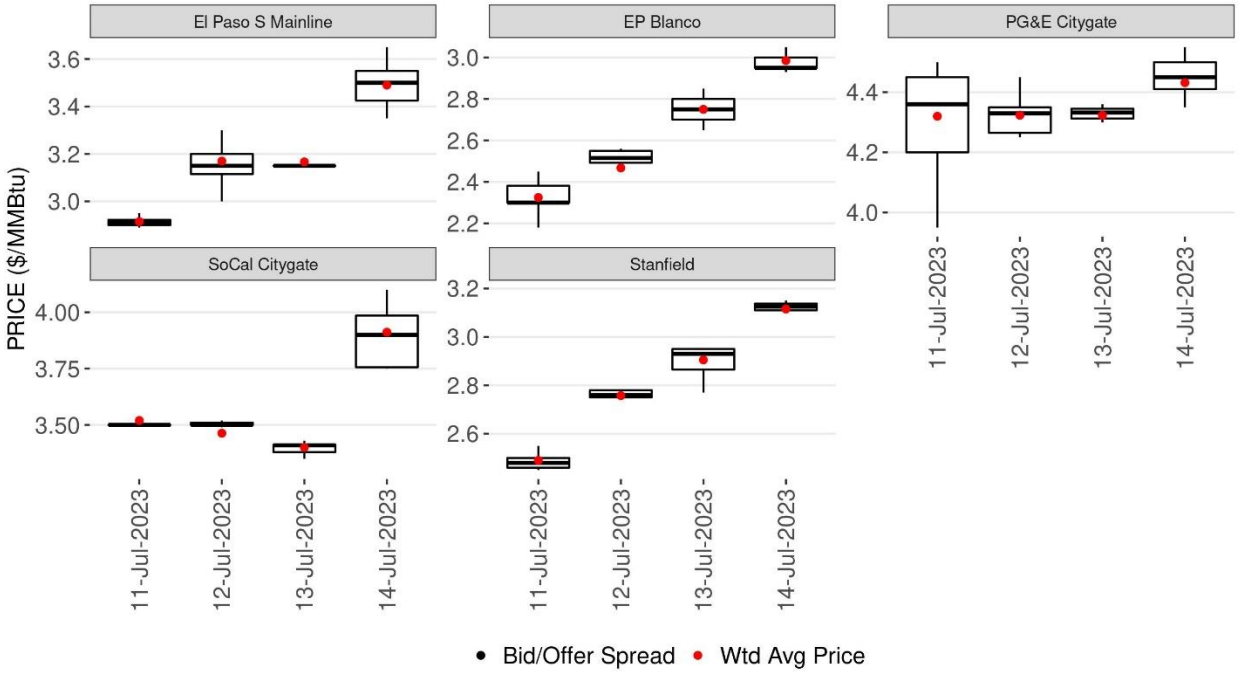
- Day-over-day volatility, where the GPI of two consecutive gas days diverge, may reduce the accuracy of reference levels because reference levels for all 24 hours of the electric day cover two gas trading days.

- Price dispersion, where discrete prices at which a specific resource purchases gas falls above and below the average, may pose cost recovery risk to gas generators if they cannot procure fuel near the commodity market index price.

Both types of volatility can typically be observed under normal conditions to some degree but the distribution of prices should be within the 110/125 percent range of the GD2 GPI. Figure 4 below illustrates a non-volatile period. The box and whisker plot indicates the weighted average price, represented by a red dot, in relation to the median and range of prices. When the mean settles on or near the median, the range of prices above and below the mean are similar i.e. the GPI would over- and under-estimate a similar range of costs. Most days illustrated in Figure 4 are within 110/125 percent of the next day's price, have tight bid/offer spreads, and the weighted average price settles on or near the mean.

[41] In the working group discussion, the ISO offered a high level observation that volatility has generally increased over time, but more pertinent to reference levels are discrete price movements observed in this section. The ISO has previously published observations around gas price volatility and liquidity at western hubs, some of which is included in Appendix A.

Figure 4 July 11-14, 2023 "non-volatile" period



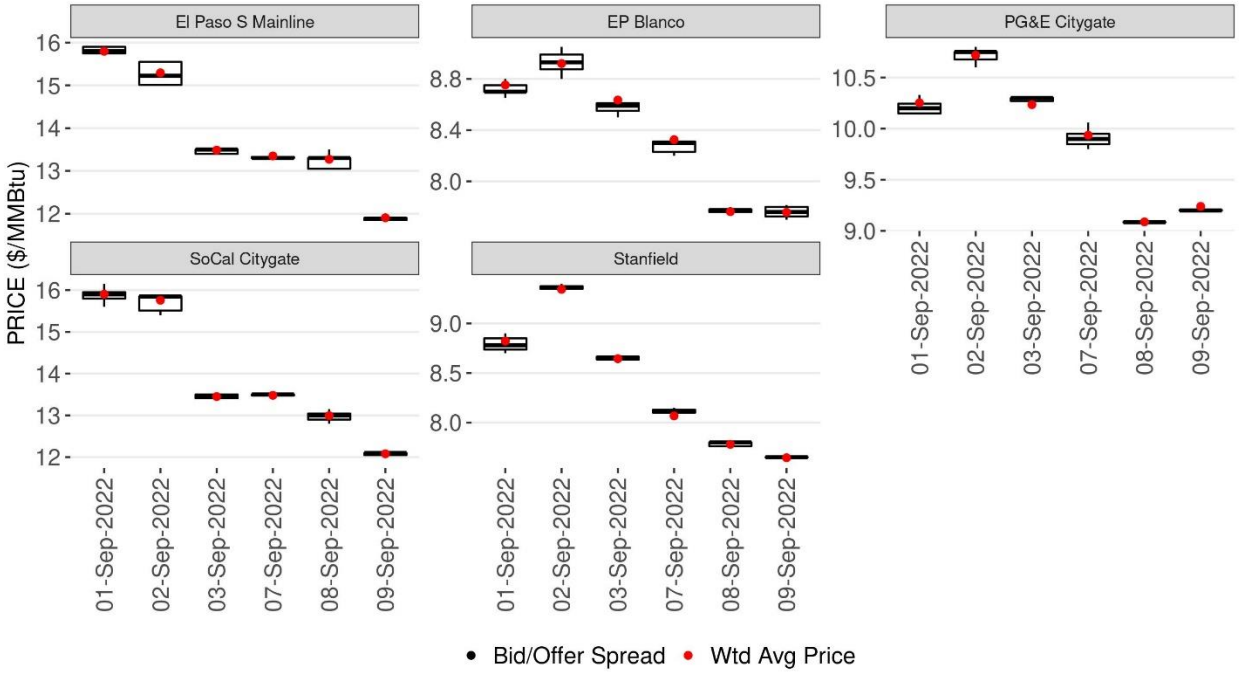
It can be observed that the incidental scalar on default reference levels—10 percent for DEBs and 25 percent for commitment costs—is sufficient to capture the range of prices around the GPI.

5.3.2 Day-over-day Price Volatility

Day-over-day volatility between consecutive settled next day gas price indices has the potential to impact reference level accuracy when GD2 averages lower than GD1. If this occurs, reference levels for HE01-HE07 may under-estimate the next day gas price index for gas flows active during those hours. In so far as consecutive gas days have the same cost drivers, the incidental scalar should be sufficient to capture most variation that would otherwise cause reference levels to under-estimate one third of the day's gas costs.

Figure 5 below illustrates gas prices with thin bid offer spreads but some observable day-over-day variation. Demand for electricity during the summer heatwave was significantly higher than normal, and higher than during the winter periods, but gas prices settle lower than during the winter volatile periods.

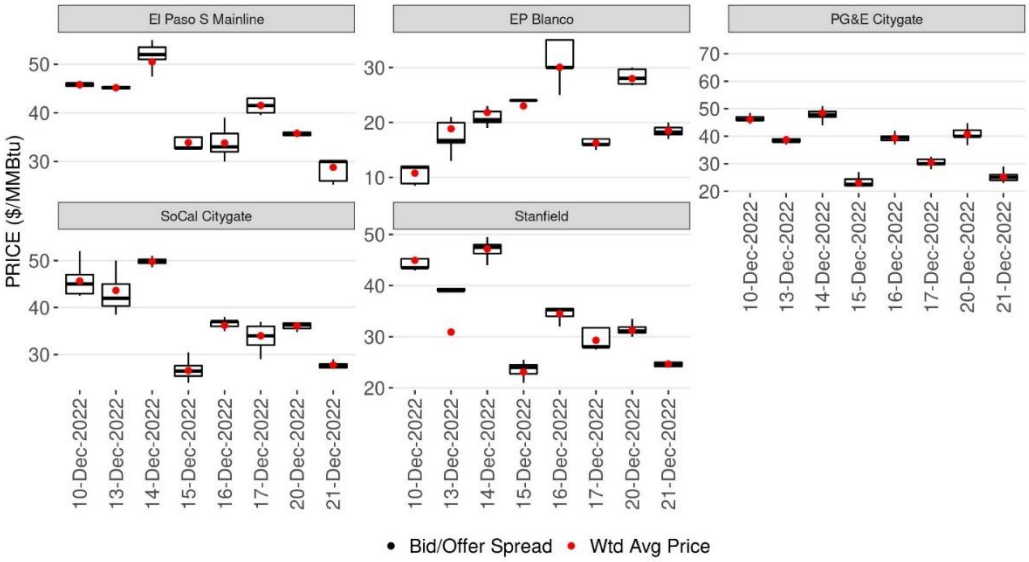
Figure 5 September 1-9, 2022 West-wide heatwave



More competition and greater liquidity may contribute to better gas index price formation and thus thin bid/offer spreads, but El Paso and SocCal Citygate both exhibit greater day-over-day volatility between September 2-3. On September 3, the GPI for GD2 would have underestimated costs for gas flows active during HE01-HE07, which are better represented by the GPI from September 2. However, the price difference between September 2 and 3 appears to be within the range of the reasonableness threshold.

The winter storm illustrated by Figure 6 below also indicates market participants experienced day-over-day variation in both the upward and downward directions, meaning some resource's references levels may have either over- or under-estimated costs on certain days.

Figure 6 December 10 – 22, 2022 winter gas volatility/winter storm Elliot



Prices appear to increase between GD1 and GD2 for December 15th and 16th by more than 110/125 percent at all hubs observed except El Paso S Mainline. Due to this price increase, reference levels would have over-estimated the average gas price for HE01-HE07, for which fuel would have been procured during GD1.

Between December 14th and 15th, prices dropped significantly between GD1 and GD2 at all hubs observed except El Paso Blanco. In this case, reference levels would have under-estimated the average gas price for HE01-HE07.

Prices during this period exhibit greater price dispersion than over the September period, so the degree impact of day-over-day volatility may have been different for different resources.

Stakeholder suggested solution to day-over-day volatility: increase the reasonableness threshold

Today's design delivers an accurate index price for two thirds of the day, and the ISO has not observed systemic inaccuracy in either direction with respect to HE01-HE07.[42] With no modification to the reasonableness threshold, price changes between GD1 and GD2 will under- or over-estimate costs depending on the direction of price movement. When prices decrease between GD1 and GD2, reference levels may under-estimate costs for HE01-HE07 but will be a reasonable representation of cost for HE08-HE24. When prices increase between GD1 and GD2, reference levels will over-estimate costs for HE01-HE07. These observations are summarized in Table 8 below.

[42] The ISO did an assessment of day-over-day gas price volatility to justify the 125% commitment cost cap as part of Commitment Cost Enhancements in 2014 before the ISO eliminated the one day lag in index price. The problem posed by the one day lag was opposite the problem described in this section. When GD2 averaged higher than GD1 reference levels would have underestimated costs. The 2014 analysis is not directly pertinent to today's problem statement since the lag was eliminated, but is included in Appendix A as an example statistical method to define and support scalars.

Table 8 Today's design ensures reference levels are accurate with respect to the gas day for two thirds of the real-time electric trade day

	Prices decrease between GD1 and GD2	Prices increase between GD1 and GD2
HE1-7	Under-estimates costs	Over-estimates costs
HE8-24	Accurate	Accurate

The expected outcome under today's policy is reasonable in aggregate compared to a policy design with a larger reasonableness threshold to accommodate HE01-HE07 when prices decrease day-over-day. In aggregate and all else being equal, a larger reasonableness threshold to account for HE01-HE07 would over estimate most costs in all other scenarios. Table 9 below summarizes how an increase in the reasonableness threshold would impact the accuracy of reference levels depending on the direction of day-over-day price movement.

Table 9 Increasing the reasonableness threshold would increase reference level accuracy for HE1-7 when prices decrease

	Prices decrease between GD1 and GD2	Prices increase between GD1 and GD2
HE1-7	More accurate	Over-estimates costs
HE8-24	Over-estimates costs	Over-estimates costs

Stakeholder suggested solution to day-over-day volatility: use dynamic input prices

Today, the ISO calculates reference levels once for the day-ahead market, around 9am, and once for the real-time market, the evening prior, on most days.[43] Stakeholders recommended the ISO use the correct gas day price for HE01-HE07. In theory and based on observation, day-over-day volatility of more than 10/25 percent will either over- or under-estimate costs for HE01-HE07. Compared to outcomes today, using the right price would deliver greater precision for HE01-HE07.

[43] Because the day-ahead market runs all 24 hours, the ISO cannot manually re-calculate reference levels for certain hours of the day. The ISO does manually re-calculate the real-time reasonableness threshold around 8-9am in exceptional circumstances.

Table 10 Reference level accuracy under today's policy compared to a policy using dynamic pricing

		Policy today	Use Dynamic Pricing
Prices go down more than 10/25 percent between GD1 and GD2	**HE1-7**	Under-estimates costs	Accurate
	HE8-24	Accurate	Accurate
Prices go up more than 10/25 percent between GD1 and GD2	**HE1-7**	Over-estimates costs	Accurate
	HE8-24	Accurate	Accurate

The ISO acknowledges that using the price for each gas delivery day could be beneficial. When prices go down more than 10/25 percent between GD1 and GD2, using the right price would ensure costs for HE1-7 are covered without relying on the RLCR process or over-estimating costs associated with HE8-24.

However, updating reference levels dynamically, e.g. without relying on a manual process, would require meaningful IT and business process changes to recalculate reference levels more than once per market each day. The ISO has not previously identified a systematic problem with how costs are represented for HE01-HE07. The ISO has found outcomes to be reasonable in aggregate, and efforts to increase accuracy may not deliver proportional value.

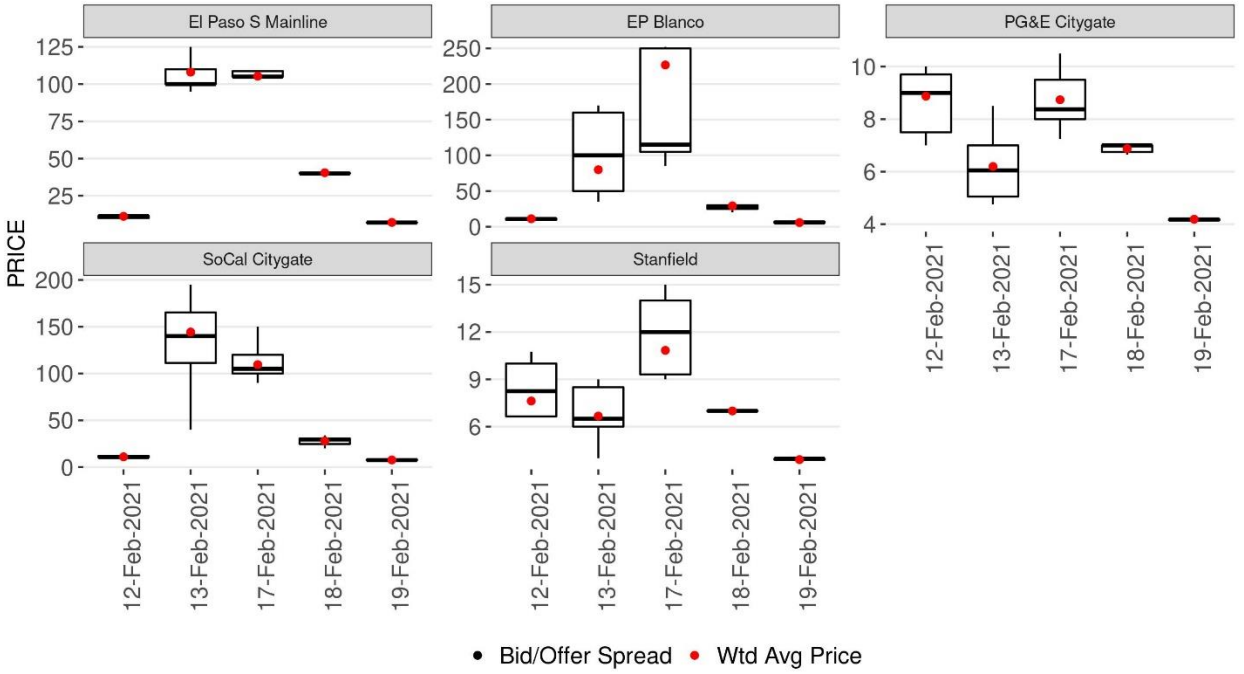
The ISO remains open to providing this functionality and encourages stakeholders to indicate the benefits and need for this functionality in considering this type of an enhancement.

5.3.3 Price Dispersion

Wide price dispersion around the GPI indicates a possibility that reference levels may not cover the full range of all resources' costs, but this risk does not impact all resources equally. The automated RLCR process is the intended solution to resource-specific volatility.

In Figure 7, variance around the GPI appears to exceed the reasonableness threshold at most hubs on most days, but most prominently on February 13th and 17th at the southern hubs.

Figure 7 Within the period of Feb. 12-19, 2021 the settled index prices exhibit larger variance



The ISO has found that automated requests are generally submitted below the reasonableness threshold, but one notable exception was February 2021. Figure 8 below shows that most of the time, a majority of automated RLCRs are accepted ex-ante meaning the reasonableness threshold offered sufficient headroom to accommodate most automated cost adjustment requests. In February 2021, all automated requests were validated at the threshold value.

Stakeholder suggested solution to price dispersion: increase the reasonableness threshold

The distribution of prices at the El Paso Blanco hub on both February 13th and 17th indicate some fuel costs were well in excess of the reasonableness threshold but to differing degrees. Importantly, the default flexibility and reasonableness thresholds do not cover a consistent percentage of trade volume for each gas day. This means that modifying the reasonableness threshold, on any given day, would have different trade-offs.

On February 17th the weighted average settles above the median indicating the price distribution is right skewed. On February 13th the weighted average settles below the median, indicating a left skewed distribution. Any marginal increase in the reasonableness threshold on February 13th would likely have covered a larger trade volume than the same increase would have on February 17th. By contrast, the percentage increase in the reasonableness threshold that would cover some given trade volume on the 17th would likely dramatically over-estimate most if not all costs on February 13th.

Increasing the reasonableness threshold may have limited merit where there are increasingly outlying transactions, for which the manual RLCR process may be a more appropriate avenue to ensure the opportunity to recover costs. The percentage above the GPI that captures all costs, or some consistent percentage of costs, would need to change dynamically—not just during certain periods but day-by-day.

Ultimately the costs and benefits of modifying the reasonableness threshold in response to price dispersion are a function of the distribution of prices. In other words, some days are more expensive to insure than others. Increasing the potential for resources to reflect higher costs increases the risk of inflated costs in the market and would require additional considerations to maintain existing balance of incentives on market participants.

Key takeaways: The impact of observed volatility to date is difficult to uniformly characterize across regions, and across resources within each region. On different days observed in the analysis, increasing bidding flexibility would have yielded different trade-offs. This variability creates a challenge when considering standardized solutions that are designed to apply to most market participants, and when developing forward looking policy.

➔ The ISO is seeking stakeholder feedback on the conclusions described in this section, and how to best characterize the impact of these issues on market participants. The ISO is open to considering alternative methodologies[44] to assess the efficacy of today's policy and determine threshold values moving forward.

5.4 Unique Fuel Supply Arrangements

Gas resource reference level calculations include a daily fuel region price based on each resource's specific, registered fuel supply arrangements. SCs assign a resource to a fuel region that accounts for a region-specific gas price index and total transportation costs associated with a resource's fuel shipping company.[45]

A resource's fuel costs can be represented by a single fuel region—one active gas hub and one gas transportation option—or a BAA-level fuel region:

- Under the single fuel region option, gas resources can only have one fuel region active at a time but can register multiple fuel hubs and gas transportation options to a gas resource. To activate different fuel options, SCs must update the fuel region in the Masterfile which is a multi-business day process. The ISO expects that for most resources a single fuel region can capture most costs in aggregate.

- Alternatively, a BAA-level fuel region is associated with more than one hub and shipping option. The fuel cost for a BAA-level fuel region is the minimum of all fuel region values.

These options are considered reasonable because, in competitive conditions, reasonable and prudent gas resources will seek out the cheapest source of fuel they have access to. A single fuel region serves as competitive benchmark, and the minimum of all BAA-level values is a reasonable representation of

[44] See Appendix A for more examples of statistical methods the ISO and DMM have used to date to inform scalar values.
[45] Fuel regions can also include greenhouse gas compliance costs, and miscellaneous costs, like taxes. More information on Fuel Region Gas Price Calculation Rules can be found in the BPM for Market Instruments Attachment C

these resources' costs under competitive conditions. However, these assumptions may not hold when a resource is not able to access the least cost source of fuel associated with their fuel region. A resource may not have access to the least-cost source of fuel associated with their fuel region, or have sufficient information due to volatility and illiquid trading to procure the least-cost fuel available.

During the GRM working group effort, stakeholders described two scenarios where today's options may be too restrictive and may under-estimate costs:

> *Stakeholder Problem Statement: Generators that switch fuel regions regularly have trouble reflecting their costs in the market.*
>
> *Stakeholder Problem Statement: When switching fuel types, i.e. using diesel instead of gas, generators are unable to reflect accurate costs and operating parameters in the market in a dynamic or timely manner.*

Gas generators that switch fuel regions or fuel types infrequently—due to exceptional circumstances like outages or tight conditions due to extreme weather conditions—can use the manual RLCR process to update their costs in the ISO's systems but this process is not intended for regular use. Most stakeholders who switch fuel types describe only doing so under test conditions or in critical conditions, but not regularly.

To accommodate regular fuel switching, GRM working groups suggested the ISO and stakeholders consider alternative conventions to using the least-cost fuel source. These recommendations are discussed in Section 5.4.1 below. Section 5.4.2 discusses opportunities available to SCs today to customize reference level calculations on a case-by-case basis.

5.4.1 Registering Fuel Regions

During the GRM working group effort, stakeholders identified alternative conventions for modeling the GPI or fuel region price of a resource associated with unique supply arrangements. Instead of taking the minimum of all values, stakeholders recommend a weighted average across multiple regions, or the higher cost fuel region value.

Using the higher cost fuel region value conflicts with the policy's objective to reinforce competitive incentives, but the ISO has found a more dynamic methodology is prohibitively challenging to validate and implement.

In the Bidding Rules Enhancements (BRE)[46] initiative, the ISO and stakeholders considered policy that would allow resources to represent their costs as a composite rate based on a weighted average formula. The ISO would calculate a static weighted average formula for the year based on the percent of

[46] Revised Draft Final Proposal for Bidding Rules Enhancements —Generator Commitment Cost Improvements http://www.caiso.com/Documents/RevisedDraftFinalProposal-BiddingRulesEnhancements-GeneratorCommitmentCostImprovements-redlined.pdf Page 20

volumetric usage shipped by each company in the year prior[47]. This solution is both retrospective and static, which does not solve the problems characterized by stakeholders to date as dynamic.

This policy was approved by stakeholders and the Board but implementation was delayed in anticipation that more tailored solutions would be developed through the CCDEBE stakeholder initiative. The RLCR process does offer one possible solution to this problem and stakeholders have not yet re-considered development to dynamically model composite costs.

➔ The ISO is seeking stakeholder feedback to assess the demand for revisiting this methodology, or some permutation of a standard blended methodology, given the limitations identified in this section.

5.4.2 Customized and Negotiated Resource Parameters

In lieu of a broadly available, pre-determined methodology, the ISO offers opportunities for SCs to negotiate or customize reference level calculations, fuel costs, and other resource parameters.

A SC can request a Negotiated DEB (NDEB) to capture resource specific supply arrangements. Resources may seek consideration of tailored reference levels to reflect more complex cases then the standard formulas do. Approved calculations only apply to the DEB. They are not applicable to commitment costs.

If market participants have a valid reason to develop a unique convention to calculate fuel costs, SCs can work with the ISO to customize a methodology. While this option would still be static, it offers resources with an opportunity to identify a unique equilibrium where reference levels over- and under-estimate costs equally over time.

An SC can negotiate individual reference level parameters, which would apply to all reference level calculations including commitment costs. Two negotiated parameters exist today:

- A negotiated variable operations and maintenance adder[48] allows an SC to instead work with the ISO to determine a more accurate value if the default VOM, which depends on a resource's registered technology and fuel type, does not accurately reflect a resource's characteristics.

- If eligible as use-limited,[49] resources may negotiate opportunity costs when costs cannot be accurately modeled using the standard methodology. The opportunity cost adder for eligible use-limited resources is not intended or approved for gas resources with limited access to fuel due to short-run gas system constraints.

[47] The ISO found that updating costs iteratively, on a monthly instead of annual basis, would introduce an overly burdensome validation process and would not be feasible.
[48] See BPM for Market Instruments Attachment D Section D.5.4
[49] Resources must be registered in the Masterfile as use limited in order to qualify for an opportunity cost adder. Eligibility criteria can be found in the BPMs for Market Operations Section 2.1.15

➔ Some GRM working group participants specifically raised the issue of opportunity costs as an addition to the problem statements identified by the GRM working group. The ISO is seeking stakeholder feedback on including opportunity costs for use-limited resources in scope.

5.5 Prior Proposals to Transition to Market-Based Commitment Costs

GRM working group participants expressed interest in better understanding policy proposed through CCDEBE to transition to market-based commitment costs, and requested the ISO explain the trade-offs that informed the ISO's decision not to implement them.

The ISO understands that many stakeholders and participants in the market today were not yet active participants in the stakeholder process that developed these proposals. As an immediate next step, the ISO supports stakeholder efforts to better understand these issues and to ensure broad stakeholder engagement on the direction of continuing efforts.

This section provides an overview of the proposals, key design issues and implementation challenges that the ISO and DMM have identified to date. This section concludes with a commitment cost cap analysis the ISO and stakeholders discussed in the GRM working groups. In response to stakeholder feedback from that discussion, the ISO offers additional context and a preliminary perspective on what these observations demonstrate.

5.5.1 Dynamic Market Power Mitigation

Static policy like a commitment cost cap is relatively simple to validate but serves as a crude tool for capturing a wide diversity of costs that change dynamically. Market-based (supplier submitted) offers do not require administrative validation but are only feasible when the ISO can identify un-competitive conditions efficiently. Detecting local market power from commitment cost bidding is more complicated than through energy bids, so much so that policy puts an upper limit on what commitment costs resources can offer into the market[50].

The ISO validates all commitment cost bids against the proxy commitment cost calculation. While this method of validation has the potential to limit bidding flexibility in otherwise competitive conditions, policy is designed to minimize this risk by capturing most resource's commitment costs with reasonable accuracy in reference level calculations. The RLCR process provides an incremental level of flexibility to accurately reflect costs in the market but is not a perfect substitute for competitive market participant-submitted offers.

A market power mitigation procedure for commitment costs is ideal in theory but difficult to design, implement, and unavoidably computationally intensive. Detecting market power through commitment costs requires considering multiple intervals and possible permutations of advisory intervals for each

[50] Other ISOs/RTOs have unique ways of dealing with this but a ceiling, or a conduct threshold, is a common approach. For example, PJM : PJM Manual 15 : Cost Development Guidelines

commitment decision. This problem is further exacerbated when market horizons, such as the real time market, have truncated look ahead horizons.

The CCDEBE proposal for an enhanced dynamic competitive path assessment included substantial changes to account for a) how commitment cost impacts are addressed within the critical constraint list that is tested for market power, b) effects of lumpy dispatches on mitigation methodology, c) the potential for economic capacity withholding.

Dynamic market power mitigation applied to commitment costs could provide the necessary market power protection to support enhanced commitment cost bidding flexibility and reduce the risk from inaccurate reference level calculations. This policy proposed resources could bid commitment costs up to 200 percent of reference level costs as a backstop cap, and allow resources to negotiate commitment costs similar to how resources can negotiate DEBs today.

However, the DMM did not find the CCDEBE design could support the simultaneously proposed increase in bidding flexibility as it would likely "frequently fail to detect the local market power that it is designed to detect."[51] The DMM identified a number of outstanding gaps in the proposed methodology including a mitigation for uncommitted units, portfolio level bidding strategies, and gaming of inter-temporal constraints.

Other stakeholders expressed concern about implementation cost, and identified a need to spend more time studying, testing, and considering alternative options. As a result, the ISO did not move forward with the policy at that time, and the ISO considers there to be outstanding concerns that would need to be worked through if there was interest in reconsidering that policy direction with respect to commitment cost caps.

5.5.2 Negotiated Commitment Costs

A negotiated option for commitment costs was intended to deliver value specifically in cases where resources have access to multiple sources of fuel or fuel shipping arrangements, fuel replacement costs, or some additional cost component that is not reflected in the proxy commitment cost formula.

Policy assumed this option would be feasible given that a similar business process exists today in support of negotiated DEBs under the authority of the DMM, but DMM noted the potentially limited value of a negotiated commitment cost option may not warrant the additional business process requirements. In response to the CCDEBE revised draft final proposal, DMM observed that "neither the ISO nor participants have identified any other costs that need to be covered by the headroom already in the ISO's commitment cost caps."[52] Resources have the option to negotiate cost components—O&M and opportunity cost adders -- and the scalar on commitment cost provides more flexibility than DEBs provide which should be sufficient to accommodate other sources of variation that might arise.

[51] The Department of Market Monitoring Comments on Commitment Costs and Default Energy Bids Revised Draft Final Proposal, February 28, 2018. (P. 17).
[52] The Department of Market Monitoring Comments on Commitment Costs and Default Energy Bids Revised Draft Final Proposal, February 28, 2018. (P. 12).

5.5.3 Commitment Cost Cap Analysis

The ISO developed an analysis of commitment cost bidding behavior during the same four periods identified in Section 5.3 to see how often and to what extent ISO calculated commitment cost caps are binding. Stakeholders discussed this analysis in a working group on January 25, 2024[53], and requested the ISO provide additional context and interpretation.

The figures in this section show commitment cost bids as a percentage of a resource's specific commitment cost cap. The ISO caps commitment cost bids at 125% of included costs in the commitment cost calculation. Insofar as commitment cost variation is driven entirely by fuel cost,[54] bids using 100% of the commitment cost cap reflect fuel that costs 125% of the GPI, and bids using 80% of the commitment cost cap reflect fuel costs equal to the GPI.

More generally, when resources bid above 80% of the cap, resources are using their headroom to reflect costs between the weighted average gas price and the cap. The ISO expects most commitment cost bids to be grouped around 80% of the cap when the bid/offer spread is fairly tight, and above 80% when conditions introduce the potential for cost-risk.

The ISO assessed CAISO BA gas resource commitment costs separately from WEIM gas resource commitment costs.[55] The CAISO BA analysis shows both day-ahead and real-time commitment cost bids. The real-time bids include re-bid commitment costs from resources that did not receive day-ahead awards. Consistency between day-ahead and real-time indicates resources that do not receive day-ahead awards are not re-bidding commitment costs at a significantly different cost. The WEIM commitment cost analysis shows real-time bids.

Stakeholders requested the ISO clarify whether this analysis includes WEIM BAA base-scheduled resources. This analysis includes all economically participating resources, which are required to submit economic bids.

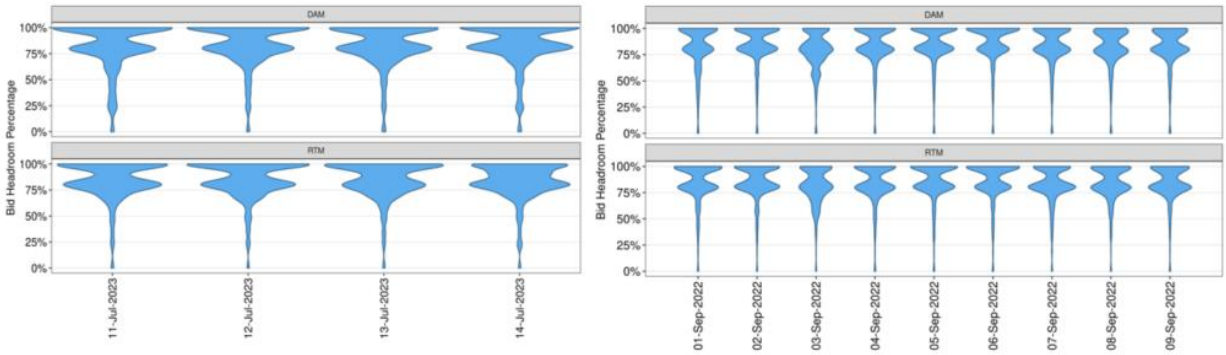
CAISO BA resource bidding behavior observed exhibits two prominent bidding strategies; most resources either bid just above the GPI or used their full headroom.

[53] Gas Resource Management working group (January 25, 2024) Presentation https://stakeholdercenter.caiso.com/InitiativeDocuments/Presentation-GasResourceManagement-Jan25-2024.pdf

[54] This simplifying assumption is intended to help stakeholders interpret and provide feedback on the analysis in this section. If commitment cost variation is driven entirely by fuel cost, a 125 percent increase in gas prices would result in a total cost increase of 125 percent. In practice, a 125 percent increase in gas prices would result in a total cost increase of less than 125 percent because of other costs included in the calculation.

[55] Some stakeholders requested the ISO breakdown the WEIM analysis into regional areas or BAAs. Some BAs in the WEIM only have a few gas resources.

Figure 8 CAISO BA commitment cost bidding mimics bidding behavior observed during the non-volatile period (left) during the summer volatile period (right)

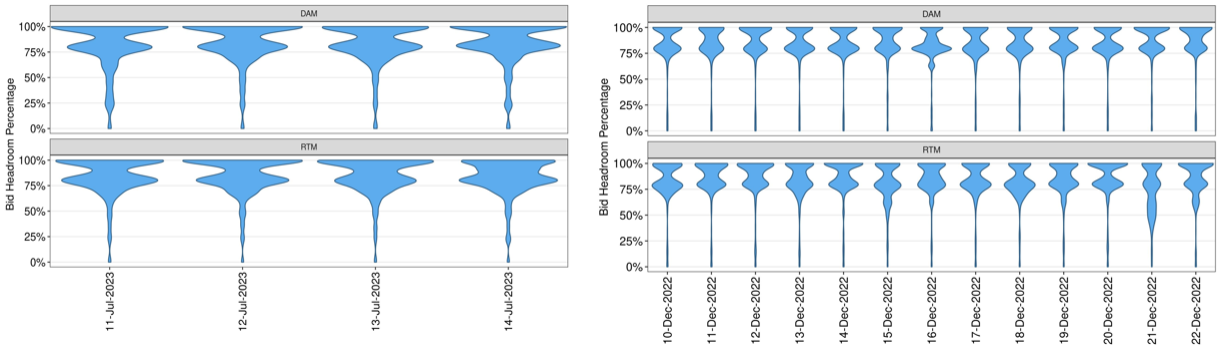


In Figure 9, bidding behavior during the non-volatile day and summer volatile day appears consistent. Most bids tend to cluster around or above the GPI. Day-over-day volatility and variance around the GPI remained within the 125% threshold even while prices are generally higher than usual during the summer volatile period.

The observable portion of bids at 100% of the cap indicates the commitment cost cap regularly binds that portion of commitment costs at around 125% of the GPI. The ISO has heard from stakeholders that there may be a number of possible reasons for this. Values other than the GPI fluctuate.

Figure 10 compares the same non-volatile period above with the winter volatile period, December 10 – 22, 2022. Prices for SoCal Citygate and PG&E Citygate during the December volatile period exhibit tight bid-offer spreads but significant day-over-day volatility. Bidding behavior does not appear to change in response to day-over-day volatility[56].

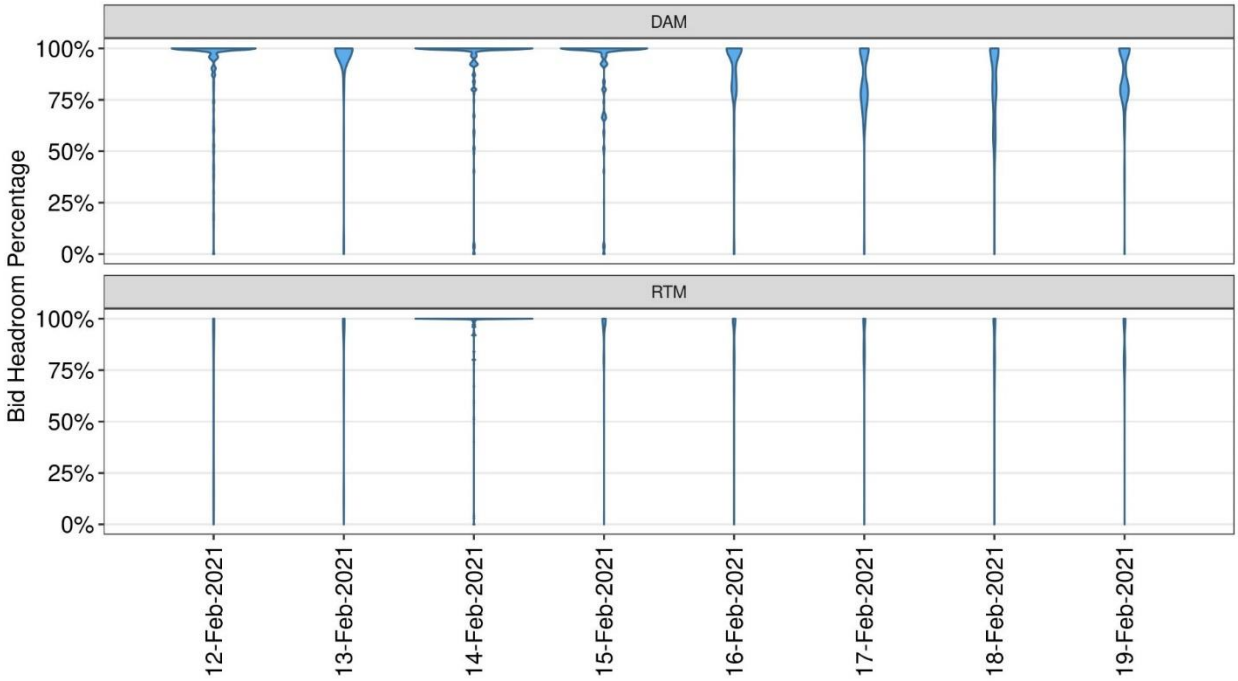
Figure 10 CAISO resources exhibit similar bidding behavior during non-volatile (left) and volatile (right) periods



[56] The ISO understands that gas pipelines provide a monthly tolerance band which CAISO BA gas resources may use to manage day-over-day imbalances. CAISO BA gas resources may also use their gas storage to manage variability.

Figure 11 illustrates CAISO BA gas resource commitment costs during the volatile period between February 12-19, 2021. Bidding during the February volatile period appears to follow a single paradigm; most resources bid at or above the cap and there is little to no variance in commitment costs. During this period, gas prices at both SoCal Citygate and PG&E Citygate exhibited day-over-day volatility and wide bid-offer spreads.

Figure 11 CAISO gas resources utilized almost all of their commitment cost bid headroom in their bids



Figures 12 and 13 below illustrate WEIM gas resources' commitment cost bids. WEIM gas resource bidding behavior appears to differ slightly from CAISO BA resources during the summer periods, but differs significantly during the winter volatile periods.

Figure 12 illustrates WEIM resource commitment cost bids during the summer non-volatile and summer volatile period, which appear consistent with CAISO BA bidding behavior. Prices at the western hubs—El Paso South Mainline, El Paso Blanco, and Stanfield—exhibited tight bid-offer spreads and day-over-day volatility within a normal range, consistent with gas prices observed at CAISO BA hubs.

The distribution of bids appears to have a greater spread, with a larger proportion of resources are bidding at or below the GPI, compared to CAISO BA resources during the non-volatile period and summer volatile period.

Figure 12 WEIM during the non-volatile period (left) and summer volatile period (right)

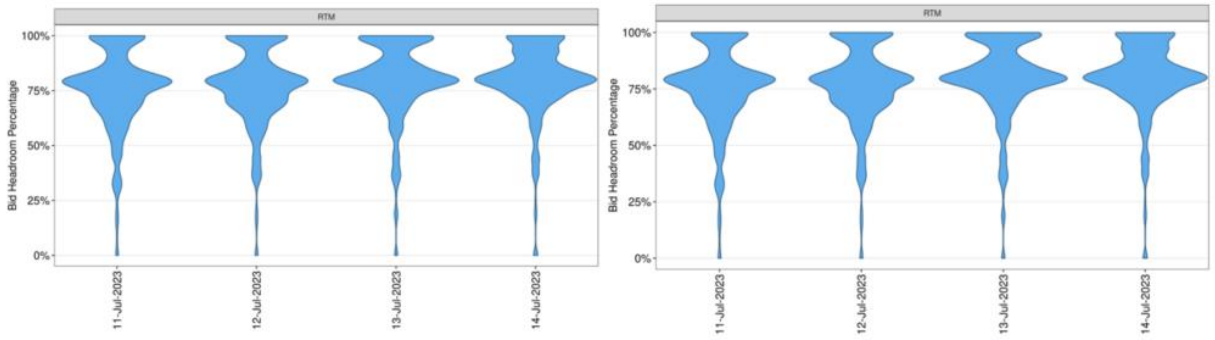
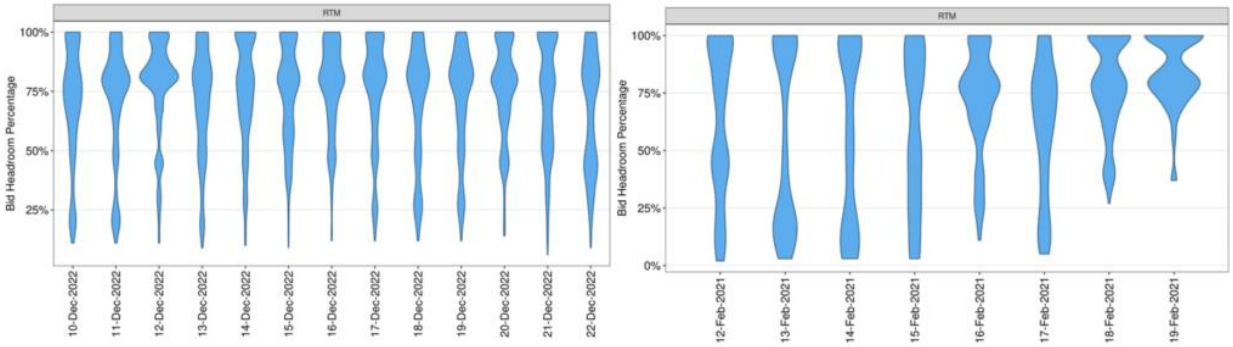


Figure 13 WEIM resources during the December (left) and February (right) volatile periods



WEIM commitment cost bids during the winter volatile periods, illustrated in Figure 13, exhibit a much wider variance than CAISO BA resources. In December more bids seem to be clustered around or above 100% of GPI compared to the February period, but overall the variance in commitment cost bids during both periods indicate commitment costs are based on a wide variance of costs.

One possible explanation for the pattern exhibited above is that WEIM resources may be bidding commitment costs close to the resource-specific cost of fuel they purchased. These patterns mimic the distribution of costs seen in Figures 4-7 for regional gas hubs, which indicates that these resources are not using the additional headroom to reflect significant differences in costs beyond the cost of fuel purchased. If true, this analysis does not show resources are using the full headroom provided today to account for potential fuel cost uncertainty during these periods, and does not indicate a need for higher threshold values.

Key Takeaway: The ISO does not observe binding commitment cost caps for most WEIM entities today, which indicates that today's threshold values are sufficient to capture most costs. The ISO is open to stakeholder feedback on this conclusion, and stakeholder recommendations for further analysis.

6 Accessibility of RLCR Process

The gas price index used in reference level calculations correlates with most resource's costs, and the RLCR process acknowledges and provides redress should that correlation be weaker for some resources

under specific conditions. SCs may request the ISO use a different fuel cost or reference level value in circumstances when cost expectations change significantly from administratively calculated cost estimates and can be supported by contemporaneously available documentation.

Under the umbrella of the RLCR process, two options exist—the automated and manual processes—which serve distinct purposes and accommodate somewhat different potential use-cases:

> **The automated RLCR process** allows resources to request the ISO use a different value on an hourly basis for DEBs or commitment costs. The process automatically validates or caps requested values by comparing them to a reasonableness threshold. A fuel volatility scalar limits cost-adjustment requests to a reasonable range above a gas price index within which a resource's cost can be verified. Using the static values as the cost basis, this process allows resources to effectuate costs that change dynamically throughout the day.
>
> **The manual RLCR process** allows resources to provide fuel cost information directly to the ISO. ISO staff will review this request along with all submitted relevant materials. If the cost adjustment is approved, the ISO will re-calculate all reference levels for the relevant trade-day using the new fuel price. This is appropriate when a resource's costs do not correlate with the default value the ISO is using, i.e. a pipeline outage forces a resource to procure fuel from a different hub than it is registered to.

The design differences between these two processes—timeline, submission, and process for review—should be appropriate to accommodate intended use cases.

Table 11 Summary of Automated and Manual Reference Level Change Request Processes

	Automated	Manual
Timeline	Any time prior to close of the applicable market—10am PST for the day-ahead market, T-75 for real-time.	By 8AM PST on the day the applicable market is executed
Submission	Directly in SIBR	CIDI ticket
Review process	Automatically validated in SIBR against the Reasonableness Threshold	Manually validated by the ISO between 8-9AM PST
Supporting documentation	Retained by SC in the event of an after-the-fact audit	Submitted in CIDI ticket
Resulting ISO system updates	The requested value supplants the resource's default calculation for the relevant trade-hour(s).	The ISO re-calculates all reference levels for the relevant trade-day using the requested fuel cost. Recalculated reference levels do not include the incidental or fuel volatility scalars.
Example use-cases	Day-over-day volatility, GD2 GPI averages up after ISO estimate is pulled, intra-day gas price volatility	Pipeline outages, resource switches fuel type or source

These processes are intended to serve as a check-point to bring resources to the table and facilitate validation, but as a consequence may be challenging for resources to navigate. The automated process is not intended to be complex to use, while the manual request process has a higher standard of validation and review. The ISO understands that many manual requests are rejected because the market participant failed to provide a valid basis for the request or did not provide appropriate supporting documentation.

Stakeholders anecdotally view complexity as limiting the process's intended use:

> *Stakeholder problem statement: The reference level change request process is complex and does not always lead to request approval.*

Stakeholders recommend modifications to both the automated and manual RLCR processes. Some stakeholder recommendations include modifying the timeline for the manual RLCR process submission and review, offering tools to streamline the process for multiple resources at a time, or updating the process to better accommodate certain use-cases.

This section considers stakeholder problem statements and recommended solutions within the context of some example use-cases for the RLCL process. The ISO is seeking stakeholder feedback to identify specific challenges associated with these use-cases, or elucidate other use-cases the ISO should consider.

- **Section 6.1 Supporting Valid Requests** reviews the principles and best practices around validating adjustments through the RLCR process

- **Section 6.2 Timeline and Submission Process** compares the timeline and submission process to the gas and electric market timelines, discusses some specific use-cases and stakeholder identified problem statements

6.1 Supporting Valid Requests

Both the automated and manual RLCR processes require the same standard of supporting documentation. As a general practice, the ISO requires that resource-supplied documentation reflects prudent procurement practices that avoid jeopardizing pipeline or electric system reliability, and best practices of procurement consistent with industry norms.[57] Reference levels are cost-based offers, and valid cost adjustments follow the same philosophy.

The primary justification for a cost adjustment must be the prevailing cost of fuel. Supporting documentation must explicitly indicate that the timing and driver of the request are appropriate:

[57] Details on required documentation can be found the BPM for Market Instruments Attachment O.1 BPM_for_Market Instruments_V86_Redline.pdf (caiso.com)

1. Timing: Resources must support requests with contemporaneously available information. The request should be based on next-day procurement for RLCRs in the day-ahead market and same-day procurement for real-time requests. Resources may not request cost adjustments to accommodate non-contemporaneous costs, like fuel purchased previously. For non-standard gas trading days, i.e. fuel procurement that is not purchased as part of same-day or next-day procurement, documents must show the price of fuel is for procurement no sooner than the most recent standard gas trading day.

2. Driver: Cost adjustments must be based on fuel prices, and documentation must include a quantity and price. Resources may not use market conditions to indicate risk or uncertainty around fuel prices, or include adders or multipliers in the request to account for market conditions. A resource may not request adjustments to reflect non-compliance penalties.

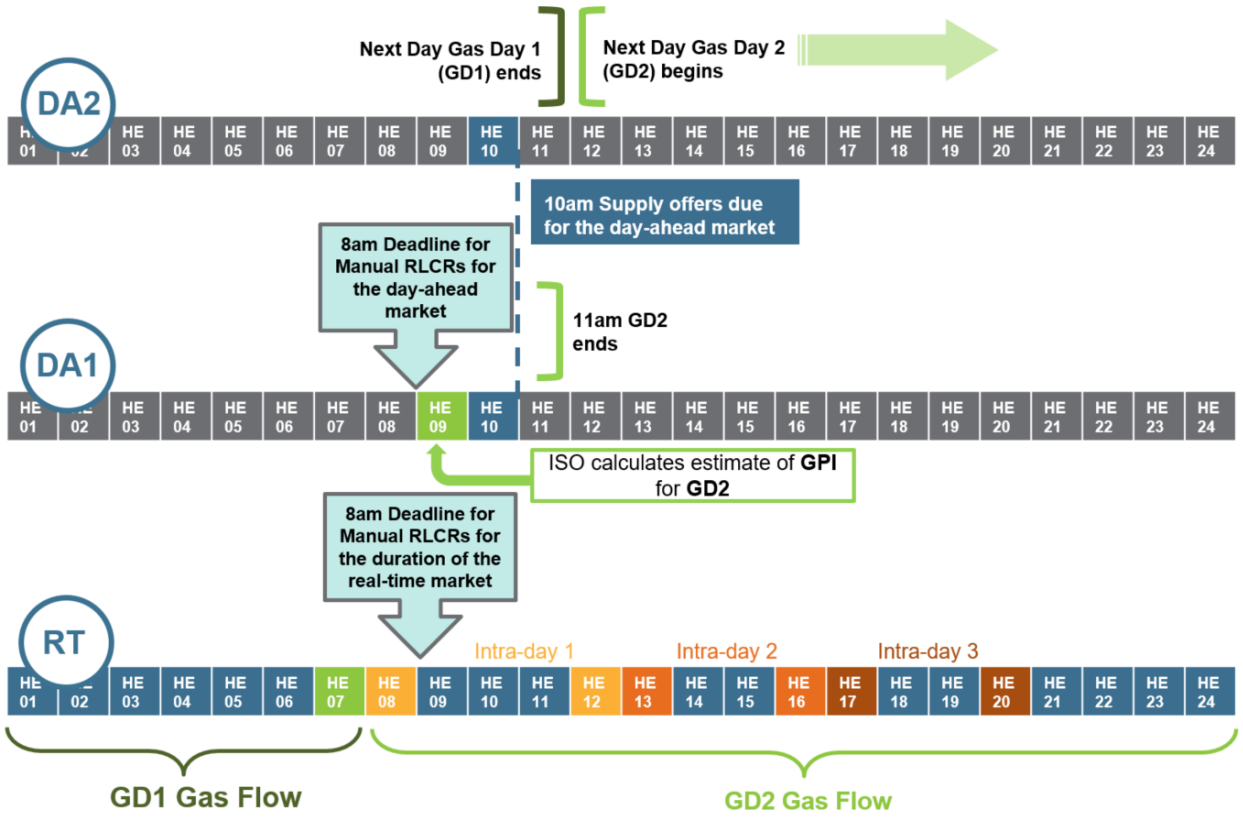
The ISO understands that resources may not have perfect fuel cost information in time to submit a cost adjustment request, and therefore offers flexibility around the process and the types of supporting documentation accepted. Resources can support an increase in *expected* fuel prices with a quote or evidence of an unsuccessful good faith effort to procure fuel at or near nominal gas prices.

For example, a resource may not request a cost adjustment for the day-ahead market based on their perceived risk that intra-day gas prices may exceed the next day gas day GPI. A resource may request a day-ahead cost adjustment if they are unable to procure gas at a price near the index by the time the relevant market window closes, and can justify the requested adjustment value with proof of a rejected offer value.

6.2 Timeline and Submission Process

The timing and submission process today is intentionally designed, based on previous stakeholder feedback, based on when the ISO and market participants need information prior to the applicable market. The deadline for review through the manual process is 8am to ensure sufficient time for the ISO to process the request, and give the requesting SC sufficient time to update their systems and submit bids before the close of the market. Figure 9 below compares the timing of when gas market information is available, when the ISO needs information, and the manual RLCR process.

Figure 14 RLCR process deadlines and active gas flows



For the day-ahead market on DA1, resources must submit manual RLCRs by 8am and automated RLCRs by 10am on DA1 for the ISO to reflect requested adjustments in the day-ahead market run. At that time, market participants know the settled GPI for GD1 and have, what the ISO understands is, a good estimate of the GPI for GD2.

Resources can use the automated process to reflect price differences should the GPI average change after the ISO estimates the GPI.

For real-time, resources must submit manual RLCRs by 8am for the ISO to reflect requested adjustments for the rest of the real-time operating day. At this time, market participants know the settled GPI for both GD1 and GD2.

Resources may request automated adjustments to DEBs and commitment costs (if not already committed) for each real-time operating hour until the close of the relevant market window. Market participants have intra-day gas price information, which can inform automated RLCRs throughout the real-time operating day.

Stakeholders broadly expressed concern that, should the automated process not provide sufficient flexibility to reflect volatility, the manual process would not be accessible due to timing. GRM working

group participants identified challenges with, and recommended changes to, the timing of the manual RLCR process given when information is available to support decision making.

Sections 6.2.1 and 6.2.2 below review opportunities for cost adjustments afforded by policy today and how the ISO understands market participants make decisions and support cost adjustment requests, and discuss GRM problem statements and recommendations in that context.

6.2.1 The Automated RLCR Process

The automated RLCR process facilitates cost adjustments in response to volatility that might cause a resource's fuel costs to diverge from the weighted average price at their hub. While reference levels are static, the automated RLCR process allows resources to more dynamically reflect price variation that might impact costs on an hourly basis. Headroom between the default reference level calculations and the reasonableness threshold accounts for potential differences between a resource's expected costs, as calculated by the ISO, and actual costs.

This process is intended to be more dynamic than the manual process, but some stakeholders find the process burdensome in specific use-cases:

> *Stakeholder Problem Statement: The automated reference level change request process can only be submitted for one resource at a time.*[58]

To solve this problem today, the ISO understands that some market participants may use an application programming interface (API) to automate submissions through SIBR and streamline the process.

Although suppliers are not required to provide supporting documentation at the time of the request, each request must be supported by contemporaneously available documentation. A resource can request automated adjustments before fuel costs are known but should revise their reference levels if realized costs differ from requested, if possible. The ISO reserves the authority to audit automated RLCRs.

If the requested value is lower than the reasonableness threshold, it is accepted and used in the next applicable market run. If the requested value is greater than the reasonableness threshold, it is capped at the level of the reasonableness threshold and used in the next market run. Resources may request the ISO or FERC review fuel cost recovery requests for any amount requested that exceeded the reasonableness threshold.

The ISO understands that resources have sufficient information and may use the this process today for the following use-cases:

- Day-over-day volatility: GD2 averages lower than fuel purchased for HE1-7. Resources know the cost of fuel purchased during GD1 and are able to submit automated requests at any time after fuel is purchased with precise cost information.

[58] Manual RLCR tickets can contain requests for multiple resources.

- Volatility during GD2: SCs may not know the exact fuel or fuel-equivalent costs facing their resource by the time they must submit their automated request but can still request adjustments based on expected costs. If audited, SCs should be able to resolve discrepancies with documentation given the timeline of information available.

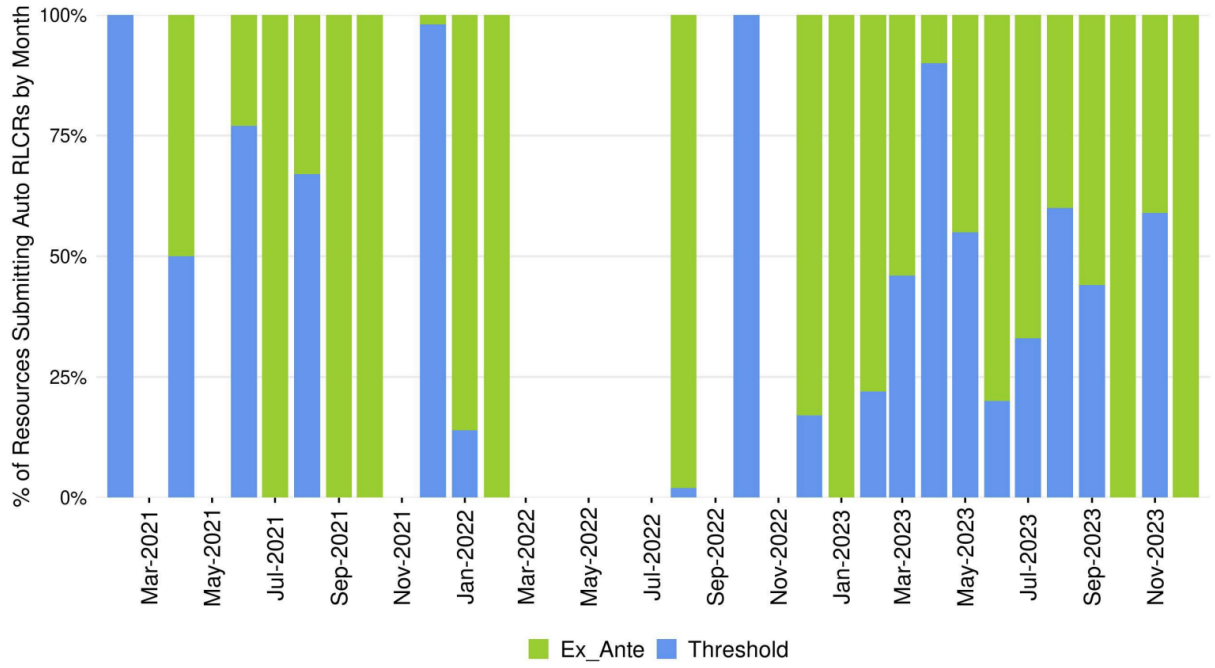
- Same-day gas prices are higher than GD2: The ISO will update the reasonableness threshold in the morning when observed same-day prices are higher than the reasonableness threshold. While no such process exists later in the day, the ISO has not observed that real-time prices deviate significantly from next day gas prices except under exceptional circumstances.

Stakeholders have cited other use-cases where a resource may not have sufficient cost information to inform a request. In cases like this, a resource is expected to request what they think their costs will be and make a good faith attempt to revise their reference levels should realize costs differ from expected. If a request is rejected because it is in excess of the reasonableness threshold the resource is still eligible to pursue after-the-fact cost recovery for the amount originally requested but will only be able to recover costs that actually materialized.

During GRM working group discussions, stakeholders expressed concerns about experiencing or anticipating cost volatility that might exceed the reasonableness threshold. They noted challenges in having sufficient information in time to support a manual request, and that the after-market cost recovery process is cumbersome and inefficient.

The ISO has found that automated requests are generally submitted below the reasonableness threshold. Figure 10 below shows that most of the time, a majority of automated RLCRs are accepted ex-ante meaning the reasonableness threshold offered sufficient headroom to accommodate most automated cost adjustment requests.

Figure 95 Automated RLCRs accepted ex ante and at the threshold per month



In some instances, requests capped at the reasonableness threshold were in response to extreme weather events or real-time gas pipeline capacity reductions. These are cases for which the manual processes could have been ideal given that the trigger for needing cost adjustments may not have relied on live gas price information, and the underlying root cause of changes in fuel costs are correlated over at least a day. However, these triggers would also need to be known in time to request cost adjustments.

➔ The ISO is seeking input to identify non-price-based triggers associated with extreme gas price volatility, and how often/under what conditions stakeholders experience price spikes in intra-day trading cycles 2 and 3 but not intra-day 1.

6.2.2 The Manual RLCR Process

For the day-ahead market on DA1, resources must submit manual RLCRs by 8am. This gives the ISO sufficient time to review requested adjustments, and gives the ISO and market participants time to update their systems to reflect validated adjustments prior to the close of the day-ahead market window.

GRM working group participants recommended the ISO move the timeline of the day-ahead manual RCLR deadline as late as possible to ensure resources have sufficient gas price information from the next day gas day:

> *Stakeholder Problem Statement: Stakeholders may not have the actual gas cost information necessary to submit a manual reference level change request by the 8am deadline for the day-ahead market run.*

The manual RLCR process relies on resource provided documentation indicating the price of fuel purchased or attempted to purchase which can pose a challenge when precise cost information is not yet known. However in some scenarios, resources do not need GD2 or ID1-3 information to support requests. For example, in the event that day-over-day volatility may cause fuel costs from GD2 to diverge from GD1, a resource would already have cost information from GD1 to serve as valid documentation for both the day-ahead and real-time markets.

Cost adjustments for real-time incremental procurement can pose a different challenge. For example, stakeholders expressed concern that increasing volatility in same-day gas trading will exceed the reasonableness threshold (based on GD2), but that resources will not have sufficient information by 8am in real-time in time to support manual requests the morning of the real-time market:

> *Stakeholder Problem Statement: To procure additional supply for real-time, stakeholders have to rely on intra-day trading periods for which pricing information necessary to inform cost adjustments is not available until the afternoon of that gas day.*

The solution explicitly intended for intra-day volatility is the automated RLCR process, and in exceptional circumstances the manual same-day adjustment to the reasonableness threshold. Resources can use the manual process if they have evidence that they were unable to procure fuel near nominally indexed prices and can provide a price quantity pair, and may be eligible for after-market cost recovery for amounts in excess of what they could get approval for absent precise cost information.

The ISO has observed that while most manual requests are submitted on time, the most common reason for the ISO to reject manual RLCRs is an *invalid cost basis* for requests:

Table 12 Rational for rejecting manual RLCR tickets received since 2021[59]

Rationale	Total Approved	Total Rejected
Met all required criteria and approved	8	
Invalid cost basis for request		26
Ticket lacked necessary supporting documentation		21
Requested adjustment for gas hub which is not mapped to resource		2
SC asked for request to be cancelled		2
Duplicate ticket		2
Requested price not greater than threshold of 10%/$0.50		1
CCDEBE tariff provisions not yet effective		1
Ticket not submitted by 8:00 AM PST		1
Total:	8	64

The manual RLCR process is designed for events that may block a resource's access to regular fuel supply like pipeline outages, fuel switching, or other extenuating circumstances. If approved, the ISO recalculates all reference levels but does not include the multiplier on default values or the reasonableness threshold.

Moving the deadline poses a trade-off between feasibility—both for the ISO and market participants—and the potential for incremental information becoming available.

7 Gas Burn Limitations

The ISO coordinates closely with gas pipeline companies to exchange critical information, fostering effective communication with market participants and supporting the reliability of both gas and electric systems. For instance, the ISO provides daily gas burn reports based on its forward looking market results. These reports help ensure sufficient gas pipeline capacity is available to meet day-ahead thermal generation commitments, even in cases where gas generators have not yet submitted their expected nominations.

In situations where gas system imbalances arise, gas pipeline operators may take proactive measures to ensure the system operates safely and reliably. For example, they might issue operational flow orders (OFOs), emergency flow orders (EFOs), or curtailments to maintain proper operational pressure when they notice nominations do not align with anticipated system needs. A gas pipeline operator could issue a low operational flow order if the nominated gas is insufficient to meet the expected customer demand, prompting thermal generators to nominate additional gas flows.

Because these notifications support gas pipeline reliability, ISO policies seek to ensure resources do not have a disincentive to follow gas pipeline instructions. The ISO coordinates with gas pipeline companies

[59] At the time of this analysis in January 2024, the ISO had received 72 manual RLCR tickets (some of which may have contained requests for multiple resources).

to ensure reliability, and ensure gas pipeline companies can send the appropriate signals to resources. With limited exceptions, gas resources are expected to manage these limitations through their bids.

The ISO understands that the notifications issued by regional gas companies vary in terms of the frequency of notification based on the unique conditions and structure of the gas system, associated penalty structure, implied reliability risk, and expected resource behavior as a result. The ISO also understands that some resources may have limited options for recourse.[60]

It remains the SC's responsibility to procure fuel to meet market awards based upon how it offers the resources in the market. Individual resources, or a portfolio of resources, that draw supply from a pipeline will still need to economically manage system tolerances, including variations resultant from intra-day nominations. Should resources in real-time expect to be able to procure supply to meet their day-ahead commitments, they may be at risk of price volatility and system limitations when they, or other generators, procure additional fuel to support incremental energy offers.

During the GRM working group effort, stakeholders described challenges with managing pipeline system limits through energy bids alone. Stakeholders have anecdotally indicated that increasing gas price volatility and gas system constraints are leading to more frequent OFOs on some gas systems, and describe a more limited set of options due to differences in physical infrastructure, including accessible gas storage and pipeline conditions. Some stakeholders describe experiencing constrained conditions on a daily basis that they manage economically.

A gas resource might try to increase their offer price to avoid being dispatched beyond what they can support with incremental fuel purchases without violating gas pipeline instructions. But there is a risk that the resource may be needed and possibly mitigated in real-time:

> *Stakeholder Problem Statement: Gas burn limitations issued by gas companies are not reflected in the market for WEIM balancing areas, leading to potentially inaccurate commitment or infeasible dispatch instructions*

To resolve this issue, stakeholders requested further discussion of how to reflect gas burn limitations in the optimization to help manage the efficiency of resources given daily or hourly limitations and avoid gas burn limitations. Stakeholders recommended consideration of gas constraints, hourly gas limits, or opportunity costs to manage limitations. The ISO requests feedback from stakeholders to understand if the economic challenge described by GRM working group participants also poses a reliability risk.

- **Section 7.1** discusses the application of gas nomograms for reliability in ISO markets, and identifies issues with extending the use of gas market constraints beyond reliability.

[60] In CCDEBE, the ISO observed that gas generators can use their pipeline pack or storage inventory to manage imbalances. Differences in gas pipeline policies and physical infrastructure across western market participants may result in a different, or more limited, set of options.

- **Section 7.2** discusses previous attempts to develop tools to manage daily gas burn limitations more efficiently, and identifies key issues the ISO and stakeholders will need to resolve.

7.1 Gas Constraint Using Nomograms for Reliability

Gas constraint nomograms are one of many tools the ISO can use to maintain gas and electric system reliability. Where applicable, the ISO maintains a nomogram for a zone, under conditions specified by the gas company.[61] The ISO may implement a gas constraint[62] in either the day-ahead market or real-time market to limit the gas burn in an area with gas capacity limitations that risks gas system reliability.[63] The ISO may activate a nomogram constraint when ISO market operators, in coordination with the gas pipeline company, identify a gas system reliability risk from limited fuel supply and high demand in the gas system.

A gas constraint nomogram works by effectively suppressing LMPs in the gas constrained location to make a gas generator appear uneconomic and forcing the market to dispatch supply from elsewhere on the system. When a gas constraint is active and binding, the shadow price of the constraint will be reflected in the congestion component of LMPs at the nodes used to dispatch associated generators with a shift factor of 1. This shadow price will be applied with a shift factor of 0 to all other pricing nodes that are used to settle demand, but the shadow price of the constraint will not be included at pricing nodes used to model injections and withdrawals. The outcome ensures that the gas system reliability constraint can be satisfied without distorting energy market outcomes.

Gas nomograms are valuable tools in managing gas system reliability but have practical limitations that influence their regular use. Activation of a nomogram involves a manual process requiring coordinated communication between the ISO market operators, gas pipeline operators, and gas generator scheduling coordinators (SCs). Typically, a day-ahead nomogram is activated for all 24 hours but may be applied to specific periods as specified by the gas pipeline operator. Given the inherent complexities, the ISO makes some simplifying assumptions. For instance, the ISO utilizes a single, average heat rate to represent each unit when formulating constraints, which is a necessarily blunt approximation of each individual gas resource's heat rate. Furthermore, because nomograms require significant computational resources, the ISO monitors and manages the volume of active nomogram constraints to maintain robust market performance while supporting system reliability.

Gas nomograms are an important tool for reliability but not a panacea. Depending on the notice period and nature of the gas limitation, the ISO and gas pipeline operators may instead opt for other

[61] The gas nomograms were a solution that originated from reliability risks associated with Aliso Canyon, which experienced a large gas leak in 2015. Limited operability presented, and was expected to continue to pose, challenges including reliability and market distortion risks. Intended as a temporary measure.
[62] See BPM for Full Network Model Section 4.2.7 for more information on nomogram constraints
[63] The use of a gas nomogram has only been implemented for the SoCalGas area as a means of supporting Aliso Canyon based reliability concerns.

procedures like gas curtailments or exceptional dispatch to more quickly and efficiently manage gas system reliability.

7.2 Tools for Efficient Daily Gas Limitation Management

The ISO understands from stakeholder comments that a gas nomogram constraint may not be an appropriate solution to stakeholder identified problems. Nomograms support reliability, often at the cost of gas generator efficiency but still ensuring the total gas burn constraint is not violated with the market's objective function of minimizing total system cost.

Stakeholders have not cited reliability concerns, but request that the ISO develop new tools that would improve the efficiency of fuel procurement for sets of resources based on daily or hourly gas system limitations. Stakeholders recommend considering a broad set of solutions including modeling these objectives directly in the optimization with multiple resource constraints, modeling daily gas burn limits, or expanded use of opportunity costs.

In the past, CAISO BA resources have requested the ISO consider tools to help resources manage OFOs associated with financial penalties but through various stakeholder efforts identified a number of challenges that would limit the feasibility of options that both preserve system reliability and improve efficiency for gas electric generators.

For example, the ISO and stakeholders considered whether reflecting an opportunity cost or scarcity value in reference levels would be a feasible way to manage gas burn limits and support reliability; the ISO has determined that this functionality doesn't ensure continued incentives intended to support gas and electric system reliability:

- In 2012, DMM considered various methodologies to reflect the risk of violating gas system constraints in reference levels but ultimately found this approach to be problematic.[64] Risk associated with imbalance notifications is difficult to model into reference levels because the structure of gas imbalance notifications, which may be based on daily gas imbalances, is not congruent with hourly marginal costs. Further, reference levels are resource-specific while gas system constraints involve groups of resources and an individual resource's bidding behavior could impact the whole group.

- A CCDEBE proposal would have allowed gas resources to reflect fuel availability through a risk margin or scarcity value but only beginning in HE17 when gas resources can no longer schedule gas through intra-day gas cycles.[65] However, the ISO could not identify what documentation

[64] *Potential Methodology to Account for OFO Penalties Incurred due to Real-Time Energy Dispatches*, Department of Market Monitoring White Paper, February 2012. 2 (caiso.com)
[65] *Commitment Costs and Default Energy Bids* Draft Final Proposal P. 96: https://stakeholdercenter.caiso.com/InitiativeDocuments/DraftFinalProposal_CommitmentCosts_DefaultEnergyBidEnhancements.pdf

would support these changes, and could not provide an example of how the scarcity value would be determined.

FERC's discussion on the ISO's efforts to develop nomograms for gas system reliability highlights additional concerns with respect to fairness, jurisdiction and stakeholder impact. Specifically, FERC noted the potential for imbalance if an entity would be able to develop a constraint to help manage gas supply issues while other market participants rely on appropriate bidding and contracting.[66] Additionally, FERC questioned how the ISO could effectively monitor and implement these policies, given that the process relies on market participants for the relevant information.

These issues raise questions about transparency, equity, and regulatory oversight in the policy's design and application. For stakeholders, this means the ISO is taking steps to ensure fairness by directly collaborating with gas pipeline companies to address only limited, reliability specific concerns. This coordination helps balance the needs of the market while maintaining the integrity and reliability of the gas and electric system.

In the context of a broad regional market the challenge of ensuring equity and transparency is exacerbated. The diversity of gas pipeline company policies across the West poses a challenge when developing a single, standardized solution that impacts all market participants fairly. Importantly, the ISO does not have sufficiently accurate or timely information about pipeline limitations or how individual resources are situated. At a minimum, the ISO would need greater transparency into the diversity of gas pipeline company policies and the nature of notifications to determine what appropriate next steps might be.

➔ The ISO is seeking stakeholder input previously identified challenges may be similar or different from how stakeholders would characterize this effort today. The ISO is seeking input on what source(s) of information would help inform this effort.

8 Stakeholder Engagement and EIM Governing Body Role

Stakeholder input is critical for developing market design policy. The schedule proposed below allows opportunity to for stakeholder involvement and feedback.

8.1 Schedule

Table 13 below lists the proposed schedule for the stakeholder process.

Table 13: Schedule for Stakeholder Process

Item	Date
Issue Paper	1/23/2025

[66] FERC Order on Aliso Canyon Gas Electric Coordination Enhancements November 28, 2017. P18. Microsoft Word - 20171128-3054(32550206) (caiso.com)

Stakeholder call on Issue Paper	2/13/2025
Publication of Straw/Revised Straw Proposal	Q2 2025
Publication of Draft Final Proposal	Q3 2025
Governance Approval	Q3 2025

8.2 Governing Body Classification

This initiative proposes modifications to rules and processes for gas resources to reflect costs in the market with a focus on regional market participants. As explained below, CAISO staff believes that the WEM Governing Body will have joint authority with the Board of Governors over the proposed changes.

The role of the WEM Governing Body with respect to policy initiatives changed on March 20, 2024, when the Board of Governors adopted revisions to the corporate bylaws and the Charter for WEM and EDAM Governance to implement the Governance Review Committee's EDAM governance proposal. Under the new rules, the Board and the WEM Governing Body have joint authority over any

> proposal to change or establish a tariff rule applicable to the WEIM/EDAM Entity balancing authority areas, WEIM/EDAM Entities, or other market participants within the WEIM/EDAM Entity balancing authority areas, in their capacity as participants in WEIM/EDAM… The scope of this joint authority excludes, without limitation, any other proposals to change or establish tariff rule(s) applicable only to the CAISO balancing authority area or to the CAISO-controlled grid.

Charter for WEIM and EDAM Governance § 2.2.1. The tariff changes contemplated here would apply to the entire market footprint, and thus be "applicable to WEIM/EDAM Entity balancing authority areas, WEIM/EDAM Entities, or other market participants within WEIM/EDAM Entity balancing authority areas, in their capacity as participants in WEIM/EDAM." They would not be applicable "only to the CAISO balancing authority area or to the CAISO-controlled grid." Accordingly, the proposed changes will fall within the scope of joint authority.

This proposed classification reflects the current state of this initiative and could change as the stakeholder process moves ahead. Stakeholders are encouraged to submit a response in their written comments to the proposed classification of as described above, particularly if they have concerns or questions.

8.3 Next Steps

The ISO will discuss the Issue Paper during the stakeholder meeting on February 13, 2025. The ISO requests stakeholders submit written comments in response to the Gas Resource Management paper and stakeholder meeting by March 11, 2025.

Appendix A

Section 5 describes how increasing the reasonableness threshold would increase the range above the GPI within which resources could request DEB or commitment cost adjustments through the automated RLCR process, but how doing so could create trade-offs. Increasing bidding flexibility with respect to reference levels might accommodate a larger trade volume at times but would also reduce intended market power protection. The trade-off between incremental flexibility and reduced market power protection is not straight forward to predict or evaluate because it depends, in part, on the distribution of prices on any given day.

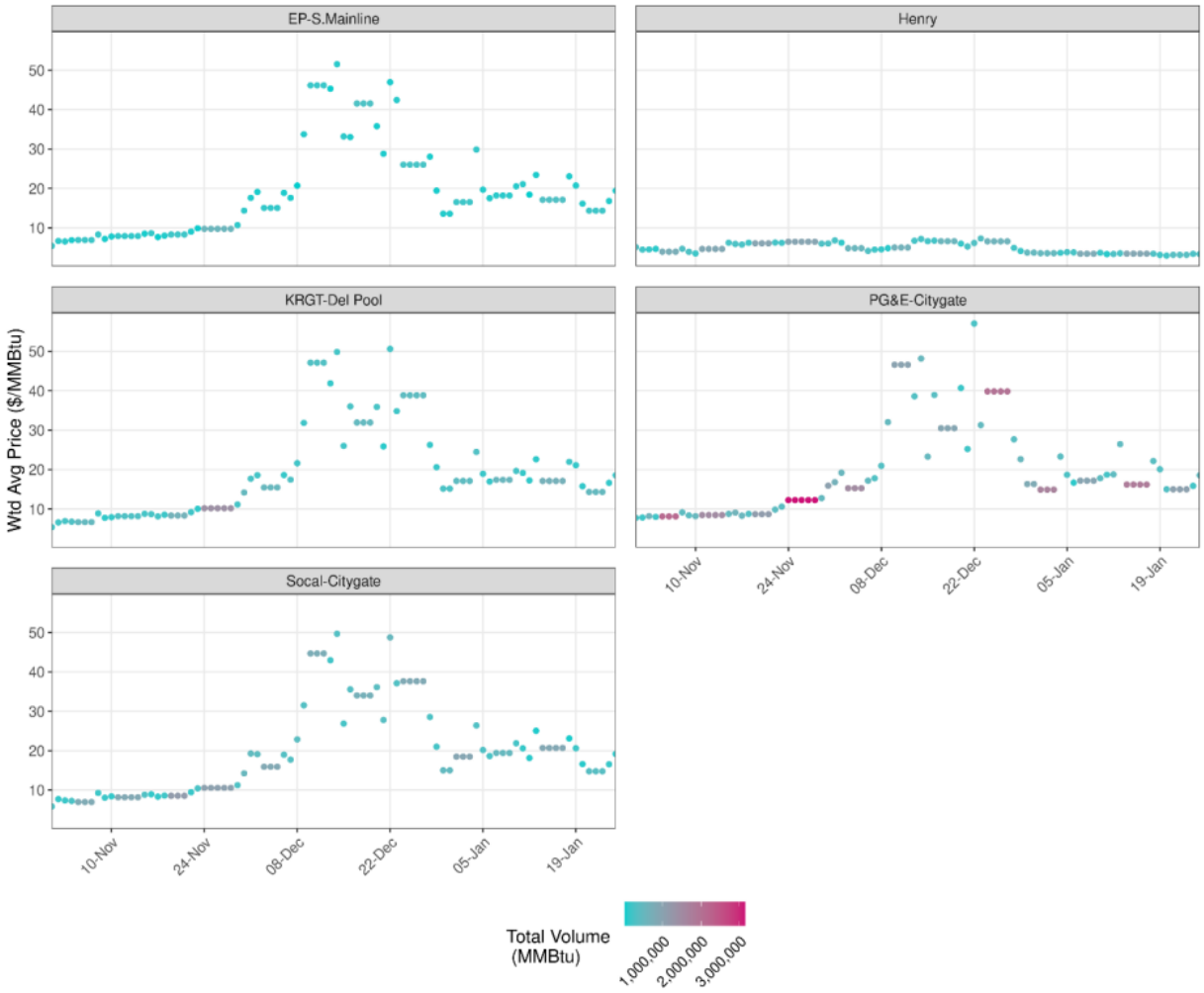
Analysis in support of policy as it exists today has focused on how well threshold values cover most trade volume in aggregate by separating the outliers instead of focusing on them as Section 5 does. This approach of limiting but not eliminating outliers is valuable because, aggregated over time, gas and electric prices skew asymmetrically (like the long right tail distribution observable in the DMM analysis in Section 5.2, and below). When prices are distributed like this, no threshold value can guarantee all costs will be covered all the time.

Identifying the potential for outliers is useful for multiple potential policy goals. Any attempt to capture incremental trade-volume could either facilitate inflated costs or else require additional backstops to maintain market power protection, so understanding degree of potential impact can inform supplementary policy actions. It is not necessary to cover all costs by default because multiple avenues exist for cost adjustments and cost recovery. However, policy should be designed such that, to the extent outliers are observed, cost adjustment and cost recovery processes should be equipped to accommodate them.

Stakeholders are encouraged to consider, provide feedback on, and/or recommend alternatives to the methodologies in this section to adapt for GRM policy development.

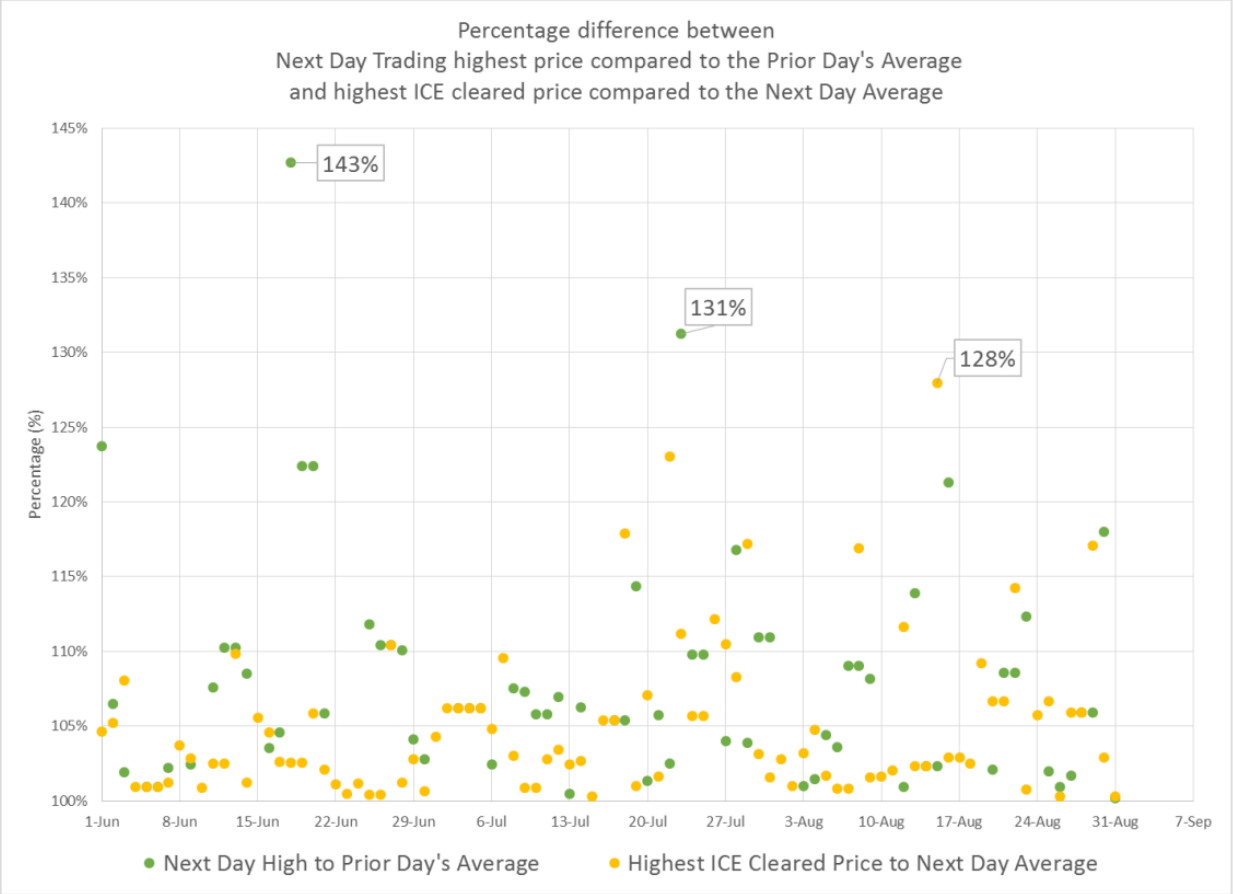
Examples 1 and 2 below were developed by the ISO to compare price trends and liquidity across regional gas hubs, and compare high trades to next day indices for gas scalar evaluation:

Example 1[67]: Weighted average price and volume gradient by hub, November 2022 through January 2023



[67] California ISO Market Analysis, "Gas Conditions and CAISO Markets Report for December 2022 – January 2023", February 6, 2023. Gas-Conditions-and-CAISO-Markets-Report-for-Dec2022-Jan2023.pdf

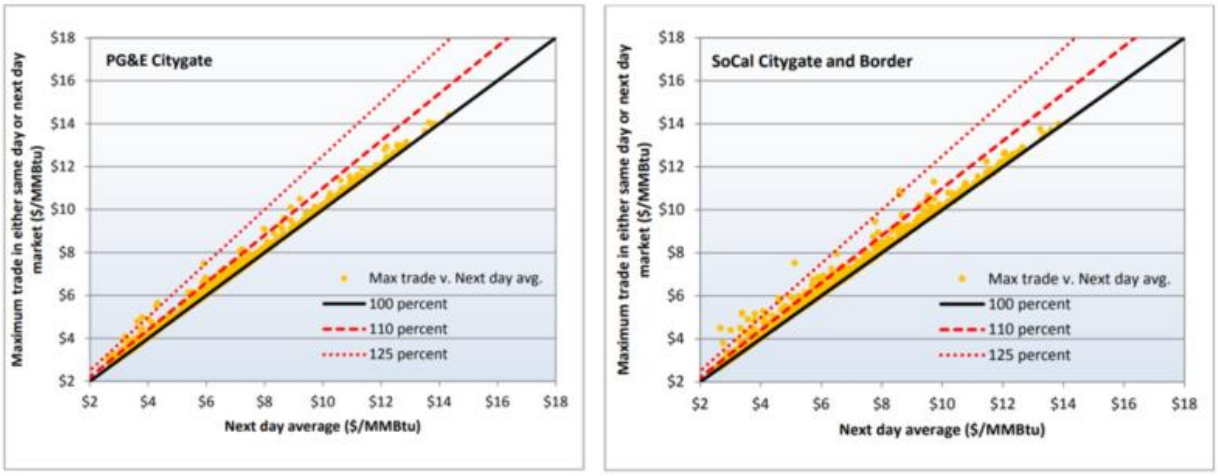
Example 2 Compare high trades to next day gas indices[68]



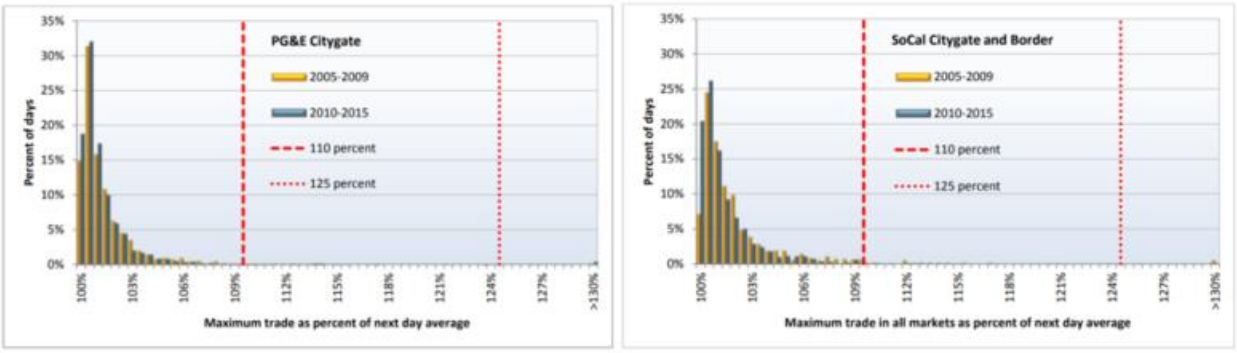
The DMM has played a significant role in monitoring gas price volatility and evaluating the effectiveness of gas price scalars. Examples 2 and 3 below the DMM published, in addition to those in this issue paper, to illustrate trends in gas price volatility and the relationship between a threshold value and gas cost outliers.

[68] *Aliso Canyon Gas Electric Coordination Phase 2* Draft Final Proposal September 23, 2016. DraftFinalProposal-AlisoCanyonGasElectricCoordinationPhase2.pdf

Example 3[69]: Next day index price versus maximum trade price, 2005-2009



Example 4: Distribution of daily maximum price, comparison of 2005-2009 and 2010-2015



[69] Examples 2 and 3: California ISO Department of Market Monitoring, "Report on natural gas price volatility" September 21, 2025.