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# Report Briefing Winter 2022-2023 Southern California Gas Reliability Assessment

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California Public  
Utilities Commission

# Presentation Outline

- Introduction
- Stochastic Daily Mass Balance Model (Developed by ERM)
- Reliability Assessment: Assumptions and Inputs
- Reliability Assessment: Summary of Findings
- Questions

# **Report Briefing Winter 2022-2023 Southern California Gas Reliability Assessment**

Introduction

# Winter 2022-2023 Southern California Gas Reliability Assessment: Introduction

- Since the Aliso Canyon leak in 2015, the Gas Policy and Reliability team has been conducting seasonal reliability assessment of the SoCalGas system, for both the Winter and Summer as well as 1-in-10 peak day analysis.
- Using monthly gas balance sheets, the short-term reliability of the SoCalGas natural gas system was assessed primarily by tracking monthly storage inventories and pipeline capacity reserve margins.
- Having sufficient inventory levels throughout the winter to meet peak day demand is one indication of reliability.

# Winter 2022-2023 Southern California Gas Reliability Assessment: Introduction

- The monthly balance sheets were usually done for 3-4 supply scenarios and different climate assumptions, e.g., cold and dry hydro or average year.
- One of the main drawbacks of the monthly mass balance model was relying on historical data especially injection capabilities, which is becoming increasingly inaccurate as restrictions on storage are added or storage retirements are considered.
- In addition, the monthly mass balance model assumes the same daily demand throughout a calendar month.

# Winter 2022-2023 Southern California Gas Reliability Assessment: Introduction

- This year, the Energy Resource Modeling team is conducting the short-term reliability assessment using its newly developed Stochastic Daily Mass Balance model.
- The model was originally developed to validate the minimum, or feasible, inventory levels of the non-Aliso storage fields throughout a cold 2020 winter as well as the minimum required level at Aliso Canyon to maintain reliability during a 1-in-10 peak day within a cold and dry year.

# Winter 2022-2023 Southern California Gas Reliability Assessment: Introduction

- The model is more computationally expensive but offers more insight to dynamics of the natural gas system owing to its stochastic nature. It also quantifies some of the uncertainties that already exist in the natural gas system.
- ED Staff intend to use the Stochastic Daily Mass Balance Model for all Southern California Gas Reliability Assessments going forward (Winter 2022 and onwards)



# **Report Briefing Winter 2022-2023 Southern California Gas Reliability Assessment**

New ERM Stochastic Daily Mass Balance Model

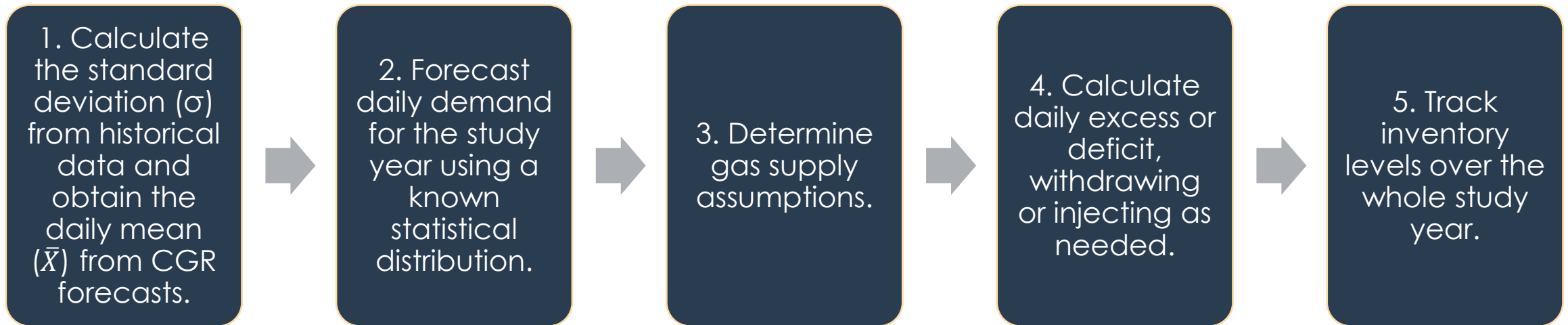
# Stochastic Daily Mass Balance Model Overview

- The model builds on the monthly mass balance model by creating demand distributions using the forecasted monthly averages and historical variability.
- The model attempts a daily mass balance on each day of the study year instead of a monthly balance.
- Having daily values of supply and demand, injection and withdrawal rates, enables the calculation of new metrics such as the expected number of imbalance days and the expected daily inventory levels.

# Stochastic Daily Mass Balance Model Inputs and Methodology

- The model inputs are:
  - Forecasted daily demand using random draws from a known distribution.
  - Assumed pipeline capacity\*.
  - Withdrawal and injection curves.
  - Working gas capacity of storage fields.
- The model then determines whether there is excess or deficit in gas supply, then injects or withdraws accordingly, while respecting injection and withdrawal limits.
- If there isn't sufficient supply to meet the demand (mass imbalance) on a given day, the model flags that day as an imbalance day. EFOs (Emergency Flow Order) are used as a proxy for insufficient supply or imbalance.

# Stochastic Daily Mass Balance Model Summary of Methodology



# **Report Briefing Winter 2022-2023 Southern California Gas Reliability Assessment**

Reliability Assessment: Assumptions and Inputs

# Winter 2022-2023 Southern California Gas Reliability Assessment: Supply Assumptions

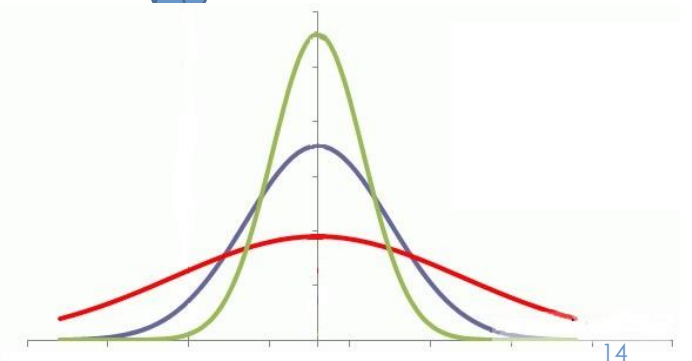
|                      | System Receipt Capacity (MMcfd) for Scenario |       |       | 2022-2023 Average Daily Demand (MMcfd) for |                          |
|----------------------|--|-------|-------|--|--------------------------|
|                      | 1  | 2     | 3     | Cold Temp. Dry Hydro                       | Average Temp. Base Hydro |
| Month                |  |       |       |  |                          |
| October, 2022        | 3,255  | 2,860 | 2,860 | 2,172                                      | 2,151                    |
| November, 2022       | 3,255  | 2,945 | 2,945 | 2,580                                      | 2,491                    |
| December, 2022       | 3,255  | 3,195 | 2,959 | 3,208                                      | 3,014                    |
| January, 2023        | 3,255  | 3,195 | 2,959 | 3,081                                      | 2,905                    |
| February, 2023       | 3,255  | 3,195 | 2,959 | 3,022                                      | 2,856                    |
| March, 2023          | 2,615  | 2,615 | 2,615 | 2,656                                      | 2,540                    |
| April, 2023          | 2,395  | 2,395 | 2,395 | 2,462                                      | 2,386                    |
| <b>Average Daily</b> | 3,040  | 2,913 | 2,812 | 2,738                                      | 2,619                    |
|                      | <b>Total Available Supplies (Bcf)</b>        |       |       | <b>Total Forecasted Demand (Bcf)</b>       |                          |
| <b>April-October</b> | 644  | 617   | 596   | 581  | 555                      |

Assumed Capacity is lower than average forecasted demand for cold and dry hydro

# Winter 2022-2023 Southern California Gas Reliability Assessment: Variability Assumption

|   | Expected Number of Days |                        |                        |
|---|-------------------------|------------------------|------------------------|
|   | Low SD                  | Normal SD              | High SD                |
| <b>Demand Range (Bcfd)</b>                |                         |                        |                        |
| <b>Higher than 4.672</b>                  | Negligible              | 0.09                   | 0.85                   |
| <b>4.0 to 4.672</b>                       | 0.27                    | 2.58                   | 6.24                   |
| <b>3.5 to 4.0</b>                         | 8.25                    | 14.31                  | 17.71                  |
| <b>2.5 to 3.5</b>                         | 136.93                  | 119.89                 | 105.72                 |
| <b>Lower than 2.5</b>                     | 66.55                   | 75.13                  | 81.48                  |
| <b>Total</b>                              | <b>212</b>              | <b>212</b>             | <b>212</b>             |
| <b>December percentile of 4,762 MMcfd</b> | 99.99897 <sup>th</sup>  | 99.78485 <sup>th</sup> | 98.47995 <sup>th</sup> |
| <b>December days above 4,762 MMcfd</b>    | Negligible              | 0.07                   | 0.47                   |

Higher standard deviation results in more days with higher demand because the distribution is "wider"



# Winter 2022-2023 Southern California Gas Reliability Assessment: Other Inputs

- Withdrawal and injection curves
  - Forecasted monthly withdrawal and injection curves based on well availability and planned maintenance outages.
  - SoCalGas submitted these curves for the period from September to April.
- Initial inventory level
  - The initial or starting inventory level of all four storage fields was obtained from SoCalGas ENVOY on October 3, 2022.



# **Report Briefing Winter 2022-2023 Southern California Gas Reliability Assessment**

Reliability Assessment: Summary of Findings

# Reliability Assessment: Summary of Findings

## Winter is reliable – negligible imbalance days

- The highest number of imbalance days is less than one per month for all months and all scenarios.
- If held to the same standard as the electric reliability (1 event in 10 years), imbalance days should be less than 0.058<sup>+</sup> per study period
- However, actual imbalance days could be lower than predicted when customers respond to OFO/EFO and penalties.

Number of imbalance days (days) for Scenarios 1-3

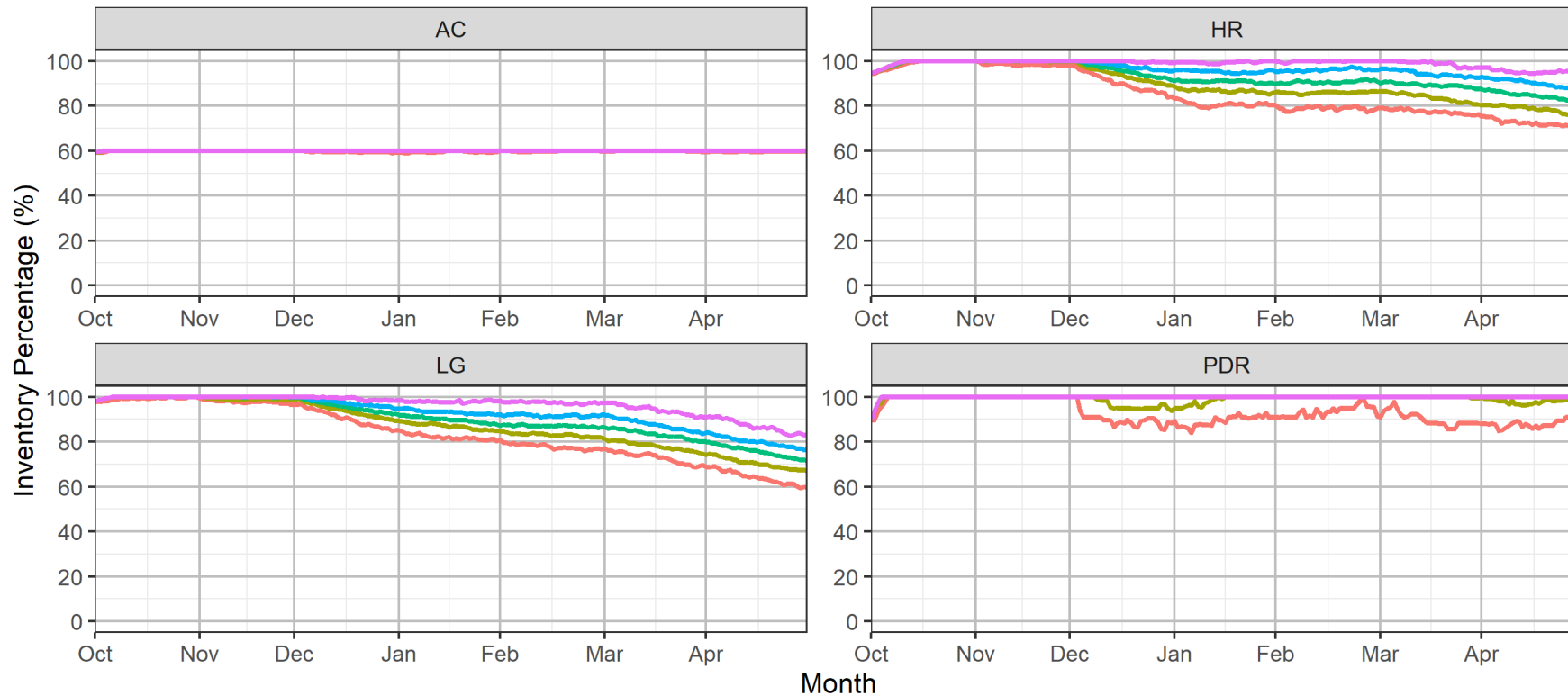
|       |               | Scenario |          |             |
|-------|---------------|----------|----------|-------------|
|       |               | 1        | 2        | 3           |
| Month | October       | 0        | 0        | 0           |
|       | November      | 0        | 0        | 0           |
|       | December      | 0        | 0        | 0           |
|       | January       | 0        | 0        | 0           |
|       | February      | 0        | 0        | 0           |
|       | March         | 0        | 0        | 0           |
|       | April         | 0        | 0        | 0.02        |
|       | October-April | <b>0</b> | <b>0</b> | <b>0.02</b> |

# Reliability Assessment: Summary of Findings

## Inventory Tracking for Scenario 2

Storages Inventory Percentage (%)

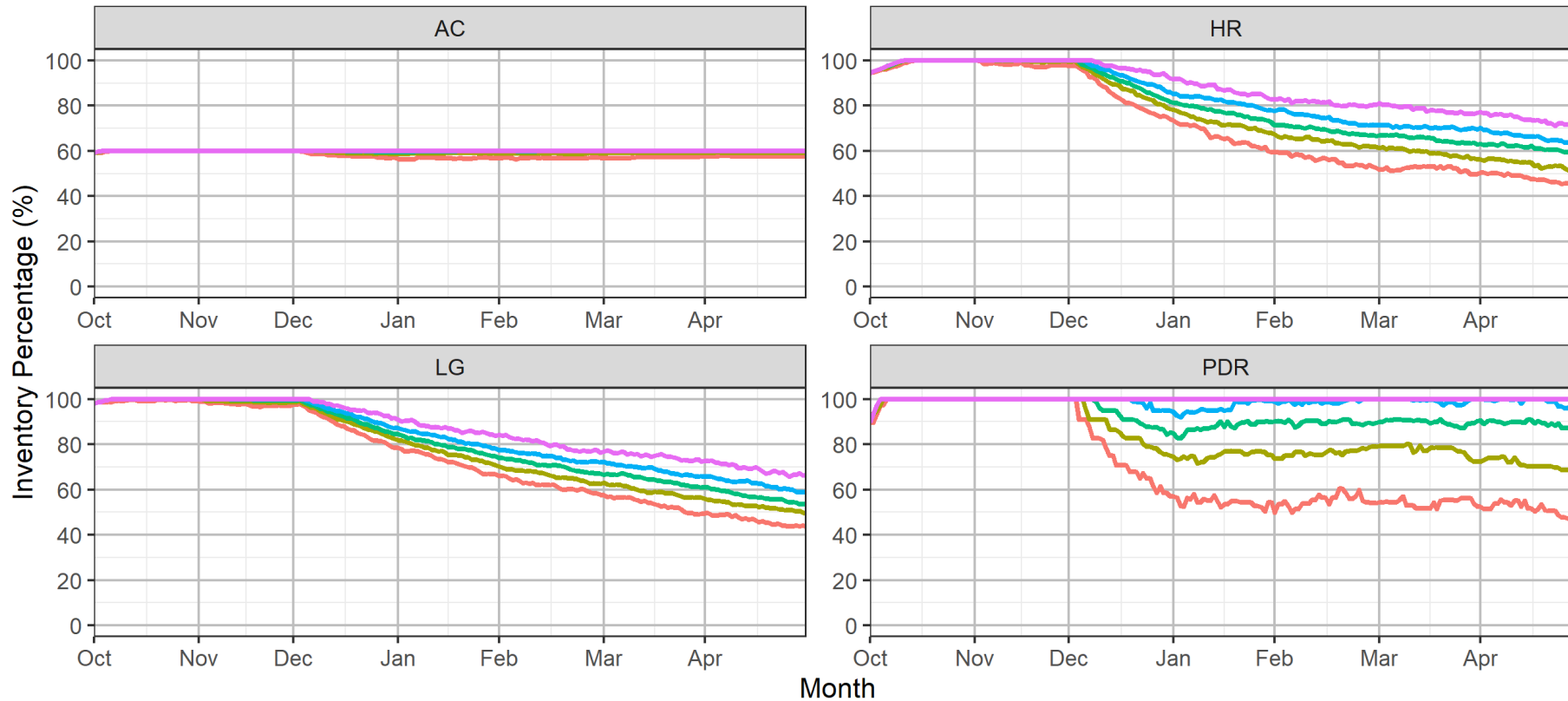
Quantile — q.05th — q.25th — q.50th — q.75th — q.95th



# Reliability Assessment: Summary of Findings Inventory Tracking for Scenario 3

Storages Inventory Percentage (%)

Quantile — q.05th — q.25th — q.50th — q.75th — q.95th



# Reliability Assessment: Summary of Findings

## Inventory Tracking: Month-end Inventory (median)

| Scenario 2    |     | Month |       |       |       |       |       |       |
|---------------|-----|-------|-------|-------|-------|-------|-------|-------|
|               |     | 10    | 11    | 12    | 1     | 2     | 3     | 4     |
| Storage Field | AC  | 41.16 | 41.16 | 41.16 | 41.16 | 41.16 | 41.16 | 41.16 |
|               | HR  | 27.00 | 27.00 | 24.67 | 24.35 | 24.53 | 23.59 | 22.29 |
|               | LG  | 21.50 | 21.41 | 19.91 | 18.85 | 18.59 | 17.20 | 15.34 |
|               | PDR | 1.9   | 1.9   | 1.9   | 1.9   | 1.9   | 1.9   | 1.9   |
| Total         |     | 91.56 | 91.47 | 87.65 | 86.26 | 86.18 | 83.85 | 80.69 |

| Scenario 3    |     | Month |       |       |       |       |       |       |
|---------------|-----|-------|-------|-------|-------|-------|-------|-------|
|               |     | 10    | 11    | 12    | 1     | 2     | 3     | 4     |
| Storage Field | AC  | 41.16 | 41.16 | 40.75 | 41.12 | 41.04 | 41.16 | 41.1  |
|               | HR  | 27.00 | 27.00 | 22.07 | 19.59 | 18.00 | 16.94 | 16.02 |
|               | LG  | 21.5  | 21.38 | 18.18 | 16.06 | 14.39 | 13.13 | 11.49 |
|               | PDR | 1.90  | 1.90  | 1.62  | 1.71  | 1.700 | 1.72  | 1.65  |
| Total         |     | 91.56 | 91.44 | 82.62 | 78.47 | 75.14 | 72.95 | 70.27 |

# Reliability Assessment: Summary of Findings

## EUV and EUS

- EUV (Expected Unserved Volume) is 0, 0, and 3.32 MMcf for Scenarios 1-3, i.e., EUV is negligible for all three scenarios.
- EUS (Expected Unused Supplies) is the sum of supplies that couldn't be injected into storage due to injection limitations or inventory levels reaching their maximum allowed level, averaged over the study period.
- It could also be interpreted as additional supplies available at the border that never went into SoCalGas system.

Expected Unused Supplies (Bcf) for Scenarios 1-3

|       |               | Scenario     |              |              |
|-------|---------------|--------------|--------------|--------------|
|       |               | 1            | 2            | 3            |
| Month | October       | 30.1         | 18.4         | 18.3         |
|       | November      | 19.8         | 11.0         | 10.6         |
|       | December      | 4.48         | 3.66         | 0.98         |
|       | January       | 5.46         | 4.26         | 0.895        |
|       | February      | 6.16         | 4.56         | 0.93         |
|       | March         | 1.85         | 2.03         | 0.79         |
|       | April         | 1.06         | 0.99         | 0.41         |
|       | October-April | <b>68.95</b> | <b>44.77</b> | <b>32.92</b> |

# Additional Sensitivity Results

## Summary of Findings: Storage Outages

- Sensitivity 1: Utilization factor of La Goleta is set to 50%
- Sensitivity 2: Utilization factor of all storage fields is set to 80%

|                      | End of April Inventory Levels |            |            |            |            |       |
|----------------------|-------------------------------|------------|------------|------------|------------|-------|
|                      | AC                            | HR         | LG         | PDR        | Total      | EFO   |
|                      | <u>Bcf</u>                    | <u>Bcf</u> | <u>Bcf</u> | <u>Bcf</u> | <u>Bcf</u> | #/day |
| <b>Scenario 3</b>    | 41.1                          | 16.02      | 11.49      | 1.65       | 70.26      | 0.02  |
| <b>Sensitivity 1</b> | 40.5                          | 14.48      | 15.50      | 1.40       | 71.88      | 0.05  |
| <b>Sensitivity 2</b> | 40.5                          | 16.23      | 12.04      | 1.69       | 70.46      | 0.13  |

# Winter 2022-2023 Southern California Gas Reliability Assessment: Summary of Findings

- With the current natural gas assets and withdrawal protocols in place, the stochastic daily mass balance model predicts no curtailments or emergency flow orders in the Winter of 2022-2023.
- The model captures some details about the dynamics of SoCalGas natural gas system that couldn't otherwise be captured using monthly mass balance sheets or hourly transient analysis. Specifically, the model shows withdrawals that are occurring in months where the available supplies are higher than the demand.
- Sensitivities show that storage outages cause a relatively slight decrease in reliability, but not to an alarming level.



# Winter 2022-2023 Southern California Gas Reliability Assessment: Summary of Findings

- Note that the daily mass balance model tracks storage used for reliability only. Storage withdrawals used for price arbitrage and preventing local pressure drops is not captured by the model.
- An enhancement to the model would include demand elasticity or response to price and operating flow orders.
- Note that the 1-in-10 peak day demand drops from 4.987 Bcfd forecasted by the 2018 California Gas report to 4.672 Bcfd (-6.3%) forecasted by the 2022 California Gas Report primarily due to updating climate warming assumptions.

# **Report Briefing Winter 2022-2023 Southern California Gas Reliability Assessment**

Questions?

# **Report Briefing Winter 2022-2023 Southern California Gas Reliability Assessment**

Appendix

# **Report Briefing**

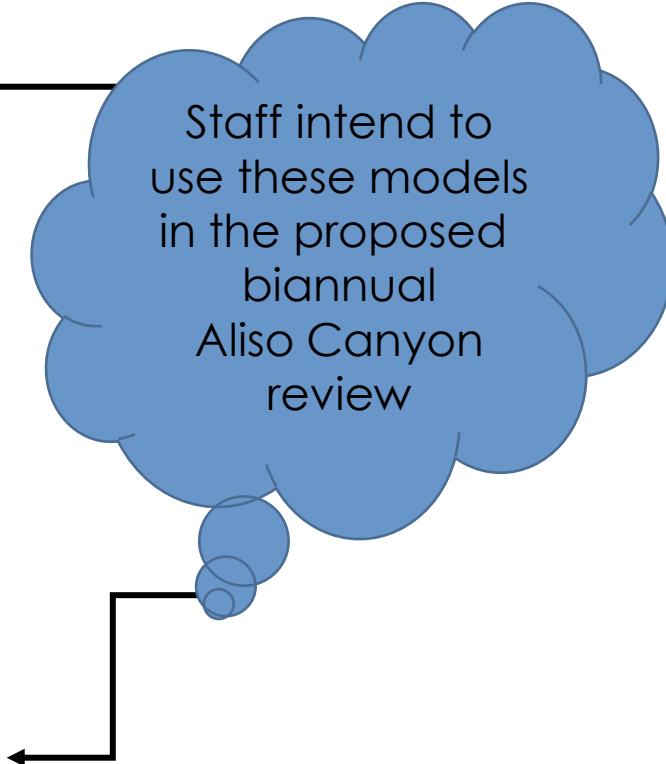
# **Winter 2022-2023 Southern California**

# **Gas Reliability Assessment**

Overview of Natural Gas Models

# Overview of Natural Gas Models ERM staff use

- Stochastic Daily Mass Balance (New)
  - Conserves mass only on a daily basis (using random sampling)
  - Simulates an entire season or year
  - Models daily inventory, withdrawal, and injection capacities available
  - Predicts the number and size of imbalances during the winter season
  - Developed by Energy Resource Modeling staff using R
- Monthly Mass Balance
  - Simplest model (Excel spreadsheet)
  - Conserves mass only on a monthly basis (using known monthly means)
  - Used widely to calculate seasonal storage needs
- Synergi Gas or NextGen (sub-hourly):
  - Conserves mass and momentum at each time step
  - Most detailed model, most computationally expensive, and laborious
  - Limited to no more than a few days
  - Simulates the transmission network of the IOU (or more if desired)
  - Multi-state models or multi-utility models do not exist



Staff intend to use these models in the proposed biannual Aliso Canyon review

# **Report Briefing**

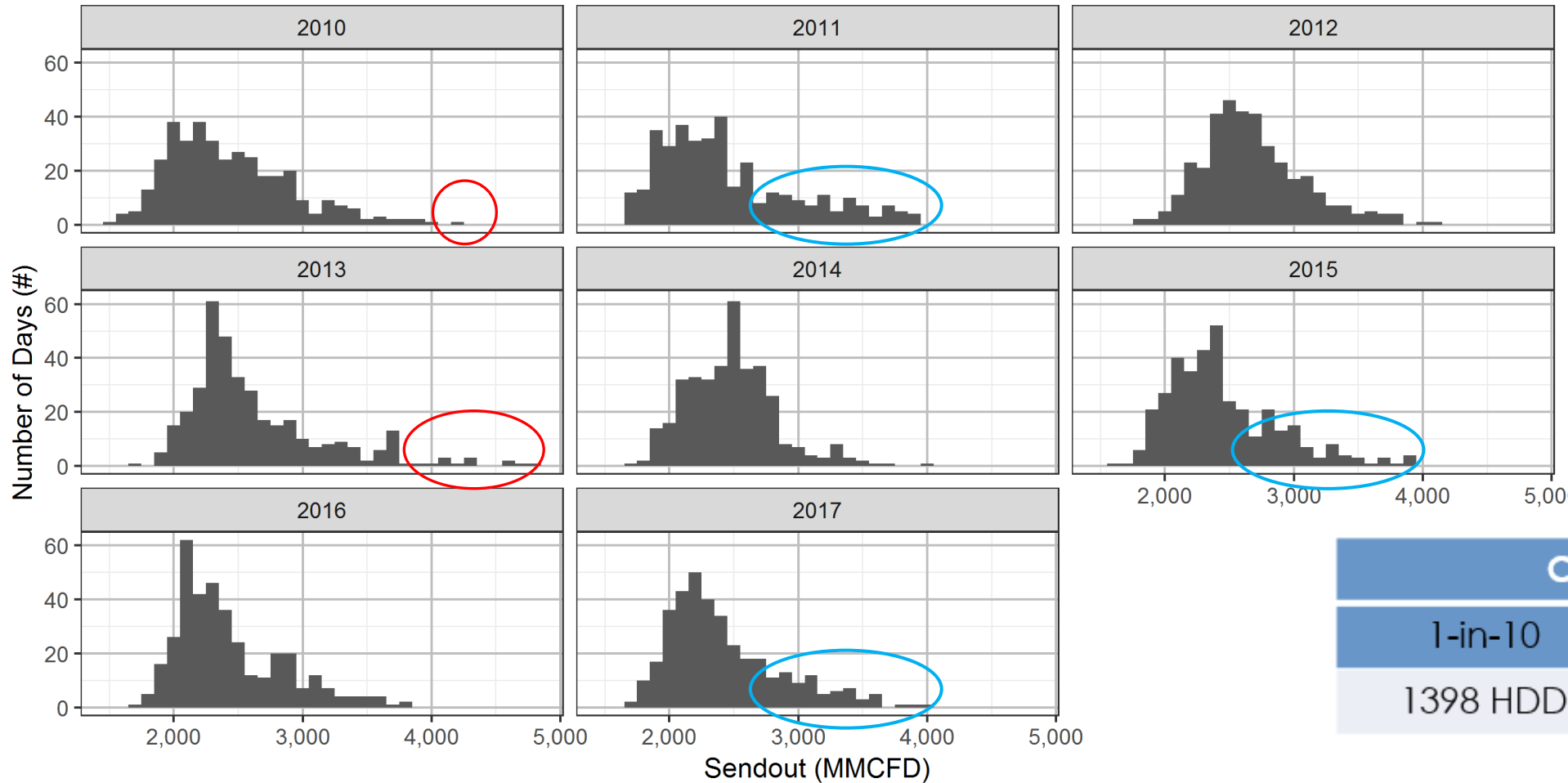
# **Winter 2022-2023 Southern California**

# **Gas Reliability Assessment**

About Historical Variability

# Historical Sendout by Year (2010-2017)

Histograms of Historical Sendout Data



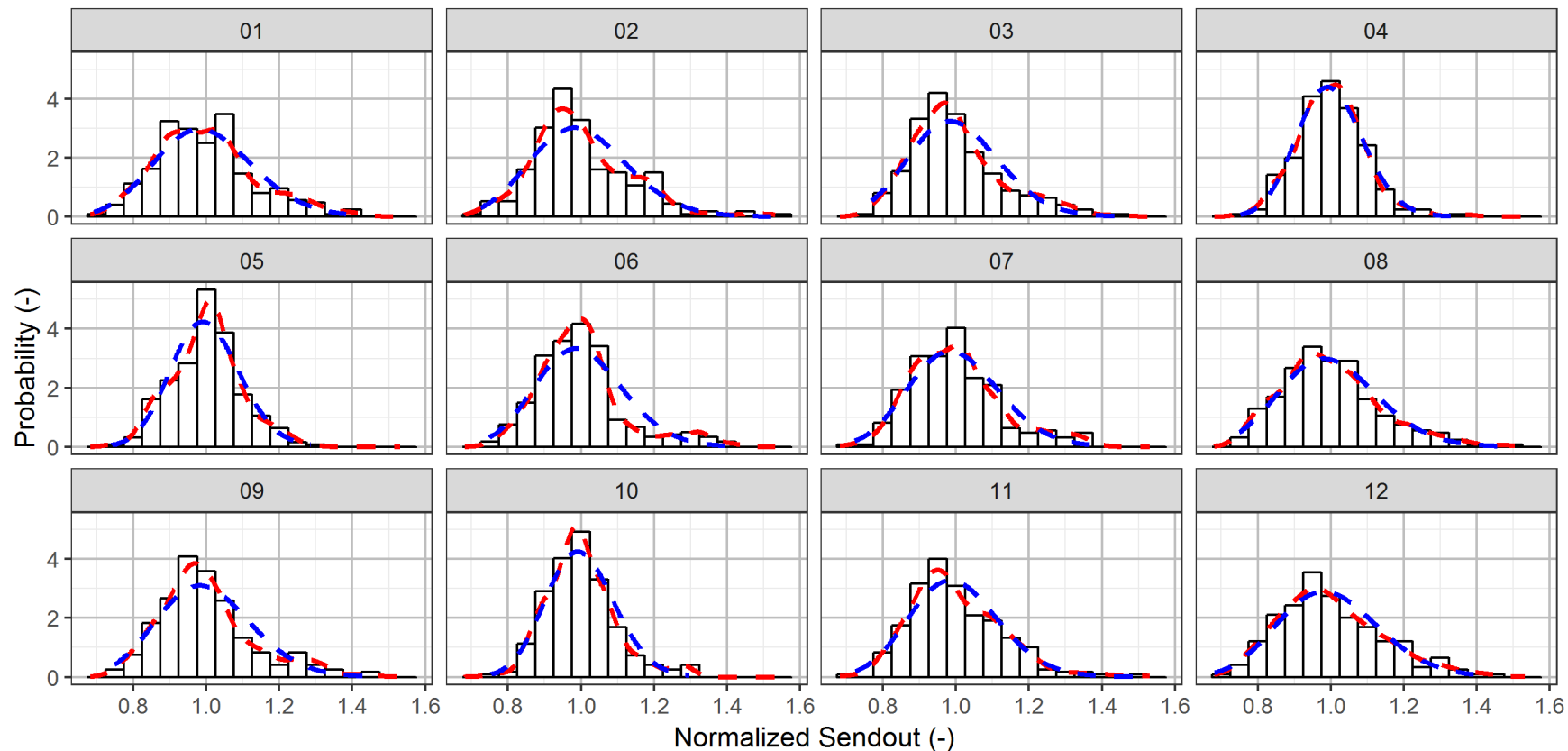
| CGR 2022 |      |
|----------|------|
| Year     | HDD  |
| 2010     | 1440 |
| 2011     | 1587 |
| 2012     | 1283 |
| 2013     | 1212 |
| 2014     | 775  |
| 2015     | 963  |
| 2016     | 1009 |
| 2017     | 967  |

| CGR 2022 |          |
|----------|----------|
| 1-in-10  | 1-in-35  |
| 1398 HDD | 1476 HDD |

Bin width is 100MMCFD

# Stochastic Daily Mass Balance Model Historical Sendout by Month (2010-2017)

Probability Density Functions (PDF) of  
the Normalized Historical Sendout Data (Red) and Gamma Distributions (Blue) by Month



Bin width is 0.05. Historical data is used to calculate the standard deviation and the mean of the normalized sendout and hence the Gamma distribution parameters.