



Winter 2017-18 SoCalGas Conditions and Operations Report

Prepared by Energy Division Staff
December 6, 2018

Executive Summary

The Winter 2017-18 SoCalGas Conditions and Operations Report presents a summary and analyses of natural gas and electric system operations in Southern California from November 2017 through March 2018 (the winter) by the California Public Utilities Commission's (CPUC) Energy Division (ED) staff. The purpose of the report is to provide a summary of weather and system occurrences, operational actions taken, and lessons learned for future system operations and policymaking, with a focus on usage of the Aliso Canyon natural gas storage facility (Aliso Canyon).¹

From the beginning of the winter, Southern California Gas Company's (SoCalGas) system faced higher gas reliability risks than Winter 2016-17. These higher risks were attributable to multiple transmission pipeline outages on top of the post-leak restrictions on Aliso Canyon usage. Those higher risks were mitigated from November through mid-February by unusually warm weather conditions in Southern California, which kept demand for natural gas low. The warm weather allowed SoCalGas to largely meet demand with flowing pipeline gas and retain inventory in its four gas storage fields: Honor Rancho, Playa del Rey, La Goleta, and Aliso Canyon. However, a 15-day period of exceptionally cold weather (the cold snap) began on February 19, 2018, which led SoCalGas to issue a systemwide curtailment of electric generation and to withdraw 7.64 Bcf from its non-Aliso storage fields. SoCalGas also withdrew gas from Aliso Canyon six times during this period in accordance with the CPUC's Aliso Canyon Withdrawal Protocol (Withdrawal Protocol), which only allows Aliso Canyon to be used as "an asset of last resort."²

After analyzing receipt point utilization and usage of both non-Aliso and Aliso storage, ED staff concludes that SoCalGas' use of storage and system operations during the cold snap appears to have been warranted and the Withdrawal Protocol appears to have been followed. In contrast, ED staff finds that there is room for improvement in the forecasts used by the SoCalGas Gas Acquisition Department (Gas Acquisition), which purchases gas for core customers.³ While the accuracy of the forecasts during the cold snap was not out of line with historical norms, there

¹ For more information on the Aliso Canyon well failure and a history of developments, see

<http://cpuc.ca.gov/aliso/>

² The Aliso Canyon Withdrawal Protocol can be found here:

http://cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/News_Room/News_and_Updates/11.2Protocol%20PUBLIC%20UTILITIES%20COMMISSION.PDF. Energy Division's November 29, 2017, email to SoCalGas providing clarification on how the Withdrawal Protocol should be implemented can be found here:

http://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/News_Room/WithdrawalProtocolClarification_2017-12-21.docx.pdf. In the email, ED staff note that the Withdrawal Protocol requires SoCalGas to request voluntary reductions in demand, not mandatory curtailments, from the Balancing Authorities before Aliso Canyon is used. ED staff also provide clarification on how the Withdrawal Protocol interacts with the mandatory curtailment procedures defined under [SoCalGas Rule No. 23](#). It is important to note that the systemwide curtailment during the cold snap consisted wholly of the voluntary reductions in demand required by the Withdrawal Protocol. There were no mandatory, Rule 23 curtailments during this period.

³ The forecasts used by Gas Acquisition are created by the Demand Forecasting Group located in SoCalGas' Department of Regulatory Affairs and separated from Gas Acquisition by a firewall.

were eight days when the forecasts underestimated the core's actual gas burn by more than 5% and one day when they underestimated it by 16%.

Finally, ED staff summarizes the direct costs incurred by the Los Angeles Department of Water and Power (LADWP) and the California Independent System Operator (CAISO) as a result of the systemwide curtailment as well as the low Operational Flow Order (OFO) penalties paid by noncore customers.

Since current system conditions remain similar to last year, this report provides stakeholders with information to plan possible actions and expectations for the upcoming winter season.

Early Winter Events

On October 1, 2017, SoCalGas' Line 235-2 ruptured in a remote and unpopulated region near Newberry Springs, California. The rupture led to safety concerns about nearby Line 4000, which was also taken out of service. Together, the loss of the two major transmission pipelines resulted in an 800 million cubic feet per day (MMcfd) reduction in total SoCalGas system pipeline capacity. These outages were in addition to an existing outage on Line 3000 and a 200 MMcfd reduction in capacity on Line 2000. Gas supplies to the greater Los Angeles area were drastically reduced.

In response to legislation passed in the aftermath of the 2015 gas leak, the CPUC had also limited Aliso Canyon inventory to 23.6 Bcf.⁴ In the November 2, 2017, update to the Aliso Canyon Withdrawal Protocol, the CPUC further ordered that the facility be used only as an asset of last resort. It is under these conditions that the Aliso Canyon Technical Assessment Group — which is composed of technical experts and staff from the CPUC, the California Energy Commission (Energy Commission), the CAISO, and LADWP — released their Aliso Canyon Winter Risk Assessment Technical Report 2017-18 Supplement (Winter 2017-18 Technical Assessment)⁵ on November 28, 2017.

The Winter 2017-18 Technical Assessment was the fourth assessment completed since the 2015 Aliso Canyon gas leak. With SoCalGas' pipeline capacity reduced from 3,325 MMcfd to between 2,325 and 2,675 MMcfd by the unexpected outages, the assessment told a sobering tale.⁶

⁴ SB 380 added Section 715 to the California Public Utilities Code, which requires the CPUC to determine "the range of working gas necessary [in Aliso Canyon] to ensure safety and reliability for the region and just and reasonable rates in California." The CPUC has issued several "715 Reports" to make that determination, modifying the authorized inventory in response to changing conditions. At the time of the pipeline rupture, the authorized Aliso inventory was 23.6 Bcf. On December 11, 2017, the CPUC increased the authorized inventory to 24.6 Bcf due to the pipeline rupture. SoCalGas was not able to reach 24.6 Bcf in inventory during the 2017-18 winter season, likely because the authorization came after the end of natural gas injection season. An archive of the CPUC's 715 Reports can be found at: <http://www.cpuc.ca.gov/General.aspx?id=6442457392>.

⁵ The Winter 2017-2018 Technical Assessment and all other technical reports can be found here: <http://cpuc.ca.gov/alisoassessments/>

⁶ Winter 2017-2018 Technical Assessment, pg. 7

Were a 1-in-10 cold winter to occur, significant curtailments of gas service to noncore customers would be needed even using gas from Aliso Canyon. On an extreme winter peak day, with 1-in-35 demand by core customers, the deliverability balance remains positive, but only if sufficient inventory has been preserved to support the assumed withdrawal of 2.0 billion cubic feet (Bcf) from storage (including 400 MMcfd from Aliso Canyon) and all the pipeline receipt points into the SoCalGas system are full, with no additional outages or capacity loss of any kind...

The higher risk of curtailments this winter are largely the result of significant and unprecedented unplanned outages on SoCalGas pipelines combined with a series of other planned maintenance requirements and delays...⁷

As the winter progressed, monthly situational updates to the Winter 2017-18 Technical Assessment found storage inventories to be higher than forecasted due to warm temperature conditions in the SoCalGas service territory during November, December, and January.⁸ The February update stated that “most of the winter curtailment risk identified in the [Winter 2017-18 Technical Assessment] is now gone.” Lower than normal demand “allowed SoCalGas to serve a large portion of demand using receipts of pipeline gas instead of using gas from underground storage.”⁹ Most importantly, the February update closed by stating that “the risk of gas service curtailments for the rest of this winter is greatly diminished.”¹⁰

The Cold Snap

Just when it looked like the system would enter the spring season relatively unscathed, a period of cold temperatures hit, lasting from February 19 to March 5, 2018. SoCalGas’ composite weighted average temperature¹¹ dropped from 53.5°F on February 19 to 47.7°F the next day. Figure 1 depicts the temperature drop during the cold snap (highlighted by the blue box) relative to the beginning and middle of the winter. A historical composite weighted average temperature for each date going back to 2010 is also shown in grey; by comparing winter 2017-18 to historical averages the unique nature of winter 2017-18 can be seen.

Several cities saw all-time record lows, including Lancaster (15°F), Pasadena (35°F), and Long Beach (39°F).¹² On February 19, “system demand rapidly increased from 141 MMCFH¹³ to 226

⁷ Winter 2017-18 Technical Assessment, pg. 6-7.

⁸ All monthly updates can be found on the same website as the Technical Assessments previously cited.

⁹ Ibid., page 2.

¹⁰ Ibid., page 3.

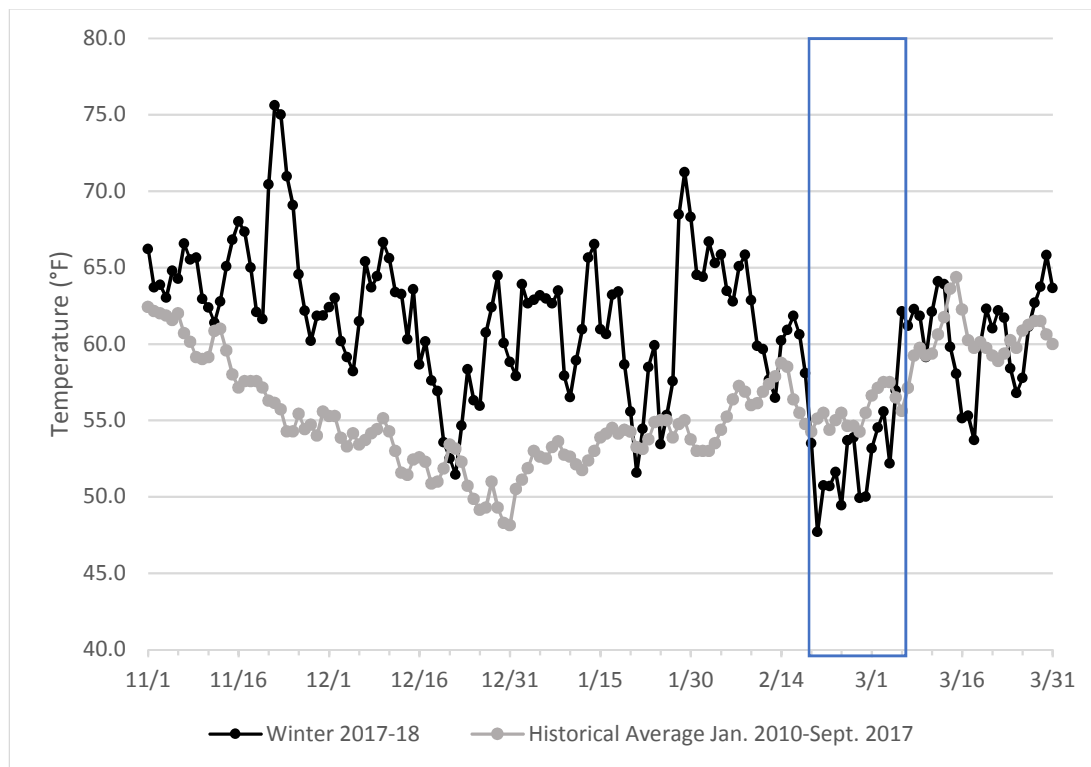
¹¹ Temperature data is from actual composite weighted average temperature in response to Data Request 48. Composite weighted average temperature first takes the average daily temperature of several locations in the territory, then averages those into one number.

¹² Temperature source: National Centers for Environmental Information (formerly the National Climatic Data Center) <http://www.noaa.gov/>.

¹³ Million cubic feet per hour.

MMCFH (a daily equivalent rate of 3.4 BCFD to 5.4 BCFD¹⁴) over the span of four hours...”¹⁵ In comparison, during the same hourly time period on March 9, 2018 — well after the cold snap — system demand increased from 96 MMCFH to 121 MMCFH (a daily equivalent rate of 2.3 BCFD to 2.9 BCFD). The continuous stretch of cold weather did not allow the system adequate time to recover from each of the previous day’s demands. The length of the February-March cold snap contrasts with the shorter-lived temperature drops of December 22, 2017, and January 21, 2018, which are analyzed as a point of comparison later in this paper. The following section takes a detailed look at gas operations, supply, and prices during the 15-day cold snap.

Figure 1: Composite Weighted Average Temperature



Data source: Winter 2017-18 from SoCalGas ENVOY and Historical from SoCalGas data request

Storage Usage

In Figure 2, daily receipts, deliveries, and storage injection or withdrawal are graphed for the cold snap and the preceding 11 days. Deliveries exceeded receipts on all but three days — February 8, 9, and 18. SoCalGas withdrew gas from storage on 100% of the cold snap days.¹⁶

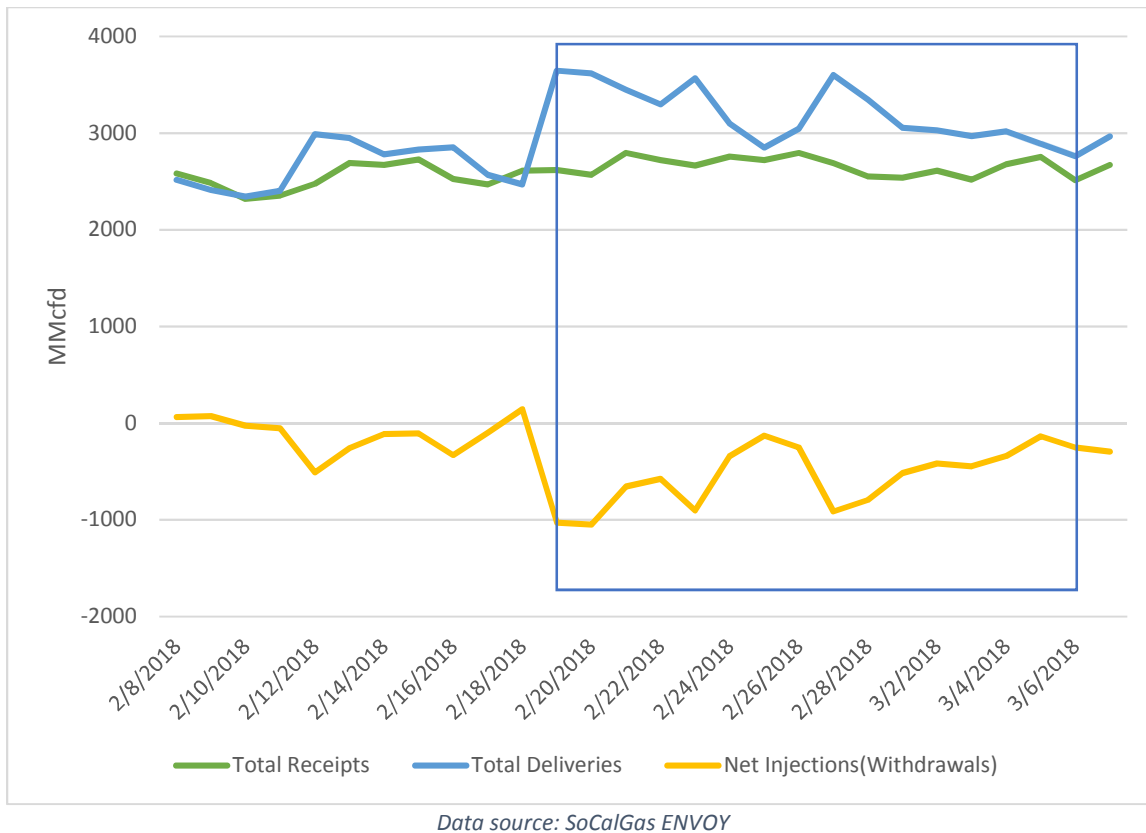
Figure 2: Daily Cold Snap Receipts, Deliveries, and Storage Injection

¹⁴ Billion cubic feet per day.

¹⁵ 30-Day Aliso Canyon Withdrawal Report by SoCalGas, pg. 6

http://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/Safety/Aliso%20WD%2030_Day%20Report_Public%20Version.pdf.

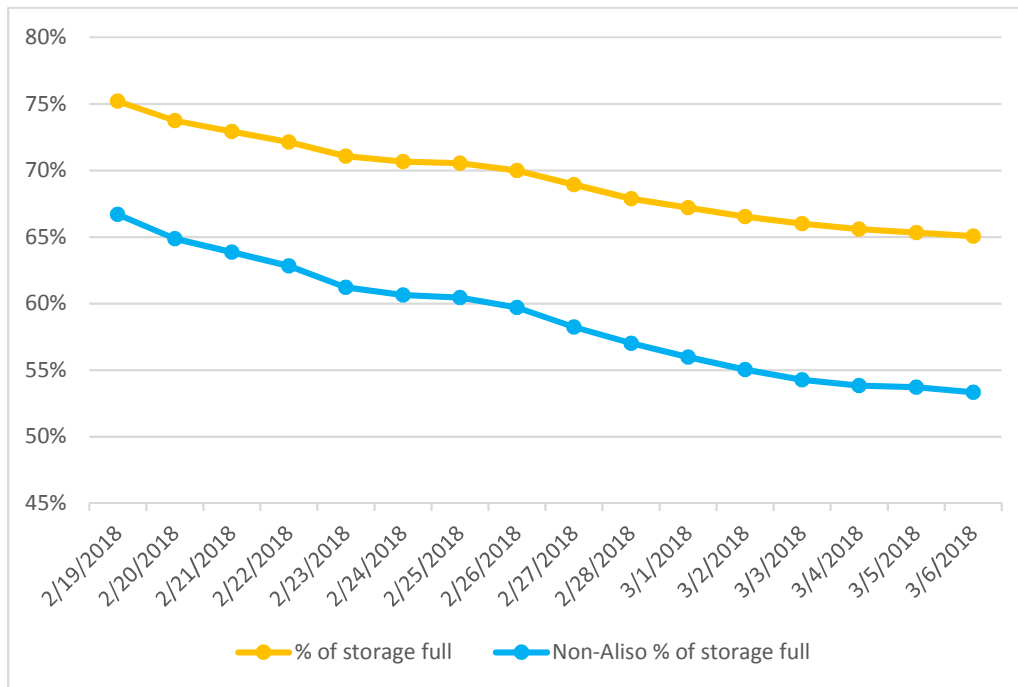
¹⁶ SoCalGas ENVOY.



Storage inventory was drawn down by approximately 10% during the cold snap due to daily withdrawals. Since withdrawal rates decline as inventory and pressure levels decline, SoCalGas' capability to meet the rapid hourly increases in gas demand with the non-Aliso facilities decreased towards the end of the cold snap. From February 15 to March 5, Honor Rancho and Playa Del Rey's withdrawal rates (the amount of gas that can be withdrawn in MMcf per hour) declined by 18% and 25%, respectively. As mentioned previously, the cold snap resulted in significant increases in gas demand within a span of four hours. During the rest of the winter, it was uncommon to have such extreme withdrawals.

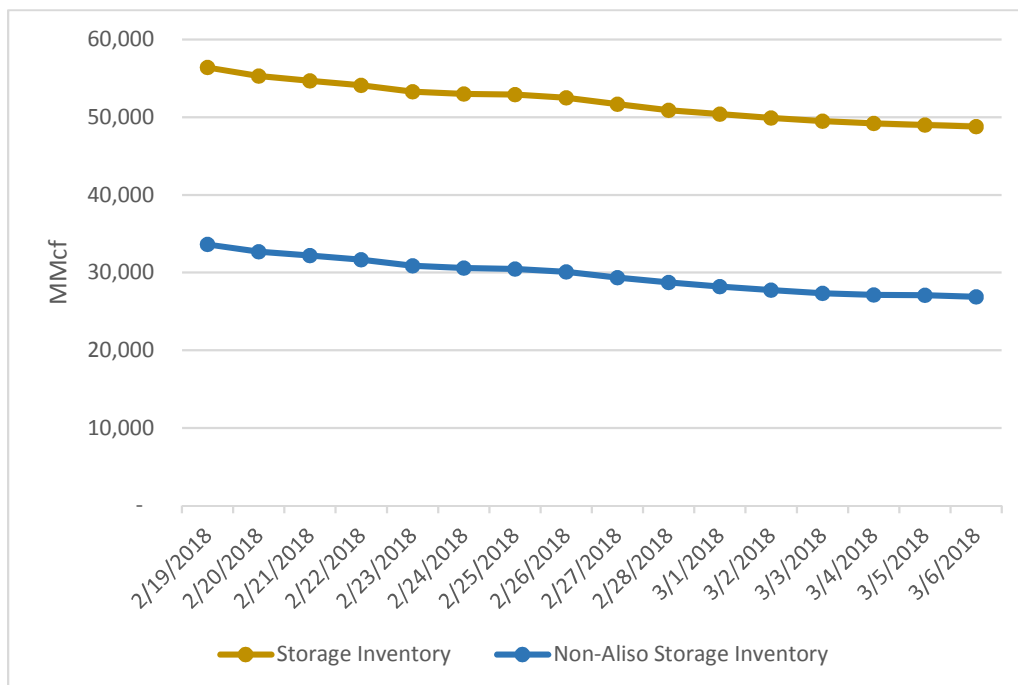
Figure 3 presents storage inventory in percentage full during the cold snap. The yellow line is the result of total storage inventory divided by total storage capacity available (with Aliso Canyon restricted to 24.6 Bcf). The blue line takes total storage inventory at the non-Aliso fields and divides it by total storage capacity available without Aliso Canyon.

Figure 3: Storage Inventory During the Cold Snap in Percentage



Data source: SoCalGas ENVOY and January 6, 2016 Data Request to provide daily logs in the future

Figure 4: Storage Inventory During the Cold Snap



Data source: SoCalGas ENVOY and January 6, 2016 Data Request to provide daily logs in the future

In Figure 4, the dark yellow line, “Storage Inventory,” reflects actual gas storage inventory during the cold snap as reported on ENVOY (ENVOY is SoCalGas’ online bulletin board and online system for scheduling). The dark blue line, “Non-Aliso Storage Inventory,” illustrates total gas storage inventory after excluding Aliso Canyon. This decline in inventory is generally consistent with expectations. However, the steep decrease in Honor Rancho’s inventory and withdrawal rate was concerning given pipeline system limitations. As discussed more below, Honor Rancho’s withdrawal capacity was also affected by maintenance work related to converting the wells to tubing-only flow.

As the cold snap progressed, some ongoing planned maintenance work continued to be performed, which reduced withdrawal capacity. Table 1 lists all planned maintenance work that affected withdrawal capacity during the cold snap. It should be noted that this table is from a March 21, 2018, response from SoCalGas, and the capacity reduction shown below is a maximum amount, as the capacity reduction on a given day can vary. SoCalGas has stated that the work could not be deferred due to regulatory compliance with the Storage Integrity Management Program (SIMP).¹⁷

¹⁷ Source: Energy Division Data Request 43a to SoCalGas. SoCalGas proposed SIMP as an incremental, standalone program during their 2016 general rate case to proactively identify and mitigate potential storage well safety and/or integrity issues using new inspection technologies and risk management disciplines to address well integrity. For information on SIMP, refer to D.16-06-054: <http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M164/K606/164606603.pdf>.

Table 1: Planned Maintenance Work During the Cold Snap

Storage Field	Start Date	End Date	Max. Capacity Reduction (MMcf)	Description	Reason Not Deferred
Goleta	12/1/2017	TBD	180	SIMP	Safety Related: conversion to tubing-only flow
Honor Rancho	3/15/2017	TBD	215	SIMP	Safety Related: conversion to tubing-only flow

Data source: Data Request 43a to SoCalGas

While storage inventory is important and enables SoCalGas to meet its winter demand, the majority of the gas burned is from daily flows from interstate pipelines through the receipt points at the California border to the SoCalGas pipeline system. The following section analyzes how customers used the pipeline system during the cold snap.

Receipt Point Utilization

Receipt point utilization is the ratio between the flow rate at a gas pipeline receipt point and the maximum operating capacity of that receipt point. Analyzing receipt point utilization provides a supplemental perspective to storage facility usage, since demand is fulfilled by either gas in the pipelines or gas from storage facilities. Gas demand changes in real-time as customer usage changes; thus, it is necessary to assess storage withdrawal and receipt point utilization at the hourly level. It is important to note that the SoCalGas System Operator, which is charged with keeping the gas system in balance, does not have primary responsibility for scheduling gas deliveries.¹⁸ With a few relatively minor exceptions, it is the customers of SoCalGas, including the SoCalGas Gas Acquisition Department (Gas Acquisition), who deliver gas to the system.¹⁹ The System Operator decides when to call OFOs and when to pull from storage for balancing.

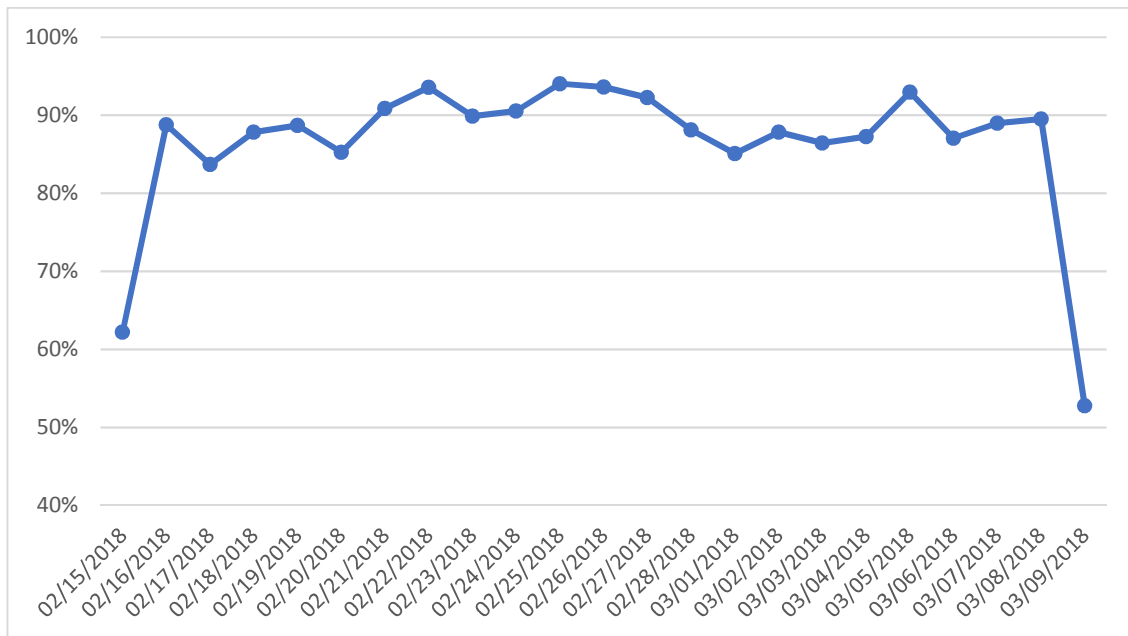
Figure 5 combines daily receipt point utilization from Ehrenberg, Otay Mesa, Transwestern/North Needles, Kramer Junction, Kern/Mohave, Kern River, and Occidental Elk Hills for total system capacity utilization. It also includes several days before and after the cold snap for comparison. From February 15 to 16, receipt point utilization increased from 62% to 89%, presumably due to low temperature forecasts and warnings. In comparison, SoCalGas has historically seen 85% receipt point utilization.²⁰ There was a corresponding increase in storage withdrawals during the same period, as previously seen in Figure 2.

¹⁸ Under certain circumstances, the System Operator can purchase gas to support demand on the Southern System, which includes San Diego. See SoCalGas Rule 41: <https://www.socalgas.com/regulatory/tariffs/tm2/pdf/41.pdf>.

¹⁹ SoCalGas' Gas Acquisition Department procures gas for SoCalGas and San Diego Gas & Electric (SDG&E) core customers, which are made up of residential and small business customers. There is a firewall between Gas Acquisition and the System Operator; Gas Acquisition only has access to public information about the SoCalGas system.

²⁰ Summer 2018 Technical Assessment, pg. 18-19

Figure 5: System Capacity Utilization



Data source: Data Request 48 to SoCalGas

From February 16 through March 8, receipt point utilization averaged 89%, then decreased back to pre-cold snap levels. As expected, the SoCalGas system saw higher receipt point utilization during the cold snap. However, it is not apparent why receipt point utilization was below 90% during several days in the period. On an hourly level, receipt point utilization from Kramer Junction and the Wheeler Ridge zone (which consists of Occidental Elk Hills, Kern/Mohave at Wheeler, and Kern River) was within the mid-80% to 100% range during the hours of Aliso Canyon withdrawal. During “typical” winter weather conditions prior to the Aliso leak, receipt point utilization has historically ranged from 30-70%. By comparison, receipt point utilization was relatively high during the cold snap.

Gas travels at approximately 30 miles per hour, making proximity important when determining the effectiveness of incoming gas in meeting demand. SoCalGas experienced rapid demand increases on all days Aliso Canyon withdrawal occurred. Similarly, through all six Aliso Canyon withdrawal events, steep demand increases occurred within the time span of four to five hours. Energy Division staff analyzed receipt point utilization during the cold snap and determined that Aliso Canyon withdrawal was needed given the proximity of Aliso Canyon to the Los Angeles basin and the physical constraints on the SoCalGas transmission system. To assess an alternative scenario, ED staff modeled what gas deliveries would have been if daily system utilization averaged 92% throughout the cold snap. Although an additional 165 MMcfd, or 6.9 MMcfh would have been delivered under this scenario, it still would not have enough to avoid usage of Aliso Canyon. Each Aliso Canyon withdrawal event is listed in Table 2 below:²¹

²¹ See footnote 15 for a link to the 30-Day Aliso Canyon Withdrawal Report by SoCalGas

Table 2: Aliso Canyon Withdrawals

Aliso Canyon Withdrawal Initiated	Aliso Canyon Withdrawal Ended	Volume of Gas Withdrawn (BCF)*	Peak Hourly Withdrawal (MMCF)*
7:36 PM February 19, 2018	11:49 AM February 20, 2018	0.43	33
5:00 AM February 21, 2018	12:45 PM February 21, 2018	0.14	22
6:20 AM February 22, 2018	10:38 AM February 22, 2018	0.04	11
2:55 AM February 24, 2018	10:16 AM February 24, 2018	0.08	17
4:15 AM February 28, 2018	1:45 PM February 28, 2018	0.24	35
9:45 AM March 4, 2018	3:50 PM March 5, 2018	0.21	17
*Inventory volumes are based on Gas Control system data and/or OSI Soft PI Historian, and are subject to adjustment based on SoCalGas' routine monthly reconciliation between real-time SCADA system data, and the measurement data recorded by our Measurement Data Operations (MDO) department.			

Source: 30-Day Aliso Canyon Withdrawal Report by SoCalGas

Aliso Canyon Usage

Aliso Canyon withdrawals occurred six times over the course of the 15-day cold snap (see Table 2) and corresponded with days of greater than usual differences between receipts and system sendout as well as maximum withdrawal rates at Honor Rancho and Playa del Rey. Each withdrawal can span more than one gas day (7:00 AM to 7:00 AM). The withdrawals also occurred during concurrent withdrawals at the other three storage fields.

As previously stated, proximity is an important factor in gas usability. Aliso Canyon is closest to the Los Angeles basin where the bulk of the cold snap demand occurred, and it has historically been the field best placed to meet that demand. Additionally, Aliso Canyon also provides the most flexible combination of withdrawal and injection. Honor Rancho is the only other large field near enough to Los Angeles to support intraday variations in gas demand, so its rapidly declining inventory was of significant concern during the cold snap. La Goleta, located more than 100 miles from the Los Angeles basin, is not often used for meeting demand beyond the coastal communities from San Luis Obispo to Ventura due to its limited pipeline transmission capacity and distance from other demand centers. In addition to proximity, the amount of deliverable gas from a storage facility also depends on a field's individual characteristics and limitations. Playa del Rey, for example, is comparatively small, its withdrawal capability diminishes quickly as inventory drops, and it takes approximately 4-5 times as long to inject gas than it does to withdraw the gas.²² Therefore, it can provide only limited support to the Los Angeles area during sustained cold weather.

²² Letter from SoCalGas letter to CPUC:

http://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/News_Room/News_and_Updates/SoCalGasResponse.pdf

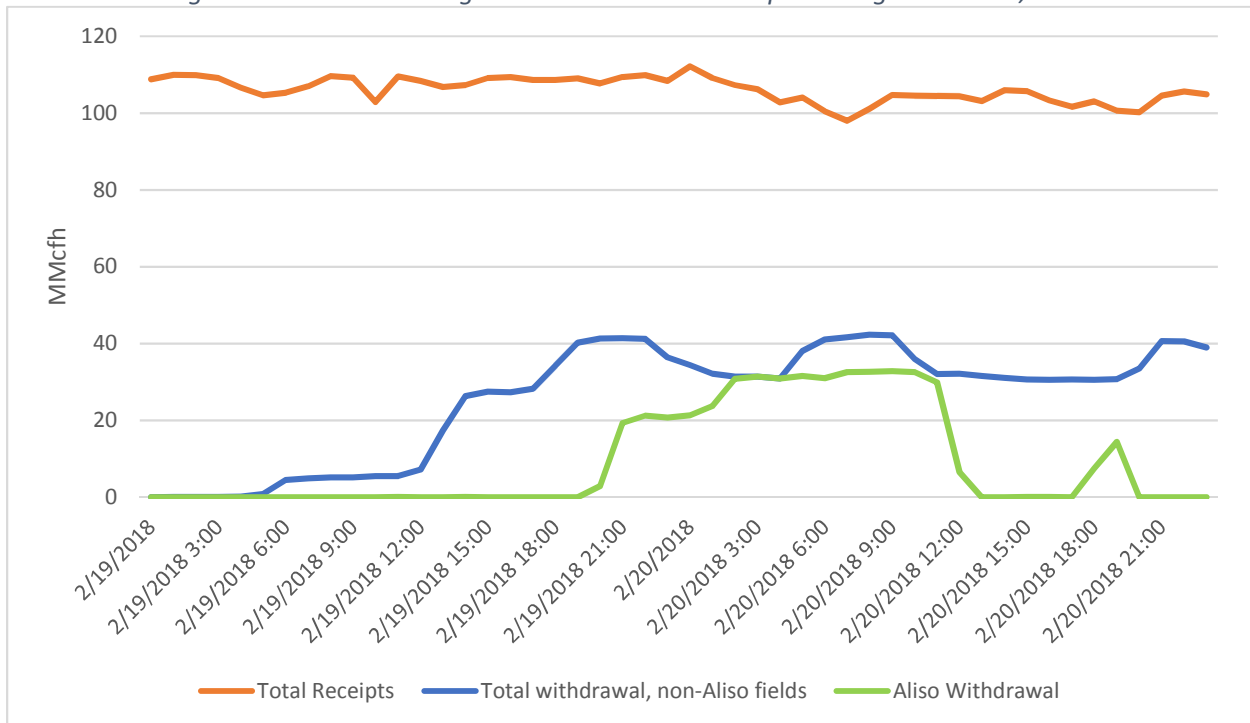
Large gas withdrawals during the first week of the cold snap resulted in a corresponding decrease in SoCalGas' ability to withdraw gas from the non-Aliso Canyon fields in the second week. Since the Withdrawal Protocol was in effect, SoCalGas was limited to using Aliso Canyon as an asset of last resort. The Aliso Canyon Withdrawal Protocol requires the following conditions to be in effect before Aliso Canyon is used:²³

- 1) SoCalGas has taken all appropriate actions it deems available and necessary to meet demand and to avoid curtailment of electric load and/or gas curtailments to core and noncore, non-electric generation customers.
- 2) To avoid curtailments of electric load, the CAISO and/or LADWP, in coordination with SoCalGas, have activated their appropriate capacity emergency plans based on the existing and forecast conditions; and
- 3) There remains an imminent risk that curtailments of electric load will occur without additional gas supply
- 4) There is an imminent and identifiable risk of gas curtailments created by an emergency condition that would impact public health and safety or result in curtailments of electric load that could be mitigated by withdrawals from Aliso Canyon. Such risk could arise due to emergencies on the gas pipeline system or because conditions require additional gas supply otherwise unavailable.

To evaluate how SoCalGas managed their storage fields during the cold snap and analyze the need for Aliso Canyon withdrawals, ED staff performed an hourly analysis of receipt point utilization and storage field withdrawals. An example of the hourly analysis is summarized below in Figure 6 to provide insight into intraday and system operations during the Aliso Canyon withdrawal event with the highest ramping period, from February 19-20. Beginning at 7:36 PM on February 19, Aliso Canyon withdrawal occurred at a time when Honor Rancho withdrawals were nearly maximized. Total gas receipts were generally constant throughout the 48 hours. The hourly analysis shows that Aliso was used intermittently to meet intraday ramps in demand.

²³ See footnote 2 for a link to the Withdrawal Protocol.

Figure 6: SoCalGas Storage Withdrawals and Receipts during Feb. 19-20, 2018



Data Source: SoCalGas Data Request 43a

On March 2, 2018, SoCalGas sent the CPUC a request for “the ability to *immediately* begin using Aliso Canyon to manage gas storage inventory and preserve withdrawal deliverability at SoCalGas’ non-Aliso storage fields.”²⁴ The letter also asked for permission to use Aliso Canyon to “baseload some withdrawals at lower, constant rates for longer periods of time” to “preserve inventory and deliverability at Honor Rancho, La Goleta, and Playa del Rey.” With inventory at the combined non-Aliso Canyon facilities at roughly 50 percent of maximum and Honor Rancho significantly below that level, ED staff agreed that it was crucial to preserve the remaining non-Aliso inventory. The CPUC’s March 3, 2018, response confirmed that SoCalGas’ operation of Aliso Canyon “in the current circumstance where the non-Aliso storage facilities have been used at or close to their maximum capacity... and are now at critically low levels” was “consistent with the protocols provided that SoCalGas continues to also follow the provisions in the protocol to coordinate with the Balancing Authorities...”²⁵

Accordingly, on March 4 and 5, SoCalGas withdrew 105 MMcf and 110 MMcf respectively from Aliso Canyon. On March 6, temperatures increased, ending the cold snap and SoCalGas’

²⁴ Letter from SoCalGas to CPUC:

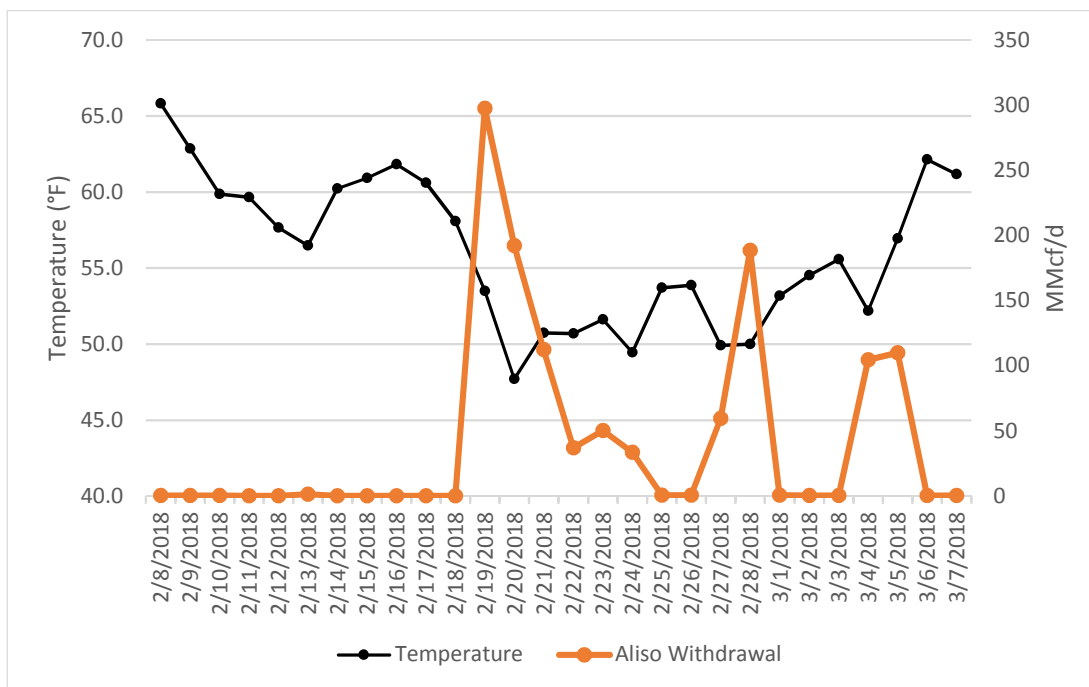
http://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/Safety/Letter%20to%20Edward%20Randolph_CPUC%20from%20Rodger%20Schwecke_SoCalGas-March%202.pdf.

²⁵ CPUC response to SoCalGas letter:

http://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/Safety/Letter%20to%20Rodger%20Schwecke.pdf.

withdrawals from Aliso Canyon. System temperature and Aliso Canyon withdrawals are shown on Figure 7.

Figure 7: Composite Weighted Average Temp. vs. Aliso Canyon Withdrawals



Data Source: SoCalGas ENVOY and Data Request 43a

Based on the foregoing, ED staff does not see evidence that SoCalGas failed to comply with the Withdrawal Protocol.

Gas Acquisition

SoCalGas' Gas Acquisition Department procures gas for SoCalGas and San Diego Gas & Electric (SDG&E) core customers, which are made up of residential and small business customers. Core customers make up the largest customer base on the SoCalGas system. They are different from noncore customers in that their individual use is relatively small, the utility provides their gas, and they are the last group to be curtailed in an emergency.²⁶ The core's protected status is due in large part to the expense of relighting millions of individual pilot lights in the aftermath of a core curtailment. In exchange for more comprehensive and higher priority service, core customers are allocated a higher portion of system costs than noncore customers.

Due to the CPUC's Omnibus Decision (D.07-12-019), Gas Acquisition operates independently from the rest of the company and only has access to pipeline and storage data that has been made publicly available by the SoCalGas System Operator. Thus, in many ways, Gas Acquisition operates like any other SoCalGas customer. However, there are some important

²⁶ See SoCalGas Rule 23: <https://www.socalgas.com/regulatory/tariffs/tm2/pdf/23.pdf>.

differences. Among them is the current requirement that Gas Acquisition balance to a forecast rather than to actual burn on high or low operational flow order days.²⁷ Therefore, it is important to analyze the accuracy of the daily forecasts and Gas Acquisition's purchases to further complete the story of events during the cold snap. Energy Division staff analyzed Gas Acquisition's role in the cold snap by comparing daily core forecasts to estimated actual burns, then comparing core's confirmed gas receipts to the estimated actual burn.

During the cold snap, the core load forecast was often below estimated actual burns, and there were two days when the forecast was significantly off.²⁸ On February 25, 2018, the core forecast was 10% lower than its estimated actual burn. The impact this imbalance had on reliability is uncertain, as receipt point utilization was 94% and gas was not withdrawn from Aliso Canyon. Similarly, while a Stage 3 low OFO was called that day,²⁹ OFO penalties were relatively low, as can be seen in Table 2. The next major deviation was at the end of the cold snap, on March 5, 2018. On that day, the core forecast was 16% off, a Stage 2 low OFO was called, receipt point utilization was high at 93%, composite weighted average temperature was 57°F, and gas was withdrawn from Aliso Canyon. Again, OFO penalties on this day were lower than other instances during the cold snap.

²⁷ For natural gas pipeline systems to remain physically "in balance," they must operate within a set range of pressures. If there is not enough gas in the system, the pressure falls, and gas does not flow properly. If there is too much gas, the pressure rises, posing a risk to the structural integrity of the pipelines. The SoCalGas System Operator is responsible for maintaining the system's balance, but it does not control most gas procurement. To maintain balance, the system operator calls low OFOs when gas deliveries are too low and high OFOs when deliveries are too high. When an OFO is called, all customers are required to deliver a certain percentage of their burn. Since the Aliso leak, that percentage has typically been +/-5%. If customers deliver less than 95% of their burn on a low OFO day, or more than 105% of their burn on a high OFO day, they pay a penalty for every unit under or over.

²⁸ The term "estimated actual burn" is used since it is derived by subtracting the noncore from System Sendout.

²⁹ OFO penalties are designed to become increasingly severe to incentivize gas deliveries during shortages when gas prices may be high. Penalties are: \$.25/dekatherm (Dth) in Stage 1; \$1/Dth in Stage 2; \$5/Dth in Stage 3; and \$25/Dth in Stage 4.

Table 3: OFO Penalties During Cold Snap

OFO Date	SoCalGas	SDG&E	OFO Penalties Charged to Noncore	% Difference in Core Forecast to Estimated Actual Gas Burn
02/20/2018	\$ 107,446	\$ -	\$ 107,446	1.03%
02/21/2018	\$ 225,980	\$ -	\$ 225,980	-3.41%
02/22/2018	\$ 143,023	\$ -	\$ 143,023	-5.92%
02/23/2018	\$ 56,788	\$ -	\$ 56,788	-8.40%
02/25/2018	\$ 5,162	\$ -	\$ 5,162	-9.99%
02/26/2018	\$ 40,247	\$ -	\$ 40,247	-5.41%
02/27/2018	\$ 36,044	\$ -	\$ 36,044	3.01%
03/01/2018	\$ 16,243	\$ -	\$ 16,243	-2.35%
03/02/2018	\$ 13,658	\$ 3,296	\$ 16,954	-7.03%
03/03/2018	\$ 35,125	\$ -	\$ 35,125	-1.31%
03/04/2018	\$ 62,795	\$ -	\$ 62,795	-3.31%
03/05/2018	\$ 11,052	\$ -	\$ 11,052	-15.95%

Data Source: SoCalGas Data Request

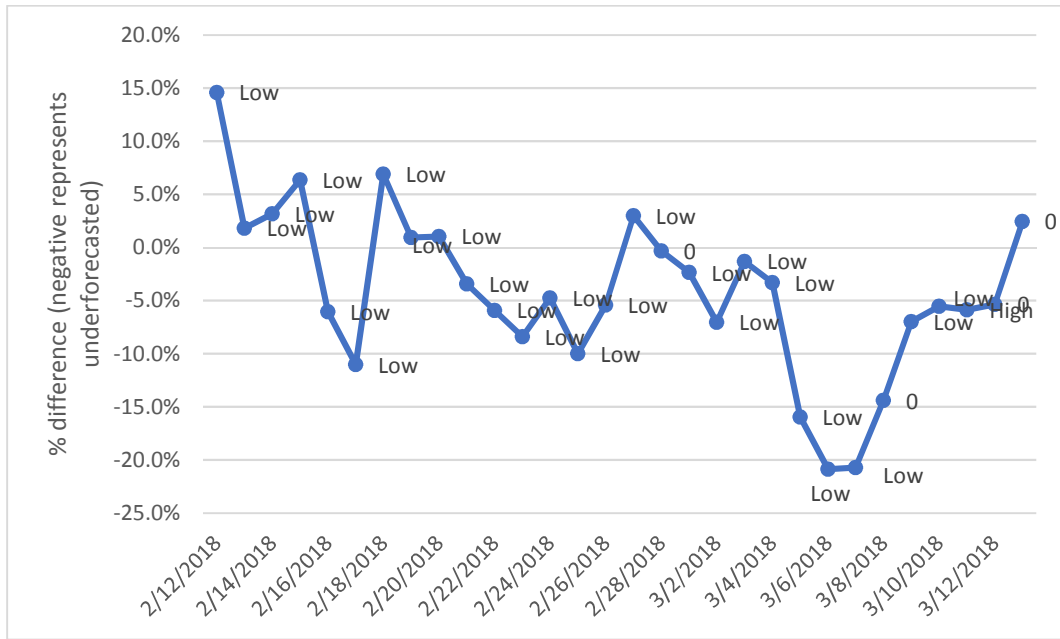
Energy Division also analyzed the amount of core's confirmed gas receipts in contrast to the estimated actual amount of gas burned by core customers to determine if there were large discrepancies occurring during this sensitive timeframe.³⁰ In the gas scheduling process, confirmed gas is the amount of nominated gas approved for scheduled delivery into the SoCalGas system. Gas Acquisition's confirmed gas deliveries were less than estimated actual burn but were within 10% during 13 of the 15 cold snap days. On March 5, 2018, Gas Acquisition saw approximately the same amount of gas confirmed as forecasted. However, as mentioned earlier, core demand greatly exceeded the forecasted burn on this date.

Both the core forecast and core's confirmed gas receipts were below estimated actual through most of the cold snap. However, core's confirmed gas was always within 5% of the forecast, which is what is required by the current rules. Therefore, core paid no OFO penalties during the cold snap; only noncore received penalties, as can be seen in Table 3 above. Given the historical pattern of Gas Acquisition's forecasts, the pattern of forecast errors during the cold snap (see Figure 8B) does not stand out as an oddity. While there was not a clear relationship between core forecasting errors and OFO penalties during the cold snap, core under-deliveries could have led to increased gas procurement costs for noncore customers.³¹

³⁰ Core's confirmed gas deliveries, forecasts, and estimated actual figures cannot be shared due to confidentiality.

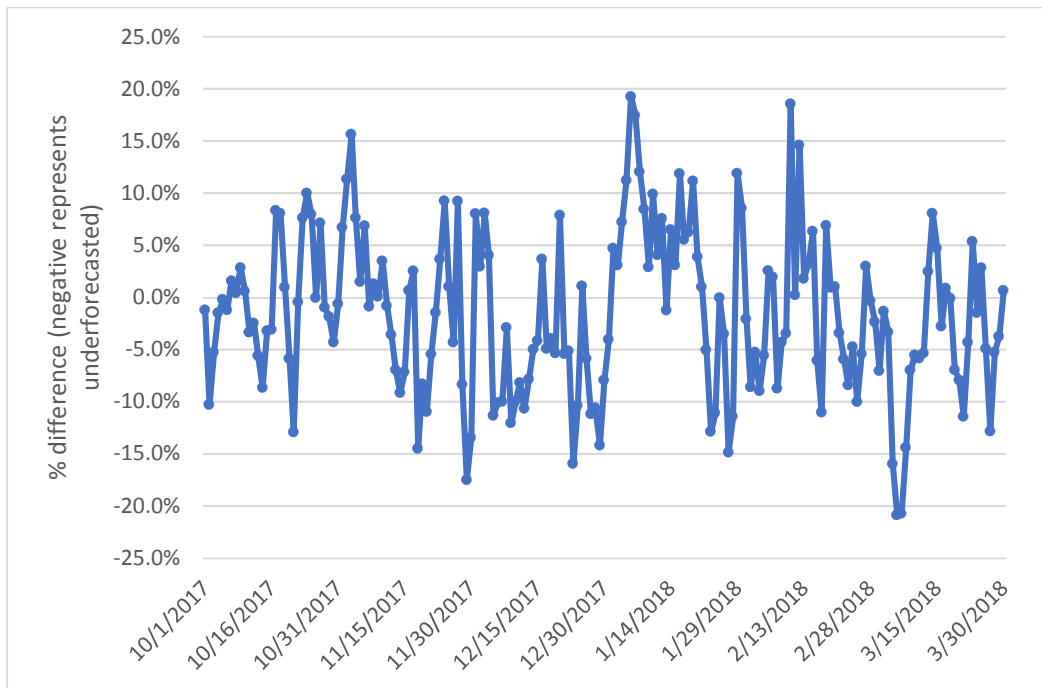
³¹ Low OFOs were called every day of the cold snap, apart from February 28th.

Figure 8A: Core Forecast vs. Estimated Actual Burn and OFO Calls During Cold Snap (Instances of low OFO are labeled “low” and no OFO days with “0”)



Data source: SoCalGas Data Request 48

Figure 9B: Core Forecast vs. Estimated Actual Burn During Winter 2017-18



Data source: SoCalGas Data Request 48

Natural Gas Prices

The pipeline outages and restrictions on SoCalGas' system reduced gas supply, and the cold snap increased demand; this combination led to price spikes. In the beginning of the cold snap, SoCalGas Citygate gas prices shot up from about \$3.50 to nearly \$25 per million British Thermal Units (MMBtu).³² Conversely, PG&E Citygate and SoCalGas Border prices remained steady. SoCalGas Citygate prices returned to their previous range after the first week of the cold snap (see Figure 9).

Temperature dips on Friday, December 22, 2017, and Sunday, January 21, 2018 brought price spikes as well, although of a much smaller magnitude. Why weren't the price spikes as high on these days? Storage withdrawals and receipt point utilization were similar to other days before and after the temperature dips. On December 22, it is plausible that the relatively short timeframe of colder weather and lower load forecasts during the Christmas holiday led to smaller price increases than during the cold snap. Similarly, an analysis of January 21, 2018, leads ED staff to suggest that the lack of an extraordinary price increase can be attributed to weather forecasts showing only one day of colder temperatures.

Figure 9: SoCal Citygate Prices in Winter 2017-18

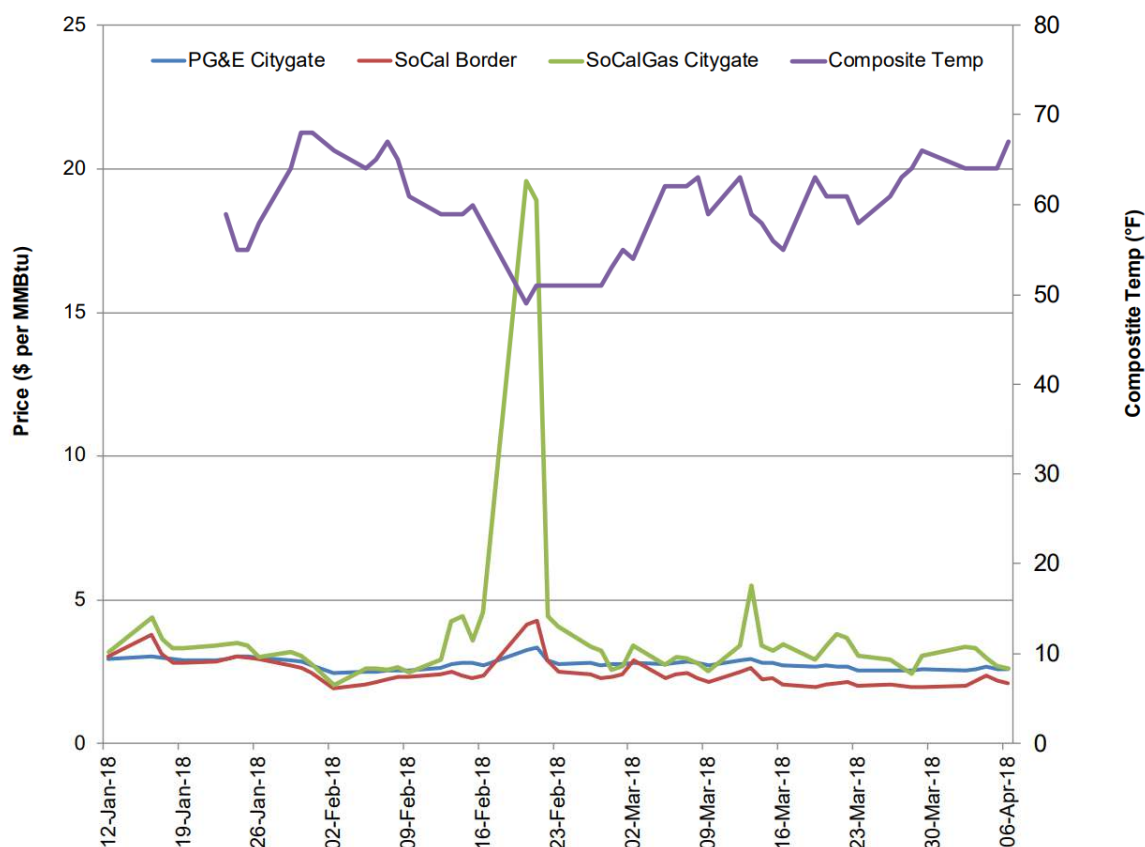


Image Source: Joint Agency Summer 2018 Technical Assessment, page 15

³² One MMBtu is equal to one dekatherm.

Electricity Prices

On February 19, 2018, SoCalGas and SDG&E posted a systemwide curtailment for electric generation customers effective 7:00 AM PCT, February 20, 2018. The curtailment lasted until 7:00 AM, March 6, 2018. During that time, SoCalGas worked with the CAISO and LADWP balancing authorities to manage reliability on both the gas and electric systems. The CAISO activated their gas nomogram constraints to redispatch resources and also activated gas scalars in the real-time market for fuel regions in Southern California. In brief, nomograms can be activated by the CAISO to enforce a gas constraint/limitation in a region, and scalars can be activated to increase the gas price index in a region. Both nomograms and scalars make gas-based generation more expensive in Southern California.

The impact of SoCalGas' system constraints and the cold snap were undeniably felt by the CAISO and LADWP. In the CAISO Department of Market Monitoring's Quarterly Report on Market Issues and Performance for Quarter 1, 2018,³³ it found that February "real-time [bid cost recovery] payments were about \$11 million, the highest amount in any month since 2011. During February 20-23, when SoCalGas Citygate prices were high, these payments totaled about \$5 million."³⁴ The real-time bid cost recovery payment is one parameter by which the impact of higher gas prices was realized in electricity costs.

Additionally, real-time energy imbalance costs totaled roughly \$19 million for the four-day period between February 20-23 when "real-time gas burn constraints associated with Aliso Canyon gas-electric coordination were enforced and binding during peak hours in the real-time market."³⁵ In other words, during the CAISO's two-step settlement process, the real-time 15-minute and five-minute markets from February 20 to 23 resulted in the CAISO paying about \$19 million more than the day-ahead settlement. While it is impossible to know exactly how much of these costs were due to the activation of gas scalars or gas nomograms versus higher gas prices and management of transmission constraints, the impact was still significant, as seen in Figure 10.³⁶

³³ *Q1 2018 Report on Market Issues and Performance*, Department of Market Monitoring — California ISO, page 25:

<http://www.caiso.com/Documents/2018FirstQuarterReportonMarketIssuesandPerformance.pdf>.

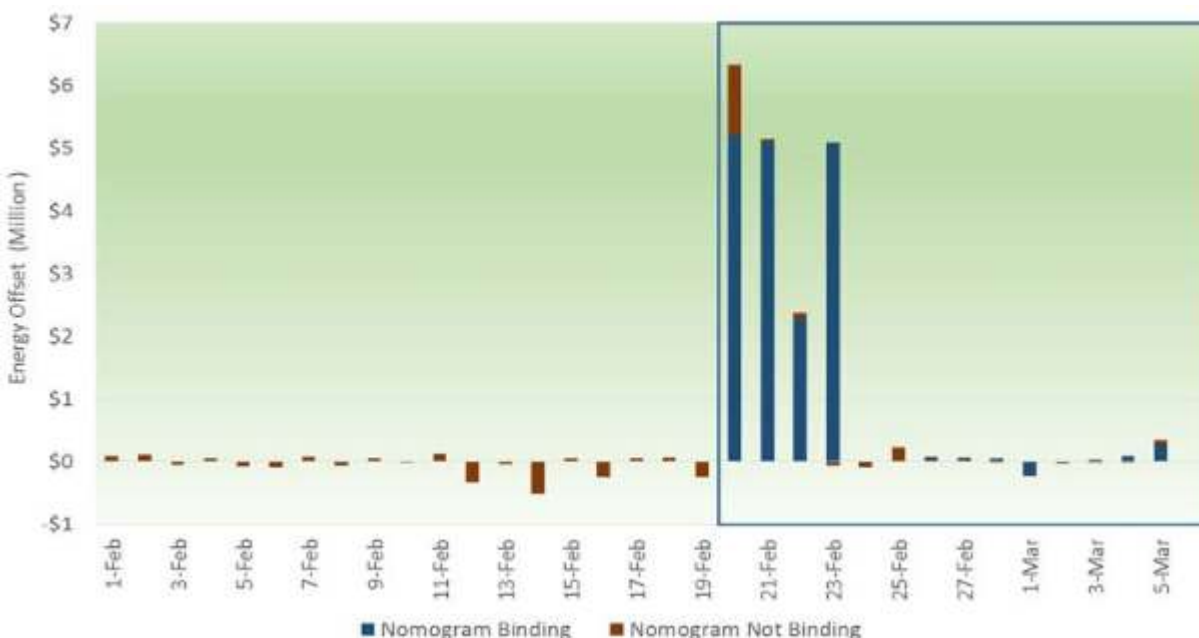
³⁴ The real-time bid cost recovery payment allows generating resources to recuperate their losses. It is a CAISO mechanism to ensure sufficient revenue is paid to the resources.

³⁵ *Q1 2018 Report on Market Issues and Performance*, Department of Market Monitoring — California ISO, page 31:

<http://www.caiso.com/Documents/2018FirstQuarterReportonMarketIssuesandPerformance.pdf>.

³⁶ Figures 10, 11, and 12 were taken from: <http://www.caiso.com/Documents/Agenda-Presentation-MarketPerformance-PlanningForum-Apr192018.pdf>.

Figure 10: Daily Cost of Real-time Imbalance Energy Offset

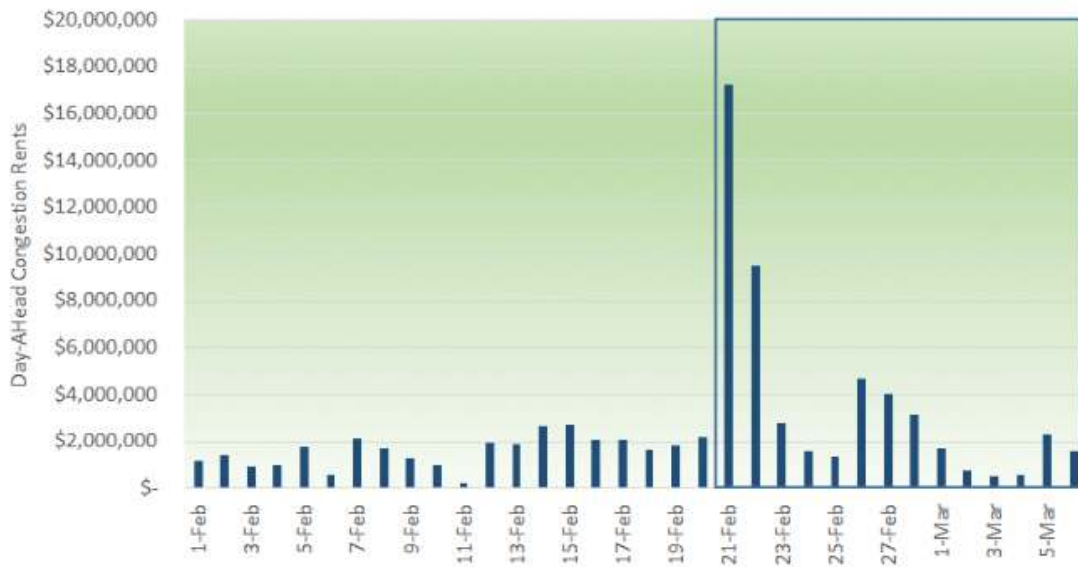


Source: CAISO

The last major costs ED staff considered are congestion costs, which are an indirect effect of the constrained operating conditions during the cold snap. Through the interplay of transmission constraints and gas constraints, the CAISO saw the market managing both types of constraints simultaneously. Congestion occurs on the electric system as power flow begins to reach a transmission line limit. Congestion causes the market to create a price signal to value the congestion. Figures 11 and 12 show CAISO day-ahead congestion rents and daily real-time congestion offset costs.³⁷ On February 21-22, day-ahead congestion rent totaled over \$25 million.

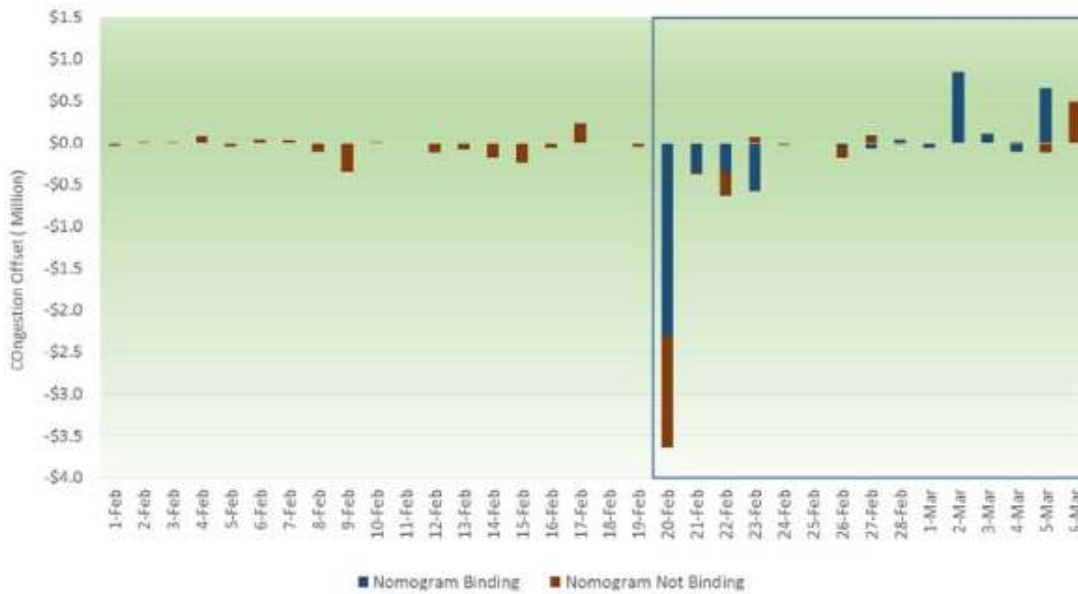
³⁷ Daily real-time congestion offset reflects the congestion settled in the 15 and 5 minute markets. In the day-ahead market, the costs are called rents instead of offsets.

Figure 11: Day-ahead Congestion Rents



Source: CAISO

Figure 12: Real-time Congestion Offset



Source: CAISO

A request asking LADWP for information about its costs during the cold spell yielded the following data that LADWP has authorized ED staff to share in this report. It estimated the following total additional costs during the SoCalGas system curtailment:

Table 4: LADWP Additional Costs During 02/20/2018 - 03/06/2018

Uneconomic Dispatch	\$341,276.00
Hedged Purchases	\$573,478.00
Lost Sales	\$788,840.00
Call Option Allocation	\$75,000.00
Net Loss (Reasonable Estimate)	\$1,778,594.00

Source: LADWP Data Request

These electric costs are not comprehensive, as several other figures are confidential due to market sensitivity. It should be noted that costs realized to comply with operational flow orders are not included, and some congestion cost increases during the cold snap were also due to electrical equipment and station outages — not gas prices.

Closing Summary

The October 1, 2017, rupture of Line 235-2 threatened SoCalGas system reliability throughout the subsequent winter. The warm conditions that persisted until mid-February played a significant role in maintaining SoCalGas system reliability. To meet gas demand during the cold snap that lasted from February 19 through March 5, 2018, SoCalGas maximized withdrawals from the non-Aliso fields, imposed operational flow orders, issued a systemwide curtailment, and ultimately withdrew gas from Aliso Canyon. While curtailment of electric generation is permitted under certain circumstances, it should be a low-probability event. CAISO and LADWP were able to reduce gas demand for electric generators in response to the systemwide curtailment. These reductions came at significant cost but did not lead to interruptions in electric service to their customers. SoCalGas did not issue any mandatory, Rule 23 curtailments during the cold snap.

The CPUC continues to monitor SoCalGas' work on the out-of-service transmission pipelines to ensure that work is completed safely and as rapidly as possible. As winter 2018-19 approaches, there are two key differences from winter 2017-18 — an increase in the authorized Aliso Canyon inventory from 24.6 to 34 Bcf and the return of Line 3000 at reduced pressure. While the return of Line 3000 does not increase system capacity due to the bottleneck created by the outages on Lines 235-2 and 4000, it does increase redundancy. The increase in inventory at Aliso Canyon means that the field can provide higher withdrawal capacity to meet peak-day demand and support longer periods of withdrawal in the event of sustained cold weather. These additions improve the winter 2018-19 reliability outlook but are still not enough to ensure reliability throughout the winter. Lastly, there is considerable room for improvement in core forecasting. A proceeding is currently underway to examine the issues surrounding core balancing.³⁸ However, a decision isn't expected until the first half of 2019, so major changes are unlikely to occur in time for winter 2018-19.

³⁸ Core balancing is the subject of proceeding A.17-10-002, which is expected to be decided in March 2019.