414 Nicollet Mall
Minneapolis, MN 55401

August 1, 2024

—Via Electronic Filing—

Will Seuffert
Executive Secretary
Minnesota Public Utilities Commission
121 7th Place East, Suite 350
St. Paul, MN 55101

RE: ANNUAL REPORT
FEBRUARY 2021 NATURAL GAS PRICE INVESTIGATION
DOCKET NOS. G999/CI-21-135 AND G002/CI-21-610

Dear Mr. Seuffert:

Northern States Power Company, doing business as Xcel Energy, submits to the Minnesota Public Utilities Commission (Commission) this Annual Report in compliance with the Commission's February 17, 2023 ORDER REQUIRING ACTIONS TO MITIGATE IMPACTS FROM FUTURE NATURAL GAS PRICE SPIKES, SETTING FILING REQUIREMENTS, AND INITIATING A PROCEEDING TO ESTABLISH GAS RESOURCE PLANNING REQUIREMENTS in Docket Nos. G999/CI-21-135, G008/M-21-138, G004/M-21-235, G002/CI-21-610 and G011/CI-21-611.

We have electronically filed this document with the Commission, and copies have been served on the parties on the attached service lists. Please contact me at lisa.r.peterson@xcelenergy.com or (612) 330-7681 or Jennifer Roesler at jennifer.roesler@xcelenergy.com or (612) 330-1925 if you have any questions regarding this filing.

Sincerely,

/s/

LISA PETERSON
DIRECTOR, REGULATORY PRICING AND ANALYSIS

Enclosure
cc: Service List

STATE OF MINNESOTA
BEFORE THE
MINNESOTA PUBLIC UTILITIES COMMISSION

Katie J. Sieben	Chair
Hwikwon Ham	Commissioner
Valerie Means	Commissioner
Joseph K. Sullivan	Commissioner
John A. Tuma	Commissioner

IN THE MATTER OF A COMMISSION INVESTIGATION INTO THE IMPACT OF SEVERE WEATHER IN FEBRUARY 2021 ON IMPACTED MINNESOTA NATURAL GAS UTILITIES AND CUSTOMERS	DOCKET NO. G999/CI-21-135
IN THE MATTER OF A PETITION OF NORTHERN STATES POWER COMPANY D/B/A XCEL ENERGY TO RECOVER FEBRUARY 2021 NATURAL GAS COSTS	DOCKET NO. G002/CI-21-610

ANNUAL REPORT

INTRODUCTION

Northern States Power Company, doing business as Xcel Energy, submits to the Minnesota Public Utilities Commission (Commission) this Annual Report in response to the Commission's February 17, 2023 ORDER REQUIRING ACTIONS TO MITIGATE IMPACTS FROM FUTURE NATURAL GAS PRICE SPIKES, SETTING FILING REQUIREMENTS, AND INITIATING A PROCEEDING TO ESTABLISH GAS RESOURCE PLANNING REQUIREMENTS (February 17 Order) in Docket Nos. G999/CI-21-135, G008/M-21-138, G004/M-21-235, G002/CI-21-610 and G011/CI-21-611.

Order Point 15 states:

> 15. *By August 1 of each year, each gas utility in this docket must make an annual compliance filing that details its recent efforts and addresses parties' recommendations made in this proceeding.*

We provide details of our recent efforts below.

A. Interruptible Tariffs

2. *No later than its next rate case, each gas utility in this docket shall update its existing interruptible tariffs to ensure customers understand the possibility of economic interruptions and propose new or alternative interruptible tariffs that include additional economic curtailment provisions that could protect the system from future price spikes.*

Our proposed tariff changes in compliance with the order point were included in Scott S. Hults' Direct Testimony (pages 7-16) submitted on November 1, 2023, with Rebuttal Testimony submitted by Gerald E. Traut on May 29, 2024, in Docket No. G002/GR-23-413 (Gas Rate Case).

The Company proposed tariff language to ensure that all interruptible customers understand the potential for curtailment during extraordinary economic events. The Company also proposed to modify its existing Interruptible Service rate schedule by establishing two tiers of interruptible service:

- Tier I Interruptible customers shall be subject to curtailment whenever the Company determines that the supply or capacity of the natural gas system is at risk.
- Tier II Interruptible customers shall be subject to curtailment whenever the Company determines that the supply or capacity of the natural gas system is at risk and/or during economic events.

On June 26, 2024, a Comprehensive and Unanimous Settlement Agreement (Settlement Agreement) was filed in the Gas Rate Case. Beginning on page 19 of the Settlement Agreement, section H. Tariff Revisions, the parties agree that the Company's tariffs should include the Company's proposed two tiers of Interruptible Service (Tier I and Tier II) with the rates set so that the Interruptible class revenue recovery is consistent with the Interruptible class revenue recovery absent the economic curtailment proposal. The Settlement Agreement is pending regulatory action in the Gas Rate Case.

B. Daily Spot Market Prices that Exceed 5x the Average Price for Current Month's PGA

3. *If a gas utility in this docket pays prices on the daily spot market that exceed five times the average price of gas in the utility's filed purchased-gas adjustment for the current month when the gas was purchased, the utility shall make a filing to the Commission within 14 days identifying:*

A. *Its costs for procuring gas for Minnesota customers while gas prices were inflated above this amount,*
B. *What actions the utility took to account for or mitigate those costs, and*
C. *Justifications for why its actions were prudent.*

The Company submitted our first of these filings on January 26, 2024 and commits to continuing the practice of submitting a filing within 14 days if the described situation arises.

C. North American Energy Standards Board (NAESB) Participation

4. *The gas utilities in this docket shall participate in the North American Energy Standards Board Gas/Electric Harmonization Forum and other relevant efforts to track and pursue beneficial reforms, such as improving the force majeure language in the NAESB standard contract.*

The Commission's Order in the docket directs the Company to participate in the NAESB Gas/Electric Harmonization Forum (GEH) to track and pursue beneficial reforms. The Company participated in the process and detailed its participation in the GEH meetings in our quarterly compliance filings regarding recovery or offsets in Docket No. G002/CI-21-610. In the Company's quarterly update submitted on February 29, 2024, we detailed that the GEH process was concluded with a final report released on July 28, 2024. The report contained 20 recommendations for various regulatory or governing bodies to consider. In addition, NAESB held separate discussions around changing the base gas contract – specifically around *force majeure* language. Those discussions were terminated, without any modifications to the base gas contract, by weighted vote of the NAESB participants over our objections. In the Company's view, both of the NAESB related efforts envisioned by this order point have now concluded, and no further updates or developments are expected on these points. However, the Company commits to participate in any future industry efforts to address these issues.

D. Contracting, Hedging, and Supply Options

5. *The gas utilities in this docket shall continue exploring the availability and cost of contracting, hedging, and supply options that would provide better protection against price spikes.*

The Company is continually exploring, evaluating, and pursuing supply options – including contracting, hedging, and physical storage – that may provide protection

against extraordinary price spikes. Options discussed below include: fixed price contracts, physical storage, and financial hedging.

One option for price certainty is to fix the price of gas for a period. Long-term fixed price contracts (i.e., contracts of one year or more) provide price protection against the potential for higher seasonal winter prices and daily price spikes. However, this price guarantee requires customers to forego market price declines if actual gas prices in the heating season end up being below the earlier forecasted price at which the contract price was set. It is typical for actual prices to be higher or lower than earlier forecasts, and sometimes, substantially different. If actual prices do fall below the contracted price, it may be considered retrospectively as a gas cost "loss." For example, assume we were to purchase a one-year baseload package of 50,000 Dth per day at $4/Dth fixed price, for a total cost of $73 million annually. If the average First of Month (FOM) Index prices for the year settle just one dollar lower than the fixed price transaction, the total annual costs to customers would be $18.25 million more than they otherwise would have been at the FOM index price. The prudence and cost recovery of fixed price contracts would need to be assessed based on the facts at the time the contract is entered into, and not after-the-fact based on whether the contract was above or below actual gas prices. Additionally, this solution is typically for baseload type purchases, and thus is not generally a substitute for protection against price spikes in daily priced gas.

Physical underground storage is the best hedge against daily price spikes. The Company holds storage to address almost 30 percent of its winter design day requirements, which provides important reliability and price protection measures. In addition to providing price certainty, storage provides a critical role in assuring physical supply when needed and balancing system operations every day to provide continuous service. The Company is actively exploring options to expand its storage portfolio. An analysis of our storage withdrawal strategy is discussed later.

Finally, the Company employs financial hedges against monthly natural gas commodity price volatility to protect customers from high market prices for baseload gas. These hedges are designed to provide protection against longer-term trends in rising gas prices rather than spikes in the daily market. This hedging activity is annually reviewed and approved by the Commission. The currently approved hedging plan limits the Company to hedging no more than 50 percent of our annual expected winter requirements (through either physical storage or financial hedging), and no more than 25 percent of our annual expected winter requirements can be hedged with financial instruments. The 50 percent level has been determined to be a prudent target level when balancing costs and benefits of financial hedging programs. These financial

instruments have proven to be quite costly in the past and, in many years, there is not enough gas price market volatility to make them beneficial.

In its recent Petition for an extension of rule variances to recover the costs of financial instruments through the purchased gas adjustment clause (PGA) in Docket No. G002/M-23-521, the Company proposed to pilot several new or different tools for hedging. These included the incorporation of physical fixed price deals and a new financial product of gas daily (GD) swap agreements. The incorporation of these tools into our hedge plan may provide additional measures to mitigate the impact of an extreme price spike. The Company continues to explore financial hedging (such as the GD swap agreements), or other solutions that would provide protection from daily price spikes, such as occurred during Winter Storm Uri. However, hedge products for this type of supply are extremely limited as suppliers do not want to take on the added risk of significant quantities under these type of supply arrangements. The Company was able to secure one physical swing supply arrangement for the winter of 2021-2022 for up to 10,000 Dth per day priced at the FOM Index to test the use of such options. For winter 2022-2023 and 2023-2024, suppliers were not willing to offer this type of supply option due to the high price uncertainty in the marketplace. The Company continues to survey the market for financial hedging products that would protect against daily price swings. However, while the Company may test some newer financial products, these products are not offered by the market at price levels or at quantity levels that would significantly offset cost risk.

E. Baseload Purchases

6. *The gas utilities in this docket shall consider variations to, and explain their plans to, incorporate a greater degree of baseload purchases.*

The foundational elements of our gas supply planning and procurement are baseload packages of gas we commit to take each day of a month regardless of customer load. Baseload packages are typically purchased prior to the beginning of the heating season or at the end of the previous month for the upcoming month and are priced at a FOM Index price. Baseload agreements have no flexibility to match daily load with supply. The contracted quantity must be taken regardless of whether it is an unusually warm day or an unusually cold day. The purchaser must accept delivery of the daily contract quantity every day, even if baseload purchases exceed actual load. In addition, baseload purchases are generally locked in at the FOM Index price, which may be higher or lower than the daily spot price.

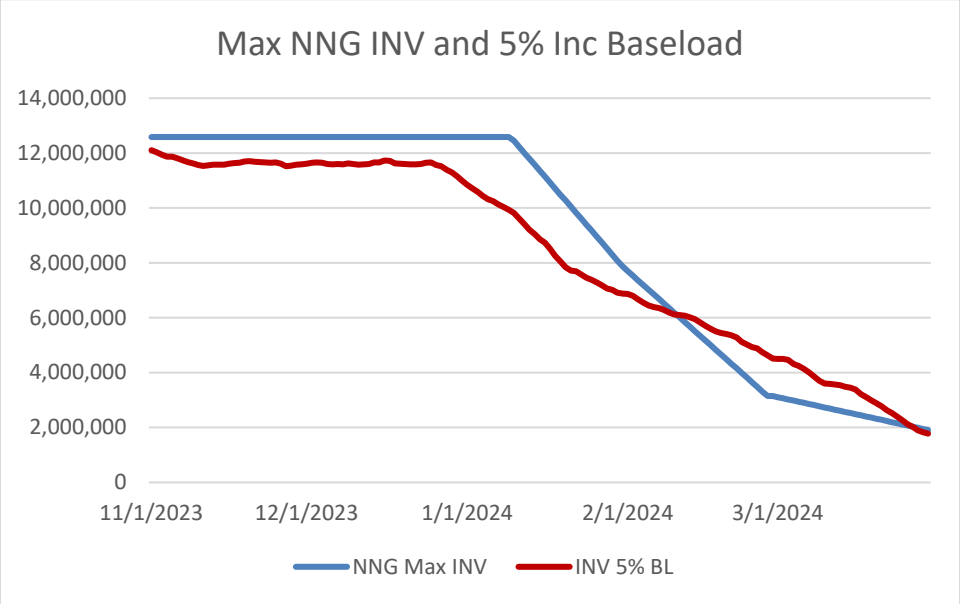
The baseload quantity determination each month is based on several factors. First, we review forecasted sales and average weather. Second, we consider previous years'

actual loads for each month and the forecasted weather for the upcoming month. Finally, we consider current storage inventory levels, mandated inventory levels at the end of the winter season, and the associated storage deliverability limits and/or requirements. Storage factors are crucial to baseload decisions, as any gas purchased that is not used on a day is typically an offset to storage withdrawals to be used later. The goal is to purchase enough baseload, accounting for storage limits and withdrawals, to serve the minimum customer needs every day for that month.

Following the extraordinary price spikes of Winter Storm Uri, the Company reviewed its levels of baseload gas and increased term and monthly baseload purchases during the winter of 2021-2022 by 12 percent (or an additional 30,000 Dth/day). Similar volumes were also purchased for winter 2022-2023 and 2023-2024.

In addition, the Company updated a study of its baseload supplies to determine if more could be added to the portfolio, further reducing purchases exposed to the daily price market. The study tested increased baseload volumes by between 5 and 30 percent over the baseload volumes purchased for the winter of 2023-2024. These increased volumes were then compared to historical daily load. On days where purchases were higher than system load, excess gas volumes were assumed to be injected into storage. On days where load exceeded purchases, the difference was assumed to come from storage withdrawals. In each instance where baseload gas was increased, our projected storage inventory on Northern Natural Gas (NNG) (our largest, most flexible storage provider) went above the total storage capacity plan starting in February. Our storage plan is produced prior to each heating season as a guide for storage balances to maintain compliance with NNG storage contract and tariff limits. A storage inventory above the storage plan exposes the Company to financial penalties for being out of compliance with contract limits. Graphs of the lowest scenario are shown below as Figures 1 and 2. The study shows that additional baseload above current levels pose risks to the Company meeting contractual limits for storage, limits flexibility for storage use late in the heating season, and a risk for increased penalties. These results are in line with previous analyses showing increases in baseload purchases expose the Company to breaching the total NNG storage capacity.

Figure 1
2023-2024 Base Year



Recent operational experience from the winter of 2023-2034 provides more evidence that weather variability renders term baseload contracting levels difficult to predict. This past winter was much warmer than average, dampening overall demand. As the winter progressed, storage inventory levels remained higher than planned, threatening to exceed our contract limits by the end of the winter. The Company adjusted its supply plans and was able to meet contract requirements by managing purchases. However, this significantly reduced flexibility to optimize gas supply for our customers.

Overall, the level of baseload is at the upper limit that the Company feels comfortable with to manage loads and storage inventories. It is important to note that depending on forecasts and storage levels the monthly baseload levels may be adjusted from past levels. Buying more baseload gas than base customer needs would lead to operational concerns and issues that, over the long-term, outweigh any potential benefit of buying additional baseload gas.

F. Storage Inventory Management

7. *The gas utilities in this docket shall explore modifications to storage inventory management that could preserve withdrawal capabilities for later in the winter.*

The February 17 Order (page 14) encouraged Minnesota utilities to explore options for utilizing their storage assets to maximize late season access to stored gas supplies.

The Company agrees that it is important to preserve storage inventory and withdrawal capability until late in the winter heating season as significant cold weather can occur in Minnesota in late February. As the following discussion will demonstrate, the Company manages its assets to preserve storage capability through February.

The Company meets a large portion of its gas supply needs through storage services on three major interstate pipeline/storage companies. Currently, the Company holds 14.7 Bcf, or approximately 26 percent of our firm winter requirements, and 27 percent of a design day, of storage capacity with up to 242,800 Dth/day of daily deliverability (withdrawal) capacity. The storage capacity is primarily used for operational purposes to provide reliable supply during high demand seasons and for day-to-day balancing of loads. However, the storage capacity also provides pricing protection during gas price upsets.

Underground storage fields each have unique operating requirements. Generally, they require an annual rest period (no or limited injection/withdrawal activity) over the summer to preserve injection and withdrawal capabilities. To oversimplify matters, most storage fields can withstand high operating pressures for a short period of time in the winter. High pressure is driven by the amount of inventory in the storage field at any given time (picture a balloon that expands and contracts as air is inserted or removed). If the field remains at high pressure for too long it may squish the stored gas out of the reservoir where it will become unusable. Or, in worse cases, it may damage the field making it unable to perform at designed levels. For these reasons, most storage services require shippers (like the Company) to empty or nearly empty their storage accounts at the end of each winter. The storage service, in many cases, also carries inventory targets where the shipper is required to fall below certain inventory levels at stated times during the winter (often referred to as a "ratchet," since quantities are being tightened down over the winter).

By far, the largest portion of the Company's storage is 12.5 Bcf of storage capacity and a maximum of 218,820 Dth of withdrawal capacity on NNG from fields located in Iowa and Kansas, which is directly connected to many of our service areas. NNG's firm storage services are currently fully subscribed. We also hold storage capacity on ANR-Pipeline and ANR-Storage. Those storage fields are located in Michigan, and through connecting pipelines provide supply flexibility and price protection to Viking connected systems, and the north end of NNG connected systems through Great Lakes Gas Transmission Company.

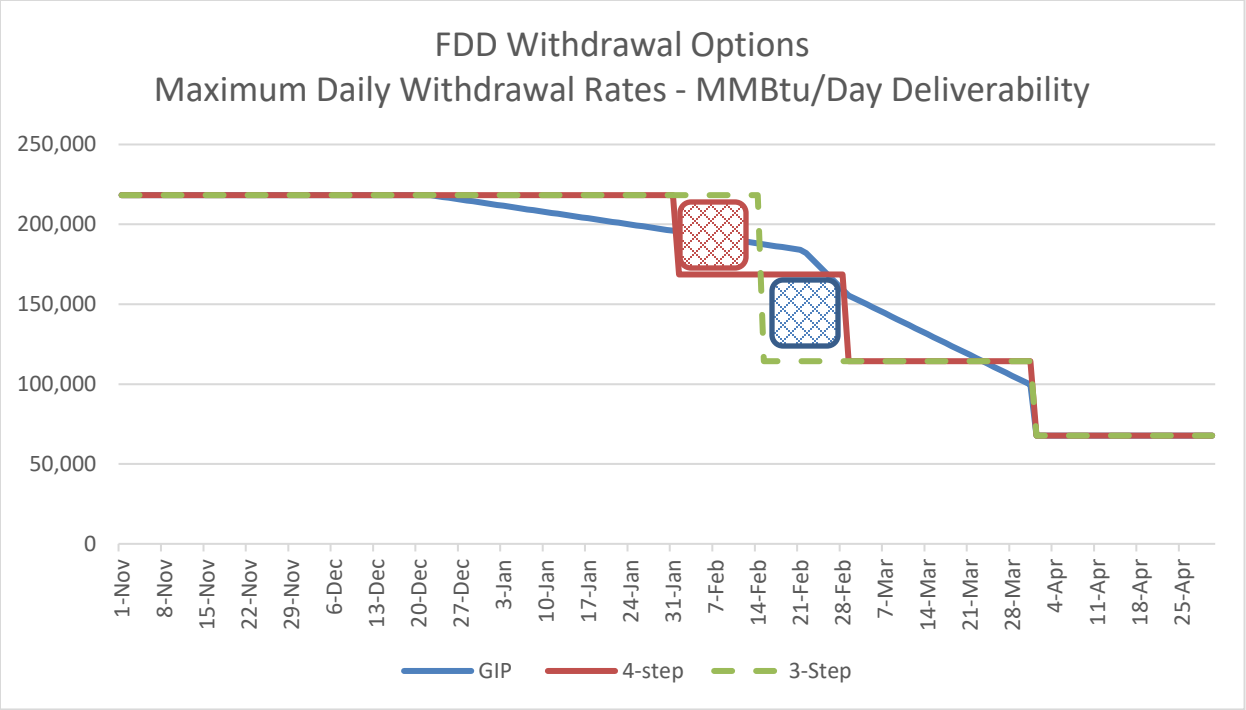
Ninety percent of the Company's contracted storage withdrawal service is provided by NNG. NNG offers three storage options to its LDC customers: i) Gas-In-Place option (GIP); ii) 3-Step option; and iii) 4-Step option. The annual costs for each

option are the same; however, the options provide varying methods of determining withdrawal quantities during the heating season. Withdrawal capability under the GIP option is determined as a formula dependent on the customer's current storage inventory. The 3-Step option has a fixed withdrawal quantity for each month as a percentage of total storage capacity under the contract, which changes three times per heating season on November 1, February 15, and April 1. The 4-Step option is similar to the 3-step with changes on November 1, February 1, March 1, and April 1. All options are subject to periodic minimum inventory requirements on January 31, and maximum inventory requirements on March 1 and May 1.

NSPM takes service under the 4-Step option because, as a utility concerned with system reliability, NSPM prefers a fixed withdrawal deliverability throughout the winter rather than having withdrawal deliverability constrained by storage inventory. Using this method, NSPM can be assured of a fixed amount of withdrawal capacity in February rather than having fluctuating quantities that could change during the middle of a significant cold weather event (GIP), or a mid-February change which would make it more difficult to plan monthly baseload (3-Step).

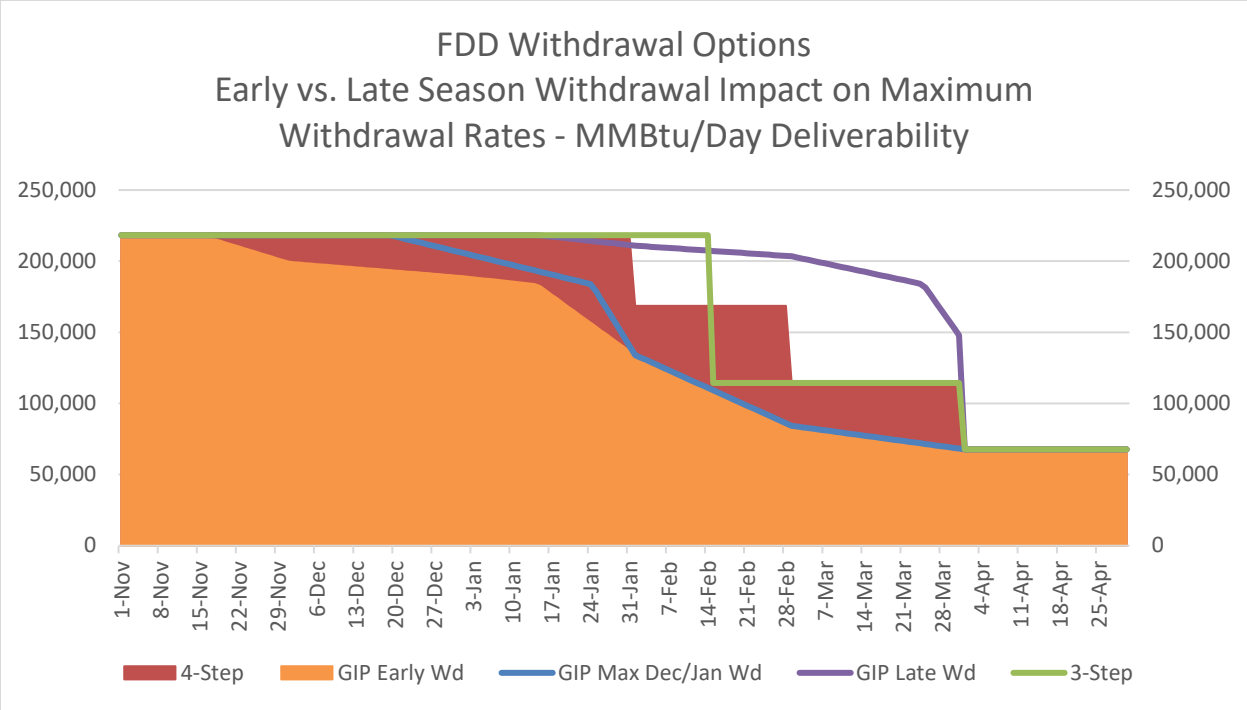
Figure 2 below shows the maximum daily withdrawal rates under each of the three options during the winter season November 1 through April 30. Both the 4-Step and 3-Step options guarantee fixed withdrawal deliverability, however the 4-Step option gives NSPM higher gas withdrawal capability later in the winter (i.e. February). This is represented in the blue shaded area below. The trade-off is less withdrawal capability during the first half of February when compared to the 3-Step option, represented by the orange shaded area. NSPM believes this trade-off provides for greater system reliability through consistent, reliable available quantities. According to a separate study of baseload purchases discussed above, even slight increases to monthly, fixed baseload gas supplies displaces early season storage withdrawals, preserving inventory to late February, and shifting significant withdrawals toward late February (see Figures 1 and 2). This highlights the need for a higher withdrawal capacity during late February to maximize the flexibility of our storage inventory and remain within the contractual limits of the service.

Figure 2



As mentioned above, the Company believes its customers are better served by a fixed withdrawal deliverability during each winter month that doesn't fluctuate with its storage inventory level. Figure 3 illustrates the trade-off between the inventory based GIP option and the 4-Step option during an unexpected early season cold spell. In the event of a colder than expected early winter, the Company would withdraw larger quantities to serve unexpected early winter demand. The resulting late season withdrawal capability would then be far less under the GIP option as opposed to the 4-Step option. In Figure 3, the orange area represents the withdrawal capability of the GIP option after early winter season withdrawals. In contrast, the brown area is the withdrawal capability still available under the 4-Step option in the same scenario. The preserved withdrawal capacity under the 4-Step option is essential for the Company's system reliability to meet demand requirements after unexpected weather and drawdowns in storage inventory. Also note the continued difference in late February withdrawal capacity between the 3-Step and 4-Step options, as discussed above. As a result, the 4-Step storage option is the preferred option for the Company.

Figure 3



As mentioned above, the February 17 Order encourages Minnesota utilities to explore options for utilizing their storage assets to maximize late season access to stored gas supplies. The Company provides for late system winter storage flexibility by using a storage service that maximizes the option for late February storage service.

G. Supply Reserve Margin Practices

8. The gas utilities in this docket shall commit to improving their supply reserve margin practices to minimize these quantities to the greatest extent reasonable and be prepared to explain the level of their supply reserve margins in the future.

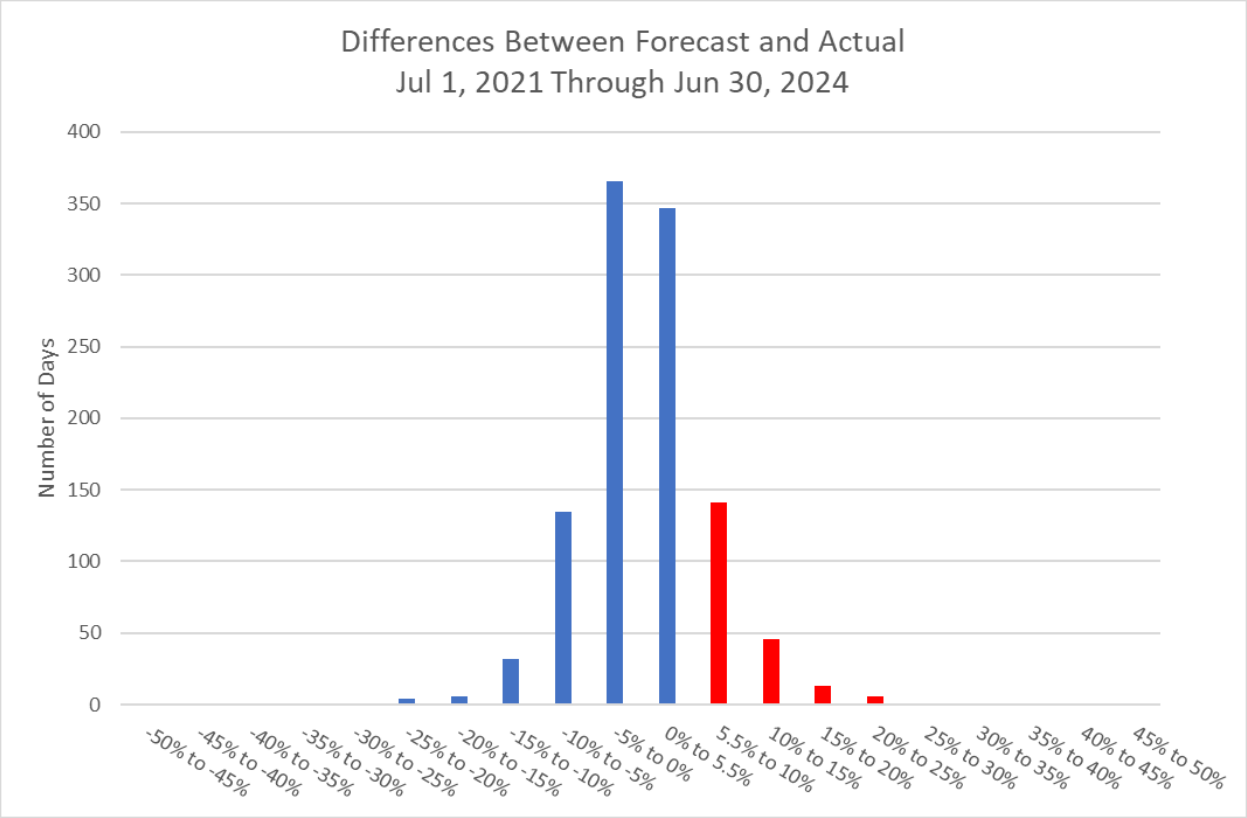
In planning daily gas supplies to serve customers, the Company always plans to have a supply reserve (or safety margin) available each day. The reserve margin is our back-up plan in case, among other things, temperatures are colder than expected, there are interstate pipeline outages, or there are supply failures. A reserve margin provides the Company and our customers a variety of other protections. First, it protects the Company and our customers from pipeline penalties if we burn more gas than we delivered to the pipeline that day. Second, it protects us from potential pipeline capacity issues by providing backup or alternative supply options on our pipelines in case one of the pipelines experiences a daily facility outage restricting capacity in part of the delivery network. Third, it protects us from possible supply failures, such as a

producer experiencing a force majeure event and not delivering promised supply to us.

Reasonable reserve margins vary depending on the weather and load forecast, time of year, storage inventories, potential for supply failures, interstate pipeline operating conditions, local distribution company (LDC) conditions, the likelihood of colder than predicted temperatures, whether upstream pipelines have declared balancing penalties, and the market availability of additional gas supply. For example, the quantity required as reserve for a warm summer day is significantly different from that reasonable for a cold winter day. Reserve supply purchases may also be informed by the length and extent of the predicated cold weather, since it is often beneficial to acquire extra gas supply at the beginning of an extended cold weather event.

One factor impacting gas supply reserve margin is the accuracy with which customer demand can be predicted. Figure 4 below compares the differences between forecasted and actual loads for the three-year period between July 2021 and June 2024. The chart shows the number of daily occurrences where the difference between forecast and actual load is sorted into defined categories (0 to 5.5 percent, 5.5 to 10 percent, and so on). The five bars on the left are denoted as negative, meaning that the actual load was less than the forecasted load creating no reliability concerns as there would have been more supply than demand. The five bars on the right (one blue and four red) are denoted as positive meaning that the actual load was greater than the forecasted load creating reliability concerns if there was no supply reserve acquired. Overall, the forecasting variance averages 0.49 percent, indicating a useful forecasting tool. However, the range includes up to 25 percent miss to actual loads, which identifies a specific need for a supply reserve to protect customer's reliable service.

Figure 4
Demand Forecast to Actual



The variability in this chart underscores the importance of evaluating current conditions each day (weather, risk of supply failures, market conditions, operating conditions, etc.) to select the appropriate supply reserve for that day. Applying a rigid reserve margin could risk reliability on some days. The Company endeavors to continuously monitor, evaluate, and improve the accuracy of its forecasts as a critical factor in providing a reasonable gas supply reserve margin.

H. Pipeline Capacity

9. *In future contract demand entitlement filings, the gas utilities in this docket shall discuss how changes to their pipeline capacity affect their supply diversity and, if pipeline capacity comes at a cost premium but increases supply diversity, provide a meaningful cost/benefit discussion of the tradeoff, including a comparison with the least-cost capacity option.*

The Company discusses the geographic diversity of its access to supply in Attachment 1 of its Contract Demand Entitlements filing which is filed concurrently with this report. A detailed discussion can be found there.

I. Supply Mix Across Different Load and Weather Conditions

10. Each gas utility in this docket shall include in its relevant annual, forward-looking gas planning or hedging filings:

A. Its expected supply mixes across different load and weather conditions throughout each month of the upcoming winter season;

B. The forecasted minimum, average, and maximum day load requirements; and

C. The expected mix of baseload, storage, and spot supply on those days.

In preparation for the upcoming 2024-2025 heating season, the Company provides in Table 1 below ranges of daily load estimates. The estimates are based on five-years of actual load and weather data for each month. We also provide an illustrative supply mix for the time period. This supply and storage mix is unlikely to follow the chart exactly as weather and market conditions change supply will have to be adjusted to manage baseload supply, storage inventories and system reliability. These changes will likely occur on a monthly and daily basis as conditions warrant changes. For example, on days where there are price spikes the Company will make every effort to maximize its storage withdrawal capabilities while maintaining operational flexibility.

Table 1
Daily Load Estimate & Supply Mix
2024-2025 Heating Season

Minimum Load	November	December	January	February	March
5 Year Load	142,151	293,236	345,665	335,313	212,681
Baseload	100%	80%	71%	65%	84%
Estimated Storage	0%	20%	29%	35%	16%
Delivered Peaking	0%	0%	0%	0%	0%
Estimated Spot	0%	0%	0%	0%	0%
Total Est Supply	208,700	293,236	345,665	335,313	212,681

Average Load	November	December	January	February	March
5 Year Load	367,127	485,213	541,409	554,663	389,298
Baseload	57%	48%	45%	39%	46%
Estimated Storage	8%	18%	31%	25%	11%
Delivered Peaking	0%	0%	0%	0%	0%
Estimated Spot	35%	34%	24%	35%	43%
Total Est Supply	367,127	485,213	541,409	554,663	389,298

Max Load	November	December	January	February	March
5 Year Load	620,346	782,293	775,523	805,192	693,688
Baseload	34%	35%	36%	33%	26%
Estimated Storage	39%	36%	36%	29%	19%
Delivered Peaking	3%	3%	3%	3%	3%
Estimated Spot	24%	26%	24%	35%	53%
Total Est Supply	620,346	668,771	668,771	668,771	693,688

J. Plans that Study Customer Responses to Conservation Calls

11. The gas utilities in this docket shall design plans that study customer responses to conservation calls.

The Company has one ongoing study and one completed study regarding customer responses to conservation calls. The ongoing study is reviewing and validating the observed responses from the Minnesota Energy Action Days demand response product offered as part of the Energy Conservation and Optimization (ECO) portfolio. This product launched in 2023, and the verification report is expected after the conclusion of third-party analysis of the 2024 cooling season. While this product currently is electric only, we continue to analyze the product for potential applications elsewhere that could impact gas LDC sales customers.

As to the completed study, attached to this filing (Attachment A) is the Colorado Conservation Messaging Research report, which was completed earlier this year. The report was prepared by Illume on behalf of Public Service Company of Colorado, a utility affiliate of Northern States Power Company. The key conclusions from the report are equally applicable to Minnesota and include:

- Limited reductions are likely to result from standalone, economic-focused conservation alerts; messaging as part of a holistic campaign (e.g. through demand-side management programs) is more effective.
- Gas forecasting teams at Xcel Energy and other utilities have not observed reductions that provide confidence in adjusting gas supply purchases on alert days.
- A chilling effect on future conservation calls could result from sending messages suggesting that behavior changes can lead to bill reductions if customers do not perceive a reduction after acting.

K. Peak-Shaving Dispatch Decisions

13. Xcel shall use the circumstances of the event, the prevailing winter, and the status of its fuel inventory to inform its peak-shaving dispatch decisions.

In evaluating the dispatch of our peak-shaving plants the Company considers several factors, including the immediate weather and load forecasts, our interstate pipeline capacity, interruptible customer load and potential curtailments, peak-shaving inventory, the overall heating season, and time of year. For example, if forecasted load exceeds the Company's interstate pipeline capacity, and interruptible customers are curtailed, the Company will evaluate whether to deploy peak-shaving inventory to meet customer needs. The Company will continue to use the immediate event circumstances, conditions of the current heating season, and fuel inventory to inform peak-shaving dispatch decisions. In addition, as described below, the Company will evaluate circumstances to use peak-shaving capacity in order to provide price mitigation for our customers during extreme pricing events.

L. Dynamic Proposals for Calling on Peaking Resources

14. Xcel and CenterPoint shall file dynamic proposals for calling on peaking resources that recognize that these decisions depend on the economic and situational context of the utility and the market.

In its February 17 Order, the Commission directed the Company to evaluate a dynamic proposal to peak shaving for price mitigation. Peak shaving has historically been designed, and used in this market, as a reliability tool for the distribution system that supplements the system in the event of near design day conditions or in response to unexpected reliability issues. That is, from a gas supply planning perspective, our peak-shaving plants are a capacity resource, to be called on in near design day conditions or to address emergent reliability issues. The peak-shaving plants are not a primary supply resource or a supplement to our normal supply portfolio as they lack the inventory to perform that function. Additionally, while it may be unlikely that design day conditions present late in the season, it is not impossible. For this reason, the Company must manage its peak-shaving plant inventory levels so that they are not depleted prematurely in the heating season.

The Company agrees that *so long as* the asset's original purpose is still met (in this case, reliability to our customers during the coldest days our system is expected to experience), the asset can be used in additional ways. To that end, the Company will continue to evaluate economic dispatch of its Wescott peaking plant during extreme price events during the 2024-2025 heating season, when certain conditions are met.

The Company expects to use LNG stored in its Wescott facility in situations where the price of gas reaches extraordinary levels, like they did during Winter Storm Uri. During the previous heating season, the Company did dispatch Wescott during the Martin Luther King Jr. Day weekend, while maintaining sufficient inventory to meet design day and operational requirements. Over the holiday weekend, the Company withdrew LNG gas from Wescott each day to support high customer demand and provide some customer price protection. The Company proposes to operate Wescott within the sole discretion of the Company when certain conditions are present.

The Company will, first and foremost, maintain inventory levels that support the system during a design day event or other operational needs. Timing of any potential price mitigation event will be a key factor in the decision to dispatch the plant for price mitigation purposes. Wescott has limited ability to liquify, or make, LNG. As a result, inventory in the tank will be reserved to ensure sufficient quantities for a design day, reliability event like an interstate pipeline failure (as in 2014 with TransCanada), system operational requirements, and the probability of other needs later in the winter. As we move through the winter season, the probabilities of such events change and may free more inventory for price mitigation.

Second, the Company expects that Interruptible customers will be curtailed during a dispatch for price mitigation. Peaking plants are a capacity resource. As the Company nears its distribution system demand capacity, Interruptible customers are called on to

curtail so that the full capacity of the peaking plants and distribution system may be used to serve Firm customers' peak needs.

Finally, the Company will evaluate the status of the gas markets when making a decision to dispatch for economics. Significant events that may warrant the dispatch of LNG for economic purposes could be, but are not limited to: significant freeze-offs or supply disruption, expectation of significant price lift, or extended trading windows. The Company will evaluate all of these factors on a dynamic basis when making a decision of whether to dispatch LNG for price mitigation.

CONCLUSION

We appreciate the opportunity to provide this information to the Commission.

Dated: August 1, 2024

Northern States Power Company

ILLUME

January 26, 2024

Project Name:

Colorado Conservation Messaging Research

Prepared for:
Xcel Energy Colorado

Prepared by:
ILLUME Advising

ACKNOWLEDGEMENTS

ILLUME Advising, LLC is a forward-thinking consulting company at the rare intersection of insight and execution. Founded in 2013, the company has quickly grown to include a deep bench of quantitative and qualitative research experts. ILLUME uses cutting edge research strategies to help build a resilient energy ecosystem to enrich lives, improve global health, and ensure a more secure and sustainable future.

For this effort, we would like to acknowledge, first and foremost, Nicholas Minderman, Cammey Mahowald, Ryan Matley, and Peyton West. Finally, we would like to acknowledge the ILLUME team members Liz Kelley, Alex Dunn, Sergio Olalla Ubierna, and Gita Subramony.

PREPARED FOR:

Xcel Energy
414 Nicollet Mall
Minneapolis, MN 55401

PREPARED BY:

ILLUME Advising, LLC
440 Science Drive, Suite 202
Madison, WI 53711

CONTACT:

Gita Subramony, Senior Managing Consultant
gita@illumeadvising.com
929.269.3839

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EXECUTIVE SUMMARY

This summary provides an overview of research conducted by ILLUME Advising, LLC (ILLUME) on conservation messaging for Xcel Energy Colorado.

Research Context and Approach

Winter Storm Uri occurred from February 13, 2021, to February 17, 2021, across the United States. The storm caused extreme cold weather in many parts of the country including Colorado. Due to the extreme cold, natural gas commodity prices rose sharply over the weekend of the storm. Prices were elevated to $150 to $190 per MMBtu compared to previous prices of $2 to $3 per MMBtu.[1] As a result, Public Service Company of Colorado (PSCo)/Xcel Energy Colorado incurred extremely high costs to obtain and provide natural gas service to customers as well as to secure natural gas for electric generation purposes.

A cost recovery proceeding occurred after the event. The proceeding and settlement resulted in an Extraordinary Gas Cost Recovery Rider added on customer bills to recover costs from Winter Storm Uri. Additionally, the settlement required Xcel Energy Colorado to engage in customer outreach around energy conservation during the 2021 – 2022 heating season. The settlement agreement also required Xcel Energy Colorado to research and identify tools for economic-based conservation messaging. This research is a result of the terms of the settlement agreement (Proceeding No. 21A-0192EG).

The study focused on the following key research questions and topics:

- What demand response (DR)/conservation messaging strategies has Xcel Energy Colorado been using and how successful have they been?
- How has Uri shaped approaches to DR/conservation messaging?
- What types of messages can settlement parties collaborate on?
- Are there best practices for messaging channels, content, or customer segments targeted?
- What practices are other utilities using for conservation messaging?
    - Motivations and triggers for conservation messaging (e.g. reliability, economic factors, etc.).
    - Timing of messaging.
    - Communication and messaging channels and content.
    - Customer response.
    - Measurement and verification of event response.
    - Impacts on operations and planning.

[1] Decision No. R22-0279. IN THE MATTER OF THE APPLICATION OF PUBLIC SERVICE COMPANY OF COLORADO FOR RECOVERY OF COSTS ASSOCIATED WITH THE FEBRUARY 2021 EXTREME WEATHER EVENT FOR ITS ELECTRIC AND GAS UTILITIES.

Research Approach

The ILLUME team undertook the following tasks to address the research questions.

- **Task 1 – Kick-off and staff interviews:** We conducted eight interviews with Xcel Energy Colorado staff and conducted listening sessions with Colorado Energy Office (CEO) and Colorado Public Utilities Commission (PUC) team members. These discussions provided context for and informed secondary and peer utility research as well as data analysis tasks.
- **Task 2 – Secondary research and peer utility interviews:**
    - The ILLUME team investigated documentation and evaluation reports of conservation messaging programs or other interventions aimed at reducing end-user energy usage and/or demand at certain times.
    - The ILLUME team also interviewed four peer utilities and received additional information via email from two more peer utilities. The team sought contacts from utilities that have issued messages or alerts to their general populations to conserve energy at various times. Topics included messaging triggers, timing, content, channels, measurement and verification, customer response, and impacts on planning and operations.
- **Task 3 – Colorado data analysis:** The ILLUME team also examined customer responses to conservation messaging issued by Xcel Energy Colorado in the winter after Uri. Using gas system data, ILLUME compared non-conservation messaging day usage to conservation messaging day usage on a system level to see if there was any evidence of conservation on those days.

Key Findings

This section provides key findings from the study organized by theme.

Figure 1. Challenges with Implementing and Measuring Conservation Messaging

Utility planning and operations teams are not comfortable making critical purchasing decisions based on anticipated reductions in usage prompted by conservation messaging.	**Peer utilities are at the beginning stages of developing, implementing, and measuring conservation messaging.**	**Utilities that have deployed conservation messaging are not measuring impacts or have seen no measurable impacts.**
• Purchasing decisions would not be impacted based on conservation messaging unless there was substantially more reliable historical evidence around the expected impact of such messaging. • Utility planning and operations staff articulated a hierarchy that guided their operations, focusing first on safety, then on reliability, and finally cost consideration. • Furthermore, they noted that the scale of consumption reductions based on conservation messaging would likely not be enough to make meaningful differences in system-wide gas purchases.	• A Western utility has issued multiple instances of conservation messaging but indicated that they are currently not seeing significant consumption reduction. They need to collect more data from conservation messaging events to understand its impacts and to result in changes in gas purchasing practices. • Another Western utility also indicated that they were in the exploratory stages of conservation messaging.	• A gas and electric utility in the Northeast issued price-based conservation messaging in late 2022, however, they also indicated that, "[The planning team does] not know what the impact was." • Another New England gas utility also indicated that they do not think that their conservation messaging around high gas prices had an impact on how gas purchases are made. • A Western utility indicated that the impacts of conservation messaging are currently anecdotal at best and are not connected to planning.

Figure 2. Xcel Energy Colorado's Conservation Messaging Journey

Transport interruptible customers were unprepared for curtailment during Uri, but Xcel Energy Colorado has improved communication and engagement with those customers.	**Cost-based conservation messaging was new after Winter Storm Uri, but Xcel Colorado had previously sent reliability-based messaging.**	**Analyzing Xcel Energy Colorado gas system data showed no evidence of differentiation in gas consumption between conservation messaging days and non-conservation messaging days.**
• Customers on transport interruptible rates are required to curtail usage when the utility calls on them to do so, resulting in conservation. • Prior to Winter Storm Uri, it had been several years since a system-wide event that impacted all customers had occurred, leading to a scenario where some customers were unaware of the implications of the rate they were on. • After Winter Storm Uri, the Xcel team has made significant enhancements in how they communicate with these customers	• After the proceedings from Winter Storm Uri, Xcel Energy Colorado set a price trigger for cost-based conservation messaging. • Since Winter Storm Uri, Xcel Energy Colorado has issued two instances of conservation messaging based on wholesale prices. • This report focuses on the December 2022 messaging event as the second event, in January 2024 occurred after the research for this report had been completed.	• Comparing the actual system-wide gas load on conservation messaging days to the load on similar weather days showed no statistically significant differences. • Additionally, using a load forecasting model, the analysis showed that observed gas loads on conservation messaging days were within the non-messaging forecasted estimates, indicating no signs of load variation influenced by messaging on conservation messaging days.

Figure 3. Considerations for Issuing Conservation Messaging

Messaging content around bill savings has the potential to erode customer trust since the utility cannot promise individual actions will result in bill savings.	**Utilities issuing conservation messaging must balance frequency of messaging and diminishing returns in savings and customer fatigue.**	**Additionally, the cost savings framing of conservation messaging might not influence behavior as much as other framings.**
• Though customers might incur small bill reductions by reducing usage, changing commodity costs and cost recovery riders might not actually result in lower monthly energy bills. • Though the energy saving tips remain important to note and standard across utilities, appeals to conserve to "control" an energy bill have the potential to backfire. • If a customer takes action, yet does not see bill savings, they will be less likely to act in future events.	• A Western utility experienced customer complaints when they issued conservation messaging too frequently. • Another utility mentioned that the first call in a season for conservation messaging is typically the most effective in resulting in customer action. The second and third instances of conservation messaging see diminishing responses. • Messaging too frequently results in customer fatigue and lack of action in future events.	• One study noted that utility customers are generally unaware of the costs of electric generation and usage and that they do not immediately perceive other negative externalities such as pollution or impacts on health. • The study suggests that using a health effects messaging approach incurred more persistent energy consumption reductions compared to the electric usage and cost framing.

Figure 4. Effective Practices for Conservation Messaging

A California utility ties statewide conservation messaging to demand response programs, which provides additional reliability in consumption reductions and demand savings.	**Demand response programs present opportunities for utilities to have set customer populations participating in time-based demand and consumption reductions.**	**Another type of intervention for customer gas conservation includes customer energy pledge programs.**
• California issues statewide FlexAlerts which are issued when CAISO indicates there will be a shortfall of supply against demand. • When statewide FlexAlerts are called, a CA utility triggers their demand response programs which asks customers to conserve energy during peak hours.	• Costs and benefits of demand response programs should be carefully weighed. • Xcel Energy Colorado currently has a suite of residential electric demand response programs (Saver's Switch, AC Rewards, and Smart Water Heaters) which can be leveraged. • Gas demand response programs are less prevalent and, given the current state of gas metering infrastructure, more complex to measure impacts.	• Utah's Dominion Energy introduced the ThermWise Energy Pledge Program, which leveraged the utility's home energy report program. • In the second-year evaluation, the results indicated that customers receiving text messages saw an average consumption reduction of 4.14 Dth and an average consumption reduction of 2.98 Dth for those who did not receive text messages. • The study indicated that pledge programs do encourage customers to participate and that text message alerts seem to incur greater action on an annual basis.

Recommendations and Considerations

The following section provides recommendations and considerations for mitigating the impacts of commodity price spikes. Notably, conservation messaging can be used as a tool alongside other solutions to achieve energy conservation during acute events. Additionally, using demand-side management (DSM) programs alongside conservation messaging communications requires the collaboration between program teams and the utility's planning and operations teams to impact gas purchasing decisions. Additional details on these recommendations and considerations are available in the body of the report.

CONSIDERATION:

It is unclear if conservation messaging as a standalone tool will result in consumption reductions. Though conservation messaging cannot be tied to specific energy savings during acute events, it can still be a tool for customer engagement. For gas system planning and operations teams, conservation messaging on its own does not provide enough reliable consumption reductions to change purchasing decisions while maintaining a safe gas network. The scale of consumption reductions and attribution to conservation messaging is also unclear. Additionally, interviews with other utilities indicated that many are not measuring the impacts of these conservation messages at all. Another utility that has issued conservation messaging has yet to see attributable impacts that could be considered robust enough to influence gas purchasing decisions on the system planning level.

ILLUME's analysis of Xcel Energy Colorado's gas usage on the conservation messaging days in December 2022 did not show an observable relationship between issuing conservation messaging and gas load on a system level on extreme cold weather days. Even though conservation messaging might not be the most effective standalone lever for driving consumption reductions during specific windows of time, it can be a tool for further customer engagement. The messaging platform can be used to inform customers about energy efficiency programs and demand response programs.

CONSIDERATION:

Conservation messaging content around bill savings or bill control has the potential to erode customer trust if customers expect, but do not subsequently see, bill reductions. In cases where customers reduce usage, factors such as commodity prices or recovery riders have the potential to negate any bill savings incurred by reducing usage. Though bill savings are possible, they cannot be guaranteed in all scenarios. If customers act and see no results on their bills, they will be less likely to change their behavior in the future. The mismatch between expectations set by bill control messaging and possible outcomes for customers erodes trust in the utility. The utility could consider providing additional education to customers on bill components to increase transparency and understanding.

However, this type of educational effort should occur separately from messaging to encourage customers to act based on acute events. Additionally, some secondary research indicates that cost-savings framings might result in less persistent consumption reductions than health framings.[2] Further research (e.g., A/B testing) on message content could provide insights into framing best practices.

RECOMMENDATION:

ILLUME recommends that conservation messaging be used as a tool to enhance other existing programmatic offerings such as demand response programs. Given that conservation messaging alone does not currently show evidence of inducing behavioral changes in customers' energy consumption and that measuring its true impacts would require more rigorous analysis, using conservation messaging as a gateway for other programs presents opportunities. Conservation messaging can be leveraged to enhance the reach of existing energy efficiency and demand response programs.

RECOMMENDATION:

If conservation messaging is used to engage customers in energy efficiency and demand response programs, Xcel Energy Colorado's DSM program team should meaningfully engage gas system planning and operations teams to ensure subsequent impacts can be incorporated into purchasing decisions. In the current framework, conservation messaging does not provide enough assurance (in scale or accuracy) for gas planning and operations to change purchasing behavior. If conservation messaging is used as a tool to engage customers in energy efficiency and demand response programs, DSM program teams need to fully understand what measurement and verification (M&V) strategies can help planning and operations consider program impacts in their forecasts. Regardless of program implementation or messaging strategy, if gas planning and operations does not feel like they have enough accuracy and precision in savings estimates, they will not change purchasing behavior. This coordination and M&V level-setting will be essential for mitigating future price-spikes.

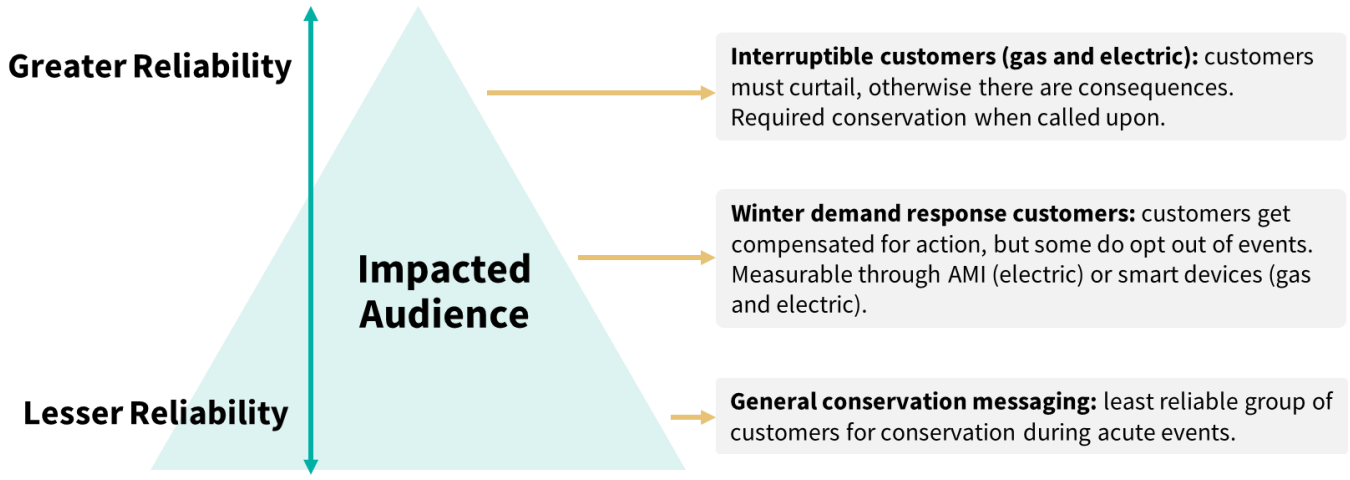
RECOMMENDATION:

ILLUME recommends developing a priority funnel for conservation tools based on reliability of consumption and demand reductions at certain times. DSM program teams and planning and operations teams will need to work closely together to deliver targeted conservation strategies. For future events where gas prices spike, conservation efforts should begin with the customers with the greatest propensity to deliver reliable curtailment (though this might only represent the smallest volume of customers or smallest volume of potential maximum savings).

[2] "The dynamics of behavior change: Evidence from energy conservation." Omar Isaac Asensio and Magali A. Delmas. Journal of Economic Behavior & Organization. 21 March 2016.

Depending on the severity of the scenario and needs for planning and operations teams, Xcel Energy Colorado can then use the next tier of levers for conservation, which expands the pool of impacted customers, but also delivers curtailment less reliably. Figure 5 shows a diagrammatic representation of a potential funnel.

Figure 5. Priority Funnel of Conservation Tools



RESEARCH CONTEXT AND APPROACH

This section provides details on the context for this research and the approach.

Winter Storm Uri and Settlement

Winter Storm Uri occurred from February 13, 2021, to February 17, 2021, across the United States. The storm caused extreme cold weather in many parts of the country including Colorado. Due to the extreme cold, natural gas commodity prices rose sharply over the weekend of the storm. Prices were elevated to $150 to $190 per MMBtu compared to previous prices of $2 to $3 per MMBtu.[3] As a result, Public Service Company of Colorado (PSCo)/Xcel Energy Colorado incurred extremely high costs to obtain and provide natural gas service to customers as well as to secure natural gas for electric generation purposes.

A cost recovery proceeding occurred after the event. The proceeding and settlement resulted in an Extraordinary Gas Cost Recovery Rider added on customer bills to recover costs from Winter Storm Uri. The settlement also sought to reduce the amount of costs passed on to customers by requiring that Xcel Energy Colorado forgo some cost recovery and share revenues with customers on a quicker timeline. Additionally, the settlement required Xcel Energy Colorado to engage in customer outreach around energy conservation during the 2021 – 2022 heating season. The settlement agreement also required Xcel Energy Colorado to research and identify tools for economic-based conservation messaging. This research is a result of the terms of the settlement agreement (Proceeding No. 21A-0192EG).

Research Approach

ILLUME Advising developed the research approach described in this section. The goal of the research was to explore the approach different utilities were taking and understand their experiences in effectively motivating conservation behavior for economic benefit to the utility and customer.

Table 1 below outlines research tasks and activities the ILLUME team undertook.

[3] Decision No. R22-0279. IN THE MATTER OF THE APPLICATION OF PUBLIC SERVICE COMPANY OF COLORADO FOR RECOVERY OF COSTS ASSOCIATED WITH THE FEBRUARY 2021 EXTREME WEATHER EVENT FOR ITS ELECTRIC AND GAS UTILITIES.

Table 1. Summary of Tasks

TASK	DESCRIPTION
Task 1 – Kick-off and staff interviews	• Kick-off meeting with Xcel Energy Colorado and key stakeholders • 8 staff and stakeholder interviews • Development of project plan and data request
Task 2 – Secondary research and peer utility interviews	• Secondary research on conservation messaging • Interviews with 4 peer utilities
Task 3 – Colorado data analysis	• Consolidated feedback from interviews and secondary research • Analyzed Xcel Energy Colorado gas system data
Task 4 – Synthesis and recommendations	• Synthesized findings from data analysis, peer utility interviews, and secondary research to provide recommendations based in best practices and recommended future research

Task 1 – Kick-Off and Staff Interviews

The study team conducted a kick-off meeting on June 6, 2023, and eight interviews with Xcel Energy Colorado personnel. The team also held a listening and feedback session with CEO and PUC team members on July 5 and September 25, 2023. At the recommendation of named stakeholders, we reached out to one additional party, but were unsuccessful at conducting an interview. ILLUME interviewed Xcel Energy Colorado personnel representing the following departments:

- Jurisdictional Communications
- PSCo Regulatory and Pricing Affairs
- PSCo Regulatory and Pricing Analytics
- Commercial Operations
- Customer Account Manager (C&I)
- Regulatory Policy
- Gas Supply Planning
- Customer Energy Solutions

The interviews and discussions covered the following topics:

- What DR/conservation messaging strategies has Xcel Energy Colorado been using and how successful have they been?
- What does conservation messaging mean to various stakeholders? What conservation messages resonate with customers?
- How has Uri shaped approaches to DR/conservation messaging?
- How do stakeholders within and outside Xcel Energy Colorado interpret the settlement agreement and what do they need to do to comply?
- What types of messages can settlement parties collaborate on?

Task 2 – Secondary Research and Peer Utility Interviews

The study team also conducted secondary research and interviews with peer utilities.

For the secondary research, the ILLUME team investigated documentation and evaluation reports of conservation messaging programs or other interventions aimed at reducing end-user energy usage and/or demand at certain times. The team also researched studies that provided information on messaging channels and content. The secondary research aimed to explore the following topics for conservation messaging:

- Messaging channels
- Messaging content
- Customer segments targeted
- Motivations for messaging (e.g., reliability, economic price trigger)
- Level of advance notice provided

ILLUME also interviewed four peer utilities and received additional information via email from two more peer utilities. The team sought contacts from utilities that have issued messages or alerts to their general populations to conserve energy at various times. While some of the messaging that these utilities provided was based on reliability, there were at least a few instances where economic factors were communicated to customers. The study team included the following topics in these peer utility interviews:

- Motivations and triggers for conservation messaging (e.g., reliability, economic factors, etc.)
- Timing of messaging
- Communication and messaging channels
- Messaging content
- Customer segments
- Customer response
- Measurement and verification of event response
- Impacts on operations and planning
- Other strategies for adapting to price spikes or reliability issues

Table 2 shows the utilities that we targeted for interviews.

Table 2. Peer Utility Interview Targets

UTILITY/PROGRAM	STATE	FUEL TYPE
FlexAlert	California	N/A
PG&E	California	Natural Gas and Electric
Con Edison	New York	Natural Gas and Electric
National Grid	New York	Natural Gas and Electric
Berkshire Gas	Massachusetts	Natural Gas
Unitil	Massachusetts	Natural Gas
Liberty Utilities	Massachusetts	Natural Gas
Black Hills Energy	Colorado	Natural Gas
Atmos Energy	Colorado	Natural Gas
City of Fort Collins	Colorado	Electric
Tucson Electric Power	Arizona	Electric
APS	Arizona	Electric

ILLUME received information from six of the targeted utilities above.

Task 3 – Colorado Data Analysis

The ILLUME team also examined customer responses to conservation messaging issued by Xcel Energy Colorado in the winter after Uri. For this task, the team requested system-level gas data from November 2021 to January 2022, and November 2022 to January 2023, on a daily interval.[4] Using this data, ILLUME compared non-conservation messaging day usage to conservation messaging day usage on a system level. The team also developed a model to predict daily gas usage and compare expected usage values to actual usage values on conservation messaging days. These methods were used to determine if there is evidence that conservation messaging has an impact on system-level load.

Task 4 – Analysis and Reporting

The final task includes synthesizing the findings from the previous tasks to develop this report and the final presentation for stakeholders.

[4] We note that this data was requested in late summer 2023 and the analysis occurred in fall 2023 prior to the 2023-2024 winter heating season.

RESEARCH FINDINGS

Key findings, organized by research task, are presented in this section.

Xcel Energy Colorado Staff Interview Findings

The following section provides key takeaways and considerations from Xcel Energy Colorado staff. These interviews provided context for subsequent research tasks.

Utility planning and operations teams are not comfortable making critical purchasing decisions based on anticipated reductions in usage prompted by conservation messaging. When we spoke with utility planning and operations teams, we heard that their purchasing decisions would not be impacted based on conservation messaging unless there was substantially more reliable historical evidence around the expected impact of such messaging. Utility planning and operations staff articulated a hierarchy that guided their operations, focusing first on safety, then on reliability, and finally cost consideration. The primacy of system safety and reliability meant that they were not willing to make changes to their purchasing plans based on a messaging appeal without evidence about expected savings. Furthermore, they noted that the scale of consumption reductions based on conservation messaging would likely not be enough to make meaningful differences in system-wide gas purchases. They articulated that for customers, the bigger impact would be shutting down of gas service rather than getting a charge on a bill several months later. Additionally, they noted that if individual customers reduce consumption, but the overall system-wide consumption reductions are not enough to result in purchasing changes, customers that acted might still see bill increases due to higher commodity prices and potential cost recovery riders. Customers who conserved energy in those scenarios would not only see bills savings erased due to commodity prices but would also experience additional charges for cost recovery. Customers acting but not seeing the desired bill savings will be less inclined to act during future events. While these conversations mainly focused on gas service and purchasing decisions, they did also touch on purchasing decisions related to electric generation.

Based on this perspective, we note that leveraging more reliable resources (such as interruptible rate customers, demand response programs, or other load-shifting programs) are likely to be more impactful in cost-based as well as reliability-based events than broad conservation messaging.

Cost-based conservation messaging was new after Winter Storm Uri, but Xcel Energy Colorado had previously sent reliability-based messaging. After the proceedings after Winter Storm Uri, Xcel Energy Colorado set a price trigger for cost-based conservation messaging. This trigger is based on the daily price for gas relative to the average daily price for gas in the respective quarter. When prices rise above the set trigger, the Xcel Energy Colorado team sends out a cost-based conservation message. Since Winter Storm Uri, Xcel Energy Colorado has issued two instances of conservation messaging based on wholesale prices, one in December 2022 and one in January 2024. This report contains an analysis of the December 2022 event. The January 2024 event occurred after the research reported here was complete.

For the December 2022 event, the Xcel Energy Colorado communications team developed news releases and customer emails. Table 3 shows the open and click rates for emails sent on December 21, 2022. The emails saw higher than average open rates, but lower than average click rates (based on MailChimp marketing email

data).[5] Xcel Energy Colorado also created Facebook and Twitter posts with conservation messaging content. Social media posts on price-based conservation messaging issued on December 21, 2022, reached over 36,000 people, and featured 84 engagements (e.g., likes, shares, reposts, and comments), representing an engagement rate of 0.23%. This engagement rate appears to be higher than average for Facebook and Twitter posts, according to Statista[6].

Table 3. Conservation Messaging Email Open and Click Rates

EMAIL TARGET	OPENS	OPEN RATE	CLICKS	CLICK RATE
Xcel Energy Colorado Gas Combo Customers	460,329	49.3%	6,997	1.5%
Xcel Energy Colorado Electric Only Customers	102,245	43.7%	1,302	1.3%

Conservation messaging content and channels deployed since Uri are tactically like reliability-based messaging in terms of how they are deployed. After the proceedings after Winter Storm Uri, Xcel Energy Colorado set a price trigger, based on the daily price for gas relative to the average daily price for gas in the respective quarter. When prices rise above the set trigger, the Xcel Energy Colorado team sends out a cost-based conservation message. The process for sending price-based messages is the same as for reliability-based messages. Messages are sent across social media channels, by leveraging key account managers to share information with their clients, through website updates, as well as through emails to customers. Winter messaging includes tips to save energy during those time periods, lowering thermostats, increasing sunlight in the home (e.g., by opening blinds), keeping doors fully closed, keeping ovens closed when cooking, and lowering water heater temperature. There is little difference between content in reliability messaging and conservation messaging, however, the energy-saving tips change depending on the season and the resource that is targeted for conservation.

Transport interruptible customers were unprepared for curtailment during Uri, but Xcel Energy Colorado has improved communication and engagement with those customers. Customers on transport interruptible rates are required to curtail usage when the utility calls on them to do so, resulting in conservation. Prior to Winter Storm Uri, it had been several years since a system-wide event that impacted all customers had occurred, leading to a scenario where some customers were unaware of the implications of the rate they were on. For example, there was a hospital that did not have sufficient backup generation capacity to remain running without receiving service from Xcel Energy Colorado during the planned interruption. For reasons of public safety and health, this customer was not interrupted during the storm. After the Winter Storm Uri, the Xcel Energy Colorado team has made significant enhancements in how they communicate with their customers on an interruptible service rate.

These include enhancements to the customer messaging system in Everbridge, 24-hour notifications before an interruptible event, manual notifications for businesses with multiple locations and different facilities

[5] https://mailchimp.com/resources/email-marketing-benchmarks/
[6] https://www.statista.com/statistics/1274133/engagement-rate-per-post-social-media/

managers, an annual interruptible customer conference call that describes the rate and requirements of the rate, as well as demo testing for every interruptible customer. For those customers who cannot comply, they must switch to a firm rate. Since implementing these measures, the team has seen a significantly more positive response, and customers have a better sense of what is required of them to be on the rate.

Peer Utility Interview and Secondary Research Findings

The following section provides findings from peer utility interviews and secondary research on conservation messaging strategies and outcomes.

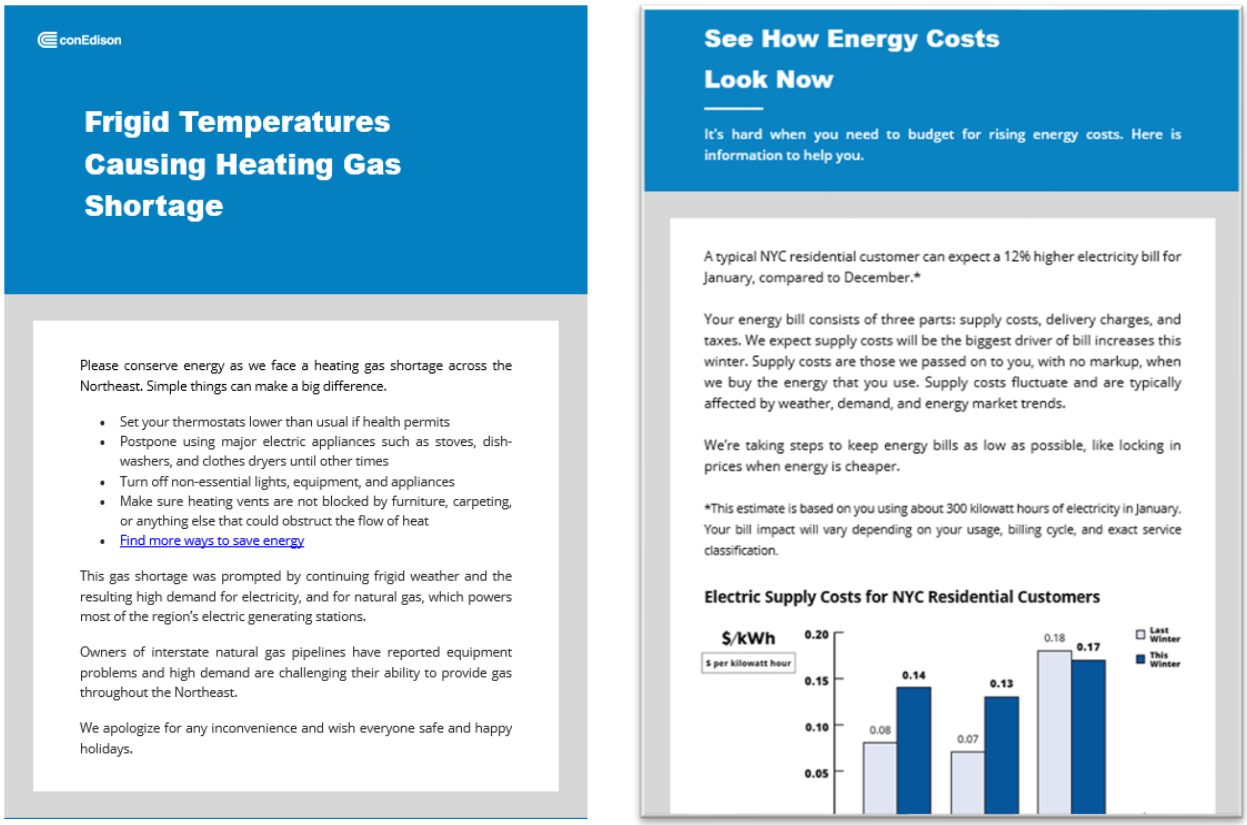
Peer Utility Interview Takeaways

Peer utilities are at the beginning stages of developing, implementing, and measuring conservation messaging. Another Western gas utility we spoke to engages in conservation messaging. They have issued multiple instances of conservation messaging but indicated that they are currently not seeing significant consumption reduction because of the messages. Their strategy for measurement includes retroactively examining the differences between forecasted and actual gas consumption on conservation messaging days. This utility also indicated that they would need to collect more data from conservation messaging events to understand its impacts and to result in changes in gas purchasing practices. Yet another Western electric utility also indicated that they were in the exploratory stages of conservation messaging, and their conservation messaging is related to grid constraints and managing peak load rather than supply costs.

Gas and dual-fuel utilities that have deployed conservation messaging are not measuring impacts or have seen no measurable impacts. A utility in the Northeast issued price-based conservation messaging in late 2022, however, they also indicated that, "[The planning team does] not know what the impact was. That message was sent around the Christmas cold spell, it was a unique day, a holiday, and any change (if any) was within forecast error. It wasn't possible to quantify with confidence." Another Northeast gas utility also indicated that they do not think that their conservation messaging around high gas prices had an impact on how gas purchases are made. They said, "I don't think any of the marketing we did during the high gas prices last year would have impacted anything on the gas planning team. While our Forecast and Supply plans to have energy efficiency (EE) incorporated, I'm not aware of more agile efforts to adjust daily load forecasts/or short-term purchasing decisions on the procurement side…" A Western gas utility also indicated that the impacts of conservation messaging are currently anecdotal at best and that these broad messages are not connected to real-time system planning. As noted above, another utility is also issuing conservation messaging, and they indicated that they are not observing reductions in gas consumption.

Other utilities engaging in conservation messaging offer similar tips to shift or reduce consumption that Xcel Energy Colorado offers. Figure 6 shows examples of conservation messaging from Con Edison. The first one is related to gas supply, but offers suggestions on lowering thermostats and reducing electric usage as well. This approach is similar to what Xcel Energy Colorado offers, shown in Figure 8. Con Edison also issued emails regarding the relationship of high supply costs and impacts to customer bills. Atmos Energy, a Colorado gas utility, offers conservation messaging, and a representative tweet is shown in Figure 7. Energy saving tips, though different based on season, remain relatively standard across utilties.

Figure 6. Example Emails from Con Edison on Conservation Messaging



conEdison

Frigid Temperatures Causing Heating Gas Shortage

Please conserve energy as we face a heating gas shortage across the Northeast. Simple things can make a big difference.

- Set your thermostats lower than usual if health permits
- Postpone using major electric appliances such as stoves, dish-washers, and clothes dryers until other times
- Turn off non-essential lights, equipment, and appliances
- Make sure heating vents are not blocked by furniture, carpeting, or anything else that could obstruct the flow of heat
- Find more ways to save energy

This gas shortage was prompted by continuing frigid weather and the resulting high demand for electricity, and for natural gas, which powers most of the region's electric generating stations.

Owners of interstate natural gas pipelines have reported equipment problems and high demand are challenging their ability to provide gas throughout the Northeast.

We apologize for any inconvenience and wish everyone safe and happy holidays.

See How Energy Costs Look Now

It's hard when you need to budget for rising energy costs. Here is information to help you.

A typical NYC residential customer can expect a 12% higher electricity bill for January, compared to December.*

Your energy bill consists of three parts: supply costs, delivery charges, and taxes. We expect supply costs will be the biggest driver of bill increases this winter. Supply costs are those we passed on to you, with no markup, when we buy the energy that you use. Supply costs fluctuate and are typically affected by weather, demand, and energy market trends.

We're taking steps to keep energy bills as low as possible, like locking in prices when energy is cheaper.

*This estimate is based on you using about 300 kilowatt hours of electricity in January. Your bill impact will vary depending on your usage, billing cycle, and exact service classification.

Electric Supply Costs for NYC Residential Customers

Figure 7. Example Tweet from Atmos Energy on Conservation Messaging

atmosenergy @atmosenergy · Dec 30, 2021

⚠️ Colorado is projected to experience colder than normal winter weather over the next few days. Winter safety & energy saving tips: bit.ly/3oPMVL1 @KOAA @KKTV11News @KRDONC13 @KDVR @fox31denver @9NEWS @DenverChannel @CBSDenver @DurangoHerald @GreeleyTribune @denverpost

COLORADO ENERGY CONSERVATION NOTICE

The state is projected to experience colder than normal winter weather.

Making a few household changes can reduce energy usage and help your family control energy costs while staying safe and warm as temperatures start to drop.

Learn more:
atmosenergy.com/energytips

ATMOS energy

1 2

Figure 8. Example Email from Xcel Energy Colorado on Conservation Messaging

Messaging content around bill savings has the potential to erode customer trust since the utility cannot promise individual actions will result in bill savings. Across these three examples above, all include a call to action which mentions a cost impact on the customer. It should be noted that though customers might incur small bill reductions by reducing usage, changing commodity costs and cost recovery riders might not actually result in lower monthly energy bills. Though the energy saving tips remain important to note and fairly standard across utilties, appeals to conserve in order to "control" an energy bill have the potential to backfire. As noted earlier, if a customer takes action yet does not see bill savings, they will be less likely to act in future events. Though bill savings are possible, they cannot be guaranteed in all scenarios. The mismatch between expectations set by bill control messaging and possible outcomes for customers can erode trust in the utility.

Another Western utility indicated that they based their conservation messaging trigger on weather rather than gas costs. They initially set their conservation messaging trigger to 75% of the design day temperature. This resulted in issuing conservation messages on days when the weather was not as severe and the need for conservation was not vital. Customers complained about receiving too many messages and the utility changed the trigger point to 90% of the design day temperature. Regardless of trigger, the suggestions for customer actions to reduce consumption are very similar.

Utilities issuing conservation messaging must balance frequency of messaging and diminishing returns in savings and customer fatigue. As mentioned above, another gas utility experienced customer complaints when they issued conservation messaging too frequently. A Western electric utility mentioned that the first call in a season for conservation messaging is typically the most effective in resulting in customer action. The second and third instances of conservation messaging see diminishing responses. For this utility, they carefully consider when they issue conservation messaging so that they deploy it when they absolutely need it to avoid peak load. Messaging too frequently results in customer fatigue and lack of action in future events.

A California gas and electric utility ties statewide conservation messaging to demand response programs, which provides additional reliability in consumption reductions and demand savings. California issues statewide FlexAlerts which are issued when CAISO indicates there will be a shortfall of supply against demand. When statewide FlexAlerts are called, a California utility triggers their demand response programs, which ask customers to conserve energy during peak hours. The program provides a bill credit for performance periods. They also have a behavior demand response program, which can be triggered by statewide FlexAlerts. The behavioral demand response program relies on nudges and comparing customers to neighbors to result in action. After the events, they evaluate how each program performed. Notably, these DR programs are electric, and the utility does not have a gas demand response program currently, though they do encourage gas efficiency measures. It should be noted that California has a long history of demand response programs and that by tying general conservation messaging to DR programs, the utilities are able to measure impacts more easily through those programs.

Secondary Research Findings

Secondary research centered around different programmatic approaches to conservation messaging as well as research on content, channel, timing, and measurable effects.

Demand response programs present opportunities for utilities to have set customer populations participating in time-based demand and consumption reductions, but costs and benefits should be carefully weighed. As mentioned above, some utilities use statewide conservation calls as a trigger for demand response programs (though it should be noted that the example is related to electric demand response programs). Xcel Energy Colorado currently has a suite of residential electric demand response programs (Saver's Switch, AC Rewards, and Smart Water Heaters). Reducing electric demand and consumption during winter events has the potential to reduce gas consumption needed for generation.

Gas demand response programs are less prevalent and, given the current state of gas metering infrastructure, more complex to measure impacts. The Brattle Group provided an overview of various utility residential gas demand response "bring your own thermostat" programs. Table 4 shows highlights of a few gas demand response programs from the Brattle Group study.

Table 4. Residential Gas Demand Response Programs[7]

UTILITY	CUSTOMER PARTICIPATION	LOAD REDUCTION
Con Edison	Enrolled 6,983 devices	Average net reduction of 202 Dth per test event, 0.025 Dth/device.
National Grid	Enrolled 8,620 devices	Average net reduction of 0.017 Dth/device.
SoCalGas	Enrolled 50,034 devices	Average net reduction of 0.006 Dth/device (AM events) and 0.004 Dth/device (PM events)
Consumers	Enrolled 5,647 customers	0.005 Dth/participant

It should be noted that the Con Edison Gas Demand Response Program has concluded. In a July 2022 report, Con Edison indicated that "the results of this pilot demonstrate the headwinds inherent in bringing customer-driven peak reduction to the gas system," and that "the benefits derived from load reduction per enrolled device is small compared to the costs incurred per enrolled device."[8] The Brattle Group study notes that though gas DR programs were successful in enrolling customers, some proved to be not cost-effective or others did not exhibit significant reductions in usage and demand.

Xcel Energy Colorado also piloted a gas demand management study called Heat Savers, which used participant thermostats to reduce gas usage during certain periods. The study's last test event is expected in quarter one of 2024, and data from these test events will be analyzed. Results are pending.

Another type of intervention for customer gas conservation includes customer energy pledge programs. Utah's Dominion Energy introduced the ThermWise Energy Pledge Program, which leveraged the utility's home energy report program. Based on participants in the home energy report program, the utility offered a two-year pilot where customers could pledge to reduce energy consumption. The utility would then track these customers' pledges. The pilot program initially recruited over 2000 customers who opted into receiving monthly emails and text messages including cold weather alerts. The alerts were designed to incur energy usage reductions during peak load times which typically coincided with cold weather events. The first-year evaluation of the pledge program documented average savings of 0.92 Dth comparing annual consumption before and after pledge participation. In the second-year evaluation, the results indicated that customers receiving text messages saw an average consumption reduction of 4.14 Dth and an average consumption reduction of 2.98 Dth for those who did not receive text messages.[9] The study indicated that pledge programs do encourage customers to participate and that text message alerts seem to incur greater action on an annual basis. It should also be noted that other utilities are exploring similar behavioral demand response programs, like the ThermWise offering in Utah.

[7] "Overview of Gas Demand Response Programs." Memo to Xcel Energy Energy Colorado by the Brattle Group. October 31, 2022.
[8] Con Edison "Gas Demand Response Report on Pilot Performance – 2021/2022" July 15, 2022.
[9] "Applying Customer Commitments to Natural Gas Utility Energy Conservation." Ted C. Peterson. November 3, 2022.

Some research on conservation messaging or emergency conservation appeals suggests that customers are receptive to action. A study of residents in Norman, Oklahoma looked at customer responses to emergency appeals for conservation in February 2021 (likely during Winter Storm Uri). The utility issued these conservation messages, primarily via social media. The study surveyed customers and indicated that 72% of respondents set their thermostat lower during the event and 86% reported not using energy-intensive appliances. The results of the survey indicate that customers are willing to respond to conservation messaging. One drawback of the survey approach is that these behaviors are based on customer self-reports, which could introduce a bias towards positive responses.[10]

Research also suggests that public campaigns to help customers understand the need to conserve energy and the relationship between gas prices and electric rates can be helpful for incurring energy conservation. California utility SoCalGas developed a conservation campaign after a gas leak at Aliso Canyon in 2015 jeopardized gas supply. The "Conserve Energy SoCal" campaign not only encouraged energy consumption reduction but also worked together with the statewide FlexAlerts. An evaluation of this campaign showed that between the conservation campaign and FlexAlerts, customers reduced electric demand by 0.024 kWh/hr during FlexAlert Events and that 22% of customer respondents indicated they took energy-saving actions after engaging with the campaign.[11] It should be noted that FlexAlerts are primarily intended as grid reliability notifications to encourage customers to reduce electric demand during certain periods.

A more recent evaluation of California FlexAlerts indicates that these statewide reliability alerts can impact consumption and demand during peak times. These FlexAlerts are issued most typically on hot summer days when demand could overtake supply for electricity and are issued by the CA Independent System Operator (CAISO). As noted above, these FlexAlerts also trigger utility demand response programs. One analysis showed a drop of 11% in residential load during these periods.[12] However, this analysis seems to be inclusive of customers who might be enrolled in utility demand response program. Additionally, it should be noted that California has a long history of issuing FlexAlerts for reliability issues, which presents a different scenario for Xcel Energy Colorado's conservation messaging around gas usage, both in terms of messaging trigger and customers' previous exposure to such messaging.

Additionally, the cost savings framing of conservation messaging might not influence behavior as much as other framings. One study investigated how conservation messaging is framed and how utility customers respond over time. The study noted that utility customers are generally unaware of the costs of electric generation and usage and that they do not immediately perceive other negative externalities such as pollution or impacts on health. The study used electric meter data to suggest that using a health effects messaging approach incurred more persistent energy consumption reductions compared to the electric

[10] "Public Responses to Emergency Energy Conservation Messaging: Evidence from the 2021 Winter Storm in Norman, Oklahoma" Amy S. Goodin, Cynthia L. Roger, and Angela Zhang. Weather, Climate, and Society. 26 May 2023.
[11] "Aliso Canyon Marketing, Education and Outreach Effectiveness Study" CPUC. June 2017.
[12] "CAISO Flex Alerts: How responsive are residential customers to voluntary demand response events?" McKenna Peplinski. Presentation at Behavior Energy and Climate Change Conference. October 2023.

usage and cost framing. The paper concluded, "conservation was short-lived with cost savings framing, but was more persistent with environmental and health framing."[13]

Another study cautions that conservation messaging might also induce the opposite behavior where customers consume more energy either before or after the conservation window after hearing emergency conservation appeals. This study looked at the impact of media coverage of a reliability-based conservation messaging effort in the Washington, DC/Baltimore metropolitan area by examining impacts on electric energy generation. The study team found that, on days when media messages on conservation went out, generation increased right before the event window and showed no reduction during the peak times. It should be noted that the study made assumptions on customer interaction with media pieces and based results around electric generation which might differ from consumer consumption. Study authors posited that "consumers may respond to emergency calls by attempting to 'store' cooling in advance of possible brownout conditions."[14]

Colorado Data Analysis Findings

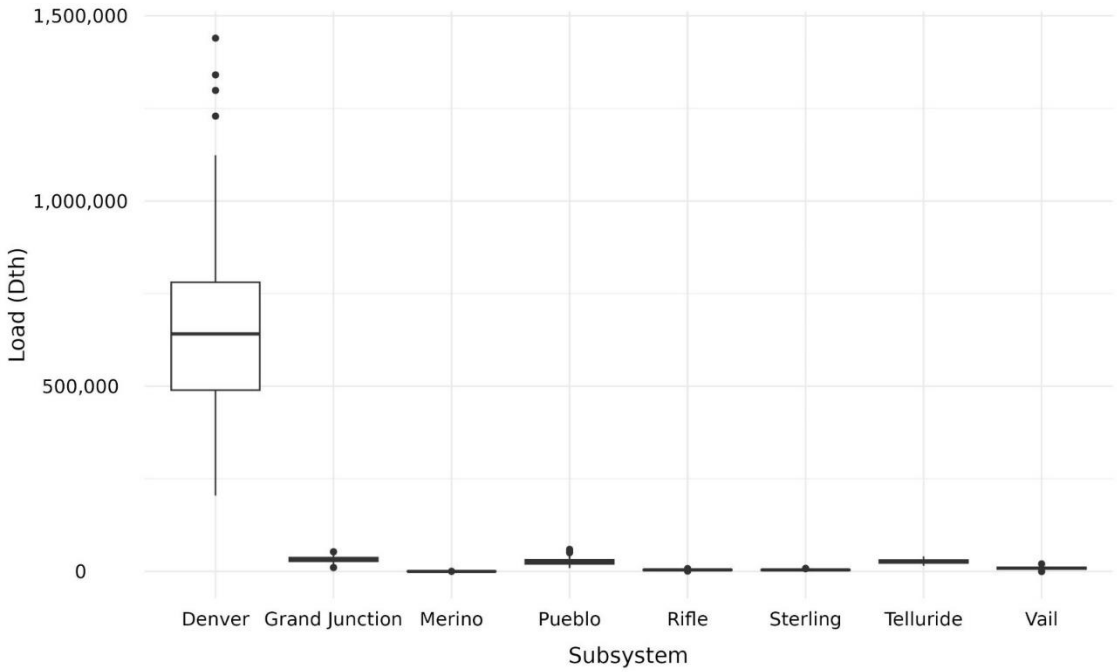
The sections below summarize findings from comparing conservating messaging day gas load to non-conservation messaging day gas load on a system level.

The Data

Figure 9 shows the distribution of the daily gas load for the period (November through January for 2021 to 2022 and 2022 to 2023) reported by subsystem data. Denver presents 86% of the total gas load for the period provided, which means that overall results are highly influenced by Denver subsystem results.

[13] "The dynamics of behavior change: Evidence from energy conservation." Omar Isaac Asensio and Magali A. Delmas. Journal of Economic Behavior & Organization. 21 March 2016.
[14] "The perverse impact of calling for energy conservation." J. Scott Holladay, Michael K. Price, and Marianna Wanamaker. Journal of Economic Behavior & Organization. February 2015.

Figure 9. Daily Load (Dth) by subsystem Boxplot



In addition to daily gas load data, the evaluation team used local weather data for this analysis. We retrieved weather data from the National Centers for Environmental Information for this evaluation. To get weather data by subsystem we undertook the following tasks:

1. Retrieved zip codes for the cities associated to each subsystem.
2. Found the weather stations closer to those zip codes.
3. Identified the weather stations that were most representative of each city.
4. Pulled hourly weather data from the identified stations.

Methodology

The team examined the effects of conservation messages through various models, considering diverse assumptions and scenarios. We note that the analysis did not differentiate between the type of conservation messaging deployed (e.g. emails vs. social media posts) nor did we consider the time of the day at which messages were sent. Our approach focused on the system-level data by day, which did not allow us to consider more granularity in the type or timing of conservation messaging. In effect, we treated day-of messaging as a binary variable for this analysis. In alignment with industry standards for assessing demand response events, an initial analysis concentrated on identifying days that exhibit the most similar meteorological characteristics. These days would act as a reference point, or counterfactual, for the days on which conservation messages were disseminated.

The days identified as having the most similar characteristics were not as closely matched as desired, primarily due to the challenge of finding a day comparable to one characterized by extreme cold weather conditions. Given these limitations, we conducted a second analysis that entailed predicting the load data for days with severe weather and subsequently contrasting the predicted values with the actual values.

Analysis Using Counterfactual Days

For each day where conservation messaging was deployed (December 21st, December 22nd, and December 23rd, 2022), ILLUME selected the three days that are not a holiday or a weekend with the most similar temperature profile under different scenarios:

- Using days that are within two weeks before and after extreme cold weather days where conservation messaging was used. Closer days to the messaging days are considered more suitable days for comparison.
- Restricting counterfactual days to days that are within two weeks before the event, considering the messaging could have an impact that lasts for the weeks after.
- Limiting counterfactual days to the two weeks before Dec 12, 2022; since there was some messaging around energy conservation on that day.
- Using all gas load data from November 2022 to January 2023.
- Including all gas load data from November 2021 to January 2022.

The team estimated the impact of messaging for each messaging day and each possible scenario using the following model specification. ILLUME specified models for robustness checks and exploratory analyses based on the evaluation regression specification below.

$$load_{ij} = \beta_0 + \beta_1\, messaging.day_i + \beta_2\, total.hdh.55_{ij} + \sum_{j=1}^{7} \beta_{3j}\, subsystem_j + \sum_{j=1}^{7} \beta_{4j}\, subsystem_j\, total.hdh.55_{ij} + \epsilon_{ij}$$

$load_{ij}$	Day load for day *i* for subsystem *j*
$messaging.day_{ij}$	Dummy variable that indicates if a day *i* was a messaging day (1) or a counterfactual day (0)
$total.hdh.55_{ij}$	Total heating degree hours (HDH) at base 55°F. Including HDH allows us to control for differences in weather and improve the model specification, which reduces the impact of not finding optimal counterfactual days to extreme weather days
$subsystem_j$	Dummy variables for each subsystem *j*
$subsystem_j\, total.hdd.55_{ij}$	Interaction term between *subsystem* and *total.hdd.55* to capture city specific relationships between *total.hdd.55* and *load*

In the specified model, $\boldsymbol{\beta_1}$ represents the impact of messaging on load, with positive coefficients indicating increased consumption and negative coefficients indicating savings. The associated p-values indicate the statistical significance of the $\boldsymbol{\beta}_1$ estimate.

Using this analysis, the team did not observe statistically significant differences in system-wide gas consumption between days without conservation messaging and days with conservation messaging, with all p-values being larger than 0.05. Our statistical tests start with a default assumption called the "null hypothesis", which suggests that there is no messaging effect or no difference. After looking at the data and conducting the analysis, we failed to reject the null hypothesis, which means that we did not find enough evidence to conclude that the original assumption (null hypothesis) is wrong. Not having enough evidence to dismiss the null hypothesis does not prove it is true, but rather that we cannot confidently claim it is false based on the data we have. Appendix A. Counterfactual Days Analysis Table Results includes a table with the specific p-values and coefficients for each scenario. Given the potential limitations of finding similar days, the team conducted an additional analysis using a forecasting approach.

Analysis Using Forecasting Values (*Ex-Ante*)

The evaluation team addressed the research question in a second analysis using a forecasting approach by subsystem. The team trained two models using data from November 01, 2022, to December 14, 2023. The team analyzed the validity of the models based on their performance on data from December 15, 2023, to December 20, 2023, and applied those models to the extreme cold weather days where conservation messaging was issued. These models would show evidence of reduced consumption if the forecasted values were significantly higher than the observed values.

ILLUME evaluated two models per subsystem:

1) A bivariate regression linear model (LM): This model used total HDH as the explanatory variable. Iterations of this model included non-linear terms but were discarded due to a lack of evidence of nonlinear relationships between load and weather.
2) A time series model (ARIMAX): This model extends the previous model and includes information about past load (autoregressive terms) and past forecasted errors (moving average components) to predict outcomes. Several models were analyzed for each subsystem, and those that yielded the best performance with training data (November 01, 2022, to December 14, 2023) were validated and used for forecasting. We show an example specification below for the model selected to predict Denver load: ARIMAX [2, 0, 1].

$$Load_t = c + \phi_1 Load_{t-1} + \phi_2 Load_{t-2} + \theta_1 \epsilon_{t-1} + \beta\, total.hdh.55_t + \epsilon_t$$

Results

Figure 10 shows how both models fit Denver's data that was used to fit the models. Both models demonstrate close performance on trained data, which is a positive indicator of their generalization capabilities. However, the model diagnostics suggest that the ARIMAX model provides a better fit.

The fit on trained data, also known as in-sample fit, can typically be expected to be accurate because the models have been adjusted specifically to capture the patterns within this data. It is not uncommon for models to perform well on the data they were trained on. However, the actual test of a model's utility is its performance on data it has not been exposed to, which is called out-of-sample performance.

Figure 10. In-Sample Fit

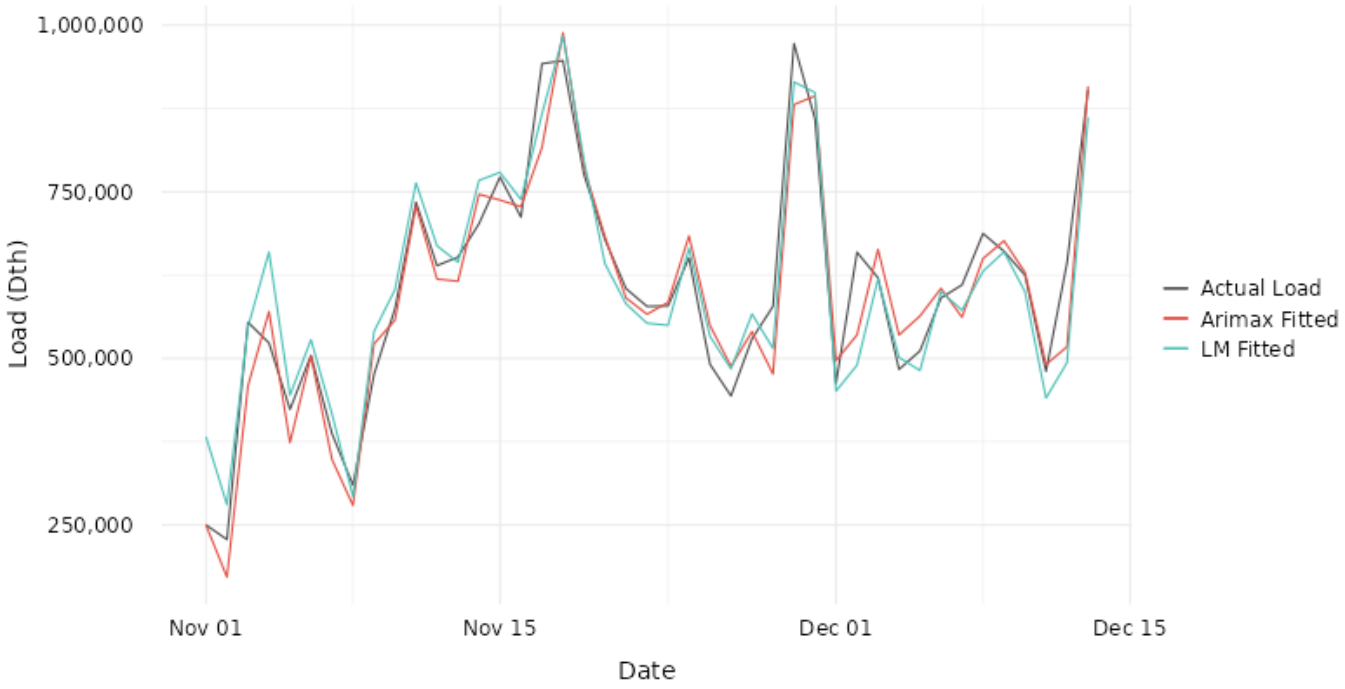


Figure 11 illustrates the predictive accuracy of Denver's Linear Model. It includes 95% confidence intervals for the projected figures. We can see mixed results of the model performance. While it predicts values that are not far from the true value, this model is less reliable than the ARIMAX model. The linear would show accurate performance if the observed values were within the 95% confidence interval in the days of December 15th to December 20th; however, as shown in the image below, the actual load is outside the confidence intervals of the forecast.

Figure 11. Out-of-Sample Predictions – Linear Model

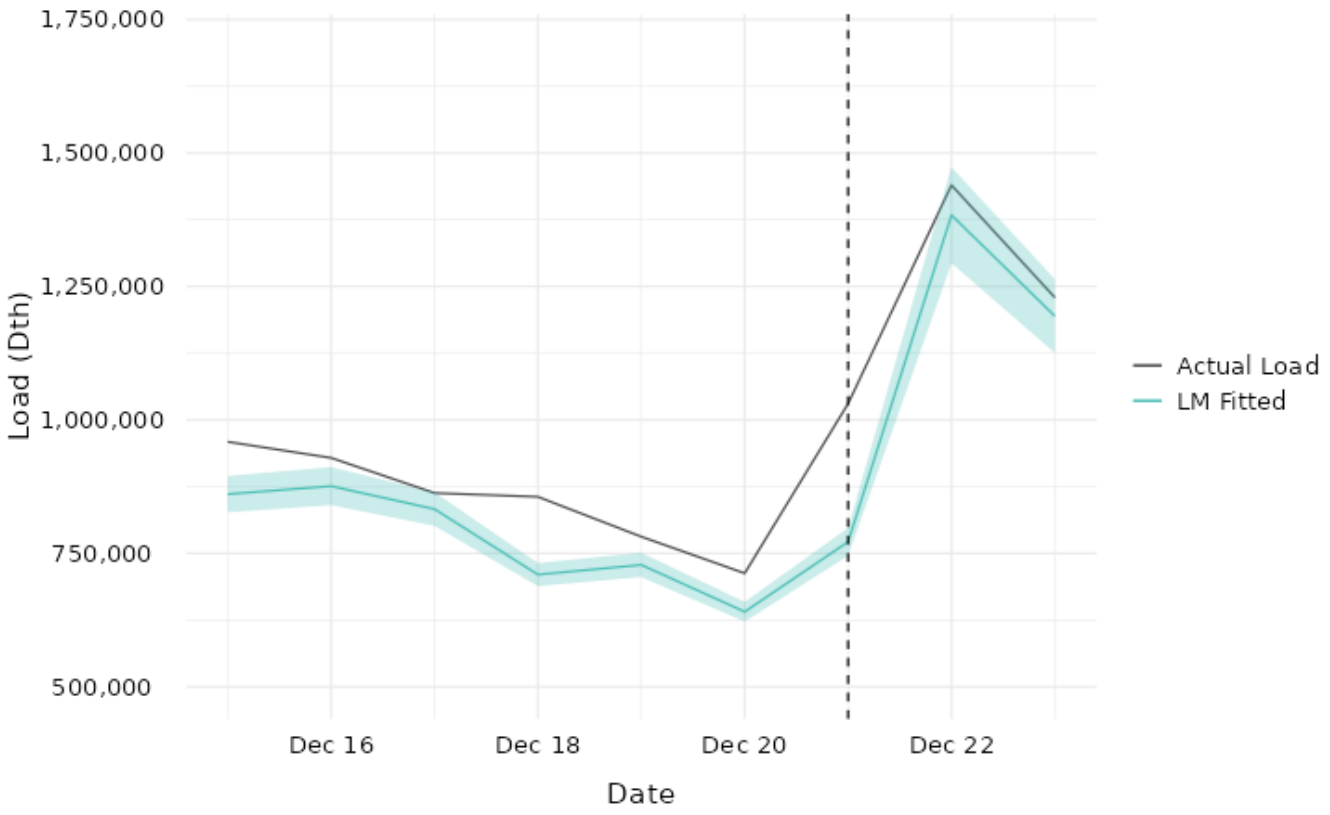
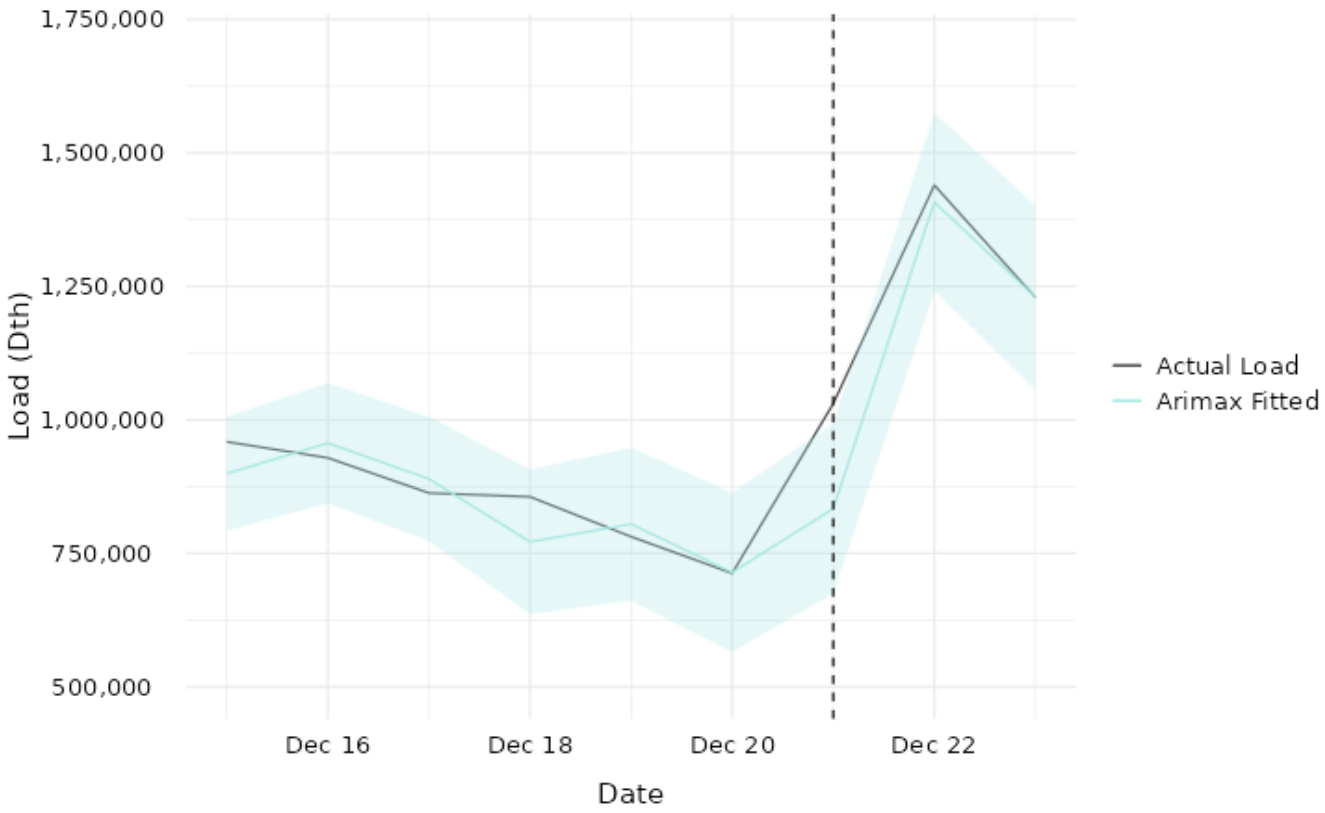


Figure 12 illustrates the predictive accuracy of Denver's ARIMAX Model. It includes 95% confidence intervals for the projected figures. The graph demonstrates that 1) until December 21st, the model's predictions closely match the actual load, which serves as our model validation, and 2) during the days of extreme cold when conservation messaging occurred, the actual load remains within the 95% confidence interval range of the forecasted values, suggesting no clear indication of load variation influenced by messaging on those days.

This model would have indicated load reductions if the observed values during extreme cold weather days (i.e. conservation messaging days) were lower than the forecasted estimates, outside of the confidence intervals. In this scenario, the load of the messaging days would have been lower than the expected load based on the validated forecasting model. However, the image below shows that the observed load on the conservation messaging days was within the range of the forecasted values. This analysis does not show any observable differences in system-wide gas load on conservation messaging days compared with days without conservation messaging.

Figure 12. Out-of-Sample Predictions – ARIMAX [2,0,1]



The same analysis was carried out across all subsystems, yielding comparable outcomes. Appendix B. ARIMAX Out-of-Sample Predictions by Subsystem includes similar graphs to the figures above for all subsystems. Overall, the ARIMAX model:

1) Outperforms the Linear Model
2) Forecasts the load effectively for new data
3) Does not show an observable relationship between conservation messaging and system-wide gas load.

RECOMMENDATIONS AND CONSIDERATIONS

This section outlines recommendations and considerations based on the findings presented in this report.

CONSIDERATION:

It is unclear if conservation messaging as a standalone tool will result in consumption reductions. Though conservation messaging cannot be tied to specific energy savings during acute events, it can still be a tool for customer engagement. For gas system planning and operations teams, conservation messaging on its own does not provide enough reliable consumption reductions to change purchasing decisions while maintaining a safe gas network. The scale of consumption reductions and attribution to conservation messaging is also unclear. Additionally, interviews with other utilities indicated that many are not measuring the impacts of these conservation messages at all. Another utility that has issued conservation messaging has yet to see attributable impacts that could be considered robust enough to influence gas purchasing decisions on the system planning level. ILLUME's analysis of Xcel Energy Colorado's gas usage on the conservation messaging days in December 2022 did not show an observable relationship between issuing conservation messaging and gas consumption on a system level on extreme cold weather days. However, even though conservation messaging might not be the most effective standalone lever for driving consumption reductions during specific windows of time, it can be a tool for further customer engagement. The messaging platform can be used to inform customers about energy efficiency programs and demand response programs.

CONSIDERATION:

If the utility is interested in understanding the impacts of conservation messaging as a standalone lever for behavioral change in customers, additional analysis tactics could be deployed; however, we do not recommend resources be deployed for additional analysis. If the utility wants to pursue conservation messaging as a standalone tool, ILLUME suggests a multi-pronged approach to measuring the impacts. First, the utility could examine the impact of conservation messaging on energy consumption during extreme cold weather days by employing a randomized controlled trial (RCT) design with households that possess Advanced Metering Infrastructure (AMI) electric data. This approach would enable a more robust and comprehensive analysis of the effects of conservation messaging. It should be noted that this would apply to electric customers, and that measuring direct gas consumption impacts via an RCT would require deployment of gas metering devices or potentially smart thermostats. However, electric conservation strategies can reduce the amount of gas needed (and thereby purchased) for electric generation. Additionally, electric heating savings factors from this type of study could be applied as an estimate of direct gas heat reductions.

Secondly, the utility should consider using a post-conservation messaging survey to assess customer reactions. For example, a short survey could be sent to customers asking if they received conservation messaging, what channel they received it from, and their actions after hearing the message. These self-reports might help connect changes in consumption with customers who received conservation messaging.

Finally, the utility could continue to monitor the effects of conservation messaging on system level gas load using a similar methodology to the methodology ILLUME used in this study. Having more than one instance of conservation messaging will provide additional data points. It should be noted that ILLUME's initial analyses did not show evidence that conservation messaging has an impact on system-wide gas load. Additionally, another utility has issued several instances of conservation messaging and has yet to see any significant changes in consumption on those days.

CONSIDERATION:

Conservation messaging content around bill savings or bill control has the potential to erode customer trust if customers expect, but do not subsequently see, bill reductions. In cases where customers reduce usage, factors such as commodity prices or recovery riders have the potential to negate any bill savings incurred by reducing usage. Though bill savings are possible, they cannot be guaranteed in all scenarios. If customers act and see no results on their bills, they will be less likely to change their behavior in the future. The mismatch between expectations set by bill control messaging and possible outcomes for customers erodes trust in the utility. The utility could consider providing additional education to customers on bill components to increase transparency and understanding. However, this type of educational effort should occur separately from messaging to encourage customers to act based on acute events. Additionally, some secondary research indicates that cost-savings framings might result in less persistent consumption reductions than health framings.[15] Further research (e.g., A/B testing) on message content could provide insights into framing best practices.

RECOMMENDATION:

ILLUME recommends that conservation messaging be used as a tool to enhance other existing programmatic offerings such as demand response programs. Given that conservation messaging alone does not currently show evidence of inducing behavioral changes in customers' energy consumption and that measuring its true impacts would require more rigorous analysis, using conservation messaging as a gateway for other programs presents opportunities.

[15] "The dynamics of behavior change: Evidence from energy conservation." Omar Isaac Asensio and Magali A. Delmas. Journal of Economic Behavior & Organization. 21 March 2016.

In California, the statewide FlexAlerts (reliability-based messaging) triggers utility demand response programs. Though these examples from California are for electric reliability, they did show promising results in terms of system-wide reductions in usage during the prescribed windows. Winter demand response programs for gas that make use of customers' smart thermostats do show evidence of gas consumption and demand reductions, though program costs and benefits do need to be carefully considered.

Utilities in California are piloting behavioral demand response programs, which use existing home energy report platforms to influence customers to reduce consumption and demand during peak times; this strategy could be deployed by Xcel Energy Colorado for gas customers. Also, the ThermWise Energy Pledge Program in Utah made use of text messages, emails, and public pledges to influence customers to reduce gas usage at key times.

Currently, Xcel Energy Colorado has several electric demand response programs that could be leveraged. The Smart Water Heaters program uses enrolled water heaters to provide load reduction in both summer and winter scenarios. Providing electric conservation during winter gas price spikes would reduce the amount of gas required for electric generation. It should also be noted that Xcel Energy Colorado has included a behavioral demand response program in its 2024-2026 Demand-Side Management & Beneficial Electrification Plan filing.

Additionally, the AC Rewards Program uses a temperature offset strategy to reduce AC load at certain times, and the program makes use of enrolled smart thermostats. Though this program is primarily used for summer demand response, it could potentially be used to reduce electric demand during winter price spikes, thereby providing indirect gas savings from the generation side. Additionally, if customers are enrolling their smart thermostats in the program, Xcel Energy Colorado could explore leveraging these devices for a winter gas demand response program based on temperature offsets. Though Xcel Energy Colorado does not have a gas demand response program, they are engaging in a study of gas demand response potential (Heat Savers Study). Given the performance of other gas demand response programs, the utility should carefully weigh the costs and benefits of such a program.

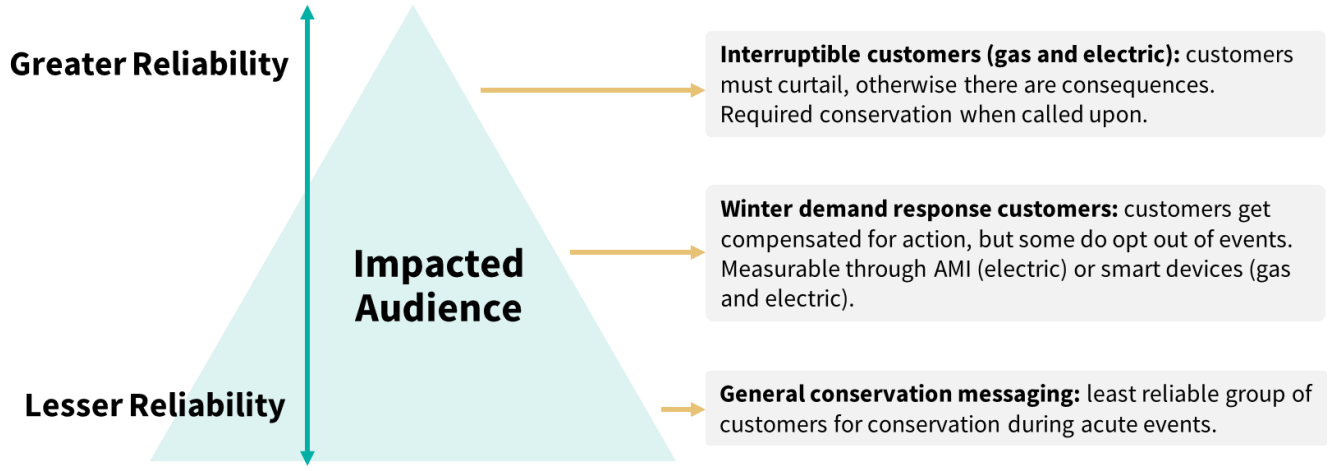
RECOMMENDATION:

If conservation messaging is used to engage customers in energy efficiency and demand response programs, Xcel Energy Colorado's DSM program team should meaningfully engage gas system planning and operations teams to ensure subsequent impacts can be incorporated into gas purchasing decisions. In the current framework, conservation messaging does not provide enough assurance (in scale or accuracy) for gas planning and operations to change purchasing behavior. If conservation messaging is used as a tool to engage customers in energy efficiency and demand response programs, DSM program teams need to fully understand what M&V strategies can help planning and operations consider program impacts in their forecasts. Regardless of program implementation or messaging strategy, if gas planning and operations does not feel like they have enough accuracy and precision in savings estimates, they will not change purchasing behavior. This coordination and M&V level-setting will be essential for mitigating future price-spikes.

RECOMMENDATION:

ILLUME recommends developing a priority funnel for conservation tools based on reliability of consumption and demand reductions at certain times. DSM program teams and planning and operations teams will need to work closely together to deliver targeted conservation strategies. For future events where gas prices spike, conservation efforts should begin with the customers with the greatest propensity to deliver reliable curtailment (though this might only represent the smallest volume of customers or smallest volume of potential maximum savings). Depending on the severity of the scenario and needs for planning and operations teams, Xcel Energy Colorado can then use the next tier of levers for conservation, which expands the pool of impacted customers, but also delivers curtailment less reliably. Figure 13 shows a diagrammatic representation of a potential funnel.

Figure 13. Priority Funnel of Conservation Tools



For example, interruptible rate customers should be the priority for consumption and demand reductions. As noted in the findings, these customers have been more engaged in understanding the requirements to curtail as specific by their rate. This presents the most reliable group for consumption reductions during acute events, but also represents a smaller group of customers.

If additional conservation is required, the next group to be called on for reductions in gas usage is customers enrolled in winter demand response programs. Given customers opt into this offering, it presents bounded parameters for consumption reduction (i.e., if everyone participates, DSM teams and system planners know the maximum consumption and demand reductions based on enrollment). Xcel Energy Colorado can leverage existing winter electric demand response programs to achieve consumption reductions, which would reduce gas purchasing needs for electric generation. Additionally, if Xcel Energy Colorado pursues gas demand response programs in the future, these customers can also be included in this group, providing bounded estimates on potential reductions, which directly reduces gas system needs.

Finally, the last category is customers reached through general conservation messaging. This group represents the least reliable group to seek conservation from but represents the greatest volume of customers.

APPENDIX

Appendix A. Counterfactual Days Analysis Table Results

MESSAGING DAY	TIME RANGE USED	COEFFICIENT	P-VALUE
21 Dec	± 2 weeks	44,586.75	0.0725
	2 weeks before	31,959.45	0.1046
	2 weeks before Dec 12	43,440.61	0.0722
	Nov 2022 to Jan 2023	41,228.57	0.1032
	Data from before messaging day, including previous year	20,051.34	0.1035
	Data from before Dec 12, including previous year	20,051.34	0.1035
	All data	23,312.27	0.1639
22 Dec	± 2 weeks	435.22	0.9328
	2 weeks before	1,446.11	0.8547
	2 weeks before Dec 12	943.37	0.9304
	Nov 2022 to Jan 2023	-4,893.08	0.6157
	Data before messaging day, including the previous year	15,057.14	0.2707
	Data from before Dec 12, including the previous year	15,057.14	0.2707
	All data	-1,442.32	0.6211
23 Dec	± 2 weeks	-6012.84	0.4668
	2 weeks before	-572.38	0.9488
	2 weeks before Dec 12	-174.82	0.9860
	Nov 2022 to Jan 2023	-6099.77	0.4694
	Data from before messaging day, including the previous year	9855.05	0.2813
	Data from before Dec 12, including the previous year	9855.0	0.2813
	All data	-5226.59	0.1618

Appendix B. ARIMAX Out-of-Sample Predictions by Subsystem

Figure 14. ARIMAX Out-of-sample prediction – Grand Junction

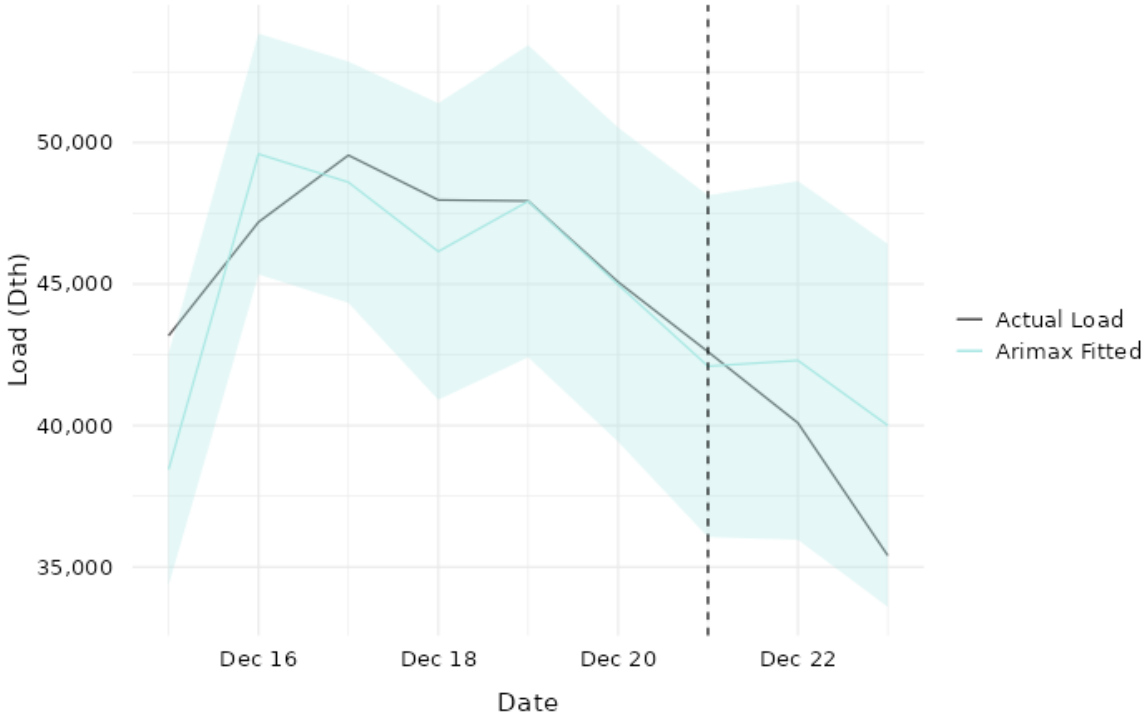


Figure 15. ARIMAX Out-of-sample prediction – Merino

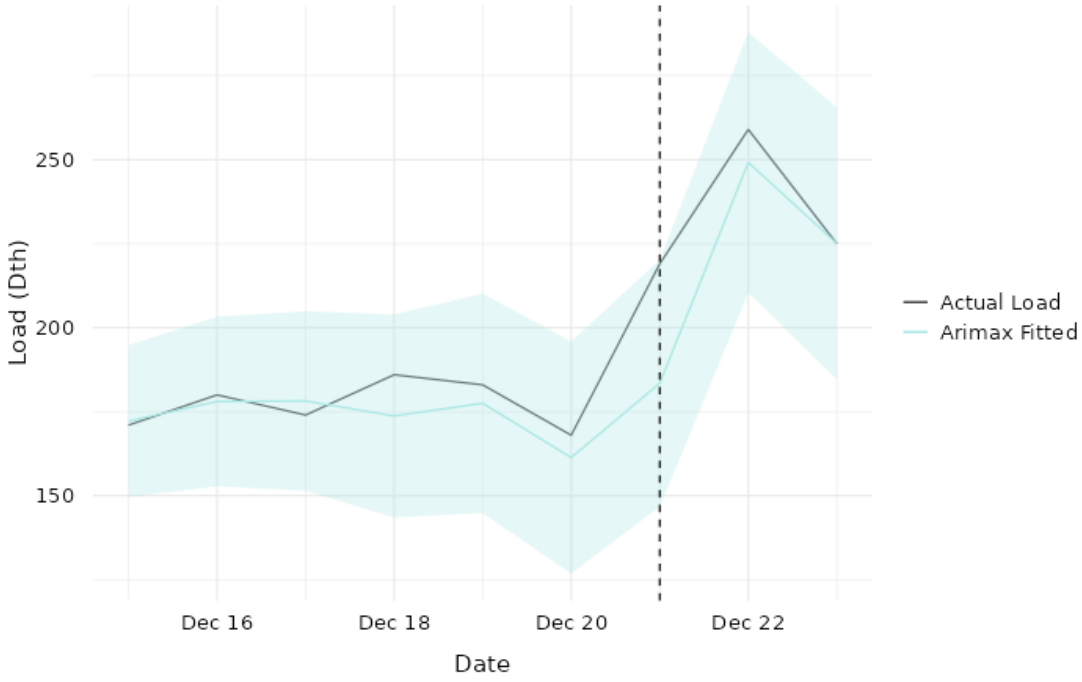


Figure 16. ARIMAX Out-of-sample prediction – Pueblo

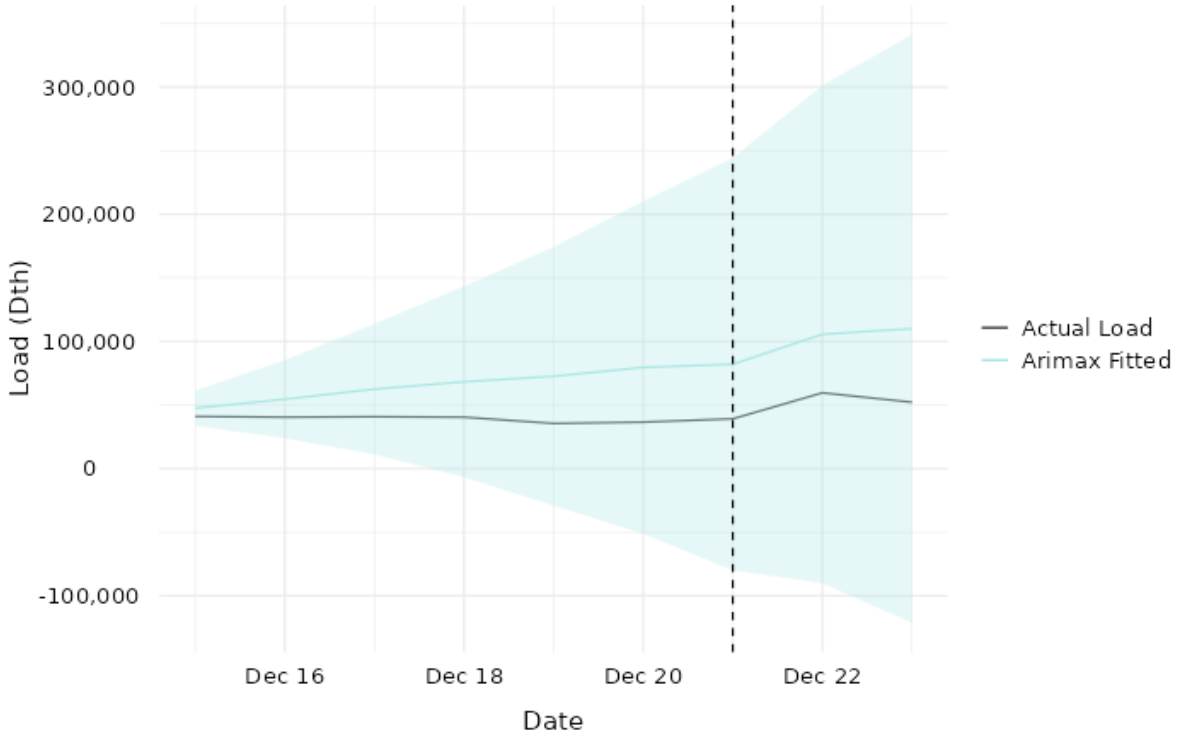


Figure 17. ARIMAX Out-of-sample prediction – Rifle

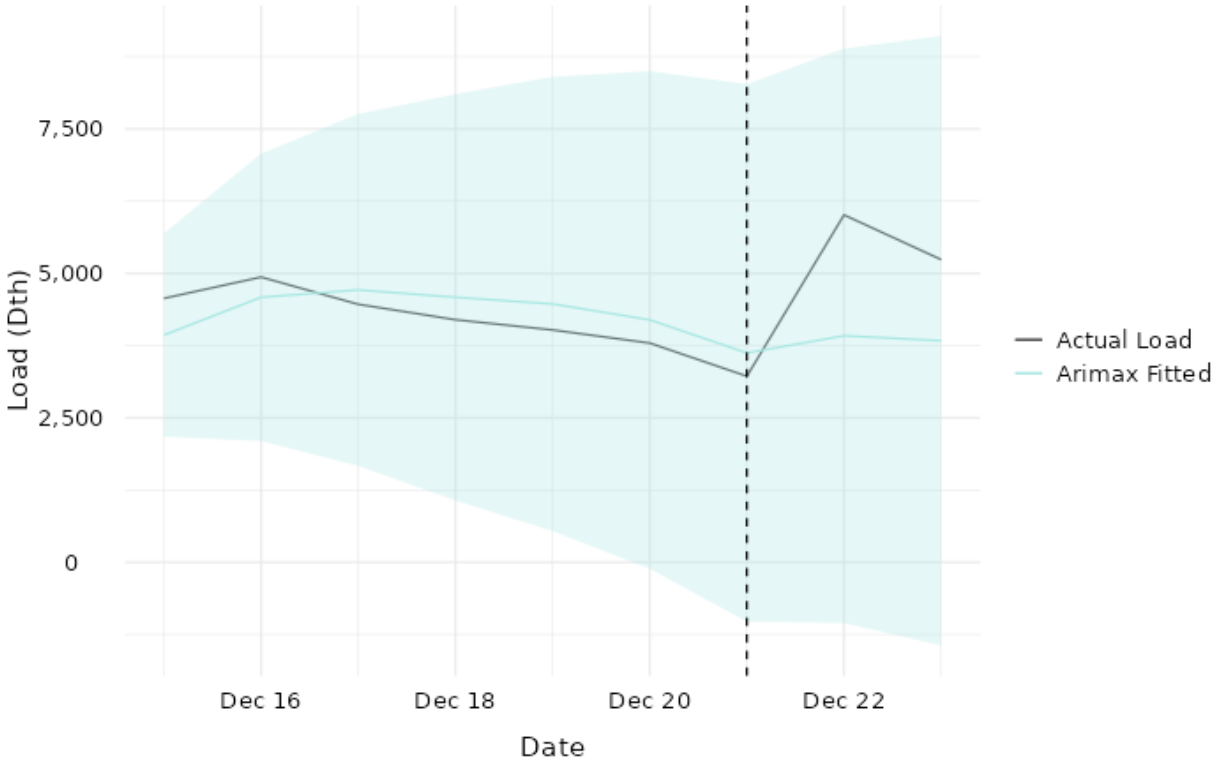


Figure 18. ARIMAX Out-of-sample prediction – Sterling

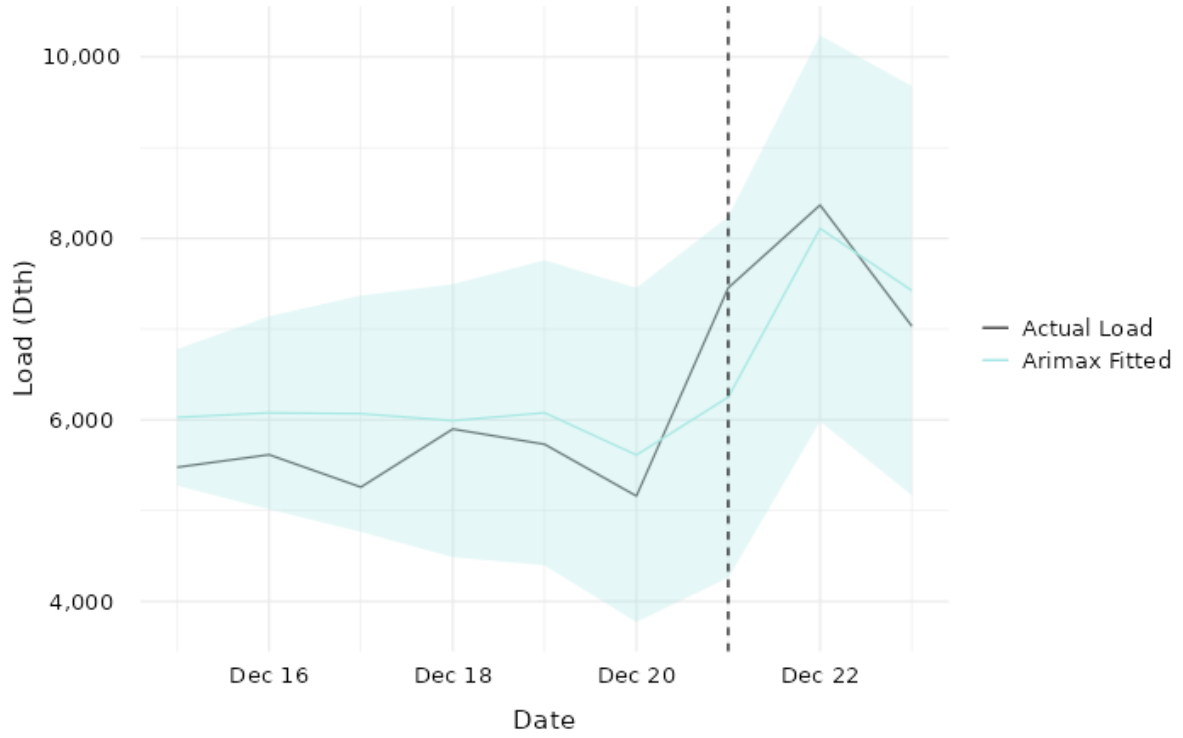


Figure 19. ARIMAX Out-of-sample prediction – Telluride

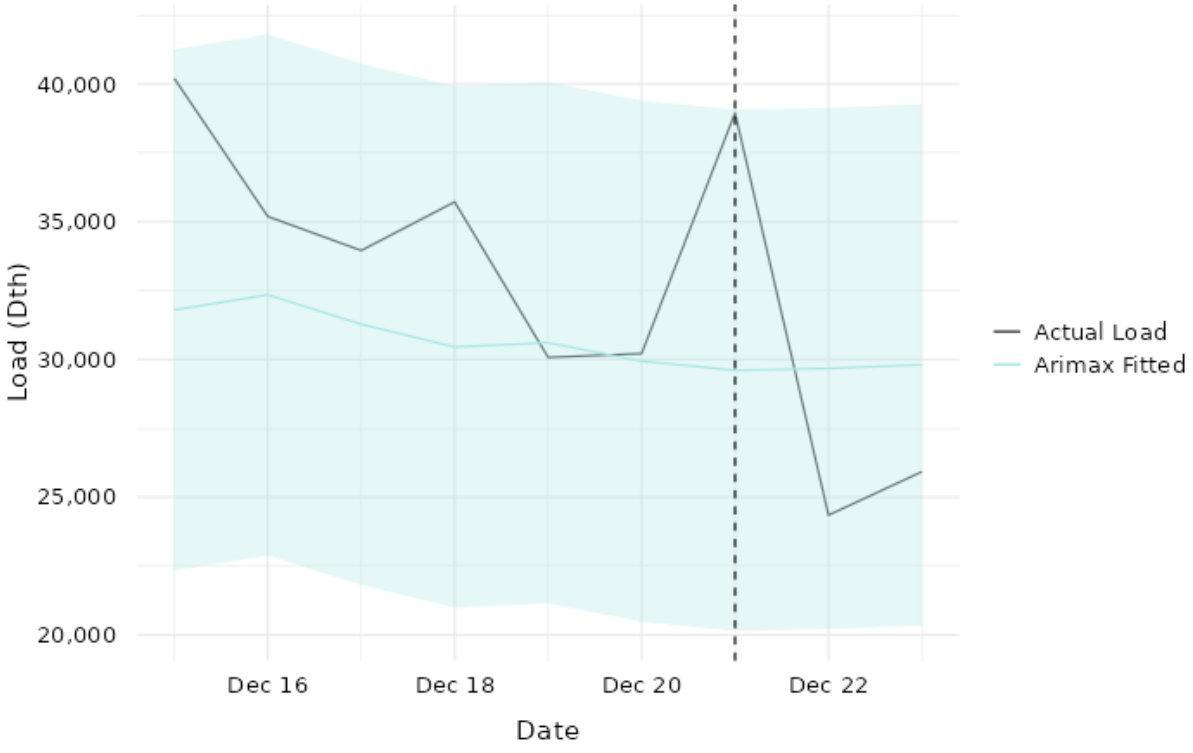
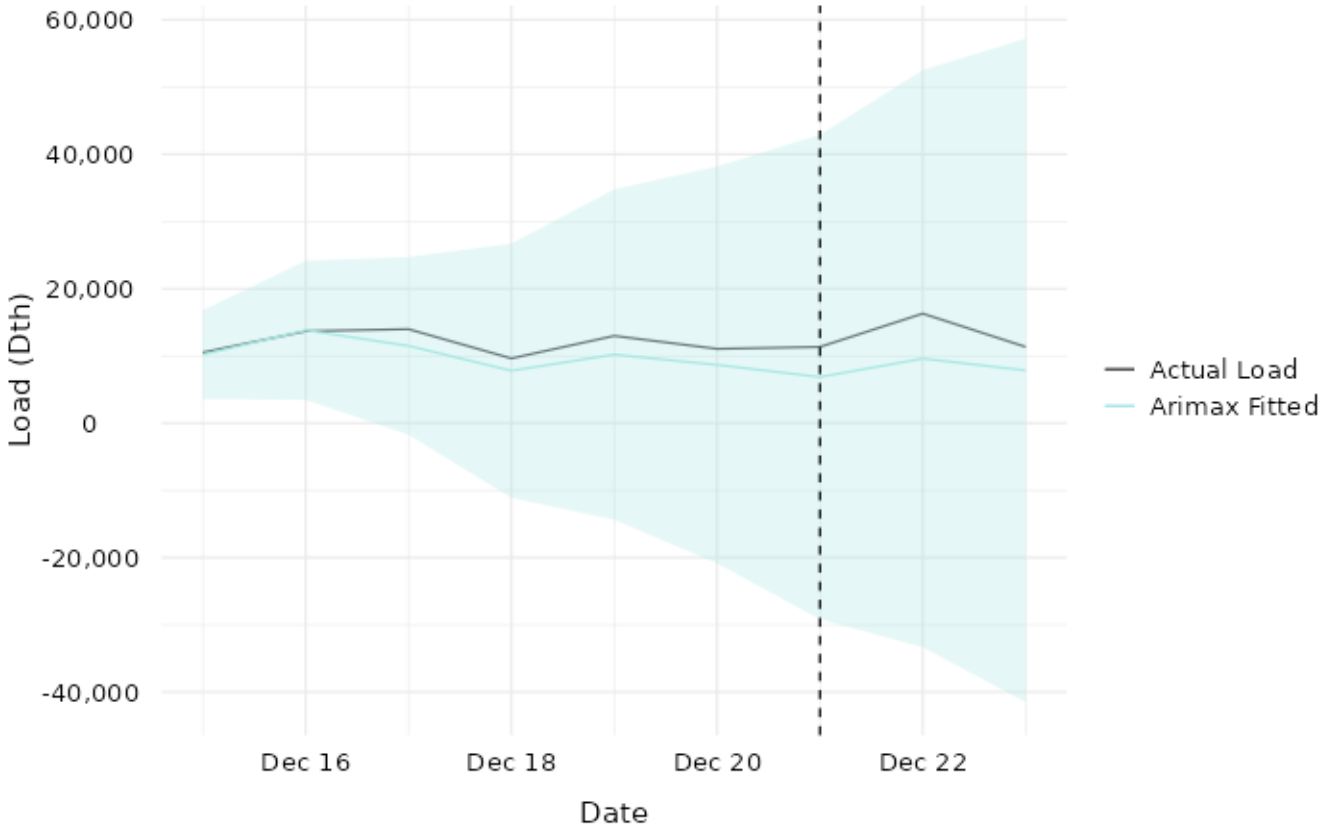


Figure 20. ARIMAX Out-of-sample prediction – Vail



CERTIFICATE OF SERVICE

I, Joshua DePauw, hereby certify that I have this day served copies of the foregoing document on the attached list of persons.

xx by depositing a true and correct copy thereof, properly enveloped with postage paid in the United States mail at Minneapolis, Minnesota

xx electronic filing

DOCKET NOS. G999/CI-21-135
G002/CI-21-610

Dated this 1st day of August 2024

/s/

_____

Joshua DePauw
Regulatory Administrator

First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
Michael	Ahern	ahern.michael@dorsey.com	Dorsey & Whitney, LLP	50 S 6th St Ste 1500 Minneapolis, MN 554021498	Electronic Service	No	OFF_SL_21-135_Official Service List
Kristine	Anderson	kanderson@greatermngas.com	Greater Minnesota Gas, Inc.& Greater MN Transmission, LLC	1900 Cardinal Lane PO Box 798 Faribault, MN 55021	Electronic Service	No	OFF_SL_21-135_Official Service List
Mara	Ascheman	mara.k.ascheman@xcelenergy.com	Xcel Energy	414 Nicollet Mall Fl 5 Minneapolis, MN 55401	Electronic Service	No	OFF_SL_21-135_Official Service List
Alicia	Berger	Alicia.E.Berger@xcelenergy.com	Xcel Energy	414 Nicollet Mall Minneapolis, MN 55401	Electronic Service	No	OFF_SL_21-135_Official Service List
James J.	Bertrand	james.bertrand@stinson.com	STINSON LLP	50 S 6th St Ste 2600 Minneapolis, MN 55402	Electronic Service	No	OFF_SL_21-135_Official Service List
Mike	Boughner	Michael.l.boughner@xcelenergy.com	Xcel Energy	414 Nicollet Mall Minneapolis, MN 55401	Electronic Service	No	OFF_SL_21-135_Official Service List
James	Canaday	james.canaday@ag.state.mn.us	Office of the Attorney General-RUD	Suite 1400 445 Minnesota St. St. Paul, MN 55101	Electronic Service	No	OFF_SL_21-135_Official Service List
Melodee	Carlson Chang	melodee.carlsonchang@centerpointenergy.com	CenterPoint Energy	505 Nicollet Mall Minneapolis, MN 55402	Electronic Service	No	OFF_SL_21-135_Official Service List
Cody	Chilson	cchilson@greatermngas.com	Greater Minnesota Gas, Inc. & Greater MN Transmission, LLC	1900 Cardinal Ln PO Box 798 Faribault, MN 55021	Electronic Service	No	OFF_SL_21-135_Official Service List
Ray	Choquette	rchoquette@agp.com	Ag Processing Inc.	12700 West Dodge Road PO Box 2047 Omaha, NE 68103-2047	Electronic Service	No	OFF_SL_21-135_Official Service List

First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
John	Coffman	john@johncoffman.net	AARP	871 Tuxedo Blvd. St, Louis, MO 63119-2044	Electronic Service	No	OFF_SL_21-135_Official Service List
Generic Notice	Commerce Attorneys	commerce.attorneys@ag.state.mn.us	Office of the Attorney General-DOC	445 Minnesota Street Suite 1400 St. Paul, MN 55101	Electronic Service	Yes	OFF_SL_21-135_Official Service List
George	Crocker	gwillc@nawo.org	North American Water Office	5093 Keats Avenue Lake Elmo, MN 55042	Electronic Service	No	OFF_SL_21-135_Official Service List
Brian	Edstrom	briane@cubminnesota.org	Citizens Utility Board of Minnesota	332 Minnesota St Ste W1360 Saint Paul, MN 55101	Electronic Service	No	OFF_SL_21-135_Official Service List
John	Farrell	jfarrell@ilsr.org	Institute for Local Self-Reliance	2720 E. 22nd St Institute for Local Self-Reliance Minneapolis, MN 55406	Electronic Service	No	OFF_SL_21-135_Official Service List
Sharon	Ferguson	sharon.ferguson@state.mn.us	Department of Commerce	85 7th Place E Ste 280 Saint Paul, MN 551012198	Electronic Service	No	OFF_SL_21-135_Official Service List
Daryll	Fuentes	energy@usg.com	USG Corporation	550 W Adams St Chicago, IL 60661	Electronic Service	No	OFF_SL_21-135_Official Service List
Edward	Garvey	edward.garvey@AESLconsulting.com	AESL Consulting	32 Lawton St Saint Paul, MN 55102-2617	Electronic Service	No	OFF_SL_21-135_Official Service List
Edward	Garvey	garveyed@aol.com	Residence	32 Lawton St Saint Paul, MN 55102	Electronic Service	No	OFF_SL_21-135_Official Service List

First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
Todd J.	Guerrero	todd.guerrero@kutakrock.com	Kutak Rock LLP	Suite 1750 220 South Sixth Street Minneapolis, MN 554021425	Electronic Service	No	OFF_SL_21-135_Official Service List
Matthew B	Harris	matt.b.harris@xcelenergy.com	XCEL ENERGY	401 Nicollet Mall FL 8 Minneapolis, MN 55401	Electronic Service	No	OFF_SL_21-135_Official Service List
Kim	Havey	kim.havey@minneapolismn.gov	City of Minneapolis	350 South 5th Street, Suite 315M Minneapolis, MN 55415	Electronic Service	No	OFF_SL_21-135_Official Service List
Adam	Heinen	aheinen@dakotaelectric.com	Dakota Electric Association	4300 220th St W Farmington, MN 55024	Electronic Service	No	OFF_SL_21-135_Official Service List
Annete	Henkel	mui@mnutilityinvestors.org	Minnesota Utility Investors	413 Wacouta Street #230 St.Paul, MN 55101	Electronic Service	No	OFF_SL_21-135_Official Service List
Joylyn C	Hoffman Malueg	Joylyn.hoffmanmalueg@wecenergygroup.com	Minnesota Energy Resources	2685 145th St W Rosemount, MN 55068	Electronic Service	No	OFF_SL_21-135_Official Service List
Michael	Hoppe	lu23@ibew23.org	Local Union 23, I.B.E.W.	445 Etna Street Ste. 61 St. Paul, MN 55106	Electronic Service	No	OFF_SL_21-135_Official Service List
Travis	Jacobson	travis.jacobson@mdu.com	Great Plains Natural Gas Company	400 N 4th St Bismarck, ND 58501	Electronic Service	No	OFF_SL_21-135_Official Service List
Alan	Jenkins	aj@jenkinsatlaw.com	Jenkins at Law	2950 Yellowtail Ave. Marathon, FL 33050	Electronic Service	No	OFF_SL_21-135_Official Service List
Richard	Johnson	Rick.Johnson@lawmoss.com	Moss & Barnett	150 S. 5th Street Suite 1200 Minneapolis, MN 55402	Electronic Service	No	OFF_SL_21-135_Official Service List

First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
Sarah	Johnson Phillips	sarah.phillips@stoel.com	Stoel Rives LLP	33 South Sixth Street Suite 4200 Minneapolis, MN 55402	Electronic Service	No	OFF_SL_21-135_Official Service List
Kyle R.	Kroll	kkroll@winthrop.com	Winthrop & Weinstine, P.A.	225 South Sixth Street Suite 3500 Minneapolis, MN 55402	Electronic Service	No	OFF_SL_21-135_Official Service List
Nicolle	Kupser	nkupser@greatermngas.com	Greater Minnesota Gas, Inc. & Greater MN Transmission, LLC	1900 Cardinal Ln PO Box 798 Faribault, MN 55021	Electronic Service	No	OFF_SL_21-135_Official Service List
Peder	Larson	plarson@larkinhoffman.com	Larkin Hoffman Daly & Lindgren, Ltd.	8300 Norman Center Drive Suite 1000 Bloomington, MN 55437	Electronic Service	No	OFF_SL_21-135_Official Service List
Annie	Levenson Falk	annielf@cubminnesota.org	Citizens Utility Board of Minnesota	332 Minnesota Street, Suite W1360 St. Paul, MN 55101	Electronic Service	No	OFF_SL_21-135_Official Service List
Amy	Liberkowski	amy.a.liberkowski@xcelenergy.com	Xcel Energy	414 Nicollet Mall 7th Floor Minneapolis, MN 554011993	Electronic Service	No	OFF_SL_21-135_Official Service List
Eric	Lipman	eric.lipman@state.mn.us	Office of Administrative Hearings	PO Box 64620 St. Paul, MN 551640620	Electronic Service	No	OFF_SL_21-135_Official Service List
Jason	Loos	jason.loos@centerpointenergy.com	CenterPoint Energy Resources Corp.	505 Nicollet Mall 3rd Floor Minneapolis, MN 55402	Electronic Service	No	OFF_SL_21-135_Official Service List
Kavita	Maini	kmaini@wi.rr.com	KM Energy Consulting, LLC	961 N Lost Woods Rd Oconomowoc, WI 53066	Electronic Service	No	OFF_SL_21-135_Official Service List
Sarah	Mead	sarah.mead@wecenergygroup.com	MERC	N/A	Electronic Service	No	OFF_SL_21-135_Official Service List

First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
Joseph	Meyer	joseph.meyer@ag.state.mn.us	Office of the Attorney General-RUD	Bremer Tower, Suite 1400 445 Minnesota Street St Paul, MN 55101-2131	Electronic Service	No	OFF_SL_21-135_Official Service List
Stacy	Miller	stacy.miller@minneapolismn.gov	City of Minneapolis	350 S. 5th Street Room M 301 Minneapolis, MN 55415	Electronic Service	No	OFF_SL_21-135_Official Service List
David	Moeller	dmoeller@allete.com	Minnesota Power	30 W Superior St Duluth, MN 558022093	Electronic Service	No	OFF_SL_21-135_Official Service List
Andrew	Moratzka	andrew.moratzka@stoel.com	Stoel Rives LLP	33 South Sixth St Ste 4200 Minneapolis, MN 55402	Electronic Service	No	OFF_SL_21-135_Official Service List
David	Niles	david.niles@avantenergy.com	Minnesota Municipal Power Agency	220 South Sixth Street Suite 1300 Minneapolis, MN 55402	Electronic Service	No	OFF_SL_21-135_Official Service List
Samantha	Norris	samanthanorris@alliantenergy.com	Interstate Power and Light Company	200 1st Street SE PO Box 351 Cedar Rapids, IA 524060351	Electronic Service	No	OFF_SL_21-135_Official Service List
Carol A.	Overland	overland@legalectric.org	Legalectric - Overland Law Office	1110 West Avenue Red Wing, MN 55066	Electronic Service	No	OFF_SL_21-135_Official Service List
Greg	Palmer	gpalmer@greatermngas.com	Greater Minnesota Gas, Inc. & Greater MN Transmission, LLC	1900 Cardinal Ln PO Box 798 Faribault, MN 55021	Electronic Service	No	OFF_SL_21-135_Official Service List
Lisa	Peterson	lisa.r.peterson@xcelenergy.com	Xcel Energy	414 Nicollet Mall FL 7 Minneapolis, MN 55401	Electronic Service	No	OFF_SL_21-135_Official Service List
Catherine	Phillips	Catherine.Phillips@wecenergygroup.com	Minnesota Energy Resources	231 West Michigan St Milwaukee, WI 53203	Electronic Service	No	OFF_SL_21-135_Official Service List

First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
Generic Notice	Residential Utilities Division	residential.utilities@ag.state.mn.us	Office of the Attorney General-RUD	1400 BRM Tower 445 Minnesota St St. Paul, MN 551012131	Electronic Service	Yes	OFF_SL_21-135_Official Service List
Kevin	Reuther	kreuther@mncenter.org	MN Center for Environmental Advocacy	26 E Exchange St, Ste 206 St. Paul, MN 551011667	Electronic Service	No	OFF_SL_21-135_Official Service List
Elizabeth	Schmiesing	eschmiesing@winthrop.com	Winthrop & Weinstine, P.A.	225 South Sixth Street Suite 3500 Minneapolis, MN 55402	Electronic Service	No	OFF_SL_21-135_Official Service List
Peter	Scholtz	peter.scholtz@ag.state.mn.us	Office of the Attorney General-RUD	Suite 1400 445 Minnesota Street St. Paul, MN 55101-2131	Electronic Service	No	OFF_SL_21-135_Official Service List
Christine	Schwartz	Regulatory.records@xcelenergy.com	Xcel Energy	414 Nicollet Mall FL 7 Minneapolis, MN 554011993	Electronic Service	No	OFF_SL_21-135_Official Service List
Will	Seuffert	Will.Seuffert@state.mn.us	Public Utilities Commission	121 7th Pl E Ste 350 Saint Paul, MN 55101	Electronic Service	Yes	OFF_SL_21-135_Official Service List
Janet	Shaddix Elling	jshaddix@janetshaddix.com	Shaddix And Associates	7400 Lyndale Ave S Ste 190 Richfield, MN 55423	Electronic Service	Yes	OFF_SL_21-135_Official Service List
Colleen	Sipiorski	Colleen.Sipiorski@wecenergygroup.com	Minnesota Energy Resources Corporation	700 North Adams St Green Bay, WI 54307	Electronic Service	No	OFF_SL_21-135_Official Service List
Ken	Smith	ken.smith@districtenergy.com	District Energy St. Paul Inc.	76 W Kellogg Blvd St. Paul, MN 55102	Electronic Service	No	OFF_SL_21-135_Official Service List
Peggy	Sorum	peggy.sorum@centerpointenergy.com	CenterPoint Energy	505 Nicollet Mall Minneapolis, MN 55402	Electronic Service	No	OFF_SL_21-135_Official Service List

First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
Byron E.	Starns	byron.starns@stinson.com	STINSON LLP	50 S 6th St Ste 2600 Minneapolis, MN 55402	Electronic Service	No	OFF_SL_21-135_Official Service List
Richard	Stasik	richard.stasik@wecenergygroup.com	Minnesota Energy Resources Corporation (HOLDING)	231 West Michigan St - P321 Milwaukee, WI 53203	Electronic Service	No	OFF_SL_21-135_Official Service List
Kristin	Stastny	kstastny@taftlaw.com	Taft Stettinius & Hollister LLP	2200 IDS Center 80 South 8th St Minneapolis, MN 55402	Electronic Service	No	OFF_SL_21-135_Official Service List
James M	Strommen	jstrommen@kennedy-graven.com	Kennedy & Graven, Chartered	150 S 5th St Ste 700 Minneapolis, MN 55402	Electronic Service	No	OFF_SL_21-135_Official Service List
Kent	Sulem	ksulem@mmua.org	MMUA	3131 Fernbrook Ln N Ste 200 Plymouth, MN 55447-5337	Electronic Service	No	OFF_SL_21-135_Official Service List
Eric	Swanson	eswanson@winthrop.com	Winthrop & Weinstine	225 S 6th St Ste 3500 Capella Tower Minneapolis, MN 554024629	Electronic Service	No	OFF_SL_21-135_Official Service List
Casey	Whelan	cwhelan@kinectenergy.com	Kinect Energy Group	605 Highway 169 N Ste 1200 Plymouth, MN 55441	Electronic Service	No	OFF_SL_21-135_Official Service List
Joseph	Windler	jwindler@winthrop.com	Winthrop & Weinstine	225 South Sixth Street, Suite 3500 Minneapolis, MN 55402	Electronic Service	No	OFF_SL_21-135_Official Service List
Kurt	Zimmerman	kwz@ibew160.org	Local Union #160, IBEW	2909 Anthony Ln St Anthony Village, MN 55418-3238	Electronic Service	No	OFF_SL_21-135_Official Service List

First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
Patrick	Zomer	Pat.Zomer@lawmoss.com	Moss & Barnett PA	150 S 5th St #1200 Minneapolis, MN 55402	Electronic Service	No	OFF_SL_21-135_Official Service List

First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
Mara	Ascheman	mara.k.ascheman@xcelenergy.com	Xcel Energy	414 Nicollet Mall Fl 5 Minneapolis, MN 55401	Electronic Service	No	OFF_SL_21-610_Official Service List
James H.	Barkley	james.barkley@bakerbotts.com	Baker Botts	910 Louisiana Street Houston, TX 77002-4995	Electronic Service	Yes	OFF_SL_21-610_Official Service List
James J.	Bertrand	james.bertrand@stinson.com	STINSON LLP	50 S 6th St Ste 2600 Minneapolis, MN 55402	Electronic Service	No	OFF_SL_21-610_Official Service List
Elizabeth	Brama	ebrama@taftlaw.com	Taft Stettinius & Hollister LLP	2200 IDS Center 80 South 8th Street Minneapolis, MN 55402	Electronic Service	Yes	OFF_SL_21-610_Official Service List
Barbara	Case	barbara.case@state.mn.us	Office of Administrative Hearings	600 N. Robert St. St. Paul, MN 55101	Electronic Service	No	OFF_SL_21-610_Official Service List
Generic Notice	Commerce Attorneys	commerce.attorneys@ag.state.mn.us	Office of the Attorney General-DOC	445 Minnesota Street Suite 1400 St. Paul, MN 55101	Electronic Service	Yes	OFF_SL_21-610_Official Service List
Brian	Edstrom	briane@cubminnesota.org	Citizens Utility Board of Minnesota	332 Minnesota St Ste W1360 Saint Paul, MN 55101	Electronic Service	No	OFF_SL_21-610_Official Service List
Sharon	Ferguson	sharon.ferguson@state.mn.us	Department of Commerce	85 7th Place E Ste 280 Saint Paul, MN 551012198	Electronic Service	No	OFF_SL_21-610_Official Service List
Edward	Garvey	garveyed@aol.com	Residence	32 Lawton St Saint Paul, MN 55102	Electronic Service	No	OFF_SL_21-610_Official Service List
Matthew B	Harris	matt.b.harris@xcelenergy.com	XCEL ENERGY	401 Nicollet Mall FL 8 Minneapolis, MN 55401	Electronic Service	No	OFF_SL_21-610_Official Service List

First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
Kim	Havey	kim.havey@minneapolismn.gov	City of Minneapolis	350 South 5th Street, Suite 315M Minneapolis, MN 55415	Electronic Service	No	OFF_SL_21-610_Official Service List
Valerie	Herring	vherring@taftlaw.com	Taft Stettinius & Hollister LLP	2200 IDS Center 80 S. Eighth Street Minneapolis, MN 55402	Electronic Service	Yes	OFF_SL_21-610_Official Service List
Travis	Jacobson	travis.jacobson@mdu.com	Great Plains Natural Gas Company	400 N 4th St Bismarck, ND 58501	Electronic Service	No	OFF_SL_21-610_Official Service List
Kyle R.	Kroll	kkroll@winthrop.com	Winthrop & Weinstine, P.A.	225 South Sixth Street Suite 3500 Minneapolis, MN 55402	Electronic Service	No	OFF_SL_21-610_Official Service List
Annie	Levenson Falk	annielf@cubminnesota.org	Citizens Utility Board of Minnesota	332 Minnesota Street, Suite W1360 St. Paul, MN 55101	Electronic Service	No	OFF_SL_21-610_Official Service List
Jason	Loos	jason.loos@centerpointenergy.com	CenterPoint Energy Resources Corp.	505 Nicollet Mall 3rd Floor Minneapolis, MN 55402	Electronic Service	No	OFF_SL_21-610_Official Service List
Joseph	Meyer	joseph.meyer@ag.state.mn.us	Office of the Attorney General-RUD	Bremer Tower, Suite 1400 445 Minnesota Street St Paul, MN 55101-2131	Electronic Service	No	OFF_SL_21-610_Official Service List
David	Moeller	dmoeller@allete.com	Minnesota Power	30 W Superior St Duluth, MN 558022093	Electronic Service	No	OFF_SL_21-610_Official Service List
Andrew	Moratzka	andrew.moratzka@stoel.com	Stoel Rives LLP	33 South Sixth St Ste 4200 Minneapolis, MN 55402	Electronic Service	No	OFF_SL_21-610_Official Service List

First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
Samantha	Norris	samanthanorris@alliantenergy.com	Interstate Power and Light Company	200 1st Street SE PO Box 351 Cedar Rapids, IA 524060351	Electronic Service	No	OFF_SL_21-610_Official Service List
Jessica	Palmer Denig	jessica.palmer-Denig@state.mn.us	Office of Administrative Hearings	600 Robert St N PO Box 64620 St. Paul, MN 55164	Electronic Service	No	OFF_SL_21-610_Official Service List
Lisa	Peterson	lisa.r.peterson@xcelenergy.com	Xcel Energy	414 Nicollet Mall FL 7 Minneapolis, MN 55401	Electronic Service	No	OFF_SL_21-610_Official Service List
Catherine	Phillips	Catherine.Phillips@wecenergygroup.com	Minnesota Energy Resources	231 West Michigan St Milwaukee, WI 53203	Electronic Service	Yes	OFF_SL_21-610_Official Service List
Generic Notice	Residential Utilities Division	residential.utilities@ag.state.mn.us	Office of the Attorney General-RUD	1400 BRM Tower 445 Minnesota St St. Paul, MN 551012131	Electronic Service	Yes	OFF_SL_21-610_Official Service List
Elizabeth	Schmiesing	eschmiesing@winthrop.com	Winthrop & Weinstine, P.A.	225 South Sixth Street Suite 3500 Minneapolis, MN 55402	Electronic Service	No	OFF_SL_21-610_Official Service List
Peter	Scholtz	peter.scholtz@ag.state.mn.us	Office of the Attorney General-RUD	Suite 1400 445 Minnesota Street St. Paul, MN 55101-2131	Electronic Service	No	OFF_SL_21-610_Official Service List
Christine	Schwartz	Regulatory.records@xcelenergy.com	Xcel Energy	414 Nicollet Mall FL 7 Minneapolis, MN 554011993	Electronic Service	No	OFF_SL_21-610_Official Service List
Will	Seuffert	Will.Seuffert@state.mn.us	Public Utilities Commission	121 7th Pl E Ste 350 Saint Paul, MN 55101	Electronic Service	Yes	OFF_SL_21-610_Official Service List

First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
Janet	Shaddix Elling	jshaddix@janetshaddix.com	Shaddix And Associates	7400 Lyndale Ave S Ste 190 Richfield, MN 55423	Electronic Service	Yes	OFF_SL_21-610_Official Service List
Peggy	Sorum	peggy.sorum@centerpointenergy.com	CenterPoint Energy	505 Nicollet Mall Minneapolis, MN 55402	Electronic Service	No	OFF_SL_21-610_Official Service List
Richard	Stasik	richard.stasik@wecenergygroup.com	Minnesota Energy Resources Corporation (HOLDING)	231 West Michigan St - P321 Milwaukee, WI 53203	Electronic Service	No	OFF_SL_21-610_Official Service List
Kristin	Stastny	kstastny@taftlaw.com	Taft Stettinius & Hollister LLP	2200 IDS Center 80 South 8th St Minneapolis, MN 55402	Electronic Service	Yes	OFF_SL_21-610_Official Service List
James M	Strommen	jstrommen@kennedy-graven.com	Kennedy & Graven, Chartered	150 S 5th St Ste 700 Minneapolis, MN 55402	Electronic Service	No	OFF_SL_21-610_Official Service List
Eric	Swanson	eswanson@winthrop.com	Winthrop & Weinstine	225 S 6th St Ste 3500 Capella Tower Minneapolis, MN 554024629	Electronic Service	No	OFF_SL_21-610_Official Service List
Michael A.	Yuffee	michael.yuffee@bakerbotts.com	Baker Botts	700 K St NW Washington, DC 20001	Electronic Service	Yes	OFF_SL_21-610_Official Service List