Appendix A

IRP PROCESS

Draft 2020 WA IRP Draft

Appendix A contains Cascade's Stakeholder Engagement document as well as Technical Advisory Group (TAG) presentations and the minutes. The purpose of the Stakeholder Engagement document is to lay out expectations that stakeholders can expect from the Company during the IRP process and vice versa. Cascade's TAG presentations and minutes can be found in this document as well on the Company's website at: https://www.cngc.com/rates-services/rates-tariffs/washington-integrated-resource-plan/

Cascade Natural Gas Corporation

Integrated Resource Plan
Technical Advisory Group Meeting #1

April 15th, 2020

Skype/Teleconference

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Agenda

- Introductions
- Safety Moment
- About Cascade Natural Gas
- Purpose of the IRP
- IRP Process
- Best Practices Discussion
- IRP Team
- Regional Market Outlook
- Key IRP Discussions for Future IRP Meetings
  - Load Forecast
  - Hedging
  - Avoided Cost
  - Carbon
  - Energy Efficiency
  - Renewables
  - Distribution System Planning
  - Stochastic Analysis Techniques
- Additional Items
- 2020 WA IRP Timeline
- Next Steps

CASCADE NATURAL GAS CORPORATION
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

A Little History Lesson…

- Prior to 1955, natural gas was virtually unheard-of in the Pacific Northwest. Seeing an opportunity, Lester Pettit, Spencer Clark, and Stewart Matthews led a group of associates to form a company that would rise to the challenge. Cascade Natural Gas Corporation was incorporated January 2, 1953.
- In July 2007, Cascade was acquired by MDU Resources headquartered in Bismarck, ND.
    - Founded in 1924 as an electric utility.
    - Core businesses are construction, gas & electric utilities, and pipeline.
    - Approximately 13,000 employees, operating in 43 states.
    - Operates four utilities across eight states:
        - Montana-Dakota Utilities Co.
        - Great Plains Natural Gas Co.
        - Cascade Natural Gas Corporation
        - Intermountain Gas Co.

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

And Today We Are…

- Cascade Natural Gas Corp. serves approximately 299,000 customers in 96 communities – 68 of which are in Washington and 28 in Oregon. Cascade's service areas are concentrated in western and south central Washington, and south central and eastern Oregon.
- Today, Cascade serves a diverse service territory covering more than 32,000 square miles and 700 highway miles from one end of the system to the other. Interstate pipelines transmit Cascade's natural gas from production areas in the Rocky Mountains and western Canada.

CASCADE NATURAL GAS CORPORATION
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Purpose of the IRP

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

IRP Guidelines and Content

Washington

- IRP Guidelines from WUTC WAC 480-90-238.

Cascade's Basic Philosophy

- Primary purpose of Cascade's long-term resource planning process has been, and continues to be, to inform and guide the Company's resource acquisition process, consistent with state regulatory requirements.
- Input and feedback from the Company's Technical Advisory Group (TAG) is an important resource to help ensure that CNGC's IRP is developed from a broader perspective than Cascade could have on its own.
- Cascade continues its commitment to securing and supporting the appropriate internal and external resources necessary to work with all stakeholders to produce a 2020 Integrated Resource Plan that meets the requirements of Washington Administrative Code 480-90-238.

Purpose of the IRP

- The purpose of an IRP is to depict the <u>overall</u> Company plan more <u>transparently</u> …
    - For immediately-contemplated actions (i.e., in the next two to four years);
    - To characterize emerging issues and related approaches for mitigation, if necessary; and
    - To outline the long-term direction a company is headed *vis-a-vis* the industry, including economic trends, industry structure (partners such as the pipeline(s) and their impact/actions), technology, customer usage, etc.

CASCADE NATURAL GAS CORPORATION
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

IRP Objectives

- Present a transparent roadmap of the overall corporate plan per the previous slide.
- Promote internal coordination.
- Describe to key stakeholders and the public the complex utility system unique to the local distribution company (LDC) and management decision-making processes.
- Provide previews of future projects and issues which can lead to improved regulatory filings.
- Meet regulatory requirements.

8

CASCADE NATURAL GAS CORPORATION
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Benefits

- A company can describe its unique circumstances, opportunities and challenges over the planning horizon.
- More specifically, while commissions do not approve the IRP—and, hence future actions—the description of potential actions generally provides for an improved process of future filings, because stakeholders have a basis, in advance, for what is driving those decisions.

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

In Conclusion

- An IRP provides an understanding of industry and utility-specific practices.
- That the Commission acknowledges the plans, rather than approve them, does not lessen the process's regulatory importance.
- The commitment from Cascade's senior leadership has been outstanding and recognized by stakeholders.

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

IRP Process

Overview of IRP Process

- Scoping
  - Work Plan, Outline, and Timeline
- Address Topical Areas
  - Studies, Analyses, and Narratives
- Gain input through iterative external engagement
- Integrate
- Draft Plan
- Final Plan

TAG Meetings in the IRP Process

- Cascade believes the TAG meetings are of significant value to the IRP process, and encourages as much active stakeholder participation as possible.
- Feedback from stakeholders is critical to the production of a document that clearly and effectively communicates the Company's plan to acquire the reasonably lowest cost mix of reliable natural gas supply and conservation resources to serve forecasted demand.
- Five TAG meetings will be held, with a potential sixth scheduled if needed.
- Multiple opportunities for public participation will be made available.

CASCADE NATURAL GAS CORPORATION
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Meeting Principles

- TAG meetings will be effective if…
  - Start and end on time, with participants fully present.
  - Allow for open, inclusive and balanced participation and discussions.
  - Ask questions.
  - Slides are disseminated to stakeholders in advance, and reviewed by stakeholders prior to the meeting.
  - Be clear about next steps and action items.
  - Deadlines to hit milestones are described and respected by all parties.

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Importance of Milestones

- The IRP team plays an internal coordination role, assisting many departments working as one.
- This can be challenging, as each department has its own core function beyond the IRP.
- Milestones allow the Company to achieve this task while being respectful of each other's individual challenges and workload.
- The Company has critical milestones related to the completion of its load forecast, price forecast, avoided cost, and other critical processes. These often inform other parts of the IRP process, and must be met on time. For example, the load forecast needs to be locked in shortly after TAG 2.

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Best Practices Discussion

Context

- Cascade is proud of its acknowledged 2018 IRP but recognizes the importance of continuing to improve and grow.
- To this end, Cascade has actively been engaged in following the IRPs of other regional LDCs. This includes reading their IRPs and attending their versions of TAG meetings.
    - The goal has been to learn IRP best practices across the industry and take back applicable elements to include in our IRP.
    - In the spirit of this, Cascade encourages stakeholder to tell us if there is an element of another LDC's IRP that they believe is particularly well done.
    - As stated earlier, Cascade has its own unique challenges and demographics, and will produce an IRP specific to Cascade.
- Cascade encourages feedback on its proposed approach to the following IRP elements, either today or future TAG meetings.

Key Items for Best Practices

- Welcomes input from stakeholders.
- Recognize stakeholders are busy so, therefore, seek to optimize participation (See Stakeholder Engagement Document).
- Provide for iterative and collaborative process.
- Promote gaining all perspectives.
- Reduce barriers with clear communication and data.

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Key Items (Continued)

- Create transparency with availability of Cascade staff for analyst-to-analyst discussions throughout process.
- Memorialize Cascade's commitments (per Stakeholder Engagement Document).
- Requests of stakeholders.
- Recognize important aspects, such as:
  - Cascade's need to lock down certain components early in process.
  - Stakeholders as point of contact within organization and coordinate organizational positions (as best as possible).

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

IRP Team

INTERNAL TEAM MEMBERS OF CNGC'S INTEGRATED RESOURCE PLAN:

LAST NAME	FIRST NAME	TITLE	COMPANY
Archer	Pam	Regulatory Analyst IV	Cascade
Burin	Kary	Supervisor, Energy Efficiency	Cascade
Chiles	Mark	Vice President, Customer Service and Regulatory Affairs	Intermountain
Connell	Kevin	Director, Gas Supply Utility Group	MDU
Cooley	John	Manager, Industrial Services	Cascade
Cowlishaw	Monica	Manager, Energy Efficiency & Community Outreach	Cascade
Cunnington	Brian	Manager, Industrial Services	Cascade
Davis	Ashton	Resource Planning Analyst, Gas Supply	Cascade
Folsom	Bruce	Consultant	Bruce W Folsom Consulting LLC
Goodman	Chad	System Administrator	Cascade
Hensyel	Phillip	Lead Economic Energy Efficiency Analyst II	Cascade
Krebsbach	Abbie	Director, Environmental	MDU
Madison	Scott	Executive Vice President, Business Development and Gas Supply	MDU
Martuscelli	Eric	Vice President, Operations	Cascade

CASCADE NATURAL GAS CORPORATION
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

INTERNAL TEAM MEMBERS OF CNGC'S INTEGRATED RESOURCE PLAN:

LAST NAME	FIRST NAME	TITLE	COMPANY
McGreal	Devin	Resource Planning Analyst, Gas Supply	Cascade
Mellinger	Becky	Financial Analyst	Cascade
Myhrum	Isaac	Regulatory Analyst II, Regulatory Affairs	Cascade
Offerdahl	Linda	Engineering II, Engineering	Cascade
Parvinen	Mike	Director, Regulatory Affairs	Cascade
Robbins	Chris	Manager, Gas Supply and Control- CNGC/IGC	Cascade/ Intermountain
Robertson	Brian	Supervisor, Resource Planning, Gas Supply	Cascade
Sellers-Vaughn	Mark	Manager, Supply Resource Planning	Cascade
Senger	Garret	Executive Vice President, Regulatory, Customer Service and Administration	MDU
Sorensen	Renie	Manager, Engineering	Cascade
Spector	Alyn	Manager, Conservation Policy	Cascade
Stone	Carolyn	Gas Supply Analyst III	Cascade
Tyssen	Nathan	Network Administrator	Cascade
Wood	Eric	Supervisor, Gas Supply	Cascade/ Intermountain

CASCADE NATURAL GAS CORPORATION
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Recommended IRP Improvements from WUTC

Validation of methods

- The Commission agrees that Cascade has made dramatic improvements in its modeling since its 2014 IRP. This is primarily the result of the expansion and increased expertise of the resource planning team. Their description in Appendix L of the Company's statistics and modeling methods, and the advantages and disadvantages of the modeling improvements, is detailed and refreshingly frank. The Commission appreciates the quality and transparency of this work. We encourage the Company to continue to review these methods for the purpose of validating whether they are producing the most accurate results possible.

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Recommended IRP Improvements from WUTC

Greenhouse gas emissions modeling

- With the passage of E3SHB 1257, requiring the use of the social cost of carbon in conservation planning, Cascade's future plans are required to incorporate the social cost of carbon. The Commission considers Cascade well positioned to achieve compliance with the law's planning requirements and full implementation of the achievable conservation potential.

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Recommended IRP Improvements from WUTC

Modeling of significant emergency events

- On October 9, 2018, a natural gas pipeline ruptured in northern British Columbia, Canada, causing Washington's natural gas distribution utilities (including Cascade) to take significant actions to ensure that they could continue to serve their customers. While this incident was an extreme occurrence not likely to be repeated, it was a significant enough event to warrant concern among the Commission and Washington's natural gas utilities.
- The British Columbia rupture event highlights the risks inherent in depending too heavily on any one resource to meet a Company's obligations to core customers. In its Plan, Cascade modeled several scenarios that limited supply from its various resources (including British Columbia) throughout the 20-year planning horizon. These scenarios could serve as the basis for modeling short-term emergency situations. The Commission encourages Cascade to expand upon the results of these scenarios, and work with Staff to identify the appropriate parameters around any additional emergency modeling that should be presented in the 2020 IRP.

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Recommended IRP Improvements from WUTC

Clarify distribution system planning priorities

- In Section 9, Cascade's IRP highlights three particular distribution projects and provides some details of each project. Unfortunately, these three projects are not necessarily the most important distribution projects planned by the Company. In future IRPs, we recommend that Cascade highlight projects of particular importance that would reasonably be of interest to the Commission, Staff, and the public.

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Recommended IRP Improvements from WUTC

Continue to monitor renewable natural gas opportunities

- Cascade for the first time evaluated potential renewable natural gas (RNG) supply options. As of the filing of the final IRP, the Company does not anticipate utilizing RNG during the planning period. The enactment of E3SHB 1257 encourages the development of RNG resources and provides guidelines to companies that opt to serve their customers with RNG. The Commission encourages Cascade to model any technically feasible RNG projects in its future IRPs. This should include a discussion of the quality of RNG, its suitability for integration into the utility's natural gas system, and quantities of RNG that the system can safely accommodate. In addition to technical modeling, Cascade should ensure the economics of a RNG project are consistent with the provisions of Section 13 of E3SHB 1257, particularly regarding cost and value of environmental attributes. We encourage Cascade to continue engagement with the Commission as well as the Department of Commerce on implementation of E3SHB 1257.

Recommended IRP Improvements from WUTC

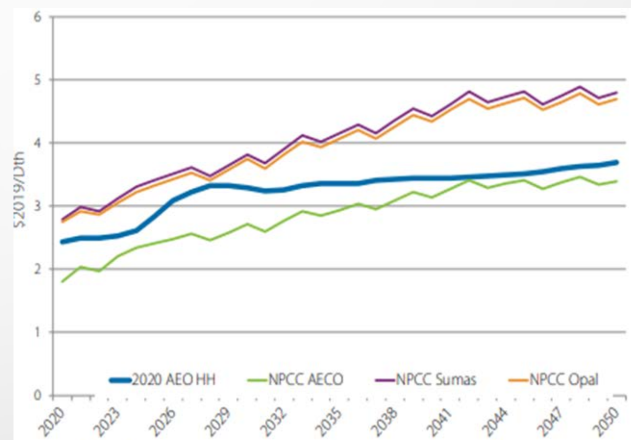
Public participation

- The Commission understands that the IRP process is technical and information heavy. Still, we encourage Cascade to consider all options for engaging additional stakeholders in the process.

Regional Market Outlook

Regional Market Outlook

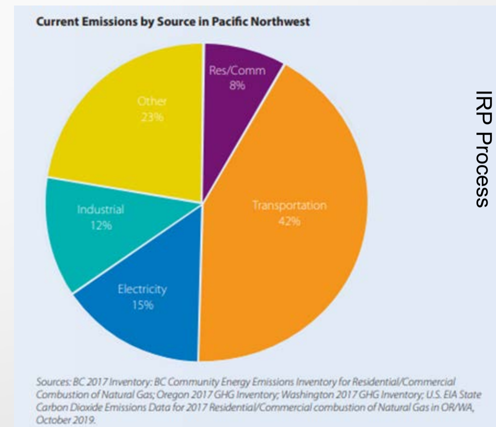
- According to various industry analysts, the natural gas market seems to be stuck in a wait-and-see mode as "traders and analysts seek more clarity on the impacts of coronavirus containment measures…" Cascade is continuing to monitor impacts on demand. [1]
- On March 17th, WUTC acknowledged the 2019 Hedge Plan. In the letter, the Commission stated that they "appreciate each utility's unique circumstances and recognizes that each utility's hedging portfolio has been tailored to respond to that company's unique market exposure." Additionally, the letter provided notice that future hedge plan filings will need to coincide with PGA filings, which Cascade is currently preparing to do.
- "EIA forecasts that prices will begin to rise in the second quarter of 2020 as U.S. natural gas production declines and natural gas use for power generation increases the demand for natural gas." [2]



Source: EIA 2020 Annual Energy Outlook; NPCC – Fuel Price Forecast, June 2019 Update

Regional Market Outlook (Cont.)

- On March 10th, Gov. Kate Brown of Oregon issued an executive order regarding cap and trade aimed at curbing greenhouse gas emissions. "Like SB 1530, Brown's order updates the state's carbon reduction goals, setting targets of a 45% reduction below 1990 levels by 2035, and an 80% reduction by 2050." [3]
- In mid-March, the Federal Energy Regulatory Commission voted to conditionally approve the Jordan Cove LNG export project located in Coos Bay, Oregon. This includes the Pacific Connector Gas Pipeline related to the project. Numerous market challenges remain, so this isn't a guarantee that the terminal and pipeline will be built.
- According to the EIA 2020 Annual Energy Outlook, Natural Gas pricing will remain under $4/MMBtu through 2050 largely due to low cost resources and higher production.
- Currently, the major Columbia Basin reservoirs range from a height of 913'-1569', while the five major Oregon River Basins range from 40%-85% (2019: 52%-87%) filled.



Key IRP Discussions for Future IRP Meetings

Load Forecast

- The Company currently utilizes an Autoregressive Integrated Moving Average (ARIMA) methodology with Fourier terms to predict customer count and usage.
- Cascade uses a 60 degree reference temperature to calculate HDDs.
- Multiple scenarios are analyzed such as high/low growth, warm/cold weather, peak day events, etc.
- Cascade has continued to evaluate other potential predictors such as housing starts, but have encountered the same problem as other regional LDCs related to the availability of data to accurately reflect its service area.

CASCADE NATURAL GAS CORPORATION
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Customer Forecast

- $C^{CG,Class} = \alpha_0 + \alpha_1 Pop^{CG} + \alpha_2 Emp^{CG} + Fourier(k) + ARIMA \in (p,d,q)$
- Model Notes:
  - C = Customers; CG = Citygate; Class = Residential, Commercial, Industrial, or Interruptible; ARIMA∈(p,d,q) = Indicates that the model has p autoregressive terms, d difference terms, and q moving average terms; Pop = Population; Emp = Employment; Fourier(k) = Captures seasonality of k number of seasons.

CASCADE NATURAL GAS CORPORATION
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Use Per Customer Forecast

- Therms/$C^{CG,Class} = \alpha_0 + \alpha_1 HDD^{CG,D} + \alpha_2 Wind^{CG,D} + \alpha_3 I^{w}$ + ARIMA$\in$(p,d,q)
- Model Notes:
  - Therms/C = Therms per customer; CG = Citygate; Class = Residential, Commercial, Industrial, or Interruptible; HDD = Heating Degree Days; Wind=Average Windspeed; D= Day; I_w = Indicator Variable set to 1 if it is a weekend; ARIMA$\in$(p,d,q) = Indicates that the model has p autoregressive terms, d difference terms, and q moving average terms.

Hedging

- Cascade is actively involved with Washington Utilities and Transportation Commission (WUTC) Docket UG 132019, Inquiry into Local Distribution Companies' Natural Gas Hedging Practices and Transaction Reporting.
  - Cascade filed the 2019 Annual Hedge Plan on September 12, 2019 and received an acknowledgement letter on March 17, 2020.
  - The Commission stated that they "appreciates each utility's unique circumstances and recognizes that each utility's hedging portfolio has been tailored to respond to that company's unique market exposure."
  - The 2019 Annual Hedging Plan will be filed on or before July 23rd , 2020.

Avoided Cost

- Cascade is closely following a number of dockets related to the treatment of the avoided cost calculation for electric utilities in Washington.
- New to the 2020 IRP, the Company will incorporate a value for the impact of peak hour, to be used in conjunction with distribution system values.
- Cascade has continued its active participation in UM 1893, Staff Investigation of Methodology and Process of EE Cost-Effectiveness in Oregon.

Avoided Cost Formula

$$AC_{nominal} = TC_f + TC_v + SC_f + SC_v + (CC * C_{tax} * E_{adder}) + (DSC * HM) + RP$$

Where

- $AC_{nominal}$ = The nominal avoided cost for a given year. To put this into real dollars you must apply the following: Avoided Cost/(1+discount rate)^Years from the reference year.
- TC_f = Incremental Fixed Transportation Costs
- TC_v = Variable Transportation Costs
- SC_f = Incremental Fixed Storage Costs
- SC_v = Variable Storage Costs
- CC = Commodity Costs
- C_{tax} = Carbon Tax
- E_{adder} = Environmental Adder, as recommended by the Northwest Power and Conservation Council
- DSC = Distribution System Costs
- HM = Hourly Modifier
- RP = Risk Premium

Energy Efficiency

- The IRP team is an active participant in Cascade's Conservation Advisory Group (CAG). The Company will continue to integrate relevant aspects of the CAG meetings in its IRP process.
- The Company is currently in contract talks with Applied Energy Group (AEG) and is on track to finalizing the CPA in Q2. The negotiations include a two phase updated CPA for our 2020 and 2022 IRP's with phase one using much of the 2018 IRP data as it is still relevant with phase two being a full comprehensive update. The DSM section will also include a re-run of the model's potential based on updated inputs for 2020 and a recap of some of the elements contained within the Conservation Plan.

Carbon

- The Company will continue to comply with SB 5116 by using the Social Cost of Carbon (SCC) as its primary carbon forecast.
- Cascade will continue to analyze various carbon reduction scenarios in its 2020 IRP, including a stochastic carbon scenario that is new to the 2020 IRP.
- The Company will determine the impacts of regional carbon policy and will model the impacts of restrictions on the use of natural gas within local communities.
- Cascade will continue to work with its regulators and Commerce to ensure compliance with the requirements of HB 1257, and to understand any potential impacts to resource planning.

Environmental Policy

- Provides environmental regulatory interpretation and compliance support and policy review for all Company facilities and operations across all eight states.
- There are six full time employees and we are zoologists, biologists, chemists, engineers, a certified hazardous material manager, and also have degrees in environmental sciences and natural resources management.
- We review and draft the Environmental Considerations and Policy section of IRP in collaboration with IRP Team
- As Director, I have a chemical engineering degree and have had the opportunity to work directly in the majority of environmental subject matter areas that we cover for the Company.

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Renewables

- Cascade has an internal Renewable Natural Gas Working Group that is led by Industrial Services. Other members include; Regulatory, Business Development, Energy Efficiency, Public Affairs, Resource Planning Team, and Gas Supply
- Cascade is getting several inquiries from the developers of prospective RNG projects in both Washington and Oregon. Cascade is having ongoing discussions and weighing each opportunity.
- Two members of Cascade will be running a WEI session during the WEI RNG Conference.
- Cascade is monitoring HB1257 in Washington as well as SB98 in Oregon. The Company is working with other LDCs and industry groups to respond to the legislation.

Distribution System Planning

- 2020 IRP includes a discussion of the elements utilized in distribution system planning to determine needed system enhancements.
- Cascade will provide all planned WA projects and costs under confidential treatment.
- Cascade encourages stakeholder feedback related to distribution system planning.

Stochastic Analysis

- Cascade appreciated stakeholder feedback requesting further stochastic analysis in the Company's 2018 IRP.
- In the 2018 IRP, Cascade only ran stochastic analysis on the preferred deterministic portfolio.
- For the 2020 IRP, Cascade will perform Monte Carlo simulations on all potential portfolios before scenario and sensitivity testing.

Resource Integration

- Cascade will stochastically test multiple portfolios in its 2020 IRP to capture the extrinsic value of all portfolios before selecting a candidate portfolio.
- This candidate portfolio will then be tested through stochastic scenario and sensitivity modeling.
- Cascade will compare the Value at Risk (VaR) of the candidate portfolio in each scenario/sensitivity to a VaR limit to ensure that the extrinsic risk of the portfolio is within tolerable levels.
- Cascade will detail its determination of future long-term resource needs, its analysis of the expected costs and associated risks of the alternatives to meet those needs, and its action plan to select the best portfolio of resources to meet those needs.

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

2020 IRP Schedule

Date (Subject to change)	Process Element	Location (Subject to change)
Wednesday, April 8, 2020	TAG 1 slides distributed to stakeholders	
Wednesday, April 15, 2020	**TAG 1: Process, Key Points, IRP Team, Timeline, Regional Market Outlook, Plan for dealing with issues raised in the 2018 IRP**	**Skype/Teleconference Meeting Only**
Wednesday, May 13, 2020	TAG 2 slides distributed to stakeholders	
Wednesday, May 27, 2020	**TAG 2: Demand and Customer Forecast and Non-Core Outlook, Drilling down into segments of demand forecast. Upstream Pipeline presentation.**	**SeaTac Airport - 9 am to 12 pm**
Wednesday, June 17, 2020	TAG 3 slides distributed to stakeholders	
Wednesday, June 24, 2020	**TAG 3: Distribution System Planning, Planned Scenarios and Sensitivities, Alternative Resources, Price Forecast, Avoided Costs, Current Supply Resources, Transport Issues.**	**SeaTac Airport - 9 am to 12 pm**
Wednesday, July 29, 2020	TAG 4 slides distributed to stakeholders	
Thursday, August 6, 2020	**TAG 4 Carbon Impacts, Energy Efficiency, Bio-Natural Gas, Preliminary Resource Integration Results.**	**Community Service Room in Bellingham, WA - 9 am to 3 pm**
Wednesday, September 16, 2020	TAG 5 slides distributed to stakeholders	
Wednesday, September 23, 2020	**TAG 5: Final Integration Results, finalization of plan components, Proposed new 4-year Action Plan.**	**SeaTac Airport - 9 am to 12 pm**
Tuesday, November 17, 2020	Draft of 2020 WA IRP distributed	
Wednesday, December 23, 2020	Comments due on draft from all stakeholders	
Wednesday, January 27, 2021	TAG 6, if needed	WebEx Only
Friday, February 26, 2021	IRP filing in Washington	

Questions/Next Steps

- Review Plans for TAG 2 Discussion
  - Demand and Customer Forecast.
  - Non-Core Forecast.
  - Pipeline Capacity Overview.
  - Next TAG is Wednesday, May 27th in the Amsterdam room at the Seattle-Tacoma Airport Conference Center.

Cascade Natural Gas Corporation

Integrated Resource Plan
Technical Advisory Group Meeting #1

April 15th, 2020

Skype/Teleconference

CASCADE NATURAL GAS CORPORATION
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

TAG #1 – WUTC TAG Meeting

Date & time: 04/15/2020, 9:00 to 11:20 AM

Location: Skype Meeting

Presenters: Brian Robertson, Devin McGreal & Ashton Davis

In attendance: Mark Sellers-Vaughn, Brian Robertson, Devin McGreal, Ashton Davis, Alyn Spector, Kary Burin, Phillip Hensyel, Monica Cowlishaw, Brian Cunnington, Carolyn Stone, Chris Robbins, Eric Wood, Kevin Connell, Linda Offerdahl, Mike Parvinen, Bruce Folsom, Abbie Krebsbach, Garret Senger, Andrew Rector – WUTC, Nicholas Columbo – OPUC, Mike Paruszkiewicz – NWN, Chad Stokes – Cable Huston, Marty Saldivar – NWP, Mark Iverson – Ruby, Corey Dahl – Public Counsel

Minutes: Carolyn Stone

Brian began the meeting with a Safety Moment asking if we all know the exits to our home offices in the event of an emergency. Brian also reminded everyone that we are abiding by the CDC guidelines regarding COVID 19 and went through introductions.

Brian went through the Agenda for the meeting and introduced Bruce Folsom by stating that he brings industrial knowledge and helped them build the IRP and helped the Resource Planning team understand the dynamics of the industry – kudos to Bruce for his expertise!

Bruce thanked Brian and gave the group a bit of his background. He was in the regulatory world at WUTC, then went into Energy Efficiency and IRP's. At Avista, he was in regulatory for 13 years, then moved into Energy Efficiency. For the last 4 years he has been a part time consultant and said it is a pleasure working with Cascade!

Presentation #1 – A LITTLE HISTORY LESSON (Mark Sellers-Vaughn)

Presentation #2 – PURPOSE OF THE IRP (Brian Robertson)

Presentation #3 – IRP PROCESS (Brian Robertson)

- Brian said that after TAG #2, the load forecast was the milestone used to feed the avoid cost calculation and for energy efficiency needs.
- Each step feeds a step in the process and get feedback locked in early, but it is OK to give feedback later in the process as well!

Question: Andrew asked if they could go back to the stakeholder document and...in lieu of the new social distancing practices, does this document need changing?

Answer: Brian said they put together the stakeholder document thinking we would be having face to face meetings. Brian said he will look back at this document to see if there is anything regarding the "reasonable accommodation – meeting locations" section – this may fall into the type of item you are discussing.

- Mark added that it is important to recognized, that they favor "face to face" meetings, but the process is designed for either way. He said they don't foresee anything creating conflicts or delays. The process should produce the same quality IRP, as with normal standards.
- Andrew added that he wasn't sure if the current situation changes things. Brian thanked Andrew for his feedback!

Presentation #4 – BEST PRACTICES DISCUSSION (Brian Robertson)

Validation of Methods

- Brian askes what Staff had in mind for validation methods.
- We are keeping Appendix L in the IRP (pros/cons of models and methodologies).
- Improving models – We are using SENDOUT®, but we have reached out to another company to replace SENDOUT®.
- Brian said his question to Andrew is, are you looking for more?

Question: Andrew asked about replacing SENDOUT®, you're looking into another software?
Answer: Brian said "Yes, we are in discussions with them". However, the vendor is not at the point where SENDOUT® is now. They are doing a test trail this summer and will move on from there.

Question: Andrew stated that since CNGC's last IRP, there are significant and beneficial changes to the modeling process. He asked, "Are those working as expected?"
Answer: Brian asked, in reply, if Andrew was asking about specific types of changes to optimization or resource integration or the Load forecast/Avoided Cost calculations?

Andrew specified the "Stochastic Model – Cholesky Matrix". He said he will look and see if there were others and forward ideas.
Brian thanked Andrew and said that was helpful!

Slide #24 – Recommendations (cont'd)

- Brian brought up the recommended improvements to the Greenhouse Gas (GHG) modeling. They are using the social cost of carbon with a 3% discount rate. In Section 15 of the IRP there is mention of a 2.5% discount rate? Brian asks if WUTC would rather use 2.5% rather than 3%?
- Andrew replied "Yes", 2.5%.

Slide #25 – Recommendations (cont'd)

Modeling of Significant Emergency Events

- Gas structure in BC in October 2018 - In the past we limit gas that we get from Alberta & Rockies to imitate this event – can't model all elements of emergency.
- Should we put in more narrative about the scenarios where we limit gas or can't get gas...?

- Andrew said put more narrative in, not much there around the scenarios…the biggest way to address this. Show what the impact is if/when the event happens…and what the unserved demand would be.
- Brian asked if anyone else would like to add to this? There was no further comment.

Presentation #5 – REGIONAL MARKET OUTLOOK (Ashton Davis)

- Ashton started with a "snapshot of the region".
- As far as COVID 19's impact – analysts agree to "wait & see", looking for clarity and we need more data. CNGC continues to monitor.

Question: Dan Kirschner asked about "anecdotal evidence"?

Answer: Brian said they attended a WBI conference and it was brought up after that weather normalization demand is down 1-3%. More on electric side, no evidence on the gas side.
Ashton said they are doing demand forecast analysis right now so will provide more information.

Presentation #6 – KEY IRP DISCUSSIONS FOR FUTURE IRP MEETINGS (Ashton Davis)

- Ashton started by stating that they really need feedback!

Question: Andrew had 2 questions:
1. Remind me when the PGA filings take place?
2. Jordan Cove, what is the involvement?

Answer: Ashton said that the PGA filings are in late summer early fall. Mike Parvinen stated that the filing is done by October 1 – Nov 1. They file 2 weeks early, but it is effective November 1 in both states. As far as Jordan Cove, Ashton stated that they are just monitoring that to see how it impacts the region – no monetary involvement.

Slide #33 - Load Forecast

- Ashton explained that this slide shows their primary drivers
- In TAG #2, we will dig into the results.
- We use a dynamic regression model
- They use a 60-degree HDD and ARIMA
- Scenarios high/low growth & stochastic analysis

Slide #34 – Customer Forecast
- Customer forecast
- Model Notes – Citygate by class

Slide #35 – Use per Customer Forecast
- Regression on HDD's, Wind & use ARIMA
- Therms per customer

Ashton ended asking if there were any further questions on his presentation? There were none.

Slide #36 – Hedging (Devin McGreal)
- Docket UG #132019

- On 9/12/2019 CNGC filed 2019 Annual Hedge Plan. Plan was acknowledged on 3/17/2020.
- Devin said we have other needs that other utilities do not have... different regulatory needs
- We are willing to look at utilities individually
- 2020 Annual Hedge Plan will be filed on or before 7/23/2020.
- Mark said the 2020 Annual Hedge Plan draft will be **READY** on 7/23 for management to review. Devin said that is correct.

Slide #37 - **Avoided Cost**

- Finding regional diversities...
    - New 1 – incorporating value for impact of Peak Hour used in conjunction with distribution system values & savings that occur.
    - New 2 – Capacity risk premium value – Theoretical value to be hedged – if purely hedged! Tested 2 years ago and included in OPUC IRP....value comes up negative – high premium. Could be zero again.

Question: Andrew asked if UM 1893 is annually looked at, avoided cost numbers?
Answer: Devin replied that it is an annual process. The utilities come together and use inputs. These regional utilities say what the inputs will be.

Question: Andrew asked if it is a "Single Rule" used in calculation?
Answer:

1. Capital distribution system costs - $ invested.
2. Hourly modification looks at actual flows on cold days...i.e. how much more gas flowed on cold days. How much more on the coldest hour vs the average hour – this is important on distribution costs.

Andrew said he understand the concept and will wait for the TAG on avoided costs. Devin offered to give Andrew this information before that TAG meeting.

Slide #39 – **Energy Efficiency** (Monica Cowlishaw)

- Updates play into the IRP
- CPA approved by submission – February.
- There will be more on energy efficiency in a later TAG meeting.

Question: Andrew said he hasn't looked at what is planned for tomorrow yet....
Answer: Monica said there will be CPA and COVID update...we can dig into more tomorrow. Devin said resource planning will be attending!

Slide #40 – **Carbon** (Devin McGreal)

- Internal discussion on SB 5116, social cost of carbon as primary carbon forecast.
- WUTC uses a 3%, for 2.5% we have no qualms about that. He asked if there were any other opinions, from the group about the discount rate?
- Monica said, there are some calculations on custom projects on community projects – custom to be updated later.
- Corey said the main concern is the consistency across utilities. They are comfortable in moving forward incorporating social cost of carbon.

Slide #41 – **Environmental Policy** (Abby Krebsbach)

- We provide regulatory interpretation and policy review as best we can. We are in North Dakota but reaching out virtually. Nothing replaces being "on the ground". We are looking forward to getting back out in the field. There are 6 employees' and we value "all boots" on the ground.

Slide #42 – Renewables (RNG) (Brian Cunnington)

- Brian stated that they will have to get everyone involved in business development, regulatory in phone calling...about renewable natural gas. In the CNGC territory we are working closely with CNGC Gas Supply. How would we purchase it? We are working closely with Resource Planning at how it will be managed going forward. Continuously changing legislation on RNG and businesses in Washington, Oregon. On #2, there is a correction – lots of inquiries about RNG, but since the COVID 19 pandemic, there have been no new inquiries. Do we buy? Do they put gas on our system and sell it to industrial customers? We are looking at 4 good projects right now...putting gas into our distribution system. We are still in the discussion mode. We are going to conferences, keeping a finger on the pulse of RNG and what that looks like in the Pacific Northwest.
- We are monitoring HB 1257 in Washington and SB98 in Oregon. Other districts are going and keeping up.
- There will be more discussion as the year goes on... on methodologies and more to share down the road.
- Brian asked if there were any further questions?

Question: Andrew asked when the next RNG conference is?
Answer: Brian C said that the Western Energy meetings have one for RNG, brings utilities together to discuss and share. Alyn will be monitoring a session tomorrow AM...a virtual meeting. Andrew said he hopes it goes well. He will look at the website to view.

Slide #43 – Distribution System Planning (Linda Offerdahl)

- In 2020 IRP included methodology on planning
- We encourage feedback!
- The planning processes and methodology will be in June at TAG #3.

Slide #44 – Stochastic Analysis (Devin McGreal)

- The more stochastic analysis - we are on the ball with that!
- We use the lowest unserved/lowest cost. Should be done on all portfolios for risk management. Monte Carlo simulations will be done on all portfolios.

Question: Andrew asked what the thinking in Step #5 was (using the MAP) as in the 2018 IRP?
Answer: Devin said no, step #2 or #3 we start the ranking process. We are robust in how we are ranking the portfolios. Andrew said will it interested in hearing more about this later. Devin said "Absolutely!"

- Devin went on to explain that using multiple portfolios adds extrinsic value and shows resiliency.
- Once the candidate portfolio is selected, we do more testing. Not to "harp" but when we are doing this modeling it is important **not** to prescribe a certain "event" to modeling. If an unknown event happens, we position ourselves properly – I'm hesitant to call it a certain event. For example, events limiting storage...we try not to get too specific!
- Regarding the feedback from Andrew we received about extreme events. We can talk about what the impact is to cost or unserved demand. Scenario could be if contracts have no "evergreen" provision, for example.
- Devin asked if there were more questions about this?

- Andrew added that, it is understandable where you're coming from, and he is OK with that. It is not necessary to say you're modeling the Enbridge incident, but should show the impact in the narrative.
- Devin replied "Exactly" and asked if there were more questions.

Slide #46 – 2020 IRP Schedule (Brian Robertson)

- Brian thanked everyone for presenting. Hopefully, he said, we can meet faced to face in the future. He went over the schedule as follows:

TAG #2-	Demand Forecast
TAG #3-	June 24 – Distribution System Planning (SeaTac conference center)
TAG #4-	August 6
TAG #5-	September 23 – integration results, new 4-year action plan
NOV 17-	Draft distributed
JAN 27-	6th TAG meeting if necessary
FEB 26, 2021	Filing in Washington

- Brian asked if there were questions on the timeline or on anything else?
- Brian thanked everyone for their attendance!
- If there are no questions now, Brian said, thing about it and if you have them later, contact us.

The Meeting was Adjourned

Cascade Natural Gas Corporation

2020 WA Integrated Resource Plan
Technical Advisory Group Meeting #2

Wednesday, May 27th, 2020

Location - Teleconference

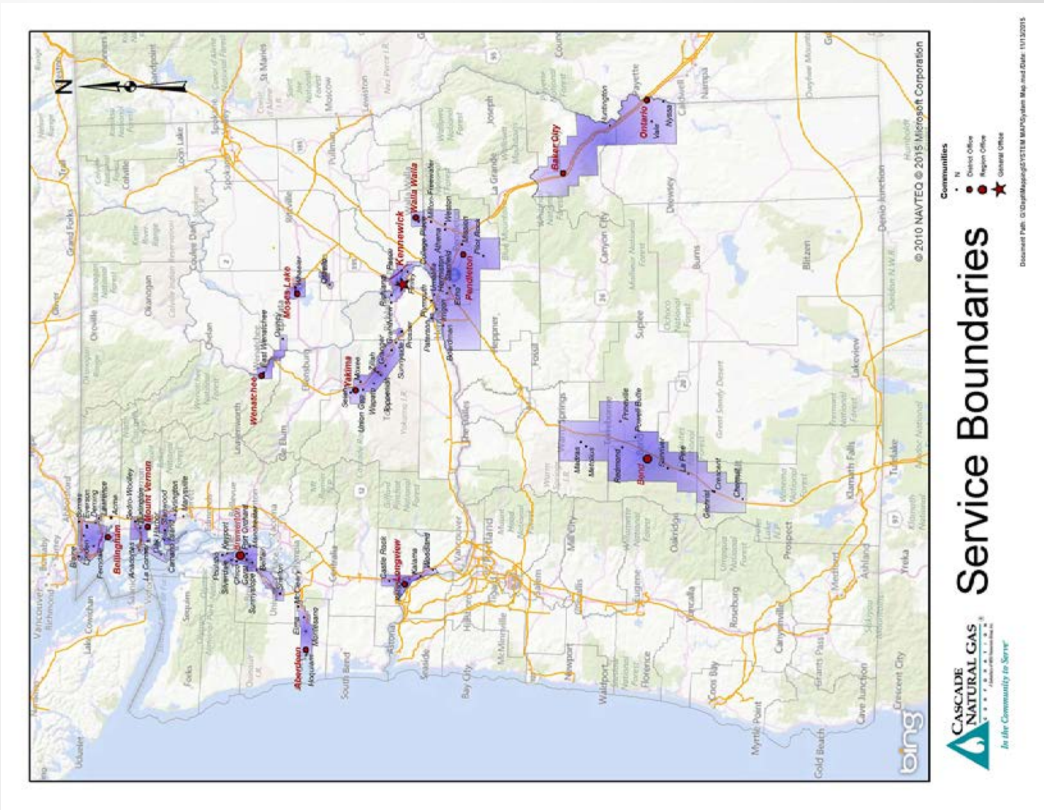
Agenda

- Introductions
- Safety Moment
- Demand Forecast
- Customer Forecast
- Forecast Results
- Non-Core Outlook
- Market Outlook and Long Range Price Forecast
- 2020 IRP Remaining Schedule

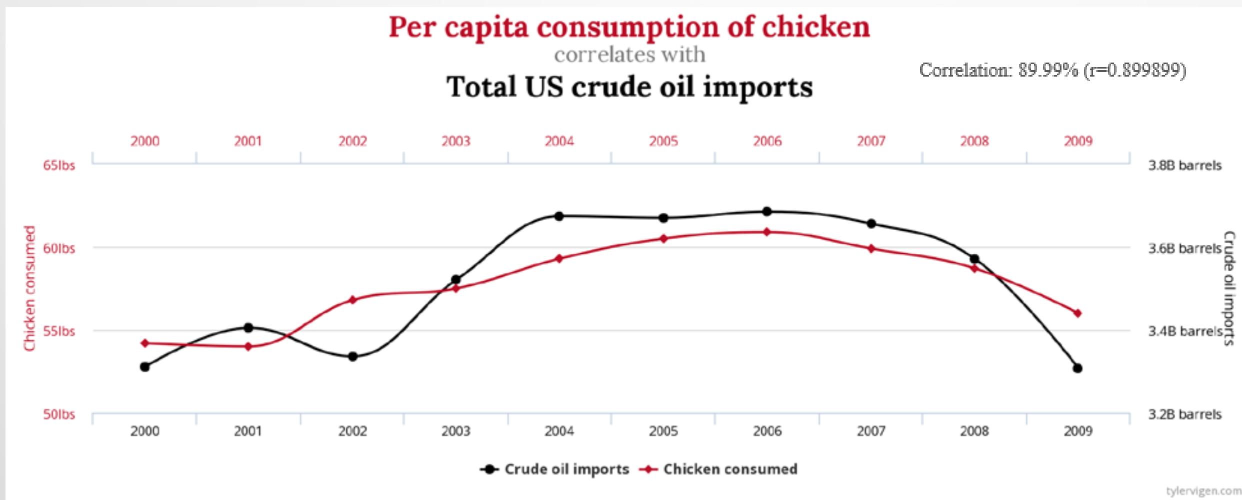
CASCADE NATURAL GAS CORPORATION
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Demand Forecast

4


Service Boundaries
© 2010 NAVTEQ © 2015 Microsoft Corporation
Communities

A Little Fun with Spurious Correlations…



In the Community to Serve®

Demand Forecast

- The Cascade demand forecast developed for the IRP is a forecast of customers, core natural gas demand, and core peak demand for the next 20 years.
- Demand is forecasted at:
  - the citygate and citygate loop level;
  - the rate schedule level; and
  - the daily level.

Key Definitions

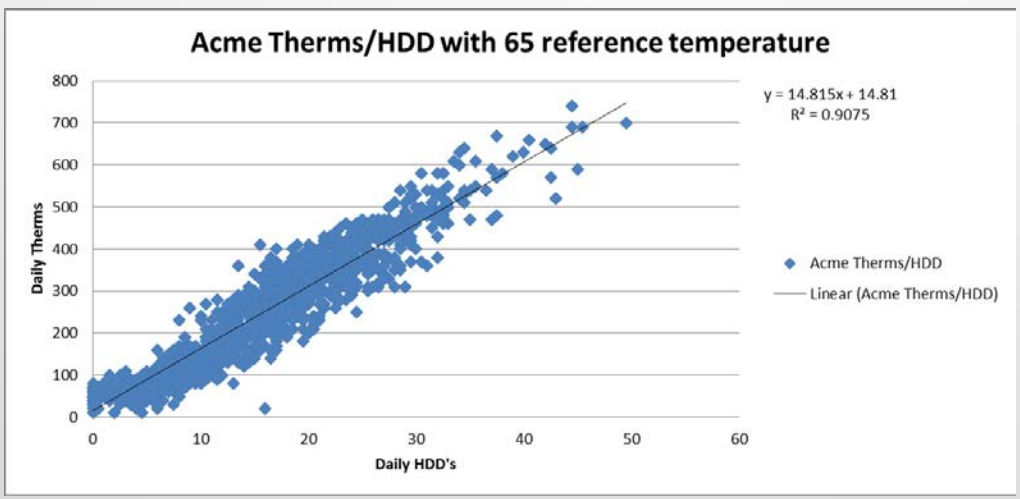
- AIC: The Akaike information criterion (AIC)
  - A measure of the relative quality of statistical models for a given set of data. Given a collection of models for the data, AIC estimates the quality of each model, relative to each of the other models. Hence, AIC provides a means for model selection.
- ARIMA: Auto-Regressive Integrated Moving Average
  - Type of model that is fitted to time series data.
  - When doing regressions using time series variables, it is common for the errors (or residuals) to have a time series structure. This could mean there is a predictable structure to the errors, meaning they can also be modeled. This is where the ARIMA term comes in.
- Define weather in terms of HDDs (Heating Degree Day).
- Citygate loops are a group of citygates that service a similar area that are forecasted together due to pipeline operations.

Key Assumptions

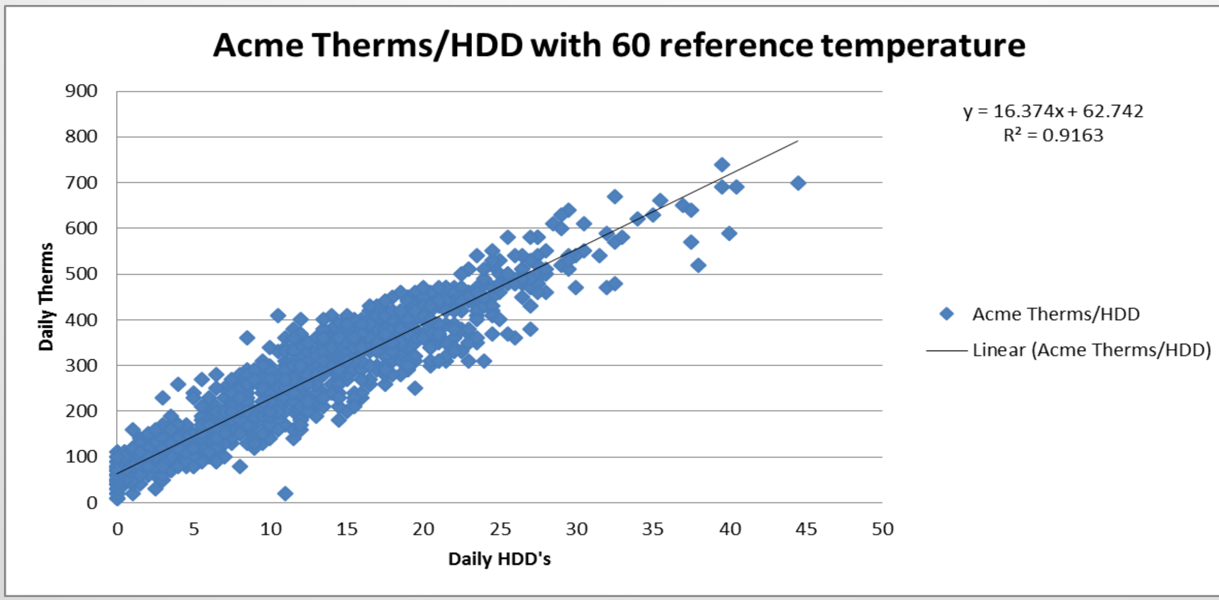
- Seven weather locations effectively cover Cascade's service territory.
- This forecast uses 30 years of recent weather history as the "normal" temperatures.
- Heating demand does not appreciatively start until average temps dip below 60° F, therefore a 60° F threshold is used to calculate heating degree days.

65 vs 60 HDD Threshold

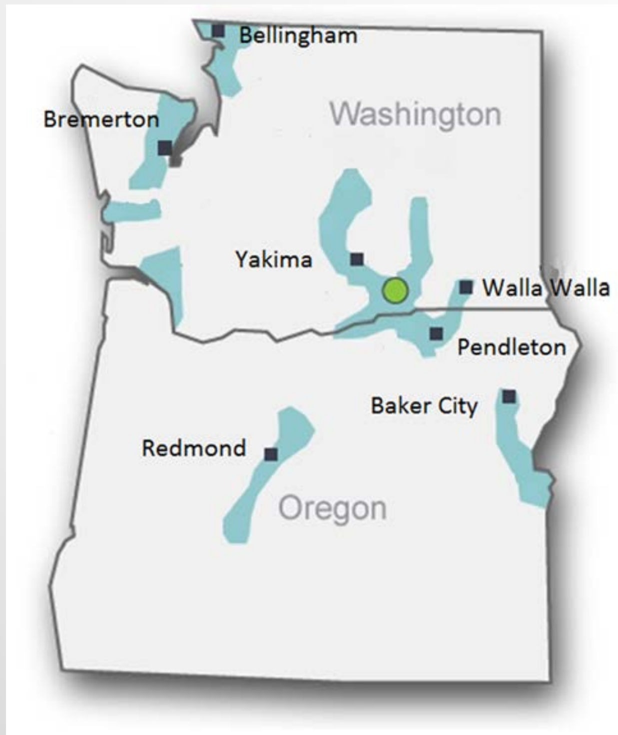
- The historical threshold for calculating HDD has been 65°F .
- It was determined that lowering the threshold to 60°F produces better results for Cascade's service territory.
- The graph shows that heating demand does not begin to increase until an HDD of five if the traditional 65°F is utilized.



Acme Therms/HDD with 60 degree reference temperature

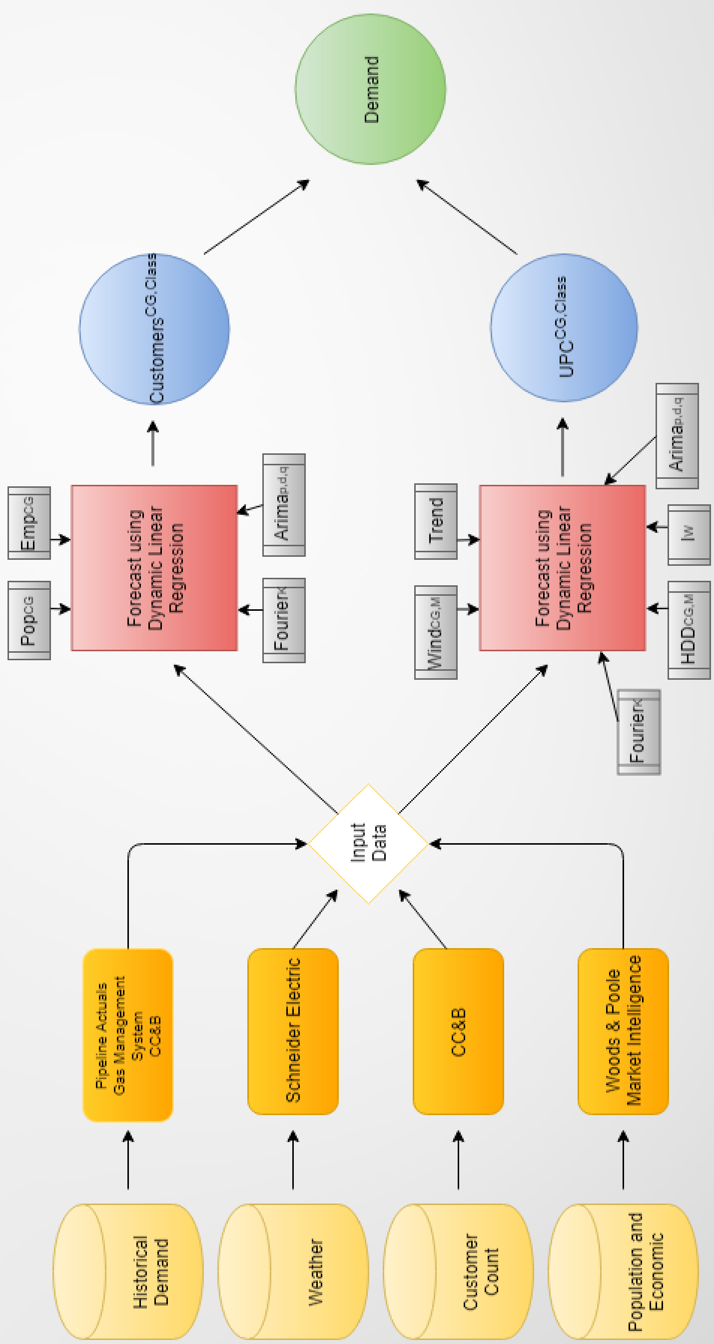


Weather Stations



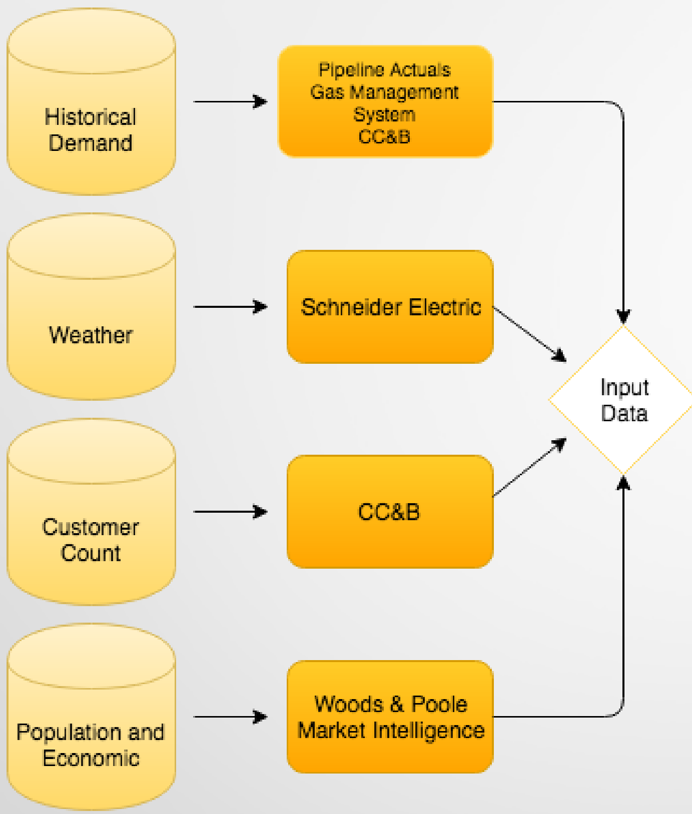
12

Process



Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

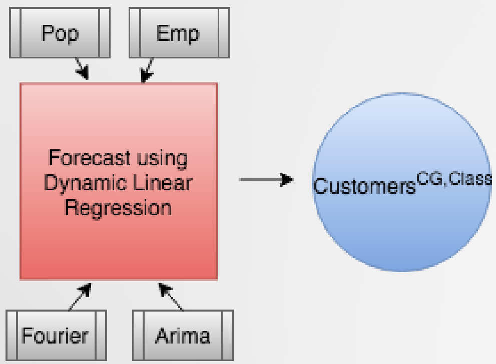
Inputs



- Pipeline actuals at Citygate level.
- Woods & Poole at county level.
- CC&B citygate allocations

Customer Forecast

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®



Customer Forecast

- $C^{CG,Class} = \alpha_0 + \alpha_1 Pop^{CG} + \alpha_2 Emp^{CG} + Fourier(k) + ARIMA \in (p,d,q)$
- Model Notes:
  - C = Customers; CG = Citygate; Class = Residential, Commercial, Industrial, or Interruptible; ARIMA∈(p,d,q) = Indicates that the model has p autoregressive terms, d difference terms, and q moving average terms; Pop = Population; Emp = Employment; Fourier(k) = Captures seasonality of k number of seasons.

Customer Forecast Inputs

CC&B Data

County		Populatic	Employme
ALBANY-LEBANON	OR	70.221	29.329
ASTORIA	OR	27.905	12.293
BAKER	OR	15.219	6.517
BEND	OR	29.726	12.947
BEND-PRINEVILLE	OR	39.554	17.551
BENTON	OR	51.491	19.344
BROOKINGS	OR	13.18	4.988
CLACKAMAS	OR	156.015	47.703

Acctg Year	Acctg Mon	Gate (Loop)	Rate	Number of Prem
2019	2	Bend/South Bend	CNGOR104	144
2015	2	Pendleton/Pilot Rock	CNGOR104	64
2018	8	Ontario/NYSSA/Vale	CNGOR101	5
2015	7	Hermiston	CNGOR101	4
2018	5	Mission	CNGOR104	18
2018	8	Gilchrist Cresent	CNGOR101	78
2016	5	Ontario/NYSSA/Vale	CNGOR104	19

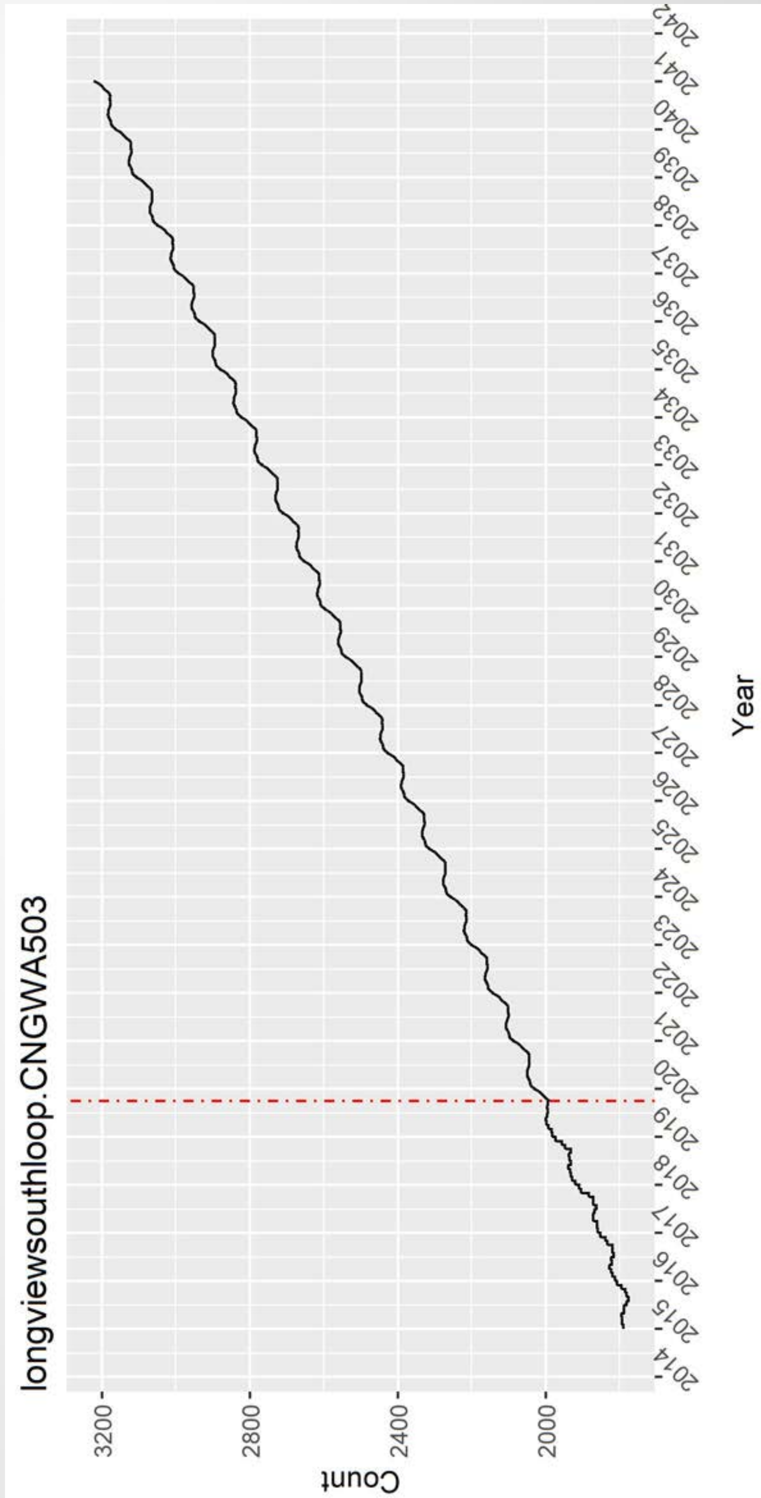
Model Selection

Xregs	AICc
Fourier	1505.389
Population + Fourier	1506.871
Employment + Fourier	1507.519
Employment	1562.932
Population	1566.24
Employment + Population + Fourier	1568.108
Arima Only	1597.354

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve

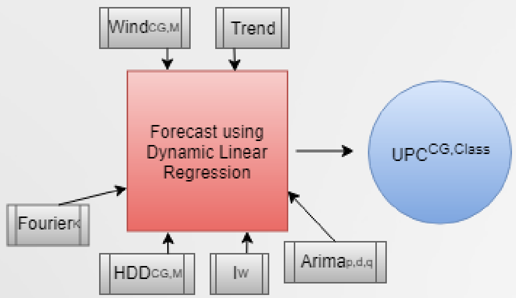
17

Customer Forecast



Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Use Per Customer Forecast



- Therms/$C^{CG,Class} = \alpha_0 + \alpha_1 HDD^{CG,M} + \alpha_2 I_w + \alpha_4 WIND^{CG,M}$ +Trend+ Fourier(k)+ARIMA$\in$(p,d,q)
- Model Notes:
  - Therms/C = Therms per customer; CG = Citygate; Class = Residential, Commercial, Industrial, or Interruptible; HDD = Heating Degree Days; M= Month; I_w = Indicator Variable set to 1 if it is a weekend; T = Trend Variable increasing by 1 for each day forecasted; WIND = Daily average wind speed.

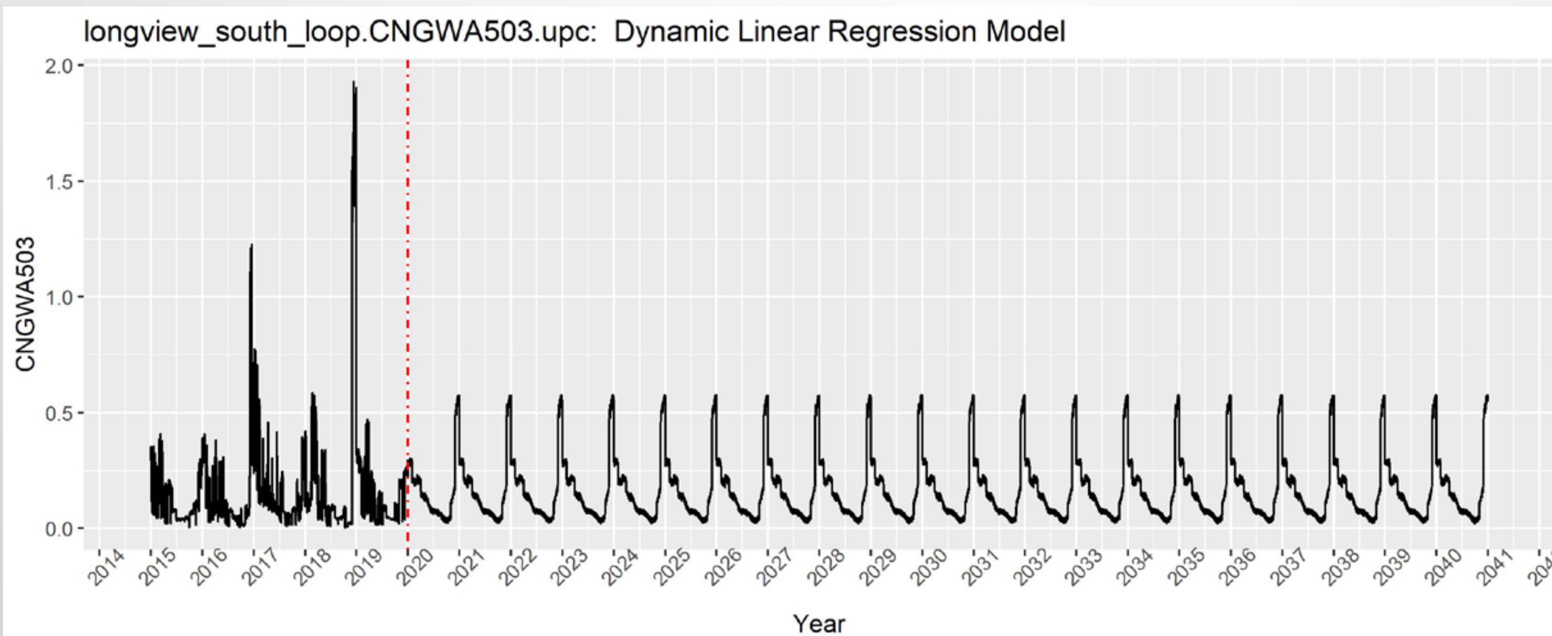
$$\text{Citygate/Rateclass} = \alpha_0 + \alpha_1 HDD^M + \alpha_2 I_w + \alpha_4 WIND^M + \text{Fourier} + \text{ARIMA}$$

Year.Month.Day	CNGOR101	weekend	jan.hdd	feb.hdd	...	nov.hdd	dec.hdd	jan.wind	feb.wind	...	nov.wind	dec.wind
1/1/2015	0.31838107	0	41.5	0	...	0	0	3	0	...	0	0
1/2/2015	0.380307614	0	39	0	...	0	0	2	0	...	0	0
1/3/2015	0.266972209	1	38.5	0	...	0	0	2	0	...	0	0
1/4/2015	0.263826734	1	31	0	...	0	0	2	0	...	0	0
1/5/2015	0.27680182	0	16	0	...	0	0	4	0	...	0	0
1/6/2015	0.276113747	0	18.5	0	...	0	0	4	0	...	0	0
1/7/2015	0.326048166	0	24	0	...	0	0	2	0	...	0	0

UPC Forecast Results

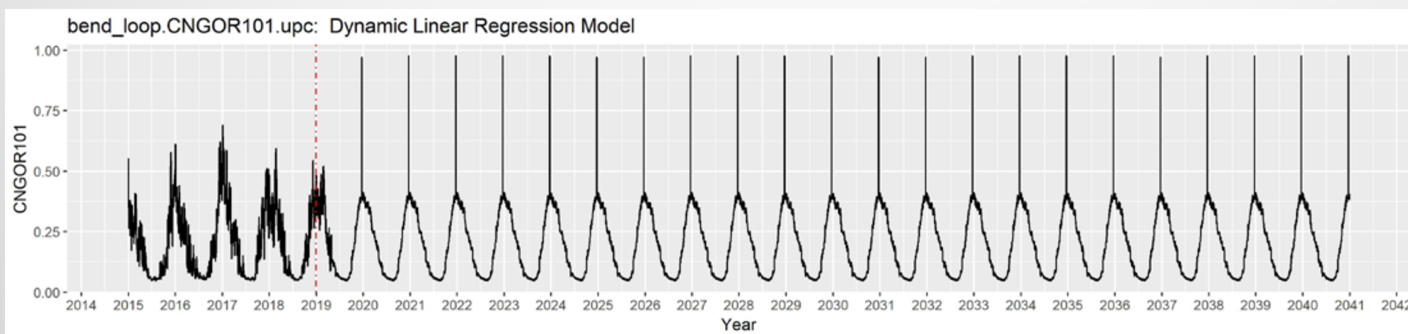
ar1	ar2	ar3	ar4	ma1	ma2	ma3	intercept	weekend	jan.hdd	feb.hdd	mar.hdd	apr.hdd	may.hdd	jun.hdd	jul.hdd	aug.hdd	sep.hdd
1.550827	-0.1753	-0.91098	0.501914	-0.70202	-0.50903	0.628802	0.147384	-0.01757	0.003997	0.000935	0.001474	-0.00286	-0.00082	-0.00111	-0.00041	-0.00071	-0.00237

oct.hdd	nov.hdd	dec.hdd	jan.wind	feb.wind	mar.wind	apr.wind	may.wind	jun.wind	jul.wind	aug.wind	sep.wind	oct.wind	nov.wind	dec.wind	S1-365	C1-365	S2-365	C2-365	S3-365	C3-365
-0.00215	0.000909	0.016195	-0.00267	-0.00565	-0.00323	-0.0018	-0.00192	-0.00216	-0.00116	-0.0023	-0.00246	-0.00153	4.10E-05	-0.00109	0.06475	0.055895	0.00772	0.008905	-0.00838	0.008431



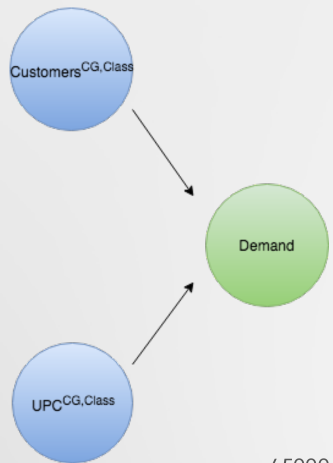
Peak Day Use-Per-Customer

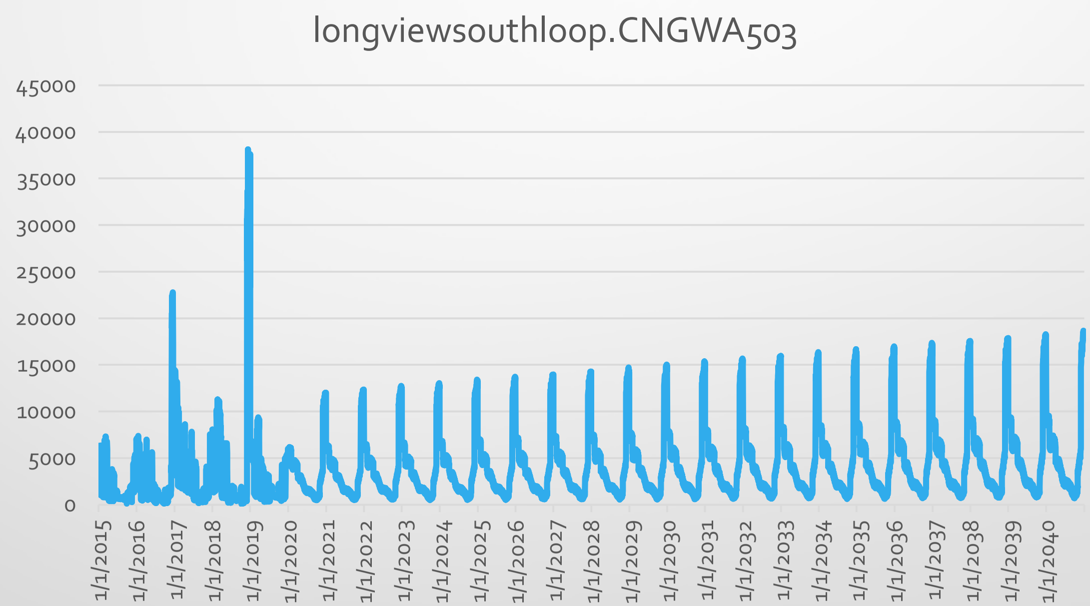
- Peak HDD: Coldest in past 30 years for each weather zone
- Peak Scenarios: Plan on running other scenarios such as 5-day peak event, 3-day peak event, coldest in 20 years, and various Monte Carlo percentiles.



Forecast Results

Final Demand Calculation



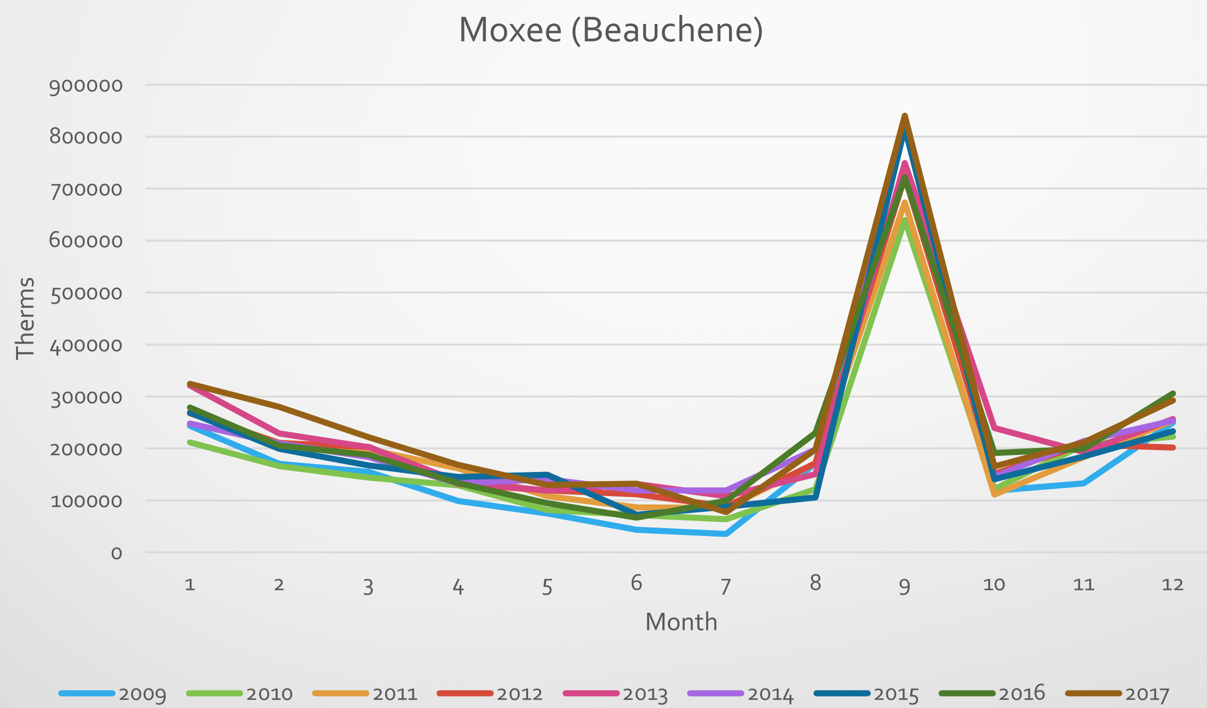


Non-Weather Dependent Demand

- Demand that is not influenced by weather.
- Typically caused by a customer who ramps up production based on the time of season.
- Previously, demand was removed prior to running the use per customer vs. weather analysis.
- Now using monthly coefficients, Cascade can run the analysis while leaving the non-weather demand in.

CASCADE NATURAL GAS CORPORATION
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Moxee (Beauchene)



Low Customer Growth Areas

	deming	prosser	zillah/toppenish
Average Year over year growth	0.18%	0.48%	0.70%

- Deming is a small city in northwestern Washington. Higher unemployment than the national average coupled with a decline in population over the past decade has resulted in little to no customer growth. [1]
- Prosser is a small city in southern Washington. Prosser has seen high unemployment, low job growth, and slow population growth. [1]
- Zillah and Toppenish are located in southcentral Washington. Higher unemployment and slow population growth limit customer growth in these areas. [1]

[1] According to bestplaces.net, worldpopulationreview.com, and city-data.com

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

High Customer Growth Areas

	burbankheightsloop	kennewickloop	longviewsouthloop
Average Year over year growth	1.89%	1.84%	1.94%

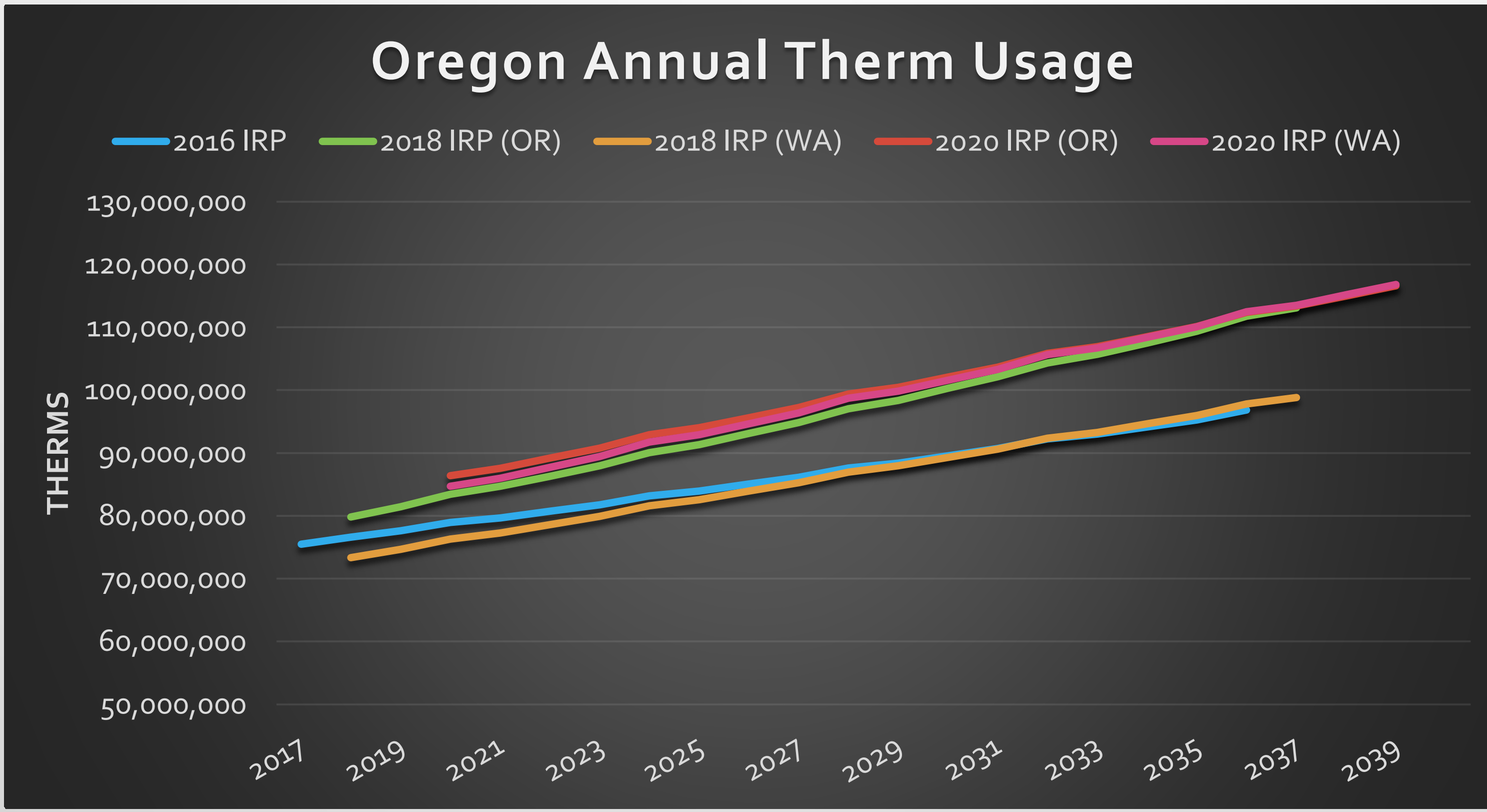
- Burbank Heights Loop consists of Pasco, North Pasco, and Burbank Heights citygates. These are located in southeastern Washington. Pasco sits in one of the fastest growing counties in the state, Franklin county. Future job growth is optimistic. [1]

- Kennewick Loop consists of the Richland Y, Kennewick, and Southridge citygates. These are located in southeastern Washington. Many new developments are a direct result of high population growth rates and optimistic job outlooks. [1]

- Longview South Loop consists of South Longview and Kelso citygates. Both cities are located in western Washington. Both cities are seeing steady population growth coupled with optimistic job growth estimates. [1]

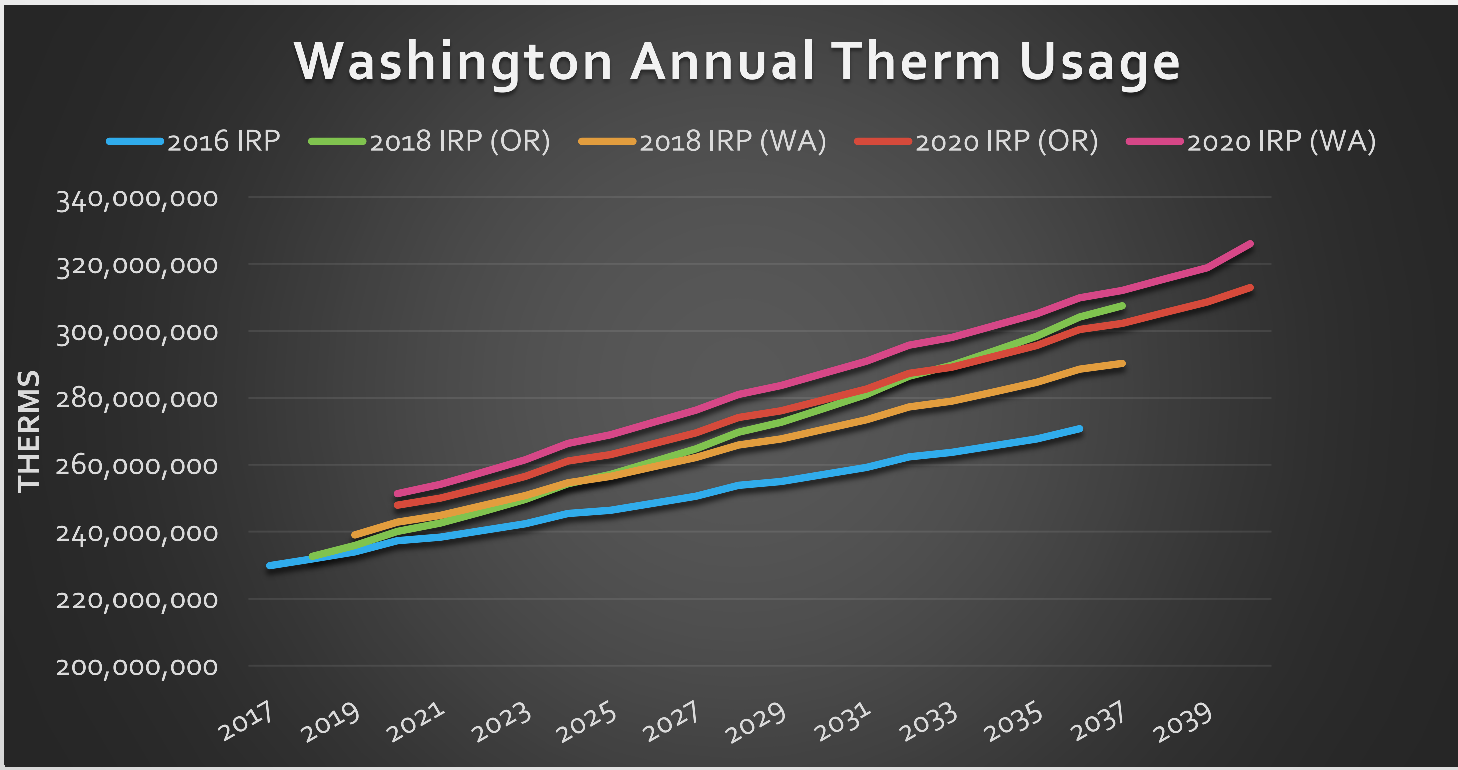
[1] According to bestplaces.net, worldpopulationreview.com, and city-data.com

Oregon Demand

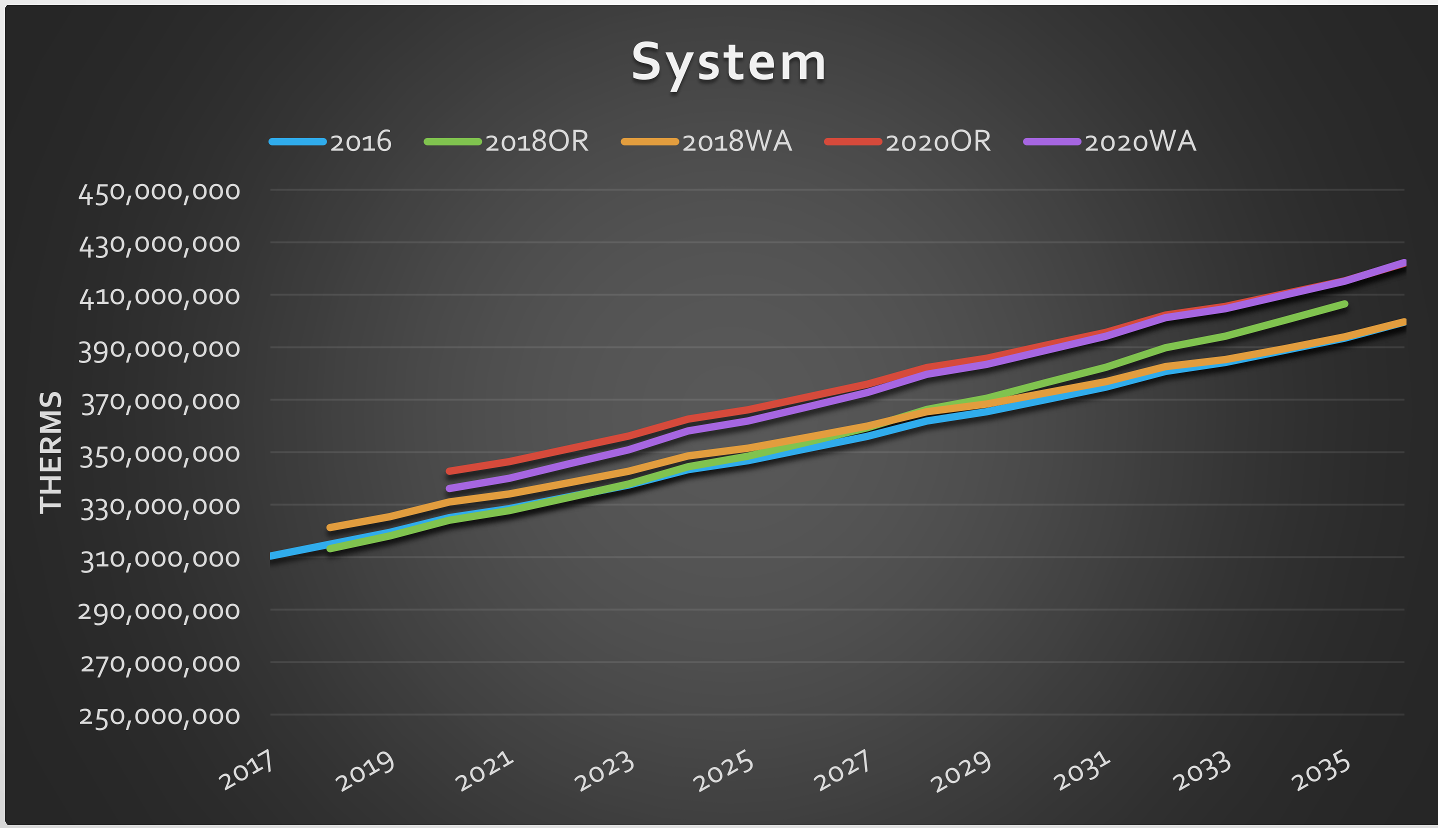


Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Washington Demand



Total System Demand



Non-Core Outlook

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Non-Core Outlook

- Cascade forecasts the non-core for five years.
- Unlike the core, non-core (or transportation) customers are customers who schedule and purchase their own gas, generally through a marketer, to get gas to the citygate. The customer then uses Cascade's distribution system to receive the gas.
- Cascade's transportation customers include all types of industrial customers. It includes farms that may not use any gas during the winter to food manufacturers that average 800,000 therms per month throughout the year.
- Cascade also serves five electric generation customers in Washington. Those five customers project to use approximately 224,000,000 therms in 2020.

Transportation Customers

- Cascade's transportation customer forecast increased from the previous forecast. The current forecast projects the customer count to be 205 in 2020 with plans to bring on several new customers over the next five years. Cascade's industrial managers are working closely with potential industrial customers.
- Cascade's projection decreased by 15 million therms from the previous forecast. The decrease is mainly a direct result from several large customers moving from a non-core rate schedule over to a core rate schedule.
- Cascade projects the transportation customers in Washington to consume approximately 498 million therms in 2020.

Electric Generation

- Cascade serves five electric generation customers in Washington. Those five customers project to use approximately 224,000,000 therms in 2020.
- Cascade doesn't anticipate bringing on additional electric generation over the next five years.
- Washington passed SB 5116 which would require that non-emitting electric generation and electricity from renewable resources supply one hundred percent of all sales of electricity to Washington retail electric customers by January 1, 2045. Essentially, this would phase out Washington electric generation customers that Cascade would serve.

CASCADE NATURAL GAS CORPORATION
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

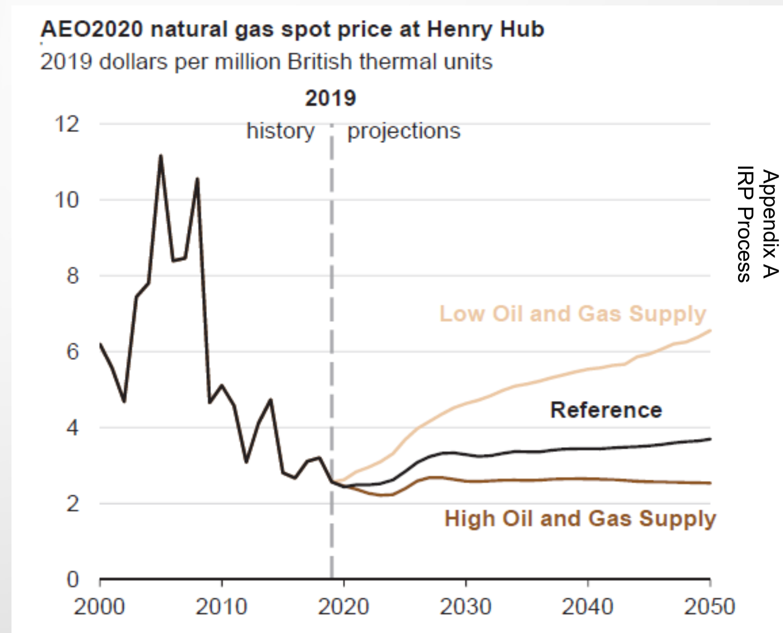
Non-Core Forecast

- Transportation customers in Washington forecast to use 498 million therms in 2020.
- Transportation customers in Oregon forecast to use 63.5 million therms in 2020.
- Electric Generation customers forecast to use 390 million therms in 2020.
- Non-Core total forecast for 2020 is approximately 951 million therms.

Market Outlook and Long Range Price Forecast

Long Range Market Outlook

- Natural gas prices in the AEO2020 Reference case remain lower than $4 per million British thermal units (MMBtu) through 2050 because of an abundance of lower cost resources, primarily in tight oil plays in the Permian Basin. These lower cost resources allow higher production levels at lower prices during the projection period. [1]
- Natural gas consumption in the residential and commercial sectors remains largely flat because of efficiency gains and population shifts to warmer regions that counterbalance population growth. Although natural gas consumption rises in the transportation sector--particularly for freight trucks, rail, and marine shipping--it remains a small share of both transportation fuel demand and total natural gas consumption.[1]



Coronavirus and Natural Gas

- Resilient Demand
  - According to a Forbes article, citing data from JTC, an energy research institute, "Despite immense downward pressure, U.S. natural gas demand has actually been higher for the first third of 2020 than year-ago levels."
  - Amidst the coronavirus pandemic, analysts at Wood Mackenzie have stated that "Globally, gas demand has been fairly resilient, down 2% versus 6% for oil. The stability reflects some of the big gas-consuming sectors, such as residential heating and power." These analysts believe prices will return to normal (flat) within 5 years and demand will stabilize gradually. [2]
- Supply Concerns
  - "exports are down a bit amid COVID-19 and could struggle through the summer, as low prices and demand globally make it harder to compete." 2
  - Goldman-Sachs expresses concerns over rebounding demand hitting a slowing supply and possible shortages due to "production cuts implemented by all major producers. [3]

Long Range Price Forecast

- Cascade's long-term planning price forecast is based on a blend of current market pricing along with long-term fundamental price forecasts.
- The fundamental forecasts include sources such as Wood Mackenzie, EIA, the Northwest Power and Conservation Council (NWPCC), Bentek and the Financial Forecast Center's long-term price forecasts.
- While not a guarantee of where the market will ultimately finish, Henry Hub NYMEX is the most current information that provides some direction as to future market prices.
- Wood Mackenzie's long-term forecast is at a monthly level by basin. Cascade uses this to help shape the forecast's monthly basis pricing.

Long Range Price Forecast (Cont.)

- The Company also relies on EIA's forecast; however, it has its limitations since it is not always as current as the most recent market activity. Further, the EIA forecast provides monthly breakdowns in the short-term, but longer-term forecasts are only by year.
- CNGC assigns a weight to each source to develop the monthly Henry Hub price forecast for the 20-year planning horizon.
- Although it is impossible to accurately estimate the future, for trading purposes the most recent period has been the best indicator of the direction of the market. However, Cascade also considers other factors (historical constraints) which can lead to minor adjustments to the final long-range forecast.

Price Forecast Weights

- Considerations in weight assignments:
  - Cascade has modified its weighting system based on an analysis of the symmetric mean absolute percentage error (SMAPE) of its sources since 2010;
    - Wood Mackenzie (monthly, covers all basins)
    - EIA (industry barometer, annual long term)
    - NWPCC (regional perspective, but recognize it is also a blend)
    - NYMEX Henry Hub
  - Some sources produce forecasts daily, while others are far less frequent.
    - Cascade uses an age dampening mechanism to account for this in its price forecast, reducing the impact of forecasts that do not account for more current market information.

SMAPE to Weights

- SMAPE = |(Actual – Forecast)/((Actual + Forecast)/2)|
- Cascade calculates the weight of the inverse of the SMAPEs of each source, which are then smoothed using Holt-Winters smoothing.

Rank (order of severity)	Weight		Interval
	Source 1	Source 2	
MSE	0.605111033	0.394888967	0.210222067
MAE	0.563119545	0.436880455	0.12623909
MAPE	0.562986465	0.437013535	0.12597293
RMSE	0.553149363	0.446850637	0.106298727
MAAPE	0.546818641	0.453181359	0.093637282
SMAPE	0.546045931	0.453954069	0.092091861

Example of SMAPE Calculations by Source

	Source 1	Source 2	Source 3	Source 4
T+1	0.11476063	0.217300759	0.100303147	0.150149419
T+2	0.155600954	0.208054622	0.210782631	0.183031285
T+3	0.180080034	0.159751563	0.211083367	0.188603149
T+4	0.180885987	0.216499212	0.116823262	0.205636302
T+5	0.204540958	0.17058102	0.13103414	0.227583943
T+6	0.205116131	0.158629542	0.123911318	0.235010724
T+7	0.193435025	0.017802511	0.087262544	0.218316379
T+8	0.153245566	0.108208036	0.125836311	0.150703308
T+9	0.19521638	0.182278012	0.083976291	0.212140322
T+10	0.173129437	0.171413928	0.100741558	0.172400617
T+11	0.209019609	0.19815898	0.159935388	0.180704729
T+12	0.206179306	0.064646764	0.09191201	0.176900657

Price Forecast Weights

- In Months T+1 to T+15, Cascade uses NYMEX Forward pricing for all locations exclusively;
  - For short term forecasting, the marketplace is ideal because forward prices should reflect all current events that impact the forecast (weather, storage, etc.)
  - Long term forecasting is more concerned about the fundamental market intelligence, which is reflected in the analysis of Cascade's sources.
- Months T+16 to T +40 are used to interpolate the weights from exclusively NYMEX to the weights calculated from each source's SMAPE.
- Months T + 41 onward use the age dampened weights of each source.

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Example Weights Price Forecast For 2020 IRP (Not Interpolated)

	Source 1	Source 2	Source 3	Source 4
Nov-20	100.000%	0.000%	0.000%	0.000%
Dec-20	48.519%	10.056%	30.541%	10.884%
Jan-21	45.422%	8.696%	35.080%	10.803%
Feb-21	41.871%	6.459%	40.277%	11.393%
Mar-21	42.306%	6.147%	38.331%	13.216%
Apr-21	43.894%	6.873%	35.403%	13.830%
May-21	46.037%	7.801%	31.618%	14.543%
Jun-21	46.341%	7.786%	30.066%	15.808%
Jul-21	47.217%	7.910%	28.157%	16.716%
Aug-21	47.463%	7.852%	28.039%	16.646%
Sep-21	43.274%	5.700%	33.440%	17.585%
Oct-21	42.655%	5.209%	35.035%	17.101%

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Example Weights Price Forecast For 2020 IRP (Interpolated)

	Source 1	Source 2	Source 3	Source 4
Nov-20	100.000%	0.000%	0.000%	0.000%
Dec-20	97.695%	0.450%	1.367%	0.487%
Jan-21	95.407%	0.732%	2.952%	0.909%
Feb-21	93.118%	0.765%	4.768%	1.349%
Mar-21	90.829%	0.977%	6.093%	2.101%
Apr-21	88.541%	1.404%	7.231%	2.825%
May-21	86.252%	1.988%	8.055%	3.705%
Jun-21	83.963%	2.327%	8.986%	4.724%
Jul-21	81.675%	2.746%	9.776%	5.804%
Aug-21	79.386%	3.081%	11.002%	6.532%
Sep-21	77.097%	2.301%	13.501%	7.100%
Oct-21	74.808%	2.288%	15.391%	7.512%

2020 IRP Remaining Schedule

Wednesday, June 17, 2020	TAG 3 slides distributed to stakeholders	
Wednesday, June 24, 2020	**TAG 3: Distribution System Planning, Planned Scenarios and Sensitivities, Alternative Resources, Price Forecast, Avoided Costs, Current Supply Resources, Transport Issues.**	**SeaTac Airport - 9 am to 12 pm**
Wednesday, July 29, 2020	TAG 4 slides distributed to stakeholders	
Thursday, August 6, 2020	**TAG 4 Carbon Impacts, Energy Efficiency, Bio-Natural Gas, Preliminary Resource Integration Results.**	**Community Service Room in Bellingham, WA - 9 am to 3 pm**
Wednesday, September 16, 2020	TAG 5 slides distributed to stakeholders	
Wednesday, September 23, 2020	**TAG 5: Final Integration Results, finalization of plan components, Proposed new 4-year Action Plan.**	**SeaTac Airport - 9 am to 12 pm**
Tuesday, November 17, 2020	Draft of 2020 WA IRP distributed	
Wednesday, December 23, 2020	Comments due on draft from all stakeholders	
Wednesday, January 27, 2021	TAG 6, if needed	WebEx Only
Friday, February 26, 2021	IRP filing in Washington	

ADDITIONAL QUESTIONS?

Mark Sellers-Vaughn – Manager, Supply Resource Planning: (509) 734-4589
mark.sellers-vaughn@cngc.com

Brian Robertson – Supervisor Resource Planning: (509) 734-4546
brian.robertson@cngc.com

Devin McGreal – Resource Planning Analyst II: (509) 734-4681
devin.mcgreal@cngc.com

Ashton Davis – Resource Planning Analyst I: (509) 734-4520
ashton.davis@cngc.com

Bruce Folsom - Consultant

Cascade Natural Gas Corporation

2020 WA Integrated Resource Plan

Technical Advisory Group Meeting #2

Wednesday, May 27th, 2020

Location TBD

CASCADE NATURAL GAS CORPORATION
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

TAG #2 – WUTC TAG Meeting

Date & time: 05/27/2020, 09:00 AM – 11:00 AM

Location: Microsoft Teams Meeting

Presenters: Brian Robertson, Ashton Davis & Devin McGreal

In attendance: Mark Sellers-Vaughn, Brian Robertson, Devin McGreal, Ashton Davis, Bruce Folsom, Abbie Krebsbach, Renie Sorensen, Carolyn Stone, Eric Wood, Kary Burin, Chris Robbins, Linda Offerdahl, Monica Cowlishaw, Patrick Darras, Brian Cunnington, Mike Parvinen, Becky Hodges, Phillip Hensyel, Mike Paruszkiewicz – NWN, Mark Iverson – Ruby Pipeline, Corey Dahl – Public Counsel, Bradley Cebulko – WUTC, Andrew Rector – WUTC, Kyle Depew – WUTC, Marty Saldivar – NWP, Nicholas Columbo – OPUC,

Minutes: Carolyn Stone

Brian began the meeting with a "Safety Moment" reminding all of us to use safety precautions in mind of the COVID 19 pandemic. Mark stated he was looking forward to today's discussion prior to filing the IRP. Brian then went through introductions and the agenda.

Presentation #1 – DEMAND FORECAST (Ashton Davis)

QUESTION: Andrew asked if this process has changed?
ANSWER: Ashton said this process is the same.

QUESTION: Andrew asked when the forecast was changed from using 65 to 60 HDD?
ANSWER: Brian said it was introduced in 2014 by consultants, 5 to 6 years ago. Mark added that it was used in the 2016 IRP.

Presentation #2 – CUSTOMER FORECAST (Ashton Davis)

QUESTION: Andrew asked what does it mean, that the model "ignores" those variables?
ANSWER: Ashton said "co-linearity". The population increases at a certain rate.... employment information increases at the same rate. So, the model sees these are "parallel lines". The model regression shows "funky" results if these are left in. Without the parallel line information, the model normalizes information. The model eliminates redundancies.

Andrew further asked if the model sets these redundant variables to zero.

Ashton says it doesn't do the regression on those variables. Model doesn't take those variables into account; it does not set them to zero.

QUESTION: Andrew asked what the "trend variable" was?
ANSWER: Over the entire historical timeline, it captures the trend. ARIMA with Fourier – term tell model to not differentiate data – takes predicted values & ARIMA value being forced not to trend.

Presentation #3 – FORECAST RESULTS (Ashton Davis)

QUESTION: Andrew asked if the "Y Axis" represent Therms?
ANSWER: Therms is on the Y Axis - use per day.

QUESTION: Bradley asked what the source of the data is?
ANSWER: Ashton said they use the internal forecast for customer by Citygate.

QUESTION: Andrew asked if Resource Planning has gone back to 2016 IRP to compare forecast to actual?
ANSWER: Ashton said they have not actually graphed it out as a comparison but have "checks and balances" with Gas Supply and multiple departments. If there was an issue, those departments would come back to us, if it didn't add up. Ashton said they will do a back cast. Brian Said that they check the variance between past forecasts and this forecast, there were some demand changes. These changes are related to Non-core switching to Core. In 2018, for example, large Non-core customers switched to Core, totaling 10m Therms jumping to the Core side. This is the reason the forecast moves around from past IRP's. Ashton said this is a good point. Our forecast is for the Core.

QUESTION: Brad asked how Resource Planning includes economic downturns? Like now, for instance with the COVID 19 pandemic – do you adjust for today?
ANSWER: The long-term forecast – 20-year looks at typical day. There is no pandemic indicating variables at this moment. Devin added that their scenarios/sensitivity analysis are used in getting robust "what-if's" in. We can't predict the future. We run low growth scenario and then put it in the narrative in the IRP. There were no decisions made on the low growth scenario.

FURTHER DISCUSSION:

- Corey asked if 1 variable is useful in relation to the Pandemic…economic outlook…? He said, we have no crystal ball, but we can say the economic outlook has changed since Jan 2020. I would be interested in looking at the variable in demand = economic outlook.
- Mark said no one forecasted the pandemic. it would take 2 years to determine the impact now. What elements of economic forecast you would expect us to change?
- Corey asked how often are the sources updated? The economic outlook data – how fresh is it - how often refreshed?
- Ashton said every forecast is a "point in time". Once we get more data and vet it, then we can use it. Preliminary data has conflicting information…if significant data we will rerun the forecast. The next IRP will show that. We must lock numbers for the current forecast.
- Mark said they can contact Wood & Poole for updates of economic data they provide to us and include that in our IRP narrative or adjust before the draft IRP comes out and identify differences.
- Andrew asked what does the underlying data say that economic data will look like in the next few years? When is your forecast "lock down"?

- Brian said lock down to happen very quickly after Tag #2. We must send off numbers to the Energy Efficiency team for Tag #4.

QUESTION: 5 electric generators, were these "peakers" or combination cycle?
ANSWER: Brian referred to Chris Robbins, who said it was a combination of both.

QUESTION: Nick asked about the OPUC, electric generation slide...is this OR or WA?
ANSWER: Brian said it is total Non-Core, Washington & Oregon transportation & electric generation.

Presentation #4 – MARKET OUTLOOK & LONG-RANGE PRICE FORECAST (Ashton Davis)

QUESTION: Andrew asked if the NWPCCs Forecast was part of the forecast in 2018?
ANSWER: Devin said "Yes", the weight ascribed to it at the time was not outdated at that time.

QUESTION: Andrew asked about Slide #44. He asked if supply during COVID showing up in Nymex? Is the Nymex data updated consistently?
ANSWER: Devin said the NYMEX data is updated daily, in market forward strips. The market is making the decisions considering constraints, etc.

Brian Robertson asked if there were any questions or comments about anything in the presentation:

QUESTION: Corey said it would be helpful for next meeting, to make available the data on the delta between the forecast & actual.
ANSWER: Brian asked if the "back cast" they talked about earlier would work?
Corey said "Yes".
Brian asked if they wanted the price or demand forecast?
Corey asked for the "demand forecast".

Brian then reminded all attendees of IRP website, located at IRP@cngc.com and went over the schedule:

- TAG #3 is in one month – June 24 – will include distribution planning
- August 6, TAG #4 planned to be in Bellingham, but Resource Planning will let everyone know if that will be the location.
- TAG #5, Wednesday 9/23
- Nov 17, 2020 – Draft of IRP
- Jan 27, 2021 – TAG #6, if needed
- Feb 26, 2021 - IRP filing in Washington

Brian showed attendees all members of Resource Planning's contact information.
Brian reminded the group that the demand forecast must be locked in soon!

Mark said that it was good discussion today and thanked everyone reminding them to keep safe and healthy!

Brian remarked that this meeting sets a record for attendees at TAG #2. He thanked everyone for their participation!

The meeting was adjourned

Cascade Natural Gas Corporation

2020 Integrated Resource Plan
Technical Advisory Group Meeting #3

Wednesday, June 24th, 2020

Microsoft Teams Meeting

Agenda

- Introductions
- Distribution System Planning
- Cascade Gas Supply Overview
- Planned Scenarios and Sensitivities
- Alternative Resources
- Price Forecast Results
- Avoided Cost Methodology and Calculation
- 2020 IRP Remaining Schedule

Distribution System Planning

Linda Offerdahl, PE – Engineer II

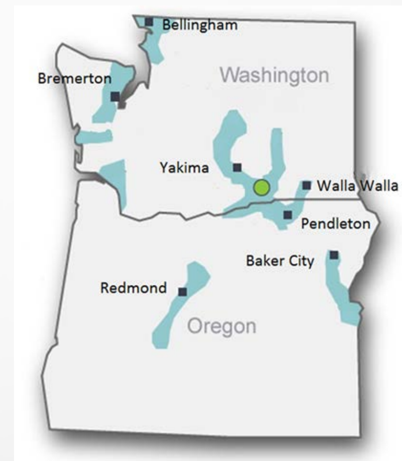
Technical Advisory Group

June 24th, 2020

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Summary

- System Overview
- Software Tools
- Data Gathering
- Synergi System Model
- Distribution Enhancement Options
- Project Process Flow
- Future Projects



Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

System Overview

Pipelines:

- Diameter – ½" to 20"
- Material – Polyethylene and Steel
- Operating Pressure – 20 psi to 900 psi
- Washington – approx. 4,744 miles of distribution main
- Oregon – approx. 1,604 miles of distribution main

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

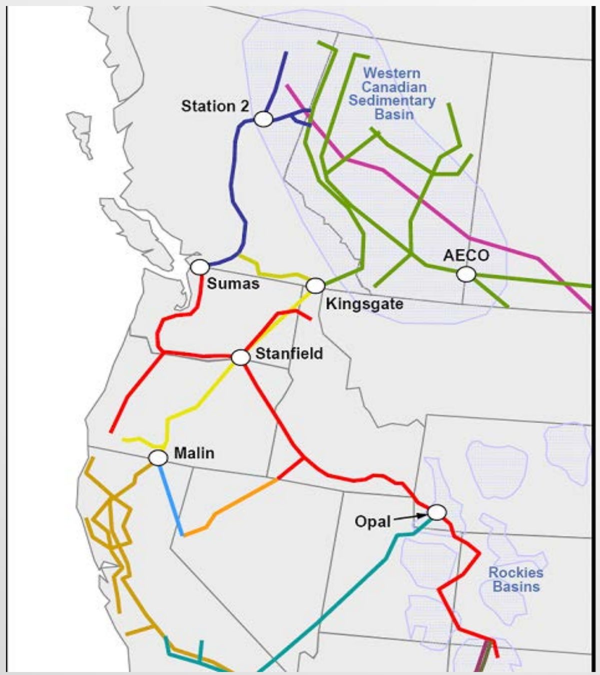
System Overview

Facilities:

- Regulator stations – Over 700
- Valves – Over 1,600
- Other equipment such as heaters, odorizers and compressors

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

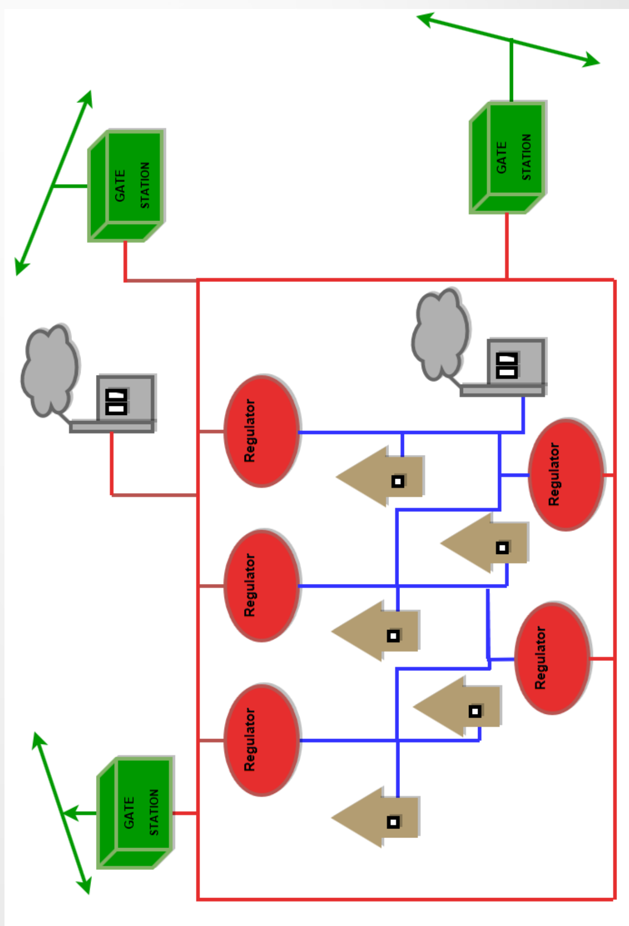
Where do we get our gas?



- Many interstate pipeline companies
- Williams Northwest Pipeline (red)
- TransCanada Pipelines (yellow)

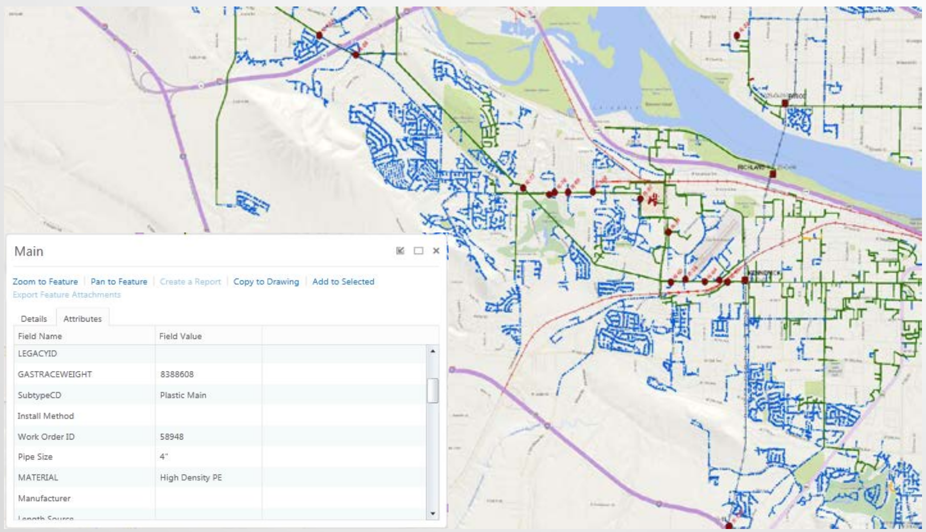
8

Network Design Fundamentals



GIS – Geographic Information System

- GIS System keeps an up to date record of pipe and facilities complete with all system attributes.



System Modeling

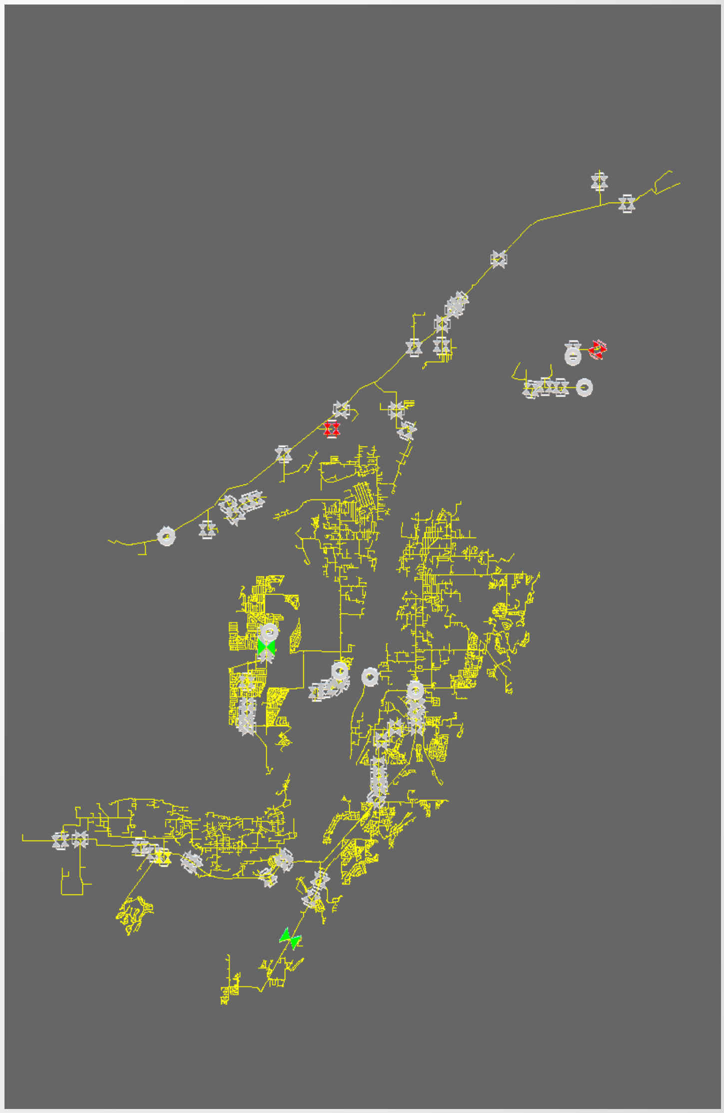
- Using internal GIS environment and other input data, CNG is able to create system models through the software – Synergi.

What is Synergi?

- Software to model piping and facilities to represent current pressure and flow conditions while also predicting future events and growth.

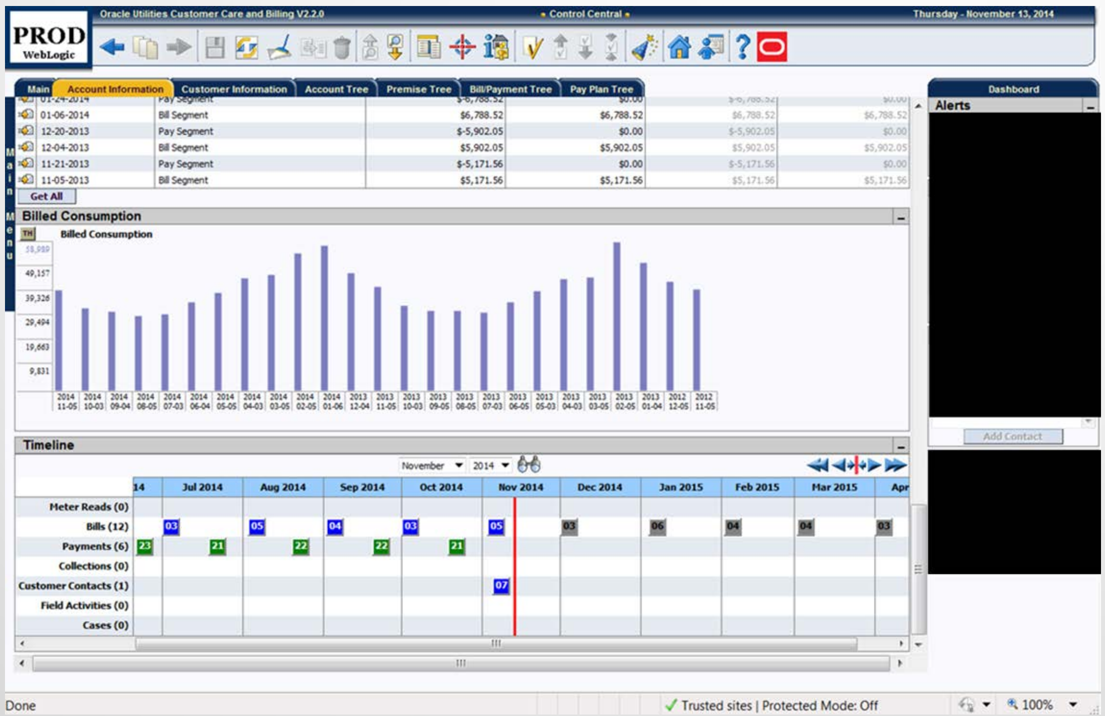
11

Synergi Model Example



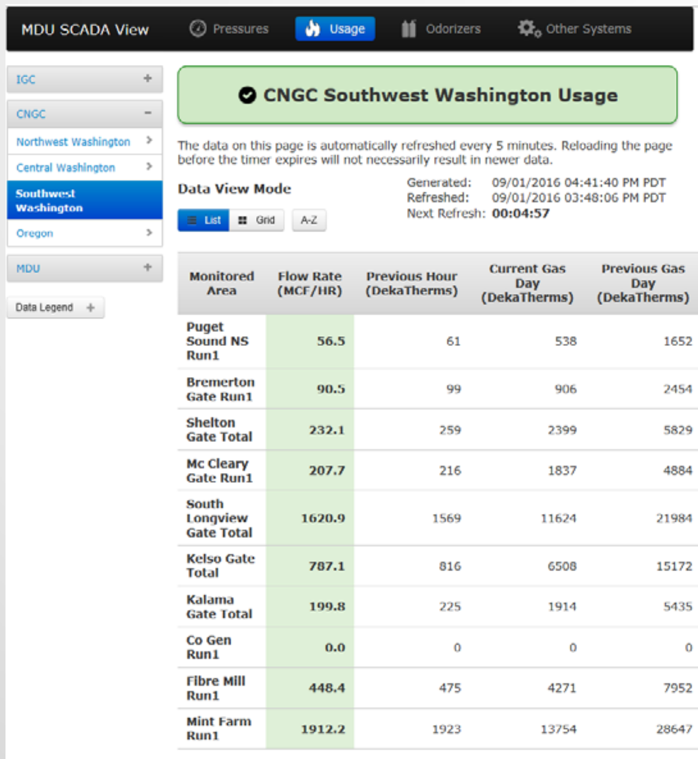
Data Gathering

- CC&B (Customer Billing Data)



Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Data Gathering



Monitored Area	Flow Rate (MCF/HR)	Previous Hour (DekaTherms)	Current Gas Day (DekaTherms)	Previous Gas Day (DekaTherms)
Puget Sound NS Run1	56.5	61	538	1652
Bremerton Gate Run1	90.5	99	906	2454
Shelton Gate Total	232.1	259	2399	5829
Mc Cleary Gate Run1	207.7	216	1837	4884
South Longview Gate Total	1620.9	1569	11624	21984
Kelso Gate Total	787.1	816	6508	15172
Kalama Gate Total	199.8	225	1914	5435
Co Gen Run1	0.0	0	0	0
Fibre Mill Run1	448.4	475	4271	7952
Mint Farm Run1	1912.2	1923	13754	28647

- SCADA Data
- Real time and historical flow characteristics at specific locations in the system

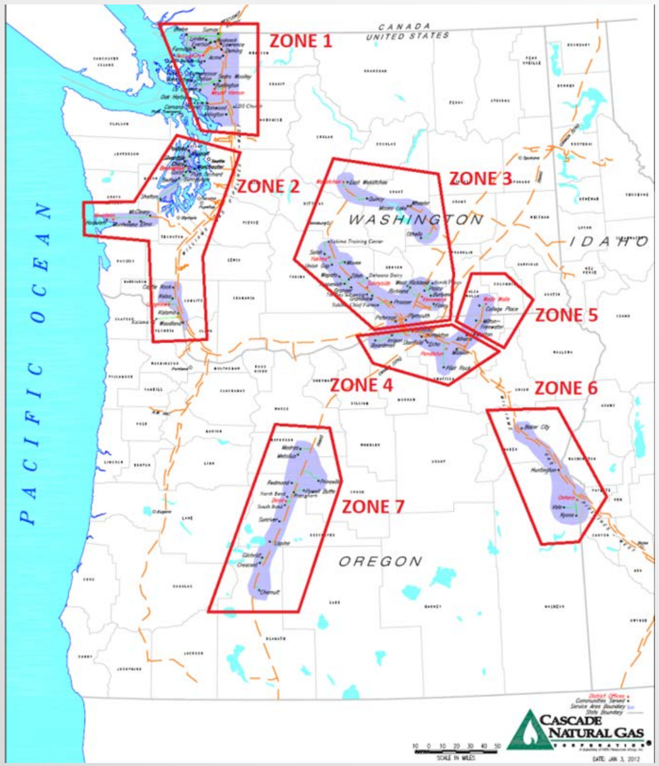
Data Gathering

- IRP Customer Growth

	Burbankheights Loop		Kennewick Loop		Longviewsouth Loop	
	Customers	Growth	Customers	Growth	Customers	Growth
2020	12,503		18,984		2,981	
2021	12,873	2.95%	19,396	2.17%	3,051	2.35%
2022	13,240	2.86%	19,815	2.16%	3,120	2.27%
2023	13,572	2.51%	20,215	2.02%	3,190	2.24%
2024	13,901	2.42%	20,619	2.00%	3,260	2.20%
2025	14,227	2.35%	21,031	2.00%	3,330	2.15%
2026	14,558	2.33%	21,449	1.98%	3,399	2.08%
2027	14,877	2.19%	21,866	1.94%	3,469	2.05%
2028	15,186	2.08%	22,283	1.91%	3,539	2.02%
2029	15,491	2.01%	22,701	1.88%	3,609	1.98%
2030	15,789	1.92%	23,123	1.86%	3,678	1.91%

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Data Gathering

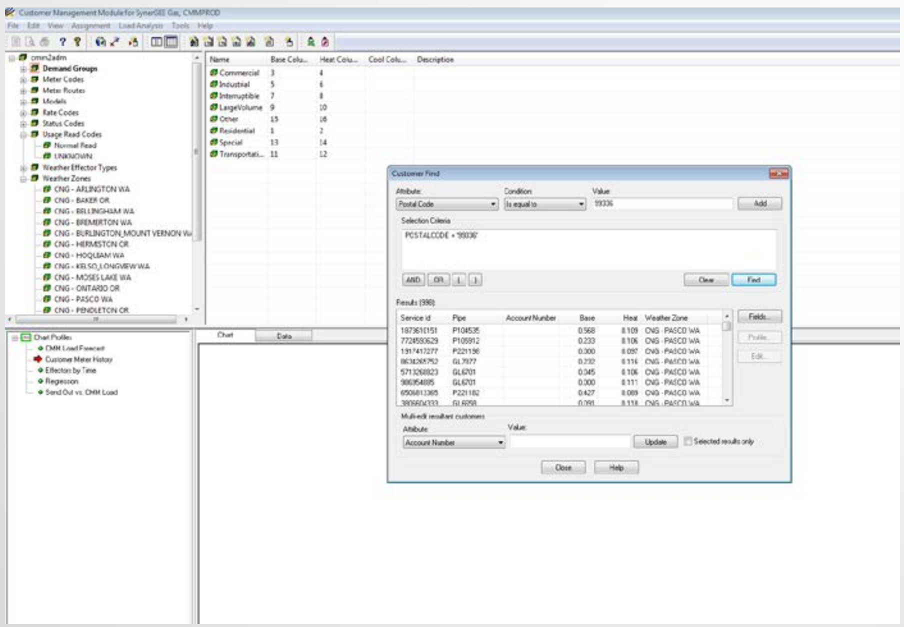


- Peak Heating Degree Day (HDD) modeled by CNG weather zone based on historical weather data

  Peak HDD = 60 – Average Daily Temp

System Peak Day	12/21/90
System Peak HDD	56
Zone 1	46
Zone 2	46
Zone 3	58
Zone 4	67
Zone 5	65
Zone 6	70.5
Zone 7	70.5

Customer Management Module (CMM)



- Software that compiles data from CC&B and HDD to manage customer loads
- Works directly with Synergi to input customer data and represent pressures and flows in the model

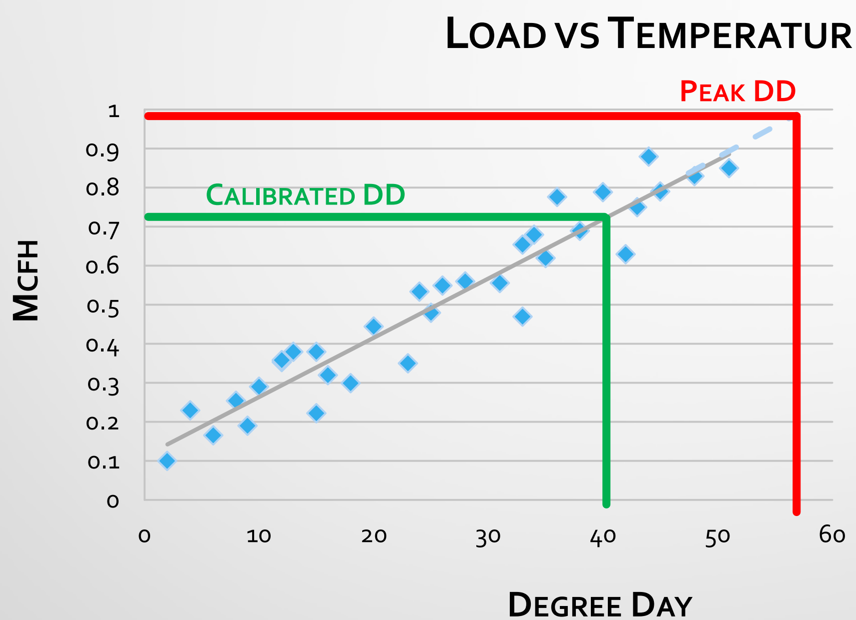
CMM → Synergi System Model

- Conversion can result in 3 model types:
  - Calibrated Model – Model to represent a specific date and time.
  - Design Day Model – Uses the peak HDD for selected areas to simulate a cold weather event (worst case scenario).
  - Growth Model – Uses design day model along with growth data to predict future projects.

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Calibrated vs Peak Degree Day

- Different loads will be applied to each customer



y = 0.0152x + 0.1118

BASE

40 DD = 0.72 MCFH

58 DD = 0.99 MCFH

Synergi System Model

- All customers are loaded based upon base and heat trend.
- Growth model – works with design day model and customer growth numbers to simulate pressures and flows in the future.
- Benefits of the models:
  - Customer requests
  - Future planning
  - System reliability
  - Optimizing distribution enhancement options

Distribution Enhancement Options

- Pipeline:
  - Replacements
  - Reinforcements
  - Loops
- Regulator Stations
- Compressors

CASCADE NATURAL GAS CORPORATION
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Pipeline Enhancements

Pros

- Reliable capacity
- Low maintenance
- Permanent

Cons

- Can be expensive
- Potential land acquisition and/or permitting issues

Reg Station Upgrades/Installs

Pros

- Adds source pressure to alternate system location
- Increases flow control
- Increases pressure control

Cons

- Long term regulator and valve maintenance
- High installation/fabrication costs
- Potential land acquisition issues

Compressor Stations

Pros

- Adding capacity at lower initial cost
- Less land required
- Situational operation

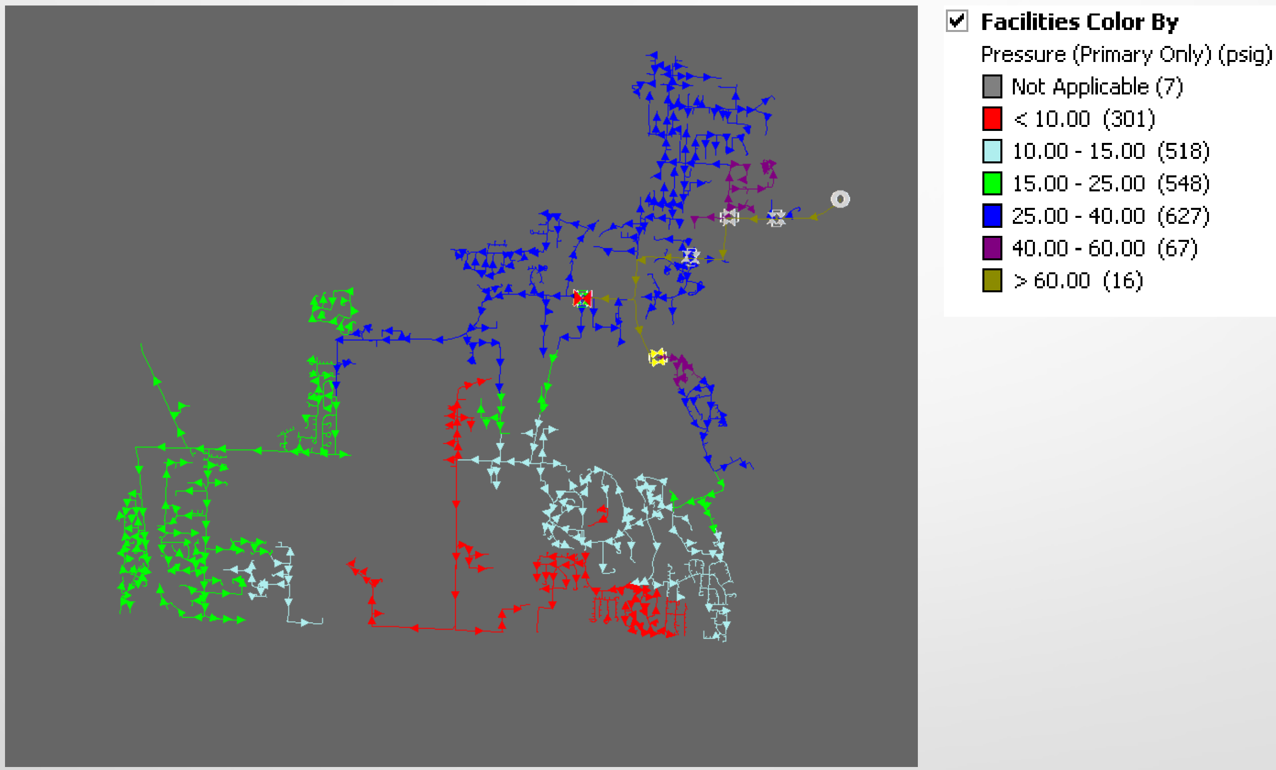
Cons

- Continuous maintenance/training
- Cost of fuel consumption
- Emissions/permitting
- Beneficial only on transmission/HP lines

CASCADE NATURAL GAS CORPORATION
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

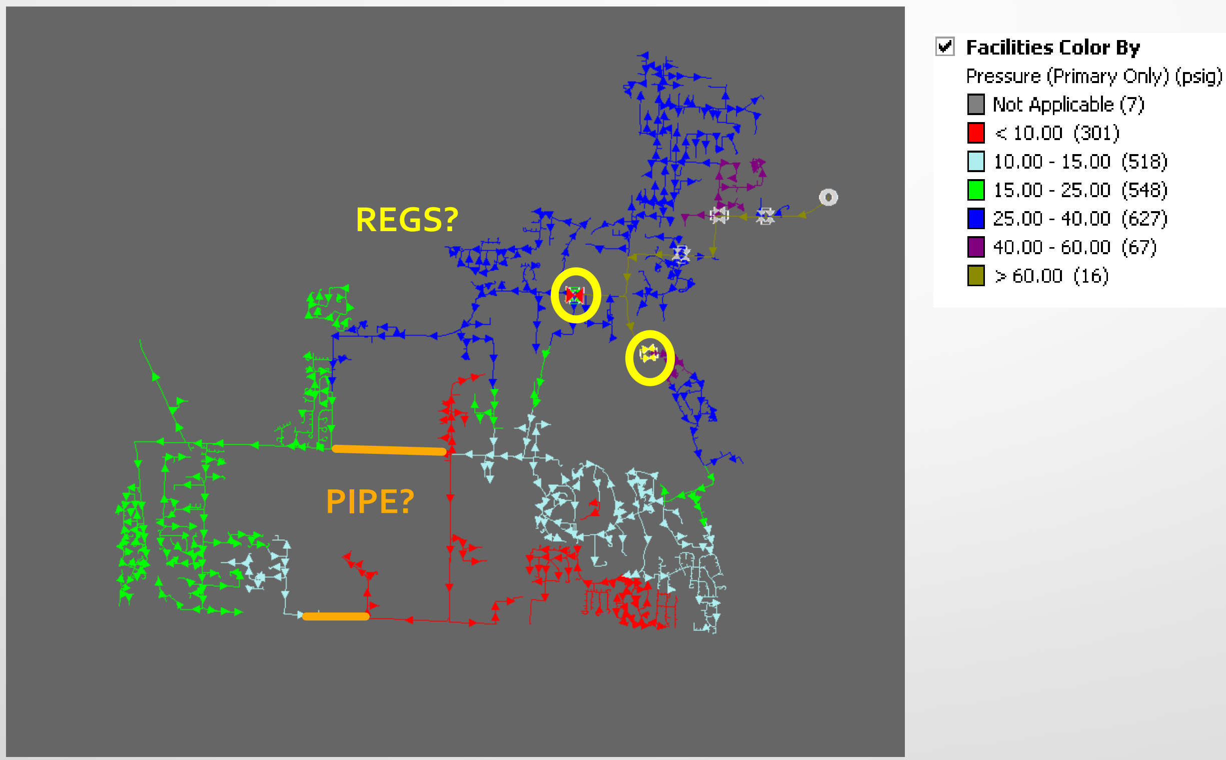
Distribution Enhancement Options

- Theoretical low pressure scenario



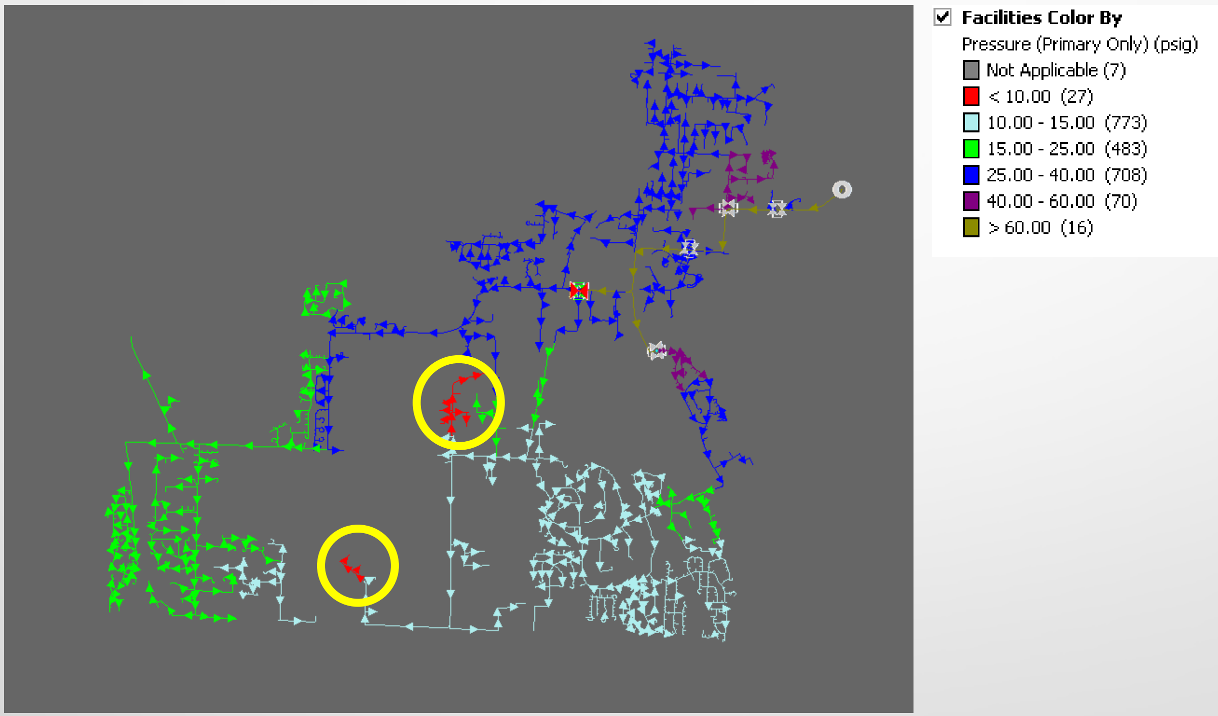
Distribution Enhancement Options

- Low pressure scenario



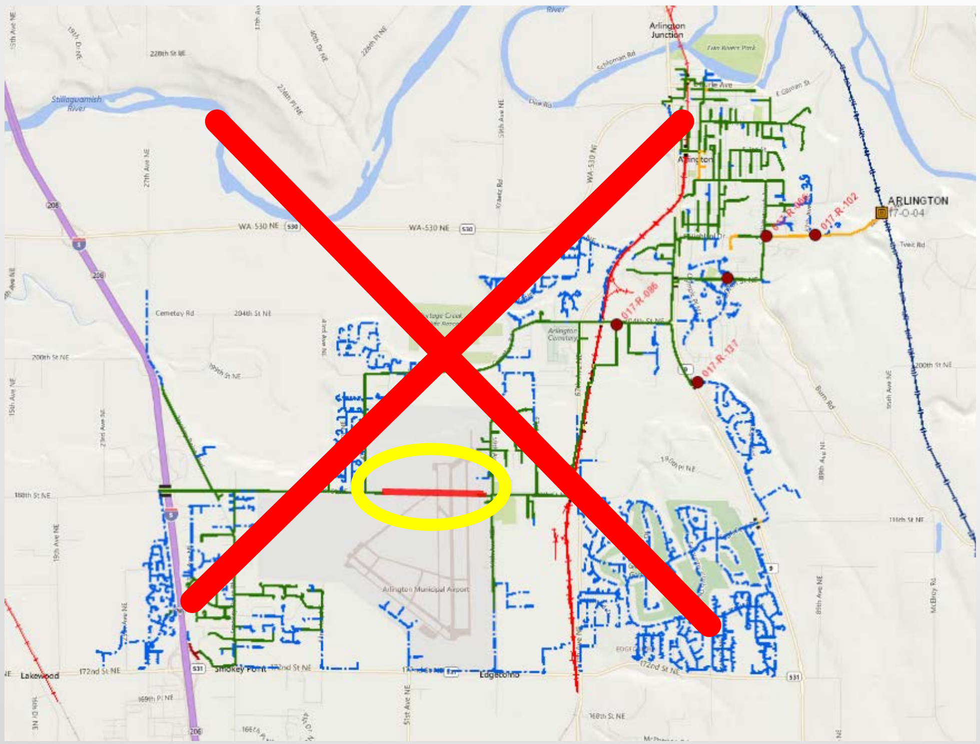
Distribution Enhancement Options

- Possible solutions – raising reg station set points



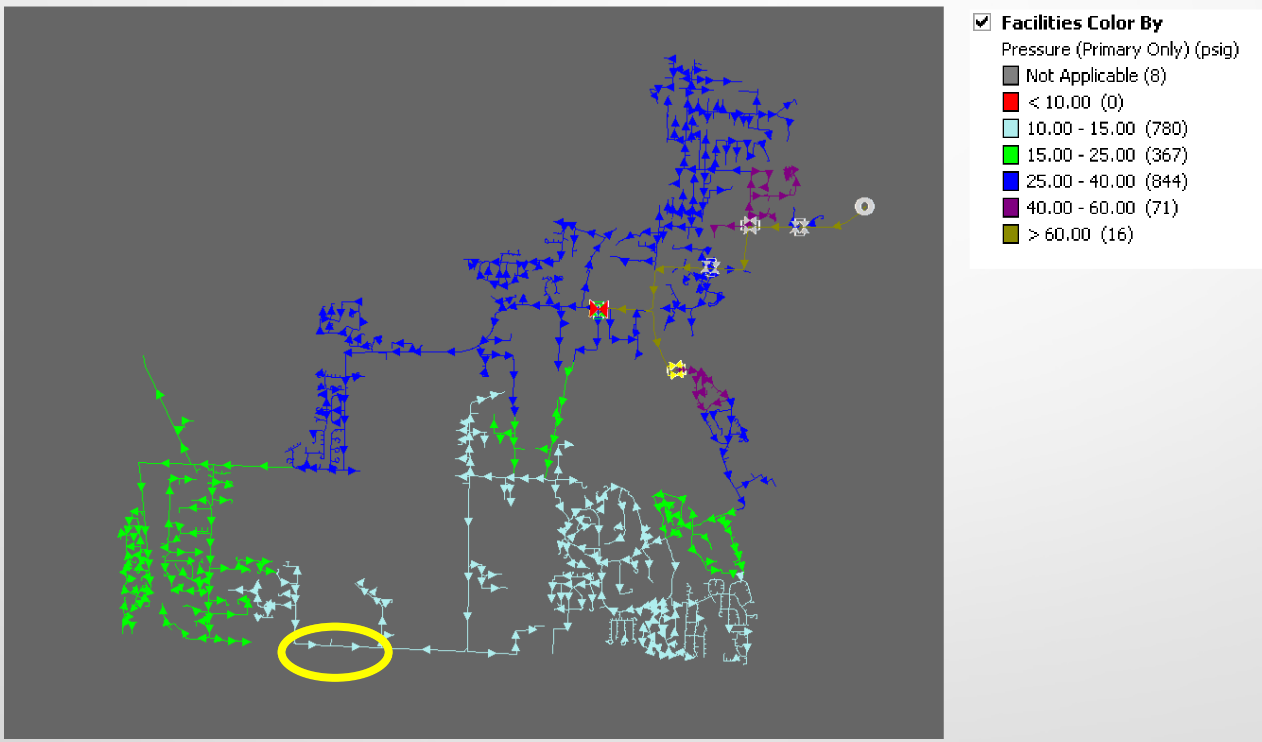
Distribution Enhancement Options

- Reinforcement option #1



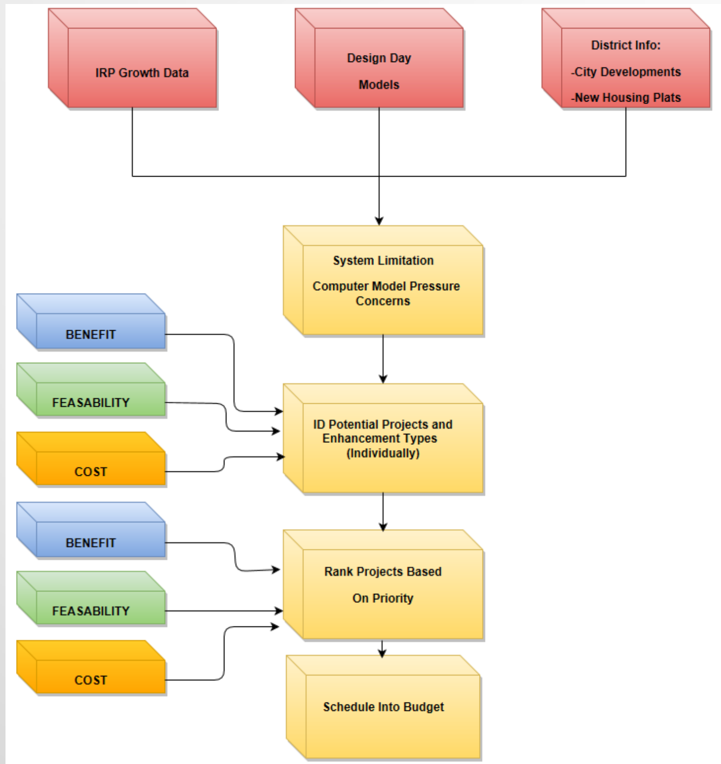
Distribution Enhancement Options

- Reinforcement option #2



Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Project Process Flow



Project & Schedules

Future Projects

- South Kennewick Gate Station
- Elma Gate Station
- South Longview Gate Station Rebuild
- Aberdeen Pipeline Reinforcement
- Kitsap Pipeline Reinforcement
- Arlington, Anacortes, Sedro Woolley, & Oak Harbor Pipeline Reinforcements
- Bellingham Pipeline Reinforcement
- Yakima Pipeline Reinforcement
- Richland & Kennewick Pipeline Reinforcements
- Walla Walla Pipeline Reinforcements

Conclusion

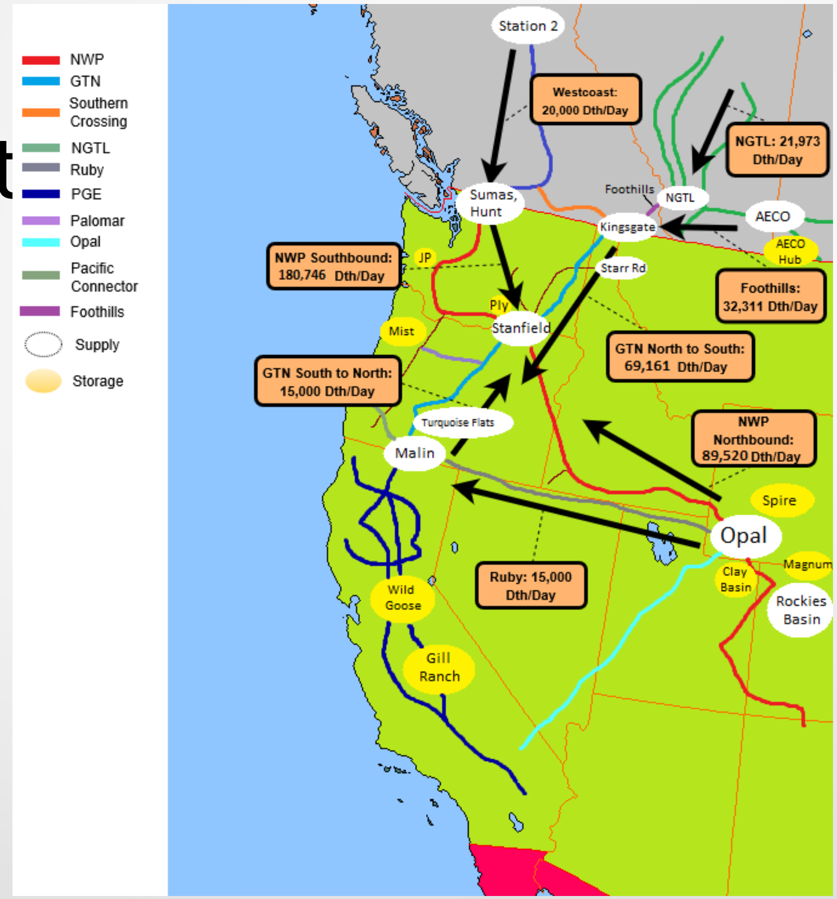
- CNG strives to use technology to gather data, analyze, plan, and design a reliable, safe, and economical distribution system.

Questions ?

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Cascade Gas Supply Overview

Pipeline transport flow

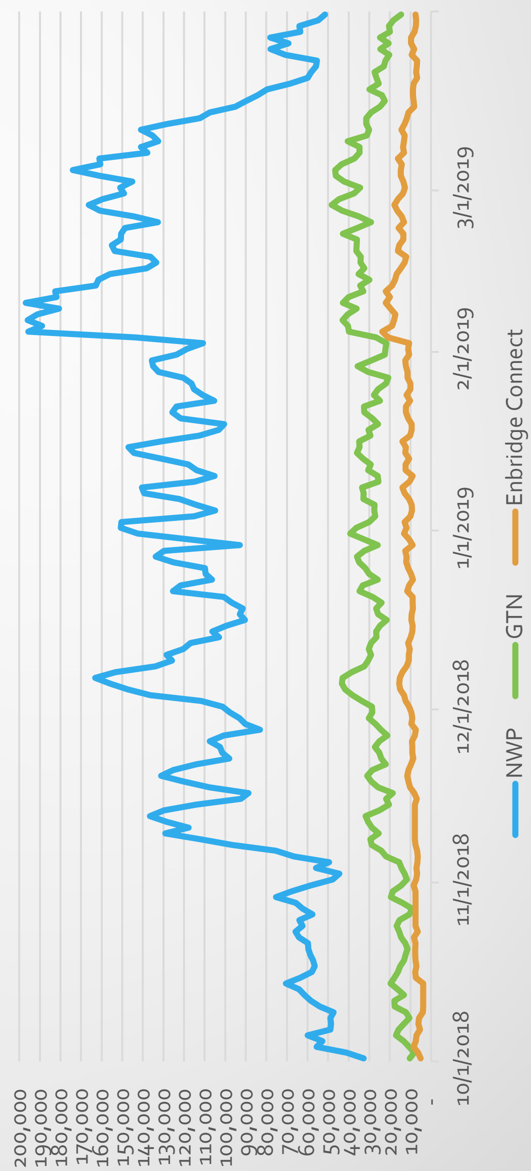


33

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

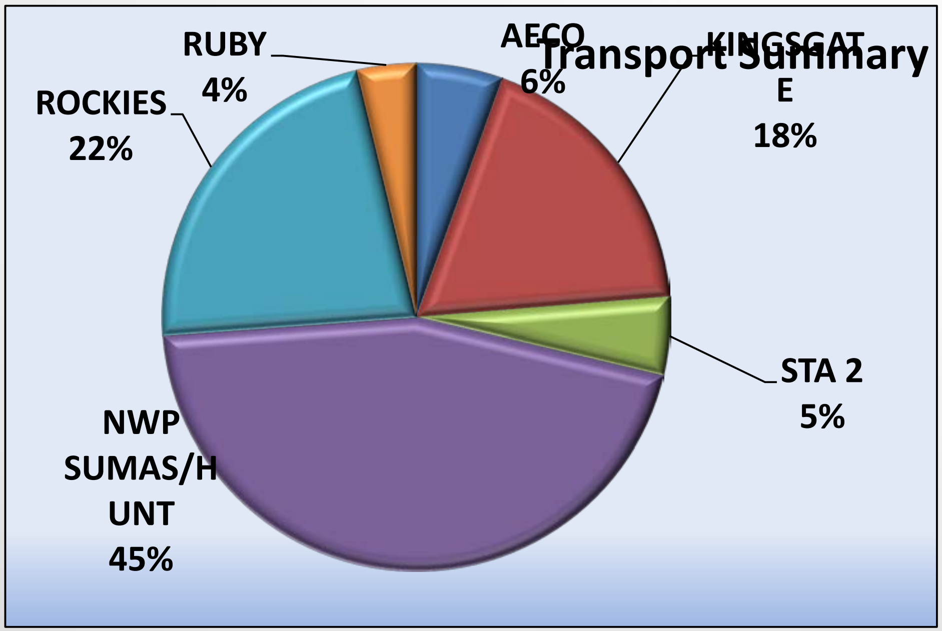
Winter Usage

Usage Per Pipeline

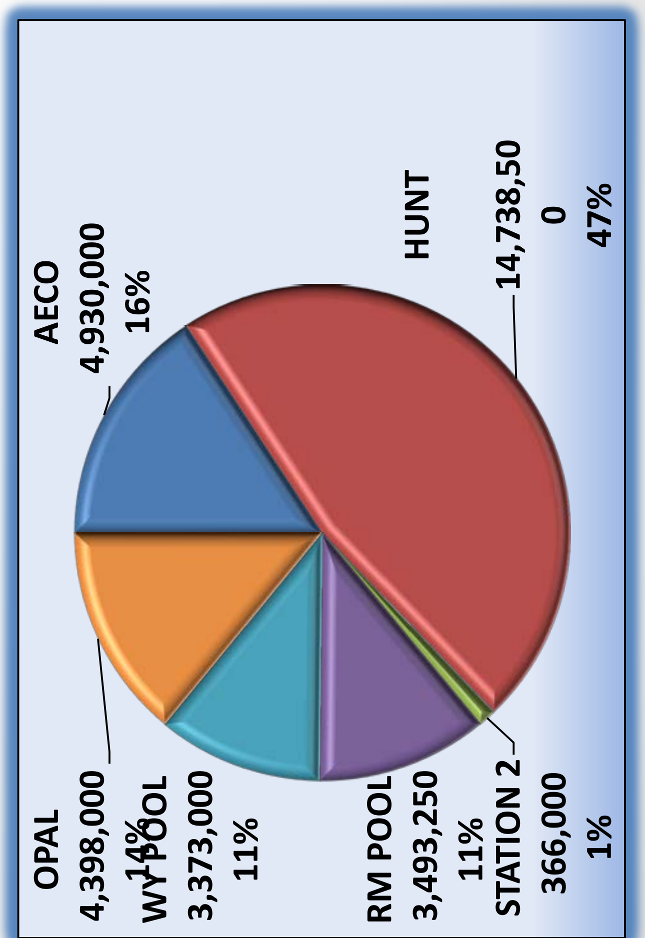


Dekatherms

Transport Summary



Supply Summary By Location

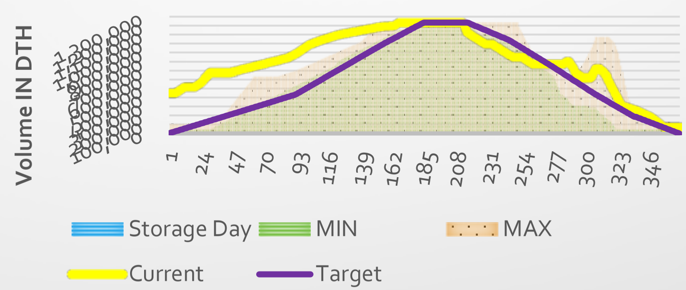


Storage Resources

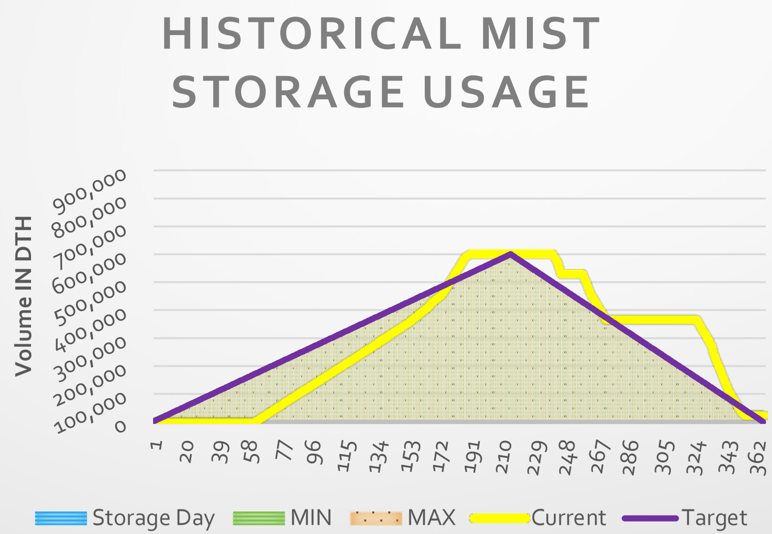
- Jackson Prairie
  - 4 accounts with 1,235,593 dth capacity, 56,366 dth of demand
  - CNGC cycled approximately 95% of Jackson Prairie storage over the past winter season
  - CNGC targets cycling Jackson Prairie
- Plymouth
  - 2 accounts with 662,200 dths capacity, 78,125 dth of demand
  - In addition to above we have TF-2 (Firm Redelivery Transportation) of 10,675 dths
  - CNGC remains committed to using Plymouth as a peaking resource
- MIST
  - Added in the spring of 2019
  - 600,000 dth of capacity, 30,000 dth of demand

2019/2020 JP Storage Utilization

HISTORICAL JACKSON PRAIRIE STORAGE USAGE

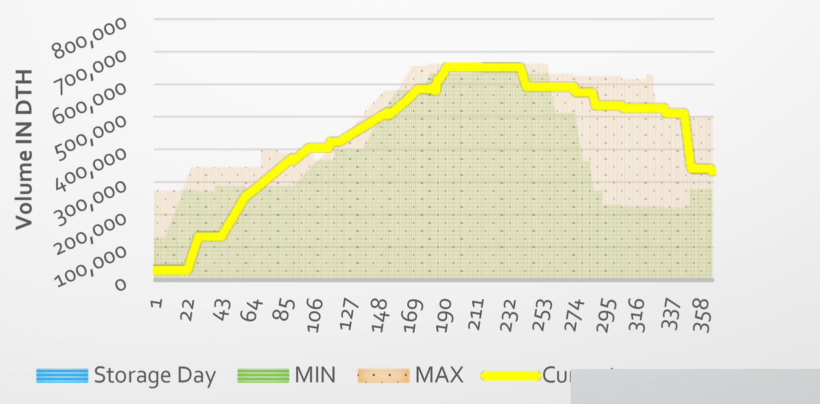


2019/2020 MIST Storage Utilization



2019/2020 Plymouth Storage Utilization

HISTORICAL PLYMOUTH STORAGE USAGE



HIGHLIGHTS FOR THE 2020 PORTFOLIO DESIGN

- PORTFOLIO PROCUREMENT DESIGN BASED ON A DECLINING PERCENTAGE EACH YEAR, ACCORDINGLY: Year 1: Approximately 80% of annual requirements; Year 2: 60%, Year 3: 20%.
  - 80% allows more flexibility operationally.
  - Allows us to be in the market monthly through FOM purchase or Day Gas purchases.
- Hedged Percentages (fixed-price physical) Currently max 50% of annual requirements. Second year max is set at 30%, and 10% hedged volumes for year three.
  - Cascade's hedging program is flexible and can be adjusted in response to changes in market conditions.
- CNGC's Gas Supply Oversight Committee (GSOC) would consider a modification of this plan if the outer year 3 year forward price is 20% higher/lower than the front month over a reasonably sustained period.
- Annual load expectation (Nov-Oct) is approximately 34,000,000 dths, consistent with recent load history.

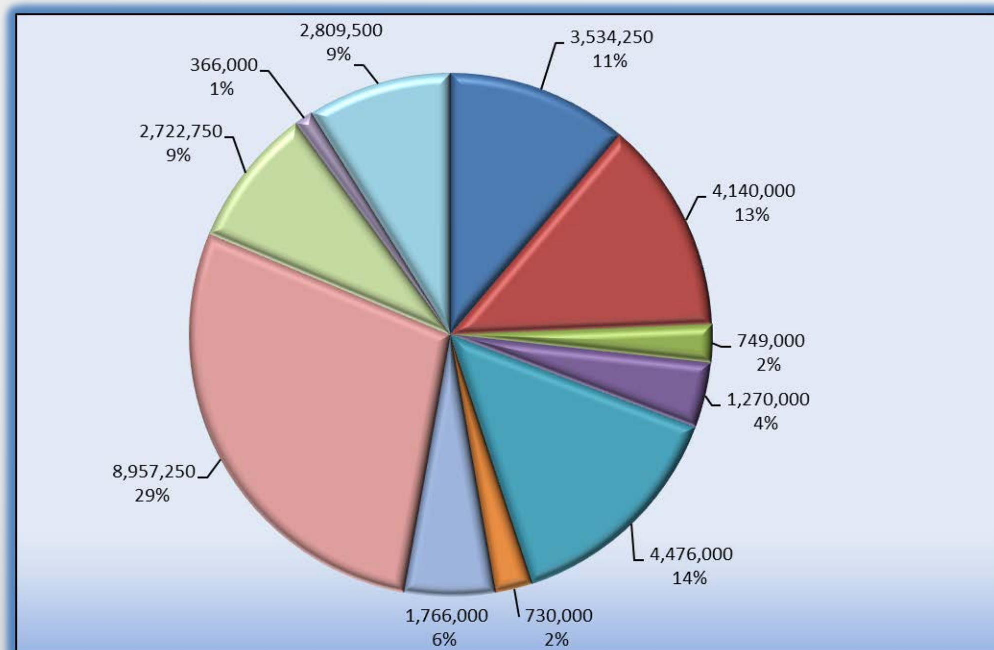
CASCADE NATURAL GAS CORPORATION
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Hedge Calculation Table

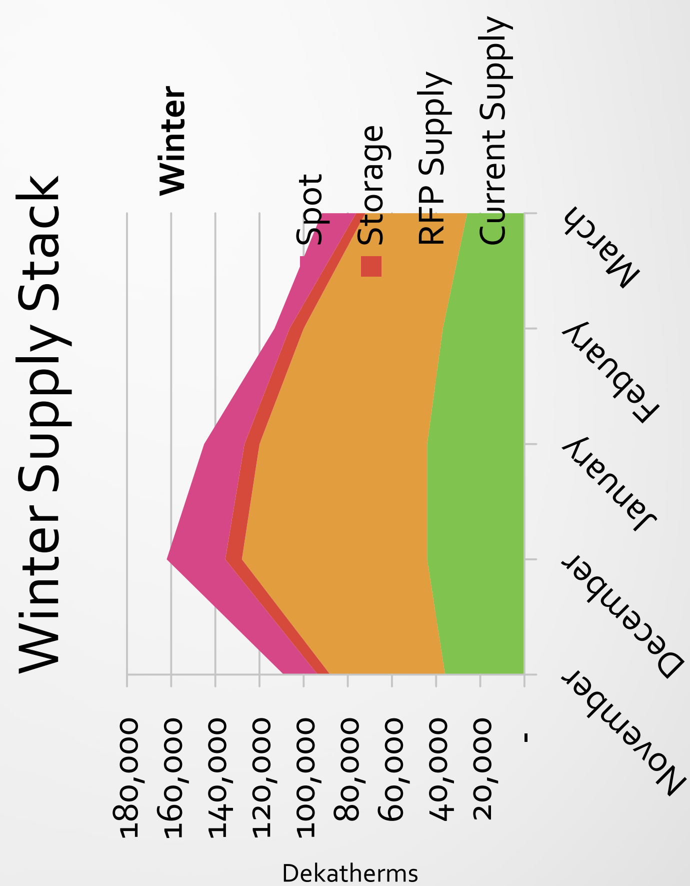
	Year 1	Year 2	Year 3
Contracted Base Supply Target	80%	60%	20%
Hedge Target	50%	30%	10%
Forecast Annual Usage	34,493,326	34,991,857	35,484,895
Needed Base Supply to Contract	27,594,661	20,995,114	7,096,979
Hedge Target	17,246,663	10,497,557	3,548,490
Current Hedged	10,110,000	5,592,000	-
Current Indexed	4,712,000	-	-
Remaining to Hedge	7,136,663	4,905,557	3,548,490
Remaining Indexed Supply Needed	5,635,998	10,497,557	3,548,490

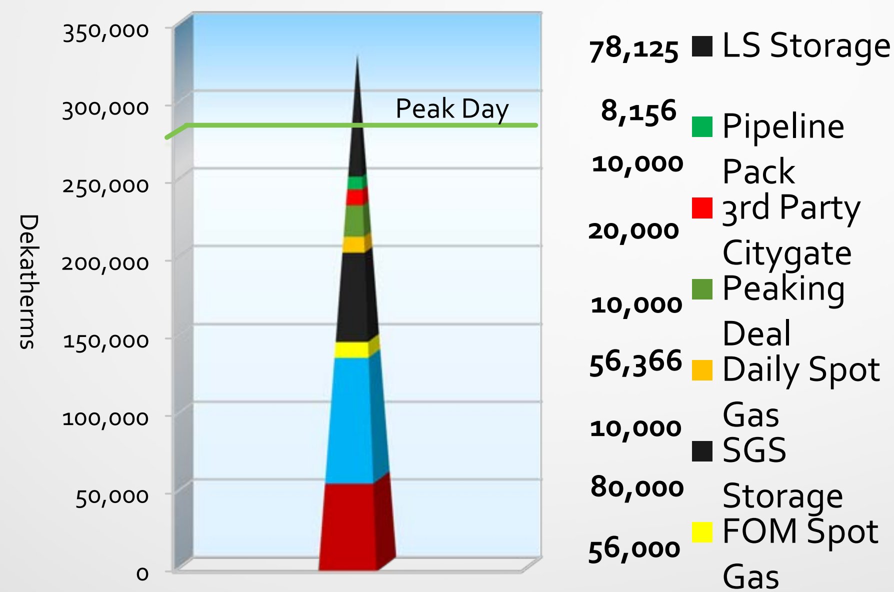
**Forecast*	The Forecast is based on the IRP 20 year forecast
**Contracted Base Supply*	Base Supply is the overall amount of the contracted supply wether indexed or hedged. CNG uses 80% of the forecast to allow for storage usage and operational flexibility. The outward years use a ladder scale down to obtain a portion of the portfolio annually.
**hedge Target*	A percentage of the forecasted amount

Current Supply Percentage by Supplier



Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®


Winter Supply Stack
Winter
Spot
Storage
RFP Supply
Current Supply
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
-
November
December
January
Febuary
March
Dekatherms


Dekatherms
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
Peak Day
78,125 LS Storage
8,156 Pipeline Pack
10,000 3rd Party Citygate
20,000 Peaking Deal
10,000 Daily Spot Gas
56,366 SGS Storage
10,000 FOM Spot Gas
80,000
56,000

Planned Scenarios and Sensitivities

SENDOUT® Model

- Cascade utilizes SENDOUT® for resource optimization.
- This model permits the Company to develop and analyze a variety of resource portfolios to help determine the type, size, and timing of resources best matched to forecast requirements.
- SENDOUT® is very powerful and complex. It operates by combining a series of existing and potential demand side and supply side resources, and optimizes their utilization at the lowest net present cost over the entire planning period for a given demand forecast.

CASCADE NATURAL GAS CORPORATION
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

SENDOUT® Model Cont’d

- SENDOUT® utilizes a linear programming approach.
- The model knows the exact load and price for every day of the planning period based on the analyst’s input and can therefore minimize costs in a way that would not be possible in the real world.
- Therefore, it is important to acknowledge that linear programming analysis provides helpful but not perfect information to guide decisions.

Modeling Challenges

- Supply needs to get gas to the citygate.
- Many of Cascade's transport agreements were entered into decades ago, based on demand projections at that point in time.
- Sum of receipt quantity and aggregated delivery quantity can help identify resource deficiency depending on how rights are allocated.
- The aggregated look can mask individual citygate issues for looped sections, and the disaggregated look can create deficiencies where they don't exist.
- In many cases operational capacity is greater than contracted.
- SENDOUT® has perfect knowledge.

Supply Resource Optimization Process

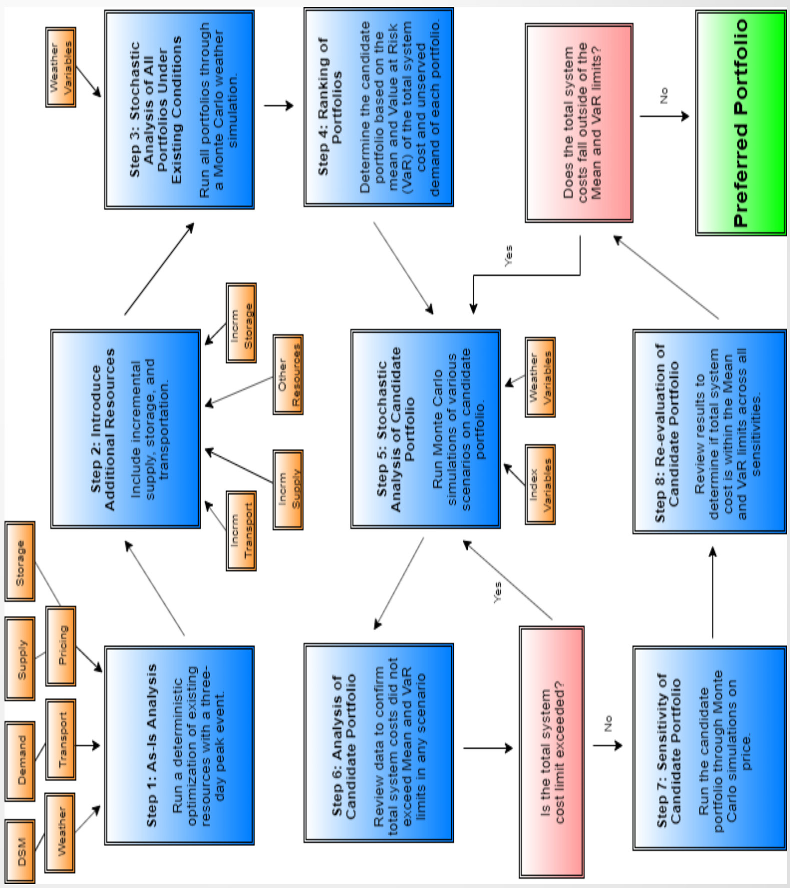
- **Step 1: As-Is Analysis**
  - Run a deterministic optimization of existing resources with a three-day peak event to uncover timing and quantity of resource deficiencies.
- **Step 2: Introduce Additional Resources**
  - Include incremental supply, storage, and transportation to derive a deterministic optimal portfolio, additional portfolios.
- **Step 3: Stochastic Analysis of All Portfolios Under Existing Conditions**
  - Run all portfolios through a Monte Carlo weather simulation, using expected growth, supply and storage accessibility. Record the probability distributions of total system costs for each portfolio.
- **Step 4: Ranking of Portfolios**
  - Determine the preferred portfolio based on the mean and Value at Risk (VaR) of the total system cost and unserved demand of each portfolio. This resource mix will be the best combination of cost and risk for Cascade and its customers.

CASCADE NATURAL GAS CORPORATION
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Supply Resource Optimization Process (Cont'd)

- **Step 5: Stochastic Analysis of Preferred Portfolio**
  - Run Monte Carlo simulations of various scenarios on preferred portfolio; comparing Mean and VaR to a managerial limit.
- **Step 6: Analysis of Preferred Portfolio**
  - Review data to confirm total system costs did not exceed Mean and VaR limits in any scenario. If limit is exceeded, repeat step 5 with next highest ranked portfolio.
- **Step 7: Sensitivity of Preferred Portfolio**
  - Run the preferred portfolio through Monte Carlo simulations on price. Review results to determine if total system cost is within the Mean and VaR limits across all sensitivities.
- **Step 8: Re-evaluation of Preferred Portfolio**
  - If the total system costs fall outside of the Mean and VaR limits in sensitivity analysis, select the next most optimal portfolio to run scenario and sensitivity analysis on. Repeat as needed.

Supply Resource Optimization Process Flow Chart



52

Additional Preferred Portfolio Considerations

- Does it get supply to the citygate?
- Is it reliable?
- Does it have a long lead time?
- How much does it cost?
- New build vs. depreciated cost
- The rate pancake
- Is it a base load or peaking resource?
- How many dekatherms are needed?
- What is the "shape" of resource?
- Is it tried and true technology, new technology, or yet to be discovered?
- Who else will be competing for the resource?

Scenarios and Sensitivities

- Scenario:
  - Change in projected demand
  - Change in availability of existing resources to serve demand
  - Change in availability of supply
- Change in price forecast
- Change in environmental adder
- Change in carbon forecast

Both carry the same importance, failure to pass either of them can lead to a portfolio being rejected

All In Case

KEY ELEMENTS IN SENDOUT SCENARIO		
Medium Load Growth, Stochastic Pricing, Stochastic Weather, Carbon Forecast. No new elements considered. All items in RED mean those elements were excluded from the scenario		
KEY ELEMENTS IN SENDOUT SCENARIO		
Current Station2	**JP1**	**AECO Base/Fixed, Winter, Day W/S, Peak**
Current NOVA	**JP2**	**SUMAS Base/Fixed, Winter, Day W/S, Peak**
Current GTN	**JP3**	**ROCKIES Base/Fixed, Winter, Day W/S, Peak**
Current NWP	**JP4**	**HUNT Base/Fixed, Winter, Day W/S**
Current Foothills	**PLY-1**	**KINGSGATE BASE**
Current Ruby	**PLY-2**	**OPAL BASE**
	MIST	**KERN WINTER**
		STAT2 BASE
Incremental NGTL ***Incremental GTN N-S*** ***NWP I-5 Mainline EXP*** ***Incremental Ruby*** ***NWP Wen lateral EXP*** ***Incremental Foothills*** ***NWP Z20 lateral EXP*** ***T-South-So Crossing*** ***Bremerton/Shelton*** ***Trails West (Palomar)*** ***NWP East OR Mainline EXP*** ***Incremental GTN S-N*** ***Incremental Enbridge*** ***Pacific Connector***	***Spire Storage*** ***Gill Ranch Storage*** ***Wild Goose Storage*** ***Aeco Hub Storage*** ***Magnum Storage*** ***Clay Basin Storage***	***Opal Incrm Supply*** ***Renewable Natural Gas*** ***Resource Mix - 3 Basins*** ***DSM***

The All In Case run allows the Company to see what the model would select if all current and probable resources are available.

Low Growth and High Growth

KEY ELEMENTS IN SENDOUT SCENARIO		
Low Load Growth, Stochastic Pricing, Stochastic Weather, Carbon Forecast. No new elements considered. All items in RED mean those elements were excluded from the scenario		
KEY ELEMENTS IN SENDOUT SCENARIO		
Current Station2	JP1	AECO Base/Fixed, Winter, Day W/S, Peak
Current NOVA	JP2	SUMAS Base/Fixed, Winter, Day W/S, Peak
Current GTN	JP3	ROCKIES Base/Fixed, Winter, Day W/S, Peak
Current NWP	JP4	HUNT Base/Fixed, Winter, Day W/S
Current Foothills	PLY-1	KINGSGATE BASE
Current Ruby	PLY-2	OPAL BASE
	MIST	KERN WINTER
		STAT2 BASE
Incremental NGTL *Incremental GTN N-S* *NWP I-5 Mainline EXP* *Incremental Ruby* *NWP Wen lateral EXP* *Incremental Foothills* *NWP Z20 lateral EXP* *T-South-So Crossing* *Bremerton/Shelton* *Trails West (Palomar)* *NWP East OR Mainline EXP* *Incremental GTN S-N* *Incremental Enbridge* *Pacific Connector*	*Spire Storage* *Gill Ranch Storage* *Wild Goose Storage* *Aeco Hub Storage* *Magnum Storage* *Clay Basin Storage*	*Opal Incrm Supply* *Renewable Natural Gas* *Resource Mix - 3 Basins* *DSM*

KEY ELEMENTS IN SENDOUT SCENARIO		
High Load Growth, Stochastic Pricing, Stochastic Weather, Carbon Forecast. No new elements considered. All items in RED mean those elements were excluded from the scenario		
KEY ELEMENTS IN SENDOUT SCENARIO		
Current Station2	JP1	AECO Base/Fixed, Winter, Day W/S, Peak
Current NOVA	JP2	SUMAS Base/Fixed, Winter, Day W/S, Peak
Current GTN	JP3	ROCKIES Base/Fixed, Winter, Day W/S, Peak
Current NWP	JP4	HUNT Base/Fixed, Winter, Day W/S
Current Foothills	PLY-1	KINGSGATE BASE
Current Ruby	PLY-2	OPAL BASE
	MIST	KERN WINTER
		STAT2 BASE
Incremental NGTL *Incremental GTN N-S* *NWP I-5 Mainline EXP* *Incremental Ruby* *NWP Wen lateral EXP* *Incremental Foothills* *NWP Z20 lateral EXP* *T-South-So Crossing* *Bremerton/Shelton* *Trails West (Palomar)* *NWP East OR Mainline EXP* *Incremental GTN S-N* *Incremental Enbridge* *Pacific Connector*	*Spire Storage* *Gill Ranch Storage* *Wild Goose Storage* *Aeco Hub Storage* *Magnum Storage* *Clay Basin Storage*	*Opal Incrm Supply* *Renewable Natural Gas* *Resource Mix - 3 Basins* *DSM*

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Limit BC and Limit Alberta

KEY ELEMENTS IN SENDOUT SCENARIO		
Medium Load Growth, Stochastic Pricing, Stochastic Weather, Carbon Forecast. No new elements considered. All items in RED mean those elements were excluded from the scenario. All items in BLUE mean those elements were excluded from the scenario.		
KEY ELEMENTS IN SENDOUT SCENARIO		
Current Station2	JP1	AECO Base/Fixed, Winter, Day W/S, Peak
Current NOVA	JP2	SUMAS Base/Fixed, Winter, Day W/S, Peak
Current GTN	JP3	ROCKIES Base/Fixed, Winter, Day W/S, Peak
Current NWP	JP4	HUNT Base/Fixed, Winter, Day W/S
Current Foothills	PLY-1	KINGSGATE BASE
Current Ruby	PLY-2	OPAL BASE
	MIST	KERN WINTER
		STAT2 BASE
Incremental NGTL *Incremental GTN N-S* *NWP I-5 Mainline EXP* *Incremental Ruby* *NWP Wen lateral EXP* *Incremental Foothills* *NWP Z20 lateral EXP* *T-South-So Crossing* *Bremerton/Shelton* *Trails West (Palomar)* *NWP East OR Mainline EXP* *Incremental GTN S-N* *Incremental Enbridge* *Pacific Connector*	*Spire Storage* *Gill Ranch Storage* *Wild Goose Storage* *Aeco Hub Storage* *Magnum Storage* *Clay Basin Storage*	*Opal Incrm Supply* *Renewable Natural Gas* *Resource Mix - 3 Basins* *DSM*

KEY ELEMENTS IN SENDOUT SCENARIO		
Medium Load Growth, Stochastic Pricing, Stochastic Weather, Carbon Forecast. No new elements considered. All items in RED mean those elements were excluded from the scenario. All items in BLUE mean those elements were excluded from the scenario.		
KEY ELEMENTS IN SENDOUT SCENARIO		
Current Station2	JP1	AECO Base/Fixed, Winter, Day W/S, Peak
Current NOVA	JP2	SUMAS Base/Fixed, Winter, Day W/S, Peak
Current GTN	JP3	ROCKIES Base/Fixed, Winter, Day W/S, Peak
Current NWP	JP4	HUNT Base/Fixed, Winter, Day W/S
Current Foothills	PLY-1	KINGSGATE BASE
Current Ruby	PLY-2	OPAL BASE
	MIST	KERN WINTER
		STAT2 BASE
Incremental NGTL *Incremental GTN N-S* *NWP I-5 Mainline EXP* *Incremental Ruby* *NWP Wen lateral EXP* *Incremental Foothills* *NWP Z20 lateral EXP* *T-South-So Crossing* *Bremerton/Shelton* *Trails West (Palomar)* *NWP East OR Mainline EXP* *Incremental GTN S-N* *Incremental Enbridge* *Pacific Connector*	*Spire Storage* *Gill Ranch Storage* *Wild Goose Storage* *Aeco Hub Storage* *Magnum Storage* *Clay Basin Storage*	*Opal Incrm Supply* *Renewable Natural Gas* *Resource Mix - 3 Basins* *DSM*

Limit Canada and Limit Rockies

KEY ELEMENTS IN SENDOUT SCENARIO		
Medium Load Growth, Stochastic Pricing, Stochastic Weather, Carbon Forecast. No new elements considered. All items in RED mean those elements were excluded from the scenario. All items in BLUE mean those elements were excluded from the scenario.		
KEY ELEMENTS IN SENDOUT SCENARIO		
Current Station2	JP1	AECO Base/Fixed, Winter, Day W/S, Peak
Current NOVA	JP2	SUMAS Base/Fixed, Winter, Day W/S, Peak
Current GTN	JP3	ROCKIES Base/Fixed, Winter, Day W/S, Peak
Current NWP	JP4	HUNT Base/Fixed, Winter, Day W/S
Current Foothills	PLY-1	KINGSGATE BASE
Current Ruby	PLY-2	OPAL BASE
	MIST	KERN WINTER
		STAT2 BASE
Incremental NGTL *Incremental GTN N-S* *NWP I-5 Mainline EXP* *Incremental Ruby* *NWP Wen lateral EXP* *Incremental Foothills* *NWP Z20 lateral EXP* *T-South-So Crossing* *Bremerton/Shelton* *Trails West (Palomar)* *NWP East OR Mainline EXP* *Incremental GTN S-N* *Incremental Enbridge* *Pacific Connector*	*Spire Storage* *Gill Ranch Storage* *Wild Goose Storage* *Aeco Hub Storage* *Magnum Storage* *Clay Basin Storage*	*Opal Incrm Supply* *Renewable Natural Gas* *Resource Mix - 3 Basins* *DSM*

KEY ELEMENTS IN SENDOUT SCENARIO		
Medium Load Growth, Stochastic Pricing, Stochastic Weather, Carbon Forecast. No new elements considered. All items in RED mean those elements were excluded from the scenario. All items in BLUE mean those elements were excluded from the scenario.		
KEY ELEMENTS IN SENDOUT SCENARIO		
Current Station2	JP1	AECO Base/Fixed, Winter, Day W/S, Peak
Current NOVA	JP2	SUMAS Base/Fixed, Winter, Day W/S, Peak
Current GTN	JP3	ROCKIES Base/Fixed, Winter, Day W/S, Peak
Current NWP	JP4	HUNT Base/Fixed, Winter, Day W/S
Current Foothills	PLY-1	KINGSGATE BASE
Current Ruby	PLY-2	OPAL BASE
	MIST	KERN WINTER
		STAT2 BASE
Incremental NGTL *Incremental GTN N-S* *NWP I-5 Mainline EXP* *Incremental Ruby* *NWP Wen lateral EXP* *Incremental Foothills* *NWP Z20 lateral EXP* *T-South-So Crossing* *Bremerton/Shelton* *Trails West (Palomar)* *NWP East OR Mainline EXP* *Incremental GTN S-N* *Incremental Enbridge* *Pacific Connector*	*Spire Storage* *Gill Ranch Storage* *Wild Goose Storage* *Aeco Hub Storage* *Magnum Storage* *Clay Basin Storage*	*Opal Incrm Supply* *Renewable Natural Gas* *Resource Mix - 3 Basins* *DSM*

CASCADE NATURAL GAS CORPORATION
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Limit JP and Limit Ply Storage

KEY ELEMENTS IN SENDOUT SCENARIO		
Medium Load Growth, Stochastic Pricing, Stochastic Weather, Carbon Forecast. No new elements considered. All items in RED mean those elements were excluded from the scenario. All items in BLUE mean those elements were excluded from the scenario.		
KEY ELEMENTS IN SENDOUT SCENARIO		
Current Station2	JP1	**AECO Base/Fixed, Winter, Day W/S, Peak**
Current NOVA	JP2	**SUMAS Base/Fixed, Winter, Day W/S, Peak**
Current GTN	JP3	**ROCKIES Base/Fixed, Winter, Day W/S, Peak**
Current NWP	JP4	**HUNT Base/Fixed, Winter, Day W/S**
Current Foothills	**PLY-1**	**KINGSGATE BASE**
Current Ruby	**PLY-2**	**OPAL BASE**
	MIST	**KERN WINTER**
		STAT2 BASE
Incremental NGTL	***Spire Storage***	***Opal Incrm Supply***
Incremental GTN N-S	***Gill Ranch Storage***	***Renewable Natural Gas***
NWP I-5 Mainline EXP	***Wild Goose Storage***	***Resource Mix - 3 Basins***
Incremental Ruby	***Aeco Hub Storage***	***DSM***
NWP Wen lateral EXP	***Magnum Storage***	
Incremental Foothills	***Clay Basin Storage***	
NWP Z20 lateral EXP		
T-South-So Crossing		
Bremerton/Shelton		
Trails West (Palomar)		
NWP East OR Mainline EXP		
Incremental GTN S-N		
Incremental Enbridge		
Pacific Connector		

KEY ELEMENTS IN SENDOUT SCENARIO		
Medium Load Growth, Stochastic Pricing, Stochastic Weather, Carbon Forecast. No new elements considered. All items in RED mean those elements were excluded from the scenario. All items in BLUE mean those elements were excluded from the scenario.		
KEY ELEMENTS IN SENDOUT SCENARIO		
Current Station2	**JP1**	**AECO Base/Fixed, Winter, Day W/S, Peak**
Current NOVA	**JP2**	**SUMAS Base/Fixed, Winter, Day W/S, Peak**
Current GTN	**JP3**	**ROCKIES Base/Fixed, Winter, Day W/S, Peak**
Current NWP	**JP4**	**HUNT Base/Fixed, Winter, Day W/S**
Current Foothills	PLY-1	**KINGSGATE BASE**
Current Ruby	PLY-2	**OPAL BASE**
	MIST	**KERN WINTER**
		STAT2 BASE
Incremental NGTL	***Spire Storage***	***Opal Incrm Supply***
Incremental GTN N-S	***Gill Ranch Storage***	***Renewable Natural Gas***
NWP I-5 Mainline EXP	***Wild Goose Storage***	***Resource Mix - 3 Basins***
Incremental Ruby	***Aeco Hub Storage***	***DSM***
NWP Wen lateral EXP	***Magnum Storage***	
Incremental Foothills	***Clay Basin Storage***	
NWP Z20 lateral EXP		
T-South-So Crossing		
Bremerton/Shelton		
Trails West (Palomar)		
NWP East OR Mainline EXP		
Incremental GTN S-N		
Incremental Enbridge		
Pacific Connector		

Limit Both Storage and No JP

KEY ELEMENTS IN SENDOUT SCENARIO		
Medium Load Growth, Stochastic Pricing, Stochastic Weather, Carbon Forecast. No new elements considered. All items in RED mean those elements were excluded from the scenario. All items in BLUE mean those elements were excluded from the scenario.		
KEY ELEMENTS IN SENDOUT SCENARIO		
Current Station2	JP1	**AECO Base/Fixed, Winter, Day W/S, Peak**
Current NOVA	JP2	**SUMAS Base/Fixed, Winter, Day W/S, Peak**
Current GTN	JP3	**ROCKIES Base/Fixed, Winter, Day W/S, Peak**
Current NWP	JP4	**HUNT Base/Fixed, Winter, Day W/S**
Current Foothills	PLY-1	**KINGSGATE BASE**
Current Ruby	PLY-2	**OPAL BASE**
	MIST	**KERN WINTER**
		STAT2 BASE
Incremental NGTL ***Incremental GTN N-S*** ***NWP I-5 Mainline EXP*** ***Incremental Ruby*** ***NWP Wen lateral EXP*** ***Incremental Foothills*** ***NWP Z20 lateral EXP*** ***T-South-So Crossing*** ***Bremerton/Shelton*** ***Trails West (Palomar)*** ***NWP East OR Mainline EXP*** ***Incremental GTN S-N*** ***Incremental Enbridge*** ***Pacific Connector***	***Spire Storage*** ***Gill Ranch Storage*** ***Wild Goose Storage*** ***Aeco Hub Storage*** ***Magnum Storage*** ***Clay Basin Storage***	***Opal Incrm Supply*** ***Renewable Natural Gas*** ***Resource Mix - 3 Basins*** ***DSM***

KEY ELEMENTS IN SENDOUT SCENARIO		
Medium Load Growth, Stochastic Pricing, Stochastic Weather, Carbon Forecast. No new elements considered. All items in RED mean those elements were excluded from the scenario. All items in BLUE mean those elements were excluded from the scenario.		
KEY ELEMENTS IN SENDOUT SCENARIO		
Current Station2	**JP1**	**AECO Base/Fixed, Winter, Day W/S, Peak**
Current NOVA	**JP2**	**SUMAS Base/Fixed, Winter, Day W/S, Peak**
Current GTN	**JP3**	**ROCKIES Base/Fixed, Winter, Day W/S, Peak**
Current NWP	**JP4**	**HUNT Base/Fixed, Winter, Day W/S**
Current Foothills	**PLY-1**	**KINGSGATE BASE**
Current Ruby	**PLY-2**	**OPAL BASE**
	MIST	**KERN WINTER**
		STAT2 BASE
Incremental NGTL ***Incremental GTN N-S*** ***NWP I-5 Mainline EXP*** ***Incremental Ruby*** ***NWP Wen lateral EXP*** ***Incremental Foothills*** ***NWP Z20 lateral EXP*** ***T-South-So Crossing*** ***Bremerton/Shelton*** ***Trails West (Palomar)*** ***NWP East OR Mainline EXP*** ***Incremental GTN S-N*** ***Incremental Enbridge*** ***Pacific Connector***	***Spire Storage*** ***Gill Ranch Storage*** ***Wild Goose Storage*** ***Aeco Hub Storage*** ***Magnum Storage*** ***Clay Basin Storage***	***Opal Incrm Supply*** ***Renewable Natural Gas*** ***Resource Mix - 3 Basins*** ***DSM***

CASCADE NATURAL GAS CORPORATION
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

No Ply Storage and No Storage

KEY ELEMENTS IN SENDOUT SCENARIO		
Medium Load Growth, Stochastic Pricing, Stochastic Weather, Carbon Forecast. No new elements considered. All items in RED mean those elements were excluded from the scenario. All items in BLUE mean those elements were excluded from the scenario.		
KEY ELEMENTS IN SENDOUT SCENARIO		
Current Station2	**JP1**	**AECO Base/Fixed, Winter, Day W/S, Peak**
Current NOVA	**JP2**	**SUMAS Base/Fixed, Winter, Day W/S, Peak**
Current GTN	**JP3**	**ROCKIES Base/Fixed, Winter, Day W/S, Peak**
Current NWP	**JP4**	**HUNT Base/Fixed, Winter, Day W/S**
Current Foothills	**PLY-1**	**KINGSGATE BASE**
Current Ruby	**PLY-2**	**OPAL BASE**
	MIST	**KERN WINTER**
		STAT2 BASE
Incremental NGTL ***Incremental GTN N-S*** ***NWP I-5 Mainline EXP*** ***Incremental Ruby*** ***NWP Wen lateral EXP*** ***Incremental Foothills*** ***NWP Z20 lateral EXP*** ***T-South-So Crossing*** ***Bremerton/Shelton*** ***Trails West (Palomar)*** ***NWP East OR Mainline EXP*** ***Incremental GTN S-N*** ***Incremental Enbridge*** ***Pacific Connector***	***Spire Storage*** ***Gill Ranch Storage*** ***Wild Goose Storage*** ***Aeco Hub Storage*** ***Magnum Storage*** ***Clay Basin Storage***	***Opal Incrm Supply*** ***Renewable Natural Gas*** ***Resource Mix - 3 Basins*** ***DSM***

KEY ELEMENTS IN SENDOUT SCENARIO		
Medium Load Growth, Stochastic Pricing, Stochastic Weather, Carbon Forecast. No new elements considered. All items in RED mean those elements were excluded from the scenario. All items in BLUE mean those elements were excluded from the scenario.		
KEY ELEMENTS IN SENDOUT SCENARIO		
Current Station2	**JP1**	**AECO Base/Fixed, Winter, Day W/S, Peak**
Current NOVA	**JP2**	**SUMAS Base/Fixed, Winter, Day W/S, Peak**
Current GTN	**JP3**	**ROCKIES Base/Fixed, Winter, Day W/S, Peak**
Current NWP	**JP4**	**HUNT Base/Fixed, Winter, Day W/S**
Current Foothills	**PLY-1**	**KINGSGATE BASE**
Current Ruby	**PLY-2**	**OPAL BASE**
	MIST	**KERN WINTER**
		STAT2 BASE
Incremental NGTL ***Incremental GTN N-S*** ***NWP I-5 Mainline EXP*** ***Incremental Ruby*** ***NWP Wen lateral EXP*** ***Incremental Foothills*** ***NWP Z20 lateral EXP*** ***T-South-So Crossing*** ***Bremerton/Shelton*** ***Trails West (Palomar)*** ***NWP East OR Mainline EXP*** ***Incremental GTN S-N*** ***Incremental Enbridge*** ***Pacific Connector***	***Spire Storage*** ***Gill Ranch Storage*** ***Wild Goose Storage*** ***Aeco Hub Storage*** ***Magnum Storage*** ***Clay Basin Storage***	***Opal Incrm Supply*** ***Renewable Natural Gas*** ***Resource Mix - 3 Basins*** ***DSM***

CASCADE NATURAL GAS CORPORATION
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Sensitivities Analyses

Sensitivities		Assumpitons
Price	High	Medium Load Growth, Average Weather with Peak Event, High Gas Price Environment
	Low	Medium Load Growth, Average Weather with Peak Event, Low Gas Price Environment
Env. Adder	0%	Medium Load Growth, Average Weather with Peak Event, Medium Gas Price Environment with No Adder for Unknown Regulatory Impacts
	20%	Medium Load Growth, Average Weather with Peak Event, Medium Gas Price Environment with 20% Adder for Unknown Regulatory Impacts
	30%	Medium Load Growth, Average Weather with Peak Event, Medium Gas Price Environment with 30% Adder for Unknown Regulatory Impacts
Carbon Adder	Various	Medium Load Growth, Average Weather with Peak Event, Medium Gas Price Environment with Various Potential Carbon Futures Modeled

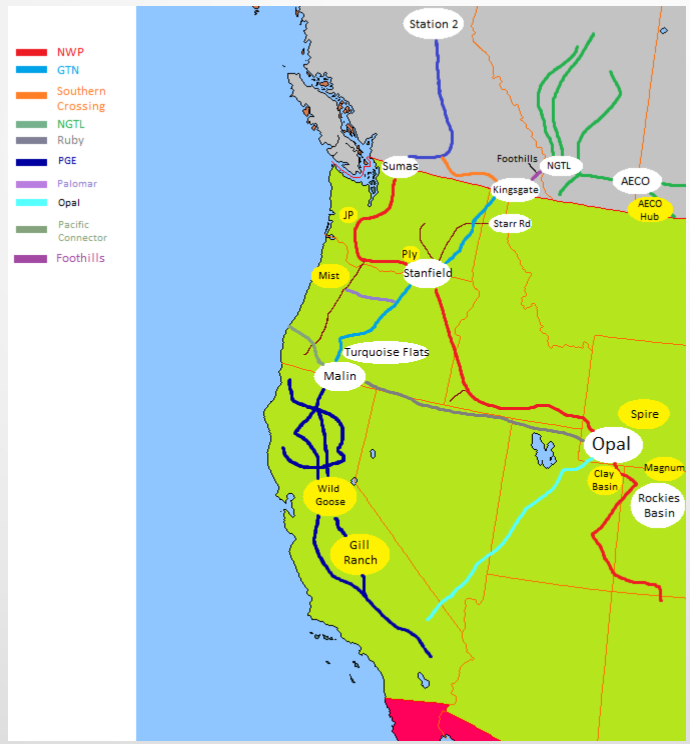
Alternative Resources

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Major resource issues on the horizon

- Once a deficiency is identified, Cascade must analyze potential solutions to ensure service over the planning horizon.
- Conversations with partners at various pipelines, storage facilities, new supply sources.
- SENDOUT® is used to ultimately derive the optimal mix of resources, referred to as the "preferred portfolio."

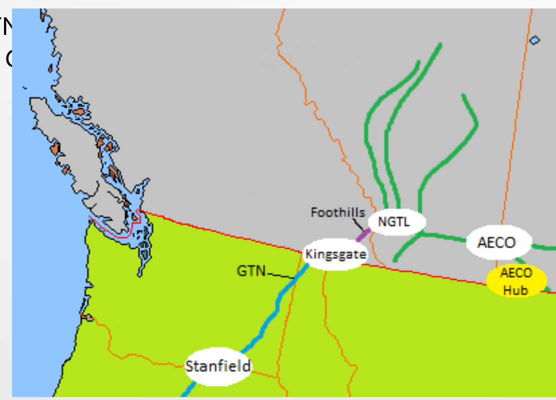
Location of Current & Alternative Resources



CASCADE NATURAL GAS CORPORATION
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

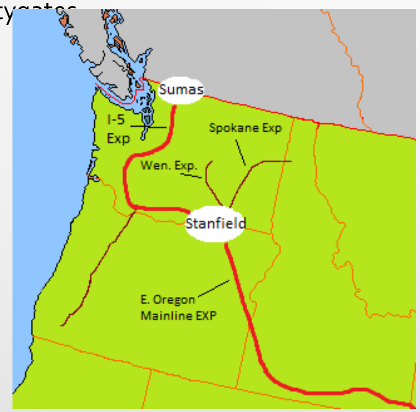
Incremental Transport – North to South

- Incremental NGTL – Additional capacity to move gas from AECO basin to Alberta/BC border
- Incremental Foothills – Additional capacity to move gas from Alberta/BC border to Kingsgate
- Incremental GTN … sgate to various citygates along …



Incremental Transport – Northwest Pipeline

- I-5 Mainline Expansion – Additional capacity to move gas along I-5 corridor in western Washington
- Wenatchee Lateral Expansion – Additional capacity to move gas along Wenatchee Lateral to central Washington
- Spokane Lateral Expansion – Additional capacity to move gas along Spokane Lateral to eastern Washington
- Eastern Oregon Mainline Expansion – Additional capacity to move gas along Eastern Oregon Lateral to Oregon citygates

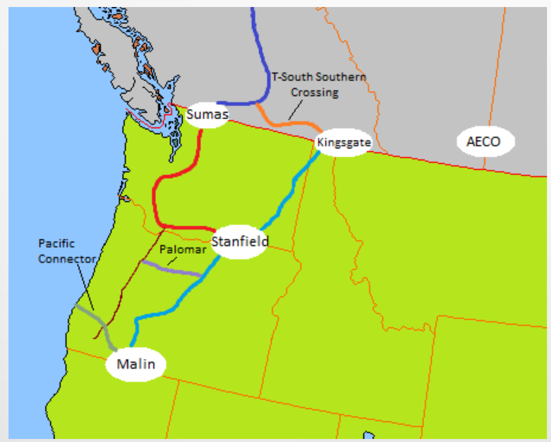


Incremental Transport – South to North

- Incremental Opal– Additional capacity to move gas from Utah to Opal
- Incremental GTN S/N – Additional capacity to move gas from Turquois Flats to various citygates along GTN
- Incremental Ruby – Additional capacity to move gas from Rockies Basin to Turquoise Flats

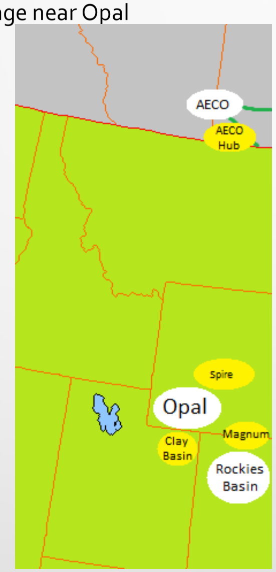
Incremental Transport – Bilateral

- T-South Southern Crossing – Price arbitrage opportunity to move gas between Sumas and AECO basins bilaterally
- Trails West (Palomar) – Additional capacity to move Rockies gas to the I-5 corridor
- Pacific Connector – Pipeline that will feed LNG facility on Oregon coast, increasing liquidity at Malin



Incremental Storage - North and East

- Ryckman Creek Storage – Additional storage in southwest Wyoming serving the system, primarily Oregon
- Magnum Storage – Additional storage near Rocky Mountains, serving the system, primarily Oregon
- AECO Hub Storage – Additional storage near AECO Hub, serving the system
- Clay Basin Storage – Additional storage near Opal

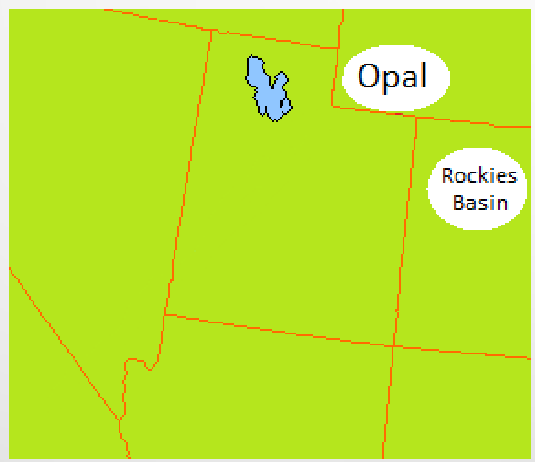


Incremental Storage - South and West

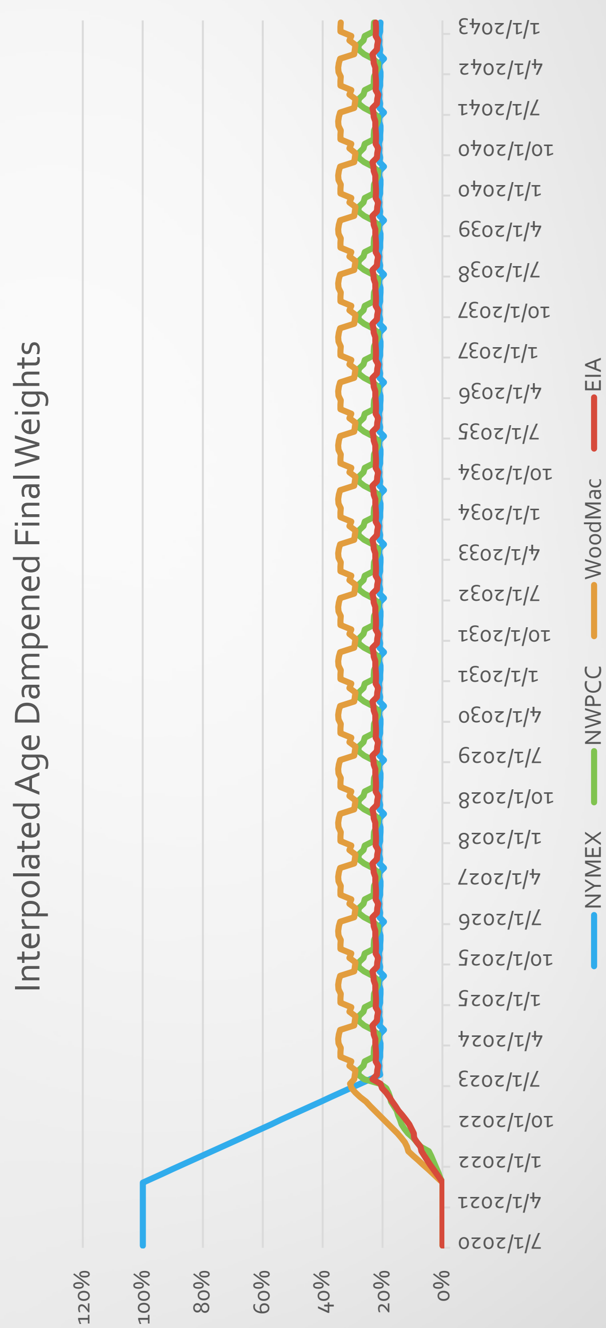
- Gill Ranch Storage – Additional storage in central California, serving the system, primarily Oregon
- Mist Storage – Additional storage in northern Oregon, serving the system, primarily Washington
- Wild Goose Storage – Additional storage in northern California, serving the system, primarily Oregon

Incremental Supplies

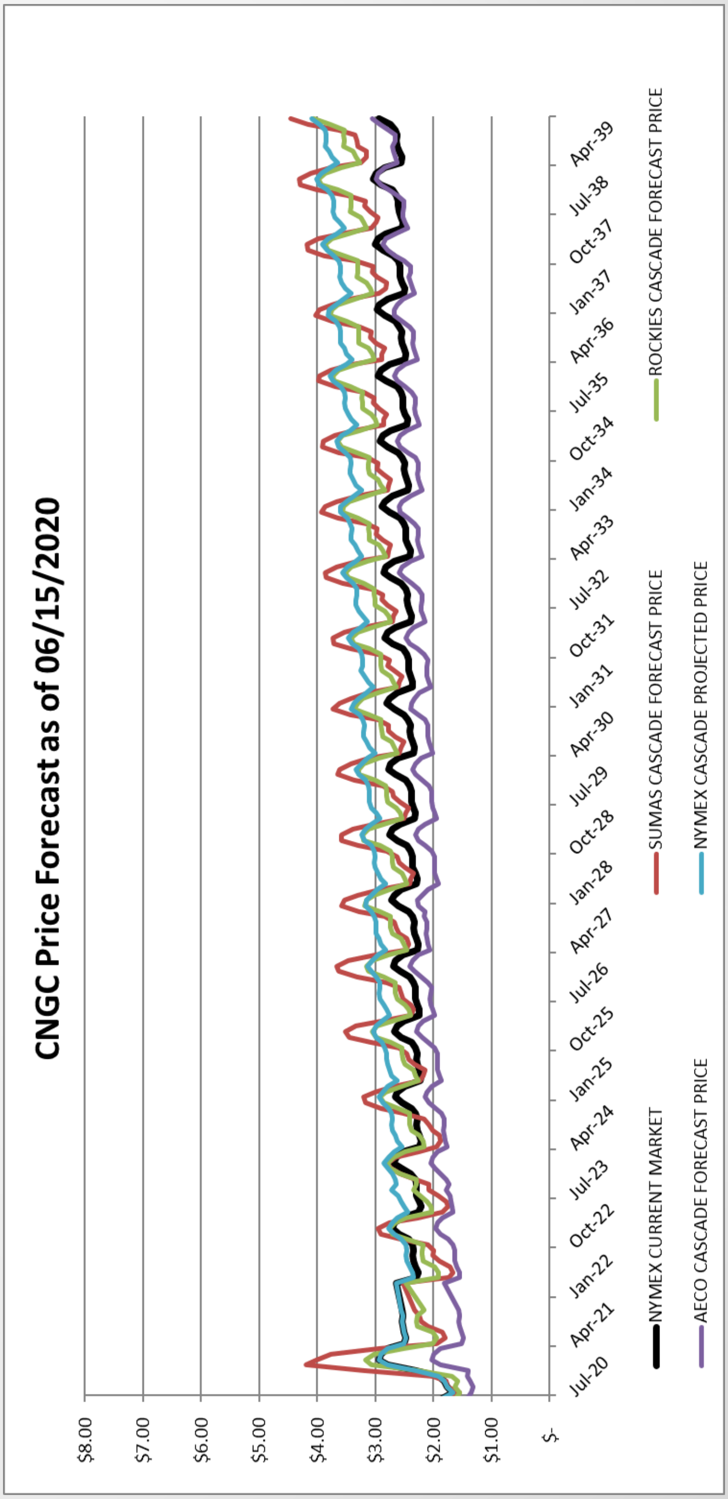
- Incremental Opal Supply – Additional supply around the Rockies Basin
- Renewable Natural Gas – Incremental biogas supply directly to distribution system



Price Forecast Results


Interpolated Age Dampened Final Weights
120%
100%
80%
60%
40%
20%
0%
7/1/2020
4/1/2021
1/1/2022
10/1/2022
7/1/2023
4/1/2024
1/1/2025
10/1/2025
7/1/2026
4/1/2027
1/1/2028
10/1/2028
7/1/2029
4/1/2030
1/1/2031
10/1/2031
7/1/2032
4/1/2033
1/1/2034
10/1/2034
7/1/2035
4/1/2036
1/1/2037
10/1/2037
7/1/2038
4/1/2039
1/1/2040
10/1/2040
7/1/2041
4/1/2042
1/1/2043
NYMEX
NWPCC
WoodMac
EIA

74


CNGC Price Forecast as of 06/15/2020
$8.00
$7.00
$6.00
$5.00
$4.00
$3.00
$2.00
$1.00
$-
Jul-20
Apr-21
Jan-22
Oct-22
Jul-23
Apr-24
Jan-25
Oct-25
Jul-26
Apr-27
Jan-28
Oct-28
Jul-29
Apr-30
Jan-31
Oct-31
Jul-32
Apr-33
Jan-34
Oct-34
Jul-35
Apr-36
Jan-37
Oct-37
Jul-38
Apr-39
NYMEX CURRENT MARKET
SUMAS CASCADE FORECAST PRICE
ROCKIES CASCADE FORECAST PRICE
AECO CASCADE FORECAST PRICE
NYMEX CASCADE PROJECTED PRICE

75

Avoided Cost Methodology and Calculation

Avoided Cost Overview

- As part of the IRP process, Cascade produces a 20-year price forecast and 45 years of avoided costs.
- The avoided cost is an estimated cost to serve the next unit of demand with a supply side resource option at a point in time. This incremental cost to serve represents the cost that could be avoided through energy conservation.
- The avoided cost forecast can be used as a guideline for comparing energy conservation with the cost of acquiring and transporting natural gas to meet demand.

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

- For the 2020 IRP, Cascade has continued to evolve its avoided cost formula to create a more transparent and intuitive final number.
  - Methodologies for calculating Distribution System Costs and Risk Premium have been refined.
- Cascade evaluates the impact that a range of environmental externalities, including CO_2 emission prices, would have on the avoided costs in terms of cost adders and supply costs.
- The Company produces an expected avoided cost case based on peak day and, in the case of distribution system costs, peak hour.

Avoided Cost Formula

The components that go into Cascade's avoided cost calculation are as follows:

$$AC_{nominal} = TC_v + SC_v + ((CC + C_{tax}) * E_{adder}) + DSC + RP$$

Where

- $AC_{nominal}$ = The nominal avoided cost for a given year. To put this into real dollars you must apply the following: Avoided Cost/(1+inflation rate)^Years from the reference year.
- TC_v = Variable Transportation Costs
- SC_v = Variable Storage Costs
- CC = Commodity Costs
- C_{tax} = Carbon Tax
- E_{adder} = Environmental Adder, as recommended by the Northwest Power and Conservation Council
- DSC = Distribution System Costs
- RP = Risk Premium

Methodology

- Transportation costs are pulled directly from the major pipelines that Cascade utilizes (NWP, GTN, Enbridge, Ruby, Nova Gas Transmission (NGTL) and Foothills).
- Storage costs are only captured if there is an avoidable future storage cost (ie. On system storage).
- Commodity Costs are taken from Cascade's 20-year price forecast.
- Risk Premium is the cost associated with hedging.
- Distribution System Costs only look at costs associated with growth. Pipeline integrity cannot be avoided.

Methodology - Carbon

- Modeling carbon compliance costs is a challenge because the future of carbon is uncertain.
- As discussed during scenarios and sensitivities, Cascade will model the impact of a variety of potential carbon pathways.
- Cascade's primary carbon forecast is the Social Cost of Carbon (SCC) forecast using a 2.5% discount rate, adjusted to real 2020 dollars. From a modeling perspective the Company does not take a stance in support or opposition of a particular carbon forecast. This complies with guidance provided in HB 1257.

CASCADE NATURAL GAS CORPORATION
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Methodology – Distribution System Costs

- Cascade's distribution system costs are calculated as a function of the Company's authorized margin, weighted by the load share of each rate class.
- Authorized margin is defined as the applicable cost of service including authorized rate of return.
- The weighted margin number is then multiplied by the percentage of projects of Cascade budgeted projects specifically related to growth.
- Since Avoided Cost is based on peak day, the margin calculation is then multiplied by the ratio of peak day demand to an average day's demand to get the margin impact on peak day.
- Distribution system analysis is concerned with the pressure during peak hour, so the daily number must then be multiplied by the ratio of peak hour demand to that day's total demand.

Example of Distribution Cost Calculation

Data Item	Value
Weighted Margin (Dth)	0.084967
* Growth Share (37%)	0.031438
*Peak Day Impact (Peak Demand/Average Demand)	0.119075
*Peak Hour Impact (Peak Hour/Peak Day Demand)	0.006112

Methodology – Risk Premium

- Cascade defines risk premium as the additional cost the Company would have to pay for a fixed price to fully hedge its portfolio versus open market FOM prices.
- Theoretical fixed pricing comes from the company's Asset Management Agreement (AMA) Partner, Tenaska Marketing Ventures.
- Pricing is received at all three basins Cascade purchases gas from, and then blended based on expected supply needs at the basins.
- Following regional best practices, if this value is negative the Company records the risk premium as zero, as described in the following table.

2020 Avoided Cost Risk Premium

Year #	Calendar Year	Risk Reduction Value (Real $/Dth)
1	2020	-$0.159
2	2021	-$0.139
3	2022	-$0.108
4	2023	-$0.067
5	2024	-$0.104
6	2025	-$0.245
7	2026	-$0.301
8	2027	-$0.221
9	2028	-$0.109
10	2029	-$0.078
11	2030	-$0.105
12	2031	-$0.069
13	2032	$0.000
14	2033	-$0.001
15	2034	-$0.016
16	2035	-$0.030
17	2036	-$0.057
18	2037	-$0.141
19	2038	-$0.459
20	2039	-$0.304

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Avoided Cost - Conclusion

- Cascade is continuing to improve its avoided cost calculation with enhancements to its distribution system and risk premium cost calculations
- Cascade's resource planning team will be providing its avoided cost figures to the Company's energy efficiency team, who will be sending back a conservation potential assessment based on these inputs.

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

2020 IRP Remaining Schedule

Date (Subject to change)	Process Element	Location (Subject to change)
Wednesday, June 17, 2020	TAG 3 slides distributed to stakeholders	
Wednesday, June 24, 2020	**TAG 3: Distribution System Planning, Planned Scenarios and Sensitivities, Alternative Resources, Price Forecast, Avoided Costs, Current Supply Resources, Transport Issues.**	**Teleconference Only**
Wednesday, August 5, 2020	TAG 4 slides distributed to stakeholders	
Wednesday, August 12, 2020	**TAG 4 Carbon Impacts, Energy Efficiency, Bio-Natural Gas, Preliminary Resource Integration Results.**	**Community Service Room in Bellingham, WA - 9 am to 3 pm**
Wednesday, September 16, 2020	TAG 5 slides distributed to stakeholders	
Wednesday, September 23, 2020	**TAG 5: Final Integration Results, finalization of plan components, Proposed new 4-year Action Plan.**	**SeaTac Airport - 9 am to 12 pm**
Tuesday, November 17, 2020	Draft of 2020 WA IRP distributed	
Wednesday, December 23, 2020	Comments due on draft from all stakeholders	
Wednesday, January 27, 2021	TAG 6, if needed	WebEx Only
Friday, February 26, 2021	IRP filing in Washington	

ADDITIONAL QUESTIONS?

mark.sellers-vaughn@cngc.com

Brian Robertson – Supervisor, Resource Planning: (509) 734-4546
brian.robertson@cngc.com

Devin McGreal – Resource Planning Analyst II: (509) 734-4681
devin.mcgreal@cngc.com

Ashton Davis – Resource Planning Analyst I: (509) 734-4520
ashton.davis@cngc.com

irp@cngc.com

Cascade Natural Gas Corporation

2020 Integrated Resource Plan

Technical Advisory Group Meeting #3

Wednesday, June 24th, 2020

Microsoft Teams Meeting

TAG #3 – WUTC TAG Meeting

Date & time: 06/24/2020, 09:00 AM – 11:20 AM

Location: Microsoft Teams Meeting

Presenters: Brian Robertson, Ashton Davis & Devin McGreal

In attendance: Mark Sellers-Vaughn, Brian Robertson, Devin McGreal, Ashton Davis, Bruce Folsom, Chris Robbins, Eric Wood, Carolyn Stone, Taylor Mead, Sheila McElhinney, Kary Burin, Garret Senger, Carolyn Stone, Philip Hensyel, Monica Cowlishaw, Linda Offerdahl, Christopher Mickelson, Brian Cunnington, Patrick Darras, Jon Storvick, Andrew Rector – WUTC, Bradley Cebulko – WUTC, Corey Dahl – Public Counsel, Mark Iverson – Ruby, Kyle Depew – WUTC, and Tom Pardee – Avista,

Minutes: Carolyn Stone

Brian began the meeting with a "Safety Moment" reminding all of us to stay hydrated in the neat and lay off the "sugary" drinks. Temperatures are rising! Brian asked Mark if he had any beginning comments. Mark thanked everyone and encouraged questions and comments. He said he you want his team to "dive into" more, let the group know and he hopes everyone stays safe and healthy!

Brian then went through the Agenda and introductions of attendees.

Brian started Tag #3 by updating the group on a Tag #2 "Action Item", the back-cast work. Brian said they have done a lot of work on this but have no results to share yet. They will present this information at Tag #4 or Tag #5.

Presentation #1 – DISTRIBUTION SYSTEM PLANNING – *Linda Offerdahl*

QUESTION: Andrew asked for a quick reminder on the difference between a regulator and compressor?
ANSWER: Linda said compressors use turbines to produce pressure, regulator reduces that pressure.

QUESTION: Andrew also asked what is the "set point"?
ANSWER: Linda answered that a set point lowers the pressure – gives the option of including a set point if the MAOP is not higher.

QUESTION: Andrew asked if they are modeling "continuously" and this feed into the IRP?
ANSWER: Linda said, "Yes, it does!" Using tools and programming potential growth to feed shortfalls on our system. The IRP is the beginning point. We want to identify shortfalls ASAP and include them in the IRP.

Devin added that it is an iterative process. We do work with projects engineering identifies. Analysis they do impacts another department's work.

Presentation #2 – Cascade Gas Supply Overview – *Eric Wood*

QUESTION: Andrew noted on Slide #43, labels do not show who the suppliers are, are these companies?

ANSWER Eric answered stating they are specific companies. Gives an example of how many suppliers we have here. Eric stated here are lots of options and resources to meet Peak day. He went on to say, we can enter into a peaking deal for 20K, for example or do daily spot transactions for 10K and storage as well.

Presentation #3 – PLANNED SCENARIOS & SENSITIVITIES – *Brian Robertson*

QUESTION: Andrew asked if the program's recommended price is higher than what you can get out of storage?

ANSWER: Brian answered that when the model fills storage with purchased gas, if prices higher in summer than winter it decides to purchase that gas rather than use storage.

QUESTION: Andrew asked if about a new "software". He was curious if this was able to solve problems that Sendout® has issues with now?

ANSWER: Brian said the model is very experienced in electricity, but preliminary with natural gas. It does have functionality that has piqued our interest – granularity of detail in optimization. We can definitely discuss this later! It is very preliminary.

Carolyn asked what the name of this software is, but Mark replied that the group does not want to have a full-blown discussion of this software right now.

QUESTION: Andrew asked if the group could talk more about the transport agreements entered years ago...he asks are these relevant to our current load?

ANSWER: Mark answered stating that back in the "dark ages" we entered into #100002. This was entered under open access. Essential for Long-term demand. Some capacity needs to be turned back. We do look at the termination dates of our contracts and occasionally we do terminate them. Overall no material changes needed to 100002 and thanks for this context!

Brian added that a theoretically, use supply between two transport agreements, then maybe don't need as much - distribute transport...but we just stay on top of supplies and make sure they are liquid and that transport agreements tie together as well as what Mark stated.

QUESTION: Andrew asked if there were any changes made to these 8 steps since the last IRP?

ANSWER: Brian said he doesn't thing any of the steps changed, but only details within those steps. Devin added that the only thing they did change from 2018 Washington IRP was the stochastic analysis (when done and on what). Brian said he will go back and look and get back to Andrew. Andrew said Devin may have hit on the only change but asked to check. Brian said he will definitely check and confirm!

QUESTION: Andrew asked what the reason is for doing 2 separate IRPS for WASH & OR?

ANSWER: Brian said for both, timing one reason, plus some rules are different in both IRP's. Brian said they are not against combining them in the future!

Mark added that they tried to combine them in 2014, but there are different sets of rules between WA and OR, for example one has a 4-year action plan vs a 2-year action plan. Washington files 2 years based on the date of filing; Oregon's date was 2 years from the acknowledgement. Also, there are concerns on operational documents on carbon - no clarity between the 2 states. We have kept the two filings separate for the last couple of years. It is a continuing evolution between the 2 states. It is a timing issue for us!

Andrew said he was just curious to understand it.

Brian added that for the next IRP, OR & WA are both on the same timeline. Might be a discussion for 2022!

QUESTION: Andrew asked if any 1 scenario/sensitivity does not meet criteria, then do you discard that portfolio – in terms of serving load?

ANSWER: If one portfolio doesn't get gas to the customer...we ask if that is a "likely scenario". We look at how like it is to happen. More goes into it then just discarding it.

Devin added that more that goes into it if doing a Monte Carlo simulation. Dramatic increase at a 99 percentile, sensitive costs, shortfalls, etc. May be changes in that portfolio made only...tweaks might be more appropriate!

Mark reminded that Sendout® has perfect knowledge, for 20 years. We bring subjectivity to this...operational considerations. We partner with gas supply and other teams. For example, if all gas was recommended to be purchased at AECO, we don't have enough capacity there to do that!

Andrew said this is helpful in getting a peek into this process!

Presentation #4 – ALTERNATIVE RESOURCES – *Ashton Davis*

QUESTION: When is the lockdown for the price forecast?

ANSWER: Devin said late to mid-June. Ideally most current info possible but have deadlines for Energy Efficiency group, so they can start building Avoided Cost calculation.

Presentation #5 – AVOIDED COST METHODOLOGY & CALCULATION (Devin McGreal)

QUESTION: Andrew asked about the previous slide, comparing 100% hedging to 100% open market prices?

ANSWER: Devin answered "Yes".

QUESTION: Andrew asked on the next slide, does this mean that formula on Slide 79, your value, Risk Premium = to 0 for all IRP?

ANSWER: Devin said "Yes", the level ends up at 0 Risk Premium value for this iteration (latest) is 0. The conclusion for us is the way market prices are, there is not necessarily a premium associated with floating prices. No benefit to locking prices.

QUESTION: Andrew asked if there are changes to the method in the IRP?

ANSWER: Devin said Resource Planning reached out to CNGC's AMA partner for a 20-year quote of 20-year hedged prices for the first time – more realistic. For distribution cost we would have to look at what we did in the past – in the 2018 IRP. We'd have to look at this before we see what is different. I will get you that answer.

Slide #87 – 2020 IRP Remaining Schedule - Brian Robertson

- The 4th TAGE meeting moved to Wednesday, August 12. Currently scheduled for Bellingham but it is not likely to be there – but things change quickly!
- TAG #5 is on Sep 23
- Draft to be filed on Nov 17
- Comments on draft Dec 23
- TAG #6 on Jan 27 if needed
- Final Version on Feb 26

Brian showed the group their contact information. He stated they appreciates stakeholder feedback and today's feedback and thanked everyone for coming!

The meeting was adjourned.

Cascade Natural Gas Corporation

2020 Integrated Resource Plan
Technical Advisory Group Meeting #4

August 12th, 2020

Teleconference Only

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Agenda

- Introductions
- Safety Moment
- IRP Carbon Update and Assumptions
- DSM
- Renewable Natural Gas
- Discussion of RNG Cost Effectiveness Evaluation Tool
- Sendout Modeling
- Preliminary Resource Integration Results
- 2020 IRP Remaining Schedule
- Questions

IRP Carbon Update and Assumptions

Devin McGreal

Abbie Krebsbach

August 12, 2020

CASCADE NATURAL GAS CORPORATION
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Topics to Cover Today

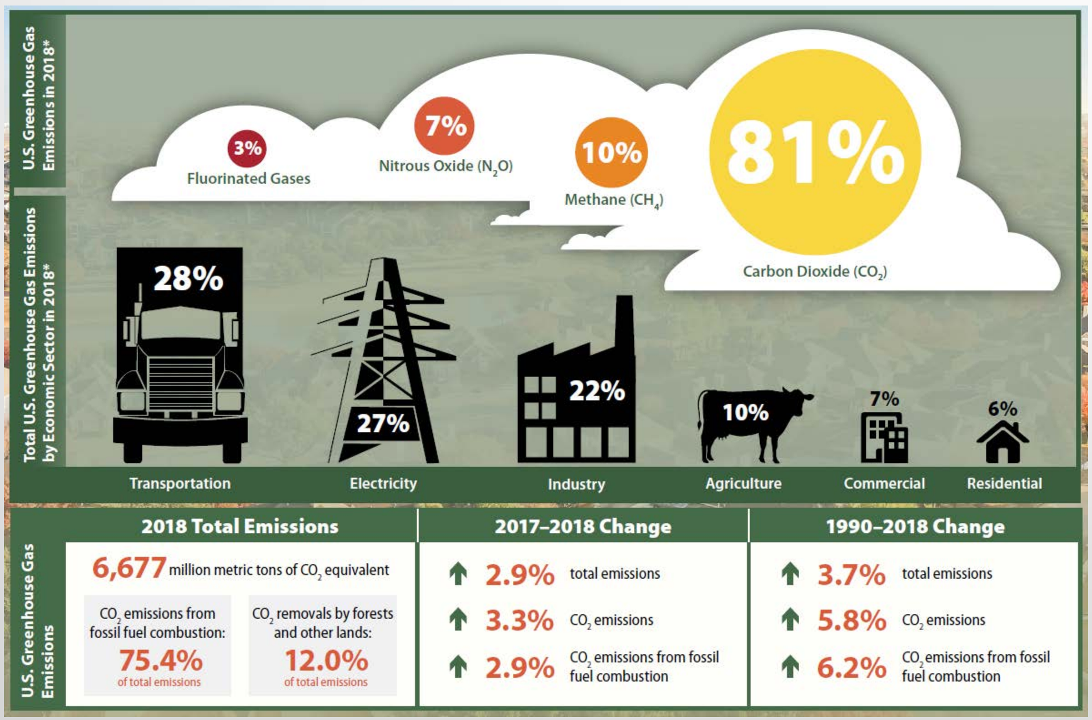
- Purpose
- Laying the Foundation
- GHG Emissions and Reducing Emissions
- GHG Policy Trends
  - The National Focus
  - The Regional Focus
  - Washington
  - Oregon
  - The Local Focus
- Types of CO_2 Adder Analyses
- Sensitivities and Impacts on Prices
- Next Steps and Conclusion

Purpose

- GHG Policy Update
  - Provide insight into current national, regional/state and local policy activities that inform Cascade Natural Gas Corporation's IRP process.
  - Provide discussion on Cascade's actions to reduce methane leaks and fugitive emissions while ensuring safe, reliable and economic service, and utilizing natural resources efficiently to minimize environmental impact.
- Carbon Modeling Assumptions
  - To explain Cascade's approach in determining range of carbon dioxide emissions values and assumptions for calculating inputs to project a 20 year avoided cost of natural gas, with associated two-year action items.

Laying the Foundation

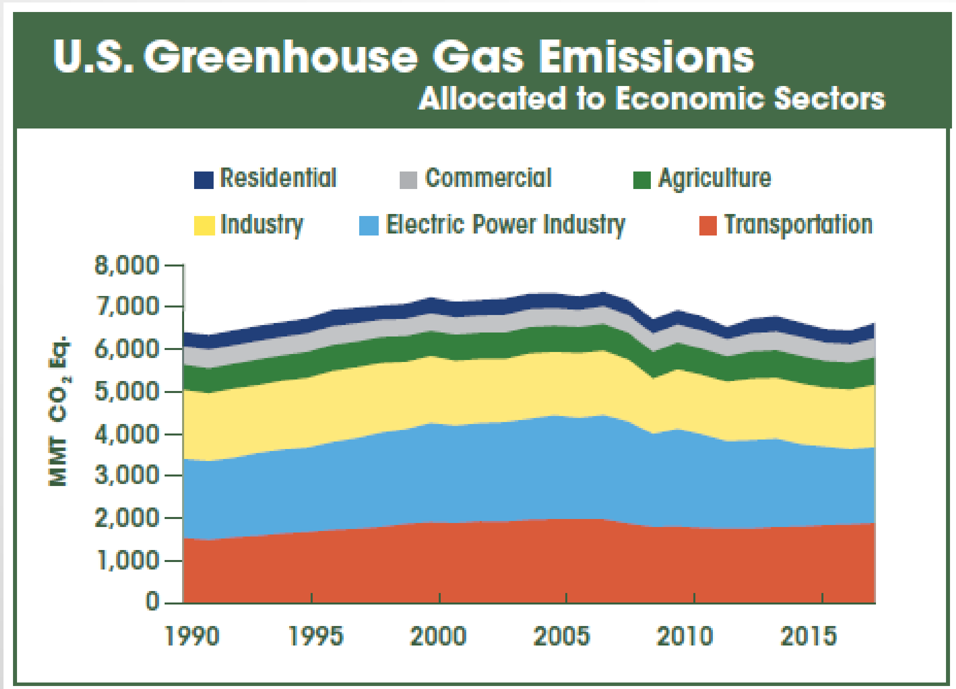
- Carbon dioxide (CO_2) is the primary greenhouse gas (GHG) emitted through human activities. Methane is second.



https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-fast-facts-and-data-highlights

Laying the Foundation

- Main sources of United States GHGs emitted from human activities:

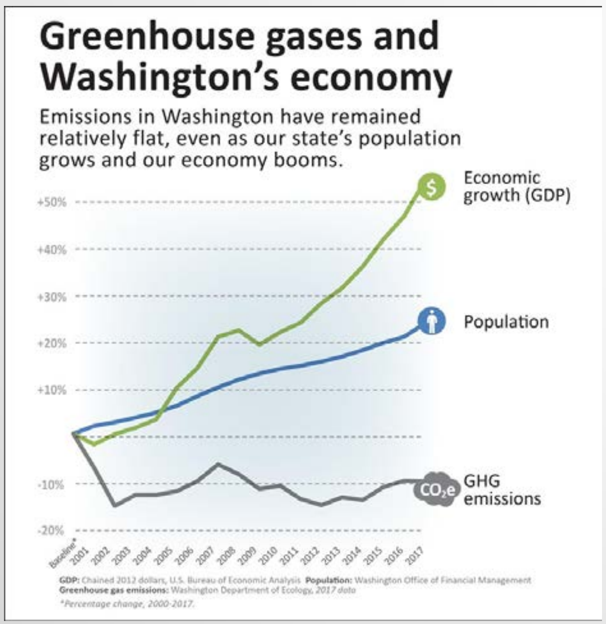


Note: Does not include U.S. territories and LULUCF sector.

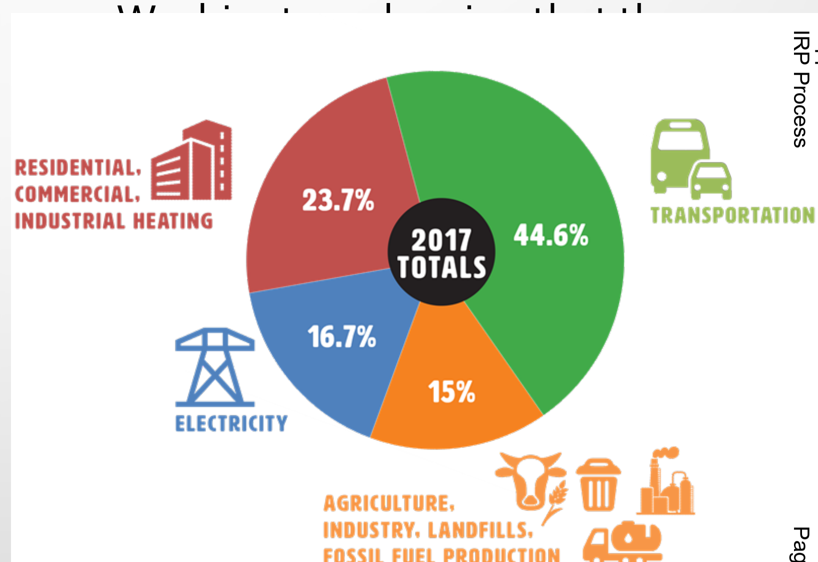
https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-fast-facts-and-data-highlights

Laying the Foundation

Washington State GHG Emissions Trend

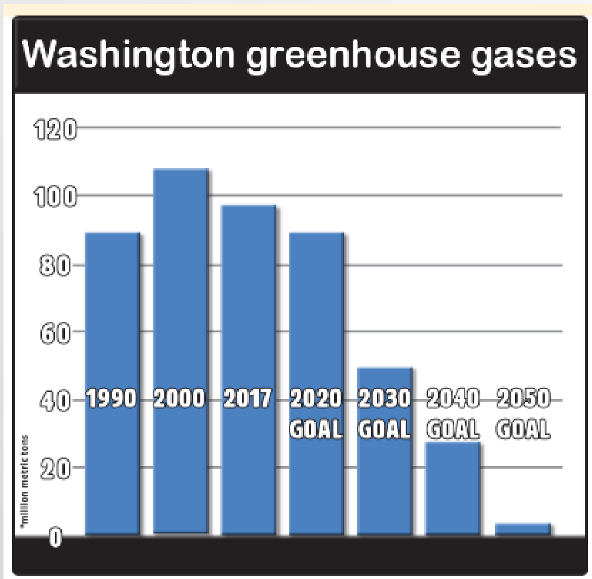


- Growth in emissions has significantly lagged economic and population growth in



Laying the Foundation

Washington State GHG Reduction Targets



- In 2020, HB 2311 passed which revised the anthropogenic GHG reduction targets for the state to:
  - By 2020, achieve 1990 levels
  - By 2030, reduce state GHG emissions to 45% below 1990 levels
  - By 2040, reduce state GHG emissions to 70% below 1990 levels
  - By 2050, reduce state GHG emissions to 95% below 1990 levels

GHG Emissions from Natural Gas

- Electric Generation Sector
  - Combustion emissions have dropped over time mainly due to transition from coal-fired electric generation to natural gas and renewable electric generation
- Oil and Gas Production and Exploration, Transmission, and Storage Sector
  - Fugitive methane emissions and equipment/facility combustion emissions
  - Continued debate on contribution of these emissions and how to consider emissions in total energy supply chain since emissions studies vary
- Northwest Power & Conservation Council's 7th Power Plan (2016 version)

"…there is considerable uncertainty around such issues as whether its impacts compared to carbon dioxide are over or under-stated…and whether accounting for the methane emissions from coal production would also raise that fuel's full life-cycle climate impacts…"

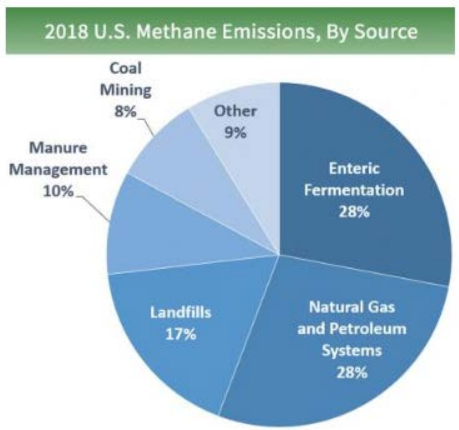
"…will likely draw on gas production new wells which have lower fugitive emissions…"

"…unless new pipeline capacity is needed, fugitive emissions from pipeline leaks remain relatively constant…"

GHG Emissions from Natural Gas (cont.)

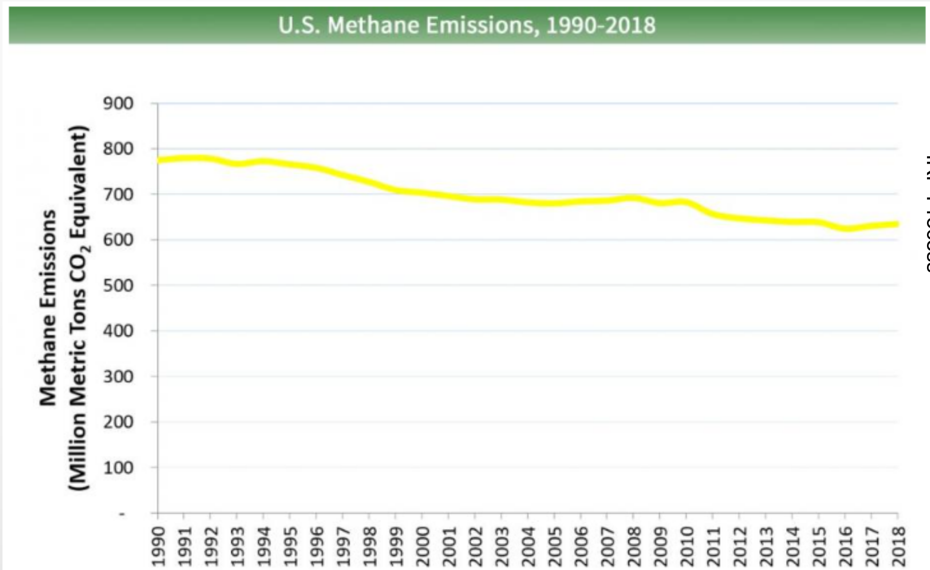
- Natural Gas Distribution <u>Facility</u> Emissions
  - Fugitive methane emissions from pipeline infrastructure and CO_2 emissions from combustion equipment
    - Nationally about 4.1 percent of the oil and gas sector GHG emissions are from natural gas local distribution companies (EPA GHG inventory 2018 data)
    - Equating to about 0.5 percent of the total US GHG emissions from all human activities are from natural gas local distribution companies (EPA GHG inventory 2018 data)
    - Cascade's annual fugitive methane emissions and compressor emissions in Washington equal about 24,000 metric tons of CO_2e
    - Fugitive Methane Emission Rate for the company in our AGA Environmental, Social and Governance (ESG) Quantitative Report Template for 2019 was 0.07% (volume of methane emitted per methane throughput volume)

National Trend of GHG Emissions From Methane



Note: All emission estimates from the *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2018*.

Larger image to save or print



Note: All emission estimates from the *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2018*. These estimates use a global warming potential for methane of 25, based on reporting requirements under the United Nations Framework Convention on Climate Change.

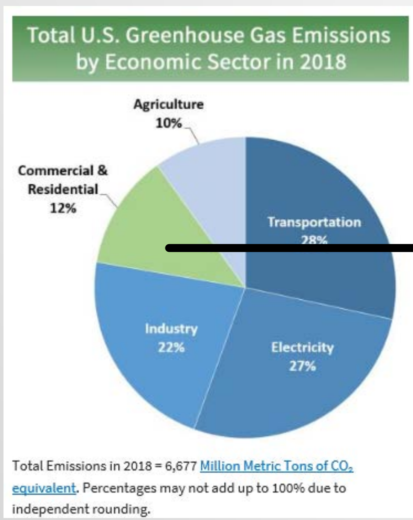
CASCADE NATURAL GAS CORPORATION
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

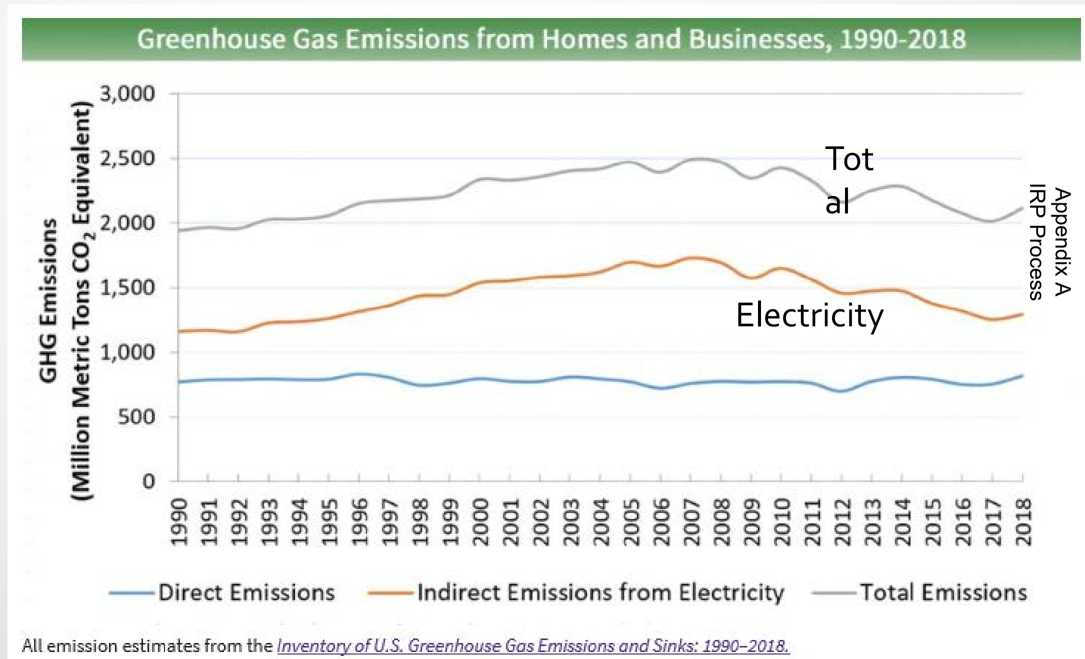
GHG Emissions from Natural Gas (cont.)

- Natural Gas Distribution Customer Emissions
  - Cascade's customers emit CO_2 emissions from the combustion of natural gas
  - Natural gas sales have increased over time
  - Cascade's core customer emissions are currently in the range of about 1.4 million metric tons of CO_2e per year (about 25.5 million dekatherm annual gas sales).
  - Transport customer emissions are about 2.5 to 3 times higher
  - Energy efficiency programs currently provide emission reductions for our customers

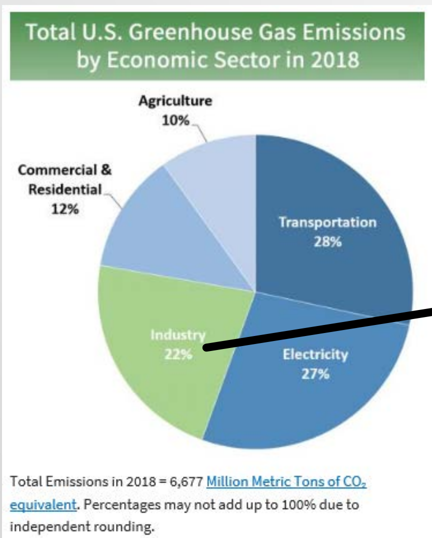
Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

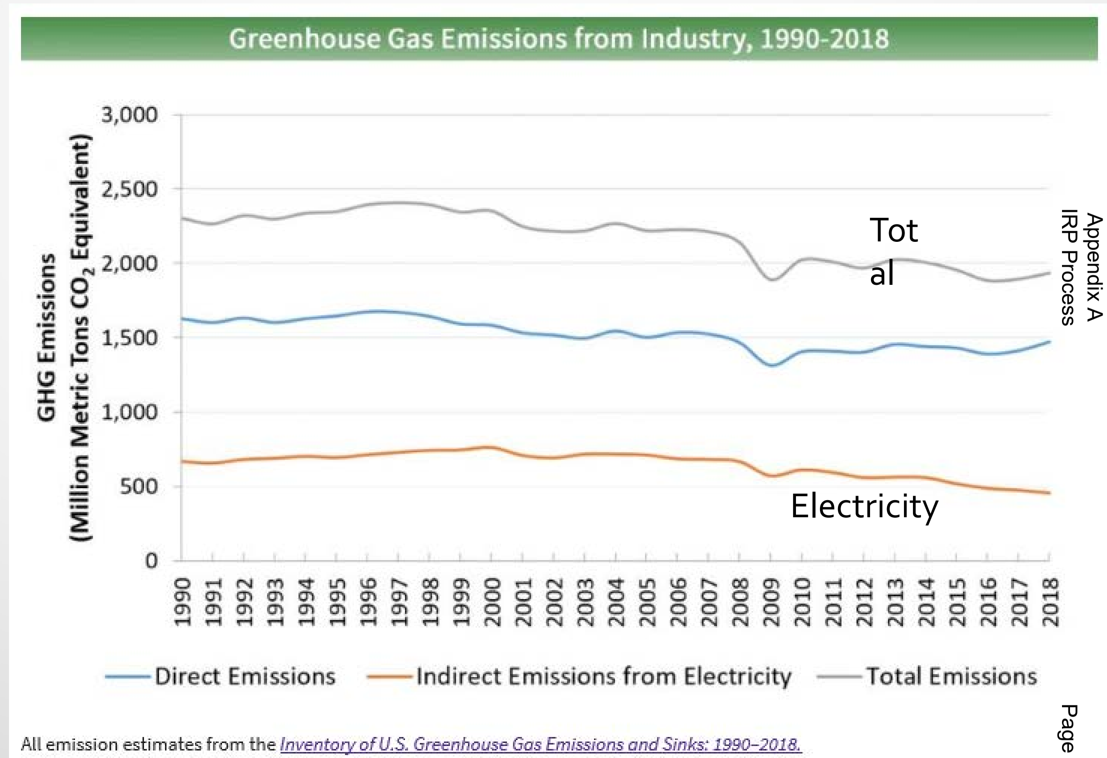
National Trend of GHG Emissions From Residential and Commercial





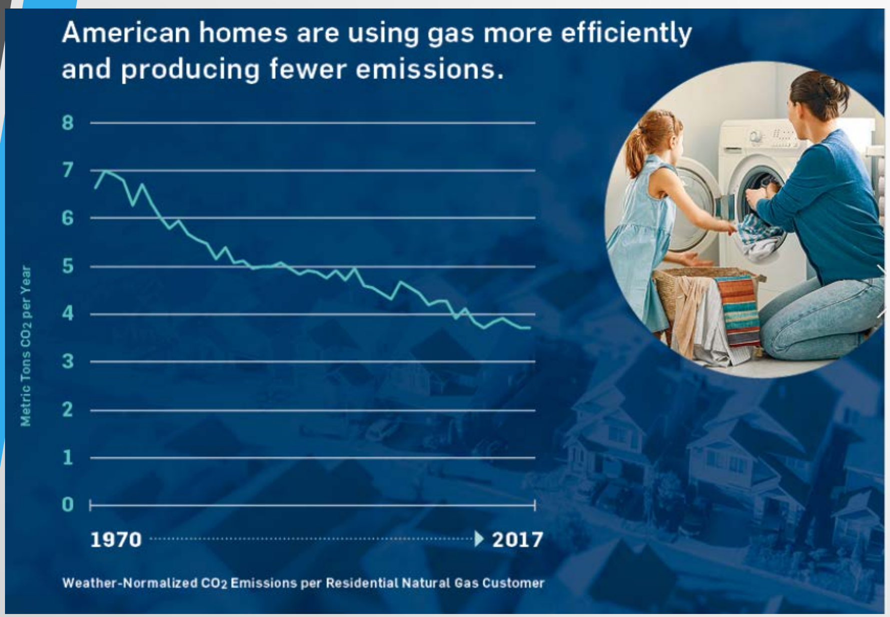
National Trend of GHG Emissions From Industrial

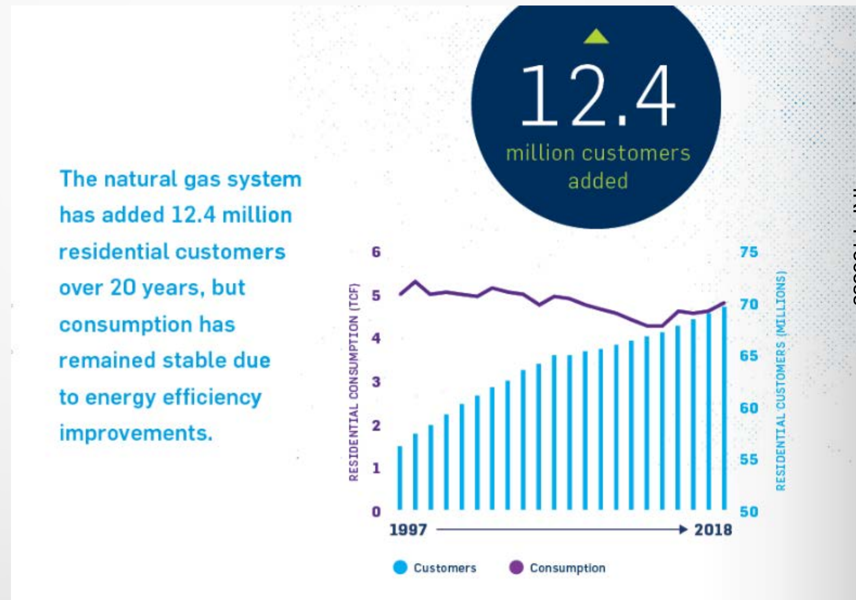




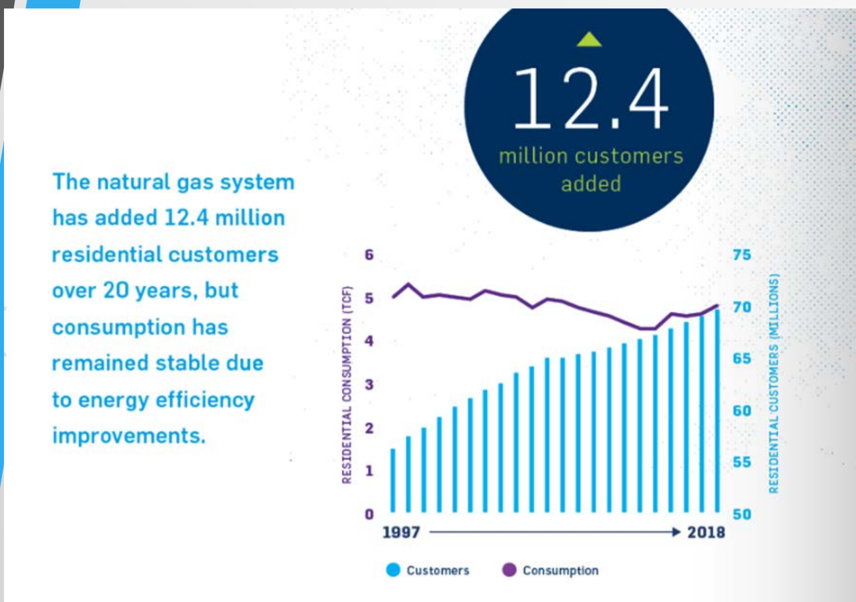
GHG Emissions From Natural Gas (Cont.)

Decreasing Trend for US Natural Gas Distribution Customer CO_2 Emissions

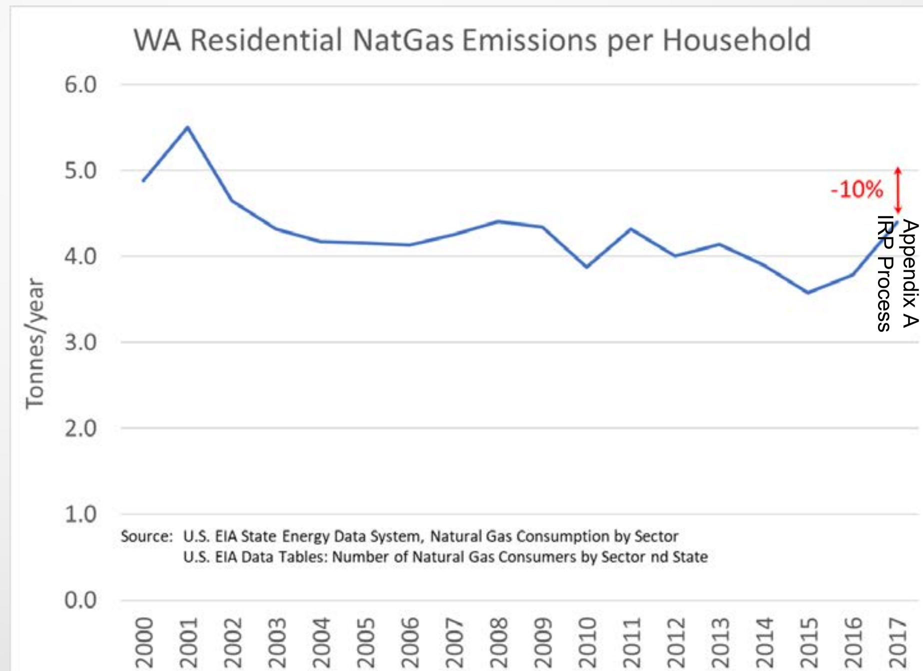




Washington Emissions Trend Similar to National Trend



American Gas Association, *Natural Gas: Our Clean Energy Future 2020 Playbook*



Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Reducing Company Emissions

- Cascade has committed to GHG reductions from the following:
  - Methane fugitive emissions and leak reductions
    - Cascade became a founding member of EPA's Natural Gas Star Methane Challenge Program in March 2016
    - Participating in Excavation Damages Prevention
      - Created Public Awareness Coordinator position and implemented a Damage Prevention Program
      - Actively participating in 811, Common Ground Alliance, local underground utility coordinating councils and damage complaint programs in Washington and Oregon.
      - Conduct incident analyses on excavation damages and report data to EPA
  - System Integrity Projects
    - Since 2012, Cascade has replaced over 75 miles of early vintage steel pipe with new steel or polyethylene pipe in Washington and over 25 miles in Oregon.
    - Cascade is better positioned than most US utilities as it has no unprotected steel pipeline and no cast iron pipe
- Streamlining emissions through demand management strategies including conservation and direct use

Reducing Customer Emissions Through Energy Efficiency

- Cascade is dedicated to expanding its EE efforts
  - Increasing focus on energy efficiency and benchmarking (HB-1257)
  - Increasing social media presence and providing virtual inspections
  - Commercial program adaptation to meet increased goals
  - Regional collaborative approach to market transformation
    - NEEA Board Member
    - Working with GTI on emerging technologies
  - Incorporation of NWPCC methodologies and are now funding regional technical forum
  - Focus on savings estimates for low income customers

CASCADE NATURAL GAS CORPORATION
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve

GHG Policy Trends

- National Focus
  - Current administration has focused less on required emissions reductions
  - In June 2017, the US withdrew from the Paris Agreement on climate change
- Regional Focus
  - Some states have been adopting emissions reduction requirements in lieu of, or in addition to, federal emission reduction requirements (ie. Washington, Oregon and California)
  - More state-level action
- Local
  - Seeing community-lead action
  - Some cities committing to 100% renewable energy through goals and referendums
    - Ready for 100% Renewables Energy and Go 100% Renewable Energy list some of these local commitments

The National Focus

- EPA's Affordable Clean Energy Rule replaced Clean Power Plan
- Relaxing standards in other regulatory areas such as vehicle emissions standards and oil and gas methane emission rules
- 2019 – Raise Wages, Cut Carbon Act (HR 3966)
- 2019 - Climate Leadership and Environmental Action for our Nation's (CLEAN) Future Act discussion draft
- 2019 - American Energy Innovation Act (AEIA) (S.2657)
- 2020 - Clean Energy Innovation and Deployment Act (CEIDA)
- 2020 – Biden's "Build Back Better" Plan

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

The National Focus (con

- FERC Review of Pipeline Projects
  - *Atlantic Coast Pipeline (ACP), LLC v. Cowpasture River Preservation Association.*
    - *FERC approved the pipeline project in Oct 2017, a joint venture between Dominion Energy, Duke Energy, and Southern Company. It was to be a 600 mi, 42" NG pipeline from WV to VA to NC.*
    - *12/14/2018 – 4th Circuit Court of Appeals, Richmond, VA, pulled the permits approved by the US Forest Service to cross 2 national forests and the Appalachian Trail, saying that the approval of the permits violated the National Forest Management Act and NEPA and that the USFS lacked the authority to authorize ROW and permits for the Appalachian Trail.*
    - *4/21/2020 – Nationwide Permit 12 vacated*
    - *6/25/2019 – ACP filed an appeal with the Supreme Court*
    - *6/15/2020 – The Supreme Court ruled in favor of ACP 7-2.*
    - *7/5/2020 - Dominion and Duke Energy cancelled the pipeline citing rising project costs beyond their budget forecast and legal uncertainties.*

The Regional Focus

- The Northwest Power & Conservation Council published its 7th Power Plan in 2016
  - Significant discussion, analysis, and scenarios regarding CO_2 contained in Chapters 3 and 15
  - In February 2019 the Council released its Midterm Assessment report on the Seventh Plan
  - Next plan is expected in 2021
    - Staff recommended a regional upstream methane emissions factor for 2021 Power Plan

SEVENTH NORTHWEST POWER PLAN

THE 2021 NORTHWEST POWER PLAN

CASCADE NATURAL GAS CORPORATION
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Washington

- Clean Air Rule (CAR)
  - Washington Dept of Ecology issued final rule to reduce GHG emissions on September 15, 2016
  - Local distribution companies (LDC) would need to purchase emission reduction units ("ERUs") to demonstrate emissions reductions required by the rule considering LDC's obligation to serve customers
  - On September 27, 2016 and September 30, 2016, Cascade and three other natural gas distribution utilities jointly filed complaints in the United States District Court for the Eastern District of Washington and the State of Washington Thurston County Superior Court, respectively, challenging the legal underpinnings of CAR

Washington (cont.)

- Clean Air Rule (CAR) (cont.)
  - On December 15, 2017, Thurston County Superior Court invalidated CAR and Ecology suspended rule requirements in late December 2017
  - On May 16, 2018, Ecology filed an appeal with the Supreme Court of Washington
  - On Jan. 16, 2020, the Washington State Supreme Court ruled that Ecology exceeded its authority under the WA Clean Air Act by expanding the scope of emissions standards to non-emitters, such as natural gas distributors and fuel suppliers. The Supreme Court invalidated CAR for non-emitters and remanded the case to Thurston County Superior Court for further proceedings.
  - Parties have filed status reports with the court agreeing to delay proceedings. Ecology has expressed the desire to evaluate its position on whether additional regulatory changes may be needed, but needed additional time due to delays caused by COVID-19 and mandatory furloughs. The report is due by October 20, 2020.

Washington (cont.)

- 2019-2020 Legislation Passed
  - 2019 Clean Buildings Act - HB 1257 and Appliance Energy Efficiency HB 1444
    - Include standards to increase efficiency of new buildings and appliances and allows utility to develop a renewable natural gas program
  - 2019 HB 1070 renewable natural gas tax bill
  - 2020 HB 2311 – GHG reduction targets revised
  - 2020 HB 2518 – Safe and efficient transmission and distribution of natural gas
- Significant other state policy or regulation with GHG impacts
  - 2019 – Clean Energy Transformation Act - 100% fossil-free electricity to consumers by 2045
  - 2020 - Zero Emissions Vehicle Law
  - 2019 – Hydrofluorocarbon reductions
  - 2020 - GHG Assessment for Projects (GAP) rulemaking
- Legislation expected in 2021
  - Possible hybrid of cap and trade and clean transportation bill or carbon tax bill

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Oregon

- Executive Order No. 20-04
  - Issued March 10, 2020
  - 13 directives to multiple state agencies to take actions necessary to cap and reduce GHG emissions from:
    - Large stationary sources
    - Transportation fuels
    - Other liquid and gaseous fuels, including natural gas
  - Revises Oregon emissions reduction targets:
    - At least 45 percent below 1990 emissions levels by 2035; and
    - At least 80 percent below 1990 emissions levels by 2050
  - Draft rule expected in 2021
  - Cap and reduce program to commence by January 1, 2022
- Appliance Efficiency Standard and Code Changes
  - Cascade engaged in ODOE and Global Warming Commission workshops
  - Potential impacts on baseline equipment used for energy efficiency program design
  - Code discussion of efficiency focus vs. carbon reduction focus

Oregon (cont'd)

- Renewable Natural Gas
  - SB 98: RNG Bill (Sept 29, 2019)
    - Allows recovery of prudently incurred, qualified investment
    - Addresses recovery provisions for small and large utilities
  - UM 2030: Investigation into the use of Northwest Natural's RNG evaluation methodology
  - AR 632: Rulemaking regarding the 2019 SB 98 Renewable Natural Gas programs (Oct 1, 2019)
    - Designates that each large and small natural gas utility must include information relevant to the RNG market, prices, technology, and availability as part of IRP

The Local Focus - City of Bellingham

- GHG Reduction and Renewables Energy Targets Resolution passed by Bellingham City Council in March 2018
  - Renewables and emissions reduction targets updated to:
    - Reduce municipal greenhouse gas emissions to 85% below 2000 levels by 2030 and 100% below 2000 levels by 2050
    - Reduce community emissions by 70% below 2000 levels by 2030 and 85% below 2000 levels by 2050
    - Obtain all energy from renewable sources and remove use of fossil fuels
- Climate Action Task Force
  - City Council created task force to explore and recommend 100% renewable energy city targets by 2050, taking into account technology, feasibility, costs and other impacts, funding mechanisms, as well as possible accelerated targets

The Local Focus - City of Bellingham (cont.)

- Climate Action Plan will be amended based on this work.

The Local Focus - City of Bellingham (cont.)

- Tier 0: Complete or already ongoing measures
  - Adopted and appended to the Climate Action Plan
- Tier 1: Ready for review and analysis. Ranked high with minimal unknowns
  - Reviewed by the public and Council and filtered onward
  - Measures would undergo additional research on feasibility including the “triple bottom line plus” criteria
  - Measures would undergo additional research on feasibility including the “triple bottom line plus” criteria

The Local Focus - City of Bellingham (cont.)

- In the next 6 months, Council will amend the CAP, and staff will develop a Climate Implementation Plan. The Plan will be reviewed ongoing
- New projects would be vetted in 2021 and 2022
- Formal CAP review and update of goals would take place in 2023
- City will solicit public feedback to drive decision-making process

https://www.cob.org/services/environment/climate/Pages/program.aspx

The Climate Action Task Force Final Report, December 2, 2019, is linked here.

The Local Focus – Whatcom County

- "Ready for 100" campaign website states the following goals, but participants can target less stringent goals:
  - 100% renewable electricity by 2035
  - 100% renewable all other energy sectors by 2050

- Whatcom County commits to:
- 100% renewable electricity for county operations and larger Whatcom County community by 2035
- Established commitments in ordinance

- Provides review and recommendations to the Whatcom County Council and Executive on issues related to the preparation and adaptation for, and the prevention and mitigation of, impacts of climate change.
- Ongoing meetings on climate and energy policy

The Local Focus – City of Bend

- Council Resolution 3044 passed in 2016 established voluntary goals for City facilities and operations with the objective to:
  - Reduce community-wide fossil fuel use by 40% by 2030
  - Reduce community-wide fossil fuel use by 70% by 2050
- A Climate Action Steering Committee (CASC) convened from April '18 – December '19 to develop a Community Climate Action Plan to support these goals.
  - 13 individuals appointed, representing business, environmental, & youth communities, and local government.
  - Developed voluntary strategies and actions to guide Bend towards the fossil fuel reduction

The Local Focus - City of Bend

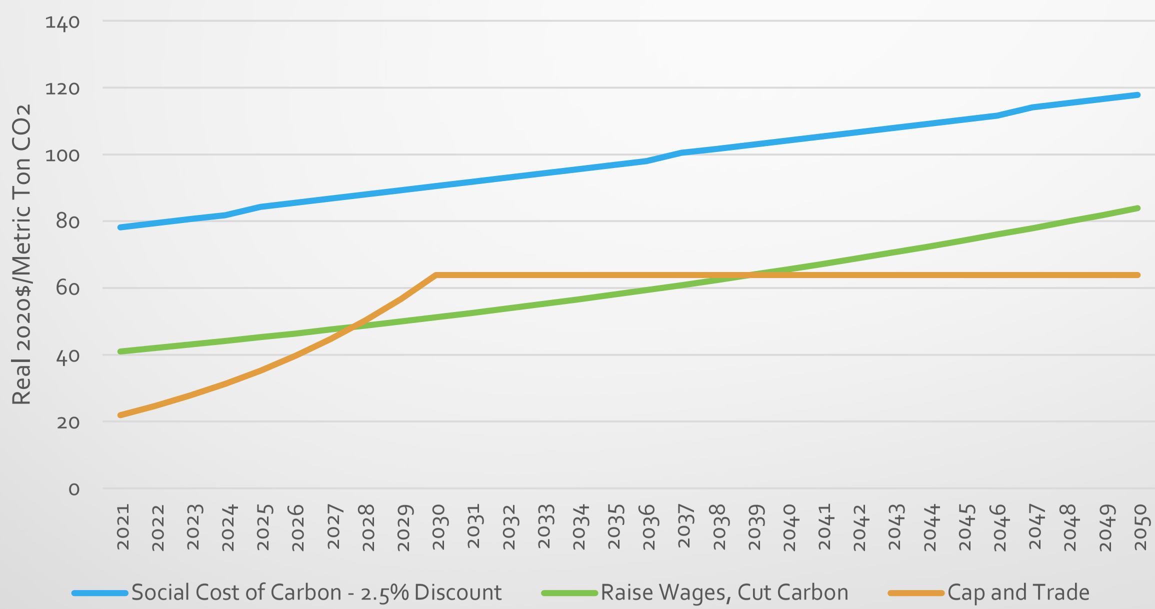
- Community Climate Action Plan was approved by City Council on December 4, 2019.
- An Environment and Climate Committee (ECC) has been established for ramp up of the recently approved plan

Types of CO_2 Adder Analys

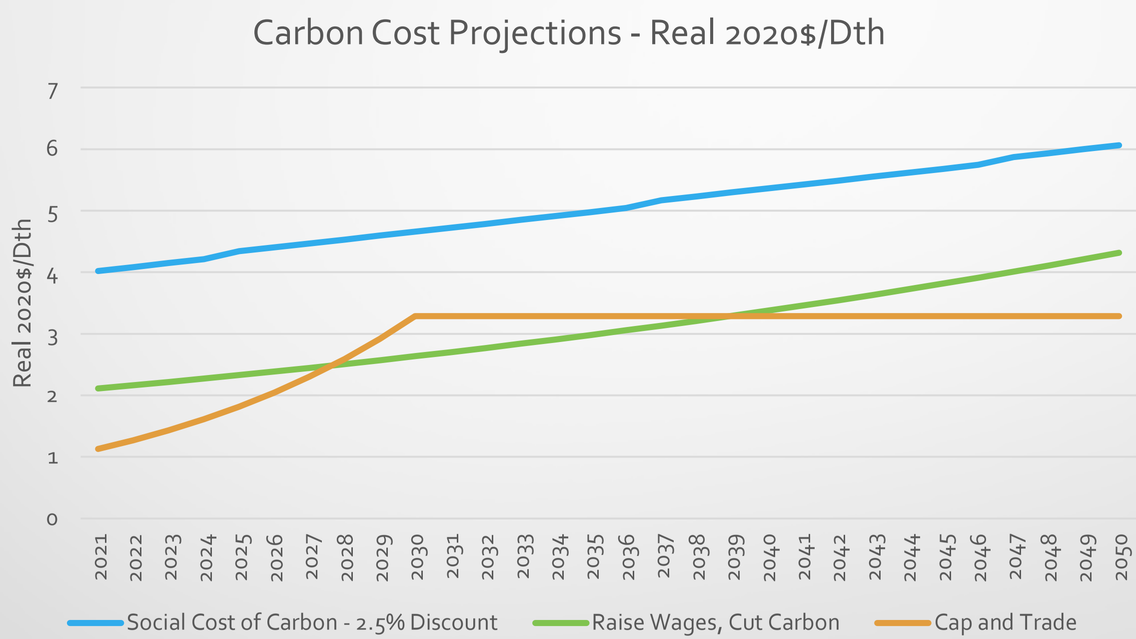
- Cascade will be using the Social Cost of Carbon forecast with a 2.5% discount rate, from the Interagency Working Group on the Social Cost of Greenhouse Gases, as per guidance received from the WUTC.
- Other methodologies were considered, and may be modeled as sensitivity analyses:
  - Cap and Trade Projections
  - House of Representatives Raise Wages, Cut Carbon Act
  - Stochastic blend of multiple approaches?

Comparing Carbon Cost Projections

Carbon Cost Projections - Real 2020$/Metric Ton CO2



Comparing Carbon Cost Projections

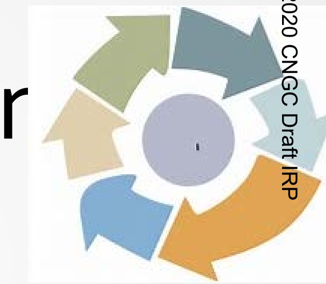


Types of CO_2 Adder Analyses (cont.)

- Analysis of potential carbon futures will impact:
  - Timing and quantity of demand side resources
  - Total system costs of candidate portfolio under stochastic conditions
  - Timing and quantity of viability of renewable natural gas

- Three additional sensitivity analyses will be performed:
  - 0% Environmental Adder
  - 20% Environmental Adder
  - 30% Environmental Adder

Next Steps and Conclusion



- Incorporate carbon planning assumptions into modeling
- Will provide a brief update of the modeling impacts at TAG 5
- Conclusion…
  - Regarding expectations, natural gas has a lesser impact on customers as compared to the electric utility industry
  - Cascade is paying close attention to National, Regional, and Local policies related to Carbon
  - Impact of ranges and sensitivity analyses will be presented to the TAG when modeling is performed

Questions…

…and thank you

DSM Forecast, 2020 IRP

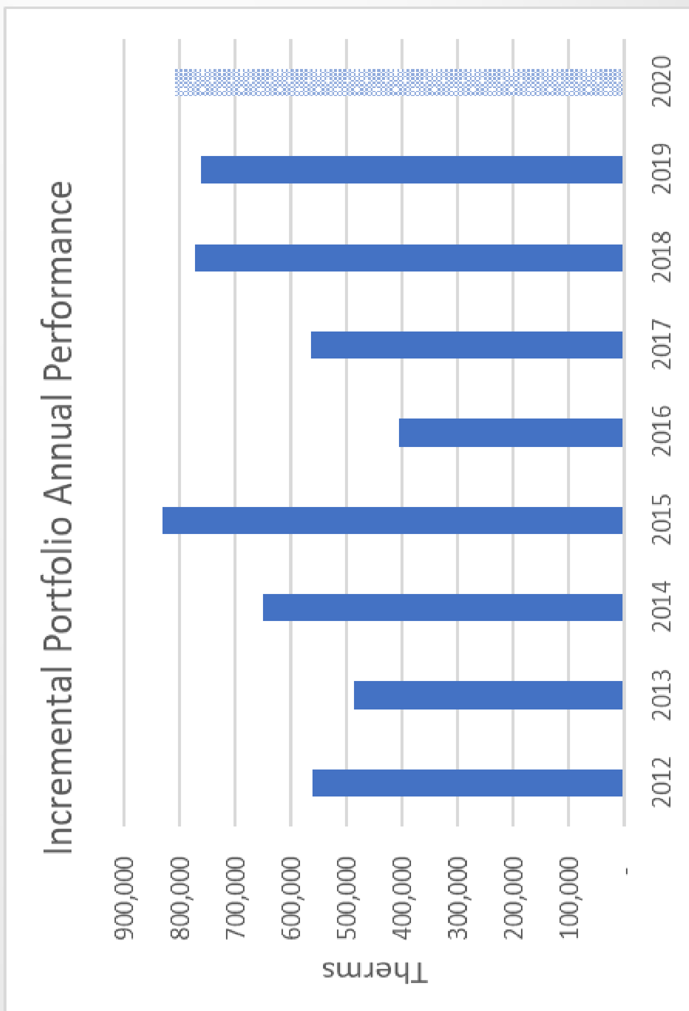
Monica Cowlishaw & Phillip Hensyel

August 12th, 2020

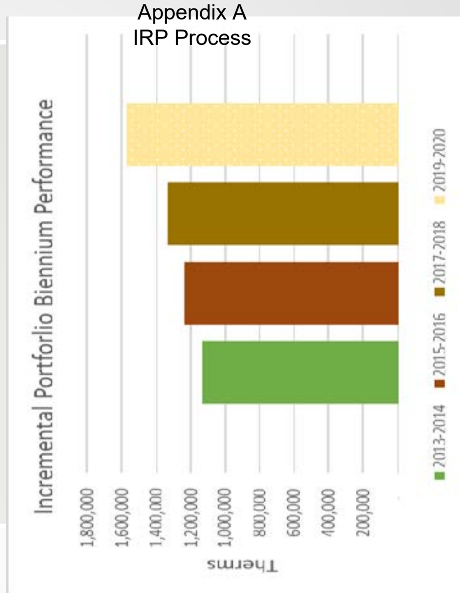
Topics to Cover Today

- Overview
  - Background
  - LoadMAP Modeling Tool
- Energy Efficiency 20-year Forecast
- Energy Efficiency Programs
  - Commercial and Industrial
  - Residential
    - Low Income
- Topics Outside DSM Potential

Overview

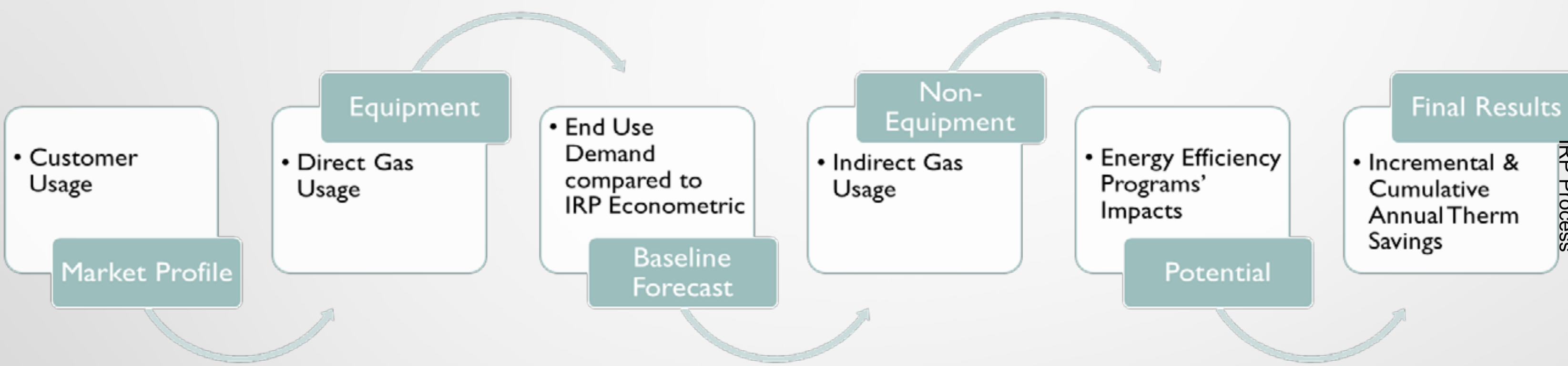


← ANNUAL PERFORMANCE



← BIENNIUM PERFORMANCE

LoadMAP Sequence



2020 Forecast Updates

2018

- Average Avoided Cost per therm ~$0.32
- Discount Rate 4.43%
- SCC Adder 3%

2020

- Average Avoided Cost per therm ~$0.57
- Discount Rate 3.40%
- SSC Adder 2.5%

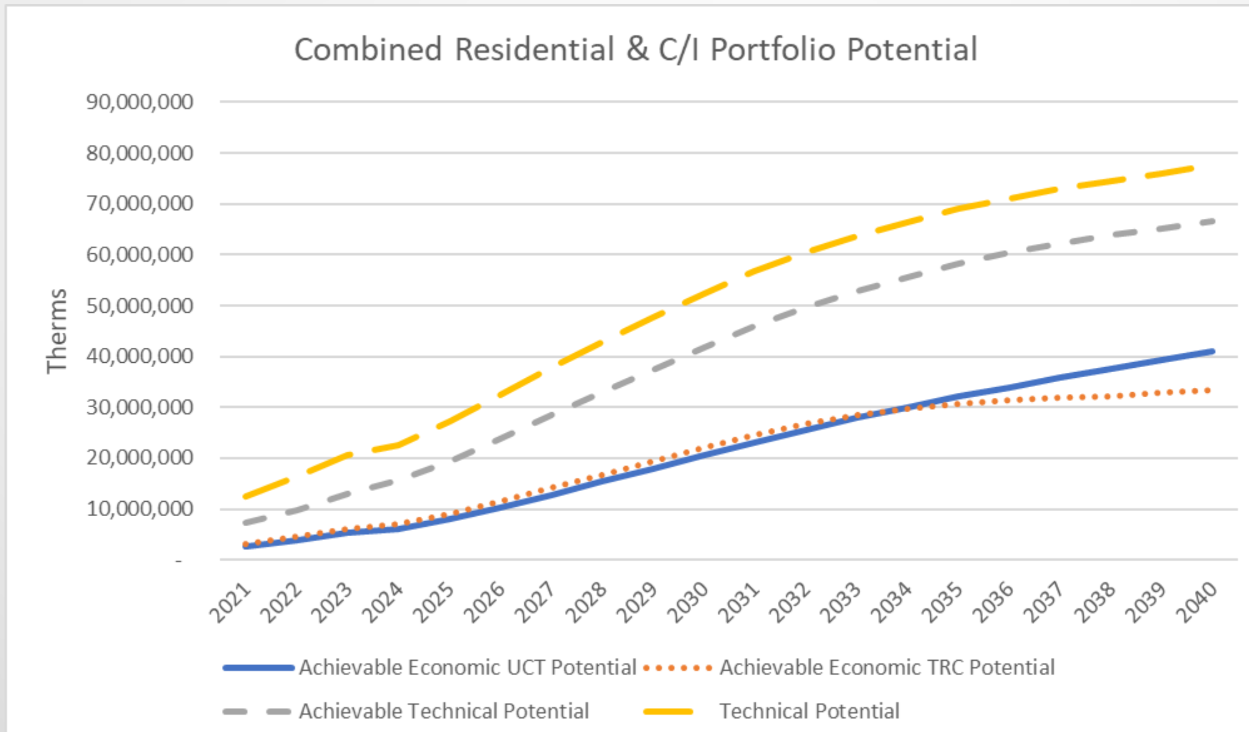
Potential Increased

2.5% Social Cost of Carbon (SSC) Adder

~78% Increase in Avoided Costs on Average

~23% Decrease in Discount Rate

Energy Efficiency 20-year Cumulative Potential Forecast



COMMERCIAL & INDUSTRIAL

COMMERCIAL FORECAST SUMMARY

Summary of Energy Savings (MM therms), Selected Years	2021	2022	2023	2030	2040
Baseline Forecast (MMtherms)	105.864	106.520	107.171	112.523	122.356
Potential Forecasts (MMtherms)					
Achievable Economic UCT Potential	104.362	103.623	102.867	97.438	100.953
Achievable Economic TRC Potential	104.405	103.700	102.978	97.898	101.739
Achievable Technical Potential	104.344	103.596	102.830	97.347	100.801
Technical Potential	103.491	102.191	100.884	92.554	93.772
Cumulative Savings (MMtherms)					
Achievable Economic UCT Potential	1.501	2.896	4.304	15.084	21.403
Achievable Economic TRC Potential	1.458	2.819	4.193	14.625	20.617
Achievable Technical Potential	1.519	2.924	4.341	15.176	21.555
Technical Potential	2.373	4.328	6.287	19.969	28.584
Energy Savings (% of Baseline)					
Achievable Economic UCT Potential	1.4%	2.7%	4.0%	13.4%	17.5%
Achievable Economic TRC Potential	1.4%	2.6%	3.9%	13.0%	16.8%
Achievable Technical Potential	1.4%	2.7%	4.1%	13.5%	17.6%
Technical Potential	2.2%	4.1%	5.9%	17.7%	23.4%
Incremental Savings (MMtherms)					
Achievable Economic UCT Potential	1.501	1.410	1.439	1.540	0.751
Achievable Economic TRC Potential	1.458	1.376	1.404	1.482	0.693
Achievable Technical Potential	1.759	1.561	1.591	1.678	0.881
Technical Potential	2.373	1.990	1.996	1.908	1.138

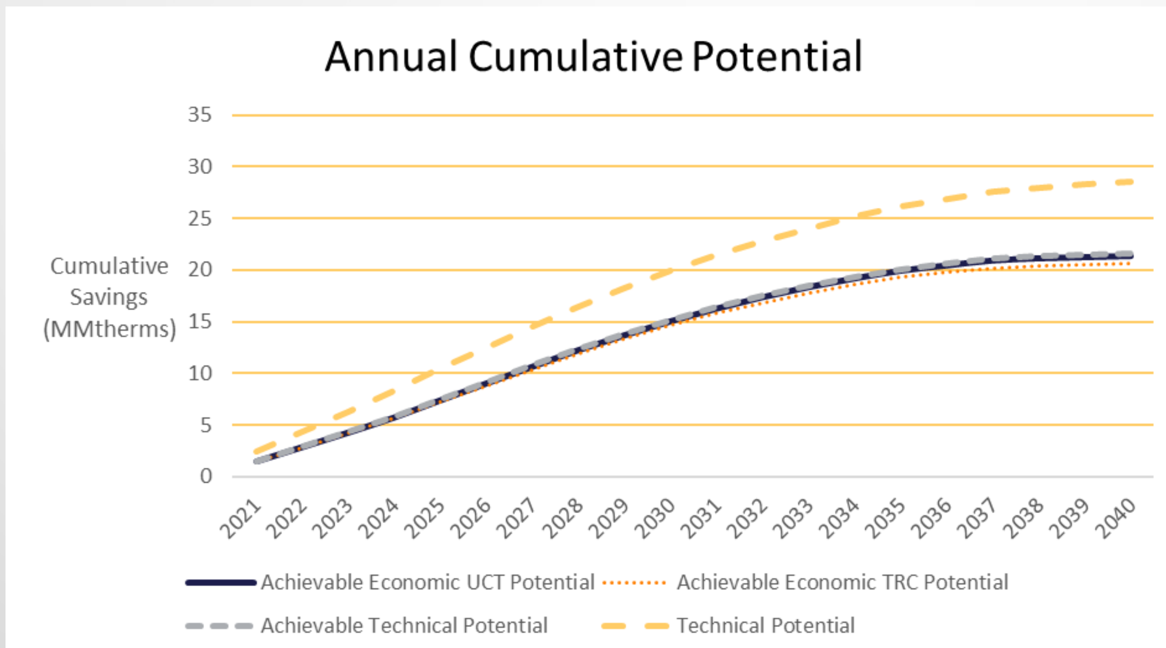
CASCADE NATURAL GAS CORPORATION
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

INDUSTRIAL FORECAST SUMMARY

Summary of Energy Savings (MM therms), Selected Years	2021	2022	2023	2030	2040
Baseline Forecast (MMtherms)	32.833	33.539	34.251	39.085	45.044
Potential Forecasts (MMtherms)					
Achievable Economic UCT Potential	32.753	33.382	33.995	38.012	43.305
Achievable Economic TRC Potential	32.758	33.393	34.024	38.130	43.442
Achievable Technical Potential	32.748	33.372	33.980	37.972	43.241
Technical Potential	32.667	33.255	33.826	37.581	42.707
Cumulative Savings (MMtherms)					
Achievable Economic UCT Potential	0.081	0.158	0.256	1.073	1.739
Achievable Economic TRC Potential	0.076	0.147	0.227	0.955	1.603
Achievable Technical Potential	0.086	0.168	0.270	1.114	1.803
Technical Potential	0.167	0.284	0.424	1.505	2.337
Energy Savings (% of Baseline)					
Achievable Economic UCT Potential	0.2%	0.5%	0.7%	2.7%	3.9%
Achievable Economic TRC Potential	0.2%	0.4%	0.7%	2.4%	3.6%
Achievable Technical Potential	0.3%	0.5%	0.8%	2.8%	4.0%
Technical Potential	0.5%	0.8%	1.2%	3.8%	5.2%
Incremental Savings (MMtherms)					
Achievable Economic UCT Potential	0.080617	0.077123	0.098242	0.114644	0.063250
Achievable Economic TRC Potential	0.075720	0.071092	0.080797	0.106231	0.060527
Achievable Technical Potential	0.092222	0.085160	0.106766	0.123404	0.070138
Technical Potential	0.166725	0.117709	0.141010	0.148716	0.085571

CASCADE NATURAL GAS CORPORATION
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Energy Efficiency 20-year Cumulative Potential Forecast: Commercial/Industrial (C/I)



C/I Top Ten Measures

Rank	Measure / Technology	2021 Achievable Technical Potential Savings (therms)
1	*Water Heater - Solar System	480,716
2	*ENERGY STAR Connected Thermostat	154,268
3	Boiler	126,814
4	Water Heater	66,799
5	Insulation - Roof/Ceiling	58,181
6	Retrocommissioning - HVAC	55,268
7	Space Heating - Heat Recovery Ventilator	54,797
8	Insulation - Wall Cavity	48,061
9	Building Automation System	39,823
10	Furnace	43,364

Water Heater – Solar and SMART Thermostat

- It has too much overlap with the other equipment measure.
  - The model assumed in 2017 that 30% of the market would be using this measure.
- Cascade did not have a commercial measure last time so the Company proxied the residential one.
  - The updated assumption for this measure saves between two and five times less.

CASCADE NATURAL GAS CORPORATION
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

54

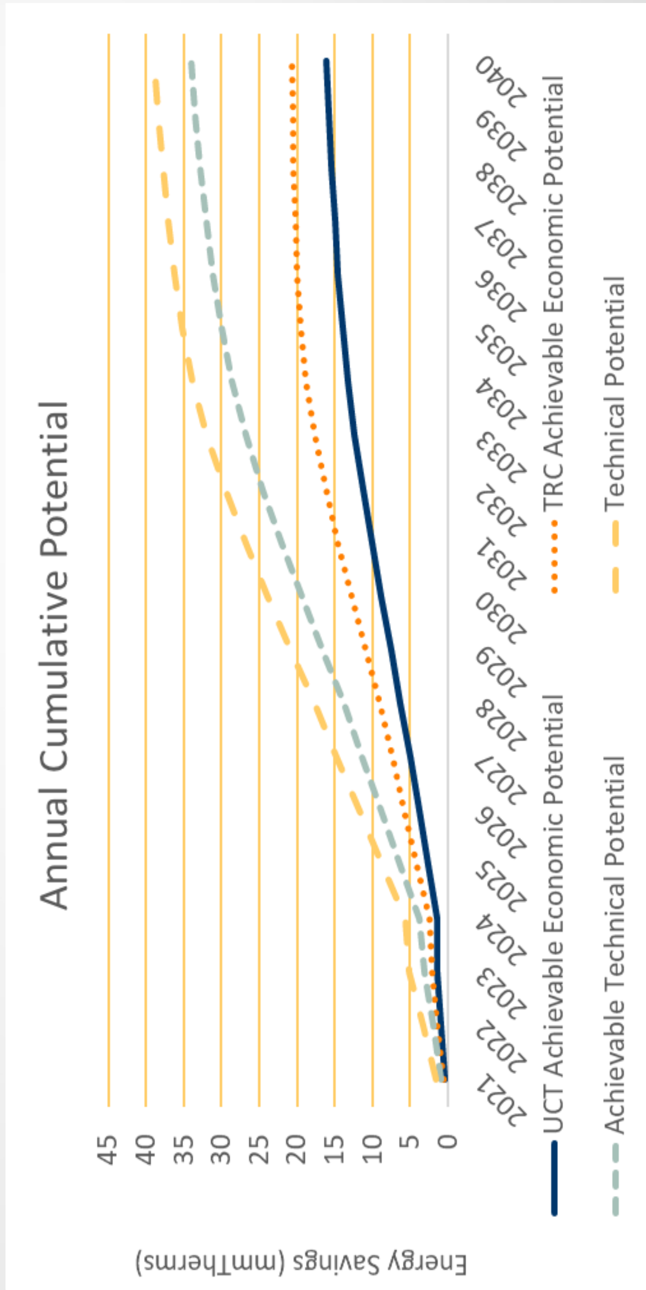
RESIDENTIAL

RESIDENTIAL FORECAST SUMMARY

Summary of Energy Savings (mmTherms), Selected Years	2021	2022	2023	2030	2040
Baseline Forecast (mmTherms)	124.029	125.349	127.214	135.725	150.521
Potential Forecasts (mmTherms)					
UCT Achievable Economic Potential	123.598	124.418	125.725	126.869	134.331
TRC Achievable Economic Potential	123.371	123.983	125.075	122.933	129.892
Achievable Technical Potential	123.112	123.400	124.110	116.357	116.511
Technical Potential	122.476	122.038	122.096	111.850	111.675
Cumulative Savings (mmTherms)					
UCT Achievable Economic Potential	0.430851	0.930947	1.488946	8.855369	16.190518
TRC Achievable Economic Potential	0.657872	1.365542	2.138726	12.791304	20.629579
Achievable Technical Potential	0.916665	1.948516	3.103777	19.367683	34.009791
Technical Potential	1.552597	3.310195	5.117903	23.874280	38.846217
Energy Savings (% of Baseline)					
UCT Achievable Economic Potential	0.3%	0.7%	1.2%	6.5%	10.8%
TRC Achievable Economic Potential	0.5%	1.1%	1.7%	9.4%	13.7%
Achievable Technical Potential	0.7%	1.6%	2.4%	14.3%	22.6%
Technical Potential	1.3%	2.6%	4.0%	17.6%	25.8%
Incremental Savings (mmTherms)					
UCT Achievable Economic Potential	0.430851	0.503824	0.563563	1.371870	0.396771
TRC Achievable Economic Potential	0.657872	0.714924	0.785228	2.004919	0.226056
Achievable Technical Potential	0.916665	1.042457	1.173012	3.076127	1.251017
Technical Potential	1.552597	1.774742	1.833045	3.502519	1.320842

CASCADE NATURAL GAS CORPORATION
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

56



Annual Cumulative Potential
Energy Savings (mmTherms)
0
5
10
15
20
25
30
35
40
45
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
2034
2035
2036
2037
2038
2039
2040
UCT Achievable Economic Potential
TRC Achievable Economic Potential
Achievable Technical Potential
Technical Potential

RES Top Ten Measures

Rank	Measure / Technology	2021 Achievable Economic UCT Potential Savings (therms)
1	Insulation - Floor/Crawlspace	111,398
2	*Water Heater - Solar System	62,455
3	Windows - High Efficiency	53,565
4	Insulation - Ceiling, Installation	34,773
5	Space Heating - Furnace - Direct Fuel	26,869
6	Insulation - Wall Cavity, Upgrade	25,268
7	Insulation - Wall Cavity, Installation	24,843
8	Insulation - Ceiling, Upgrade	22,292
9	Secondary Heating - Fireplace	12,083
10	Insulation - Basement Sidewall	12,030

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Additional EE Topics for the IRP

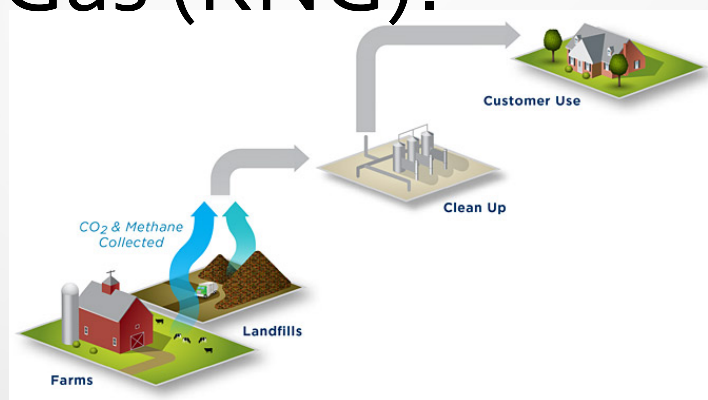
- CPA
  - August Focus
    - The new base year is 2019
    - Update Key Measures
    - Update Measure Ramp Rates
      - Reevaluate solar water heat to align with market availability
- HB 1257
- New Construction Code Changes
- Transition to Biannual Conservation Plan
- Timelines

Questions…

Renewable Natural Gas

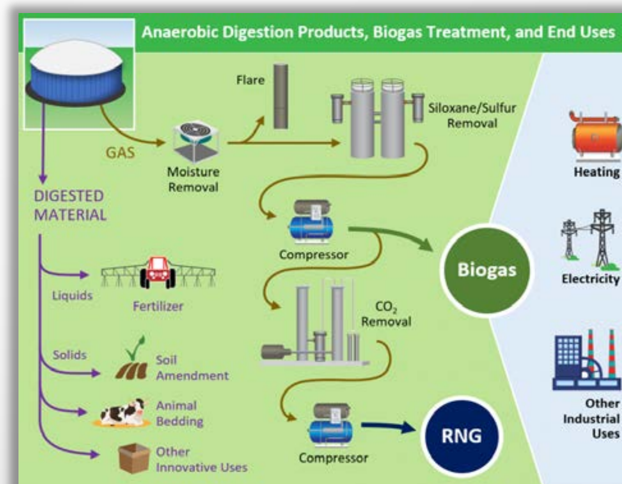
What is Renewable Natural Gas (RNG)?

- RNG is pipeline quality natural gas produced from various biomass sources through biochemical processes such as anaerobic digestion or gasification.[1]



Renewable Natural Gas

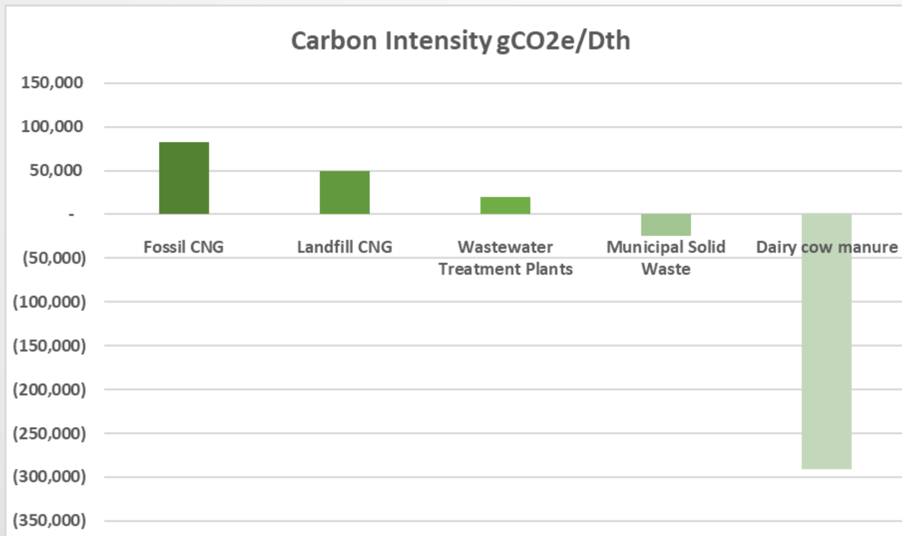
- Examples:
  - Biogas from Landfills
    - Collect waste from residential, industrial, and commercial entities.
    - Digestion process takes place in the ground, rather than in a digester.
  - Biogas from Livestock Operations
    - Collects animal manure and delivers to anaerobic digester.
  - Biogas from Wastewater Treatment
    - Produced during digestion of solids that are removed during the wastewater treatment process.
  - Other sources include organic waste from food manufacturers and wholesalers, supermarkets, restaurants, hospitals, and more.[1]



Renewable Natural Gas

63

Carbon Intensity



Regulatory Matters Regarding RNG

- HB 1257 in Washington
  - HB 1257 Section 13 states that a natural gas company may propose a renewable natural gas program under which the company would supply renewable natural gas for a portion of the natural gas sold or delivered to its retail customers. Section 14 states that each gas company must offer by tariff a voluntary renewable natural gas service available to all customers to replace any portion of the natural gas that would otherwise be provided by the gas company.
- AR 632 and UM 2030
  - AR 632 is an open docket regarding RNG Rulemaking. Rules were filed on July 17, 2020. A few key points for IRPs:
    - IRPs should include an RNG-specific chapter.
    - Include information relevant to the RNG market, prices, technology, and availability that would otherwise be required under the Commission's IRP Guidelines.
  - UM 2030 is an open docket for determining the cost-effectiveness of RNG resources for Northwest Natural. Cascade has reviewed this docket and is an active participant.
- SB 98 in Oregon
  - SB 98 requires the Public Utility Commission to adopt by rule renewable natural gas program for natural gas utilities to recover prudently incurred qualified investments in meeting certain targets for including renewable natural gas in gas purchases for distribution to retail natural gas customers.

Regulatory Matters Regarding RNG (Cont'd)

- Cascade is aware of the Washington State University Study on Renewable Natural Gas
  - A study around what RNG is and a possible roadmap of RNG in WA State.
- Treatment of Carbon Intensity
  - Cascade understands there are differing schools of thought for how to record Carbon Intensity of different sources of RNG and will continue to monitor the related legislative efforts.
- Any other items Cascade should be following?

CASCADE NATURAL GAS CORPORATION
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Cascade Market Research

- Options for securing RNG will involve purchase and/or participation in infrastructure.
- No "spot market" for RNG at this point due to long off-take commitments.
- Lead times on new RNG projects up to 36 months.
- Landfill projects are typically the largest RNG opportunity at 1,000-7,000 dth/day and usually require lowest capital investment.
- Digester projects, due to higher carbon intensity, do very well in the Renewable Identification Numbers (RINs) market and run 50-500 dth/day (expensive to operate).
- Food waste/wastewater treatment projects seen as an ideal option for utilities as they have low RINs and Low Carbon Fuel Standards (LCFS) potential.
- $10-$30/dth long-term off-take deals.

CASCADE NATURAL GAS CORPORATION®
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Cascade Market Research (Cont'd)

- New landfill projects typically command $10-$19/dth with environmental attributes and facility investment recovery.
- Digesters need $15-$20/dth off-take deals.
- Dairy projects can be $25-$30/dth.
- Fortis B.C. has 9 Bcf/yr of RNG under contract.
- Some surveys have found customers will not pay more than $7/dth to natural gas.

What is Cascade doing?

- **RNG planning**

Internal Attendees

  - Regulatory
  - Business Development – Oregon & Washington
  - Energy Efficiency
  - Public Affairs
  - Resource Planning Team
  - Gas Supply

External Attendees

  - Lobbyists
  - NWGA
  - Other LDC's located in Oregon & Washington

Climate Action Plan Support

  - Inclusion of biogas and offset program exploration as part of City of Bend's Climate Action Plan

Cascade’s RNG Goals

- The Company’s long-term view and approach to RNG
- Roles and Responsibilities
- RNG Policy – federal, state and local guidelines and requirements
  - Electrification and RNG parity
- Voluntary Programs/Offsets
- Energy Efficiency & RNG
- Future opportunities
- Standards

Potential RNG Projects in Cascade's Service Territory

- Working with municipals, wastewater treatment plants, biodigesters with industrial customers, and landfills.

Discussion of RNG Cost Effectiveness Evaluation Tool

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Top Level Discussion

- Cascade is in the process of developing a tool to evaluate the cost effectiveness of potential RNG projects.
- The Company's methodology follows guidance from OPUC AR 632 and UM 2030.
- Feedback is highly encouraged; this model is still evolving with input from internal and external stakeholders.

Cascade Project Cost Effectiveness Evaluation Methodology

$$C_{RNG} = I_{RNG} - AC_U - AC_D + \sum_{T=1}^{365} (P_{RNG} + VC - CIF) * Q$$

$$C_{Conventional} = \sum_{T=1}^{365} (P_{Conventional} + VC) * Q$$

If $C_{Conventional} \geq C_{RNG}$, a project can be deemed cost effective under the inputs given, and should be considered for acquisition. If not, the project may still be considered under regulatory exceptions discussed earlier in this chapter.

Model Notes

$\boldsymbol{C_{RNG}}$ = The all-inclusive annual cost of a proposed RNG project

$\boldsymbol{I_{RNG}}$ = The annual required investment to procure a proposed RNG resource. If Cascade is simply buying the gas and/or environmental attributes, this value is zero.

$\boldsymbol{AC_U}$ = Avoided upstream costs

AC_D = Avoided distribution system costs

P = Daily price of gas being evaluated

Q = Daily quantity of gas being evaluated

VC = Variable cost to move one dekatherm of gas to Cascade's distribution system. This value can be zero if a project connects directly to the Company's system.

CIF = Carbon Intensity Factor. This is calculated by multiplying the Company's expected carbon compliance cost by 1 minus the ratio of a proposed projects carbon intensity to conventional gas' carbon intensity.

$\boldsymbol{C_{Conventional}}$ = The all-inclusive annual cost of conventional natural gas.

Annual Required Investment

- Accounts for the upfront costs to build infrastructure needed to transport RNG from the source to either Cascade's distribution system or upstream pipeline
- Includes interconnect facilities, pipeline extensions, and applicable taxes and permitting charges
- Costs are amortized over the life of the project

Avoided Costs

- Accounts for costs that are mitigated by the potential acquisition of RNG
- Upstream costs includes fixed, variable elements of incremental pipeline needed that can be offset by RNG
- Downstream costs include distribution system enhancements that can be replaced by RNG
- Avoided cost values come from most recently acknowledged IRP

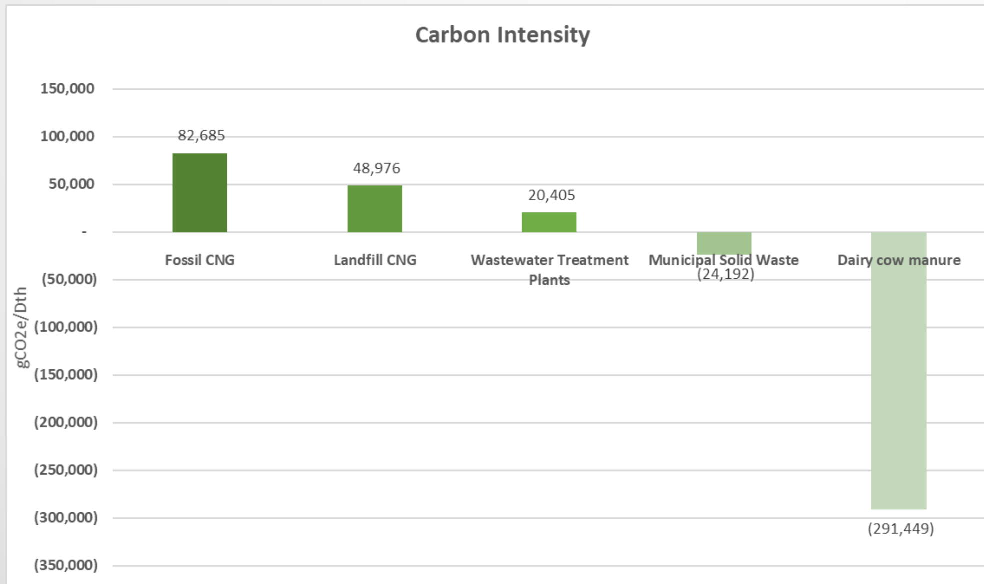
Cost of Gas

- Price of conventional gas derived as a demand weighted split of Cascade’s 20-year price forecast at Sumas, Rockies, and AECO
- Price of RNG can be difficult to quantify as it is often a negotiated value
  - If a value cannot be provided, this can be optimized using Excel’s solver functionality to derive the highest price that RNG from a project can be considered cost-effective

Carbon Intensity Factor

- Quantifies the value of the environmental attributes associated with RNG
- Carbon impact is multiplied by the projected cost of carbon mitigation
- This element is one difference between Cascade's methodology and the methodology proposed in UM 2030
  - UM 2030 methodology calculates the carbon compliance cost for conventional gas, RNG separately
  - CNGC methodology calculates the ratio of the carbon impact RNG to that of conventional gas, uses this value to calculate the carbon compliance savings of RNG

Jaffe 2016 Carbon Intensity Values



An Example of Conventional Gas Vs. Landfill Gas

- Suppose the cost of carbon is $2/dth of conventional gas
- UM 2030 Methodology:
  - Cost of Conventional Gas = $2/dth
  - Cost of RNG = 48,976/82,685 * $2/dth, or approx. $1.185/dth
- Cascade Methodology:
  - Ratio of RNG to conventional gas = 48,976/82,865
  - 1-(48,976/82,865)*$2/dth = $.815/dth, which is equal to 2-1.185 in the example above

Cost-Effectiveness Evaluation

- Levelized costs are evaluated for the projected lifespan of the RNG project. As discussed earlier, if the total cost of conventional gas exceeds that of RNG, the project may be deemed cost effective
  - Important to recognize that a model is only as good as its inputs; Without definitive answers for values like the cost of carbon compliance, price of gas, this cost-effectiveness determination should be used in conjunction with qualitative analysis from subject matter experts.

If Not Cost-Effective…

- Cascade's model is able to project the impact to revenue requirement.
  - If under a certain threshold, a project may still be considered favorable to acquire
  - If not, the model will be able to calculate the price point needed to achieve that threshold
  - Projects may still be considered under a voluntary tariff

SENDOUT®
Optimization Modeling

SENDOUT® Model

- Cascade utilizes SENDOUT® for resource optimization.
- This model permits the Company to develop and analyze a variety of resource portfolios to help determine the type, size, and timing of resources best matched to forecast requirements.
- SENDOUT® is very powerful and complex. It operates by combining a series of existing and potential demand side and supply side resources, and optimizes their utilization at the lowest net present cost over the entire planning period for a given demand forecast.

SENDOUT® Model (Cont'd)

- SENDOUT® utilizes a linear programming approach.
- The model knows the exact load and price for every day of the planning period based on the analyst's input and can therefore minimize costs in a way that would not be possible in the real world.
- Therefore, it is important to recognize that linear programming analysis provides helpful but not perfect information to guide decisions.

CASCADE NATURAL GAS CORPORATION
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Modeling Transportation In SENDOUT® is a Balancing Act

- Start with a point in time look at each jurisdiction's resources
- Use the Nov19-Oct20 PGA portfolio
- Contracts –Receipt and Delivery Points
- We start with current transport contracts, using centralized receipts and approximately 67 delivery locations
- Rates - Current contractual, with CPI increase every 3 years
- Contractual vs. Operational
- Contractual can be overly restrictive
- Operational can be overly flexible
- Incorporating operational realities into our modeling can defer the need to acquire new resources.
- Gas Supply's job is to get gas from the supply basin to the pipeline citygate
- IRP focus is on the core
- Operations job is to take gas from the pipeline gate to our customers
- Operations focus is on the system, not just the core
- Limiting factor is receipt quantity –how much can you bring into the system?

Modeling Challenges

- Supply needs to get gas to the citygate.
- Many of Cascade's transport agreements were entered into decades ago, based on demand projections at that point in time.
- Sum of receipt quantity and aggregated delivery quantity can help identify resource deficiency depending on how rights are allocated.
- The aggregated look can mask individual citygate issues for looped sections, and the disaggregated look can create deficiencies where they don't exist.
- In many cases operational capacity is greater than contracted.
- SENDOUT® has perfect knowledge.

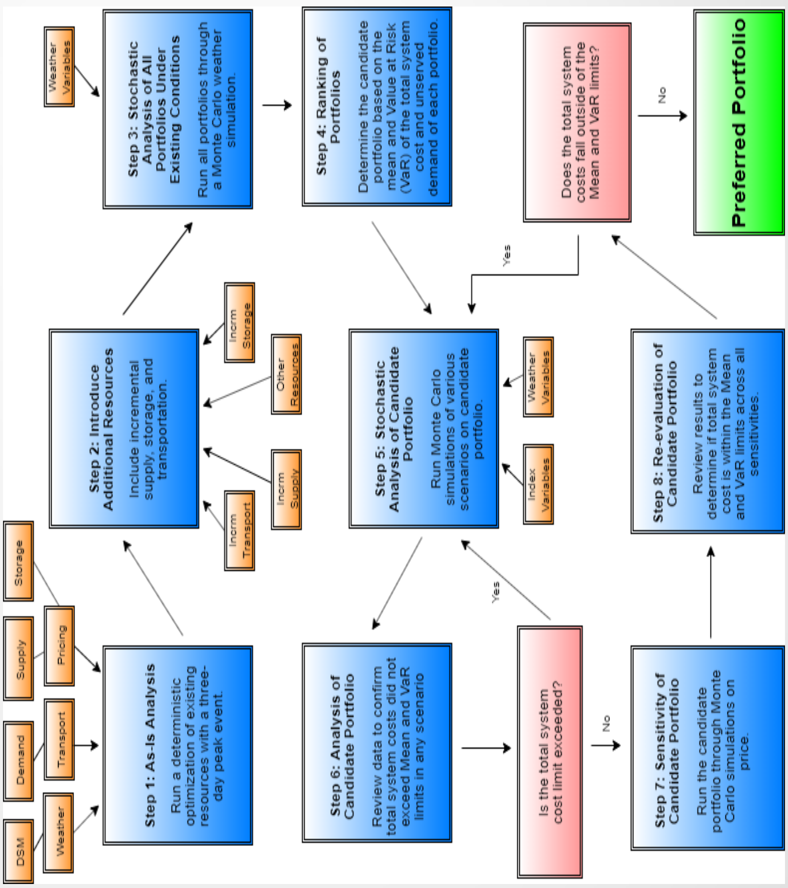
Supply Resource Optimization Process

- **Step 1: As-Is Analysis**
  - Run a deterministic optimization of existing resources with a three-day peak event to uncover timing and quantity of resource deficiencies.
- **Step 2: Introduce Additional Resources**
  - Include incremental supply, storage, and transportation to derive a deterministic optimal portfolio, additional portfolios.
- **Step 3: Stochastic Analysis of All Portfolios Under Existing Conditions**
  - Run all portfolios through a Monte Carlo weather simulation, using expected growth, supply and storage accessibility. Record the probability distributions of total system costs for each portfolio.
- **Step 4: Ranking of Portfolios**
  - Determine the candidate portfolio based on the mean and Value at Risk (VaR) of the total system cost and unserved demand of each portfolio. This resource mix will be the best combination of cost and risk for Cascade and its customers.

Supply Resource Optimization Process (Cont'd)

- **Step 5: Stochastic Analysis of Candidate Portfolio**
  - Run Monte Carlo simulations of various scenarios on candidate portfolio; comparing Mean and VaR to a managerial limit.
- **Step 6: Analysis of Candidate Portfolio**
  - Review data to confirm total system costs did not exceed Mean and VaR limits in any scenario. If limit is exceeded, repeat step 5 with next highest ranked portfolio.
- **Step 7: Sensitivity of Candidate Portfolio**
  - Run the candidate portfolio through Monte Carlo simulations on price. Review results to determine if total system cost is within the Mean and VaR limits across all sensitivities.
- **Step 8: Re-evaluation of Candidate Portfolio**
  - If the total system costs fall outside of the Mean and VaR limits in sensitivity analysis, select the next most optimal portfolio to run scenario and sensitivity analysis on. Repeat as needed until preferred portfolio is confirmed.

91


DSM
Weather
Demand
Transport
Supply
Pricing
Storage
Step 1: As-Is Analysis
Run a deterministic optimization of existing resources with a three-day peak event.
Incrm Transport
Incrm Supply
Other Resources
Incrm Storage
Step 2: Introduce Additional Resources
Include incremental supply, storage, and transportation.
Weather Variables
Step 3: Stochastic Analysis of All Portfolios Under Existing Conditions
Run all portfolios through a Monte Carlo weather simulation.
Step 4: Ranking of Portfolios
Determine the candidate portfolio based on the mean and Value at Risk (VaR) of the total system cost and unserved demand of each portfolio.
Index Variables
Weather Variables
Step 5: Stochastic Analysis of Candidate Portfolio
Run Monte Carlo simulations of various scenarios on candidate portfolio.
Step 6: Analysis of Candidate Portfolio
Review data to confirm total system costs did not exceed Mean and VaR limits in any scenario
Is the total system cost limit exceeded?
Yes
No
Step 7: Sensitivity of Candidate Portfolio
Run the candidate portfolio through Monte Carlo simulations on price.
Step 8: Re-evaluation of Candidate Portfolio
Review results to determine if total system cost is within the Mean and VaR limits across all sensitivities.
Does the total system costs fall outside of the Mean and VaR limits?
Yes
No
Preferred Portfolio

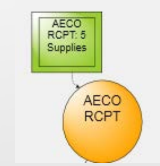
Base Case Sendout Inputs

- Supply
- Storage
- Transportation
- Constraints
- Demand
- Weather
- Price Forecast

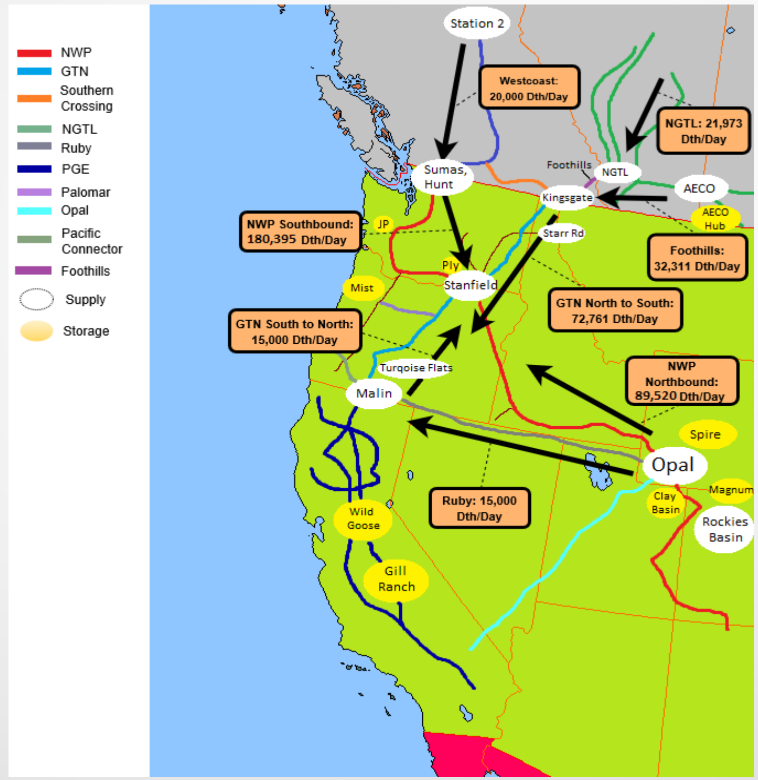
Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Supply

- Cascade can purchase gas at four markets; AECO, SUMAS, KINGSGATE and OPAL.
- At each market Cascade can purchase gas at different locations along the pipeline.
- For the first year, Cascade uses all current contracts for Supply inputs.
- For years 2-20, Cascade uses Base, Fixed, Winter base, Summer and Winter day gas, and Peak day incremental supplies as inputs.
- Over the planning horizon, the contracts are renewed in November and April.



Supply


NWP
GTN
Southern Crossing
NGTL
Ruby
PGE
Palomar
Opal
Pacific Connector
Foothills
Supply
Storage
Station 2
Westcoast: 20,000 Dth/Day
NGTL: 21,973 Dth/Day
Foothills
NGTL
AECO
AECO Hub
Sumas, Hunt
Kingsgate
Starr Rd
NWP Southbound: 180,395 Dth/Day
JP
Foothills: 32,311 Dth/Day
Ply
Stanfield
Mist
GTN North to South: 72,761 Dth/Day
GTN South to North: 15,000 Dth/Day
Turqoise Flats
Malin
NWP Northbound: 89,520 Dth/Day
Spire
Opal
Magnum
Clay Basin
Rockies Basin
Ruby: 15,000 Dth/Day
Wild Goose
Gill Ranch

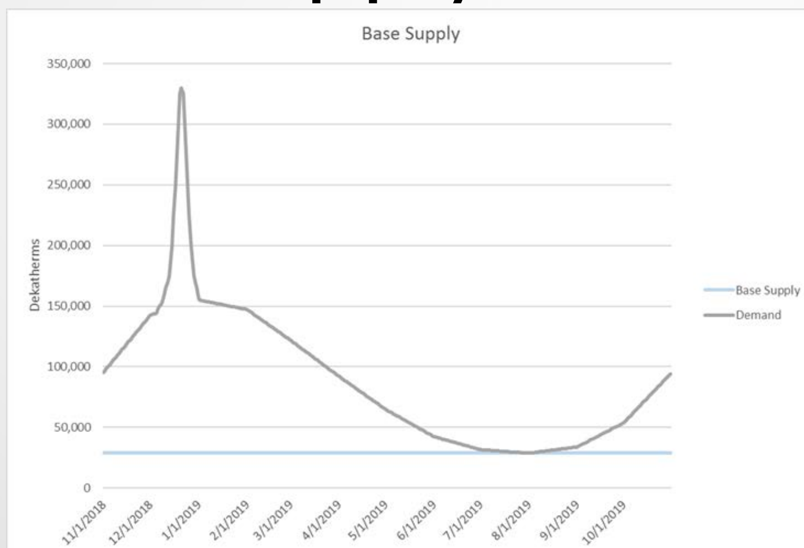
Supply Base and Fixed

- Supply Base and Fixed are the baseline supply contracts that are entered into every 12 months.
- A base contract has a basis rate. This is defined as the price of gas at a given market (i.e., AECO base is the expected cost of gas at NYMEX plus the basis for AECO, for a given month).
- A fixed contract has a fixed rate.
- A penalty is applied to each contract when the gas is not taken for a day. This type of penalty forces these types of contracts to only take the optimal amount of gas to serve the base demand.

Supply Example

	JAN 2017	FEB 2017	MAR 2017	APR 2017	MAY 2017	JUN 2017	JUL 2017	AUG 2017	SEP 2017	Extension Option	Escalation Pattern	Monthly Multiplier	Index	Adder	Multiplier
*Daily MDQ	25000									Same					
*Daily Minimum Percent	100									Same					
Annual Maximum										Same					
Annual Minimum Percent										Same					
Monthly Maximum										Same					
Monthly Minimum Percent										Same					
Seasonal Maximum										Same					
Seasonal Minimum Percent										Same					
Known Take										Same					
*Rate - Commodity	2.5									Same	CPI				
Rate - Dispatch										Same					
Rate - Known Commodity Cost										Same					
Rate - Other Variable 1										Same					
Rate - Other Variable 2										Same					
Rate - Penalty Annual										Same					
Rate - Penalty Seasonal										Same					
Rate - Penalty Monthly										Same					
Rate - Penalty Daily	2.5									Same				-0.01	
Rate - D1										Same					
Rate - D2										Same					
Volume - D1 Volume										Same					
Volume - D2 Volume										Same					
Temp Cutoff Max Temperature										Same					
Available % Below Min/Above Max										Same					
Temp Cutoff Min Temperature										Same					
Apply Temperature Cutoff										Same					
Energy Conversion Factor										Same					
Process Indicator										Same					
Resource Mix Start\Stop Indicators	Start									Last Year					
Rmix MDQ Range Max	25000									Same					

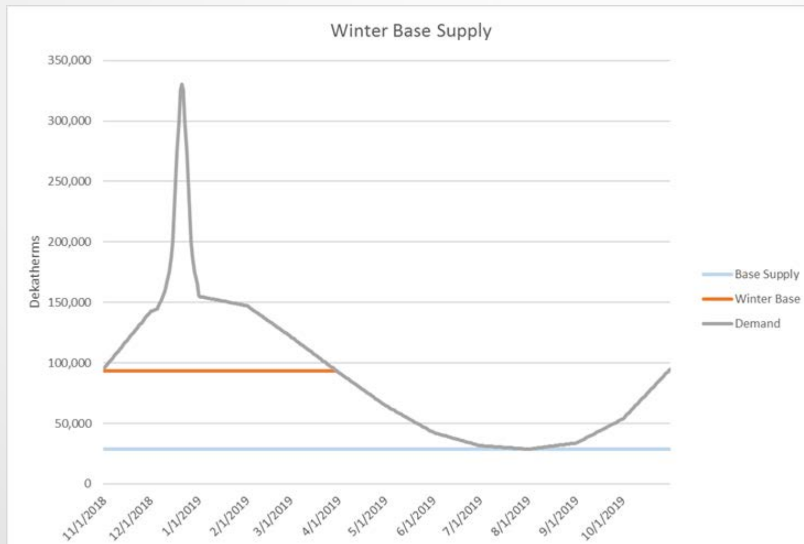
Base Supply (Cont’d)



Winter base Supply

- Winter base supply is contracted supply with a premium charge that is slightly higher than base gas.
- The Maximum Daily Quantity (MDQ) is optimally set by SENDOUT.
- Winter supply is renewed every November and completes at the end of March.
- Winter Supply is additional baseline supply on top of the base or fixed supplies for the winter months.
- There is a penalty associated to this contract to force SENDOUT to take the optimal amount of additional winter base gas.

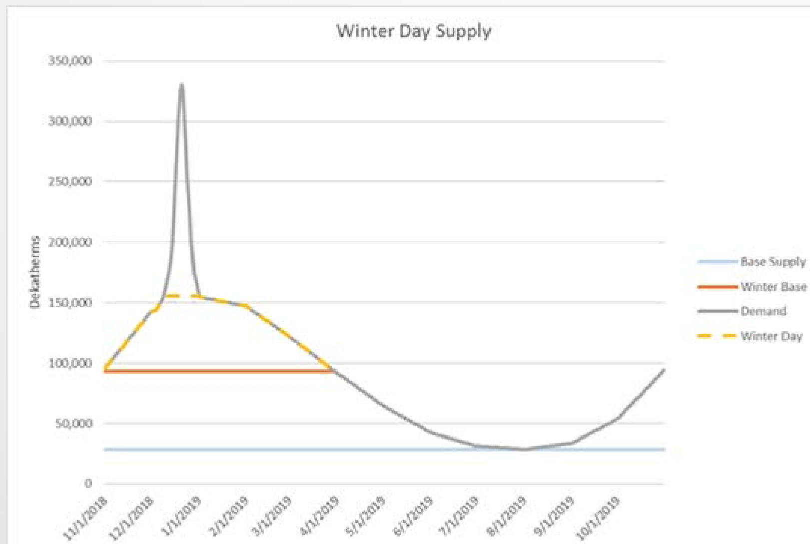
Winter Base Supply (Cont'd)



Day Supply (Winter)

- Winter Day supply is gas that is R-mixed at the beginning of November each year.
- The R-mix function takes into account the fixed and variable costs of a resource to determine the proper amount to take in a given period.
- Winter day gas has an MDQ cap but is not a must take supply.
- If a winter day supply has an MDQ of 10,000 dth then it can take anywhere from 0 to 10,000 dth of gas on any given day in the winter.
- Winter day supply has a slightly higher premium than winter base supply and it can be contracted from November to April.

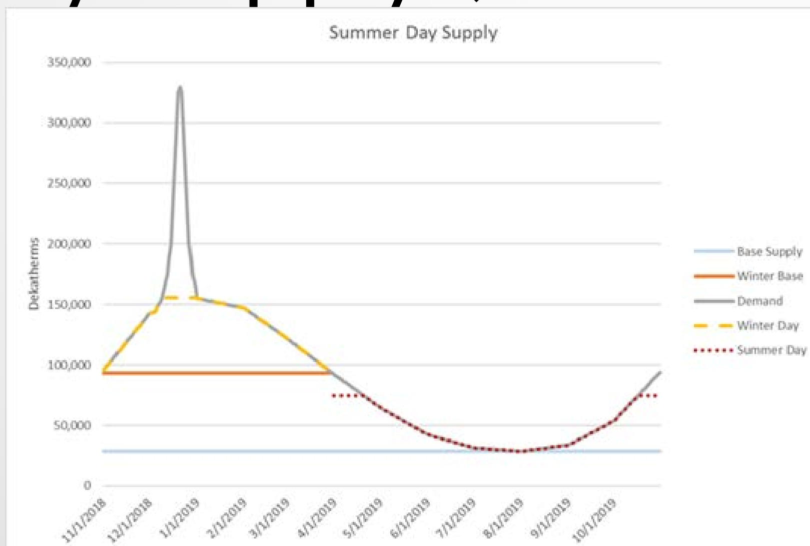
Winter Day Supply (Cont'd)



Day Supply (Summer)

- Summer day supply is gas that is R-mixed at the beginning of April each year.
- Summer day gas has an MDQ cap but is not a must take supply.
- If a summer day supply has an MDQ of 10,000 dth then it can take anywhere from 0 to 10,000 dth of gas on any given day in the summer.
- Summer day supply has a slightly higher cost than base supply and it can be contracted from April to November.

Day Supply (Summer)

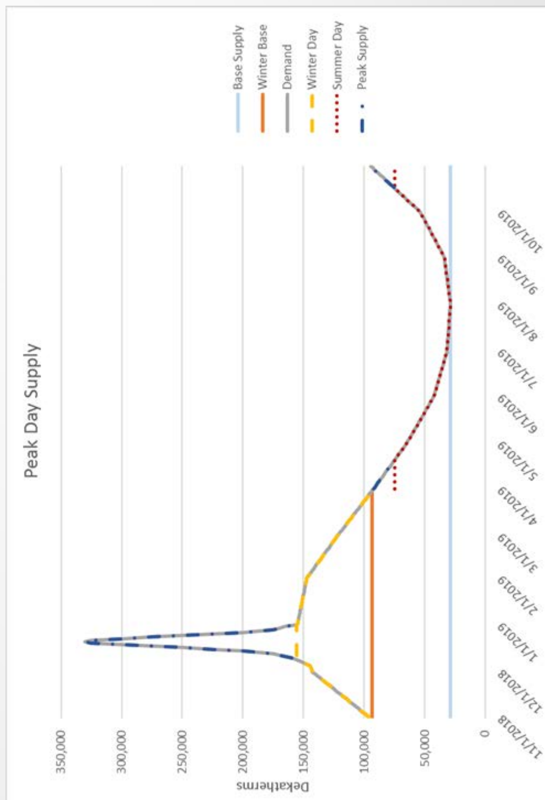


Peak Supply

- Peak supply is gas purchased on high demand days where base, index, winter base, or day supply cannot accommodate.
- Peak supply has a slightly higher premium to buy than day supply.
- As long as Cascade has the transport capacity or can utilize a third party's transport capacity, we can purchase as much peak supply as needed to meet peak demand.

105

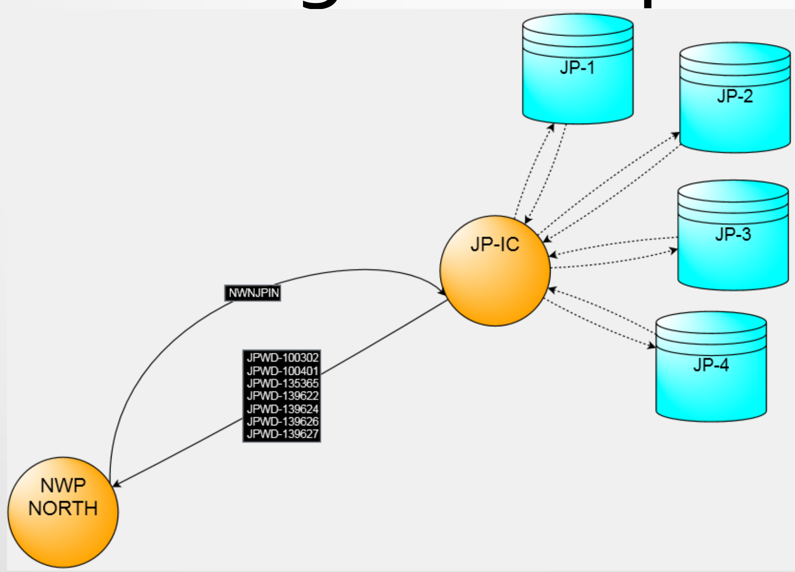
Total Supply



Storage

- Cascade leases storage at 3 locations: Jackson Prairie (JP), Plymouth (Ply), and Mist.
- Cascade has 4 storage contracts with JP, 2 contracts with Plymouth, and 1 with Mist.
- Storage injections targets are set at 35% by the end of June, 80% by the end of August, and 100% by the end of September.
- These targets are set by upstream pipelines' tariffs.
- Cascade can withdrawal approximately 56,000 dth per day from JP, 78,000 dth per day from Plymouth, and 30,000 Dth per day from Mist for a total of approximately 164,000 dth per day.

Storage Example



Storage Example 2

	JAN 2017	FEB 2017	MAR 2017	APR 2017	MAY 2017	JUN 2017	JUL 2017	AUG 2017	SEP 2017	Extension Option	Escalation Pattern	Monthly Multiplier
Process Indicator										Same		
Inventory Maximum Physical Capacity	604351									Same		
Inventory Minimum Physical Percent										Same		
*Target Inv - End of Period Max Pct										Same		
*Target Inv - End of Period Min Pct						35		80	100	First Year		
*Inventory Adjustment - Value per Unit										Same		
*Inventory Adjustment - Volume										Same		
*Injection Daily MDQ				16789						First Year		
*Injection Daily Min Percent										Same		
*Withdrawal Daily MDQ				0						Last Year		
*Withdrawal Daily Min Percent										Same		
Fuel - Injection	0.15									Same		
Fuel - Withdrawal	0.15									Same		
Rate - Carry										Same		
Rate - Injection										Same		
Rate - Withdrawal										Same		
Rate - Other Injection										Same		
Rate - Other Withdrawal										Same		
Rate - Volume Charge										Same		
Rate - D1	.01558									Same		DaysInMonth
Rate - D2	.00057									Same		DaysInMonth
Volume - D1 Volume	16789									Same		
Volume - D2 Volume										Same		
Storage Ratchets Table	JP									Same		
Starting Inv Layer 1 Value per Unit	3									Same		
Starting Inv Layer 1 Volume	604351									Same		
Energy Conversion Factor										Same		
Injection Costing List - Transport										Same		
Injection Costing List - Source										Same		

CASCADE NATURAL GAS CORPORATION
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Transportation

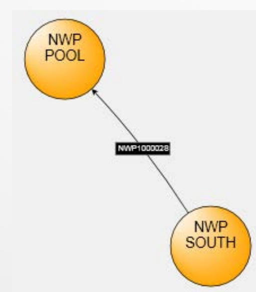
- Transportation contracts are the means of how Cascade gets the gas from the supplier to the end user.
- Cascade has multiple types of transportation:
  - A single delivery point.
  - Multiple delivery points.
- The multiple delivery point contracts gives Cascade the flexibility to move the gas where it's most needed.
- On NWP, transportation goes to the zonal level because MDDO's can be reallocated within a zone to the citygate. Additionally, NWP typically issues constraint concerns at the zonal level.
- On GTN, transportation goes to the citygate level as MDDO's cannot be reallocated within the GTN zone.

Transportation (Cont'd)

- Transportation has an MDQ, a D1 rate, a transportation rate, and a fuel loss percentage.
- A maximum delivery quantity (MDQ) which is the maximum amount of gas Cascade can move on the pipeline on a single day.
- A D1 rate which is the reservation rate to have the ability to move the MDQ amount on the pipeline.
- A transportation rate which is the rate per dekatherm that is actually moved on the pipeline.
- The fuel loss percentage is the statutory percent of gas based on the tariff from the pipeline that is lost and unaccounted for from the point of where the gas was purchased to the citygate.

CASCADE NATURAL GAS CORPORATION
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Transport Example



Transport Example

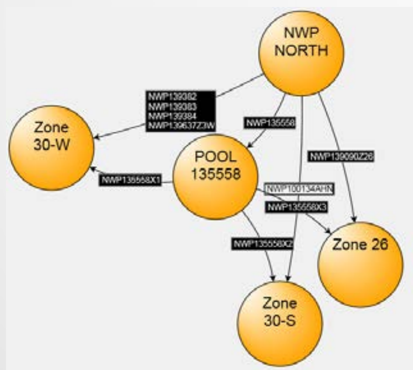
	JAN 2017	FEB 2017	MAR 2017	APR 2017	MAY 2017	JUN 2017	JUL 2017	AUG 2017	SEP 2017	Extension Option	Escalation Pattern	Monthly Multiplier
*Daily MDQ	116866									Same		
*Daily Minimum Percent										Same		
Fuel	1.28									Same		
Rate - Transportation	0.03									Same		
Rate - Other Variable										Same		
Rate - D1 Rate	0.39249									Same		DaysInMonth

Delivery Rights vs Receipt Rights

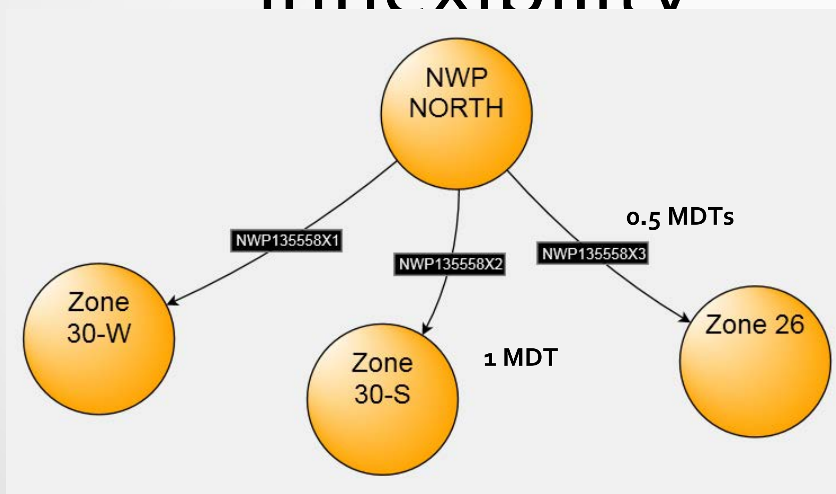
- Cascade has more Delivery Rights than Receipt Rights.
- Approximately 457,000 Dth of Delivery Rights.
- Approximately 360,000 Dth of Receipt Rights.
- The excess Delivery Rights allow Cascade to be flexible with the 360,000 Dth of Receipt Rights.

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve

Example of delivery right flexibility



Example of delivery right inflexibility



Transport Constraints

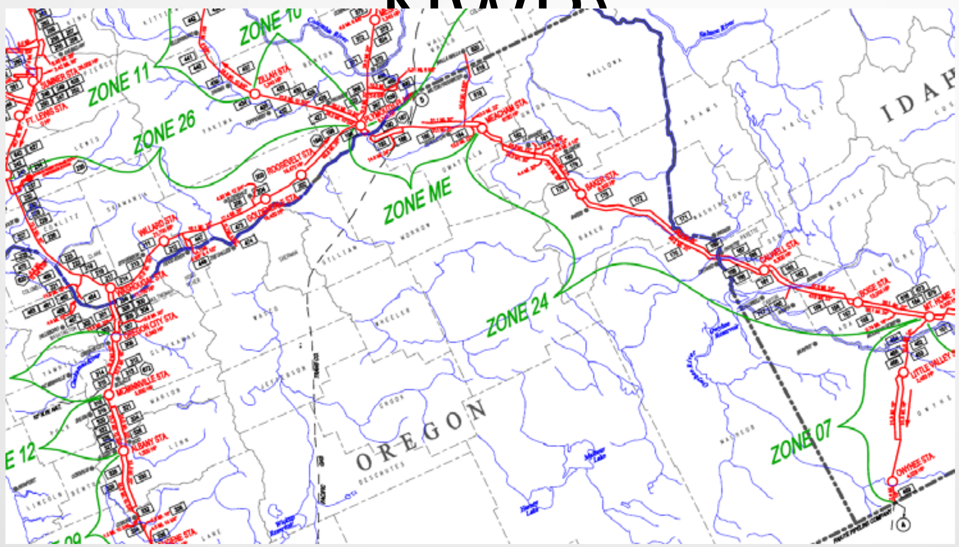
- To simplify modeling in SENDOUT®, the software allows the user to group multiple paths of one contract into a constraint group.
- This tells SENDOUT® to allow each path to take up to X Dekatherms, but not to exceed X Dekatherms for all paths of the contract.
- The analyst identifies which contracts should be in the group and assigns an MDQ for the constraint group.

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Transport Constraints Example

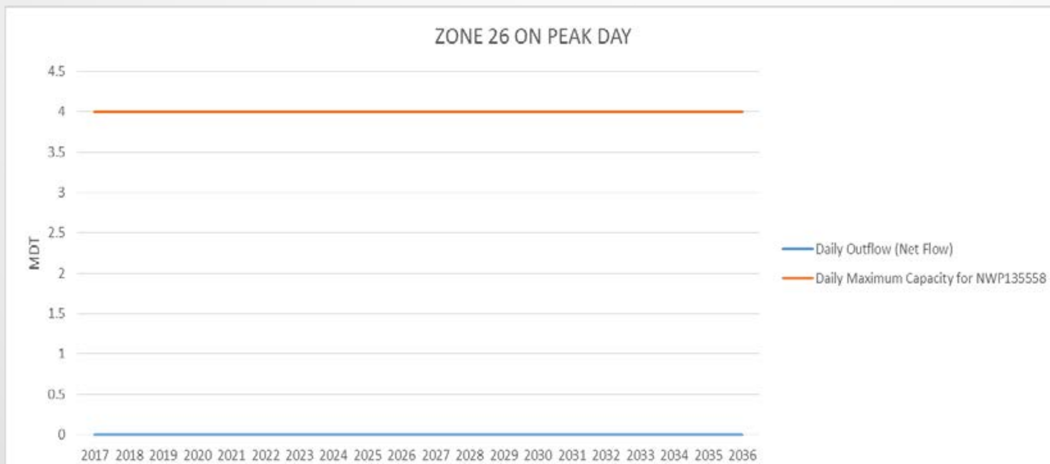
	JAN 2017	FEB 2017	MAR 2017	APR 2017	MAY 2017	JUN 2017	JUL 2017	AUG 2017	SEP 2017	Extension Option
Annual Max										Same
Annual Min Percent										Same
Seasonal Max										Same
Seasonal Min Percent										Same
Monthly Max										Same
Monthly Min Percent										Same
*Daily Max	47603									Same
*Daily Min Percent										Same
Resource Mix Start\Stop Indicators										Same
RMIX MDQ Max										Same
RMIX MDQ Min										Same
Fixed Rate										Same
Demand Annual Max Percent										Same
Demand Annual Min Percent										Same
Demand Seasonal Max Percent										Same
Demand Seasonal Min Percent										Same
Demand Monthly Max Percent										Same
Demand Monthly Min Percent										Same
*Demand Daily Max Percent										Same
*Demand Daily Min Percent										Same

Location of Zones (Source: NWP)

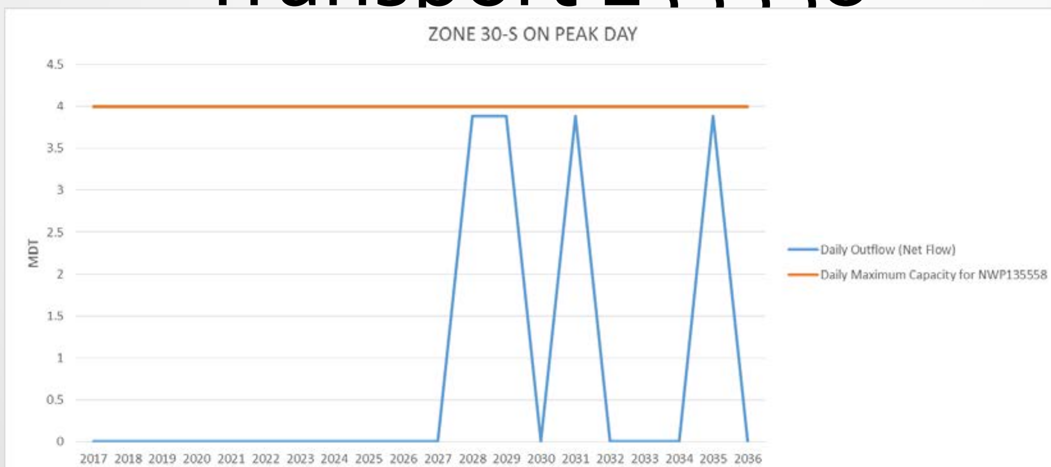


Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

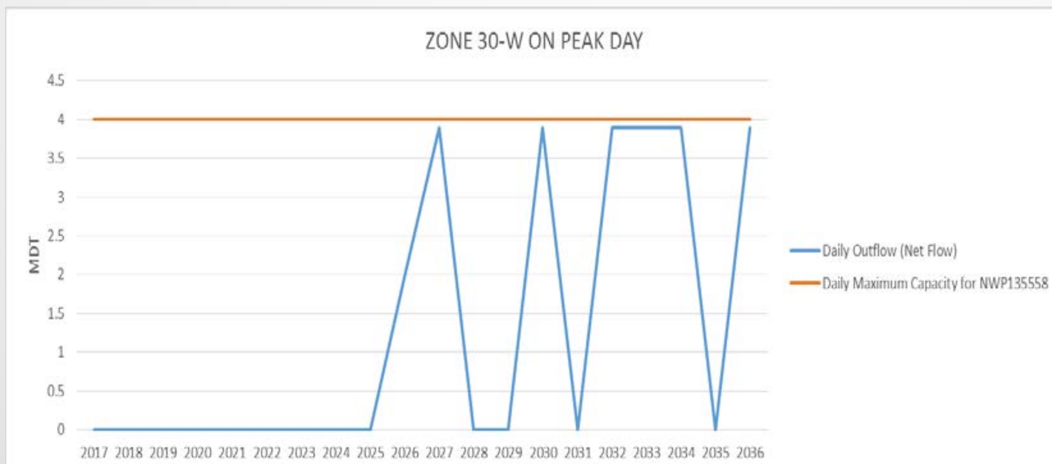
Zone 26 on Peak Day for Transport 135558



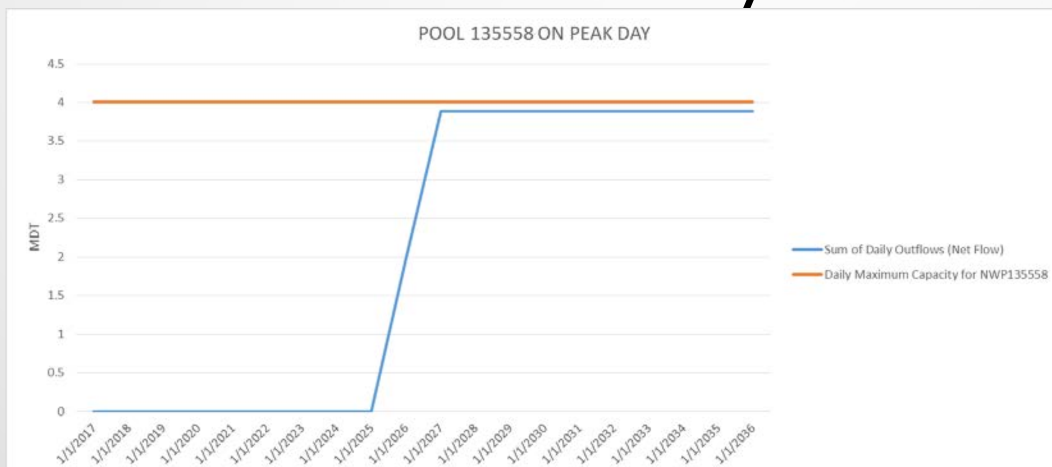
Zone 30-S on Peak Day for Transport 135558



Zone 30-W on Peak Day for Transport 135558



Transport Contract 135558 on Peak Day



Demand Behind the Gate

- Cascade has strived over the last several years to enhance the IRP forecast and resource analysis to get to as granular a level as possible using the available data.
- Attempts to forecast demand behind the gate using existing forecasting methodology has been challenging.
- Customer billing data does not have daily meter reads for core customers making regression analysis on use per HDD per customer difficult.
- Some towns can be served by multiple pipelines and the mix can change over time.

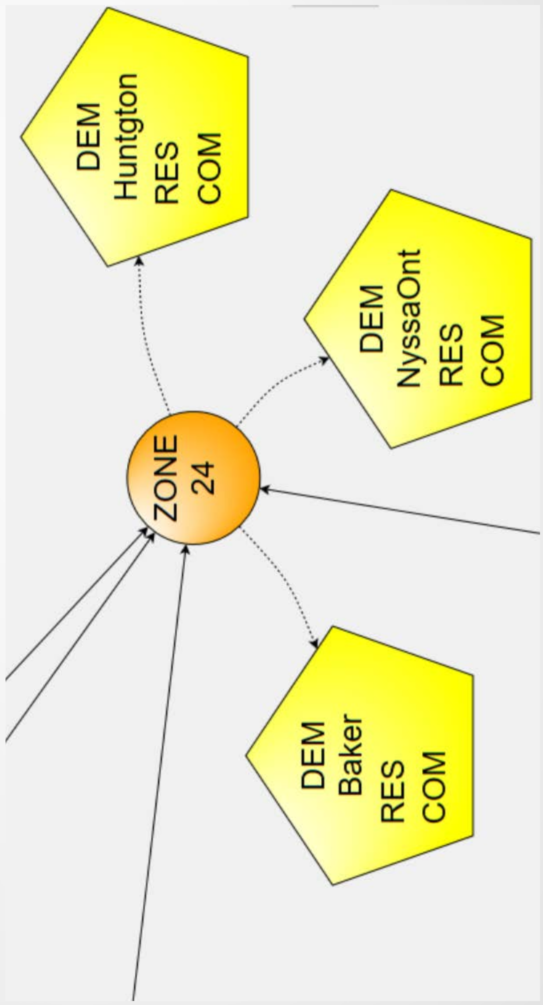
Demand

- Demand is forecasted at the citygate level by rate schedule.
- For NWP, each citygate's demand is associated with the zone.
- For GTN, each citygate's demand is associated with it's respective citygate interconnect.
- Demand Inputs
  - Forecast type (Monthly amount or Regressions).
  - Monthly projected customers for 20 years.
  - Regression coefficients if using the Regression forecast type.
  - If using a monthly number, it is the 2020 demand for that month with a growth factor.

CASCADE NATURAL GAS CORPORATION
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

125

Demand Example



CASCADE NATURAL GAS CORPORATION
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Demand Example 2

	JAN 2017	FEB 2017	MAR 2017	APR 2017	MAY 2017	JUN 2017	JUL 2017	AUG 2017	SEP 2017	Extension Option	Escalation Pattern	Monthly Multiplier	Index	Adder	Multiplier
Forecast Method	Usage Fac									Same					
Customers	28347	28386	28429	28435	28456	28442	28450	28469	28489	Same					
*Demand - Daily										Same					
Demand - Monthly Base										Same					
Demand - Monthly Heat										Same					
Demand - Monthly Total										Same					
Demand - Percent Factor - non P non Q										Same					
Demand - Percent Factor - non Q										Same					
Usage Factors - Weekday Base	0.1919	0.1659	0.1396	0.0979	0.0741	0.0625	0.0589	0.0581	0.06	First Year					
Usage Factors - Weekday Heat	0.007448									Same					
Usage Factors - Weekend Base	0.186298	0.160298	0.133998	0.092298	0.068498	0.056898	0.053298	0.052498	0.054398	First Year					
Usage Factors - Weekend Heat	0.007448									Same					
*Rate - Unserved Dispatch (Pri 1)										Same					
*Rate - Unserved (Pri 2)	960									Same					

CASCADE NATURAL GAS CORPORATION
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Weather

- Weather inputs for SENDOUT include:
  - Monte Carlo
  - Historical
  - Normal
- Monte Carlo inputs include mean, standard deviation, max, minimum, and distribution.
- Historical data is used to build weather profiles for Monte Carlo.
- Normal weather is the daily average of the 30-year most recent history (1989-2019).

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Weather Example – Monte Carlo

	JAN 2014	FEB 2014	MAR 2014	APR 2014	MAY 2014	JUN 2014	JUL 2014
HDD Mean	1031.8	804.1	639.6	453.9	254.2	92.6	10.3
HDD Std Dev	145.4	133.1	84.4	93.0	72.2	40.4	15.2
HDD Distribution	Normal						
HDD Max	1291	1242	841	641	426	170	75
HDD Min	772	568	448	254	92	19	0
CDD Mean							
CDD Std Dev							
CDD Distribution							
CDD Max							
CDD Min							
Scaling Year	Best Match						

CASCADE NATURAL GAS CORPORATION
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Preliminary Resource Integration Results

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Preliminary Results

- Cascade has finalized its load forecast for the 2020 WA IRP.
- All of Cascade's existing resources have been run through SENDOUT® to complete the Company's As-is analysis as discussed in Step 1 of the Supply Resource Optimization Process.
  - Assuming contracts evergreen.
  - These preliminary results do not include the impacts of DSM as discussed earlier.
- Cascade has identified no potential shortfalls.

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Next Steps

- Cascade will still perform the portfolio analysis as detailed early to identify if a particular resource mix provides a more optimal, least cost/least risk solution.
- Even without current shortfalls, the top ranking candidate portfolio will need to undergo scenario/sensitivity analyses to ensure test its performance under a number of externalities.
- The results of this analysis will be presented in TAG 5

Remaining Schedule

Date (Subject to change)	State	Process Element	Location (Subject to change)	Notes
Wednesday, September 16, 2020	WA	TAG 5 slides distributed to stakeholders		
Wednesday, September 23, 2020	**WA**	**TAG 5: Final Integration Results, finalization of plan components, Proposed new 4-year Action Plan.**	**SeaTac Airport - 9 am to 12 pm**	
Tuesday, November 17, 2020	WA	Draft of 2020 WA IRP distributed		
Wednesday, December 23, 2020	WA	Comments due on draft from all stakeholders		
Wednesday, January 27, 2021	WA	TAG 6, if needed	WebEx Only	
Friday, February 26, 2021	WA	IRP filing in Washington		

CASCADE NATURAL GAS CORPORATION
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

ADDITIONAL QUESTIONS?

mark.sellers-vaughn@cngc.com

Brian Robertson – Supervisor of Resource Planning: (509) 734-4546
brian.robertson@cngc.com

Devin McGreal – Resource Planning Analyst II: (509) 734-4681
devin.mcgreal@cngc.com

Ashton Davis – Resource Planning Analyst I: (509) 734-4520
ashton.davis@cngc.com

Bruce Folsom - Consultant

Cascade Natural Gas Corporation

2020 Integrated Resource Plan
Technical Advisory Group Meeting #4

August 12th, 2020

Teleconference Only

TAG #4 – WUTC TAG Meeting

Date & time: 08/12/2020, 09:00 AM – 11:20 AM

Location: Microsoft Teams Meeting

Presenters: Brian Robertson, Ashton Davis, Devin McGreal, Abbie Krebsbach, Monica Cowlishaw, and Phillip Hensyel

In attendance: Mark Sellers-Vaughn, Brian Robertson, Devin McGreal, Ashton Davis, Bruce Folsom, Chris Robbins, Eric Wood, Carolyn Stone, Sheila McElhinney, Andrew Rector (WUTC), Jon Storvik, Corey Dahl, Shawna Nieraeth, Dan Kirschner (NWGA), Abbie Krebsbach, Philip Hensel, Monica Cowlishaw, Alyn Spector, Kary Burin, Linda Offerdahl, Brian Cunnington, JP Cordaro (Ruby) and Tom Pardee (AVA)

Minutes: Carolyn Stone

Presentation #1 – IRP CARBON UPDATE & ASSUMPTIONS (Devin McGreal & Abbie Krebsbach)

Slide #13 – GHG Emissions from NG (Cont'd)

QUESTION: Andrew asked if these were from Energy Efficiency programs, the per year 33K tons?

ANSWER: Abbie said that when we add up accumulation every year and emissions savings, this year decreased an estimated 33K metric tons, depending on how we discount the emissions – levelized number. 1st year – more success with wear and tear on the equipment. I could be being more conservative. Cost savings of the program – only looking back to 2008.

QUESTION: Andrew asked if this is the life cycle savings of all Energy Efficiency measures since 2008?

ANSWER: Abbie said "Yes!"

Slide #18 – Reducing Company Emissions

QUESTION: Andrew asked, 100 total miles of steel pipeline, how much more is needed to be replaced?

ANSWER: Abbie answered she is not sure. She said we are still replacing some – not sure of the number. She asked if anyone on the phone could answer this? We can get that answer for you. This has been ongoing for a number of years!

Slide #29 thru #32 - Local Focus – Bellingham (Alyn Spector)

QUESTION: Andrew asked, on Slide #29, of the targets listed, are these currently in place or proposed?

ANSWER: Alyn said these are currently in place but aiming to be more aggressive targets 2030 – 2035 for electrification.

QUESTION: What is it in the triple bottom line?
ANSWER: People, profits, planet – Social, and economic benefits. Is the technology feasible and market ready?

Slide #34 & #35 – Local Focus – City of Bend

QUESTION: Andrew asked if Bend was the only one CNG directly involved with?
ANSWER: Alyn answered saying "Yes, it is in our service territory".

QUESTION: Andrew asked if these initiatives modeled in the IRP process and if so, how?
ANSWER: Alyn said this is a question for Brian R and Devin…Brian said they are included in the IRP as reported, not modeled at present but have discussed modeling. Goal is to model but still need to do that actual modeling. Mark added that if there are insights Staff have on this, let him know.

QUESTION: Will it be in this IRP or next?
ANSWER: Mark answered, "That's a tough question", he said it depends on the timing. Expect to see it mentioned in our action plan. There won't be specific modeling in the September draft.

- Andrew said he didn't have input right now but will put thought into it!

Slide #40 – Next Steps & Conclusion
- Tag #5 – brief Update

QUESTION: Mark asked, back on the "Local impacts of Modeling" slides - how we model Bend and Whatcom discussion… Would Staff want us to explain in the narrative how we are considering doing that modeling?
ANSWER: Yes, should share what you're considering and add to Tag #5

Andrew added "Sounds good". Tag #5 and add to narrative. I will queue up email to the IRP leads to see what NWP and PSE are doing on this front and point you in a direction.

Presentation #2 - DSM Forecast, 2020 IRP (Monica Cowlishaw & Philip Hensyel)

Slide #46 -2020 Forecast Updates (Phillip Hensyel)

QUESTION: Andrew asked…remind me is the discount rate in the most recent GRC?
ANSWER: Phillip asked Devin…Devin said for CNGC it is tied to the 30-year fixed price, mortgage rate between 4.43 and 4.3%

COMMERCIAL & INDUSTRIAL

QUESTION: Andrew asked when you have a baseline forecast, is it a "baseline" usage?
ANSWER: Phillip said, it is based on the last CPA and last IRP assumptions. Based on the calculation for the new Avoided Cost, to be updated later this month, based on 2019 usage.

Slide #58 - Additional EE Topics for the IRP (Alyn Spector)

QUESTION: Corey asked about the impact of COVID 19 – economic recession... What has Commission done historically when something out of their control happens in meeting targets?

ANSWER: Andrew said in 2020 we meet targets or set 2021 targets.

QUESTION: Corey asked what would happen if a utility falls short of meeting their goals?

ANSWER: Specific answer – I don't know what happened in the past, 2008/2009 neighborhood similar situation. No target obligation at that time. In 2020 recommended keep shooting for goals – adaptive management. If company does fall short, more leeway with gas than electricity. Not a lot to say on this.

Corey said a lot is unknown right now...that is expected...how Commission is to handle this

Andrew said, "A lot is up in the air". Glad I meet your expectations.

Corey further stated that the 2008 requirements were very different, EIA, in place then.

Andrew commented that there was no Renewable requirement but probably conservation requirements. Trying to compare now to then, probably shouldn't do that.

Monica said she appreciates the question. How do we plan for the unknown?

Phillip added that in reducing targets based on the economy, how do we reduce that goal without being arbitrary? Utilities making their best efforts to meet goals is very different than saying we "Can't do it".

QUESTION: Andrew asked, is the current situation, recession and not getting as much conservation as expected showing up in the LoadMap model?

ANSWER: Monica said she doesn't believe it shows up. Phillip said it does not show up currently but will bring up this to AEG. Andrew appreciated this and Phillip said he would have a better answer at TAG #5.

Presentation #3 – RENEWABLE NATURAL GAS (Brian Cunnington)

Slide #64 – Carbon Intensity

QUESTION: Andrew asked if this is "subjective" and if there is a lot of uncertainty?

ANSWER: Devin answered "yes", about carbon intensity (CI) and how to apply CI to RNG values. How good is the carbon reduction value...demand side management, purchasing RNG and REC's? Do you look at a project based on what type of project it is? Call RNG, RNG and take a simple average of all the RNG projects. We follow rulemaking and prescriptive values for treatment. This is the best we have. If you have any input or opinions, let us know. This is all still very dynamic and up in the air. The type of project "moves the needle". Some may argue it moves it positively! We are following this closely.

Slide #66 – Regulatory Matters regarding RNG (cont'd)

QUESTION: Brian R asked Andrew – Should we be following anything else?
ANSWER: Andrew answered, "I can't think of anything right now."

QUESTION: Andrew asked was the state study done 2 to 3 years ago, or was this new?
ANSWER: Brian said it was done 2 to 3 years ago.

Slide #70 – CNGC's RNG Goals

QUESTION: Andrew asked if currently CNGC has any RNG?
ANSWER: Brian C said none currently signed up for it flowing on our system.

Presentation #4 – Discussion of RNG Cost Effectiveness Evaluation Tool (Devin McGreal)

Slide #73 – Top Level Discussion

QUESTION: Internally… should we do this project or not?
ANSWER: Devin said it depends if OR wants this in their IRP (for 2020 we talk about RNG). Cost effectiveness rationale finalized is good for IRP

Andrew added that ultimately, it is good for the IRP

Devin said "Exactly", 2022-2024 might be more solidified. Not in this IRP but say this is what we are doing.

Mark added that this has not been vetted by the corporation.

Slide #78 – Cost of Gas

QUESTION: Andrew asked how this is done, proposing the same thing with fossil gas price forecast?
ANSWER: Devin said, "Yes", we forecast at all our basins, then put those prices in. But with RNG, the need is 1 price vs. 3. I don't know which basin would be offset from. 50% of blend of basin price, using 3 basins.

Slide #79 – Carbon Intensity Factor

QUESTION: Andrew asked, your methodology advantages RNG a bit more? Do you think that would always happen algebraically?
ANSWER: Devin answered that it is the same #, but hey would have their own difference in conventional and RNG. We just calculate the ratio – how much better is the RNG and we subtract that from the total. Ultimately it does the same thing!

Andrew said ultimately you end up in the same place

Devin said that NWN inspired their calculation on this.

Slide #88 – Model Challenges

QUESTION: Andrew asked if operational Dth's are greater than contracted, is there room to grow?

ANSWER: Brian said "Yes, in some areas". With the Walla Walla lateral, there is a contracted amount at that location but operationally we can get more gas in there. But in SENDOUT® we put the contracted value in.

Mark said that there is a received amount but operationally could receive more. We put in the IRP what we are guaranteed for. Contract #100002 came in because of "open access". NWP/GTN had to allocate capacity at that time, so we have more delivery rights than receipt rights. NWP looks at capacity at a "zonal" level – we can have more gas within the zone.

Andrew said, "I'm with you!"

Slide #89 – Supply Resource Optimization Process

QUESTION: After going over the flow chart on Slide #91 Brian asked Staff what else they would like to see...?

ANSWER: Andrew did not have anything to add at this time.

Slide #95 – Supply Base & Fixed

QUESTION: Andrew asked if the base contracts price rates fluctuate...do they follow Nymex?

ANSWER: Base supply contracts use our price forecast. We input this into SENDOUT® as the base price.

Slide #98, #99 #100 & #101 – Winter Base Supply, Winter Day Supply, Summer Day Supply

QUESTION: Andrew asked what "R-Mix" meant?

ANSWER: Brian stated that is "Resource Mix" = SENDOUT® gives us an optimization of supply – but no more than asked. SENDOUT® decides the daily MDQ.

Presentation #6 – Preliminary Resource Integration Results (Devin McGreal)

Slide #130 – Preliminary Results

Slide #131 – Next Steps

Slide #132 – Remaining Schedule

1. Sep 23 - TAG #5
2. Nov 17 - Draft of 2020, WA IRP distributed
3. Dec 23 - Comments back from stakeholders
4. Jan 27 - Tag #6, if necessary
5. Feb 26 - IRP filed in Washington

Slide #133 – Questions? Contact information

The meeting was adjourned

Cascade Natural Gas Corporation

2020 Integrated Resource Plan
Technical Advisory Group Meeting #5

September 23rd, 2020

Microsoft Teams

CASCADE NATURAL GAS CORPORATION
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve

Agenda

- Introductions
- Safety Moment
- Backcast Overview
- Summary of Alternative Resources
- Components and Ranking of Candidate Portfolios
- Stochastic Methodology
- Scenario and Sensitivity Results
- Proposed Two-Year Action Plan
- 2020 IRP Remaining Schedule
- Questions

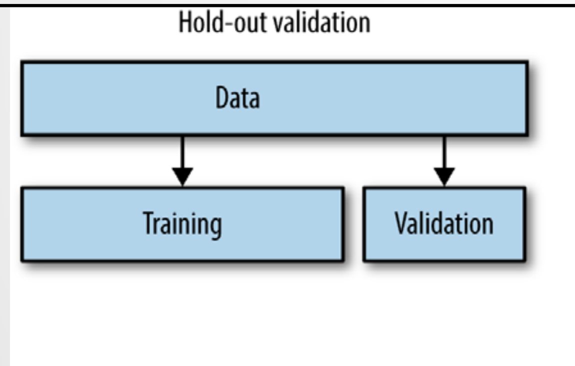
Backcast Overview

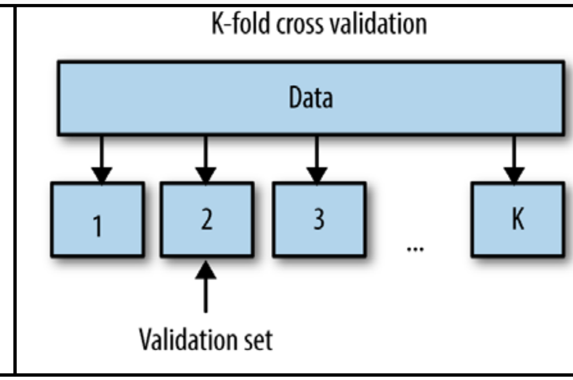
Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

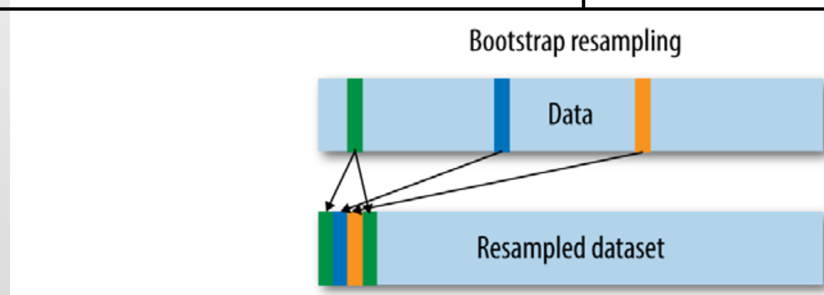
- 3 main types
  - Hold-out Validation Method
    - Strong validation
    - Low computation time
  - K-fold Cross Validation Method
    - Strong validation
    - High computation time
  - Bootstrap Resampling Method
    - Bootstrapping is not recommended for data dependent on time because the order of the data matters.
    - Introduces random training set selections which may leave out data or repeat data.

Backcasting (Cross-validation)

- Strong validation
- Low computation time

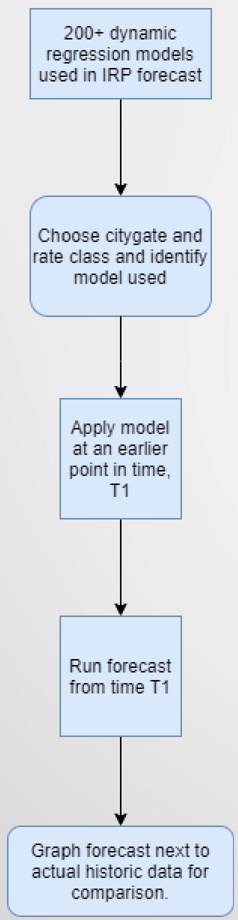


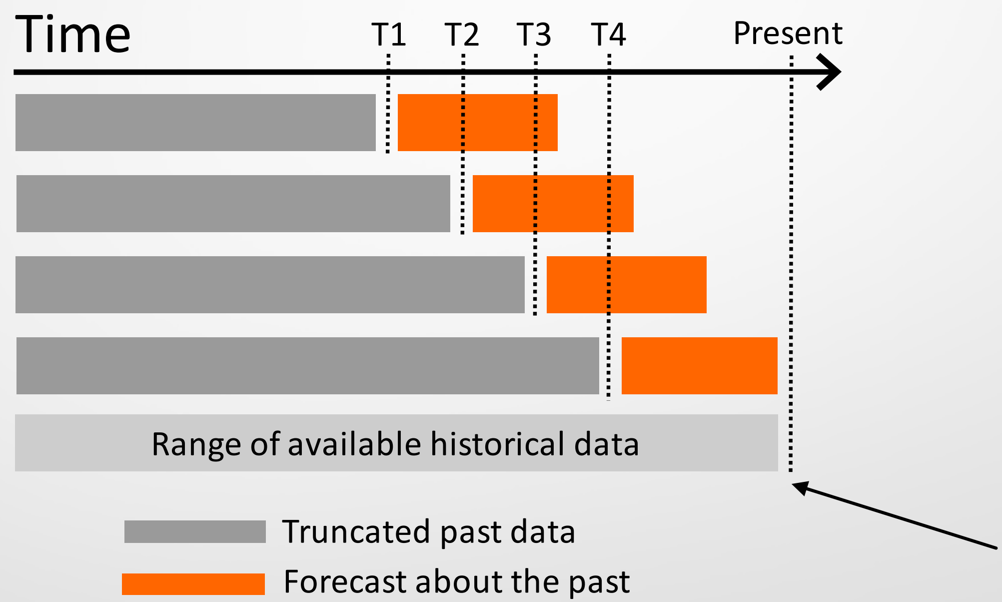




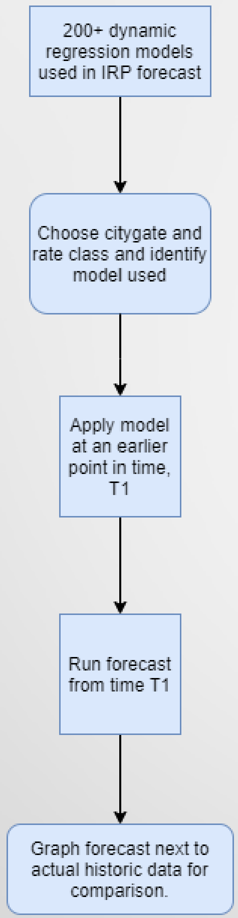
- Bootstrapping is not recommended for data dependent on time because the order of the data matters.
- Introduces random training set selections which may leave out data or repeat data.

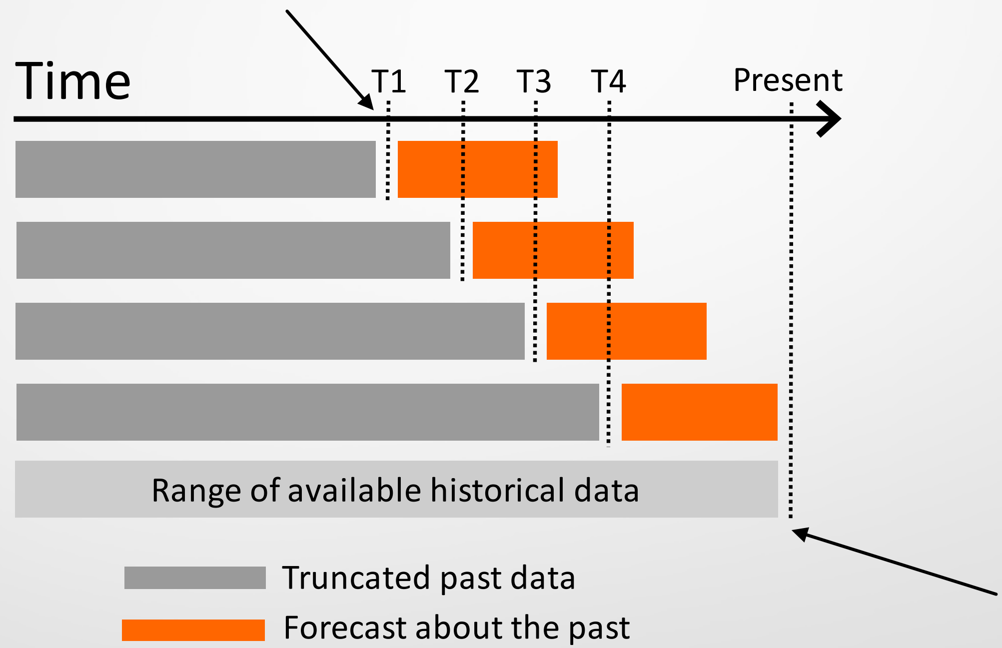
Steps in Each Backcast





Steps in Each Backcast



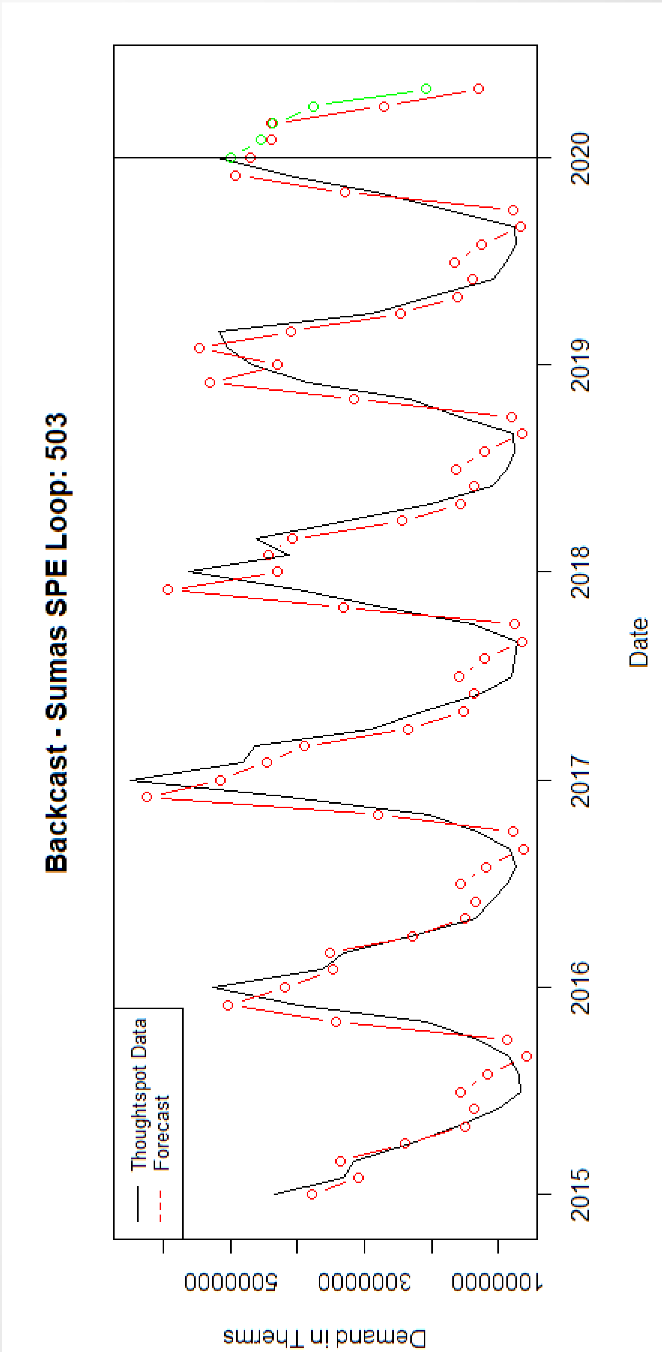


Cross-Validation Run

- Sumas SPE Loop
  - 503 (Res)
  - 504 (Com)
  - 505 (Ind)
  - 511.Ind
- Yakima Loop
  - 503
  - 504
  - 505

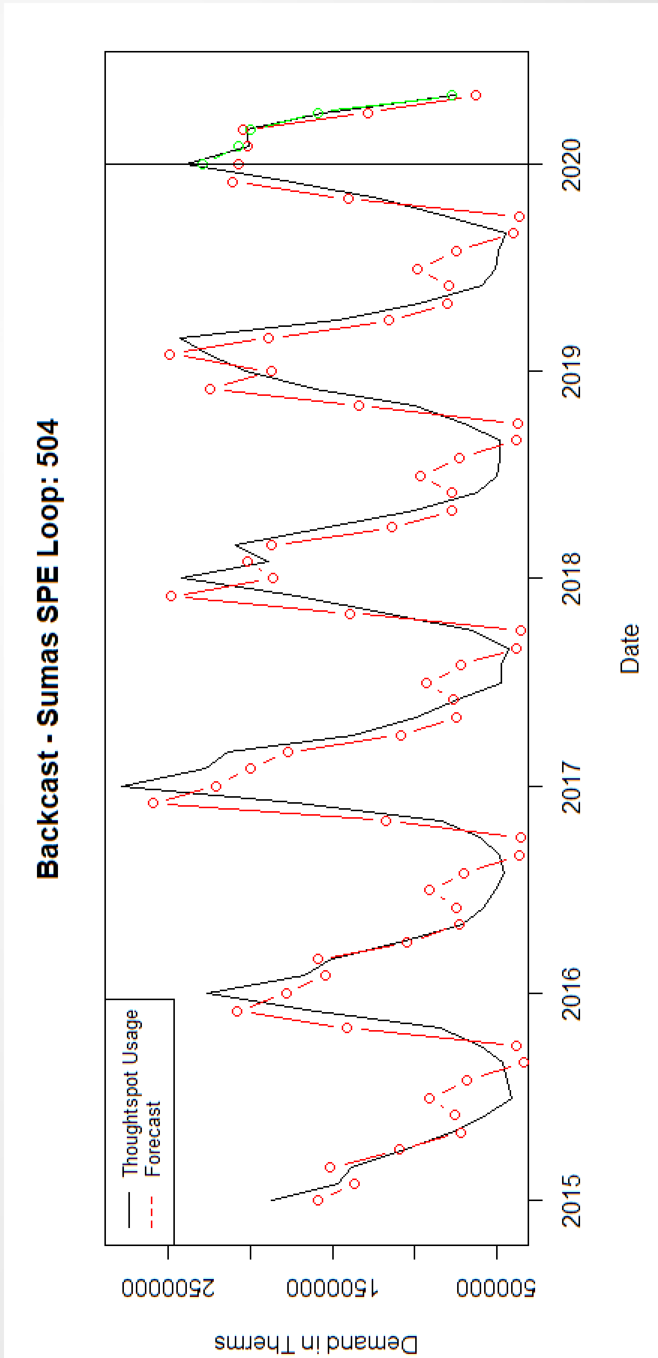
9

Sumas SPE Loop - 503

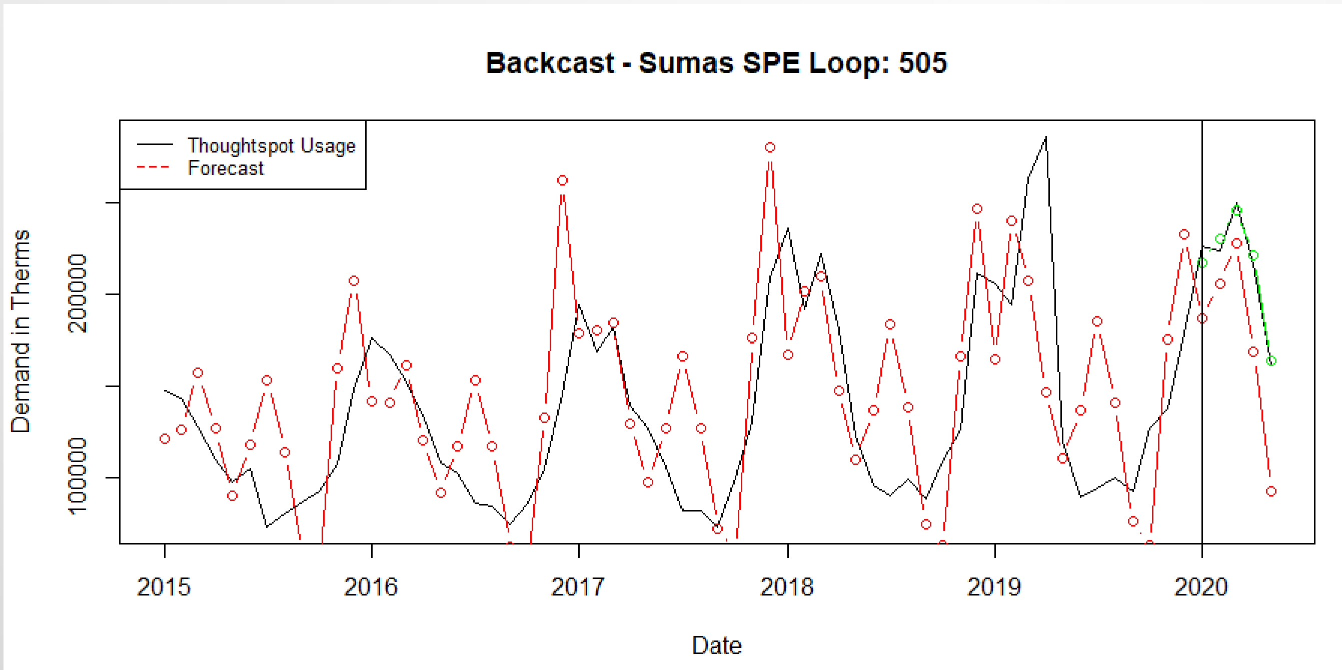


Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve

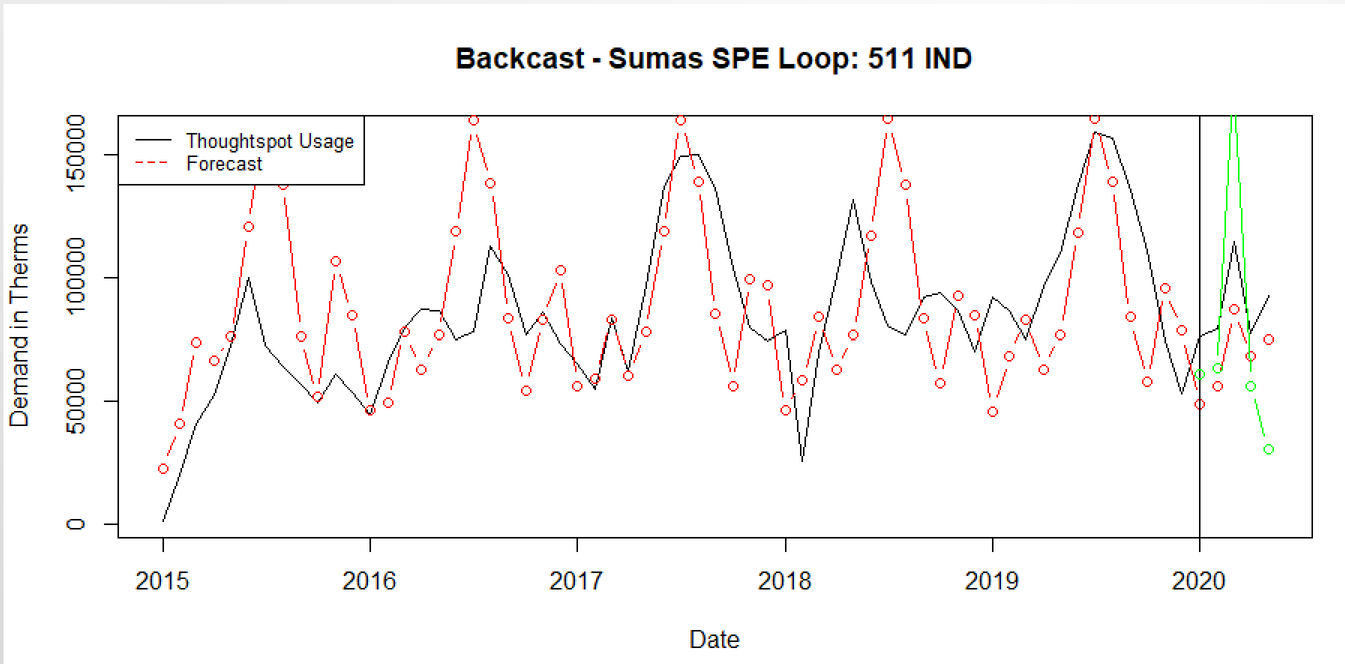
Sumas SPE Loop - 504



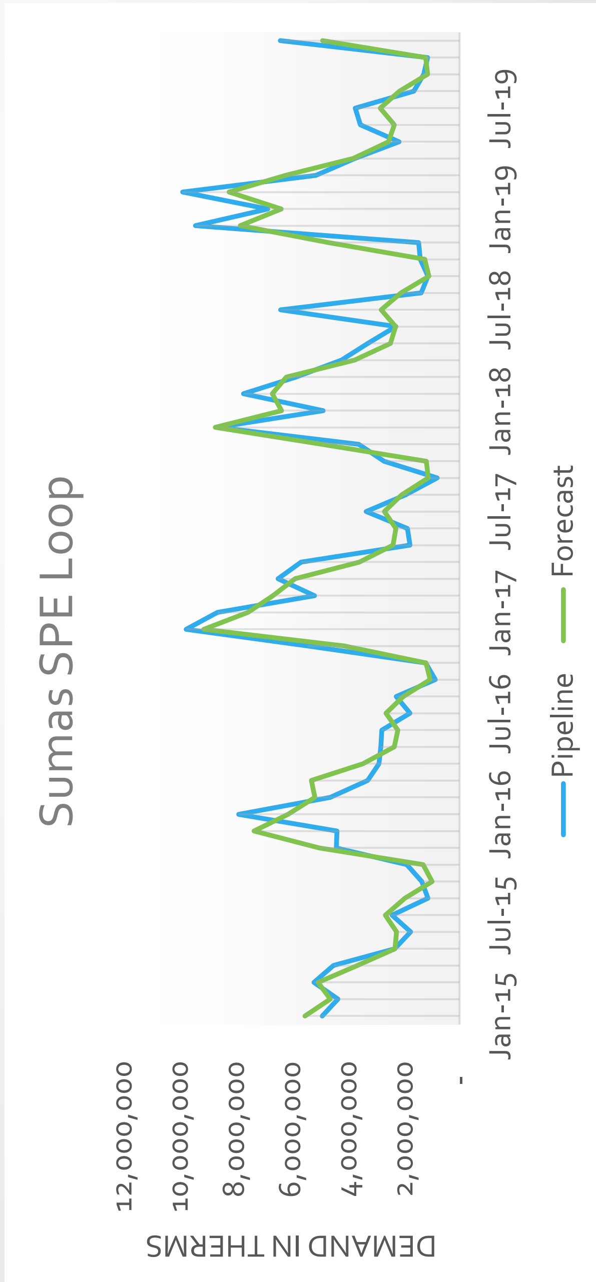
Sumas SPE Loop - 505



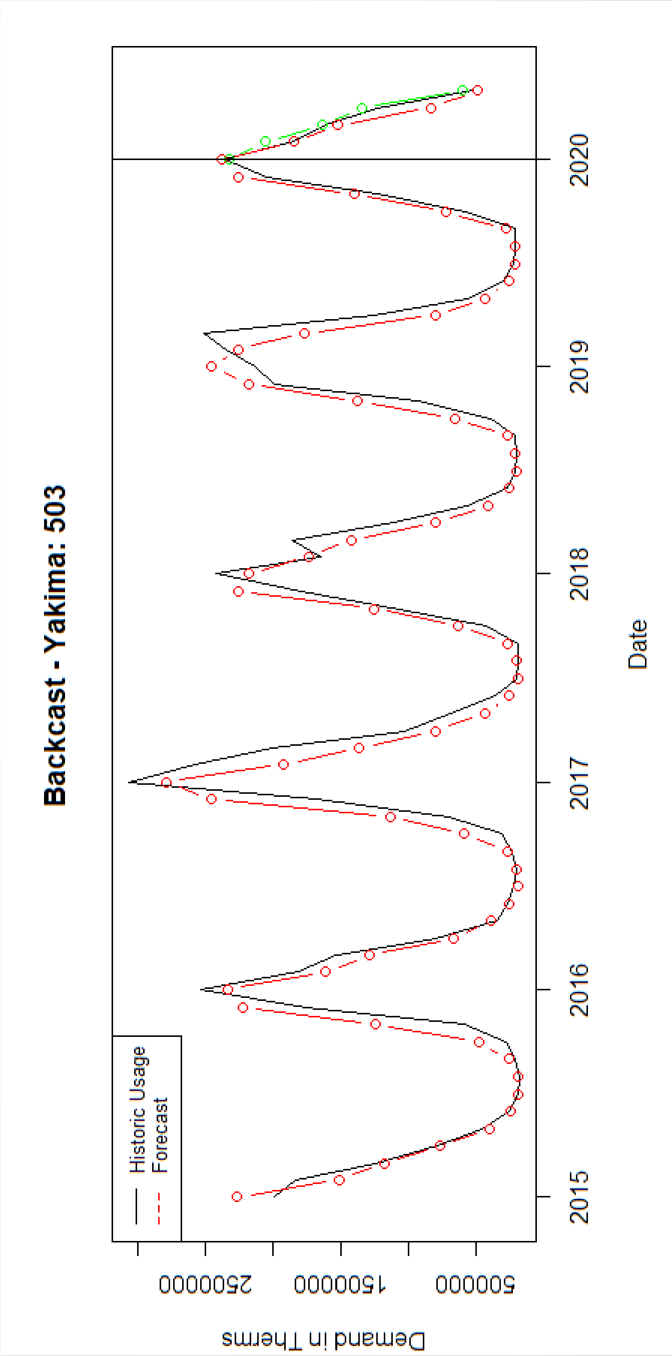
Sumas SPE Loop – 511.IND



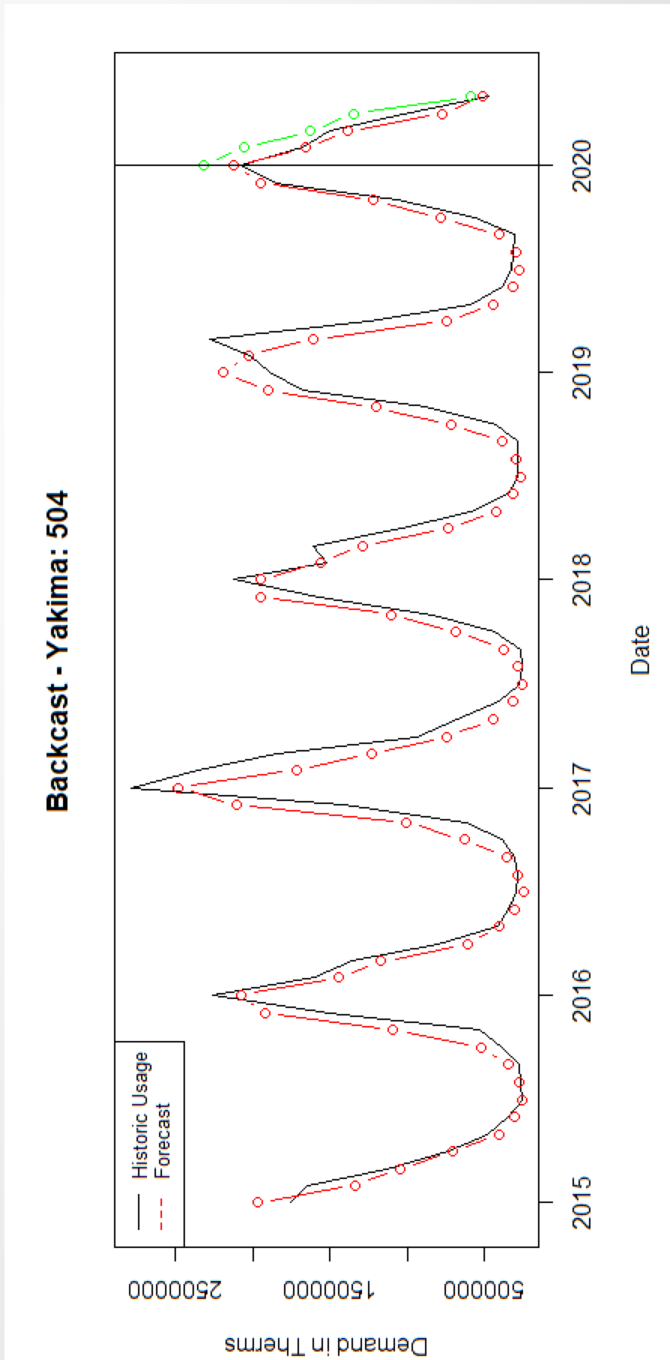
Sumas SPE Loop



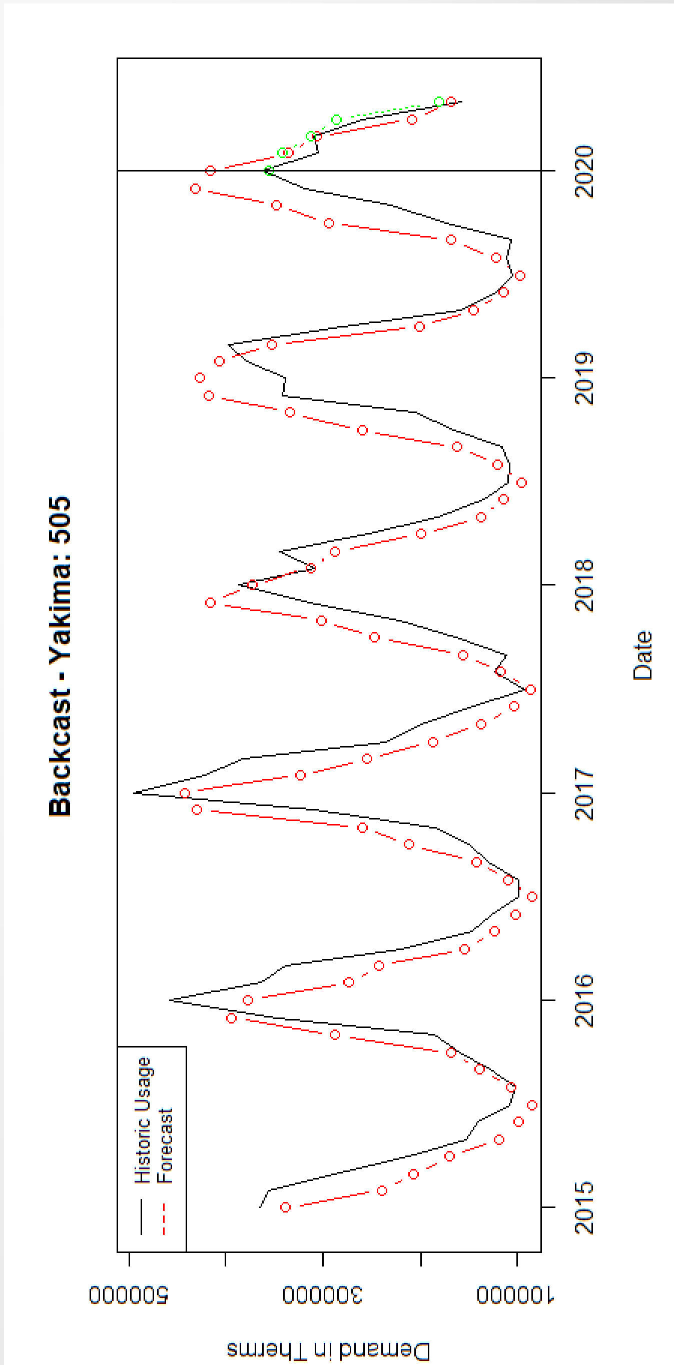
Yakima - 503


Backcast - Yakima: 503
Historic Usage
Forecast
Demand in Therms
500000
1500000
2500000
2015
2016
2017
2018
2019
2020
Date

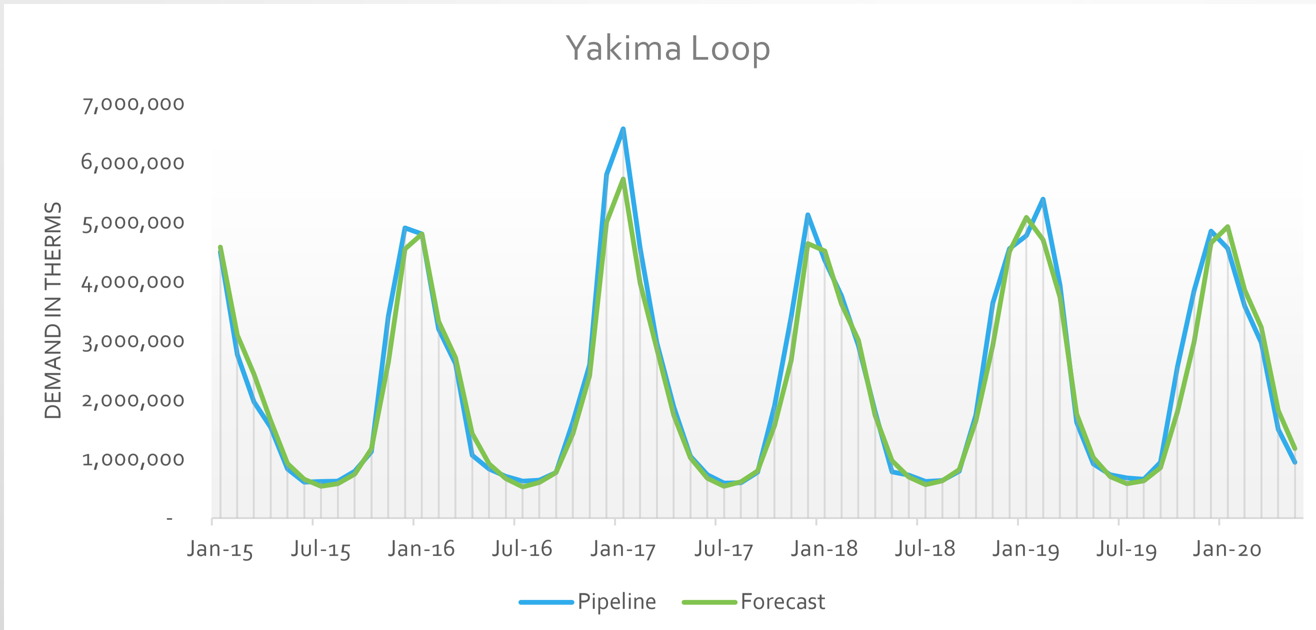
Yakima - 504


Backcast - Yakima: 504
Historic Usage
Forecast
Demand in Therms
500000
1500000
2500000
2015
2016
2017
2018
2019
2020
Date

Yakima – 505


Backcast - Yakima: 505
Historic Usage
Forecast
Demand in Therms
100000
300000
500000
Date
2015
2016
2017
2018
2019
2020

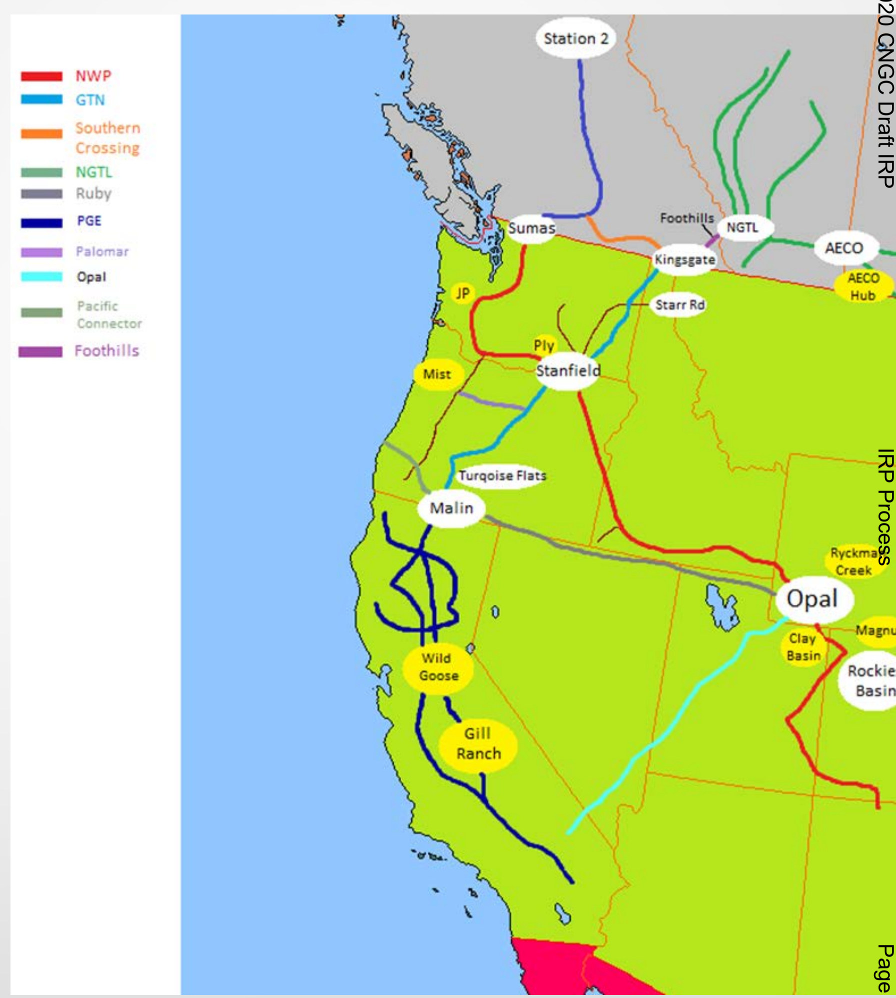
Yakima Loop


Yakima Loop
7,000,000
6,000,000
5,000,000
4,000,000
3,000,000
2,000,000
1,000,000
-
DEMAND IN THERMS
Jan-15
Jul-15
Jan-16
Jul-16
Jan-17
Jul-17
Jan-18
Jul-18
Jan-19
Jul-19
Jan-20
Pipeline
Forecast

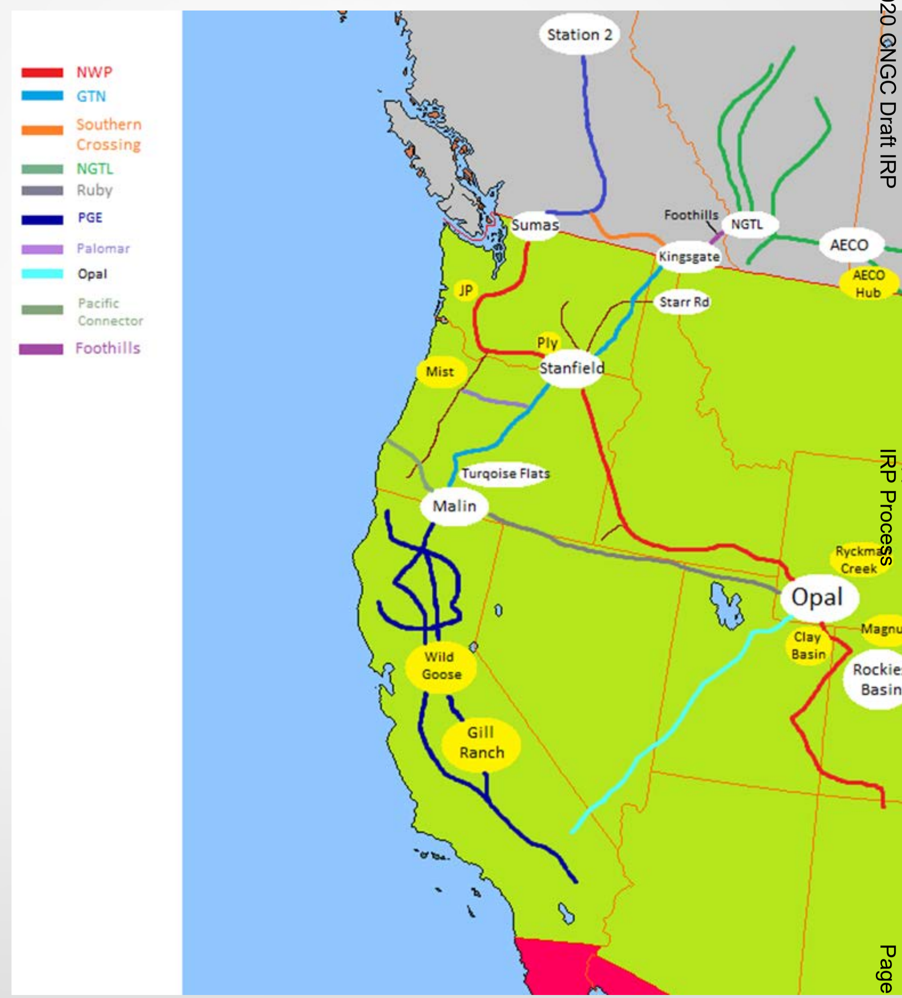
Summary of Alternative Resources

Additional Potential Resources

- Incremental Transport – North to South
- Incremental Transport – Northwest Pipeline
- Incremental Transport – South to North
- Incremental Transport – Bilateral

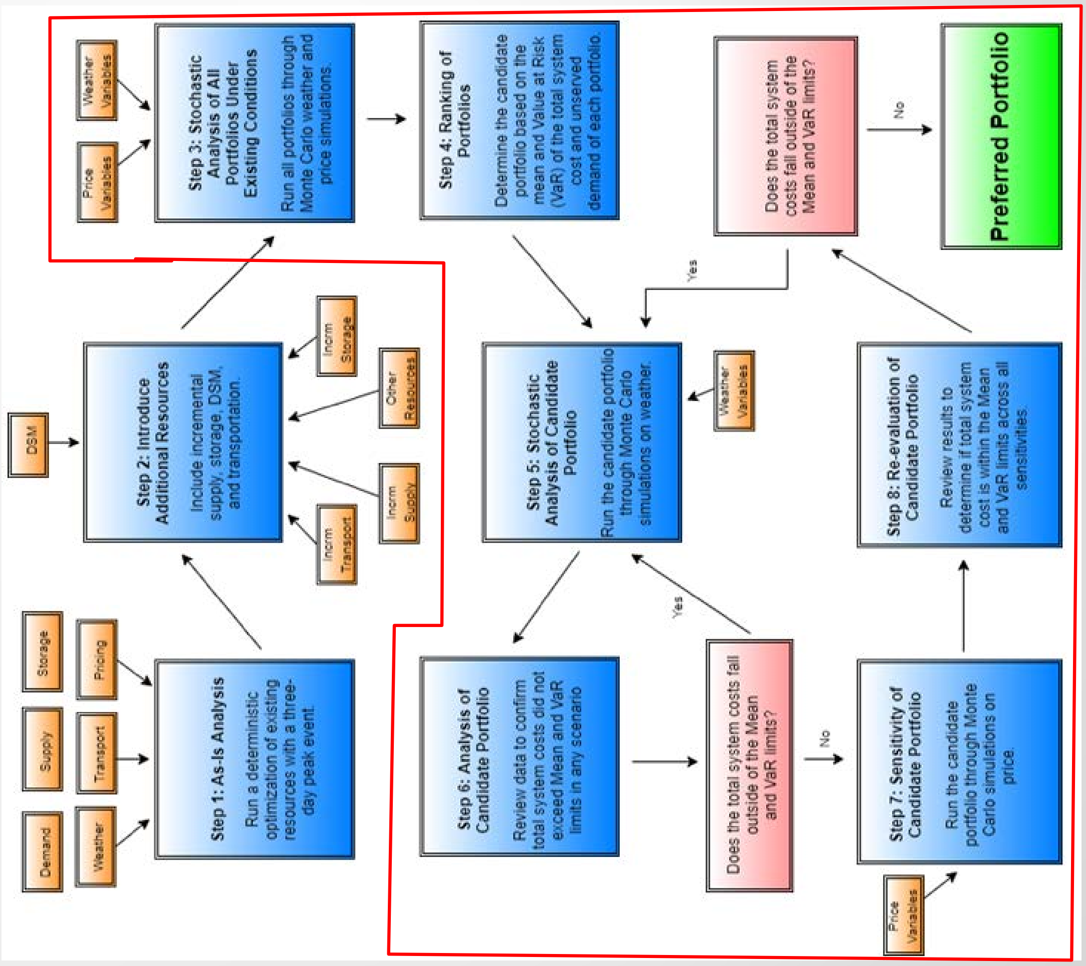


- Incremental Storage - North and East
- Incremental Storage - South and West
- Renewable Natural Gas



Components of Candidate Portfolios

22


Demand
Supply
Storage
Weather
Transport
Pricing
Step 1: As-Is Analysis
Run a deterministic optimization of existing resources with a three-day peak event.
DSM
Step 2: Introduce Additional Resources
Include incremental supply, storage, DSM, and transportation.
Incrm Transport
Incrm Supply
Other Resources
Incrm Storage
Price Variables
Weather Variables
Step 3: Stochastic Analysis of All Portfolios Under Existing Conditions
Run all portfolios through Monte Carlo weather and price simulations.
Step 4: Ranking of Portfolios
Determine the candidate portfolio based on the mean and Value at Risk (VaR) of the total system cost and unserved demand of each portfolio.
Step 5: Stochastic Analysis of Candidate Portfolio
Run the candidate portfolio through Monte Carlo simulations on weather.
Weather Variables
Step 6: Analysis of Candidate Portfolio
Review data to confirm total system costs did not exceed Mean and VaR limits in any scenario
Does the total system costs fall outside of the Mean and VaR limits?
Yes
No
Step 7: Sensitivity of Candidate Portfolio
Run the candidate portfolio through Monte Carlo simulations on price.
Price Variables
Step 8: Re-evaluation of Candidate Portfolio
Review results to determine if total system cost is within the Mean and VaR limits across all sensitivities.
Does the total system costs fall outside of the Mean and VaR limits?
Yes
No
Preferred Portfolio

Recap – As-Is Analysis

- Cascade has finalized its load forecast for the 2020 WA IRP.
- All of Cascade's existing resources have been run through SENDOUT® to complete the Company's As-Is analysis as discussed in Step 1 of the Supply Resource Optimization Process.
    - Assuming contracts evergreen.
    - These preliminary results do not include the impacts of DSM as discussed earlier.
- Cascade has identified no potential shortfalls.

List of Candidate Portfolios

- All-In Portfolio
- All-In Portfolio Less DSM
- GTN Only Portfolio
- GTN Plus Storage Portfolio
- NWP Only Portfolio
- NWP Plus Storage Portfolio
- Storage Only Portfolio

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

All-In Portfolio

- Best deterministic mix of all alternative resources considered:
  - Incremental Transport – North to South
  - Incremental Transport – Northwest Pipeline
  - Incremental Transport – South to North
  - Incremental Transport – Bilateral
  - Incremental Storage – North and East
  - Incremental Storage – South and West
  - Cost Effective DSM from CPA

All-In Portfolio – SENDOUT® Suggested Resource Mix

- All Cost-Effective DSM
- Monitor Incremental Nova – 338 Dth in 2030
- Spire (Formerly Ryckman Creek) Storage – 1,000 Dth In 2021

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

All-In Less DSM Portfolio

- Best deterministic mix of all alternative resources considered:
  - Incremental Transport – North to South
  - Incremental Transport – Northwest Pipeline
  - Incremental Transport – South to North
  - Incremental Transport – Bilateral
  - Incremental Storage – North and East
  - Incremental Storage – South and West

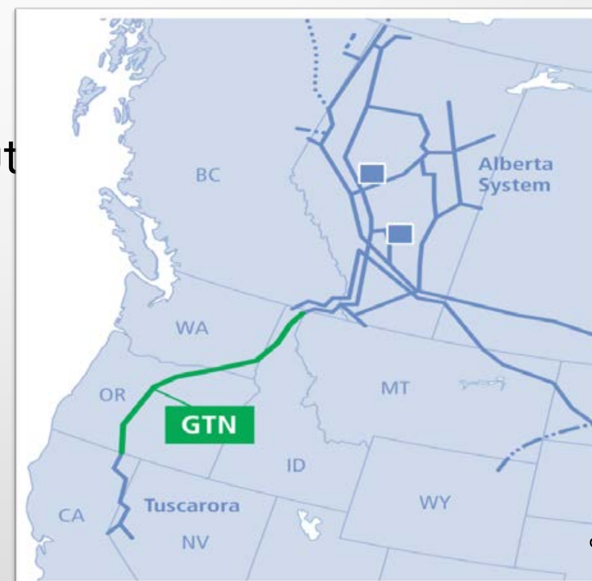
All-In Less DSM Portfolio – SENDOUT® Suggested Resource Mix

- Incremental GTN Capacity From Kingsgate – 1,097 Dth by 2030
- Monitor Incremental Nova – 338 Dth in 2030
- Spire (Formerly Ryckman Creek) Storage – 1,000 Dth In 2021

CASCADE NATURAL GAS CORPORATION
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

GTN Only Portfolio

- Best deterministic mix of all potential resources available on GTN:
  - Incremental Transport – North to South
  - Incremental Transport – South to North
  - Incremental Transport – Bilateral via Sout



GTN Only Portfolio – SENDOUT® Suggested Resource Mix

- Incremental GTN Capacity From Kingsgate – 1,097 Dth by 2030
- Monitor Incremental Nova – 338 Dth in 2030

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

GTN Plus Storage Portfolio

- Best deterministic mix of all potential resource available on GTN plus storage:
  - Incremental Transport – North to South on GTN
  - Incremental Transport – South to North on GTN
  - Incremental Transport – Bilateral via Southern Crossing
  - Incremental Storage – North and East
  - Incremental Storage – South and West

GTN Plus Storage Portfolio – SENDOUT® Suggested Resource Mix

- Incremental GTN Capacity From Kingsgate – 1,097 Dth by 2030
- Monitor Incremental Nova – 338 Dth in 2030
- Spire (Formerly Ryckman Creek) Storage – 1,000 Dth In 2021

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

NWP Only Portfolio

- Best deterministic mix of all potential resources available on NWP:
    - Incremental Transport – North to South
    - Incremental Transport – Northwest Pipeline
    - Incremental Transport – Bilateral via Trail West

NWP Only Portfolio – SENDOUT® Suggested Resource Mix

- No New Resources

NWP Plus Storage Portfolio

- Best deterministic mix of all potential resources available on NWP plus Storage:
  - Incremental Transport – North to South
  - Incremental Transport – Northwest Pipeline
  - Incremental Transport – Bilateral via Trail West
  - Incremental Storage – North and East
  - Incremental Storage – South and West

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

NWP Plus Storage Portfolio – SENDOUT® Suggested Resource Mix

- Spire Storage – 1,000 Dth in 2021

Storage Only Portfolio

- Best deterministic mix of all potential storage resources available:
  - Incremental Storage – North and East
  - Incremental Storage – South and West

Storage Only Portfolio – SENDOUT® Suggested Resource Mix

- Spire Storage – 1,000 Dth in 2021

Summary of – SENDOUT® Suggested Resources by Portfolio

	All-In	All-In Less	NWP Only	NWP + Storage	GTN	GTN + Storage	Storage Only
Incremental NGTL							
Incremental Foothills							
Incremental GTN N/S							
I-5 Mainline Exp.							
Wenatchee Lateral Exp.							
Spokane Lateral Exp.							
Eastern OR Mainline Exp.							
Incremental Opal							
Incremental GTN S/N							
Incremental Ruby							
T-South Southern Crossing							
Trail West							
Pacific Connector							
Spire Storage							
AECO Hub Storage							
Clay Basin Storage							
Gill Ranch Storage							
Wild Goose Storage							
Incremental DSM							

Legend	
	Selected resource for the portfolio
	Considered but not selected resource
	Not considered for the portfolio

Methodology Behind Ranking of Portfolios

- Cascade uses deterministic results to identify the intrinsic value of a portfolio, and Value at Risk (VaR) analysis to capture the extrinsic value.
- Additionally, portfolios are ranked primarily on their peak day unserved demand, and secondarily on their total system costs.
- Deterministic results are given 75% weight, and stochastic results 25% weight. The concluding values are Cascade's Risk-Adjusted Results.

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Final Ranking of Portfolios

	Deterministic		Stochastic		Risk Adjusted Results	
Portfolio	Unserved Demand (DT)	Total System Cost ($000)	Unserved Demand (DT)	Total System Cost ($000)	Risk Adjusted Unserved Demand (DT)	Risk Adjusted Total System Cost ($000)
All-In	-	3,492,023	-	3,749,061	-	3,556,283
GTN + Storage	-	3,592,846	-	3,795,175	-	3,643,428
All-In Less DSM	-	3,593,146	-	3,795,149	-	3,643,647
GTN	-	3,596,248	-	3,799,775	-	3,647,130
Storage Only	-	3,590,294	-	3,784,480	-	3,638,841
NWP + Storage	-	3,590,508	-	3,784,467	-	3,638,998
NWP	-	3,593,933	-	3,789,313	-	3,642,778

CASCADE NATURAL GAS CORPORATION
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Top Ranked Candidate Portfolio Components

- All Cost-Effective DSM
- Monitor Incremental Nova – 338 Dth in 2030
- Spire (Formerly Ryckman Creek) Storage – 1,000 Dth In 2021

Stochastic Methodology

2018 IRP Methodology

- Prior to the 2018 IRP, Cascade used the Monte Carlo functionality within SENDOUT® to run its stochastic analyses.
  - SENDOUT® has computational limitations related to the number of draws it can perform, and the time it takes to complete those draws.
- For the 2018 IRP, Cascade enhanced its methodology to allow for a more robust Monte Carlo simulation on weather and price.
- For the 2020 IRP, Cascade has further enhanced the Monte Carlo simulation's basin correlations regarding price.

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Cascade’s Methodology

- This year, Cascade will continue to perform a 10,000 draw Monte Carlo Simulation of weather and price using R.
- For each weather location Cascade records daily mean temperatures, standard deviations, correlations, and the largest 1 day jump to have historically occurred in that month.
- For each basins’ pricing, Cascade records historic averages, lows, highs, standard deviations, and correlations.
- This data is all loaded into R.

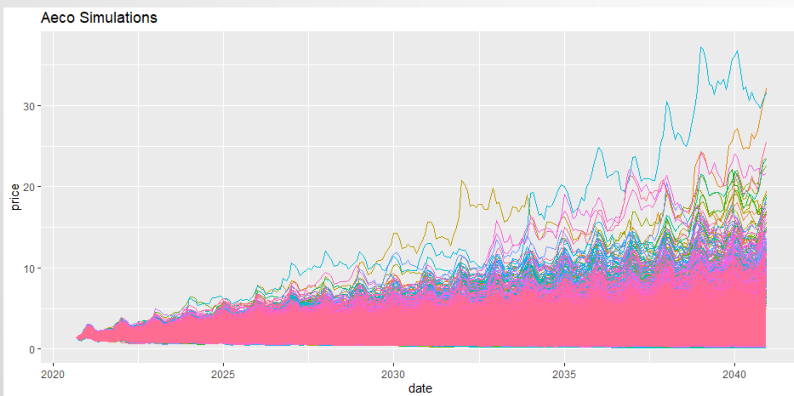
Cascade’s Methodology

- First, Cascade runs 1 draw of its Monte Carlo simulation for its first weather location.
- The remaining weather locations are then ran for draw 1 but correlated to the first weather location’s results using a mathematical process called Cholesky Decomposition. This process helps create a more realistic simulation for each draw.
- This process is repeated 10,000 times, with the calculated HDDs from each draw stored in a separate matrix.
- A similar process is followed for price.

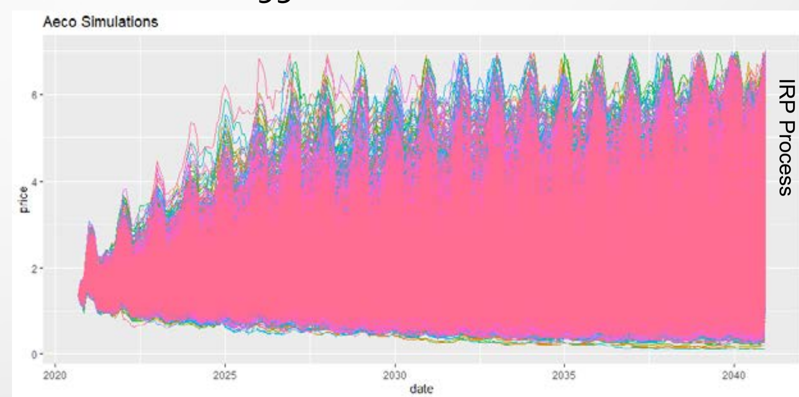
Cascade's Methodology

- Cascade calculates a system weighted HDD for each draw, identifying the draw that results in the 99^{th} percentile of stochastic weather.
- The daily HDDs of each weather location in this draw are then loaded into SENDOUT®, which allows the Company to capture the costs and unserved demand of a given portfolio under extreme conditions.
- A similar process is undertaken for Monte Carlo simulations on price.

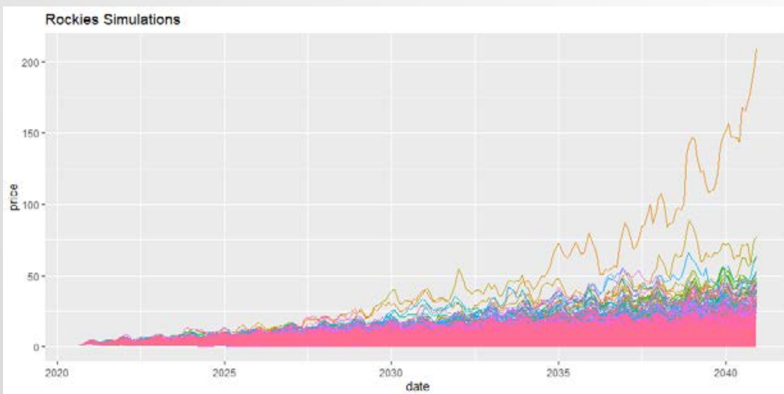
Aeco Price Simulations



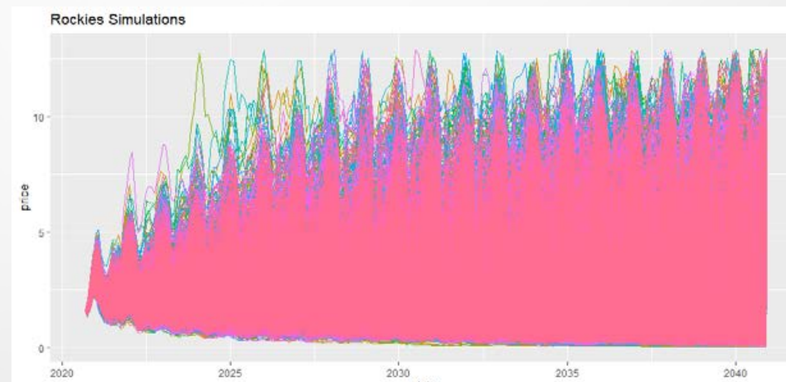
95th Percentile



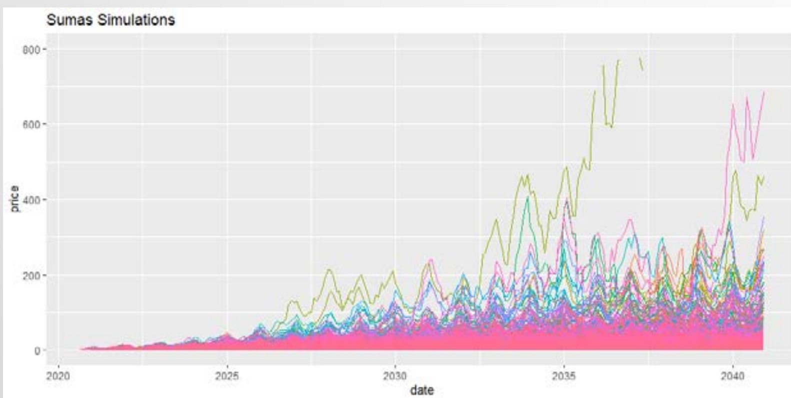
Rockies Price Simulations



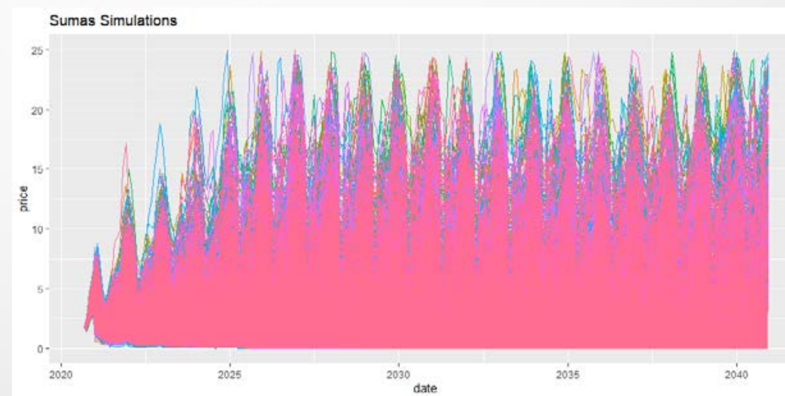
95th Percentile



Sumas Price Simulations



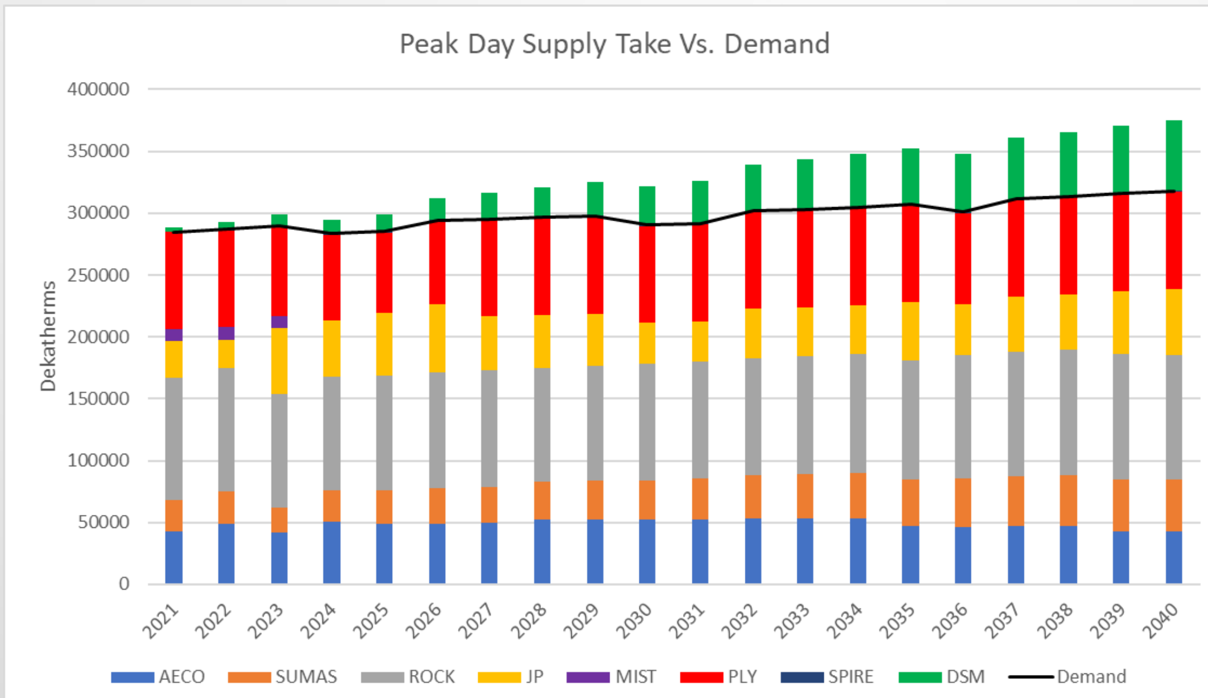
95th Percentile



Scenario and Sensitivity Results

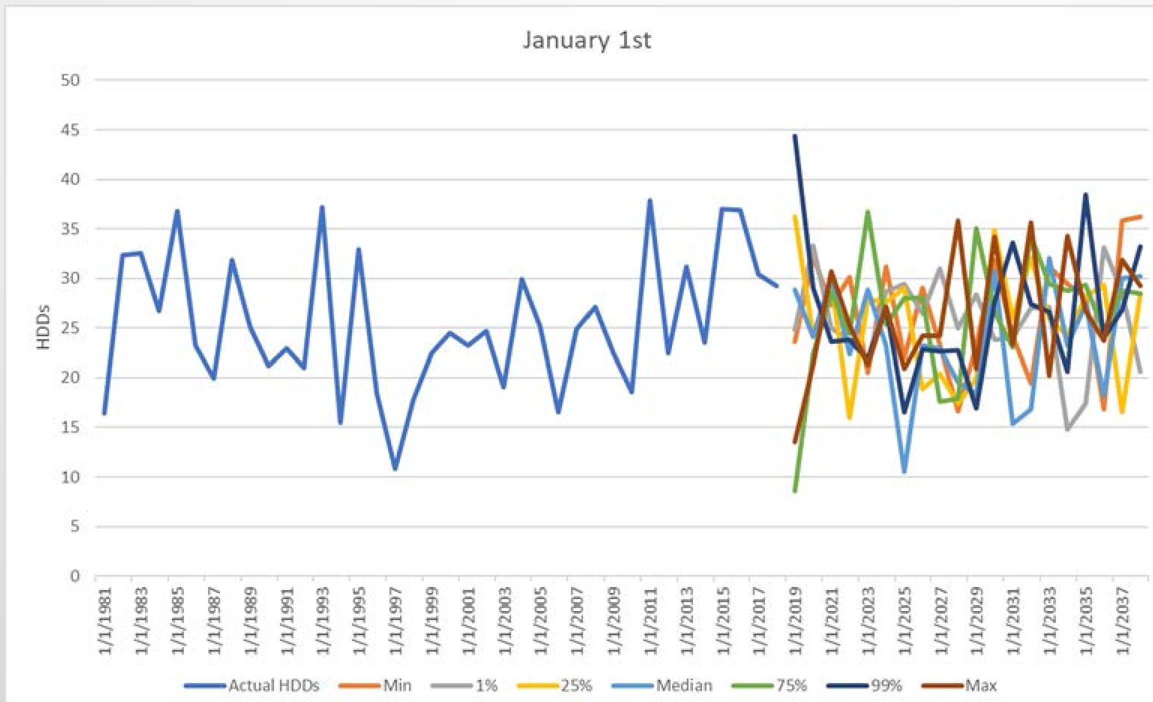
CASCADE NATURAL GAS
CORPORATION
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Peak Day Take Vs. Demand



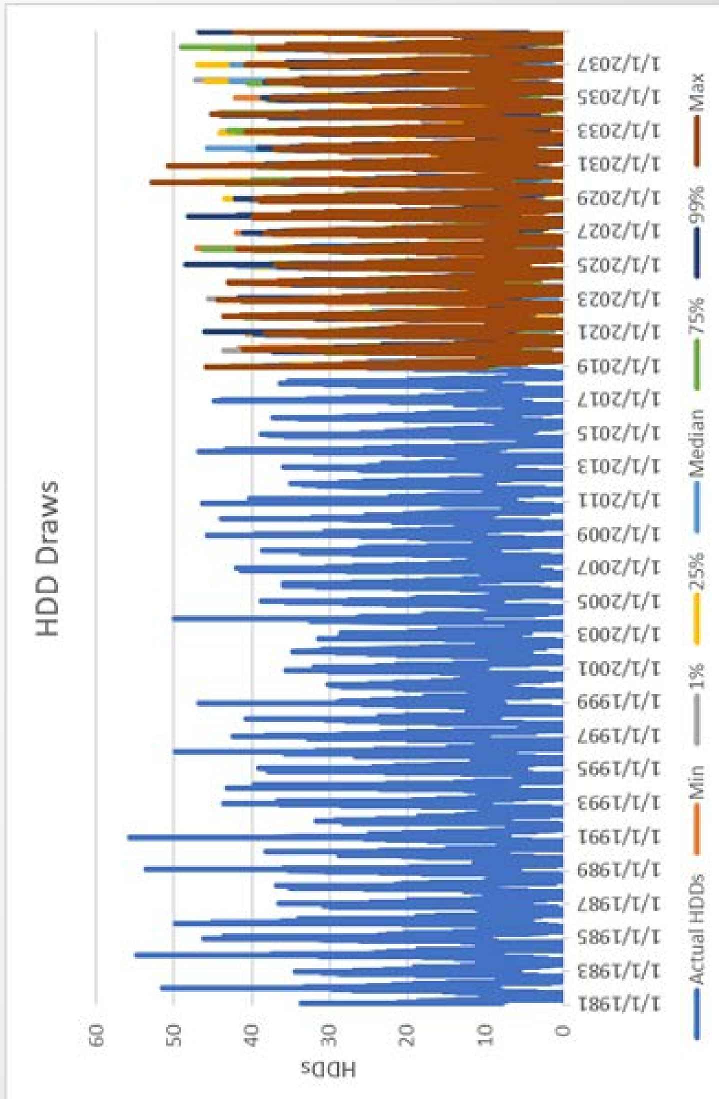
CASCADE NATURAL GAS CORPORATION
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

HDD Draw Graph – January 1st



54

HDD Draw Graph – All Days



Carbon Sensitivity Discussion

- Cascade will include an analysis of three carbon sensitivities in its IRP:
  - Cap and Trade Projections
  - House of Representatives Market Choice Act
  - Raise Wages, Cut Carbon Act
- The Energy Efficiency department's use of AEG's LoadMAP modeling tool provides quality insights into its programs' ability to meet projected DSM savings for different carbon scenarios

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Carbon Sensitivity Discussion

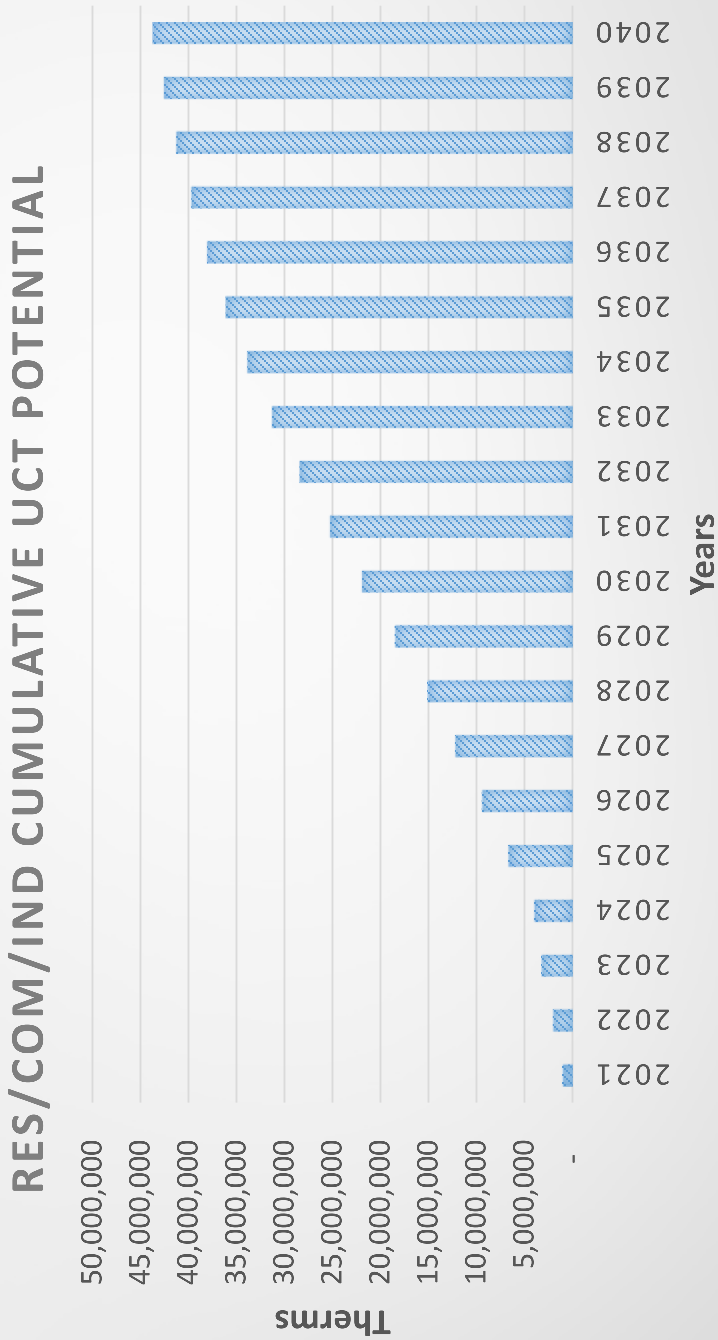
Residential: Under all scenarios, there is a 15% decline in potential energy savings over the cumulative forecasts as well as in the short term with minimal differences between scenarios.

Commercial: Under all scenarios, there was a very similar trend to Residential with a 15% cumulative decline to potential energy savings over the Cumulative forecasts.

Industrial: Both Cap and Trade and Raise Wages yielded marginal positive results of just over 1%, with Market Choice reflecting 0.1% decline in potential over the short term and, 0% change over the cumulative forecast.

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

57


RES/COM/IND CUMULATIVE UCT POTENTIAL
Therms
50,000,000
45,000,000
40,000,000
35,000,000
30,000,000
25,000,000
20,000,000
15,000,000
10,000,000
5,000,000
-
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
2034
2035
2036
2037
2038
2039
2040
Years

2020 DSM forecast

The DSM forecast reflects additional research into the feasibility of introducing new measures to the programs. Phase 2 of the Conservation Plan Assessment (CPA) will involve more robust evaluation starting in 2021. Below is a brief summary of the DSM forecast by program in therms per year:

Incremental UCT Potential

Year	2021	2022	2023	2030	2040
Residential	471,164	504,604	608,734	1,746,689	796,499
Com/Ind	578,483	509,641	594,290	1,858,213	920,756
Total	1,049,647	1,014,245	1,203,025	3,604,902	1,717,255

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

- The increases in Residential are attributable to the Gas Furnace measure moving into the number one position achieving 145,000 in year 2021
- The reduction in Commercial/Industrial is attributable to solar water heat assumptions being addressed
  - The model initially assumed an unrealistic 38% saturation rate in the marketplace

Year	2021	2022	2023	2030	2040
Residential	9.4%	17.1%	41.3%	29.2%	177.8%
Com/Ind	-63.4%	-67.8%	-62.4%	-55.8%	-3.8%
Weighted Average	-27.0%	-25.3%	-10.6%	-13.3%	87.0%

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Scenario/Sensitivities versus Cost Limit

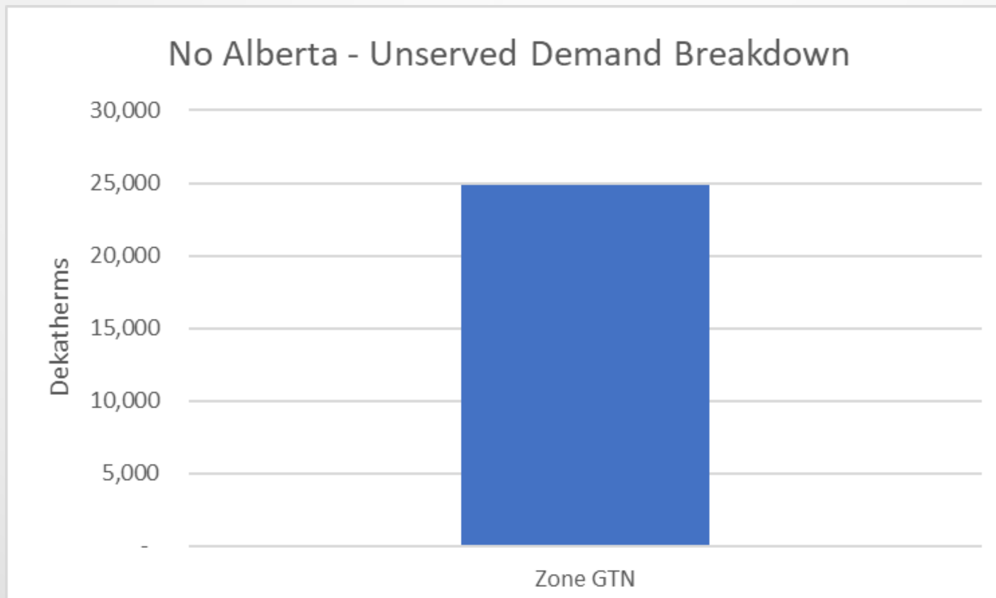
Scenario	Total System Cost ($000)
VaR Limit	**4,445,353**
Raise Wages, Cut Carbon	3,676,480
Cap and Trade Carbon Forecast	3,666,840
Market Choice Carbon Forecast	3,633,645
Price Forecast High	3,727,700
Environmental Adder 0%	3,706,580
Environmental Adder 20%	3,745,896
Environmental Adder 30%	3,765,518
No Evergreen	3,804,451
Low Growth	3,993,361
High Growth	4,008,684
Limit BC	4,128,569
No BC	3,045,886
Limit Alberta	4,193,793
No Alberta	4,383,694
No Rockies	4,922,205
Limit Rockies	4,406,073
Limit Canada	4,425,722
No Canada	2,905,166
No Plymouth	4,082,441
Limit Plymouth	4,061,374
Limit JP	4,115,604
No JP	4,156,474
Limit Mist	4,007,506
No Mist	4,010,087
No Storage	4,269,858
RNG #1	4,003,411
RNG #2	4,005,107

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Extreme Scenario Discussion

- Cascade is continuing to refine its methodology for evaluating extreme scenarios. For this IRP, four extreme scenarios are considered:
  - No Alberta gas, no BC gas, no Canadian gas, and no Rockies gas
- Results from these scenarios are not considered for rejection of the candidate portfolio, as resource acquisition decisions based on these cases would be imprudent
- That being said, the results of these optimizations can contain valuable information as to what may happen to Cascade's system if such an event were to occur.

No Alberta Scenario – Peak Unserved Analysis



No Alberta Scenario – Discussion

- In this scenario, the Company identifies potential shortfalls starting in 2024 under stochastic conditions.
- These shortfalls are unique to Cascade's citygates that receive gas off the GTN Pipeline, where gas is primarily sourced from Alberta.
- While it is highly unlikely that Cascade will lose ability to obtain gas from Alberta for a sustained period, this scenario provides valuable insight as to the Company's exposure on peak day if such an instance were to occur.
- Total system cost for this scenario was $4.34B, which does not exceed the VaR limit.

Conclusion

- Cascade has not identified any potential shortfalls under full deterministic conditions.
- The top ranking candidate portfolio includes all cost-effective DSM measures as outlined in the CPA, as well as monitoring opportunities for incremental Nova capacity and Spire storage.
- Through scenario/sensitivity testing, the Company has uncovered valuable information regarding the performance of this candidate portfolio under extreme conditions.
- Additionally, this portfolio passes the VaR Limit for all non-extreme scenario and sensitivity testing. It is Cascade's Preferred Portfolio.

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Proposed Two-Year Action Plan

Demand

- Include wind in the stochastic weather analysis.
- Look into climate sensitivity analysis for consideration to be included in future IRPs.
- Continue discussions to implement a new methodology of peak day. Cascade's peak day is currently the coldest day in past 30 years. Beginning with the 2022 IRP, Cascade's current peak day will fall outside of the 30-year range.

Resource Planning

- Cascade recognizes the importance of gathering best practices from its fellow local distribution companies (LDCs). To that end, the Company will participate in the IRP process of at least three regional utilities over the course of the next two years with the objective of incorporating aspects that may enhance Cascade's IRP.
- Cascade will continue to work with Northwest Pipeline to pursue opportunities to better align MDDOs contract delivery rights at no incremental costs to customers through the use of segmentation or other.
- Cascade will determine if the temporary Jackson Prairie account JP3 release from PSE should be made permanent.
- Cascade will continue to work on developing scenarios to replicate potential supply and transport impacts for pipeline operational flow orders (OFO) and consideration of other strategies to minimize OFO impacts.
- To better improve the alignment of resources/costs between the PGA and the IRP, Cascade will continue to develop SENDOUT direct models for gas cost workbooks provided to commissions during PGA filings.
- Cascade will develop more scenarios to specifically address potential Canadian supply market changes such as diversion of Station 2 supplies to LNG and/or NGTL., impact of the new federal fuel charge on the price and potential switching of supply basins utilization/needs of upstream pipeline transportation over time as new LNG facilities come into service in BC.

Avoided Cost

- Work with stakeholders to ensure Cascade is properly quantifying upstream emissions reductions benefits in the Company's avoided cost calculation.

DSM

Actions EE will take to meet HB-1257 requirements throughout 2021-2122

- Implement Phase 2 of the CPA and file with the Commission in Summer 2021
  - Allowing for complete review of measure assumptions, market availability and ramp rates per the NWPCC's Seventh Northwest Power Plan
  - Include a Low-Income market segment within the CPA
    - Determine energy efficiency potential in the at-needs community
  - Allow for a reality check to the goals set for 2021 through Phase 1
- Revise timeline of the Conservation Plan from annual to biannual starting in 2021
- Meet WA Clean Buildings requirements for early adopters including baseline data review through ENERGY STAR®'s Portfolio Manager

DSM (Continued)

- Evaluate, and potentially expand, C/I Mid-Stream pilot for tankless water heaters
- Research:
  - Multi-family offerings to target the sector for building upgrades
  - Alternatives to current no-cost/low-cost Energy Saving Kits which will be retired as a result of WA's new building code
    - Furnace filter replacement is a potential candidate
- Continue partnerships (NEEA and GTI) to incorporate new technologies as they become viable
- Adaptively manage programs based on COVID-19 impacts:
  - Explore assumptions with CAG to run alternative scenarios through LoadMAP
  - Target C/I customers based on economic impact, closures and renovation opportunities
  - Explore efficiency opportunities associated with improvements to air quality in buildings
  - Implement a remote quality inspection process

Environmental Policy

- Engage and provide feedback as part of public discussions surrounding City of Bellingham Climate Actions.
- Continue to identify opportunities to engage with City of Bend on renewable gas or offset opportunities as implementation of Climate Action Plan begins.
- Monitor service areas for potential GHG reduction goal development relating to energy delivery and supply.
- Identify county level climate initiatives and monitor regional discussions on alternative energy delivery.
- Monitor and provide feedback on carbon pricing and policy developments (i.e., carbon tax or cap and trade bills, ballot measures, electrification bills, etc.).
- Monitor and adapt programs and policies to meet federal and state GHG regulations for energy industry.
- Identify impacts of evolving energy code on energy delivery and supply and continue to pursue maximum-efficiency natural gas technologies for inclusion in DSM efforts.
- Continue our current emission reduction and monitoring endeavors (i.e., Methane Challenge Program, Renewable Natural Gas studies).

Cascade Natural Gas Corporation®
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Distribution System Planning

- Cascade has identified engineering projects to be put into the IRP. The projects as well as the costs will be provided in the draft IRP under confidential treatment.

Remaining Schedule

Date (Subject to change)	Process Element	Location (Subject to change)	Notes
Tuesday, November 17, 2020	Draft of 2020 WA IRP distributed		
Wednesday, December 23, 2020	Comments due on draft from all stakeholders		
Wednesday, January 27, 2021	TAG 6, if needed	WebEx Only	
Friday, February 26, 2021	IRP filing in Washington		

ADDITIONAL QUESTIONS?

mark.sellers-vaughn@cngc.com

Brian Robertson – Supervisor, Resource Planning: (509) 734-4546
brian.robertson@cngc.com

Devin McGreal – Resource Planning Analyst II: (509) 734-4681
devin.mcgreal@cngc.com

Ashton Davis – Resource Planning Analyst I: (509) 734-4520
ashton.davis@cngc.com

Bruce Folsom - Consultant

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

Cascade Natural Gas Corporation

2020 Integrated Resource Plan

Technical Advisory Group Meeting #5

September 23rd, 2020

Microsoft Teams

Cascade Natural Gas Corporation
A Subsidiary of MDU Resources Group, Inc.
In the Community to Serve®

CASCADE NATURAL GAS CORPORATION
A Subsidiary of MDU Resources Group, Inc.

TAG #5 – WUTC TAG Meeting

Date & time: 09/23/2020, 09:00 AM – 11:24 AM

Location: Microsoft Teams Meeting

Presenters: Brian Robertson, Devin McGreal, Ashton Davis, Monica Cowlishaw & Philip Hensyel

In attendance: Mark Sellers-Vaughn, Brian Robertson, Devin McGreal, Ashton Davis, Chris Robbins, Eric Wood, Brian Cunnington. Carolyn Stone, Kary Burin, Abbie Krebsbach, Dan Kirschner, Mike Paruszkiewicz, Mike Parvinen, Scott Madison, Andrew Rector (WUTC), Philip Hensyel, Monica Cowlishaw, Tom Pardee (AVA), Amy Wheeles (NW Energy), Marty Saldivar (NWP), Bruce Folsom, Corey Dahl (Public Counsel)

Minutes: Carolyn Stone

Brian introduced the presenters & began the meeting with a "Safety Moment".

Mark welcomed everyone! He said this should be a very interesting TAG meeting. The team put together this including all pieces from past TAGS towards the conclusion.

Brian then went through the meeting Agenda.

Presentation #1 - BACKCAST OVERVIEW (Ashton Davis)

Slide #4 & #5 – Back casting (Cross-validation) Ashton said for back casting "cross validation" is a misnomer

QUESTION: Andrew asked if what was said was that you are using all the data and validating numerous times?

ANSWER: Aston answered "Yes", we validate the data in "chunks", then forecast the two slots to actual data. We can then remove chunks and then use the model to forecast that chunk. One thing I would like to do in the future is automate this process, but right now we are doing it by hand. We are focused on the Hold-out validation, but when automated, we can load in excel files and run a script and that will pop up the information. Both methods are strong measures but could be added work to do the K-Fold. We choose City Gate and Rate Class to cross-validate.

Slide #13 – Suma SPE Loop

QUESTION: Andrew asked about the pipeline data – throughput from pipeline itself and billed right?

ANSWER: Ashton said "Yes." We applied to throughput, looking to improve this!

Slide #17 – Yakima Loop

QUESTION: Great information, thank you! Do you have any high level take away or changes of methodology for future cycles?

ANSWER: 1. After our Sumas homework – looking at summer peaks and summer spikes carrying to residential – Looking at ways to improve.
2. We want to dive into writing script for importing any Citygate, run it, get graph– much faster results. Right now, it takes an hour or two. We would like to speed up the process.

QUESTION: Lessons from Sumas &Yakima – applicable to other CG's on the system?

ANSWER: Oh yes, back casts focus on CG's that have similar issues at Sumas. Some bias toward CG's that have crazy volatility, more beneficial.

Andrew said, "That was a really good summary, thank you!"

Presentation #2 - SUMMARY OF ALTERNATIVE RESOURCES (Ashton Davis)

Slide #19 & #20 – Additional Potential Resources

Presentation #3 – COMPONENTS OF CANDIDATE PORTOLIOS (Devin McGreal)

Slide #39 – Summary of SENDOUT® Suggested Resources by Portfolio

QUESTION: Andrew asked, regarding the new resources, are you diving into monitoring NOVA and Spire issues? When writing IRP, spend some time on discussing the Spire issues and why selected or not. On Slide #39, why isn't there any NWP storage portfolio?

ANSWER: Yes, will do. Was not an exclusive pipeline option coming out with an NWP and storage portfolio - less expensive than the "all in" with DSM - this gives good information. It helps us quantify, that it is still cost-effective.

Slide #40 – Methodology Behind Ranking of Portfolios

QUESTION: Andrew asked who was the other LDC that had the 25/75% weighting?

ANSWER: Devin said it was NW Natural. He attended one of their TAG meetings in 2018 – 2019 and thought it was a great idea.

Presentation #4 – STOCHASTIC METHODOLOGY (Brian Robertson)

Slide #46 – CNGC methodology

QUESTION: Andrew asked, from 2018 – none of these things are different?

ANSWER: Brian answered that he thinks that is correct, same process from the IRP 2018. He said, we may have made slight changes. Ashton added that there is a difference in pricing. They are taking the historical correlation in basins to show how the other basins react, put using the Cholesky Decomposition and did that for weather but not for price. This is a more realistic simulation on the basins. Brian said they used the Cholesky Decomposition methodology on weather in 2018 but used this method with price for this IRP. Process repeated 10K times. Correlating all weather zones to each to build draws and put that into SENDOUT®.

QUESTION: Andrew asked what matrix was used for the 5th percentile?

ANSWER: Brian said Cholesky Decomposition correlation weather patterns together. If 95% of cold weather, we put that into SENDOUT® then see what the impact is to the optimization process. We do the same for price. We can run a high/low price scenario. This give us a different type of possible ranges of weather/price that could happen in the future.

Slide #61 – Refinements to DSM Forecast over TAG #4

QUESTION: Andrew asked about the solar water heat measure and decline from TAG #4, is that attributed to water heat measure?

ANSWER: Philip stated that there is a significant amount of solar water heat, 500K Therms that is why decline – measure is realistic capture, but technology is not widely available.

QUESTION: Andrew asked how could that one measure be so off?

ANSWER: Philip said it is a function of the 2018 CPA – changed a discount rate provided potential in cost measure. Brought in solar water as a cost effective when they are not. Technology not widely available so not cost-effective.

Monica added that it Is not readily available in our service territory – not viable. We have looked at it. Costs are higher than anticipated. Not impossible, but nowhere near available than what LOADMAP had indicated. LOADMAP indicated erroneously, shows high potential!

QUESTION: Andrew asked if this affects residential?

ANSWER: Philip answered that it didn't carry as much potential. Increase here driving - furnaces replaced to higher efficiency units, then drop off in 2023 – change in what efficiency rating standard will be. Efficiency standard moves from 80 to 90%...decrease potential – furnaces have most potential after 2023. Insulation is a driver as well.

Monica added that residential actually went up between TAG #4 & 5, go to slide #58. This year goal for residential is less - not sure how viable to achieve it. Forecast achieved 120 % of residential goal this year. 70K short of goal – aggressive residential rebate! Even commercial goal is higher this year. We will need to ramp up to meet those!

Slide #60 – Scenarios & Sensitivities vs Cost Limit (Devin McGreal)

QUESTION: Andrew asked what are RNG #1 & RNG #2, from slide #60?

ANSWER: Devin said RNG #1 is "on system" and RNG #2 is "off system. Details on this can be found in the RNG chapter of the IRP.

Presentation #6 – PROPOSED TWO-YEAR ACTION PLAN (Brian Robertson)

Slide #66 – Demand

QUESTION: Andrew asked if wind is being used as a variable in determining demand forecast?

ANSWER: Brian answered that wind is a variable like HDD, put into model used stochastically in regular runs.

Slide #67 – Resource Planning

QUESTION: Andrew asked for an explanation on the JP account.
ANSWER: Brian stated that there was a temporary release to Puget Sound Energy (PSE) which gives us JP account 3. We can make this account permanent or give it back to PSE. Mark added that it is 6,700 Dth per day – a temporary release acquired from PSE - for capacity we weren't utilizing. Expires in 2025. We will decide in 2021 as to whether we want it permanently.

QUESTION: Andrew asked if this is a discussion or negotiation with PSE?
ANSWER: Mark said both parties have an interest!

Slide #68 – Avoided Cost (Brian Robertson)

QUESTION: Andrew said it would be useful to do the workshop. Not clear on how this is happening, and I need to be clear!
ANSWER: Brian said they are very close, comfortable to move forward, will work on it before meeting with IRP stakeholders.

QUESTION: Andrew asked if there will be a writeup or presentation? That would be useful.
ANSWER: Brian said, for the conversation, what's best strategically to move forward with this – a document explaining it? Will keep in mind to make sure everyone is involved.

Slide #69 – **DSM** (Monica Cowlishaw)
- ❖ CPA filed in summer 2021.

Slide #70 – DSM (Continued)

QUESTION: Andrew commented that he appreciates the long-term thinking, how to handle COVID…how to keep efficiency programs running. You will be thinking through how things look in the future. Interesting to think about!
ANSWER: Monica said what is the new norm? What will it look like? Let's be creative! What do we think it will be like – the unknowns.

Slide #73 – Remaining Schedule (Brian Robertson)
- ❖ Nov 17 – Draft 2020 IRP distributed
- ❖ Dec 23 – Comments are due back
- ❖ Jan 27 – TAG #6, if needed
- ❖ Feb 26 – IRP filed in Washington

The Meeting was Adjourned.

CASCADE
NATURAL GAS
CORPORATION
A Subsidiary of MDU Resources Group, Inc.

In the Community to Serve®

CASCADE NATURAL GAS STAKEHOLDER ENGAGEMENT DESIGN DOCUMENT

Abstract

This document contains the rational, assumptions, and explanation behind the Stakeholder Engagement process of Cascade's IRP Process

Table of Contents

I. Introduction 1
II. Purpose 1
III. Principles 1
IV. Context 2
V. Mutual Expectations 2
VI. Desired End-Result 3
VII. Conclusion 4

Introduction

Cascade welcomes input from technical experts and the interested public in developing its Integrated Resource Plan (IRP). Cascade seeks to employ best industry practices and recognizes external participation can add incremental improvements.

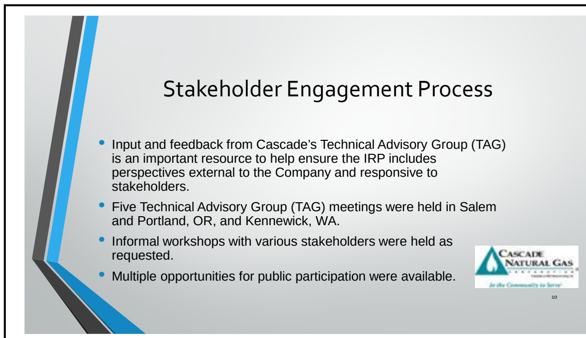
Cascade recognizes stakeholders have a multitude of projects before them. This Design Document is intended to assist in optimizing participation by interested parties to yield a solid IRP to the benefit of customers and the Company.

Purpose

The goal of the IRP process is to produce a plan that addresses meeting long-term load giving consideration to the best combination of expected costs and associated risks and uncertainties for the utility and its customers. Cascade strongly believes this process is best accomplished with input from all stakeholders.

The purpose of this document is to align perspectives for maximizing the effectiveness, influence, and amount of contributions from stakeholders in an environment of robust workloads by all parties. The stakeholder engagement process is summarized in Box #1.

Box #1: From OPUC 5/15/18 Workshop



Principles

Cascade applies the following four principles throughout this Design Document and the overall IRP process.

- A quality stakeholder engagement process is an iterative activity that requires collaboration and commitment

- Input from diverse perspectives improves the resulting IRP
- Removing barriers to participation and communicating in clear language with solid data is critical
- Transparency, and availability of Cascade staff for associated discussions, is central to the IRP process

Context

This Design Document is provided with the understanding that some organizations (e.g., Commission Staffs) may rotate its members through its various utility's IRP processes as well as onboard new Staff. Thus, beyond memorializing Cascade's commitments, this Document can be a primer for analyst-to-analyst mutual expectations.

Cascade's perspective is to capture the benefits of interested parties' knowledge by seeking to implement best-practices of stakeholder engagement, beyond this simply being a regulatory requirement.

Mutual Expectations

The Company will commit to the following series of actions for an efficient process to enhance stakeholders' participation. In turn, Cascade hopes that participating stakeholders will agree to general expectations on their part.

<u>Cascade Commitments</u>

- The Company will provide reasonable accommodations for people with disabilities. Additionally, the Company will reasonably accommodate items such as requests for meeting locations, audio and visual capabilities, and other items requested by external stakeholders
- Publishing an annual schedule of meetings, for calendaring and coordination purposes, to be included in the workplan
- Publish a brief section that lists the recommendations from the previous Commission IRP acknowledgement
- Providing meeting materials (agenda and PowerPoint) approximately 7 days in advance of meetings
- Responding to pre- or post-meeting communication going over information of interest to stakeholders
- Offering separate workshops (e.g., forecasting, Sendout®, DSM) as requested
- Recognize that some (e.g., Commission Staffs) organizational representatives cannot bind their organizations (i.e., Commissioners) but are making best efforts to provide relevant information
- Keeping a running list of items that need to be further addressed if not directly related to the then-meeting topic or if more time is required to respond
- Allowing for open, inclusive, and balanced participation and information sharing
- Recognizing that some parties may not have the industry knowledge or the resources to devote to analyzing all aspects of the IRP and that their interest may be one of breadth

- Understanding TAG members can and should speak up if they need more information or if the time for discussion is too short and merits further discussion
- Responding to questions in a reasonable time period
- Noting when confidential information has been requested (or provided) and associated treatment
- Seeking perspectives on inputs and results of the components of the IRP
- Present information in a clear and transparent manner

Cascade Requests of Stakeholders

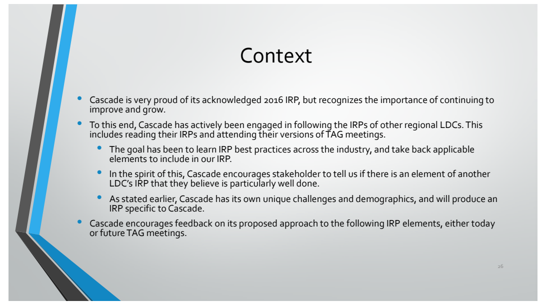
- Ask questions of the Company on technical and methodological aspects
- Be a point of contact within their organization so as to distribute information to peers unless specifically requested of Cascade to provide distribution to their peers. However, if the latter occurs, Cascade respectfully requests that the designated lead analyst or organization representative respond to all Cascade requests unless directed otherwise
- By sharing information among internal colleagues, provide organizational positions, opinions, or perspectives to all stakeholders. (This is particularly relevant for organizations that have different lead analysts assigned to different companies or who have relatively new Staff members participating in any given IRP process.)
- Recognize relative informality of the meetings and ability to interject for clarification and understanding
- These requests of stakeholders are not to say, “speak now or forever hold your peace” or to put undue pressure on others’ timelines and workload; rather these are ways to maximize the effectiveness of the stakeholders’ comments, which optimizes the process. Again, comments received earlier in the process can better influence the final draft document.
- When possible, provide feedback to meeting materials in advance of the meeting, to give Company representatives time to prepare information for an informed discussion.

Desired End-Result

A well-planned and executed stakeholder engagement process would have all technical and methodological issues examined in meetings prior to parties later providing comments on the final draft document. This is the proverbial win-win-win situation. Commission Staffs and interested parties would have full understanding of the Company's data and analytical approaches. These studies can be refined through analyst-to-analyst discussions. Consideration of new approaches can be put to the forefront for current or future IRPs, based on budgets and benefit to customers. The Company benefits by gaining access to perspectives perhaps not otherwise known. Commission Staff and others may be aware of emerging policies and approaches given the breadth of their interactions with Commissioners and new issues. As Cascade strives to implement best planning practices, as depicted in Box #2, stakeholders can provide advice based on what they've seen in the industry.

The Company has and will continue to encourage stakeholder feedback, questions and suggestions to assist Cascade in producing an IRP that meets the regulatory requirements and Cascade's customers' needs. Cascade prefers to receive feedback as early as possible in the process (e.g., in the course of its technical advisory group meetings or soon thereafter) so that the Company has a better opportunity to address questions or analyze/apply more stakeholder suggestions. Cascade recognizes that all parties are extremely busy, but strongly believes that stakeholder participation is crucial from the outset.

Box #2: From WUTC 6/18/18 Workshop



The above recognizes that key analytical components of the IRP—such as the demand forecast—need to be "locked down" at least midway through the process so that resource integration can be addressed. Interested parties can best influence these components earlier, rather than later, in the process.

Conclusion

While Cascade "owns" and is responsible for the IRP, the Company desires to have involvement from stakeholders to provide a diversity of perspectives. A best practices IRP is informed by perspectives, analyses and access to concerns and approaches that the Company may not have considered. Some stakeholders participate in multiple IRP processes and have a line-of-sight that may not be available to Cascade, despite the Company monitoring other utilities' IRPs and associated processes.

Cascade recognizes parties will submit sometimes-detailed comments at the conclusion of the stakeholder involvement process in advance of Commission acknowledgement. The Company's hope is that the guidelines contained in this Document will allow stakeholders to demonstrate to the Commission their work in the final IRP while concurring with its conclusions given the parties' influence.