CASCADE NATURAL GAS CORPORATION®

A Subsidiary of MDU Resources Group, Inc.

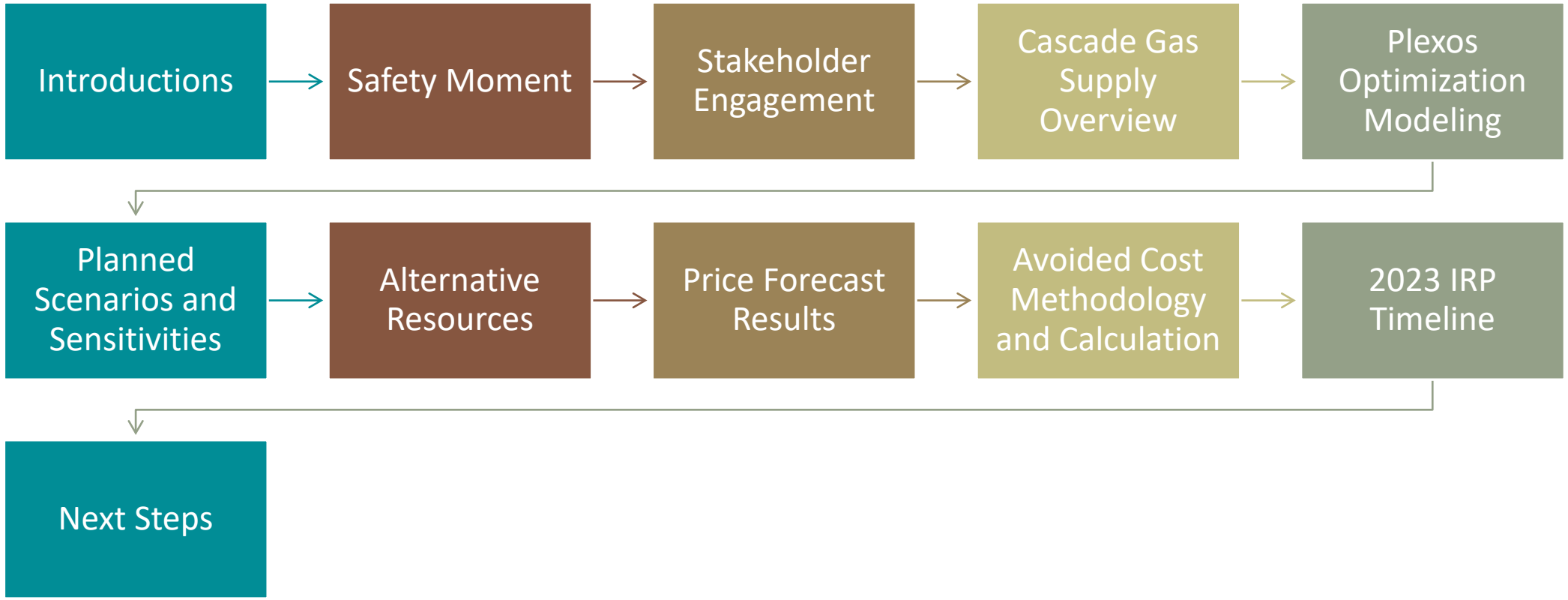
In the Community to Serve®

Integrated Resource Plan Technical Advisory Group Meeting #3

JUNE 29, 2022

MICROSOFT TEAMS/TELECONFERENCE

Agenda


Introductions
Safety Moment
Stakeholder Engagement
Cascade Gas Supply Overview
Plexos Optimization Modeling
Planned Scenarios and Sensitivities
Alternative Resources
Price Forecast Results
Avoided Cost Methodology and Calculation
2023 IRP Timeline
Next Steps

Safety Moment

Hot Weather Safety Tips:

- **Stay hydrated –** Drink plenty of fluids. Drink at least 15 ounces before starting work outside, and then 5-7 ounces more every 15-20 minutes.
- **Avoid dehydrating liquids –** Drinks such as alcohol, coffee, tea, and caffeinated beverages can cause dehydration.
- **Wear protective clothing –** Clothing that is lightweight, light-colored, and lose-fitting help protect against the heat.
- **Pace yourself –** Work at a slower even pace and know your limits and abilities, especially when working outdoors.
- **Schedule frequent breaks –** Take time to drink water and rest in a cool, shaded location, preferably with air conditioning.
- **Avoid getting sunburn –** Wear sunscreen and a hat.
- **Be alert to signs of heat-related illness –** Know what to look for and check on other workers for signs of heat stress.
- **Avoid direct sun –** Find shade or block out the sun if possible.
- **Eat smaller meals –** Eat fruits high in fiber and natural juices. Avoid eating meals that are high in protein.

The More You Know....

Heat Stroke	Heat Exhaustion	Heat Cramps
Lack of Sweating, Dry, reddish, hot Skin	Excessive Sweating	Pain in legs, arms, or abdomen
High Body Temperature	Weakness or tiredness	Muscle spasms in legs, arms, or abdomen
Rapid pulse	Clammy skin	
Chills	Muscle Cramps	
Slurred speech	Dizziness and/or confusion	

Article Reference: https://blog.societyinsurance.com/10-safety-tips-for-working-in-hot-weather/

Stakeholder Engagement[1]

CASCADE COMMITMENTS

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.

REQUESTS OF STAKEHOLDERS

Ask questions of the Company on technical and methodological aspects.

Recognize relative informality of the meetings and ability to interject for clarification and understanding.

When possible, provide feedback to meeting materials in advance of the meeting, to give Company representatives time to prepare information for an informed discussion

1: SEE STAKEHOLDER ENGAGEMENT DESIGN DOCUMENT AT WASHINGTON INTEGRATED RESOURCE PLAN - CASCADE NATURAL GAS CORPORATION (CNGC.COM)

Cascade Gas Supply Overview

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HIGHLIGHTS FOR THE 2022 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: 25%.

- 80% allows more flexibility operationally.
- Allows us to be in the market monthly through First of Month (FOM) purchase or Day Gas purchases.

Hedged Percentages (fixed-price physical) Currently 50% of annual requirements. Second year max is set at 40%, and 25% 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 35,000,000 dths, consistent with recent load history.

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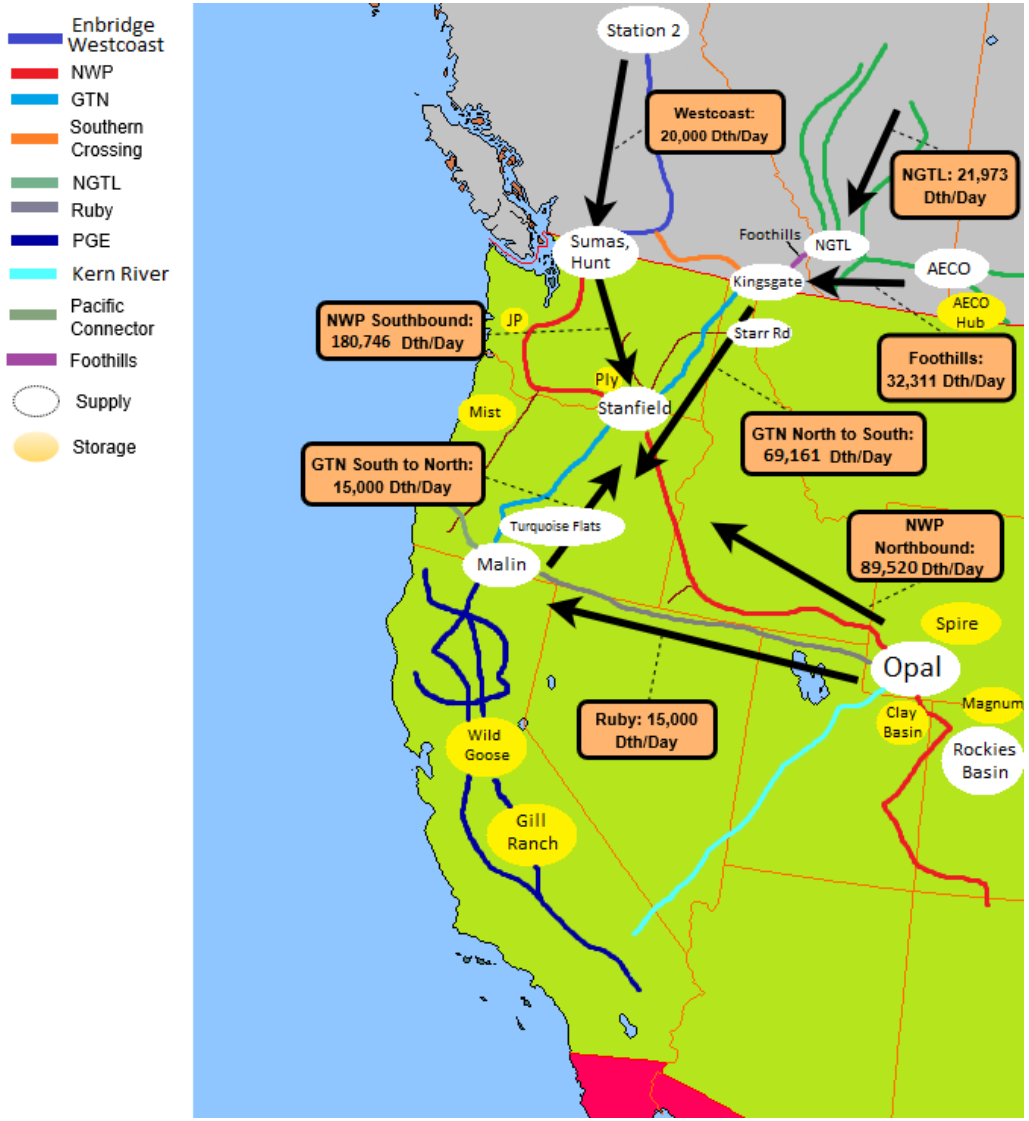
TRANSPORTATION

Cascade holds transport on 6 Pipelines
- Enbridge
- Williams Northwest Pipeline
- GTN Pipeline
- Nova
- Foothills
- Ruby

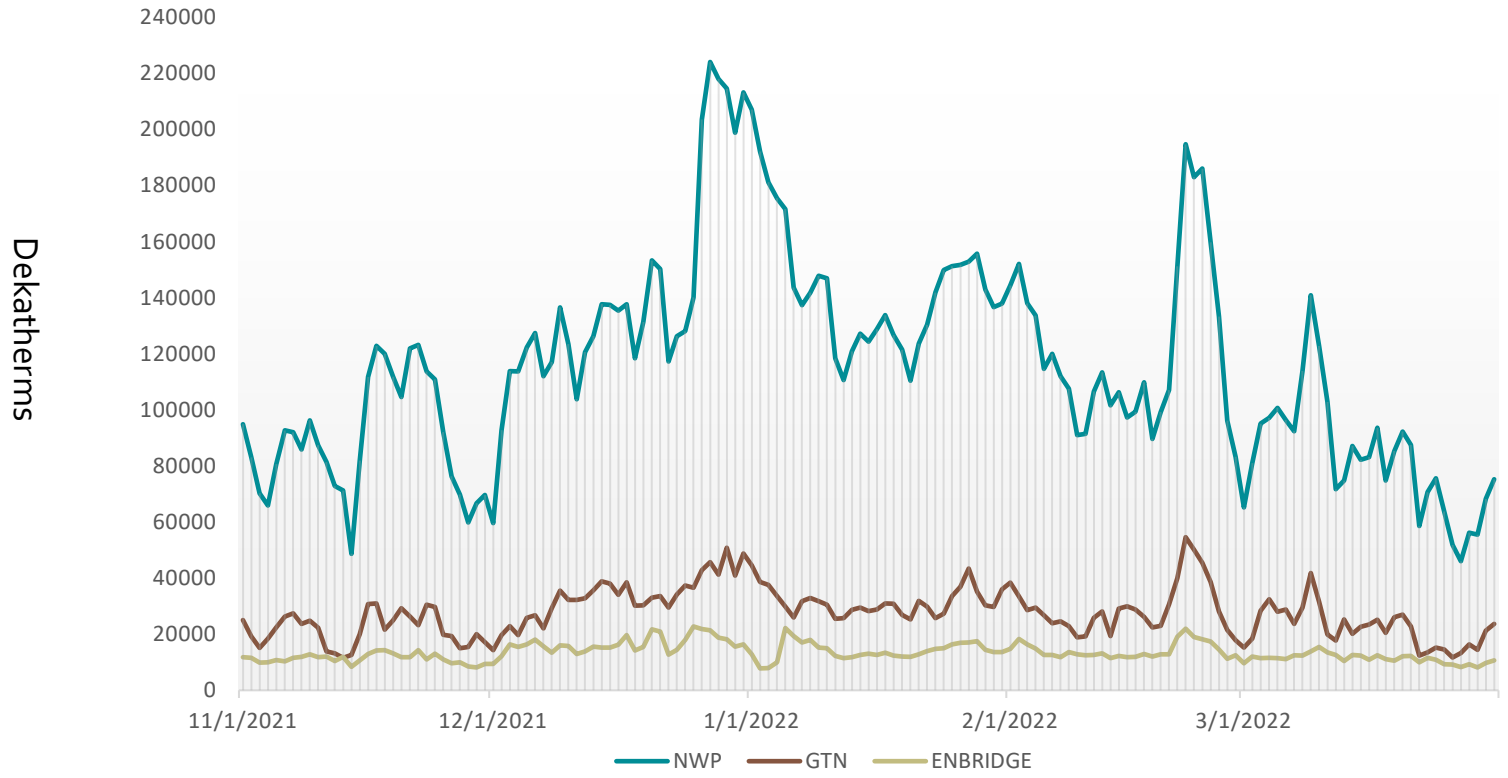
End delivery is on 3 pipelines
- Enbridge
- Williams Northwest Pipeline
- GTN Pipeline

Portfolio is arranged around available transport and system demands.



Pipeline transport flow

Winter Usage 21/22



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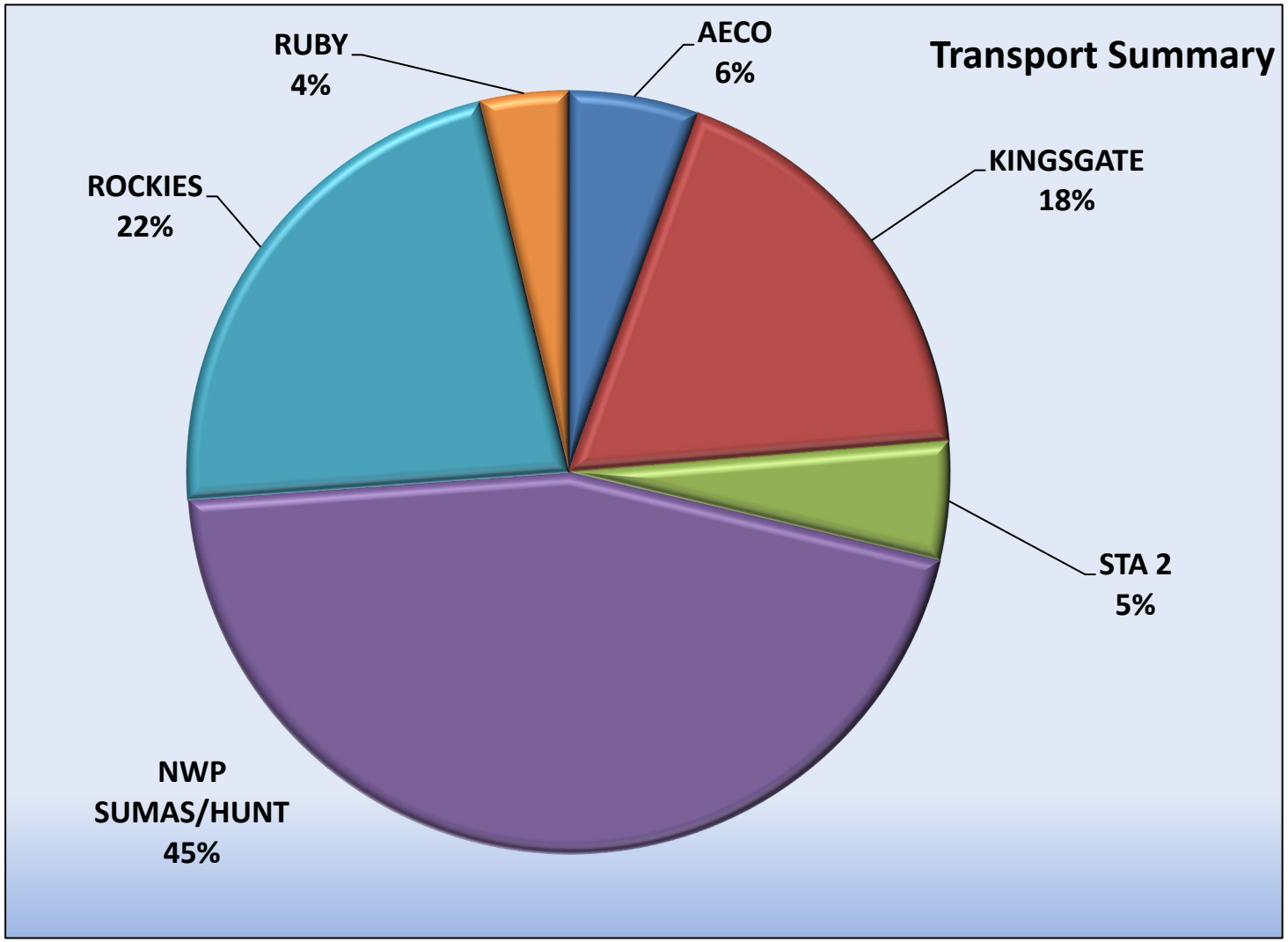

Transport Summary

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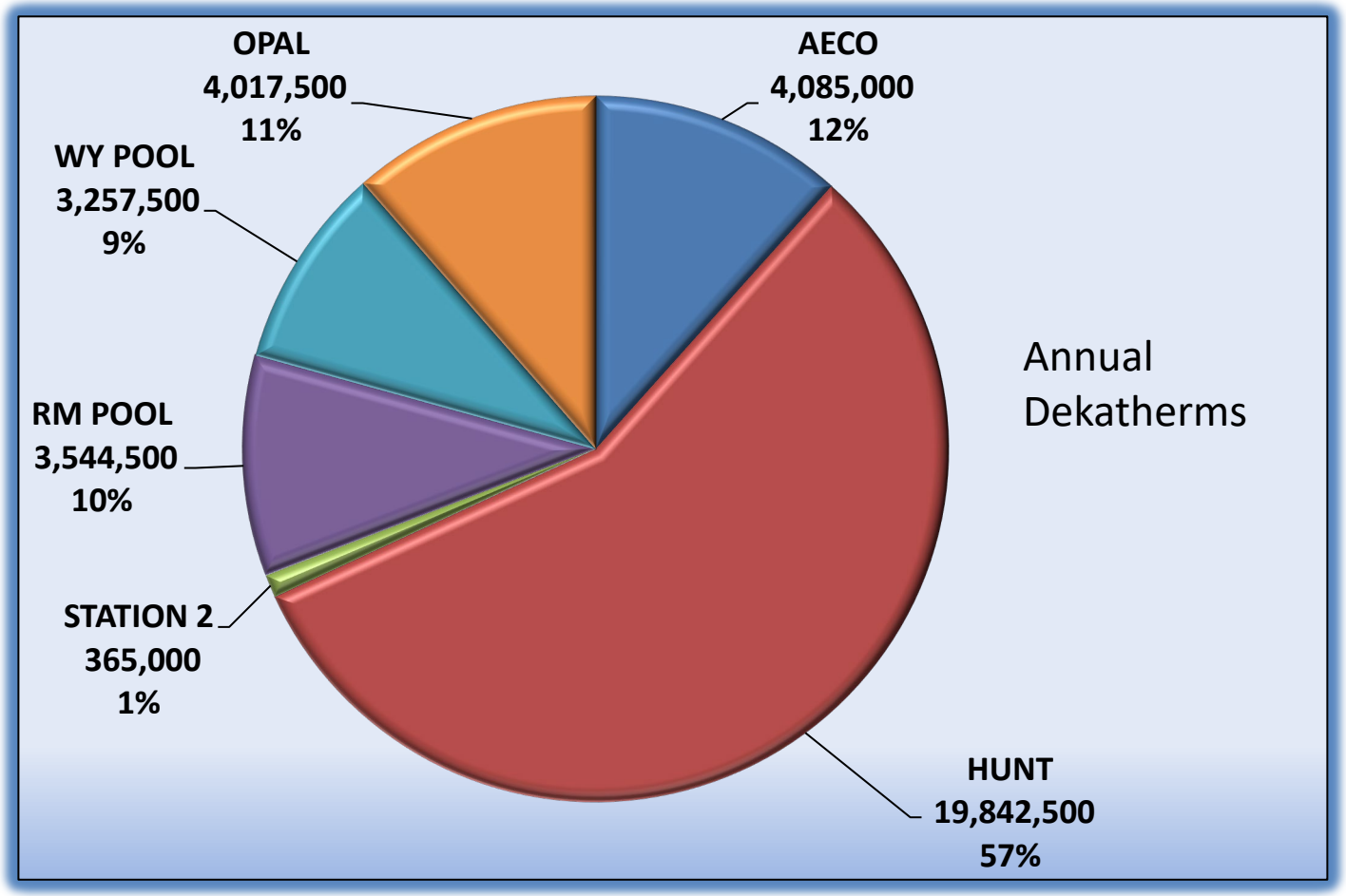
Supply Summary By Location 21/22 Season



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Storage Resources

Jackson Prairie

- 4 accounts with 1,235,593 dth capacity, 56,366 dth of withdrawal rights
- CNGC cycled approximately 99.48% of Jackson Prairie storage over the past winter season
- CNGC targets cycling Jackson Prairie, with pricing and other market and operating conditions considered

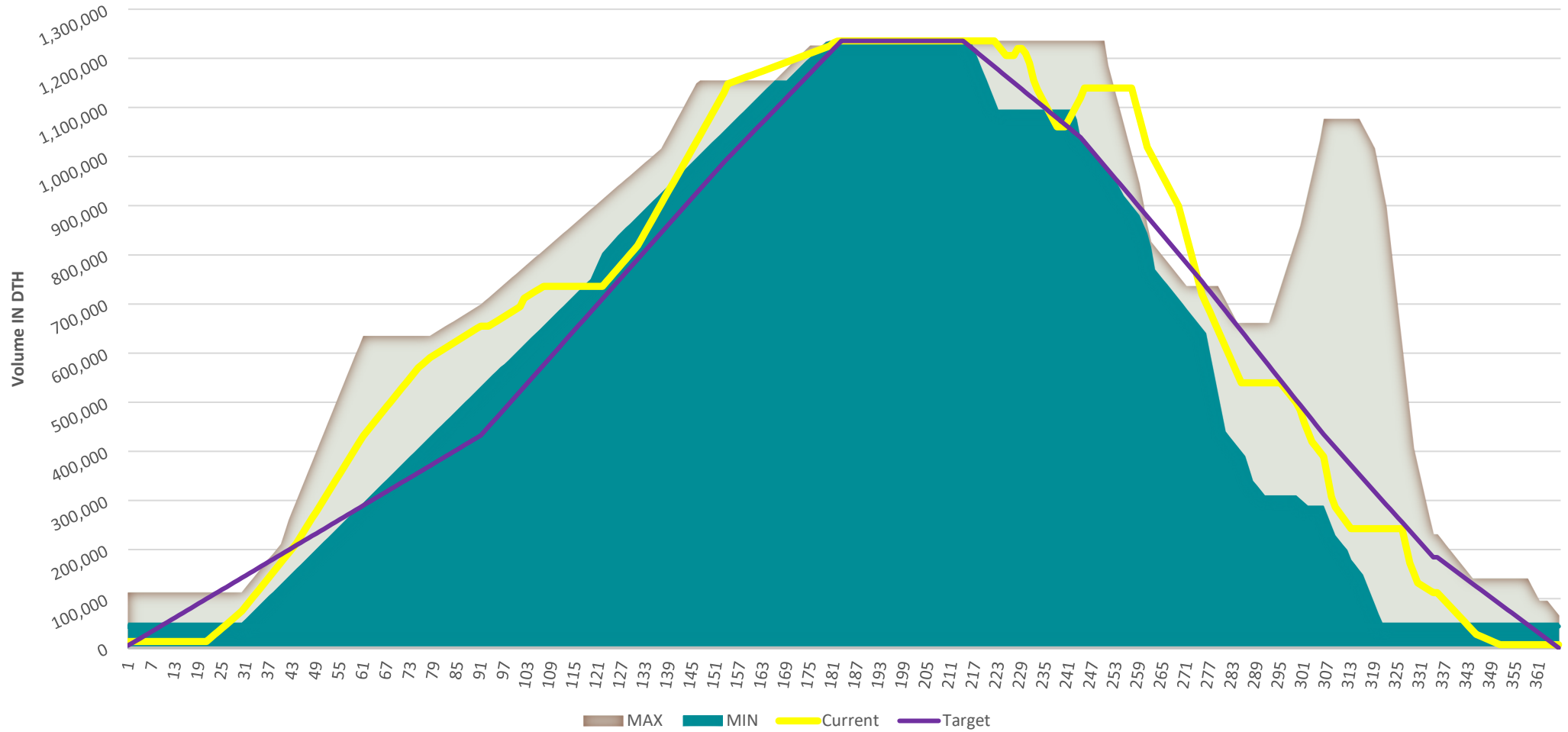
Plymouth

- 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, addition capacity and demand added in fall of 2021.
- The added Demand and capacity is a valuable operating resource in winter
- 1,640,000 dth of capacity, 50,000 dth of demand
- CNGC targets cycling Mist, with pricing and other market and operating conditions considered
- At 100% of demand, Cascade can meet approximately 67% of Peak Day needs.
- Total Storage Capacity accounts for approximately 14.75% of Winter demand
- Winter Demand is approximately 68% of Annual Demand

JACKSON PRAIRIE STORAGE USAGE FOR 21/22



Storage map runs from April 1 to March 31

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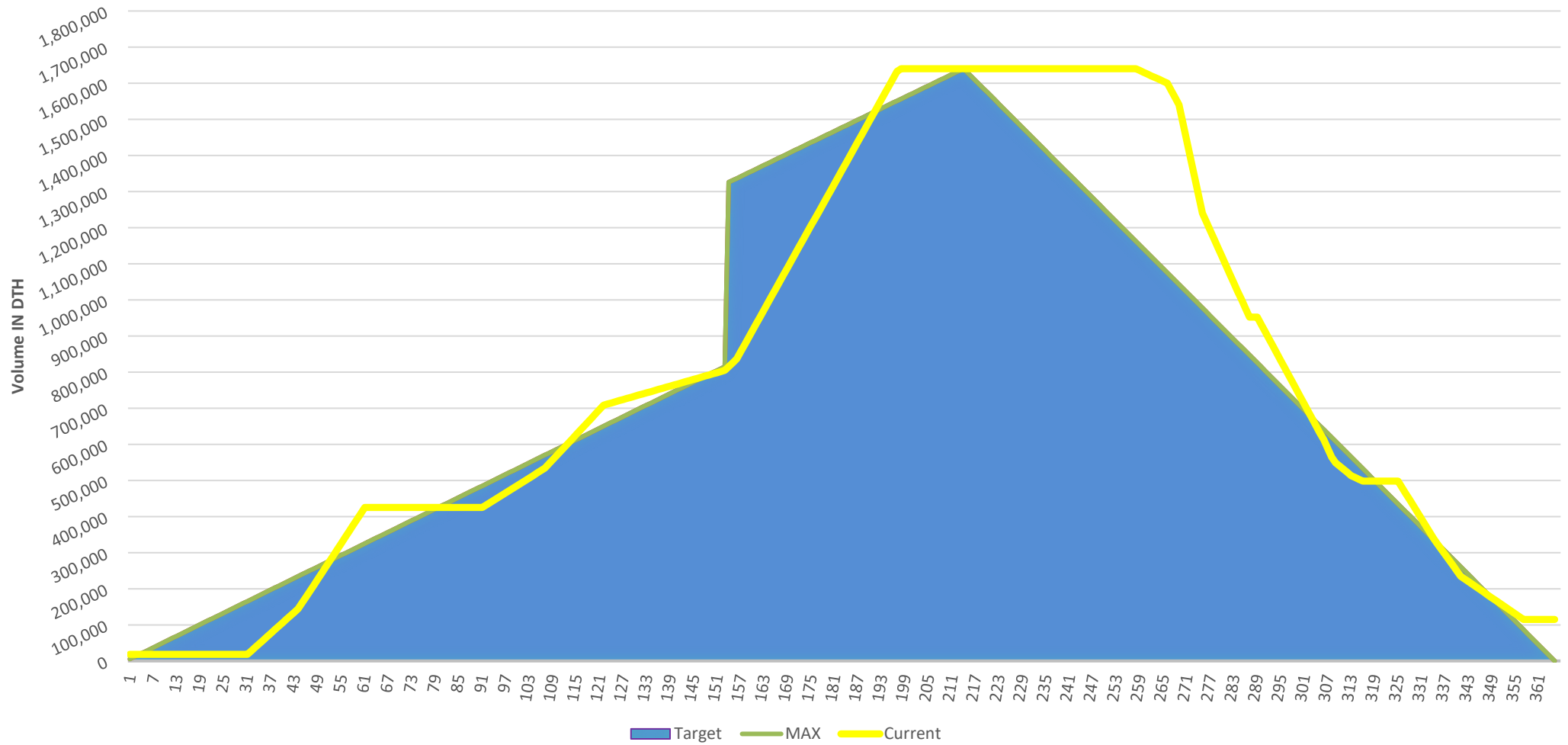
MIST STORAGE USAGE FOR 21/22



Storage map runs from April 1 to March 31

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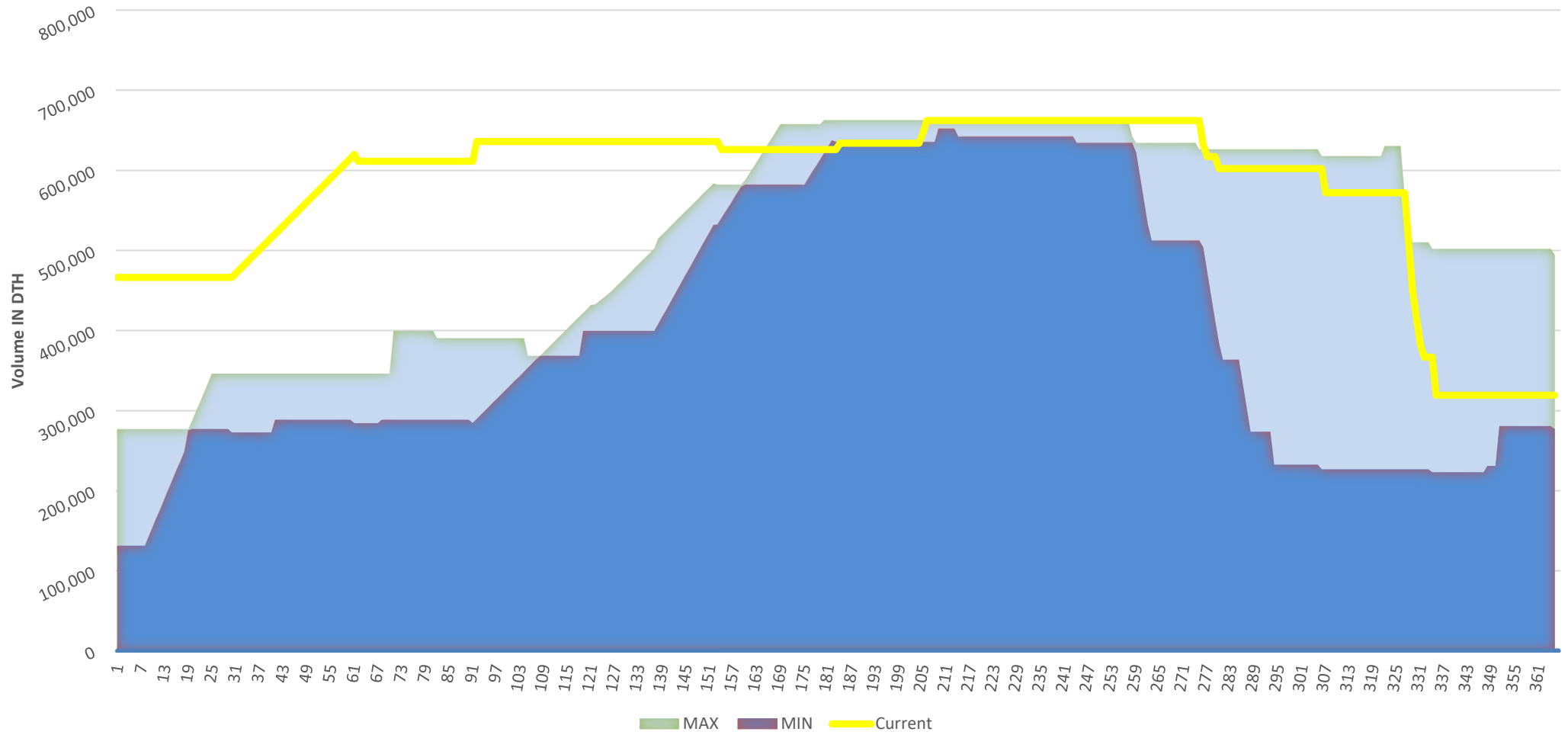
PLYMOUTH STORAGE USAGE FOR 21/22



Storage map runs from April 1 to March 31

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Hedge Calculation Table			
	Year 1	Year 2	Year 3
Contracted Base Supply Target	80%	60%	25%
Hedge Target	50%	40%	25%
Forecast Annual Usage	36,142,302	36,759,083	37,114,597
Needed Base Supply to Contract	28,913,842	22,055,450	9,278,649
Hedge Target	18,071,151	14,703,633	9,278,649
Current Hedged	14,292,000	7,094,000	-
Current Indexed	4,771,500	-	-
Remaining to Hedge	**3,599,821**	**7,609,633**	**9,278,649**
Remaining Indexed Supply Needed	**5,963,593**	**7,351,817**	**-**

***Forecast** — The Forecast is based on the IRP 20 year forecast

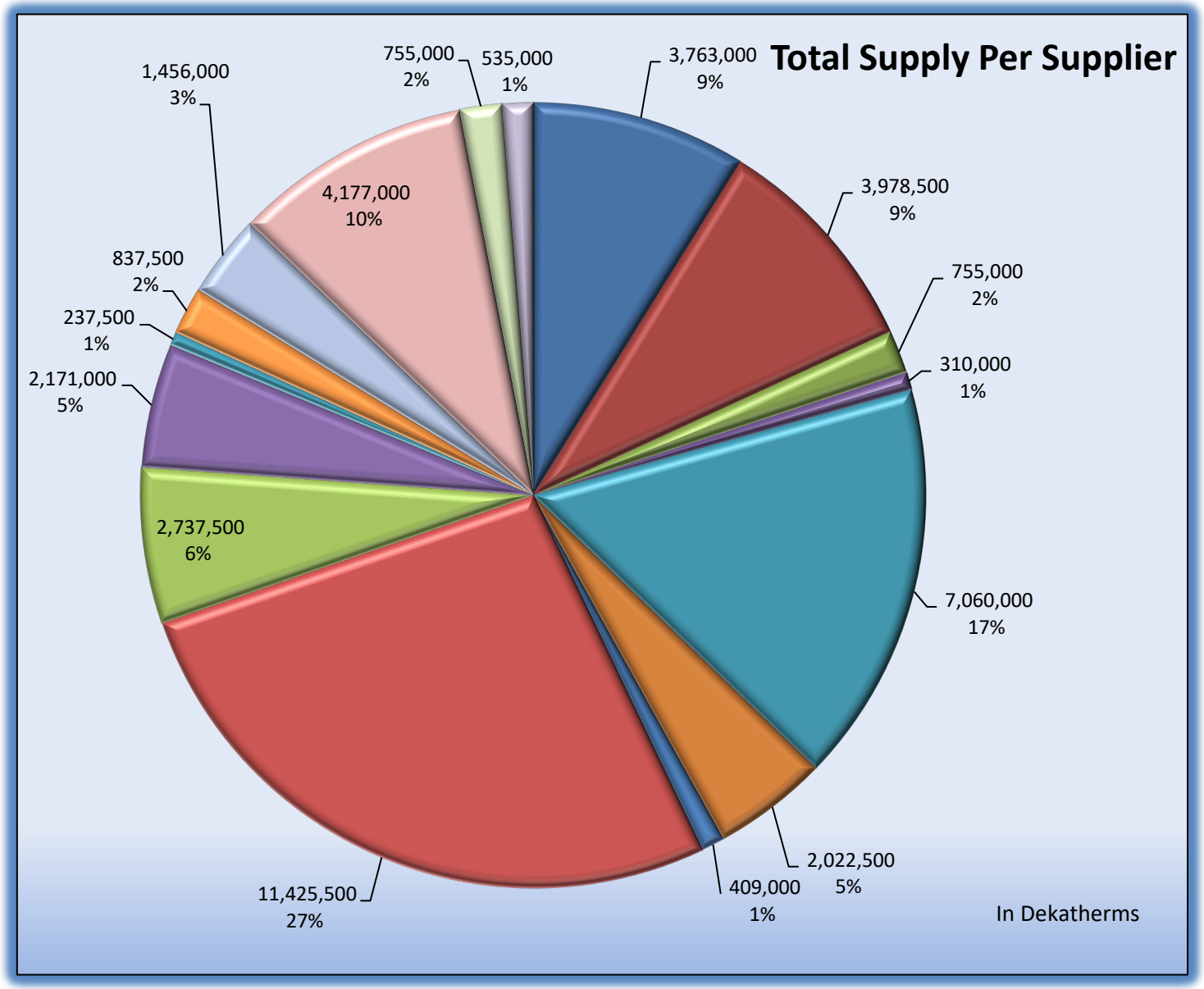
***Contracted Base Supply** — Base Supply is the overall amount of the contracted supply whether indexed or hedged. CNG uses 80% of the forecast to allow for storage usage and operational flexibility. The outward years use a ladder scale down to obtain a portion of the portfolio annually.

***hedge Target** — A percentage of the forecasted amount

Cascade strives for supplier diversity

Cascade has over 25 active NAESB's

16 currently have active agreements for gas purchases



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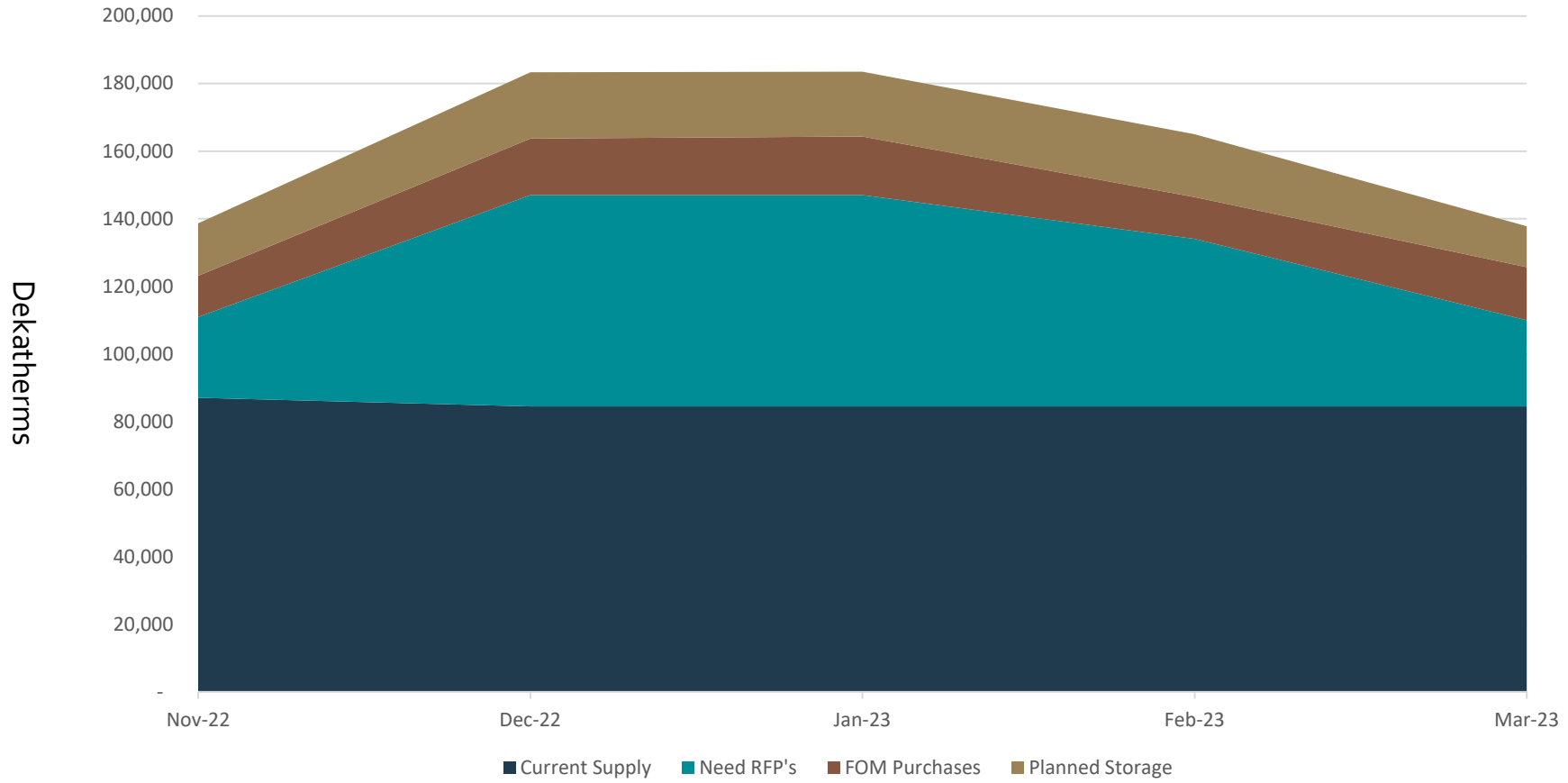
Renewable Natural Gas

Cascade is the successful bidder in response to a Deschutes County RFP issued to make beneficial use of the landfill gas produced at the Knott Landfill located in Bend, OR. Cascade does not yet have a contract in place with Deschutes County, but our intent is to develop a landfill gas conversion facility, improve the gas to pipeline quality RNG specifications, and inject the RNG into Cascade's distribution system pending successful contract negotiations.

Cascade's business development department is continuously looking at new RNG opportunities.

More information on RNG opportunities will be provided in TAG 4.

Winter Supply Stack



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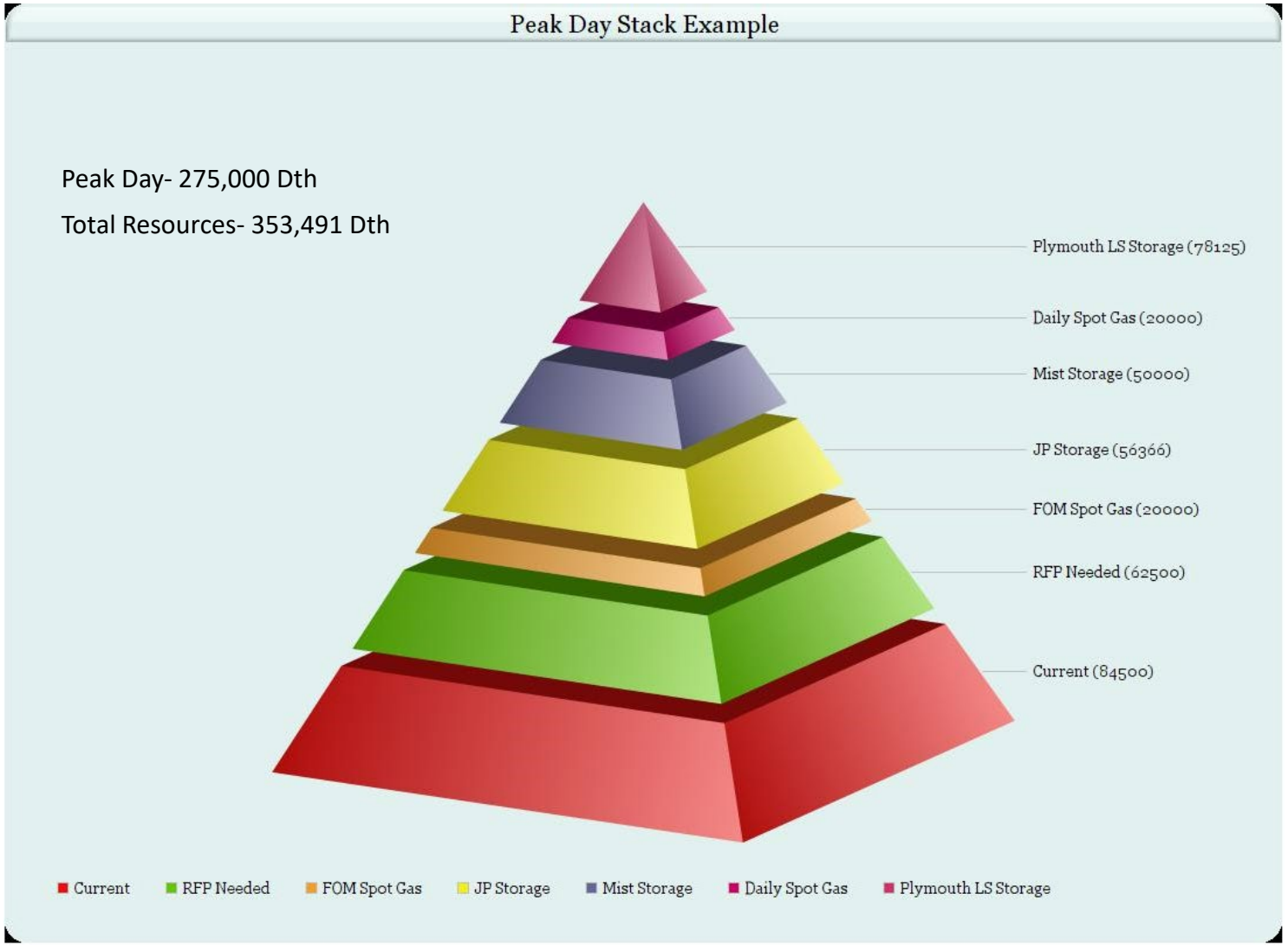

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Plexos Optimization Modeling

Plexos Model

Cascade utilizes Plexos 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.

Plexos 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 and emissions constraints.

Plexos is a unified energy modeling and forecasting software platform. Its powerful simulation engine analyzes zonal and nodal energy models ranging from long-term investment planning to medium-term operational planning and down to short-term, hourly, and intra-hourly market simulations.[1]

It is important to recognize that Plexos provides helpful but not perfect information to guide decisions.

1 SEE: PLEXOS | ENERGY MARKET SIMULATION SOFTWARE | ENERGY EXEMPLAR

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.

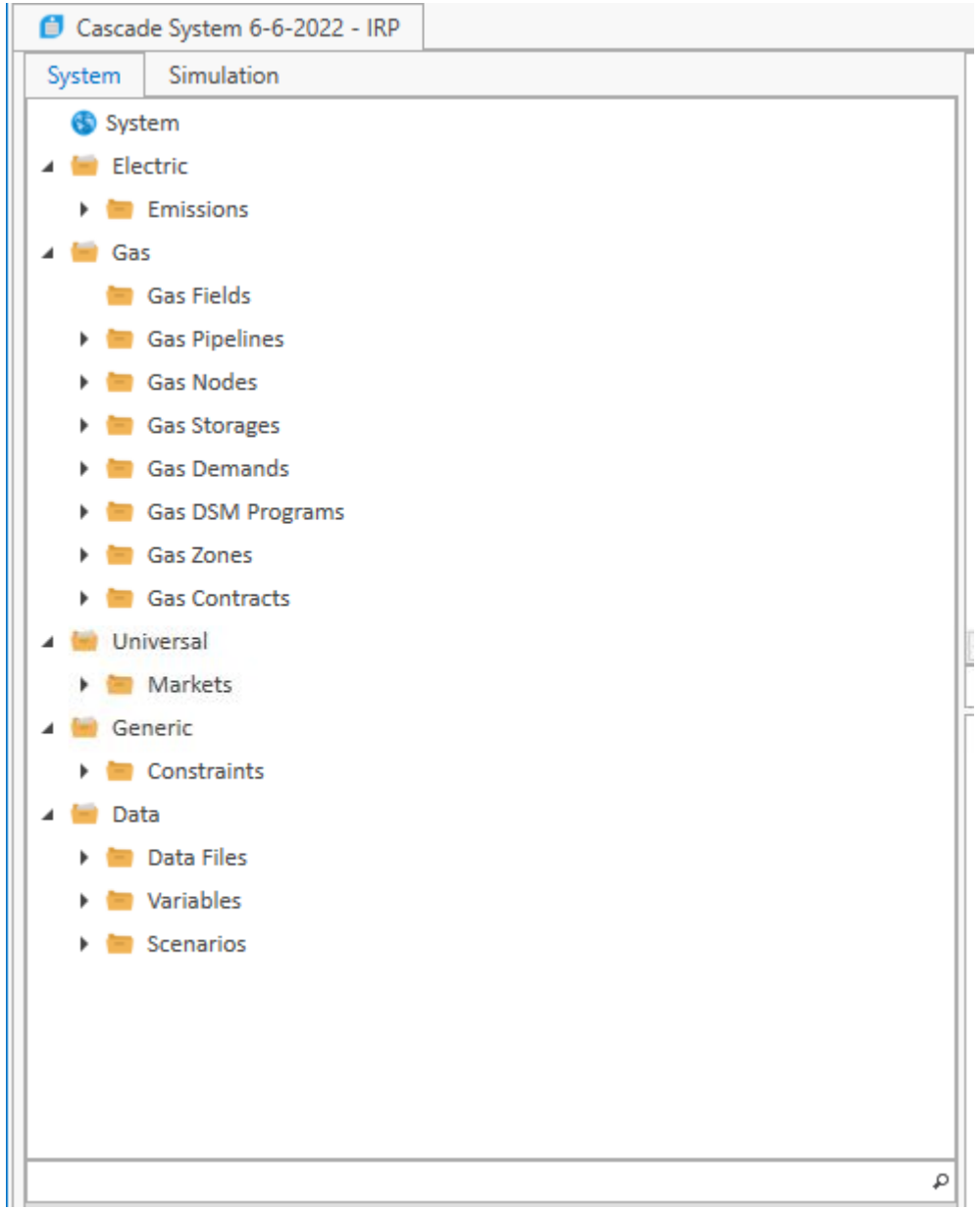
In many cases operational capacity is greater than contracted.

Supply, storage, and upstream transportation focuses on the core, but non-core must be included for emissions modeling.

Plexos has perfect knowledge.

Base Case Plexos Inputs

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



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.

For more information on the customer and demand forecast, please visit Cascade's webpage[1] for TAG 2 information or reach out to Cascade's Resource Planning team.

1 WASHINGTON INTEGRATED RESOURCE PLAN - CASCADE NATURAL GAS CORPORATION (CNGC.COM)

Demand

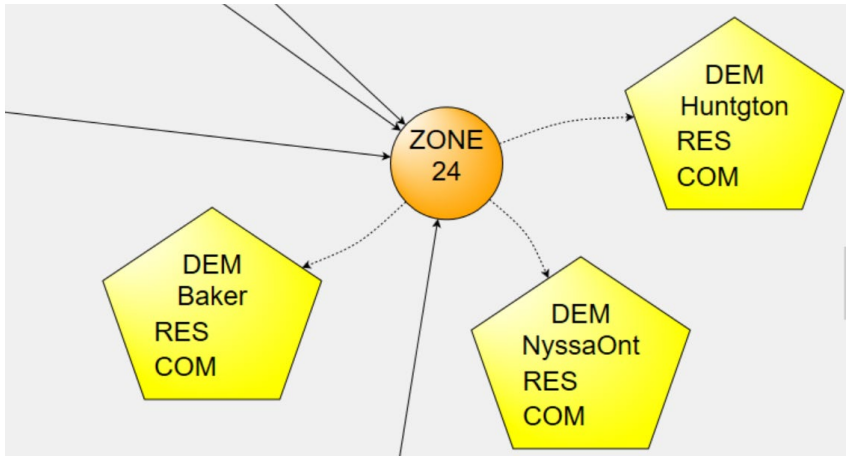
Demand is forecasted at the citygate level by rate schedule.

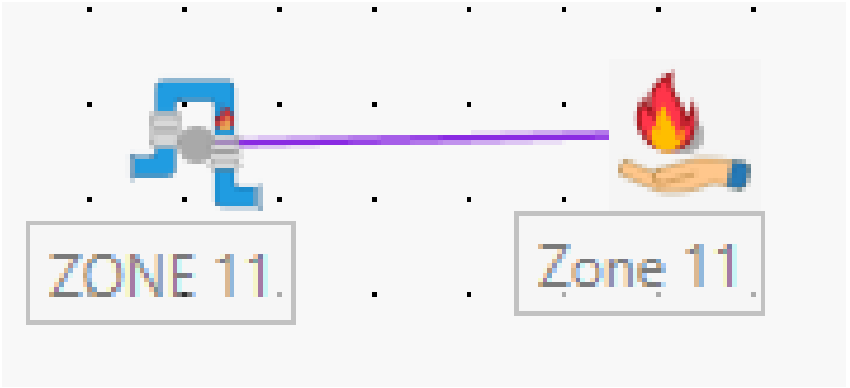
For NWP, each citygate demand is associated with the zone.

For GTN, each citygate demand is associated with it's respective citygate interconnect.

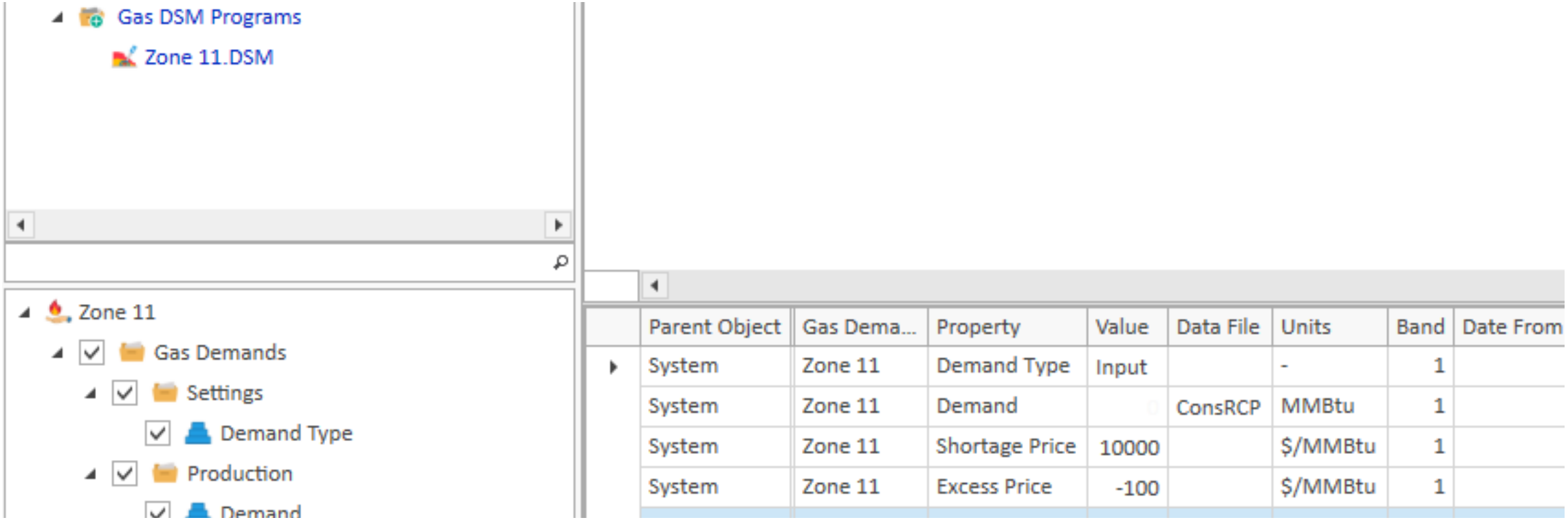
Demand Inputs

- Forecast type is the daily amount as an input.
- Daily projected usage from 2023-2050.
- DSM is not an input in the base case. DSM is added once the projected therm savings when modeled against competing resources is finalized. DSM is modeled as a decrement to demand in Plexos.





Demand Example



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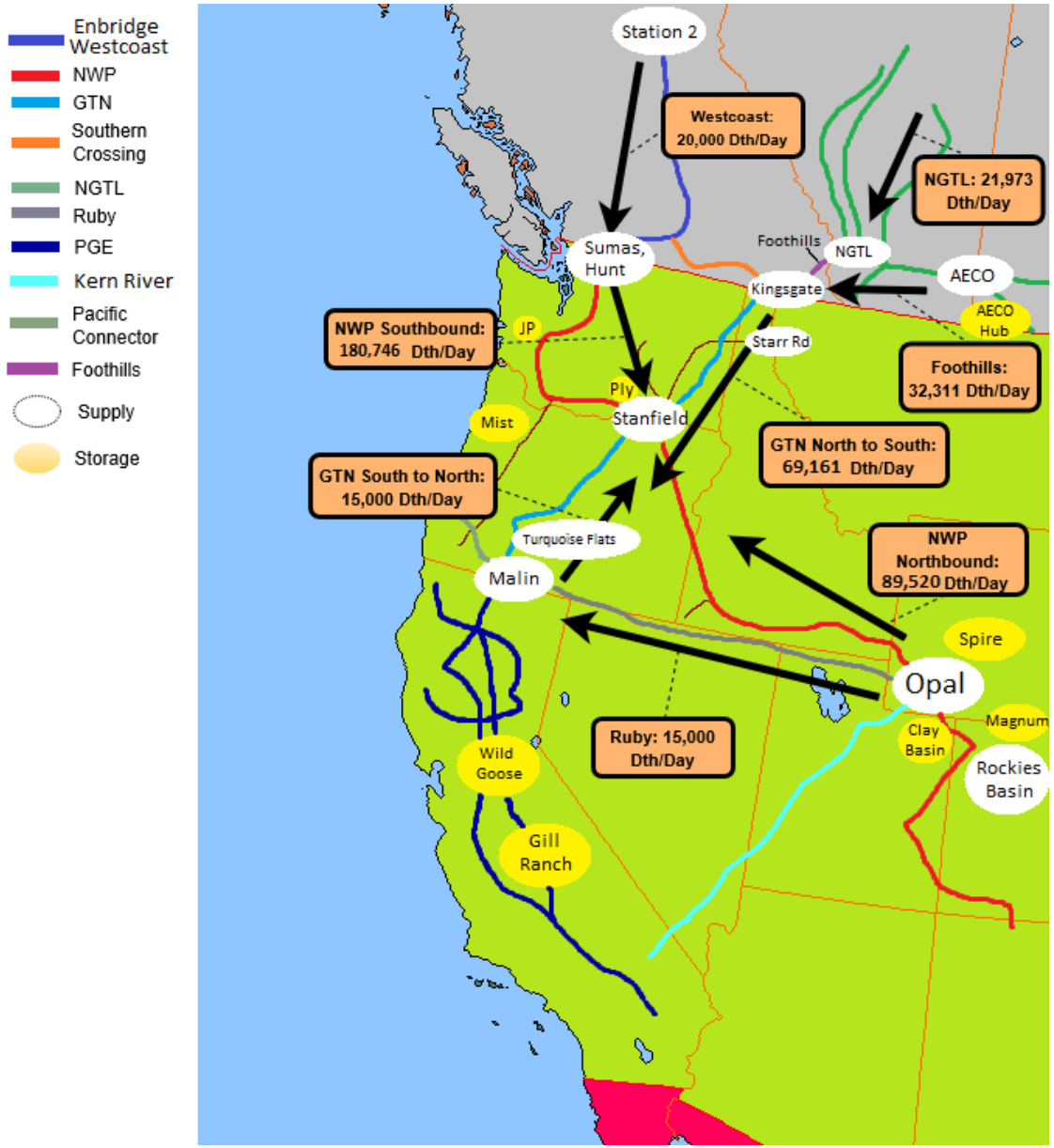
System	Zone 11	Demand Type	Input		-	1	
System	Zone 11	Demand		ConsRCP	MMBtu	1	
System	Zone 11	Shortage Price	10000		$/MMBtu	1	
System	Zone 11	Excess Price	-100		$/MMBtu	1	

Demand Example 2

Supply


Enbridge Westcoast
NWP
GTN
Southern Crossing
NGTL
Ruby
PGE
Kern River
Pacific Connector
Foothills
Supply
Storage
Station 2
Westcoast: 20,000 Dth/Day
NGTL: 21,973 Dth/Day
Sumas, Hunt
Foothills
NGTL
AECO
Kingsgate
AECO Hub
NWP Southbound: 180,746 Dth/Day
JP
Starr Rd
Foothills: 32,311 Dth/Day
Ply
Stanfield
Mist
GTN North to South: 69,161 Dth/Day
GTN South to North: 15,000 Dth/Day
Turquoise Flats
NWP Northbound: 89,520 Dth/Day
Malin
Spire
Opal
Magnum
Clay Basin
Ruby: 15,000 Dth/Day
Wild Goose
Rockies Basin
Gill Ranch

Supply

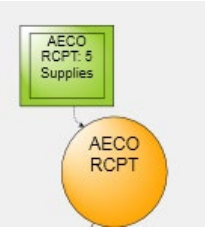
Cascade can purchase gas at four markets; AECO, SUMAS, KINGSGATE and OPAL.

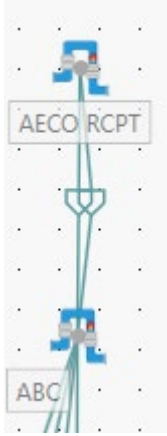
At each market Cascade can purchase gas at different locations along the pipeline.

For the first year, Cascade uses all current contracts for Supply inputs.

For years 2-28 (2023-2050), 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 Base and Fixed

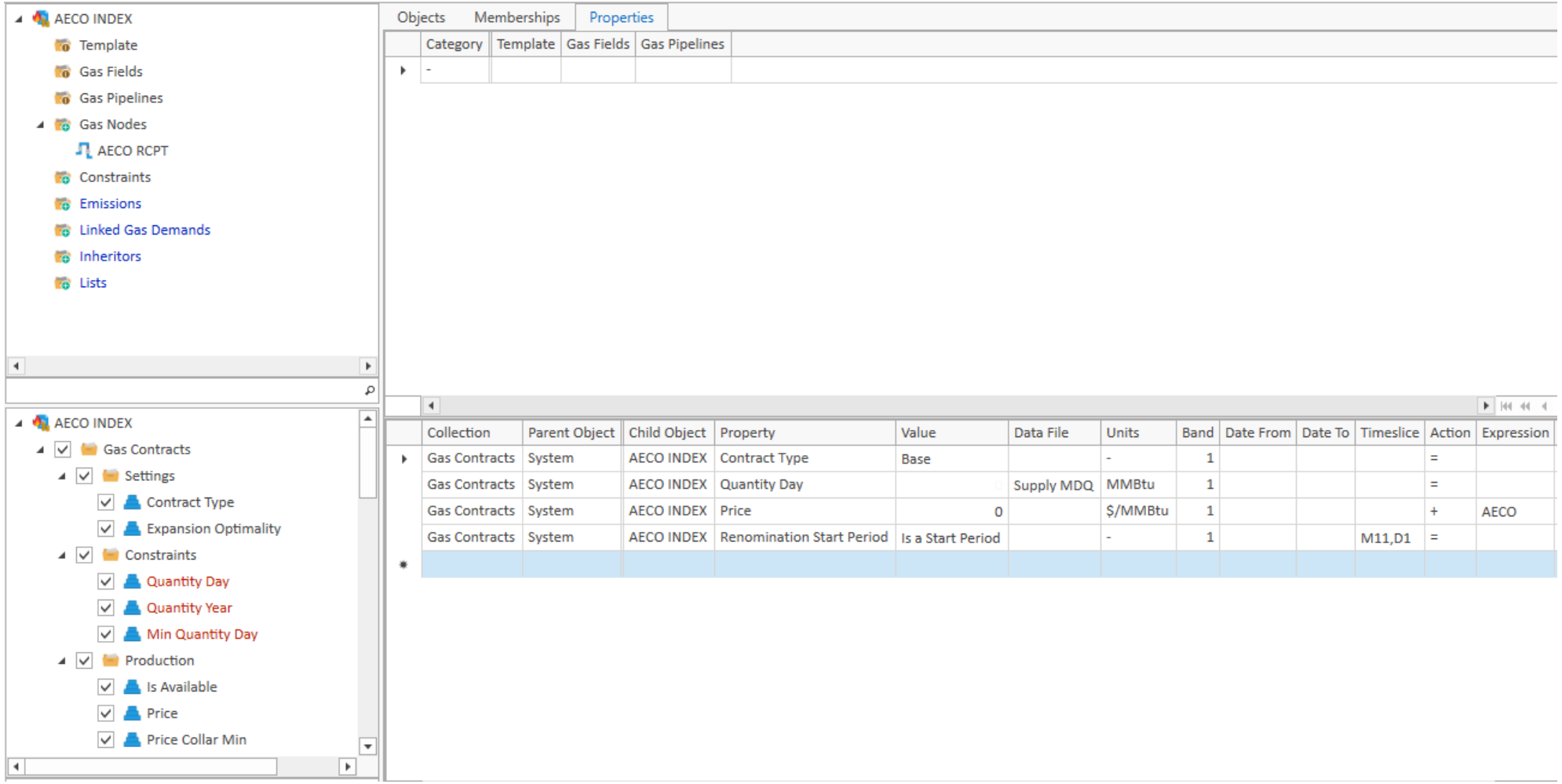
Supply Base and Fixed are the baseline supply contracts that are entered into every 12 months.

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).

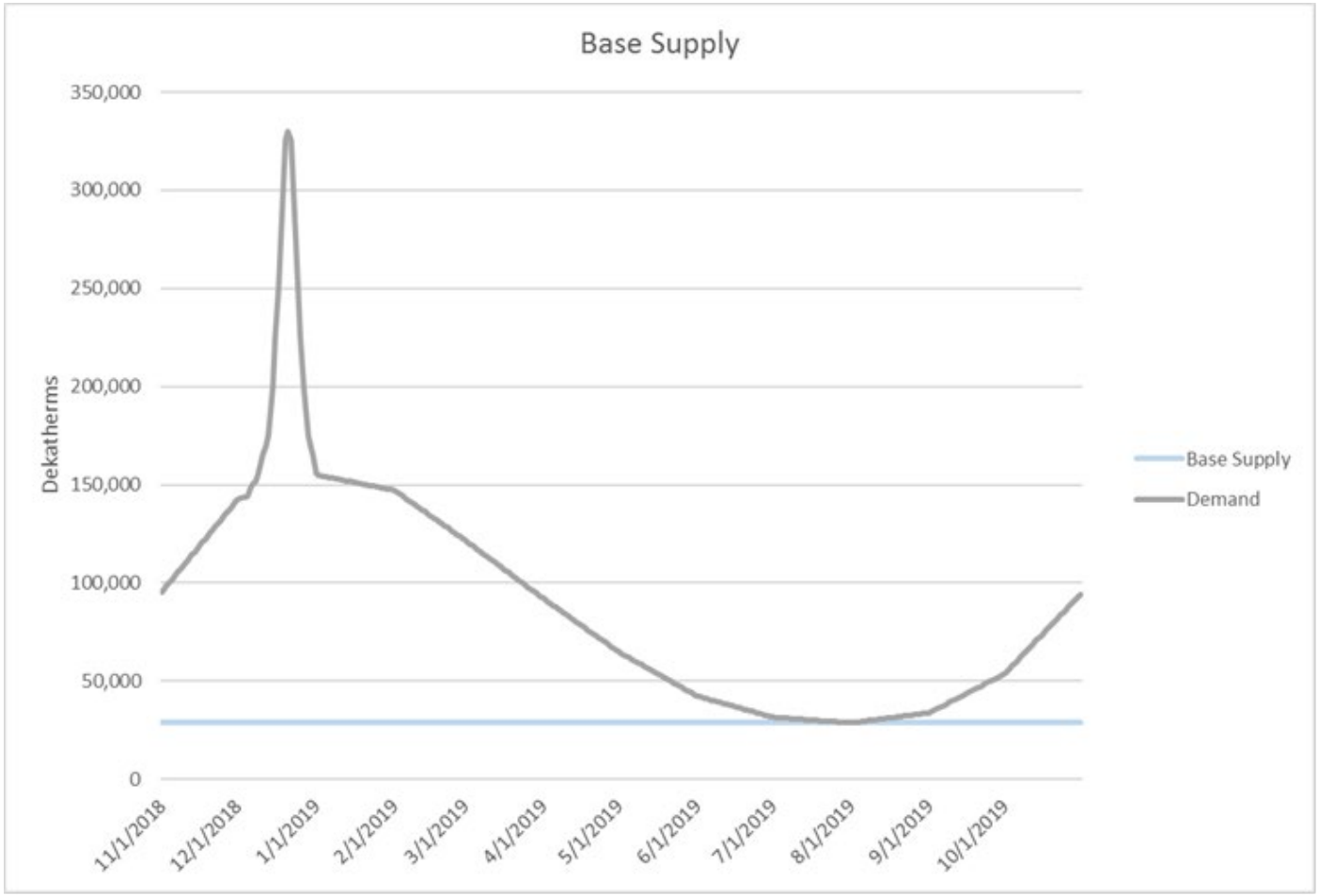
A fixed contract has a fixed rate.

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



Base Supply (Cont'd)



Winter Base Supply

Winter base supply is contracted supply with a premium charge that is slightly higher than base gas.

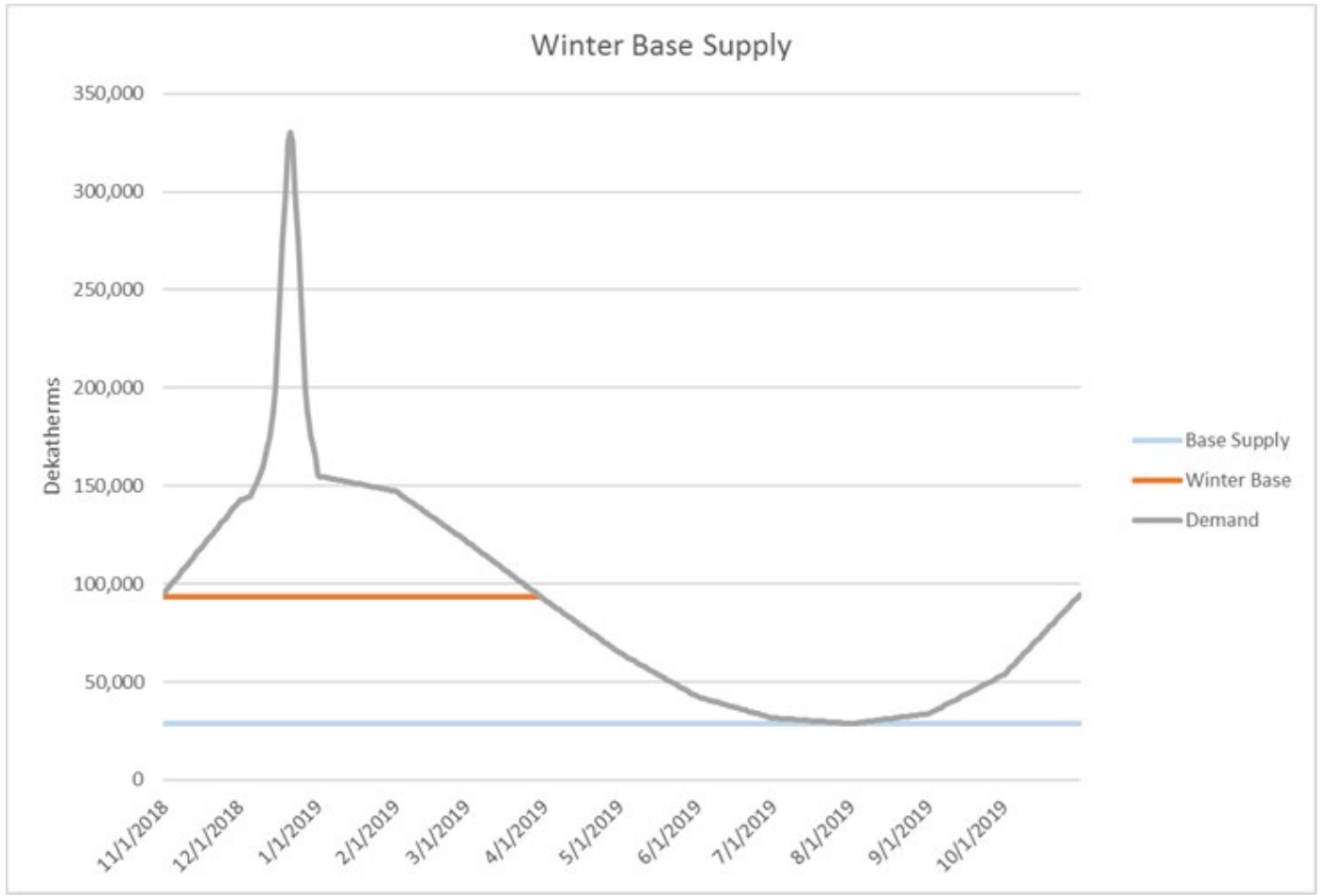
The Maximum Daily Quantity (MDQ) is optimally set by Plexos.

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 Plexos 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 Renominated at the beginning of November each year.

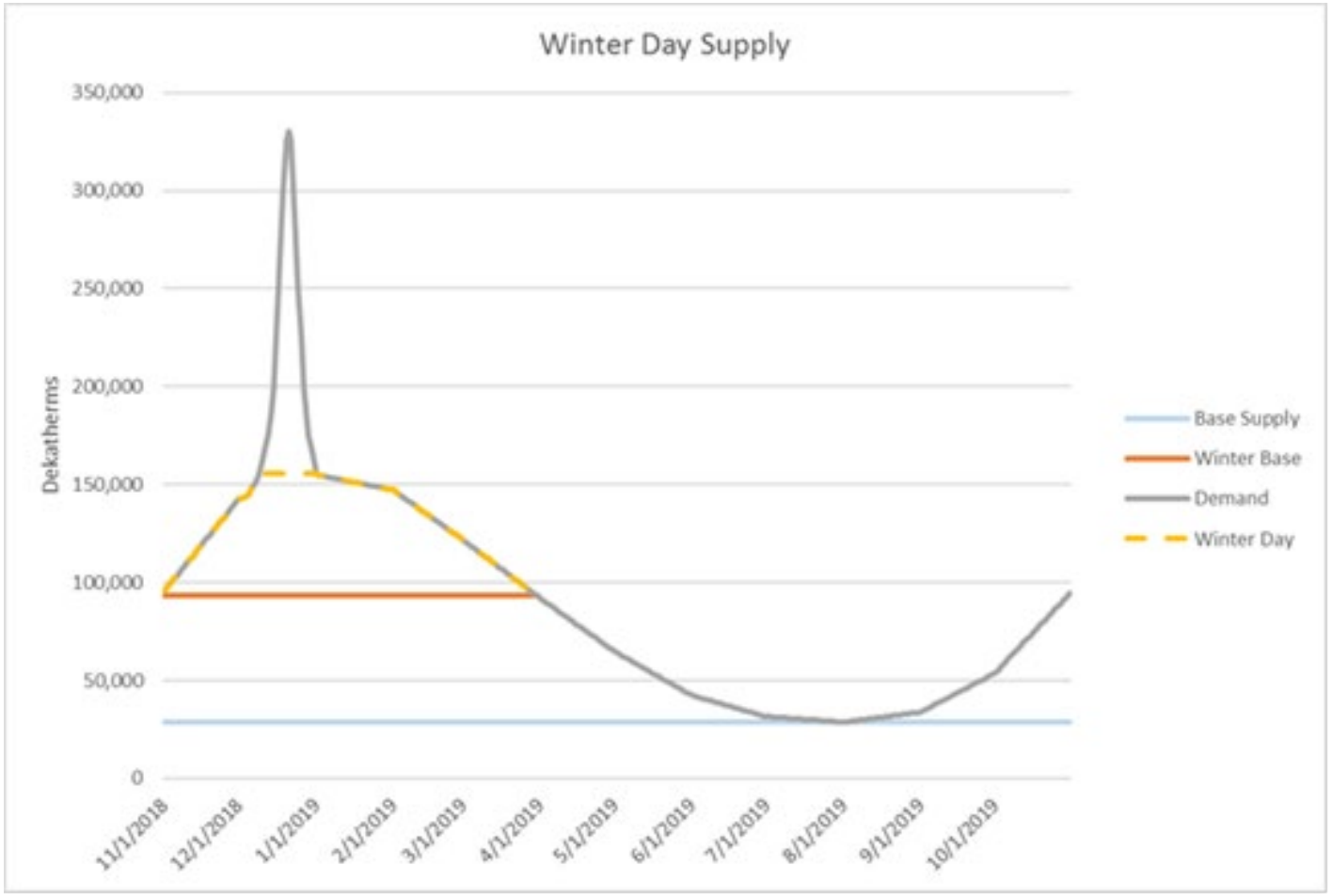
The Renomination function takes into account the fixed and variable costs of a resource to determine the proper amount to take in a given period.

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)

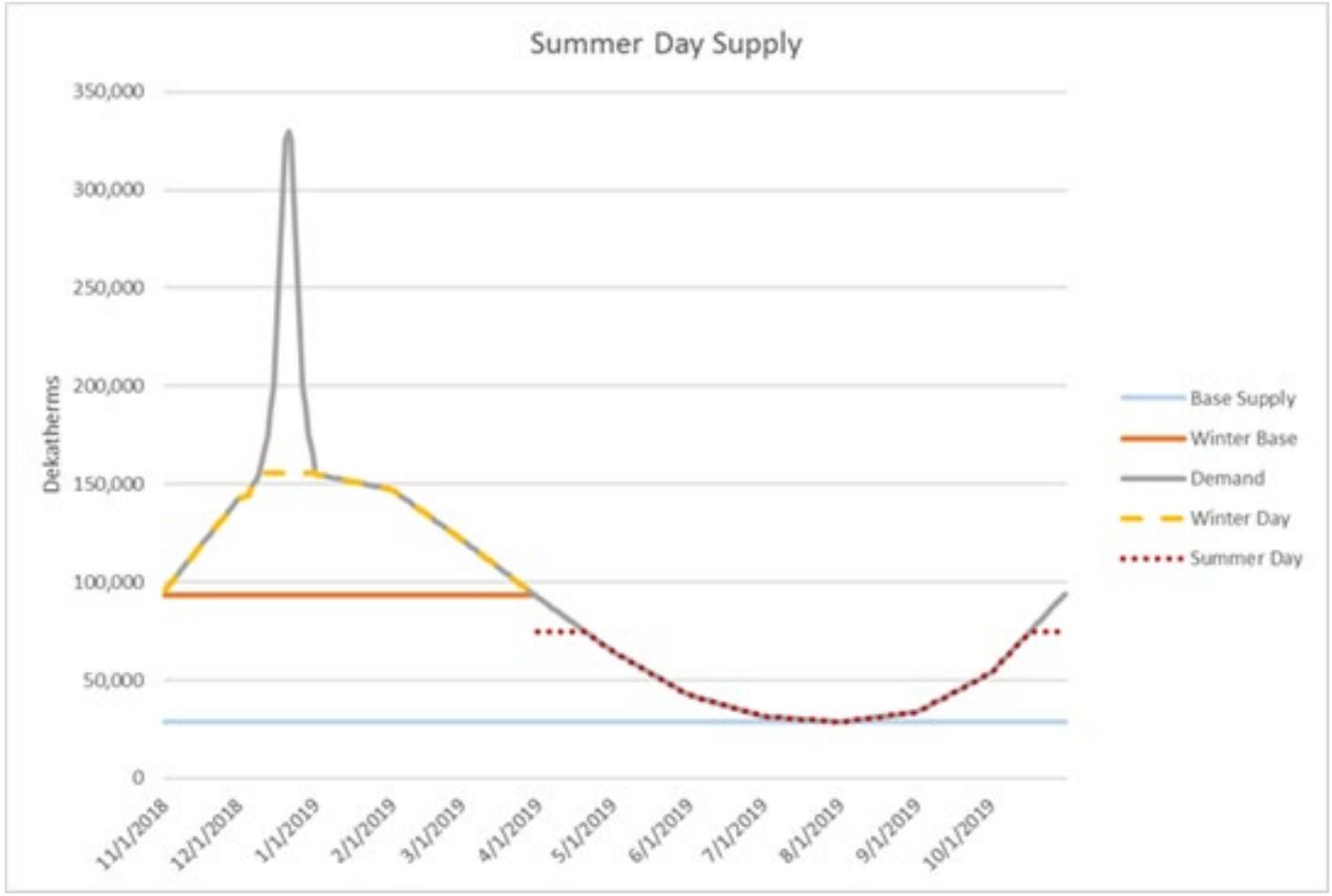
Summer day supply is gas that is Renominated at the beginning of April each year.

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)



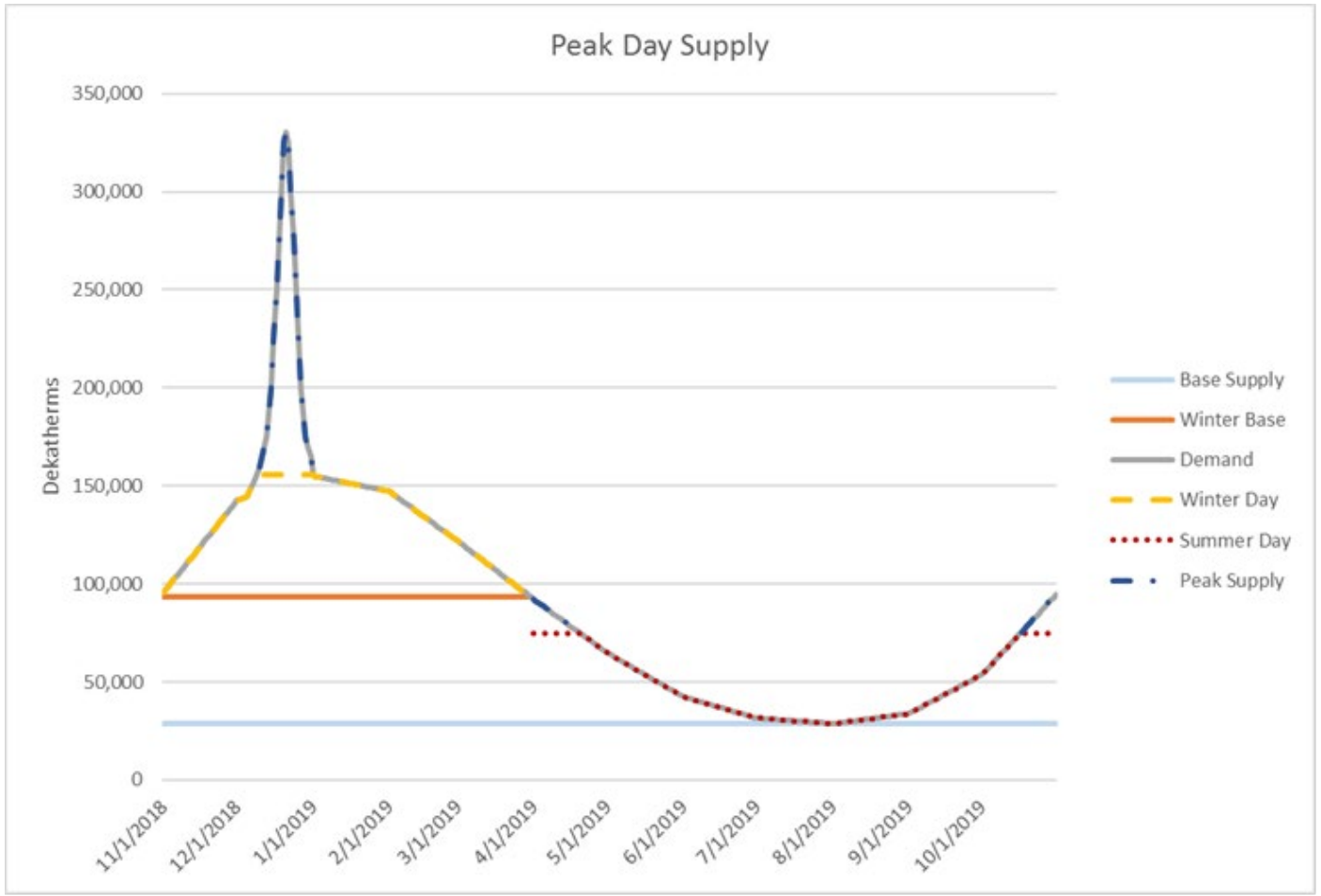
Peak Supply

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.

Total Supply



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Storage

Cascade leases storage at 3 locations: Jackson Prairie (JP), Plymouth (Ply), and Mist.

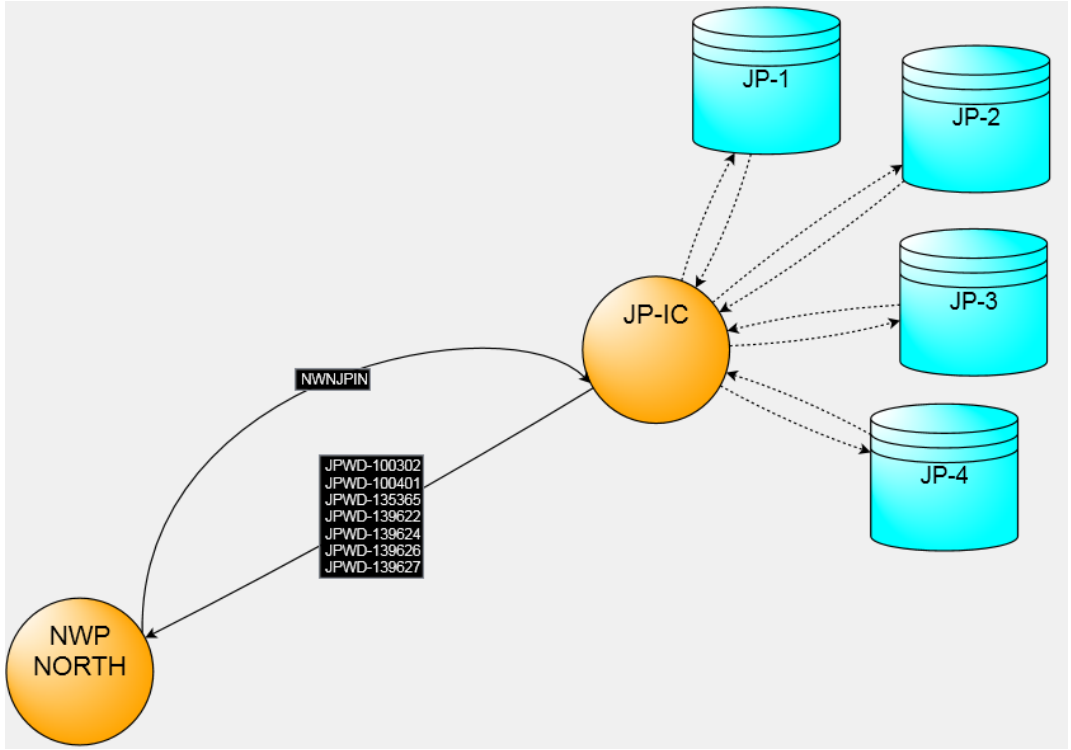
Cascade has 4 storage contracts with JP, 2 contracts with Plymouth, and 2 with Mist (will go to 1 combined contract in 2024).

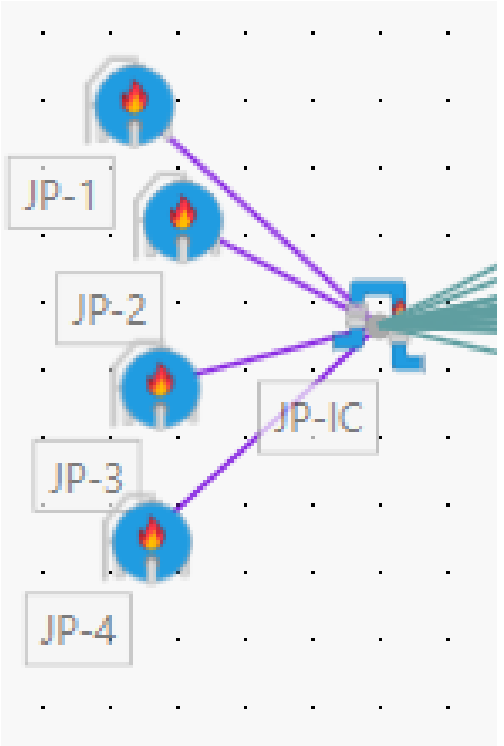
Storage injections targets for JP are set at 35% by the end of June, 80% by the end of August, and 100% by the end of September.

These targets are set by upstream pipelines' tariffs.

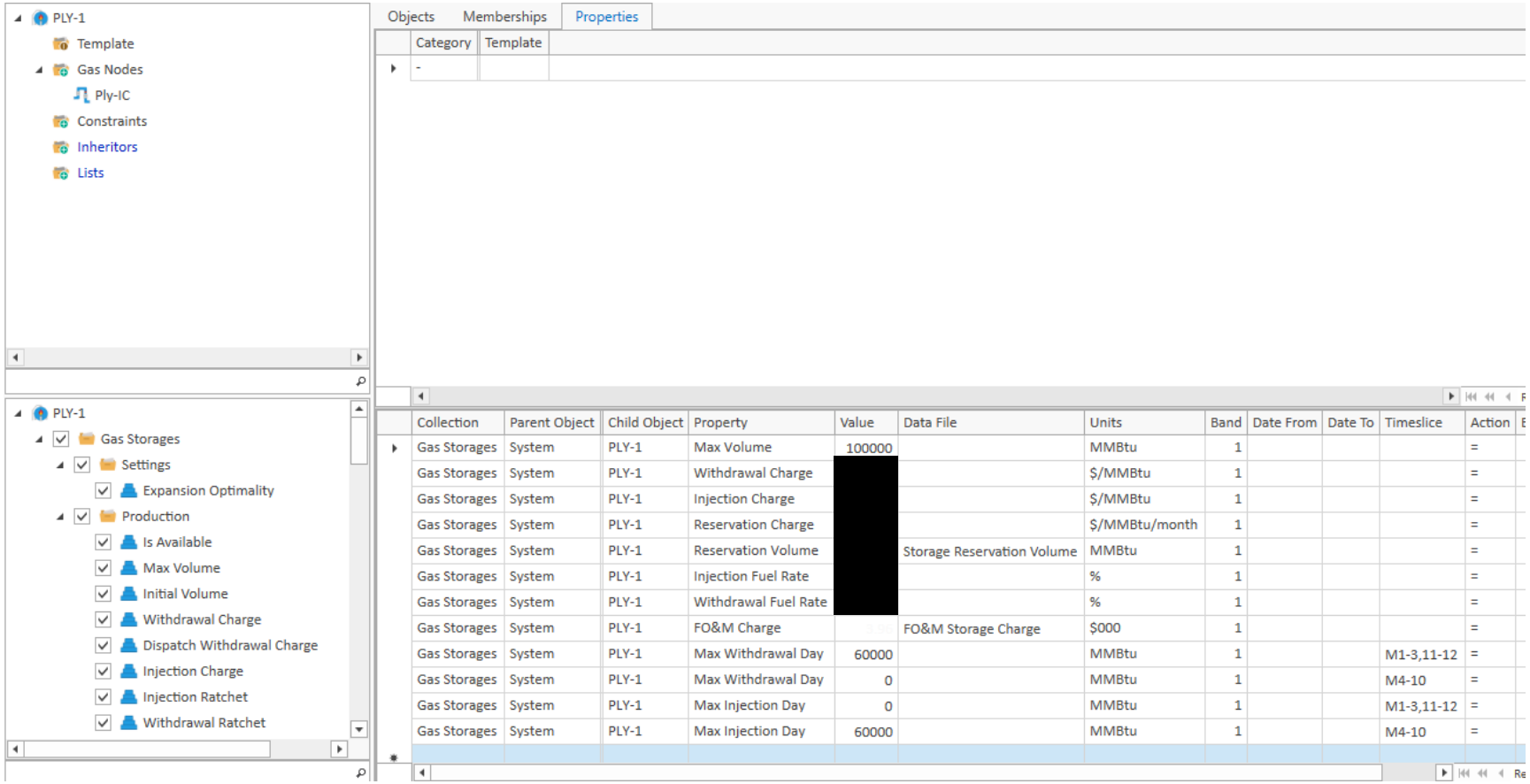
Cascade can withdrawal approximately 56,000 dth per day from JP, 78,000 dth per day from Plymouth, and 50,000 Dth per day from Mist for a total of approximately 184,000 dth per day.

Storage Example





Storage Example 2



Collection	Parent Object	Child Object	Property	Value	Data File	Units	Band	Date From	Date To	Timeslice	Action
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Gas Storages	System	PLY-1	Withdrawal Charge	[redacted]		$/MMBtu	1				=
Gas Storages	System	PLY-1	Injection Charge			$/MMBtu	1				=
Gas Storages	System	PLY-1	Reservation Charge			$/MMBtu/month	1				=
Gas Storages	System	PLY-1	Reservation Volume		Storage Reservation Volume	MMBtu	1				=
Gas Storages	System	PLY-1	Injection Fuel Rate			%	1				=
Gas Storages	System	PLY-1	Withdrawal Fuel Rate			%	1				=
Gas Storages	System	PLY-1	FO&M Charge	[redacted]	FO&M Storage Charge	$000	1				=
Gas Storages	System	PLY-1	Max Withdrawal Day	60000		MMBtu	1			M1-3,11-12	=
Gas Storages	System	PLY-1	Max Withdrawal Day	0		MMBtu	1			M4-10	=
Gas Storages	System	PLY-1	Max Injection Day	0		MMBtu	1			M1-3,11-12	=
Gas Storages	System	PLY-1	Max Injection Day	60000		MMBtu	1			M4-10	=

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.

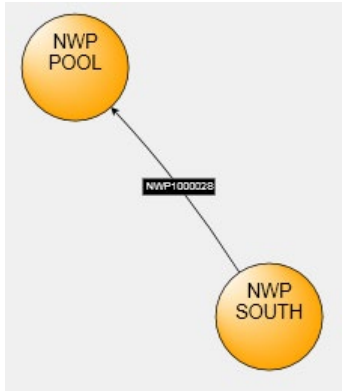
A maximum delivery quantity (MDQ) which is the maximum amount of gas Cascade can move on the pipeline on a single day.

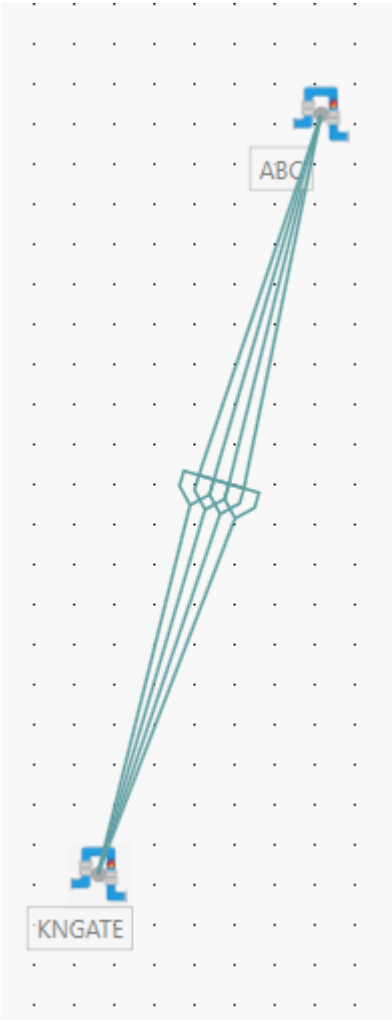
A D1 rate which is the reservation rate to have the ability to move the MDQ amount on the pipeline.

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.

Transport Example





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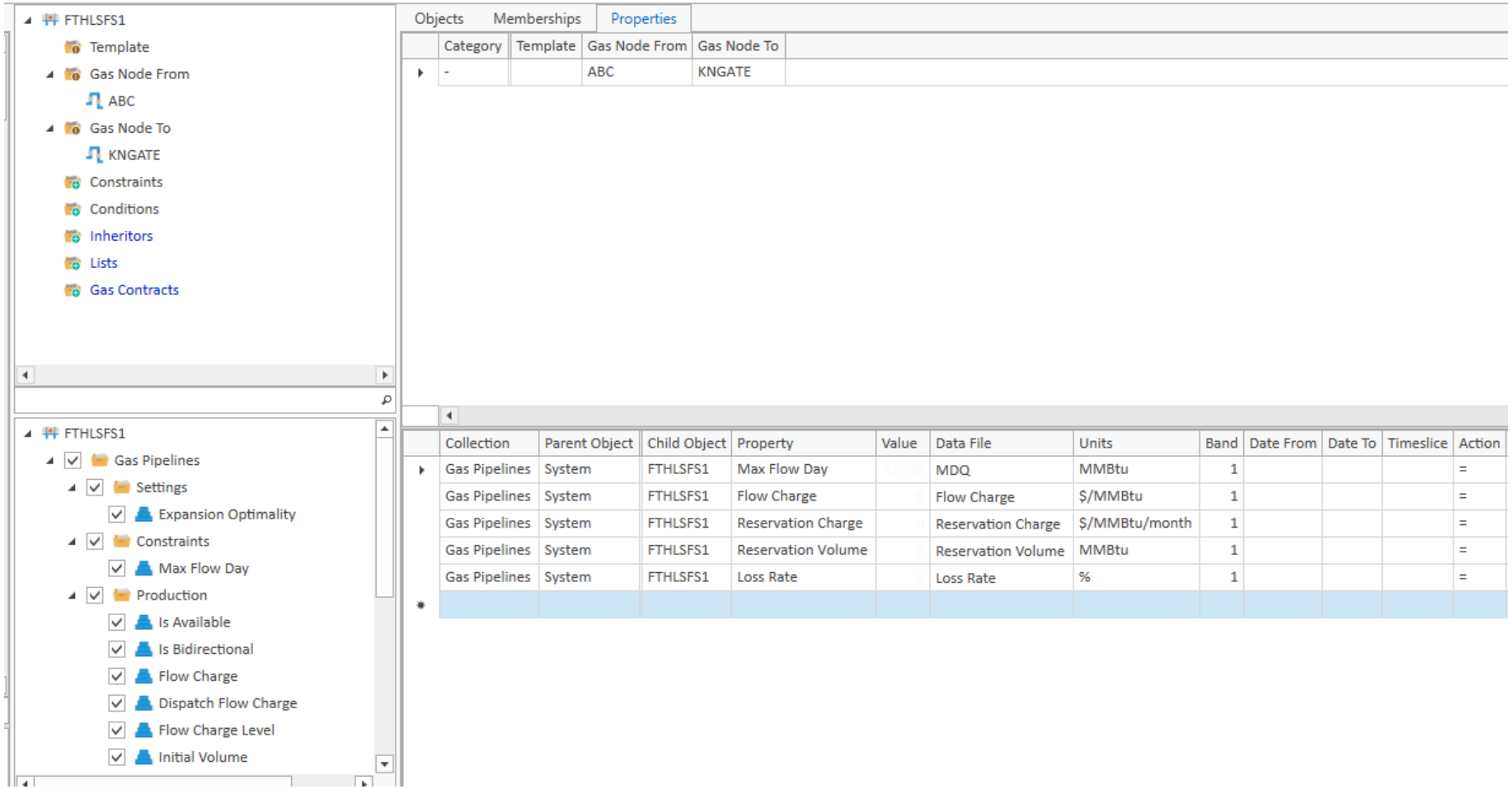
Transport Example



Delivery Rights vs Receipt Rights

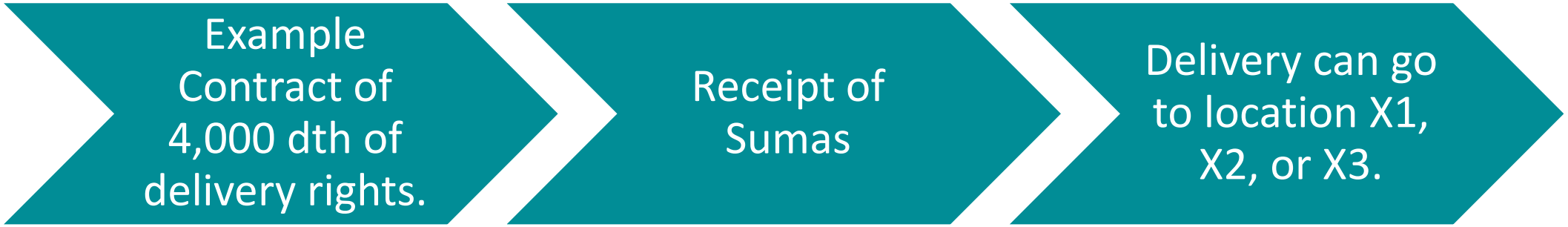
Cascade has more Delivery Rights than Receipt Rights.

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.

Example of delivery right flexibility



All of the following must be true

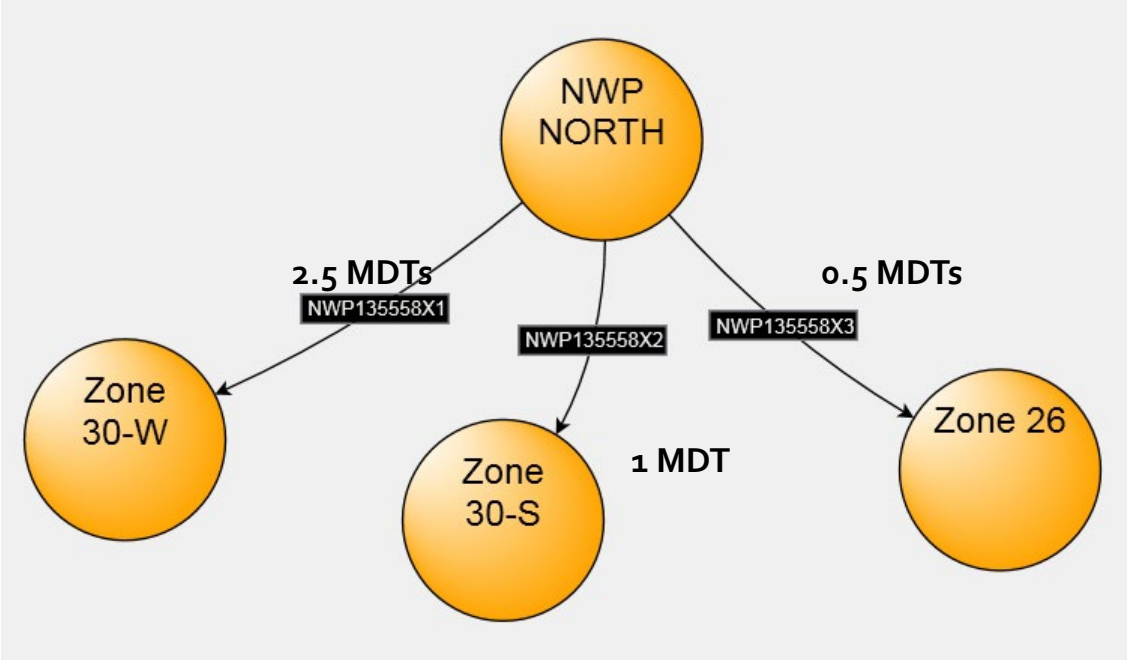
$$X1 \leq 4\text{MDTs}$$

$$X2 \leq 4\text{MDTs}$$

$$X3 \leq 4MDTs$$

$$X1 + X2 + X3 \leq 4MDTs$$

Example of delivery right inflexibility



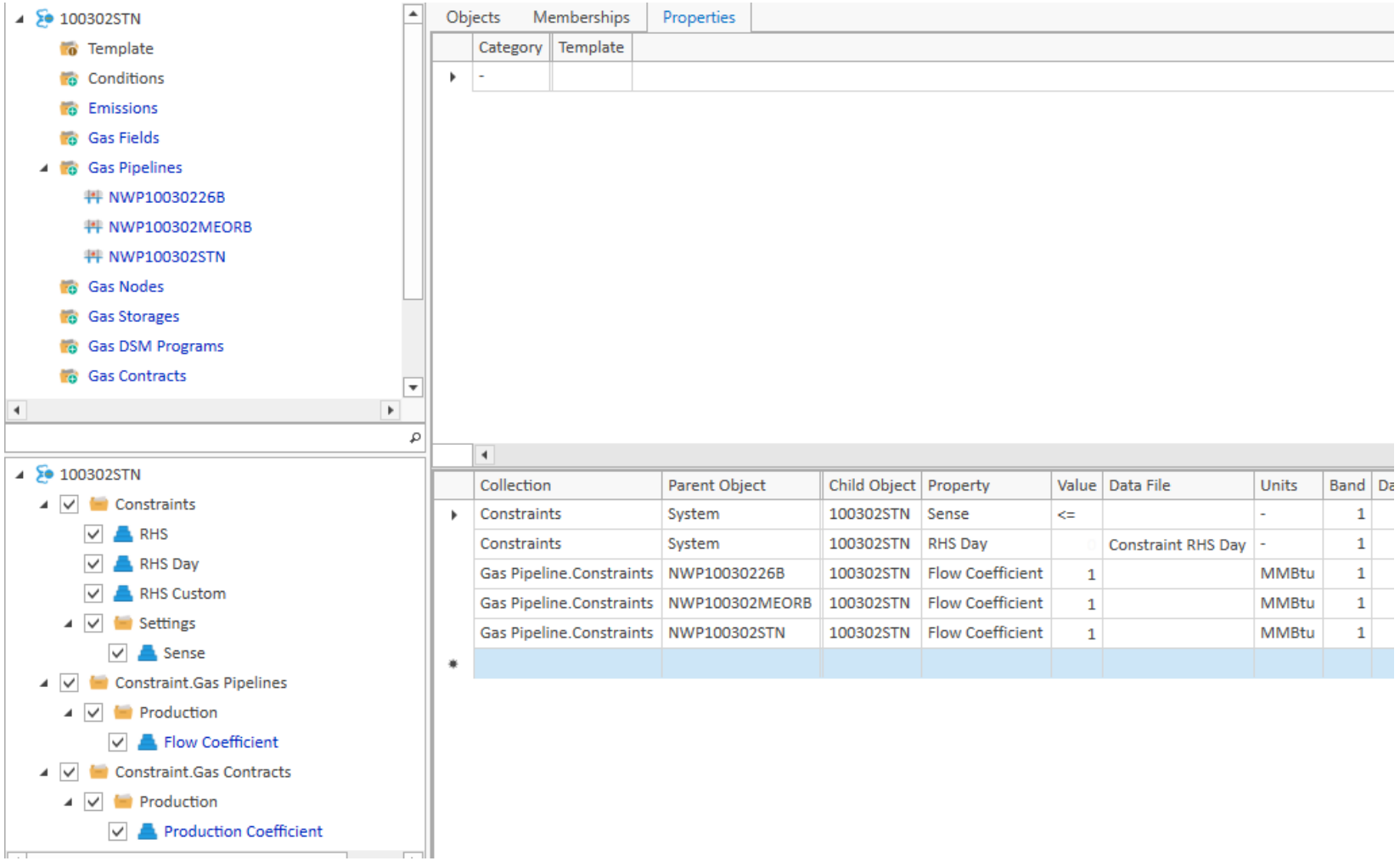
Transport Constraints

To simplify modeling in Plexos the software allows the user to group multiple paths of one contract into a constraint group.

This tells Plexos 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.

Transport Constraints Example



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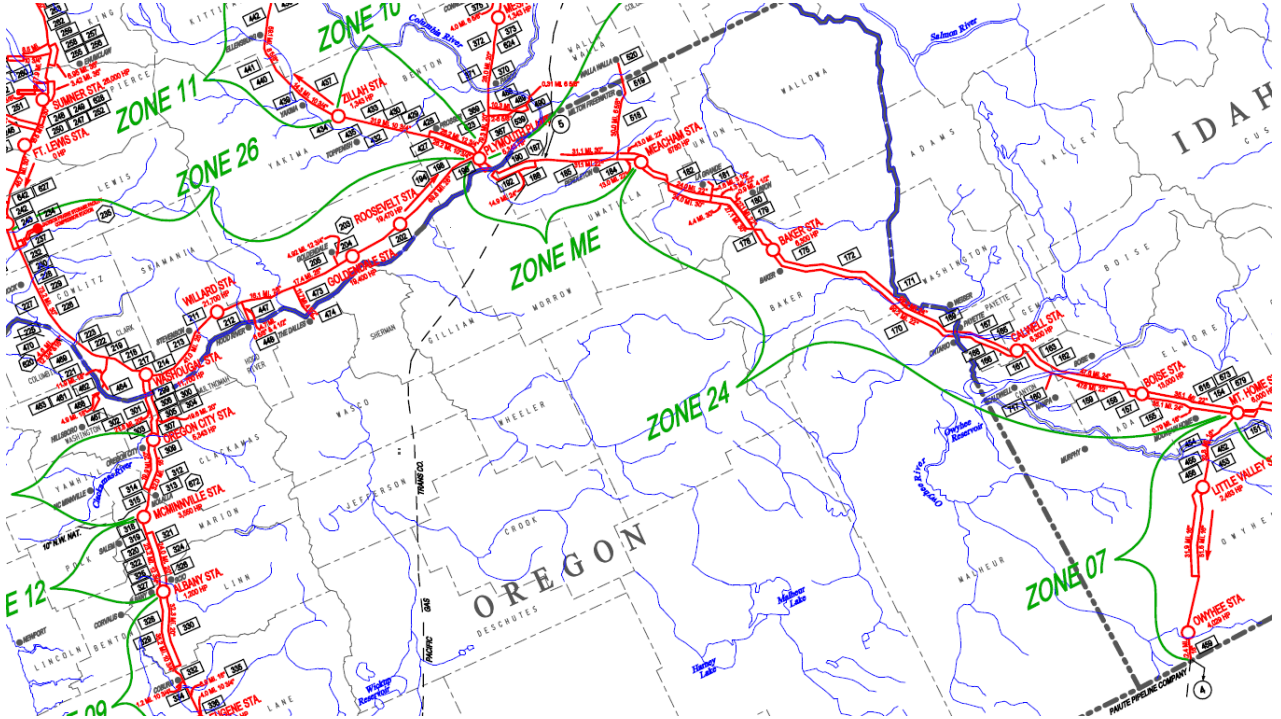
Location of Zones (Source: NWP)



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Emissions

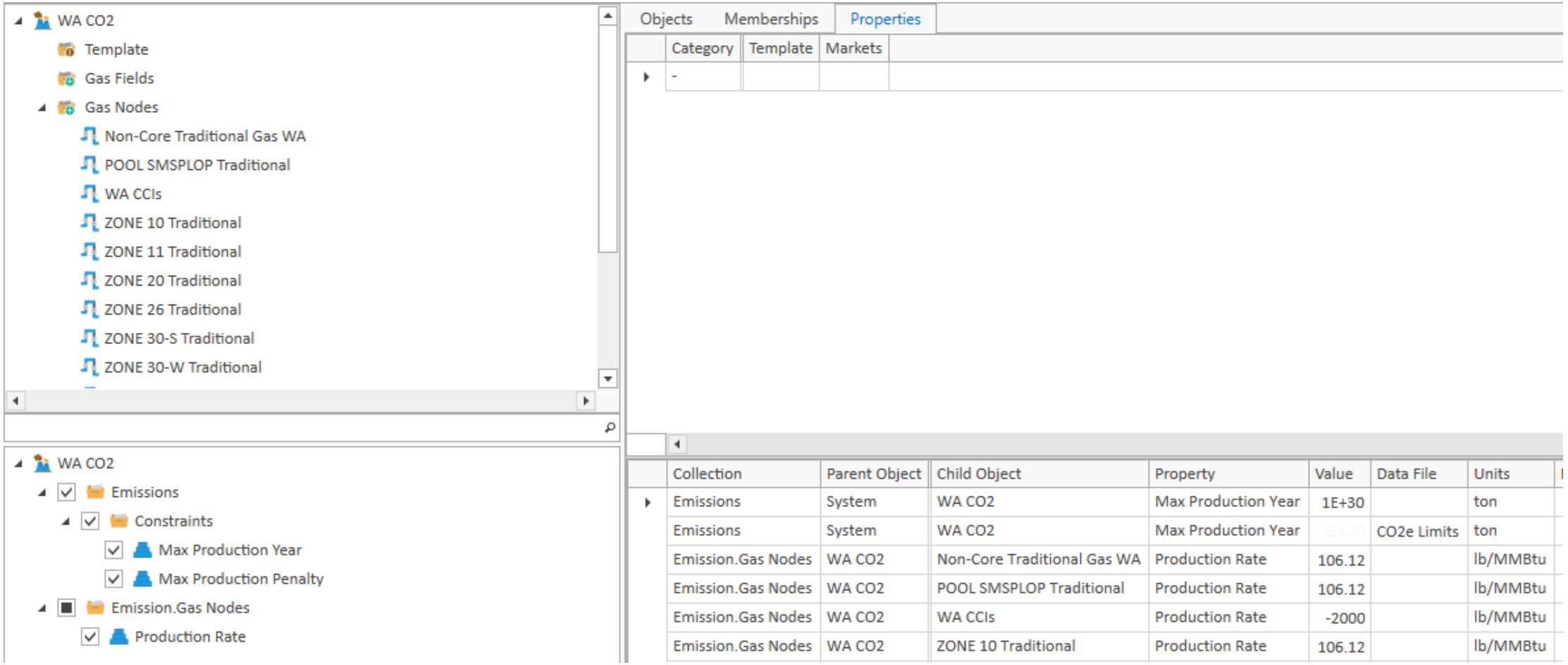
Cascade is modeling emissions as a constraint.

Emissions constraints are based on the Climate Commitment Act (CCA) for Washington and the Climate Protection Plan for Oregon.

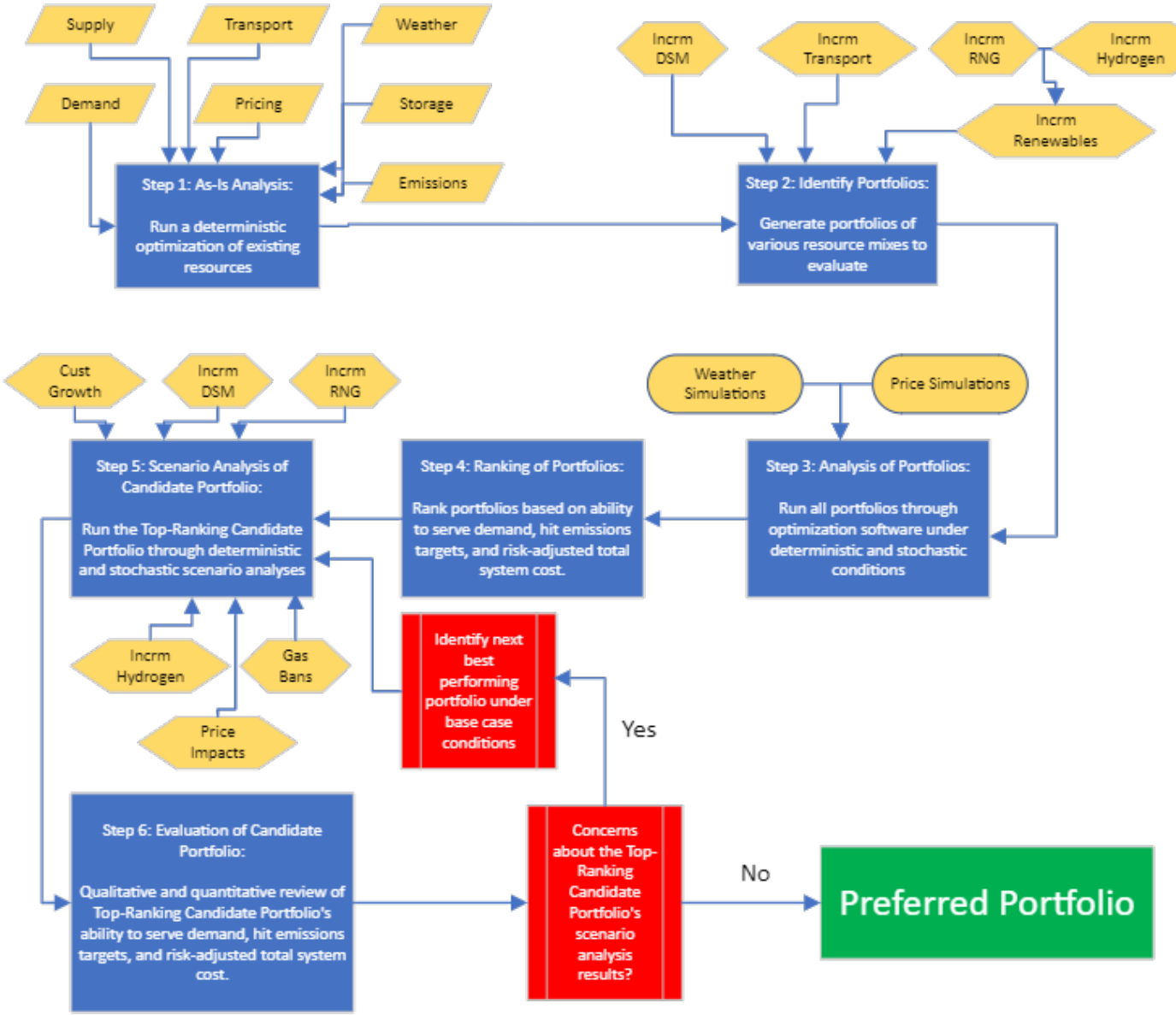
Plexos must balance traditional gas along with carbon offsets and renewable natural gas to meet demand while hitting emission reduction targets.

Cascade will discuss decarbonization planning further at TAG 4.

Emissions Example



Planned Scenarios and Sensitivities



Supply Resource Optimization Process Flow Chart

Supply Resource Optimization Process

Step 1: As-Is Analysis

- Run a deterministic optimization of existing resources to uncover timing and quantity of resource deficiencies.

Step 2: Identify Portfolios

- Cascade will be evaluating six different portfolios of incremental resources for the 2023 IRP. Each will be a mix of various incremental resources, including transportation capacity, RNG, Hydrogen, and DSM.

Step 3: Analysis of Portfolios

- Each portfolio will be run through the Plexos optimizer under expected conditions (see Base Case scenario.) The portfolios will be evaluated under deterministic and stochastic weather/pricing, and the timing/quantity if applicable of unserved demand and emissions reductions shortfalls will be recorded. Cascade will also record the risk-adjusted total system cost of each portfolio.

Supply Resource Optimization Process Cont.

Step 4: Ranking of Portfolios

- The Top Ranking Candidate Portfolio will be the portfolio that is able to serve all forecasted demand over the planning horizon while hitting all emissions reductions goals. In the case of multiple portfolios accomplishing this, the portfolio that does it with the lowest risk-adjusted total system cost will be the Top-Ranking Candidate Portfolio.

Step 5: Scenario Analysis of Candidate Portfolio

- The Top Ranking Candidate Portfolio is re-run through the Plexos optimizer under five scenarios. These scenarios will provide sensitivity testing of customer growth, energy efficiency, RNG, hydrogen, Natural Gas bans, and Natural Gas pricing. The portfolio will be evaluated under deterministic and stochastic weather/pricing, and the timing/quantity if applicable of unserved demand and emissions reductions shortfalls will be recorded. Cascade will also record the risk-adjusted total system cost of each portfolio.

Step 6: Evaluation of Candidate Portfolio

- Cascade performs a qualitative and quantitative review of Top-Ranking Candidate Portfolio's ability to serve demand, hit emissions targets, and the risk-adjusted total system cost of the portfolio under the scenarios evaluated. If there are concerns about the portfolio's ability to hit these metrics, or the cost of hitting these metrics, the Company may loop back to Step 5 with a new portfolio that might be more insulated against identified risks. Otherwise, the portfolio is named Cascade's Preferred Portfolio.

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?

2023 IRP Proposed Scenarios	Scenario						
	Base Case - OR-CPP and WA-CCA	**Carbon Neutral by 2050**	**Limited RNG availability**	**Electrification**	**High Customer Case**	**High Price - Interrupted Supply**	**Other?**
Customer Growth	Current Expectations			No new customers after 2030	High Customer Counts	Current Expectations	
Energy Efficiency	CPA Projections	Scenario 2 CPA Projections				CPA Projections	
Renewable Natural Gas	Expected Availability	Expected - High Avail.	Low Availability	Expected - High Avail.		Expected Availability	
Hydrogen	Expected Availability	Expected - High Avail.	Low Availability	Expected - High Avail.		Expected Availability	
Natural Gas Bans	Current Bans			Additional Bans	Current Bans		
Natural Gas Price	Expected Price	Adjusted Price?	Expected Price	Adjusted Price?		High Price	

Resource Integration

Scenario 1 – Base Case

- Main Element: Expected values for all sensitivities
- Customer Growth: Based on 2023 IRP Load Forecast
- Energy Efficiency: Based on 2023 CPAs from Cascade (WA) and ETO (OR)
- RNG Availability: Cascade weighted share high/technical blend of AGF/ICF Study
- Hydrogen Availability: Maximum blend of 20% supply by volume
- Natural Gas Bans: Consideration of all expected bans in load forecast
- Natural Gas Price: Based on 2023 IRP Price Forecast

Scenario 2 – Carbon Neutral by 2050

- Main Element: Zero CO2e emissions by 2050 as per CCA/CPP guidelines
- Customer Growth: Based on 2023 IRP Load Forecast
- Energy Efficiency: Based on adjusted 2023 CPAs from Cascade (WA) and ETO (OR) using higher commodity cost as input into avoided cost
- RNG Availability: Cascade weighted share of technical potential of AGF/ICF Study
- Hydrogen Availability: Maximum blend of 30% supply by volume
- Natural Gas Bans: Consideration of all expected bans in load forecast
- Natural Gas Price: 10% downward adjustment to 2023 IRP Price Forecast, higher price of RNG volumes above and beyond base case, capped at $26/dth

Scenario 3 – Limited RNG Availability

- Main Element: Competition and stagnating technology leads to lower than expected RNG availability, conservative approach to hydrogen blending
- Customer Growth: Based on 2023 IRP Load Forecast
- Energy Efficiency: Based on adjusted 2023 CPAs from Cascade (WA) and ETO (OR) using higher commodity cost as input into avoided cost
- RNG Availability: Cascade weighted share of low potential of AGF/ICF Study
- Hydrogen Availability: Maximum blend of 5% supply by volume
- Natural Gas Bans: Consideration of all expected bans in load forecast
- Natural Gas Price: Geologic gas based 2023 IRP Price Forecast. Consideration of higher price for RNG

Scenario 4 – Increased Electrification

- Main Element: Lower than expected load projections due to both discretionary electrification and increased regulatory bans on natural gas.
- Customer Growth: customer growth in Cascade's residential and commercial rate classes gradually slows to zero growth in 2025 and afterwards, residential and commercial customer count reduced to 10% by 2050
- Energy Efficiency: Based on adjusted 2023 CPAs from Cascade (WA) and ETO (OR) using higher commodity cost as input into avoided cost
- RNG Availability: Cascade weighted share high/technical blend of AGF/ICF Study
- Hydrogen Availability: Maximum blend of 20% supply by volume
- Natural Gas Bans: Consideration of all expected and proposed bans in load forecast
- Natural Gas Price: 10% downward adjustment to 2023 IRP Price Forecast

Scenario 5 – High Customer Growth

- Main Element: Higher than expected customer growth, with the same emissions reduction requirements in the CPP/CCA
- Customer Growth: Based on high growth projections of the 2023 IRP Load Forecast
- Energy Efficiency: Based on adjusted 2023 CPAs from Cascade (WA) and ETO (OR) using higher commodity cost as input into avoided cost
- RNG Availability: Cascade weighted share of the technical potential in the AGF/ICF Study
- Hydrogen Availability: Maximum blend of 30% supply by volume
- Natural Gas Bans: Consideration of all expected bans in load forecast
- Natural Gas Price: 10% upward adjustment to 2023 IRP Price Forecast, higher price of RNG volumes above and beyond base case, capped at $26/dth

Scenario 6 – High Price – Interrupted Supply

- Main Element: Indiscriminate, stochastically derived incidents cause disruptions in availability of geologic gas at specific basins
- Customer Growth: Based on expected growth projections of the 2023 IRP Load Forecast
- Energy Efficiency: Based on 2023 CPAs from Cascade (WA) and ETO (OR)
- RNG Availability: Cascade weighted share high/technical blend of AGF/ICF Study
- Hydrogen Availability: Maximum blend of 20% supply by volume
- Natural Gas Bans: Consideration of all expected bans in load forecast
- Natural Gas Price: During incidents, price at other basins spike to 99th percentile stochastic pricing

Alternative Resources

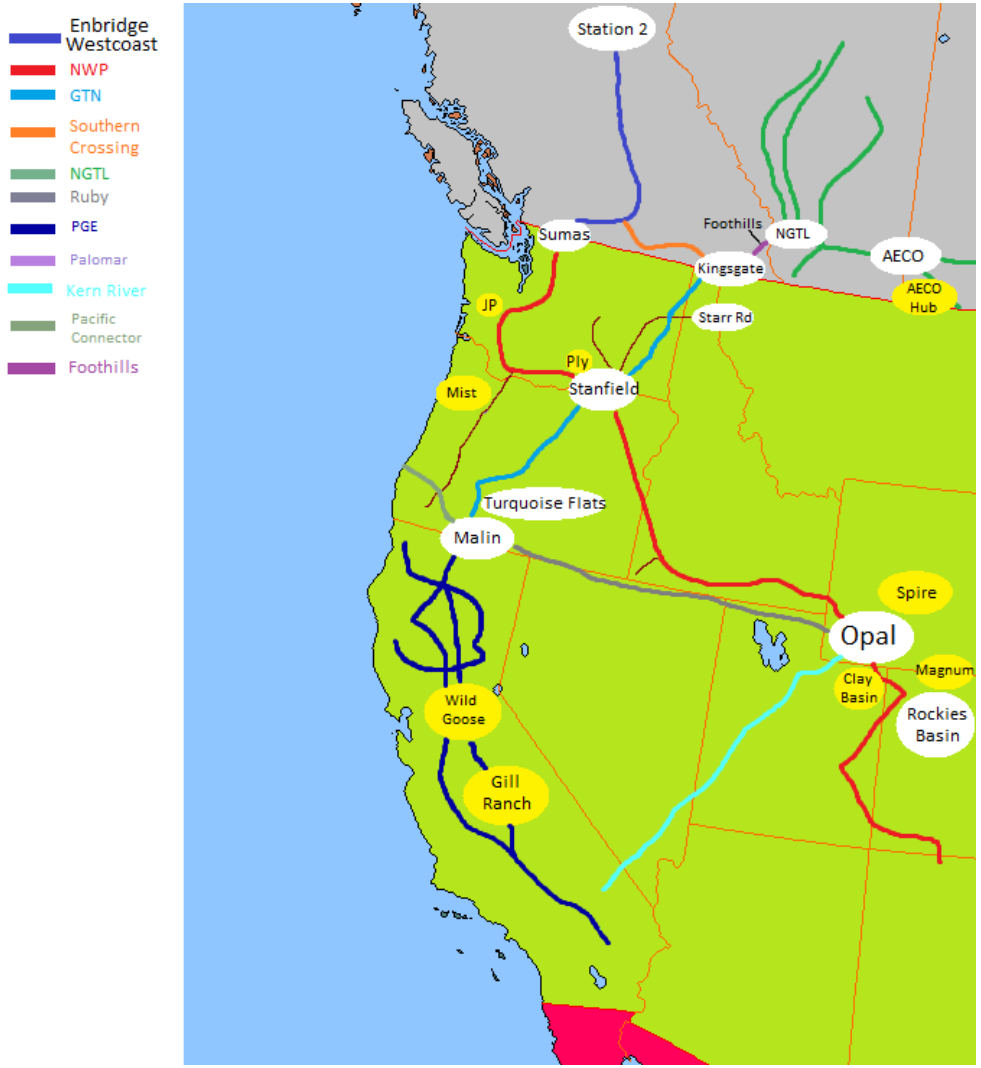
Major resource issues on the horizon

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.

Emissions reduction planning has added another level of planning that could create modeling shortfalls.

Plexos is used to ultimately derive the optimal mix of resources, referred to as the “preferred portfolio.”



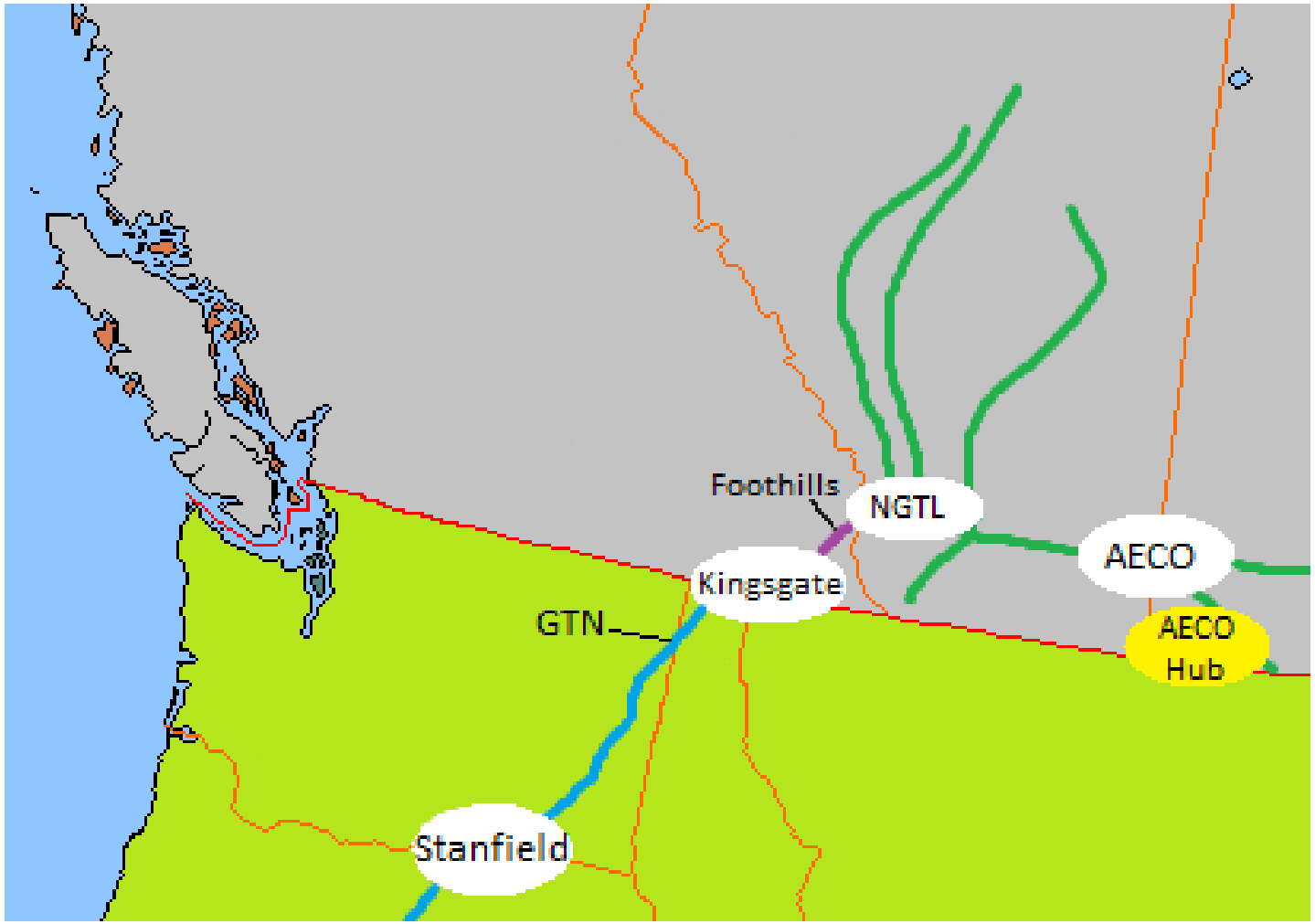
Location of Current & Alternative Resources

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 N/S – Additional capacity to move gas from Kingsgate to various citygates along GTN



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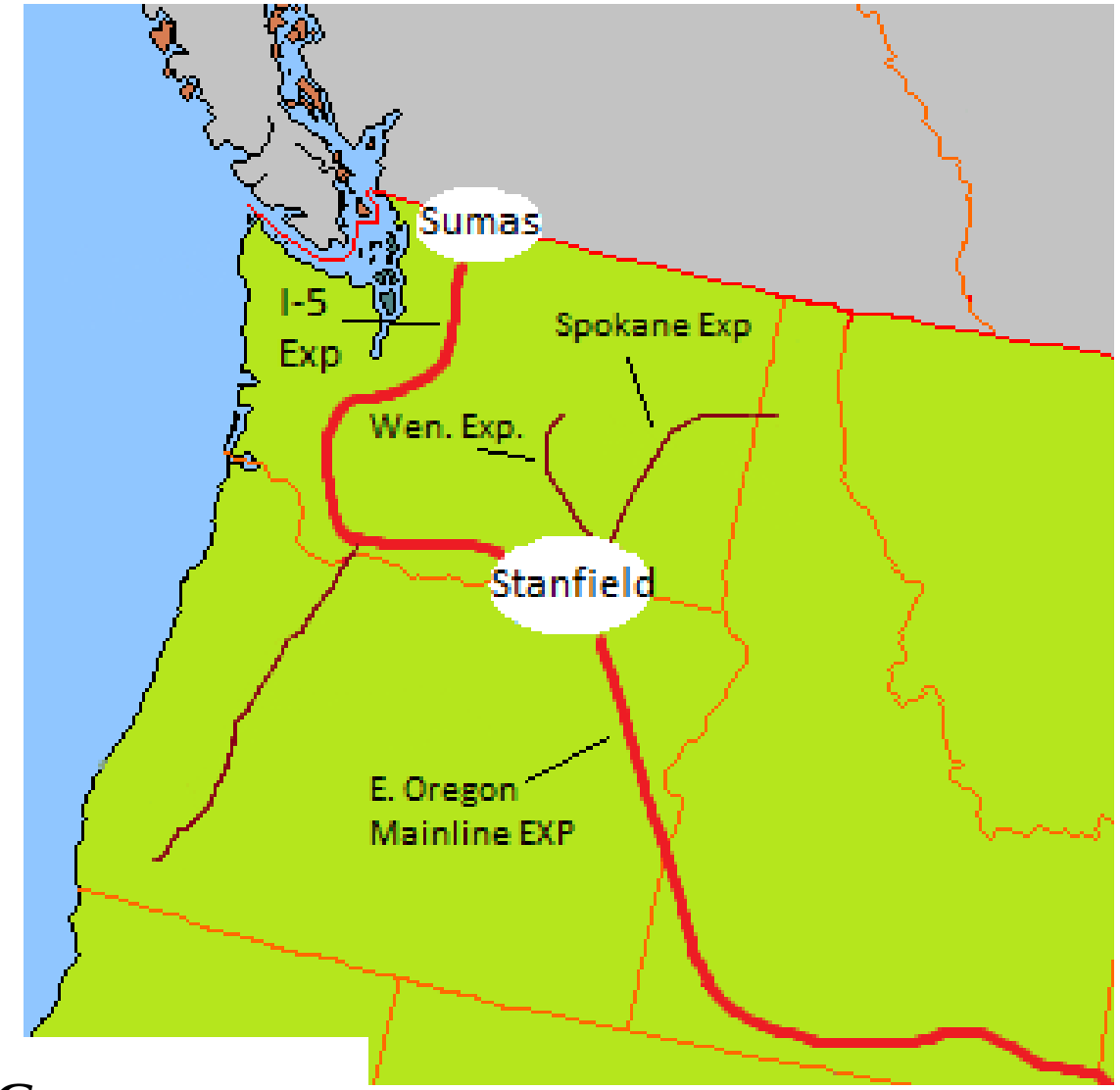

Incremental Transport – Northwest Pipeline

- 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

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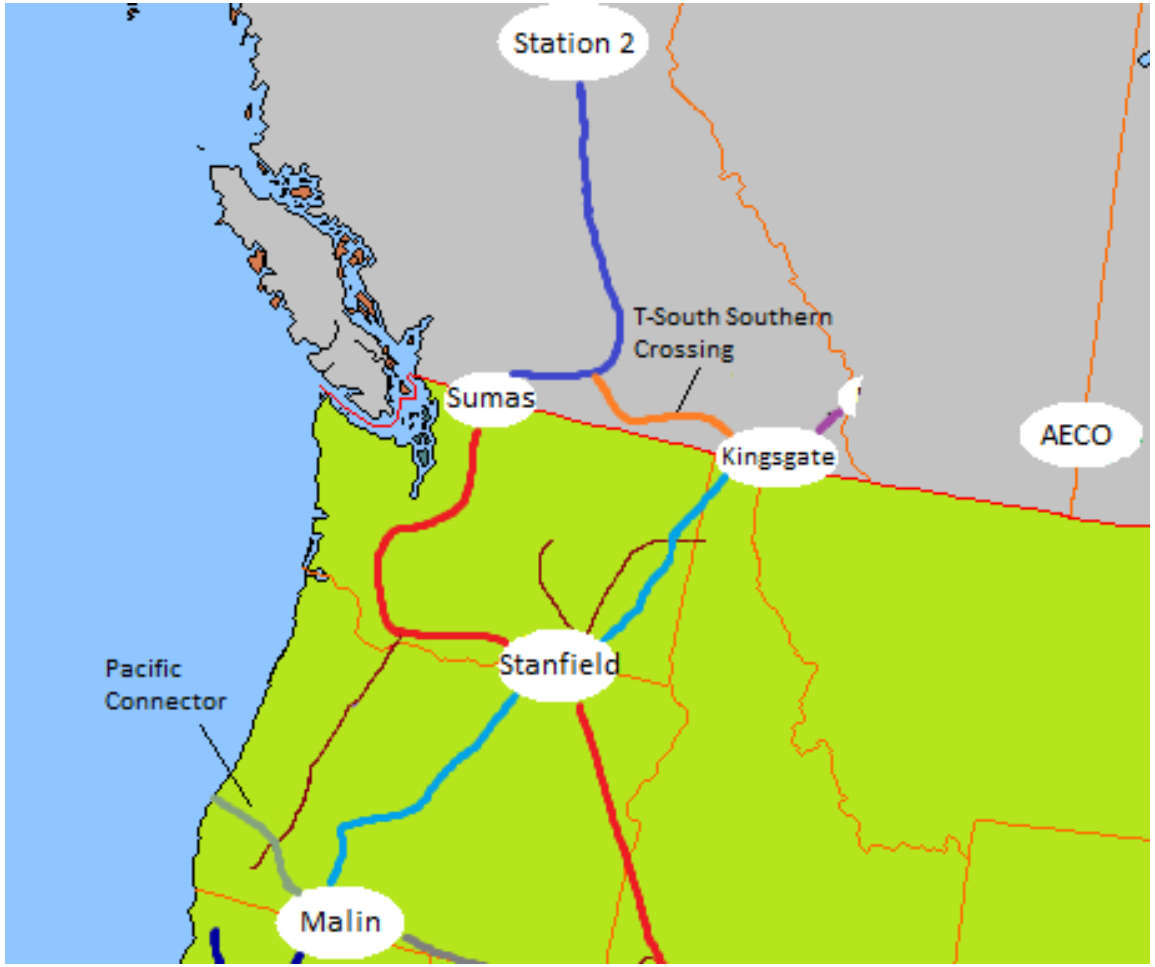


Incremental Transport – Bilateral

- T-South Southern Crossing – Price arbitrage opportunity to move gas between Sumas and AECO basins bilaterally
- Pacific Connector – Pipeline that will feed LNG facility on Oregon coast, increasing liquidity at Malin

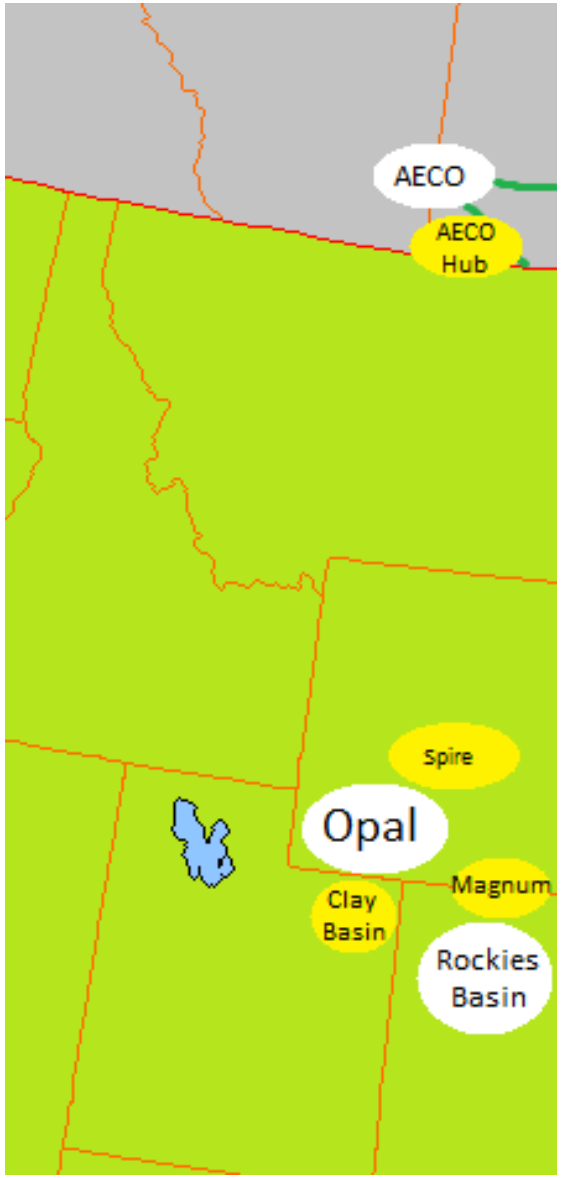
Incremental Storage - North and East

Spire 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



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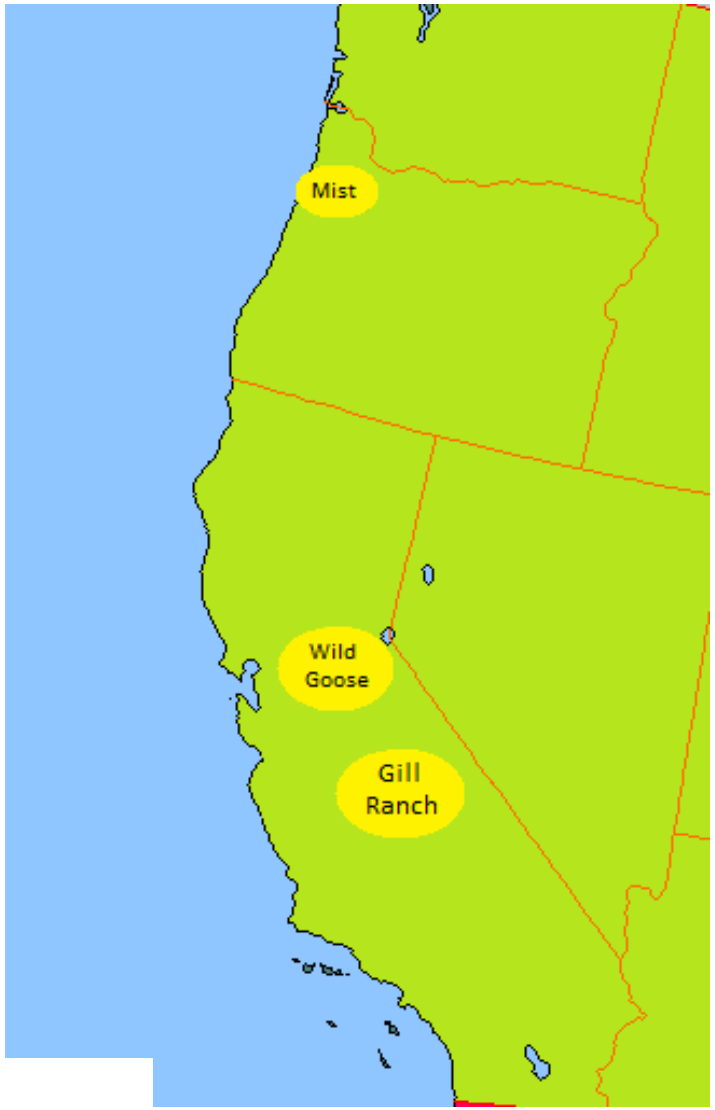


Incremental Storage - South and West

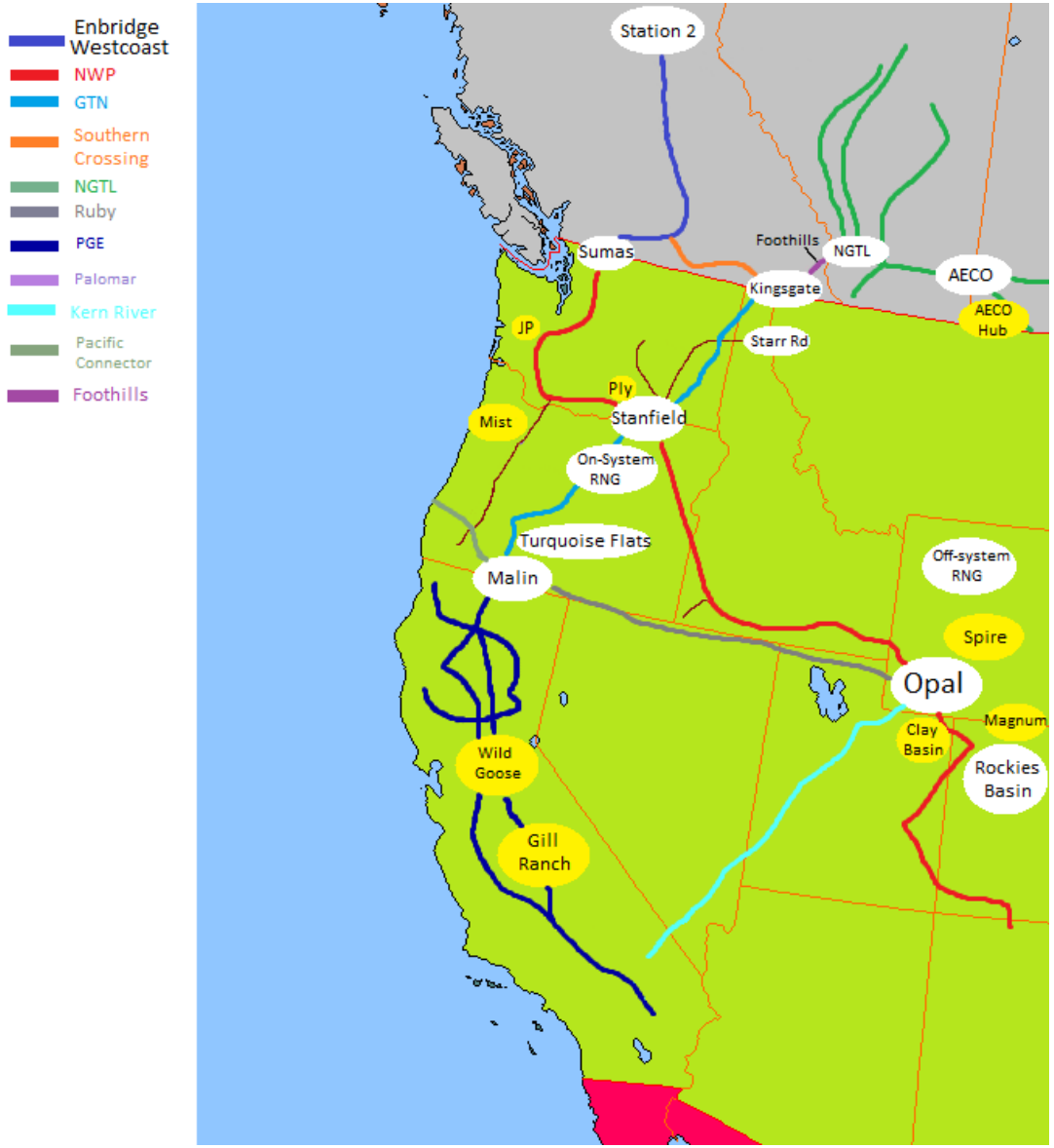
- Gill Ranch Storage – Additional storage in central California, serving the system, primarily Oregon
- Mist Storage – Additional storage in northern Oregon, serving the system, primarily Washington
- Wild Goose Storage – Additional storage in northern California, serving the system, primarily Oregon

Incremental Supplies

Incremental Opal Supply – Additional supply around the Rockies Basin

Renewable Natural Gas – Incremental biogas supply directly to distribution system

Hydrogen – Incremental Hydrogen supply directly to distribution system



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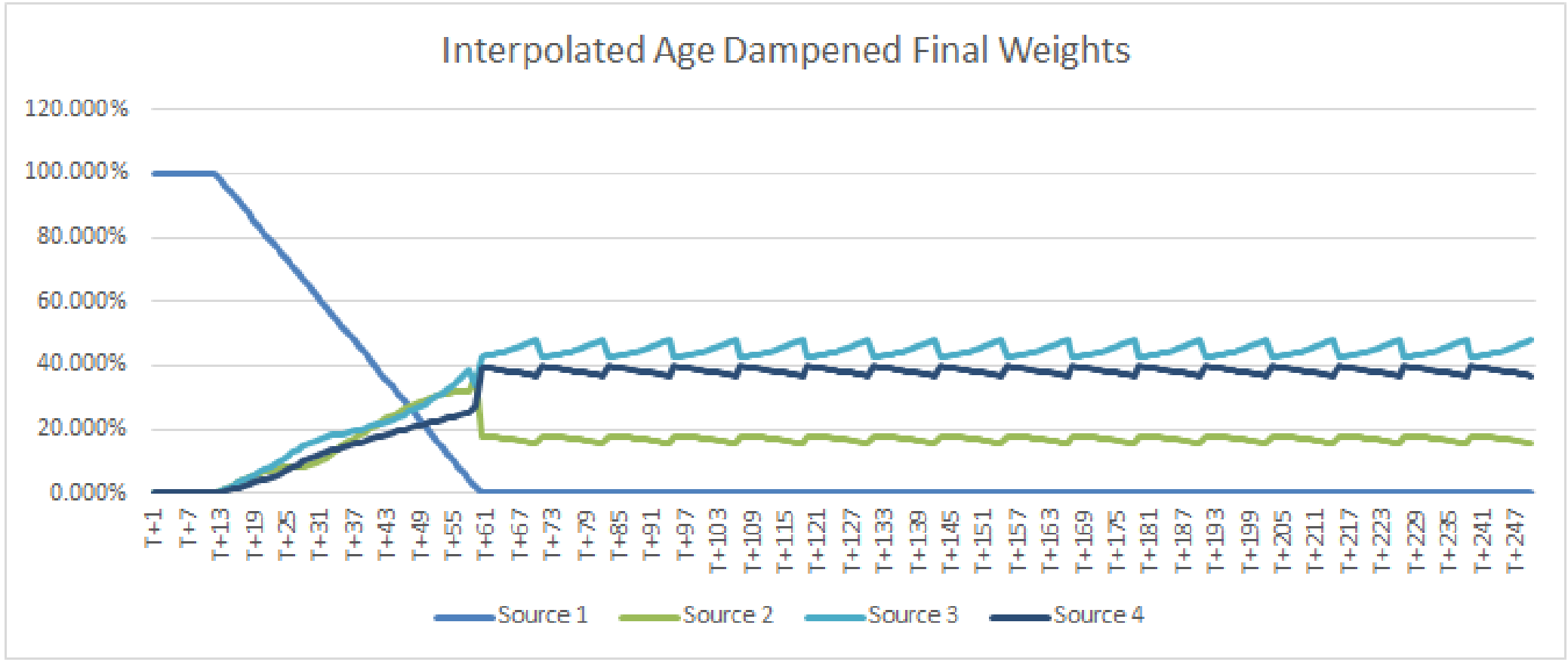
Price Forecast Results


Interpolated Age Dampened Final Weights
120.000%
100.000%
80.000%
60.000%
40.000%
20.000%
0.000%
T+1
T+7
T+13
T+19
T+25
T+31
T+37
T+43
T+49
T+55
T+61
T+67
T+73
T+79
T+85
T+91
T+97
T+103
T+109
T+115
T+121
T+127
T+133
T+139
T+145
T+151
T+157
T+163
T+169
T+175
T+181
T+187
T+193
T+199
T+205
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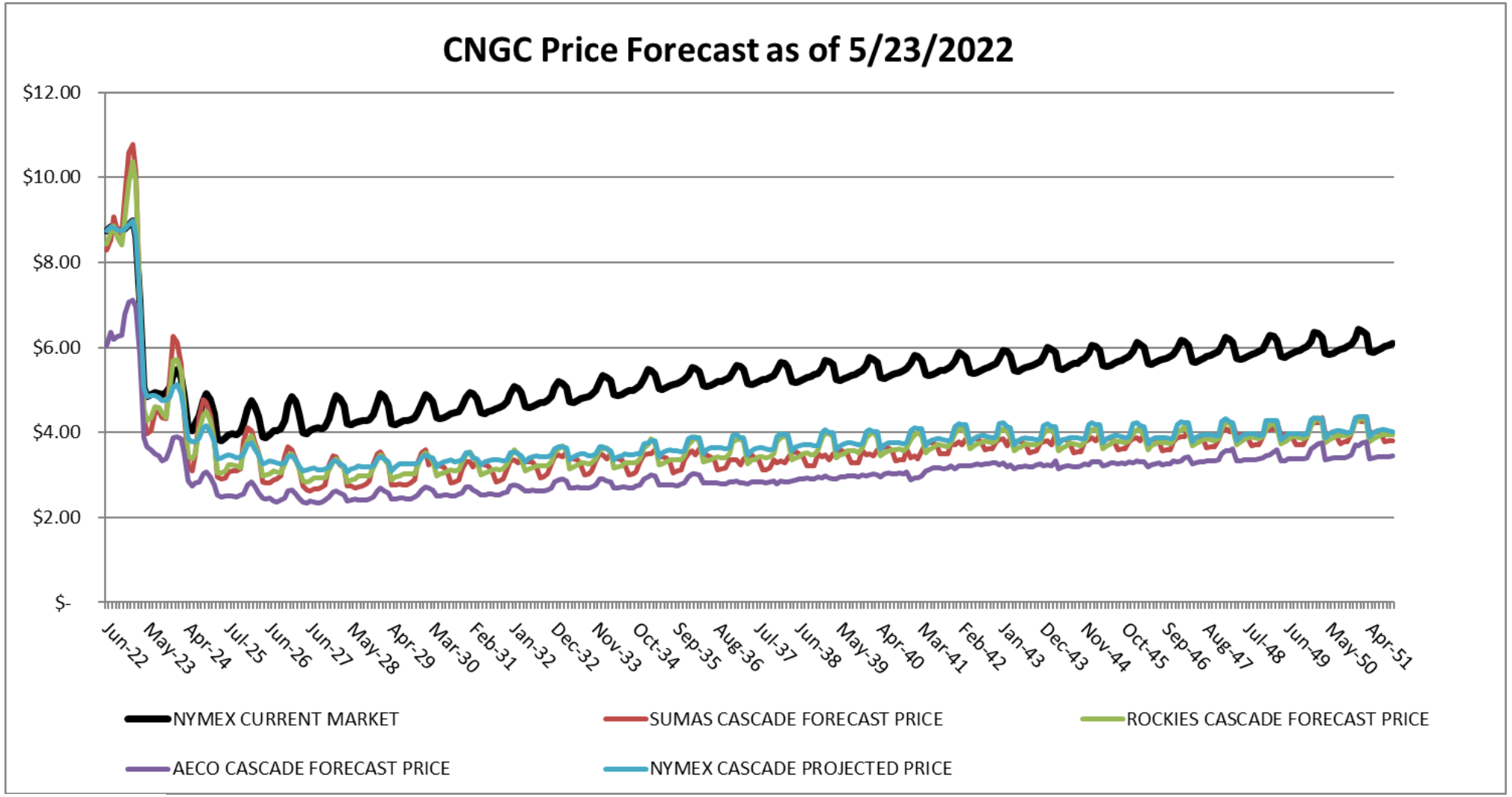
T+217
T+223
T+229
T+235
T+241
T+247
Source 1
Source 2
Source 3
Source 4


CNGC Price Forecast as of 5/23/2022
$12.00
$10.00
$8.00
$6.00
$4.00
$2.00
$-
Jun-22
May-23
Apr-24
Jul-25
Jun-26
Jun-27
May-28
Apr-29
Mar-30
Feb-31
Jan-32
Dec-32
Nov-33
Oct-34
Sep-35
Aug-36
Jul-37
Jun-38
May-39
Apr-40
Mar-41
Feb-42
Jan-43
Dec-43
Nov-44
Oct-45
Sep-46
Aug-47
Jul-48
Jun-49
May-50
Apr-51
NYMEX CURRENT MARKET
SUMAS CASCADE FORECAST PRICE
ROCKIES CASCADE FORECAST PRICE
AECO CASCADE FORECAST PRICE
NYMEX CASCADE PROJECTED PRICE

Avoided Cost Methodology and Calculation

Avoided Cost Overview

As part of the IRP process, Cascade produces a 28-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.

Avoided Cost Overview

For the 2023 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 revised from the 2020 IRP.

The various elements of the avoided cost will need to be reconsidered with regards to emissions reductions goals.

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:

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

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_v = Variable Transportation Costs

TC_v = Fixed Transportation Costs (When Avoidable)

SC_v = Variable Storage Costs

CC = Commodity Costs

E_{Comp} = Environmental Compliance Costs

DSC = Distribution System Costs

RP = Risk Premium

E_{adder} = Environmental Adder, as recommended by the Northwest Power and Conservation Council

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Methodology – Unchanged from 2020 IRP

Variable Transportation costs are pulled directly from the major pipelines that Cascade utilizes (NWP, GTN, Enbridge, Ruby, Nova Gas Transmission (NGTL) and Foothills).

Fixed Transportation are only included when avoidable (i.e.. potential to offset upstream capacity acquisition)

Storage costs are only captured if there is an avoidable future storage cost (i.e.. On system storage).

Commodity Costs are taken from Cascade's 28-year price forecast.

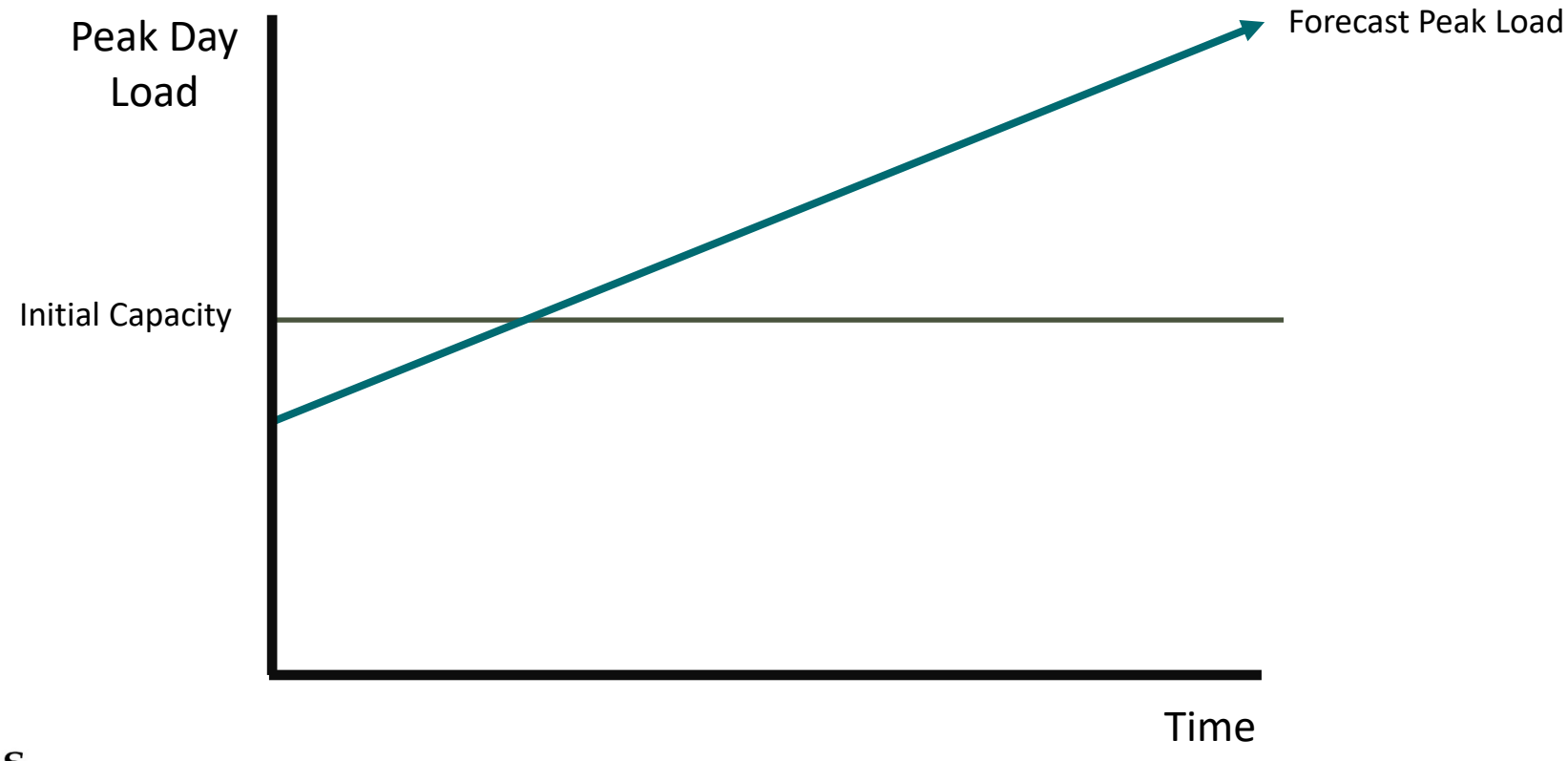
Environmental Compliance costs are derived from social cost of carbon with 2.5% discount rate, scaled up to real $2021

Environmental adder now applied to all elements of the avoided cost, still 10% as per NWPCC guidance

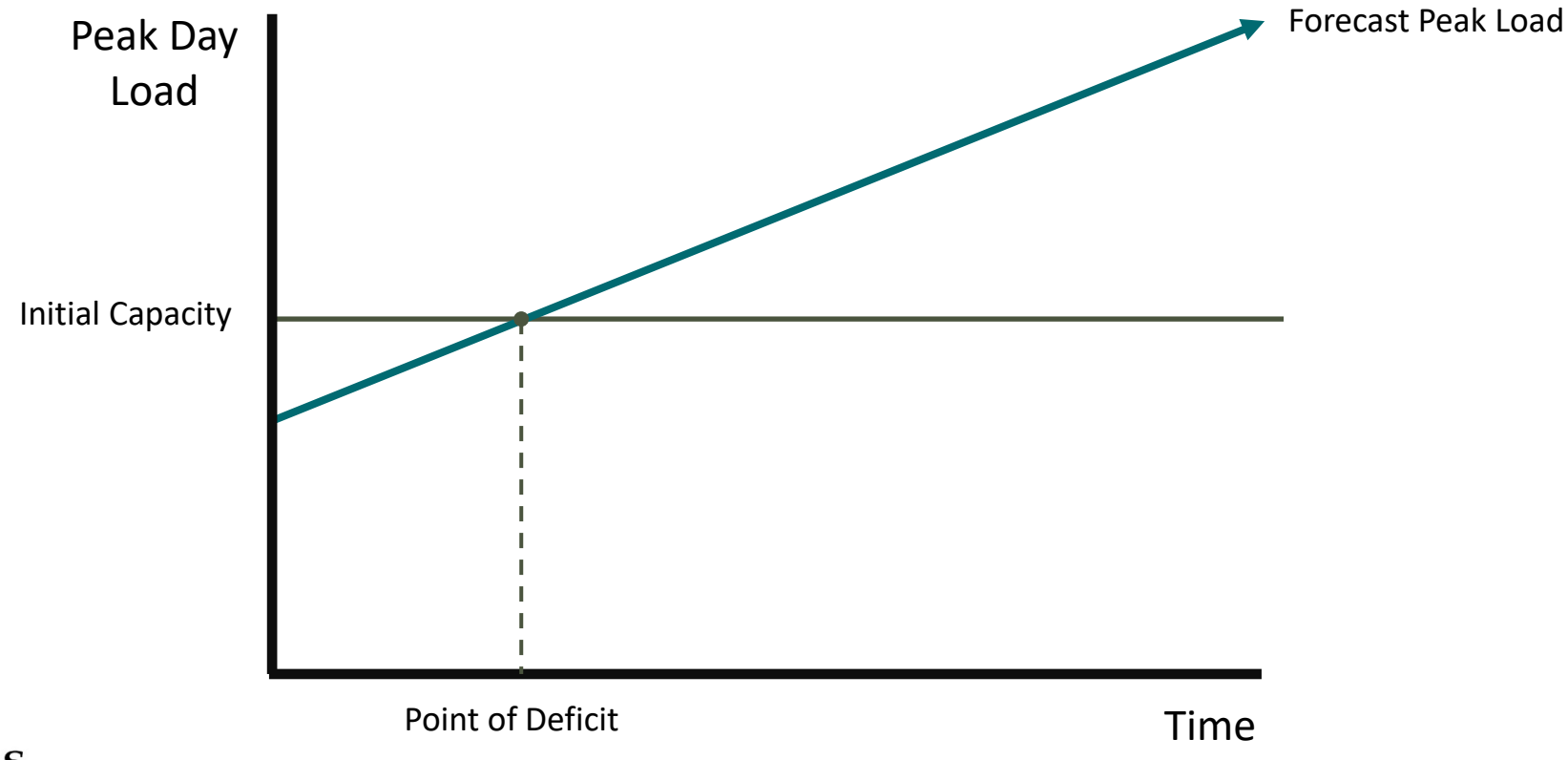
Methodology – Distribution System Costs

- For the 2023 IRP, Cascade has moved away from deriving distribution system costs from margin.
  - The Company's new distribution system cost calculation looks at forecasted capital expenses related ONLY to growth, and uses the company's load growth forecast to translate these costs to a per therm basis.
  - Additionally, it's important to recognize that while energy efficiency may not be able to fully eliminate the need for a distribution system enhancement, it can defer the need for these enhancements to a later year. Because of the economic principle of the time value of money, this deferral has value, and that value is the avoided distribution system cost
- Since Avoided Cost is based on peak day, this deferral value is then multiplied by the ratio of peak day demand to an average day's demand to get the 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.

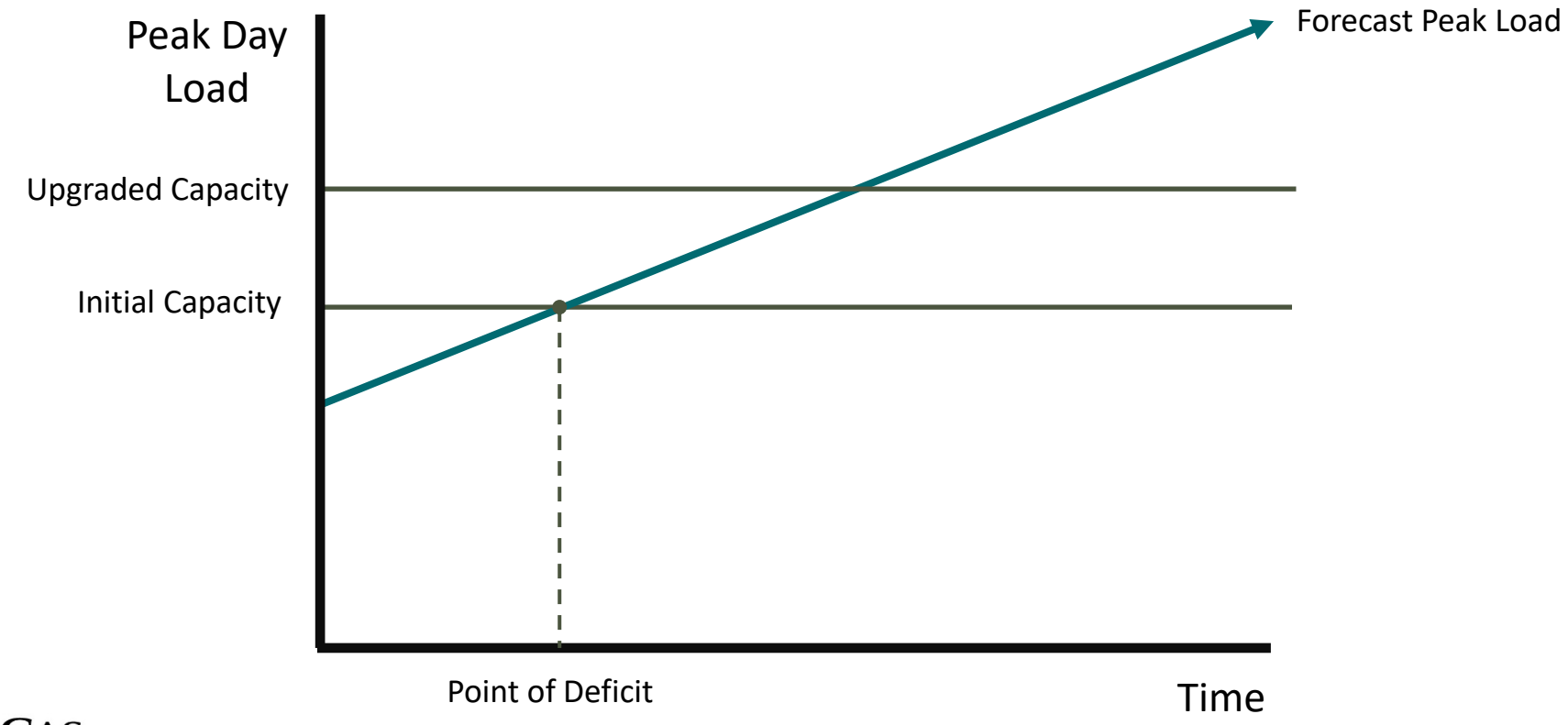
Capacity Modeling



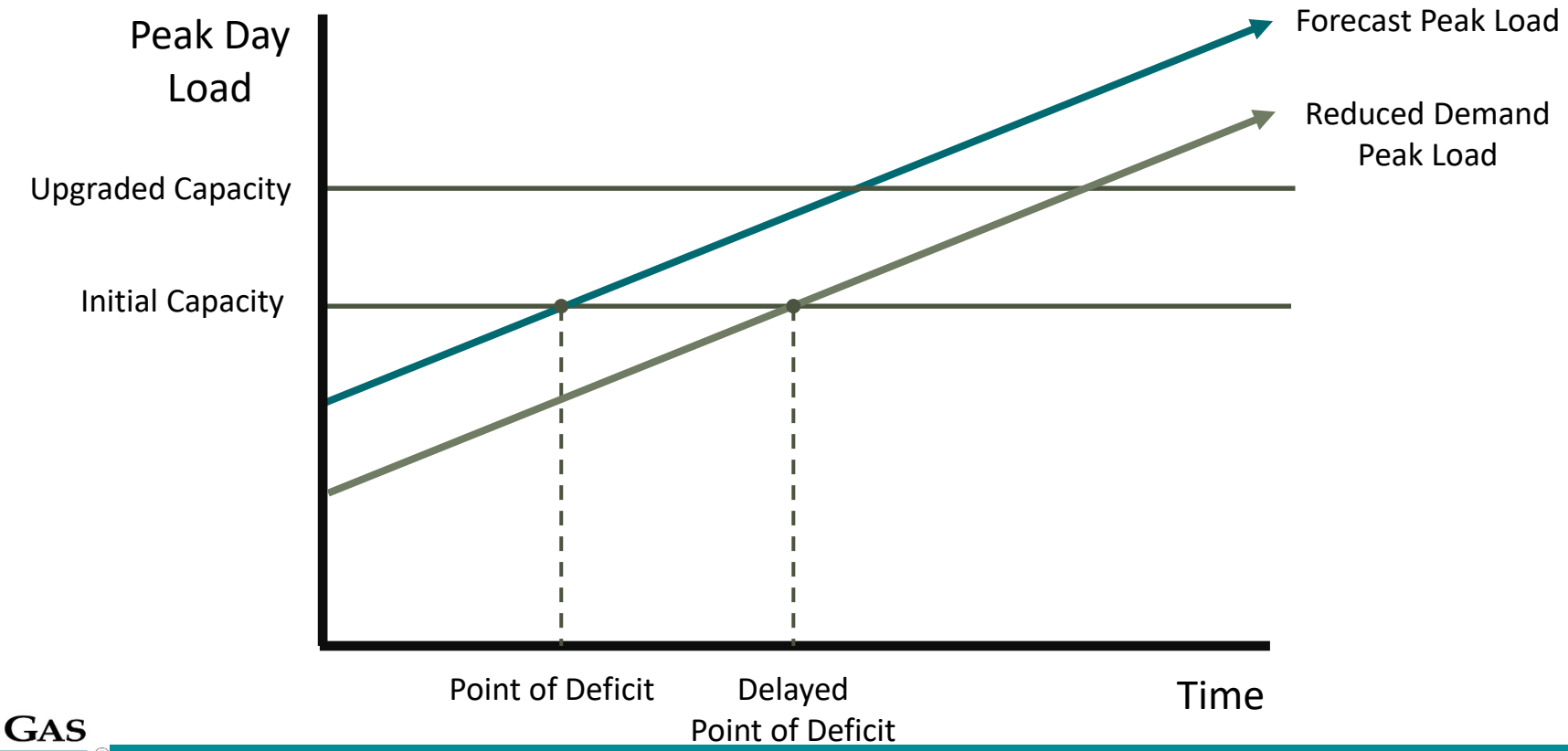
Capacity Modeling



Capacity Modeling



Capacity Modeling



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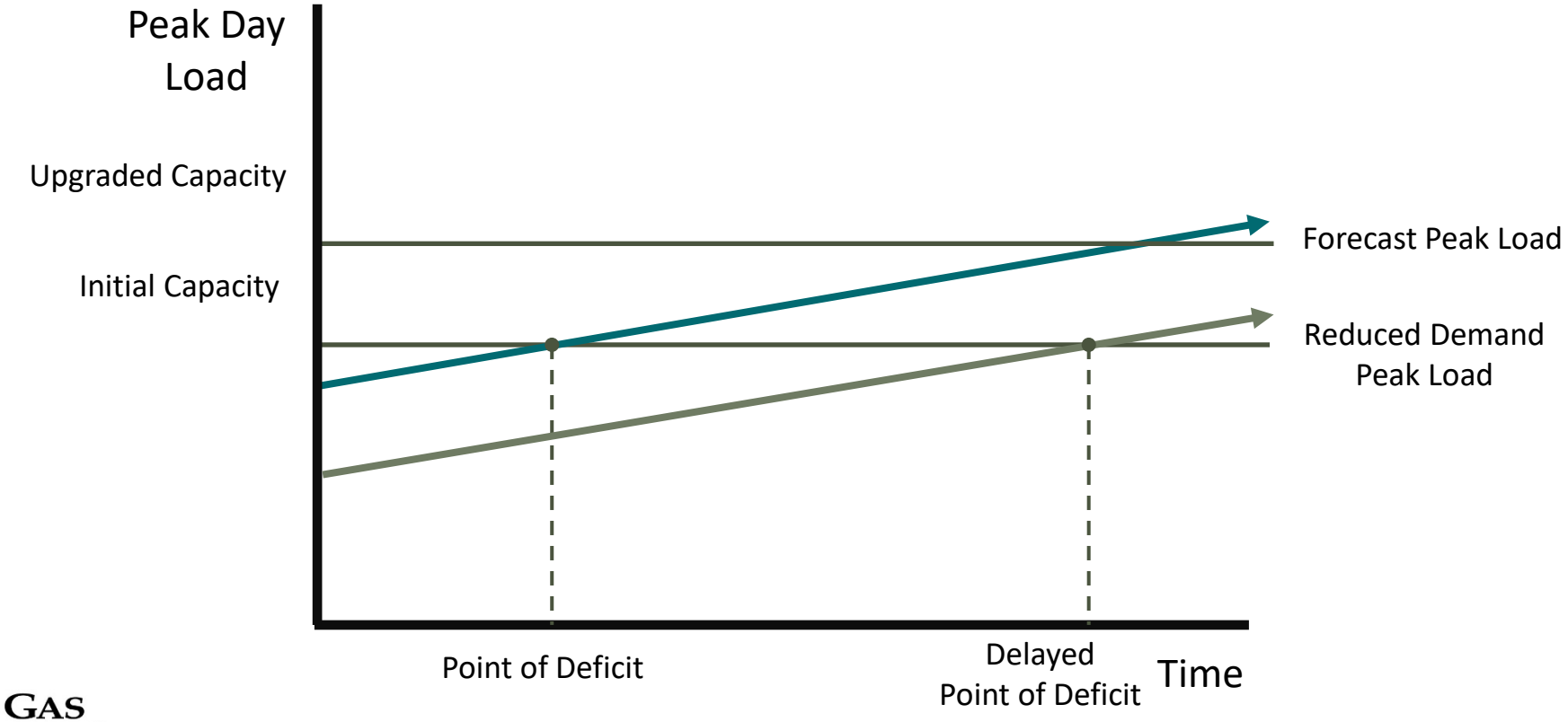
Capacity Modeling



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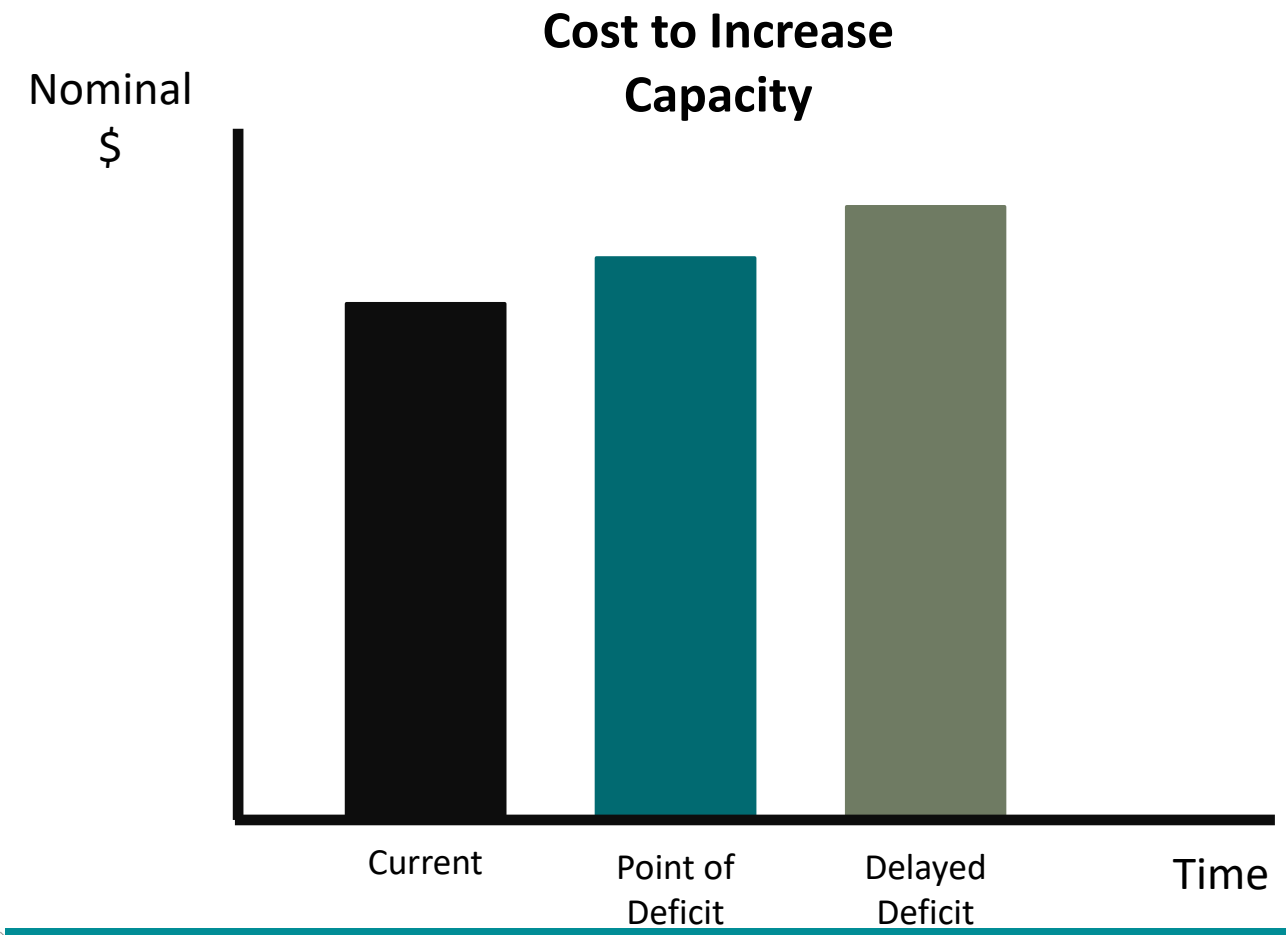
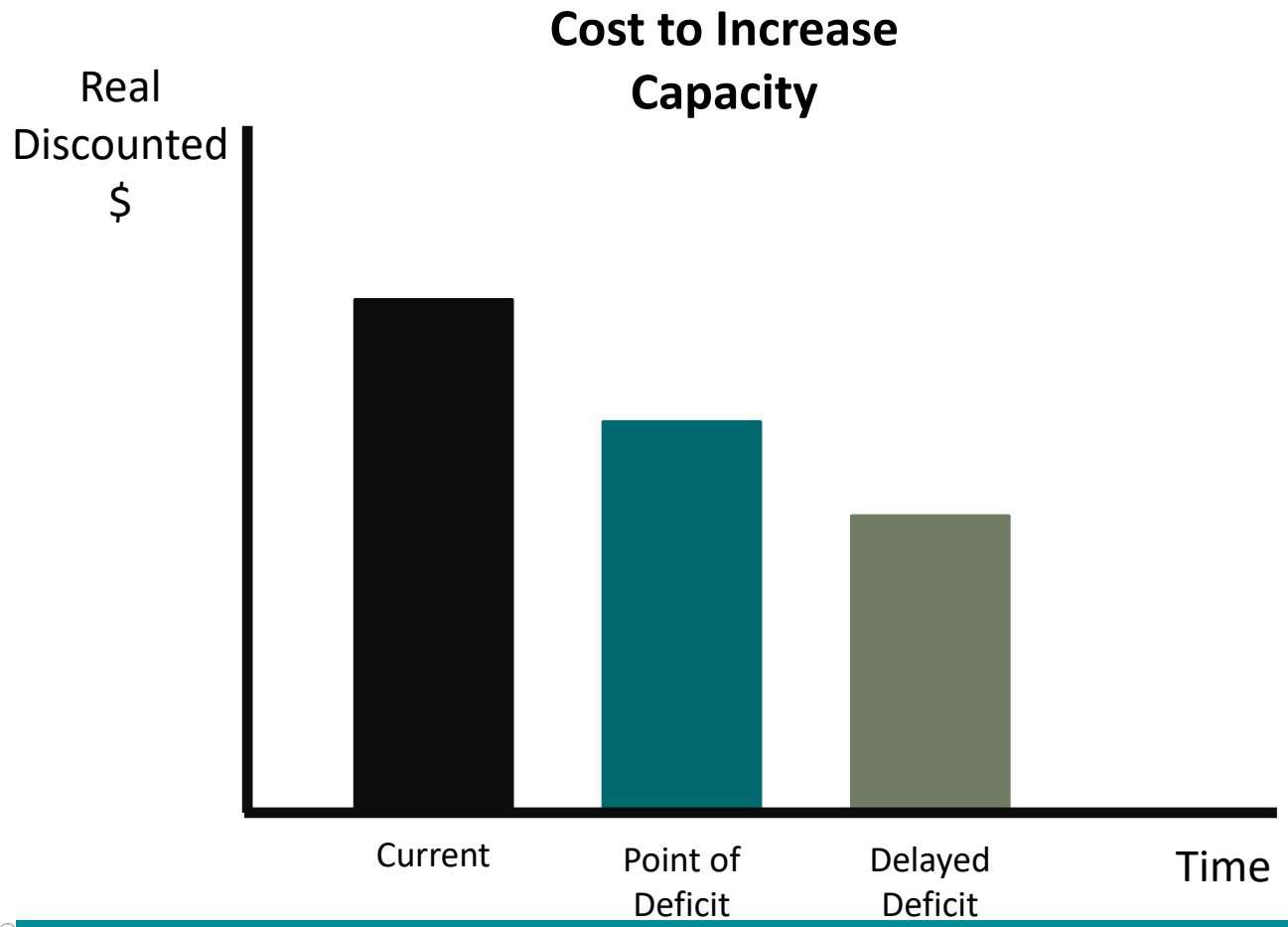
Cost of Capacity Enhancement



Deferral Valuation



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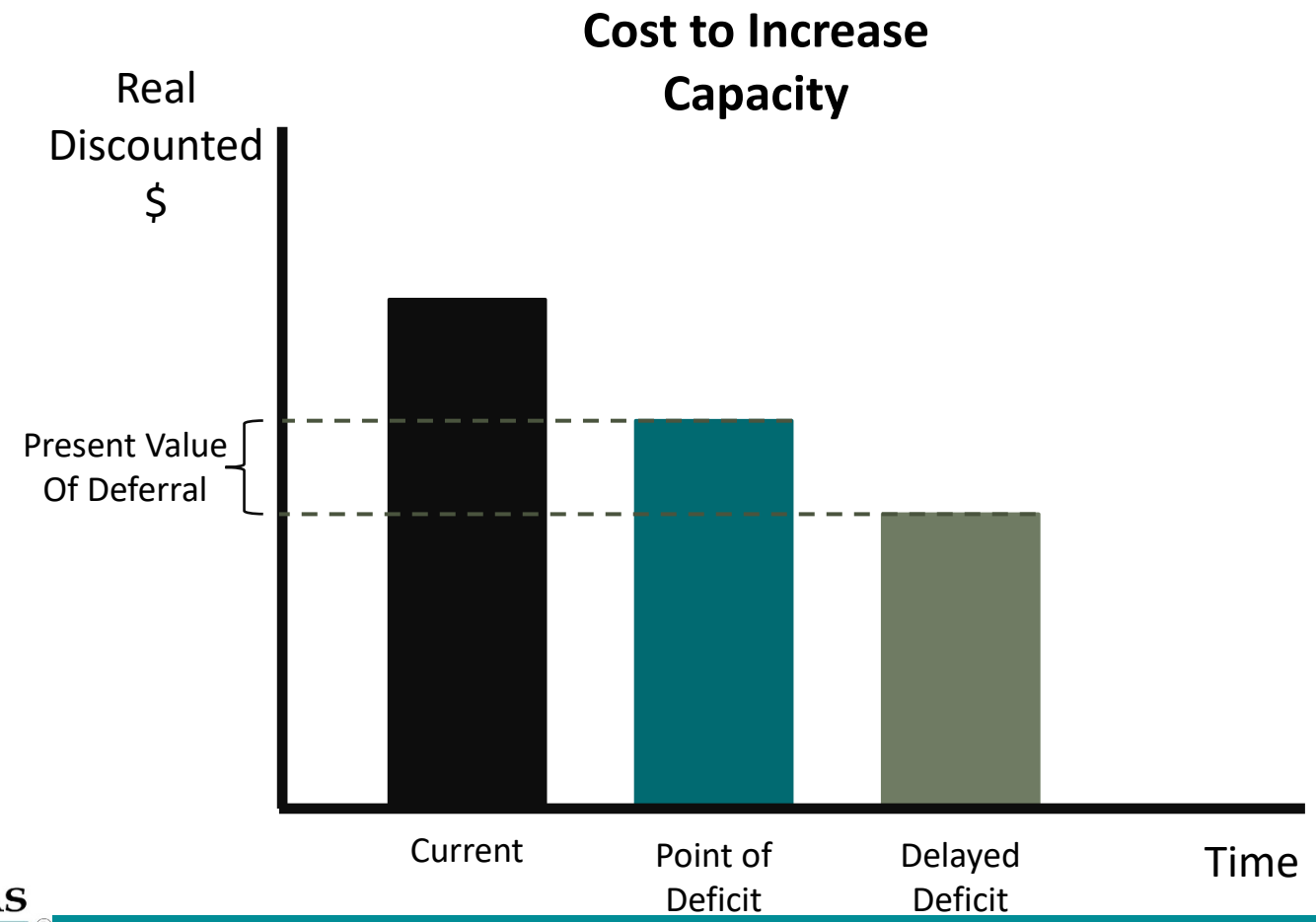
Deferral Valuation

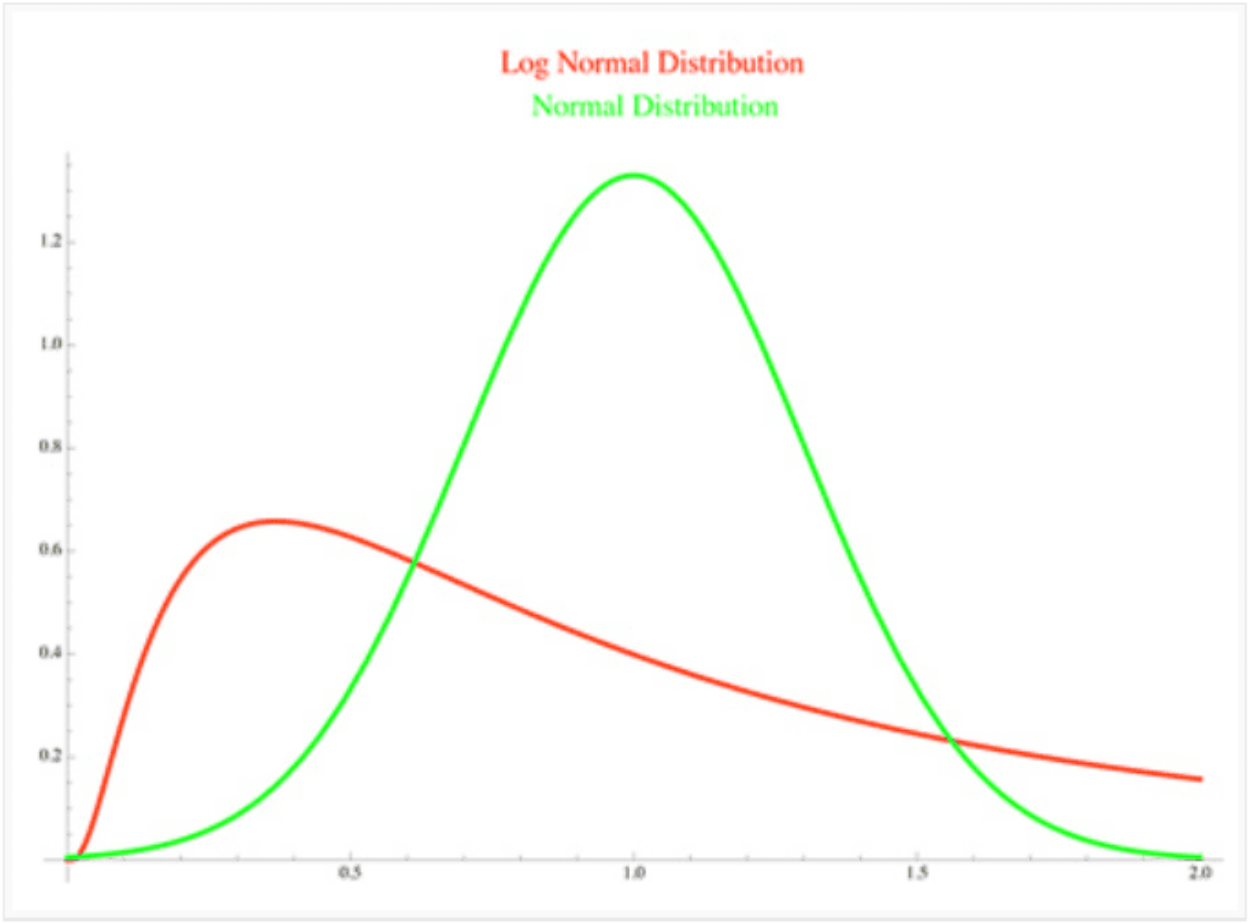


Methodology – Risk Premium

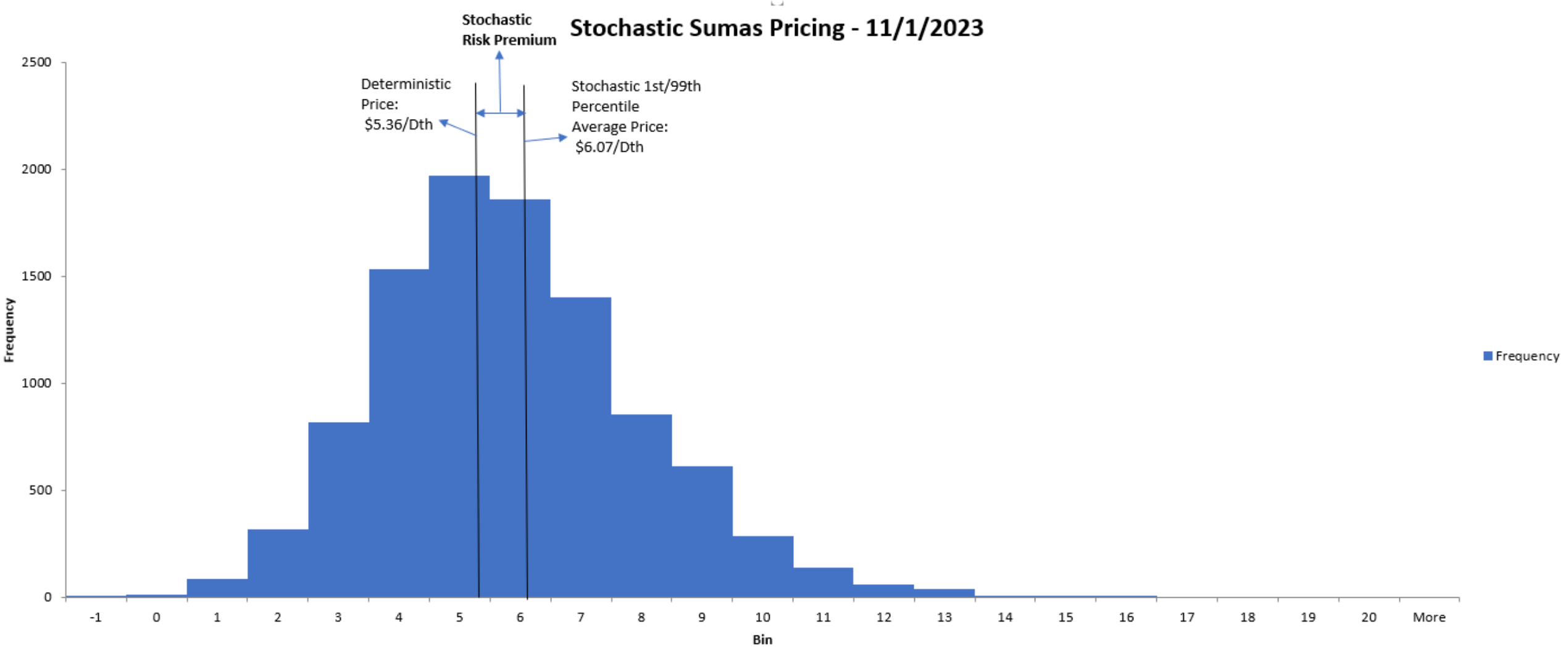
Cascade defines risk premium as the difference between the impacts of a potential extreme upward price movement versus that of an extreme downward price movement.

Due to the lognormal nature of stochastic gas prices, the risk presented from rising prices will typically exceed that of falling prices.

This analysis is used in a risk-adjusted price calculation, where the stochastic risk premium is compared to an annualized deterministic price to calculate the final risk premium.



A Quick Visual: Normal vs. Lognormal Distributions



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Risk-Adjusted Risk Premium Final Calculation

(Deterministic Price * .75 + (((99th Percentile Stochastic Price + 1st Percentile Stochastic Price) /2) * .25)) - Deterministic Price

- Captures the difference between expected pricing and a blend of deterministic and stochastic pricing
- This methodology is consistent with other risk-adjusted processes in Cascade's IRP, and informed by the calculations performed by other regional LDCs
- Accurately captures the increasing uncertainty around pricing, as nominal risk premium generally increases over time

2023 IRP Avoided Cost Risk Premium

Year #	Calendar Year	Risk Reduction Value ($/Dth)
1	2023	-$0.010
2	2024	-$0.011
3	2025	-$0.018
4	2026	-$0.013
5	2027	$0.001
6	2028	$0.014
7	2029	$0.046
8	2030	$0.077
9	2031	$0.175
10	2032	$0.239
11	2033	$0.204
12	2034	$0.146
13	2035	$0.125
14	2036	$0.256
15	2037	$0.235
16	2038	$0.168
17	2039	$0.225
18	2040	$0.263
19	2041	$0.296
20	2042	$0.296

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 has provided its avoided cost figures to the Company's energy efficiency team, who will be sending back a conservation potential assessment based on these inputs.

2023 IRP Remaining Schedule

Process Items	Process Elements	Date
TAG 3 (OR)	Alternative Resources, Price Forecast, Avoided Costs, Current Supply Resources, Transport Issues.	7/14/2022
TAG 4 (WA)	Distribution System Planning, Carbon Impacts, Energy Efficiency, Bio-Natural Gas, Preliminary Resource Integration Results.	8/10/2022
TAG 4 (OR)	Distribution System Planning, Carbon Impacts, Energy Efficiency (ETO), Bio-Natural Gas, Preliminary Resource Integration Results.	9/20/2022
TAG 5 (WA)	Final Integration Results, finalization of plan components, Proposed new 2- to 4-year Action Plan.	9/28/2022
TAG 5 (OR)	Final Integration Results, finalization of plan components, Proposed new 4-year Action Plan.	11/9/2022
Draft of 2022 IRP distributed (WA)	Filing of Draft IRP	11/24/2022
Draft of 2022 IRP distributed (OR)	Filing of Draft IRP	1/5/2023
Comments due on draft from all stakeholders (WA)	Comments due from Stakeholders	1/13/2023
Comments due on draft from all stakeholders (OR)	Comments due from Stakeholders	2/24/2023
TAG 6, if needed (WA)	An additional TAG if needed based on comments from Stakholders	2/1/2023
TAG 6, if needed (OR)	An additional TAG if needed based on comments from Stakholders	3/15/2023
IRP filing (WA)	IRP Final Filing	2/24/2023
IRP filing (OR)	IRP Final Filing	4/14/2023

Questions/Next Steps

Review Plans for TAG 4 Discussion

- Distribution System Planning
- Carbon Impacts
- Energy Efficiency
- Renewable Natural Gas
- Preliminary Resource Integration Results
- Next OR TAG (TAG 3) is Thursday, July 14
- Next WA TAG is Wednesday, August 10

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Integrated Resource Plan
Technical Advisory Group Meeting #3

JUNE 29, 2022

MICROSOFT TEAMS/TELECONFERENCE

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