

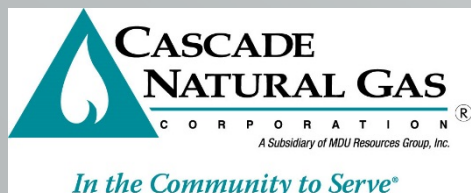
Cascade Natural Gas Corporation

2020 Integrated Resource Plan Technical Advisory Group Meeting #5

March 11, 2020

Oregon Public Utility Commission

Salem, OR



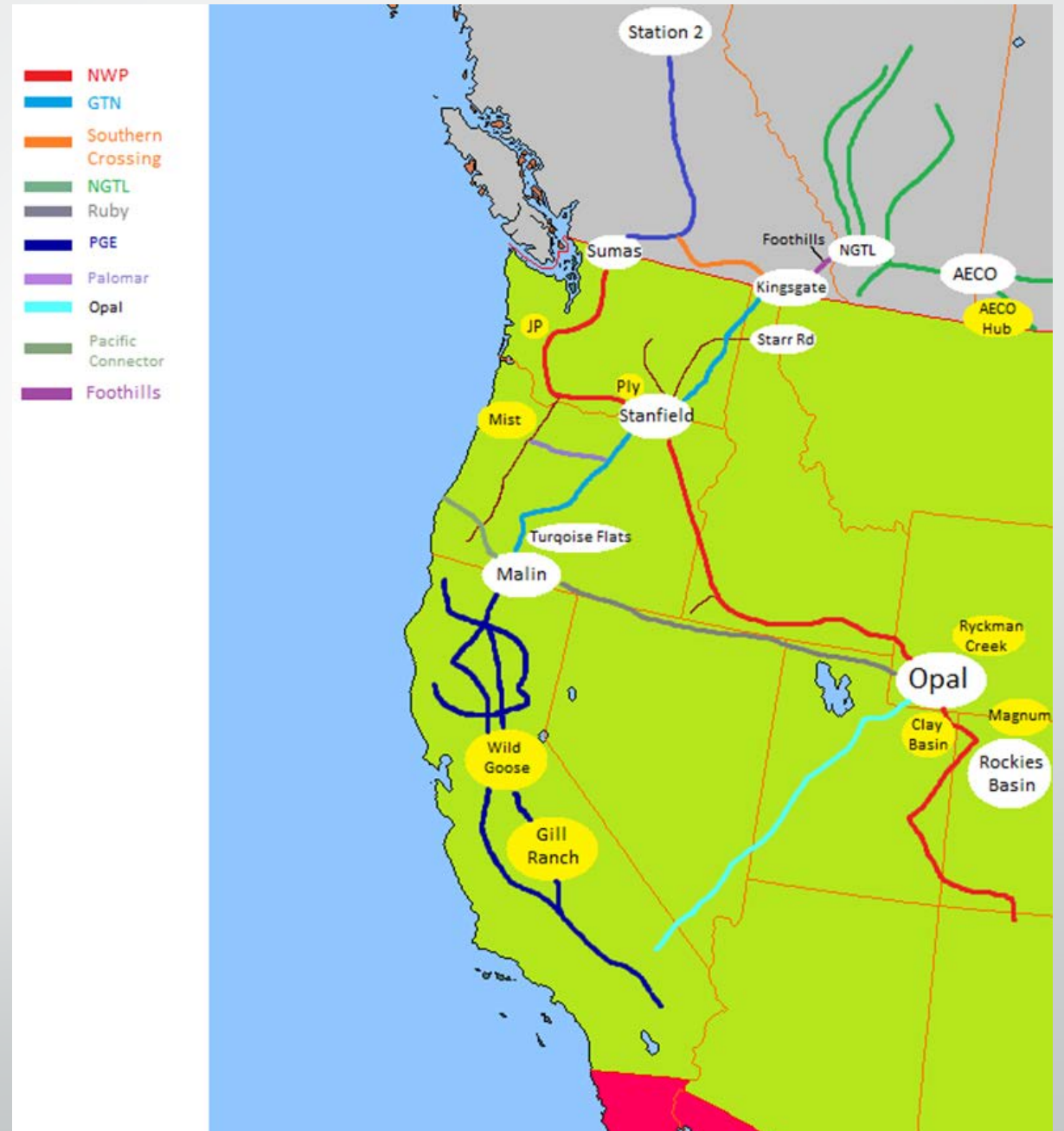
Agenda

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

Summary of Additional Resources

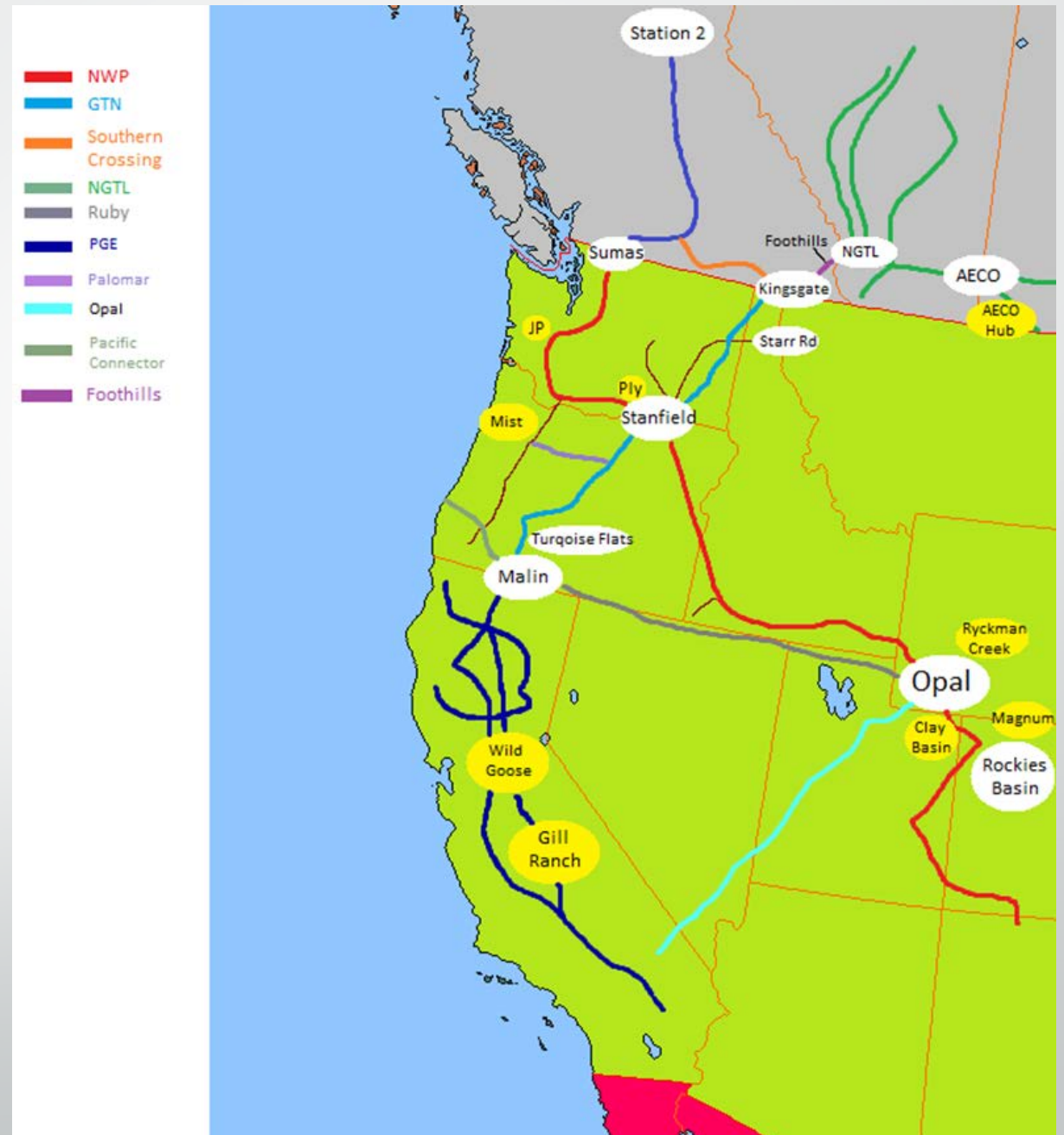
Additional Potential Resources

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

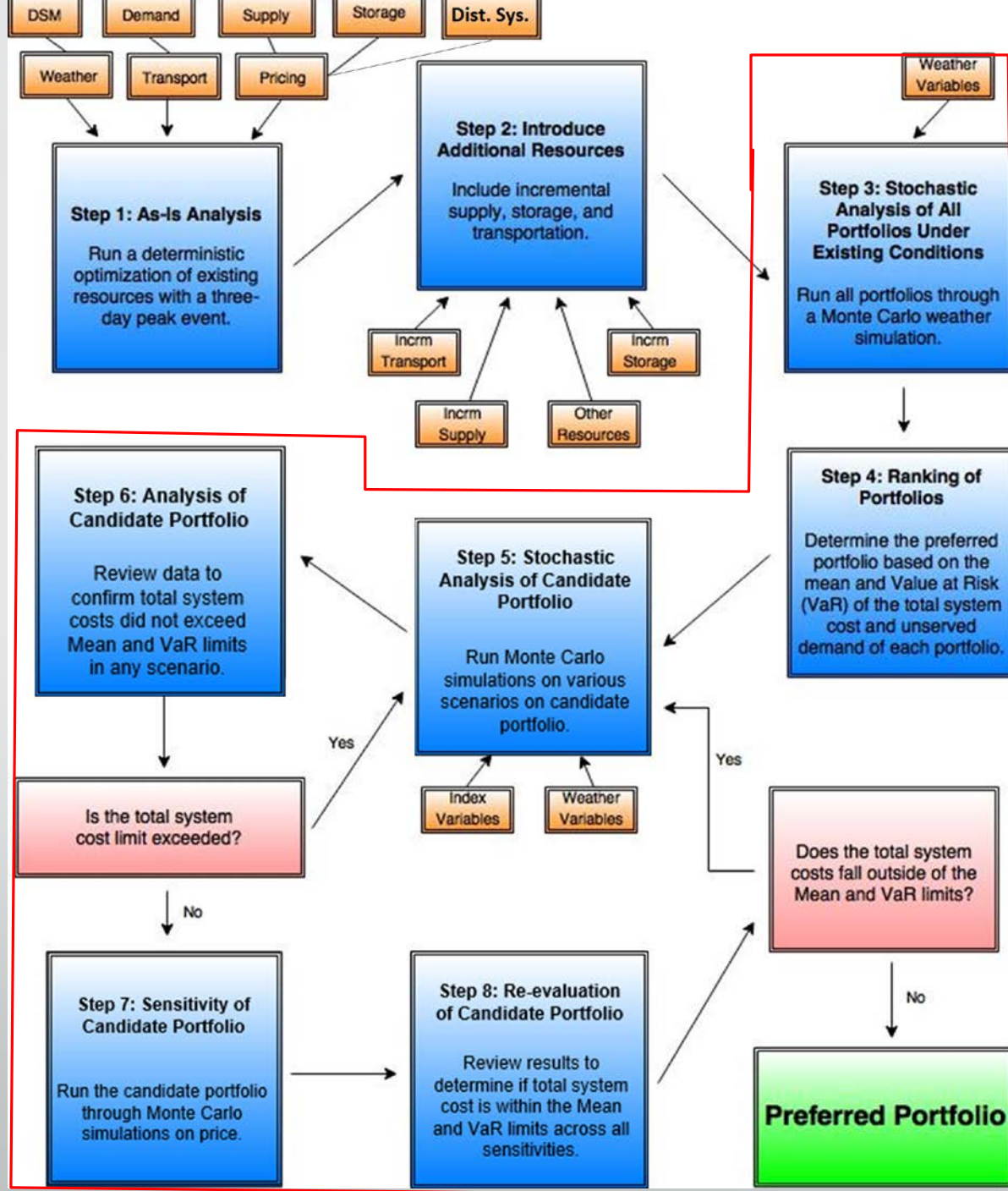


Additional Potential Resources

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



Components of Candidate Portfolios



Supply Resource Optimization Process Flow Chart

Recap – As-Is Shortfalls (Dth)

No DSM (Dth)																				
Demand Group	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Sunnyside	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	399	1,427	910
Yakima Loop	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	197	2,870	-
Kennewick Loop	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	600	240	3,726
Nyssa Ontario	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	947	792	1,084	997	1,133
Longview South Loop	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	82	82	82
Bremerton Shelton	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,603	528	4,939	4,302	4,774
Sumas Loop	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,306	1,553	4,603
Bend Loop	-	1,154	2,769	-	-	-	-	-	-	-	-	-	-	542	2,158	3,773	4,290	7,005	8,620	10,236
Walla Walla	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,464	2,524	2,690

List of Candidate Portfolios

- All-In Portfolio
- All-In less DSM option
- GTN Only Portfolio
- GTN Plus Storage Portfolio
- NWP Only Portfolio
- NWP Plus Storage Portfolio
- Storage Only Portfolio

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
 - DSM

All-In Portfolio – SENDOUT® Suggested Resource Mix

- DSM – 254,620 dth in 2020 ramping up to a cumulative figure of 6,072,310 dth in 2039 for Cascade’s service territory. On peak day the impact is 2,350 dth in 2020 ramping up to a cumulative figure of 54,530 dth in 2039.
- 3rd party citygate supply – 1,160 dth in 2022.

All-In less DSM Portfolio

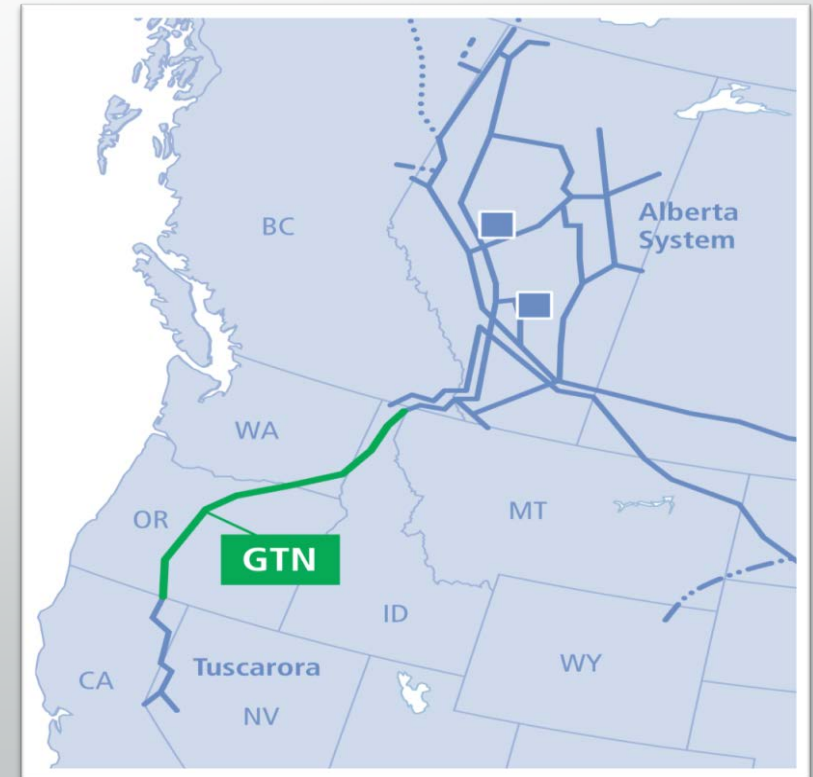
- Best deterministic mix of all alternative resources considered:
 - Incremental Transport – North to South
 - Incremental Transport – Northwest Pipeline
 - Incremental Transport – South to North
 - Incremental Transport – Bilateral
 - Incremental Storage – North and East
 - Incremental Storage – South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

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

- Incremental GTN North to South – 2,506 dth by 2029 and 9,976 dth by 2039.
- Incremental I-5 mainline – 4,555 dth by 2039.
- Spokane Lateral Expansion – 8,865 dth by 2039.
- Wenatchee Lateral Expansion – 1,173 dth by 2039.

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 Southern Crossing



GTN Only Portfolio – SENDOUT® Suggested Resource Mix

- Incremental GTN North to South – 2,506 dth by 2029 and 9,976 dth by 2039.

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 North to South – 2,506 dth by 2029 and 9,976 dth by 2039.
- Spire Storage – 1,000 Dth beginning in 2020.

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

- Spokane Lateral Expansion – 14,296 dth by 2039.
- Wenatchee Lateral Expansion – 301 dth by 2039.

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

NWP Plus Storage Portfolio – SENDOUT® Suggested Resource Mix

- Spokane Lateral Expansion – 10,364 dth by 2039.
- Wenatchee Lateral Expansion – 4,233 dth by 2039.
- Spire Storage – 1,000 Dth beginning in 2020.

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 beginning in 2020.

Summary of – SENDOUT® Suggested Resources by Portfolio

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

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

Methodology Behind Ranking of Portfolios

- New to the 2018 OR IRP, Cascade will be using deterministic results to identify the intrinsic value of a portfolio, and Value at Risk (VaR) analysis to capture the extrinsic value.
- Additionally, portfolios will be 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. This is known as the risk-adjusted cost metric.

Final Ranking of Portfolios

Portfolio	Deterministic		Stochastic		Risk Adjusted Results	
	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	-	4,279,132	0	4,398,492	-	4,308,972
All-In Less DSM	-	4,282,291	0	4,422,989	-	4,317,466
NWP + Storage	13,686	4,299,105	0	4,422,992	10,264.50	4,330,076
NWP	13,686	4,301,075	0	4,424,828	10,264.50	4,332,013
GTN + Storage	18,179	4,294,023	0	4,437,641	13,634.25	4,329,928
GTN	18,179	4,295,876	0	4,439,678	13,634.25	4,331,827
Storage Only	28,155	4,282,291	0	4,437,522	21,116.25	4,321,099

Top Ranked Candidate Portfolio Components

- DSM – 254,6200 dth in 2020 ramping up to a cumulative of 6,072,310 dth in 2039 for Cascade’s service territory.
- 3rd party citygate supply – 1,160 dth in 2022.

Unserved for Top Ranked Candidate Portfolio

DSM (Dth)		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Demand Group																					
Sunnyside		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Yakima Loop		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kennewick Loop		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nyssa Ontario		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Longview South Loop		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bremerton Shelton		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sumas Loop		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bend Loop		-	-	1,160	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Walla Walla		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Served
 Unserved
 Unserved Covered by 3rd Party Citygate Supply

New Stochastic Methodology

Stochastic Weather Methodology

- In previous IRPs, 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 2020 IRP, Cascade has enhanced its methodology to allow for a more robust Monte Carlo simulation.

Cascade's New Methodology

- This year, Cascade will be performing a 10,000 draw Monte Carlo Simulation of weather using Excel and R.
- For each weather location Cascade records daily mean temperatures, standard deviations, and the largest 1 day jump to have historically occurred in that month.
- Cascade also records the correlations on a monthly level of each weather station to each other. This data is all loaded into R.

Cascade's New Methodology

- First, Cascade runs 1 draw of its Monte Carlo simulation for its first weather location.
- The normal random seed used each day for that draw is then run through a Cholesky decomposition matrix, which uses the correlations between each location to correlate the random variables for that first draw across all weather locations.
- This process is repeated 10,000 times, with the calculated HDDs from each draw stored in a separate matrix.

Cholesky Decomposition Matrix - January

	Baker City	Bellingham	Bremerton	Pendleton	Redmond	Walla Walla	Yakima
Baker City	1						
Bellingham	0.6338301	0.7734723					
Bremerton	0.6584770	0.5837664	0.4749998				
Pendleton	0.7024465	0.3681832	0.0469737	0.6072920			
Redmond	0.7173640	0.3985243	0.1196151	0.2324631	0.5081539		
Walla Walla	0.7105065	0.3561187	0.0338146	0.5396395	0.0173972	0.2751418	
Yakima	0.6697351	0.3483110	0.0817184	0.3160165	-0.0036761	0.1685445	0.5432948

Cascade's New Methodology

- Cascade calculates a system weighted HDD for each draw, identifying the draw that results in the 99th 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.

Stochastic Price Methodology

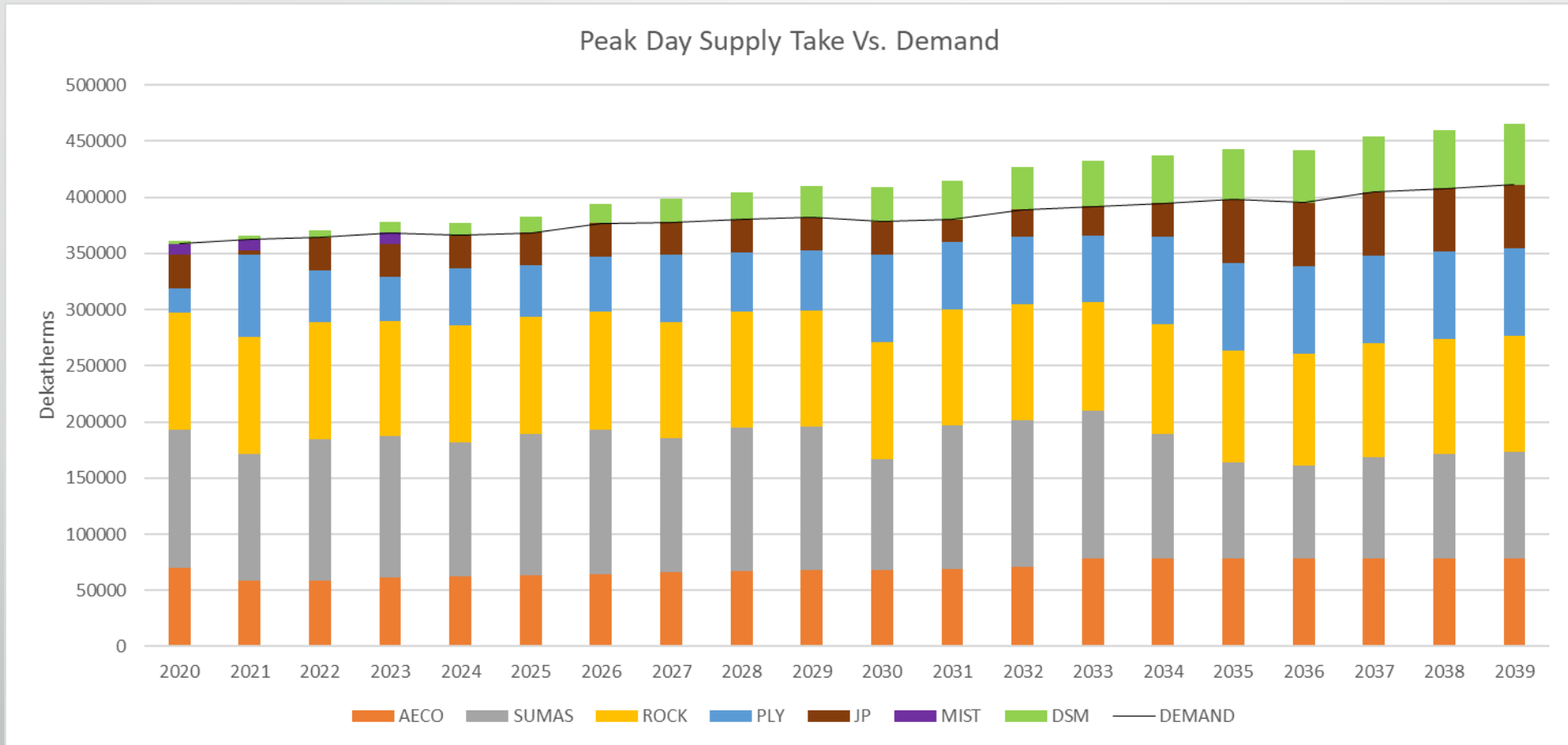
- Similar to weather, Cascade used the Monte Carlo functionality within SENDOUT® to run its stochastic analyses in previous IRPs.
- Due to the SENDOUT® computational limitations as mentioned above, Cascade has taken the analysis outside of SENDOUT and has enhanced the methodology to allow for a more robust Monte Carlo simulation.

Cascade's New Methodology

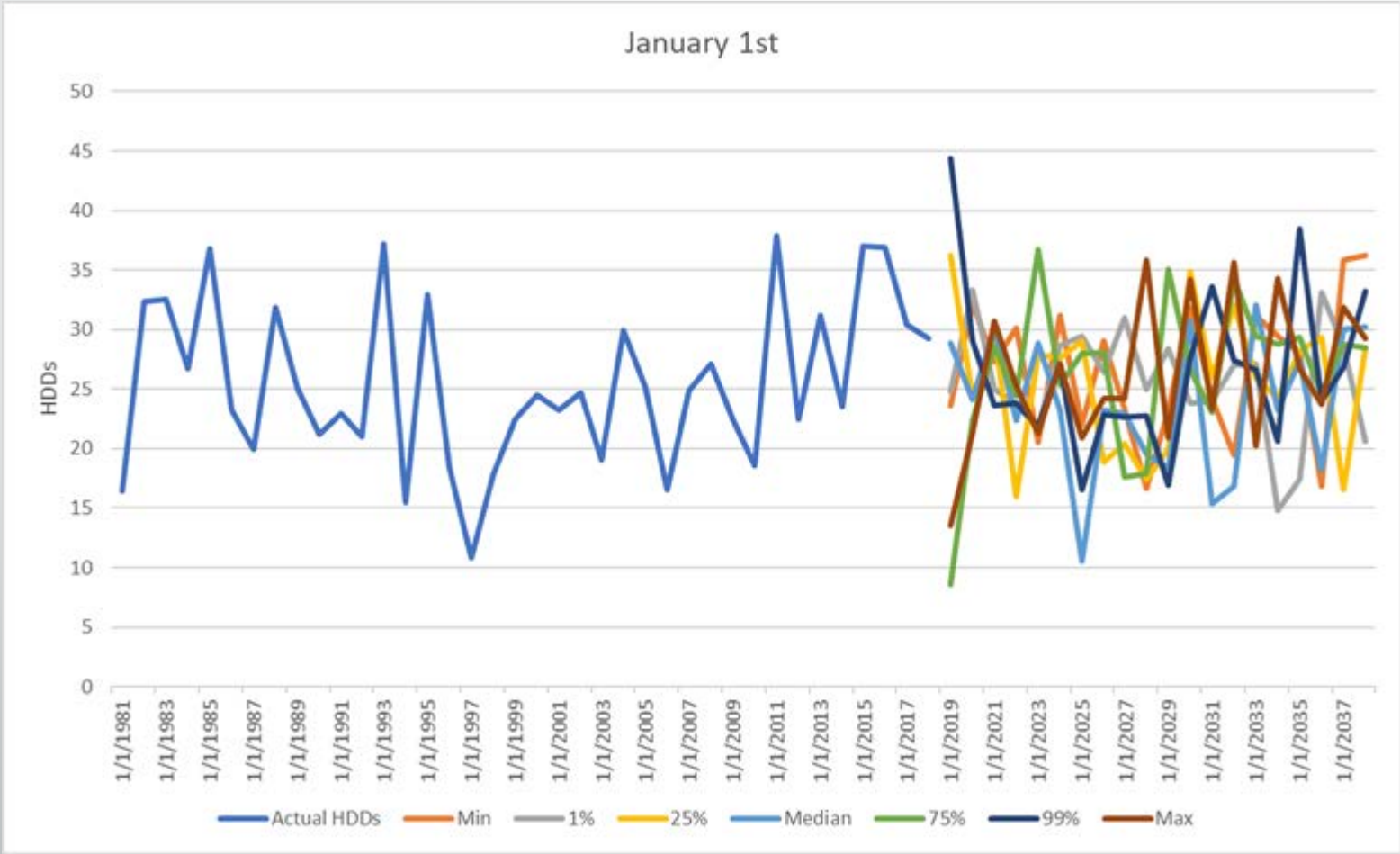
- This year, Cascade will be performing a 10,000 draw Monte Carlo Simulation of price using Excel and R.
- Cascade models price movements with a Geometric Brownian Motion stochastic process. For each of its 10,000 draws, the month over month price change is determined by 2 elements: a drift term and a shock term.
 - The drift term is the expected movement of NYMEX, derived from the Company's price forecast.
 - The shock term is the main stochastic element, which takes the month over month return variance and multiplies it by a random normal variable to create a normal distribution of price movements for a given month, and a lognormal distribution of prices.
- Similar to how weather is correlated between weather stations, Cascade correlates the supply basins using the Cholesky decomposition matrix.

Scenario and Sensitivity Results

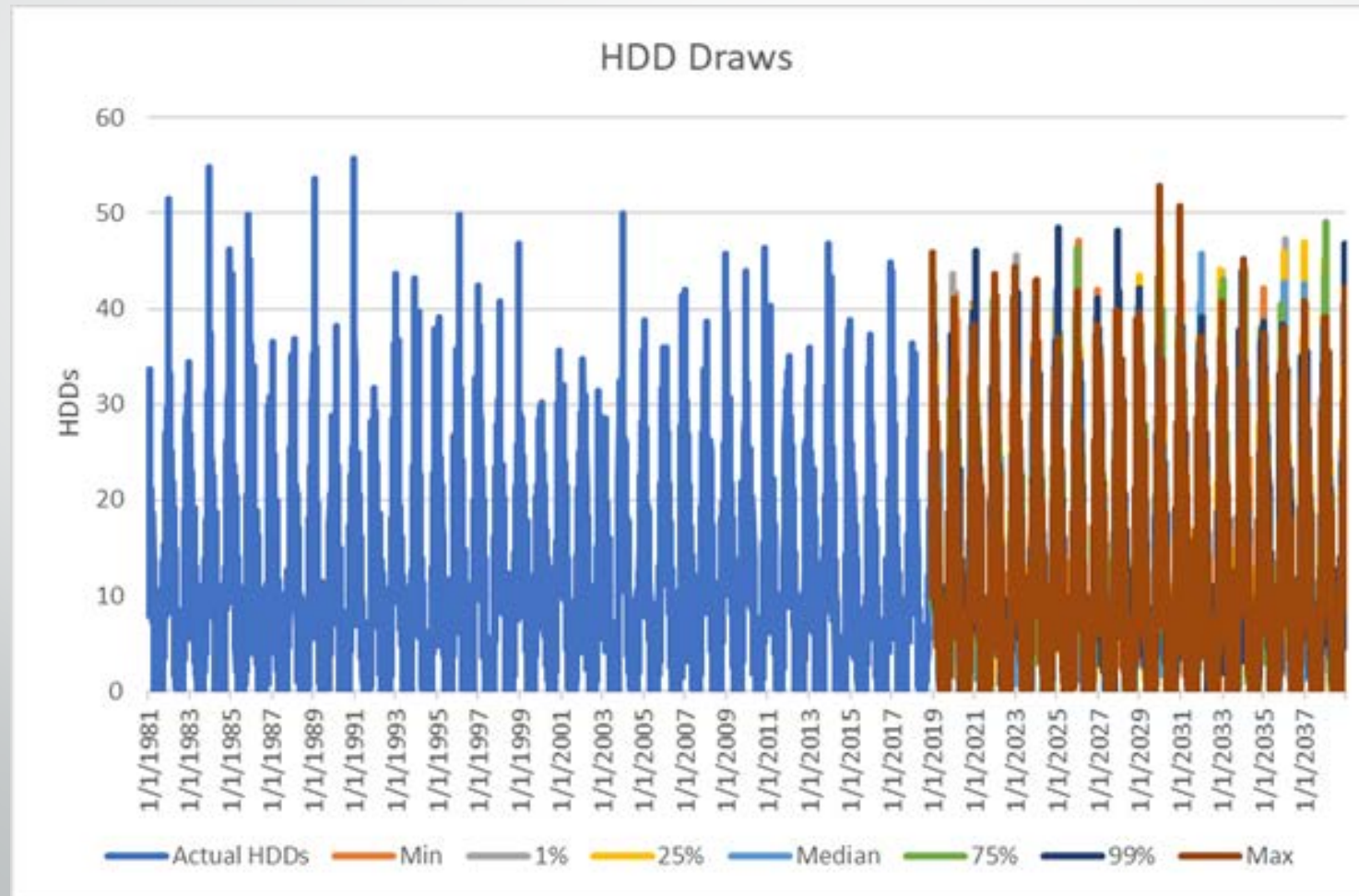
Peak Day Take Vs. Demand



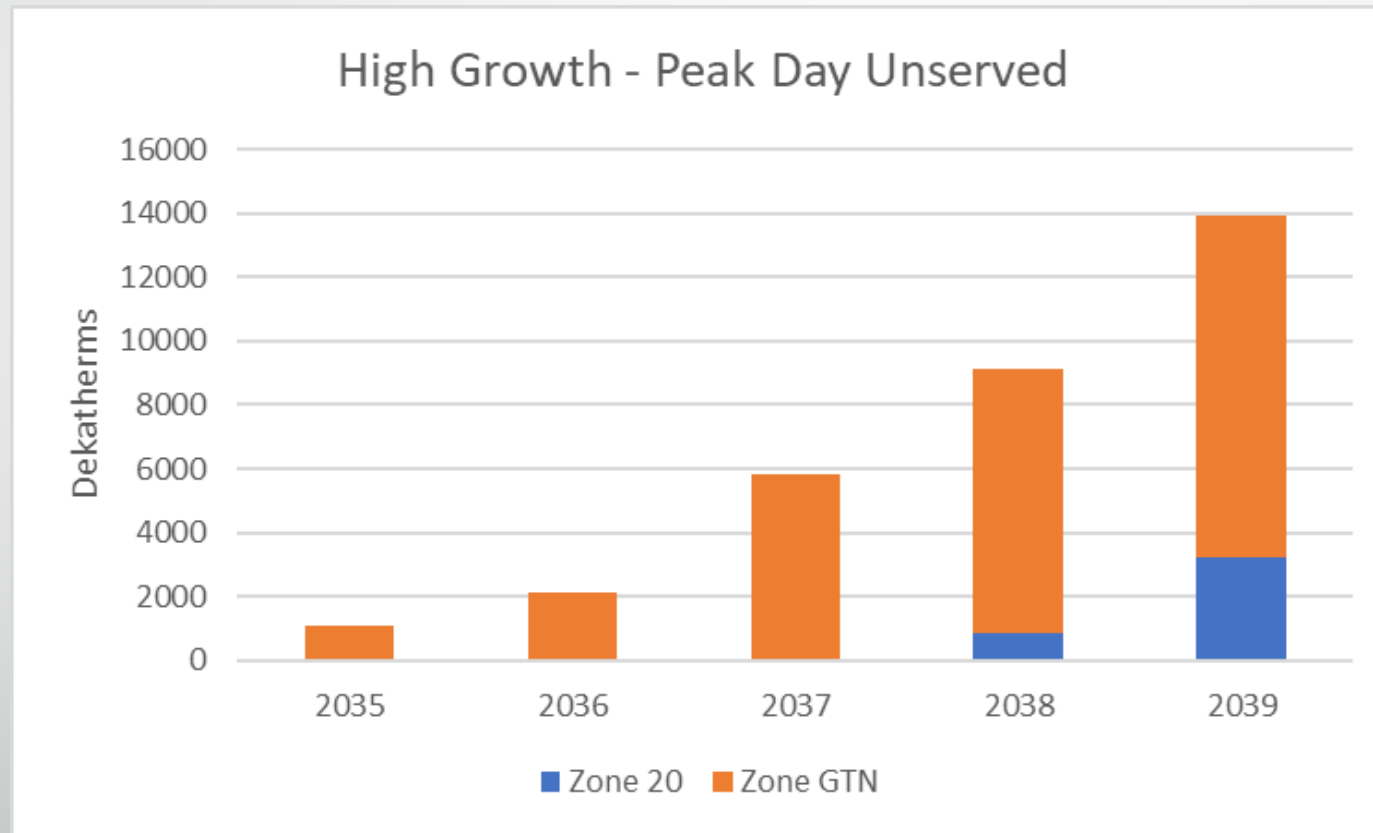
HDD Draw Graph – January 1st



HDD Draw Graph – All Days



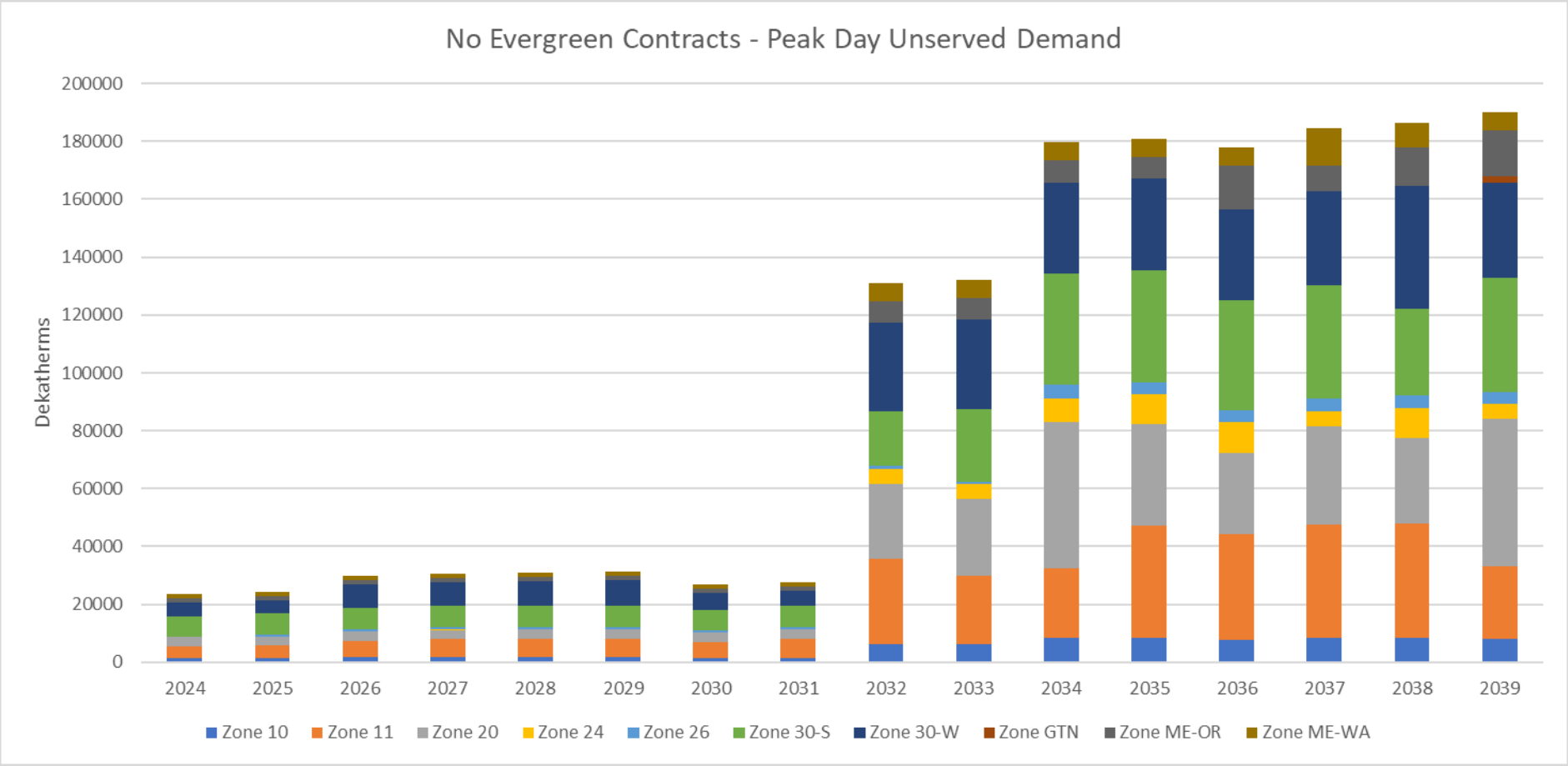
High Growth – Peak Day Unserved Demand



High Growth – Discussion

- In this scenario, the Company identifies minor potential shortfalls in Oregon and Central Washington, starting in 2035, under stochastic conditions.
- This does not invalidate the top ranked candidate portfolio, but provides a point of reference if weather and growth are unexpectedly high.
- Total system cost for this scenario was \$4.63B, which does not exceed the VaR limit.

No Evergreen – Peak Day Unserved Demand



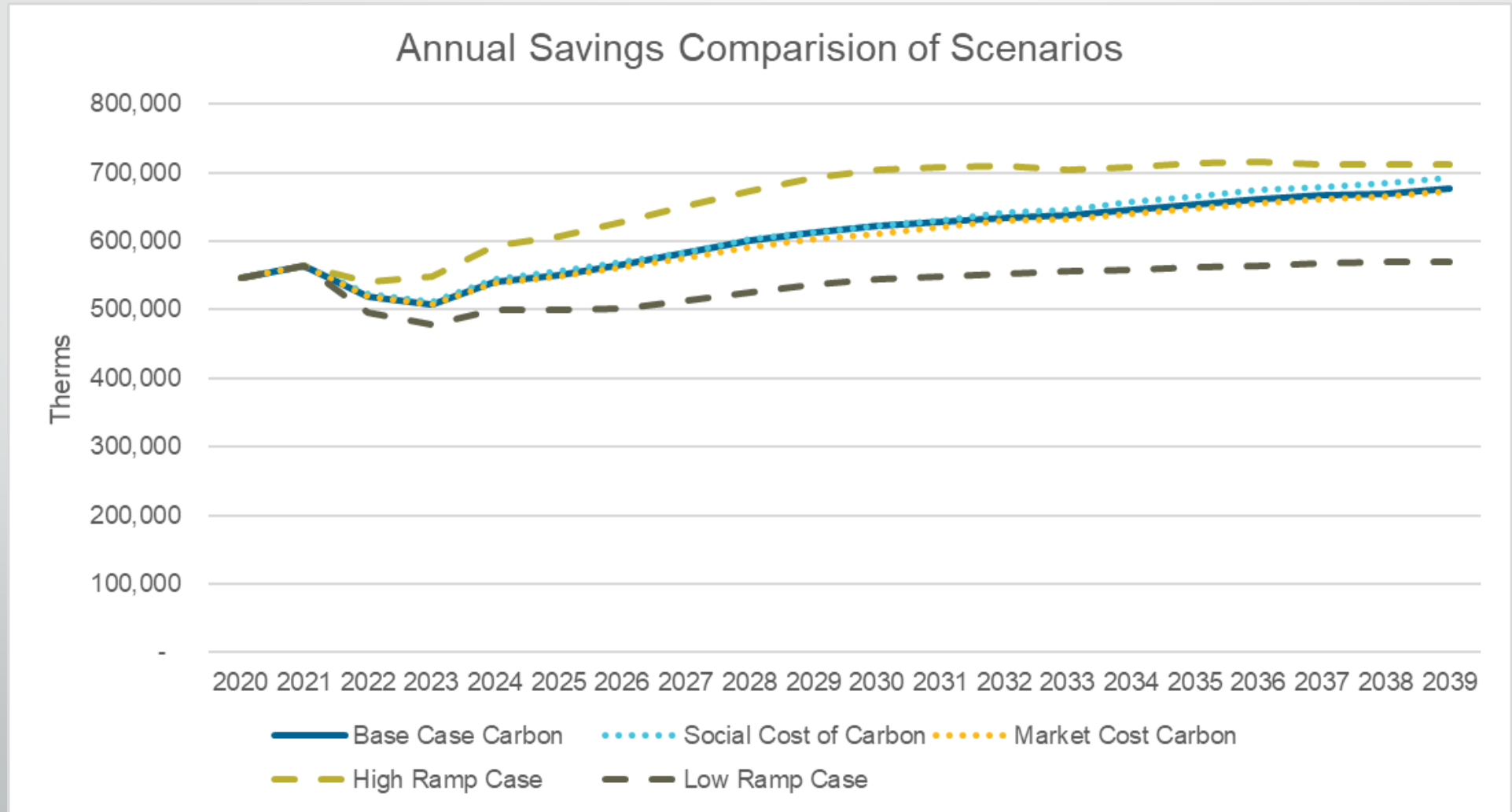
No Evergreen Contracts – Discussion

- In this scenario, the Company identifies potential shortfalls across its service area starting in 2024 under stochastic conditions.
- This does not invalidate the top ranked candidate portfolio, but rather reinforces Cascade’s practice of modeling and evaluating each of its contracts prior to their expiration.
- Without access to a significant portion of its contracts, SENDOUT® found the optimization to be infeasible.

Carbon Sensitivity Discussion

- Cascade will include an analysis of three carbon sensitivities in its IRP, as discussed in TAG 4:
 - Social Cost of Carbon
 - House of Representatives Market Choice
 - No Carbon
- New to the 2020 OR IRP, Cascade will be including a stochastic carbon analysis. On January of each year, each draw allows for the possibility of a random carbon forecast to be included in the forecasted price of gas. If a carbon forecast is selected, the draw stays on that carbon path for the duration of the planning horizon.
- Cascade's modeling has determined that its conservation programs are robust and comprehensive enough to meet projected DSM savings even at a lower than expected carbon future.

CPA Comparison: Scenarios vs Ramp Rate



Scenario/Sensitivities versus Cost Limit

Scenario	Total System Cost (\$000)	Unserved Start Year
VaR Limit	5,367,644	N/A
No Carbon Forecast	4,067,388	N/A
SCC Carbon Forecast	4,291,633	N/A
Market Choice Carbon Forecast	4,219,313	N/A
Price Forecast High	4,348,336	N/A
Environmental Adder 0%	4,200,421	N/A
Environmental Adder 20%	4,402,809	N/A
Environmental Adder 30%	4,498,902	N/A
No Evergreen	N/A*	2024
Low Growth	4,094,227	N/A
High Growth	4,627,197	2035
Limit BC	4,470,642	N/A
No BC	N/A*	2020
Limit Alberta	4,234,825	N/A
No Alberta	4,441,634	2020
No Rockies	4,543,428	2021
Limit Rockies	4,259,653	N/A
Limit Canada	4,419,800	N/A
No Canada	N/A*	2020
No Plymouth	4,384,592	2037
Limit Plymouth	4,372,424	N/A
Limit JP	4,397,880	N/A
No JP	4,421,787	N/A
Limit Mist	4,338,902	N/A
No Mist	4,339,958	N/A

* Note - SENDOUT® is unable to calculate costs for infeasible Scenarios/Sensitivities

Conclusion


- Cascade has identified potential shortfalls at the gates served by GTN in Oregon, starting in 2033.
- The top-ranking candidate portfolio included DSM and 3rd party citygate deliveries.
- Under expected conditions, this portfolio would eliminate the potential GTN shortfall.
- Additionally, the top-ranked portfolio, which is the all-in portfolio, passes all scenario and sensitivity testing. It is Cascade's Preferred Portfolio.

Preferred Portfolio Results

DSM (Dth)		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Demand Group																					
Sunnyside		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Yakima Loop		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kennewick Loop		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nyssa Ontario		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Longview South Loop		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bremerton Shelton		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sumas Loop		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bend Loop		-	-	1,160	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Walla Walla		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

 Served

 Unserved

 Unserved Covered by 3rd Party Citygate Supply

Proposed Four-Year Action Plan

Environmental Policy

- Continue to support the City of Bend's Climate Action Plan efforts which were approved by the City Council on December 4, 2019.
- Participate in City of Bellingham Climate Action Plan discussions.
- Monitor service areas for potential GHG reduction goal development relating to energy delivery and supply.
- Monitor carbon pricing and policy developments nationally and statewide (i.e., OR ballot measure, 2020 carbon tax or cap and trade bills, Social Cost of Carbon, Market Choice, The Clean Future Act, etc.).
- Monitor federal and state GHG regulation development for energy industry.
- Continuation of our current emission reduction and monitoring endeavors (i.e., Methane Challenge Program, Renewable Natural Gas studies).

DSM

- The Company will examine the impact that changes such as revised building codes, OPUC exemptions granted for non-cost-effective measures, and changes to avoided cost calculations may have on the Company's long- and short-term conservation potential. Success shall be measured by the following:
 - The Company shall hold at least one meeting with the Energy Trust to discuss any changes that might affect the Company's energy efficiency therm savings targets, and, if applicable, what actions may need to be taken to comply with or adapt to the changes.
 - Cascade will provide a summary of its meeting with the Energy Trust in its 2021 IRP Annual Update. In compliance with OAR 860-021-0400(g), the Company will file an update as soon as is reasonably possible if any changes result in a significant deviation from the 2020 IRP.
- The Company will work with the Energy Trust of Oregon to identify potential areas for expanded engagement in support of local communities' climate action planning goals. These discussions could include consideration of biogas engagement where cost-effective and regulatorily permitted. Findings on how to best support local climate plans will be included in the next IRP.

DSM (Cont'd)

- Cascade will strive to acquire the following amount of cost-effective gas therm savings over the next two years:

	2020	2021
Oregon	547,244	563,251
Washington	726,625	853,253
Total	1,273,869	1,416,504

- The Company will acquire cost-effective therm savings by partnering with Energy Trust in Oregon and by delivering programs under the oversight of the Company's Conservation Advisory Group in Washington. Short-term annual therm savings targets are refined annually in Oregon by the Energy Trust through the budgeting process and in Cascade's Conservation Plan, which the Company files each December 1st in Washington.

Demand

- Include wind in the stochastic weather analysis.
- Look into 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.

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)	State	Process Element
Tuesday, May 12, 2020	OR	Draft of 2020 OR IRP distributed
Friday, June 12, 2020	OR	Comments due on draft from all stakeholders
Tuesday, June 30, 2020	OR	TAG 6, if needed
Friday, July 31, 2020	OR	IRP filing in Oregon

ADDITIONAL QUESTIONS?

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Cascade Natural Gas Corporation

2020 Integrated Resource Plan Technical Advisory Group Meeting #5

March 11, 2020

Oregon Public Utility Commission

Salem, OR

