Cascade Natural Gas Corporation

2020 Integrated Resource Plan

Technical Advisory Group Meeting #5

September 23rd, 2020

Microsoft Teams

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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**
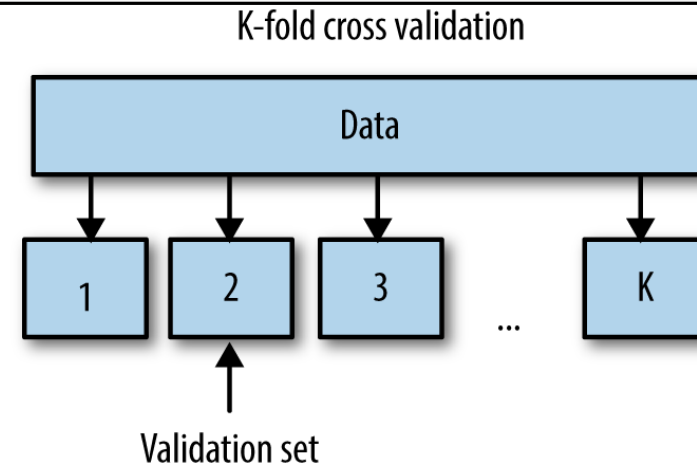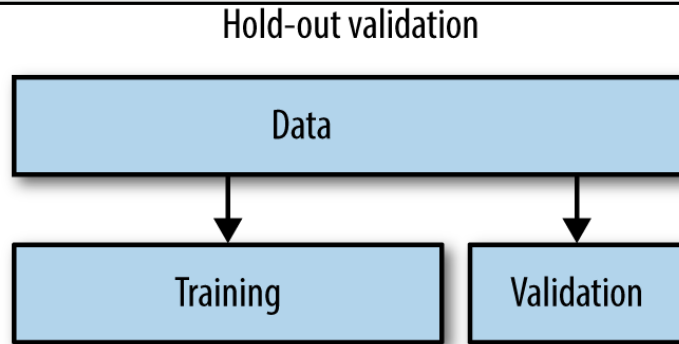- **2020 IRP Remaining Schedule**
- **Questions**

Backcast Overview

Backcasting (Cross-validation)

- 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)

Hold-out validation
- Strong validation
- Low computation time

K-fold cross validation
- Strong validation
- High computation time

Validation set

Bootstrap resampling
- 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.
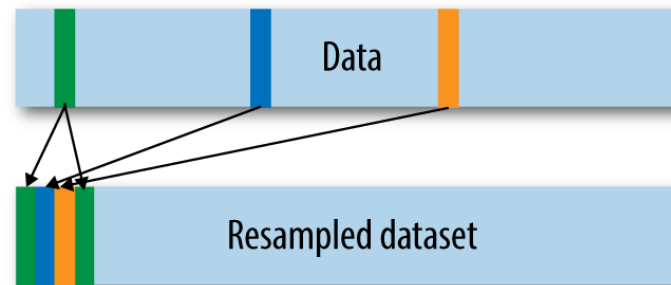
Steps in Each Backcast
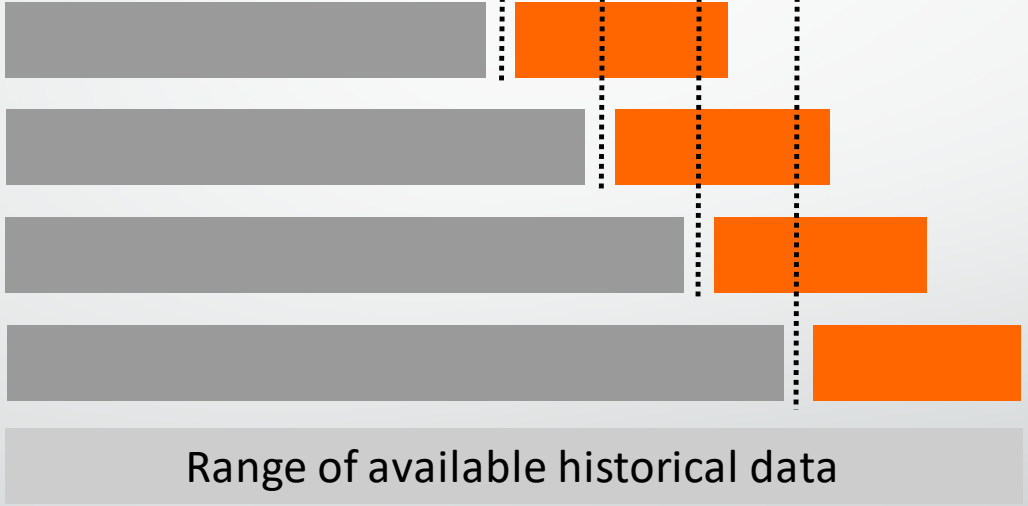
200+ dynamic regression models used in IRP forecast

↓

Choose citygate and rate class and identify model used

↓

Apply model at an earlier point in time, T1

↓

Run forecast from time T1

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Graph forecast next to actual historic data for comparison.

Time   T1   T2   T3   T4   Present

Range of available historical data

Truncated past data
Forecast about the past

Model Developed
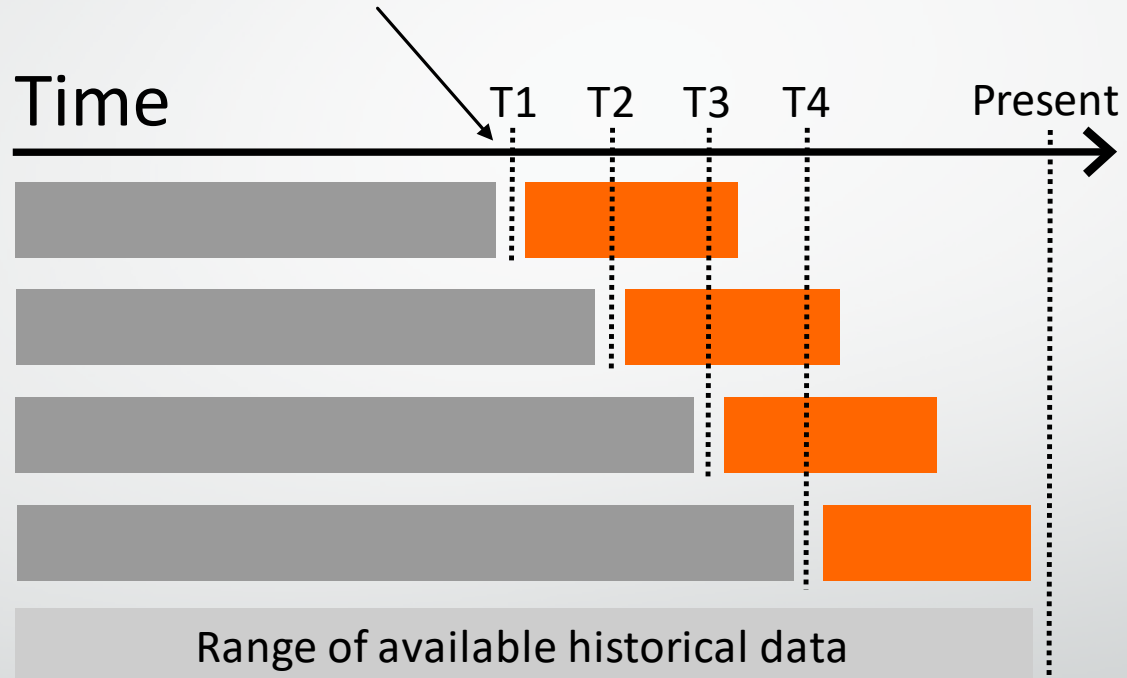
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Time — T1 T2 T3 T4 Present

Range of available historical data

■ Truncated past data
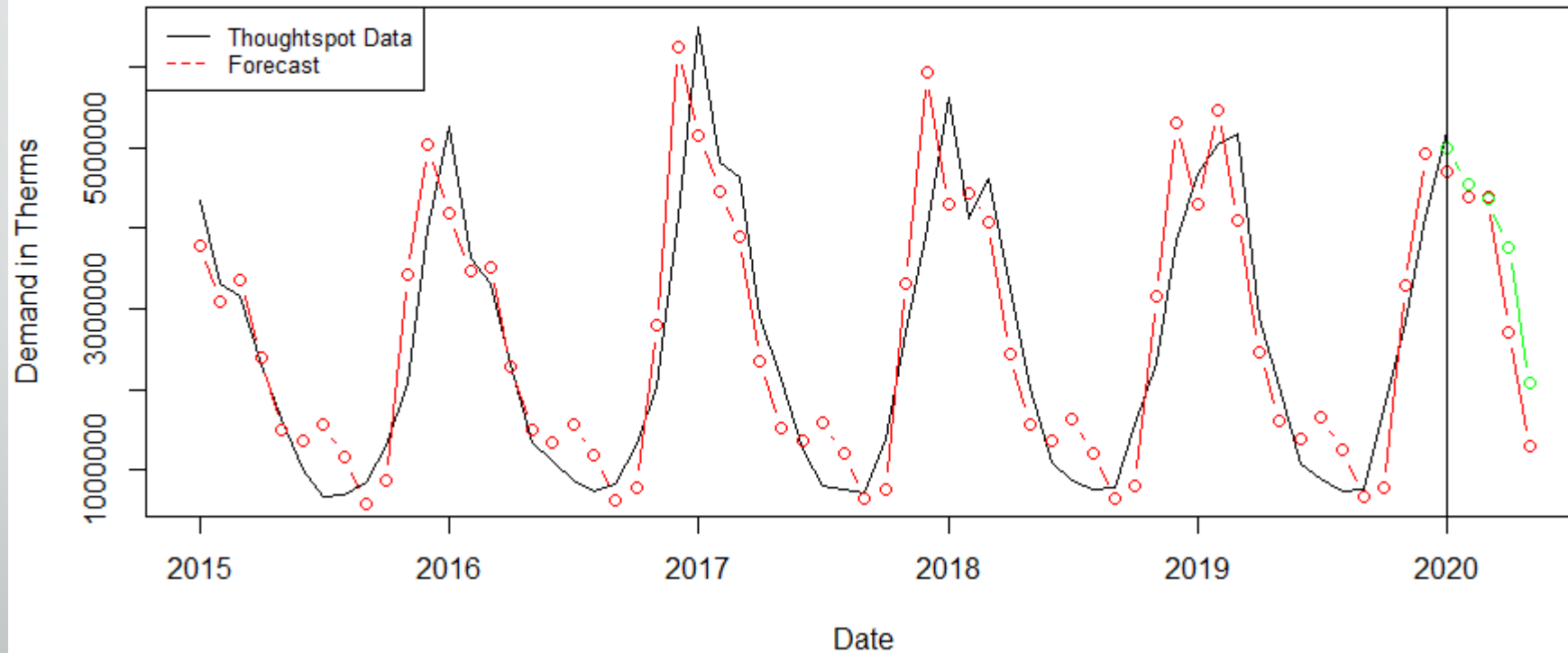■ Forecast about the past

Model Developed

Cross-Validation Run

Combination of hold out method and k-fold method
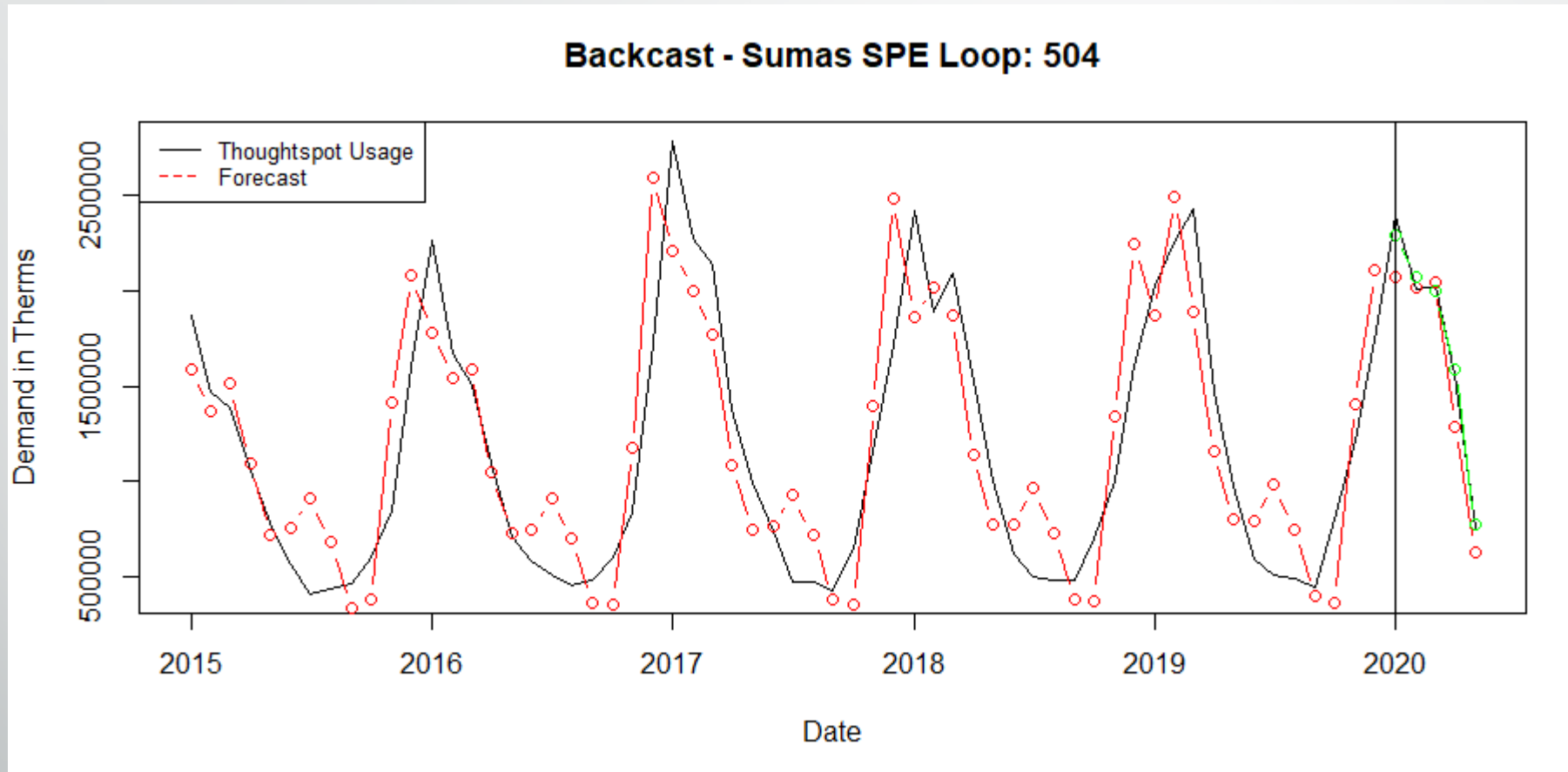
- Sumas SPE Loop
  - 503 (Res)
  - 504 (Com)
  - 505 (Ind)
  - 511.Ind
- Yakima Loop
  - 503
  - 504
  - 505

Sumas SPE Loop - 503

Sumas SPE Loop - 504

Backcast - Sumas SPE Loop: 504
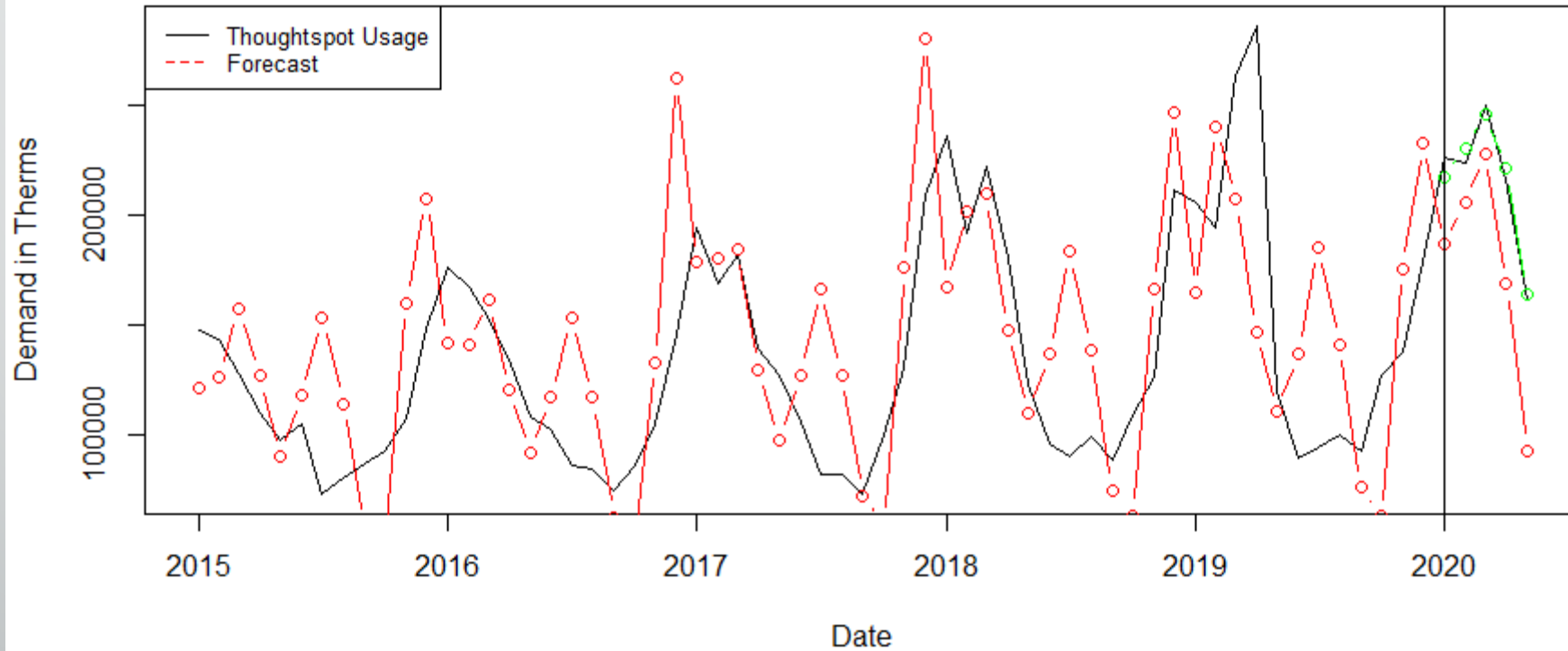
Sumas SPE Loop - 505

Sumas SPE Loop – 511.IND
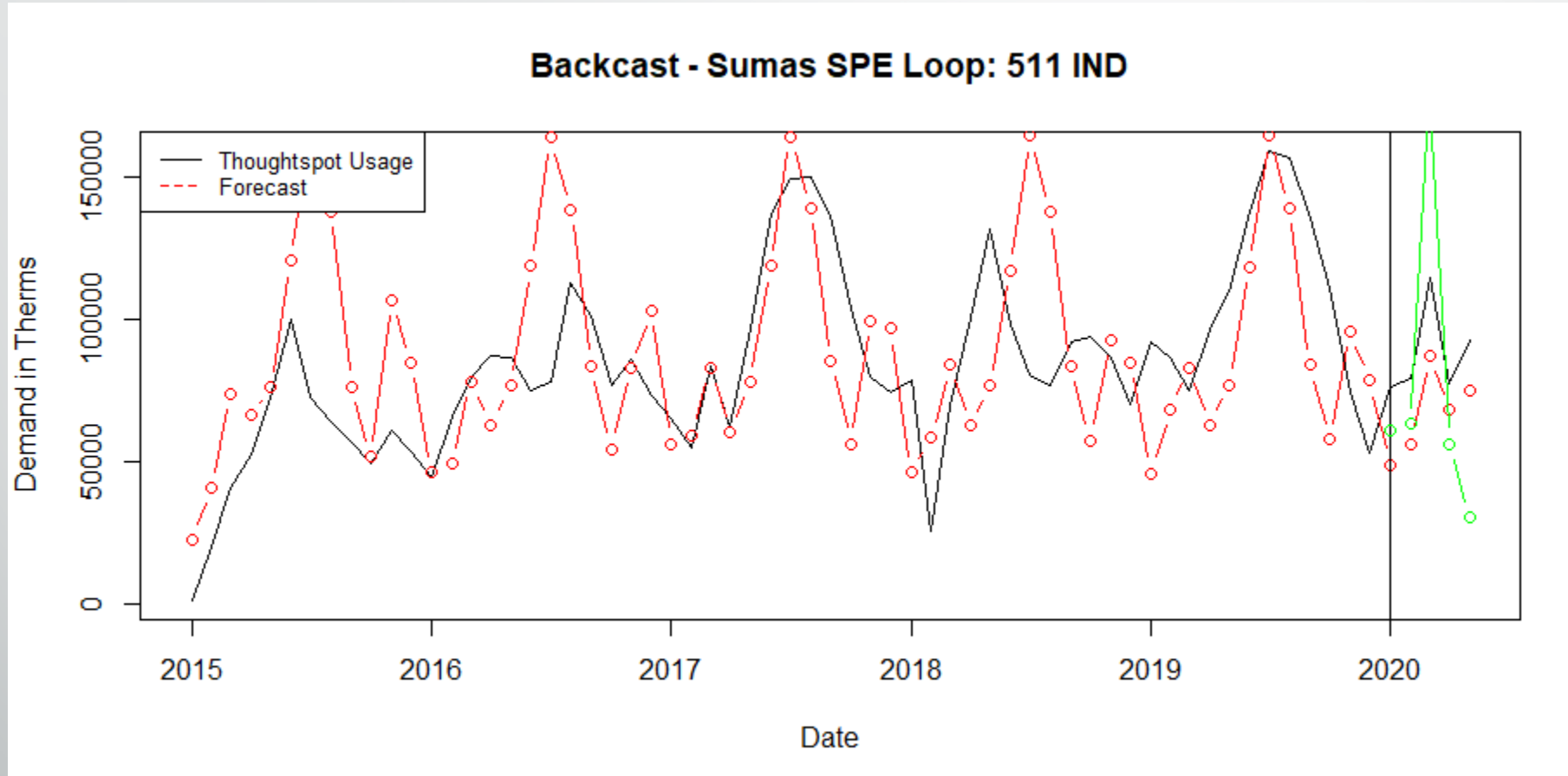
Sumas SPE Loop

Sumas SPE Loop
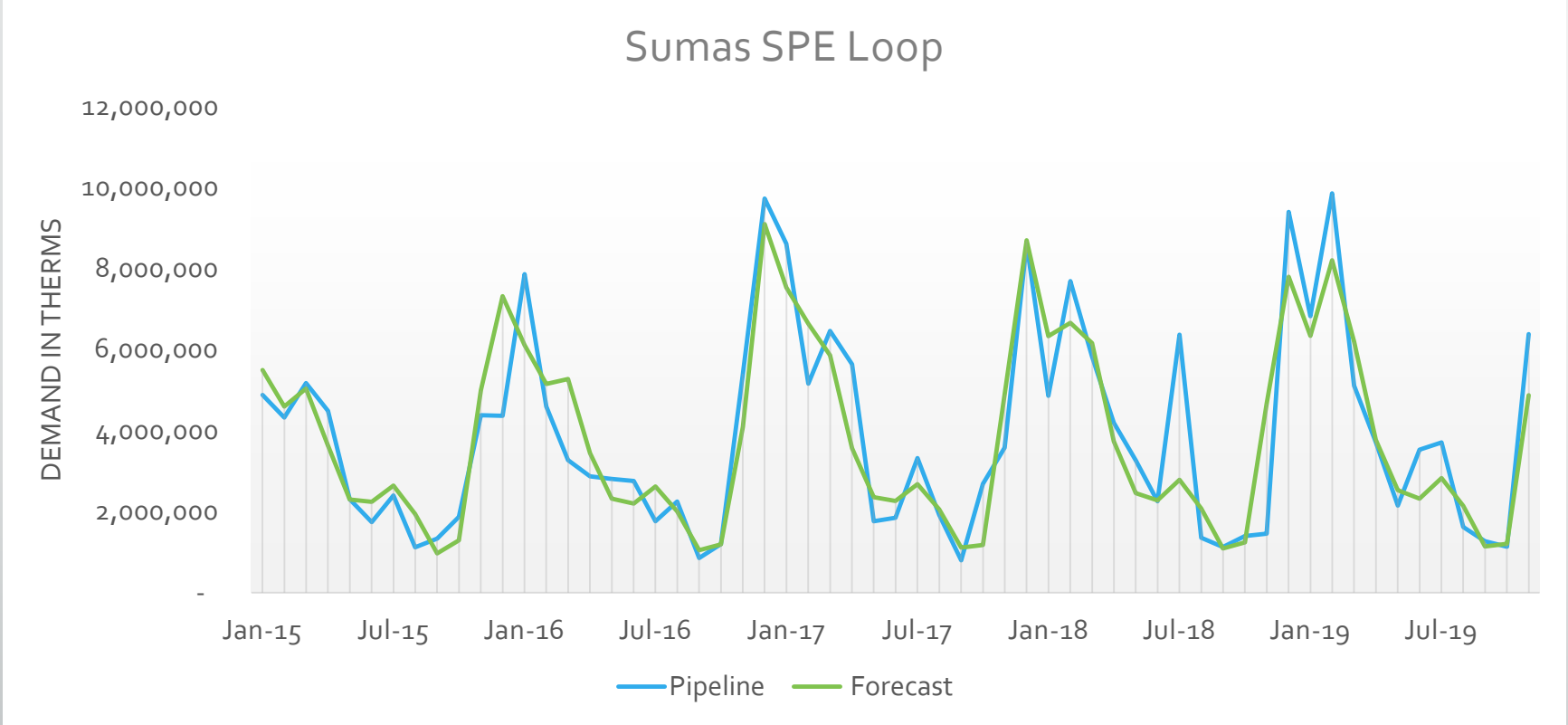
Yakima - 503

Backcast - Yakima: 503

Yakima - 504
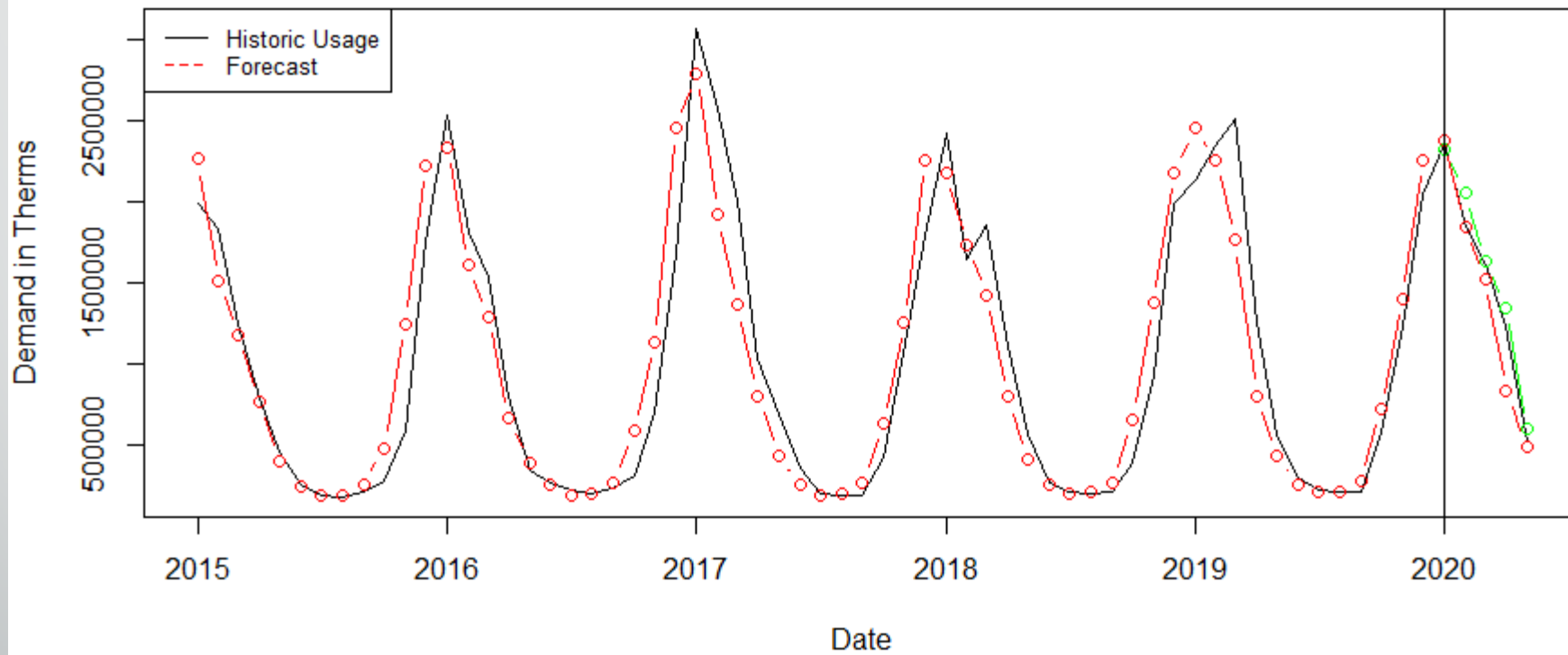
Backcast - Yakima: 504

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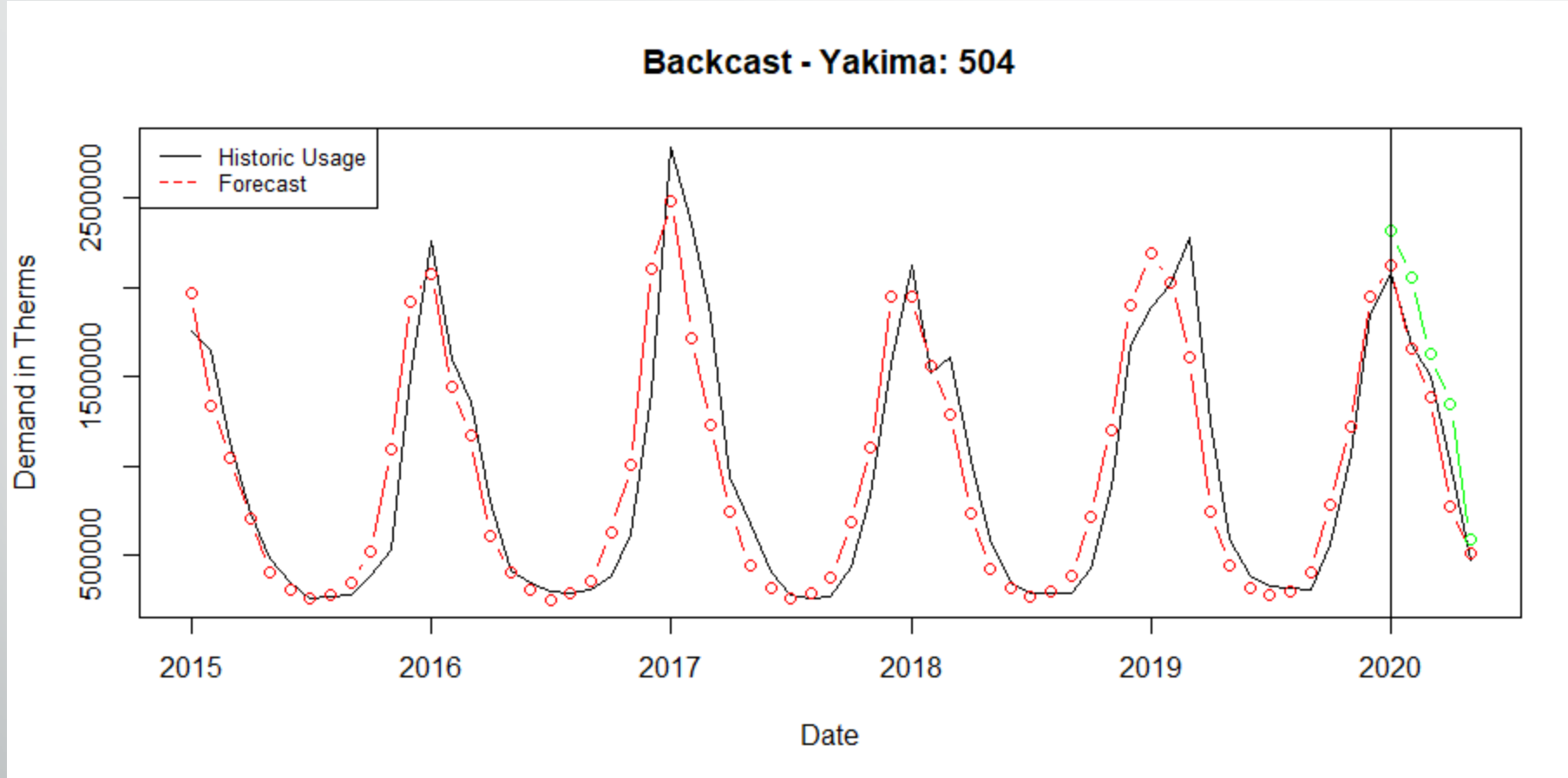
Backcast - Yakima: 505
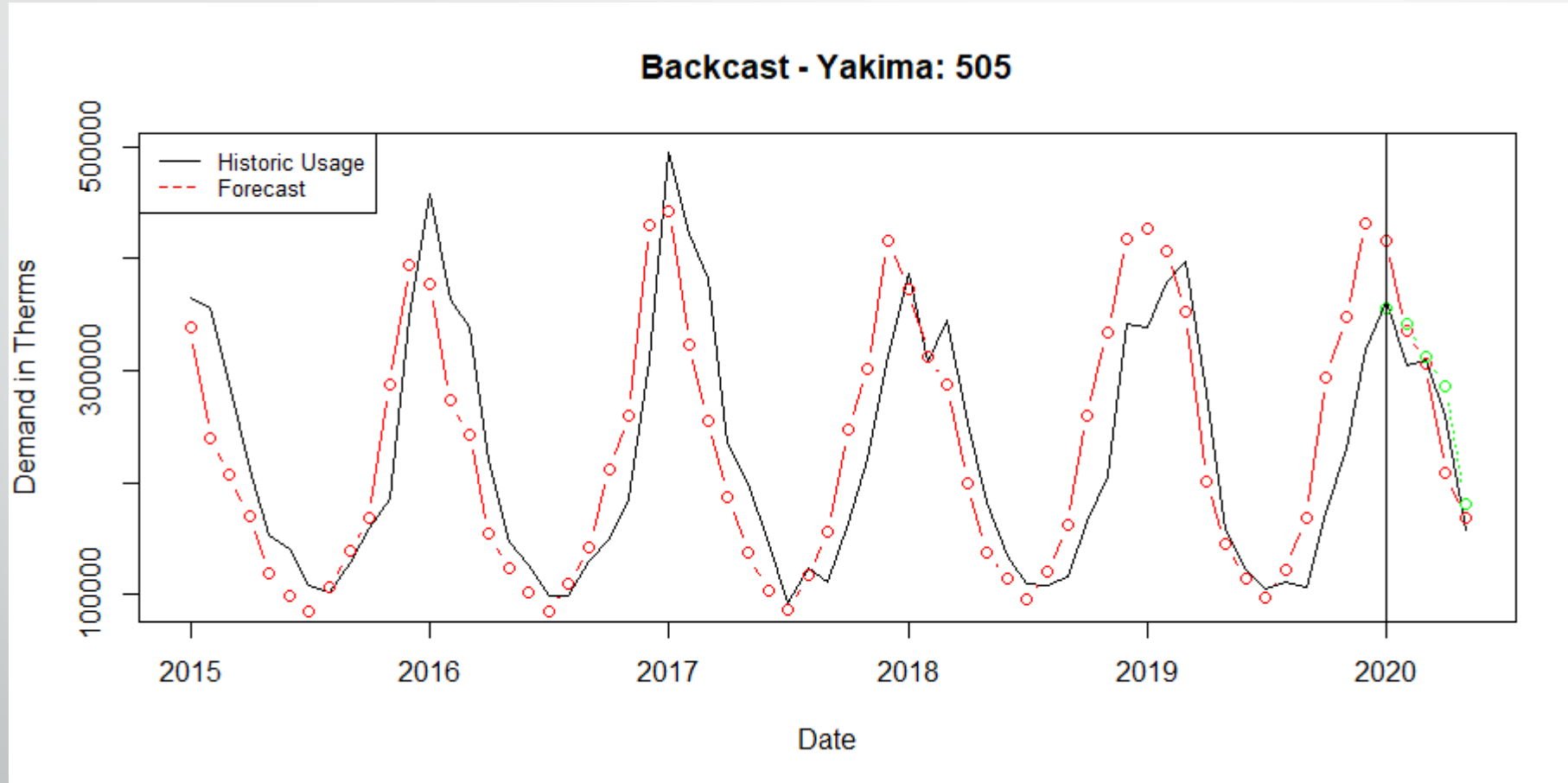
Yakima Loop
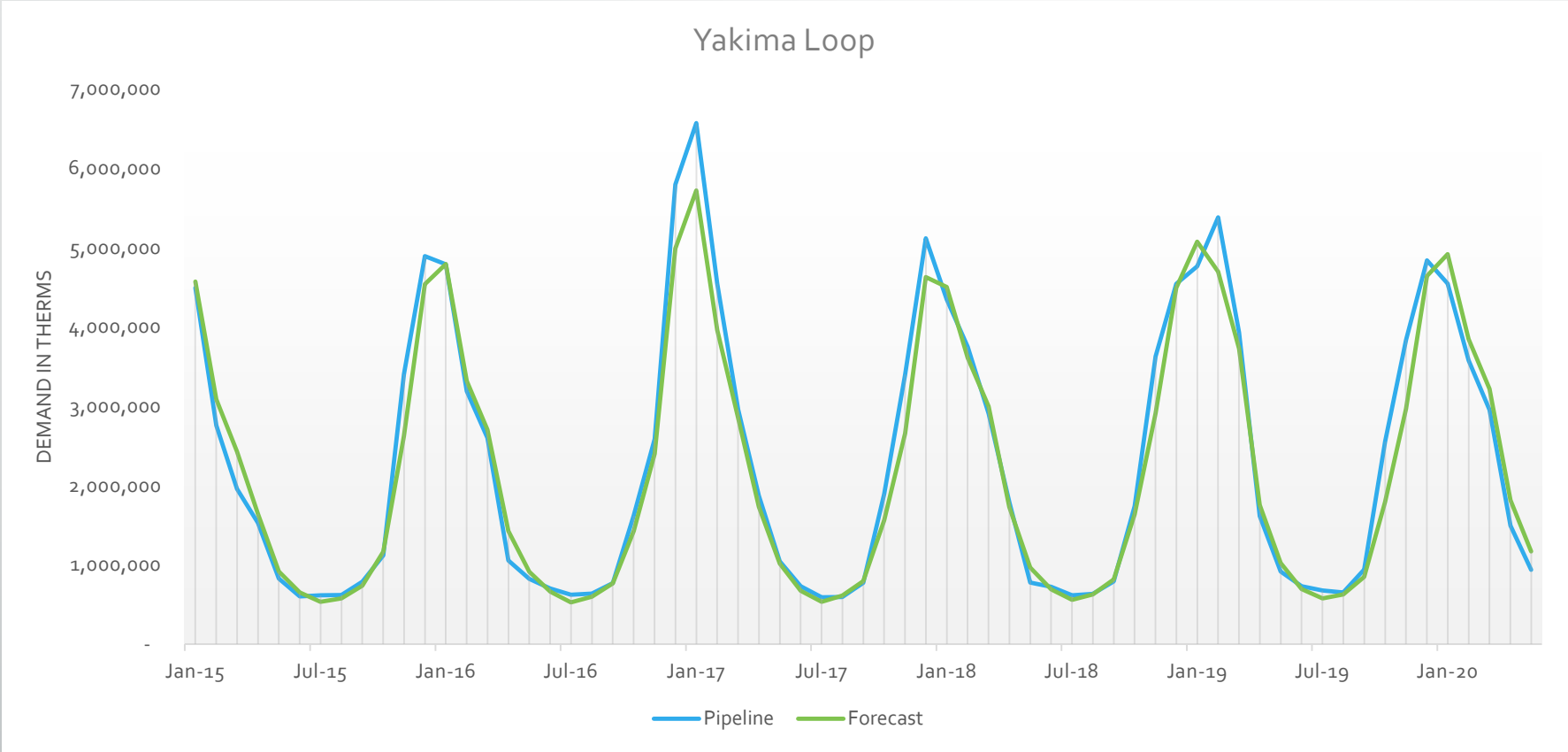
Summary of Alternative Resources

Additional Potential Resources

- Incremental Transport – North to South
- Incremental Transport – Northwest Pipeline
- Incremental Transport – South to North
- Incremental Transport – Bilateral
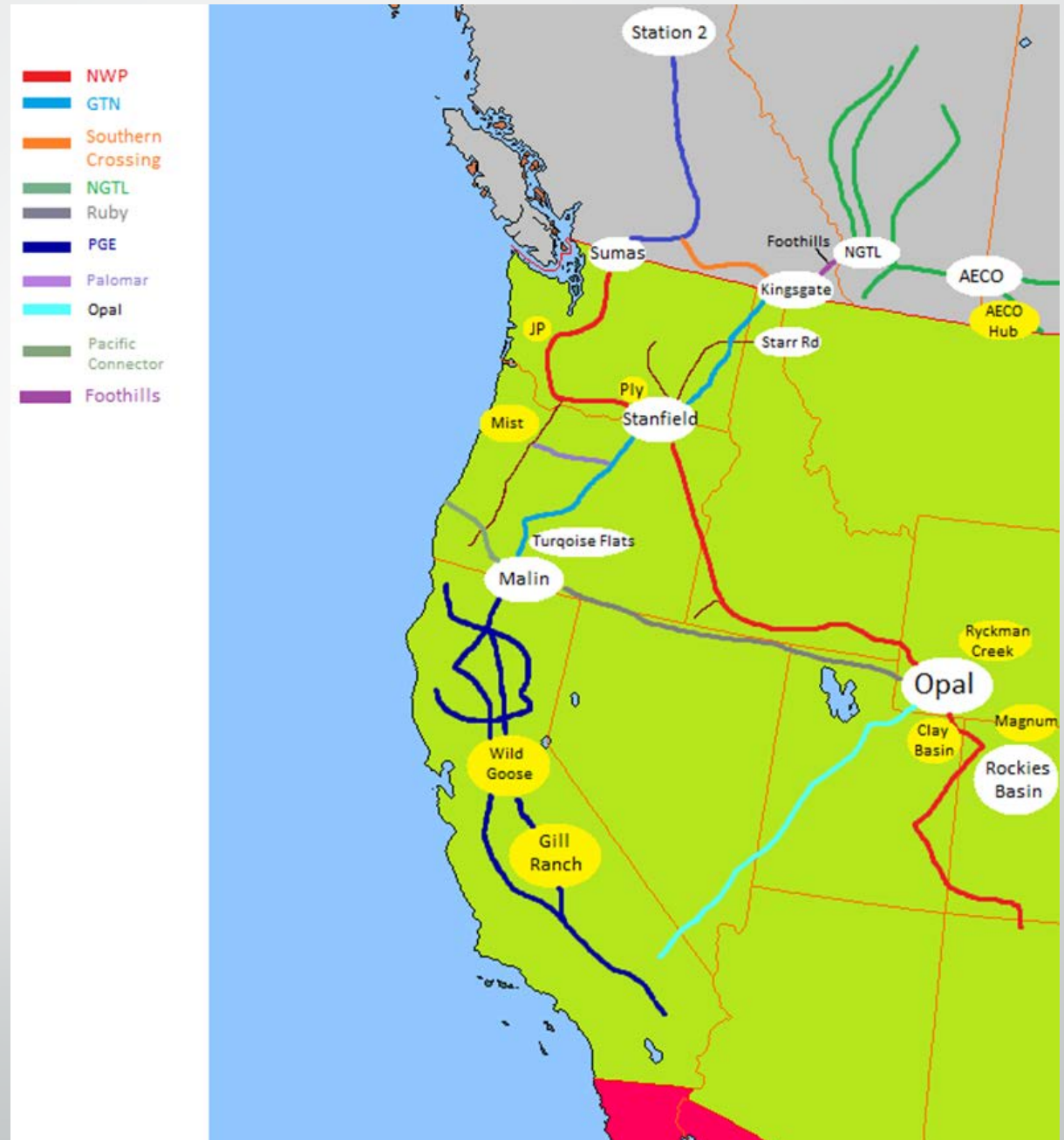
Additional Potential Resources

- Incremental Storage - North and East
- Incremental Storage - South and West
- Renewable Natural Gas
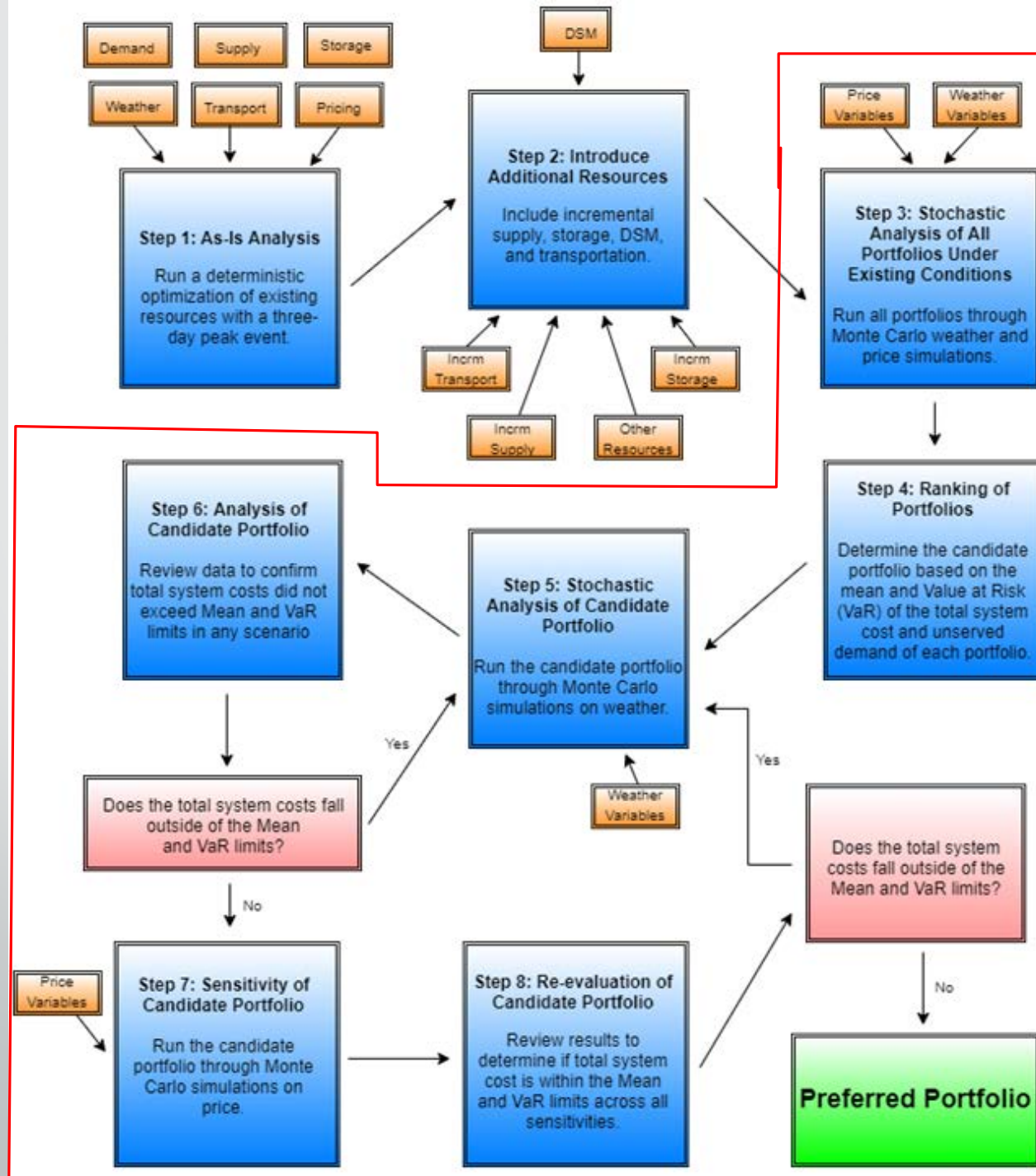
Supply Resource Optimization Process Flow Chart

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

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

All-In Less DSM Portfolio

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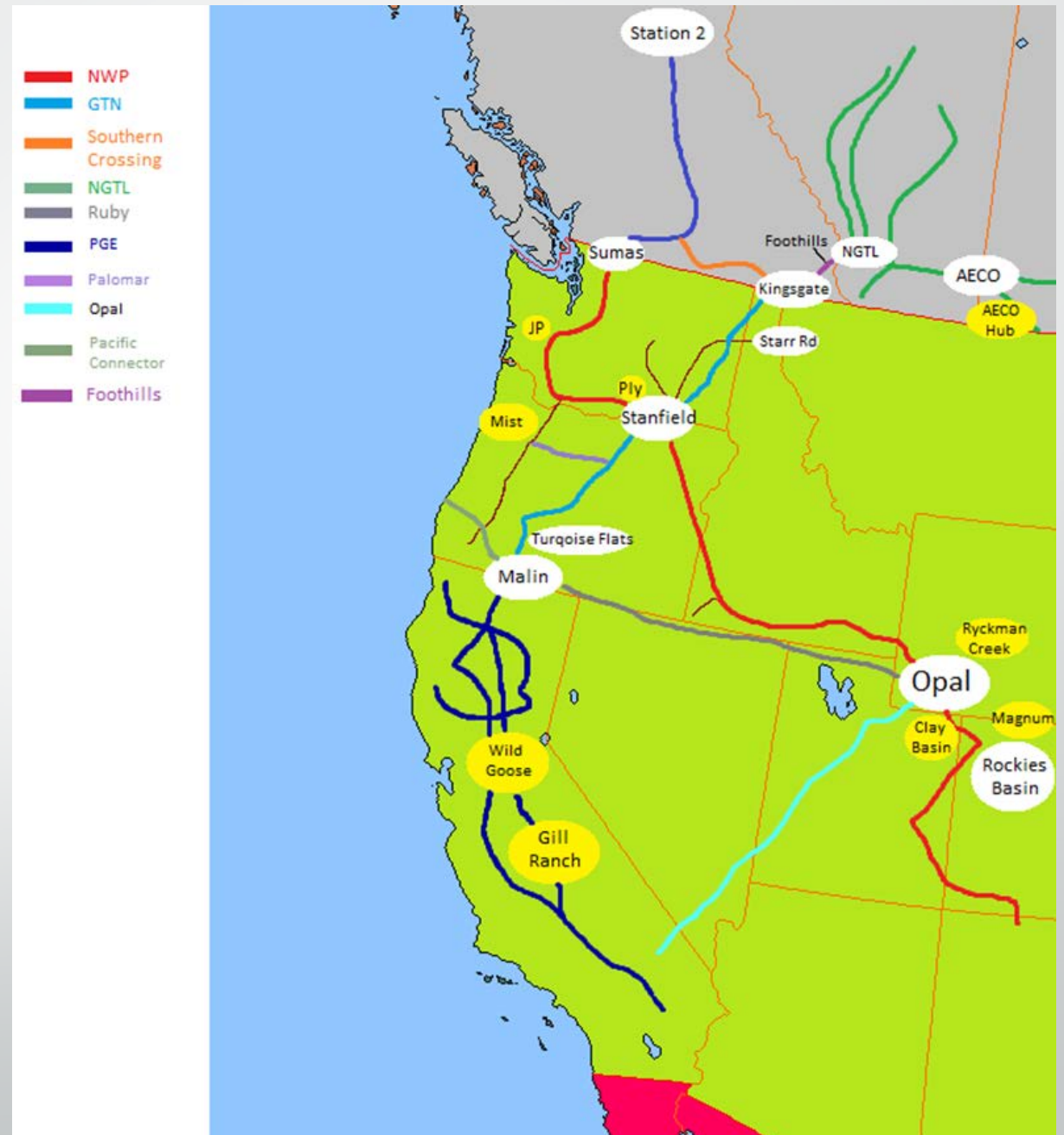 - Incremental Transport – North to South
  - Incremental Transport – Northwest Pipeline
  - Incremental Transport – South to North
 - Incremental Transport – Bilateral
  - Incremental Storage – North and East
  - Incremental Storage – South and West

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

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 Capacity From Kingsgate – 1,097 Dth by 2030

- Monitor Incremental Nova – 338 Dth in 2030

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
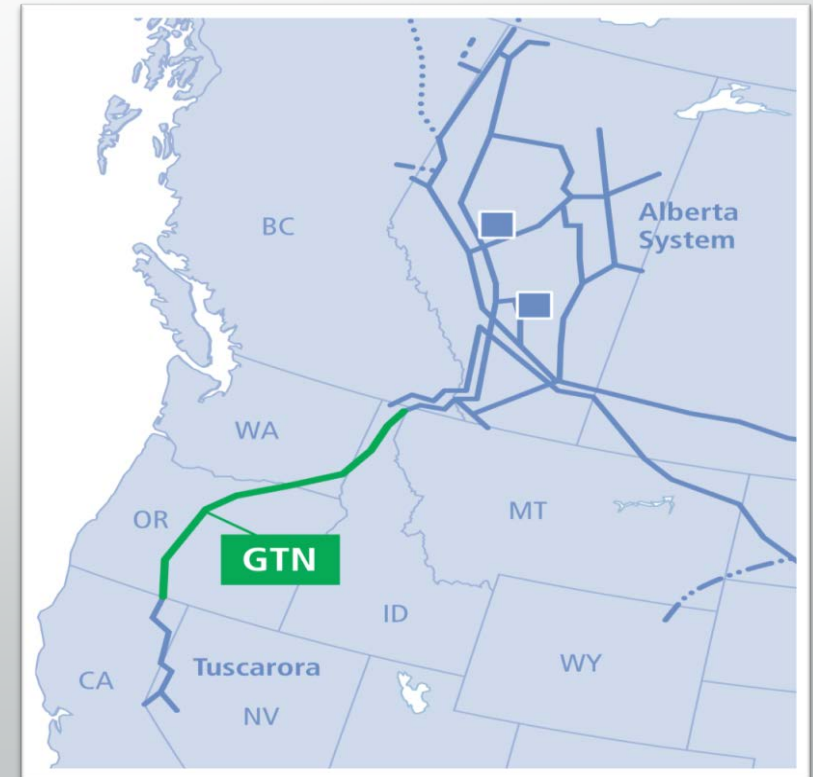
NWP Only Portfolio

- 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

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	Green	Green	Red	Red	Green	Green	Red
Incremental Foothills	Yellow	Yellow	Red	Red	Yellow	Yellow	Red
Incremental GTN N/S	Yellow	Green	Red	Red	Green	Green	Red
I-5 Mainline Exp.	Yellow	Yellow	Yellow	Yellow	Red	Red	Red
Wenatchee Lateral Exp.	Yellow	Yellow	Yellow	Yellow	Red	Red	Red
Spokane Lateral Exp.	Yellow	Yellow	Yellow	Yellow	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	Green	Green	Red	Green	Red	Green	Green
AECO Hub Storage	Yellow	Yellow	Red	Yellow	Yellow	Yellow	Yellow
Clay Basin Storage	Yellow	Yellow	Yellow	Yellow	Red	Yellow	Yellow
Gill Ranch Storage	Yellow	Yellow	Red	Yellow	Yellow	Yellow	Yellow
Wild Goose Storage	Yellow	Yellow	Red	Yellow	Red	Yellow	Yellow
Incremental DSM	Green	Red	Red	Red	Red	Red	Red

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

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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.

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

- Risk-Adjusted results simply weigh the deterministic and stochastic results by the 75/25 mix discussed earlier. We call it risk-adjusted because the stochastic portion attempts to capture the unknown quantities.

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'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 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.

Aeco Price Simulations
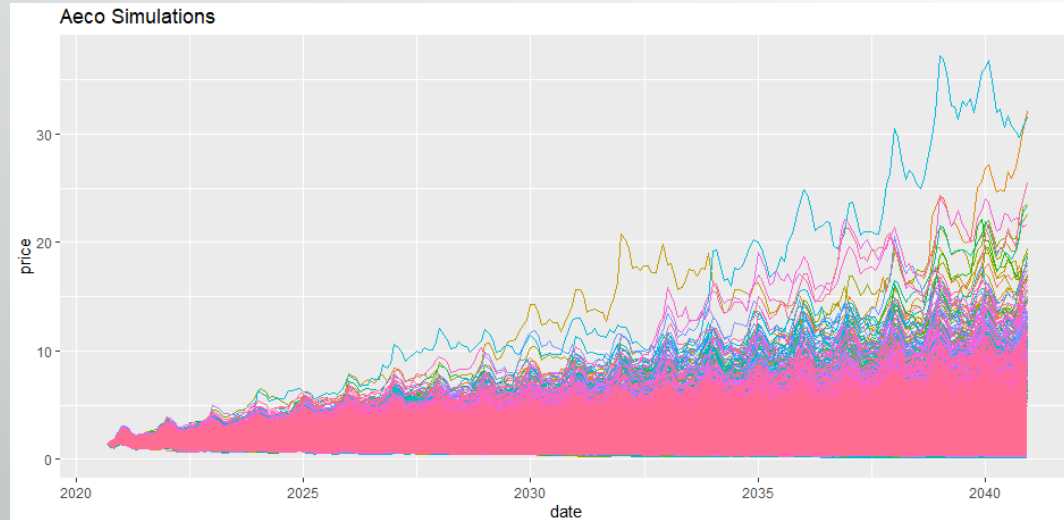
10,000 Simulations
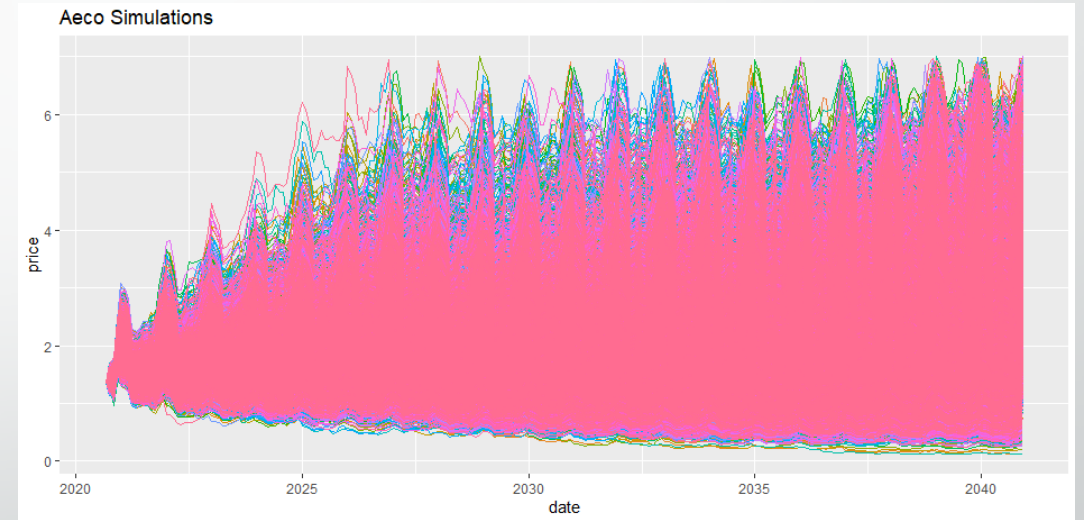
95th Percentile

Rockies Price Simulations

10,000 Simulations   95th Percentile
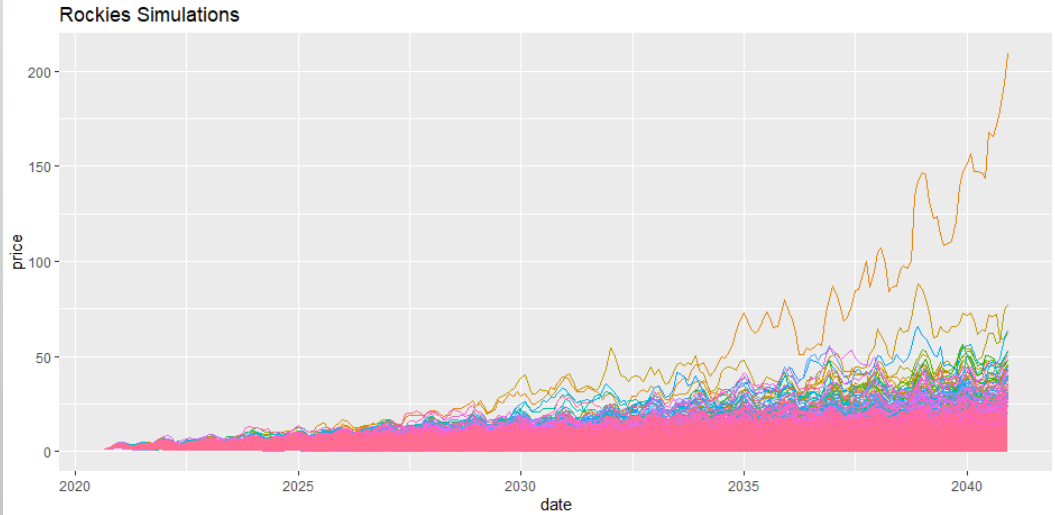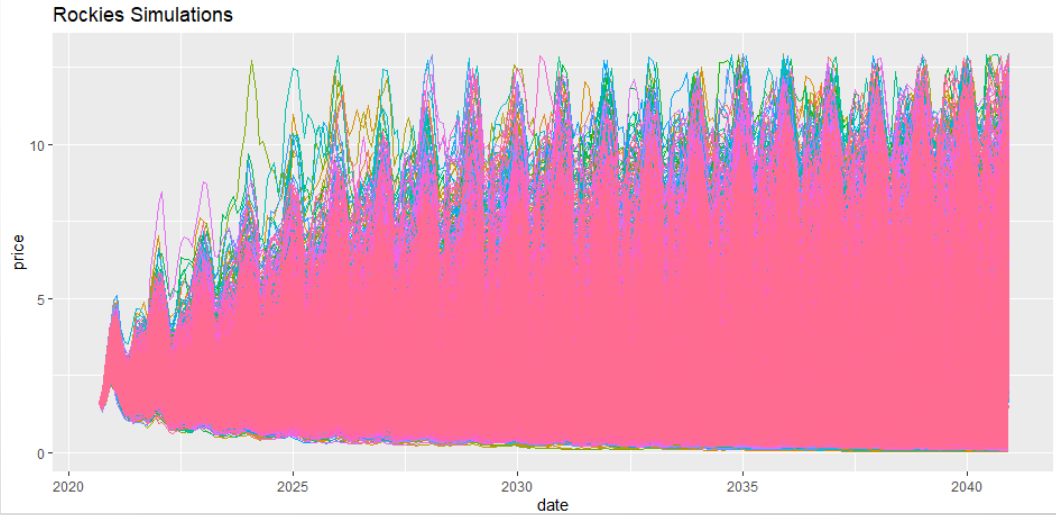
Sumas Price Simulations
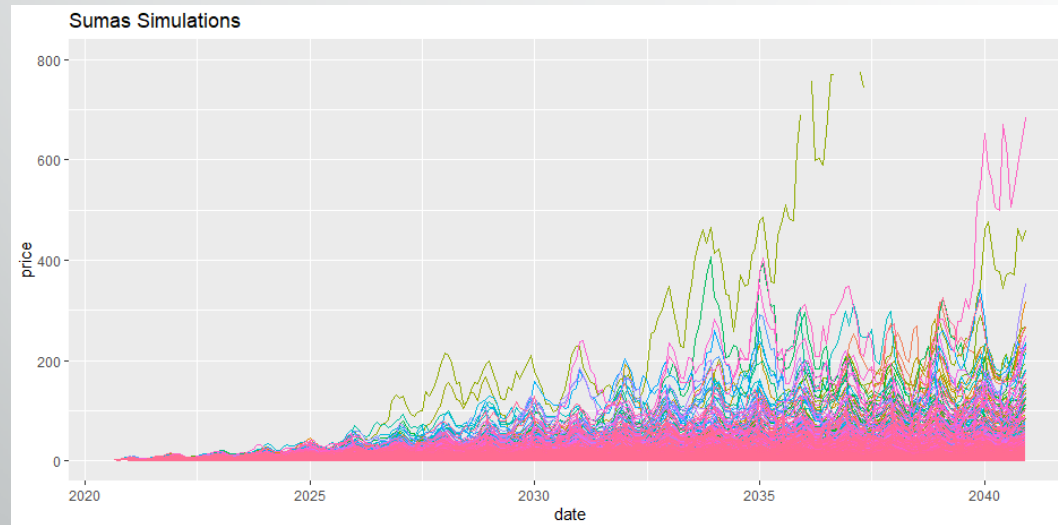
10,000 Simulations   95th Percentile
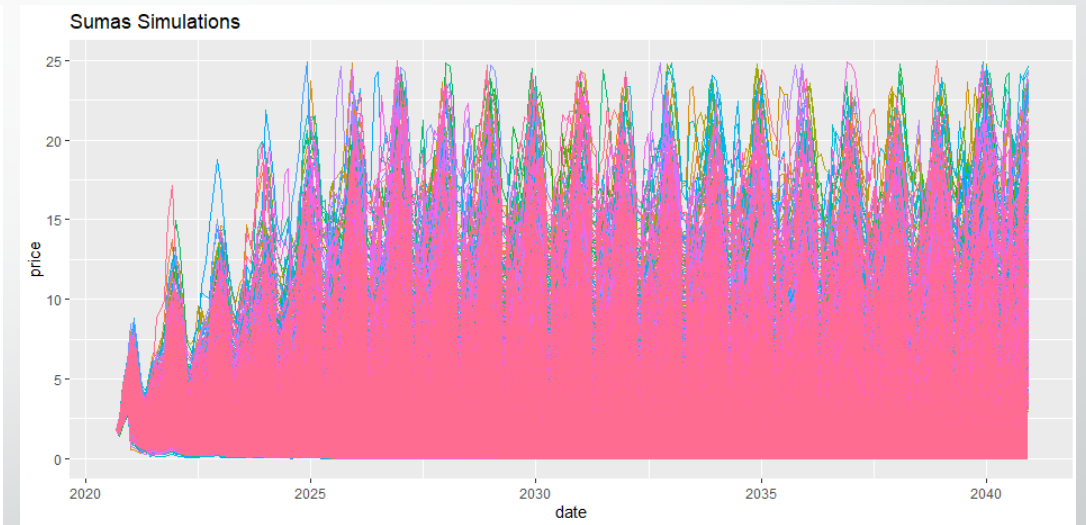
Scenario and Sensitivity Results

Peak Day Take Vs. Demand

Peak Day Supply Take Vs. Demand
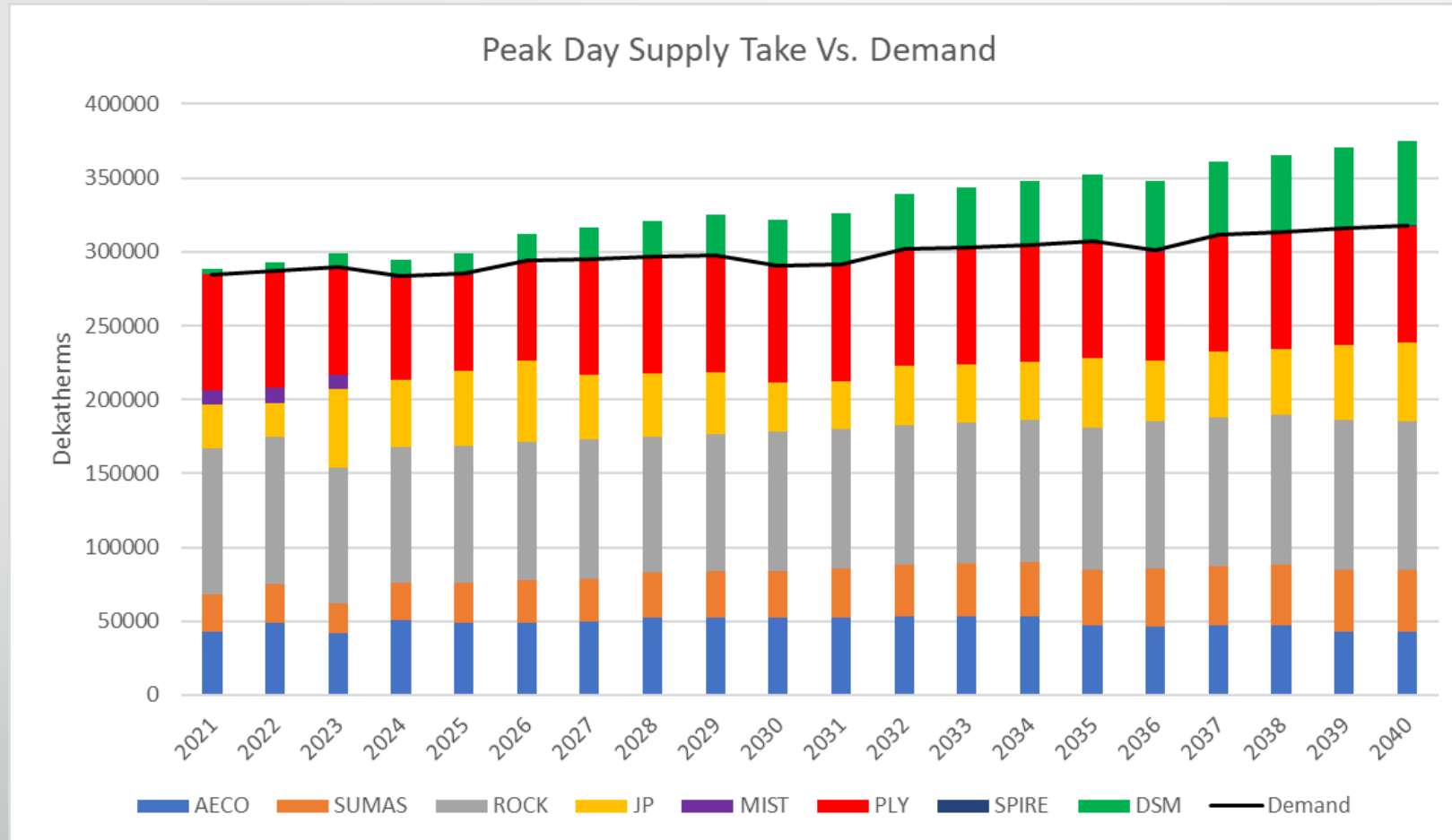
HDD Draw Graph – January 1ˢᵗ
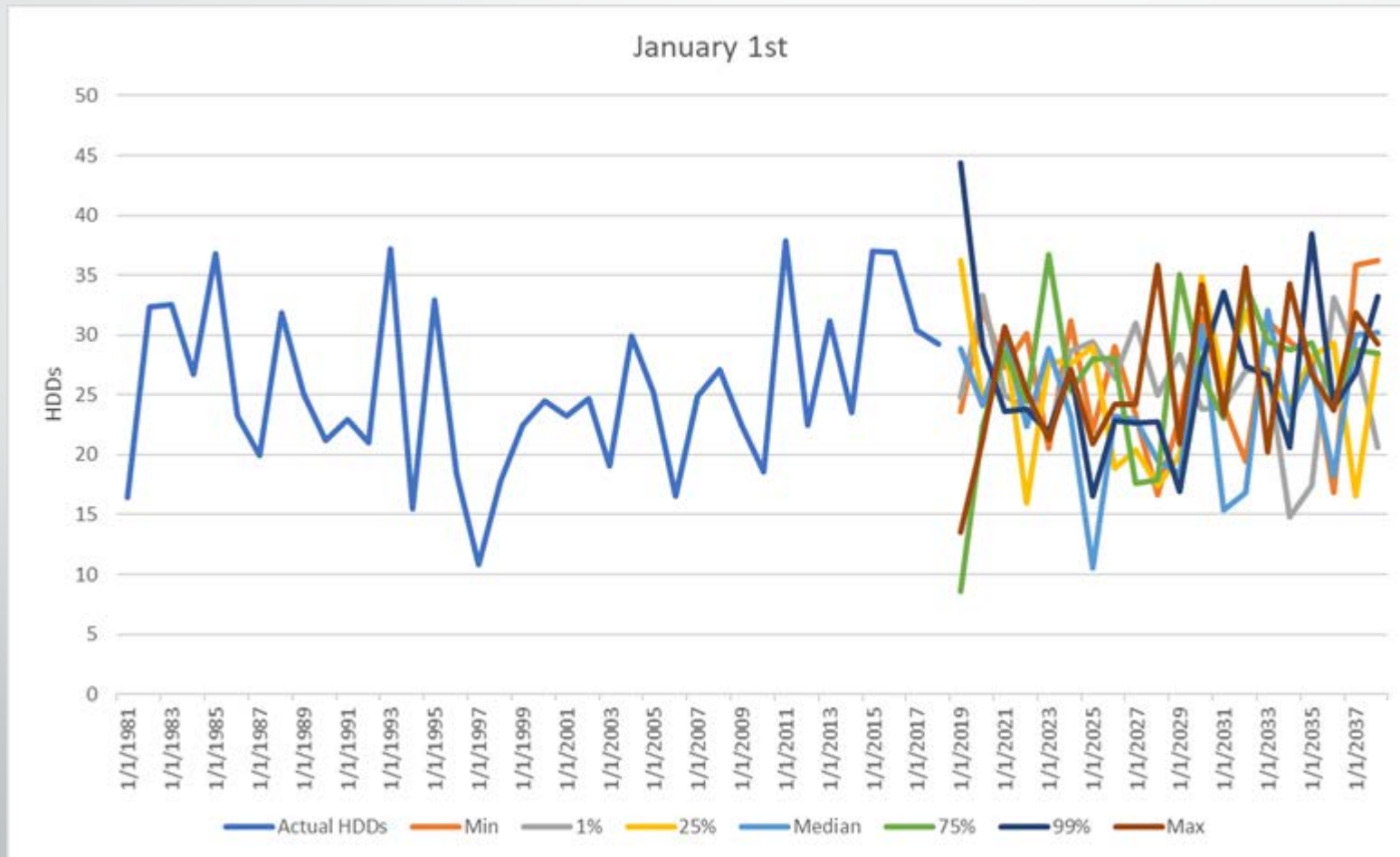
HDD Draw Graph – All Days
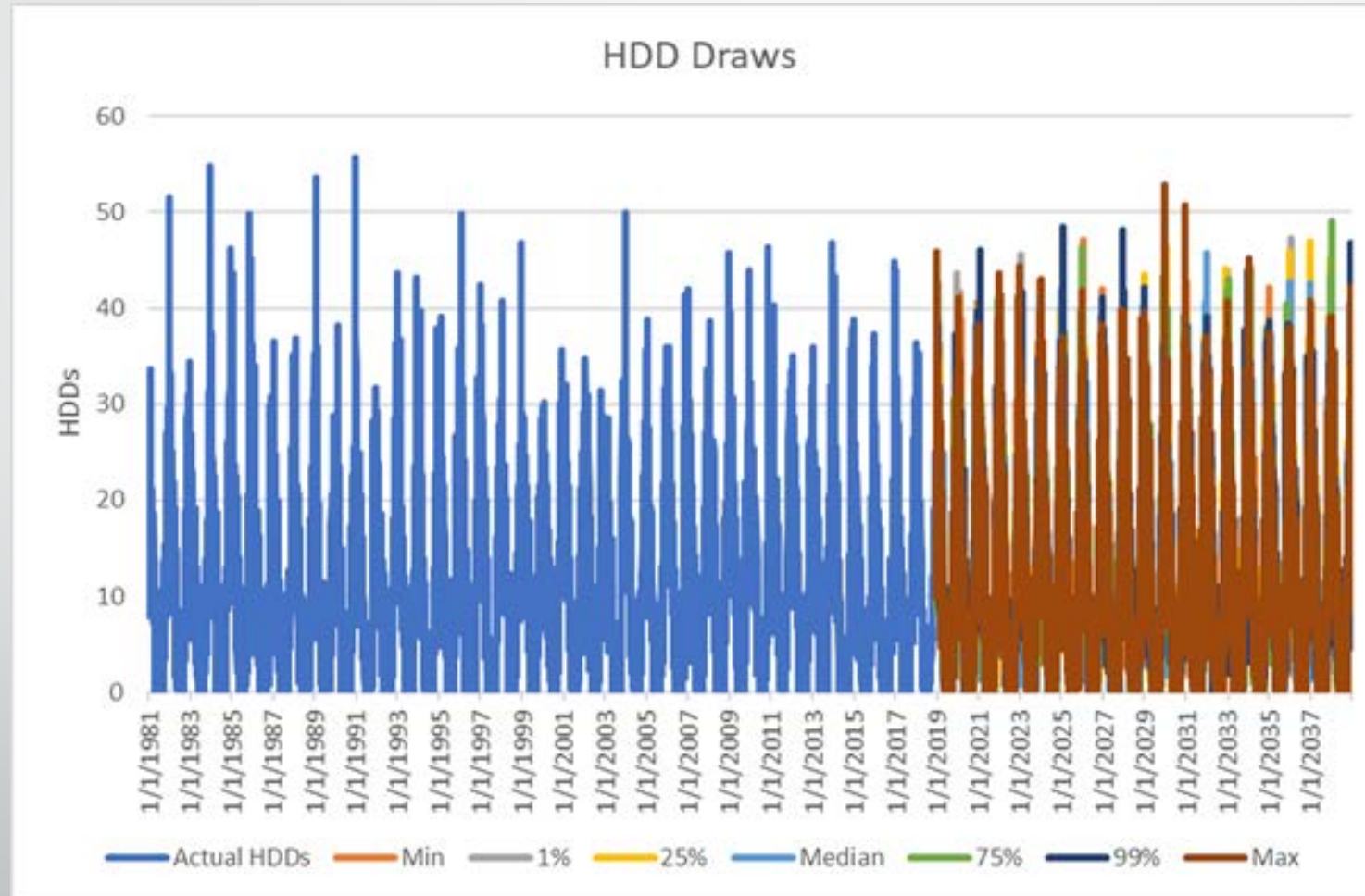
Carbon Sensitivity Discussion

- 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

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.

RES/COM/IND CUMULATIVE UCT POTENTIAL
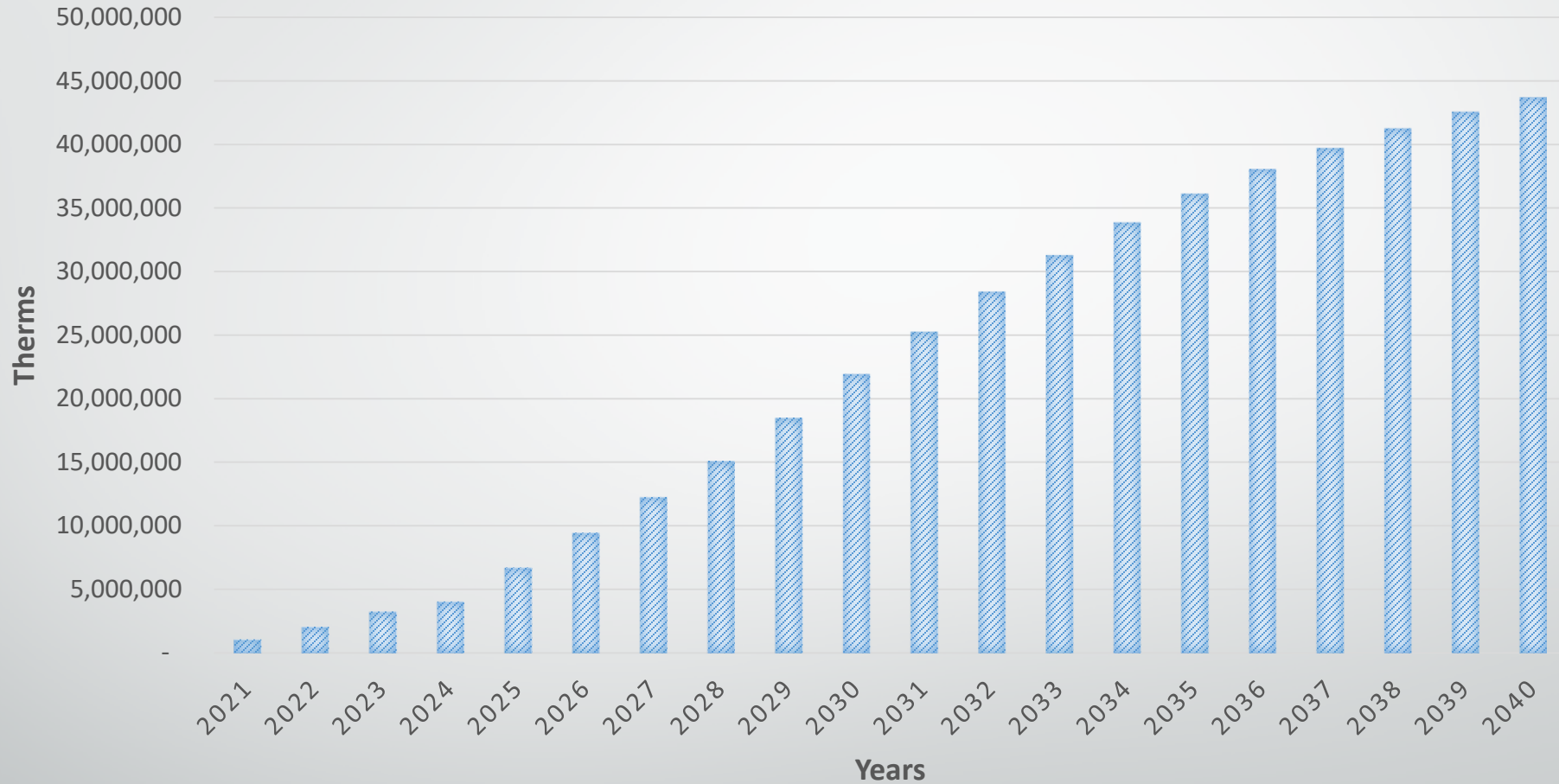
2020 DSM forecast

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

Refinements to DSM forecast over TAG 4

- 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%

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

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 - Unserved Demand Breakdown
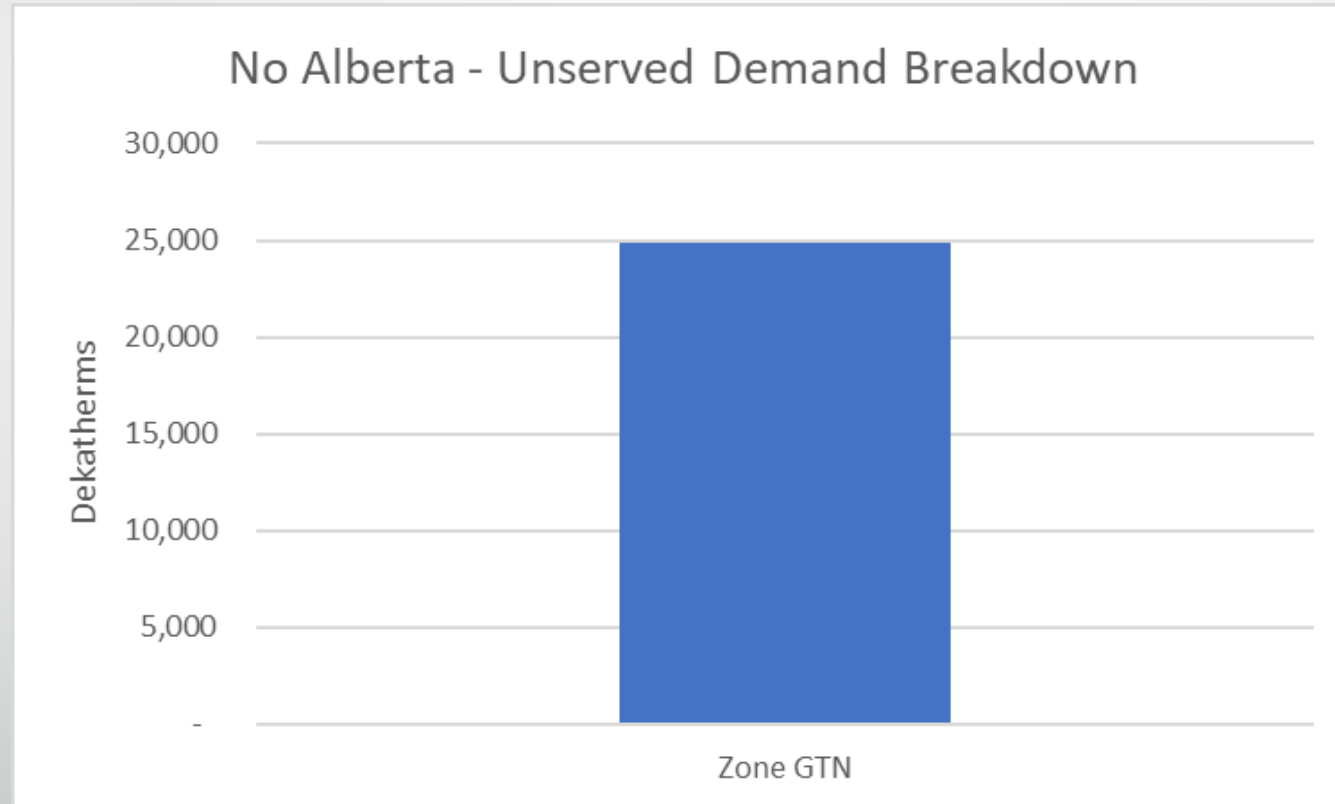
No Alberta Scenario – Discussion

- 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.

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).

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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		

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ADDITIONAL QUESTIONS?

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2020 Integrated Resource Plan
Technical Advisory Group Meeting #5

September 23rd, 2020

Microsoft Teams