CASCADE NATURAL GAS CORPORATION

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In the Community to Serve®

2014
Integrated Resource Plan

Appendix Volume 1 (Sec A)

Appendix A

IRP Process

Cascade Natural Gas Corporation

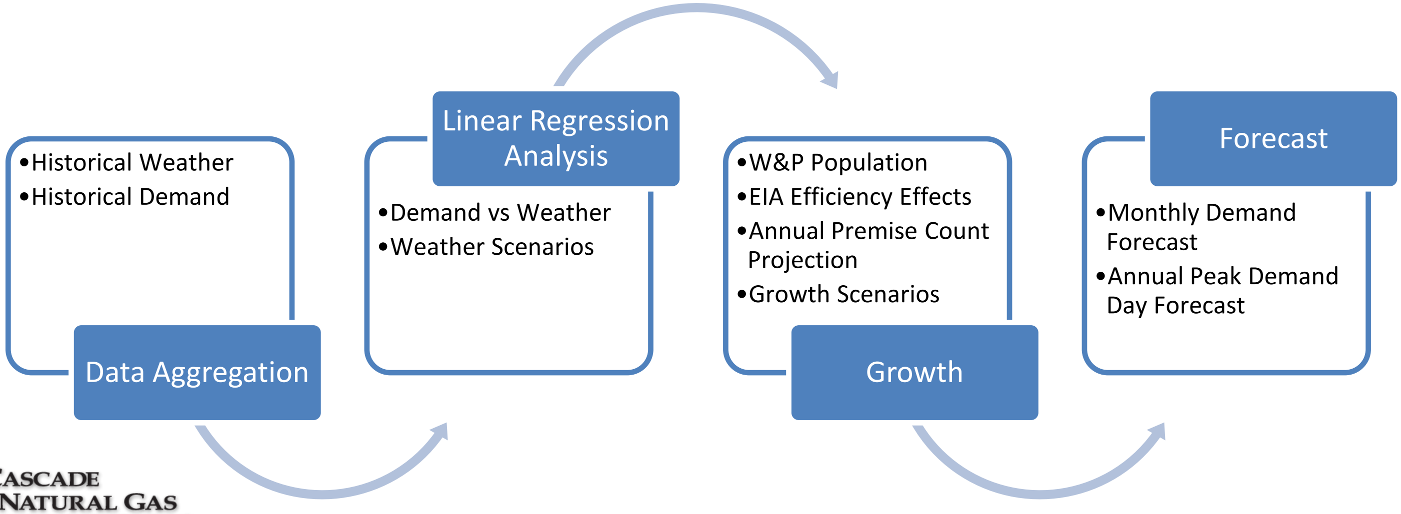
Integrated Resource Plan
Technical Advisory Group Meeting #1

Tuesday, June 24, 2014
Portland International Airport
Conference Center

Demand Forecast
Executive Summary

Overview

- The Cascade demand forecast developed for the IRP is an estimate of natural gas demand and peak demand for the next 20 years
- Cascade core load consists mostly of residential and commercial customers along with some industrial customers.



Overview

- Forecast demand at the citygate and demand loop level
- Demand loops are a group of citygates that service a similar area
- CNGC forecast model is flexible giving Cascade the ability to
  - Update input data (gas demand and weather)
  - Modify assumptions
  - Modify citygates and loops to be forecasted

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Forecast Philosophy

- Cascade's demand is principally weather driven: colder the weather, the greater the demand
- This forecast doesn't predict weather
- Forecast considers historical weather scenarios – average year, cold year, warm year, extreme cold day, etc.
- Apply weather and demand to each of the 79 citygates
- Forecast uses statistical techniques to model gas demand from weather
- Growth factors are applied to the next 20 years of data, creating ultimate output presented today

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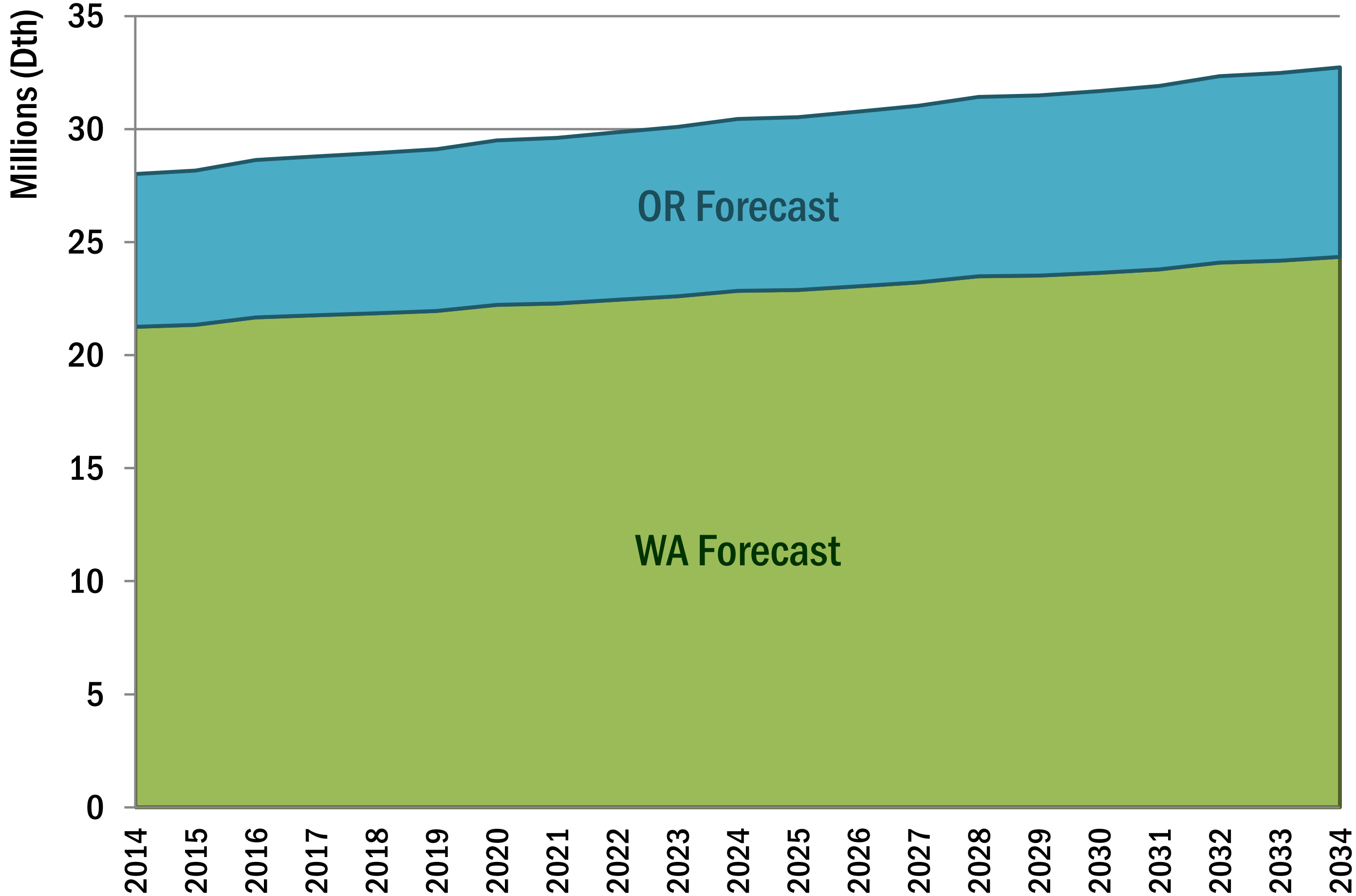
Forecast Results



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Project Team

- Gelber & Associates - Energy Market Specialist

- MRE Consulting - Technology Systems, Consulting, Human Resources

- Cascade Natural Gas- Client, Local Distribution Company

Human Resources

Consulting Resources

- Arthur Gelber
  - President of G&A
  - 25 years working with the risk management and procurement for large energy purchasers
- Kent Bayazitoglu
  - Director of Analytics at G&A
  - MIT educated in Financial Engineering and Quantitative Analysis
  - Principle architect of the Cascade Demand Forecast

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Consulting Resources cont.

- Evans Finger
  - Systems Analyst G&A
  - Univ. Of Virginia degree in Systems Engineering
  - Assisted with Demand Model, verified data integrity, main Cascade interface
- Micah Robinson
  - Project Manager MRE Consulting
  - Architect of user interface and automation
  - Cascade primary account representation

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Inputs and Data Sources

Input Data

- Historical Demand
  - Used Pipeline actuals and Gas Management System (GMS)
  - Tested and rejected Customer Care and Billing (CC&B)
- Weather - NOAA
- Population - Woods & Poole
- Efficiency - EIA regional efficiency projection
- Premise Count - CC&B

Key Assumptions

- Seven weather locations effectively covers Cascade's weather area
- Heating demand does appreciatively start until average temps dip below 60F, therefore a 60 F HDD threshold used
- Heating demand reacts to temperature in a mostly linear fashion
- A 1% increase in population translates to a 1% increase in gas demand, before accounting for any efficiency gains.

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Forecast Cases

- Base case assumes normal weather (30 year average) and average growth
- Cases for average, cold, and mild weather
- Cases with and without efficiency gains
- Cases for average, low, and high population/economic growth
- Daily peak demand cases

The Model

Demand Data

- Four years of historical demand was analyzed to create the CNGC forecast.
- Historical core monthly demand by citygate was primarily drawn from
  - Cascade's own Gas Management System (GMS)
  - Pipeline actuals from Electronic Bulletin Board (EBB)
- Also examined CC&B (Customer Care and Billing) for data verification and premise count information

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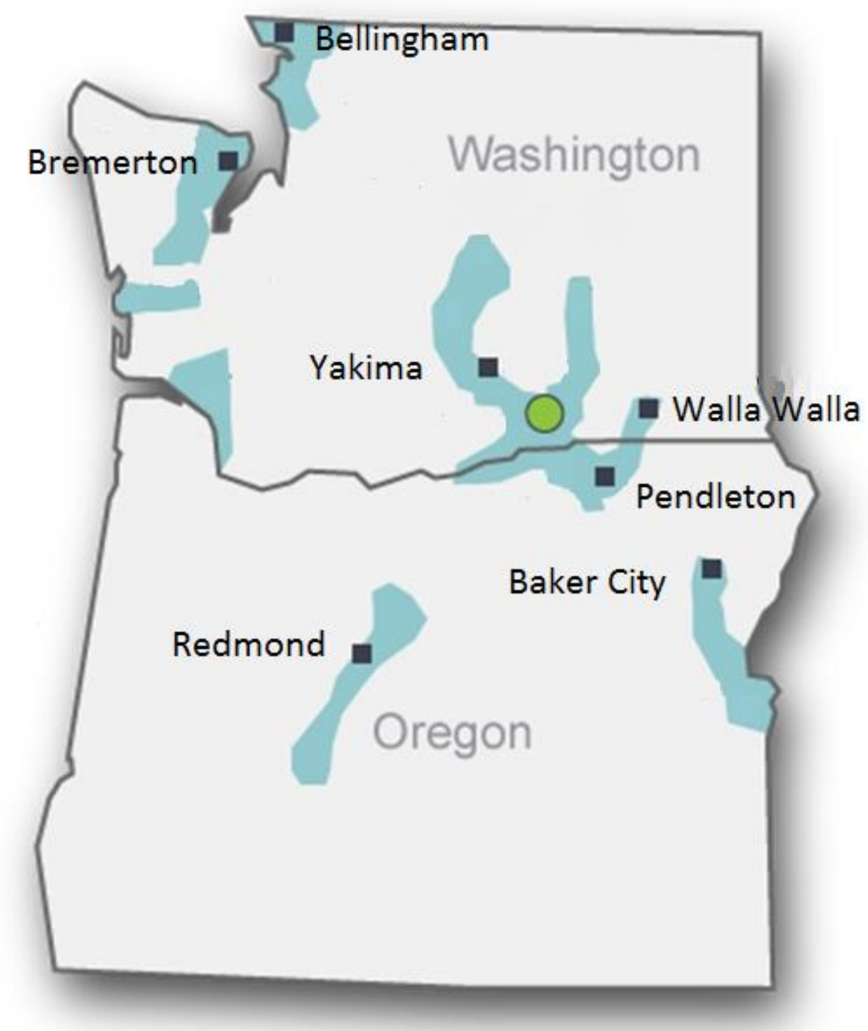
Weather Data

- Define weather in terms of HDD's (Heating Degree Day)
- The greater the colder weather, the greater the HDD
- Last four years of weather data used for regression model
- 30 years of weather data (1983 – 2013) for seven weather stations was used to make weather scenarios
- Weather data is from the National Oceanic and Atmospheric Administration (NOAA) and Schneider Electric
- Assign a weather station to each citygate or demand loop

Weather Stations



- The seven weather stations are shown on the map
- Cascade's customer base is shaded in aqua
- Each citygate and loop is assigned to a weather station

Linear Regression Analysis

- Goal is to predict weather at each citygate based on given weather (HDD)
- Perform a linear regression or best fit analysis of monthly gas demand versus monthly HDD's at each citygate for the past four years of data
- Weather is the input variable and gas demand is the output

$$\boldsymbol{Demand = b \times WeatherHDD + C}$$

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Linear Regression Analysis

historical ***historical***

$$\boldsymbol{Demand} = \boldsymbol{b} \times \boldsymbol{WeatherHDD} + \boldsymbol{C}$$

From regression ***From regression***

- Linear regression or best fit analysis produces the best coefficient ***b*** and constant ***C*** for each citygate that minimizes error
- Model error is measured with R^2
- Higher the R^2, the lower the error and the stronger the relationship between weather and demand

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Linear Regression Analysis

From regression ↓ *From regression* ↓

$$\boldsymbol{Demand = b \times Weather_{HDD} + C}$$

- Demand equation at each citygate uses ***b***'s and ***C***'s found through the regression
- Demand at each citygate can be found by plugging in an HDD (weather) from an average year, a cold year, or a mild year.

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Linear Regression Analysis

GATE As Defined in Forecas	State	Weather Station	b	c	R^2
MCCLEARY (ABERDEEN/HOQUIAM)	Washington	Bremerton	102.58	527.67	0.96
ACME	Washington	Bellingham	1.74	5.18	0.98
ARLINGTON	Washington	Bellingham	100.94	470.78	0.98
ATHENA	Oregon	Pendleton	8.88	19.50	0.99
BAKER	Oregon	Baker City	56.38	94.97	0.99
BREMERTON (SHELTON)	Washington	Bremerton	609.25	1930.46	0.96
UMATILLA	Oregon	Pendleton	12.02	19.04	0.58
CASTLE ROCK	Washington	Bremerton	2.60	14.88	0.94
CHEMULT	Oregon	Redmond	0.86	2.49	0.93
WALLA WALLA	Washington	Walla Walla	216.53	815.88	0.99
GILCHRIST	Oregon	Redmond	3.73	7.65	0.97
DEMING	Washington	Bellingham	2.93	9.86	0.98
WENATCHEE	Washington	Yakima	67.15	448.84	0.98

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Weather Scenarios

- The average scenario forecast assumes weather (HDD) for 12 months of the year from a 30 year average
- Average weather scenario is the base case forecast
- The same logic and demand equations (***b***'s and ***C'***s) were used to create the peak demand day for each citygate

Weather Scenarios

- For weather scenarios, system wide HDD's are found that appropriately weight the weather stations that greater impact on system wide demand
- To determine the high HDD case weather scenario, the six coldest years were selected (20% of 30 years) that have the highest yearly total of HDD's.
- To determine the low HDD case weather scenario, the six warmest years were selected (20% of 30 years) that have the lowest yearly total of HDD's.

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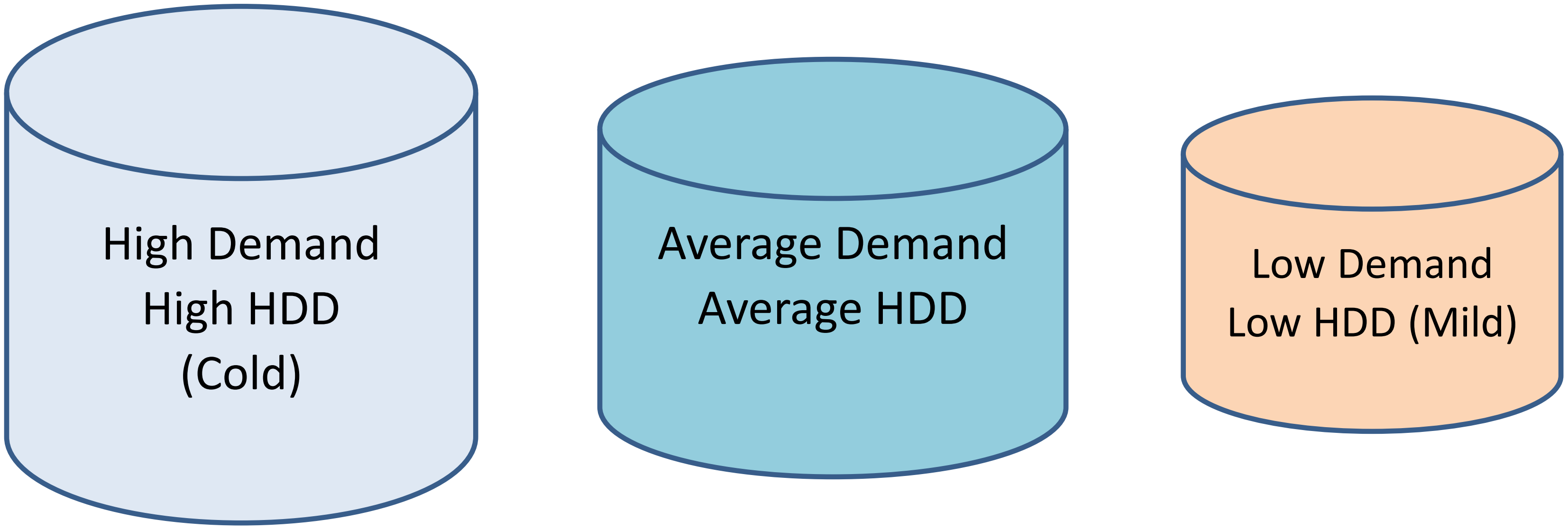
Weather Scenarios

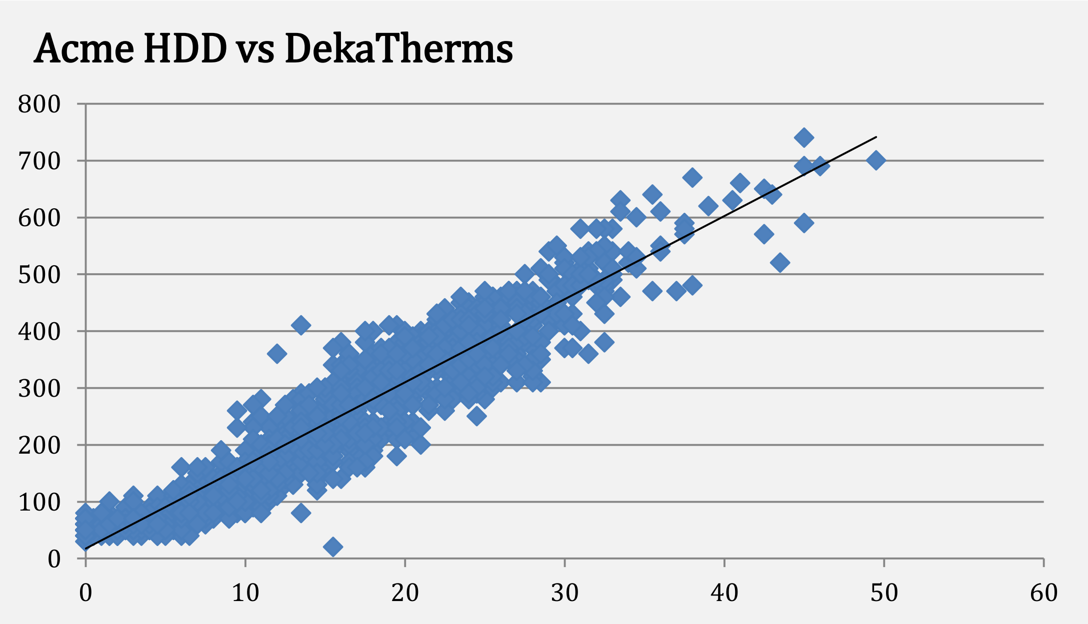


Heating Degree Day (HDD)

- Heating degree day measures coldest for modeling gas demand
- Heating degree day is calculated by:
  - Determine average high and low temperature for a given day
  - Daily average is subtracted from an HDD threshold (ex. 65°F)
  - If this produces a negative number, a value of zero is assigned
- Example
  - Daily high temperature = 60°F; Daily low temperature = 50°F
  - Calculate average → 55°F
  - Subtract from HDD threshold (we will use 65): 65-55 = 10
  - This example day has 10 HDD

65 vs 60 HDD Threshold

- Traditional threshold for calculating HDD is 65°F
- It was determined that lowering the threshold to 60°F produces better results
- The graph shows that heating demand does not begin to increase until an HDD of five if the traditional 65°F is utilized



Population Growth

- To project the natural gas demand forward, growth factors for each year are applied to gas demand predicted after assuming a weather scenario (average, cold, mild)
- Forecast assumes that gas demand customer counts grows equally with population
- A 1% growth in population translates to a 1% increase in customer growth)

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Population Growth Cont.

- Woods and Poole figures for employment, income, population, and housing demographics were reviewed
- Growth factors derived from W&P can manually be replaced by Cascade derived growth figures based on such factors such as premise growth, engineering estimates, and internal customer projections.
- Growth factors are primarily cumulative, growth in one year impacts growth subsequent years

Non cumulative Impacts

- Forecast model allows for non cumulative impacts that modify demand at a specified citygate and time period.
- Examples include plant shut downs, seasonal impacts, etc.
- Normal demand resumes after the non cumulative impact event is over

Growth Scenarios

- Forecast assumes three different growth scenarios
- Base case assumes normal growth with figures primarily from W&P population growth forecast
- High growth scenario assumes high economic and population growth and boosts growth by a given percentage (20%)
- Low growth scenario assumes low economic and population growth and decreases growth by a given percentage (20%)

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Growth Model Sample

GATE As Defined in Forecast	Average Premise Trend	Average W&P Growth	Average Manually Assigned Growth	Apply EIA Efficiency	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
					6	7	8	9	10	11	12	13	14	15	16	17	18
MCCLEARY (ABERDEEN/HOQUIAM)	0.00%	0.4%	0.0%	Yes	0.5%	0.2%	0.7%	0.9%	0.7%	0.6%	0.7%	0.8%	1.0%	1.0%	1.1%	1.1%	1.2%
ACME	0.00%	1.7%	0.0%	Yes	2.0%	3.3%	5.2%	7.0%	8.2%	9.5%	11.2%	12.8%	14.4%	15.9%	17.4%	18.9%	20.5%
SEDRO/WOOLLEY	0.00%	1.3%	0.0%	Yes	1.5%	2.2%	3.6%	4.9%	5.6%	6.4%	7.5%	8.6%	9.7%	10.8%	11.7%	12.7%	13.8%
ARLINGTON	0.00%	1.4%	0.0%	Yes	1.6%	2.5%	4.1%	5.5%	6.4%	7.3%	8.6%	9.8%	11.1%	12.3%	13.4%	14.5%	15.7%
ATHENA	0.00%	0.6%	0.0%	Yes	0.6%	0.5%	1.1%	1.5%	1.4%	1.4%	1.7%	1.9%	2.2%	2.5%	2.6%	2.8%	3.1%
BAKER	-22.03%	0.1%	0.0%	Yes	0.1%	-0.5%	-0.4%	-0.5%	-1.1%	-1.5%	-1.7%	-1.9%	-2.1%	-2.3%	-2.6%	-2.9%	-3.0%
BREMERTON (SHELTON)	0.00%	1.0%	0.0%	Yes	1.1%	1.5%	2.6%	3.5%	3.9%	4.4%	5.2%	5.9%	6.7%	7.4%	8.0%	8.7%	9.4%
BELLINGHAM 1 (FERNDALE)	0.00%	1.7%	0.0%	Yes	2.0%	3.3%	5.2%	7.0%	8.2%	9.5%	11.2%	12.8%	14.4%	15.9%	17.4%	18.9%	20.5%
BEND	0.00%	1.9%	0.0%	Yes	2.4%	4.1%	6.4%	8.6%	10.2%	11.9%	13.9%	15.8%	17.8%	19.7%	21.4%	23.2%	25.2%
NORTH BEND	2.00%	1.9%	0.0%	Yes	2.4%	4.1%	6.4%	8.6%	10.2%	11.9%	13.9%	15.8%	17.8%	19.7%	21.4%	23.2%	25.2%
SOUTH BEND	1.30%	1.9%	0.0%	Yes	2.4%	4.1%	6.4%	8.6%	10.2%	11.9%	13.9%	15.8%	17.8%	19.7%	21.4%	23.2%	25.2%
WCT-CNG INTERCONNECT(BLAINE, ETC.)	-14.82%	1.7%	0.0%	Yes	2.0%	3.3%	5.2%	7.0%	8.2%	9.5%	11.2%	12.8%	14.4%	15.9%	17.4%	18.9%	20.5%
UMATILLA	0.00%	0.6%	0.0%	Yes	0.6%	0.4%	1.0%	1.3%	1.2%	1.1%	1.4%	1.6%	1.9%	2.1%	2.2%	2.4%	2.6%

EIA Efficiency Factor

- Future gas demand, by citygate, was modified utilizing a calculated efficiency factor derived the U.S. Energy Information Administration's (EIA) 2014 Annual Energy Outlook.
- Cascade used the EIA forecast data for the entire U.S.
- Pacific Region not used - too heavily influenced by California
- Cascade used figures from EIA's reference forecast case, or base case, to calculate the expected percentage change of natural gas consumption over the next 20 years.

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Annual Premise Count Projection

- The Annual Premise Count Projection by Year and citygate was based upon trend analysis of the Historical Premise Count data pulled from CC&B from 2010 to 2013 for each citygate, Year, and Tariff.
- Historical Premise Count by CityGate, Year, and Tariff was used to forward project premise count based upon the trend between premise count and time.
- This information is used as guide to assist Cascade when forecasting customer growth.

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Final Demand Forecast

The Monthly Demand Forecast by year, month and citygate was based upon:

- Calculate demand after plugging in a weather scenario demand equation built from regression analysis
- For demand equations with poor regressions (R^2 less than 70%), recent demand is used
- Growth factors and efficiency gains are applied to all citygates

Demand Forecast

Forecast Tim	System Demand (Dth)	OR Forecast (Dth)	WA Forecast (Dth)	ATHENA	BAKER	UMATILLA	CHEMULT	GILCHRIST	HERMISTON	HUNTINGTON	LA PINE	MADRAS	MILTON-FREEWATER
Jan-15	4,487,401.28	1,070,999.79	3,416,401.48	7,542	61,720	9,970	769	3,252	88,731	1,634	6,819	36,132	6,924
Feb-15	3,643,722.02	891,556.41	2,752,165.61	5,988	48,545	7,891	652	2,751	69,735	1,256	5,798	30,545	5,492
Mar-15	3,151,494.00	769,614.48	2,381,879.51	4,754	39,346	6,200	586	2,453	53,501	952	5,274	27,184	4,292
Apr-15	2,299,911.94	574,158.76	1,725,753.18	3,153	27,895	4,043	454	1,884	33,481	610	4,156	20,818	2,893
May-15	1,522,868.33	388,672.69	1,134,195.64	1,793	17,174	2,196	308	1,245	16,082	275	2,938	13,654	1,893
Jun-15	881,520.98	202,631.55	678,889.44	822	8,076	890	165	621	4,014	6	1,716	6,681	1,263
Jul-15	664,931.23	151,927.76	513,003.47	617	3,484	605	91	299	1,212	-	1,110	3,066	1,199
Aug-15	640,074.94	120,941.28	519,133.66	619	3,776	609	94	308	1,246	-	1,128	3,167	1,202
Sep-15	1,008,739.07	231,085.68	777,653.39	910	9,891	1,010	174	663	5,136	61	1,797	7,149	1,305
Oct-15	2,168,836.77	518,031.68	1,650,805.09	2,961	27,511	3,776	395	1,621	30,843	591	3,666	17,870	2,799
Nov-15	3,510,550.29	841,870.14	2,668,680.16	5,629	45,727	7,391	621	2,611	64,777	1,154	5,563	28,965	5,196
Dec-15	4,632,517.33	1,155,445.83	3,477,071.51	7,972	61,788	10,552	820	3,474	94,169	1,636	7,247	38,614	7,335
Jan-16	4,540,632.71	1,087,524.25	3,453,108.46	7,585	61,774	10,023	774	3,270	89,270	1,636	6,975	36,243	6,966

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High Case Peak Demand Day Forecast

- The Annual Peak Day Forecast ensures that Cascade can continue to provide adequate heating to its customers even under extreme conditions which are far colder than the norm.
  - To determine the system wide peak demand day, HDD's from all seven weather stations are considered, giving appropriate weight to the weather stations having the greater impact on system wide demand.
  - It was found that December 21, 1990 was the highest system weighted HDD for this period.
  - The peak demand day was then derived from the highest HDD by applying the actual HDD from the peak day for the 30 year period to the linear regression equation for each citygate . Thus all citygates associated with the Bellingham weather station, for example, use the HDD calculated for Bellingham for December 21, 1990, and similarly for all the other weather stations and citygates. This provides a highest demand scenario for peak demand load based on 30 years of weather history for each citygate.

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High Case Peak Demand Day Forecast

Forecast Tim	Peak Day Demand (Dth	OR Peak Day (Dth	WA Peak Day (Dth	ATHENA	BAKER	UMATILLA	CHEMULT	GILCHRIST	HERMISTON	HUNTINGTON	LA PINE	MADRAS
2014	307,863.13	85,193.19	222,669.94	618	4,074	829	63	272	7,548	115	531	3,030
2015	311,160.91	86,488.64	224,672.27	618	4,050	828	63	272	7,594	116	543	3,038
2016	314,918.51	87,827.31	227,091.20	621	4,054	832	64	274	7,640	116	556	3,048
2017	318,573.74	89,160.09	229,413.65	624	4,050	835	64	275	7,687	116	568	3,058
2018	321,925.32	90,470.23	231,455.10	623	4,027	834	64	274	7,734	116	581	3,068
2019	325,337.44	91,788.67	233,548.76	623	4,007	834	64	274	7,782	116	593	3,079
2020	328,963.90	93,125.43	235,838.46	625	4,000	836	64	275	7,829	116	606	3,090
2021	332,582.01	94,465.21	238,116.80	626	3,992	838	64	276	7,878	116	618	3,101
2022	336,208.51	95,805.54	240,402.97	628	3,984	840	64	277	7,926	117	631	3,113
2023	339,805.96	97,142.62	242,663.35	630	3,975	842	64	277	7,975	117	643	3,125
2024	343,366.23	98,478.27	244,887.96	631	3,964	843	65	278	8,024	117	656	3,137

Expected Peak Demand Day Forecast

- For the past 30 years, the coldest system wide day (highest system HDD) is found for each of the past 30 years
- The actual HDD for each weather station from each of those 30 peak dates is pulled
- The 30 years of HDD figures are averaged and then plugged into the forecast model for each citygate
- For citygates with poor demand model regressions, recent peaks demand figures are used
- Growth factors are applied to predict peak demand in future years

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Growth Scenarios

- Forecast assumes three different growth scenarios
- Base case assumes normal growth with figures primarily from W&P population growth forecast
- High growth scenario assumes high economic and population growth and boosts growth by a given percentage (20%)
- Low growth scenario assumes low economic and population growth and decreases growth by a given percentage (20%)

Expected Peak Demand Day Forecast

Forecast Tim	Peak Day Demand (Dth	OR Peak Day (Dth	WA Peak Day (Dth	ATHENA	BAKER	UMATILLA	CHEMULT	GILCHRIST	HERMISTON	HUNTINGTON	LA PINE	MADRAS
2014	231,938.71	60,667.79	171,270.92	450	3,096	602	44	189	5,440	86	372	2,093
2015	234,400.55	61,576.61	172,823.94	450	3,078	601	44	188	5,473	86	381	2,099
2016	237,208.35	62,517.62	174,690.73	452	3,080	604	44	189	5,506	86	390	2,106
2017	239,939.22	63,454.05	176,485.17	454	3,077	606	44	190	5,540	86	399	2,113
2018	242,441.73	64,373.37	178,068.36	454	3,060	606	44	190	5,574	86	407	2,120
2019	244,989.74	65,298.76	179,690.98	454	3,045	605	44	190	5,608	86	416	2,127
2020	247,699.17	66,237.86	181,461.31	455	3,040	607	44	190	5,643	86	425	2,135
2021	250,402.28	67,179.01	183,223.27	456	3,033	608	45	191	5,678	87	434	2,143
2022	253,111.81	68,120.60	184,991.20	458	3,028	610	45	191	5,713	87	443	2,151
2023	255,799.49	69,059.81	186,739.68	459	3,021	611	45	192	5,748	87	451	2,159
2024	258,459.16	69,997.87	188,461.29	459	3,012	612	45	192	5,783	87	460	2,168
2025	261,116.90	70,933.91	190,182.98	460	3,004	613	45	193	5,818	87	469	2,176

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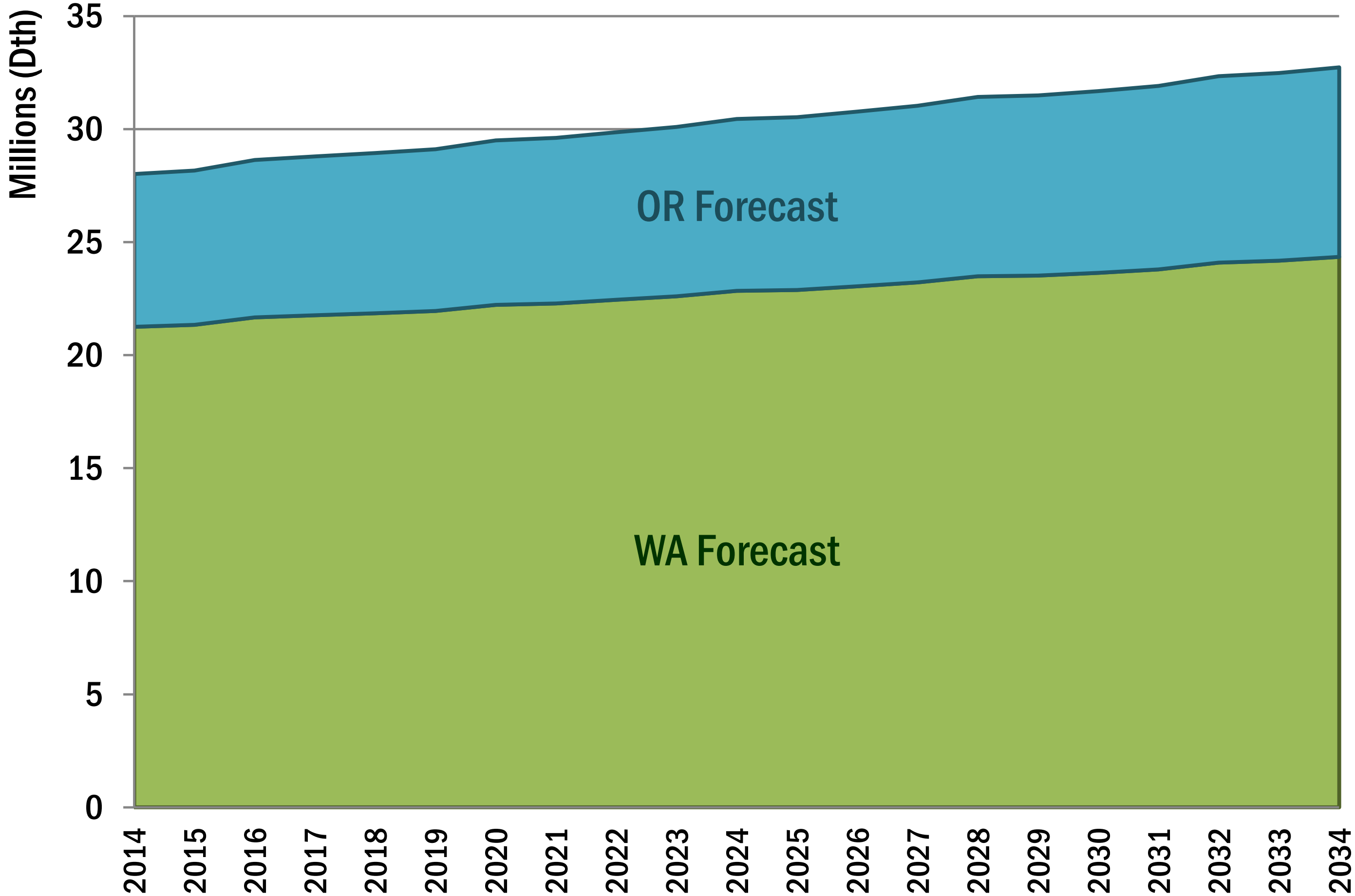
Forecast Results



Summary

- Cascade core customer demand is expected to grow modestly for the coming 20 years
- Growth is primarily dependent upon regional population dynamics tempered by natural gas efficiency gains
- Weather plays a big role in demand for any given year
- Forecast model is allows Cascade to consider numerous scenarios, including extremes, and is designed to be updated when new information becomes available

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Cascade Natural Gas Technical Advisory Group Meeting #1
Portland International Airport in Portland, OR
June 24th, 2014 9:00 AM – 12:30 PM

Attachments:
Attachment A – Technical Advisory Group Meeting #1 slides
Attachment B – Attendance sheet

I.) **Introduction** – Mark Sellers-Vaughn opened the meeting with the introductions, agenda, and background information. A few notes that were stated:

- The IRP Guidelines and Content were discussed.
- Irion Sanger expressed concern on the 5 year lockdown on the conservation forecast. Jim Abrahamson said that they use the term lockdown but the forecast can change and is not necessarily a lockdown number.
- Mark Sellers-Vaughn noted the changes in the IRP timeline.
- Market Forecast and Planning Overview were discussed.

II.) **Demand Forecast Executive Summary** – Art Gelber discussed the overview of building a load forecast model.

- The question what are demand loops was asked. The answer was demand loops are a group of CityGates that service a similar area. A follow up question was how many loops does our model contain? The answer is 8.
- An idea of what the forecast results can look like was shown on slide 37. The preference from audience members was to have tables with actual numbers.
- Data input information was shown.
- Key assumptions and different forecast cases were discussed.

III.) **The Model** – Kent Bayazitoglu presented multiple aspects of what the forecast model uses for inputs and what it provides for the outputs.

- Where CNGC got their demand inputs, weather inputs, and premise count inputs were discussed.
- CNGC is using 7 weather locations from NOAA and Schneider Electric. Also, Kent discussed why CNGC will be using 60 degrees as a reference temperature when calculation HDD's.
- Multiple weather scenarios were discussed.
- W&P is the base for population growth while CNGC is allowed to override growth numbers using internal knowledge and research.
- High/Expected case peak demand day forecast was discussed. CNGC does a system wide peak as well as being able to do a CityGate peak.

IV.) **Action Items** – Many stakeholders asked important questions and left CNGC with many items to research and discuss.

- Need to look into EIA vs ETO.
- Slides for historic growth and a comparison to previous forecast to be provided.
- Woods & Poole methodology provided to WUTC and OPUC.
- An analysis on distance in weather location and R^2 to be provided.
- Historical use/customer to EIA efficiency analysis needs to be done.
- Infrastructure of core vs non-core in SENDOUT.

Attendance:

Presenters:
Mark Sellers-Vaughn
Art Gelber
Kent Bayazitoglu

Attendees:
Lance Kaufman
Robert Fonner
Suparna Bhattacharya
Ryan Bracken
Steve Storm
Irion Sanger
Nadine Hanhan
Jim Abrahamson
Brian Robertson

Call-in attendees:
Micah Robinson
Evans Finger
Joan Wilmotte
Carolyn Stone
John Klingele
Jon Whiting
Miki Bode
Jeremy Ogden
Pamela Archer
Becky Mellinger
John Cooley
Kevin Conwell
Monica Cowlisha
Sheila McElhinney
Amanda Sargent
Deborah Reynolds

Cascade Natural Gas Corporation

Integrated Resource Plan
Technical Advisory Group Meeting #2

Tuesday, January 13, 2015

Portland International Airport
Conference Center

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Agenda

- Introductions
- Overview of Cascade
- CNGC Demand Study (High level view of the 20 year demand forecast)
  - Overview
  - Forecast Methodology and Philosophy
    - Inputs
    - Assumptions
    - Cases
    - The Model
    - Weather Data
    - Regressions
    - Weather Scenarios
    - Growth
    - Premise Count Projections
  - DRAFT Forecast Results

- Questions/Next Steps

- Adjourn

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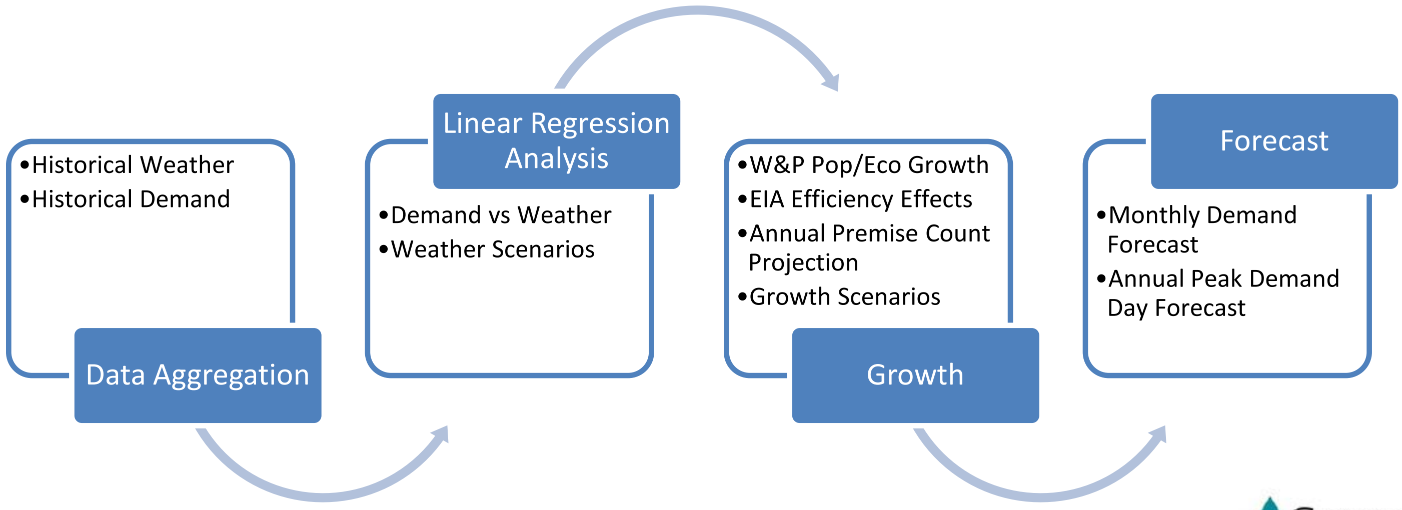
CASCADE DEMAND STUDY

High Level overview of the 20 Year demand forecast

Demand Forecast Executive Summary

Overview

- The Cascade demand forecast developed for the IRP is an estimate of core natural gas demand and peak demand for the next 20 years
- Cascade core load consists mostly of residential and commercial customers along with some industrial customers.



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Overview

- Forecast demand at the citygate and demand loop level
- Demand loops are a group of citygates that service a similar area that are forecasted together due to pipeline operations and how data is available
- CNGC forecast model is flexible giving Cascade the ability to
  - Update input data (gas demand and weather)
  - Modify assumptions
  - Modify citygates and loops to be forecasted

Forecast Philosophy

- Cascade's demand is principally weather driven: colder the weather, the greater the demand
- This forecast doesn't predict weather
- Forecasted under various weather scenarios – average year, cold year, warm year, extreme cold day, etc.
- Apply weather and demand to each of 79 citygates
- Model created by performing statistical techniques to gas demand and weather
- Growth factors are applied to the next 20 years of data, creating ultimate output presented today

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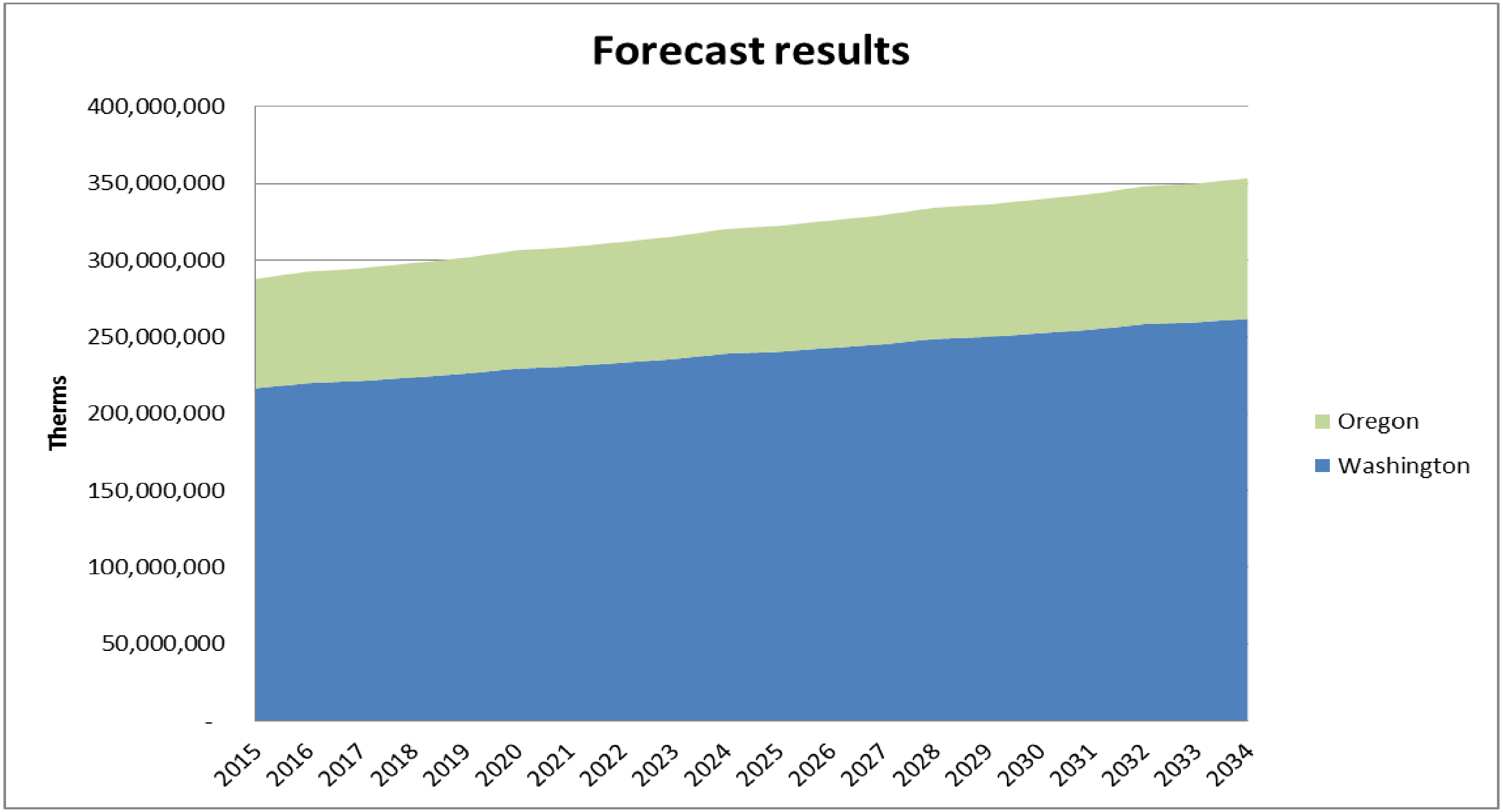
Forecast Results



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Inputs and Data Sources

Input Data

- Historical Demand
  - Used Pipeline actuals and Gas Management System (GMS)
  - Tested and rejected Customer Care and Billing (CC&B)
- Weather
  - Schneider Electric/NOAA
- Population
  - Woods & Poole
- Efficiency
  - EIA regional efficiency projection
- Premise Count
  - CC&B

Key Assumptions

- Seven weather locations effectively covers Cascade's weather area
- Heating demand does appreciatively start until average temps dip below 60F, therefore a 60 F HDD threshold used
- Heating demand reacts to temperature in a mostly linear fashion
- Using population growth assumes 1% increase in population translates to a 1% increase in gas demand, before accounting for any efficiency gains.

Forecast Cases

- Base case regression correlation of weather to demand by citygate and loops
- Sensitivity capability for cold and warm weather
- Sensitivity for low and high efficiency gains
- Sensitivity for low and high population growth

The Model

Demand Data

- Ten years of historical demand was analyzed to create the CNGC forecast.
- Historical core monthly demand by citygate was primarily drawn from
  - Cascade's own Gas Management System (GMS)
  - Pipeline actuals from Electronic Bulletin Board (EBB)
- Also examined CC&B (Customer Care and Billing) for data verification and premise count information

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Weather Data

- Define weather in terms of HDD’s (Heating Degree Day)
- The greater the colder weather, the greater the HDD
- Last ten years of weather data used for regression analysis
- 30 years of weather data (1983 – 2013) for seven weather stations was used to make weather scenarios
- Weather data is from the National Oceanic and Atmospheric Administration (NOAA) and Schneider Electric
- Assign a weather station to each citygate or demand loop

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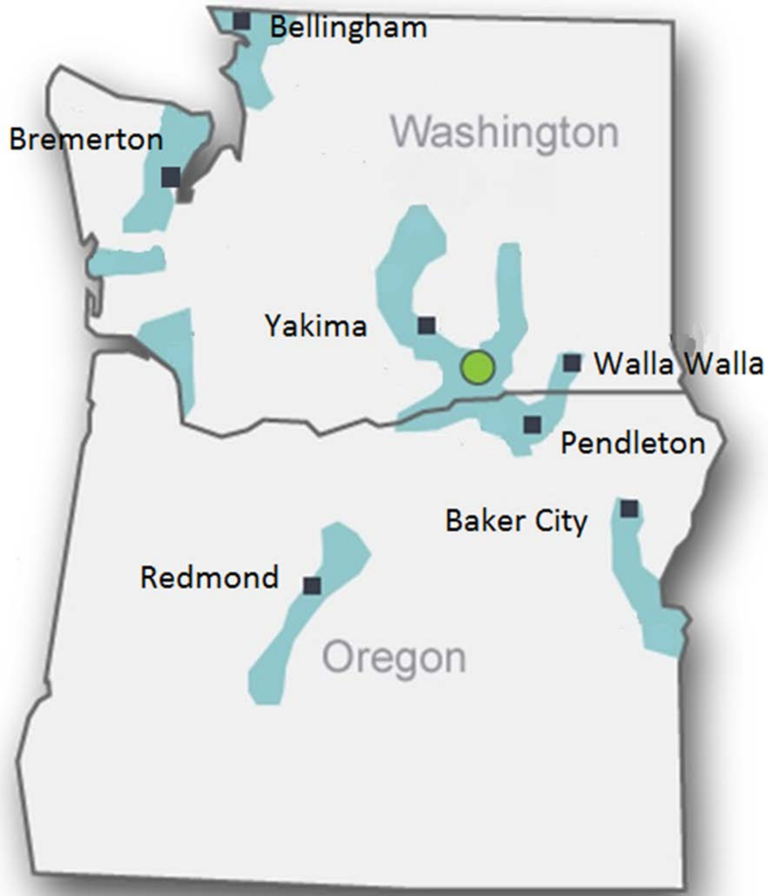
Weather Stations



- The seven weather stations are shown on the map
- Cascade's customer base is shaded in aqua
- Each citygate and loop is assigned to a weather station

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Linear Regression Analysis

- Goal is to predict weather at each citygate/loop based on given weather (HDD)
- Perform a linear regression or best fit analysis of monthly gas demand versus monthly HDD's at each citygate for the past ten years of data
- Weather is the input variable and gas demand is the output

$$\boldsymbol{Demand = b \times WeatherHDD + C}$$

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Linear Regression Analysis

historical *historical*

$$Demand = b \times WeatherHDD + C$$

From regression *From regression*

- Linear regression or best fit analysis produces the best coefficient ***b*** and constant ***C*** for each citygate that minimizes error
- Model error is measured with R^2
- Higher the R^2, the lower the error and the stronger the relationship between weather and demand

Linear Regression Analysis

From regression ↓ (b) **From regression** ↓ (C)

$$\boldsymbol{Demand = b \times Weather_{HDD} + C}$$

- Demand equation at each citygate uses ***b***'s and ***C***'s found through the regression
- Demand at each citygate can be found by plugging in an HDD (weather) from an average year, a cold year, or a mild year.

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Linear Regression Analysis

GATE As Defined in Fore	State	Weather Station	b	c	R^2
MCCLEARY (ABERDEEN/HOQUIAM)	Washington	Bremerton	111.71	657.73	0.93
ACME	Washington	Bellingham	2.03	2.56	0.98
ARLINGTON	Washington	Bellingham	98.60	611.77	0.96
ATHENA	Oregon	Pendleton	9.45	45.45	0.89
BAKER	Oregon	Baker City	55.67	153.95	0.98
BREMERTON (SHELTON)	Washington	Bremerton	631.49	2429.23	0.96
UMATILLA	Oregon	Pendleton	19.86	105.52	0.83
CASTLE ROCK	Washington	Bremerton	2.79	15.72	0.85
CHEMULT	Oregon	Redmond	0.75	5.55	0.80
WALLA WALLA	Washington	Walla Walla	238.55	1098.85	0.99
GILCHRIST	Oregon	Redmond	3.81	9.05	0.91
DEMING	Washington	Bellingham	3.21	9.21	0.95
WENATCHEE	Washington	Yakima	72.16	436.45	0.95

Weather Scenario

- The average scenario forecast assumes weather (HDD) for 12 months of the year from the 30 year average
- Average weather scenario is the base case forecast
- The same logic and demand equations (***b***'s and ***C'***s) were used to create the peak demand day for each citygate

Weather Scenarios

- For weather scenarios, system wide HDD's are found that give appropriate weight to the weather stations that have greater impact on system wide demand.
- To determine the high case HDD weather scenario, the six coldest years were selected (20% of the coldest years out of 30). These years have with the highest yearly total of HDD's.
- To determine the low case HDD weather scenario, the six warmest years were selected (20% of the warmest years out of 30). These years have the lowest yearly total of HDD's.

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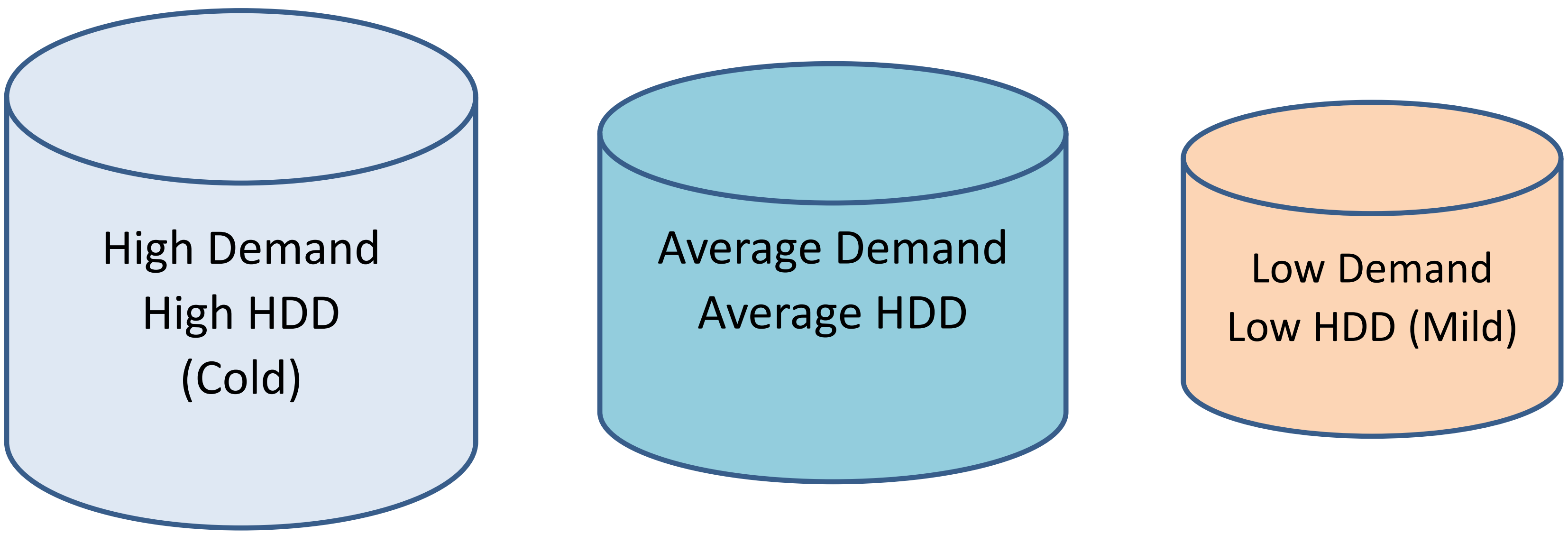
Weather Scenarios

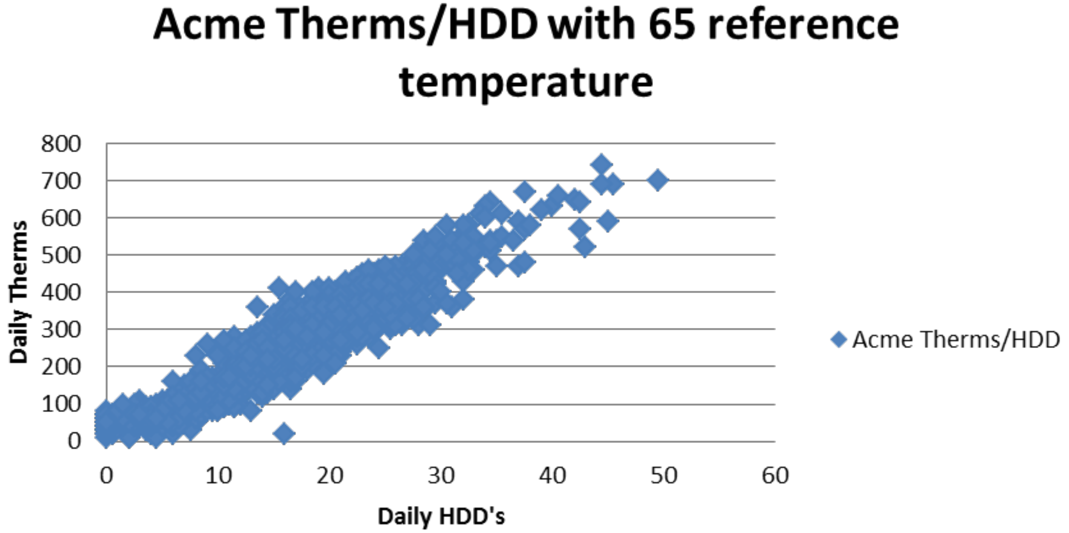


Heating Degree Day (HDD)

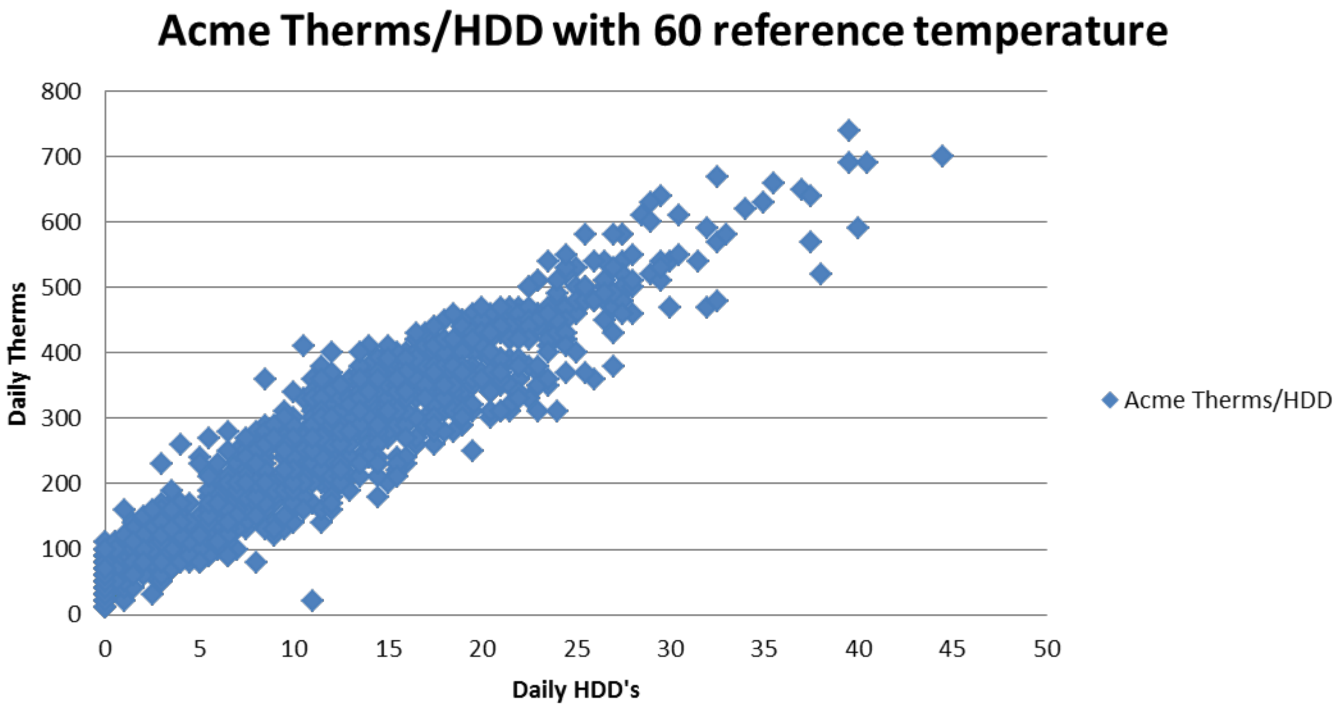
- Heating degree day is used as the unit of measure for weather in the linear regression analysis
- Heating degree day is calculated by:
  - Determine average high and low temperature for a given day
  - Daily average is subtracted from an HDD threshold (for example 65°F)
  - If this produces a negative number, a value of zero is assigned
- Example
  - Daily high temperature = 60°F; Daily low temperature = 50°F
  - Calculate average → 55°F
  - Subtract from HDD threshold (we will use 65): 65-55 = 10
  - This example day has 10 HDD

65 vs 60 HDD Threshold

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



Acme Therms/HDD with 60 degree reference temperature



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Growth

- To project the natural gas demand forward, growth factors for each year are applied to gas demand predicted after assuming a weather scenario (average, cold, mild)
- Cascade uses regional economic demographics data formulated by Woods and Poole to derive a projected customer growth by town and year.
- Woods and Poole Employment, Income, Population, and Housing demographics were reviewed. Cascade derived Population and Economic growth factors formulated from Woods and Poole's forecasted population growth and Farm, Manufacturing, and Construction earnings.
- Growth factors derived from W&P can manually be replaced by Cascade derived growth figures based on such factors such as premise growth, engineering estimates, and internal customer projections.
- To project the natural gas demand forward, growth factors for each year are applied to gas demand predicted after assuming a weather scenario (average, cold, mild)

Population Growth

- Cascade uses population growth data formulated by Woods and Poole to derive a projected customer growth by CityGate and year.
- Woods and Poole population growth forecast is provided by county and year and directly assigned to a CityGate. Cascade assumes a 1% growth in population translates to a 1% increase in customer growth

W&P Growth by CityGate was calculated utilizing the equations defined below:

$WP\_P_{[CityGate,Yr]} = \sum WP\_P_{[County,Yr]}$

$WP\_G_{[CityGate,Yr]} = (WP\_P_{[CityGate,Yr-1]} - WP\_P_{[CityGate,Yr]}) / WP\_P_{[CityGate,Yr]}$

Definitions:

- $WP\_P_{[Yr, County]}$: Woods and Poole annual population forecast based on numerous demographic factors by county and by year
- $WP\_P_{[CityGate,Yr]}$: Sum of all Woods and Poole annual population figures for all counties assigned to a CityGate
- **$WP\_G_{[CityGate,Yr]}$: Woods and Poole growth factor percentage calculated from Woods and Poole population forecast by CityGate and Yr**

Economic Growth

- To create an economic growth figure, Woods and Poole's construction, manufacturing, and farming earnings where combined for each county and year (2013-2040) to produce a total earnings number.
- The sum of all raw earning growth figures assigned to a CityGate was used to calculate the Economic Growth by year for each CityGate.

W&P Economic Growth by citygate was calculated utilizing the equations defined below:

$WP\_TE_{[County, Yr]} = (WP\_CE_{[County, Yr]} + WP\_ME_{[County, Yr]} + WP\_FE_{[County, Yr]})$

$WP\_TE_{[CityGate, Yr]} = \sum WP\_TE_{[County, Yr]}$

$WP\_EG_{[CG, Yr]} = (WP\_TE_{[CityGate, Yr-1]} - WP\_TE_{[CityGate, Yr]})/ WP\_TE_{[County, Yr]}$

Definitions:

- $WP\_TE_{[County, Yr]}$: Woods and Poole total earnings from farming, manufacturing, and construction forecast by county and by year
- $WP\_TE_{[CityGate, Yr]}$: Sum of all total earning from farming, manufacturing, and construction forecast by county and by year allocated to a CityGate
- **WP_EG[CG, Yr]: Woods and Poole economic growth percentage by CityGate and year**

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Non cumulative Impacts

- Growth factors are primarily cumulative, growth in one year impacts growth subsequent years
- Forecast model allows for non cumulative impacts that modify demand at a specified citygate and time period.
- Normal demand resumes after non cumulative impact event is over

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Growth Scenarios

- Forecast assumes three different growth scenarios
- Base case assumes normal growth with figures primarily from growth factors derived from W&P population and economic earning forecast
- High growth scenario assumes high economic and population growth and boosts growth by a given percentage (50%)
- Low growth scenario assumes low economic and population growth and decreases growth by a given percentage (50%)

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Growth

GATE As Defined in Forecast	Average Premise Trend	Average Manually Assigned Growth	W&P population/economic growth	Apply EIA Efficiency	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
					9	10	11	12	13	14	15	16	17	18	19	20	21
(ABERDEEN/HOQUIAM)	0.00%	0.0%	Population Growth	No	0.0%	0.5%	0.9%	1.4%	1.9%	2.4%	2.9%	3.4%	3.8%	4.3%	4.8%	5.3%	5.7%
ACME	0.00%	0.0%	Population Growth	No	0.0%	1.9%	3.8%	5.8%	7.7%	9.7%	11.6%	13.6%	15.6%	17.5%	19.5%	21.5%	23.5%
SEDRO/WOOLLEY	0.00%	0.0%	Population Growth	No	0.0%	1.4%	2.9%	4.3%	5.7%	7.2%	8.6%	10.1%	11.6%	13.0%	14.5%	16.0%	17.4%
ARLINGTON	0.00%	0.0%	Population Growth	No	0.0%	1.6%	3.1%	4.7%	6.3%	7.9%	9.5%	11.1%	12.7%	14.4%	16.0%	17.6%	19.2%
ATHENA	0.00%	0.0%	Population Growth	No	0.0%	0.6%	1.2%	1.8%	2.4%	3.1%	3.7%	4.3%	5.0%	5.6%	6.3%	6.9%	7.5%
BAKER	0.00%	0.0%	Population Growth	No	0.0%	0.1%	0.2%	0.4%	0.5%	0.7%	0.8%	0.9%	1.1%	1.2%	1.4%	1.6%	1.7%
BREMERTON (SHELTON)	0.00%	0.0%	Population Growth	No	0.0%	1.1%	2.2%	3.3%	4.4%	5.5%	6.6%	7.7%	8.8%	10.0%	11.1%	12.2%	13.3%
BELLINGHAM 1 (FERNDALE)	0.00%	0.0%	Population Growth	No	0.0%	1.9%	3.8%	5.8%	7.7%	9.7%	11.6%	13.6%	15.6%	17.5%	19.5%	21.5%	23.5%
BEND	0.00%	0.0%	Population Growth	No	0.0%	2.3%	4.6%	6.9%	9.2%	11.5%	13.8%	16.1%	18.4%	20.7%	23.0%	25.3%	27.6%
NORTH BEND	0.00%	0.0%	Population Growth	No	0.0%	2.3%	4.6%	6.9%	9.2%	11.5%	13.8%	16.1%	18.4%	20.7%	23.0%	25.3%	27.6%
SOUTH BEND	0.00%	0.0%	Population Growth	No	0.0%	2.3%	4.6%	6.9%	9.2%	11.5%	13.8%	16.1%	18.4%	20.7%	23.0%	25.3%	27.6%
INTERCONNECT(BLAINE, ETC.)	0.00%	0.0%	Population Growth	No	0.0%	1.9%	3.8%	5.8%	7.7%	9.7%	11.6%	13.6%	15.6%	17.5%	19.5%	21.5%	23.5%
UMATILLA	0.00%	0.0%	Population Growth	No	0.0%	0.6%	1.2%	1.8%	2.4%	3.0%	3.7%	4.3%	4.9%	5.6%	6.2%	6.8%	7.5%

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W&P

Regional Economic Demographics (W&P)

- Regional economic demographics data formulated by Woods and Poole was used to derive projected customer growth by town and year.
- Woods and Poole Employment, Income, Population, and Housing demographics were reviewed.
- Population growth formulated by Woods and Poole was determined to provide the best relationship for use in the demand study.
- Woods and Poole population growth assumes that a 1% growth in population translates to a 1% increase in customer growth.

EIA Efficiency Factor

- Future gas demand, by citygate, was modified utilizing a calculated efficiency factor derived the U.S. Energy Information Administration's (EIA) 2014 Annual Energy Outlook.
- Cascade used the 2014 EIA forecast data for the entire U.S. While Cascade considered using forecast data for the Pacific Region, a region that contains both Washington and Oregon, this region is heavily influenced by California and its high population which Cascade does not serve.
- Cascade used figures from EIA's reference forecast case, or base case, to calculate the expected percentage change of natural gas consumption over the next 20 years.

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Annual Premise Count Projection

- The Annual Premise Count Projection by Year and citygate was based upon trend analysis of the Historical Premise Count data pulled from CC&B from 2010 to 2013 for each citygate, Year, and Tariff.
- Historical Premise Count by CityGate, Year, and Tariff was used to forward project premise count based upon the trend between premise count and time.
- This information is used as guide to assist Cascade when forecasting customer growth.

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Final Demand Forecast

- The Monthly Demand Forecast by year, month and citygate was based upon:
  - The calculated forecast for weather dependent load plus the most recent year's (2013) non weather dependent core load with applied growth factors
  - Core load was forecasted by citygate utilizing linear regression equations, unless the R^2 of a citygate's linear regression was below a 70% threshold, meaning HDD is not a good predictor of demand.
  - If the R^2 was below the 70% threshold, the demand from the most recent year was used and forecasted forward using the growth factors

Demand Forecast

System Demand (Dt	OR Forecast (Dt	WA Forecast (Dt	ATHENA	BAKER	UMATILLA	CHEMULT	GILCHRIST	HERMISTON	HUNTINGTON	LA PINE	MADRAS	MILTON-FREEWATER
4,440,509.98	1,094,674.34	3,345,835.64	8,806	63,178	18,806	780	3,362	86,927	1,708	6,245	38,332	7,782
3,637,972.95	907,928.14	2,730,044.80	7,076	49,909	15,143	667	2,846	69,587	1,315	5,307	32,467	6,177
3,200,600.27	792,880.59	2,407,719.68	5,836	40,953	12,569	619	2,546	56,710	1,001	4,815	29,105	4,837
2,342,383.50	599,432.94	1,742,950.56	4,105	29,518	8,924	500	1,963	39,189	647	3,783	22,506	3,272
1,547,658.94	404,988.26	1,142,670.68	2,681	18,928	5,943	376	1,311	24,615	301	2,654	15,153	2,154
906,607.94	225,787.07	680,820.87	1,621	9,830	3,707	246	672	13,914	21	1,525	7,929	1,448
672,443.86	145,227.70	527,216.16	1,427	5,329	3,311	185	345	11,860	-	963	4,236	1,378
665,354.18	147,870.25	517,483.94	1,430	5,619	3,317	187	354	11,889	-	979	4,339	1,381
1,004,865.30	241,526.88	763,338.41	1,715	11,633	3,906	255	715	14,877	79	1,600	8,411	1,494
2,181,690.95	542,104.15	1,639,586.80	3,925	29,196	8,557	452	1,696	37,276	627	3,327	19,501	3,168
3,513,066.63	865,653.06	2,647,413.57	6,744	47,231	14,465	647	2,706	66,032	1,210	5,085	30,908	5,848
4,666,254.57	1,152,027.76	3,514,226.81	9,265	63,245	19,769	825	3,589	91,591	1,710	6,641	40,892	8,242
4,491,271.28	1,110,346.79	3,380,924.48	8,859	63,256	18,918	785	3,382	87,452	1,710	6,385	38,450	7,829

High Case Peak Demand Day Forecast

- The Annual Peak Day Forecast ensures that Cascade can continue to provide adequate heating to its customers even under extreme conditions which are far colder than the norm.
  - To determine the system wide peak demand day, HDD's from all seven weather stations are considered, giving appropriate weight to the weather stations having the greater impact on system wide demand.
  - It was found that December 21, 1990 was the highest system weighted HDD for this period.
  - The peak demand day was then derived from the highest HDD by applying the actual HDD from the peak day for the 30 year period to the linear regression equation for each citygate . Thus all citygates associated with the Bellingham weather station, for example, use the HDD calculated for Bellingham for December 21, 1990, and similarly for all the other weather stations and citygates. This provides a highest demand scenario for peak demand load based on 30 years of weather history for each citygate.

High Case Peak Demand Day Forecast

Forecast Tin	Peak Day Demand (Dt	OR Peak Day (D	WA Peak Day (D	ATHENA	BAKER	UMATILLA	CHEMULT	GILCHRIST	HERMISTON	HUNTINGTON	LA PINE	MADRAS
2015	328,251.50	85,605.12	242,646.38	683	4,195	1,444	59	279	6,862	124	501	3,168
2016	332,090.25	86,859.49	245,230.76	687	4,200	1,453	59	281	6,904	124	512	3,177
2017	335,951.88	88,118.65	247,833.23	691	4,205	1,462	60	283	6,946	124	523	3,188
2018	339,838.88	89,383.44	250,455.44	696	4,211	1,471	60	284	6,988	124	534	3,198
2019	343,744.71	90,652.34	253,092.37	700	4,217	1,479	60	286	7,031	124	546	3,210
2020	347,655.23	91,921.09	255,734.14	704	4,223	1,488	61	288	7,074	124	557	3,221
2021	351,588.25	93,195.04	258,393.21	708	4,230	1,497	61	290	7,118	125	568	3,233
2022	355,523.53	94,468.87	261,054.66	713	4,236	1,507	61	291	7,161	125	579	3,245
2023	359,457.96	95,741.71	263,716.25	717	4,242	1,516	62	293	7,205	125	591	3,258
2024	363,405.51	97,017.05	266,388.46	721	4,249	1,525	62	295	7,248	125	602	3,270
2025	367,339.20	98,288.49	269,050.71	726	4,255	1,534	63	297	7,292	125	613	3,283

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Expected Peak Demand Day Forecast

- Expected peak day demand in a given year is calculated based on the average of the peak demand days for each of the last 30 years. The actual HDD from each of those 30 peak days is averaged for each weather station resulting in an average peak HDD. Applying the associated average peak HDD to the forecast model for each citygate yields an expected peak demand for each citygate.
- For citygates where demand is not weather dependent, the peak demand day cannot be calculated by applying an associated HDD. Instead, peak demand for these citygates becomes the average daily demand for the month in which the system peak day falls. Cascade includes a multiplier to the average daily demand number to increase the figure to a more realistic peak demand.
- To determine both the high case and expected peak demand day for a given projected year, growth factors are applied. Peak day demand is in turn calculated for each citygate for each year of the twenty year forecast.

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Expected Peak Demand Day Forecast

Forecast Tin	Peak Day Demand (Dt	OR Peak Day (D	WA Peak Day (D	ATHENA	BAKER	UMATILLA	CHEMULT	GILCHRIST	HERMISTON	HUNTINGTON	LA PINE	MADRAS
2015	238,379.82	59,823.86	178,555.96	498	3,013	1,056	41	190	4,980	86	344	2,158
2016	241,162.21	60,690.50	180,471.71	501	3,017	1,062	41	191	5,010	86	352	2,165
2017	243,961.23	61,560.49	182,400.74	504	3,021	1,069	42	192	5,041	86	360	2,172
2018	246,778.70	62,434.44	184,344.26	507	3,025	1,075	42	194	5,072	86	367	2,179
2019	249,609.88	63,311.26	186,298.61	510	3,030	1,082	42	195	5,103	87	375	2,187
2020	252,444.49	64,187.99	188,256.50	513	3,034	1,088	43	196	5,134	87	383	2,195
2021	255,295.44	65,068.34	190,227.10	517	3,038	1,095	43	197	5,166	87	391	2,203
2022	258,148.06	65,948.62	192,199.44	520	3,043	1,101	43	198	5,197	87	398	2,211
2023	261,000.08	66,828.22	194,171.86	523	3,047	1,108	43	199	5,229	87	406	2,220
2024	263,861.65	67,709.57	196,152.08	526	3,052	1,115	44	201	5,260	87	414	2,228
2025	266,713.14	68,588.19	198,124.96	529	3,057	1,121	44	202	5,292	87	422	2,237

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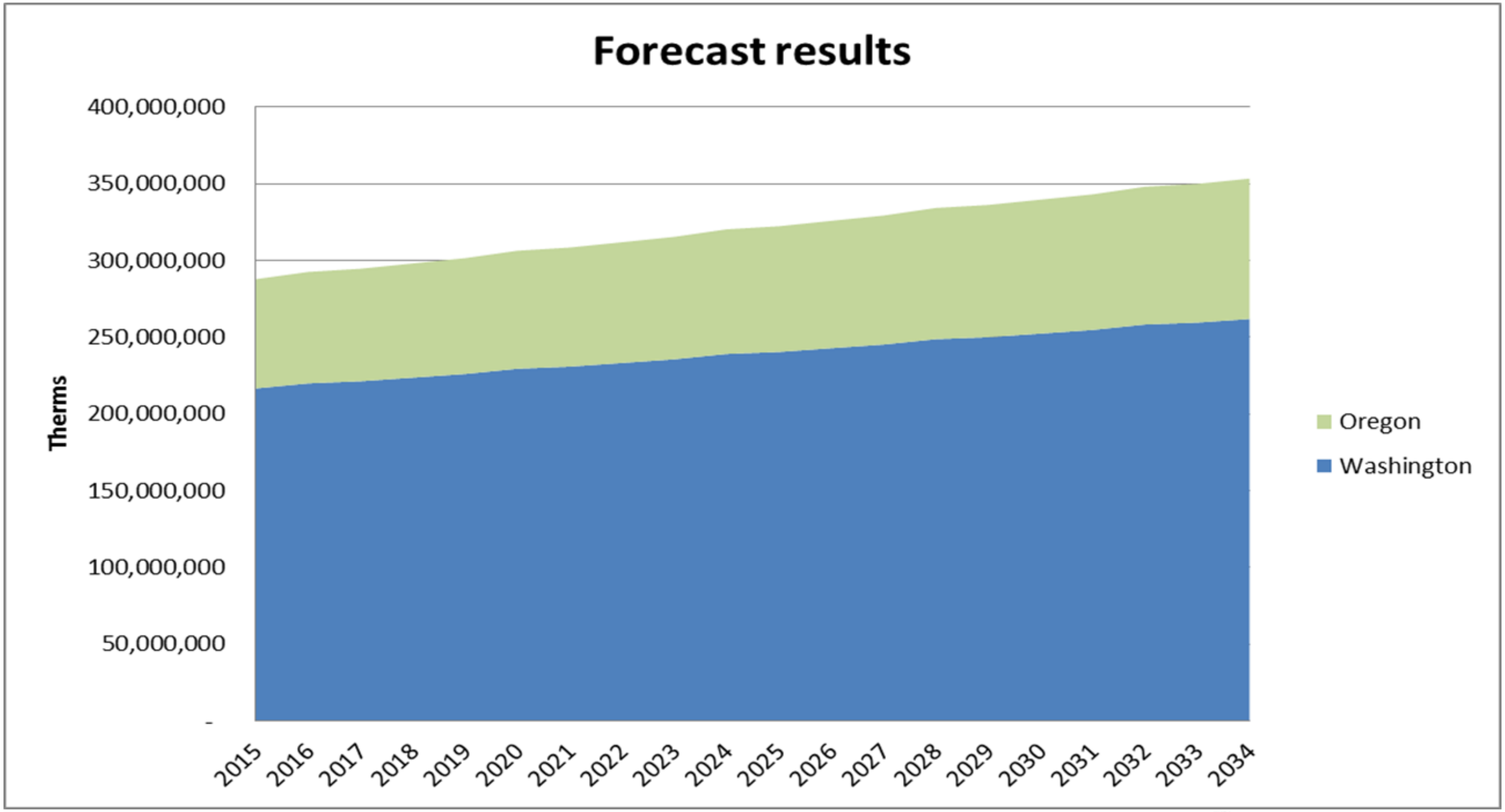
Forecast Results



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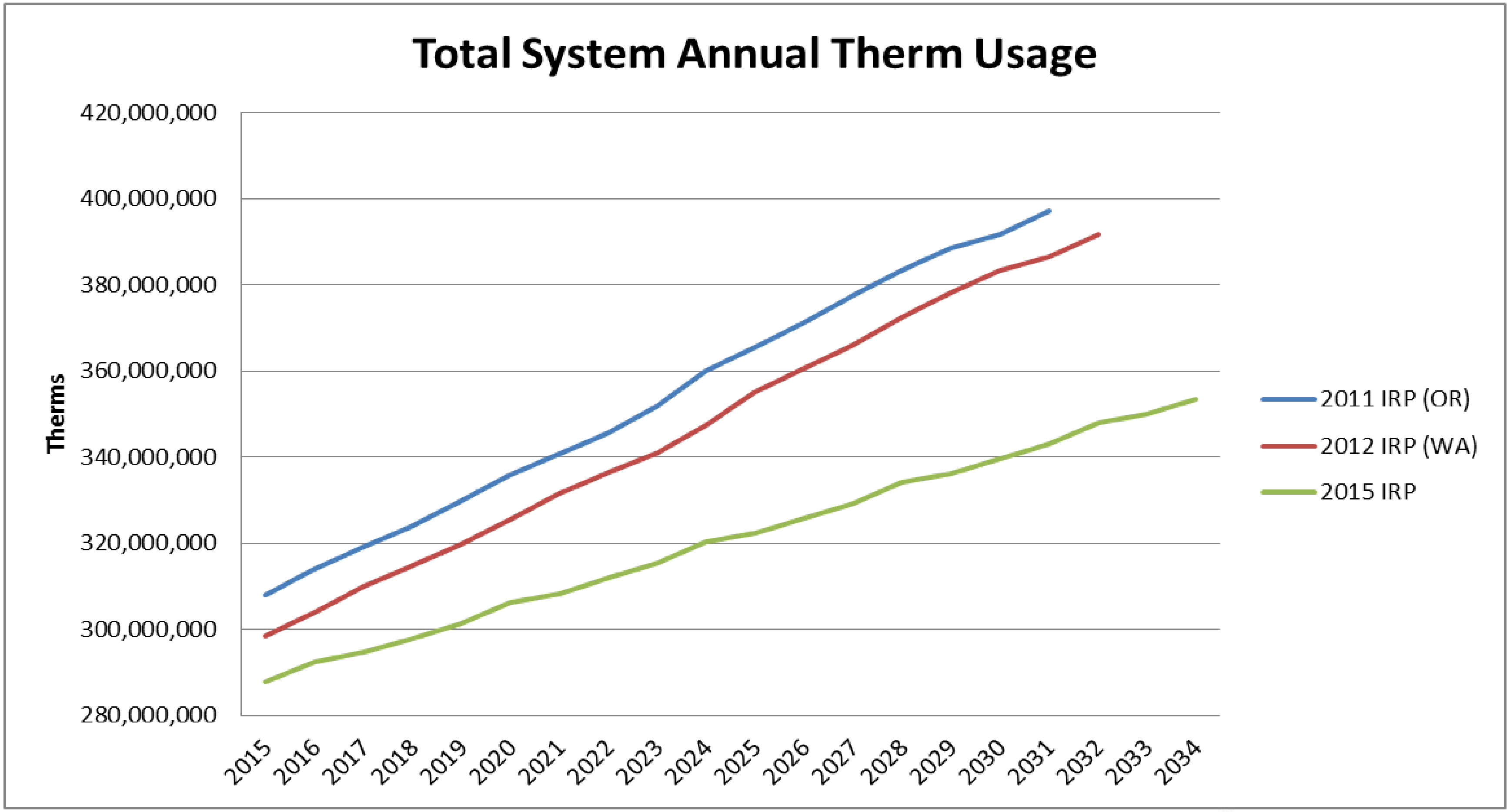
Summary

- Cascade core customer demand is expected to grow modestly over the coming 20 years
- Growth is primarily dependent upon regional population and economical growth and natural gas efficiency gains
- Weather plays a big role in demand for any given year
- Unforeseen and unanticipated regional demand shifts are not included in the Forecast model

Total System



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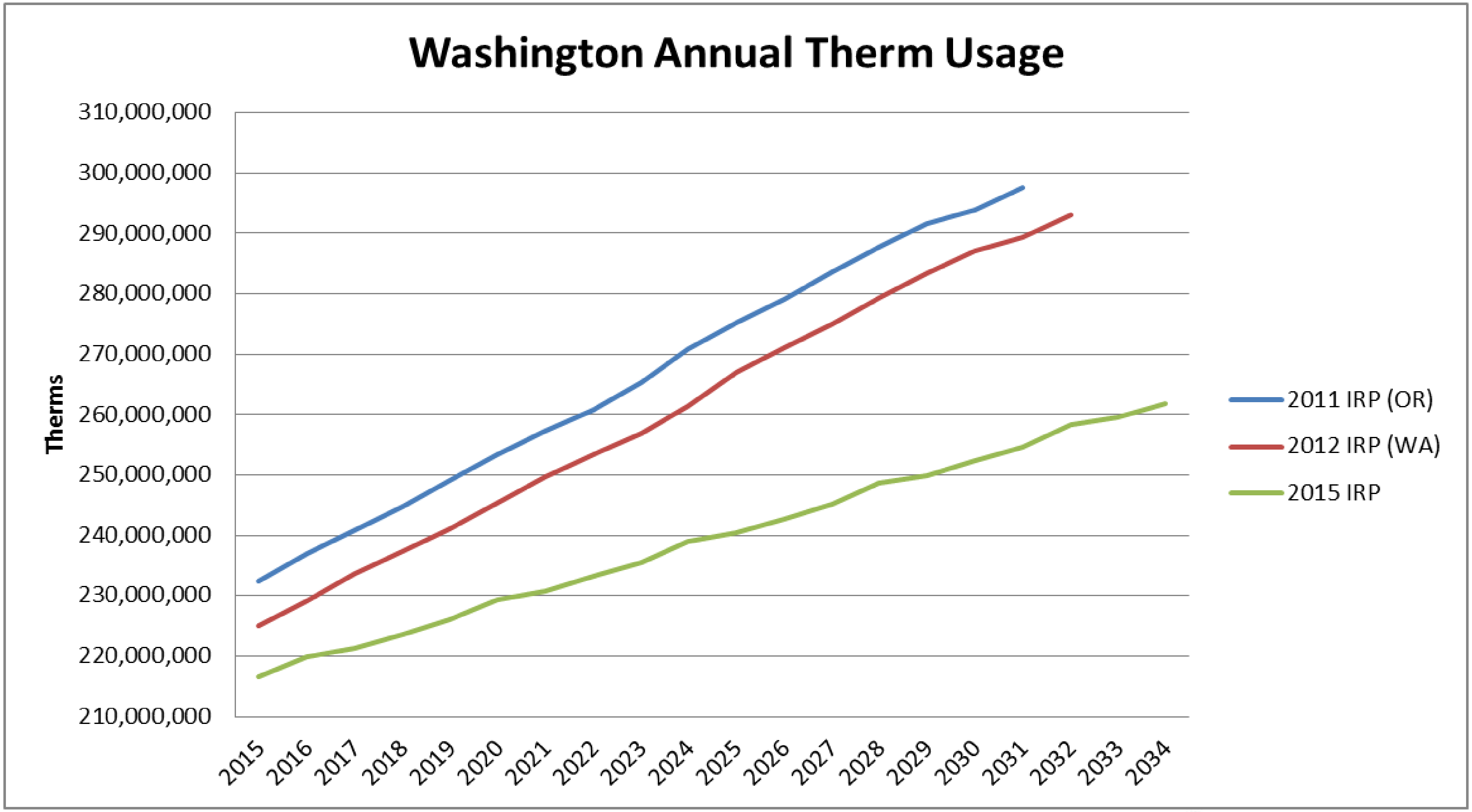
Washington



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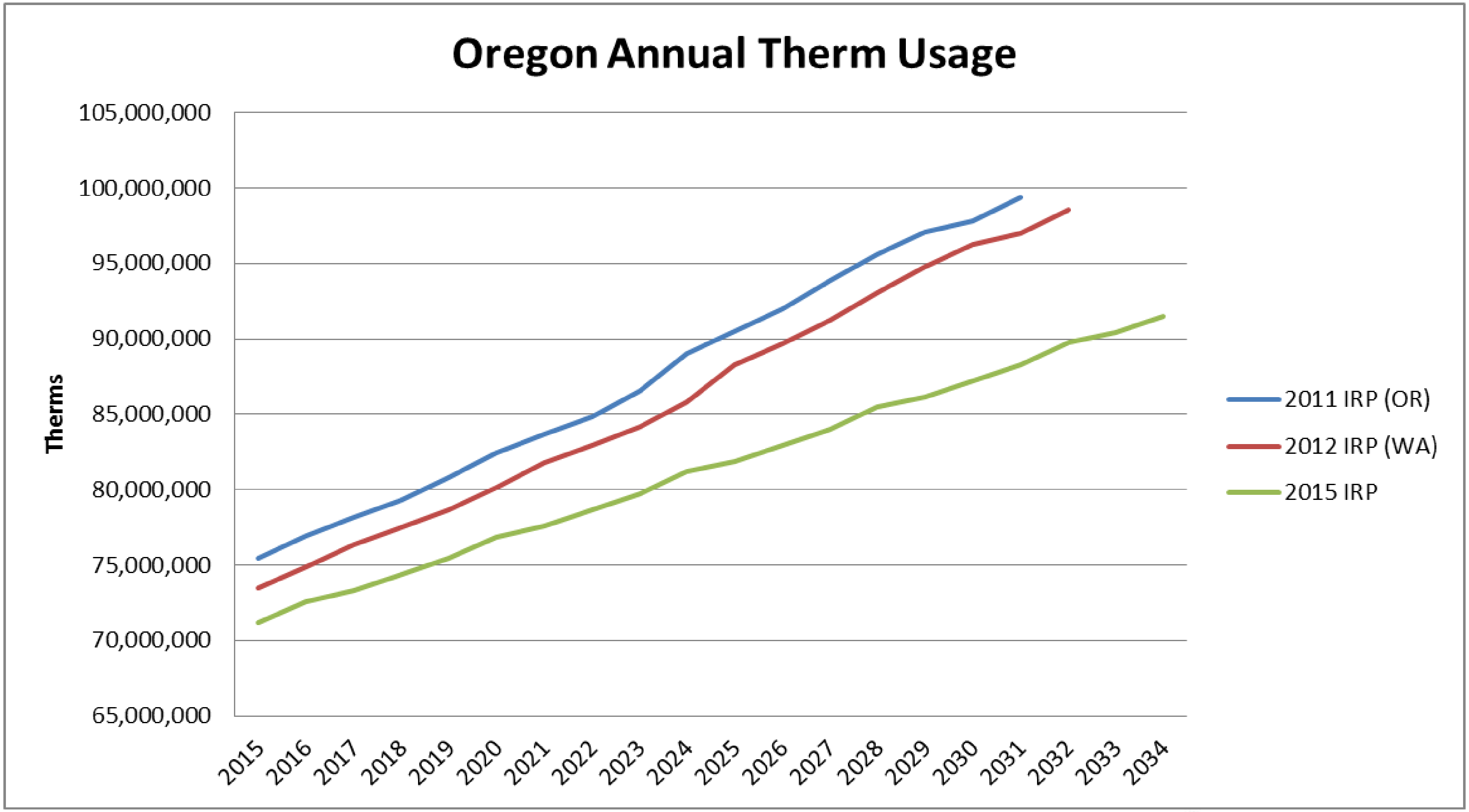
Oregon



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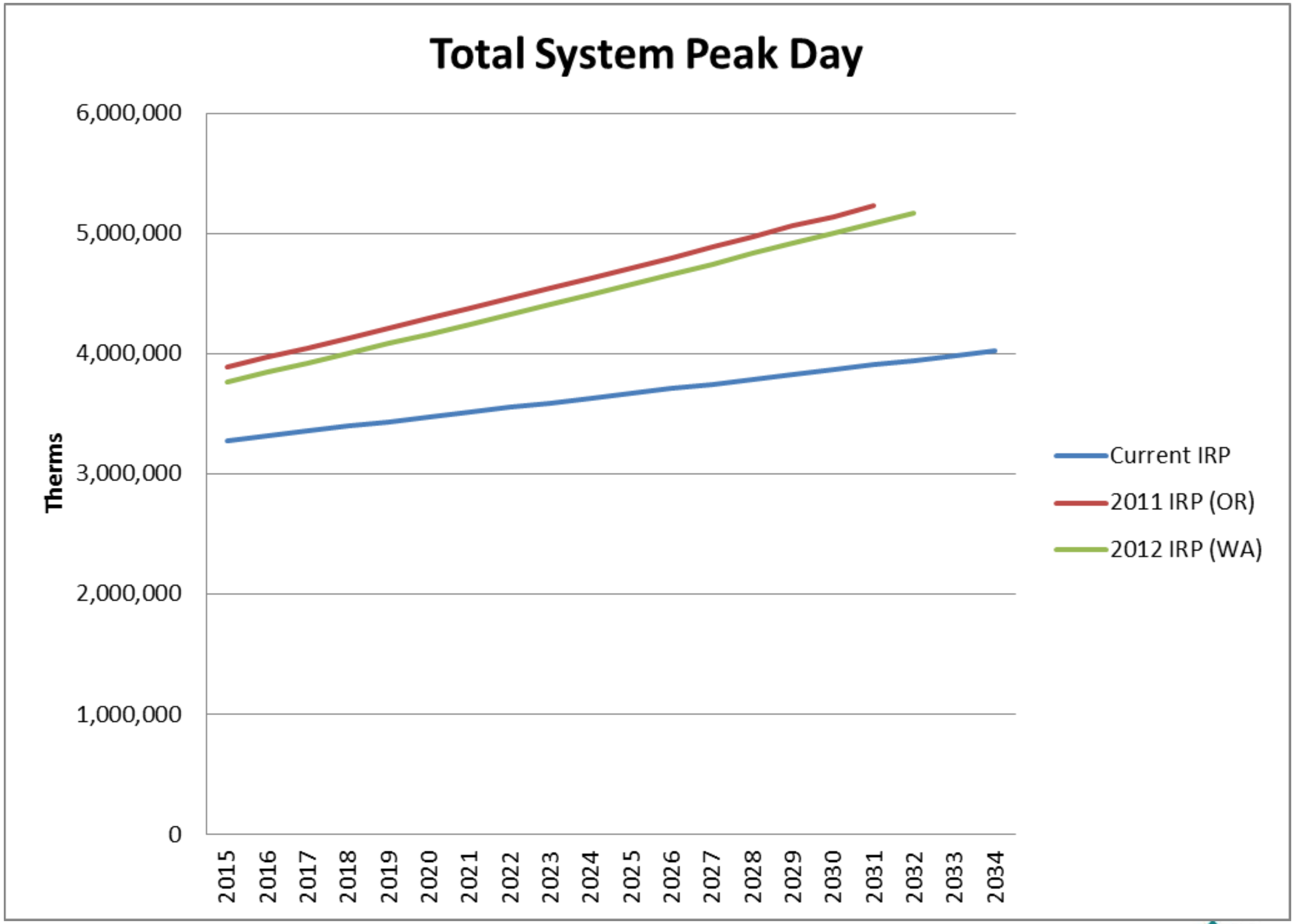
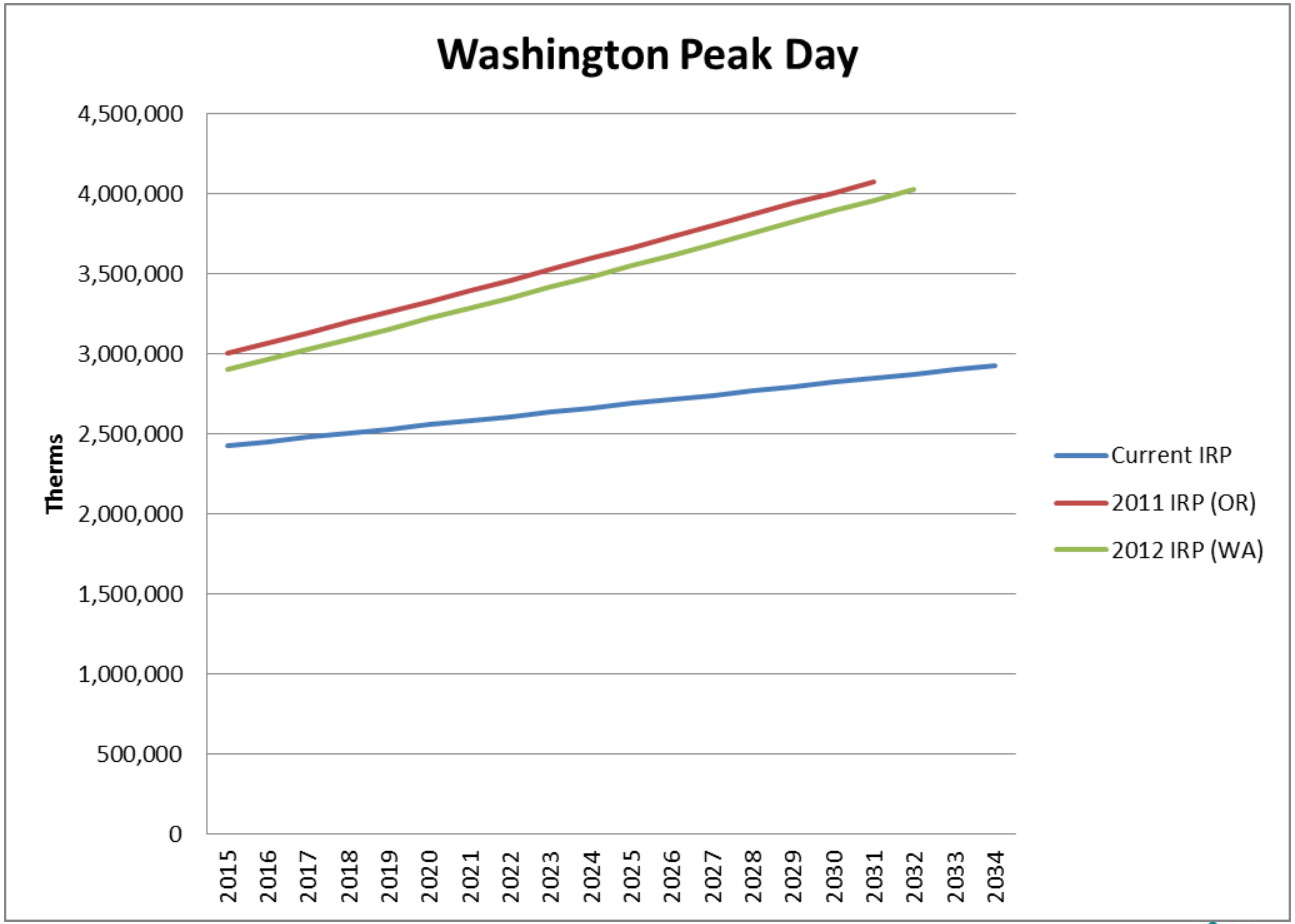
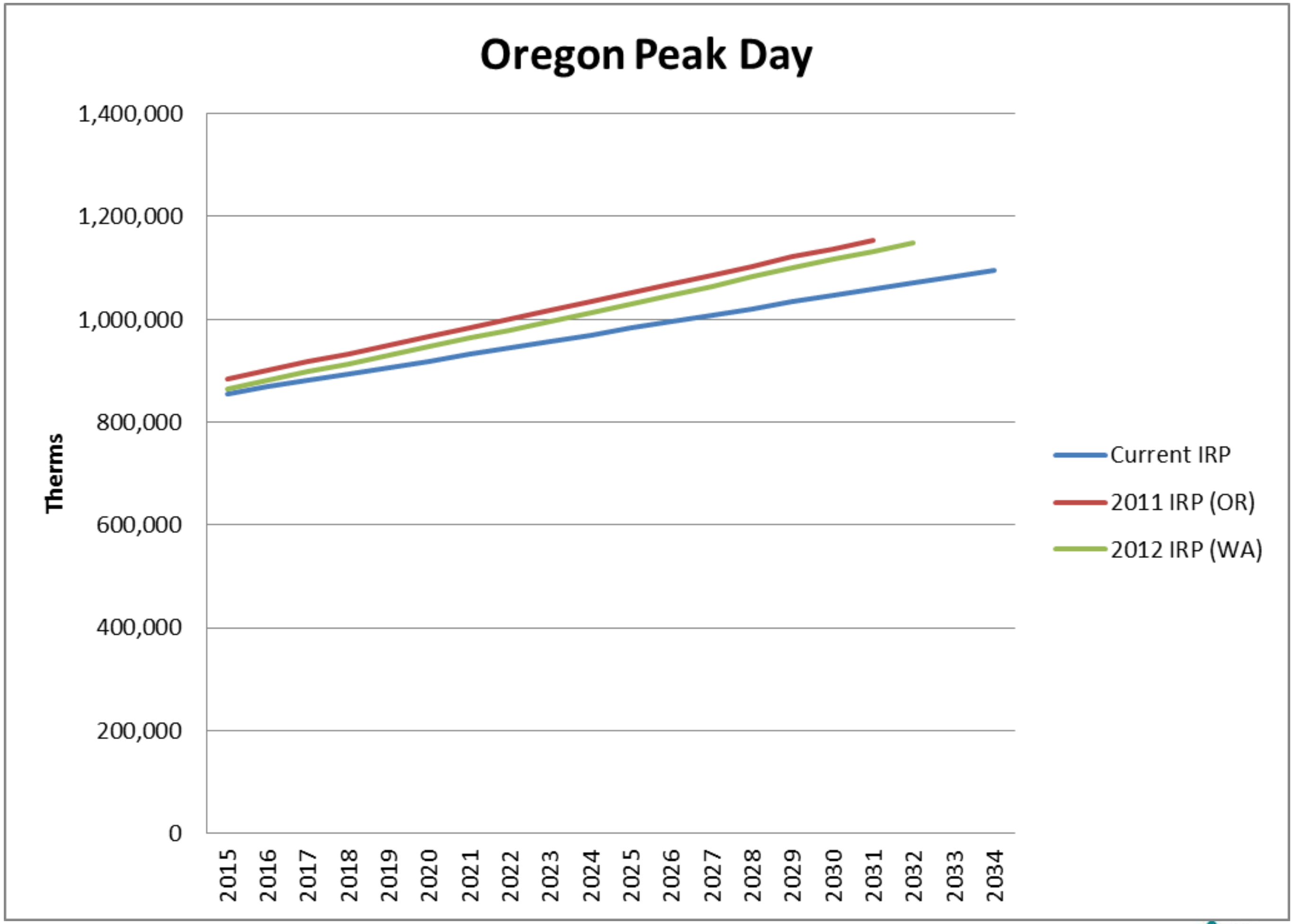
Total System Peak Day Comparison to previous IRP's



Washington Peak Day Comparison to previous IRP's



Oregon Peak Day Comparison to previous IRP's



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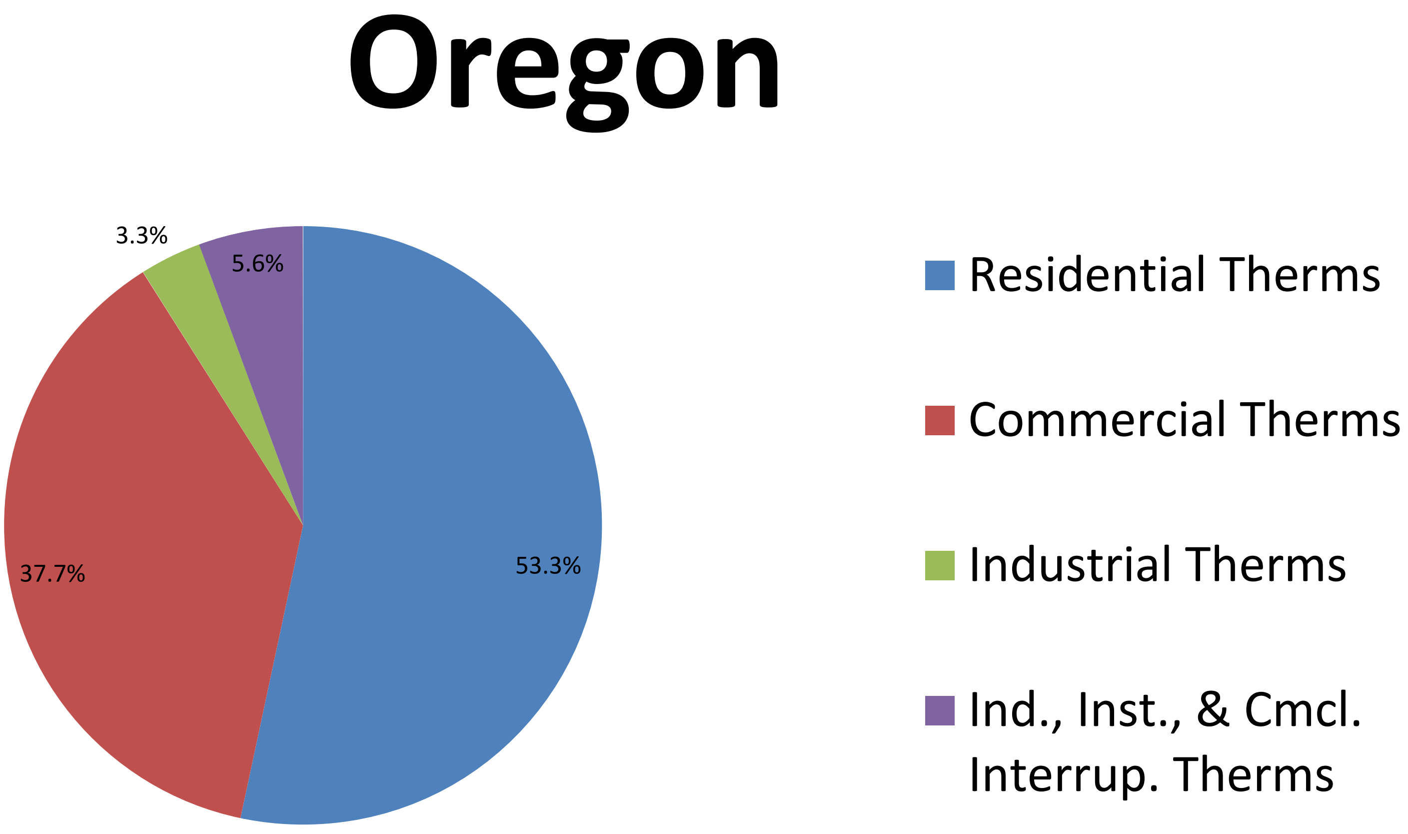
Oregon Tariff Breakout



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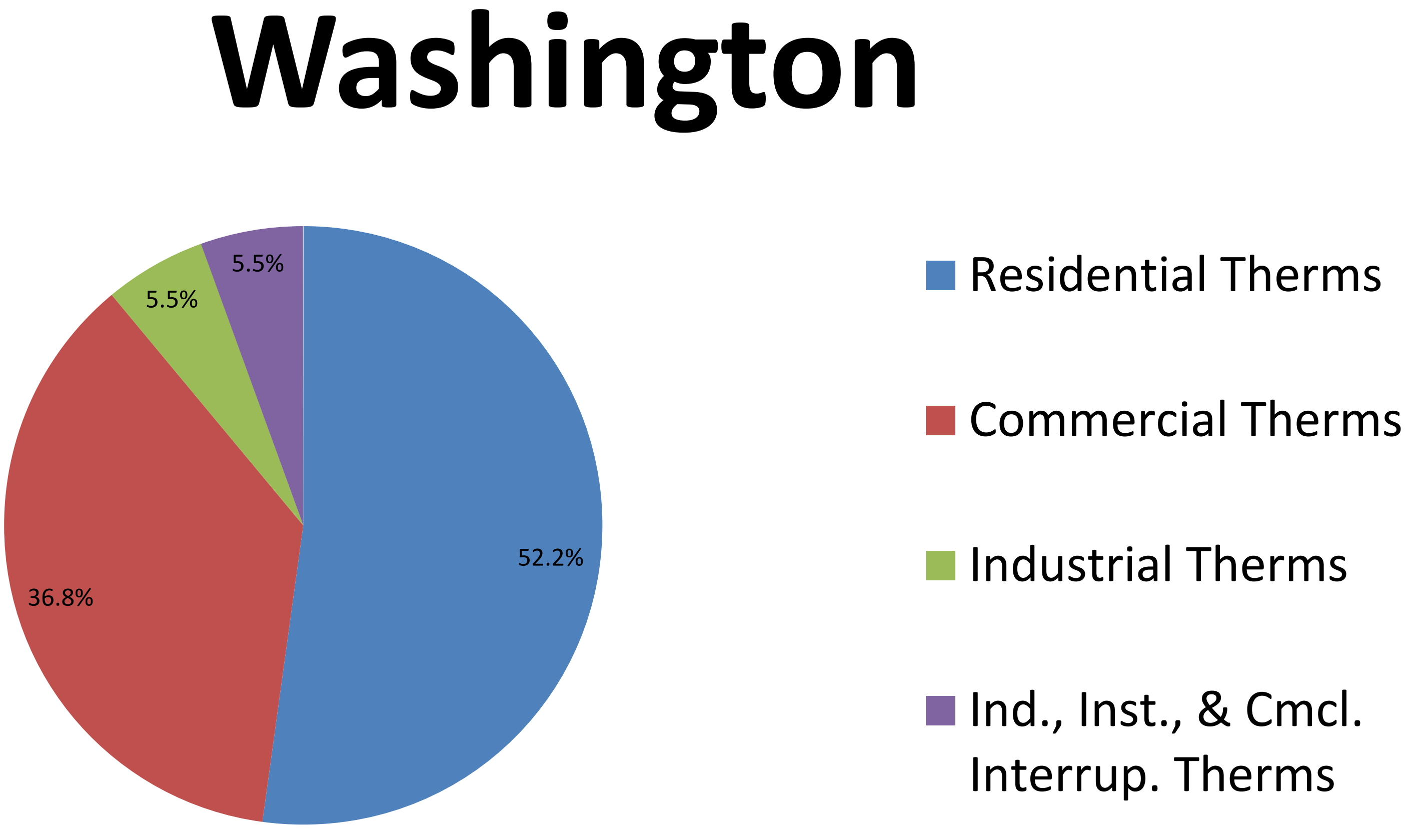
Washington Tariff Breakout



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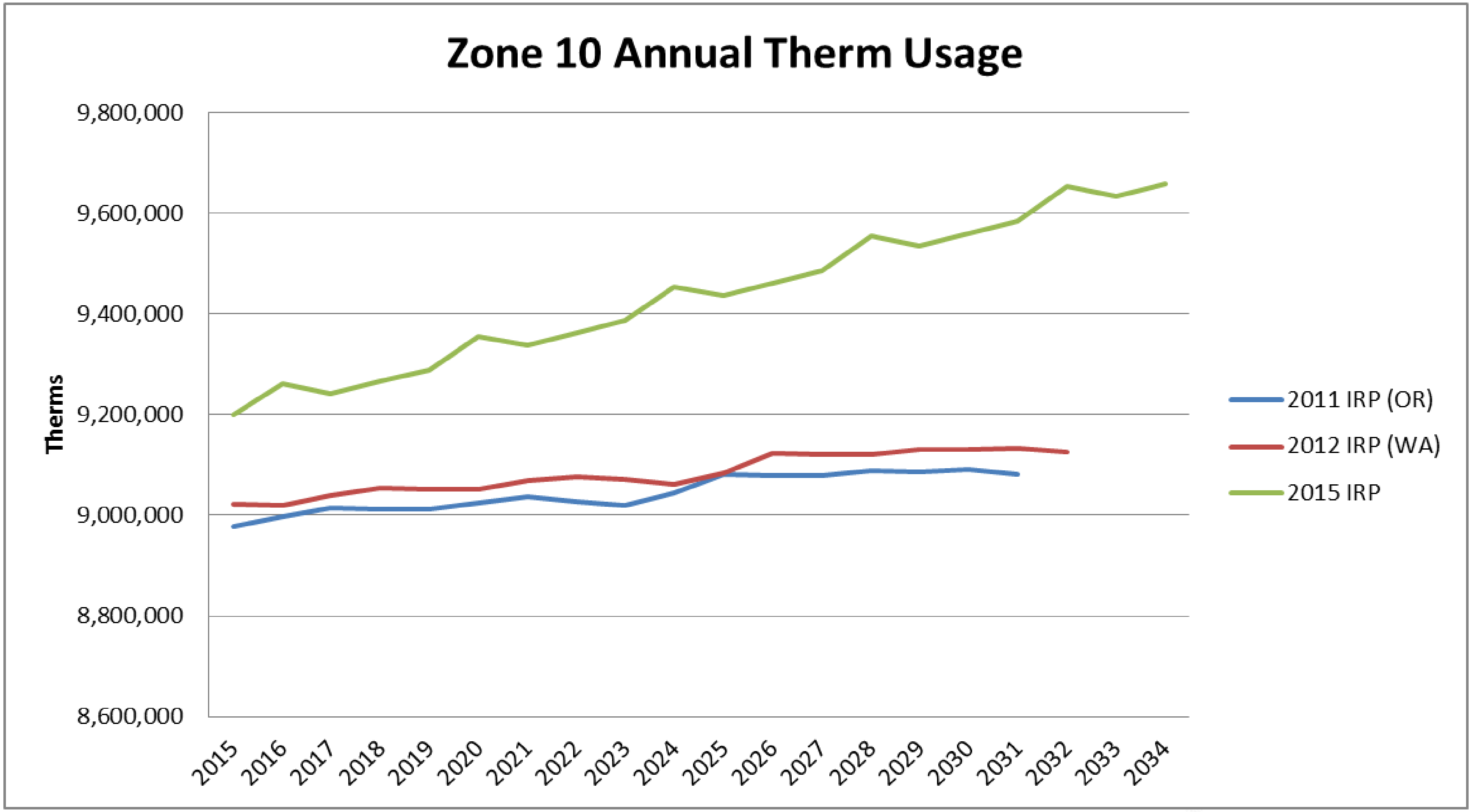
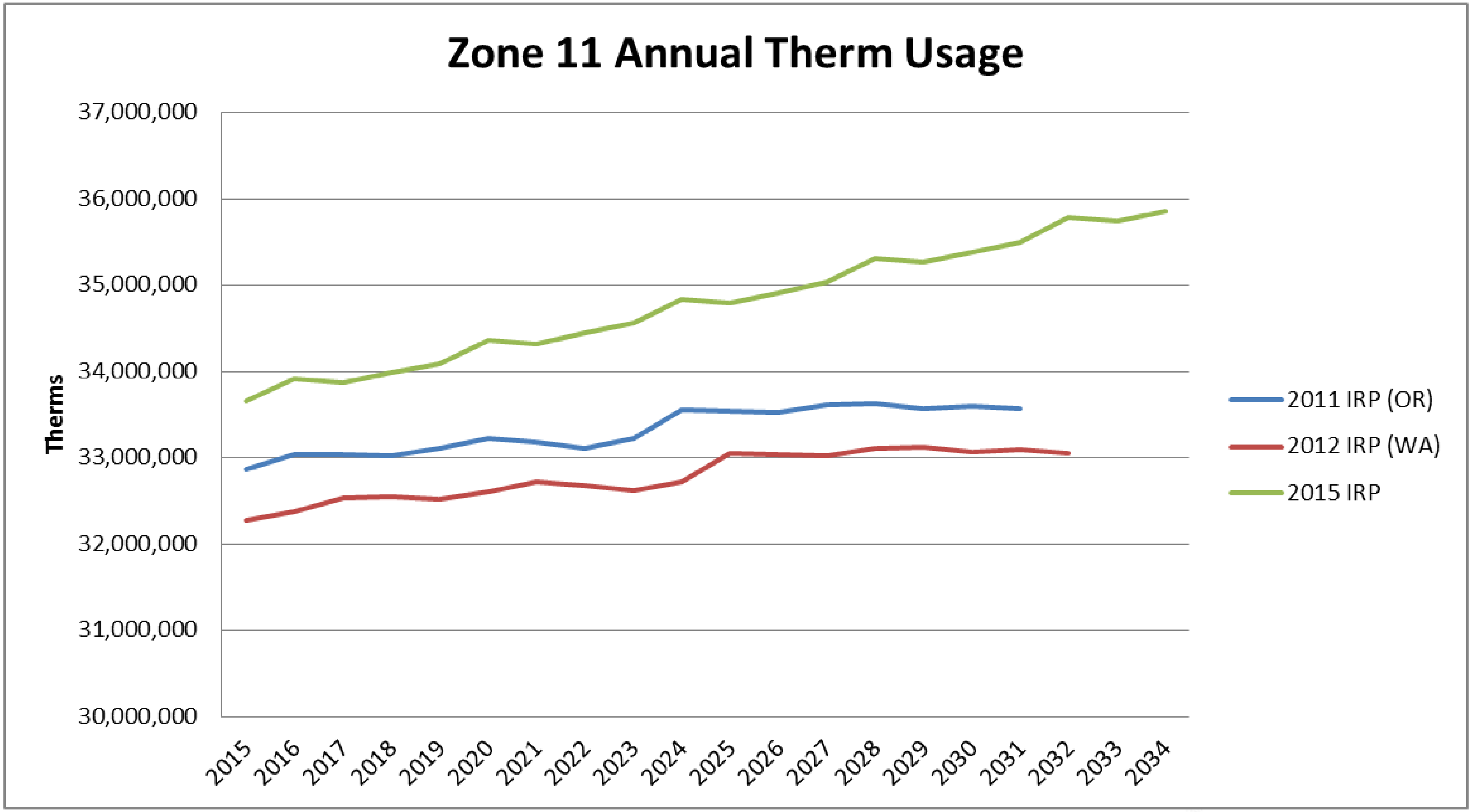
Zone 10


Zone 10 Annual Therm Usage
Therms
9,800,000
9,600,000
9,400,000
9,200,000
9,000,000
8,800,000
8,600,000
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
2034
2011 IRP (OR)
2012 IRP (WA)
2015 IRP

Zone 11


Zone 11 Annual Therm Usage
37,000,000
36,000,000
35,000,000
34,000,000
33,000,000
32,000,000
31,000,000
30,000,000
Therms
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
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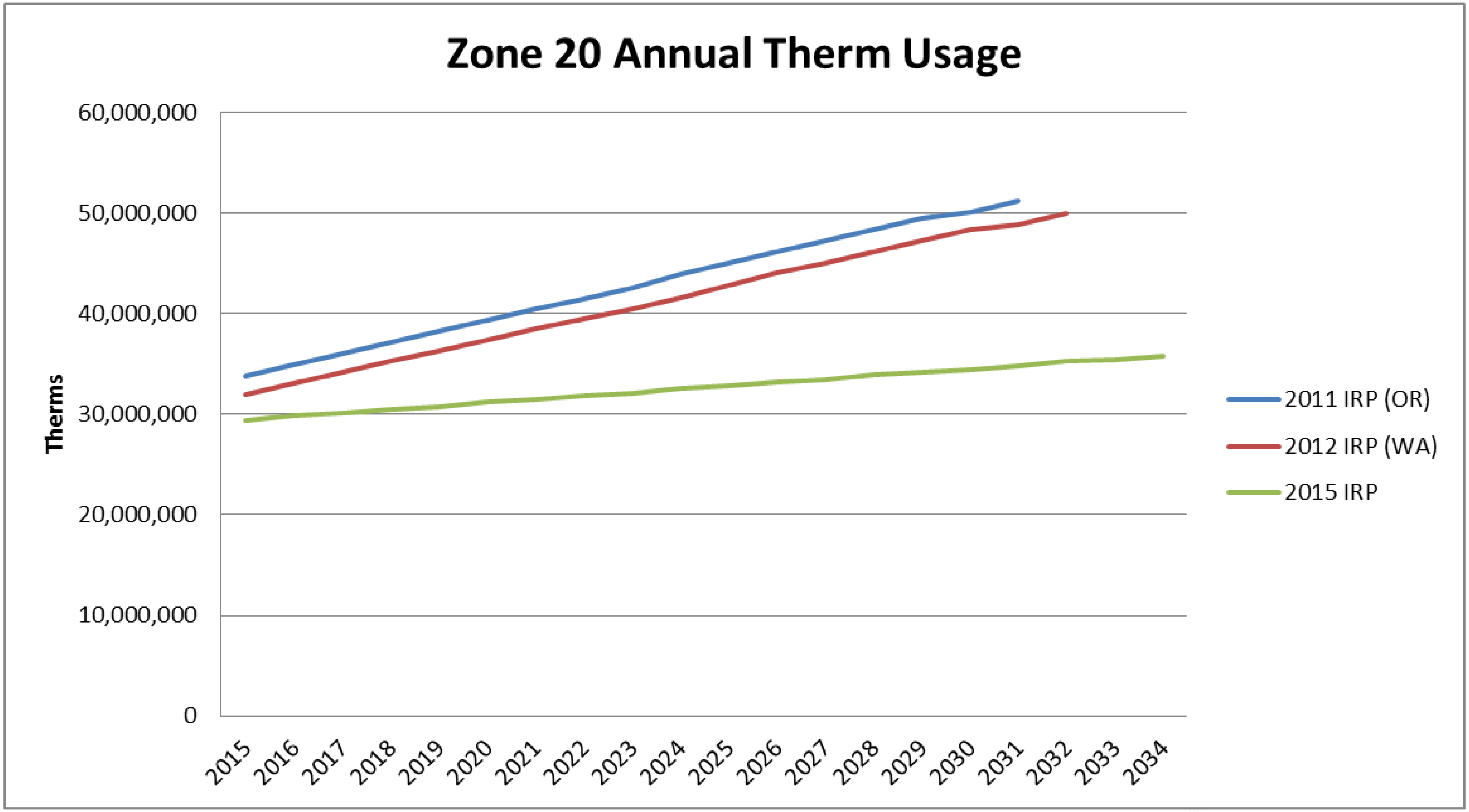
2029
2030
2031
2032
2033
2034
2011 IRP (OR)
2012 IRP (WA)
2015 IRP

Zone 20



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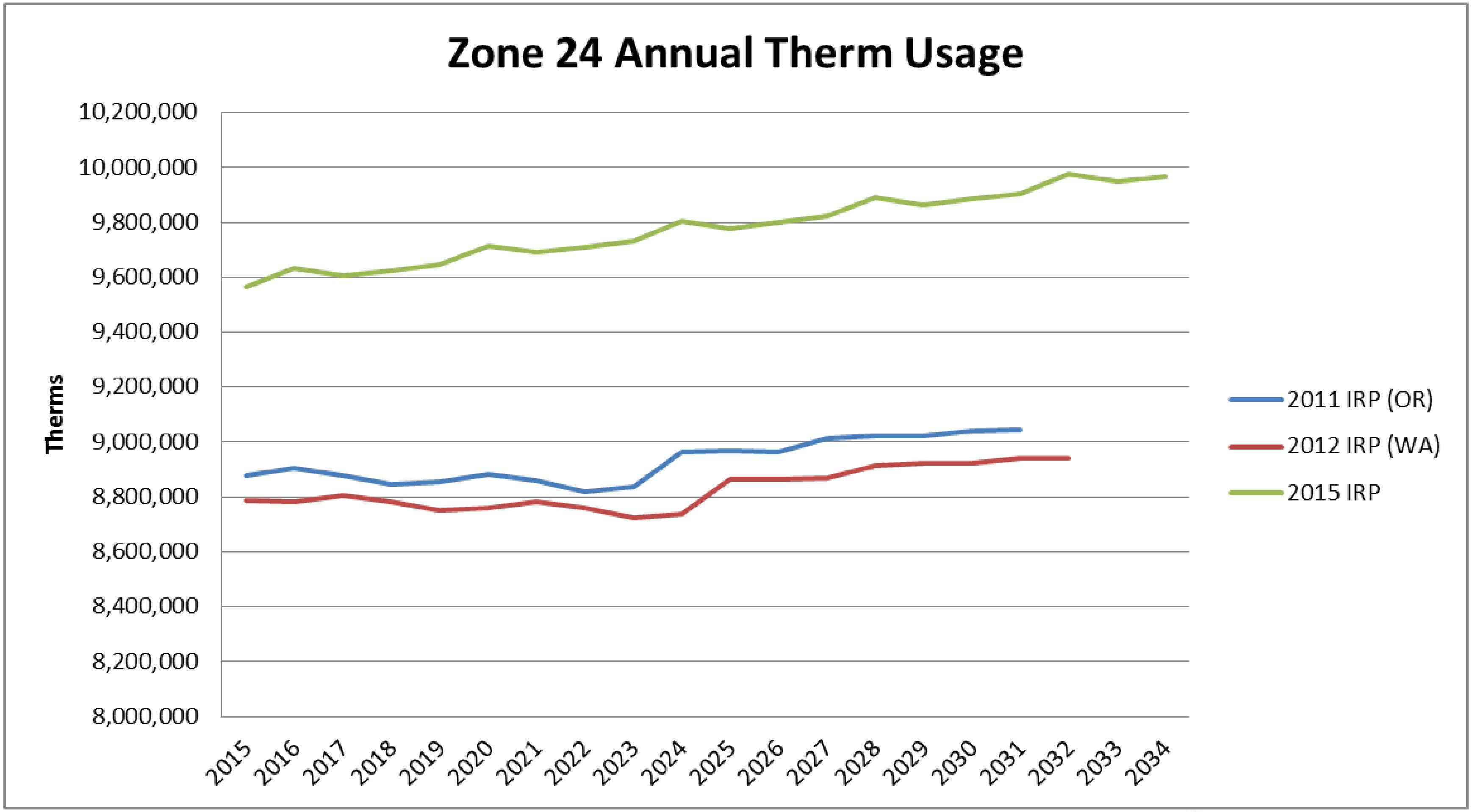
Zone 24



Cascade Natural Gas Corporation

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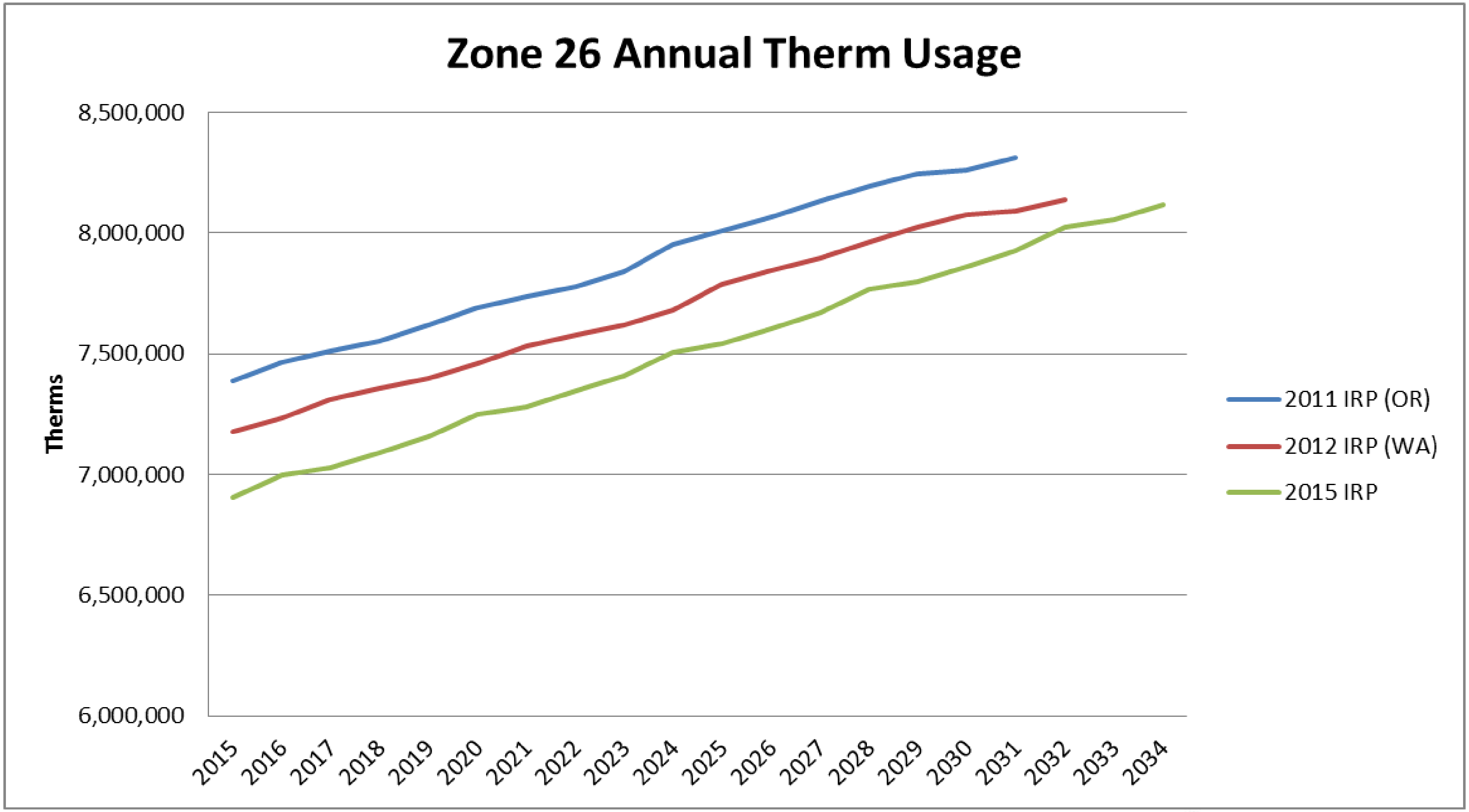
Zone 26



CASCADE NATURAL GAS CORPORATION

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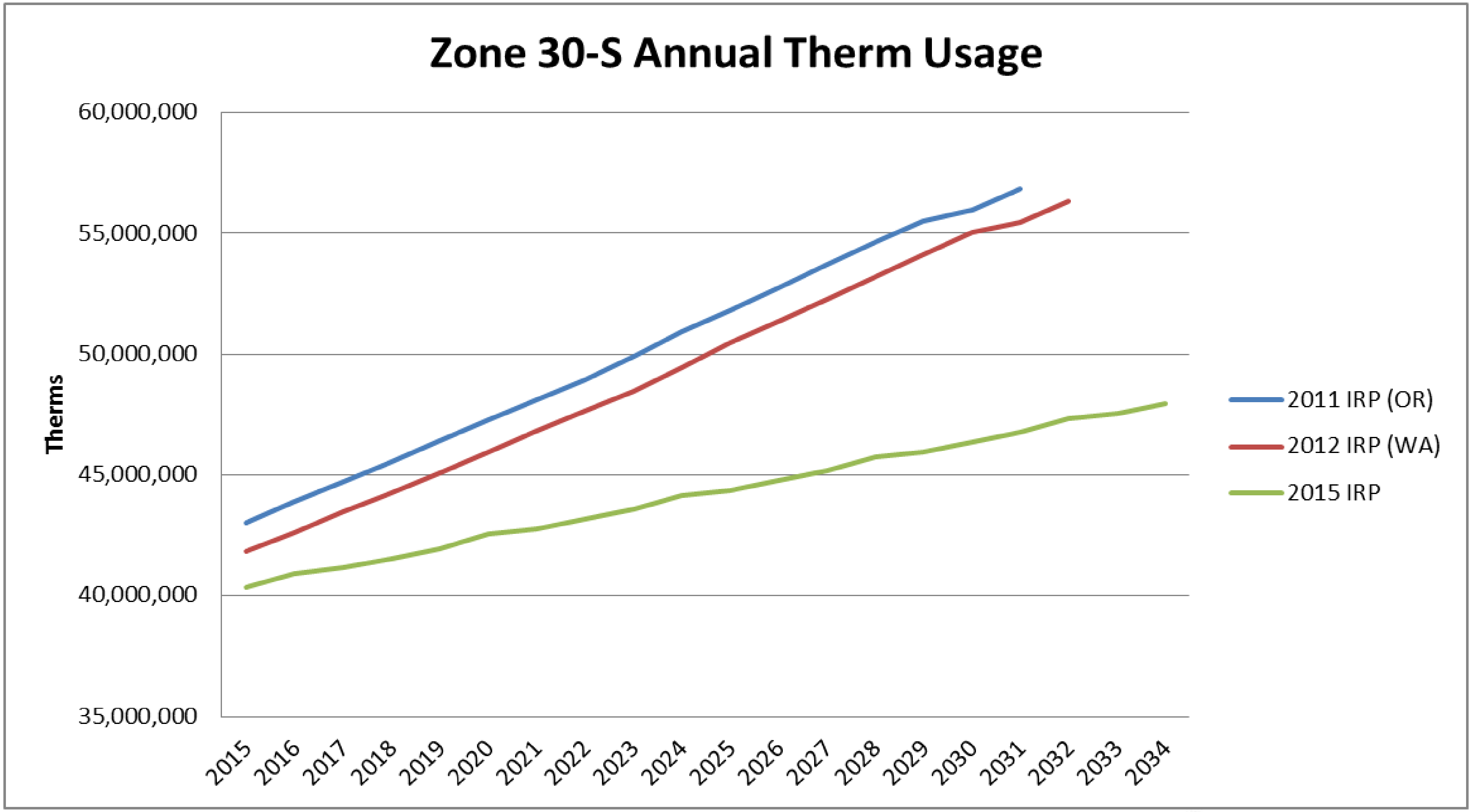
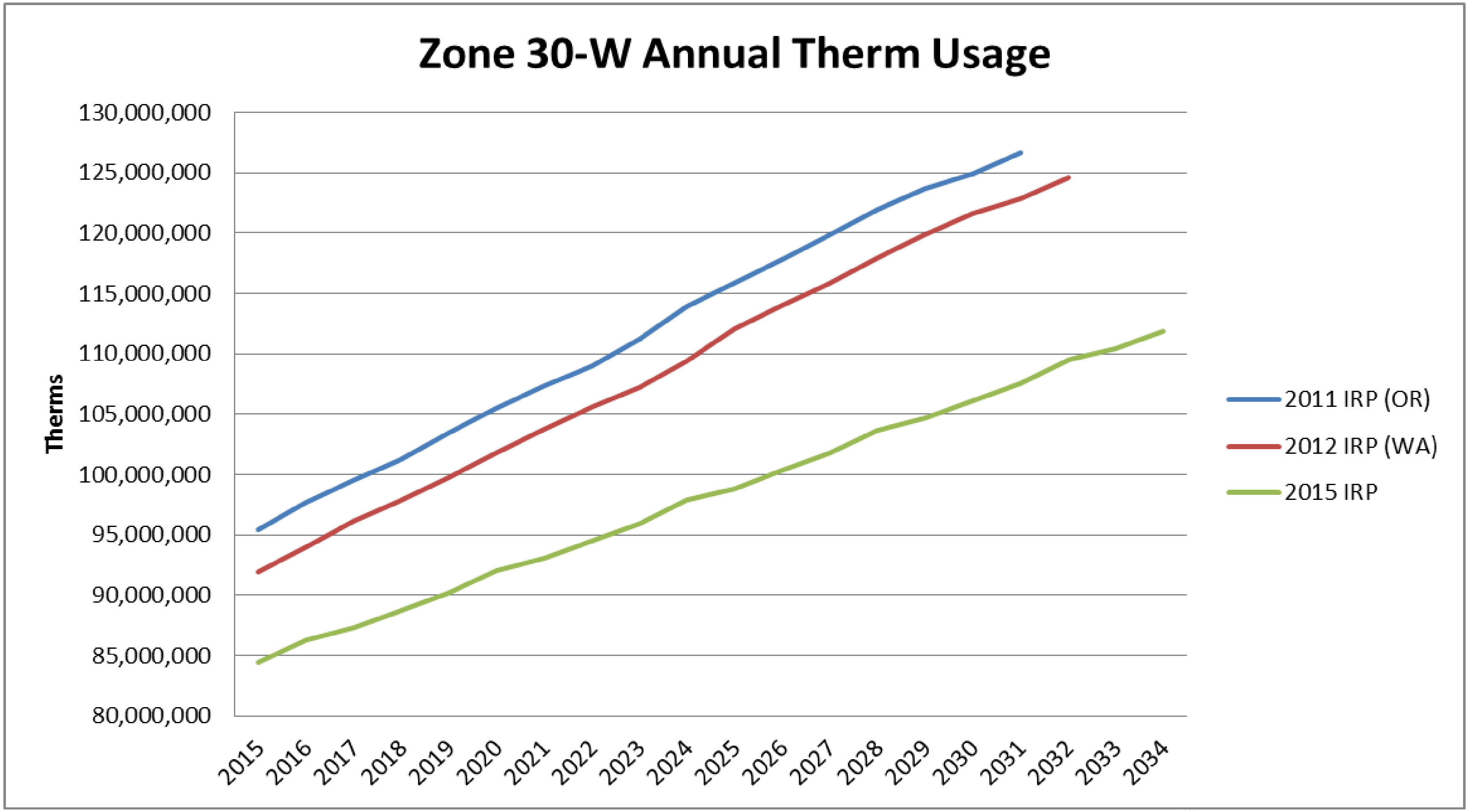
Zone 30-S



CASCADE NATURAL GAS CORPORATION

In the Community to Serve

Zone 30-W



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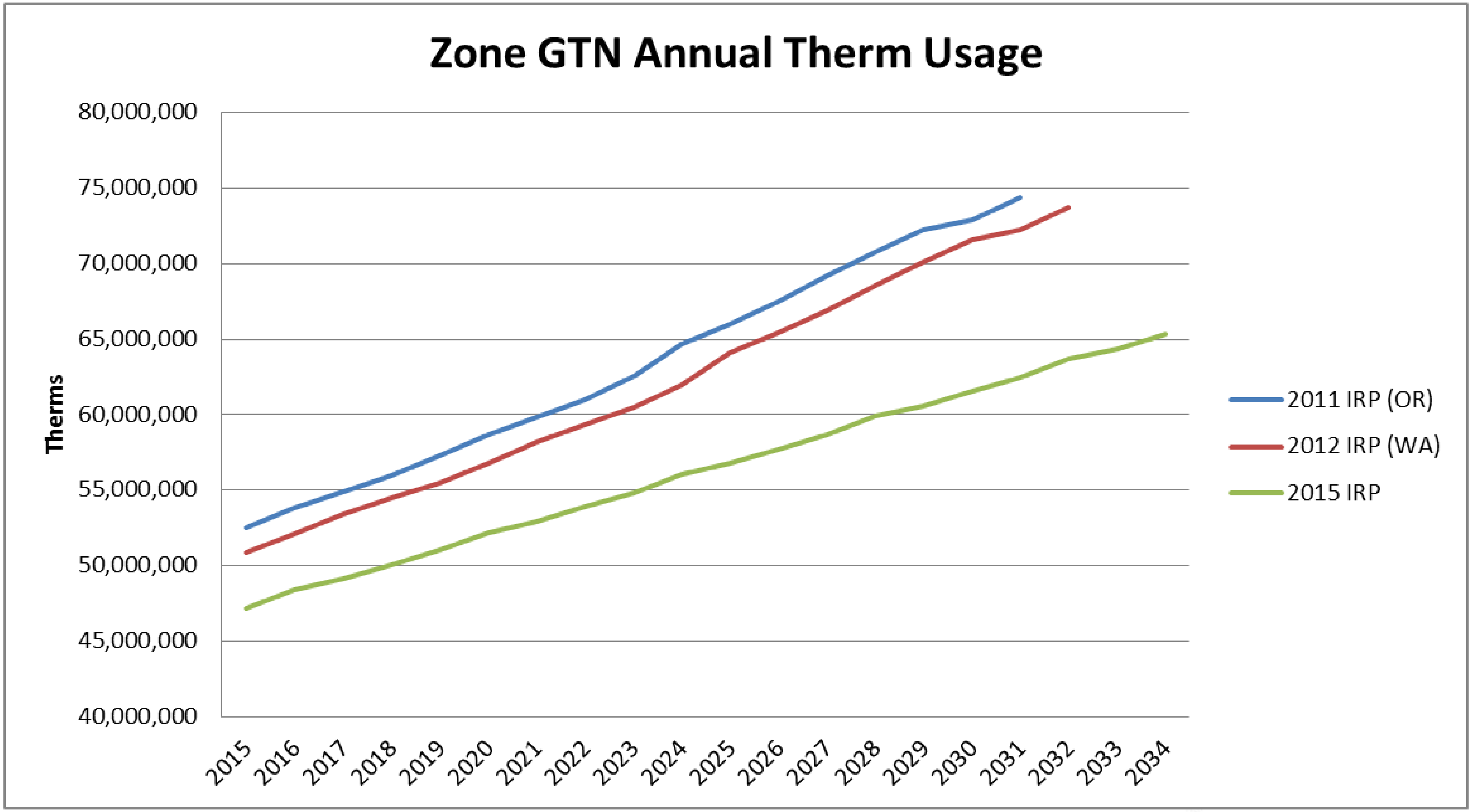
Zone GTN



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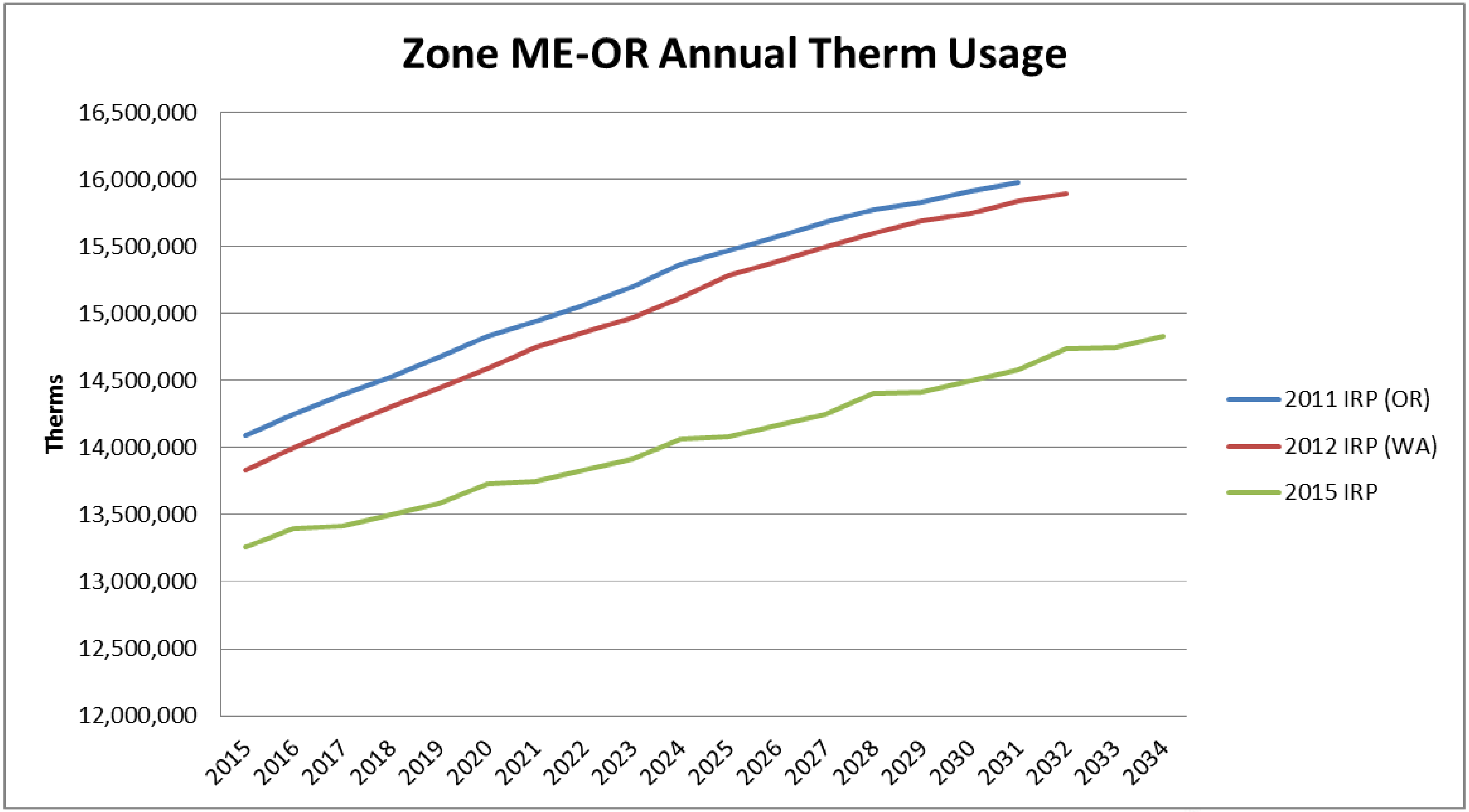
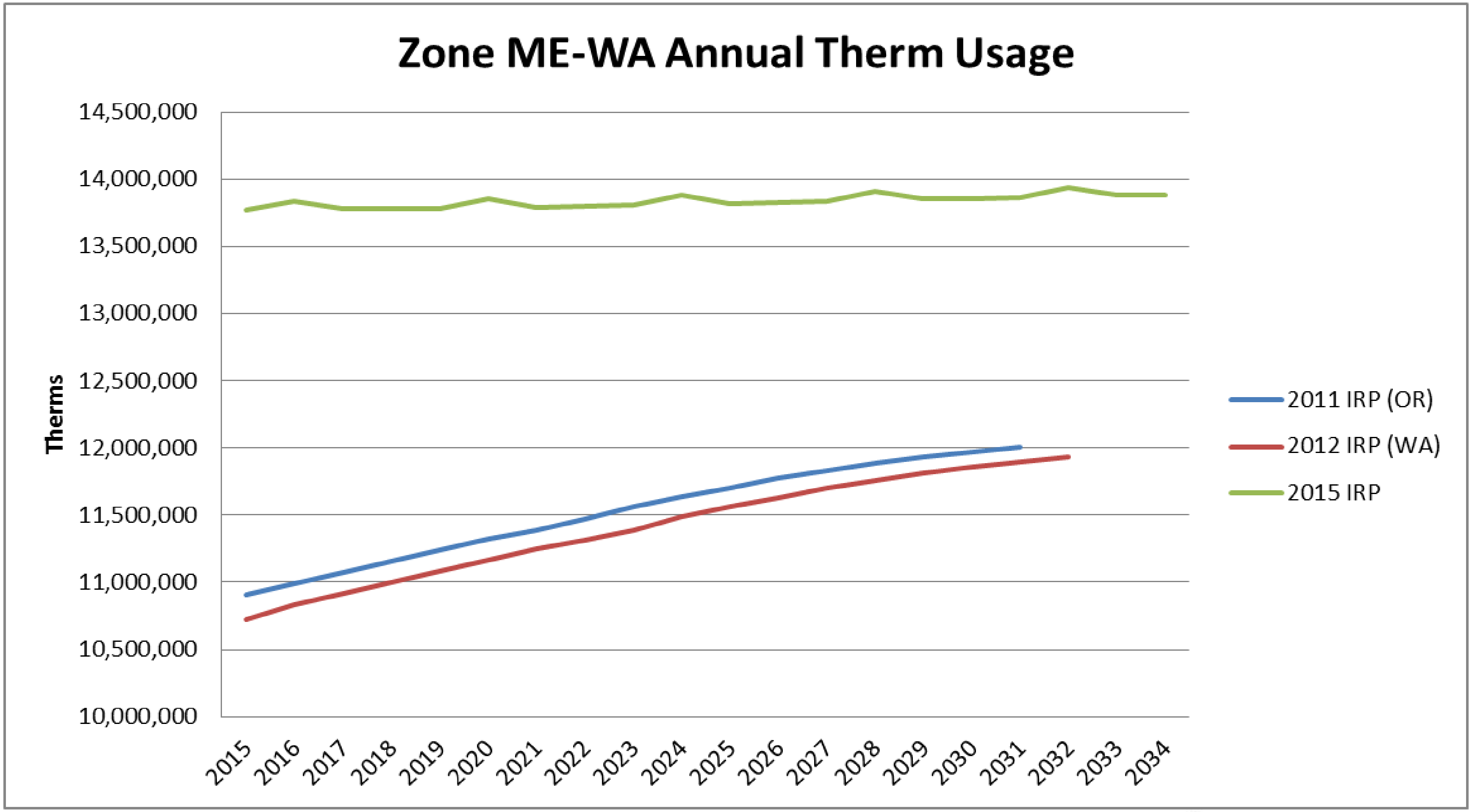
Zone ME-OR



Zone ME-OR Annual Therm Usage
16,500,000
16,000,000
15,500,000
15,000,000
14,500,000
14,000,000
13,500,000
13,000,000
12,500,000
12,000,000
Therms
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
2034
2011 IRP (OR)
2012 IRP (WA)
2015 IRP

Zone ME-WA



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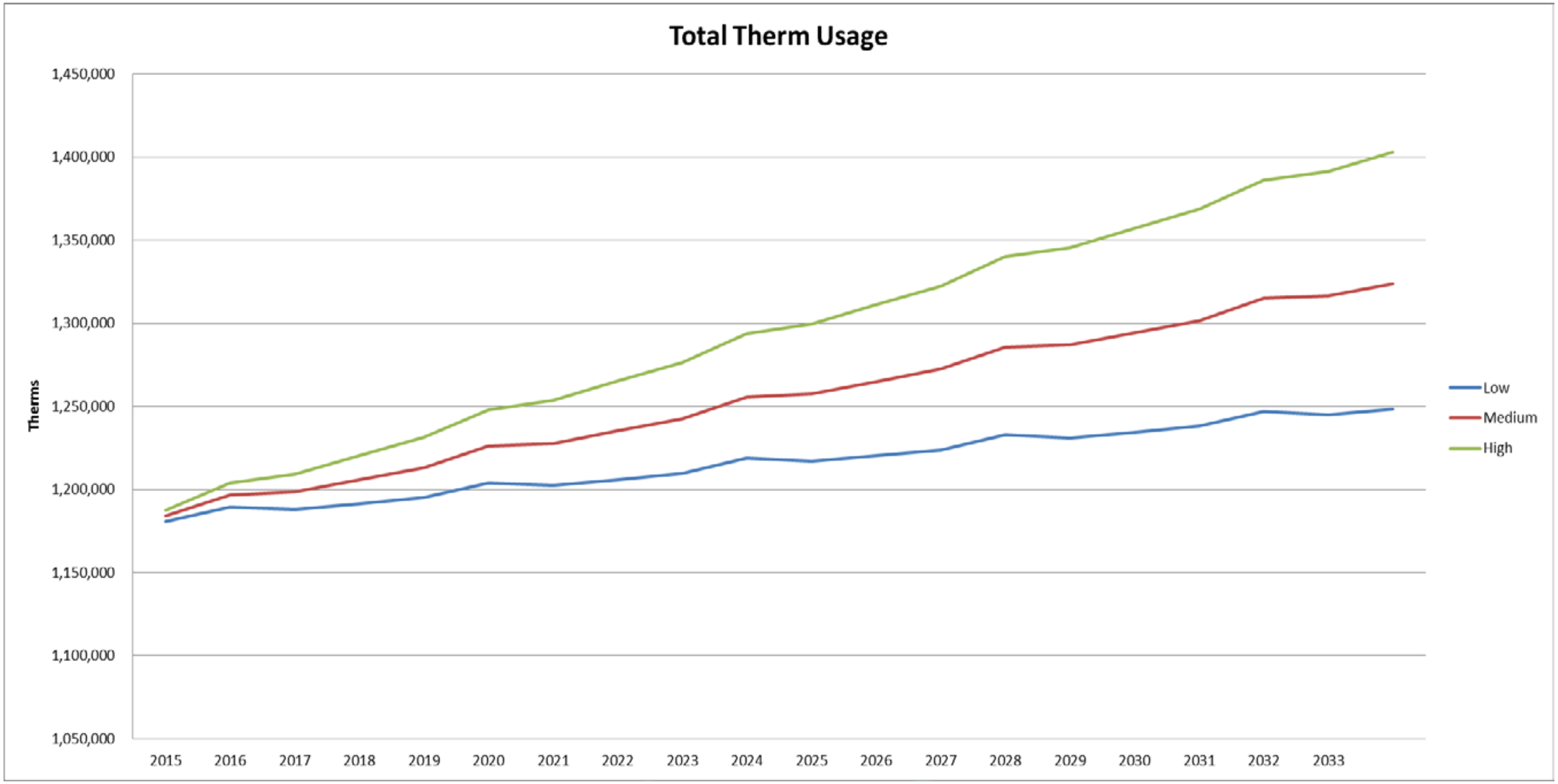
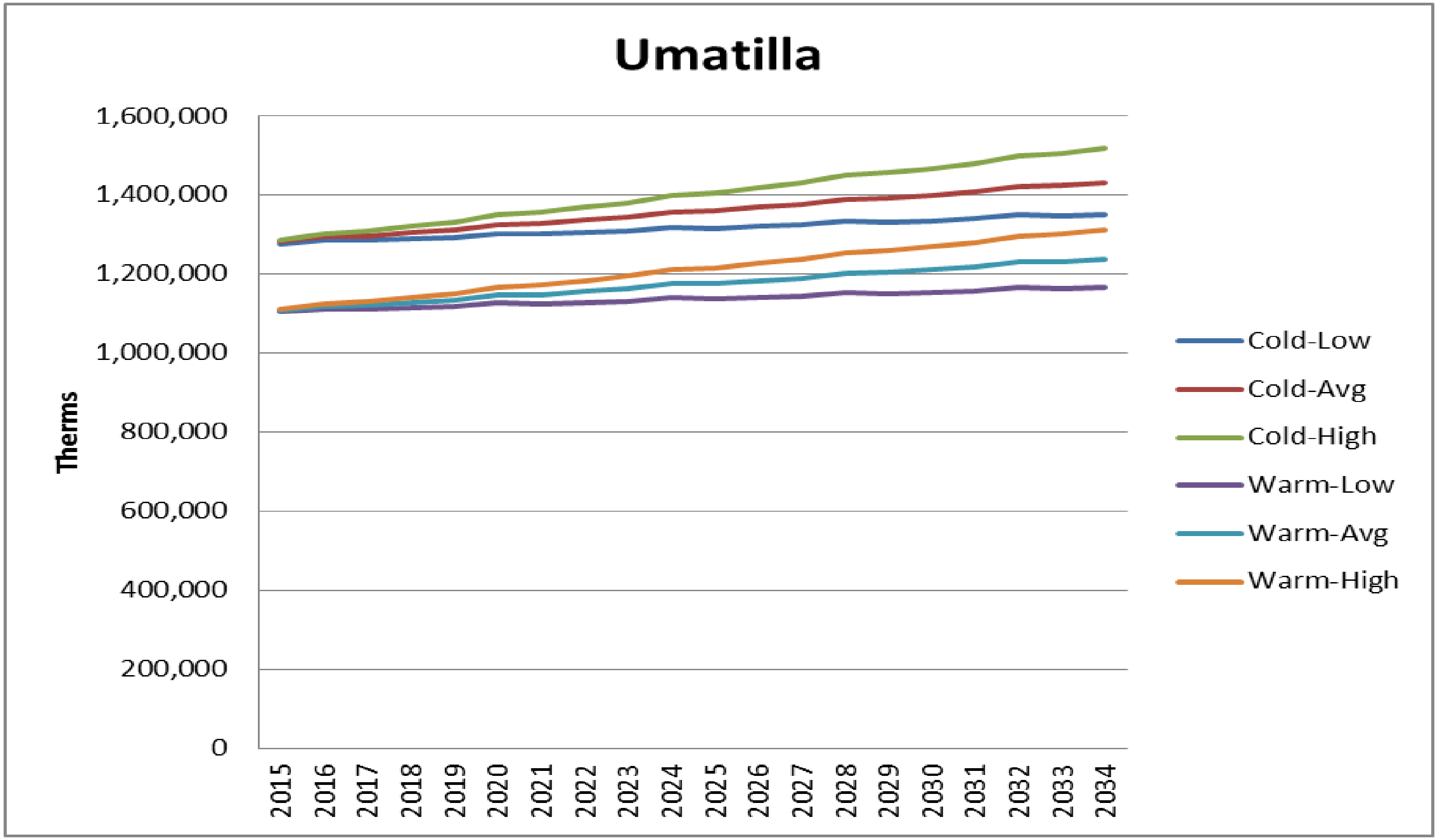
Umatilla With Average Weather



Umatilla with High and Low Weather Scenarios



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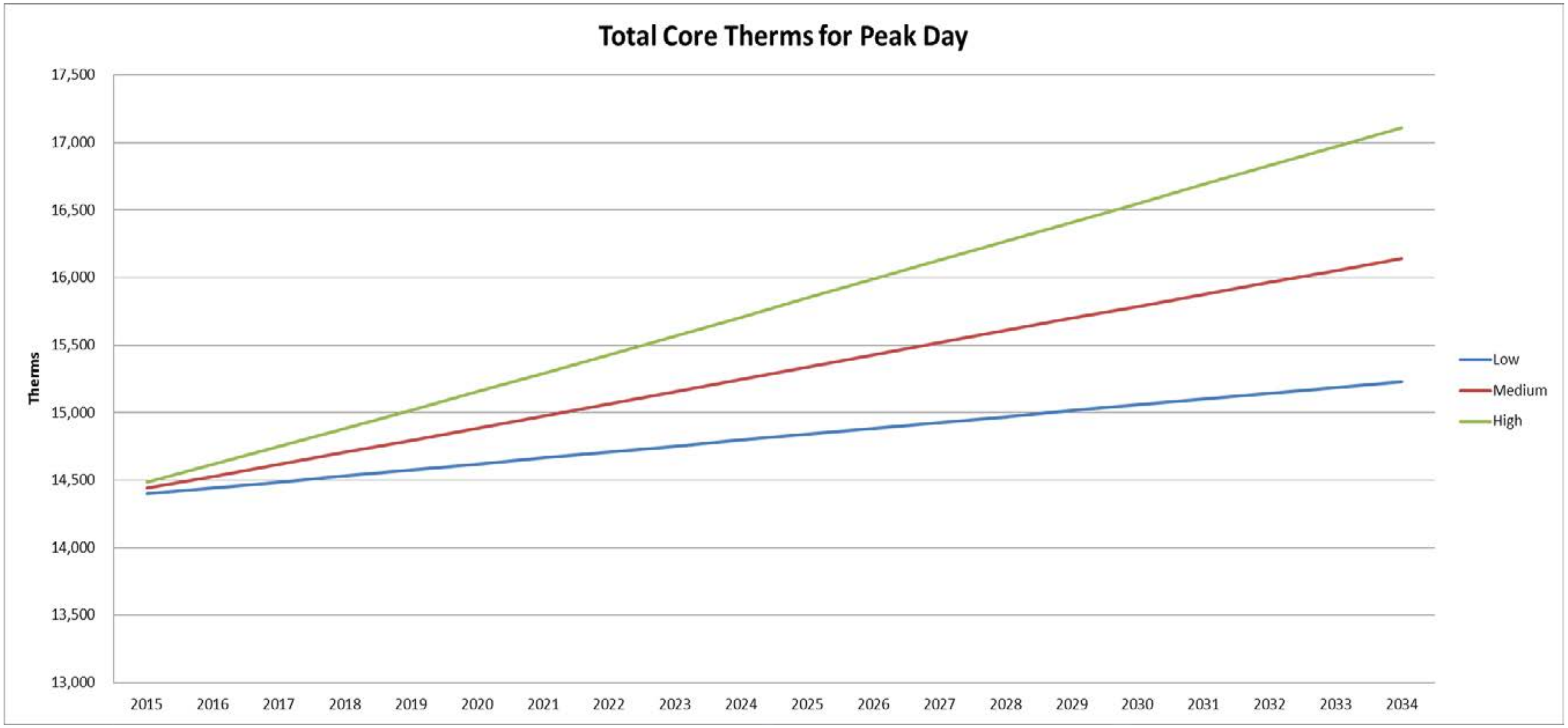
Umatilla Peak Day



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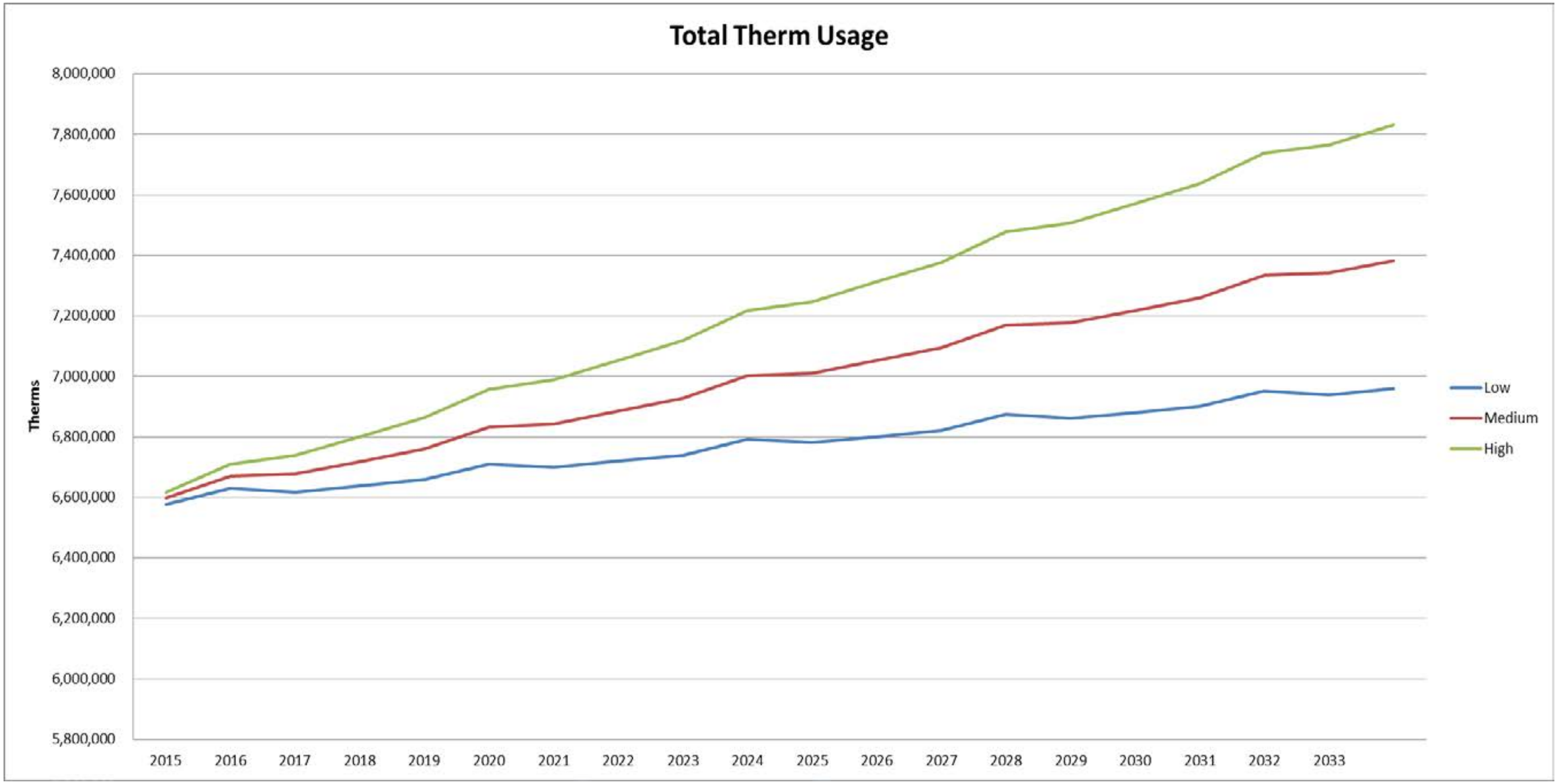
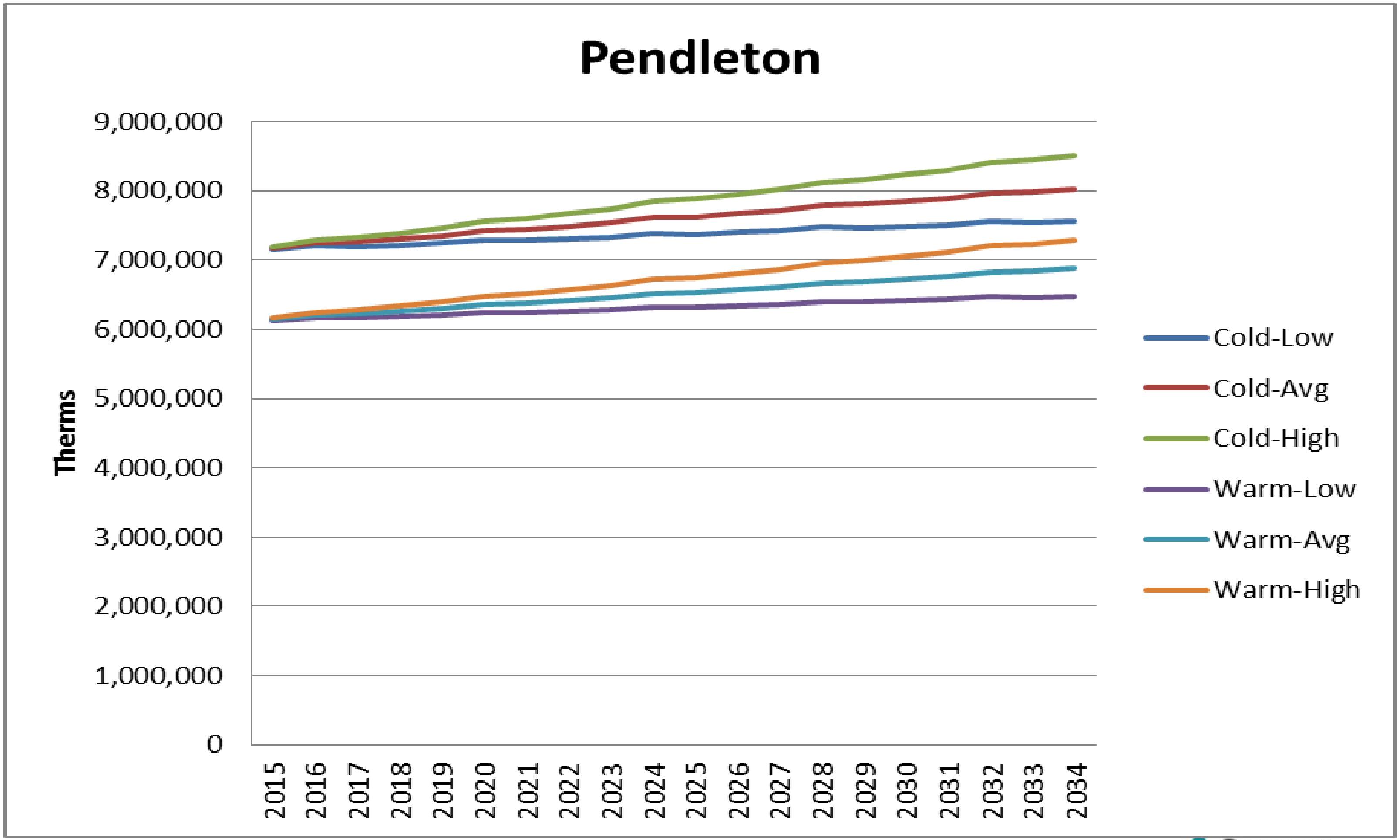
Pendleton with Average Weather



Pendleton with High and Low Weather Scenarios



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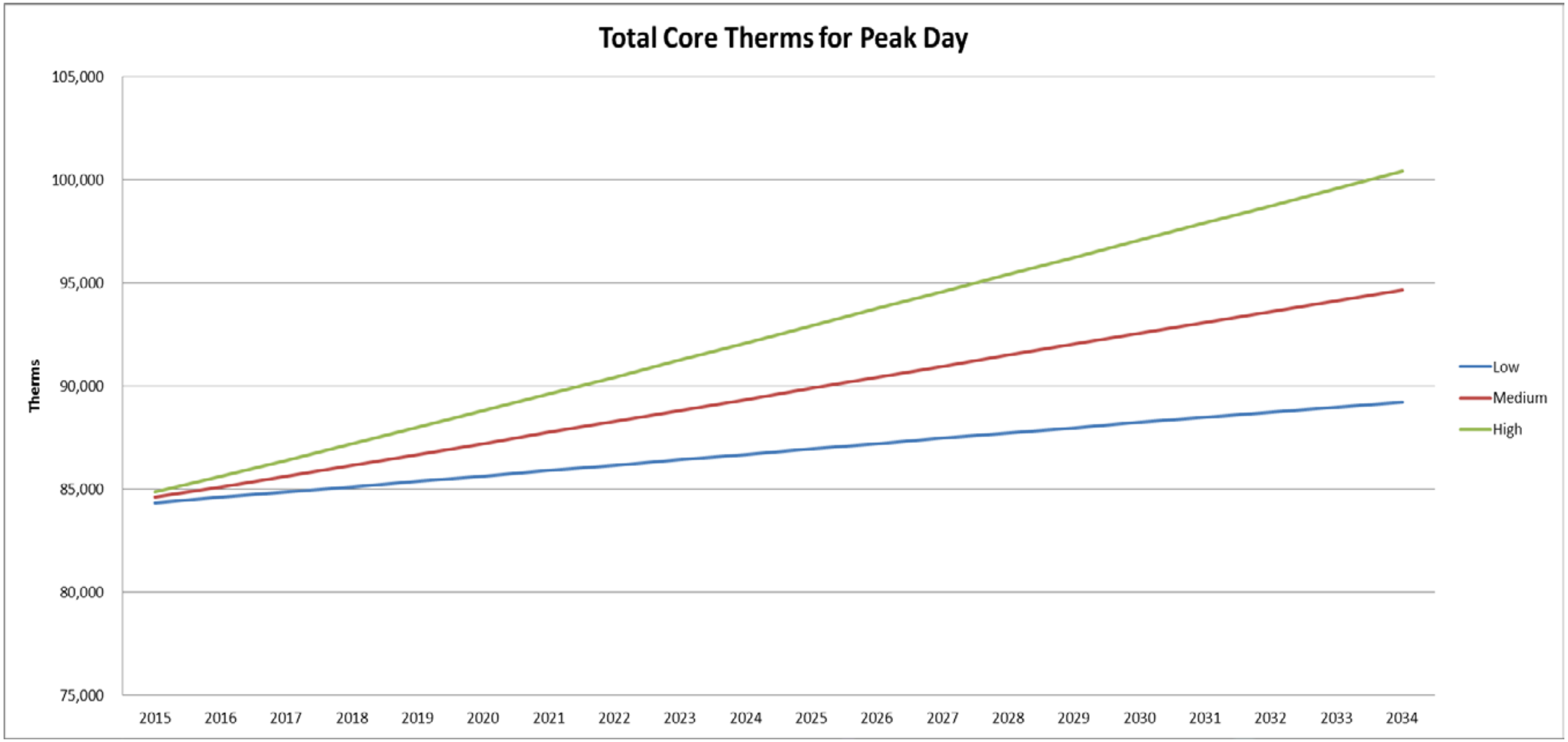
Pendleton Peak Day



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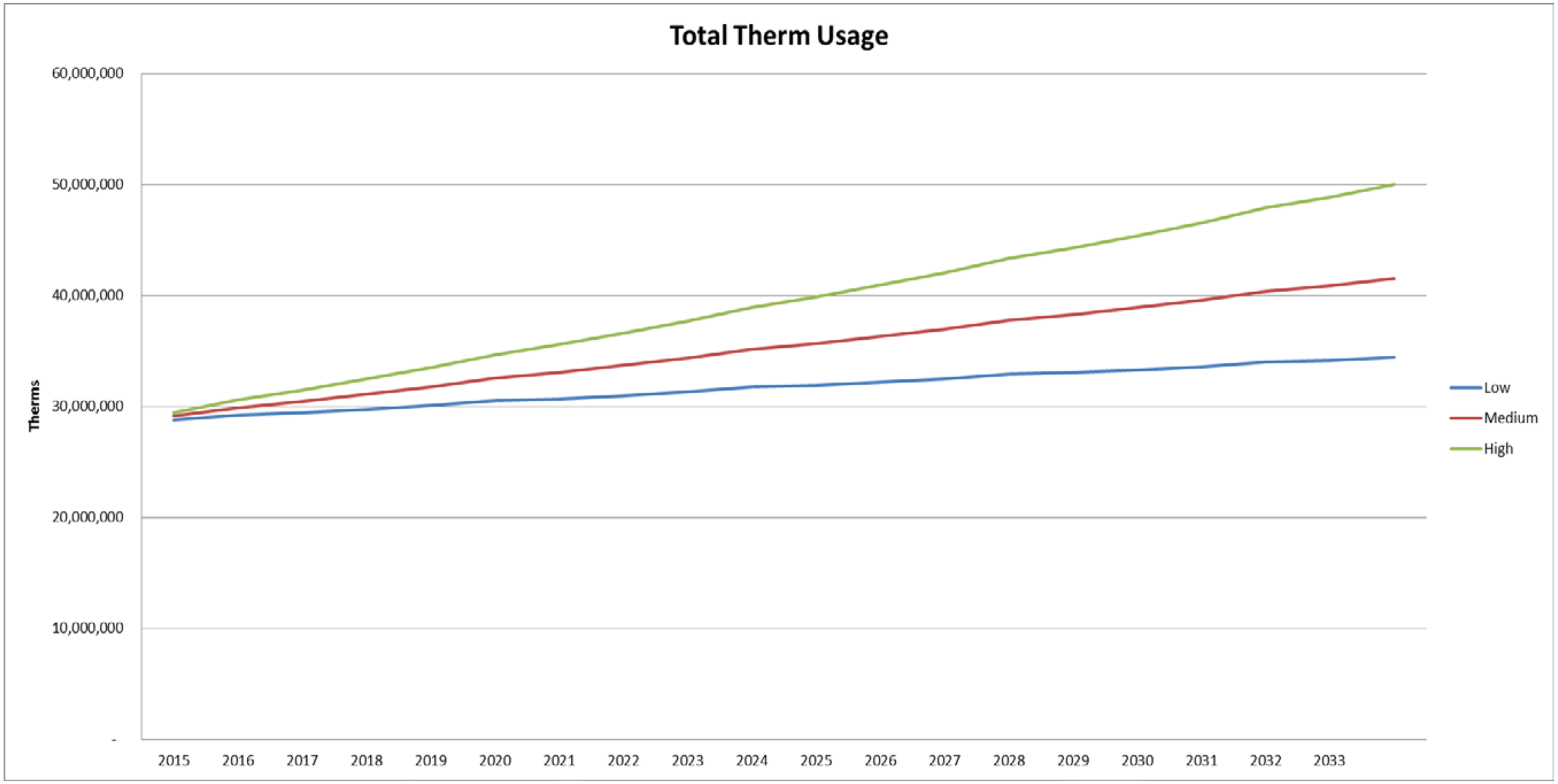
Bend Loop with Average Weather



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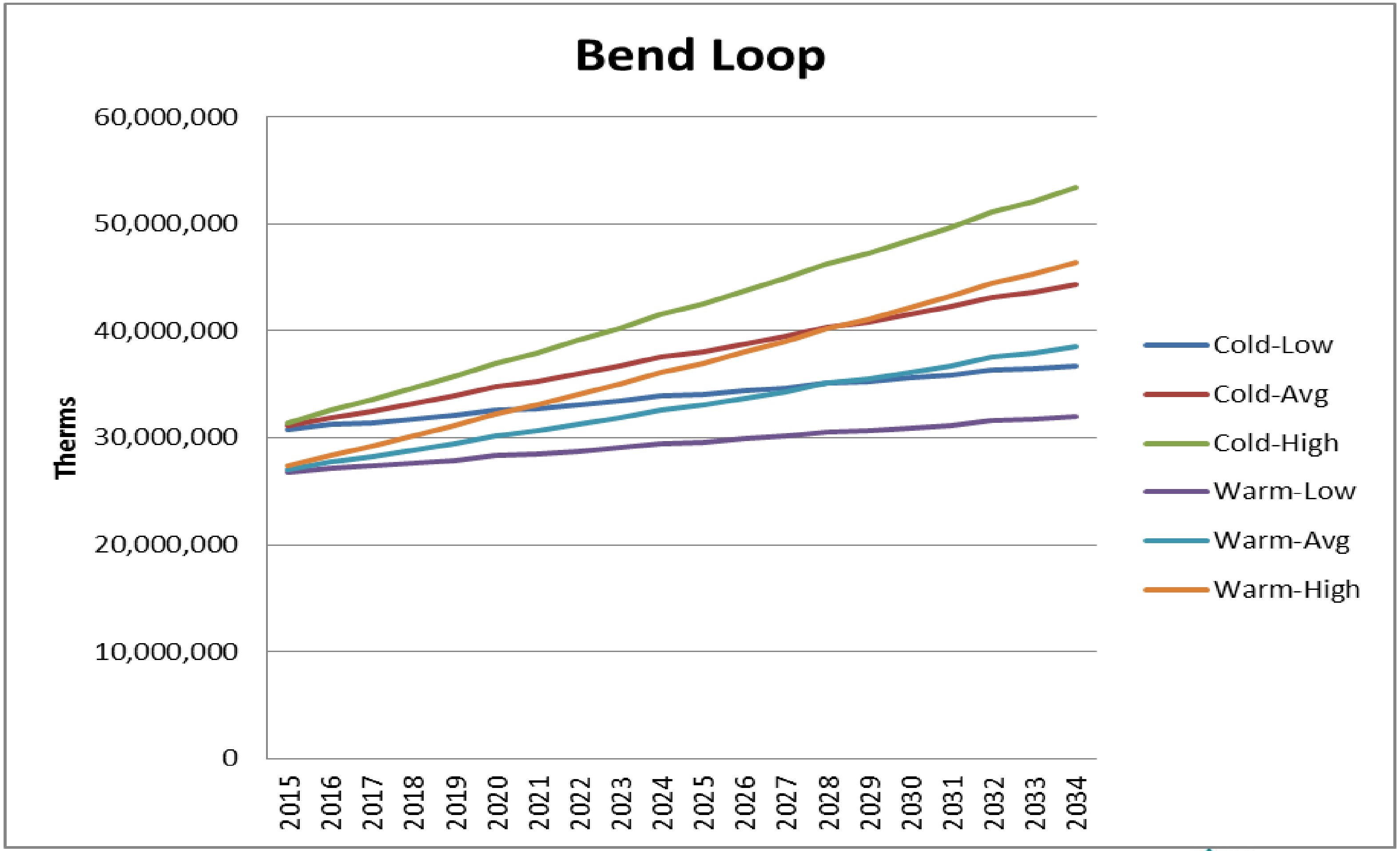
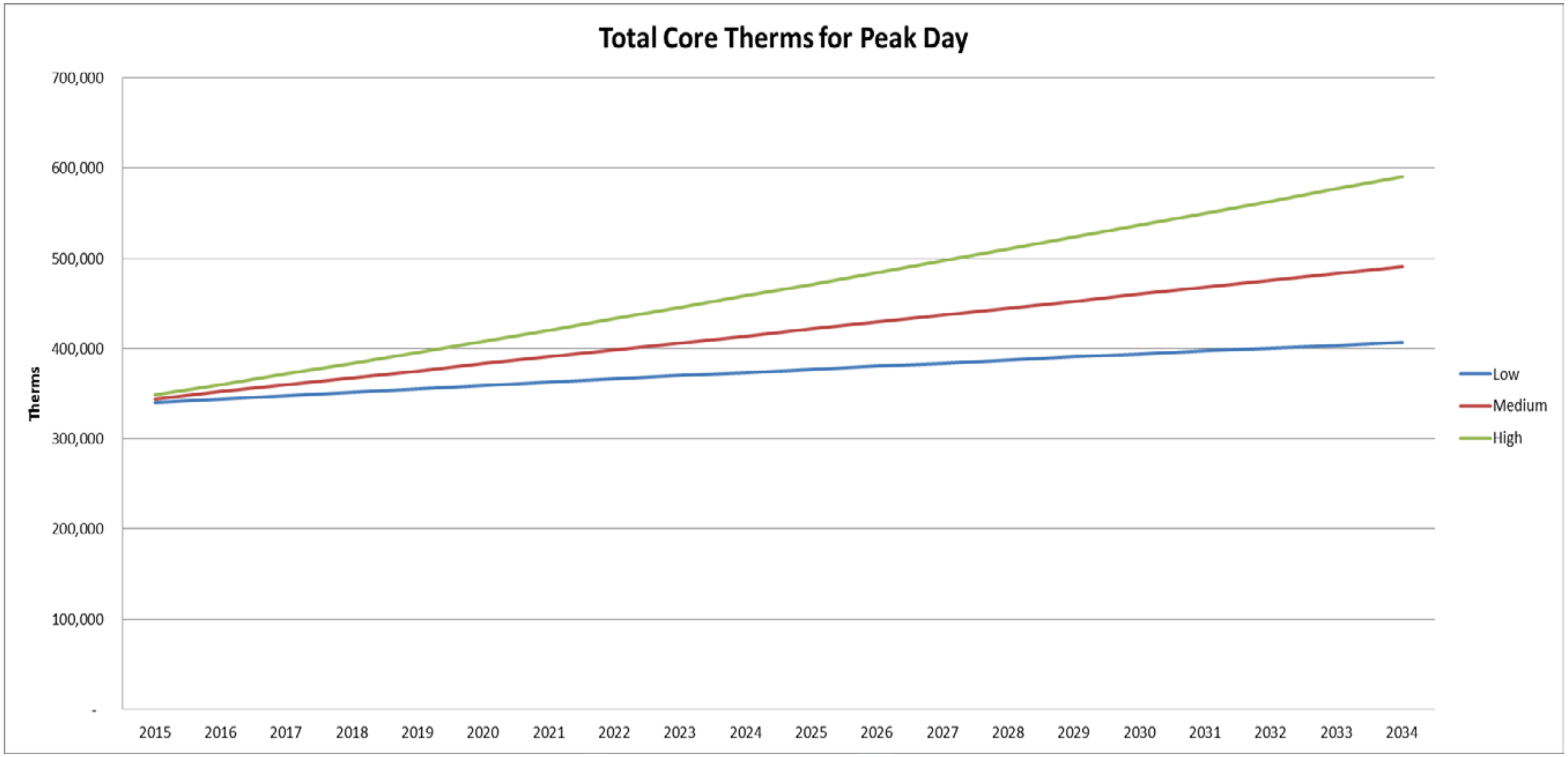
Bend Loop with High and Low Weather Scenarios



Bend Loop Peak Day



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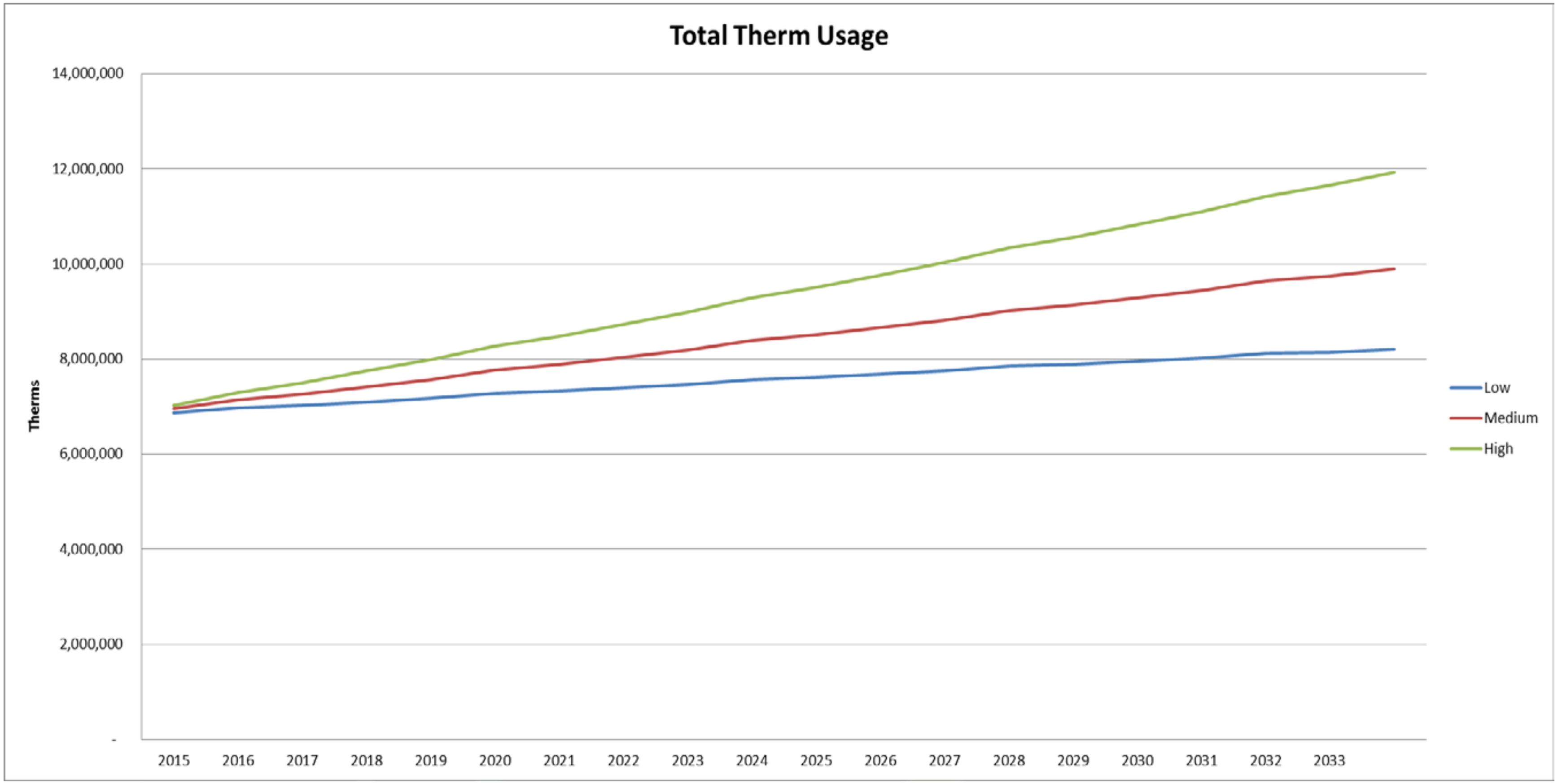
Redmond With Average Weather



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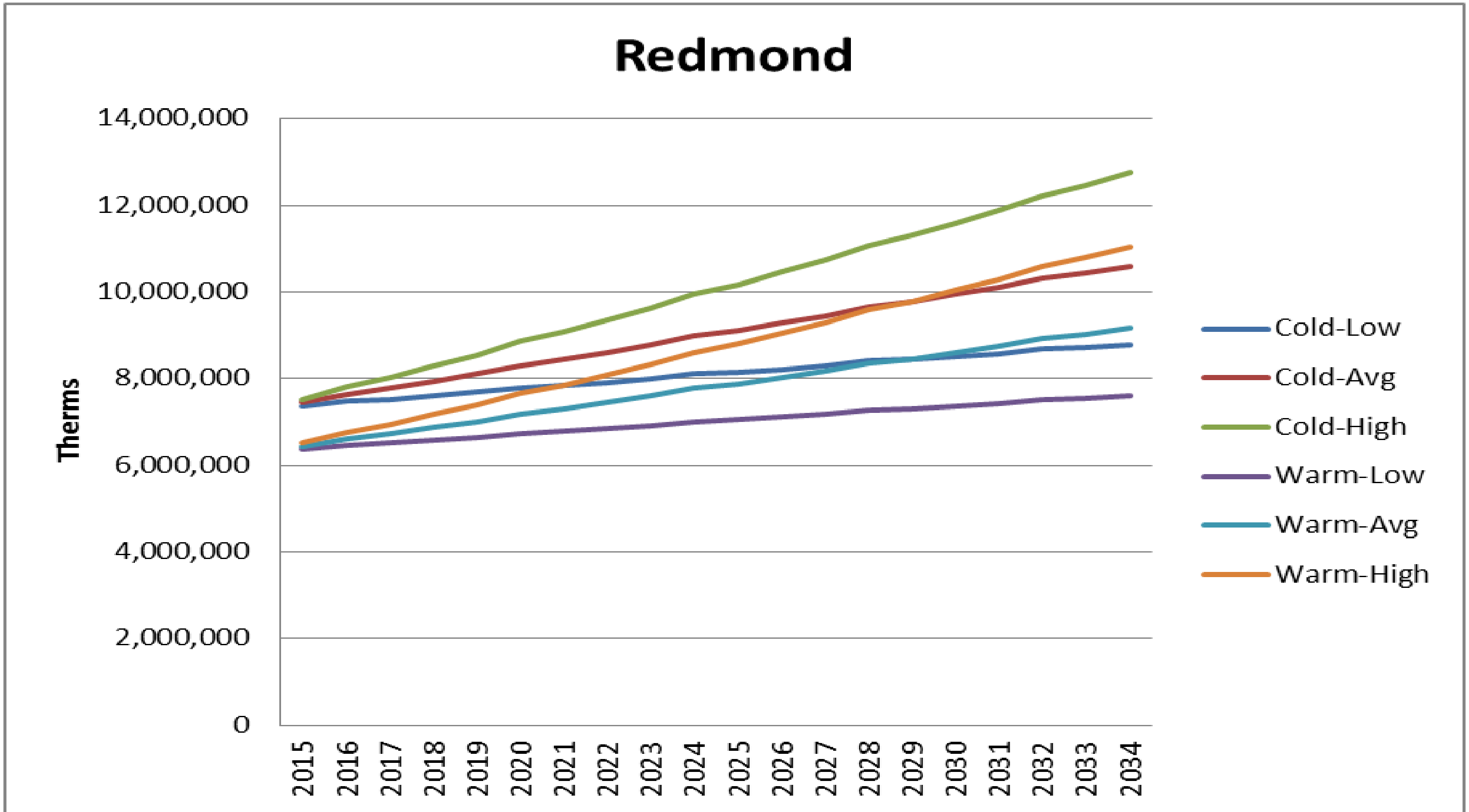
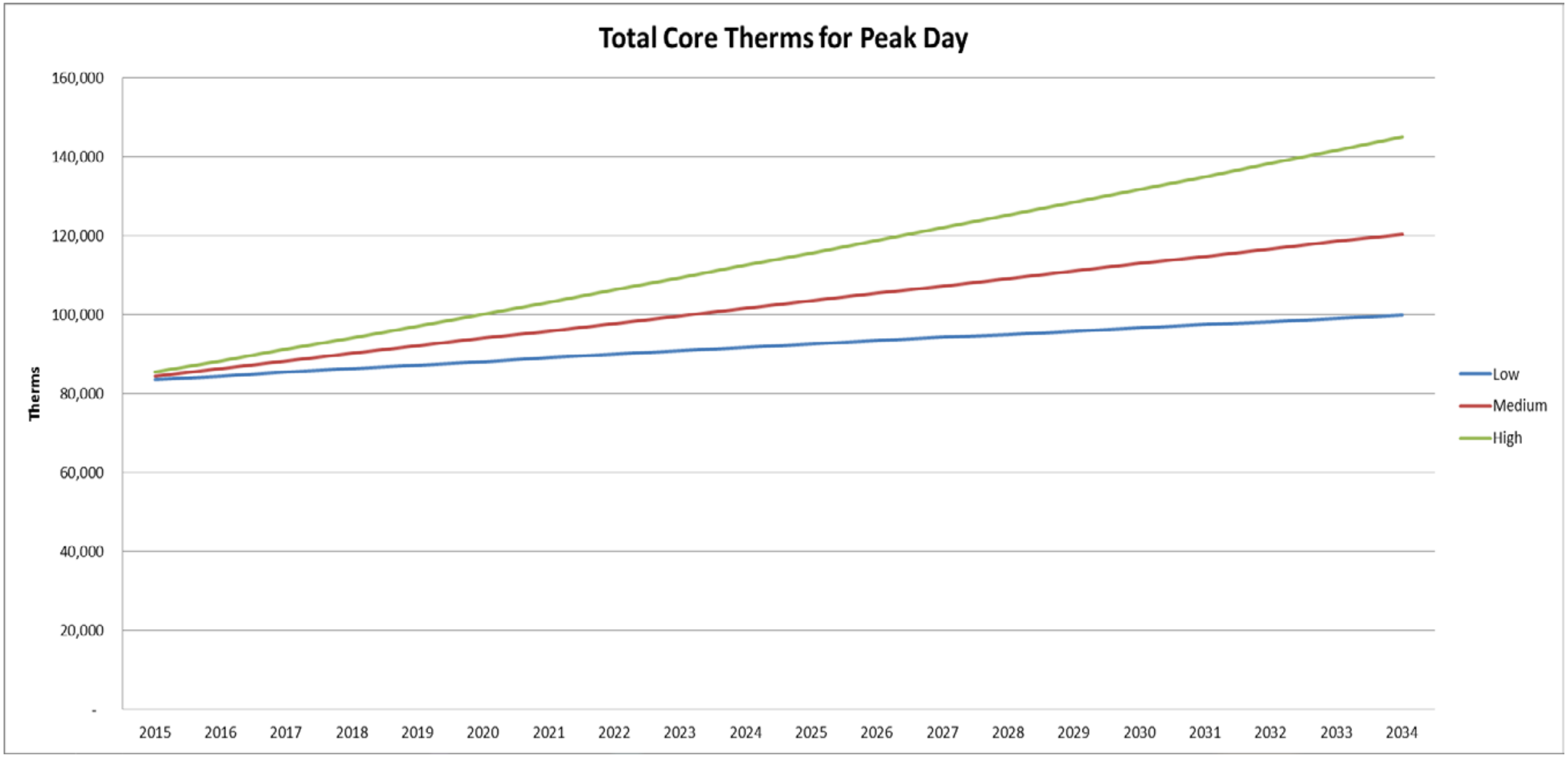
Redmond with High and Low Weather Scenarios



Cascade Natural Gas Corporation

In the Community to Serve

Redmond Peak Day



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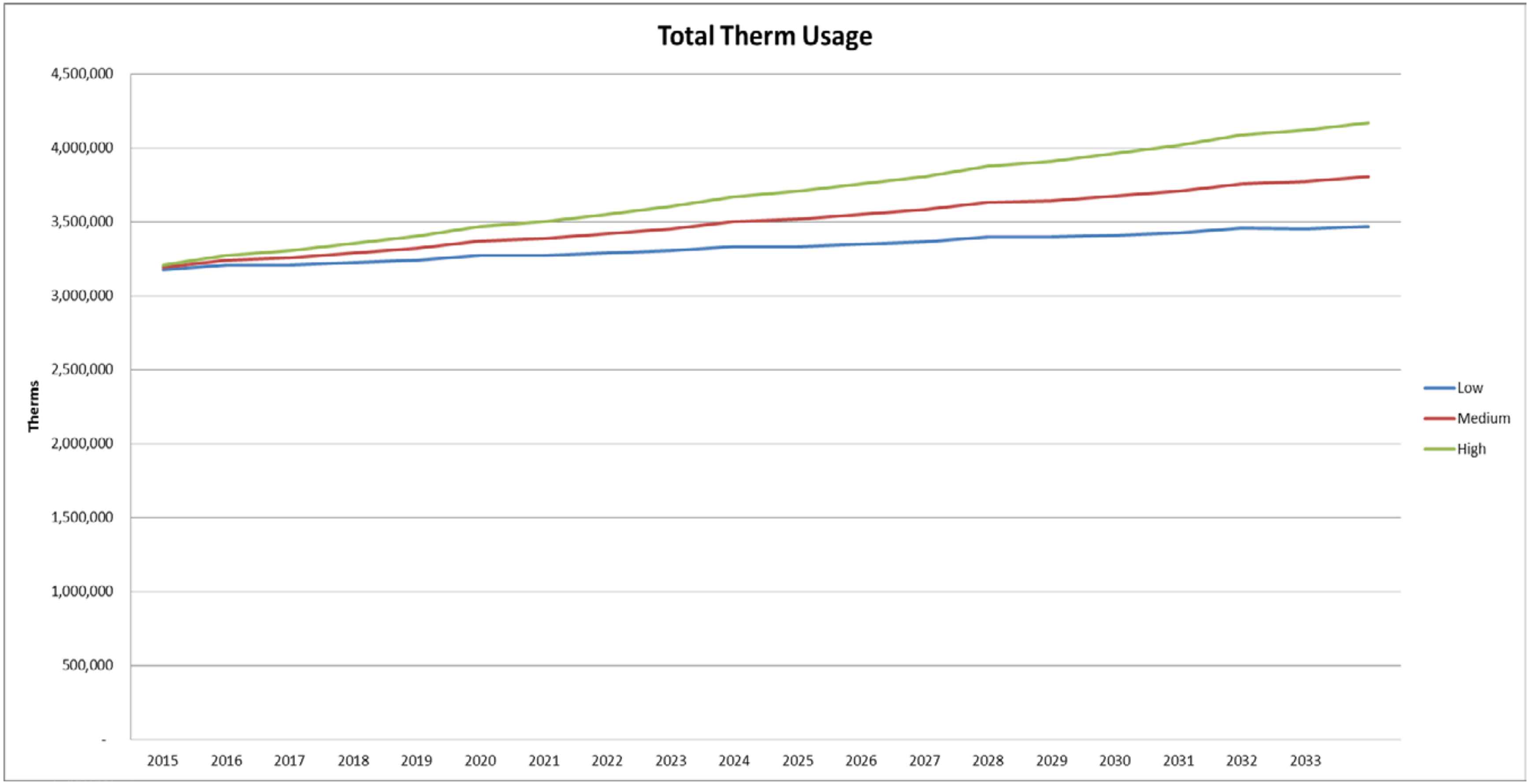
Moses Lake With Average Weather



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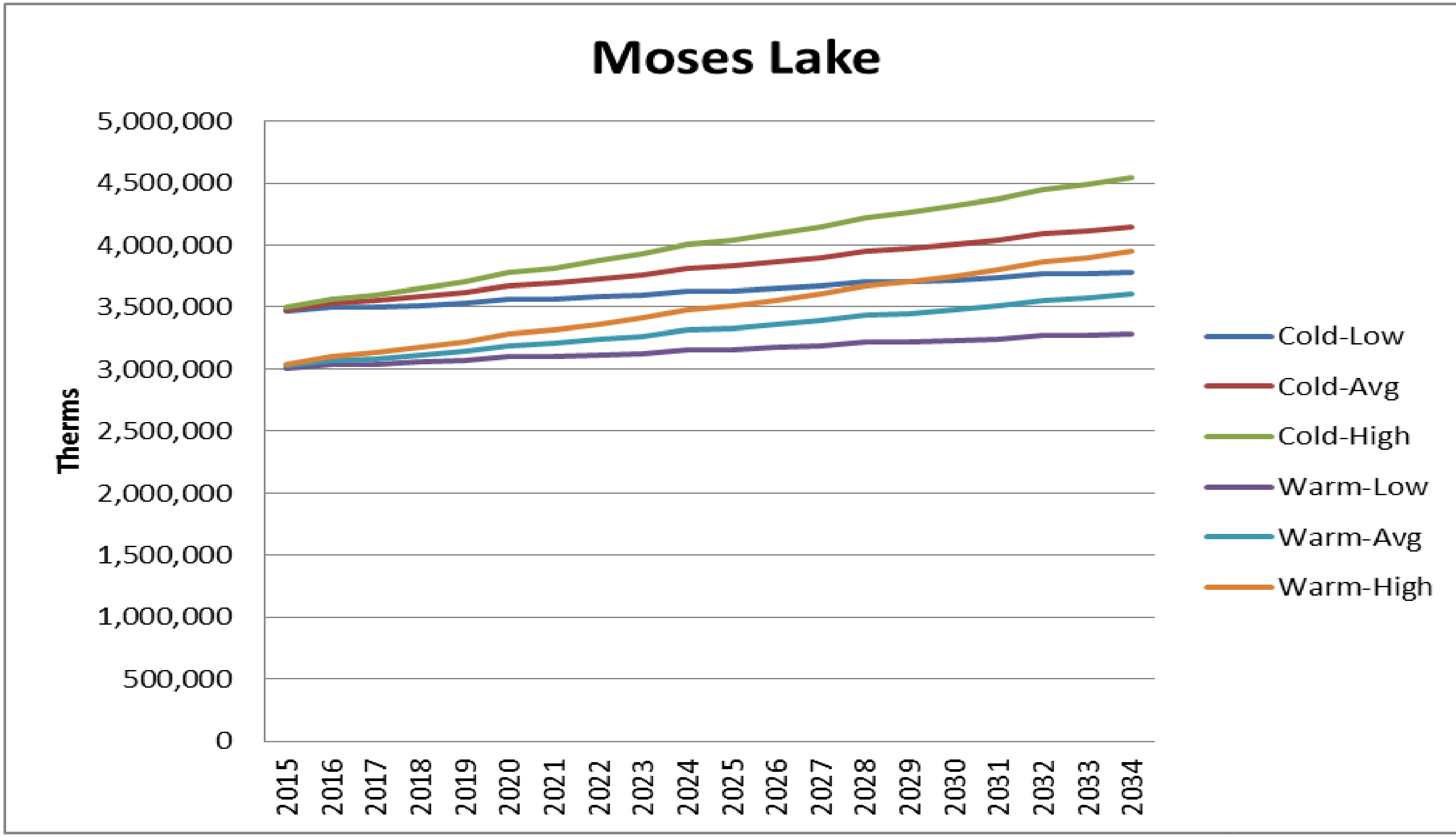
Moses Lake with High and Low Weather Scenarios



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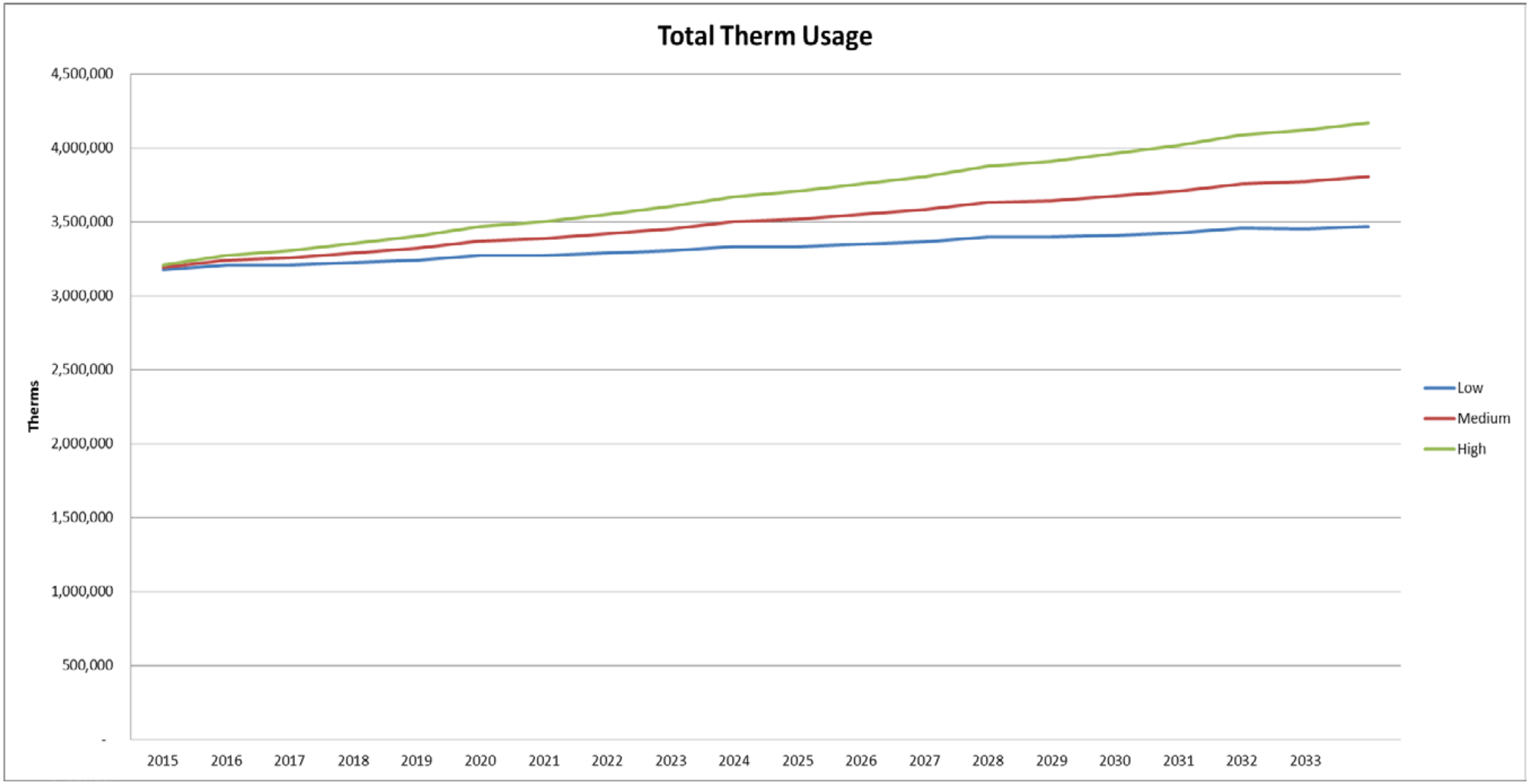
Moses Lake Peak Day



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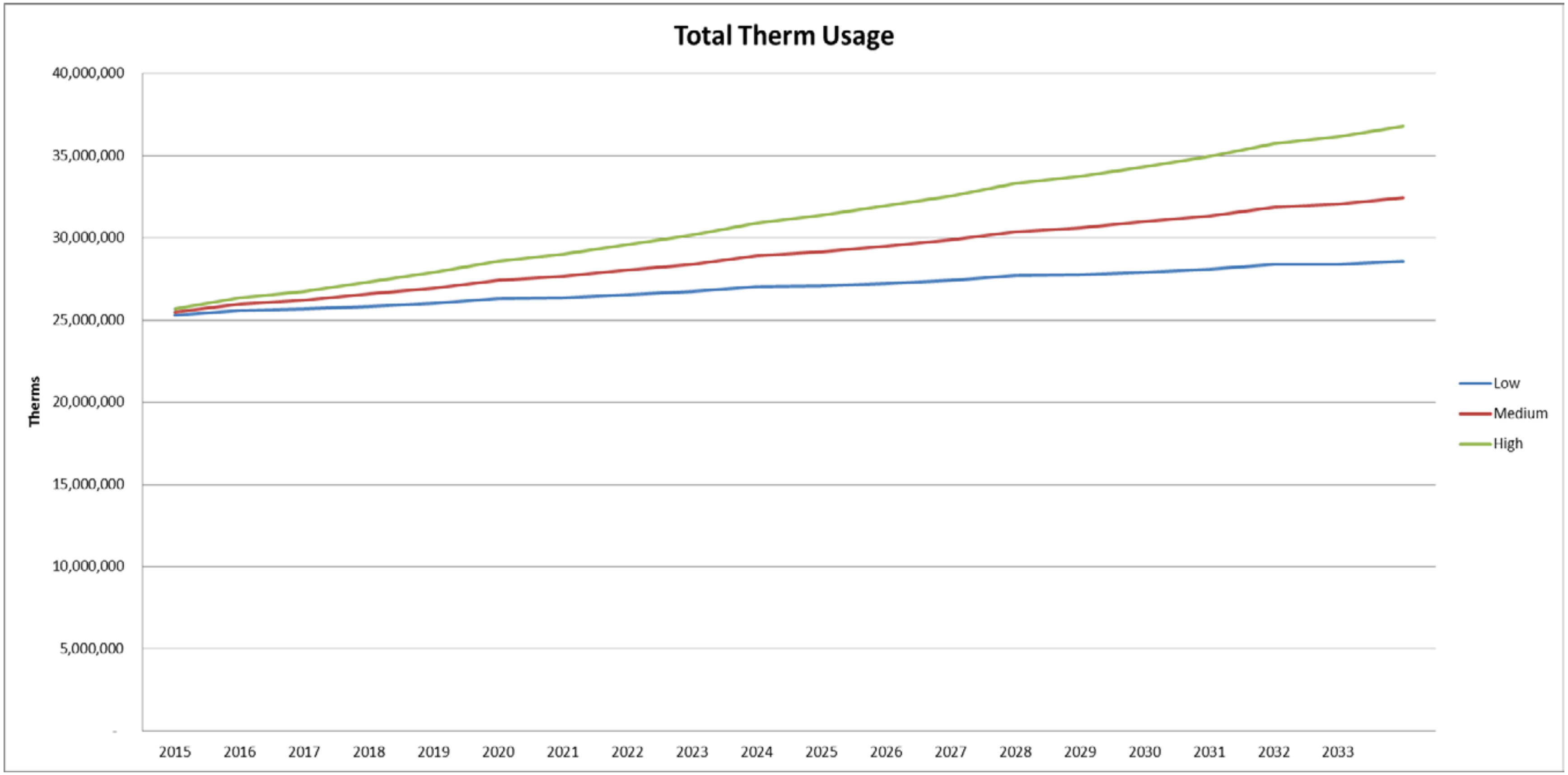
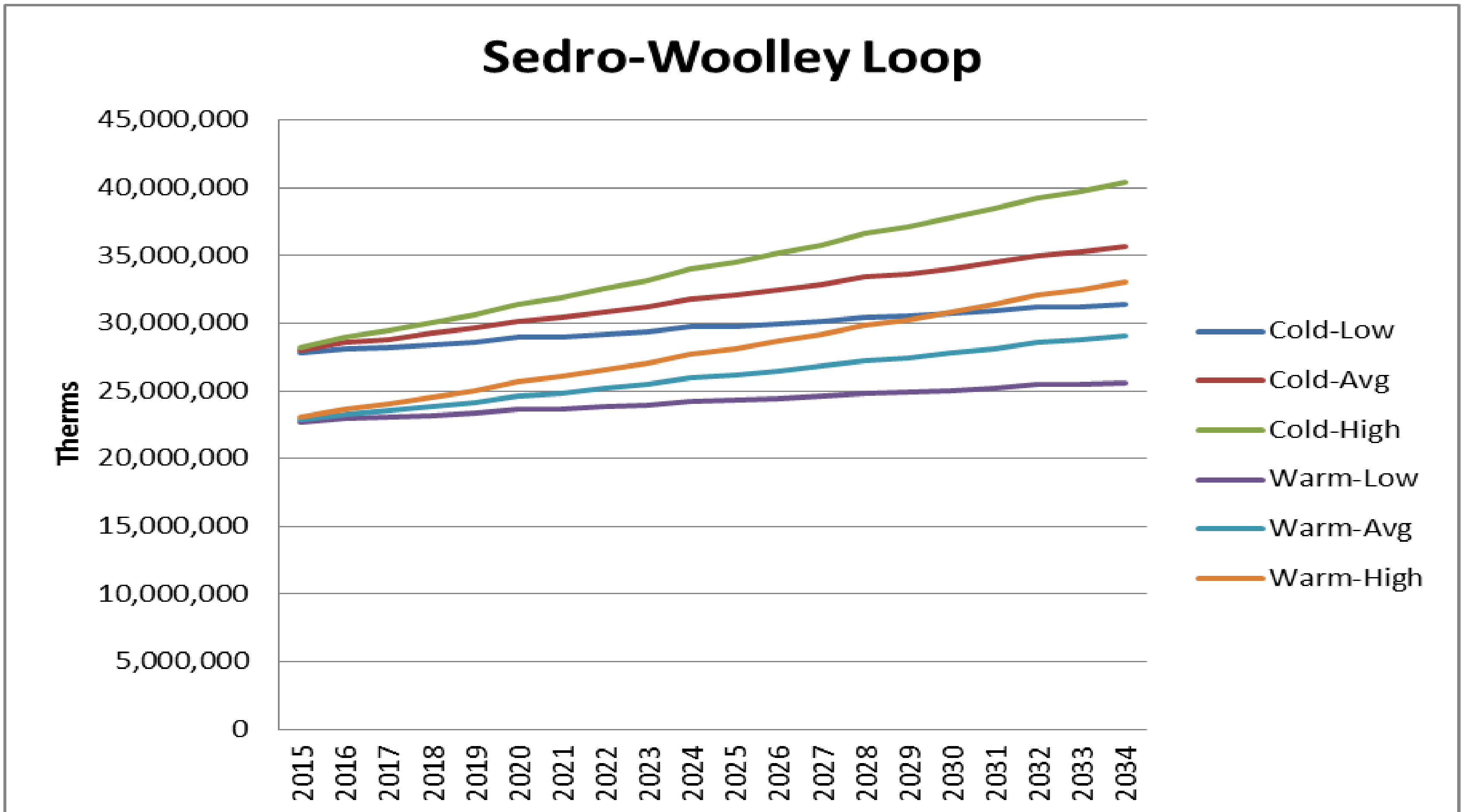
Sedro-Woolley Loop With Average Weather



Sedro-Woolley Loop with High and Low Weather Scenarios



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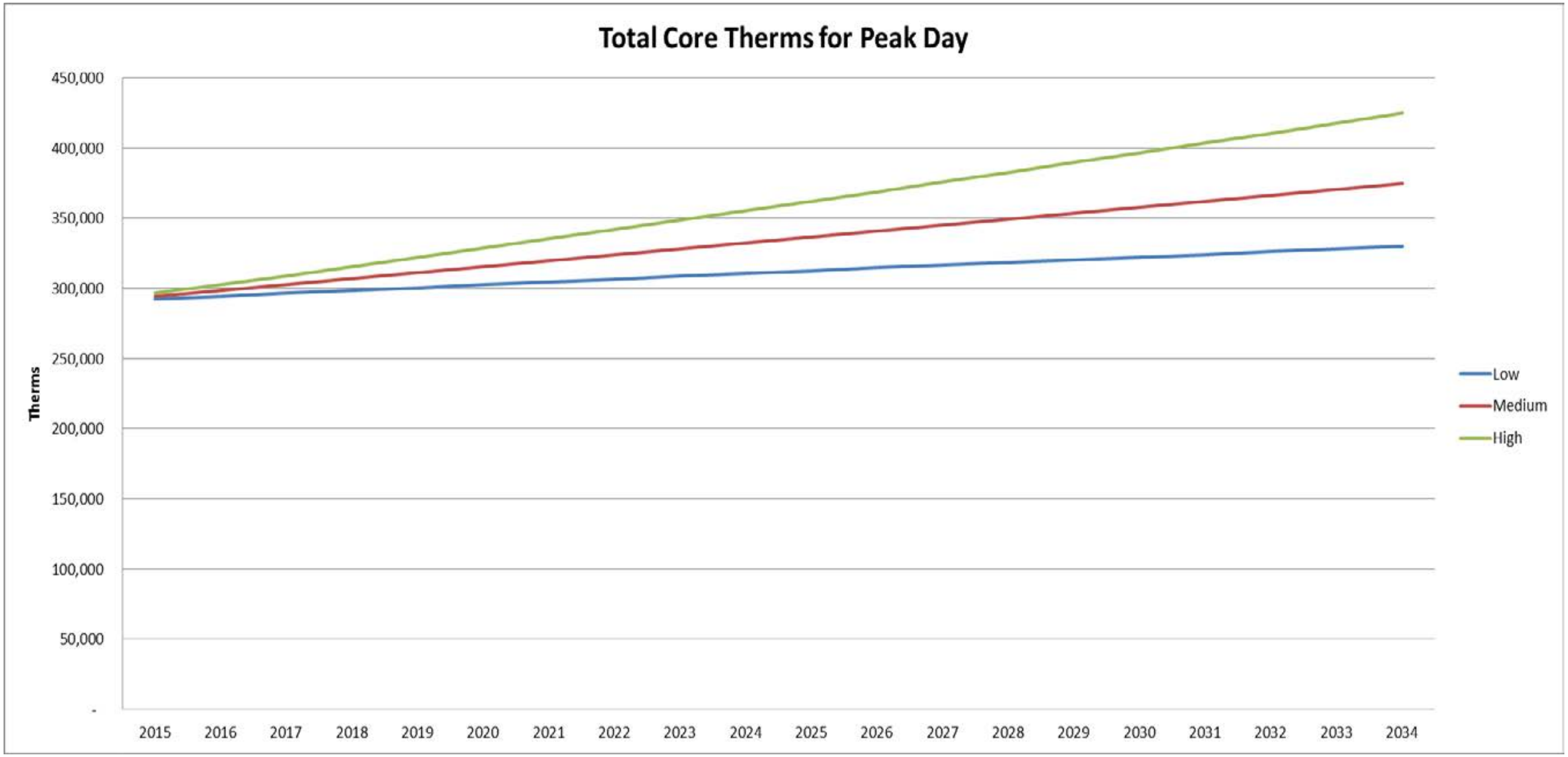
Sedro-Woolley Loop Peak Day



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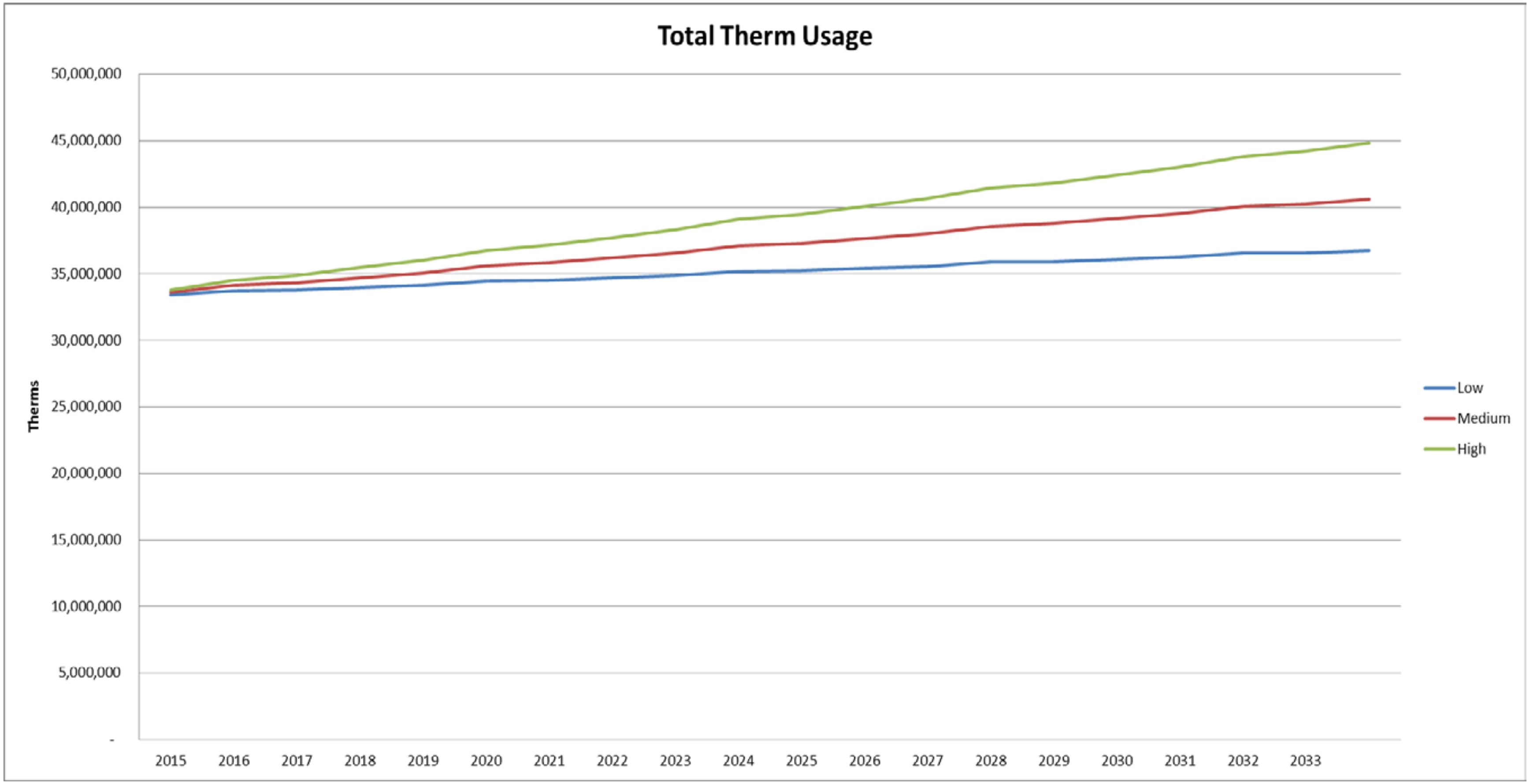
Bremerton (Shelton) With Average Weather



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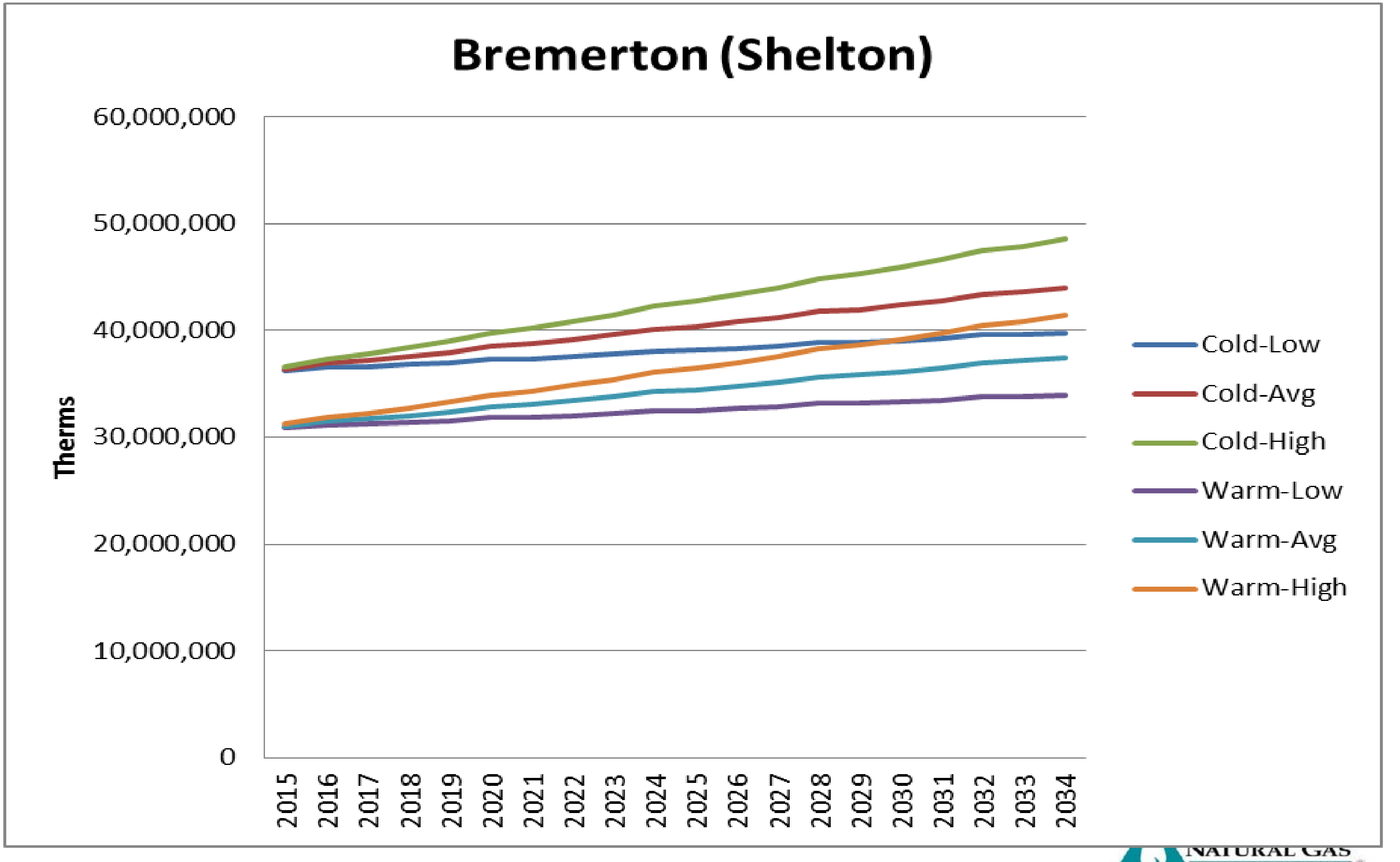
Bremerton (Shelton) with High and Low Weather Scenarios



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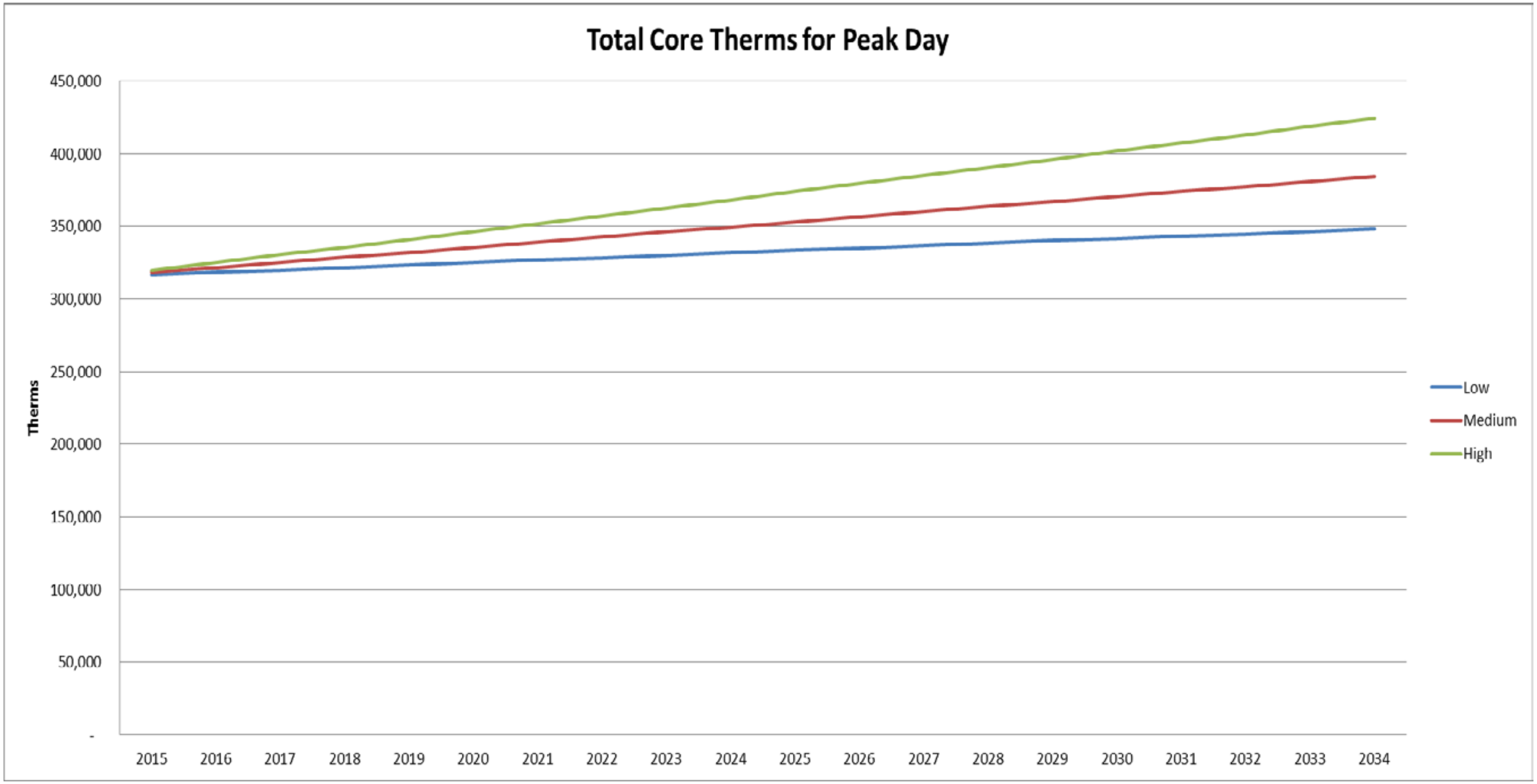
Bremerton (Shelton) Peak Day



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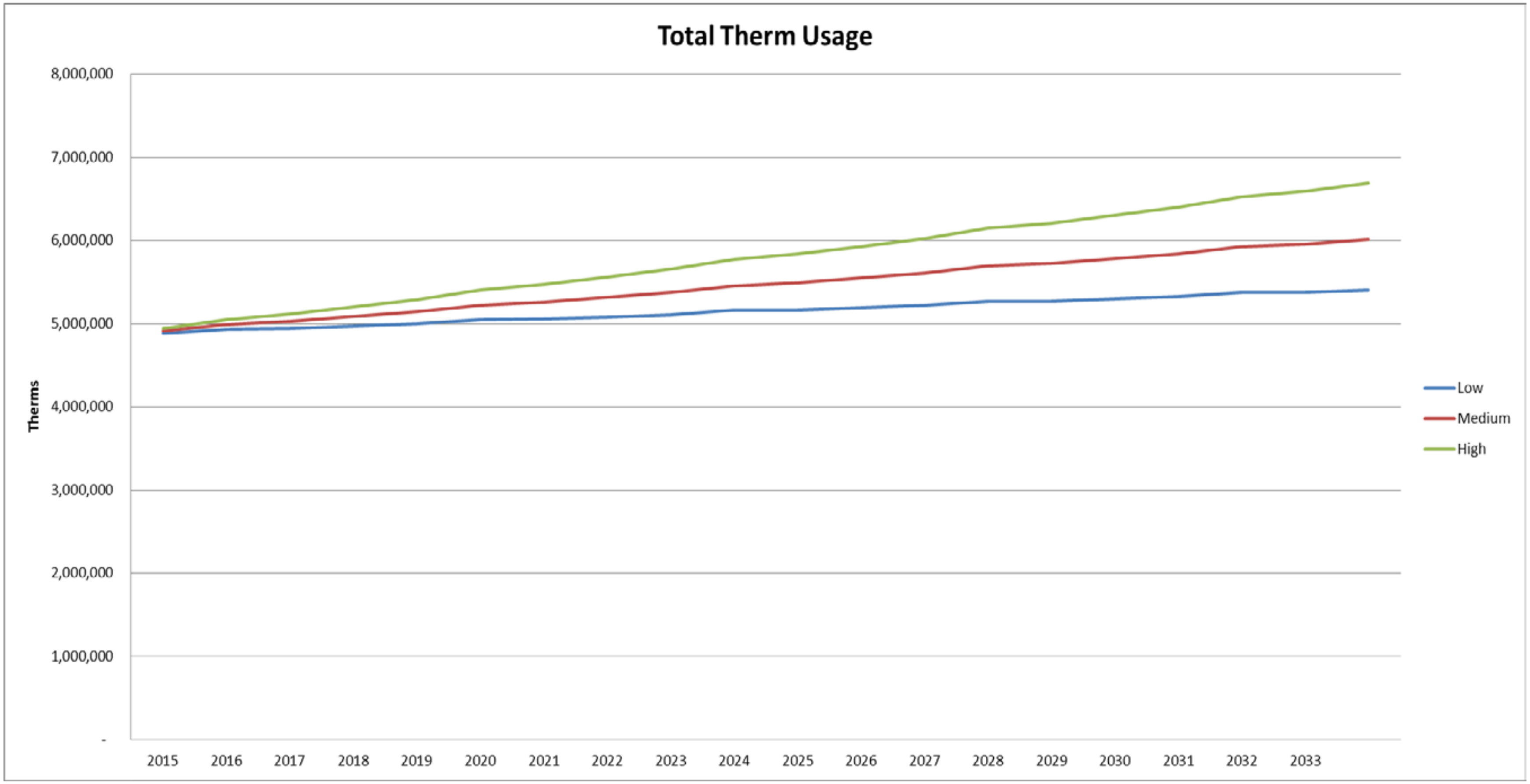
Wenatchee With Average Weather



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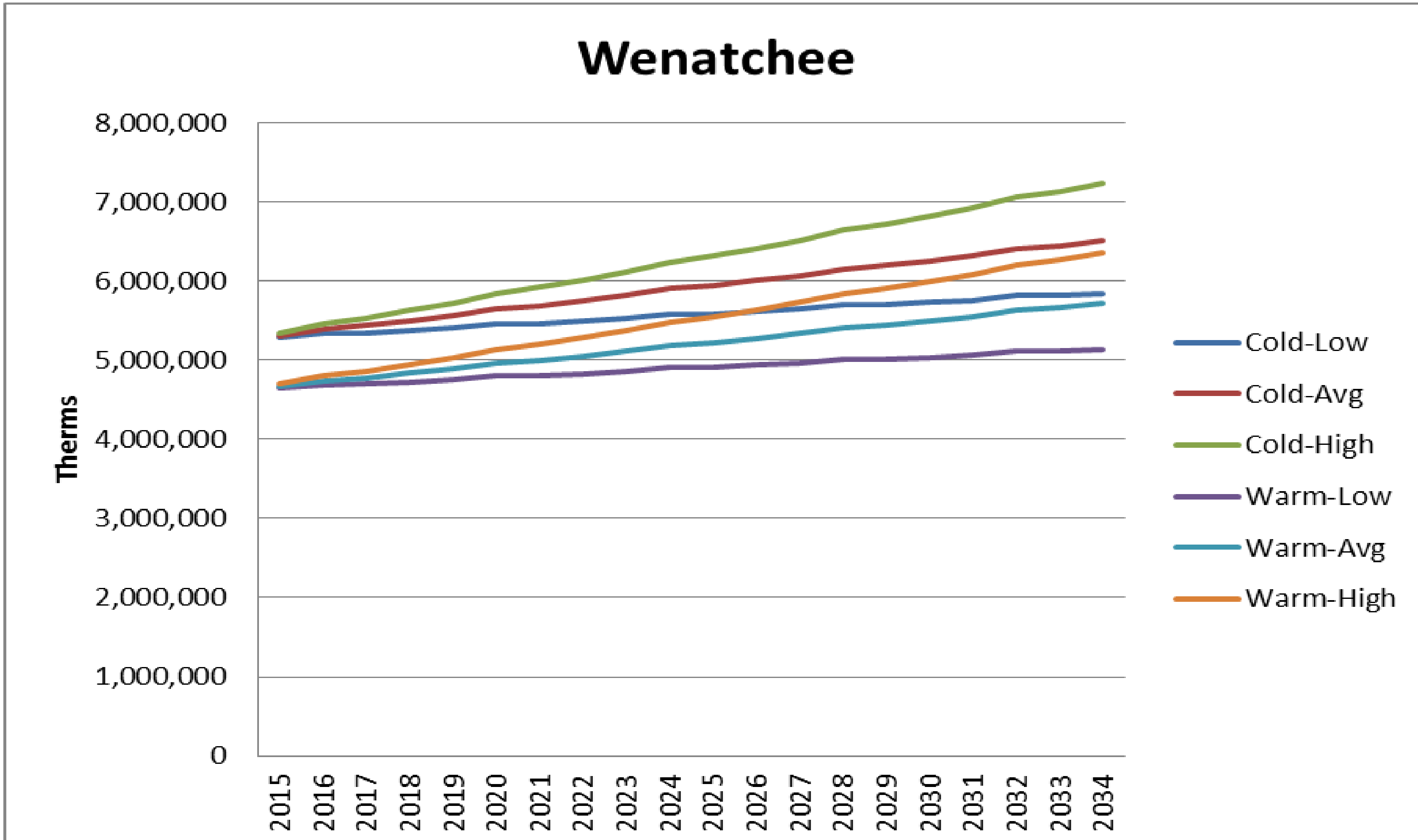
Wenatchee with High and Low Weather Scenarios



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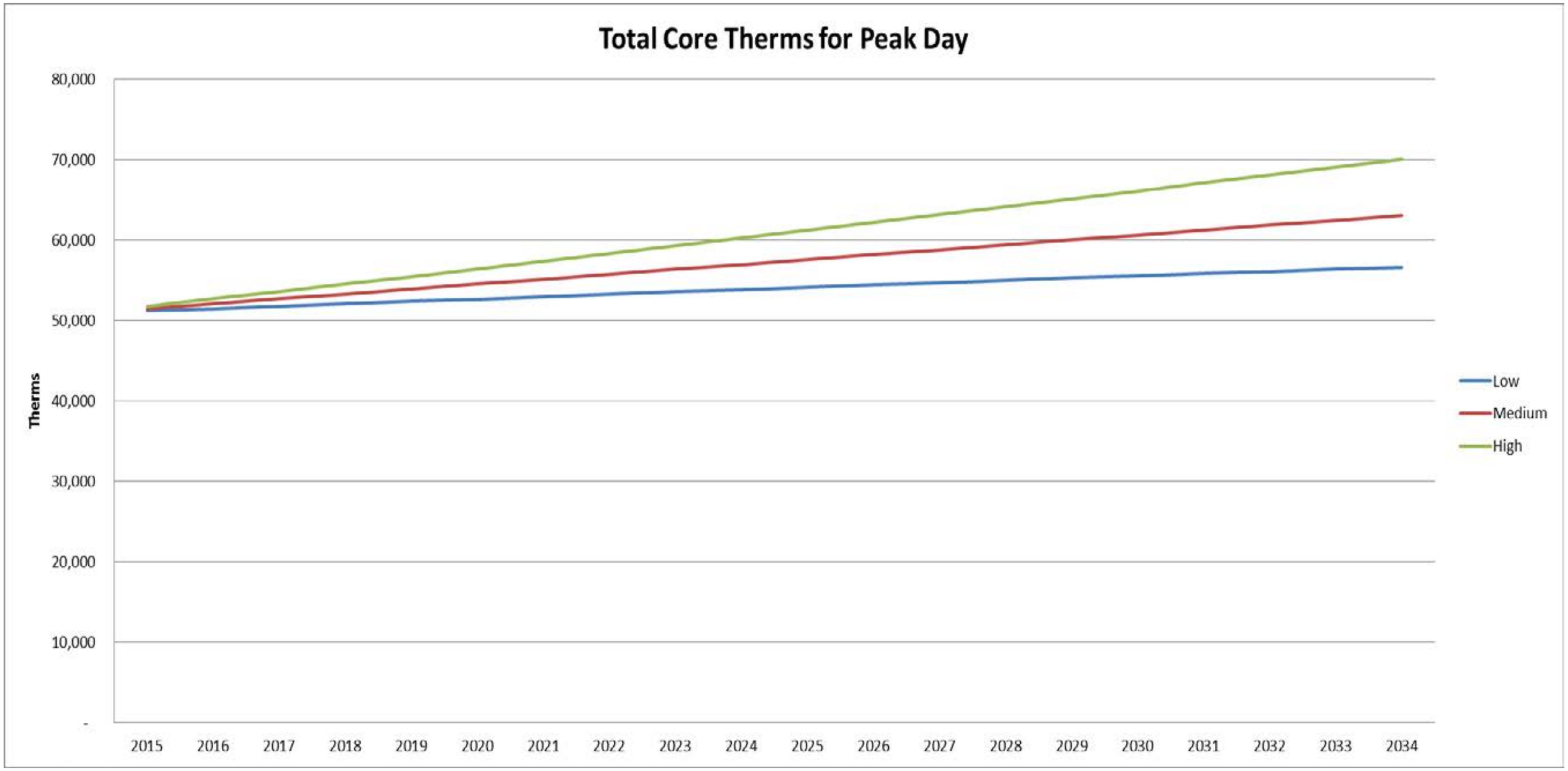
Wenatchee Peak Day



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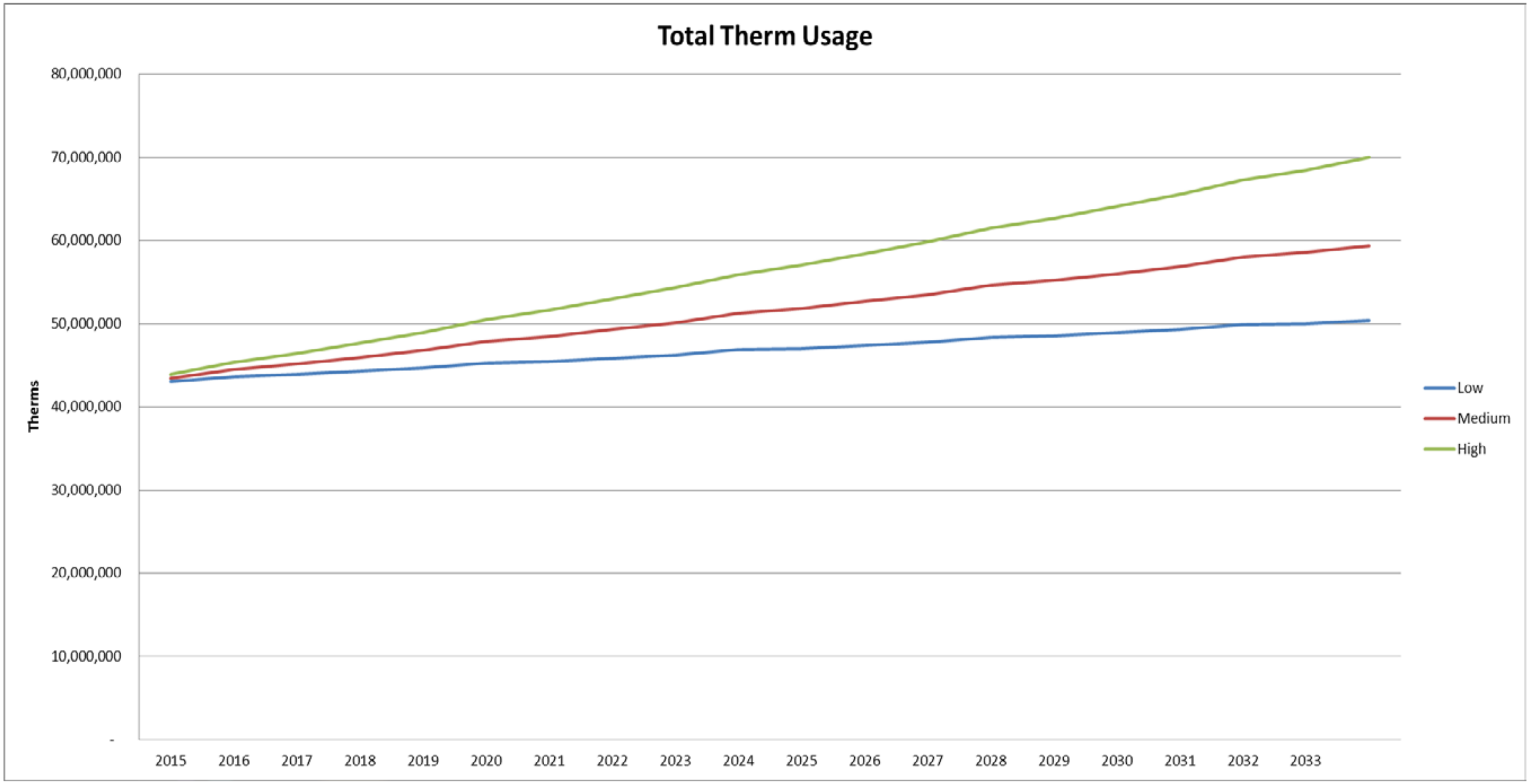
Sumas SPE Loop With Average Weather



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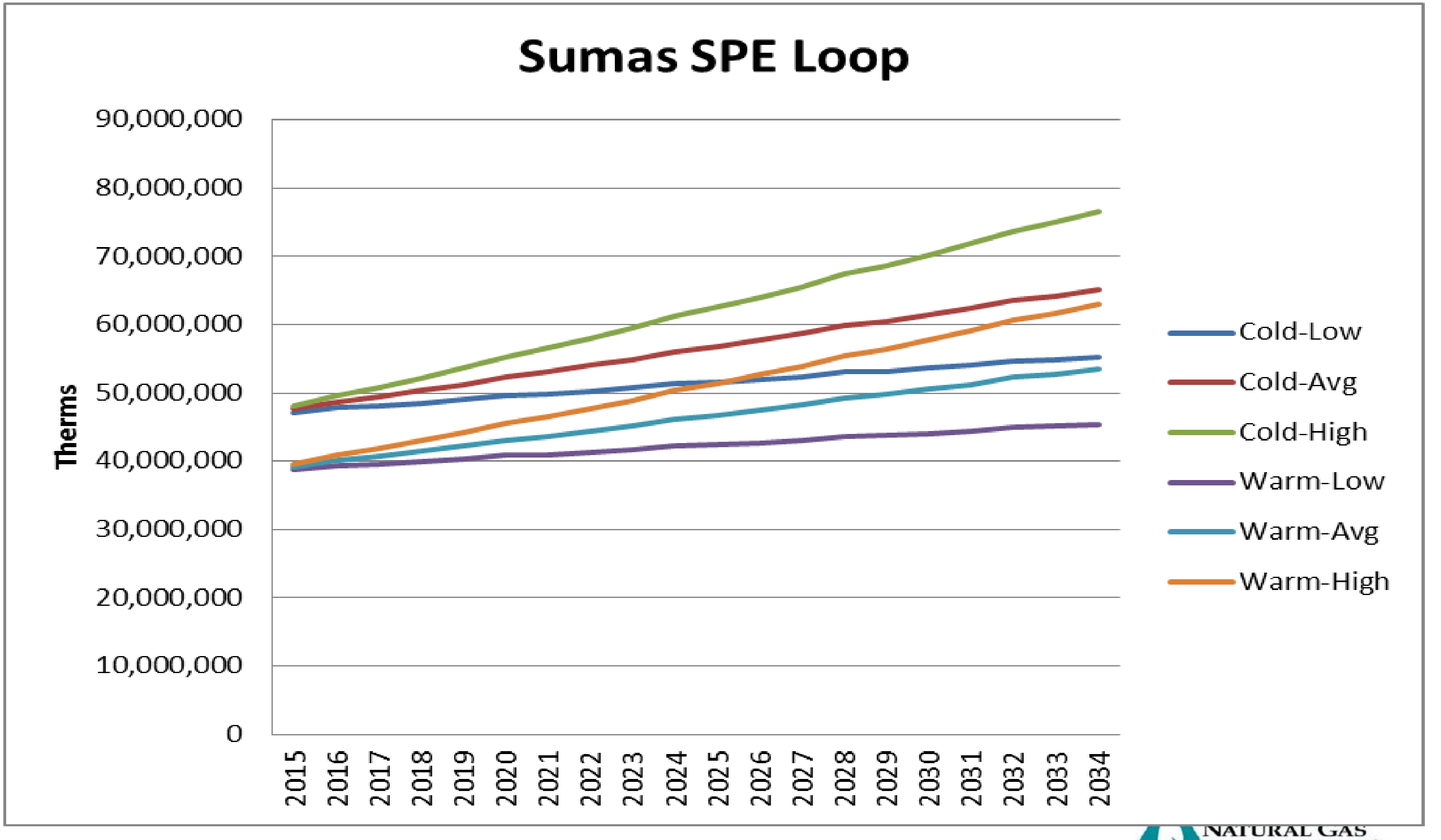
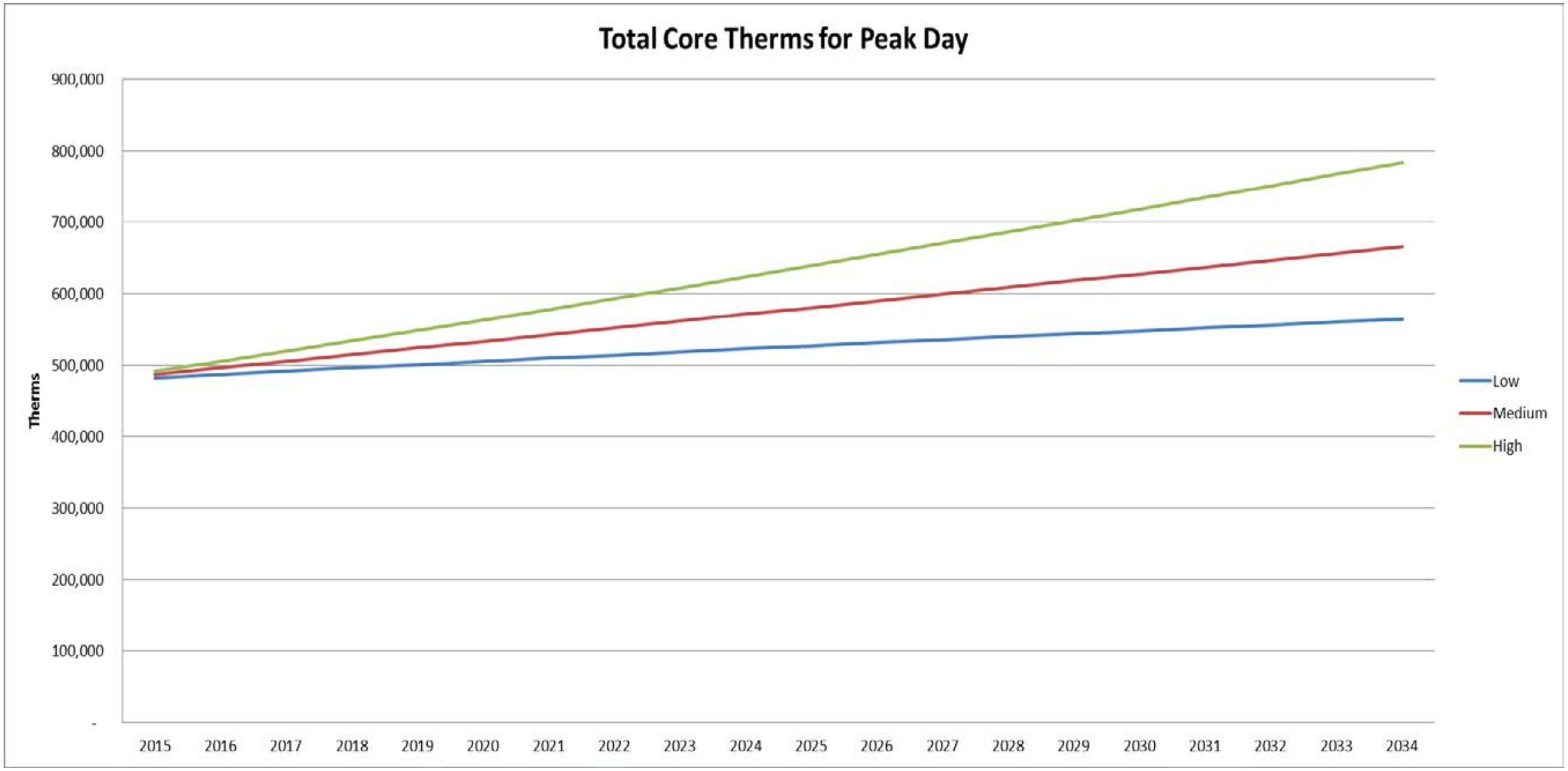
Sumas SPE Loop with High and Low Weather Scenarios



Sumas SPE Loop Peak Day



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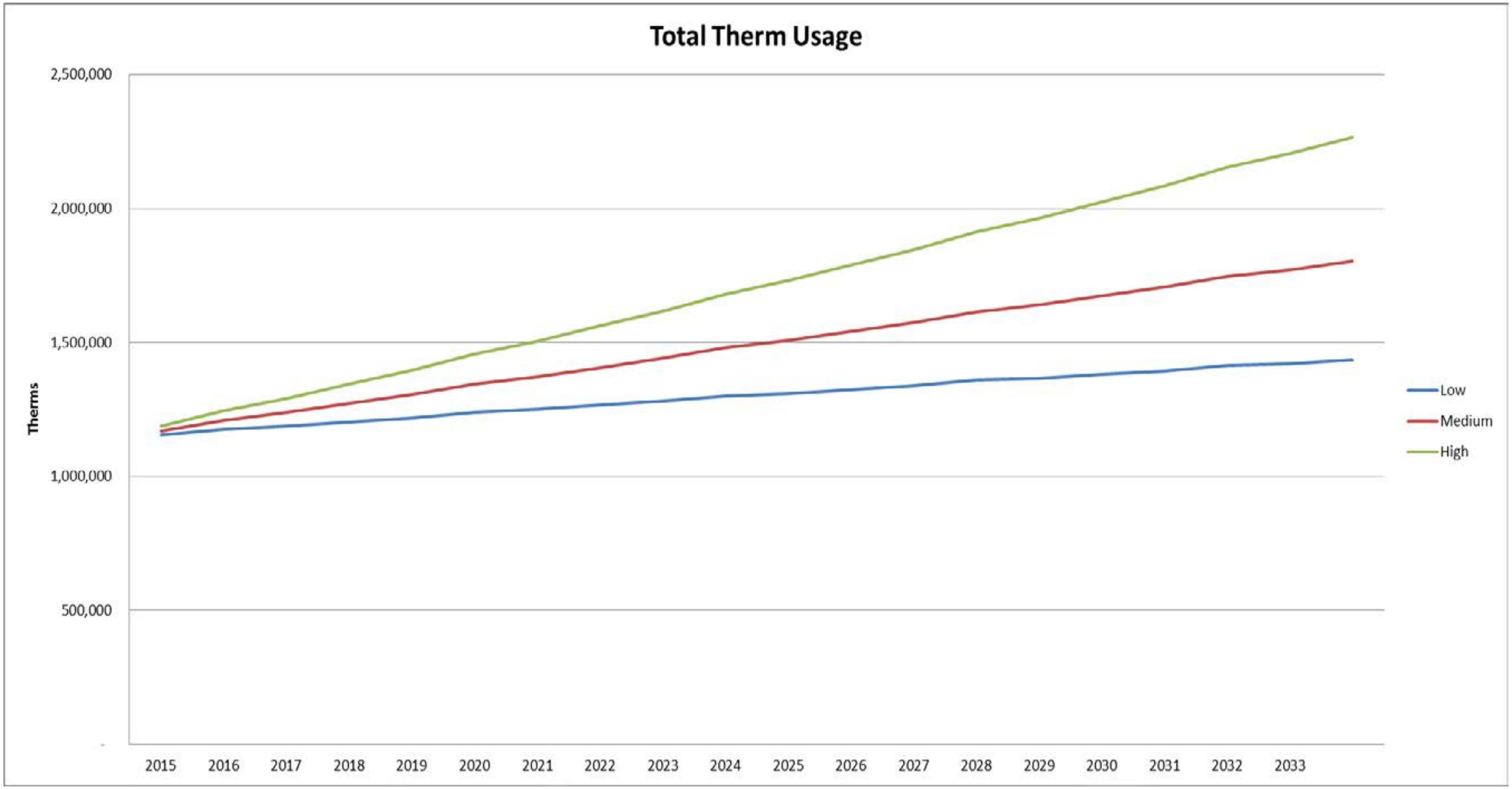
Woodland With Average Weather



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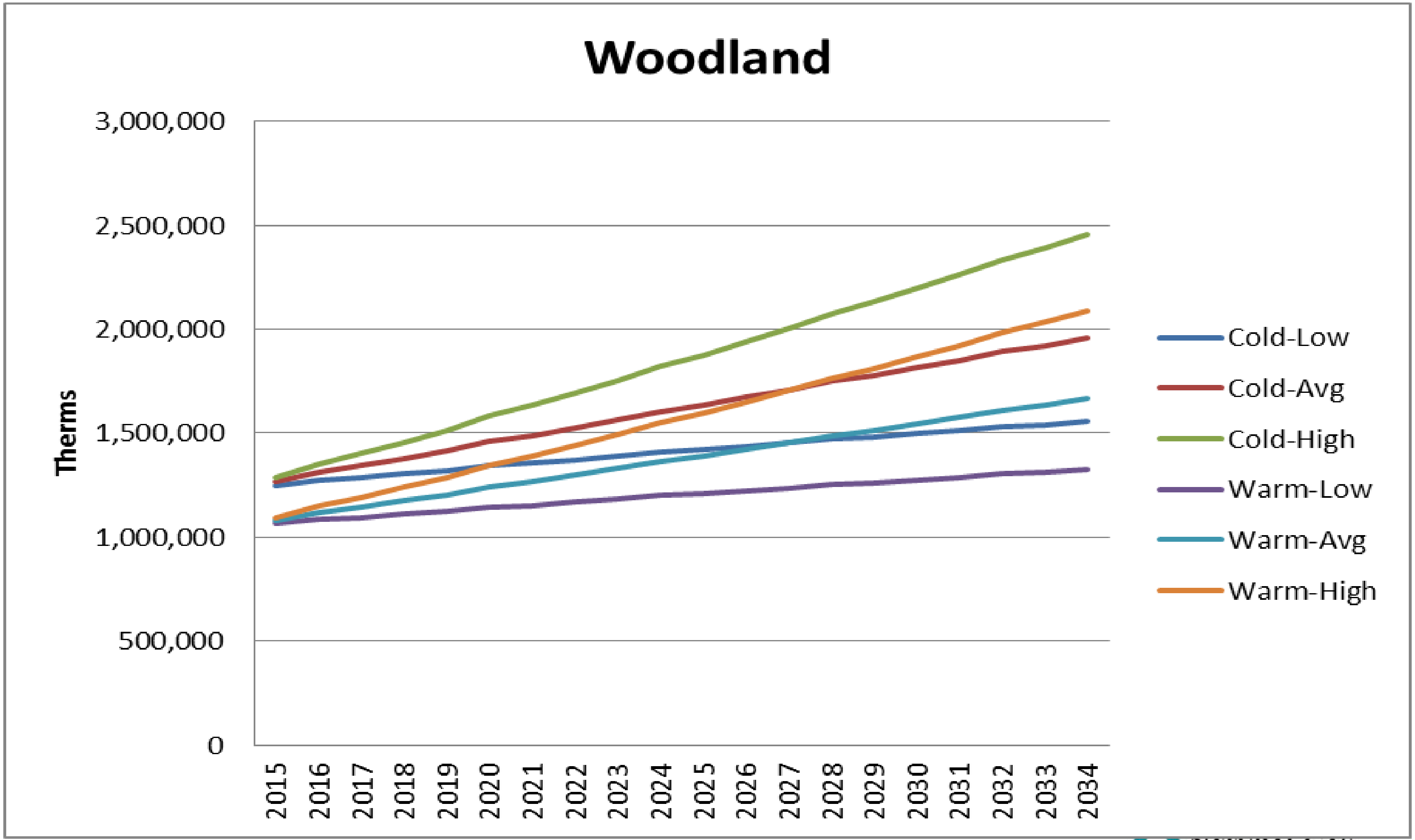
Woodland with High and Low Weather Scenarios



NATURAL GAS CORPORATION

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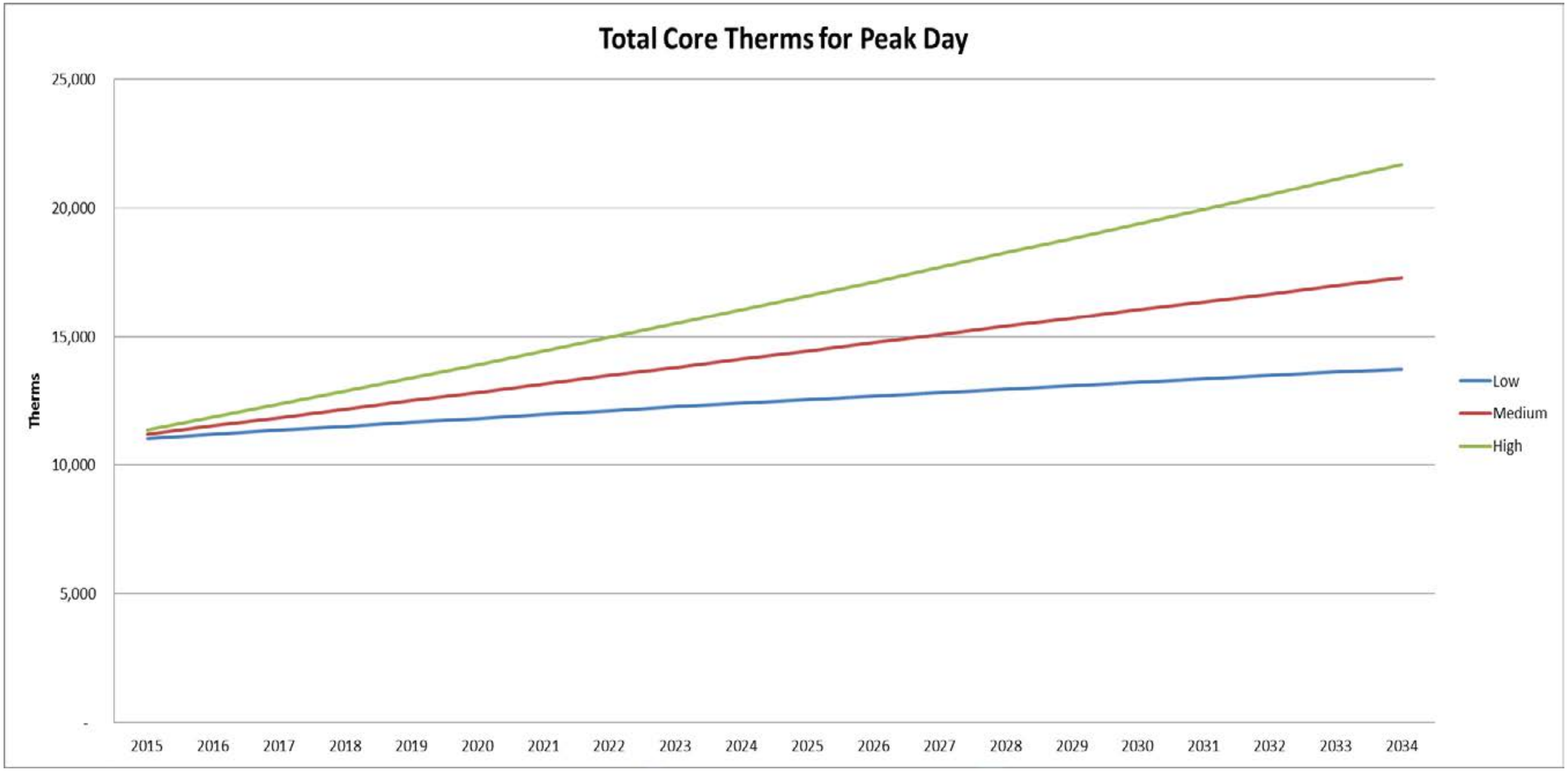
Woodland Peak Day



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Average HDD by month for each Weather Station (30 year history)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Baker City	33.80	29.22	20.94	14.89	8.19	3.11	0.32	0.49	4.19	14.13	25.48	33.84
Bellingham	20.18	18.50	15.18	10.83	5.87	2.09	0.36	0.28	2.67	9.32	16.20	21.07
Bremerton	20.34	19.20	15.67	11.91	6.59	2.74	0.49	0.37	2.39	9.29	16.99	21.51
Pendleton	25.06	21.76	14.98	9.58	4.28	0.87	0.03	0.04	1.20	8.51	18.83	26.61
Redmond	25.92	24.14	19.04	14.69	8.65	3.47	0.52	0.60	3.84	11.89	21.15	27.82
Walla Walla	24.03	20.49	12.98	7.52	2.92	0.45	0.00	0.02	0.63	6.72	17.51	25.76
Yakima	28.61	23.51	16.44	10.27	4.21	0.98	0.08	0.10	1.89	10.52	21.97	30.68

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Cold Scenario HDD by month for each Weather Station (6 years out of 30 year history)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Baker City	36.24	30.24	23.77	16.04	8.92	3.24	0.17	0.38	4.84	14.96	27.82	35.67
Bellingham	22.88	19.93	16.88	12.11	7.09	2.38	0.41	0.46	2.87	9.99	18.63	24.24
Bremerton	22.74	20.18	17.80	13.62	7.57	3.12	0.57	0.57	2.95	10.30	19.04	23.35
Pendleton	27.12	23.17	17.23	10.23	4.63	0.86	0.00	0.03	1.76	9.86	21.85	30.96
Redmond	27.76	25.47	21.59	15.46	9.74	3.41	0.56	0.75	4.56	13.15	23.24	29.93
Walla Walla	25.85	22.41	14.92	7.94	2.97	0.41	0.00	0.01	0.91	7.59	20.30	30.02
Yakima	31.04	25.64	18.38	11.60	4.78	0.73	0.09	0.07	2.64	11.57	25.63	35.24

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Warm Scenario HDD by month for each Weather Station (6 years out of 30 year history)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Baker City	30.77	25.32	19.09	12.10	6.31	2.55	0.24	0.47	2.87	12.27	24.58	33.39
Bellingham	17.95	16.24	12.98	8.97	4.13	1.32	0.23	0.22	2.01	8.01	14.19	20.32
Bremerton	18.81	17.14	13.79	9.68	4.82	2.08	0.31	0.37	1.84	7.92	15.94	21.48
Pendleton	23.83	19.24	13.58	8.09	3.37	0.95	0.06	0.05	0.73	7.12	16.54	25.51
Redmond	23.78	20.92	17.59	12.40	7.52	3.04	0.44	0.65	2.75	9.91	19.92	27.75
Walla Walla	22.33	17.60	11.39	5.75	2.06	0.46	0.02	0.04	0.33	5.60	15.12	24.50
Yakima	27.58	21.29	15.28	8.78	3.07	1.00	0.03	0.10	1.51	9.57	19.95	30.09

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Cascade Natural Gas Technical Advisory Group Meeting #2
Portland International Airport in Portland, OR
January 13, 2015 9:00 AM – 10:30 PM

Attachments:
Attachment A – Technical Advisory Group Meeting 2 PowerPoint slides
Attachment B – Attendance sheet

I.) **Introduction** – Micah Robinson began the meeting by presenting the agenda from the PowerPoint presentation.

- The PowerPoint presentation consisted of a review of the forecast methodology along with some forecast result graphs.
- The key points pointed out in the methodology were:
    - Demand Data
    - Weather Data
    - Regression Analysis
    - Weather Scenarios
    - Growth Scenarios
    - Peak Scenarios
    - Summary

II.) **Demand Forecast Results** – Micah Robinson then discussed the demand forecast results.

- A total system, Washington, and Oregon graph was presented which showed the annual therm usage and peak day comparison to past IRPs.
- The next graphs that were presented were Washington and Oregon and their tariff breakdowns.
- The next graphs were annual therms by zone compared to past IRPs.
- A handful of CityGates were selected to show the 9 permutations of weather and growth scenarios as well as a peak day scenario.
- Finally, the HDDs were given for each weather location for the low, average, and high scenarios.

III.) **Action Items** – The stakeholders asked many questions and left Cascade with very helpful action items.

- Show which gates are using the EIA efficiency factor and give the growth rates for each CityGate.
- Modify Slides to say 80% rather than 70%.
- Show the percentage change in the 20 years for each forecast.
- Provide a list with the graphs that show what is included. Ex. Walla Walla and Umatilla for Zone ME-WA.
- Tariff breakdown by zone and a comparison to previous IRPs.
- HDD percentage change from average for the high and low scenarios.
- Provide growth rates with each CityGate.

IV.) **Adjourn** – Cascade Natural Gas will hold TAG 3 on February 19, 2015 at the Portland International Airport Conference Center.

Attendance:

Presenters:
Micah Robinson
Mark Sellers-Vaughn
Brian Robertson

Attendees:
Monica Cowlisha
Mike Parvinen
Jon Whiting
Juliana Williams
Lisa Gorsuch
Nadine Hanhan
Dave Lenar
Ted Light

Call-in attendees:
John Klingele
Tommy Brookes
Kary Burin
Amanda Sargent

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Washington Demand Side Management

Presented by Monica Cowlishaw
Manager, Energy Efficiency and Community Outreach

Agenda:

- **Intro**
- Model Comparison
- Process
- Results
- Key Updates
- Final Steps

Introduction

- **Objective:**
  - Acquire cost-effective demand side resources that fit within Cascade's integrated resource plan's projected resource requirements.

- **Conservation Incentive Program Management (CIP):**
  - Residential - Electric and Gas Industry Assoc. (EGIA)
  - Commercial/Industrial – Lockheed Martin (LM)

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Agenda:

- ✓ Intro
- ➢ **Model Comparison**
- ❑ Process
- ❑ Results
- ❑ Key Updates
- ❑ Final Steps

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Model Comparison

Past: Stellar/Ecotope	Present: Nexant – TEAPOT*

- Program planning basis
- High level
- Oregon based
- Alterations in 2009 to WA
- Internal updates required

- Washington focused
- Based on Cascade territory
- Provided EM&V
- UCT and TRC** per UG-121207
- Expert review of technologies
- Easier to tie program design and potential assessment

***TEAPOT** = Technical, Economic, Achievable, Potential
**** UCT** = Utility Cost Test; **TRC** = Total Resource Cost test

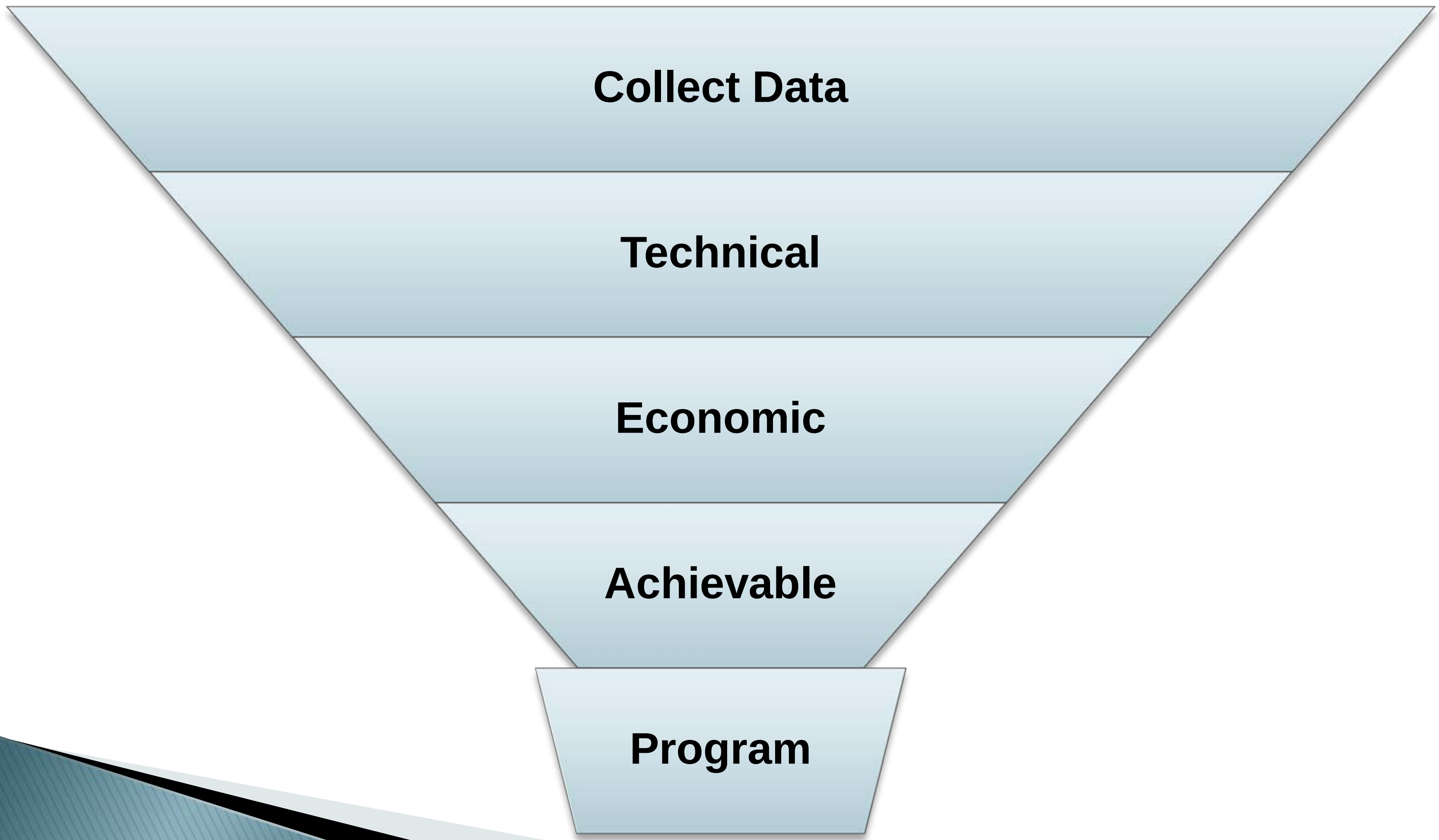
Nexant Potential Study

- Provide credible and transparent estimation of the technical and achievable energy efficiency potential by year over the next 21 (2014-2034) years within Cascade's Washington service territory;
- Assess and validate therm savings associated with key measures that qualified for, and received, a conservation incentive in the 2012 program year, and apply findings to determine realistic therm savings potential in Cascade's Washington Service area;
- Provide a user friendly, executable dynamic model that will support the potential assessment and allow for sensitivity testing of all model inputs and assumptions;
- Develop a final report including summary data tables and graphs reporting incremental and cumulative potential by year from 2014 through 2034.

Agenda:

- ✓ Intro
- ✓ Model Comparison
- ➢ **Process**
- ❑ Results
- ❑ Key Updates
- ❑ Final Steps

Process



Process

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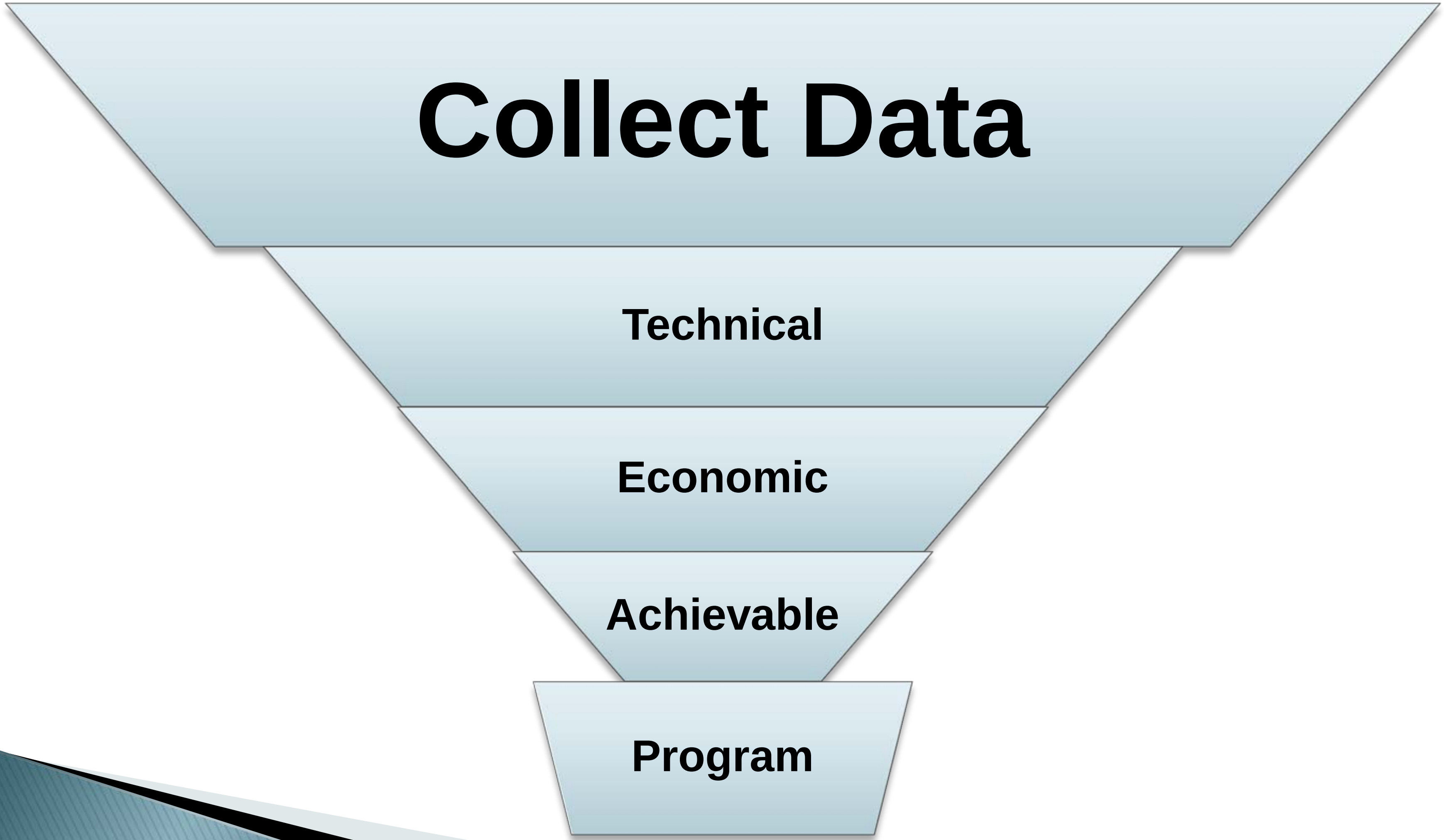

Collect Input Data

- ✓ Residential, Commercial, and Industrial 20 Year Volume and Customer Forecasts
- ✓ Updated Avoided Costs
- ✓ Long-term Discount Rate and/or Weighted Average Cost of Capital (WACC)
- ✓ Inflation Rate used by all sections of IRP
- ❑ Load Profile – waiting to incorporate

Develop Portfolio of Potential Future Measure Offerings

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- Nexant research/industry best practices
- Lockheed Martin experience/input
- On the ground program experience

from CNGC

Process

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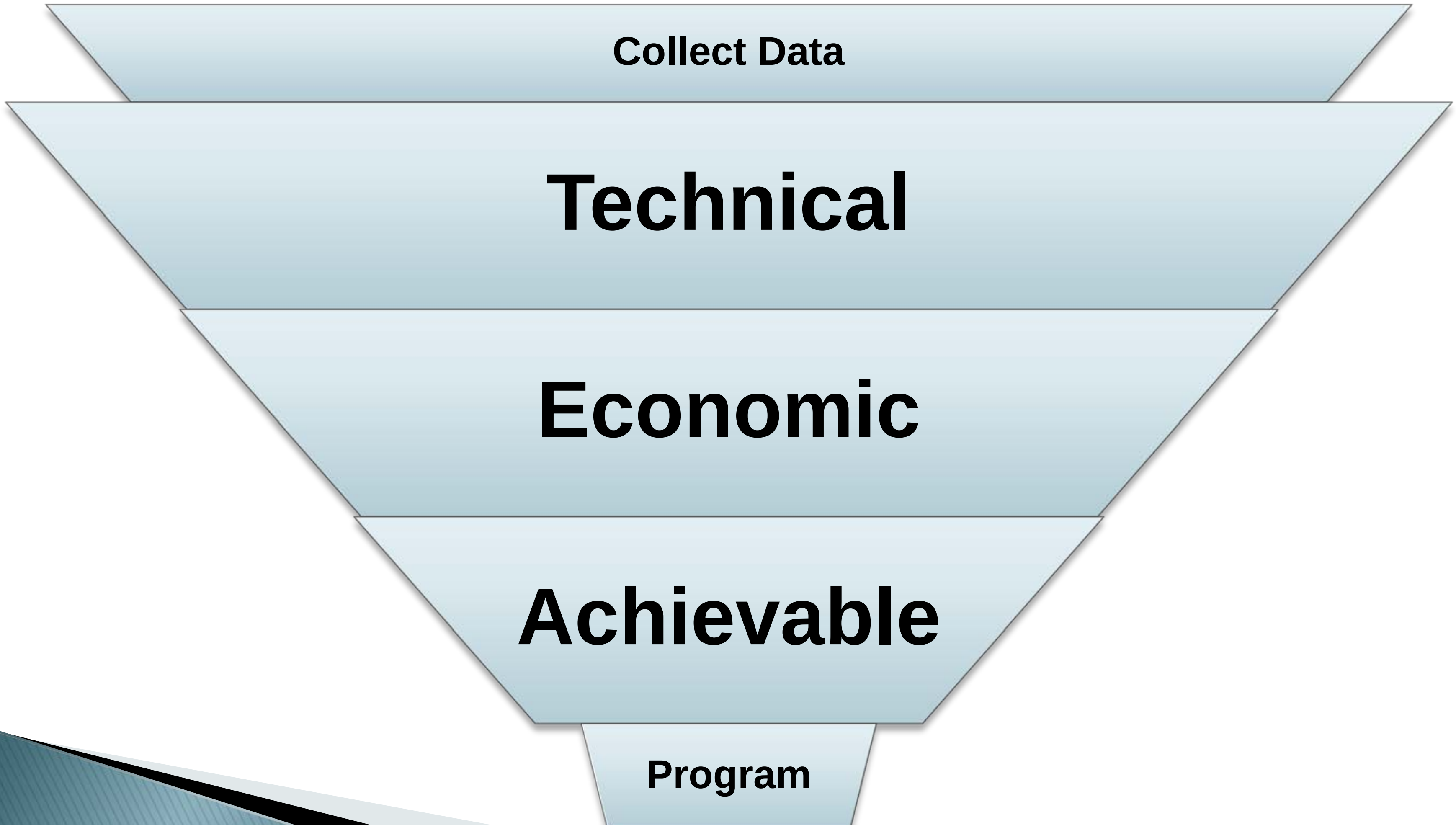

Technical Potential

- Represents substitution of all *technically* feasible measures at the end use level.

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Economic Potential

- Considers the most efficient measures that pass *economic* screening tests.

Achievable Potential

- Embodies a set of assumptions about the decisions consumers make regarding the efficiency of the equipment they purchase to simulate a *realistic estimate* of real-life conditions.

TEAPOT Model

- Ran model separately for Residential, Commercial, & Industrial forecasts under the Utility Cost Test (UCT).
- Combined Commercial & Industrial forecasts.
- Combined Commercial & Industrial forecast with the Residential forecast to reach Total CIP TEAPOT.
- Assumed current program incentive offerings for the first two years, followed by all potential measures reviewed by Nexant for years 2017 to 2034.
- Set long-term discount rate to 4.17%.

Residential TEAPOT

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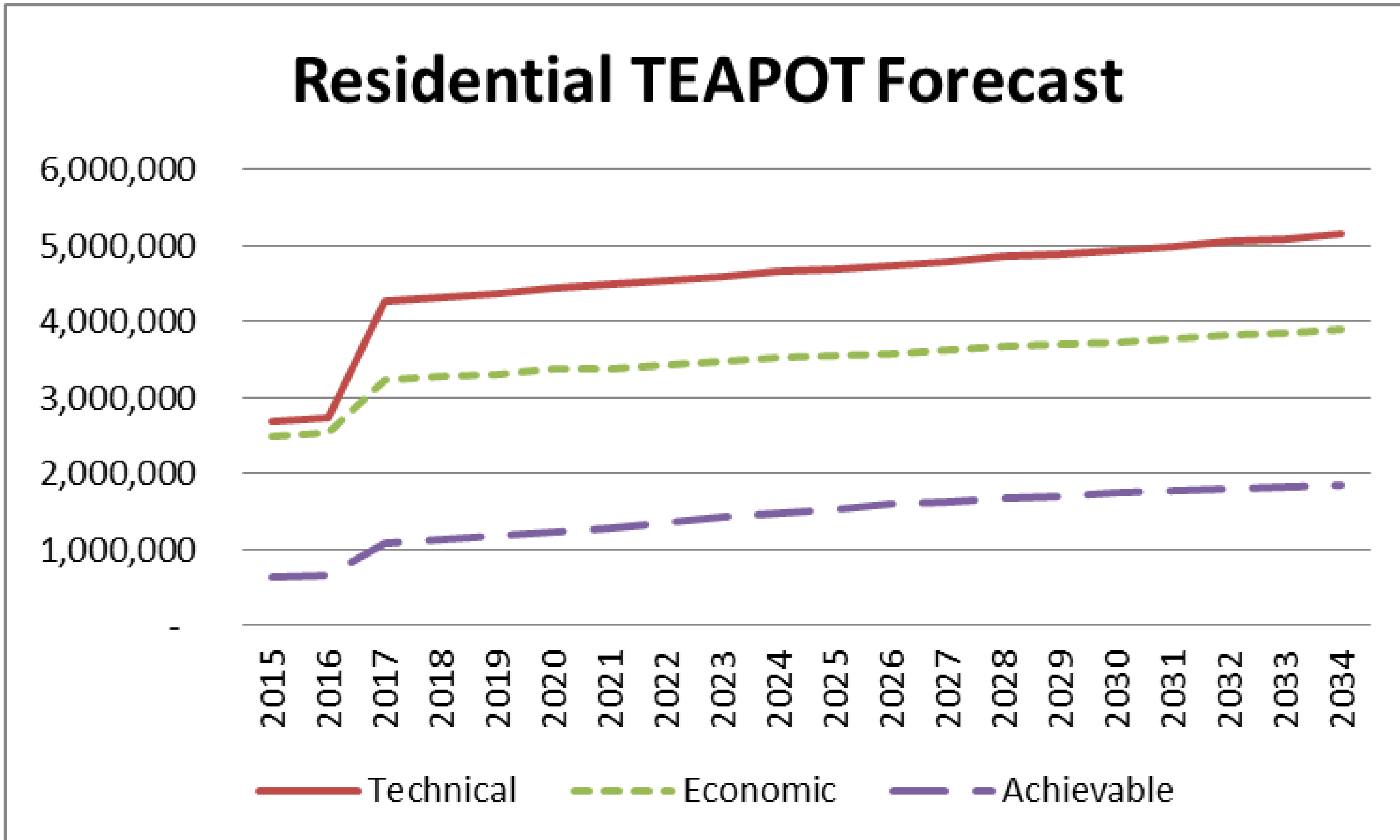

Commercial & Industrial TEAPOT

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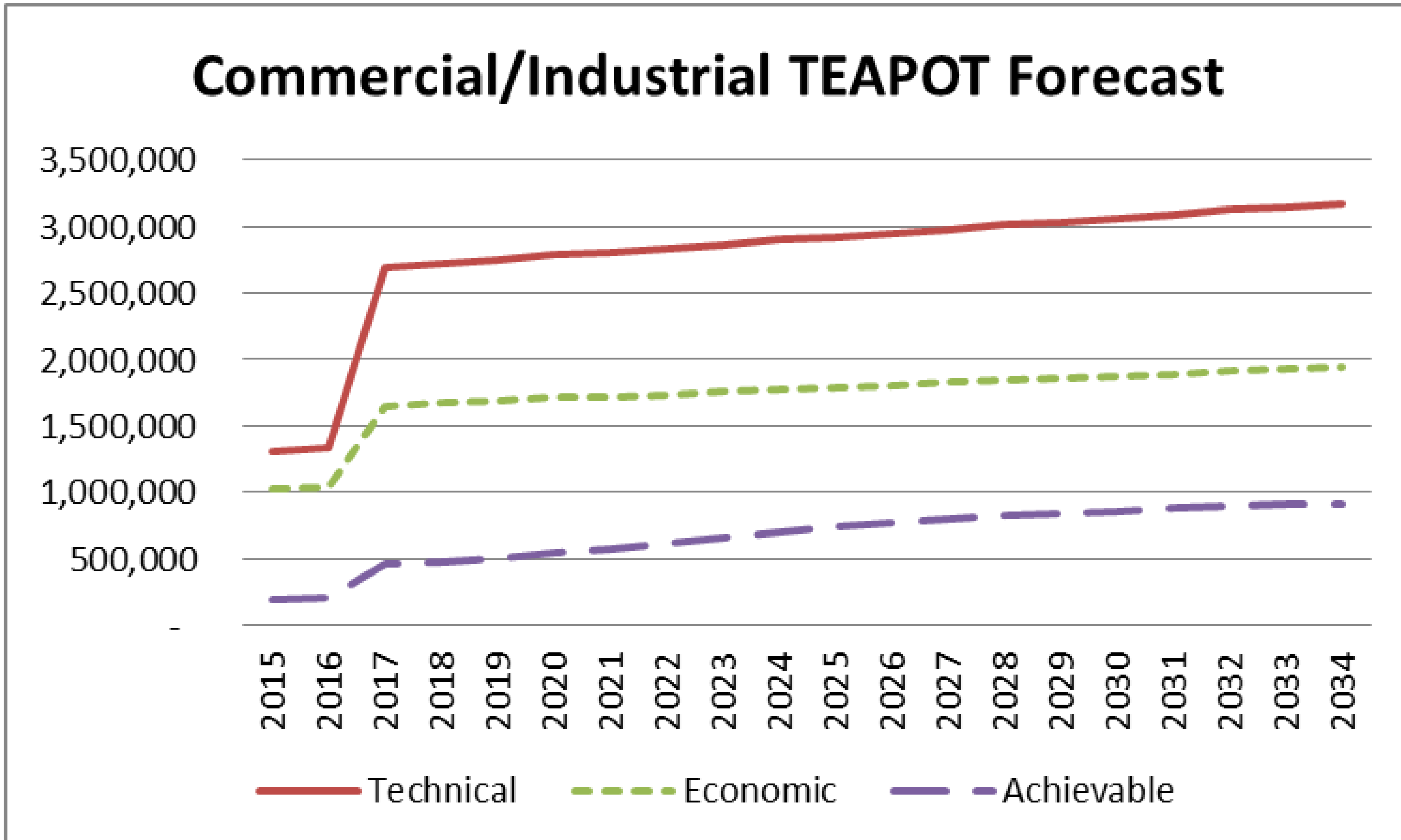
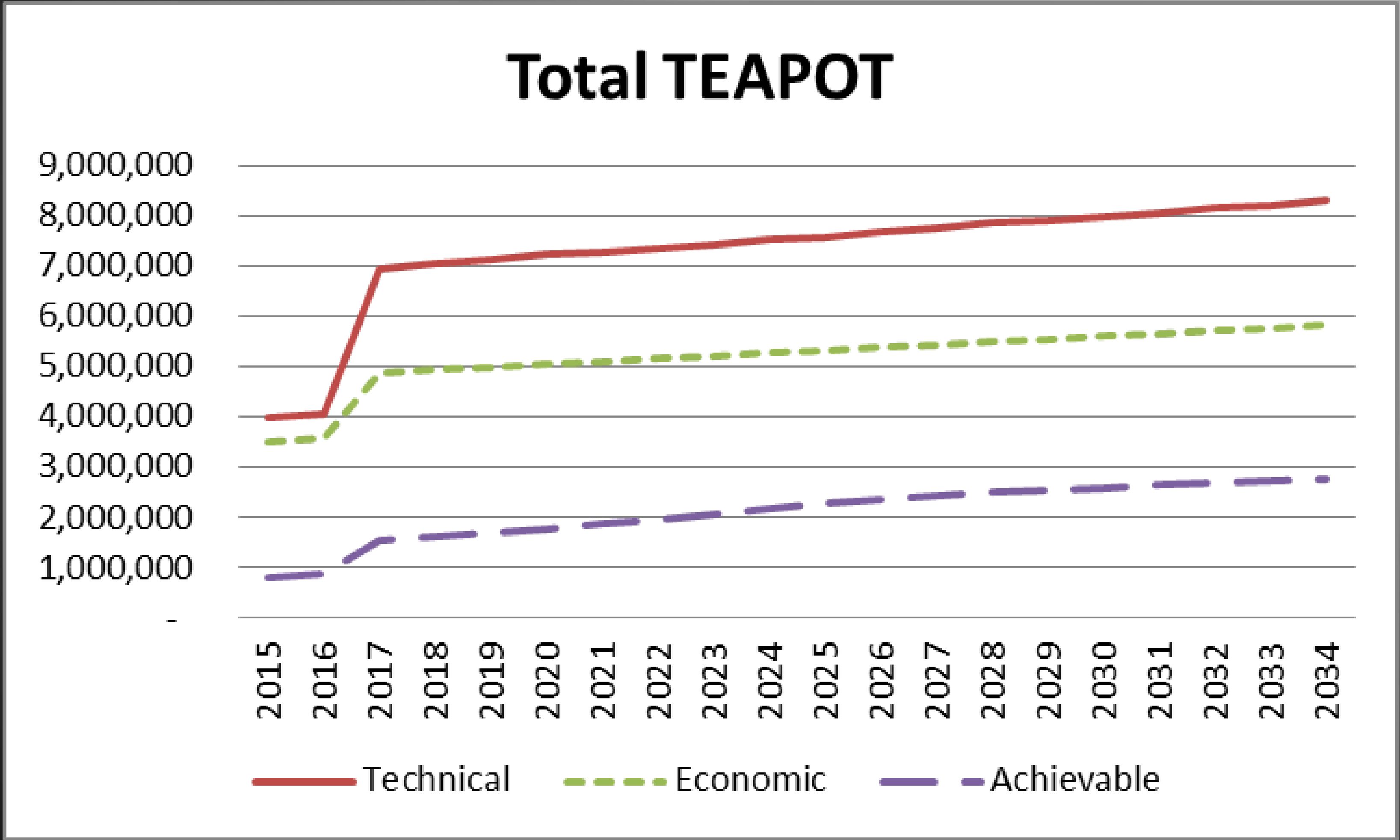


Total CIP TEAPOT Forecast



Process

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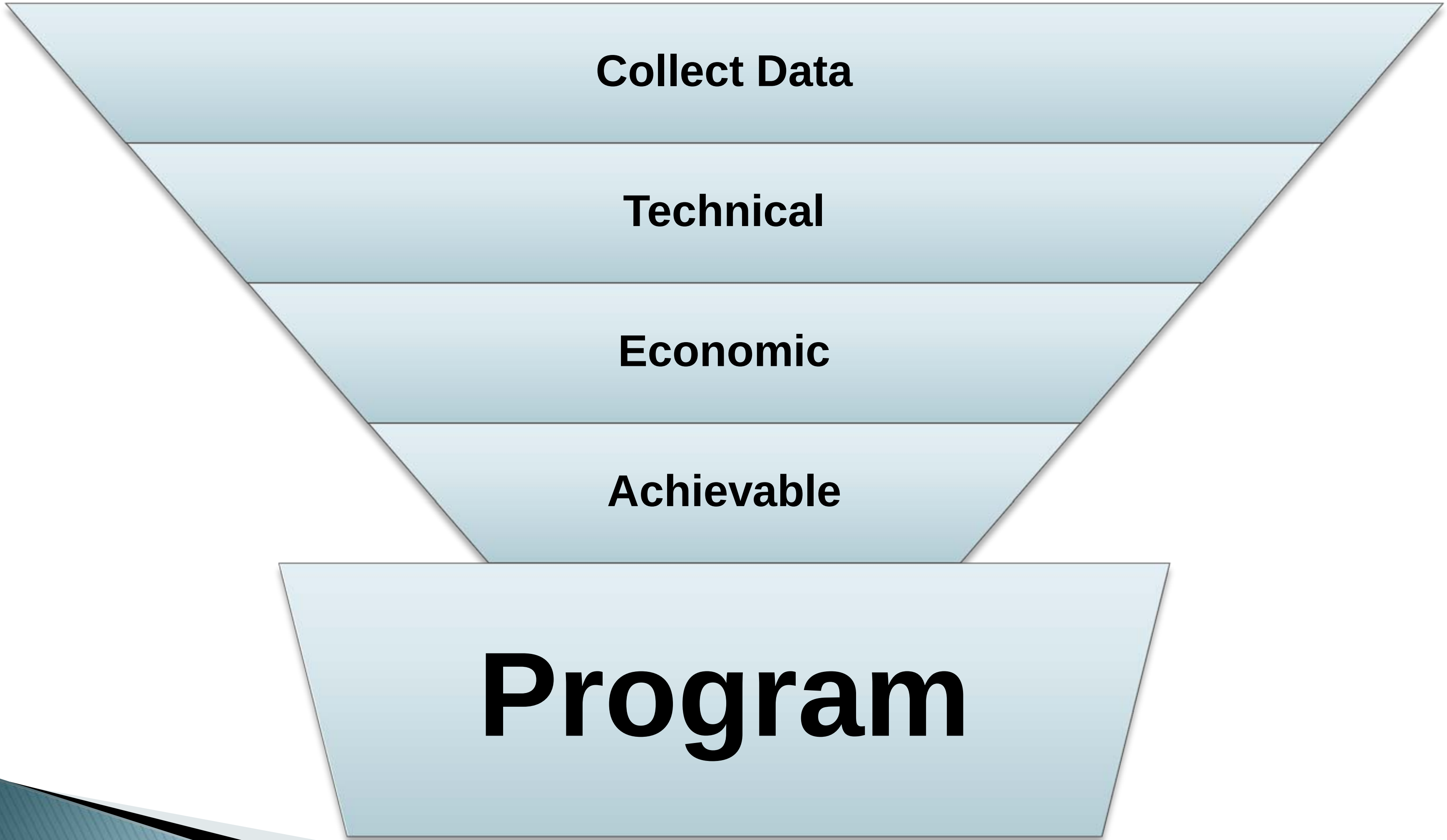


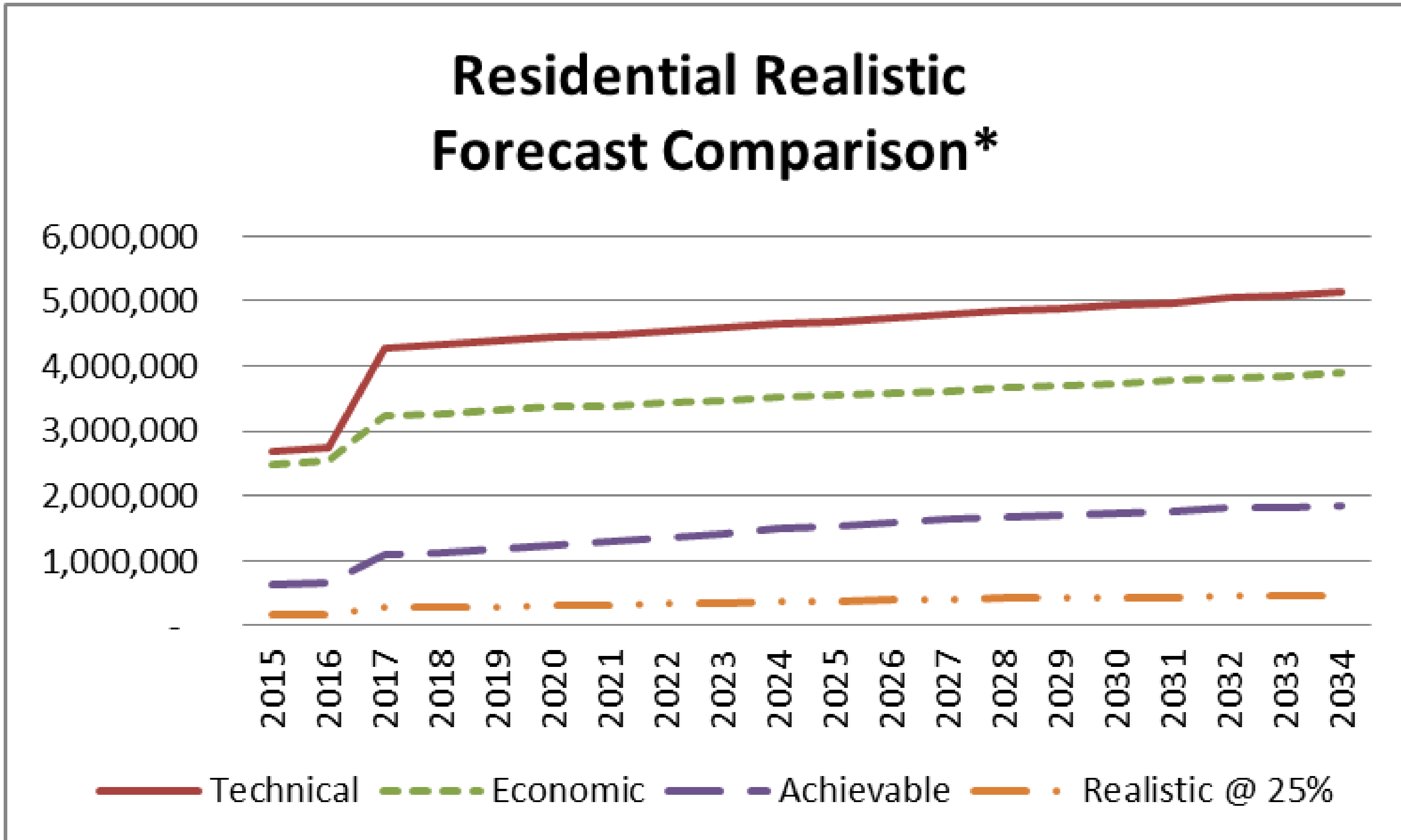
Programmatic Potential

- Program potential is the subset of achievable potential attainable given constraints on program budget and implemented measures.

Programmatic Potential

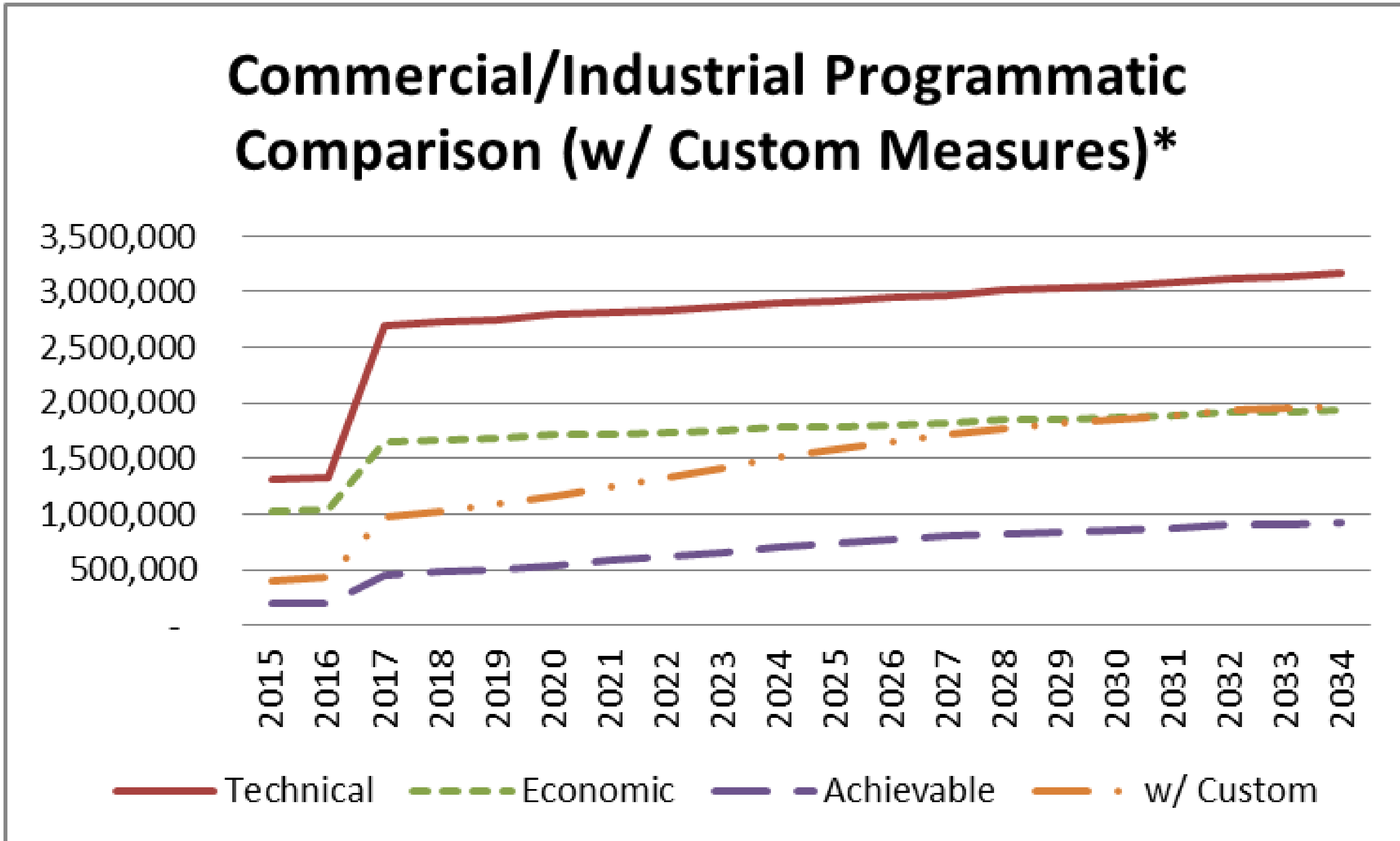
- Used 75% of Achievable for the Programmatic Commercial/Industrial forecast.
- Set Residential Realistic potential to 25% of the Achievable forecast in line with previous years' outcomes.
- **NOTE:** TEAPOT is limited to forecasting prescriptive measures. Therefore, the Commercial/Industrial outcome is set as 35% and custom measures are added to fill the remaining 65%, based on historical average proportions of conserved therms.
- Added Low Income Potential Forecast

Residential Realistic Forecast



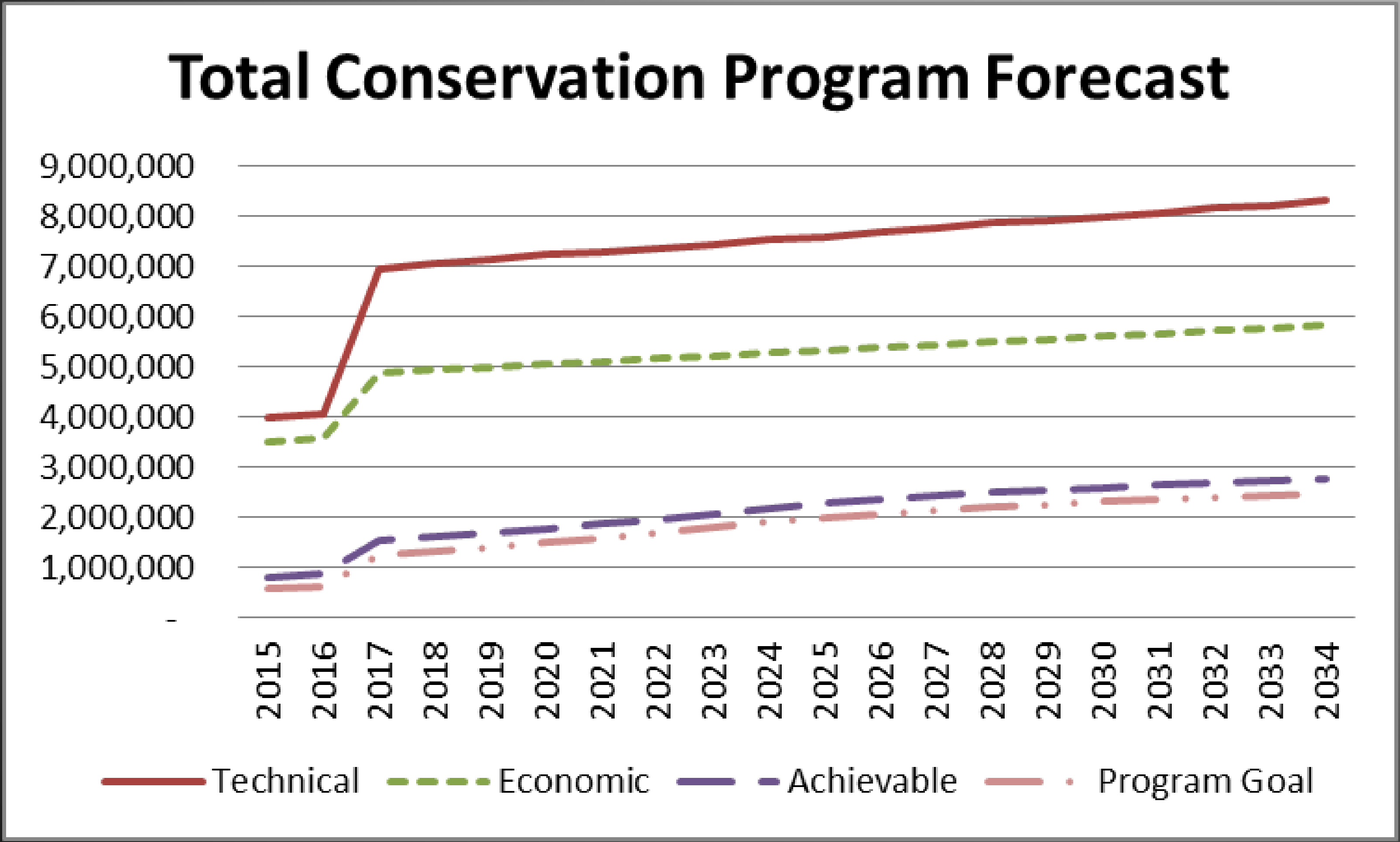
*Set at 25% of Achievable Potential

Com/Ind Programmatic Potential



* Set at 75% of Achievable Potential with Custom Measures' Potential added in (65% of total Com/Ind).

Combined Projected Savings



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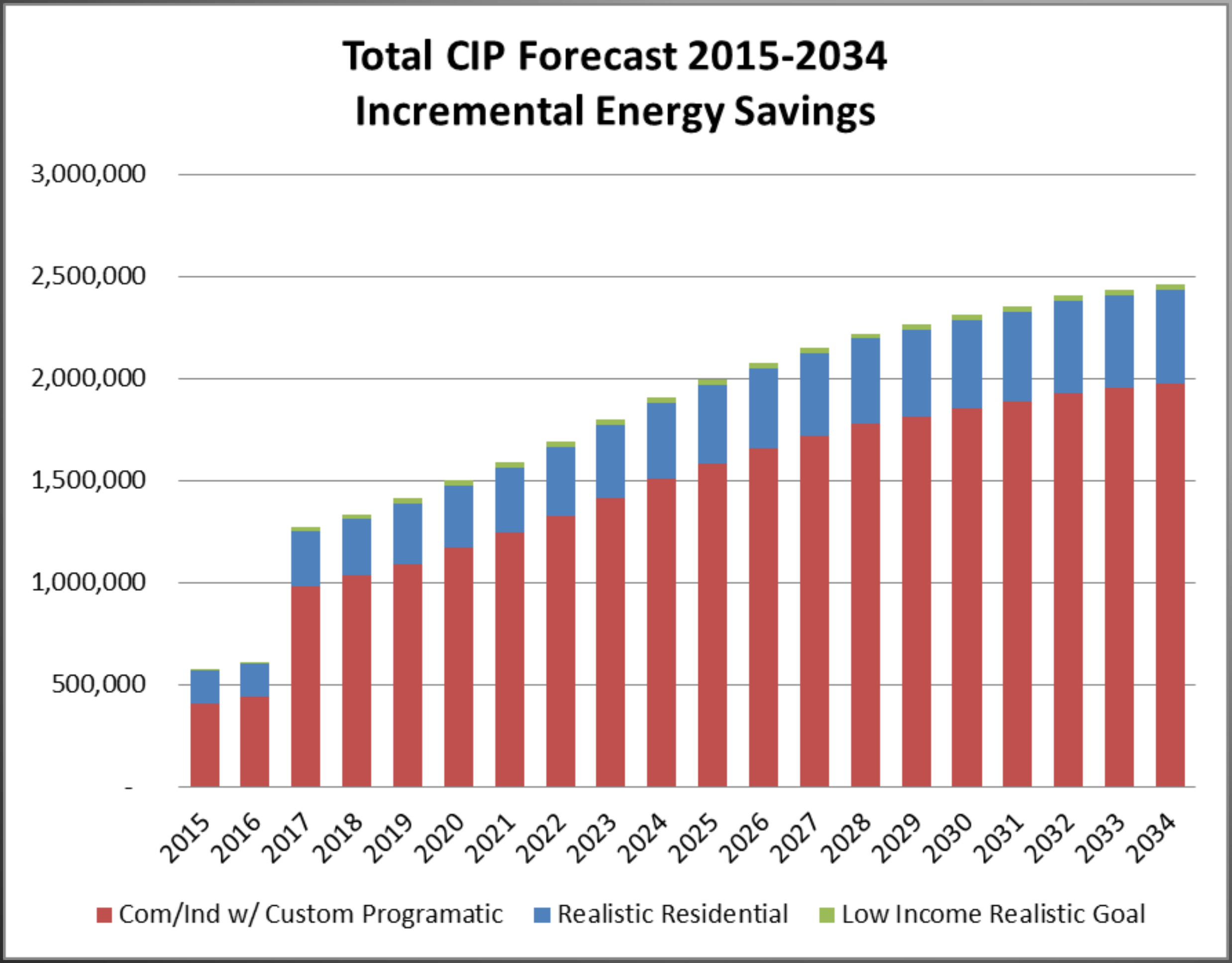
Agenda:

- ✓ Intro
- ✓ Model Comparison
- ✓ Process
- ➢ **Results**
- ❑ Key Updates
- ❑ Final Steps

Total Program Goals



Agenda:

- ✓ Intro
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- ❑ Final Steps

Key Updates for 2015 IRP

- Includes a Demand Side Management specific **Table of Contents** to ease navigation.
- **Residential & Commercial Measure Table** – see handout
- Split Washington and OR sections into separate pieces
- Incorporated Nexant potential study
- Used new TEAPOT model for forecasting

Agenda:

- ✓ Intro
- ✓ Model Comparison
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- ✓ Results
- ✓ Key Updates
- ➢ **Final Steps**

Next Steps to Finalize Forecast

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- Rerun models with the new Load Profile.
- Incorporate final revisions to load forecast.
- Integrate solicited feedback from Conservation Advisory Group (CAG).
- Update graphs and charts with final forecasts and text of IRP.

Agenda:

- ✓ Intro
- ✓ Process
- ✓ Results
- ✓ Key Updates
- ✓ Model Comparison
- ✓ Final Steps

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Questions?

Contact:

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Amanda Sargent
Conservation Analyst II
Amanda.Sargent@cngc.com

Energy Trust of Oregon

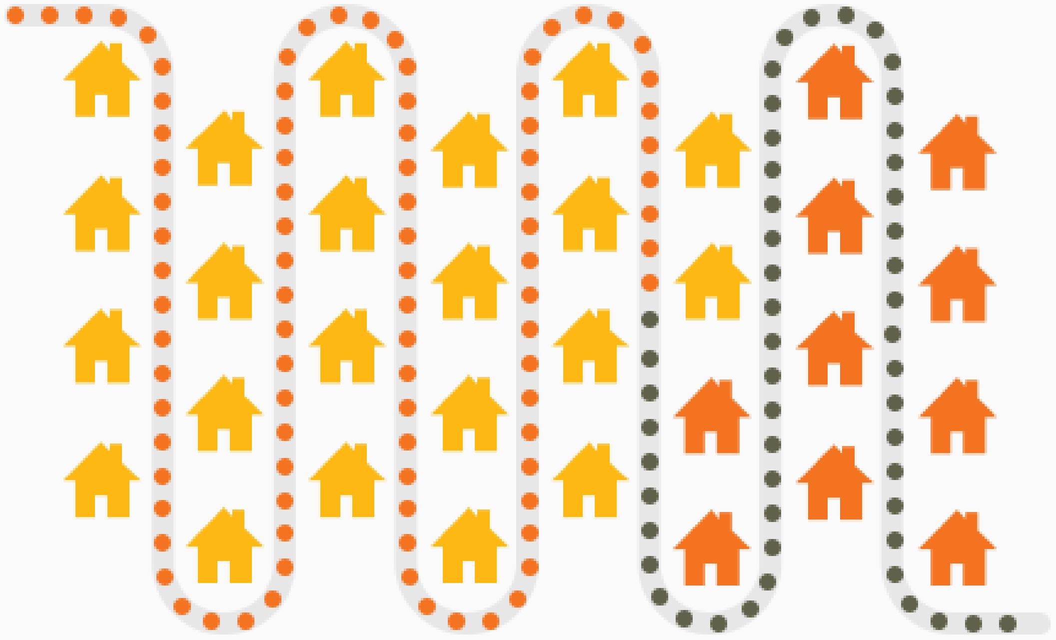
EE Potential Results

February 19, 2015

EnergyTrust of Oregon

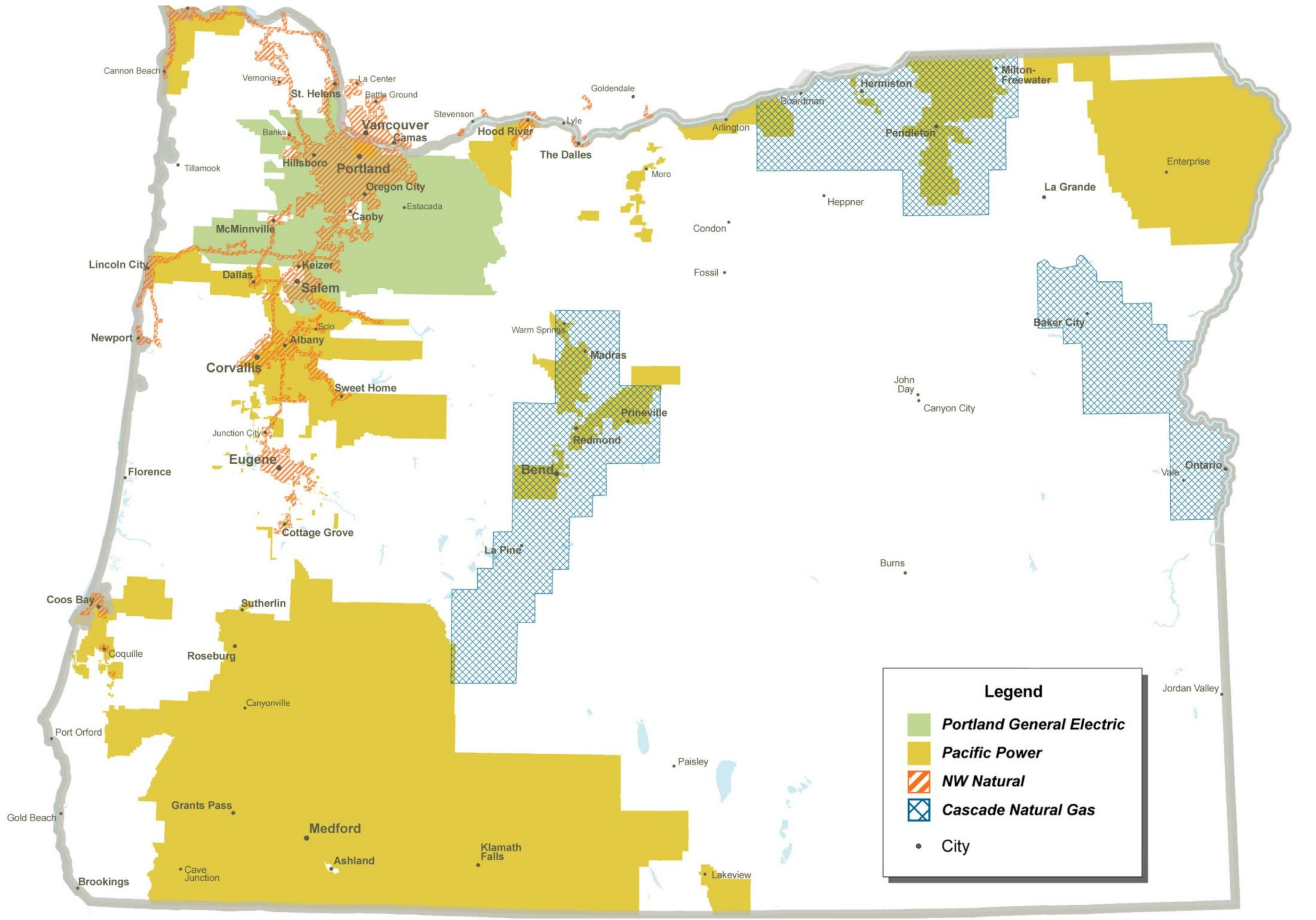
About

- Independent nonprofit
- Serving 1.5 million customers of Portland General Electric, Pacific Power, NW Natural and Cascade Natural Gas
- Helping utility customers:
  - Save energy
  - Invest in renewable energy resources
- Building a stronger Oregon and SW Washington



A clean energy power plant

- 436 average megawatts saved
- 112 aMW generated
- 33 million annual therms saved
- Enough energy to power 425,000 homes and heat 65,000 homes for a year
- Avoided 10 million tons of carbon dioxide



Cannon Beach
Vernonia
La Center
St. Helens
Battle Ground
Goldendale
Stevenson
Vancouver
Camas
Banks
Hood River
Lyle
Tillamook
Hillsboro
Portland
The Dalles
Oregon City
Estacada
Canby
McMinnville
Lincoln City
Keizer
Dallas
Salem
Scio
Newport
Albany
Corvallis
Sweet Home
Junction City
Eugene
Florence
Cottage Grove
Coos Bay
Sutherlin
Coquille
Roseburg
Canyonville
Port Orford
Grants Pass
Medford
Gold Beach
Ashland
Klamath Falls
Cave Junction
Brookings
Moro
Condon
Fossil
Warm Springs
Madras
Prineville
Redmond
Bend
La Pine
Arlington
Boardman
Hermiston
Milton-Freewater
Pendleton
Heppner
La Grande
Enterprise
Baker City
John Day
Canyon City
Vale
Ontario
Burns
Paisley
Lakeview
Jordan Valley
Legend
Portland General Electric
Pacific Power
NW Natural
Cascade Natural Gas
City

Background

What is a resource assessment?

- Estimate of available, cost-effective efficiency left to be acquired
- Uses utility load and customer forecasts, avoided costs, fuel splits, measure data, etc.

Background

- Energy Trust uses for utility IRP work & strategic plan
- Used same model, with updates, since 2005
- Issued an RFP in 2013
- Navigant Consulting selected

Methodology: Measure Definition

- Characterized 191 measures
- Across 27 customer segments
- Commercial, residential, industrial, and agriculture sectors
- Each measure has roughly 30 defining characteristics

Methodology: Measure Definition

- Incremental measure approach, no market share assumptions
- Factor in some known codes & standards

Methodology: Emerging Technology

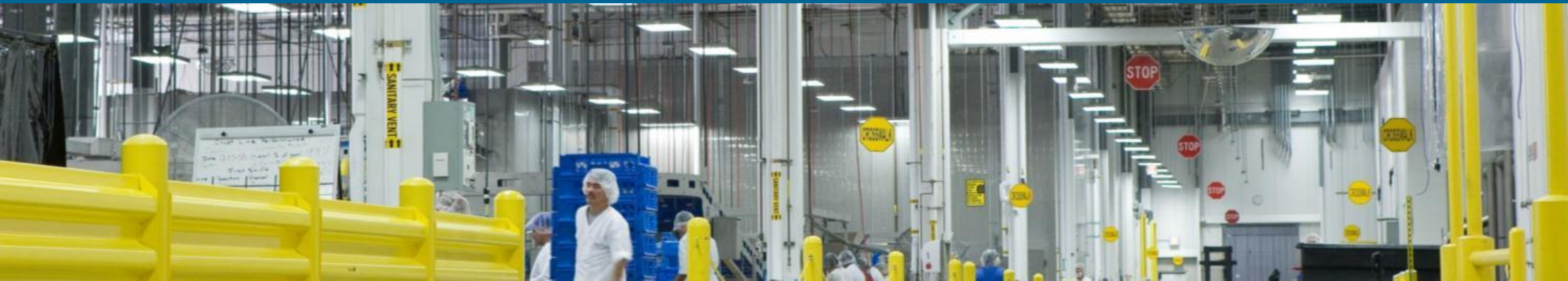
- Include some emerging technologies
- Factor in changing performance, cost over time
- Use risk factors to hedge against uncertainty

	ET Risk Factor				
Risk Category	10%	30%	50%	70%	90%
Market Risk (25% weighting)	High Risk: • Requires new/changed business model • Start-up, or small manufacturer • Significant changes to infrastructure • Requires training of contractors. Consumer acceptance barriers exist.			Low Risk: • Trained contractors • Established business models • Already in U.S. Market • Manufacturer committed to commercialization	
Technical Risk (25% weighting)	High Risk: Prototype in first field tests. A single or unknown approach	Low volume manufacturer. Limited experience	New product with broad commercial appeal	Proven technology in different application or different region	Low Risk: Proven technology in target application. Multiple potentially viable approaches.
Data Source Risk (50% weighting)	High Risk: Based only on manufacturer claims	Manufacturer case studies	Engineering assessment or lab test	Third party case study (real world installation)	Low Risk: Evaluation results or multiple third party case studies

Methodology: Emerging Technology

End result:

- The estimate for any given emerging technology is not accurate
- Taken as a whole, provides a reasonably conservative estimate of what is possible

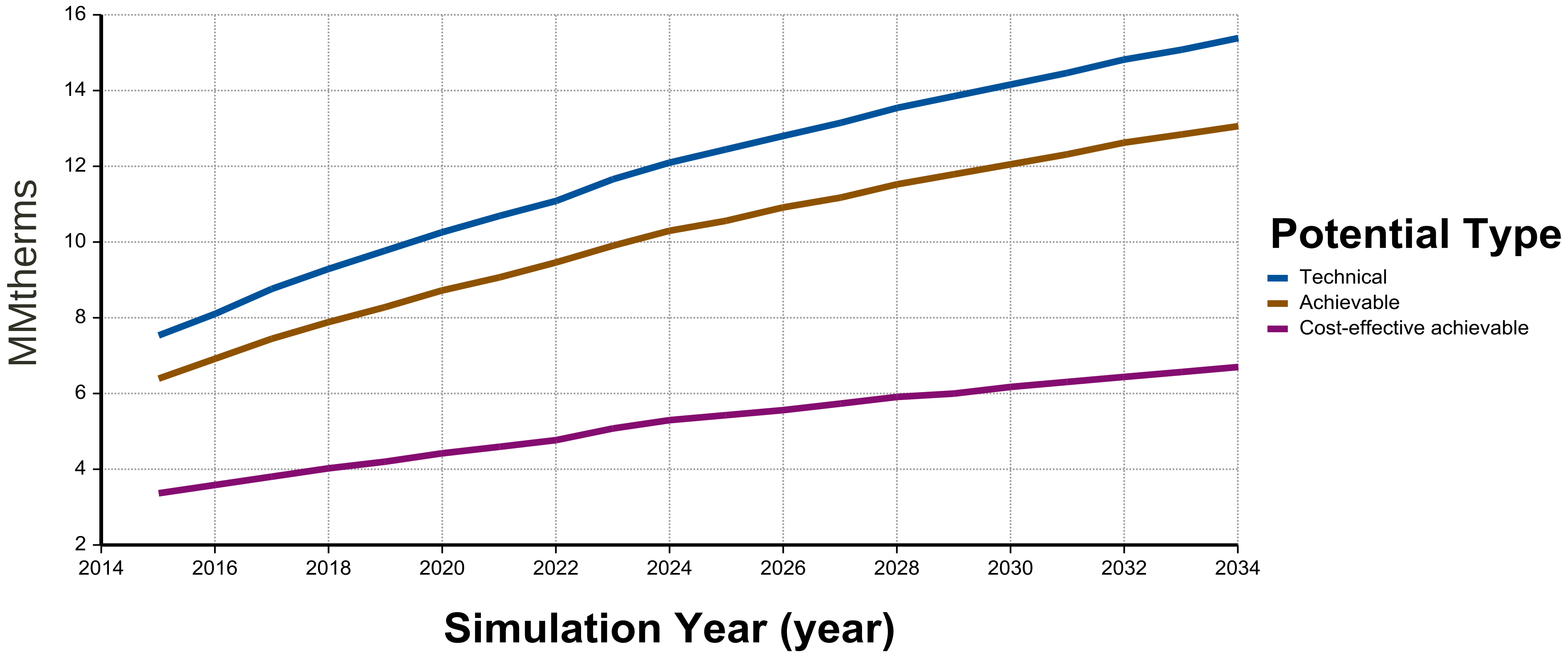


Draft Results

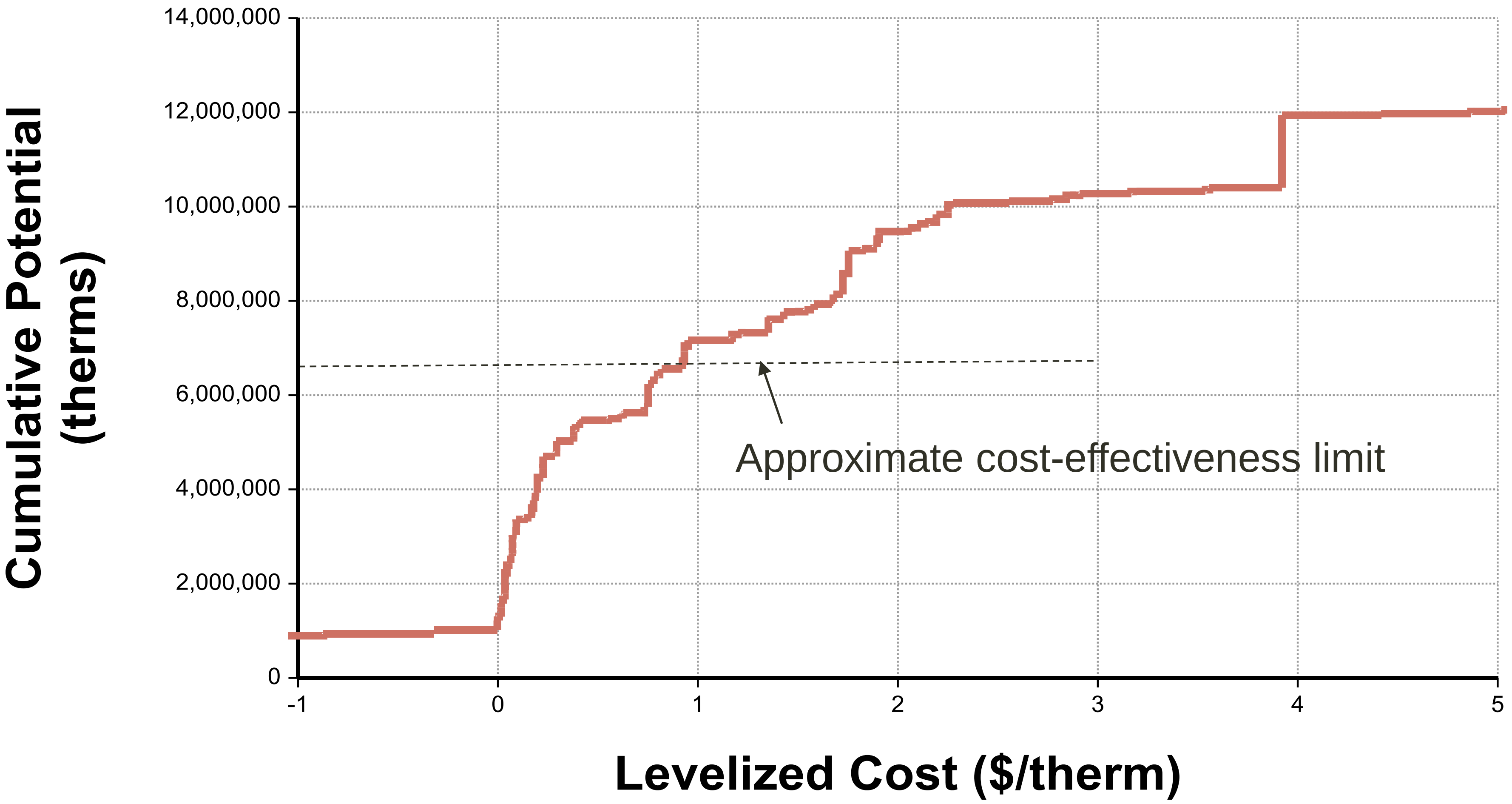
Types of Potential

Not technically feasible	Technical Potential			
Not technically feasible	Market barriers	Achievable Potential		
Not technically feasible	Market barriers	Not cost effective	Cost Effective Potential	
Not technically feasible	Market barriers	Not cost effective	Program design, budget, etc. constraints	Program Deployment

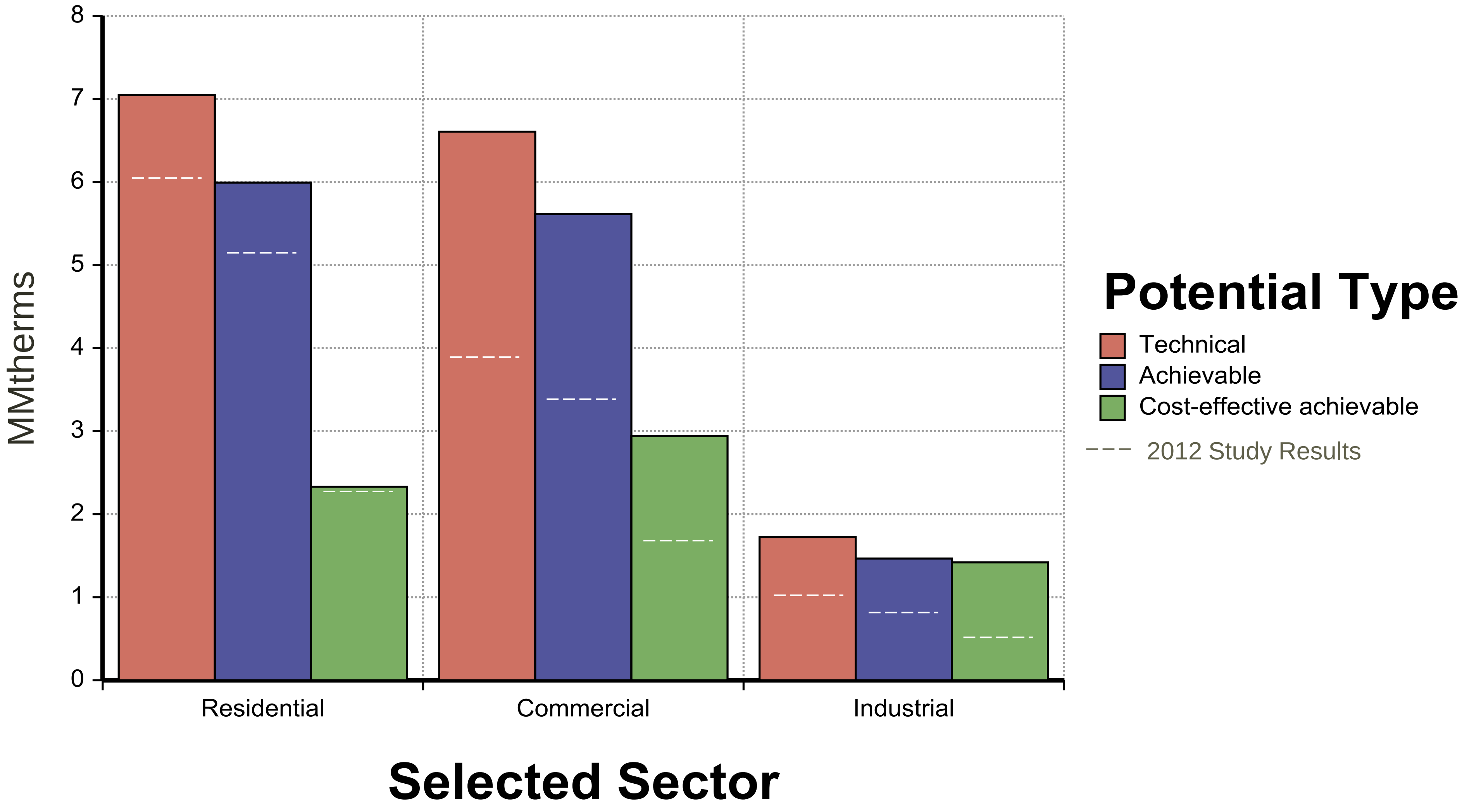
Cumulative Potential by Type and Year



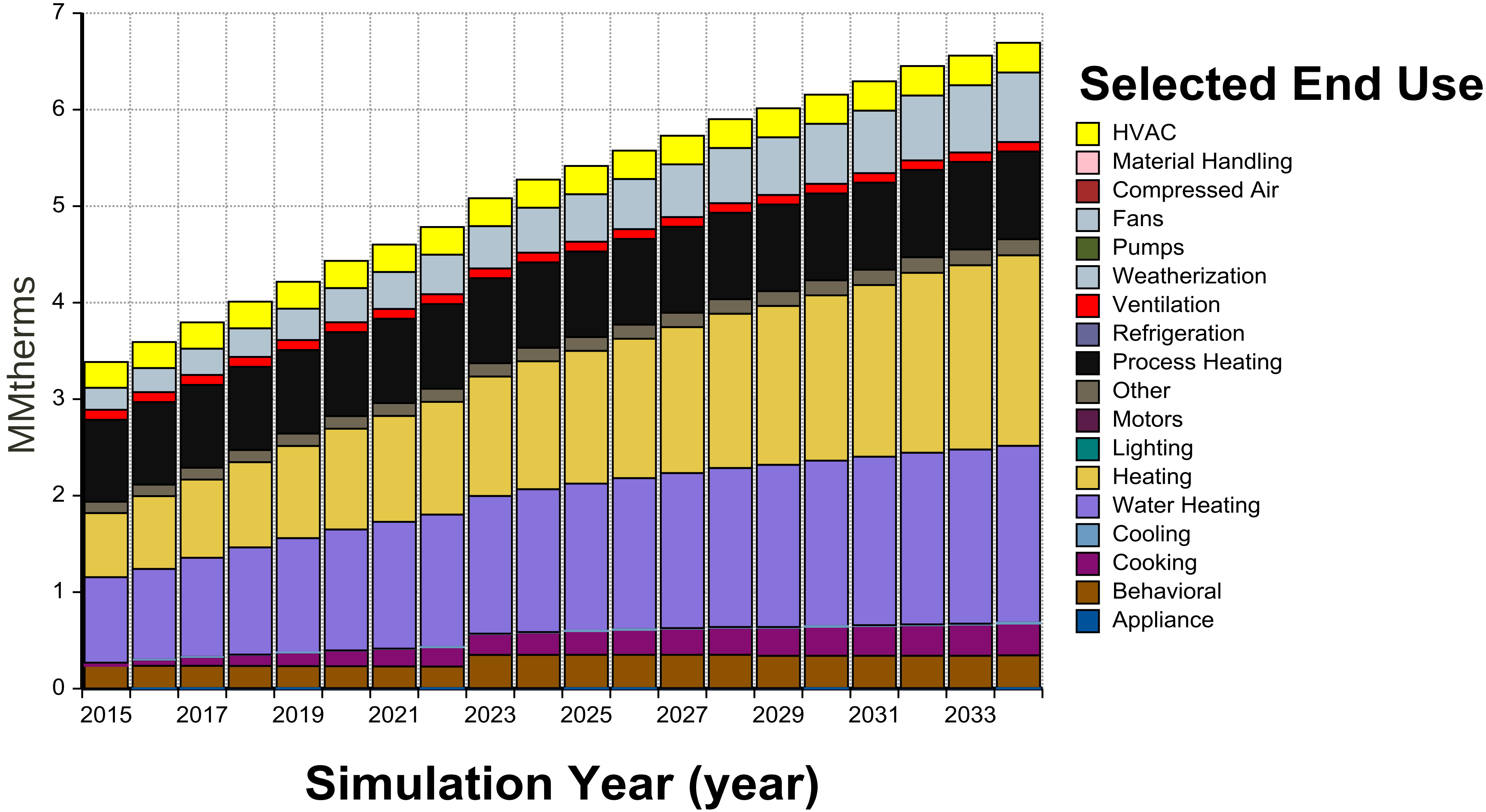
Gas Supply Curve



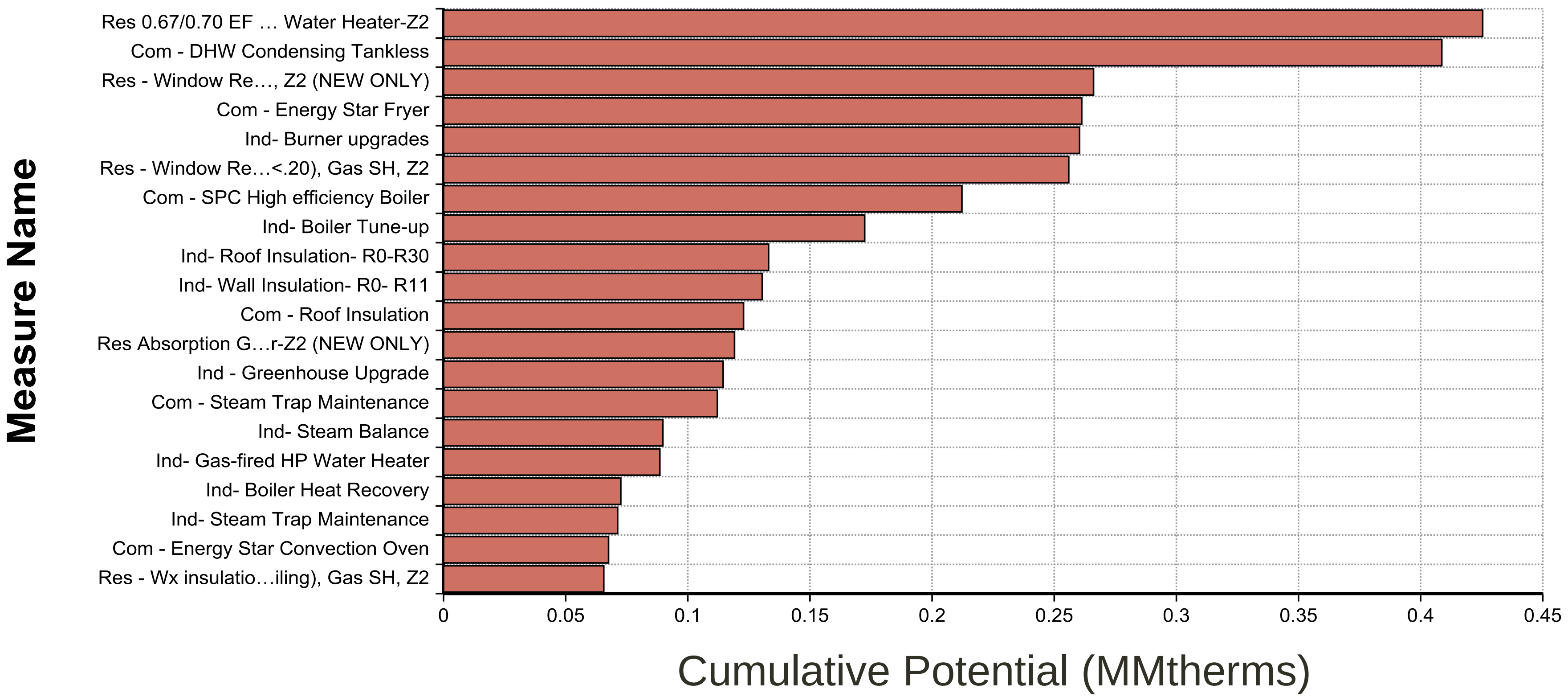
2034 Potential by Sector and Type



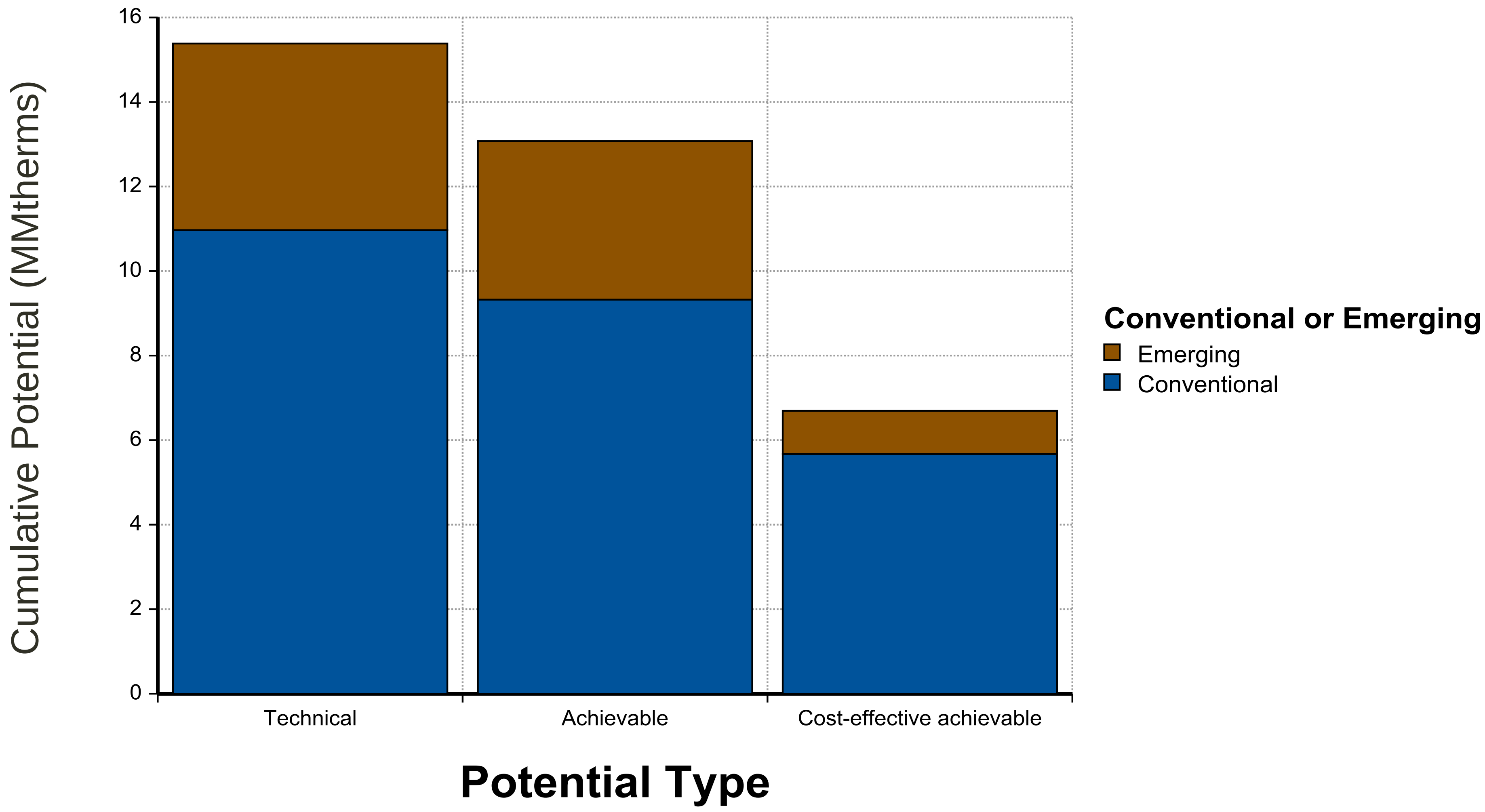
Cost-effective Potential by End Use



Top-Saving Measures



Emerging Technology Contribution



Next Steps

- Update model with final avoided costs, load forecast, updated measure assumptions
- Provide formatted 20-year projection of Energy Trust program accomplishments to Cascade IRP team

Thank You

Ted Light
Sr. Planning Project Manager

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503.445.7643

EnergyTrust of Oregon

Current Residential Program Offerings from Tariff 300

Measure	Incentive	Therm Savings Range per premise values*	Levelized Cost / Therm per premise values ($)
High Efficiency Natural Gas Furnace 95%+ AFUE	$250	100 - 134	0.25 – 0.43
High Efficiency Natural Gas Hearth /Fireplace 70% + FE	$150	74 - 76	0.21
High Efficiency Natural Gas Hearth / Fireplace 80% + AFUE	$250	74 - 76	0.21
High Efficiency Combination Hot Water and Space Heat 90% + AFUE	$825	384 - 539	0.09 – 1.40
Condensing High Efficiency Natural Gas Tankless Water Heater 0.91 + EF	$150	54 - 82	0.58 – 0.79
Conventional High Efficiency Natural Gas Water Heater 0.67 + EF	$45	14 - 43	0.28 – 0.69
High Efficiency Exterior Door ≤ U 0.21	$50	13	0.37
Floor Insulation ≥ R-30 prior NTE R-11	$0.30 / sq. ft.	108 - 132	0.37 to 0.42
Wall Insulation ≥ R-11 prior NTE R-4	$0.35 / sq. ft.	118 - 233	0.02 to 0.08
Ceiling or Attic Insulation ≥ R-38 prior NTE R-18	$0.30 / sq. ft.	24 – 194	0.21 to 0.27
Whole House Residential Air Sealing ≤ 0.0003 SLA	$100	71 - 84	0.30
Northwest ENERGY STAR Certified Home + U.30 Glazing	$600	200 - 206	0.27
Upgrade to ENERGY STAR Premium High Efficiency Natural Gas Furnace	$250	100 - 134	0.25 – 0.43
Built Green Certified Home	$600	203 - 210	0.27
Energy Savings Kit 1 or 2	Free (Value $10 or $16)	17 – 31	0.37

Current Commercial Program Offerings from Tariff 302

Measure	Incentive	Therm Savings Range per premise values	Levelized Cost / Therm per premise values ($)
Warm Air Furnace Condensing Min 91% AFUE	$3.00/kBtu/hr.	126-304	0.18 – 0.70
HVAC Unit Heater Non-Condensing Min 86% AFUE	$1.50/kBtu/hr.	92 – 611	0.52 – 1.50
HVAC Unit Heater Condensing Min 92% AFUE	$3.00/kBtu/hr.	247 – 1361	0.30 – 0.66
Radiant Heating Direct fired radiant heating	$6.95/kBtu/hr.	311 – 1382	0.02 – 0.13
Boiler - Condensing, Min 90% Therm Eff., 300 kBtu input	$4.00/kBtu/hr.	151 – 667	1.34 – 5.07
Boiler Vent Damper Min 1,000 kBtu input	$1,000	24 – 73	0.71 – 2.47
Boiler Steam Trap Min 300 kBtu input Steam pressure @ 7 psig or >	$125	73 – 261	0.08 – 0.32
Domestic Hot Water Tanks Condensing Min 91% Thermal Eff.	$2.50/kBtu/hr.	11 – 1521	0.13 – 1.63
Domestic Hot Water Tankles Water Heater ENERGY STAR 0.82 EF	$60/gpm	6 – 1137	0.15 – 1.68
Attic Insulation Tier 1 Min R-30	$0.50 /sq. ft.	46 – 204	0.151
Attic Insulation Tier 2 Min R-45	$0.65 /sq. ft.	46 – 204	0.192
Roof Insulation Tier 1 Min R-21	$0.60 /sq. ft.	288 – 744	0.14 – 0.63
Roof Insulation Tier 2 Min R-30	$0.80 /sq. ft.	288 – 744	0.14 – 0.63
Wall Insulation Tier 1 Min R-11	$0.50 /sq. ft.	211 – 935	0.17 – 0.38
Wall Insulation Tier 2 Min R-19	$0.56 /sq. ft.	211 – 935	0.16 – 0.39
Ozone Injection Laundry Venturi injection/bubble diffusion Min 125 lb. total washer/extractor capacity	$2,500	294 – 1049	0.82 – 1.78
Motion Control Faucet Max flow rate of 1.8 gpm	$105	72 – 1330	0.16 – 0.57
Clothes Washer 1.8 MEF	$180	379 – 1850	0.01 – 0.20
Gas Convection Oven ENERGY STAR ≥ 42% Cooking Eff / ≤ 13,000 Btu/ hr. Idle Rate	$450	368 – 736	0.23 – 0.41
Gas Griddle - ENERGY STAR ≥ 38% Cooking Eff / ≤ 2,650 Btu/ hr. Idle Rate	$350	155 – 274	0.08 – 0.15

Measure	Incentive	Therm Savings Range per premise values	Levelized Cost / Therm per premise values ($)
Gas Conveyor Oven > 42% tested Baking Eff	$600	137 – 589	0.69 – 2.34
Connectionless 3 Pan Gas Steamer ENERGY STAR or CEE/FSTC qual. ≥ 38% Cooking Eff / ≤ 2,083 Btu/ hr./pan Idle Rate	$850	1174 – 1283	0.05 – 2.23
Connectionless 6 Pan Gas Steamer ENERGY STAR or CEE/FSTC qual. ≥ 38% Cooking Eff / ≤ 2,083 Btu/ hr./pan Idle Rate	$1,200	1174 – 1283	0.05 – 2.23
Double Rack Oven FSTC Qualified ≥ 50% Cooking Eff / ≤ 3,500 Btu/ hr./pan Idle Rate D Rack	$2,000	65 – 587	0.151
ENERGY STAR Gas Fryer	$600	388 – 685	0.08 – 0.14
Door Type Dishwasher Low Temp ENERGY STAR ≤ 0.6 kw Idle Rate/≤1.18 gal/rack	$650	16 – 1290	0.13 – 0.65
Multi-Tank Conveyor Low Temp Dishwasher Gas Main w/Electric Booster ENERGY STAR ≤2.0 kw Idle Rate;≤0.50 gal/rack	$1,000	16 – 1290	0.08 – 1.29
Recirculation Controls Continuous Operation DWH Pump	$100	112 – 399	0.02 – 0.15
Energy Savings Kit A or B	Free - Value $55 or $25	34-45	0.37 – 0.49

2014 Integrated Resource Plan

Technical Advisory Group Meeting

April 1, 2015

Agenda

- Introductions
- Long-range market summary
- Price Forecast
- Avoided Costs
- NWP Plymouth Capacity
- SENDOUT resource inputs
- SENDOUT scenarios
- Other

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Market Outlook and Long Range Price Forecast

Long range market outlook

- Rockies production slight decline; but with other supplies serving the Midwest, the west coast is ripe for expansion.
- Once LNG flows from BC in early 2020s we should see AECO prices begin to rise relative to Rockies.
- Station 2 should become more liquid
- A number of experts say US production is expected to over 90 bcfd in 2020 and over 110 bcfd in 2030
  - Even more low-cost gas in the Marcellus.
  - Production growth in Western Canada now, but low prices will ultimately reduce any long-term production expectations.
- US demand is expected to exceed 90 bcfd in 2020 and 115 bcfd by 2030, about 7-10% higher than expected in our 2012 IRP
- Low long-term prices will likely encourage new gas-intensive industrial projects
- Power-sector consumption strengthens as coal displacement continues.
- US and Canadian LNG exports likely to ramp up by 2020
- Several projects utilizing Canadian resources continue to emerge in the US Pacific NW and British Columbia
- Mexico's power sector is expected to continue to grow as new gas-fired power plants are built and existing fuel-oil plants are converted to burn gas.

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Long Range Price Forecast

- Cascade's long term planning price forecast is based on a blend of current market pricing along with long term fundamental price forecasts.
- The fundamental forecasts include Wood Mackenzie, the Energy Information Administration (EIA), the Northwest Power Planning Council, Bentek and the Financial Forecast Center's long term price forecasts.
- Market, particularly in near term is heavily influenced by Henry Hub prices
- While not a guarantee of where the market will ultimately finish, Henry Hub NYMEX is the most current information that provides some direction as to future market prices

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Long Range Price Forecast

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

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Long Range Price Forecast

- Considerations in weight assignments
  - Typically, highest weight is given to NYMEX for the near term (approximately 3-5 years) then the others take on increasing weight over the horizon
    - Wood Mackenzie (monthly, covers all basins)
    - EIA (industry barometer, annual long term
    - NPPC (regional perspective, but recognize it is also a blend)
    - Bentek (3-5 years out years)
    - Financial Forecast Center (typically only a few years)

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Base Weights in Draft 2014 Price Forecast

Year	Current NYMEX	Wood Mac	EIA	Bentek	Financial Forecast Center
2015	50%	25%	20%	4%	1%
2016	45%	30%	20%	4%	1%
2017	40%	35%	20%	4%	1%
2018	35%	35%	25%	5%	0%
2019	30%	40%	25%	5%	0%
2020	25%	45%	30%	0%	0%
2021	20%	50%	30%	0%	0%
2022	15%	55%	30%	0%	0%
2023	10%	60%	30%	0%	0%
2024	10%	65%	25%	0%	0%
2025	10%	70%	20%	0%	0%
2026	5%	75%	20%	0%	0%
2027	5%	75%	20%	0%	0%
2028	0%	75%	25%	0%	0%
2029	0%	75%	25%	0%	0%
2030	0%	75%	25%	0%	0%
2031	0%	75%	25%	0%	0%
2032	0%	75%	25%	0%	0%
2033	0%	75%	25%	0%	0%
2034	0%	75%	25%	0%	0%
2035	0%	75%	25%	0%	0%

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Avoided Cost Calculation

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Overview

- As part of the IRP process, Cascade calculates a 20-year forecast and 45 years of avoided costs.
- The avoided cost is an estimated cost to serve the next unit of demand with a supply side resource option at a point in time. This incremental cost to serve represents the cost that could be avoided through energy conservation.
- The avoided cost forecast can be used as a guideline for comparing energy conservation with the cost of acquiring and transporting natural gas to meet demand.
- Cascade evaluates the impact that a range of environmental externalities, including CO2 emission prices, would have on the avoided costs in terms of cost adders and supply costs.
- We produce an expected avoided cost case based on the medium forecast (base case) peak day.

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Costs included in the avoided cost calculation

- The long term gas price forecast compiled from a consultant’s gas price forecast (which is the majority of the cost);
- A price for carbon included in the gas price forecast, which has been embedded by price forecast consultant
- Gas storage variable and fixed costs
- Upstream variable and fixed transmission costs;
- Peak related on-system transmission costs; and
- A 10 percent adder for unidentified environmental benefits, as recommended by the Northwest Power and Conservation Council (“NWPCC”).

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METHODOLOGY

- The SENDOUT® resource planning model is used to generate the avoided costs.
- SENDOUT® contains a marginal cost report which lists the daily incremental cost to serve the next unit of demand for each demand region.
- The model determines the lowest cost method for serving the next unit of demand and computes a marginal cost.

ALTERNATIVE RESOURCES CONSIDERED

- With regards to alternative resources considered in the optimization of the portfolio, there is a level of uncertainty as to when certain alternative supply side resources will materialize and yet a base case needs to be created to calculate the avoided cost.

- Using the base case demand parameters as inputs, including the design weather pattern, and base case customer and gas price forecasts, in addition to existing supply side resources, the Company's resource portfolio for purposes of the avoided cost calculation include:
  - Ryckman Creek storage
  - Incremental NGTL, Foothills, GTN and NWP transport (all of which are allocated between Oregon and Washington).
  - Also, a small level of satellite LNG and biogas is also included in the base case—however; these two alternative resources are assigned directly to Washington.

NOTE: The optimal portfolio will be available until TAG 5. Some of the assumptions above are subject to change.

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Alternative transport included:

Model Name	Start Date	End Date	Daily MDQ	Description	Cost Dths	Lead Time	Pipeline
Incremental NOVA-Foothills-GTN	2017	OPEN	Approx 16,000 dths/day ea pipeline	AECO NIT, Foothills to Kingsgate	NOVA, Foothills, GTN (approx $0.41)	2017	NOVA, Foothills, GTN
INCR-NWP	2017	OPEN	Appoximately 10,000 dhts/day	Sumas to WA and OR citygates	NWP Rate X 3 (min approx $1.14)	2018	NWP

Storage resources in IRP (items in yellow are incremental alternatives in the base case)

Model Name	Type	Location	Pipeline Transport Required	Start	Contract Expiration	Lead Time	PRINCIPLE DEL AREA			Max Cap	WD MDQ	Fuel Inj < 3%	SVDD	D2 RATE > $0.05 < $0.15
JP-1	Undergound	Jackson Prairie	Yes	Existing	2020	NA	MOST OR AND WA NWP POINTS			604,351	16,789	YES	SGS	YES
JP-EXP	Undergound	Jackson Prairie	Yes	Full access begins in Nov 2012	2060	NA	ZONE 30-S			350,000	30,000	YES	SGS	YES
LNG	LNG	Plymouth	Yes	Existing	2020	NA	MANY OR AND WA NWP POINTS			562,200	60,000	YES	SGS	YES
JP-3	Undergound	Jackson Prairie	Yes	Nov-12	2021		ZONE 30-S, ZONE 30-W			102,782	3,500	YES	SGS	YES
JP-4	Undergound	Jackson Prairie	Yes	Nov-12	2021		ZONE 30-S, ZONE 30-W			178,460	6,077	YES	SGS	YES
RYCKMAN	Undergound	Near Opal WY	Yes	2013	TBD		ZONE-GTN, OTHER			350000 - 500000	10,000	YES	RYCK	NEGOTIATED
JP-OTHER	Undergound	Jackson Prairie	Yes	2017	TBD		NWP			300,000	5,000	YES	SGS	YES

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METHODOLOGY

- Unfortunately, the marginal cost report in SENDOUT does not break out the components
- In order to break out the components several additional detailed supply, transport and storage costs reports are generated from SENDOUT and utilized to glean approximate allocations of resources between the two states.
- Please note that Cascade's Oregon rate case cost of service consultants for the rate case we have produced also included tabs that break out the avoided costs between Oregon and Washington.
- For the purposes of the 2014 IRP, Cascade will continue to use a system level avoided cost as we have historically.
- An Action Item will be to hold discussions regarding allocating the avoided costs at a more granular level for future IRPs

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SYSTEM AVOIDED COSTS LAYERS (dollars in therms)

	Commodity		Transport Fixed		Transport Commodity		Storage Fixed		Storage Commodity		Total Avoided Cost (nominal $/therm)		Total Avoided Cost With 10% Conservation
2015	$	0.294449	$	0.147345	$	0.002834	$	0.014888	$	0.001384	$	0.460900	$ 0.50699
2016	$	0.316554	$	0.158406	$	0.003046	$	0.016006	$	0.001488	$	0.495500	$ 0.54505
2017	$	0.337061	$	0.168669	$	0.003244	$	0.017043	$	0.001584	$	0.527600	$ 0.58036
2018	$	0.340830	$	0.170555	$	0.003280	$	0.017233	$	0.001602	$	0.533500	$ 0.58685
2019	$	0.357568	$	0.178931	$	0.003441	$	0.018079	$	0.001681	$	0.559700	$ 0.61567
2020	$	0.360443	$	0.180369	$	0.003469	$	0.018225	$	0.001694	$	0.564200	$ 0.62062
2021	$	0.361785	$	0.181041	$	0.003482	$	0.018293	$	0.001701	$	0.566300	$ 0.62293
2022	$	0.390341	$	0.195331	$	0.003757	$	0.019736	$	0.001835	$	0.611000	$ 0.67210
2023	$	0.399988	$	0.200158	$	0.003849	$	0.020224	$	0.001880	$	0.626100	$ 0.68871
2024	$	0.402480	$	0.201405	$	0.003873	$	0.020350	$	0.001892	$	0.630000	$ 0.69300
2025	$	0.392066	$	0.196194	$	0.003773	$	0.019824	$	0.001843	$	0.613700	$ 0.67507
2026	$	0.415768	$	0.208054	$	0.004001	$	0.021022	$	0.001954	$	0.650800	$ 0.71588
2027	$	0.430078	$	0.215215	$	0.004139	$	0.021746	$	0.002022	$	0.673200	$ 0.74052
2028	$	0.430781	$	0.215567	$	0.004146	$	0.021781	$	0.002025	$	0.674300	$ 0.74173
2029	$	0.424265	$	0.212306	$	0.004083	$	0.021452	$	0.001994	$	0.664100	$ 0.73051
2030	$	0.430270	$	0.215311	$	0.004141	$	0.021755	$	0.002022	$	0.673500	$ 0.74085
2031	$	0.410210	$	0.205273	$	0.003948	$	0.020741	$	0.001928	$	0.642100	$ 0.70631
2032	$	0.413021	$	0.206680	$	0.003975	$	0.020883	$	0.001941	$	0.646500	$ 0.71115
2033	$	0.438000	$	0.219180	$	0.004215	$	0.022146	$	0.002059	$	0.685600	$ 0.75416
2034	$	0.441769	$	0.221066	$	0.004252	$	0.022337	$	0.002076	$	0.691500	$ 0.76065
2035	$	0.453255	$	0.226813	$	0.004362	$	0.022918	$	0.002130	$	0.709479	$ 0.78043

UM 1622 Gas Hedge Value of Energy Efficiency

- Risk mitigation adder such as used in electric utilities
- Workshop held
- Northwest Natural is looking at development of a adder through their 2015 IRP process?
- Cascade has some concerns such as exposure to margin calls
- Cascade's 2014 IRP does not take a position

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NWP Plymouth LNG Capacity

Jon Whiting Director Gas Supply & Gas Control

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What does Cascade Commit to?

1. CNGC acquires 100,000 Dth's of Plymouth LNG storage capacity, 18,125 Dth/d of Storage Demand and 10,675 Dth/d of TF-2 capacity effective Nov. 1, 2015 through Mar. 31, 2025.
2. CNGC extends its existing Plymouth LNG capacity from Oct. 31, 2020 to March 31, 2025.

Sweetener #1

- CNGC has 30,420 Dth's of seasonal capacity from Jackson Prairie to Bremerton (Shelton), which has an expiration date of Oct. 31, 2029. **<u>CNGC does not currently hold the ROFR right on this capacity.</u>**

- NWP has brought to the table a party who is interested in a portion of this capacity, so CNGC will permanently release the capacity to this party, resulting in a reduction in pipeline costs of approximately $1.1M annually.

- This essentially nets out the costs of the 100,000 Dth's of Plymouth LNG capacity

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Sweetener #2

- NWP is allowing CNGC to transfer the 30,420 Bremerton (Shelton) MDDO's (from sweetener #1) to it's 100002 contract. CNGC would then reduce it's MDDO's where we have excess length (Bellingham II and Sedro-Woolley).

- This is a very valuable sweetener, as it allows CNGC to obtain the ROFR rights at Bremerton/Shelton. We will now control the rights to this critical point.

- Using current rates, this sweetener could be valued around $4.5M annually.

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Sweetener #3

- NWP is filing with FERC to allow Shippers holding TF-2 subordinate capacity as the receipt point to nominate in a manner that could elevate their scheduling priority from subordinate to primary firm.
- This filing will give CNGC the ability to rely on its Plymouth LNG capacity a little bit more when looking at its Peak Day deliverability for the IRP.

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Sweetener #4

- NWP will allow Cascade to lengthen its path on 7,450 Dth/d from Stanfield to Plymouth (with delivery into NE Oregon)
- After lengthening, NWP will allow CNGC to segment the capacity at Stanfield resulting in 2 segments of capacity: 1) Plymouth to Stanfield and 2) Stanfield to NE Oregon.
- This no cost transaction will provide CNGC with the flexibility to bring additional gas onto GTN off of NWP.

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SENDOUT Scenarios and Inputs

SENDOUT model

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

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SENDOUT model

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

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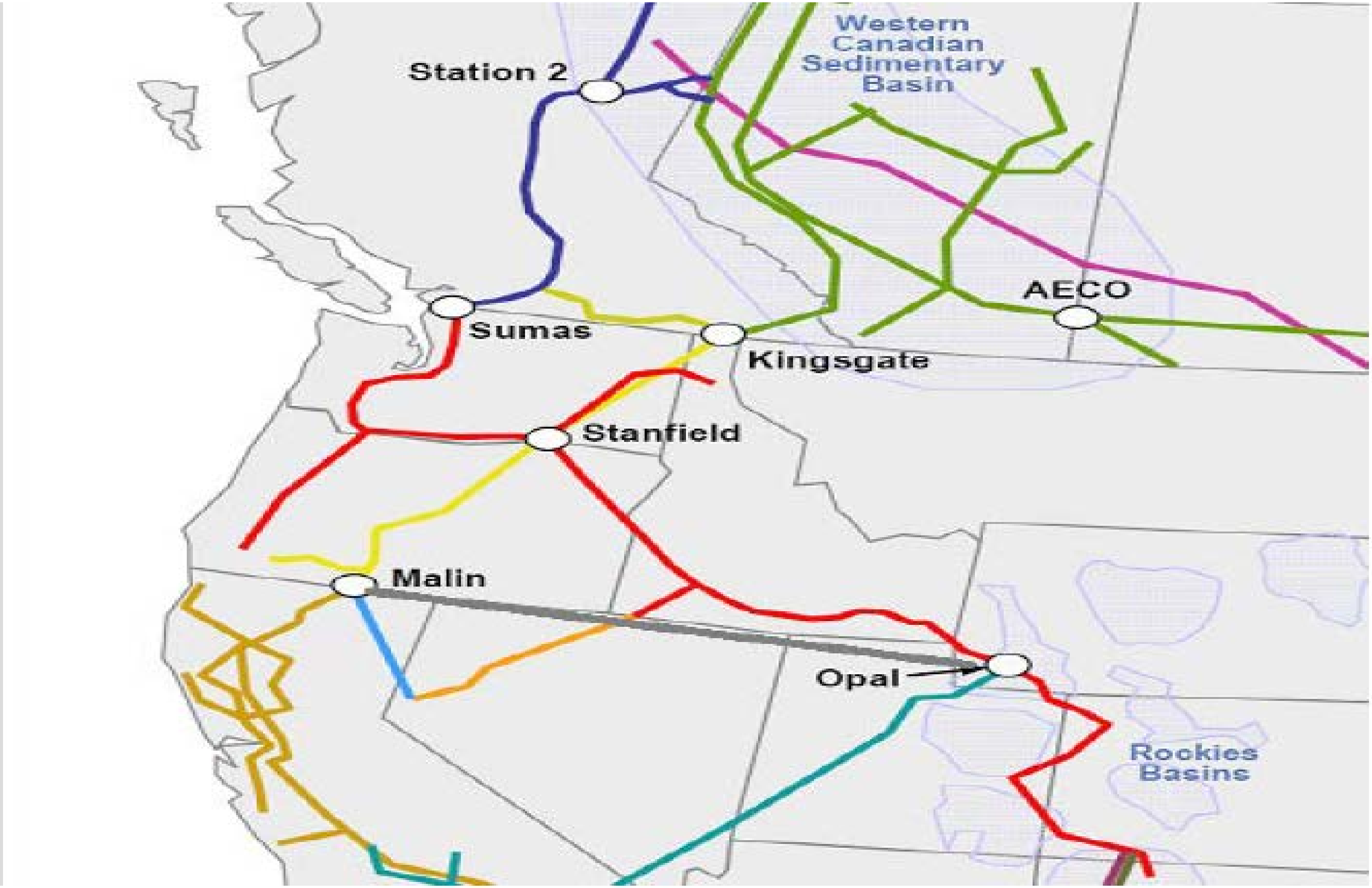
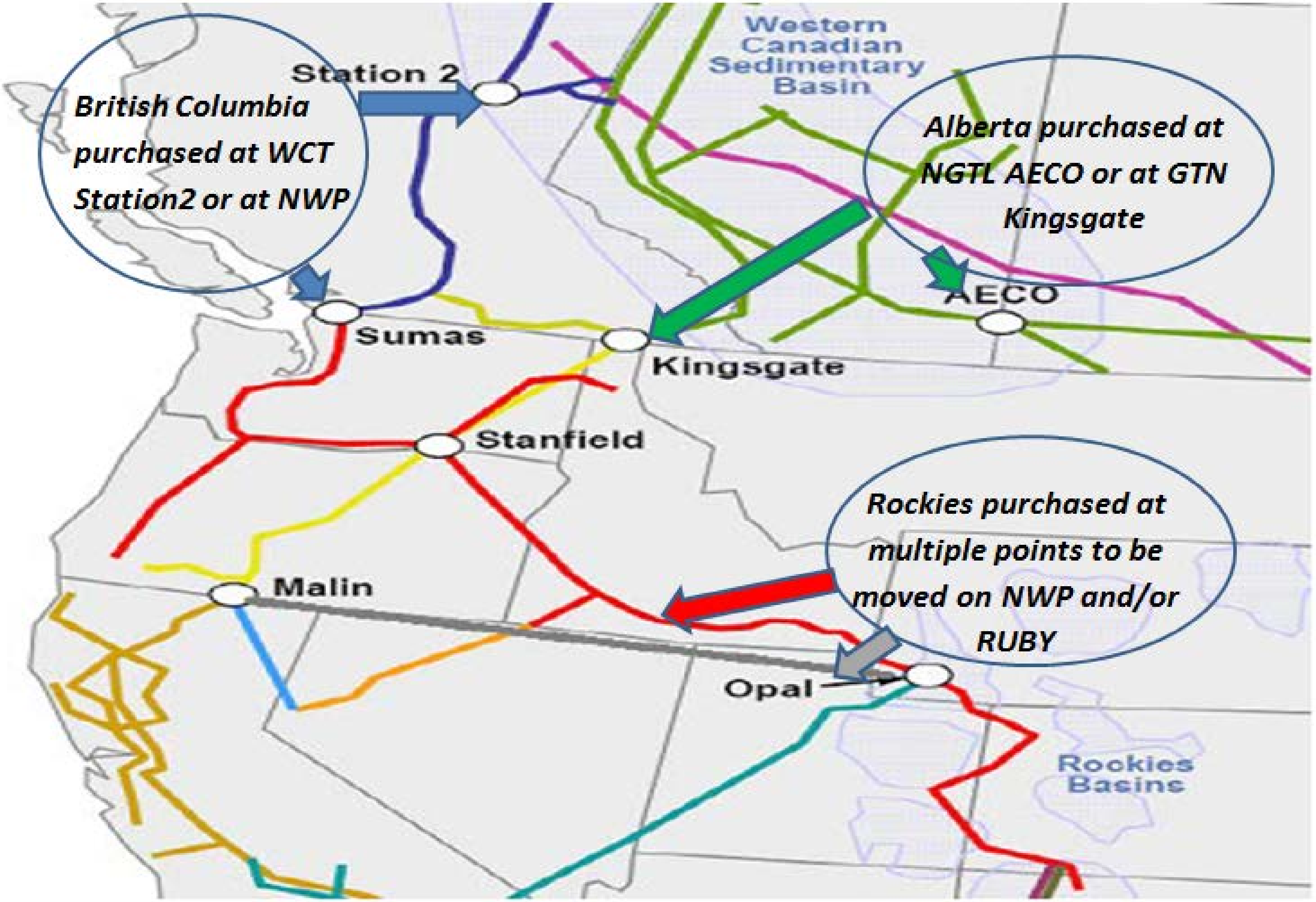
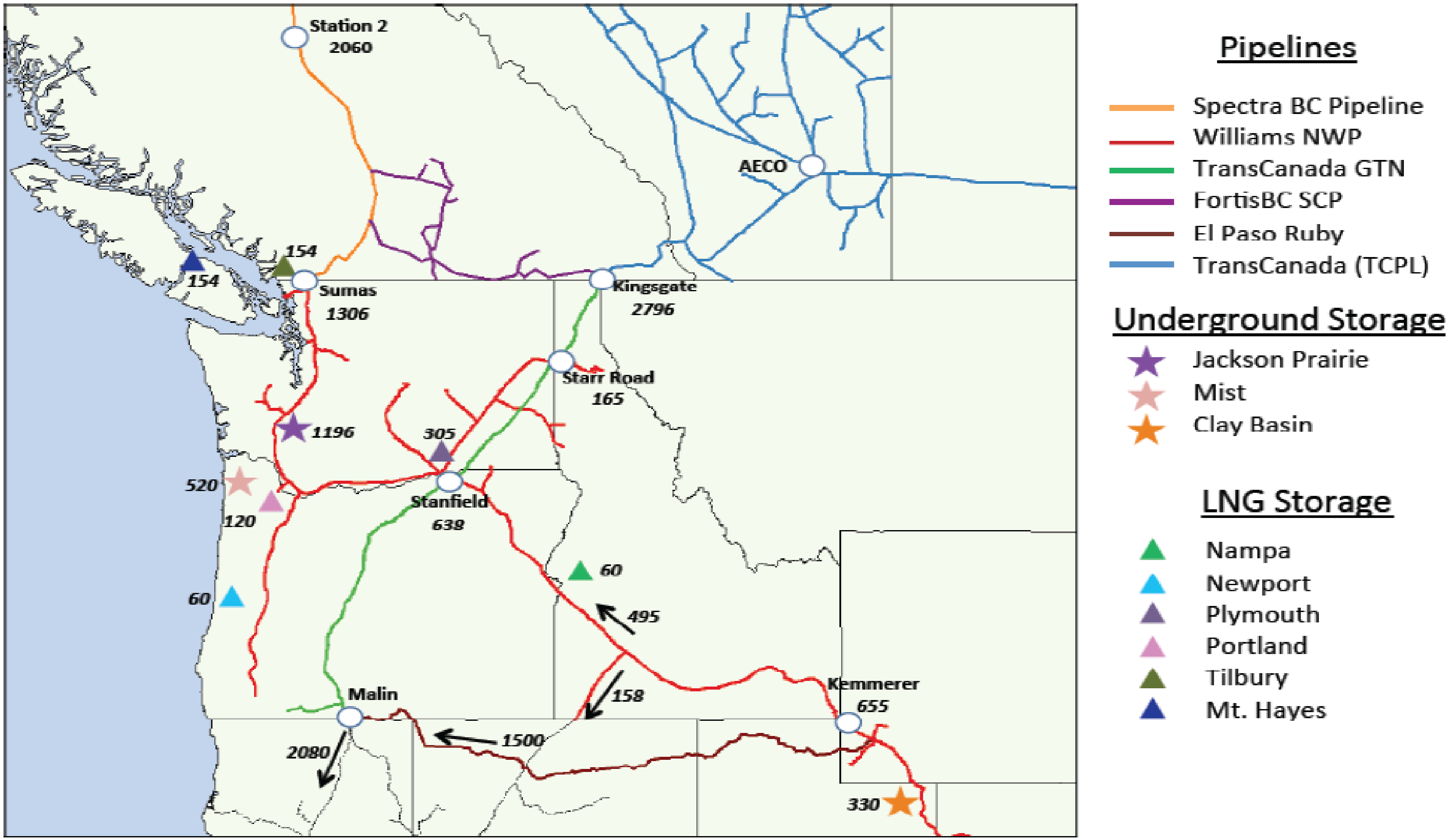
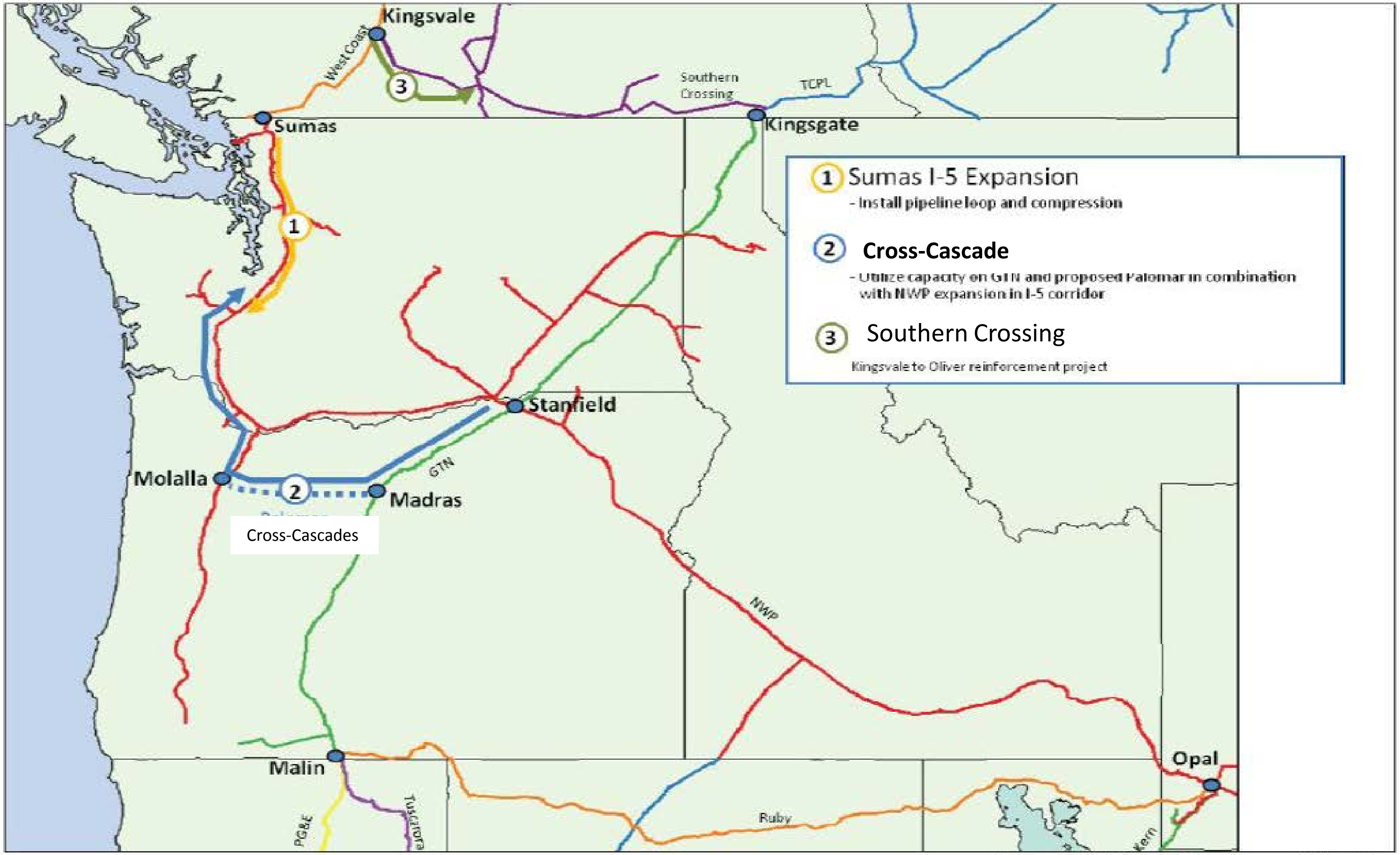

Western
Canadian
Sedimentary
Basin
Station 2
Sumas
Kingsgate
AECO
Stanfield
Malin
Opal
Rockies
Basins

PRINCIPLE SUPPLY BASINS



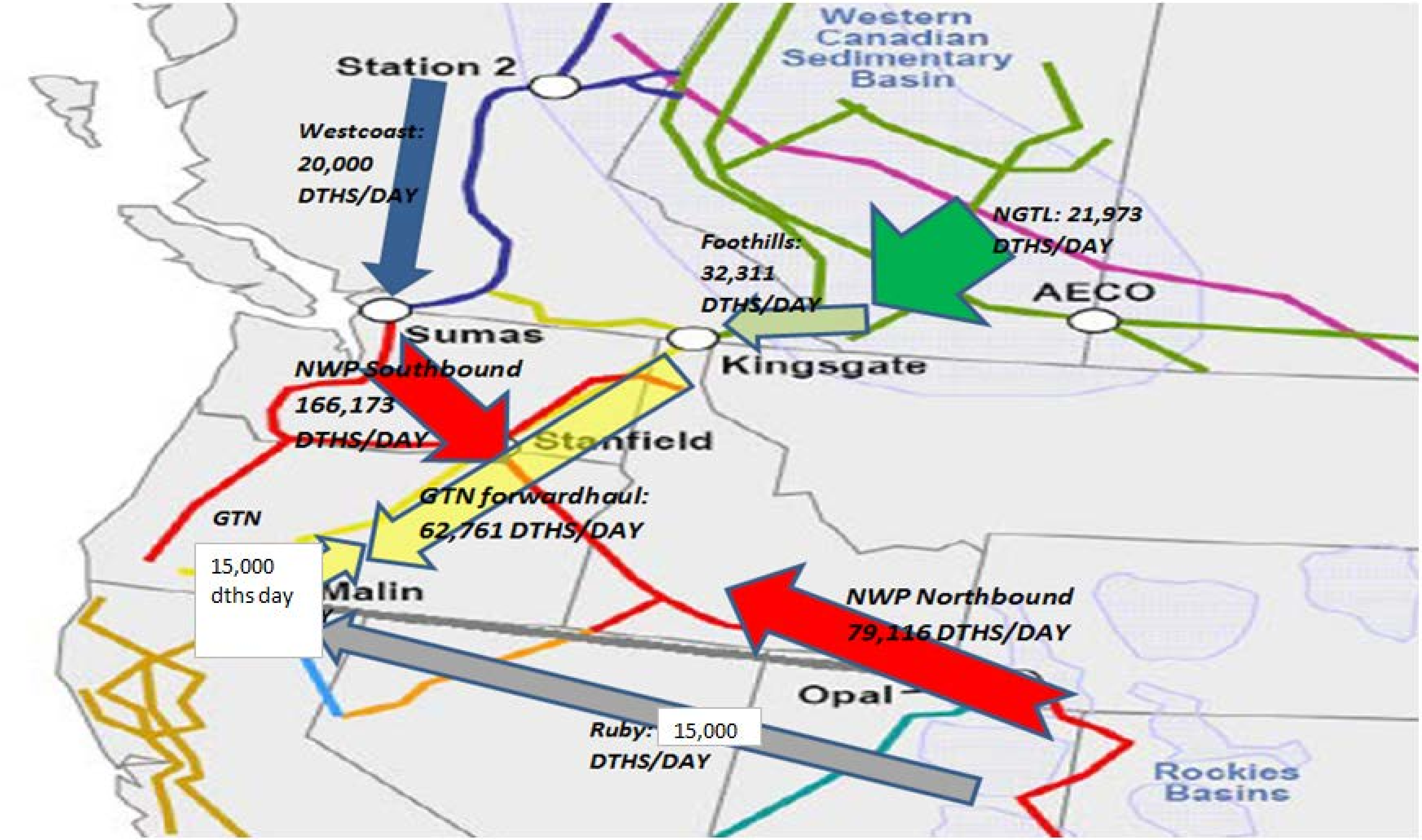


Source: Northwest Gas Association - Numbers indicate delivery or takeaway capacities in MDth.



Source: Williams Northwest Pipeline

SUMMARY OF CNGC WINTER TRANSPORT CAPACITY FLOW



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STORAGE

1) Goal is to cycle the storage accounts each heating season, dependent on demand and operating conditions
2) Assumes all accounts will be 35% full by June 30, 80% full by August 31, and 100% full by September 30
3) Unless noted, assumes normal weather with peak event
4) SGS01 balances based on historical data with inventory zero by end of April
5) SGS02, SGS622 and SGS626 assumes balance of 80% November, 40% December, 20% January and zero by end of February
6) Jackson Prairie storage and Plymouth LNG are utilized based on weather, market and operational conditions

Jackson Prairie
- SGS01
- SGS02
- SGS622
- SGS626

Plymouth LNG
- LS01

CASCADE STORAGE CONTRACTS		
	Storage Capacity	Withdrawl
Total	(decatherms)	(dths/day)
SGS01	604,351	16,789
SGS02	350,000	30,000
SGS622	102,782	3,500
SGS626	178,460	6,077
LS01	562,200	60,000

Supply inputs

- Each basin is given a resource option
  - Annual
  - November – March
  - Day gas, first of month, spot
- Commodity adders take the following into consideration:
  - Annual adder higher than seasonal or spot adders
  - Includes some structured products
  - No financial hedges
- Let SENDOUT size the amounts but limit single packages to no more than 20,000 dths/day

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Supply Inputs

MODEL NAME	CATEGORY	RECEIPT PT(S)	DELIVERY PT(S)	PRICE INDEX	INDEX DIFFERENTIAL/EST PRICE	DEMAND CHARGE	DEAL START DATE	DEAL END DATE	MDQ IN DTHS
FIRM SPT SUM	SEASONAL	SUMAS	NWP, GTN	IFERC SUMAS			11/1/2015	INCREMENTAL	VARIABLE
FIRM SPT NIT	SEASONAL	AECO	GTN	AECO (CGPR)			11/1/2015	INCREMENTAL	VARIABLE
FIRM SPT RM	SEASONAL	ROCKIES	NWP, GTN	IFERC ROCKIES			11/1/2015	INCREMENTAL	VARIABLE
INCR SUM A	ANNUAL	SUMAS	NWP, GTN	IFERC SUMAS			11/1/2015	INCREMENTAL	VARIABLE
INCR RM A	ANNUAL	ROCKIES	NWP, GTN	IFERC ROCKIES			11/1/2015	INCREMENTAL	VARIABLE
INCR NIT A	ANNUAL	AECO	GTN	AECO (CGPR)			11/1/2015	INCREMENTAL	VARIABLE
INCR SUM S	SEASONAL	SUMAS	NWP, GTN	IFERC SUMAS			11/1/2015	INCREMENTAL	VARIABLE
INCR RM S	SEASONAL	ROCKIES	NWP, GTN	IFERC ROCKIES			11/1/2015	INCREMENTAL	VARIABLE
INCR NIT S	SEASONAL	AECO	GTN	AECO (CGPR)			11/1/2015	INCREMENTAL	VARIABLE
INCR ST2	SEASONAL	STATION 2	NWP, GTN	GD SUMAS			11/1/2015	INCREMENTAL	VARIABLE
INCR STRU SU	ANNUAL	SUMAS	NWP, GTN	STRUCTURED	Index Ls $0.25 if Index >4		11/1/2015	INCREMENTAL	VARIABLE
INCR STRU RM	ANNUAL	ROCKIES	NWP, GTN	STRUCTURED	Index Ls $0.25 if Index >4		11/1/2015	INCREMENTAL	VARIABLE
INCR STRU AE	ANNUAL	AECO	GTN	STRUCTURED	Index Ls $0.25 if Index >4		11/1/2015	INCREMENTAL	VARIABLE
INCR SUM FX	ANNUAL	SUMAS	NWP, GTN	FIXED			11/1/2015	INCREMENTAL	VARIABLE
INCR RM FX	ANNUAL	ROCKIES	NWP, GTN	FIXED			11/1/2015	INCREMENTAL	VARIABLE
INCR NIT FX	ANNUAL	AECO	GTN	FIXED			11/1/2015	INCREMENTAL	VARIABLE
INCR MAL	SEASONAL	MALIN	BACKHAULS NWP, GTN	MALIN			11/1/2015	INCREMENTAL	VARIABLE
SAT LNG	SEASONAL	ZONAL	ZONAL	NYMEX HH			11/1/2015	INCREMENTAL	VARIABLE
IMP LNG NOR	SEASONAL	PALOMAR	BACKHAULS NWP, GTN	NYMEX HH			11/1/2018	INCREMENTAL	VARIABLE
IMP LNG SOR	SEASONAL	PACIFIC CONNECTOR	BACKHAULS NWP, GTN	NYMEX HH			11/1/2018	INCREMENTAL	VARIABLE
SAT PROP	SEASONAL	ZONAL	ZONAL	NYMEX HH			11/1/2016	INCREMENTAL	VARIABLE
INCR CG NWP	SEASONAL	CITYGATE	NWP	NYMEX HH		0.05	11/1/2016	INCREMENTAL	VARIABLE
INCR CG GTN	SEASONAL	CITYGATE	GTN	NYMEX HH		0.05	11/1/2016	INCREMENTAL	VARIABLE
SUPPLY MDQS ARE CAPPED AT 20,000 DTHS/DAY									

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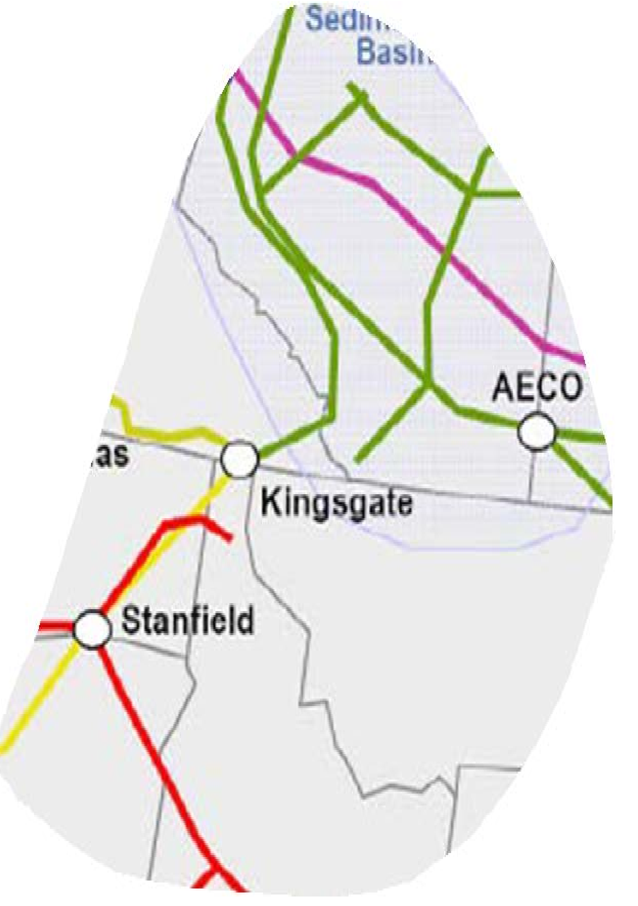
Transport Inputs

- Existing pipeline transportation agreements are in the system
- We assume an increase in transport demand rate every three years; increase is tied to Consumer Price Index
- Fuel is held flat throughout the planning horizon

POTENTIAL NOVA EXPANSION

- 2017 NGTL System Expansion Project included in Annual Plan
- Annual Plan posted on TransCanada website December 15, 2014
- Section 52 application to be filed end of 1st QTR 2015
- Anticipate certificate 3rd QTR 2016
- Start construction: 4th QTR 2016
- Target in-service: 2nd QTR 2017



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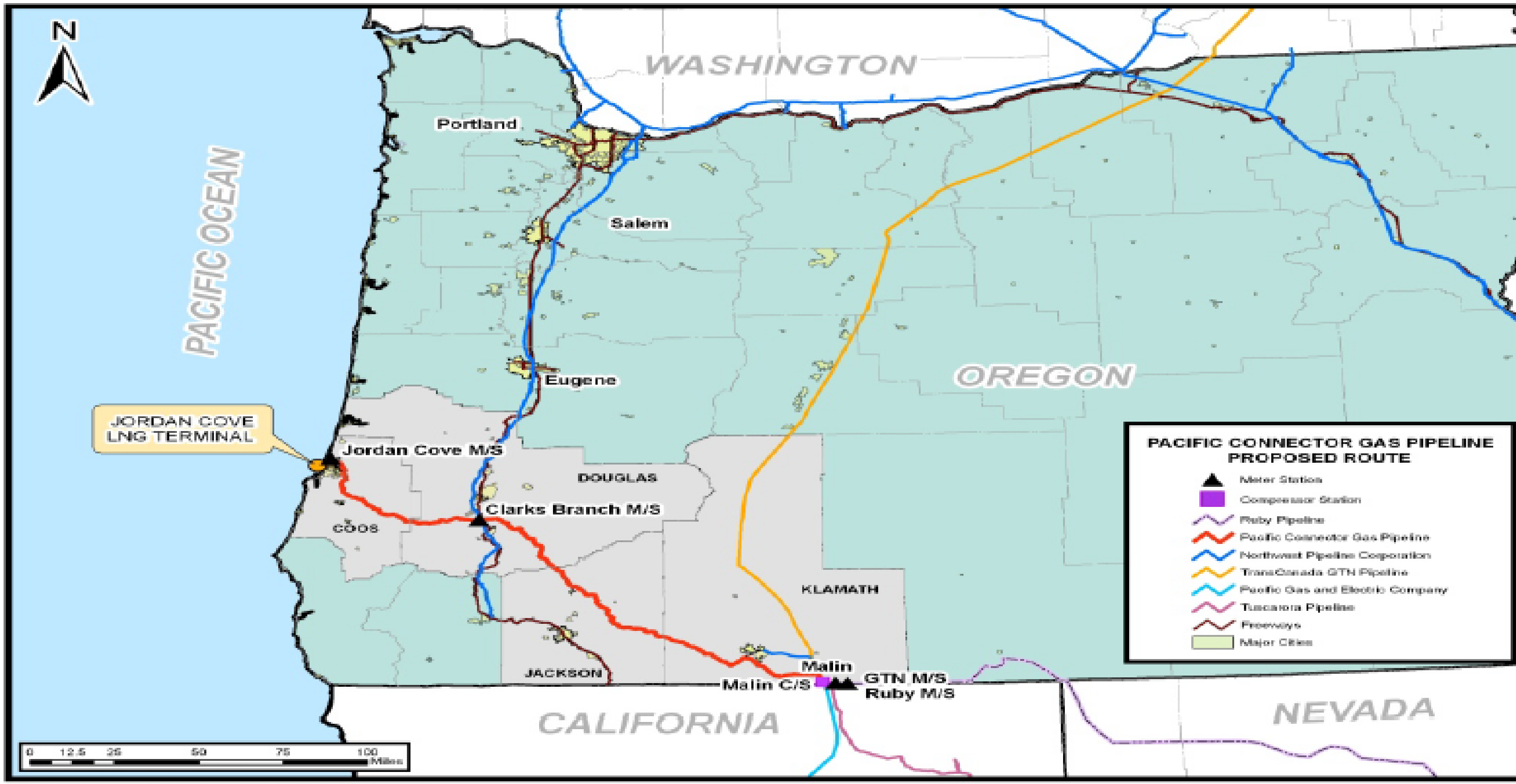
Pacific Connector Gas Pipeline Project

Williams
Ingenuity takes energy.®



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Pacific Connector Gas Pipeline (PCGP)

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- 232-mile of 36-inch diameter pipeline with:
  - 1,060,000 Dth/d of firm transportation
  - 41,000 horsepower at Malin
- Receipt interconnects with:
  - Gas Transmission Northwest
  - Ruby Pipeline
- Deliveries interconnect with:
  - Northwest Pipeline's Grants Pass Lateral
  - Jordan Cove Delivery Meter Station
- PCGP will be built primarily to serve the Jordan Cove LNG Terminal (located near Coos Bay, Oregon)
  - Waiting on permission to grant export to Non-Free Trade Agreement Countries
  - Currently first in the queue for DOE approval
    - Will facilitate permitting and marketing efforts
- Target in-service date 2018

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PCGP future growth opportunities

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- Will be able to serve:
  - Malin / Coos Bay corridor
    - Potential industrial facilities could be co-located near LNG terminal and make use of upgraded port facilities
  - Grants Pass Lateral
- New supply source on the Grants Pass Lateral will provide diversity and additional firm flow to serve new industrial/commercial markets:
  - Additional 76,196 Dth/d flowing south
  - Additional 42,525 Dth/d flowing north
    - Volumes can increase with compressor station piping modifications
  - Open Season will determine whether short-haul capacity is incorporated into design
- PCGP easily expandable to 1.5 Bcf
  - Future Open Season will be held to serve regional market growth

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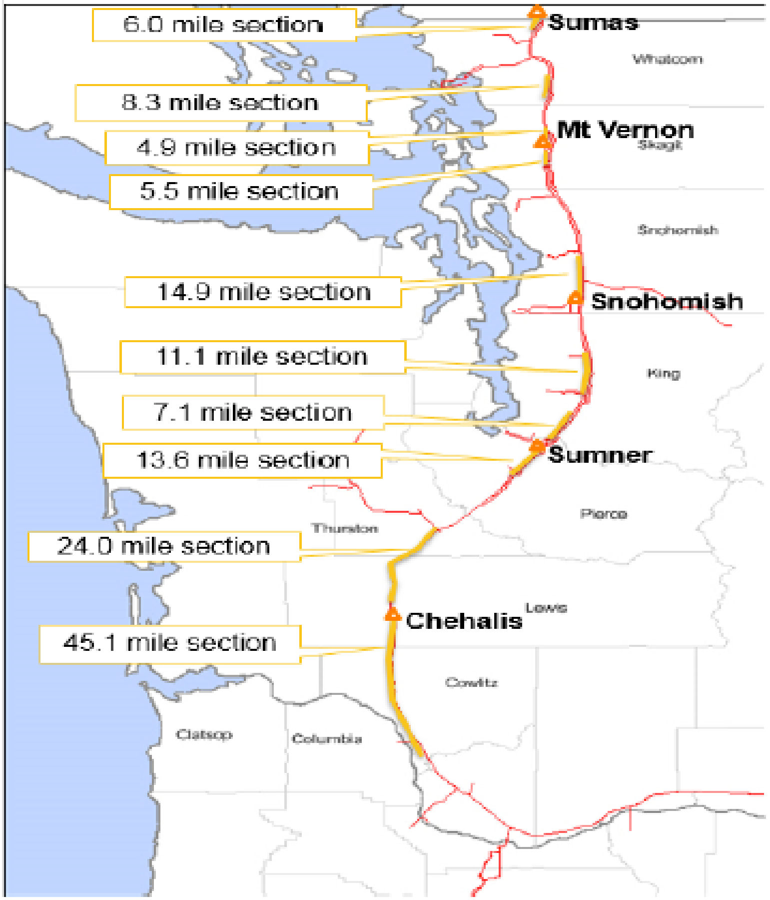
Washington Expansion Project

Williams
Ingenuity takes energy.



- FERC application filed 2013
- 140 miles of 36-inch diameter loop line with:
  - 750,000 Dth/d of firm transportation
  - 89,620 incremental horsepower required along I-5
- Rates (per Dth/d):
  - $0.74 traditional
  - $0.56 levelized
- Estimated cost $1.1 billion
- Targeted in-service date November 2018
  - Potential regional loads with in-service dates phased in

Cascade Natural Gas Corporation
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Washington Expansion is market oriented

Williams. Ingenuity takes energy.

- Provides competitively priced natural gas to committed users:
  - Supplies Oregon LNG terminal customers
  - Increases reliability:
    - Fills in un-looped sections in I-5 corridor
    - Continuous 30-inch pipe along side 36-inch loop
  - Provides opportunity to other potential customers in the region
    - Serving customers in the I-5 corridor is not contingent on Oregon LNG moving forward

- Potential users participated in an "open season" process
  - Transportation capacity was offered to <u>all customers</u> in a non-binding open season held in October 2012
    - Not limited to Oregon LNG terminal customers
    - Ongoing expressions of interest from parties for new capacity welcome
      - Capacity available as early as 2016
        - Depending on location and transportation capacity needs

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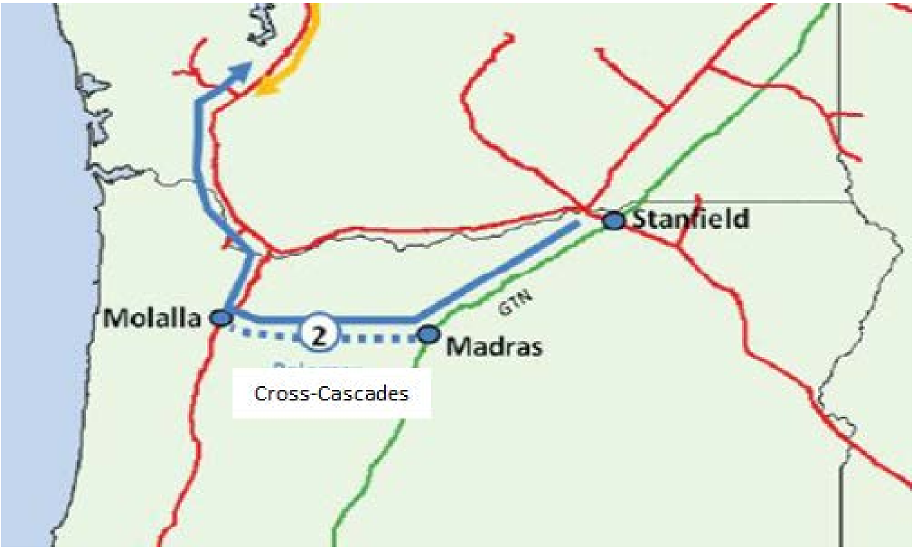
Cross Cascades Pipeline

Northwest Natural's latest IRP indicates that this proposed pipeline is possible future resource beginning in 2018

Madras is connects to GTN where gas could move to serve Central Oregon

This could perhaps be tied to North Mist expansion?



Transport Inputs

CONTRACT DESCRIPTION	RECEIPT	DELIVERY	PIPELINE	TERMINATION DATE	RATE PER DAY	Contract Demand
TF-1 Contract #100002 April 31, 1991	all rec	all del	NWP	10/31/2032	0.41	205123
Contract #135384 (JP/Bremerton), March 26, 2007	jackson prairie	bremerton/mt vernon	NWP	10/31/2029	0.246	30420
Contract #135558 (Sumas/Prtld), 4/1/2007)	sumas	stanfield/portland west	NWP	4/30/2020	0.41	25400
Contract 139382 Sumas/Sedro Wooley	sumas	sedro wooley	NWP	10/31/2050	0.41	6191
Contract 139383 Sumas/Sedro Wooley	sumas	sedro wooley	NWP	10/31/2050	0.41	1050
Contract 139384 Sumas/Sedro Wooley	sumas	sedro wooley	NWP	10/31/2050	0.41	3259
Contract #100134 January 15,1993	sumas/ignacio	burbank/yakima/aberdeen	NWP	11/30/2019	0.41	330
Contract #100149 February 15,1996	sumas/ignacio	walla walla	NWP	11/30/2019	0.41	75
Contract #100150 May 15, 1996	sumas/ignacio	menan starch	NWP	11/30/2019	0.41	160
Contract #100064 May 8, 1995	sumas	hermiston/pasco	NWP	3/31/2020	0.41	1078
Weyer Release Contract #132329 July 1, 2004	sumas	kern river	NWP	1/31/2021	0.41	5000
Contract #139090 June 2, 2011	sumas	plymouth/umatilla/bellingha	NWP	3/31/2052	0.41	27063
Contract #139637 Jan 1, 2013	sumas	hermiston/oak harbor/selah	NWP	10/31/2050	0.41	7241
Contract #139630 Sep 1, 2012	stanfield	durkee/pendelton/mission	NWP	10/31/2050	0.41	7450
Contract #140047	sumas	bellingham/ferndale	NWP	10/31/2034	0.41	15000
TF-2						
Contract #100302 TF-2 January 12, 1994	jackson prairie	Stanfield, Wenatchee, Lon	NWP	10/31/2019	0.41	16789
Contract #100304 TF-2 January 12, 1994	plymouth		NWP	10/31/2019	0.41	60000
Jackson Prairie Expansion Precident Agreement # 135365 SGS-2F	jackson prairie	jackson prairie	NWP	10/31/2060	0.04056	30000
Contract # 100401 SGS-2F	jackson prairie	jackson prairie	NWP	10/31/2019	0.03562	16789
Contract #100601 LS-2F	plymouth	plymouth	NWP	10/31/2019	0.02587	60000
Contract #139627 TF-2	jackson prairie	bellingham	NWP	3/31/2020	0.41	489
Contract #139624 TF-2	jackson prairie	bellingham	NWP	3/31/2020	0.41	282
Contract #139622 SGS-2F	jackson prairie	jackson prairie	NWP	3/31/2026	0.03562	3500
Contract #139626 SGS-2F	jackson prairie	jackson prairie	NWP	3/31/2020	0.03562	6077
					0.16381	
2003 Expansion, #08488	kingsgate	malin	GTN	10/31/2028	0.34422	20380
Firm Transportation #02812 (November 4, 1994)	kingsgate	malin	GTN	4/30/2016	0.34422	3600
Firm Transportation #00179 (October 7, 1993)	kingsgate	system	GTN	10/31/2023	0.19811	31335
Firm Transportation #00152 (December 1, 1997)	kingsgate	system	GTN	10/31/2023	0.26432	7446
Firm South-to-North Transportation #12094 11/1/12 - 3/31/18	turqouise flats	stanfield	GTN	3/31/2018	0.16381	10000
Firm South-to-North Transportation #13687 4/1/18 - 10/31/39	turqouise flats	stanfield	GTN	10/31/2039	0.20477	10000
Firm South-to-North Transportation #13688 11/1/14 - 10/31/39	turqouise flats	stanfield	GTN	10/31/2039	0.20477	5000
Service Agreement (NOVA) September 4, 2001 (#2003039348-1)	AECO	AB/C border	NOVA	10/31/2028	0.1591	21973
2002 Service Agreement (CNG FS-2)	AB/C border	kingsgate	Foothills	11/1/2017	0.076	3126
Service Agreement (ANG) September 11, 2001 (#CNG FS-3)	AB/C border	kingsgate	Foothills	10/31/2028	0.076	21583
FS-1 Transportation (ANG) June 12, 1991 (CNG FS-1)	AB/C border	kingsgate	Foothills	10/31/2023	0.076	7602
Westcoast Service Agreement January 3, 2002 (#FI-2583-B-00)	station 2	huntingdon	Westcoast	10/31/2019	0.4833	20000
Firm Service Agreement #61036000B January 9, 2012	pearl creek	turqouise flats	Ruby	10/31/2039	0.75	15000

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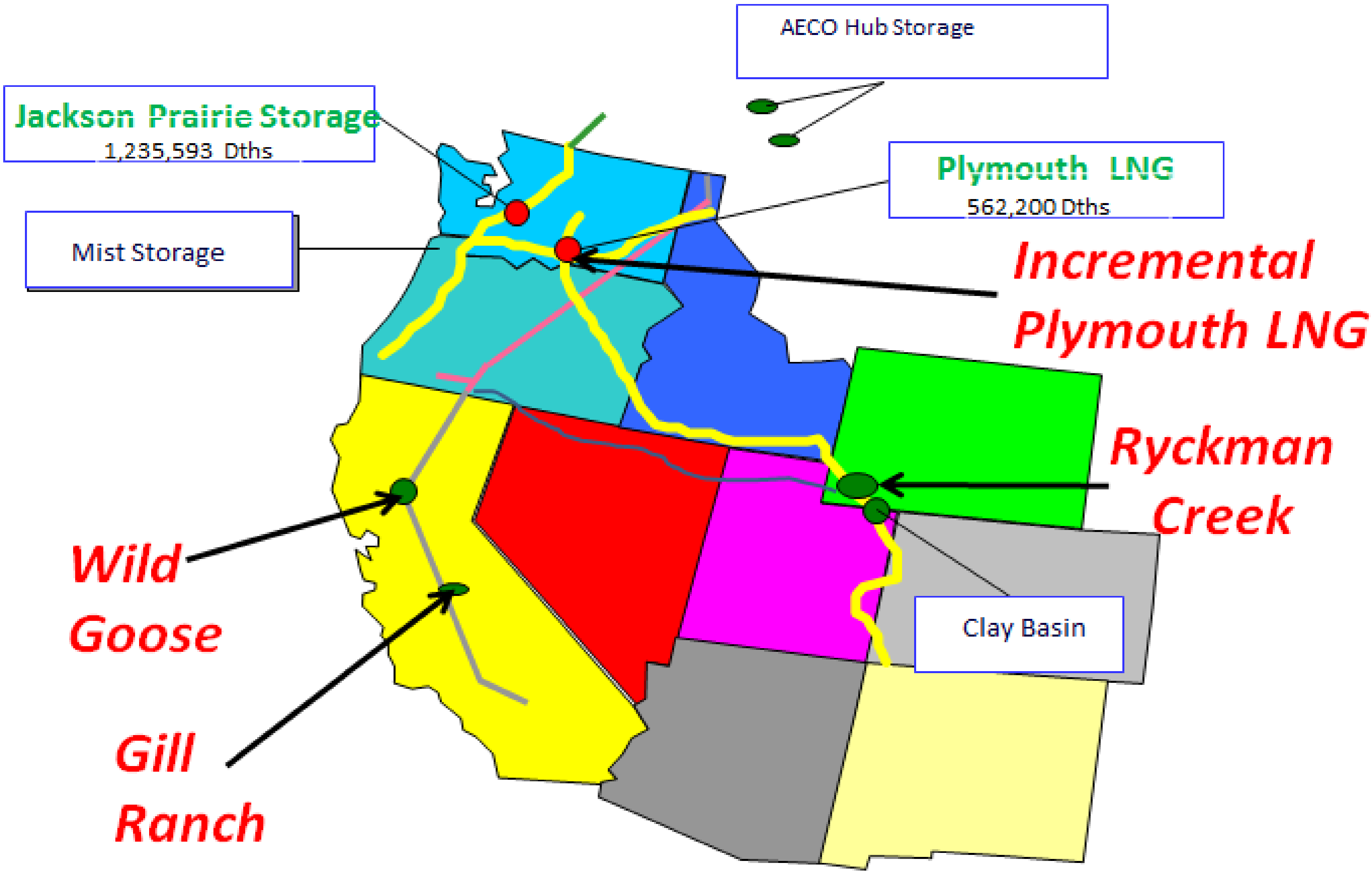
REGIONAL STORAGE



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Plymouth LNG

- Northwest Pipeline owns and operates an LNG storage facility located near Plymouth, Washington, which provides standby service for its customers during extreme peaks in demand.
- The facility has a total LNG storage capacity equivalent to 2.3 Bcf of working natural gas, liquefaction capability of 12 MMcf per day and regasification capability of 300 MMcf per day.
- Certain of Northwest's major customers own the working natural gas stored at the LNG plant.
- Centrally located to Cascade's service territory. Can utilize multiple pipelines (NWP, Ruby, GTN)

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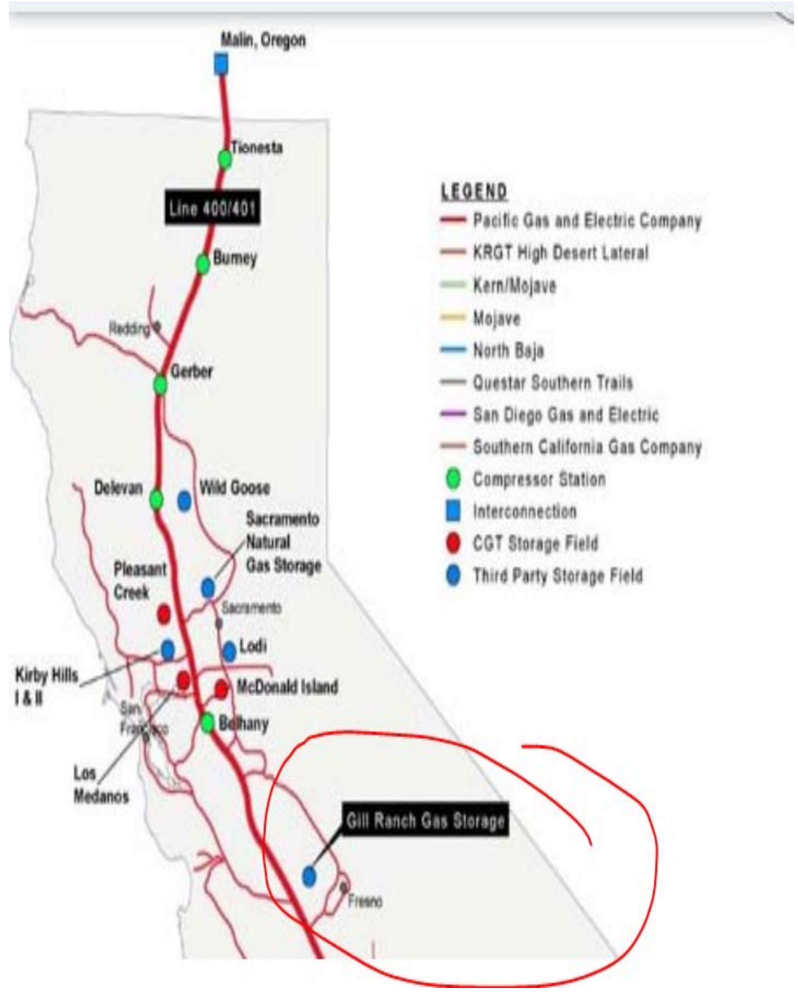
Gill Ranch Storage

- Gill Ranch Storage is an underground intra-state natural gas storage facility near Fresno, Calif. It includes a pipeline that links the facility to Pacific Gas & Electric Company's (PG&E) mainline transmission system, allowing it to serve customers throughout California.
- GRS has the capacity to ultimately provide approximately 20 billion cubic feet (Bcf) of underground natural gas storage.
- The facility is located about 25 miles west of Fresno and includes an approximately 27-mile, 30-inch pipeline, which is connected to the PG&E Line 401 north of Panoche, Calif.
- The premium storage location offers a unique opportunity to access five interconnects.
- The site was developed in a joint agreement by Gill Ranch Storage, LLC, a subsidiary of NW Natural, and PG&E.
- The site has potential for future expansion.
- Would require California Gas Transmission capacity to Malin



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Wild Goose Storage

- Wild Goose is located north of Sacramento in northern California and was the first independent storage facility built in the state. The facility commenced full commercial operations in April 1999 and in April 2004 completed its first expansion. Customers have direct access to Pacific Gas and Electric's (PG&E) backbone system.

- Total gas storage and deliverability capacity at Wild Goose currently is as follows:

- Working Gas Capacity: 75.0 Bcf
- Peak Withdrawal Rate 950 mmcf/d
- Peak Injection Rate525 mmcf/d
- Key Features

- Citygate pricing, liquidity, arbitrage opportunities;
- the ability to manage OFO/EFO's on the PG&E system; and
- supply reliability
- Would require California Gas Transmission capacity to Malin

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Mist Underground Storage Facility

- The facility consists of seven underground natural gas storage reservoirs, a compressor station and gathering pipelines.
- Located in Columbia County, beginning approximately one-half mile southwest of the unincorporated community of Mist and continuing north for approximately 3.5 miles.
- Maximum daily firm withdrawals ratchet downward from the MDWQ when inventory drops below 50% of the MSC
- Now through March 2017 - Mist Interstate Storage Service is sold out, nothing is available.
- April 1, 2017 start of injections, with withdrawals available for the following winter.
- Beyond 2026 would need to subscribe to North Mist expansion project
- Would require NWP capacity to flow to Washington, could possibly flow of Cross-Cascade

Ryckman Creek Storage

- Ryckman Creek Resources, LLC, a wholly-owned subsidiary of Peregrine Midstream Partners, LLC
- Ryckman Creek is located in Uinta County, Wyoming, near the Opal Hub.
- Ryckman Creek has converted a partially depleted oil and gas reservoir into a gas storage facility with 35 BCF of working gas and a maximum daily withdrawal rate of 480,000 Dths/d.
- Ryckman Creek Gas Storage Facility is located near the town of Evanston, Wyoming and approximately twenty-five miles southwest of the Opal Hub.
- Ryckman Creek currently has interconnects with Questar Gas Pipeline, Kern River Transmission, Questar Overthrust Pipeline, Ruby Pipeline and Northwest Pipeline.
- Events have impacted the timeline

Other considerations for alternative storage resources

- We do not plan foresee a Jackson Prairie expansion in during the planning horizon
- The desirable working inventory is set between 300,000 and 500,000, consistent with recent SENDOUT runs at various levels
- Some assumptions must be made for the negotiated rates (to be shared under confidentiality blanket)
- We assume at least one cycle of all storage
- Earliest expectation for any storage is November 2017
- Prefer 10+ year solutions

Biogas

- Cascade has been approached regarding agricultural based methane (biogas) for possible delivery into specific sites in our service territory.
- Issues surrounding pipe size, gas conditioning and gas quality need to be addressed in any potential project as well as
    - Flow measurement
    - Pressure control
    - Over pressure protection
    - Electrical and controls
- We believe at some point in the future some measure of biogas will be available to the system

MODEL NAME	CONTRACT LOCATION TYPE	PIPELINE	PRICE TYPE	XPIRY DATE	OTHER COMMENTS	PRICE OR INDEX BASIS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
SAT LNG 30-S	Satellite LNG Zone 30-S	CNG	NYMEX		RUN AT VARIABLE VOLUMES UP TO THE AMOUNT		1,000	1,000	1,000								1,000	1,000
SAT LNG OR	Satellite LNG Zone Oregon	CNG	NYMEX		RUN AT VARIABLE VOLUMES UP TO THE AMOUNT		1,000	1,000	1,000								1,000	1,000
BNG 10	Bio-natural gas Zone 10	CNG	NYMEX		RUN AT VARIABLE VOLUMES UP TO THE AMOUNT		1,000	1,000	1,000								1,000	1,000
BNG 20	Bio-natural gas Zone 20	CNG	NYMEX		RUN AT VARIABLE VOLUMES UP TO THE AMOUNT		1,000	1,000	1,000								1,000	1,000
BNG ME-OR	Bio-natural gas Zone Meacham-Oregon	CNG	NYMEX		RUN AT VARIABLE VOLUMES UP TO THE AMOUNT		1,000	1,000	1,000								1,000	1,000

SENSITIVITIES ANALYSES

Scenario Name	Key Assumptions
High Growth	Strong Economic Growth result in High Load growth, Average Weather, Medium Gas Prices
Low Growth	Economic Conditions result in Low Load growth, Average Weather, Medium Gas Prices
Environmental Externalities Carbon 1	Medium Load Growth, Average Weather, Assumes Carbon Adder Implemented in 2017 for CO2 emissions at $15/ton with adder increasing annually by 3% plus CPI (Consumer Price Index)
Environmental Externalities Carbon 2	Medium Load Growth, Average Weather, Assumes Carbon Adder Implemented in 2017 for CO2 emissions at $20/ton with adder increasing annually by 3% plus CPI (Consumer Price Index)
Environmental Externalities Carbon 3	Medium Load Growth, Average Weather, Assumes Carbon Adder Implemented in 2017 for CO2 emissions at $30/ton with adder increasing annually by 3% plus CPI (Consumer Price Index)

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SCENARIO NAME	KEY ELEMENTS IN SENDOUT SCENARIO Medium Load Growth, Medium Gas Price Forecast, Average weather with Peak Event. All elements considered. **All items in RED mean those elements were excluded from the scenario**		
All in Case	Current Station2	Incremental NOVA	AECO Year, Seas, Spot
	Current NOVA-Foothills	Incremental GTN	Sumas Year, Seas, Spot
	Current GTN	Incremental NWP	Rockies Year, Seas, Spot
	Current NWP	Incremental Ruby	Station2 Year, Seas, Spot
	Current Ruby	JP1, JPExp, JP3-4, LS	Citygate GTN, NWP
	Ryckman Crk Storage	T-South-So Crossing	BioNatualGas
	Incremental JP	Pacific Connector	Satellite LNG
	Mist Storage	N-MAX-Stan-Madr	WA Expansion
		N-MAX Madr I-5	
As Is Scenario	Current Station2	Incremental NOVA	AECO Year, Seas, Spot
	Current NOVA-Foothills	Incremental GTN	Sumas Year, Seas, Spot
	Current GTN	Incremental NWP	Rockies Year, Seas, Spot
	Current NWP	Incremental Ruby	Station2 Year, Seas, Spot
	Current Ruby	JP1, JPExp, JP3-4, LS	Citygate GTN, NWP
Limited Canadian Imports	Current Station2	Incremental NOVA	AECO *Year, Seas*, Spot
	Current NOVA-Foothills	Incremental GTN	Sumas Year, Seas, Spot
	Current GTN	Incremental NWP	Rockies Year, Seas, Spot
	Current NWP	Incremental Ruby	Station2 *Year, Seas*, Spot
	Current Ruby	JP1, JPExp, JP3-4, LS	Citygate GTN, NWP
	Ryckman Crk Storage	*T-South-So Crossing*	BioNatualGas
	Incremental JP	*Pacific Connector*	Satellite LNG
	Mist Storage	*N-MAX-Stan-Madr*	*WA Expansion*
		N-MAX Madr I-5	
Ryckman Creek	Current Station2	Incremental NOVA	AECO Year, Seas, Spot
	Current NOVA-Foothills	Incremental GTN	Sumas Year, Seas, Spot
	Current GTN	Incremental NWP	Rockies Year, Seas, Spot
	Current NWP	Incremental Ruby	Station2 Year, Seas, Spot
	Current Ruby	JP1, JPExp, JP3-4, LS	Citygate GTN, NWP
	Ryckman Crk Storage	*T-South-So Crossing*	BioNatualGas
	Incremental JP	*Pacific Connector*	Satellite LNG
	Mist Storage	*N-MAX-Stan-Madr*	*WA Expansion*
		N-MAX Madr I-5	

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SCENARIO NAME	KEY ELEMENTS IN SENDOUT SCENARIO Medium Load Growth, Medium Gas Price Forecast, Average weather with Peak Event. All elements considered. All items in RED mean those elements were excluded from the scenario		
Mist	Current Station2	Incremental NOVA	AECO Year, Seas, Spot
	Current NOVA-Foothills	Incremental GTN	Sumas Year, Seas, Spot
	Current GTN	Incremental NWP	Rockies Year, Seas, Spot
	Current NWP	Incremental Ruby	Station2Year, Seas, Spot
	Current Ruby	JP1, JPExp, JP3-4, LS	Citygate GTN, NWP
	Ryckman Crk Storage	*T-South-So Crossing*	BioNatualGas
	Incremental JP	*Pacific Connector*	Satellite LNG
	Mist Storage	*N-MAX-Stan-Madr*	*WA Expansion*
		N-MAX Madr I-5	
Mist and Ryckman Creek	Current Station2	Incremental NOVA	AECO Year, Seas, Spot
	Current NOVA-Foothills	Incremental GTN	Sumas Year, Seas, Spot
	Current GTN	Incremental NWP	Rockies Year, Seas, Spot
	Current NWP	Incremental Ruby	Station2Year, Seas, Spot
	Current Ruby	JP1, JPExp, JP3-4, LS	Citygate GTN, NWP
	Ryckman Crk Storage	*T-South-So Crossing*	BioNatualGas
	Incremental JP	*Pacific Connector*	Satellite LNG
	Mist Storage	*N-MAX-Stan-Madr*	*WA Expansion*
		N-MAX Madr I-5	
T-South Enhancement/Southern Crossing with Limited Canadian	Current Station2	Incremental NOVA	AECO *Year, Seas*, Spot
	Current NOVA-Foothills	Incremental GTN	Sumas Year, Seas, Spot
	Current GTN	Incremental NWP	Rockies Year, Seas, Spot
	Current NWP	Incremental Ruby	Station2 *Year, Seas*, Spot
	Current Ruby	JP1, JPExp, JP3-4, LS	Citygate GTN, NWP
	Ryckman Crk Storage	T-South-So Crossing	BioNatualGas
	Incremental JP	*Pacific Connector*	Satellite LNG
	Mist Storage	*N-MAX-Stan-Madr*	*WA Expansion*
		N-MAX Madr I-5	
T-South Enhancement/Southern Crossing	Current Station2	Incremental NOVA	AECO Year, Seas, Spot
	Current NOVA-Foothills	Incremental GTN	Sumas Year, Seas, Spot
	Current GTN	Incremental NWP	Rockies Year, Seas, Spot
	Current NWP	Incremental Ruby	Station2 Year, Seas, Spot
	Current Ruby	JP1, JPExp, JP3-4, LS	Citygate GTN, NWP
	Ryckman Crk Storage	T-South-So Crossing	BioNatualGas
	Incremental JP	*Pacific Connector*	Satellite LNG
	Mist Storage	*N-MAX-Stan-Madr*	*WA Expansion*
		N-MAX Madr I-5	

SCENARIO NAME	KEY ELEMENTS IN SENDOUT SCENARIO Medium Load Growth, Medium Gas Price Forecast, Average weather with Peak Event. All elements considered. **All items in RED mean those elements were excluded from the scenario**		
Pacific Northwest Regional (NMAX, WA Expansion, Palomar)	Current Station2	Incremental NOVA	AECO Year, Seas, Spot
	Current NOVA-Foothills	Incremental GTN	Sumas Year, Seas, Spot
	Current GTN	Incremental NWP	Rockies Year, Seas, Spot
	Current NWP	Incremental Ruby	Station2Year, Seas, Spot
	Current Ruby	JP1, JPExp, JP3-4, LS	Citygate GTN, NWP
	Ryckman Crk Storage	*T-South-So Crossing*	BioNatualGas
	Incremental JP	*Pacific Connector*	Satellite LNG
	Mist Storage	N-MAX-Stan-Madr	WA Expansion
		N-MAX Madr I-5	
Pacific Connector	Current Station2	Incremental NOVA	AECO Year, Seas, Spot
	Current NOVA-Foothills	Incremental GTN	Sumas Year, Seas, Spot
	Current GTN	Incremental NWP	Rockies Year, Seas, Spot
	Current NWP	Incremental Ruby	Station2Year, Seas, Spot
	Current Ruby	JP1, JPExp, JP3-4, LS	Citygate GTN, NWP
	Ryckman Crk Storage	*T-South-So Crossing*	BioNatualGas
	Incremental JP	Pacific Connector	Satellite LNG
	Mist Storage	*N-MAX-Stan-Madr*	*WA Expansion*
		N-MAX Madr I-5	

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Other thoughts, questions, concerns…

- **Are there other ideas or concerns that you feel need to be addressed?**

- **Are there other alternatives we should consider?**

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- Next Steps?
- Questions?

2014 Integrated Resource Plan

Technical Advisory Group Meeting

April 1, 2015

Cascade Natural Gas Technical Advisory Group Meeting #4
Portland International Airport in Portland, OR
April 1, 2015 9:00 AM – 12:30 PM

Attachments:
Attachment A – Technical Advisory Group Meeting 4 slides
Attachment B – Attendance sheet

I.) **Introduction** – Mark Sellers-Vaughn began the meeting by presenting the agenda for the 4th Technical Advisory Meeting.

- The presentation consisted of:
  - Long-range market summary
  - Price Forecast
  - Avoided Costs
  - NWP Plymouth Capacity
  - SENDOUT resource inputs
  - SENDOUT scenarios

II.) **Long-range Market Summary and Long-range Price Forecast** – Mark continued the meeting with the outlook of the market and price forecast.

- For the long-range price forecast, Mark discussed the current market prices that blend together to help create Cascades pricing forecast.
- Mark also discussed the weighting of each source.
- There was a request for Cascade to include reasoning behind the weighting of each source in the IRP.

III.) **Avoided Cost Calculation** – Mark then discussed the current Avoided Cost calculation as well as addressed UM 1622.

- 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.
- Mark discussed the methodology in calculating the avoided cost along with the 10% adder for unidentified environmental benefits.
- Mark discussed how SENDOUT helps calculate the avoided cost:
  - The marginal cost report from SENDOUT is used for the avoided cost but it does not break out the components. Additional detailed supply, transport and storage costs reports are generated from SENDOUT to help calculate the avoided cost.
- UM 1622 was addressed to clarify any confusion:
  - UM 1622 is not a financial derivative.
  - Cascade does not need to include UM 1622 in the 2014 IRP.

IV.) **NWP Plymouth LNG Capacity** – Jon Whiting presented the acquisition of 100,000 Dth's of Plymouth LNG and the incentives (Sweeteners) that made this acquisition beneficial for Cascade and, therefore, beneficial for rate payers.

- Cascade acquires 18,125 Dth/d of Storage Demand and 10,675 Dth/d of TF-2 capacity effective Nov. 1, 2015 through March 31. 2015.

- CNGC also extends its existing Plymouth LNG from Oct. 31. 2020 to March 31. 2015.
- Incentives:
    - o Cascade releases 30,420 Dth's of seasonal capacity to an interested party.
    - o Cascade is allowed to transfer the 30,420 Bremerton (Shelton) MDDO's to its 100002 contract.
    - o NWP is filing with FERC to allow shippers holding TF-2 to elevate their scheduling priority from subordinate to primary firm.
    - o NWP will allow CNGC to lengthen its path on 7,450 Dth/d from Stanfield to Plymouth. This allows CNGC to segment the capacity.

V.) **SENDOUT Scenarios and Inputs** – Mark Sellers-Vaughn finished the slides by discussing SENDOUT.

- He discussed the Supply inputs used in SENDOUT.
- He mentions the potential supply resources that are modeled in SENDOUT.
- The transport inputs and storage resources facilities are discussed.
- Mark and Jon Whiting shortly mention that Biogas may be available to the system sometime in the future.

VI.) **Action Items** – Cascade Natural Gas took away a few Action Items from the TAG meeting.

- Washington and Oregon staff would like to receive the IRP draft prior to the 5th TAG meeting.
- Delete Confidential on all slides that are included in the 4th IRP TAG meeting slides.
- Add 35% fixed and 65% index to the IRP Document.
- Lisa Gorsuch wants to make sure Cascade includes are resource possibilities in the IRP. This includes all resources that were discussed at prior TAG meetings even if they were not modeled in SENDOUT.

VII.) **Adjourn** – Cascade Natural Gas will hold TAG 5 on April 29, 2015 at the Portland International Airport Conference Center.

Attendance:

Presenters:
Mark Sellers-Vaughn
Jon Whiting

Attendees:
Lisa Gorsuch
Jorge Ordonez
John Klingele
Brian Robertson
Ted Light
Mike Rasmuson

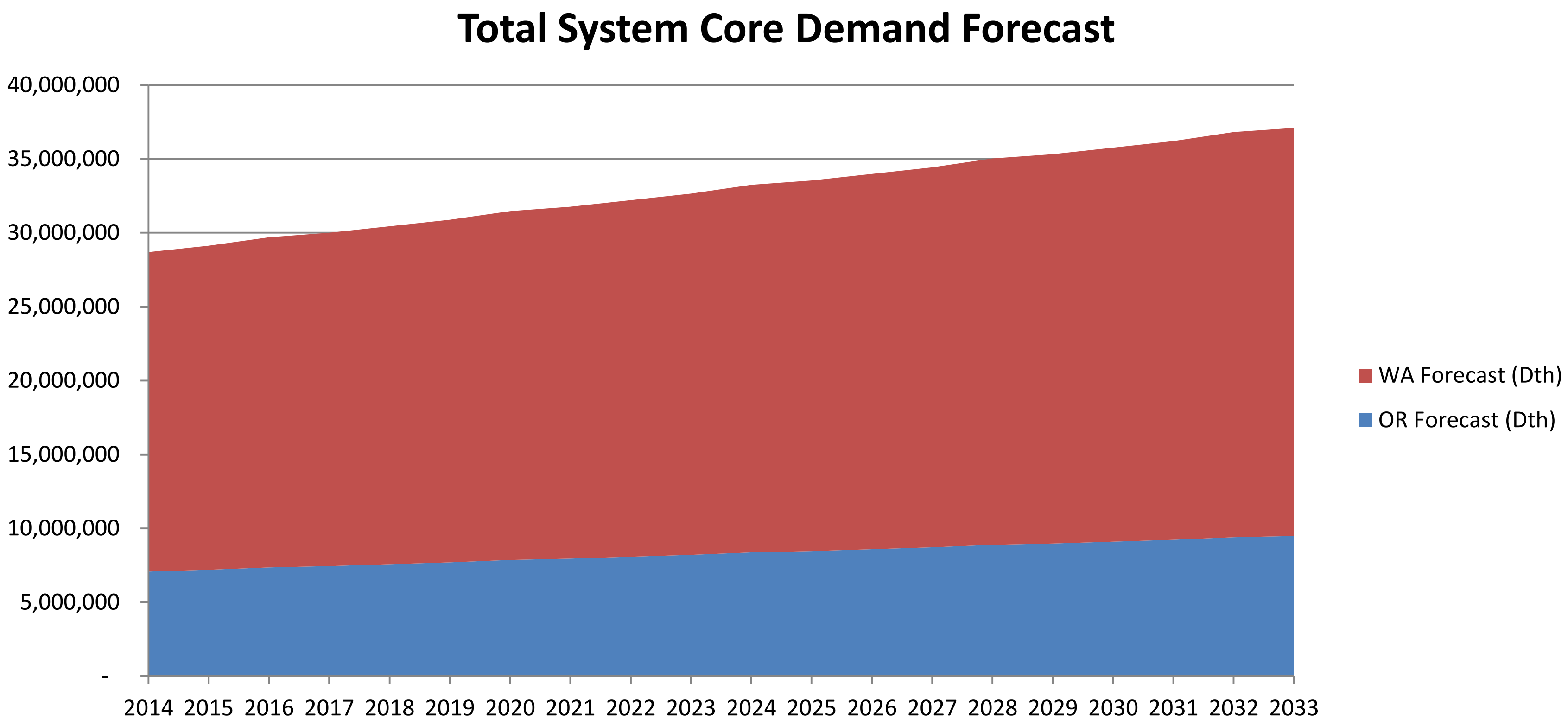
Call-in attendees:
Tommy Brookes
Nadine Hanhan
Micah Robinson
Carolyn Stone
Eric Wood
Erik Colville
Monica Cowlisha
Amanda Sargent
Jim Abrahamson
Juliana Williams
Kary Burin

First Forecast Technical Workshop

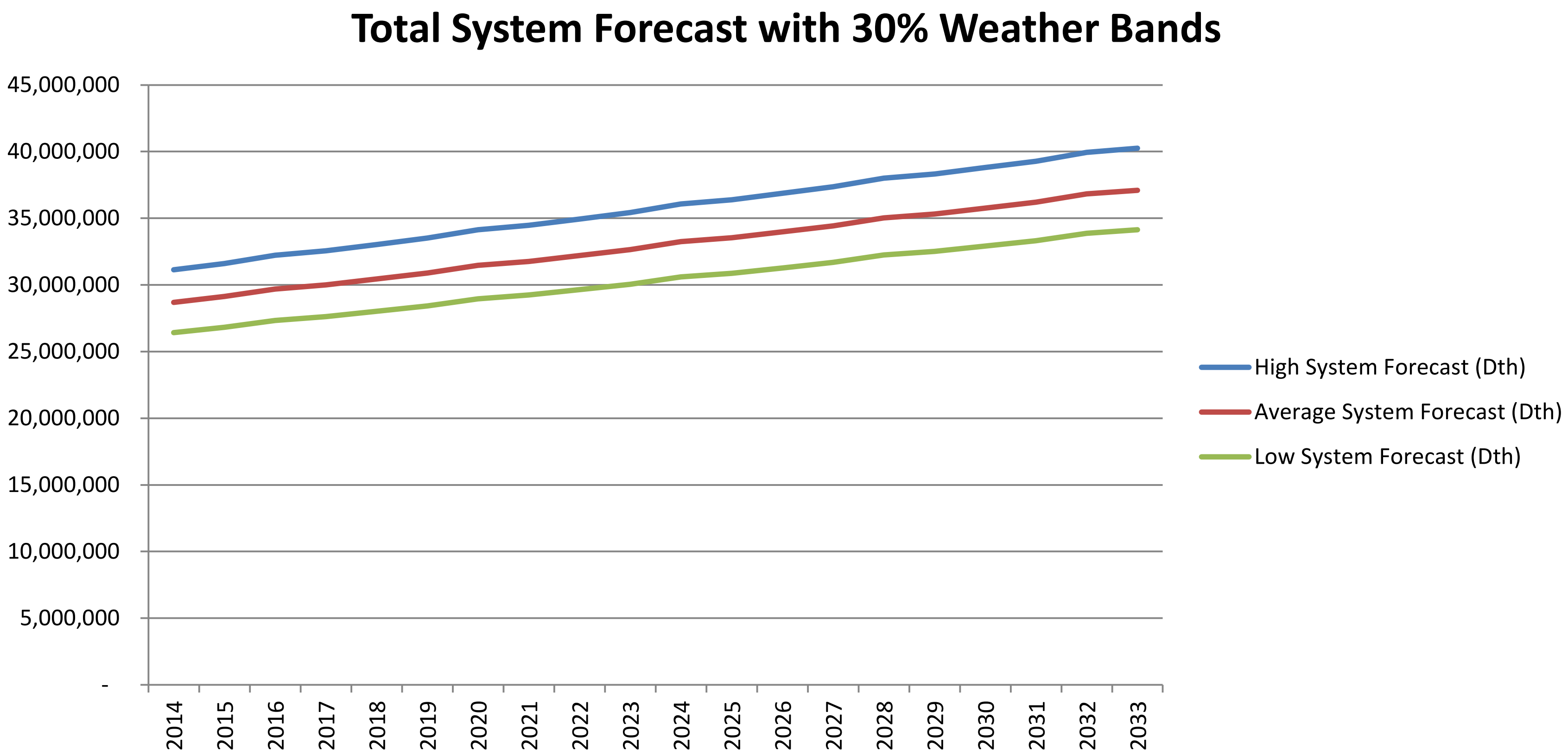
Cascade Natural Gas

Twenty Year

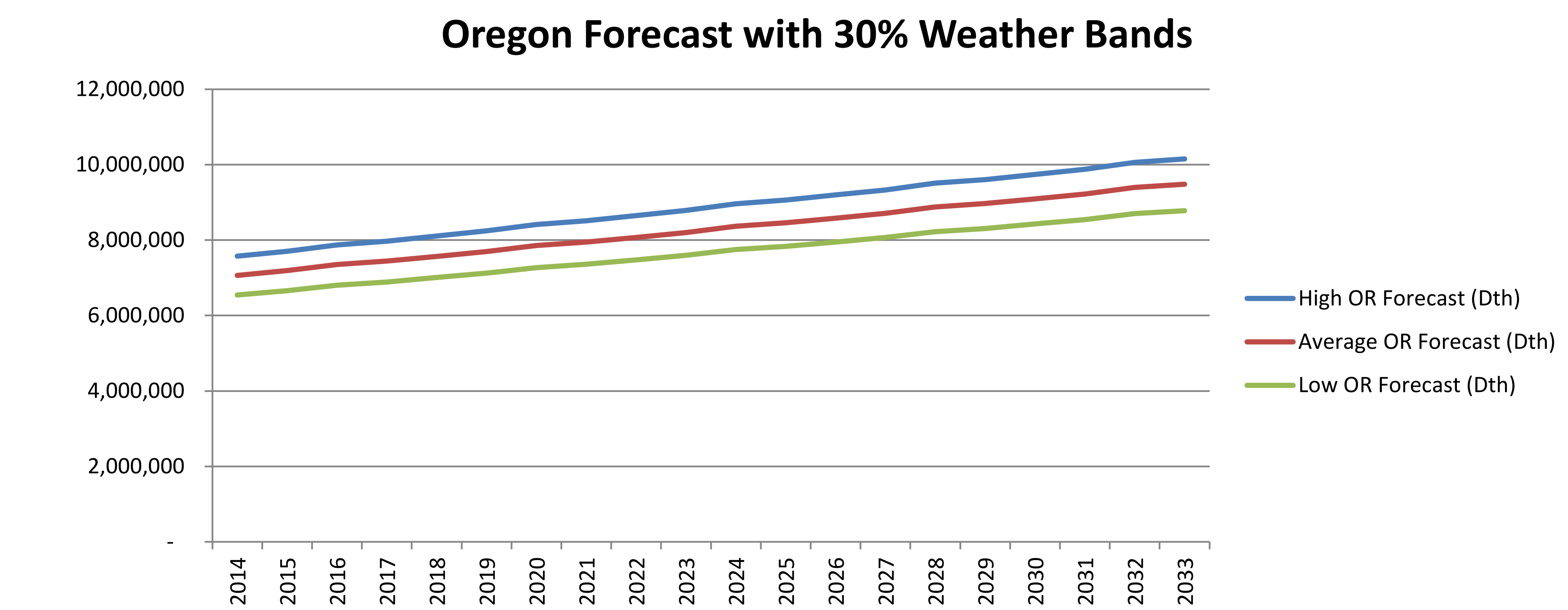
Demand Study



- 20-year Core Forecast for Oregon and Washington.



- 20-year Total System Forecast
- Based on a 30% weather range.


Oregon Forecast with 30% Weather Bands
12,000,000
10,000,000
8,000,000
6,000,000
4,000,000
2,000,000
-
2014
2015
2016
2017
2018
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2021
2022
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2024
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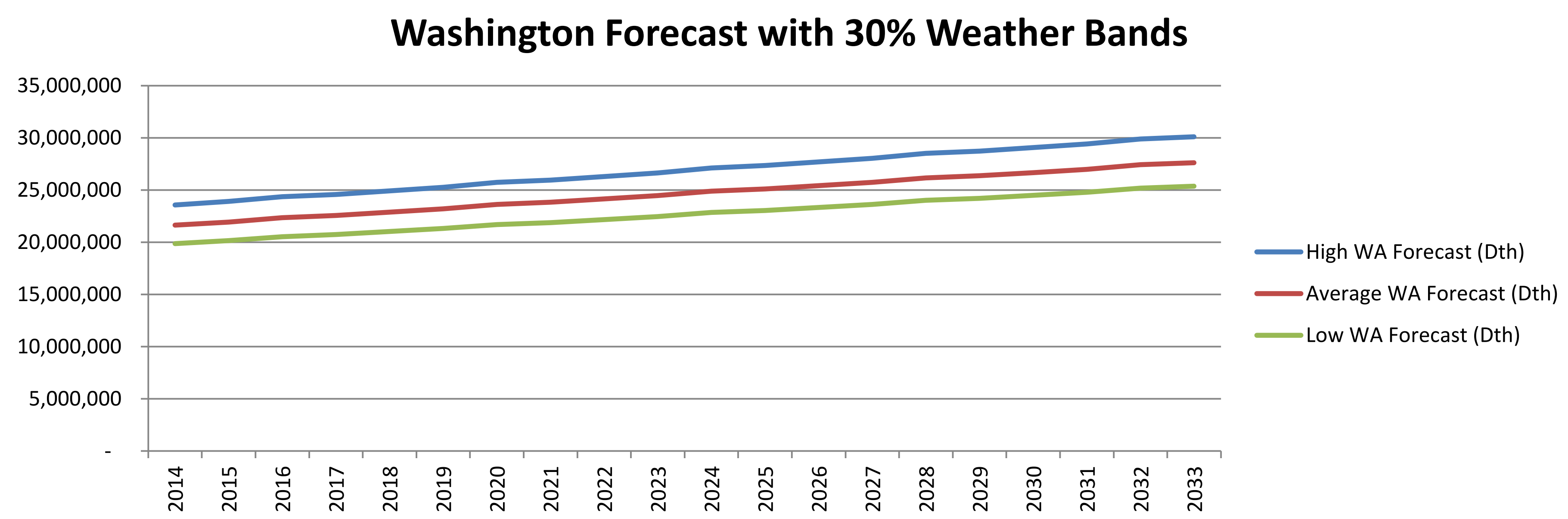
2027
2028
2029
2030
2031
2032
2033
High OR Forecast (Dth)
Average OR Forecast (Dth)
Low OR Forecast (Dth)


Washington Forecast with 30% Weather Bands
35,000,000
30,000,000
25,000,000
20,000,000
15,000,000
10,000,000
5,000,000
-
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
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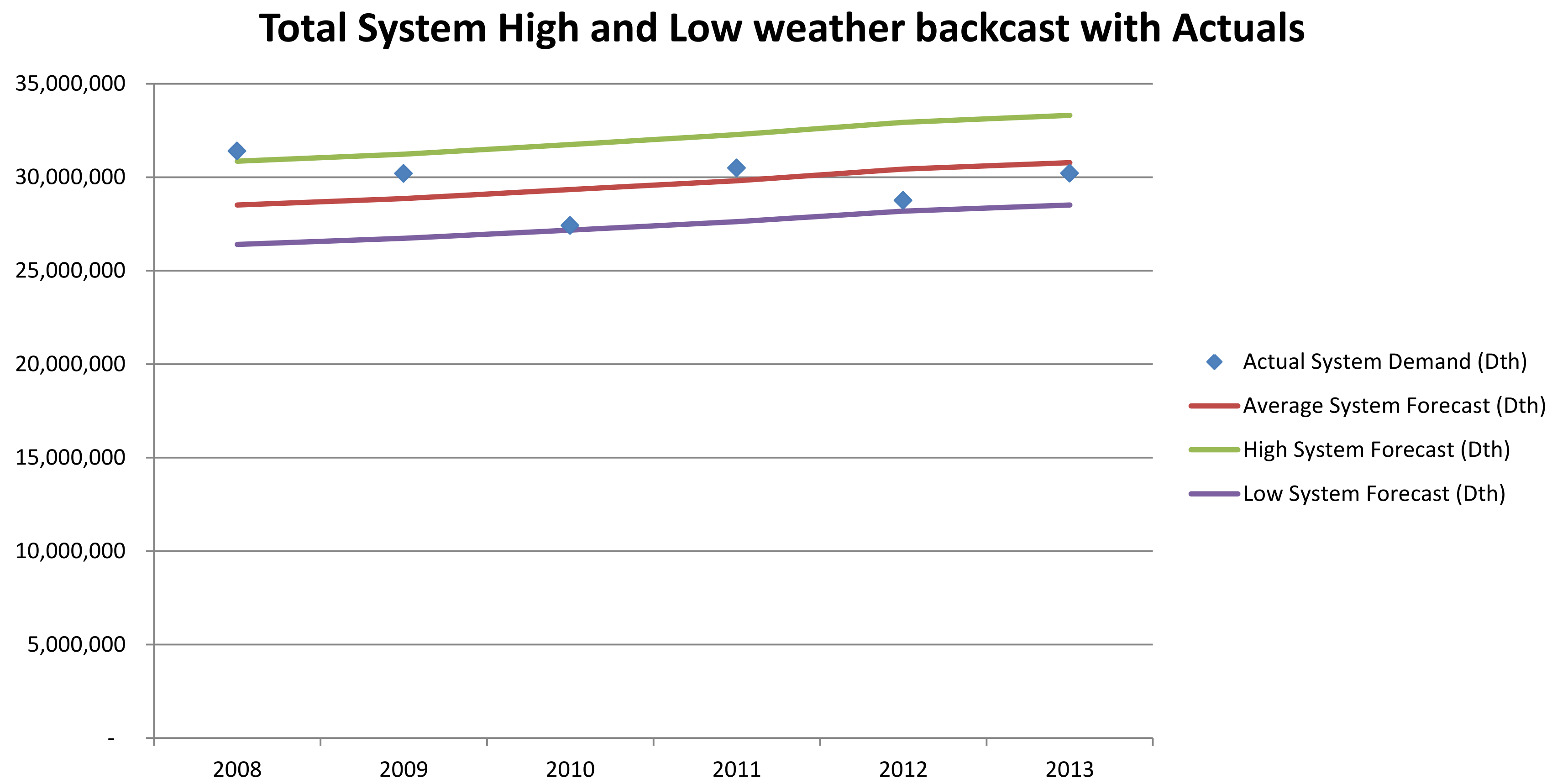
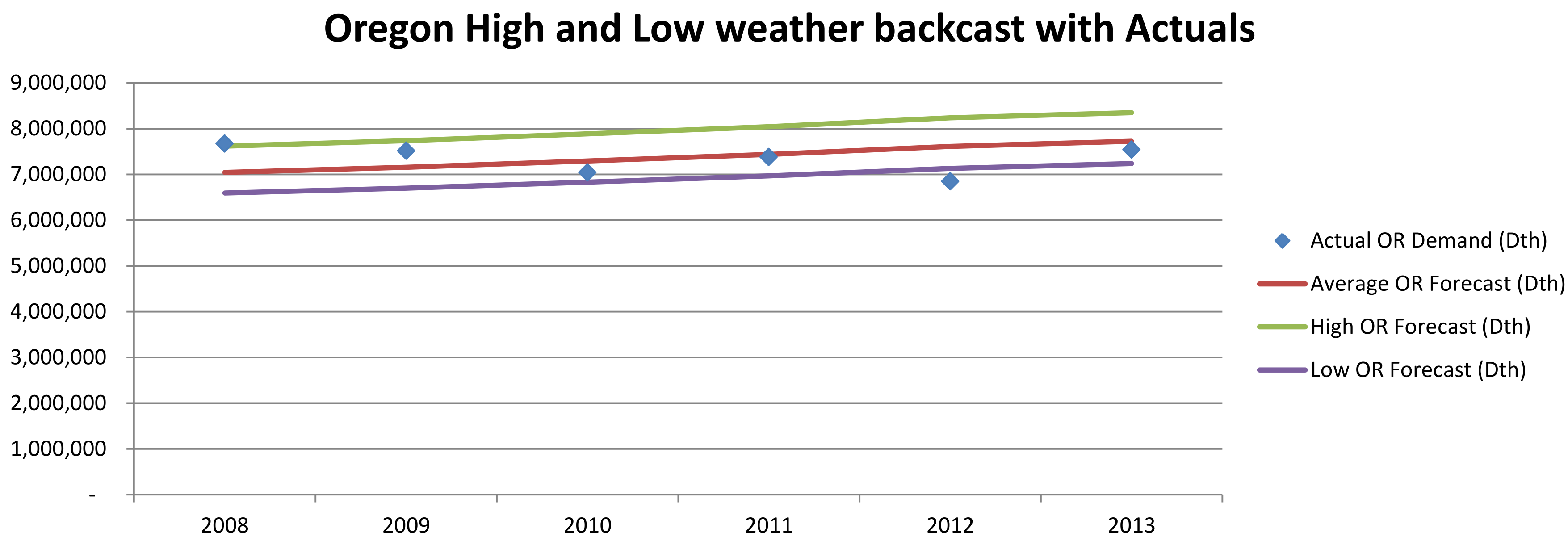
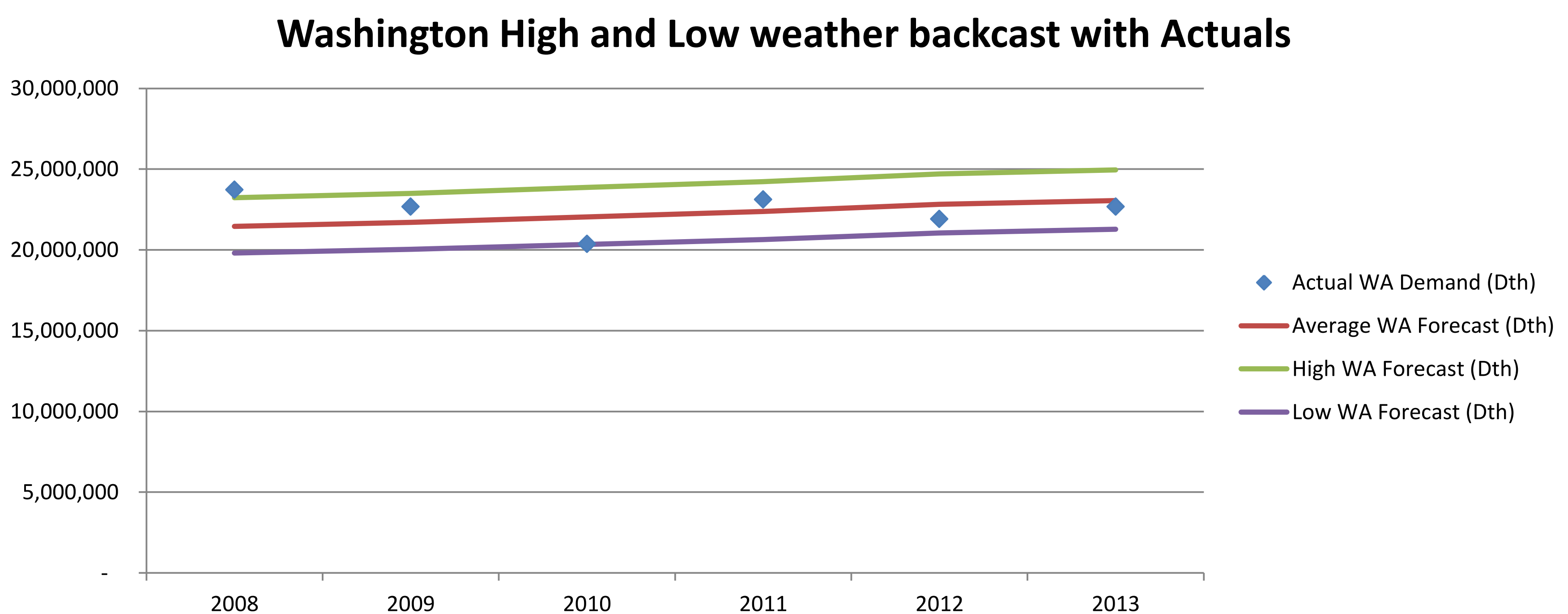
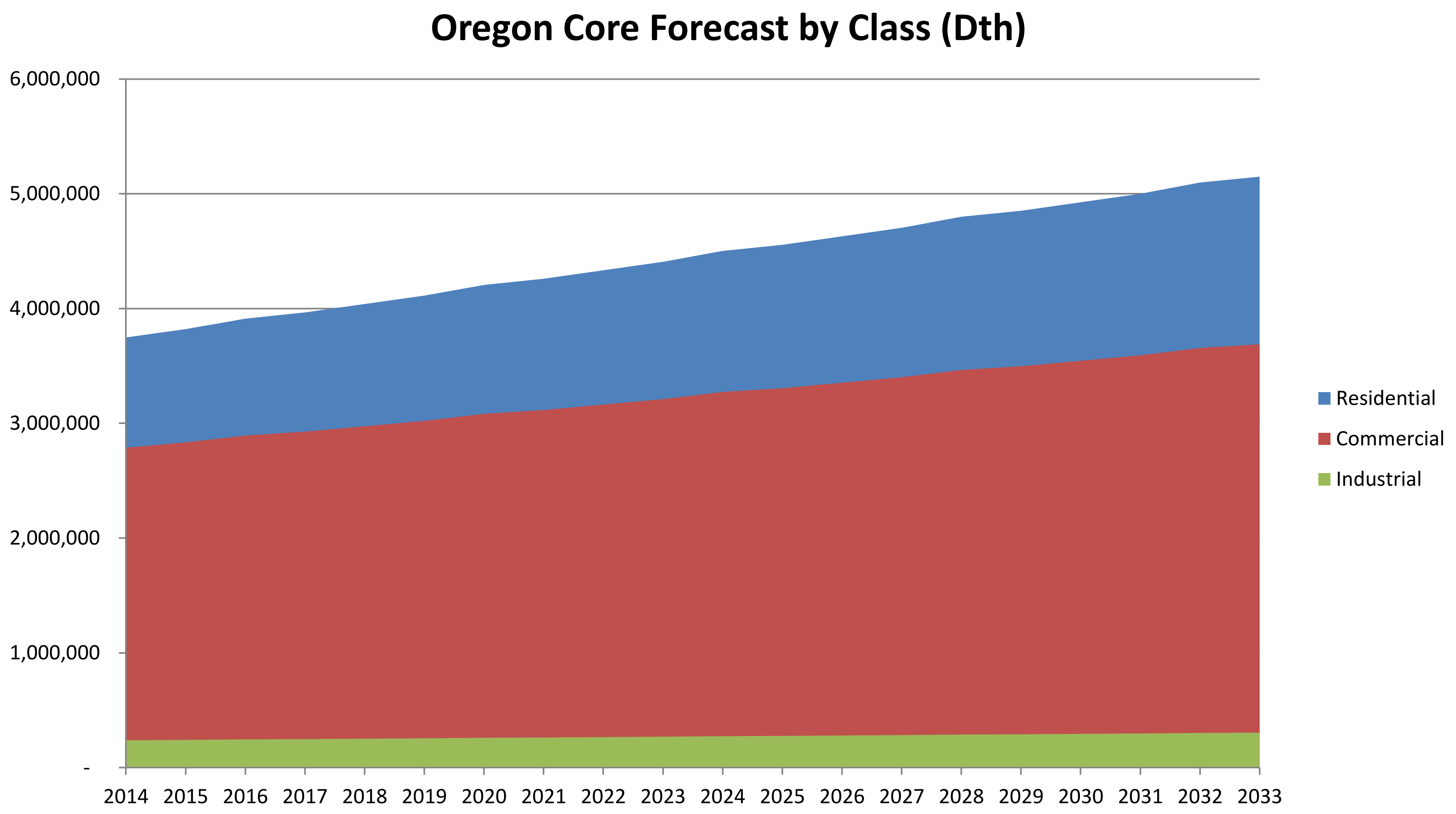
High WA Forecast (Dth)
Average WA Forecast (Dth)
Low WA Forecast (Dth)



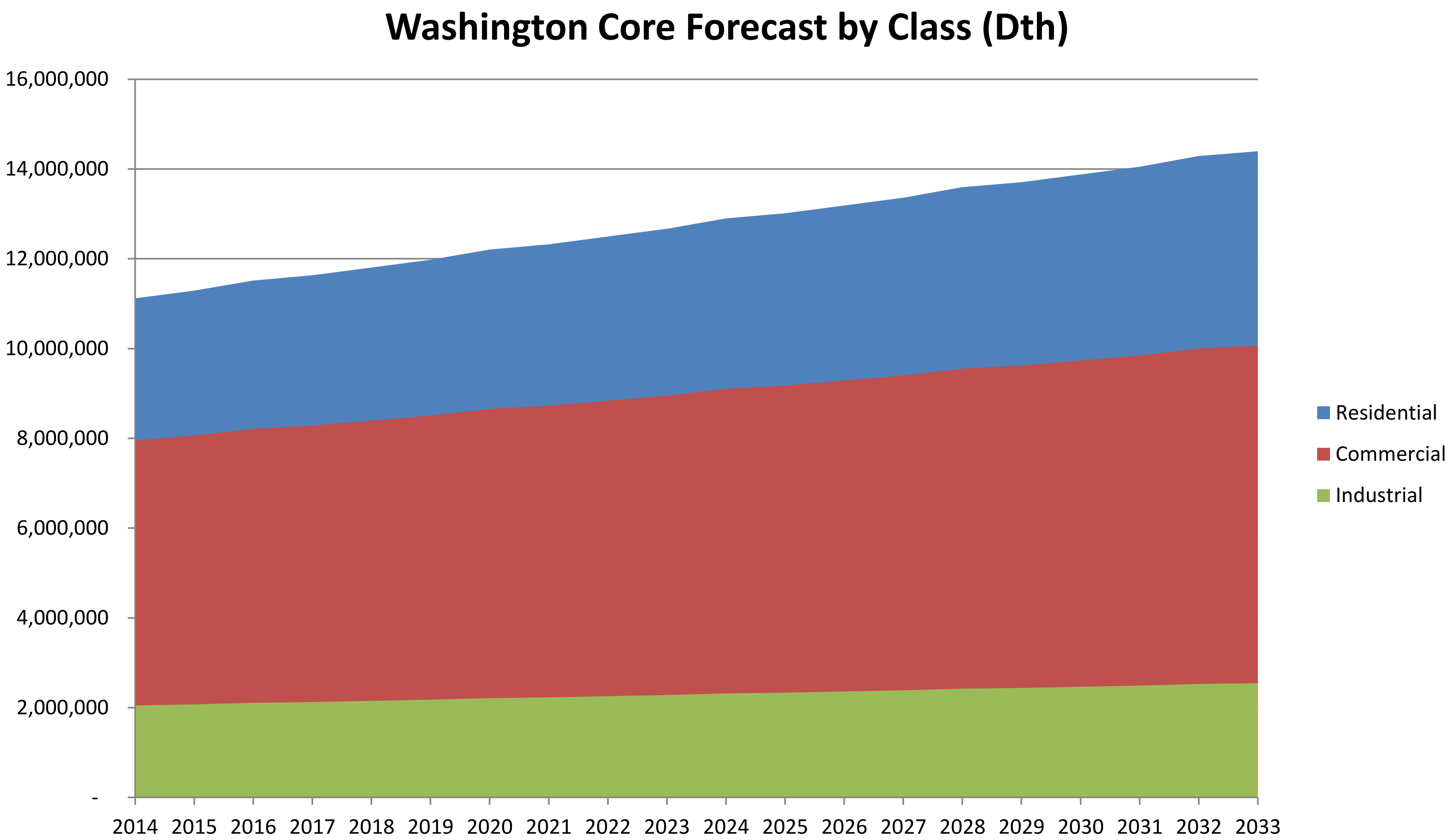
- High, Average, and Low backcast with Actuals for 2008-2013.
- Based on a 30% weather range.


Oregon High and Low weather backcast with Actuals
9,000,000
8,000,000
7,000,000
6,000,000
5,000,000
4,000,000
3,000,000
2,000,000
1,000,000
-
2008
2009
2010
2011
2012
2013
Actual OR Demand (Dth)
Average OR Forecast (Dth)
High OR Forecast (Dth)
Low OR Forecast (Dth)


Washington High and Low weather backcast with Actuals
30,000,000
25,000,000
20,000,000
15,000,000
10,000,000
5,000,000
-
2008
2009
2010
2011
2012
2013
Actual WA Demand (Dth)
Average WA Forecast (Dth)
High WA Forecast (Dth)
Low WA Forecast (Dth)

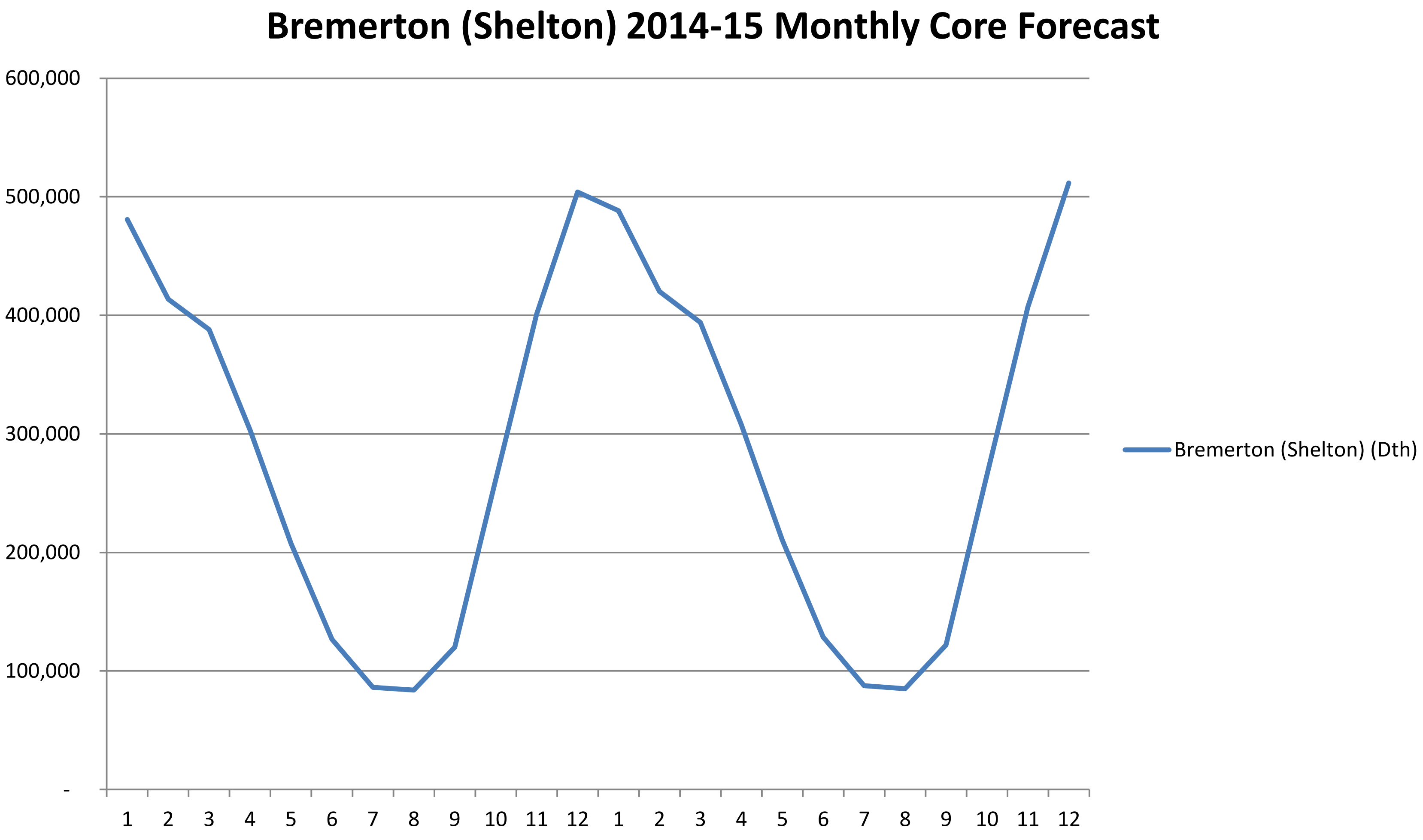


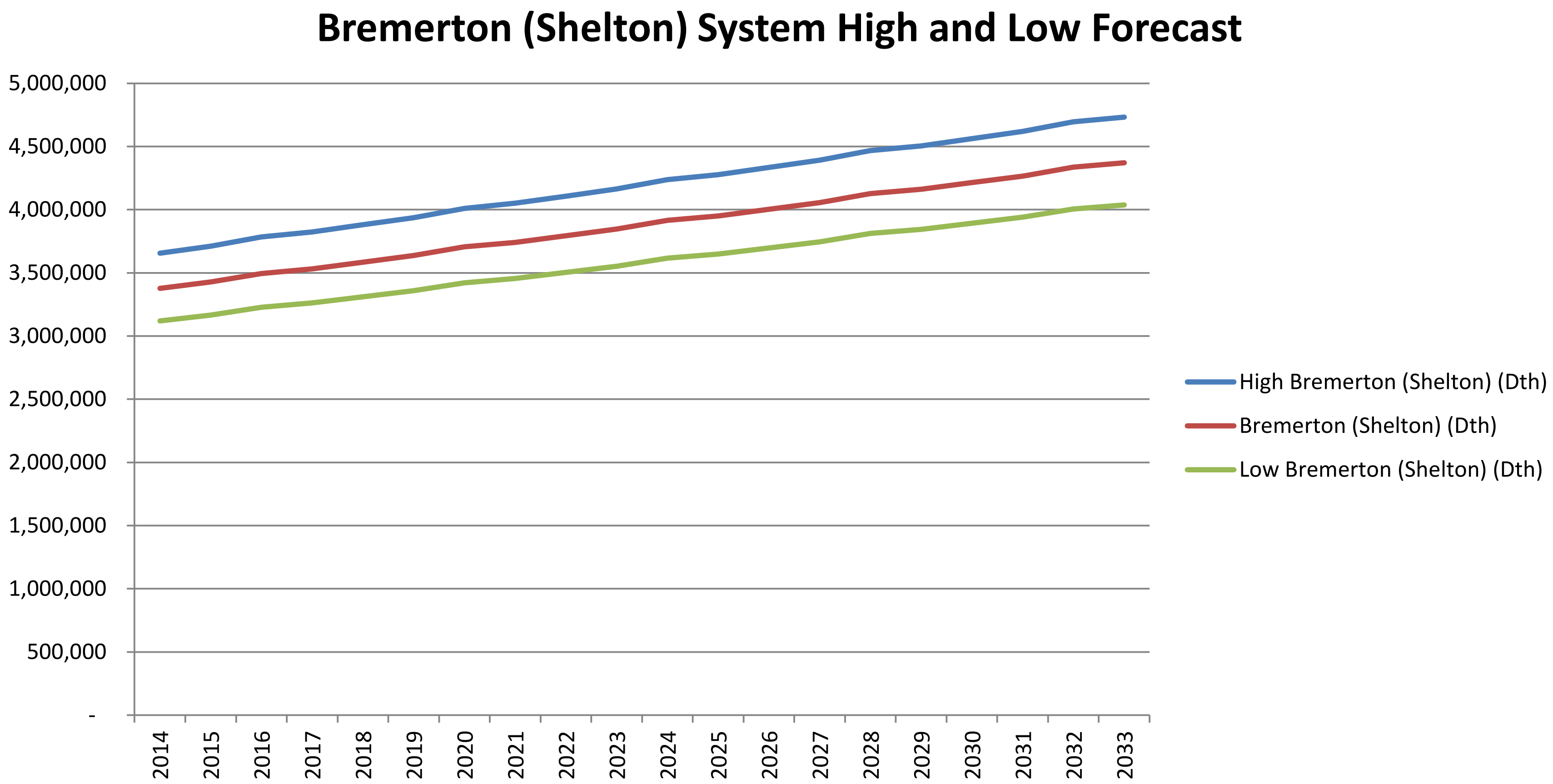
- Residential, Commercial, and Industrial Core forecast for Oregon.



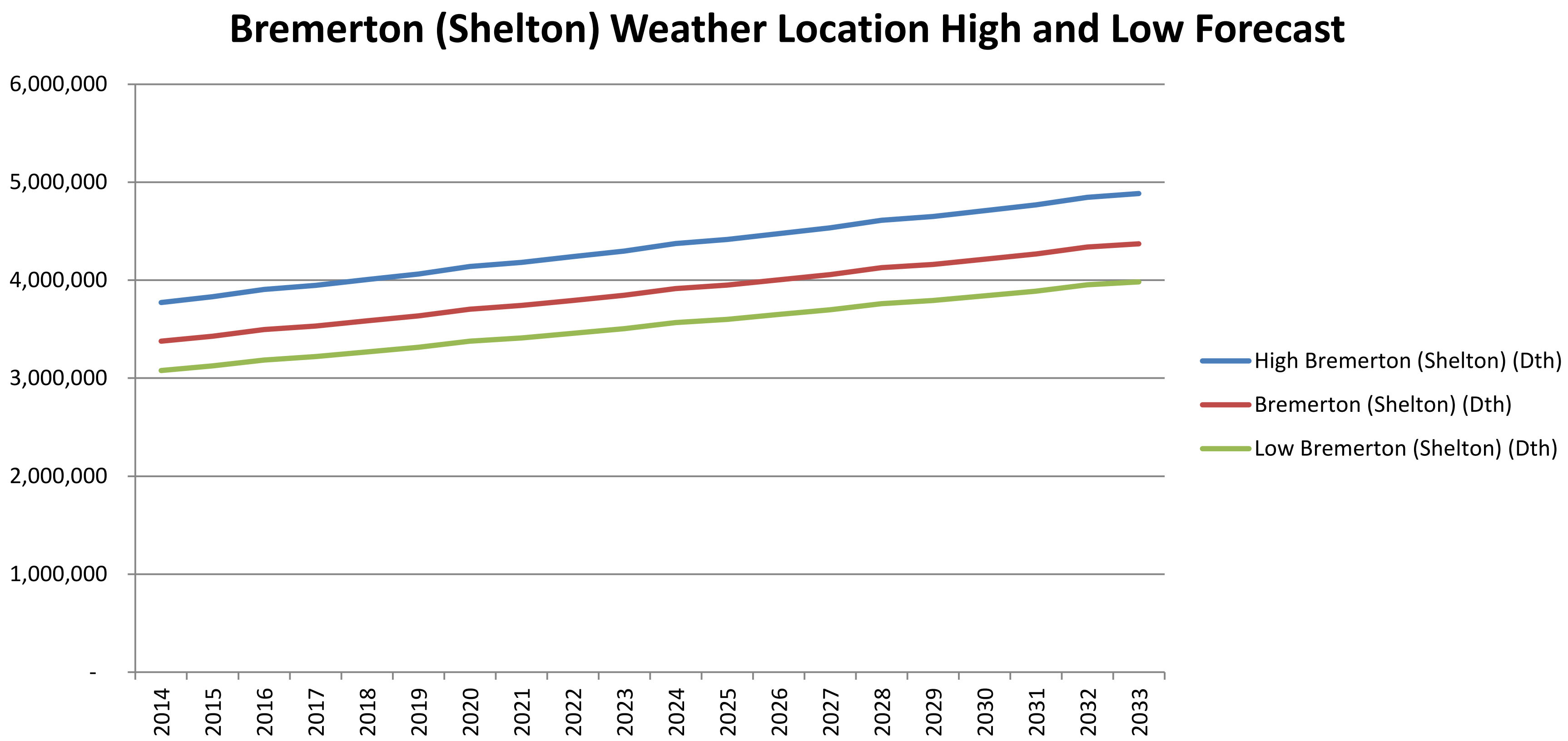
- Residential, Commercial, and Industrial Core forecast for Washington.

Bremerton (Shelton) CityGate



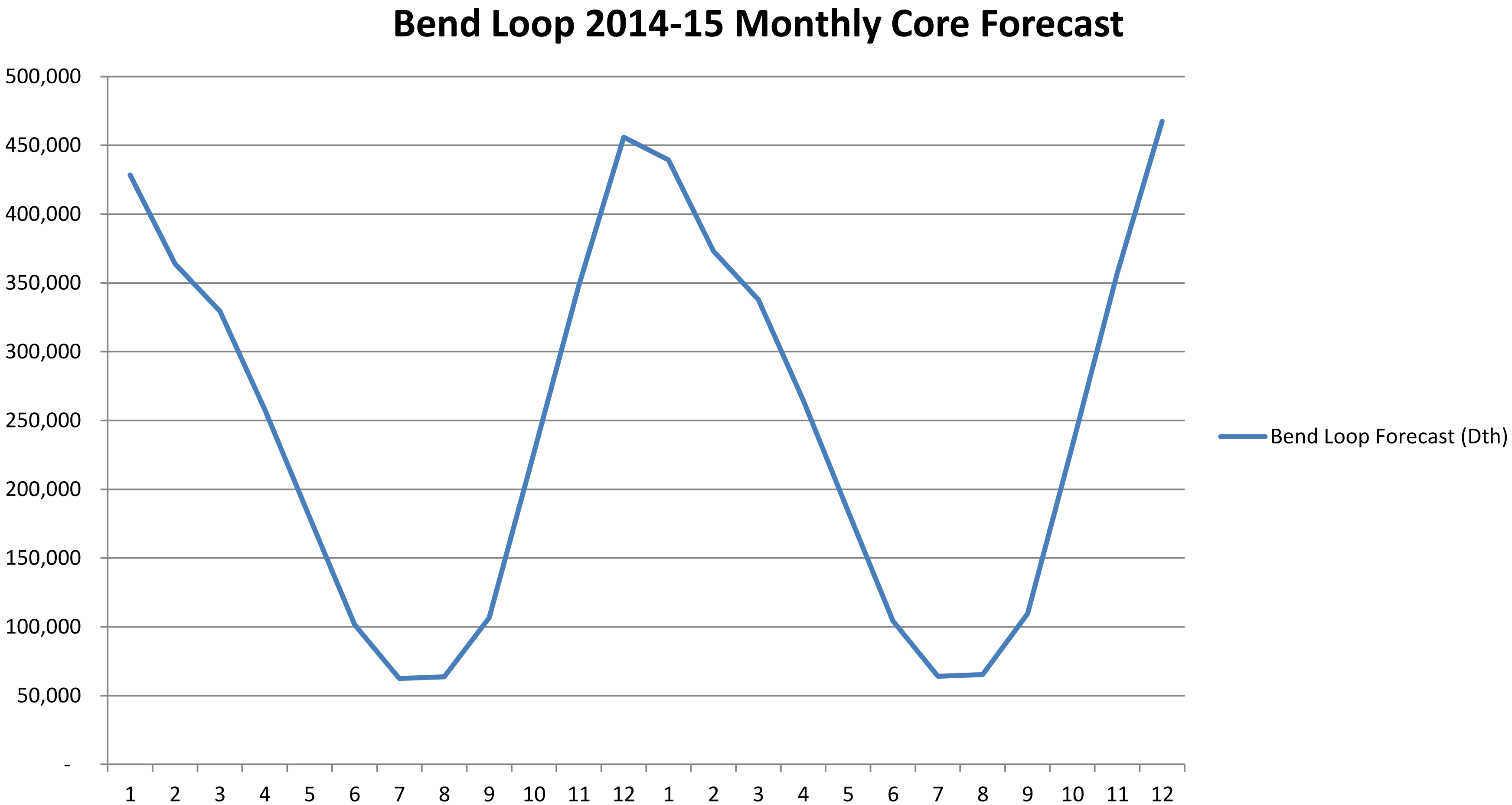


- This graph is based on highs and lows at the system level.

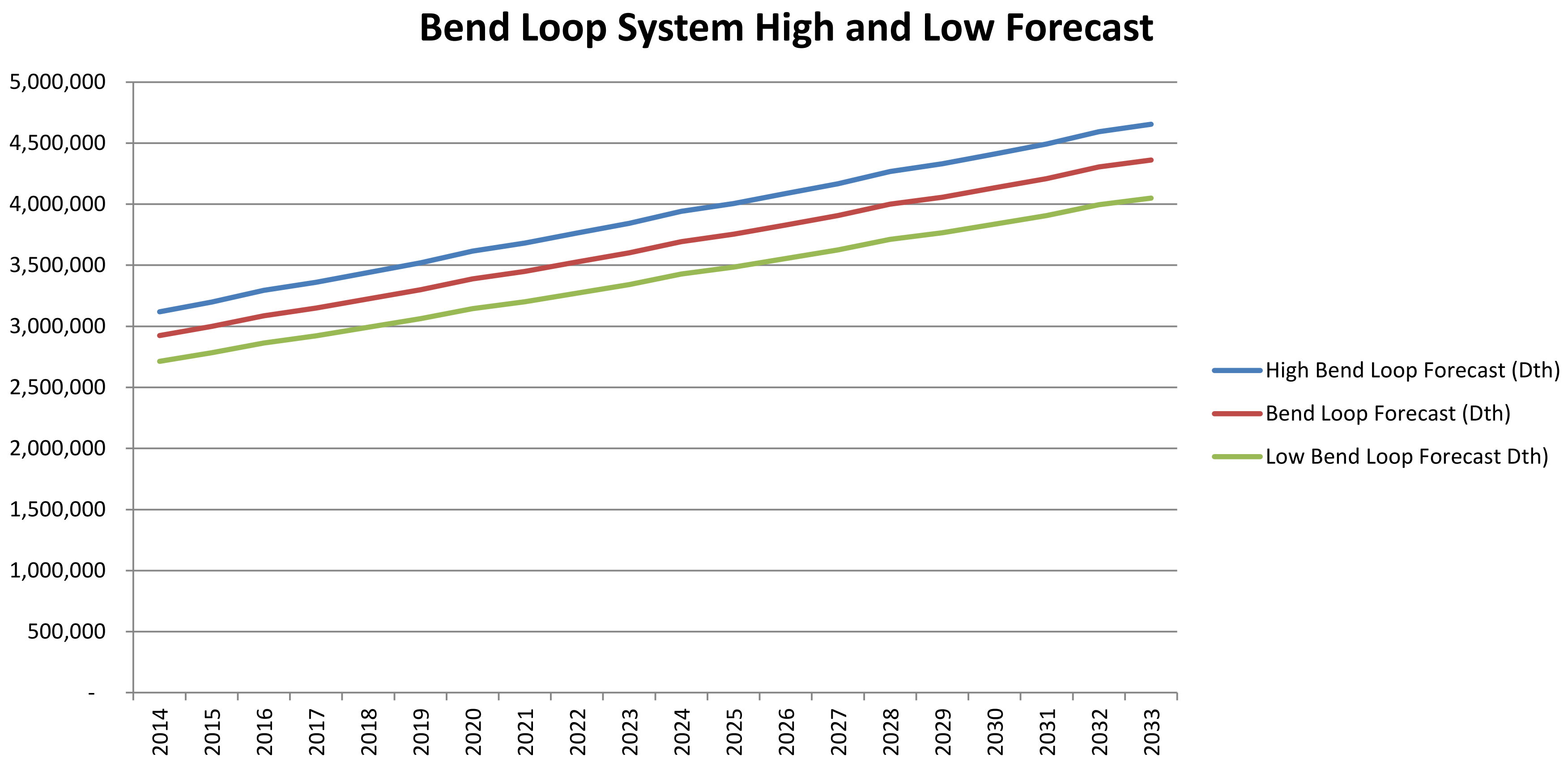


- This graph is based on highs and lows for its weather location.

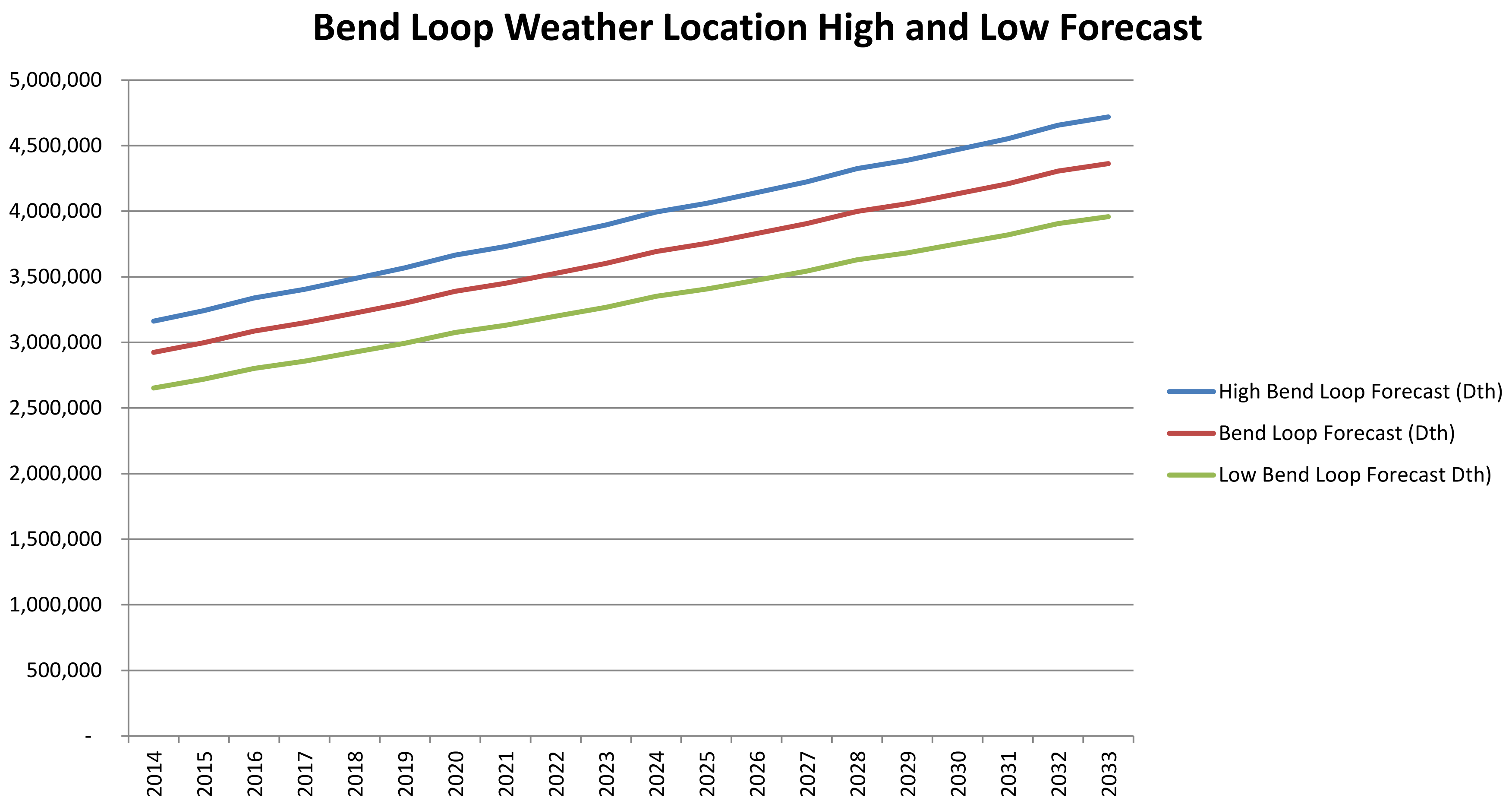
Bend Loop



Bend Loop 2014-15 Monthly Core Forecast
500,000
450,000
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
-
1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12
Bend Loop Forecast (Dth)



- This graph is based on highs and lows at the system level.



- This graph is based on highs and lows for its weather location.

Cascade Natural Gas Forecast Model Workshop #1
Portland International Airport in Portland, OR
Tuesday, September 16, 2014 9:00 AM – 12:00 PM

Attachments:
Attachment A – First Forecast Model Workshop updated slides
Attachment B – Cascade Demand Study Documentation
Attachment C – Attendance sheet

I.) **Introduction** – Mark Sellers-Vaughn opened the meeting with the introductions and reasoning for the meeting. Micah Robison led off with the agenda and then went on to the Demand Study Documentation.

II.) **Demand Study Documentation** – Micah went through the documentation to show the supporting methodology of the forecast model.

- The first discussion was on the EIA Efficiency effects and how it is built into the model.
- Three growth scenarios were explained:
  - Population growth.
  - Economic growth.
  - Combination of Population and Economic Growth.
- Micah explained the reasoning behind using Pipeline Flow Data and GMS to come up with a demand input. He also explained some issues with using CC&B.
- Many different aspects of weather were discussed:
  - The source of our weather data.
  - High and Low Weather bands.
  - Weather Locations.
  - 65 vs 60 degree reference temperature.
  - Peak Scenarios.
- Reasoning on why we chose a linear regression was explained.

III.) **The Model** – Micah Robinson went through the forecast model briefly showing the different tabs and levers the model has. The items he showed were:

- High and low scenarios for both growth and weather.
- The EIA efficiency factor
- Where demand is input and how the non-weather dependent demand is removed and then reapplied.

IV.) **Action Items** – Many stakeholders asked important questions and left CNGC with many items to research and discuss.

- Mapping and metrics of why Cascade chose a national EIA efficiency over the Pacific Region.
- Metrics to back up whether EIA has been representative of what Cascade has seen in prior years.
- Show that Woods & Poole has been indicative of what has happened in the past. Staff wants to see the metrics behind why we chose Woods & Poole.

- Information on CityGate allocation and county growth.
- Re-graph the Acme 60 vs 65 HDD table in the documentation.
- Find out if new construction is able to connect to gas services in major population areas.
- List of gates within a loop.
- Data on how we came up with the Default Peak Adder number.

V.) **Wrap-Up –** Cascade noted the second Forecast Model Workshop was tentatively scheduled for Thursday, October 23, 2014.

Attendance:

Presenters:
Mark Sellers-Vaughn
Micah Robinson

Attendees:
Brian Robertson
Mike Parvinen
Jim Abrahamson
Juliana Williams
Irion Sanger
Sommer Templet
Robby Fonner
Nadine Hanhan

Call-in attendees:
Jon Whiting
Joan Wilmotte
Pam Archer
Jon Klingele
Betty Erdahl
Joanna Huang

Action Item 3 from first forecast workshop: Support 1% Population to 1% demand assumption.

The 1% Population to 1% demand assumption was created based upon the EIA expectation in 2011-2014 energy outlooks that presented a flat growth projection through 2035. The most recent forecast presents essentially the same assumption:

Based on EIA Annual Energy Outlook 2014

"From 2012 to 2040, residential electricity use grows by 21% as the fuel mix in the residential sector moves increasingly towards electricity. Petroleum and other liquids lose fuel share for every end-use service, and particularly for space heating, where both electricity and natural gas gain share. Natural gas loses fuel share in every end-us service except space heating, and it continues to account for more than half of the fuel consumed for space heating, water heating, and cooking through the projection. In 2040 overall natural gas use in the residential sector is 1% lower, and petroleum and other liquids use is 35% lower than in 2012." – MT-7

CASCADE NATURAL GAS TWENTY YEAR DEMAND STUDY - DRAFT

2014 IRP Supporting Document

Abstract

This document contains the forecast methodology and supporting documentation for the 20 year demand forecast results generated as part of the combined demand study Cascade engaged MRE Consulting and Gelber & Associates to generate to support the 2014 IRP filing.

MRE Consulting, Ltd
Gelber & Associates Corp

Table of Contents

I. Overview

In this section upon finalization of the forecast model and methodology, Cascade will discuss a comparison of the 2014 IRP Base Demand Forecast for gas load compared to the demand forecasts used in the 2011 and 2012 IRPs.

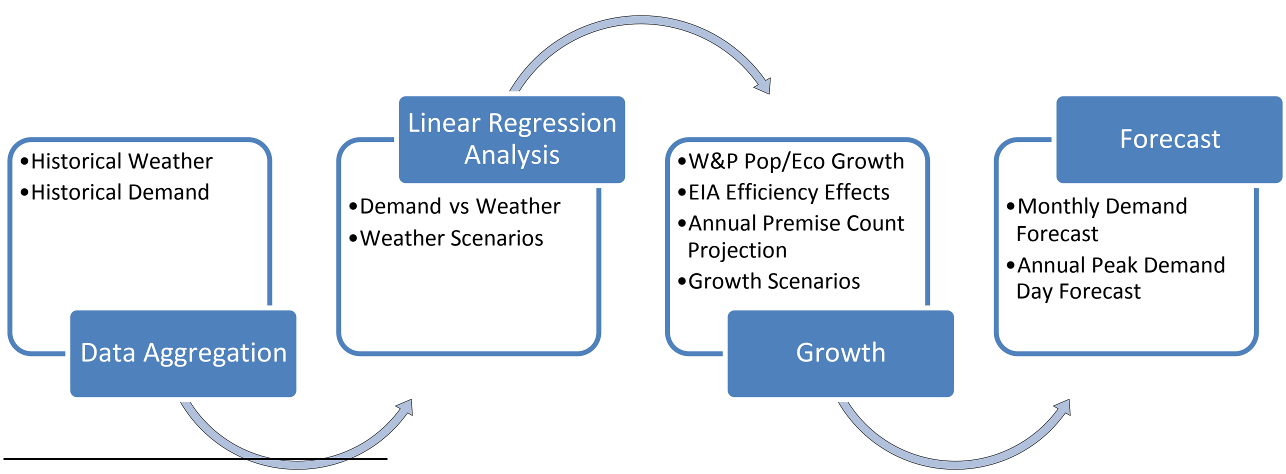
II. Methodology

a. Introduction

The Cascade demand forecast developed for the IRP is an estimate of gas demand sales and peak demand over a 20-year period for core customers at each CityGate[1] or Demand Loop[2]. Cascade core load consist mostly of residential and commercial customers along with some industrial customers. The provided forecasts are designed for use in long-term planning for resources and delivery systems. The 20-year horizon helps Cascade anticipate needs and in order to develop timely responses.

This document defines the assumptions and methods employed in generating the forecast as well as providing the definition of terms where appropriate. The past 30 years of weather data and ten years of demand data were analyzed to generate the forecast projection for the next 20 years.

Cascade has employed a methodology designed to identify and minimize uncertainties, and increase transparency and accuracy of the forecast. This forecast along with the rest of the IRP assists Cascade in providing the best service possible for the benefit of its customers.



[1] Citygate marks the point where the gas utility, Cascade, deliveries gas from the gas pipeline company to a large group of customers. This report forecasts gas demand from Cascade's 76 citygates.
[2] Demand loop is a grouping of citygates that service a similar area.

b. EIA Efficiency Effects

Future gas demand is projected to be impacted by efficiency gains due to technology advances that allow customers to reduce natural gas consumption. A 20 year forecast of efficiency gains can be derived from the demand forecast provided by the U.S. Energy Information Administration's (EIA's) *Annual Energy Outlook 2014* that has projections to 2040.

The EIA Energy Outlook report gives data based on region (census division). Cascade uses the 2014 EIA Outlook data for the entire U.S. While Cascade considered using forecast data for the Pacific Region, a region that contains both Washington and Oregon, this region is too heavily influenced by California and its high population which Cascade does not serve. Cascade uses figures from EIA's reference or base case forecast which projects annual natural gas consumption for both residential and commercial customers along with expected HDD's[3] and population. Residential and commercial numbers are combined to create a single natural gas demand number for each year. A demand per population per HDD figure is calculated by dividing demand by the population and HDDs given for each year of the EIA forecast. The demand per population per HDD figure is normalized by dividing each year's calculation by the year one (in this case 2014) results and is then converted to a percentage. This produces an efficiency growth[4] rate for each of the next 20 years. For this forecast the efficiency growth rate is the same for all of Cascade's CityGates.

EIA Efficiency was calculated utilizing the equations defined below:

$TD_{[Yr]} = RD_{[Yr]} + CD_{[Yr]}$

$EIA\_E_{[Yr]} = TD_{[Yr]} / US\_POP_{[Yr]} / US\_HDD_{[Yr]}$

Definitions:

- $RD_{[Yr]}$: Residential demand from EIA's *Annual Energy Outlook 2014* by [Yr] year
- $CD_{[Yr]}$: Commercial demand from EIA's *Annual Energy Outlook 2014* by [Yr] year
- $TD_{[Yr]}$: Total natural gas demand is the summation of the residential and commercial natural gas demand for a given year
- $US\_POP_{[Yr]}$: United States population forecasted by the EIA
- $US\_HDD_{[Yr]}$: Total Heating Degree Days for the United States as forecasted by the EIA

[3] HDD or Heating Degree Day is measure of coldness derived from the daily high and low temperature in degrees Fahrenheit. More information is provided in the weather segment of section II d. of this report.
[4] In this case efficiency gains makes for negative growth

- $EIA\_E_{[Yr]}$: Efficiency rate created using data from the EIA's *Annual Energy Outlook 2014.* This figure is normalized and converted to a percent rate.

c. Regional Economic Demographics (W&P)

Cascade uses regional economic demographics data formulated by Woods and Poole to derive a projected customer growth by town and year. Woods and Poole Employment, Income, Population, and Housing demographics were reviewed. Cascade derived Population and Economic growth factors formulated from Woods and Poole's forecasted population growth and Farm, Manufacturing, and Construction earnings.

Population Growth

Cascade uses population growth data formulated by Woods and Poole to derive a projected customer growth by CityGate and year. The Woods and Poole population growth forecast is provided by county and year and directly assigned to a CityGate. Cascade assumes a 1% growth in population translates to a 1% increase in customer growth.

W&P Growth by CityGate was calculated utilizing the equations defined below:

$$WP\_P_{[CityGate,Yr]} = \sum WP\_P_{[County,Yr]}$$

$$WP\_G_{[CityGate,Yr]} = (WP\_P_{[CityGate,Yr-1]} - WP\_P_{[CityGate,Yr]}) / WP\_P_{[CityGate,Yr]}$$

Definitions:

- $WP\_P_{[Yr,\ County]}$: Woods and Poole annual population forecast based on numerous demographic factors by county and by year
- $WP\_P_{[CityGate,Yr]}$: Sum of all Woods and Poole annual population figures for all counties assigned to a CityGate
- $WP\_G_{[CityGate,Yr]}$: Woods and Poole growth factor percentage calculated from Woods and Poole population forecast by CityGate and Yr

Economic Growth

To create an economic growth figure, Woods and Poole's construction, manufacturing, and farming earnings where combined for each county and year (2013-2040) to produce a total earnings number. These three industries where chosen because they describe the majority of industrial gas users in Cascade's service areas. The total economic earnings figure is divided by Woods & Poole's inflation forecast to calculate raw earnings growth. The sum of all raw earning growth figures assigned to a CityGate was used to calculate the Economic Growth by year for each CityGate.

W&P Economic Growth by citygate was calculated utilizing the equations defined below:

$WP\_TE_{[County, Yr]} = (WP\_CE_{[County, Yr]} + WP\_ME_{[County, Yr]} + WP\_FE_{[County, Yr]})$

$WP\_TE_{[CityGate, Yr]} = \sum WP\_TE_{[County, Yr]}$

$WP\_EG_{[CG, Yr]} = (WP\_TE_{[CityGate, Yr-1]} - WP\_TE_{[CityGate, Yr]})/ WP\_TE_{[County, Yr]}$

Definitions:

- $WP\_TE_{[County, Yr]}$: Woods and Poole total earnings from farming, manufacturing, and construction forecast by county and by year
- $WP\_TE_{[CityGate, Yr]}$: Sum of all total earning from farming, manufacturing, and construction forecast by county and by year allocated to a CityGate
- $WP\_EG_{[CG, Yr]}$: Woods and Poole economic growth percentage by CityGate and year

d. Demand Study (In House Models)

Historical Demand

Historical core monthly demand by CityGate was derived from the amalgamation and analysis of demand pulled from three sources:

- Customer Care and Billing (CC&B) Demand by Billing Town, Tariff, Year, and Month
- Gas Management System (GMS) Non-core Demand by CityGate, Year, and Month
- Pipeline Flow Data (EBB[5]) Demand by CityGate, Year, and Month

Cascade core demand is comprised of residential, commercial, and industrial customers assigned to core bundled gas services as defined by tariff[6]. Cascade calculates core demand by using pipeline flow data for each CityGate, which represents total gas flow for both core and non-core customers, and subtracting Cascade's non-core data$_2$ by CityGate. Non-core data comes from Cascade own gas management system (GMS) which tracks non-core data demand by individual customers behind each CityGate.

Core demand is improved further by the Cascade analyst who removes data that is clearly non-weather related and is atypical of Cascade's core deliveries. A review of CC&B premise counts and demand by tariff assists in identifying this data (NOTE: In the final document we will include example of how this CC&B data actually helps to identify non-weather data). The removed data is later reinserted into the forecast but only after the weather regressions are performed. Removing the data prior to performing the regressions improves the quality of the weather modeling[7]. Core demand by year, month, and CityGate is the primary unit of information upon which this forecast is constructed.

Core Demand by CityGate was calculated utilizing the equation defined below:

$CD_{[CG,Yr,Mth]} = A\_P\_D_{[CG,Yr,Mth]} - NC\_GMS\_D_{[CG, Yr, Mth]} - NWD\_CD_{[CG, Yr, Mth]}$

Definitions:

- A_P_D: Actual Pipeline Demand by CityGate, year, and month.
- NC_GMS_D: Non-Core GMS Demand by CityGate, year, and month
- $CD_{[CG, Yr, Mth]}$: Core demand by CityGate, year, month
- NWD_CD: Non Weather dependent core demand, as determined by Cascade review of C_CCB_D_A and NC_CCB_D_A (see next calculation on CC&B data)

[5] EBB or Energy Bulletin Board is system in which pipeline companies post pipeline volumes for the benefit of buyers and sellers of natural gas.

[6] Tariff is a customer classification code

[7] See regression section of the report for more information

- WD_CD: Calculated weather dependent core demand by CityGate, month, and year

Core demand data can also be generated by using CC&B demand figures. However, CC&B derived demand figures were found to not be consistent enough for use in the forecast model (NOTE: In the final document we will include samples of the supporting analysis). . Instead, the data is used only as analytical support such as helping to identifying atypical, non-weather related data. CC&B demand was allocated by town to each city gate to determine total allocated city gate demand by billing year and month. Analysis of the CC&B data determined that billed non-core load minus one month was equivalent to non-core physical flow, due to billing operations scheduled for the last day of the month. CC&B core demand was determined to not be equivalent to physical gas flow because of differences between the billing cycle and physical gas flow.

CC&B Demand data by CityGate was calculated utilizing the equations defined below:

$D\_A\_CCB_{[CG, Tarriff,Yr,Mth]} = D\_CCB_{[Tariff,Town,Yr,Mth]} \times TGA_{[Town, CG]}$

$C\_CCB\_D\_A_{[CG,Yr,Mth]} = \sum D\_A\_CCB_{[CG,Tariff,Yr,Mth]}$

$NC\_CCB\_D\_A_{[CG,Yr,Mth]} = \sum D\_A\_CCB_{[CG,Tarrif,Yr,Mth]}$

Definitions:

- D_CCB: Raw CC&B Demand data by billing Year, Month -1, Town, and Tariff
- D_A_CCB: calculated demand where CC&B demand is allocated to each CityGate$_{CG}$ based upon the TGA
- TGA: Town to Gate Allocation (TGA) where 100 % or a towns billed volume is allocated to one or more CityGates
- C_CCB_D_A: Sum of Core CC&B Demand Allocated to the CityGate by year and month
- NC_CCB_D_A: Sum of Non-Core CC&B Demand Allocated to the CityGate by year and month and year

Weather

Weather Information Gathering

Historical weather is pulled from the Schneider Electric weather service for all weather related analysis. Weather used represents the minimum (Min) and maximum (Max) Temperatures per weather station and day, where National Oceanic and Atmospheric Administration (NOAA) provides an actual weather value for a weather station and day. If NOAA weather was not available for a weather station and day, a Schneider weather estimate is used.

Average Weather by Weather Station was calculated utilizing the equations defined below:

$AVG\_WS_{[WS, WD]} = \textit{Average}(MinOfTemperature_{[WS, WD]}, MaxOfTemperature_{[WS, WD]})$

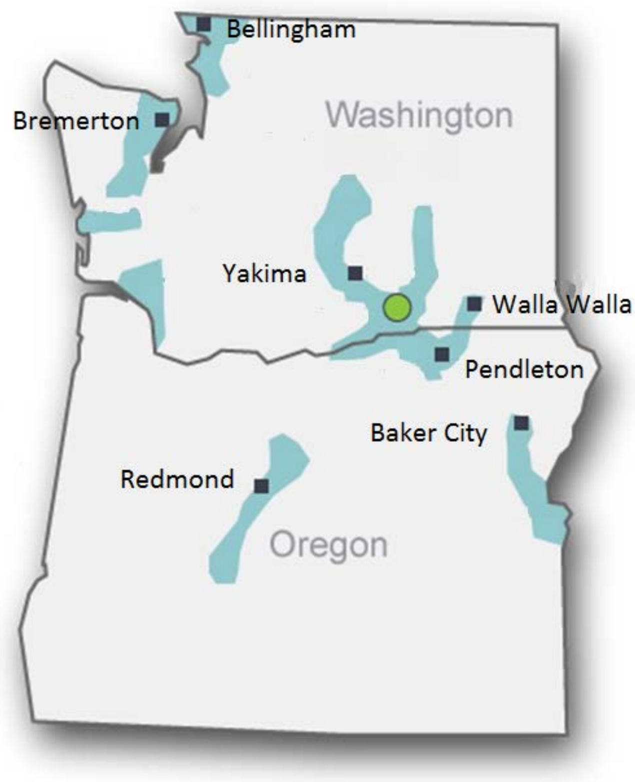
Definitions:

- $AVG\_WS_{[WS, WD]}$: calculated average temperature by $WeatherStation_{WS}$ and $WeatherDay_{WD}$
- $MinOfTemperature_{[WS, WD]}$: minimum temperature from Schneider Electric weather service by [WS] weather station and [WD] weather day
- $MaxOfTemperature_{[WS, WD]}$: maximum temperature from Schneider Electric weather service by [WS] weather station and [WD] weather day

Cascade assigns a particular weather station to represent each CityGate or demand loop it defines as a forecasting location. Seven weather stations were determined to best fit the Cascade geographic network and are located in the cities of Bellingham, Yakima, Walla Walla, Pendleton, Redmond, Baker City, and Bremerton. Considerations for selecting the weather stations are:

- Proximity of the CityGate to the weather station
- Quality of the data available at the weather station
- Geographical impediments between the weather station and the CityGate

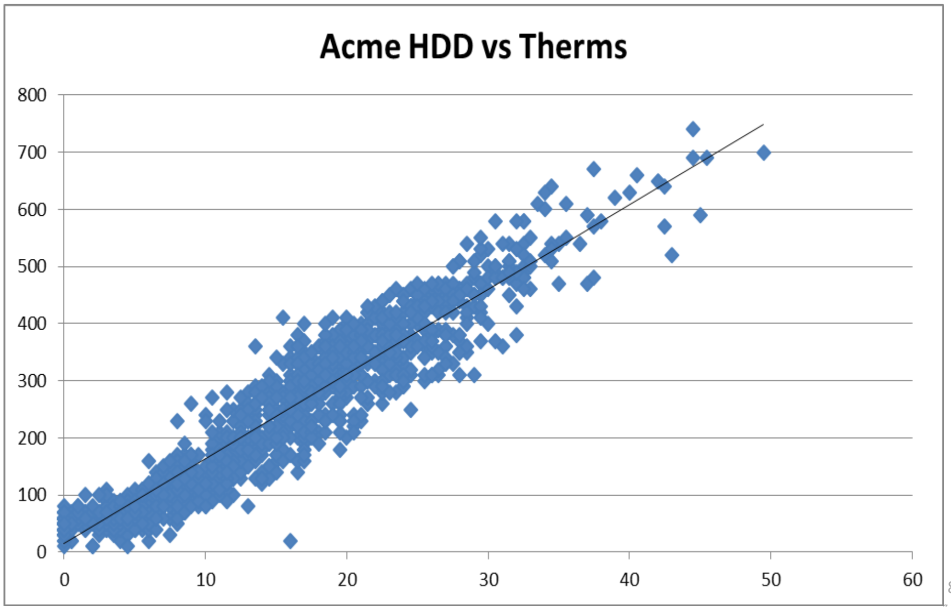
The map below shows the weather locations as well as Cascade's related customer locations (shaded in aqua).



Average weather by weather station is converted into Heating Degree Days (HDD) which becomes the unit of measure for the weather which this report is based. With weather quantified in terms of HDD's, Cascade can forecast demand scenarios based on an average year, a cold year, or a mild year. In addition, Cascade can forecast demand on peak demand days when gas loads are at their highest. These concepts enable Cascade to service its clientele during varying demand levels.

Heating Degree Days

Heating Degree Day (HDD) values are calculated by beginning with the daily average temperature, which is the simple average of the high and low temperatures for a given day. The daily average is then subtracted from an HDD degree threshold (for example 65°F) to create the HDD for a given day. Should this calculation produce a negative number, a value of zero is assigned as the HDD. Therefore, HDD's can never be negative. The HDD threshold number is designed to reflect a temperature below which heating demand begins to notably rise. The historical threshold for calculating HDD has been 65 °F. However, when modeling gas demand based on weather, Cascade has determined that lowering the threshold to 60 °F produces better results. The graph below shows why the lower threshold is preferable. It shows that heating demand does not begin to increase significantly until an HDD of five (65 °F minus 60 °F) if the traditional HDD threshold of 65 °F is utilized. Lowering the HDD threshold thus gives a better measure of the relation between HDD and dekatherms (measurement of heat usage).



[8]

Cascade's analysis has optimized the HDD threshold for each city gate by lowering the HDD threshold. A single lower HDD threshold of 60 is used for modeling all CityGates.

Historical Premise Count

The historical premise count by year and CityGate was derived from the analysis of monthly premise counts by town and tariff pulled from Customer Care and Billing (CC&B). Monthly premise counts by town, tariff, and year were allocated by town to each CityGate to determine total allocated CityGate premise count by tariff, year, and month.

Historical Premise Count by CityGate where calculated utilizing the equations defined below:

$P\_A\_CCB_{[CG, Yr, Mth, Tariff]} = P\_CCB_{[Town,Tariff,Yr,Mth-1]} \times TGA_{[Town, CG]}$

$CCB\_AAP_{[CG, Yr, Tariff]} = Average(P\_A\_CCB_{[CG, Yr, Mth, Tariff]})$

Definitions:

- P_CCB: Raw CCB premise count data by billing Year, Month -1_{Mth}, Town, and Tariff
- P_A_CCB: calculated premise count where monthly CC&B premise count by tariff is allocated to each CityGate based upon the TGA
- TGA: Town to gate allocation (TGA) where 100 % or a towns billed volume is allocated to one or more CityGates
- CCB_AAP: CC&B Average annual premise count by CityGate, tariff, and year

Growth

Growth is a calculated value which is determined based upon Woods and Poole Growth, Economic, Mixed, or a manually assigned Cascade growth adjustment plus an EIA efficiency factor. Cascade utilizes a manual growth adjustment when it determines the Woods and Poole growth figure does not best project the growth of a CityGate for a period of time. Manually assigned growth factors are based on supporting analytics related to premise growth, engineering estimates, and internal customer projections.

Growth effects are cumulative, which means that growth effects from one year carry over into the next year. However, there can occasionally be predictable events that impact demand for a specific time period but in a manner such that normal demand resumes when the event is over. For example, a factory may shut down for several months but return to full gas usage after the shutdown. This in turn would reduce CityGate demand for those months but would not affect demand thereafter. Cascade incorporates these non-cumulative events in its forecast as a manual assumption.

Forecast Adjustment Factor by CityGate and year was calculated utilizing the equations defined below:

$WP\_M_{[GC,Yr]} = [WP\_E_{[CG,Yr]} * (1- WC_{[CG]})] + [WP\_P_{[CG,Yr]} * WC_{[CG]}]$

$A\_GR_{[CG,Yr]} = Select\ (WP\_M_{[CG,Yr]}, WP\_E_{[CG,Yr]}, WP\_P_{[CG,Yr]}, MAG_{[GC,Yr]})$

$SA\_GR_{[CG,Yr]} = A\_GR_{[CG,Yr]} \times (GS_{[Avg,High,Low]} +1)$[9]

$SEC\_GF_{[CG,Yr]} = SEC\_GF_{[CG,Yr-1]} *(1 + S\_GF_{[Yr,CG]} + EIA\_E_{[GC,YR]})$

$SEC\_GR_{[CG,Yr]} = (SEC\_GF_{[CG,Yr]} – 1) /1$

$FAF_{[CG,YR,Mth]} = (SEC\_GR_{[CG,Yr]} + MA_{[Yr]} + MA_{[Yr,Mth]} + MA_{[Mth]})$

Definitions:

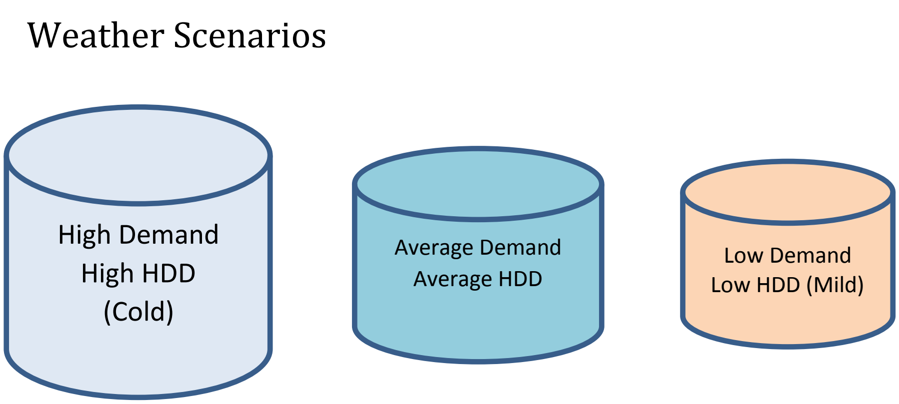
- $WC_{[CG]}$: Weather correlation R^2 coefficient for a citygate
- $A\_GR_{[CG,Yr]}$: The Assigned Annual Growth Rate, represents growth by CityGate and year (This defaults to the Woods and Poole Growth rate for the CityGate and year unless a Manually Assigned Growth rate is provided)
- $WP\_P_{[GC,Yr]}$: Woods and Poole Population Growth by CityGate and year
- $WP\_E_{[GC,Yr]}$: Woods and Poole Economic Growth by CityGate and year
- $WP\_M_{[GC,Yr]}$: Mixed Woods and Poole Population and Economic Growth factors by CityGate and year
- $MAG_{[GC,Yr]}$: Manually Assigned Growth by CityGate and year
- $SA\_GR_{[CG,Yr]}$: The Assigned Scenario Growth Rate, represents A_GR impacted by the selected growth scenario
- $GS_{[Avg,High,Low]}$: Growth Scenario Impact for average, high, and low growth given in percent terms
- $EIA\_E_{[GC,Yr]}$: EIA Efficiency factor by year
- $SEC\_GF_{[CG,Yr]}$: Applied Annual Growth Factor (With EIA Efficiency), by CityGate and year that is compounded
- $SEC\_GR_{[CG,Yr]}$: Applied Annual Growth modified from a factor to percent rate
- $FAF_{[CG,Yr,Mth]}$: Final Forecast Adjustment Factor by CityGate, year, and month
- $MA_{[Yr]}$: A Manual Forecast Adjustment Factor that affects a given year
- $MA_{[Yr,Mth]}$: A Manual Forecast Adjustment Factor that affects a given month in a given year
- $MA_{[Mth]}$: A Manual Forecast Adjustment Factor that affects a given month for all years

[9] This formula changes depending on whether the assign growth rate is positive or negative and the growth scenario (high or low). See growth scenario section for more details.

Weather Scenarios

To determine the average (medium) weather case scenario, the average HDD of each month is taken from a specified range of years for each of the seven weather locations. This forecast uses a 30 year range of weather history from the years 1984 through 2013 for each of the three scenarios. To determine the high case HDD weather scenario, Cascade selects the years representing the six coldest years (20% of the coldest years out of 30). These are the particular years with the highest system HDD. Finding the system HDD involves considering HDD's from all seven weather stations and giving appropriate weight to the weather stations that have greater impact on system wide demand. The weighting factor is determined by adding the coefficients or factors (derived from the regression[10]) for each weather station, and by then dividing the sum of the coefficients by the total value of the coefficients from all of the weather stations. Thus the system weighted HDD is the summation of HDD's from each weather station multiplied by its weighting factor. These system calculated HDD's are used to rank the years from warmest to coldest.

To determine the high case HDD weather scenario, Cascade selects the years representing the six coldest years (20% of the coldest years out of 30). These are the particular years with the highest system wide HDD. To determine the low case HDD weather scenario, Cascade selects the years representing the six warmest years (20% of the warmest years out of 30). These are the particular years with the lowest system wide HDD. For both the high and low case HDD weather scenarios, for each particular month of a given projected future year, the HDD from these six years average to provide the appropriate scenario.



[10] Refer to regression section of this report for more information.

Cascade Weather Scenario Impact

Weather Scenario Impact by Weather Station was calculated utilizing the equations defined below:

$AWS_{[Avg,Mth]} = Average(HDD_{[All\ Weather\ YRS,\ Mth]})$

$HWS_{[High,Mth]} = Average(HDD_{[Top\ X\ YRS,Mth]})$

$LWS_{[Low,Mth]} = Average(HDD_{[Bottom\ Y\ YRS,Mth]})$

Definitions:

- $AWS_{[Avg,\ Mth]}$: Average HDD by month for all weather years
- $HWS_{[High,Mth]}$: Average HDD by month for the X years with the highest HDD values (coldest), where X is the number of weather years multiplied by the weather range, e.g. 30 years * 20% = 6 years
- $LWS_{[Low,Mth]}$: Average HDD by month for the Y years with the lowest HDD values (warmest), where Y is the number of weather years multiplied by the weather range, e.g. 30 years * 20% = 6 years

Growth Scenarios

Cascade has defined three growth scenarios to adjust expected demand.

- Expected growth: is the calculated Annual Cascade Assigned Scenario Impact growth projection
- High Growth: is the High Cascade Assigned Scenario Impact
- Low Growth: is the Low Cascade Assigned Scenario Impact

Each scenario calculates a single growth factor to increase or decrease demand at a given CityGate in a given year over the projected 20 year period.

Cascade Growth Scenario Impact

High and low growth scenarios are defined by a banded +/- ranged based upon the average assigned scenario growth defined.

Growth Scenario Impact by CityGate and Year was calculated utilizing the equations defined below:

$SA\_GR_{[AVG,CG,Yr]} = SA\_GR_{[YR,CG]}$

$SA\_GR_{[High]}$ = If $A\_GR_{[YR,CG]} > 0$, THEN = $A\_GR_{[YR,CG]} * (1+GS_{[High]})$, ELSE = $A\_GR_{[YR,CG]} * (1-GS_{[High]})$

$SA\_GR_{[Low]}$ = If $A\_GR_{[YR, CG]} > 0$, THEN = $A\_GR_{[YR,CG]} * (1-GS_{[High]})$, ELSE = $A\_GR_{[YR, CG]} * (1+GS_{[Low]})$

Definitions:

- $GS_{[Avg,High,Low]}$: Growth based upon scenario Avg, High, or Low
- $A\_GR_{[CG,Yr]}$: The Assigned Annual Growth Rate, represents growth by CityGate and Year (This is the Population/Economic/Mixed Woods and Poole Growth factor for the CityGate and Year unless a Manually Assigned Growth factor is provided)
- $GS_{[High]}$: High Growth Range Adjustment is a model variable represented as %
- $GS_{[Low]}$: Low Growth Range Adjustment is a model variable represented as %

Regression Analysis

The majority of Cascade's core natural gas demand is used for heating purposes and is highly dependent on the weather. The colder the weather, the greater the demand. To forecast weather dependent load which accounts for weather differences, Cascade conducted a linear regression[11] analysis to develop a regression coefficient and constant for each CityGate. Cascade preformed a regression analysis of weather dependent monthly gas demand in comparison with monthly heating degree days at each CityGate for Historical Demand. The regression analysis calculated the coefficient ***b*** and constant ***C*** that best minimizes the error. This forecast uses a linear regression., no exponents where used[12].

Regression analysis calculates the best coefficient *b* and constant *C* values for each CityGate *utilizing the equations defined below*:

$$\boldsymbol{Demand = b \times HDD + C}$$

Definitions:

- Demand = Core Weather Dependent Gas Demand (Daily Average for a given month in dekatherms)
- HDD = Average Heating Degree Day Per month
- b = coefficient that gives gas demand (dekatherms) per HDD
- C = constant, base level of gas demand (dekatherms) that remains the same regardless of weather

The coefficient ***b*** is the central figure in the model when calculating weather dependent demand. It best describes the impact that weather has on gas demand. The larger the ***b*** coefficient, the greater the gas demand per unit of weather. The constant ***C*** is the base level of gas demand (dekatherms) that remains the same regardless of weather.

In addition to finding the coefficient ***b*** and the constant ***C***, another product of the regression analysis is the production of the correlation coefficient, *R*. This figure is typically squared to form R^2. R^2 measures the strength of the relationship between two variables. R^2 values can range from zero to one. A regression with an R^2 of 1 means it has been a perfect predictor of demand, therefore, would be an ideal regression to use. An R^2 of 1 does not guarantee a future HDD will predict the exact demand. A low R^2 value shows that it has not been a good predictor, therefore, would not be an ideal regression to use.

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[11] Regression analysis is a statistical process used to study the relationship between variables – in this case weather and demand.

[12] Cascade considered using exponential and more complex statistical techniques to find the model the relationship between weather and demand. However, Cascade saw only negligible gains in regression quality that did not merit the additional complexity.

For the purposes of this forecast, Cascade did not require the use of a Monte Carlo[13] model to calculate weather. There was sufficient historical weather data to produce high, low, and medium cases without utilizing a Monte Carlo simulation.

e. Demand Study (Calculation)

Monthly Demand Forecast

The Monthly Demand Forecast by CityGate, year, and month is based upon the calculated forecast for weather dependent core load plus the most recent year's (2013) non weather dependent core load where a single forecast adjustment was applied which included growth and Cascade assumptions.

Weather dependent core load was forecasted by CityGate utilizing the Weather Dependent Model equation, unless the R^2 of a CityGate's linear regression was below a certain 80% threshold, meaning HDD is not a good predictor of demand.

Forecast Demand by CityGate, Year, and Month was calculated utilizing the equations defined below:

$WDD_{[CG,YR,Mth]} = (b_{[CG]} \times HDD_{[High,\ Ave,\ Low,\ CG,Mth]} + C_{[CG]})* DAYS_{[Yr,Mth]} + NWDDV_{[CG,YR,Mth]}$

$MDF_{[CG,YR,Mth]} = Or(WDD_{[CG,YR,Mth]}, DDV_{[CG,YR,Mth]}) * (1+FAF_{[YR,Mth,CG]})$

Definitions:

- WDD: Weather based demand for a given weather scenario for a given CityGate and month
- b: coefficient that gives gas demand (dekatherms) per HDD for a given CityGate
- C: constant, base level of gas demand (dekatherms) that remains the same regardless of weather
- DAYS: Number of days in forecast year and month
- NWDDV: Non Weather Dependent Default Demand Value based upon forecast month
- DDV: Default demand value per CityGate based upon forecast month
- MDF: Monthly demand forecast per CityGate
- FAF: Forecast Adjustment Factor by CityGate, year, and month (Includes growth, assumptions, and scenario impact)

[13] Monte Carlo model is a statistical method used to estimate solutions for complex equations that cannot be solve for implicitly. The technique typically involves averaging the results of multiple trials using random input figures. For this forecast the primary inputs, including weather, were defined well enough that the use of Monte Carlo is not necessary.

System Peak Forecast

The purpose of finding the peak degree day is to ensure that Cascade can continue to provide adequate heating to its customers even under extreme conditions which are far colder than the norm. Cascade determines the peak demand day for the entire system by first selecting the coldest day recorded in the past 30 years. To determine the system wide peak demand day, HDD's from all seven weather stations are considered, giving appropriate weight to the weather stations having the greater impact on system wide demand. This same method weighting the weather stations is used in the weather scenario section of this report in order to find the coldest and warmest years. The calculation of the system weighted HDD is applied to the previous 30 years of weather data to determine the highest HDD of all. Cascade has found December 21, 1990 to be the highest system weighted HDD for this period.

The peak demand day is then derived from the highest HDD by applying the actual HDD from the peak day for the 30 year period to the monthly linear regression equation for each CityGate[14], and adjusting the output by a calculated Daily Peak Adder based upon the difference between peak day and Average day load from 2008 to 2013. Thus all CityGates associated with the Bellingham weather station, for example, use the HDD calculated for Bellingham for December 21, 1990, and similarly for all the other weather stations and CityGates. This provides a highest demand scenario for peak demand load based on 30 years of weather history for each CityGate. To determine the peak demand day for a given projected year, growth factors (see below) are applied to the peak demand day for the thirty year period. Peak day demand is in turn calculated for each CityGate for each year of the twenty year forecast.

Expected peak day demand in a given year, in contrast with the highest case scenario peak day demand, is calculated by Cascade based on the average of the peak demand days for each of the last 30 years. Initially, the system-weighted peak day is found for each of the last thirty years. The actual HDD from each of those 30 peak days is averaged for each weather station resulting in an average peak HDD. Applying the associated average peak HDD to the forecast model for each CityGate yields an expected peak demand for each CityGate. Cascade calculates the expected peak demand for each CityGate for each future year of the forecast by then applying appropriate growth factors.

For CityGates where demand is not weather dependent, the peak demand day cannot be calculated by applying an associated HDD. Instead, peak demand for these CityGates becomes the average daily demand for the month in which the system peak day falls. Cascade applies the calculated Daily Peak Adder (DPA) to

[14] See regression section of this report

the average daily demand number to convert the average day figure to daily peak demand. As with the weather dependent peak days, growth factors are applied to this figure.

PeakDemand by CityGate and year was calculated utilizing the equations defined below:

$DDmax_{[CG,Yr]} = (b_{[CG]} \times HDDpmax_{[day]} + C_{[CG]})$

$DDavg_{[CG,Yr]} = (b \times HDDpavg_{[day]} + C)$

$MPDF_{[CG,Yr]} = (DDmax_{[CG,Yr]})*(1+FAF_{[CG,Yr]})$ OR

$(DDV_{[CG,Yr,Mth]})/ DAYS_{[Yr,Mth]})* (1+FAF_{[CG,Yr]})*(1+DPA)$

$EPDF_{[CG,Yr]} =(DDavg_{[CG,Yr]})*(1+FAF_{[CG,Yr]})$ OR

$(DDV_{[CG,Yr,Mth]})/ DAYS_{[Yr,Mth]})* (1+FAF_{[CG,Yr]})*(1+DPA)$

Definitions:

- HDDpmax: HDD of an associated weather station on the historical peak day
- HDDpavg: Average of the weather station's HDDs from the historical peak days of each of the last 30 years
- DDmax: Daily demand based on a max peak HDD
- DDavg: Daily demand based on an average peak HDD
- b: coefficient that gives gas demand (dekatherms) per HDD
- C: constant, base level of gas demand (dekatherms) that remains the same regardless of weather
- DAYS: Number of days in forecast Year and Month
- DDV: Default monthly demand value per CityGate based upon month of peak demand day
- MPDF: Max peak demand day forecast per CityGate
- EPDF: Expected peak demand day forecast per CityGate
- FAF: Forecast Adjustment Factor by CityGate, Year (Includes Growth, Assumptions, and Scenario Impact)
- DPA: Default peak adder based on user input

Annual Premise Count Trend Forecast

The Annual Premise Count Projection by CityGate and year was based upon a linear trend analysis of the Historical Premise Count data pulled from CC&B for a CityGate, tariff, and year. Historical Premise Count by CityGate, tariff, and year was used to forward project premise count based upon the trend between premise count and time. This information is used as guide to assist Cascade when forecasting customer growth.

Premise Trends by CityGate where calculated utilizing the equations defined below:

$FPC_{[CG,Tariff,Yr]} = Trend(CCB\_AAP_{[CG,Tariff,Yr]}, Time_{[Yr]})$

Definitions:

- CCB_AAP: CCB Average Annual Premise count by CityGate, tariff, and year.
- Time: Years Raw CCB premise count data was provided
- FPC: Forward projection of annual premise count by CityGate, tariff, and year.

f. Assumptions (NOTE: All model assumptions will be included in final document)

Weather

- Forecast is based off of core data
- Core data is sourced from the pipeline company and from Cascade GMS (gas management system)
- Weather at each CityGate is represented by weather at one of the seven weather locations.
- HDD's, on a 60 F threshold, are used to measure unit of coldness
- The time period for finding historical weather is the past 30 years (1984-2013).
- The average weather case scenario is based on normal weather- the average monthly HDD of a historical time period of 30 years.
- The high case weather scenario uses the monthly average from the six coldest system wide years out of 30.
- The low case weather scenario uses the monthly average from the six warmest system wide years out of 30.

Linear Regression Model

- A linear regression model is used to model demand based on weather.
- Cascade refers to the most recent year's (2013) for CityGates that have regressions (R^2) less than a certain value assigned by Cascade (20%).

Growth

- The forecast uses outside consulting firm Woods & Poole's forecast for population growth.
- The forecast model assumes that 1% increase in population translates to a 1% increase in gas demand, before accounting for any efficiency gains.
- The EIA efficiency factor is derived from the 2014 EIA Annual Energy Outlook.

III. Forecast Results

a. Cascade System Demand Forecast

See Appendix A

20 Year Annual Core Demand Forecast by CityGate and Tariff

See Appendix A

20 Year Annual Core Demand Forecast by CityGate

See Appendix A

20 Year Monthly Core Demand Forecast by CityGate

See Appendix A

2012 to 2014 IRP Forecast Comparison

See Appendix A

b. Cascade System Peak Day Forecast

See Appendix A

20 Year Annual Peak Day Forecast by CityGate

See Appendix A

IV. Glossary of Terms and Assumptions

Core Customers – These are full service customers of Cascade that pay a delivered price of gas. These are typically residual and commercial customers users.

Non-Core Customers – These customers pay Cascade the cost of transporting the gas to Cascade and purchase the gas from another source.

Premise Count – Customer count.

NOAA – National Oceanic Administration Association, the federal agency that is the primary weather data holder for the United States.

Regression – A method of comparing two different data sets in which factors are calculated to predict one data set to the other. The closer the predicted set to the actual set the better the regression.

Correlation – A measure of the regression of between two data sets. The higher the regression or relation between two data sets the higher the correlation. Correlation figures range from zero to one.

HDD – Heating Degree Day – A unit to describe unit of coldness.

CityGate – This marks the point where the gas utility, Cascade, deliveries gas from the gas pipeline company to a large group of customers.

July 2, 2014

Michael Parvinen
Manager, Regulatory Matters
Cascade Natural Gas
8113 W Grandridge Blvd
Kennewick, WA 9933

RE:	Docket No.	Staff Request No.	Response Due By
	Load Forecast	DR 1- 4	July 16, 2014

Please provide responses to the following request for information. Contact the undersigned before the response due date noted above, if the request is unclear or if you need more time.

1. On June 24 Technical Advisory Group Meeting, Cascade presented a brief overview of the demand forecast for the next 20 years. Four-year monthly demand from the core customers at the city-gate level is considered for the demand analysis.

   a) Please provide the complete excel demand forecast model including all historic data, forecast drivers and forecasts for the 20 year demand forecast.
   b) Explain the basis for considering demand data at the city-gate level. Provide any tests/robustness checks done to clarify the choice of using city-gate over zonal or other levels of aggregation.
   c) Presentation shows that demand data has been drawn primarily from Gas Management System (GSM) and Pipeline actuals. Please provide the reasons/tests performed for considering GSM and Pipeline actuals rather than Customer Care and billing (CC&B).
   d) Please provide the historical hourly gas demand from GSM and Pipeline actuals by city gate and zones separately for both core and non-core sales. Please provide such data from January 1994 to May 2014.
   e) Please provide the historical CC&B demand by city gate and zones separately for core and non-core sales. Please use daily data if it is available. Please provide such data separately by service schedule and customer class. Please provide such data from January 1994 to May 2014.
   f) How do you aggregate city-gates to define a demand loop in your analysis? Please provide the worksheets that show demand analysis at the loop level.

g) Please provide the worksheet showing the historical weather data from NOAA and Schneider Electric for each weather station used in the model. Explain your procedure to assign a specific weather station to each city-gate/loop.
h) Please explain the method used to define normal weather in the study. Explain in detail all the weather scenarios considered and the basis for selecting six coldest and warmest years for the high and low case weather scenarios. Include the spreadsheet demonstrating the calculations for the average, high and low HDD scenarios.
i) Does the Company have weather data for any other weather stations other than the seven stations used? If yes, please provide the data.
j) Does the company have Cooling Degree Days (CDD) data from NOAA or Schneider Electric? If yes, please provide the data.
k) Please explain the method used to gather premise count information from CC&B and provide the worksheet that shows the annual premise count projection by city-gate.

2. Presentation shows that Cascade developed a linear regression model considering monthly Heating Degree Days (HDD) as an input variable and monthly gas demand as a response variable. Please explain the assumptions about the error term. Does the demand study considers alternative models with explanatory variables such as natural gas price, seasonal dummies or trend variables or any time-series ARIMA models?

3. Please provide all relevant statistical tests performed that confirm linear-model as a best-fit model. Provide statistical tests that indicate a linear (and not a non-linear) relationship between the input and the response variable.

4. Please explain the growth scenarios assumed for the demand analysis. Provide the worksheet showing all the demographic variables – Employment, Income, Population, and housing and explain the steps that determine population growth as the only relevant variable for projecting future gas demand.

Please provide an original and one complete copy of your response to the attention of Kay Barnes, PO Box 1088, Salem, OR 97308-1088, or 3930 Fairview Industrial Dr. SE Salem, OR 97302, **and** send via electronic mail to (puc.datarequests@state.or.us).

Confidential responses should not be sent via electronic mail. Confidential responses must be filed on yellow paper. Please file an original and one copy to the above addresses or on a CD clearly marked “Confidential” if it is a voluminous response.

Marc Hellman
Manager
Rates, Finance & Audit
(503) 378-6355

Staff Initiator: Suparna Bhattacharya
cc: Johanna Riemenschneider

July 9, 2014

Michael Parvinen
Manager, Regulatory Matters
Cascade Natural Gas
8113 W Grandridge Blvd
Kennewick, WA 9933

RE:	Docket No.	Staff Request No.	Response Due By
	Load Forecast	DR 1 – 7	July 23, 2014

Please provide responses to the following request for information. Contact the undersigned before the response due date noted above, if the request is unclear or if you need more time.

1. On June 24 Technical Advisory Group Meeting, Cascade presented a brief overview of the demand forecast for the next 20 years. Four-year monthly demand from the core customers at the city-gate level is considered for the demand analysis. Please provide such data as an electronic spreadsheet.

   a) Please provide the historical Customer Care and Billing (CC&B) demand by location (city-gate/zone), and by service schedule and customer class. Please provide such data from January 1994 to May 2014, if available.
   b) Please provide the historical hourly gas demand from Gas Management System (GSM) and Pipeline actuals by city gate/zones for both core and non-core sales. Please provide such data from January 1994 to May 2014, if available.

2. Please provide an electronic spreadsheet showing the historical weather data from NOAA and Schneider Electric for each weather station used in the model. How do you assign a specific weather station to each city-gate and loop?

3. Please explain the method used to define normal weather in the study. Explain in detail all the weather scenarios considered and the basis for selecting six coldest and warmest years for the high and low case weather scenarios. Include the electronic spreadsheet showing the calculations for the average, high and low HDD scenarios.

4. Does the Company have weather data for any other weather stations other than the seven stations used? If yes, please provide the data in an electronic spreadsheet.

5. Does the company have Cooling Degree Days (CDD) data from NOAA or Schneider Electric? If yes, please provide the data.

6. Please explain the method used to gather premise count information from CC&B and provide the electronic worksheet that shows the annual premise count projection by city-gate.

7. Provide an electronic spreadsheet showing the monthly or annual data for all the demographic variables – Employment, Income, Housing and Population from the period January 1994 to May 2014. Also, provide the worksheet showing monthly or annual projection data for all the demographic variables till 2040.

Please provide an original and one complete copy of your response to the attention of Kay Barnes, PO Box 1088, Salem, OR 97308-1088, or 3930 Fairview Industrial Dr. SE Salem, OR 97302, **and** send via electronic mail to (puc.datarequests@state.or.us).

Confidential responses should not be sent via electronic mail. Confidential responses must be filed on yellow paper. Please file an original and one copy to the above addresses or on a CD clearly marked "Confidential" if it is a voluminous response.

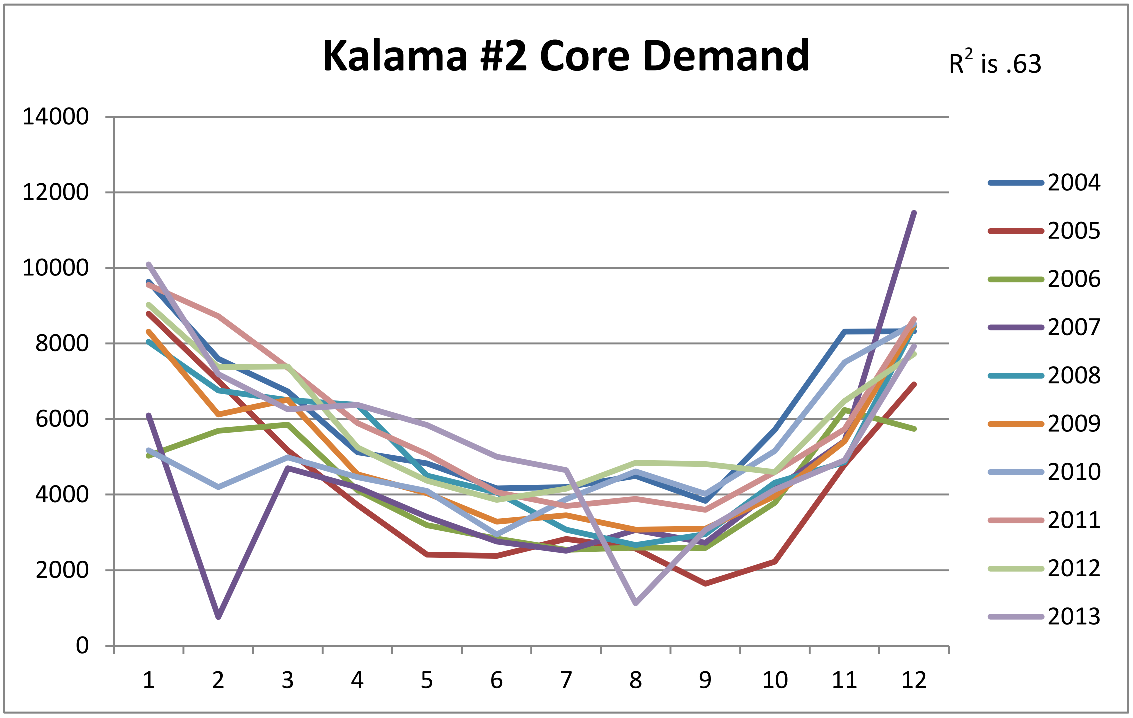
Marc Hellman
Manager
Rates, Finance & Audit
(503) 378-6355

Staff Initiator: Suparna Bhattacharya
cc: Johanna Riemenschneider

September 24, 2014

1. Please explain the EIA Efficiency term on page 3. The formula seems to reflect average number of HDD per capita, so does “efficiency” indicate energy efficiency as demand-side management? Is this an EIA specific term?
2. The Company states that the demand per population per HDD figure is normalized by dividing each year’s calculation by the year one (p. 3). Does this “year one” refer specifically to the number 2014 or does it refer to the $EIA\_E_{[Yr]}$ calculation in 2014?
3. Please provide electronic links to the EIA data used.
4. On page 5 the Company talks about an economic earnings figure divided by some inflation forecast by Woods & Poole. Is this inflation forecast similar to the consumer price index?
5. Please re-review how the Company eliminates outliers discussed on page 6.
6. Has the Company looked to using Oregon’s Office of Economic Analysis figures to forecast demand?
7. See page 18. Please give an example of a CityGate’s linear regression falling below the R^2 threshold of 80%.

1. See page 18. Please give an example of a CityGate's linear regression falling below the R^2 threshold of 80%. Kalama #2 is a CityGate that has an R^2 below .80 because of unexplainable dips in demand. The company will continue to look into the reason behind these dips.



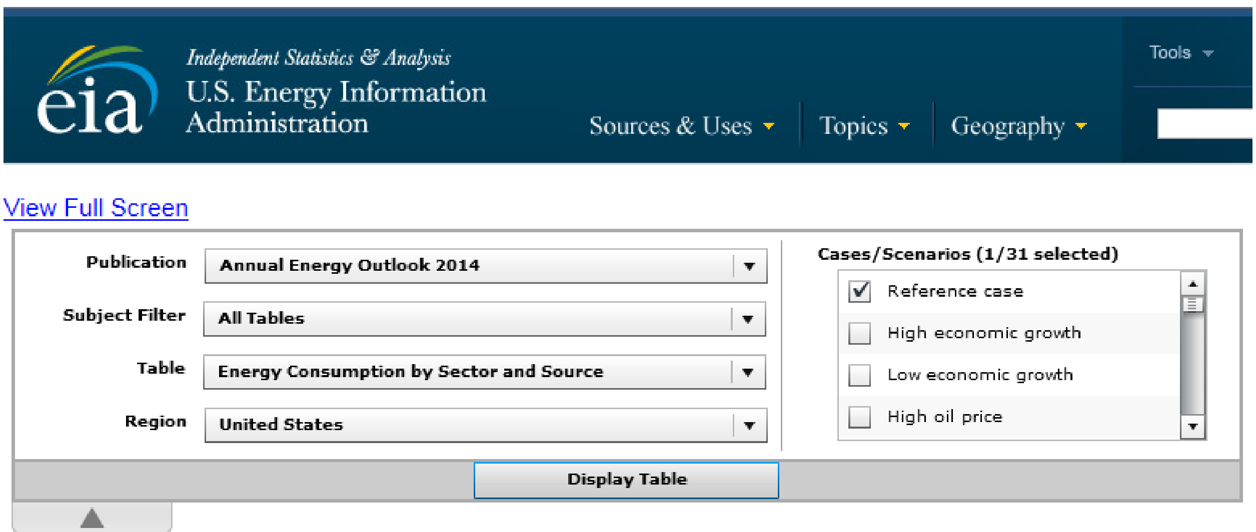
How to create EIA efficiency factor:

Follow the link: http://www.eia.gov/oiaf/aeo/tablebrowser/#release=AEO2014&subject=0-AEO2014&table=2-AEO2014&region=1-9&cases=lowmacro-d112913a,highmacro-d112913a,ref2014-d102413a

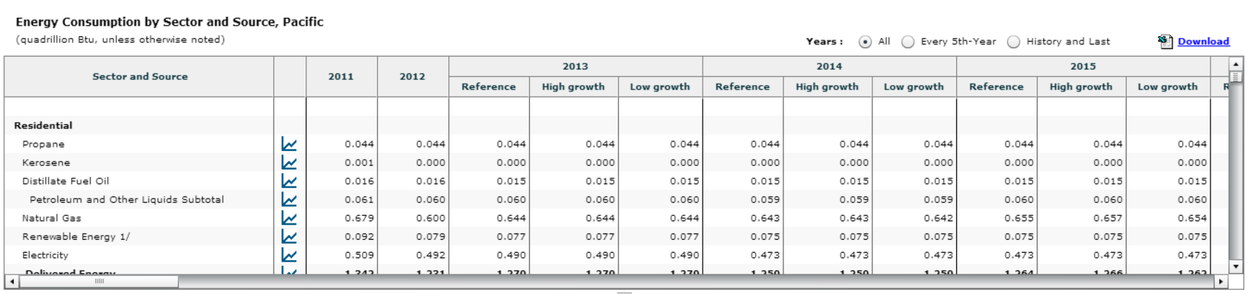
In the drop-down choices presented, select the following options shown in the screen shot below. Make sure to choose the 'United States' region and the most recent Annual Energy Outlook in the 'Publication' field.

Check the box for 'Reference Case' under the Cases/Scenarios choices.

Click 'Display Table'



The table information will appear:



Energy Consumption by Sector and Source, Pacific
(quadrillion Btu, unless otherwise noted)

Years : All / Every 5th-Year / History and Last — Download

Sector and Source	2011	2012	2013			2014			2015		
			Reference	High growth	Low growth	Reference	High growth	Low growth	Reference	High growth	Low growth
Residential											
Propane	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044
Kerosene	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Distillate Fuel Oil	0.016	0.016	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015
Petroleum and Other Liquids Subtotal	0.061	0.060	0.060	0.060	0.060	0.059	0.059	0.059	0.060	0.060	0.060
Natural Gas	0.679	0.600	0.644	0.644	0.644	0.643	0.643	0.642	0.655	0.657	0.654
Renewable Energy 1/	0.092	0.079	0.077	0.077	0.077	0.075	0.075	0.075	0.075	0.075	0.075
Electricity	0.509	0.492	0.490	0.490	0.490	0.473	0.473	0.473	0.473	0.473	0.473

On the far right, click the 'Download' link, which exports the entire table to Excel.

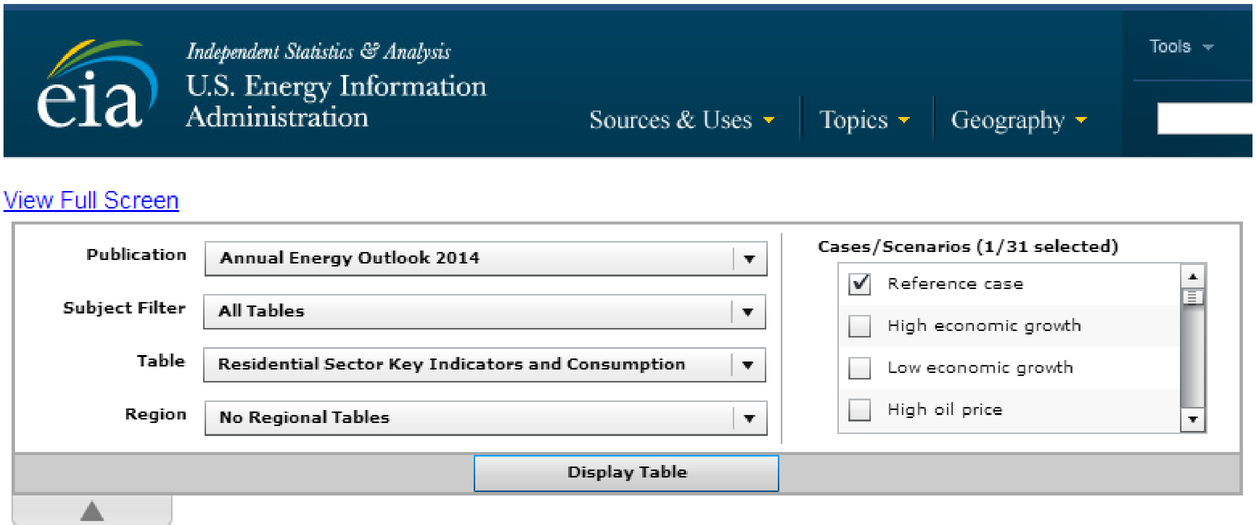
There are three rows from this table needed to calculate the efficiency factor:

- Residential Natural Gas Consumption
- Commercial Natural Gas Consumption

- Population

The Heating Degree Days for the Pacific region are presented in a different table. Select the following option in the table choices. Click ‘Display Table’.

Note: The HDDs forecasted in the ‘Residential Sector Key Indicators and Consumption’ table are the same as the HDDs forecasted in the ‘Commercial Sector Key Indicators and Consumption’ table, so either of these tables may be chosen.



Click the ‘Download’ link in the top right corner of the table to export this table’s data to Excel.

There is one row needed from this table for the calculation:

- Heating Degree Days – United States

Now that all four items are in Excel format, it is possible to calculate the efficiency factor:

1. Create a total natural gas consumption row
    a. Add up residential and consumer natural gas consumption for each year
2. Create an efficiency number row
    a. Divide the total natural gas consumption for each year by Pacific population and by Pacific heating degree days for that year
3. Create efficiency factor for each year (Normalize efficiency number)
    a. Divide each year’s efficiency number by the efficiency number of year 1
        i. Year 1 will have a factor of 1

July 2nd DR1-a. Please provide the complete excel demand forecast model including all historic data, forecast drivers and forecasts for the 20 year demand forecast.

The forecast model is a large application and its development and configuration are still a work in progress. Additionally, the application is too large and in too many components to reasonably make available by conventional means such as on a collection of CDs. Once the 20 year demand forecast is finalized as part of the IRP process Cascade can make available in excel format, extracts of historic data, elements of forecast drivers and other data elements requested by Staff. Cascade is also prepared to provide full access to the model on-site. Please note contractually Cascade can only provide full access to representatives of regulatory bodies. Due to concerns regarding protecting intellectual property we cannot provide the full application to all stakeholders.

July 2nd DR1-b. Explain the basis for considering demand data at the city-gate level. Provide any tests/robustness checks done to clarify the choice of using city-gate over zonal or other levels of aggregation.

At various times over the last decade, both commission staffs have expressed concerns about Cascade's forecast methodology and its development at the district/zonal level as opposed to citygate, particularly as it relates to acquiring capacity to meet projected transport capacity shortfalls on a peak day. Both Staffs have noted this in previous comments regarding past IRPs. It seems difficult from our perspective for us to justify to ratepayers or stakeholders to continue to use a method and configuration that has been subject to some on-going concern. We believe it is best to address the situation now with a new configuration. To do otherwise would continue to perpetuate a perceived flawed result; this provides no benefit to stakeholders.

The Company's most recently acknowledged Integrated Resource Plan's demand forecast and pipeline capacity needs were developed at the pipeline zonal level. Consequently, the analysis to determine potential peak day shortfalls was performed at the zonal level. The Company has used this analysis as part of its ongoing efforts to identify areas where pipeline capacity could be re-aligned or to pursue other means to meet the peak day demand such as acquiring incremental pipeline capacity. The Company believes that a more accurate picture of the capacity needs can be obtained if resource and demand forecast modeling and analysis are performed at a more detailed level than the zonal level. The Company feels developing the plan at the city gate level will significantly improve our planning and provide more transparency to stakeholders.

In order to accomplish this more robust demand forecast and capacity analysis the Company hired MRE and Gelber Associates to develop a new forecast methodology and model application. Additionally, Cascade has undertaken a near total reconfiguration of the SENDOUT resource optimization model. Both the application development and reconfiguring efforts are highly complex and time consuming processes. However, at the city gate level, the Company can perform more detailed analysis, allowing Cascade to better identify specific locales where shortfalls may exist. This more detailed analysis will better inform all stakeholders, allowing for a more robust discussion during the public process (technical advisory group meetings) on how best to address specific capacity needs or determine what alternative resources may be needed to meet long term demand.

Tests and comparisons of citygate vs zonal aggregation levels will be incorporated into the upcoming IRP in both the narrative section and with appendices.

List of Gates within each Loop:

Bend Loop – Bend Gate, North Bend Gate, and South Bend Gate

Burbank Heights Loop – Burbank Heights Gate and Pasco Gate

East Stanwood Loop – Oak Harbor/Stanwood Gate and East Stanwood Gate

Kennewick Loop – Kennewick Gate and Richland Gate

Longview South Loop – Longview-Kelso Gate and South Longview Gate

Sedro-Woolley Loop – Sedro/Woolley Gate and Mount Vernon Gate

Sumas SPE Loop – Bellingham 1 (Ferndale) Gate, WCT-CNG Interconnect Gate, and Lynden Gate

Yakima Loop – Selah Gate and Yakima/Union Gap Gate

Response to stakeholders request of the raw population and economic growth figures from the 2014 Woods & Poole:

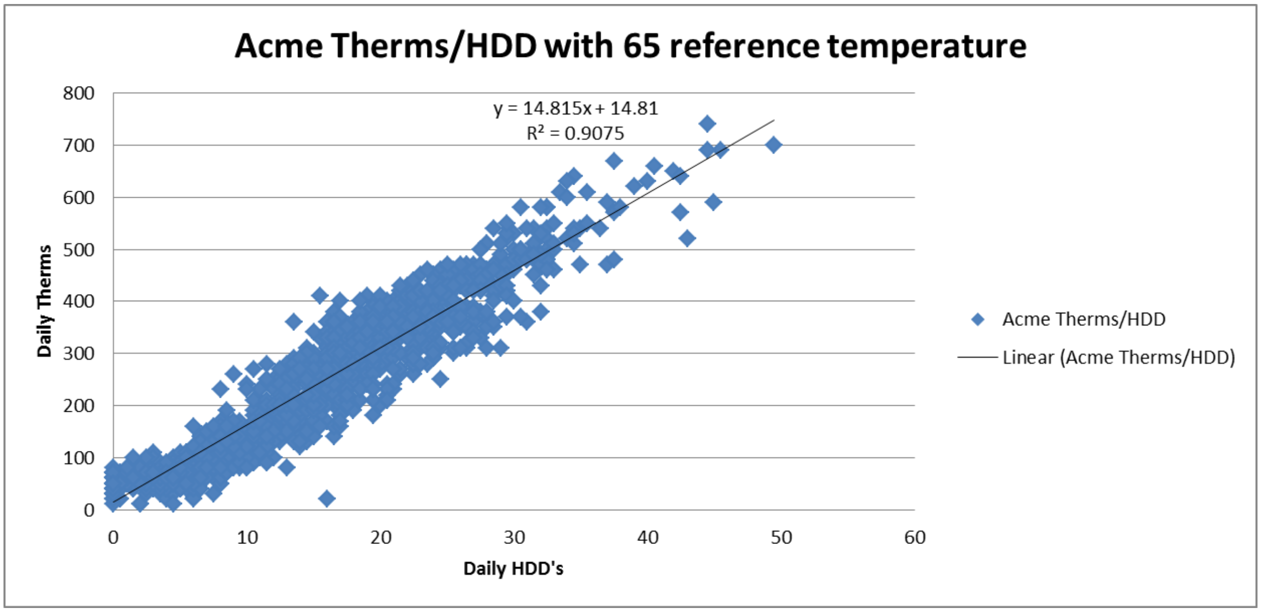
Unfortunately, Cascade's currently effective User License makes it impossible to provide stakeholders with this level of detail from Woods and Poole.

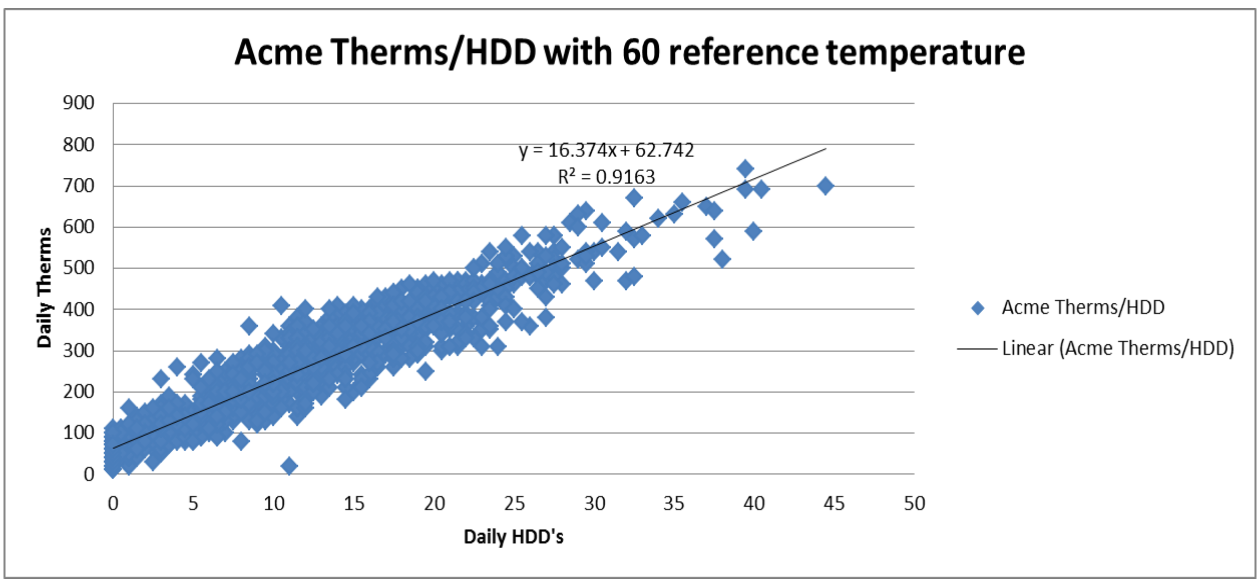
> Paragraph 1 of the Cascade-Woods & Poole License and Restrictions section states in part: "…Licensee may permit its employees at the Site to use the Product solely on its behalf and, if provided in electronic form, may make a reasonable number of copies as necessary for such use, **provided all users and all copies shall be located at the Site**, **Licensee shall not make the Product available or accessible outside of the Site or on or through the Internet or other externally accessible network."**
>
> The agreement does allow Cascade to "…incorporate small excerpts of Information from the Product into Licensee's report and similar documents (other than formal legal and financial documents}…"; however, the agreement states that "…(iii) the amount of Information in each Licensee Document must be an insubstantial portion of the overall Information in the Product, and be insubstantial and incidental to the overall Licensee Document; and (iv) Licensee may not otherwise reproduce, distribute, sublicense, transfer or disclose any of the Product, or use any of the Product to develop or commercialize any data product or service or provide any of the Product for download over a network.
>
> All bold emphasis are Cascade's.

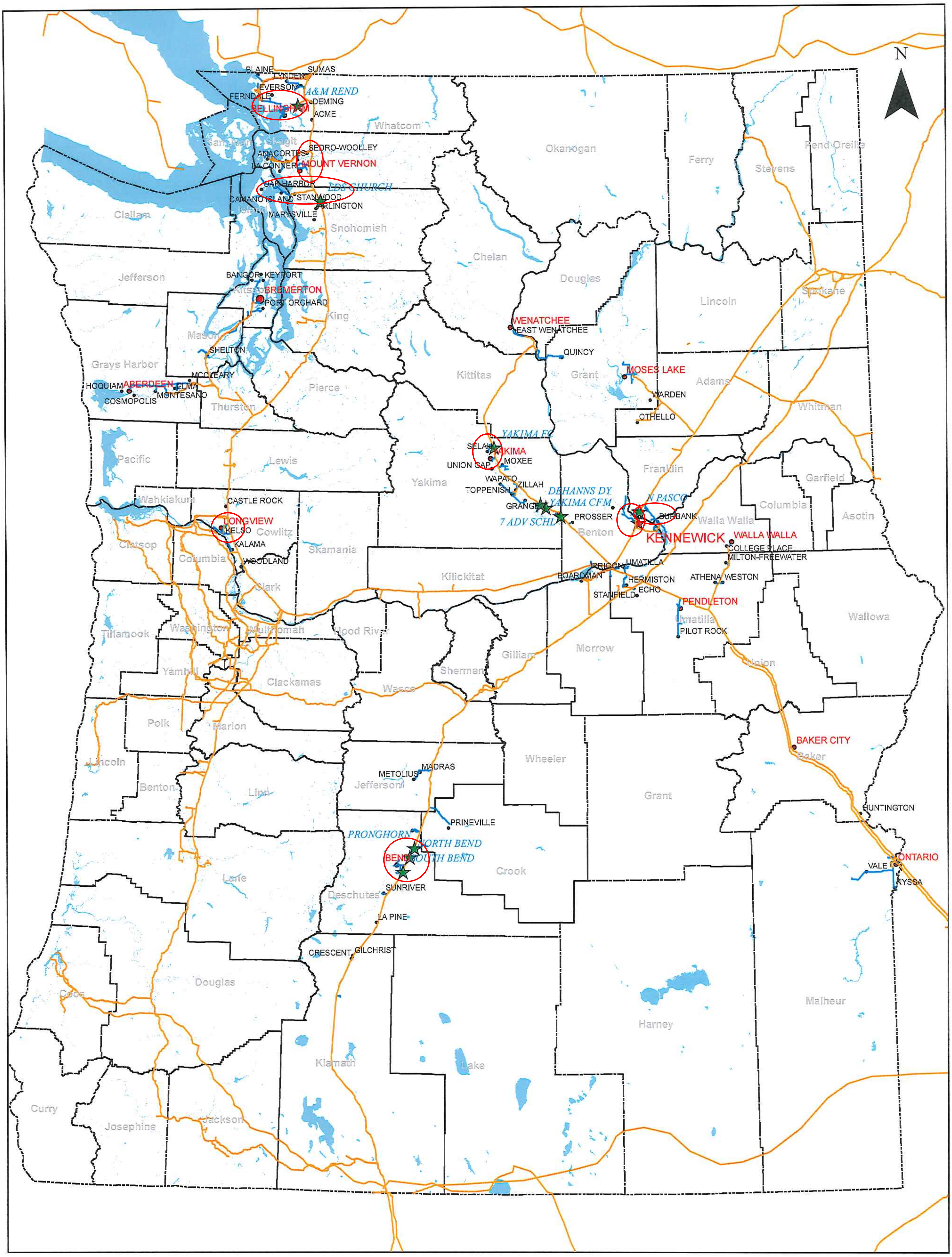
Cascade will provide Woods & Poole data, subject to the limitations on small excerpt as outlined above, or in the limited ability the user license allows us to display/use Woods & Poole information in documents such as our IRP. Unfortunately, we will not be able to provide sizeable levels of Woods & Poole data at the workshops or via other media due to the requirement that access to the data is limited to the licensed Site (i.e., Cascade's Kennewick office). However, as we indicated during the second load forecast workshop, Cascade can provide access on-site in Kennewick to the raw Woods & Poole data source and show in detail how this data is utilized by the load forecast model. As noted above we are not allowed to provide sizeable amounts Woods & Poole information via a download or across a network, which also means we cannot use WebEx as a means to show the detailed Woods & Poole data. Again, we will be happy to host stakeholders at our Kennewick headquarters to review the Woods & Poole data on-site.

The table directly below shows daily HDD’s to daily therms based on a 65 degree reference temperature.

The table below shows daily HDD’s to daily therms based on a 60 degree reference temperature.







System Map

Legend

- ★ Town Border Station selection
- Interstate Pipelines
- Transmission Main
- High Pressure

Communities

- • Communities Served

MDU Office Type

- ★ General Office
- ● Region Office
- • District Office

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Schneider:

Cascade has 30-year daily average for Bellingham, Bremerton, Yakima, and Wall Walla for Washington, Redmond, Pendleton, and Baker for Oregon. These are the weather locations that are currently built into our forecast model.

Weather, other than those listed above, that is available:

Hourly data from 1981 to 2006 and 2012-2013 and daily data from 1995-2013 for:

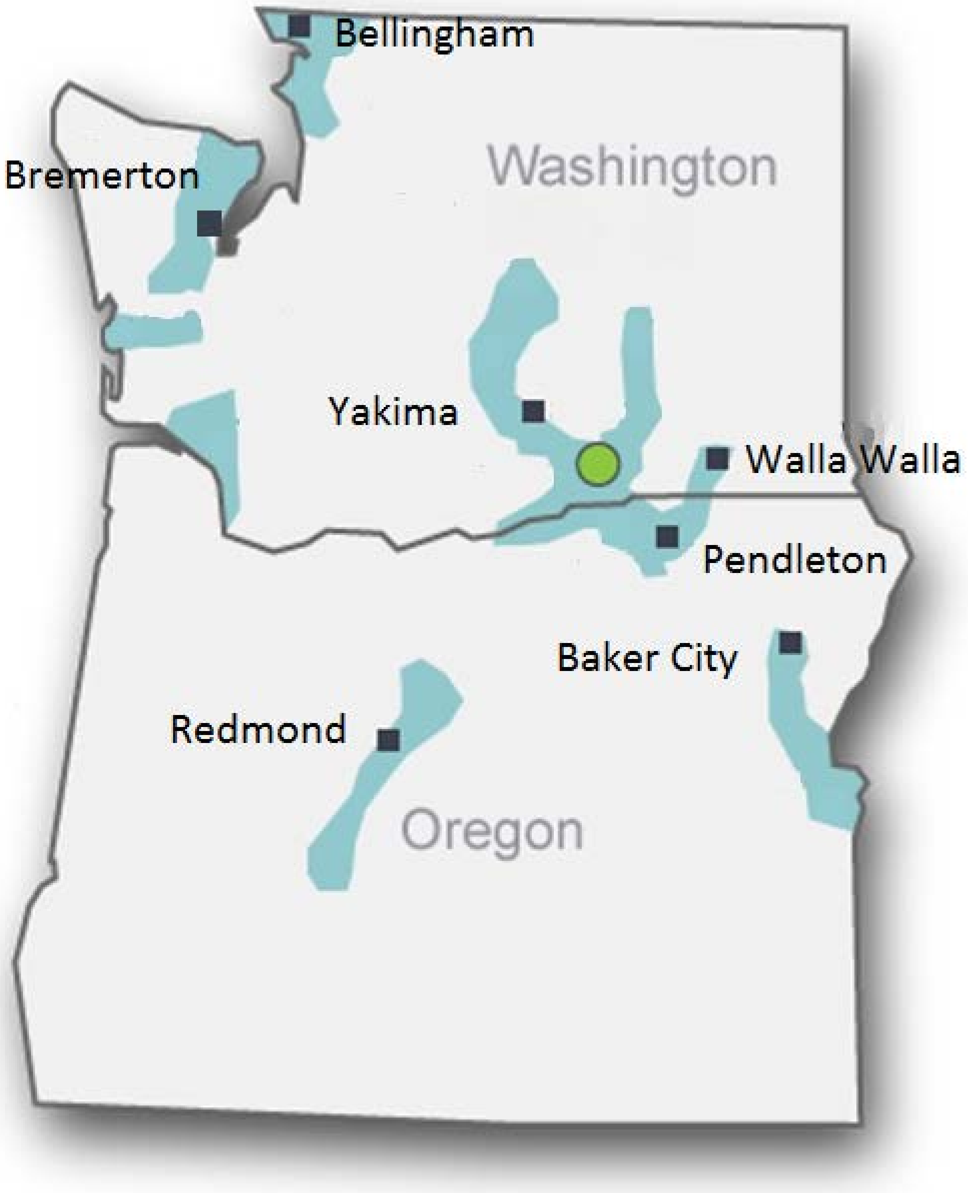
Burlington/Mount Vernon, WA

Wenatchee, WA

Kelso-Longview, WA

Pasco, WA

Ontario, OR


Bellingham
Washington
Bremerton
Yakima
Walla Walla
Pendleton
Baker City
Redmond
Oregon

Cascade Natural Gas Forecast Model Workshop #3
Portland International Airport in Portland, OR
Tuesday, December 2, 2014 9:00 AM – 9:45 PM

Attachments:

Attachment A – Attendance sheet

I.) **Introduction** – Mark Sellers-Vaughn opened the meeting with the introductions and reasoning for the meeting.

II.) **Action Items** – Brian Robertson went through action items from previous meetings and made sure there were not any more questions on the items:

- Provided a System map with the Looped CityGates circled.
- Provided the CPI table from 2014 Woods & Poole.
- Provided an Acme Graph that showed the 65 HDD vs 60 HDD.
- Provided a map with Bremerton weather station in the correct place.
- Provided the reasoning for choosing 7 weather locations. Explained that the Longview-Kelso area is only 2% of core demand. The group decided it is fine to proceed with 7 locations at this time.
- Provide an explanation on how we can host stakeholders to review raw population and economic growth values from 2014 Woods & Poole.
- Resent the CC&B data that was broken down by year.
- Explained Cascade's current weather availability.

III.) **Action Items** – Many stakeholders asked important questions and left CNGC with many items to research and discuss.

- Provide a side by side of the 60 vs 65 HDD graphs.
- Provide a better system map.

IV.) **Wrap-Up –** Cascade noted the 2nd TAG meeting was cancelled at the December 16, 2014 data and will now be scheduled for January 13, 2015.

Attendance:

Presenters:
Mark Sellers-Vaughn
Brian Robertson

Attendees:
Lisa Gorsuch
Suparna Bhattacharya
Sommer Templet
Nadine Hanhan

Call-in attendees:
Jon Klingele
Tommy Brooks
Micah Robinson
Bob Morman
Jeremy Ogden
Julianna Williams

Cascade Natural Gas Corporation

Capacity Workshop #1

Portland International Airport Conference Center

Tuesday, April 8, 2014

Agenda

- Introductions (10 min)
- Agenda (5 min)
- Workshop background and CNGC overview (15 min)
- NWP Presentation: events impacting flow on NWP (20 min)
- Break (10 min)
- NWP Presentation: pipeline capacity discussion (60 min)
- Lunch Break (45 min)
- GTN Presentation (15 min)
- Ruby Presentation (30 min)
- Next Steps (30 min)
- Adjournment

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Background

- CNGC requested IRP extensions from both OPUC and WUTC
- Extension needed for load model and methodology change to city gate level
- Extensions granted with modified timeline
- OPUC agreed to extension subject to having 2 workshops addressing capacity and potential to acquire additional Ruby capacity prior to Oct14
- Major stakeholders agreed a concurrent filing for OR and WA makes the most sense
- February 11, 2015 Final IRP Filing (dockets Oregon LC-59 and Washington UG-140181)

Background

- Capacity workshops scheduled for April 8th and May 1st
- First workshop covers capacity system-wide
- Second workshop is specific to Ruby and GTN
- CNGC required to file an update to 2011 IRP (LC-54) by June 20th, containing CNGC analysis regarding any acquisition of incremental Ruby capacity which might occur before October

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Current

- CNGC is working with MRE and Gelber & Associates on our load forecast modeling
- First internal draft of forecast in early May
- For the capacity workshops data from most recent IRPs will be used
- The focus of these workshops is directed at CNGC' s core customers; other customer groups will be discussed during the regular TAG meetings
- IRP TAG #1 in June will include a detailed presentation on the new 20 year core demand forecast model and methodology

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Current

- Projected peak day capacity shortfalls exist in several areas across the entire system, impacting GTN, NWP and Westcoast Pipeline
  - Bellingham WA Area
  - Central Oregon
  - Kennewick WA Area
  - Others

More detailed discussion of peak day capacity shortfalls at the city gates will take place during the regular TAG meetings beginning in June.

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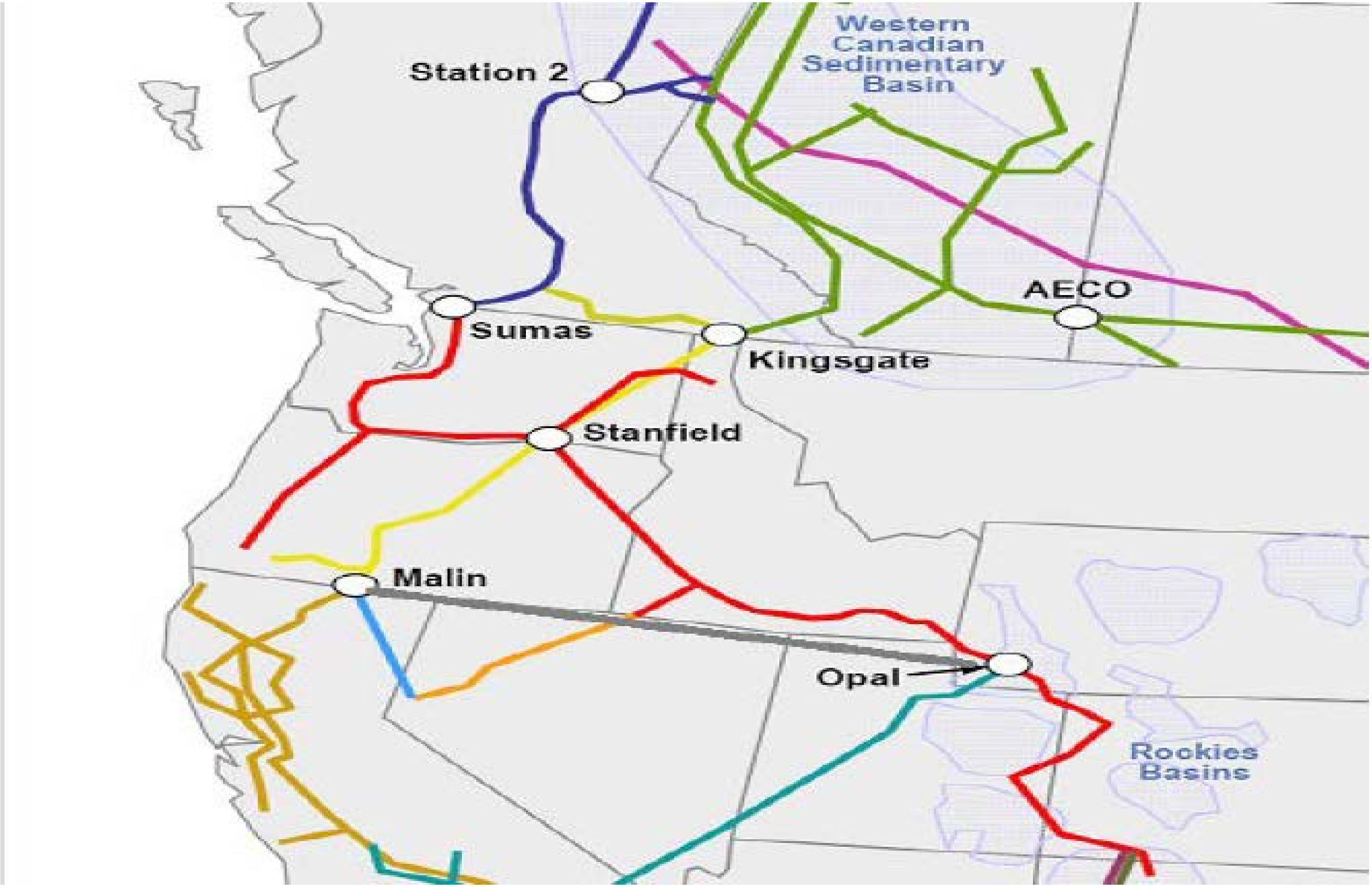
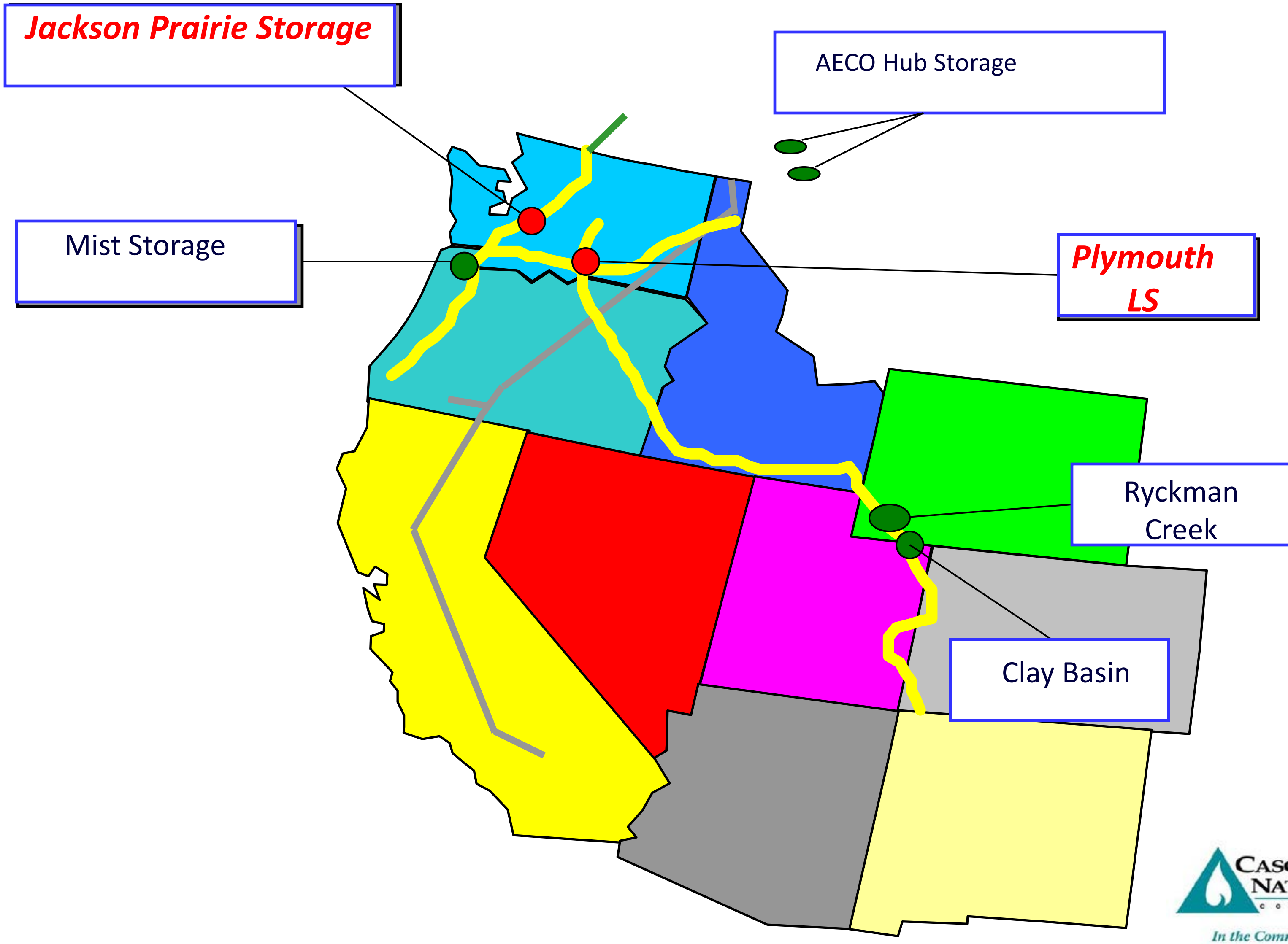

Western
Canadian
Sedimentary
Basin
Station 2
AECO
Sumas
Kingsgate
Stanfield
Malin
Opal
Rockies
Basins

STORAGE FACILITIES
(Cascade leased storage locations in red)



STORAGE

1) Goal is to cycle the storage accounts each heating season, dependent on demand and operating conditions
2) Assumes all accounts will be 35% full by June 30, 80% full by August 31, and 100% full by September 30
3) Unless noted, assumes normal weather with peak event
4) SGS01 balances based on historical data with inventory zero by end of April
5) SGS02, SGS622 and SGS626 assumes balance of 80% November, 40% December, 20% January and zero by end of February
6) Jackson Prairie storage and Plymouth LNG are utilized based on weather, market and operational conditions

Jackson Prairie
- SGS01
- SGS02
- SGS622
- SGS626

Plymouth LNG
- LS01

CASCADE STORAGE CONTRACTS		
	Storage Capacity	Withdrawl
Total	(decatherms)	(dths/day)
SGS01	604,351	16,789
SGS02	350,000	30,000
SGS622	102,782	3,500
SGS626	178,460	6,077
LS01	562,200	60,000

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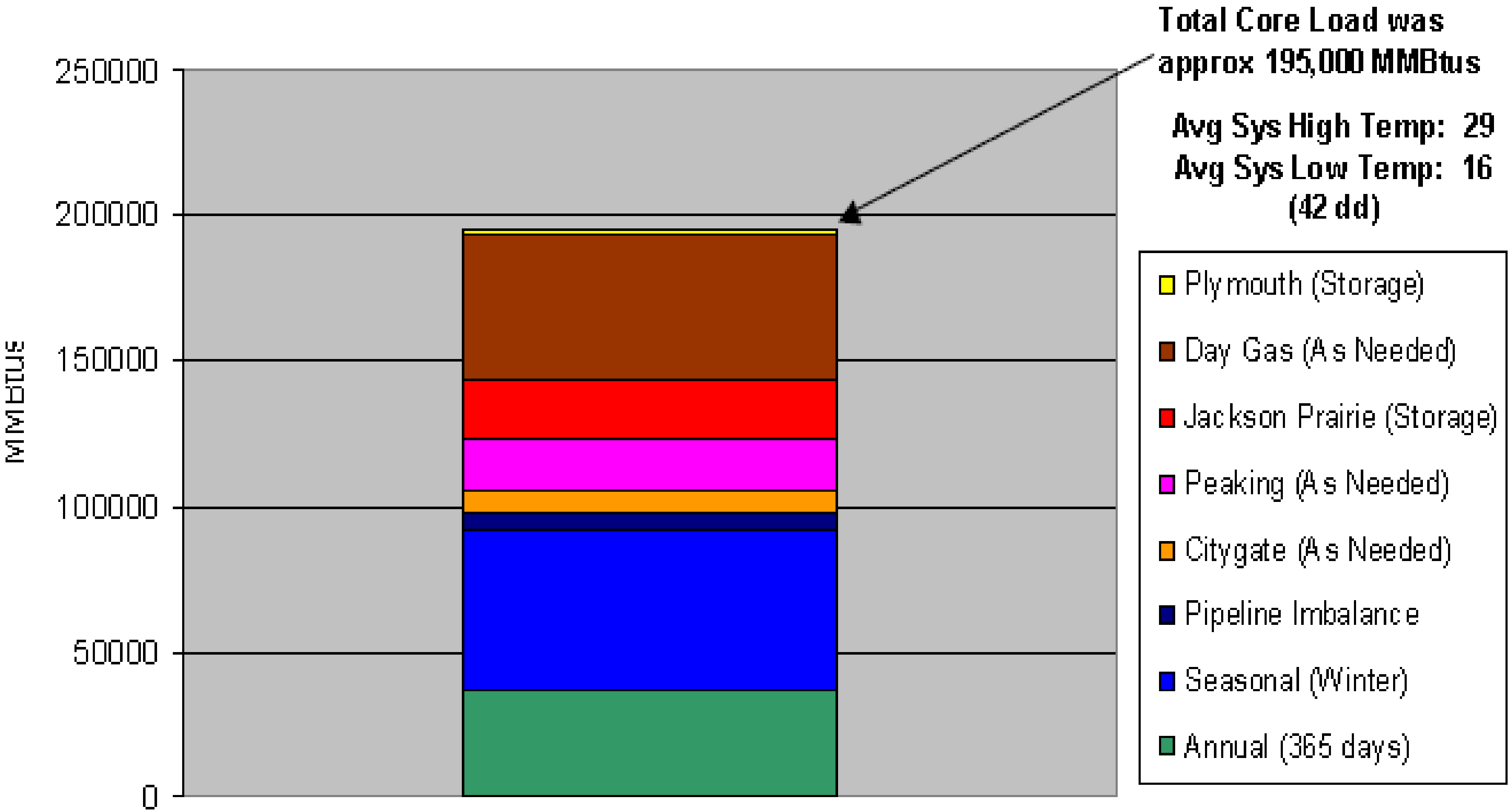
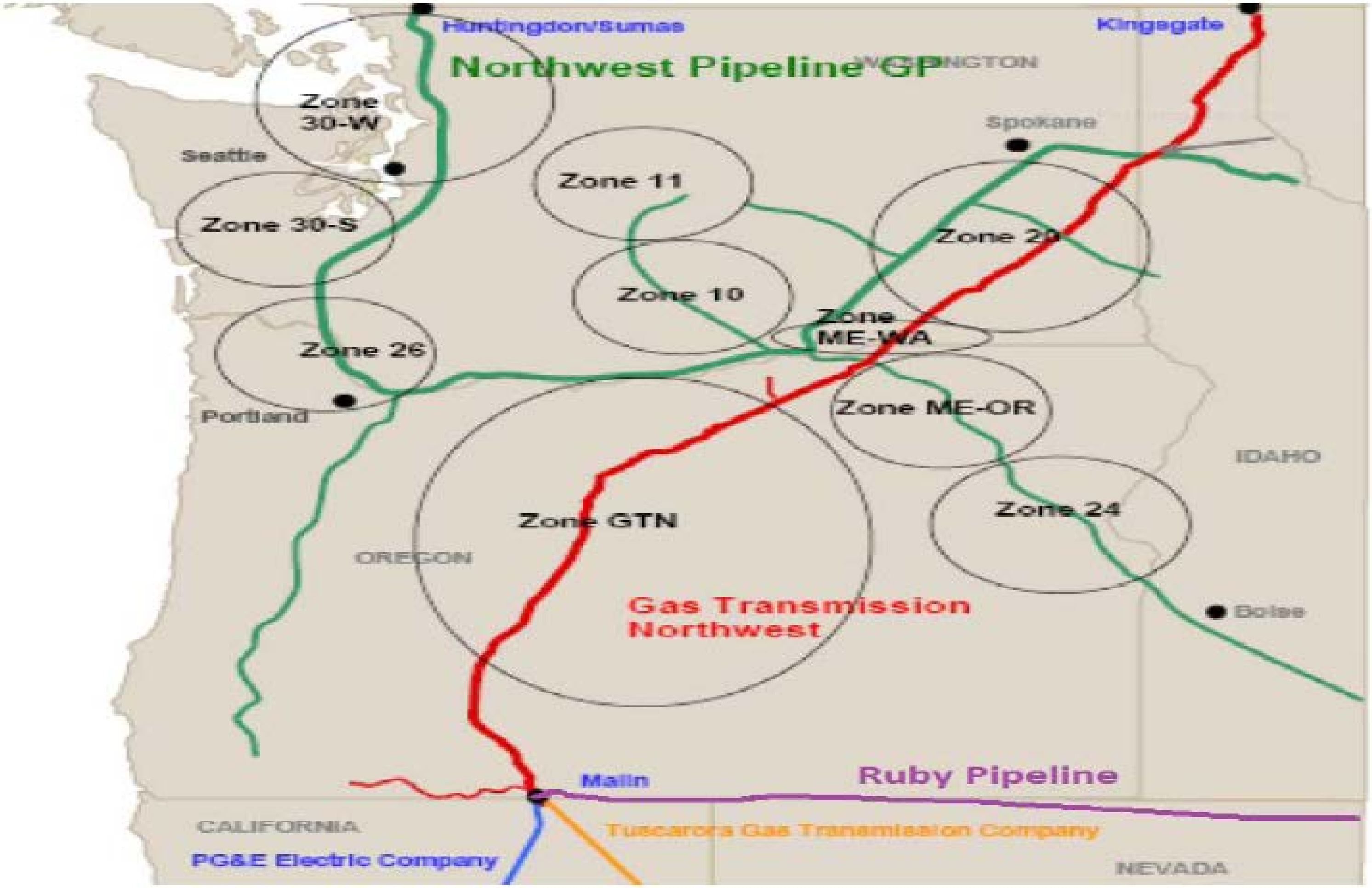
EXAMPLE OF CORE SUPPLY PORTFOLIO ALLOCATION



Cascade crosses multiple potential pipeline constraints due to the geographical complexity of our distribution system.



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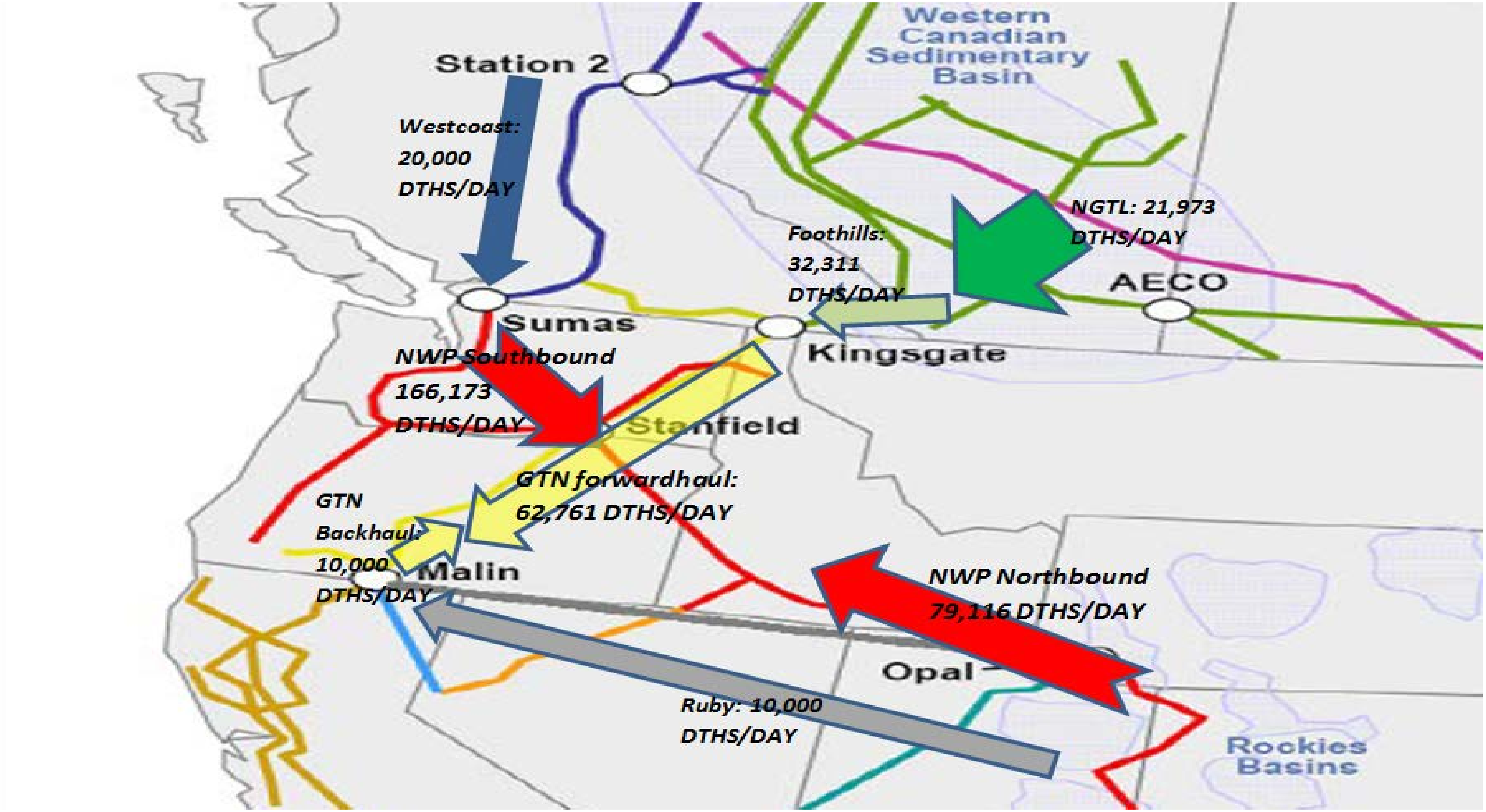
EXAMPLE OF POSSIBLE CNGC WINTER TRANSPORT CAPACITY FLOW



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Cascade's Capacity Workshop

Mike Rasmuson
Director, Marketing Services
Northwest Pipeline
April 9, 2014

Northwest Pipeline

Williams. Ingenuity takes energy.

– Northwest Pipeline Overview

– Winter Heating Season/Cold Weather Events

– System Utilization

– Northwest's Capacity remains in High Demand

– Business Development

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Northwest Pipeline Overview

> Bi-direction system with access to abundant domestic and Canadian gas supplies

– British Columbia, Alberta, Rockies, San Juan

– Proximity and abundance of Canadian gas will benefit market area expansions

> Long-term firm transportation capacity of 3.9 MMDth/d

– Northwest is fully subscribed with an average contract life of approximately 10 years

> Prepared to serve future growth

– Pacific Northwest markets growing at ~1.5 percent / year

– Gas fired generation will grow ~3.3 percent / year

– Gas will support new renewable generation and replace retiring Pacific Northwest coal generation

OFO – Nominations exceed Design Capacity

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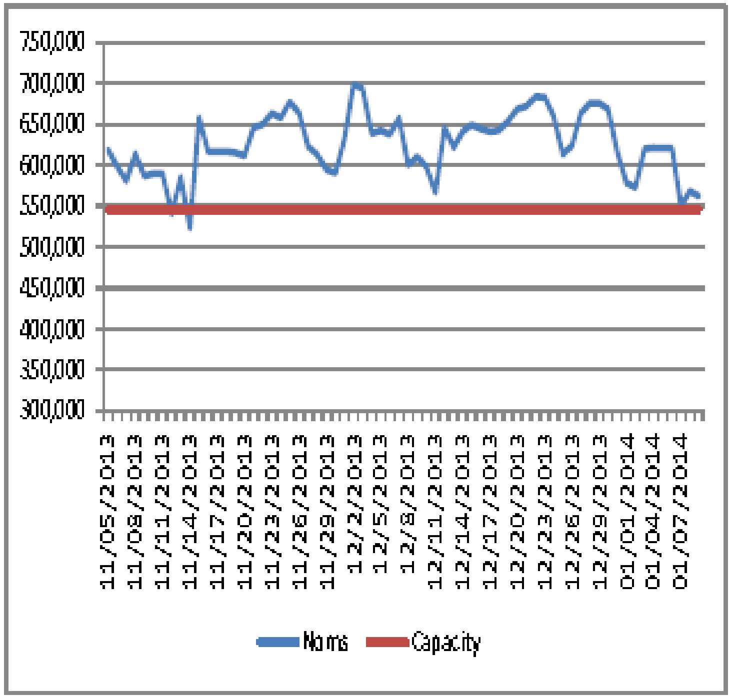
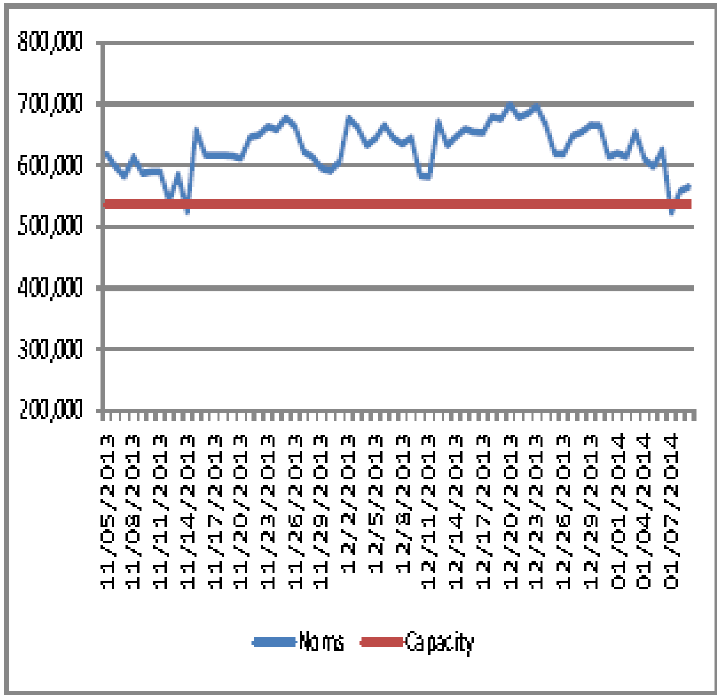
Roosevelt



Plymouth South



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December 2013 Weather Forecast

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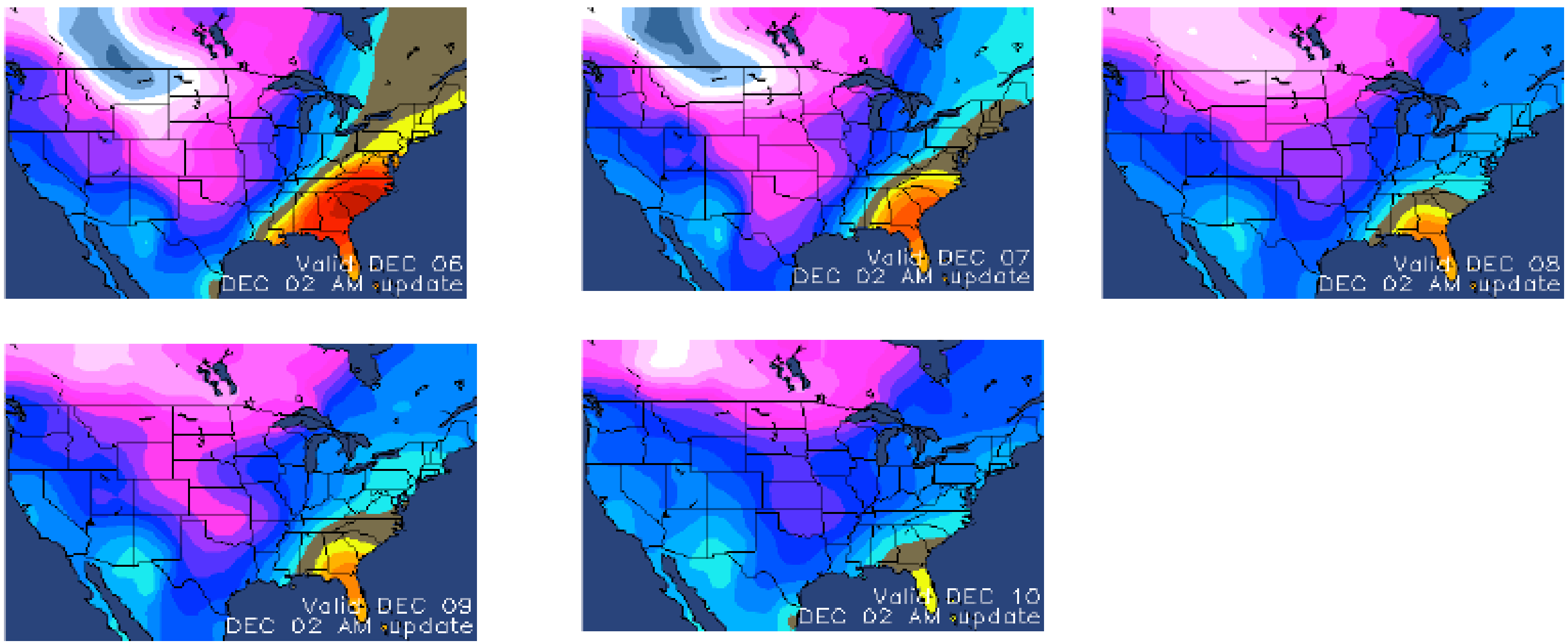
December 2nd forecast for Dec 6-10



Daily and Period Temperature Anomaly Key (F)

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February 2014 Weather Forecast

Williams.
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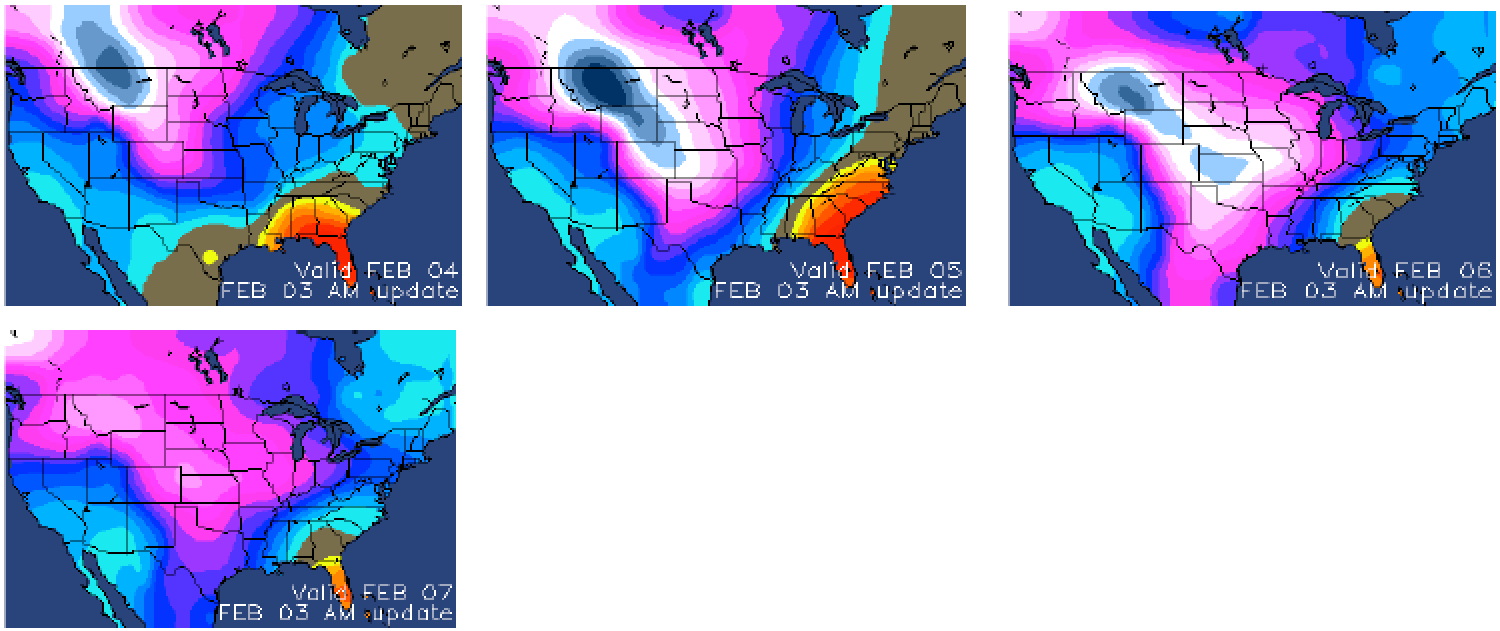
February 3[rd] forecast for Feb 6-8



Daily and Period Temperature Anomaly Key (F)

-36 -34 -32 -30 -28 -26 -24 -22 -20 -18 -16 -14 -12 -10 -8 -6 -4 -2 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36

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March 2014 Weather Forecast

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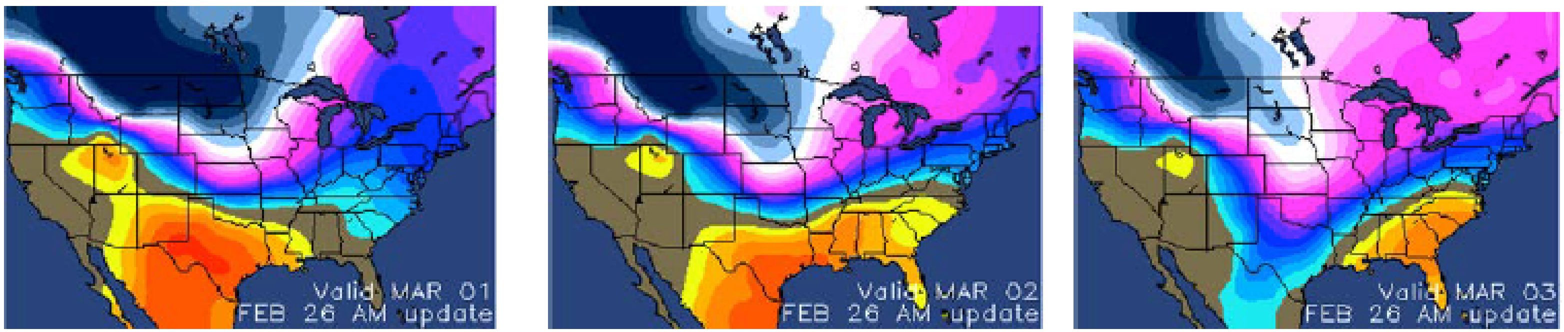
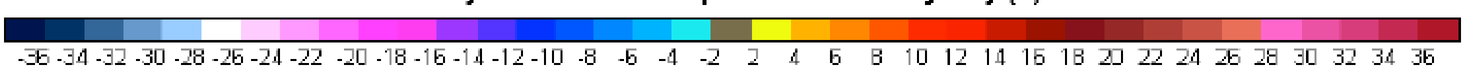
February 26 forecast for Mar 1-3



Daily and Period Temperature Anomaly Key (F)



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2013-2014 Cold Weather Events

> December and February weather was predicted to be a ten-year cold weather event.

> In response, Northwest declared a Stage II (8%) Underrun Entitlement for the system north of Kemmerer during the December and February weather events.

> For the March weather event, Northwest declared a Stage II (8%) Underrun Entitlement for the system north of Plymouth.

> Under an Entitlement, Shippers are subject to the penalty provisions in the Tariff if physical deliveries exceed nominations above the stated tolerances.

Actual Temperature and HDD

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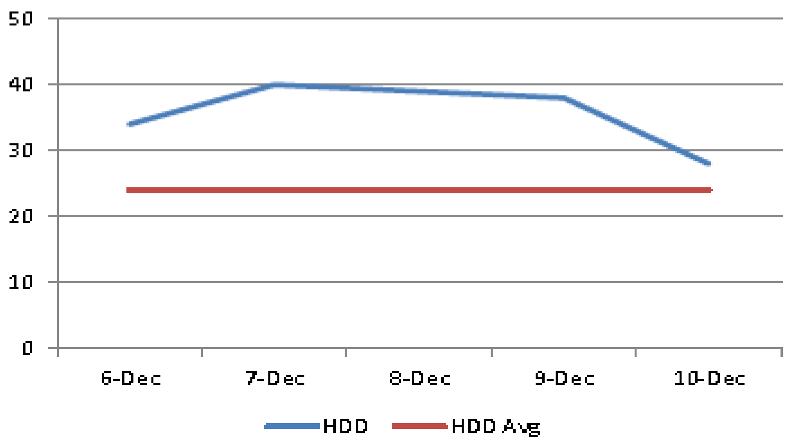
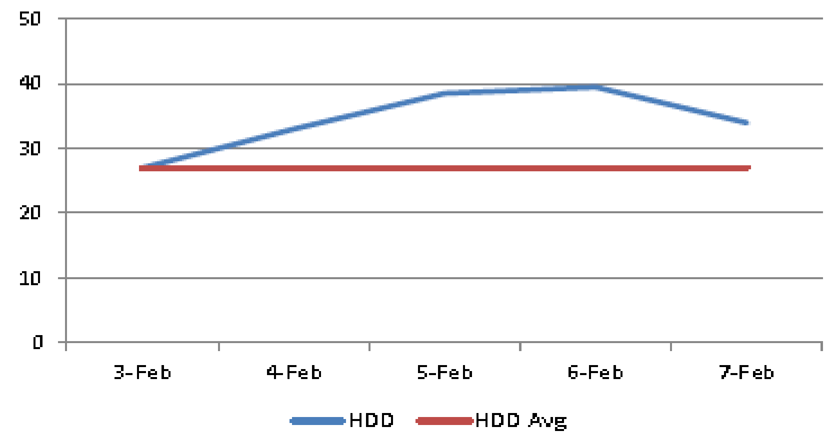
Seattle

December	Hi	Lo	HDD	HDD Avg
6	35	27	34	24
7	32	18	40	24
8	34	18	39	24
9	34	21	38	24
10	41	32	28	24

Seattle

February	Hi	Lo	HDD	HDD Avg
3	41	35	27	27
4	37	27	33	27
5	32	21	39	27
6	30	21	40	27
7	37	25	34	27





Note: Puget Sound Energy reported an all time peak day on December 7 and a new peak day on February 5.

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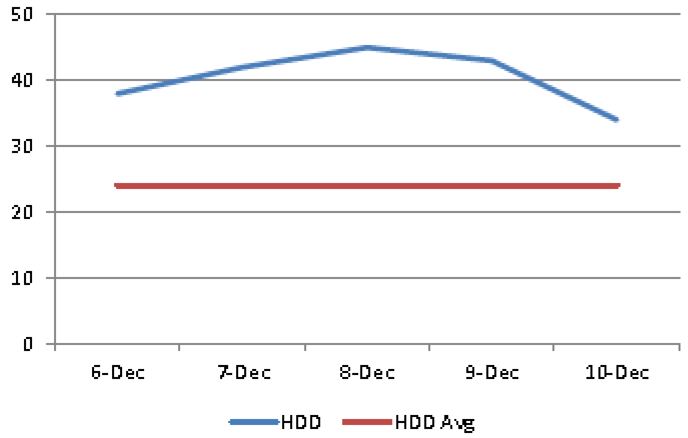
Actual Temperature and HDD

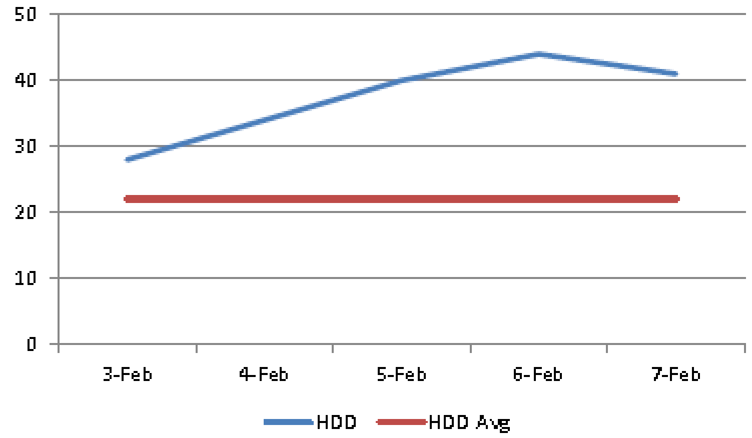
Portland

December	Hi	Lo	HDD	HDD Avg
6	30	24	38	24
7	30	15	42	24
8	28	12	45	24
9	29	14	43	24
10	34	27	34	24

Portland

February	Hi	Lo	HDD	HDD Avg
3	43	31	28	22
4	37	25	34	22
5	29	21	40	22
6	23	19	44	22
7	28	20	41	22





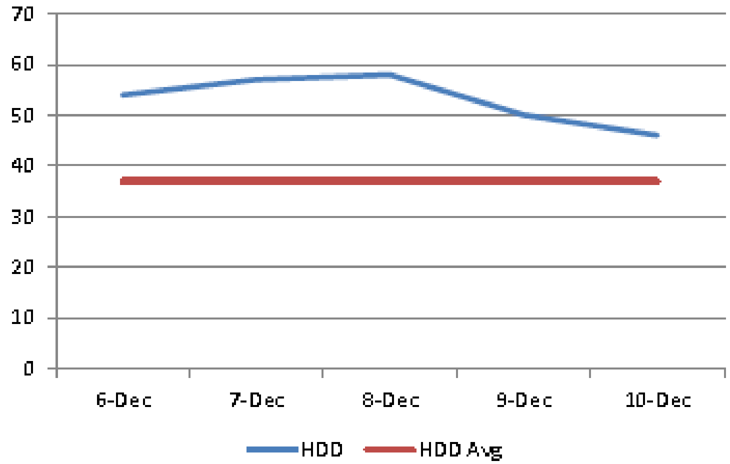
Note: Northwest Natural reported a high send-out day on February 6.

Actual Temperature and HDD

Williams. Ingenuity takes energy

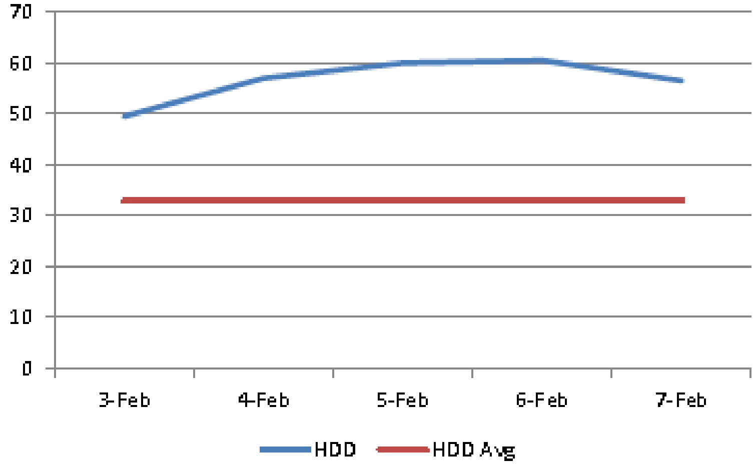
Spokane

December	Hi	Lo	HDD	HDD Avg
6	17	5	54	37
7	15	0	57	37
8	15	-2	58	37
9	20	9	50	37
10	27	11	46	37



Spokane

February	Hi	Lo	HDD	HDD Avg
3	24	7	50	33
4	15	1	57	33
5	11	-1	60	33
6	14	-5	61	33
7	13	4	57	33



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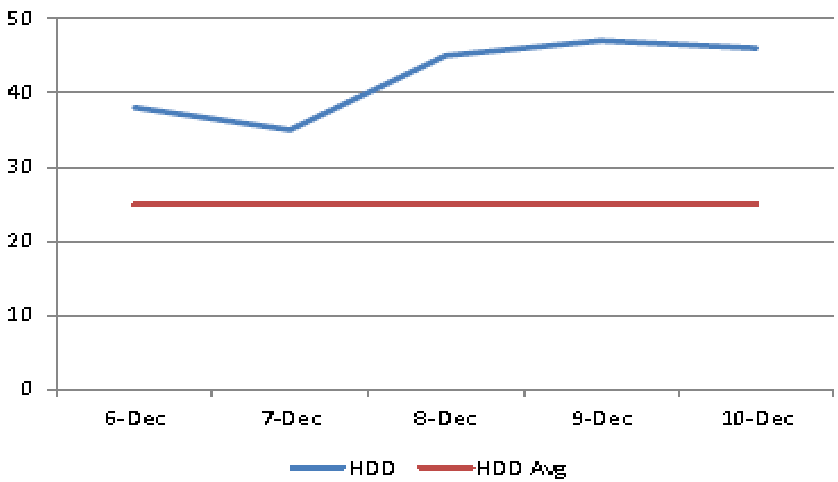
Actual Temperature and HDD

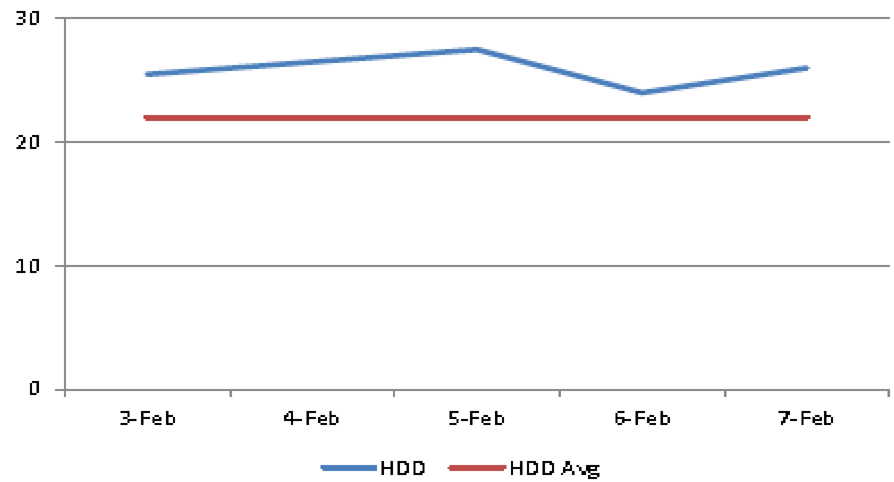
Grants Pass

December	Hi	Lo	HDD	HDD Avg
6	37	16	38	25
7	33	27	35	25
8	25	14	45	25
9	28	8	47	25
10	30	8	46	25



Grants Pass

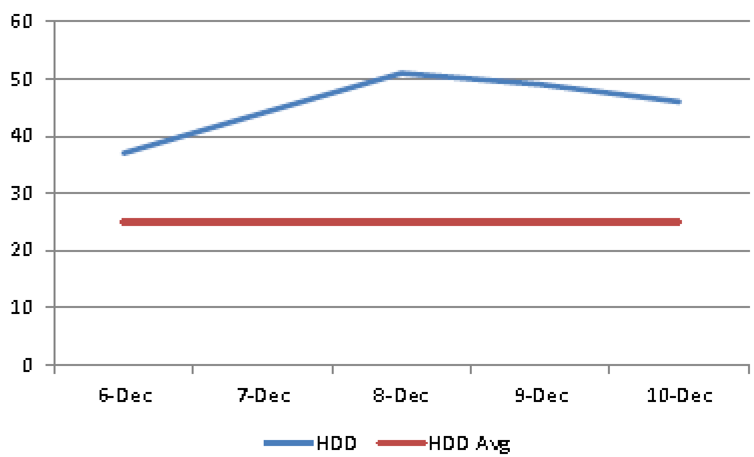
February	Hi	Lo	HDD	HDD Avg
3	47	32	26	22
4	47	30	27	22
5	46	29	28	22
6	47	35	24	22
7	42	36	26	22



Actual Temperature and HDD

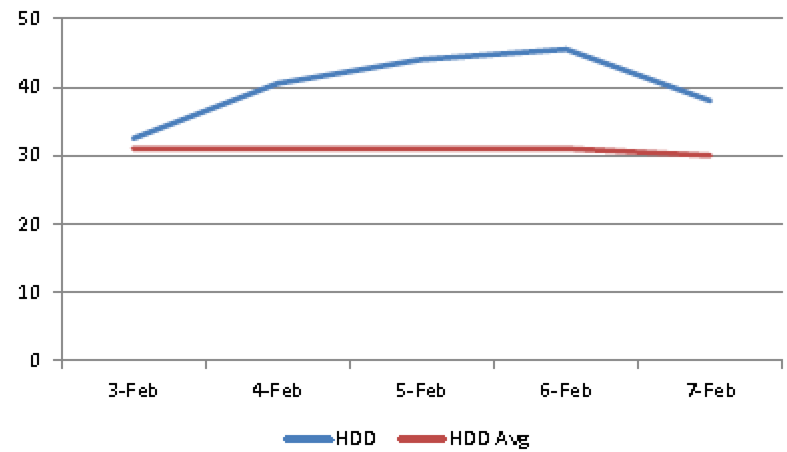
Boise

December	Hi	Lo	HDD	HDD Avg
6	26	15	44	34
7	24	2	52	34
8	11	-6	62	34
9	14	-7	61	34
10	15	4	55	34

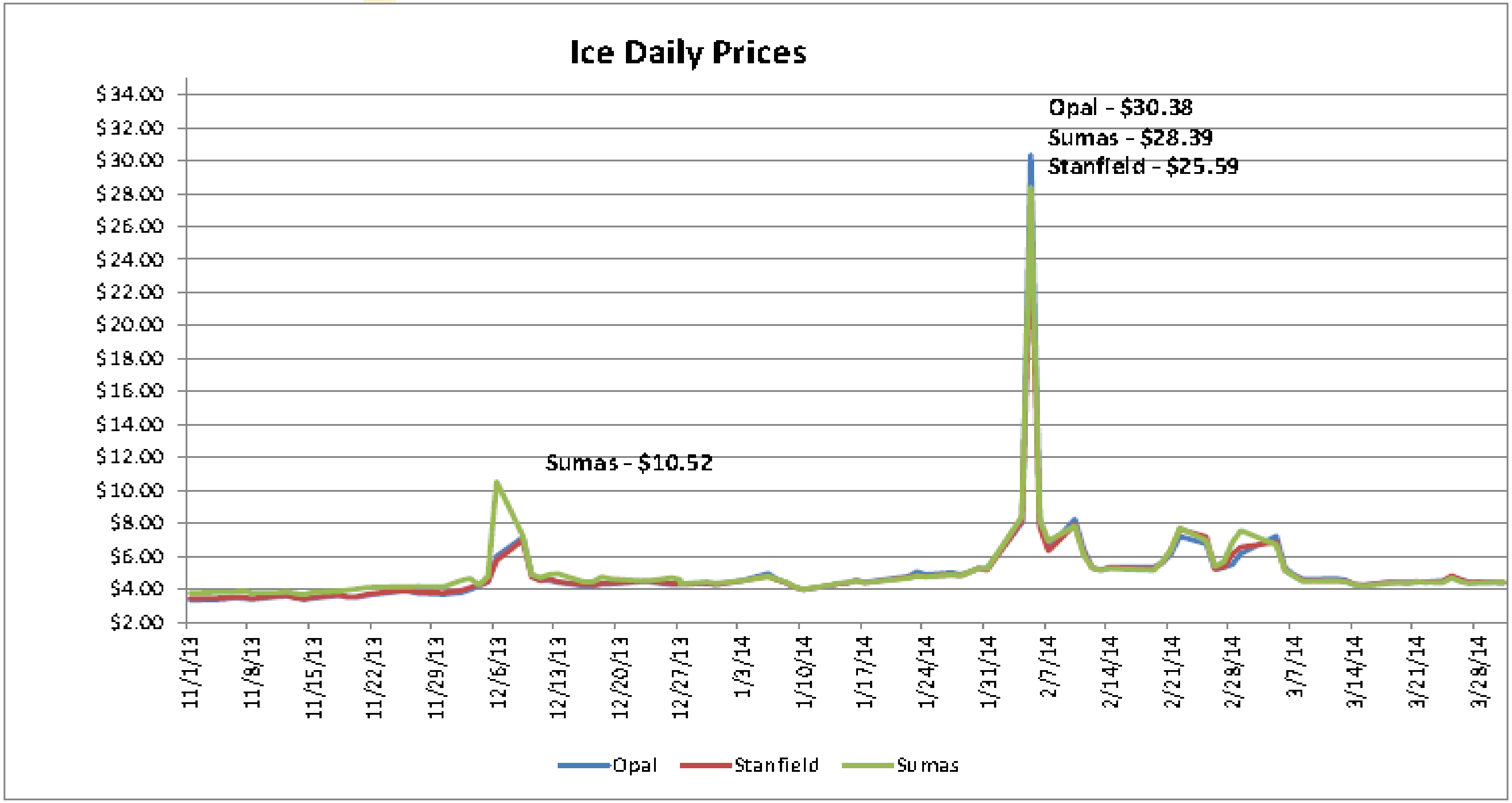


Boise

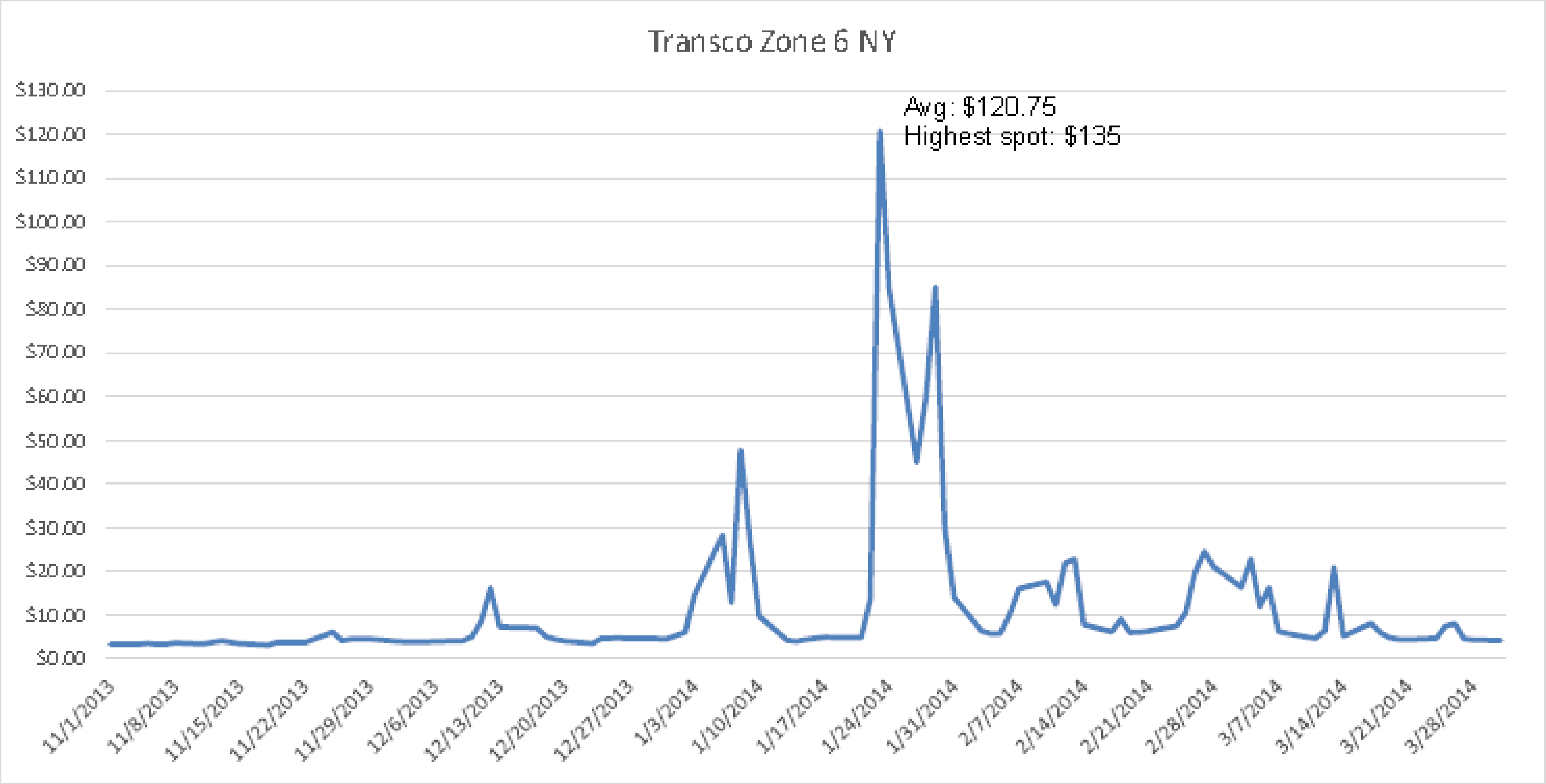
February	Hi	Lo	HDD	HDD Avg
3	37	28	33	31
4	29	20	41	31
5	25	17	44	31
6	23	16	46	31
7	35	19	38	30



Prices Nov 2013 – Mar 13, 2014



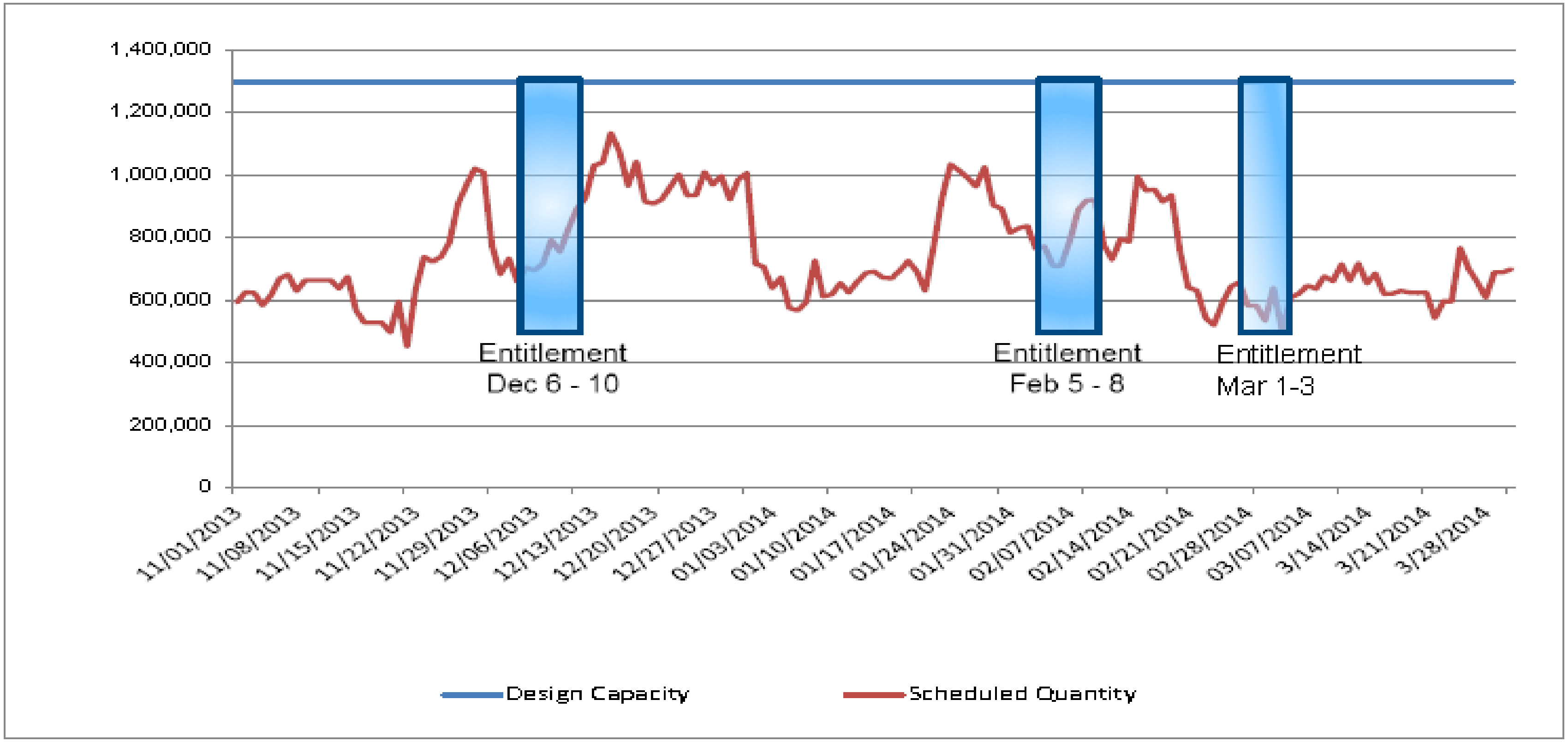
Prices Nov 2013 - Mar 2014



Source SNL

Scheduled Throughput Capacities

Sumas/Sipi



Total System Load North of Kemmerer November – Mar 15

Williams
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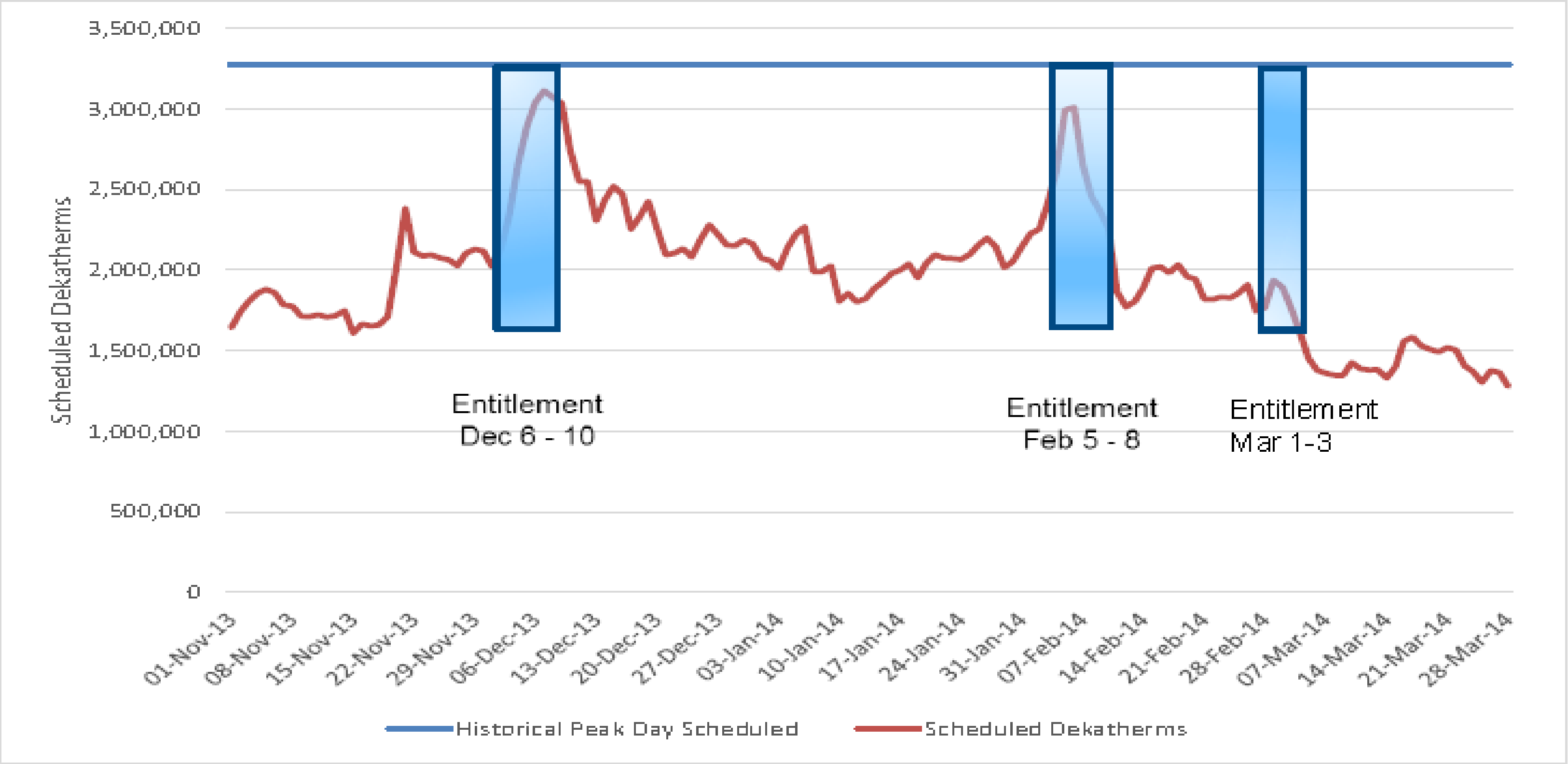

Scheduled Quantities North of Kemmerer on Northwest's Historical Peak Scheduled Day 12-15-2008

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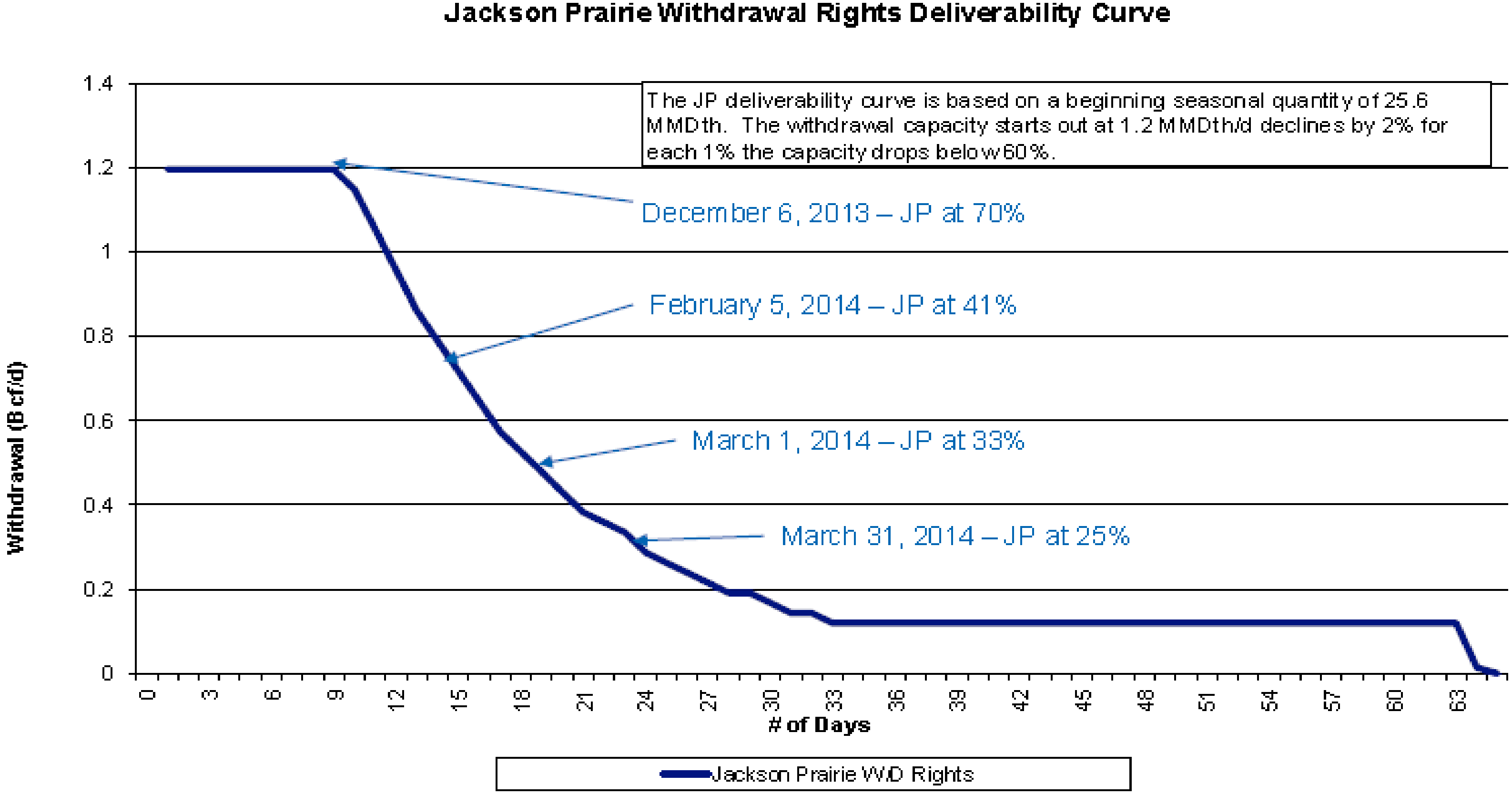
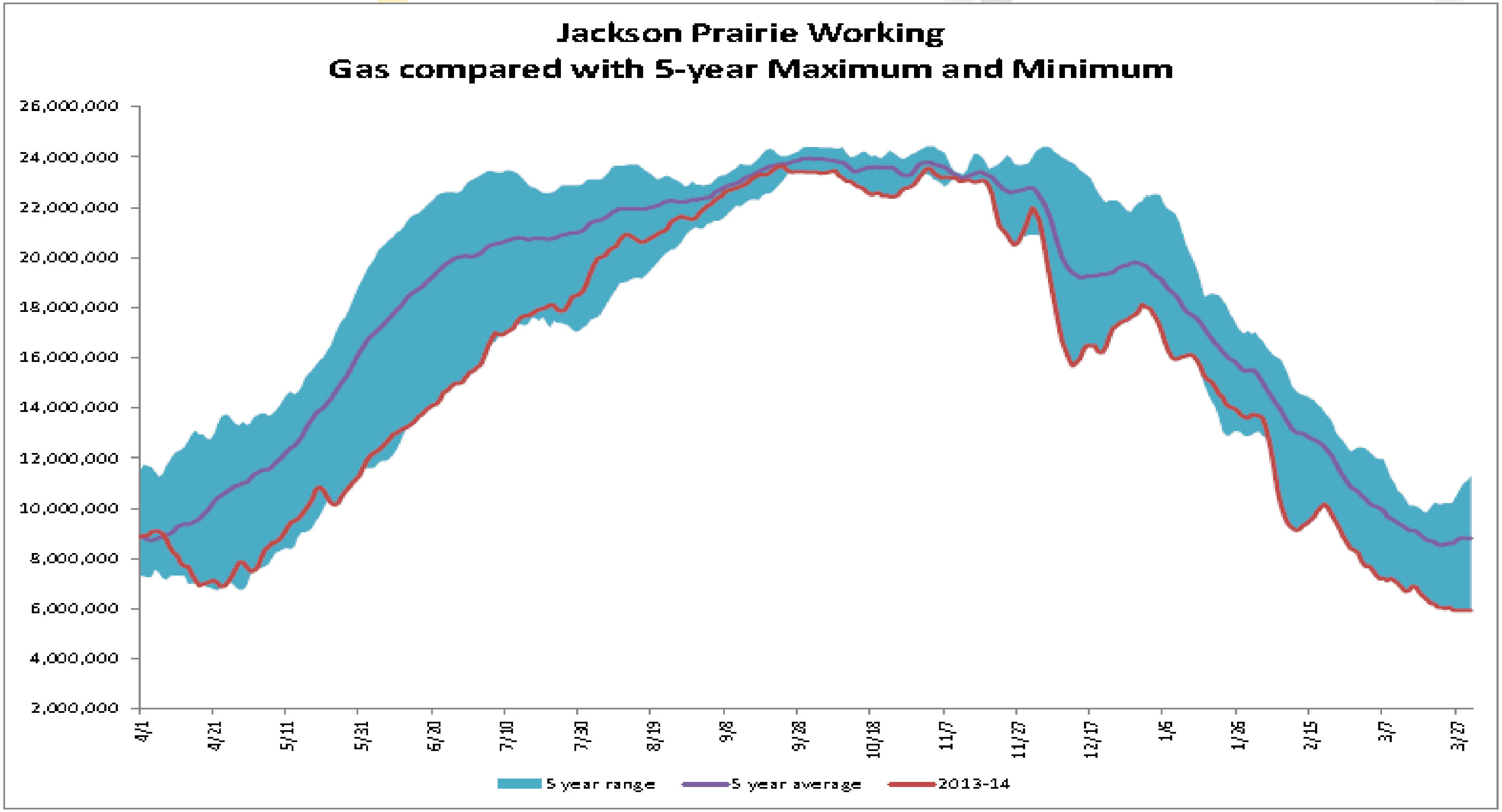
Jackson Prairie Storage Withdrawal



Jackson Prairie Storage Working Gas



Storage Withdrawals during an Entitlement Period

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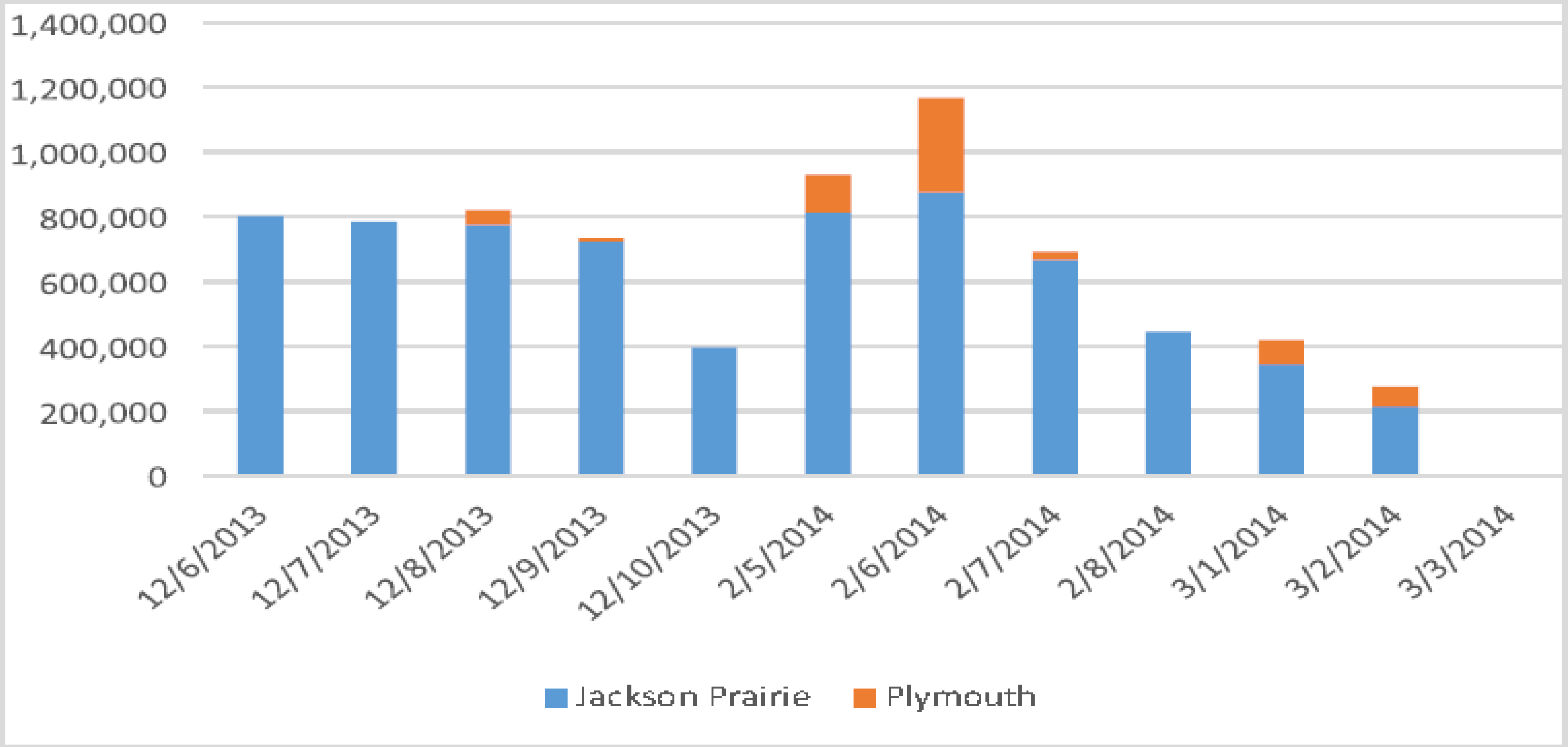

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Cold Weather Event Comparison

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> Northwest and some of its major customers experienced record throughputs this past winter.

> In the Northwest, prices spiked to over $10 per Dth in December and $30 per Dth in February. In the Northeast prices spiked to $50 Dth in December and $135 Dth in February.

> Are Northwest customer's prepared for a cold weather event such as the Polar Vortex that occurred in the Northeast? What about late in the season when storage levels are low and withdrawal capabilities decline?

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Capacity Overview

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> Capacity on Northwest is in high demand as evidence by the following factors:

– Northwest is fully subscribed;

– Northwest's average contract life as of January 1, 2014 was 9.7 years; and

– Northwest and its customers experienced record or near record throughput this past winter.

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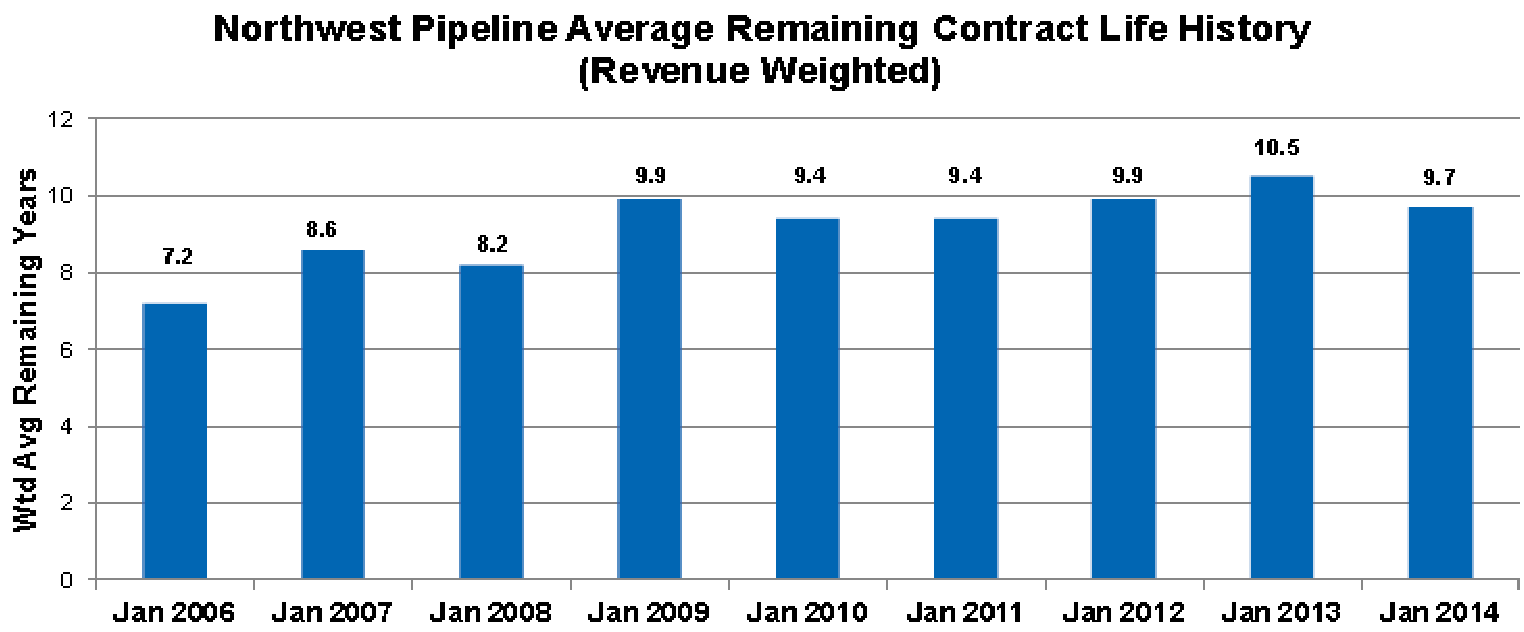
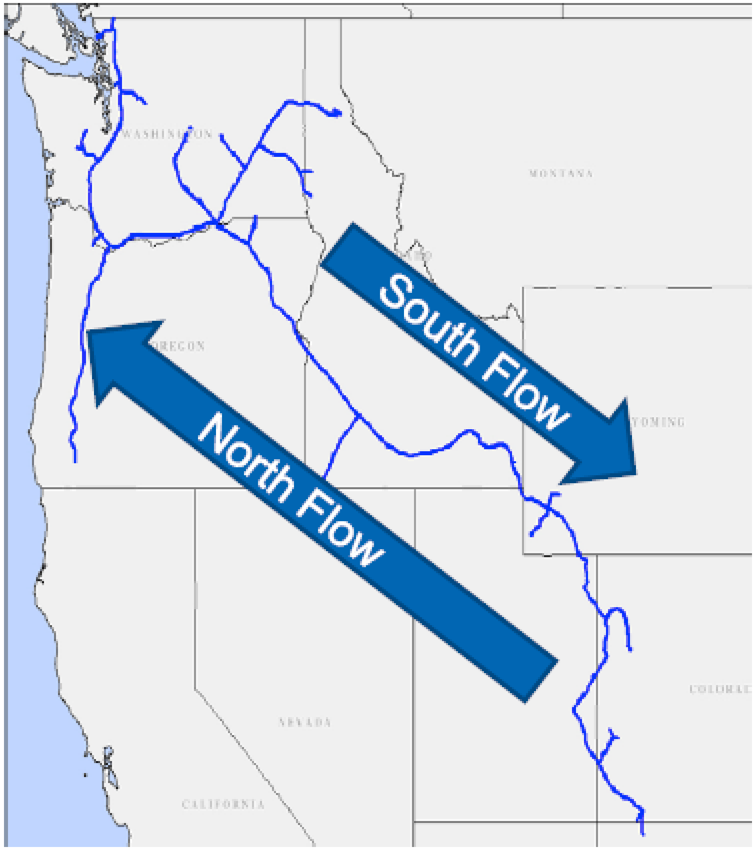

Northwest Pipeline Average Remaining Contract Life History
(Revenue Weighted)
Wtd Avg Remaining Years
12
10
8
6
4
2
0
7.2
8.6
8.2
9.9
9.4
9.4
9.9
10.5
9.7
Jan 2006
Jan 2007
Jan 2008
Jan 2009
Jan 2010
Jan 2011
Jan 2012
Jan 2013
Jan 2014

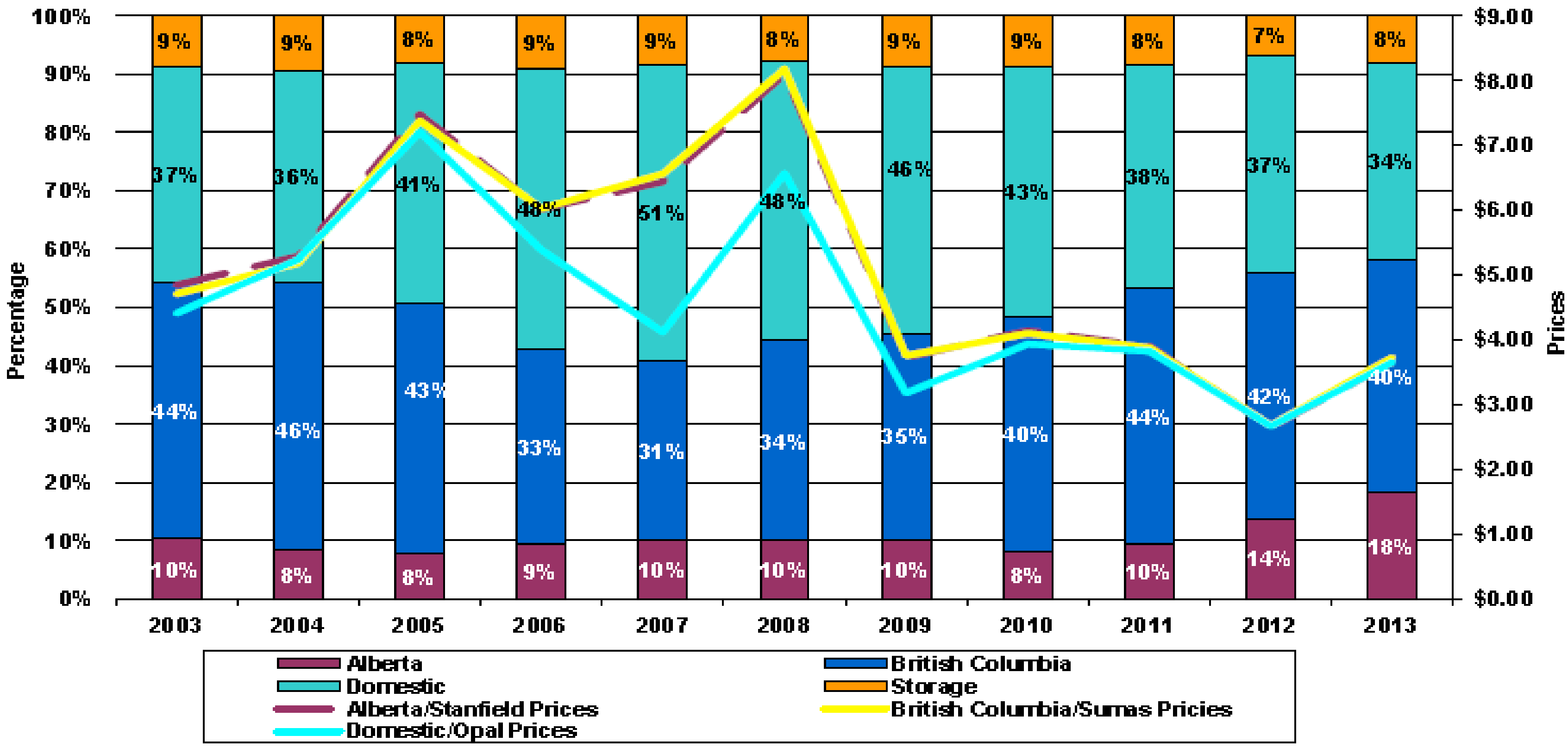
Northwest Pipeline is like two pipelines in one



> Bi-direction design allows for

- Access to multiple and diverse supply basins
- Added system reliability
- Lower rates
- Gas pricing options

Northwest Pipeline Ten-Year Supply Diversity



Northwest Pipeline 2013 Supply Diversity

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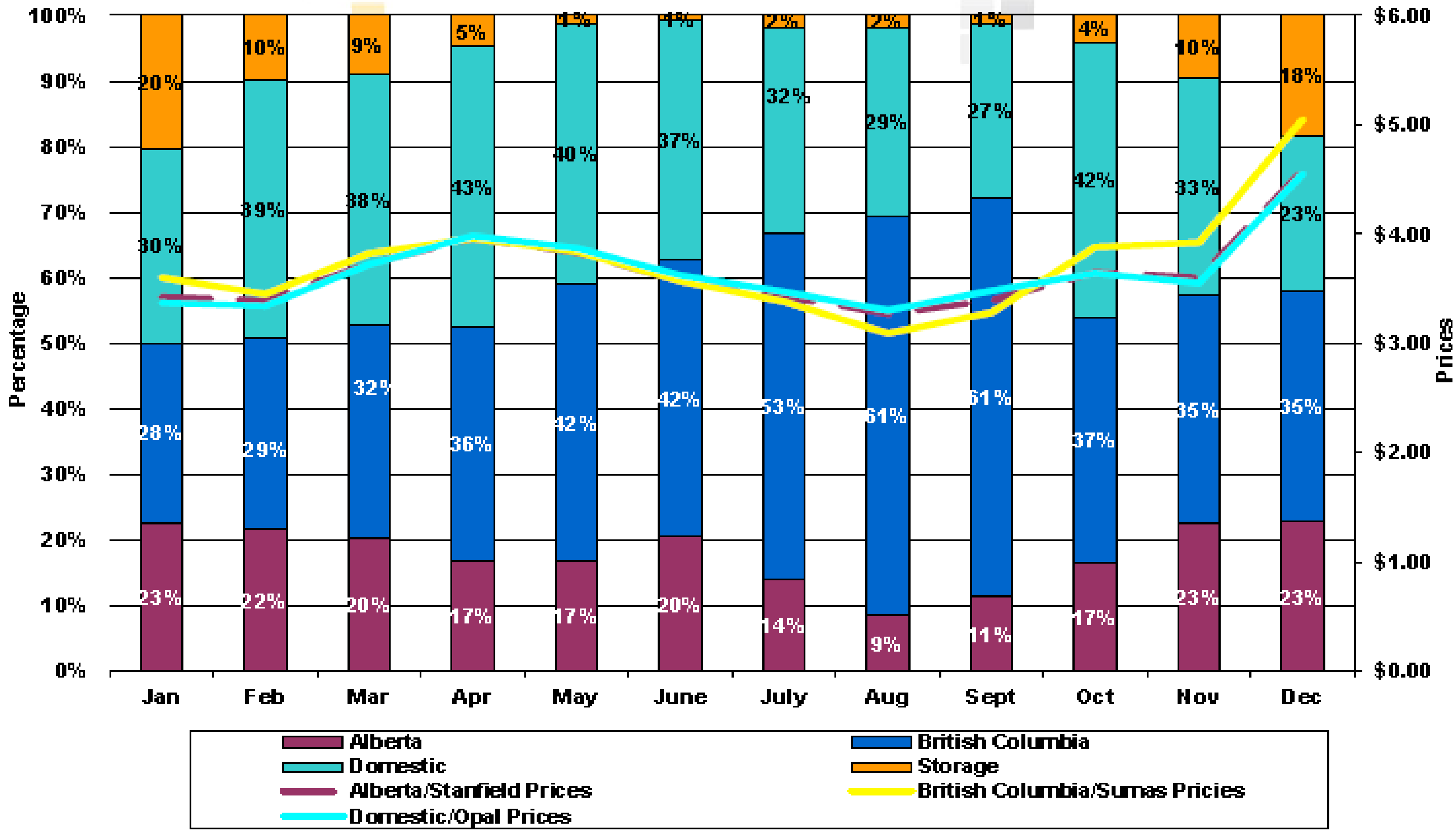

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Huntingdon Export Market Deliveries 2010 to 2013

Williams

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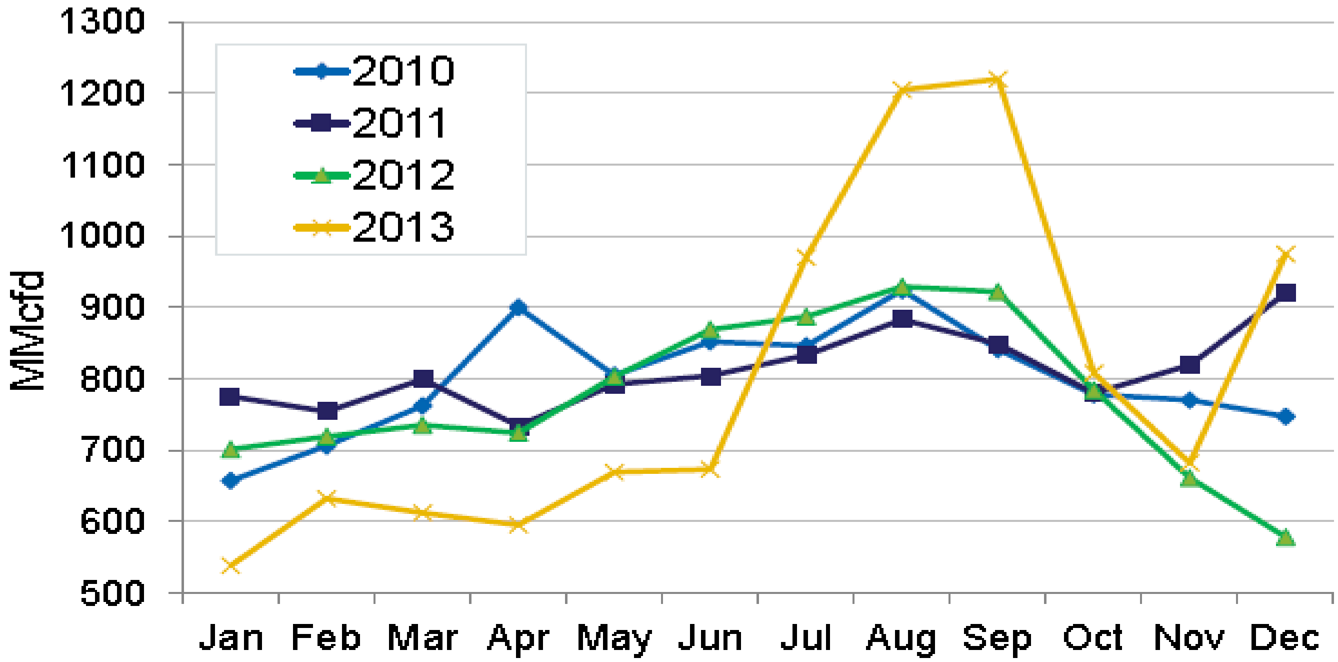

> Unprecedented volumes flowed during the 2013 summer months.

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Cascade's Contractual Rights

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> Cascade serves multiple markets across Northwest's system which creates unique contractual challenges.

> Cascade holds a variety of contracts to meet their unique needs, such as:

– point-to-point contracts;

– storage redelivery contracts, some of which have excess maximum daily delivery obligations ("MDDOs") that provide additional corridor rights flexibility; and

– conjunctive contracts that have multiple receipt and delivery point with excess MDDOs that also provides additional corridor right flexibility.

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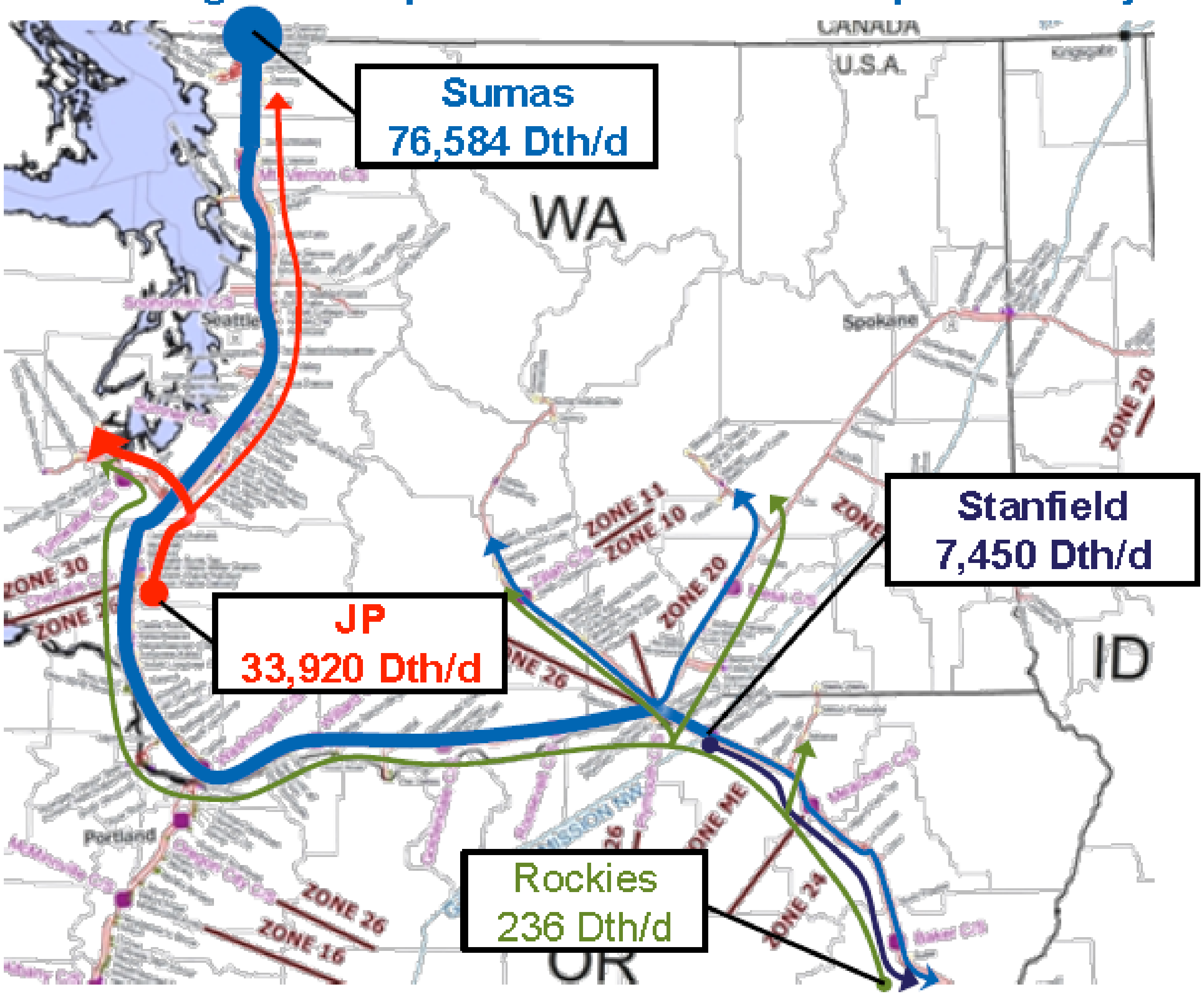
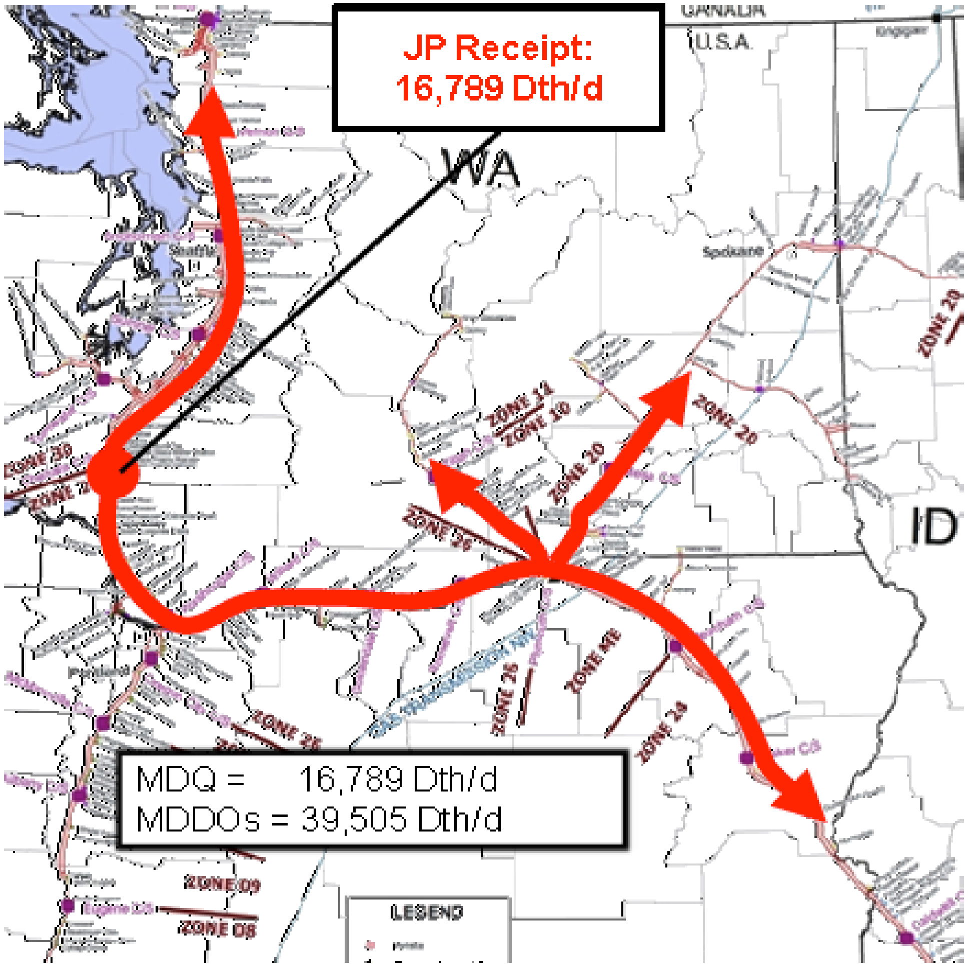
Cascade's Single Receipt Contracts with Multiple Delivery Points



Cascade Conjunctive Storage Contract No.100302



Cascade's Contract No. 100302 contains:

- Multiple delivery points; and
- excess MDDOs.

As a result, it provides flexible corridor rights.

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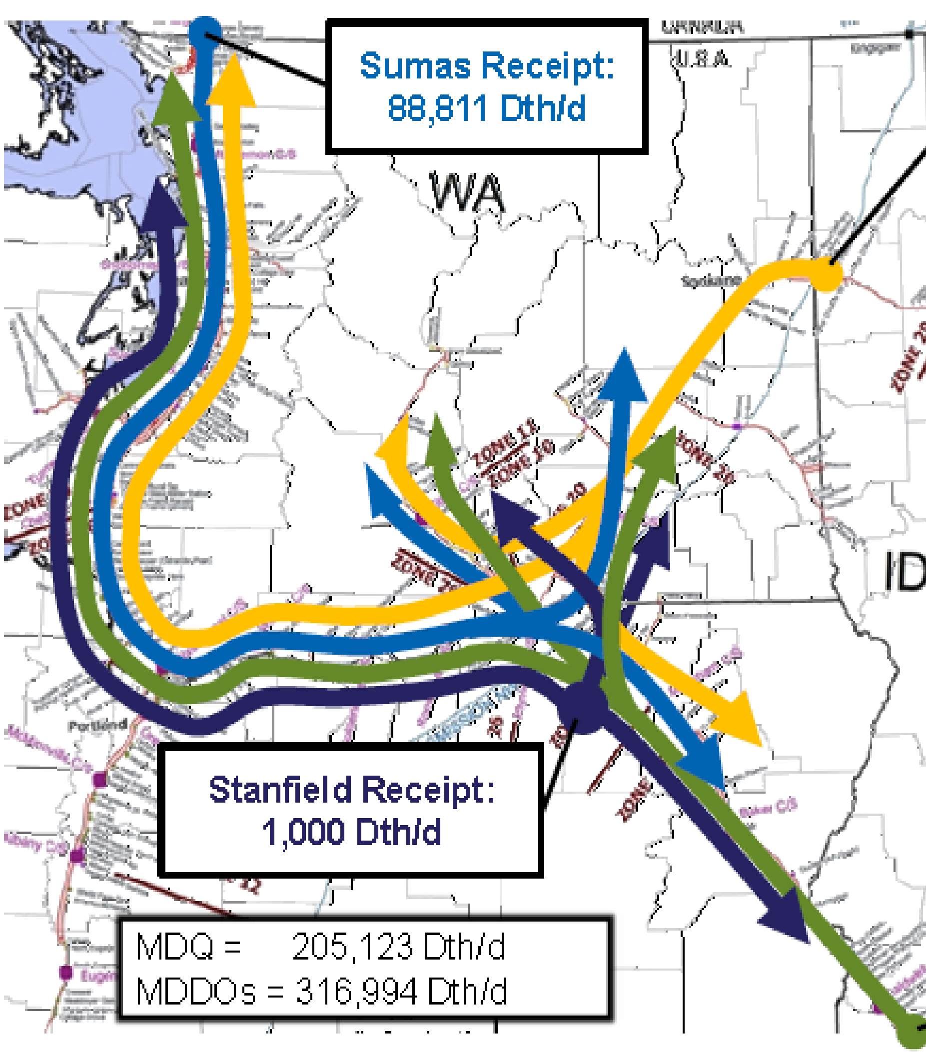
Cascade Conjunctive Transportation Contract No. 100002



Cascade's Contract No. 100002 contains:

- multiple receipt and delivery points; and
- excess MDDOs.

As a result, it provides flexible corridor rights.

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Capacity Allocation to Meet Peak-Day Demand

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> Below are some ideas to help identify potential capacity shortfalls based on peak-day load projections.

– First, allocate capacity on contracts that have a single receipt point.

– Second, allocate capacity on conjunctive contracts that provide corridor and delivery point flexibility.

> Allocationy Considerations:

– Critical deliveries

– Constrained laterals

– Maintain Corridor Flexibility (longest-haul contractual rights)

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Business Development Projects

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> Pacific Connector

> Washington Expansion

> Wenatchee Lateral

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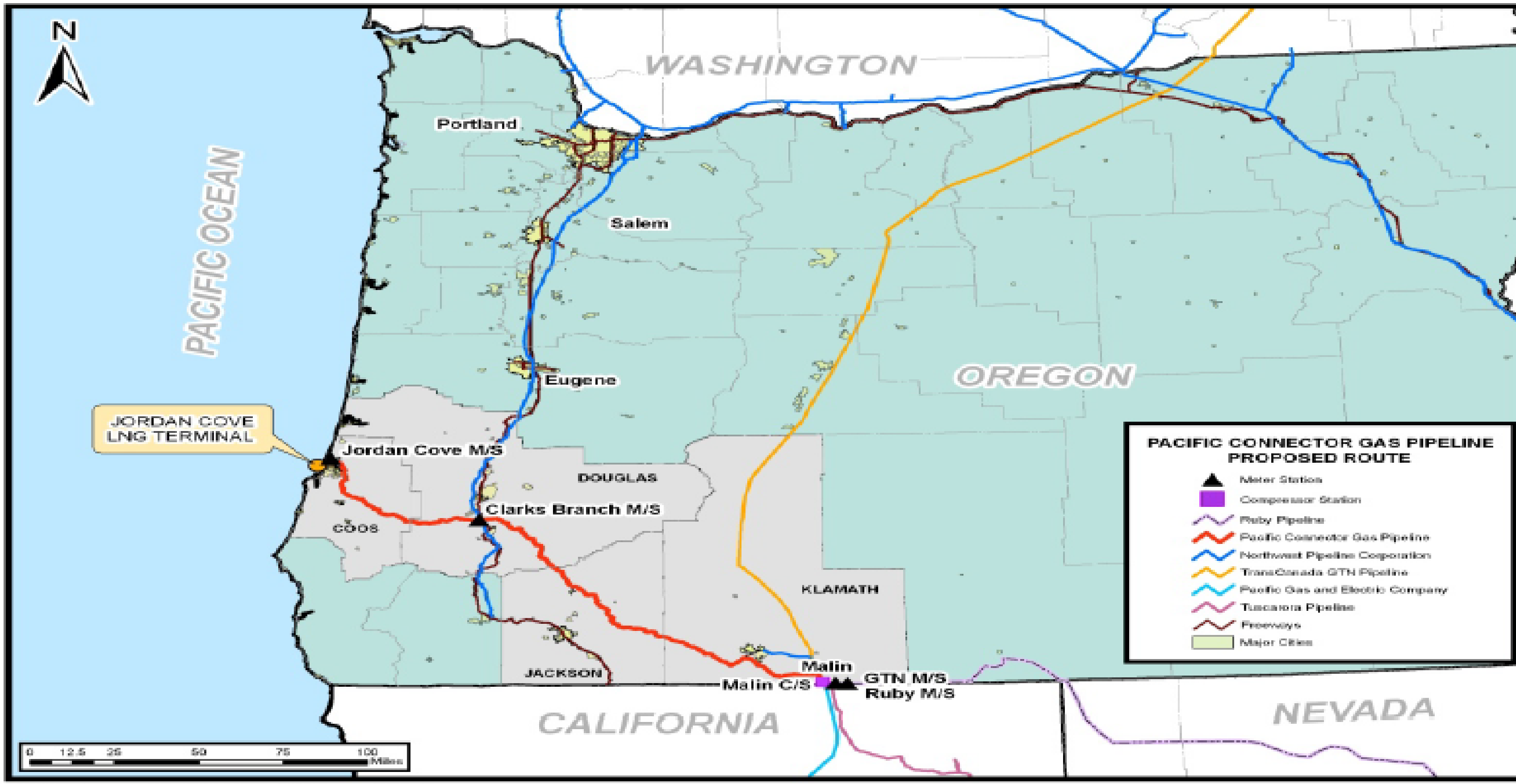
Pacific Connector Gas Pipeline Project



Pacific Connector Gas Pipeline (PCGP)

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- 232-mile of 36-inch diameter pipeline with:
  - 1,060,000 Dth/d of firm transportation
  - 41,000 horsepower at Malin
- Receipt interconnects with:
  - Gas Transmission Northwest
  - Ruby Pipeline
- Deliveries interconnect with:
  - Northwest Pipeline's Grants Pass Lateral
  - Jordan Cove Delivery Meter Station
- PCGP will be built primarily to serve the Jordan Cove LNG Terminal (located near Coos Bay, Oregon)
  - Waiting on permission to grant export to Non-Free Trade Agreement Countries
  - Currently first in the queue for DOE approval
    - Will facilitate permitting and marketing efforts
- Target in-service date 2018

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PCGP future growth opportunities

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- > Will be able to serve:
  - – Malin / Coos Bay corridor
    - Potential industrial facilities could be co-located near LNG terminal and make use of upgraded port facilities
  - – Grants Pass Lateral
- > New supply source on the Grants Pass Lateral will provide diversity and additional firm flow to serve new industrial/commercial markets:
  - – Additional 76,196 Dth/d flowing south
  - – Additional 42,525 Dth/d flowing north
    - Volumes can increase with compressor station piping modifications
  - – Open Season will determine whether short-haul capacity is incorporated into design
- > PCGP easily expandable to 1.5 Bcf
  - – Future Open Season will be held to serve regional market growth

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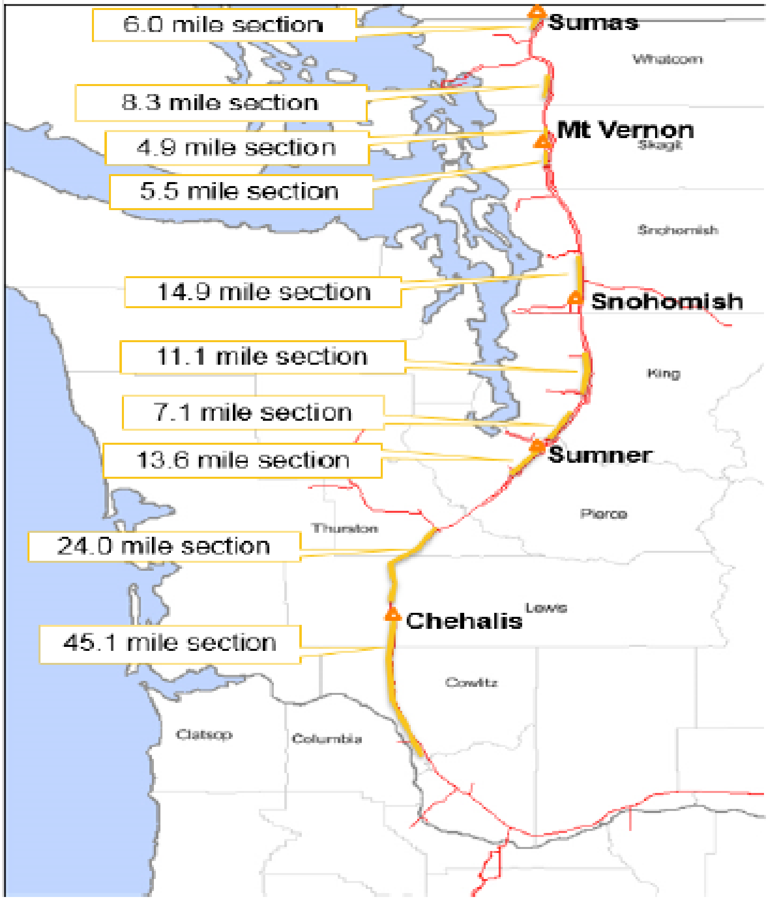
Washington Expansion Project



- FERC application filed 2013
- 140 miles of 36-inch diameter loop line with:
  - 750,000 Dth/d of firm transportation
  - 89,620 incremental horsepower required along I-5
- Rates (per Dth/d):
  - $0.74 traditional
  - $0.56 levelized
- Estimated cost $1.1 billion
- Targeted in-service date November 2018
  - Potential regional loads with in-service dates phased in

Washington Expansion is market oriented

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> Provides competitively priced natural gas to committed users:
  – Supplies Oregon LNG terminal customers
  – Increases reliability:
    - Fills in un-looped sections in I-5 corridor
    - Continuous 30-inch pipe along side 36-inch loop
  – Provides opportunity to other potential customers in the region
    - Serving customers in the I-5 corridor is not contingent on Oregon LNG moving forward

> Potential users participated in an "open season" process
  – Transportation capacity was offered to <u>all customers</u> in a non-binding open season held in October 2012
    - Not limited to Oregon LNG terminal customers
    - Ongoing expressions of interest from parties for new capacity welcome
      – Capacity available as early as 2016
        - Depending on location and transportation capacity needs

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Taking a closer look at Central Oregon

Using capacity to serve Central Oregon

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"Around the Horn"

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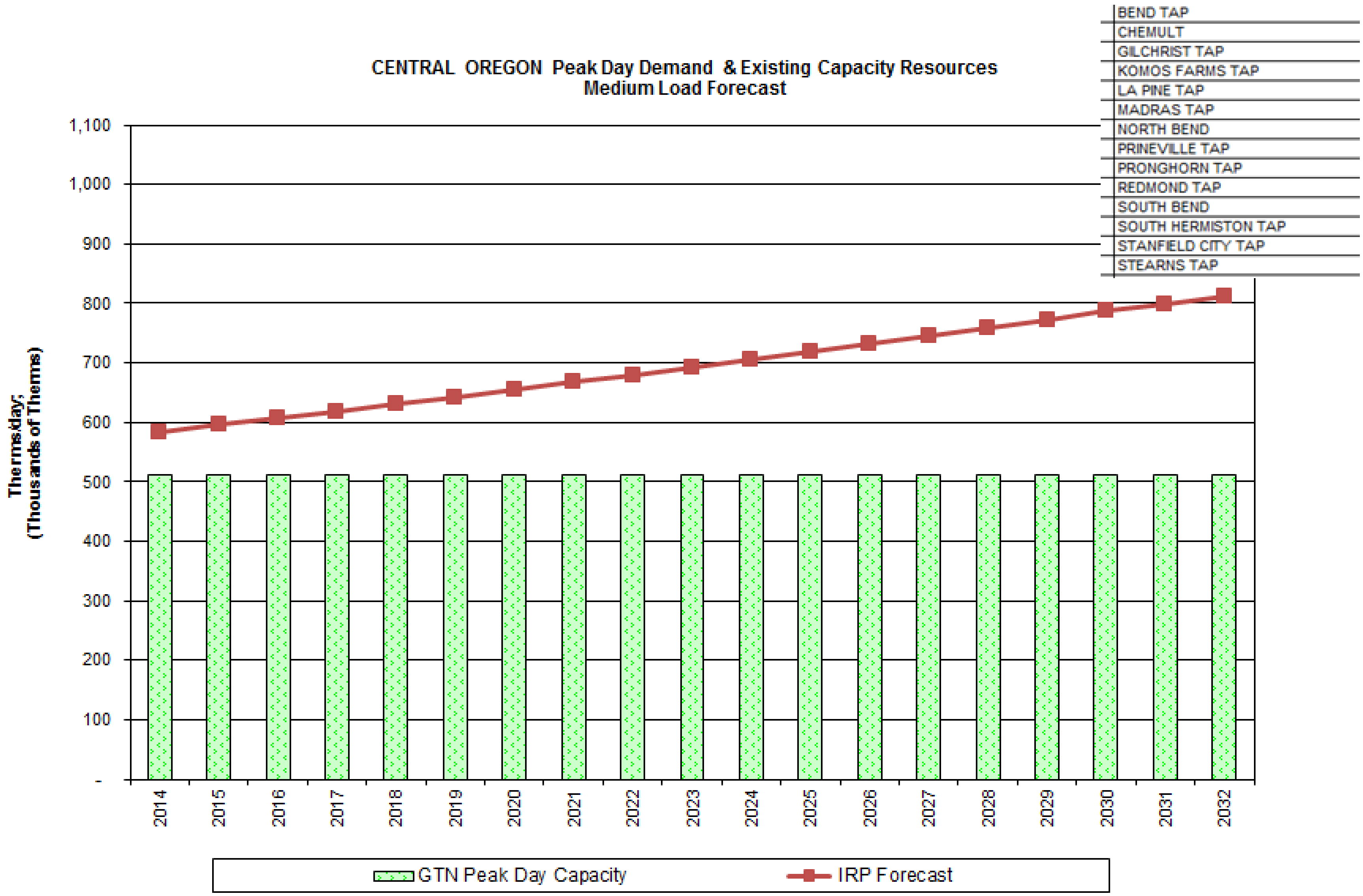
BEND TAP
CHEMULT
GILCHRIST TAP
KOMOS FARMS TAP
LA PINE TAP
MADRAS TAP
NORTH BEND
PRINEVILLE TAP
PRONGHORN TAP
REDMOND TAP
SOUTH BEND
SOUTH HERMISTON TAP
STANFIELD CITY TAP
STEARNS TAP
CENTRAL OREGON Peak Day Demand & Existing Capacity Resources
Medium Load Forecast
Thermsday;
(Thousands of Therms)
1,100
1,000
900
800
700
600
500
400
300
200
100
-
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
GTN Peak Day Capacity
IRP Forecast

Jay Story – Director, NW Distribution Markets

CNGC Capacity Workshop – Portland, OR

April 8, 2014

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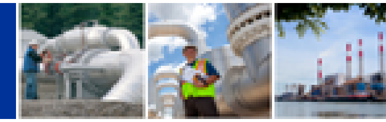
Forward-Looking Information Disclaimer



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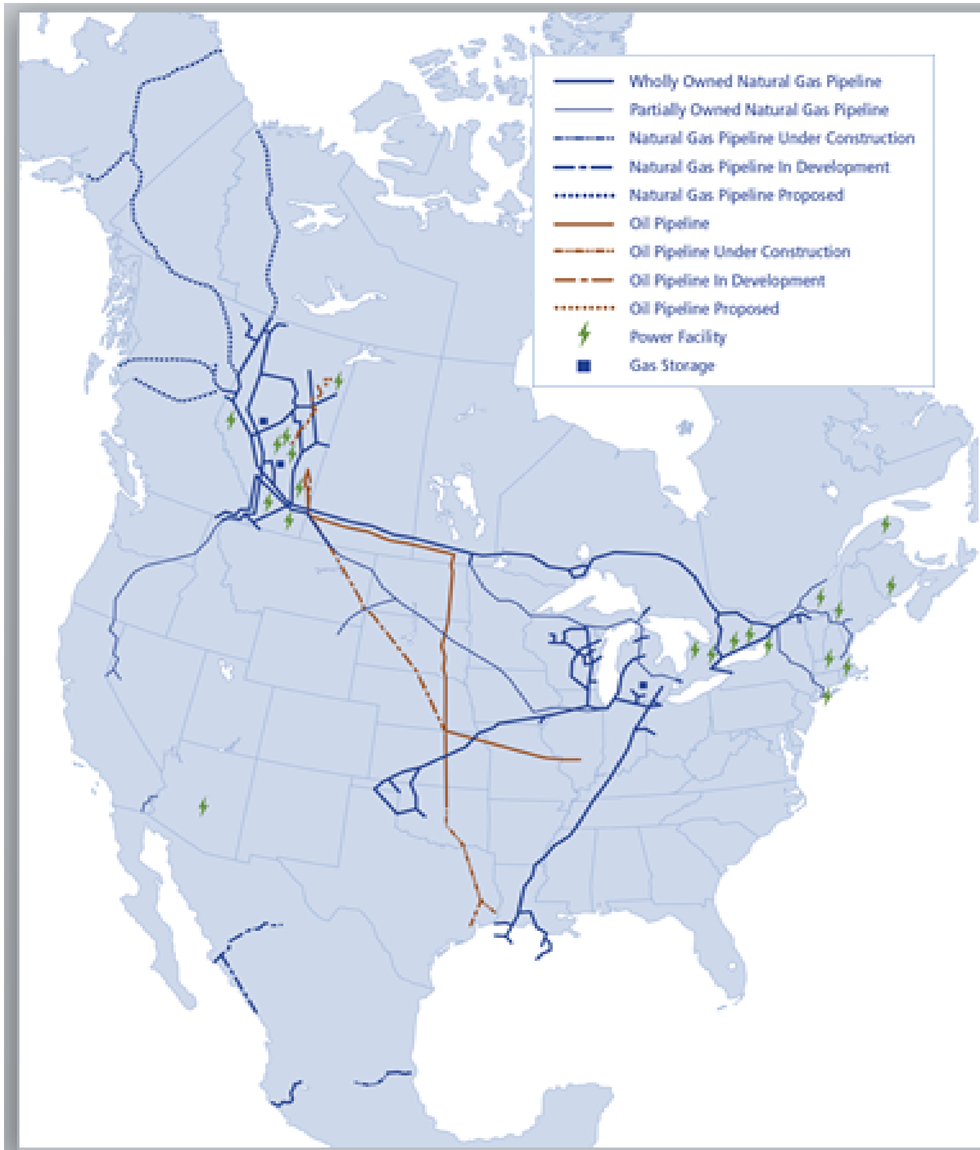

TransCanada Corporation (TSX/NYSE: TRP) Jan13

One of North America's Largest Natural Gas Pipeline Networks

- Operating 68,500 km (42,500 mi) of pipeline
- Average volume of 14 Bcf/d or 20% of continental demand

North America's 3rd Largest Natural Gas Storage Operator

- 380 Bcf of capacity

Canada's Largest Private Sector Power Generator

- 20 power plants, 10,900 MW
- Diversified portfolio, including wind, hydro, nuclear, coal, solar and natural gas

Premier North American Oil Pipeline System

- 1.4 million Bbl/d ultimate capacity*

* Keystone Wood River/Patoka and Cushing Extension sections in operation
Gulf Coast pipeline project in development
Keystone XL pipeline project in development
Houston Lateral pipeline project in development

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GTN System

Miles of Pipeline
- More than 1,350

Compression
- Greater than 520,000hp
- (all aircraft or industrial turbines)

Physical Receipt Capability:
- Kingsgate - 2.8 Bcf/d
- Stanfield – 300 MMcf/d
- Turquoise Flats – 1.1 Bcf/d

Physical Delivery Capability:
- NW Markets – 1.4 Bcf/d
- (approx 500 MMcf/d Generation Load)
- California Markets – 2.1 Bcf/d

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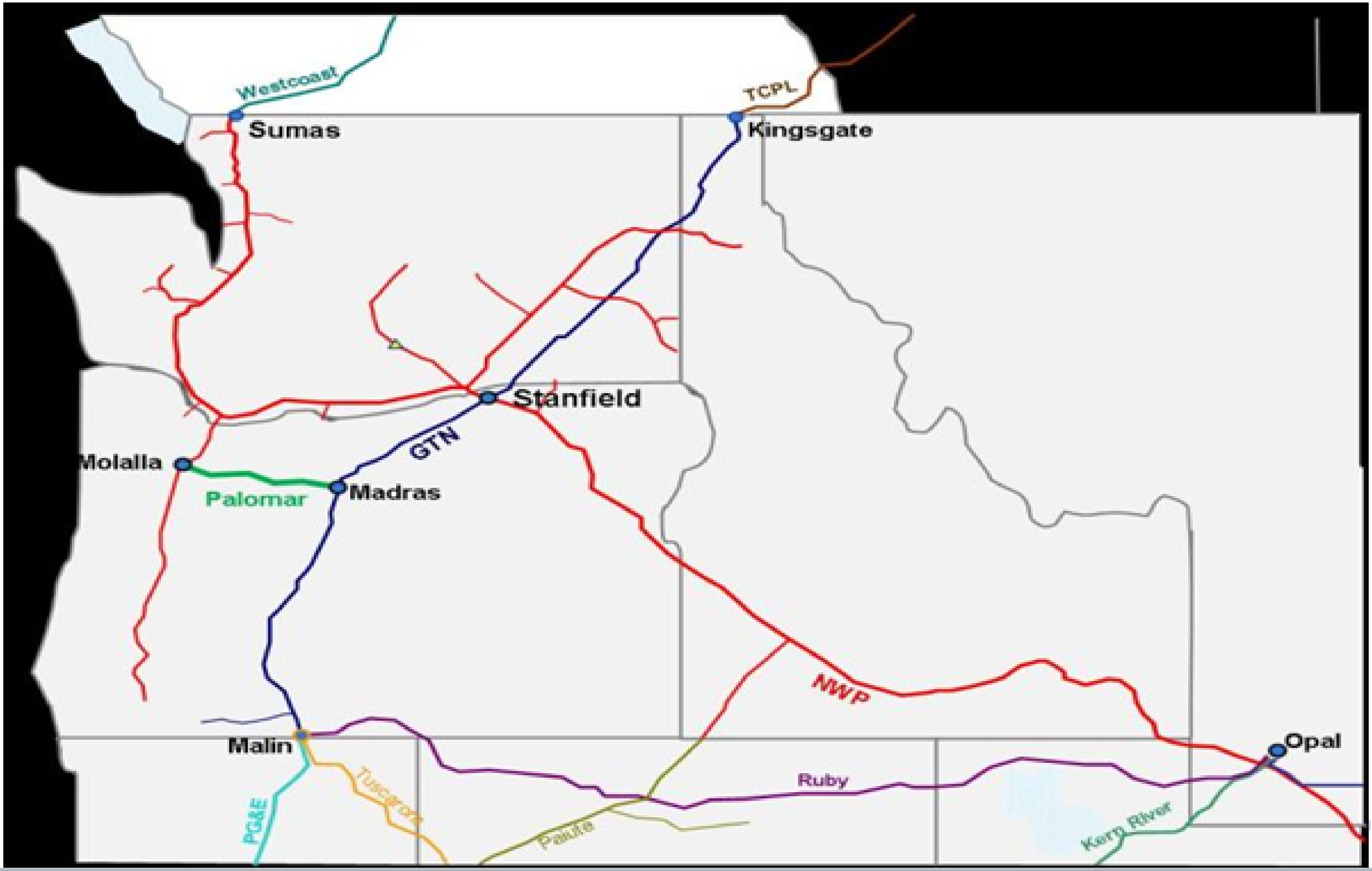
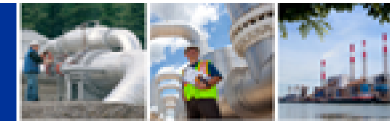
GTN – Interconnecting Pipelines



GTN System Available Capacity



- **North to South Primary Path**
  - Kingsgate to Stanfield
    - Approximately 1 Bcf/d
  - Stanfield to Malin
    - Approximately 900 MMcf/d
- **South to North Primary Path**
  - Turquoise Flats to Stanfield
    - 95,000 Dth/d

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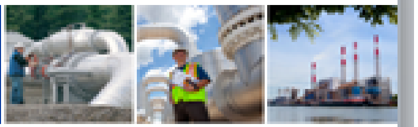
GTN System – Primary Path Options



- **North to South Primary Service**
  - Gas flows from physical receipt points to physical delivery points in a North to South direction
    - Examples of North to South Primary Paths
      - Kingsgate to Stanfield
      - Stanfield to Malin
      - Turquoise Flats to Malin
  - Shipper may use secondary receipt and delivery points anywhere inside the primary contract path
  - Shipper may not access receipt and/or delivery points outside of the primary contract path
  - Shipper may backhaul inside the primary path via displacement

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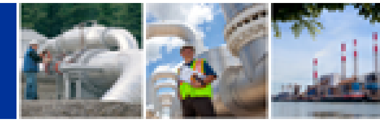
GTN System – Primary Path Options (cont'd)



- **South to North Primary Service**
  - Gas flows from physical receipt points to physical delivery points in a South to North direction
    - Examples of South to North Primary Paths
      - Turquoise Flats to Medford lateral
      - Turquoise Flats to Coyote Lateral
      - Turquoise Flats to Stanfield
  - Shipper may use secondary receipt and delivery points anywhere inside the primary contract path
  - Shipper may not access receipt and/or delivery points outside of the primary contract path
  - Shipper may backhaul inside the primary path via displacement

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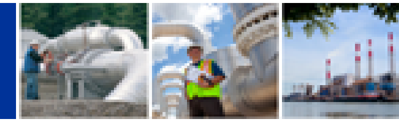
GTN System – Primary Path Differences



- **North to South Primary Service**
  - Gas flows from physical receipt points to physical delivery points in a North to South direction
  - May be nominated on a South to North basis
  - South to North is secondary, displacement type service
  - Shipper can nominate a Malin to Kingsgate Path
- **South to North Primary Path**
  - Gas flows from physical receipt points to physical delivery points in a South to North direction
  - Turquoise Flats is only Primary Receipt Point for northbound service
  - Malin is not a valid receipt point for the northbound service

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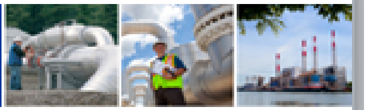
GTN System – Primary Path Differences



QUESTIONS?

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KINDER MORGAN

Ruby Pipeline
Cascade Natural Gas

Rockies Gas Supply

April 8, 2014





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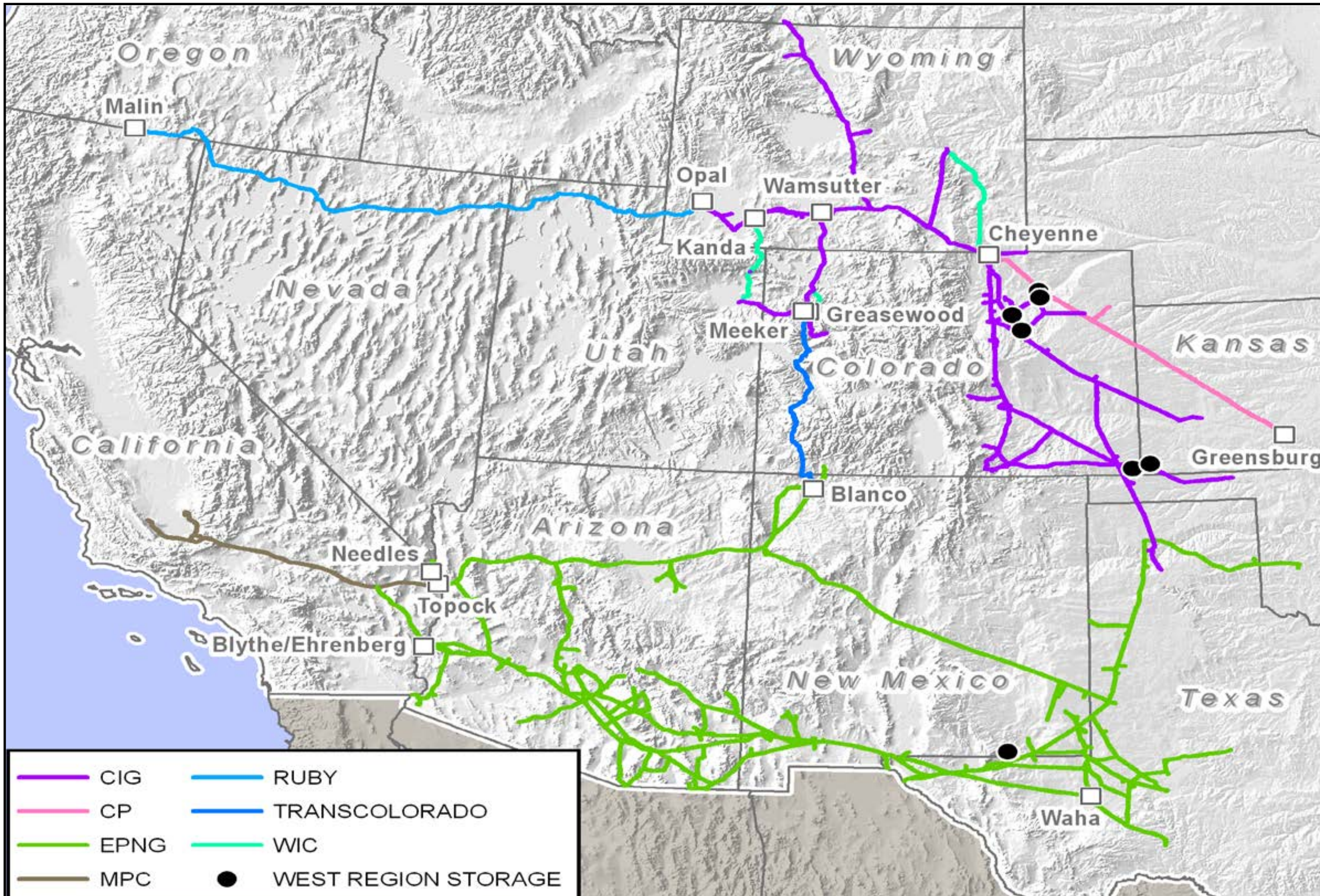
This presentation contains forward-looking statements. These forward-looking statements are identified as any statement that does not relate strictly to historical or current facts. In particular, statements, express or implied, concerning future actions, conditions or events, future operating results or the ability to generate revenues, income or cash flow or to make distributions or pay dividends are forward-looking statements. Forward-looking statements are not guarantees of performance. They involve risks, uncertainties and assumptions. Future actions, conditions or events and future results of operations of Kinder Morgan Energy Partners, L.P., Kinder Morgan Management, LLC, El Paso Pipeline Partners, L.P., and Kinder Morgan, Inc. may differ materially from those expressed in these forward-looking statements. Many of the factors that will determine these results are beyond Kinder Morgan's ability to control or predict. These statements are necessarily based upon various assumptions involving judgments with respect to the future, including, among others, the ability to achieve synergies and revenue growth; national, international, regional and local economic, competitive and regulatory conditions and developments; technological developments; capital and credit markets conditions; inflation rates; interest rates; the political and economic stability of oil producing nations; energy markets; weather conditions; environmental conditions; business and regulatory or legal decisions; the pace of deregulation of retail natural gas and electricity and certain agricultural products; the timing and success of business development efforts; terrorism; and other uncertainties. There is no assurance that any of the actions, events or results of the forward-looking statements will occur, or if any of them do, what impact they will have on our results of operations or financial condition. Because of these uncertainties, you are cautioned not to put undue reliance on any forward-looking statement.

Kinder Morgan West Region Gas Assets



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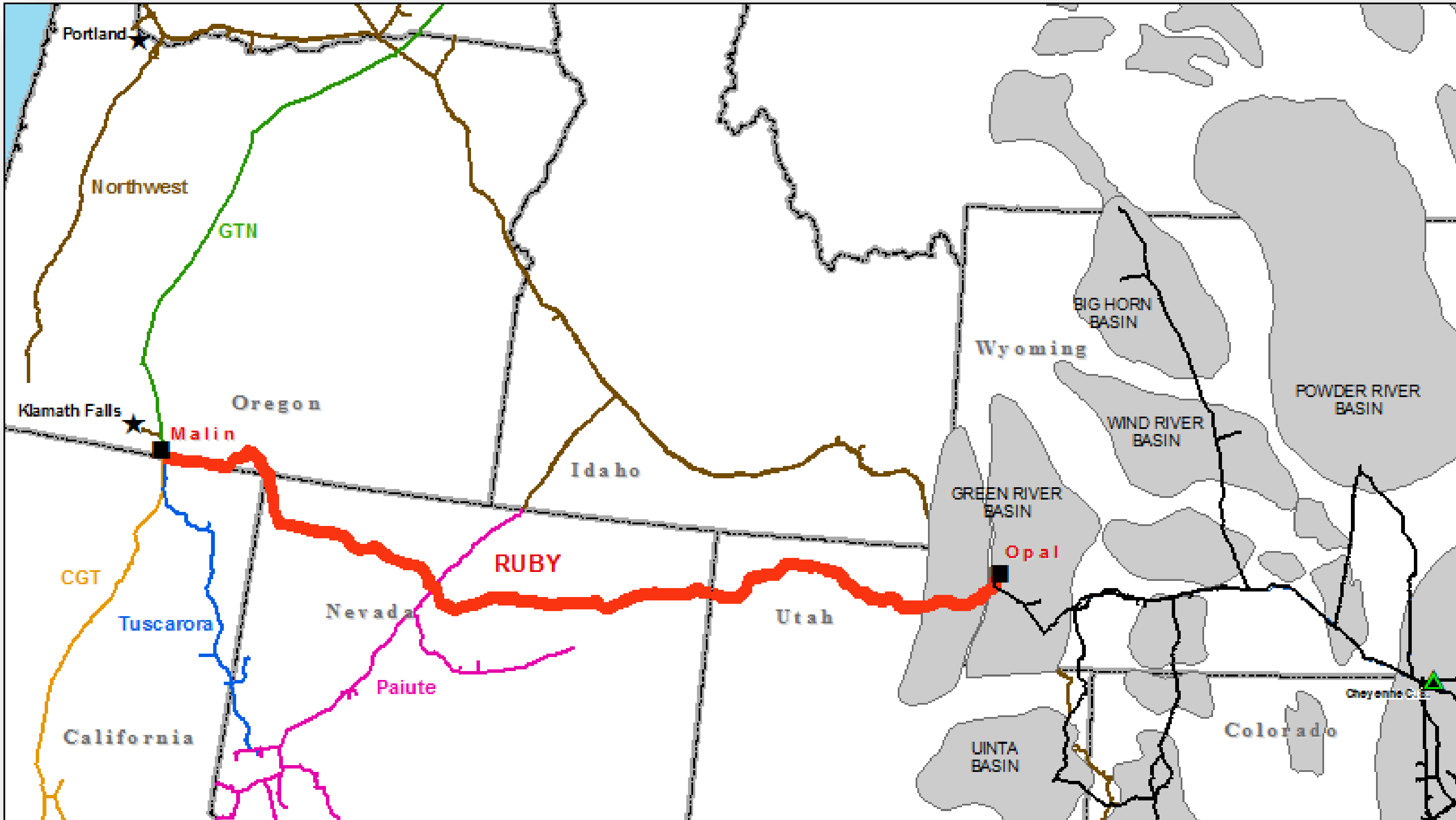
Ruby Pipeline



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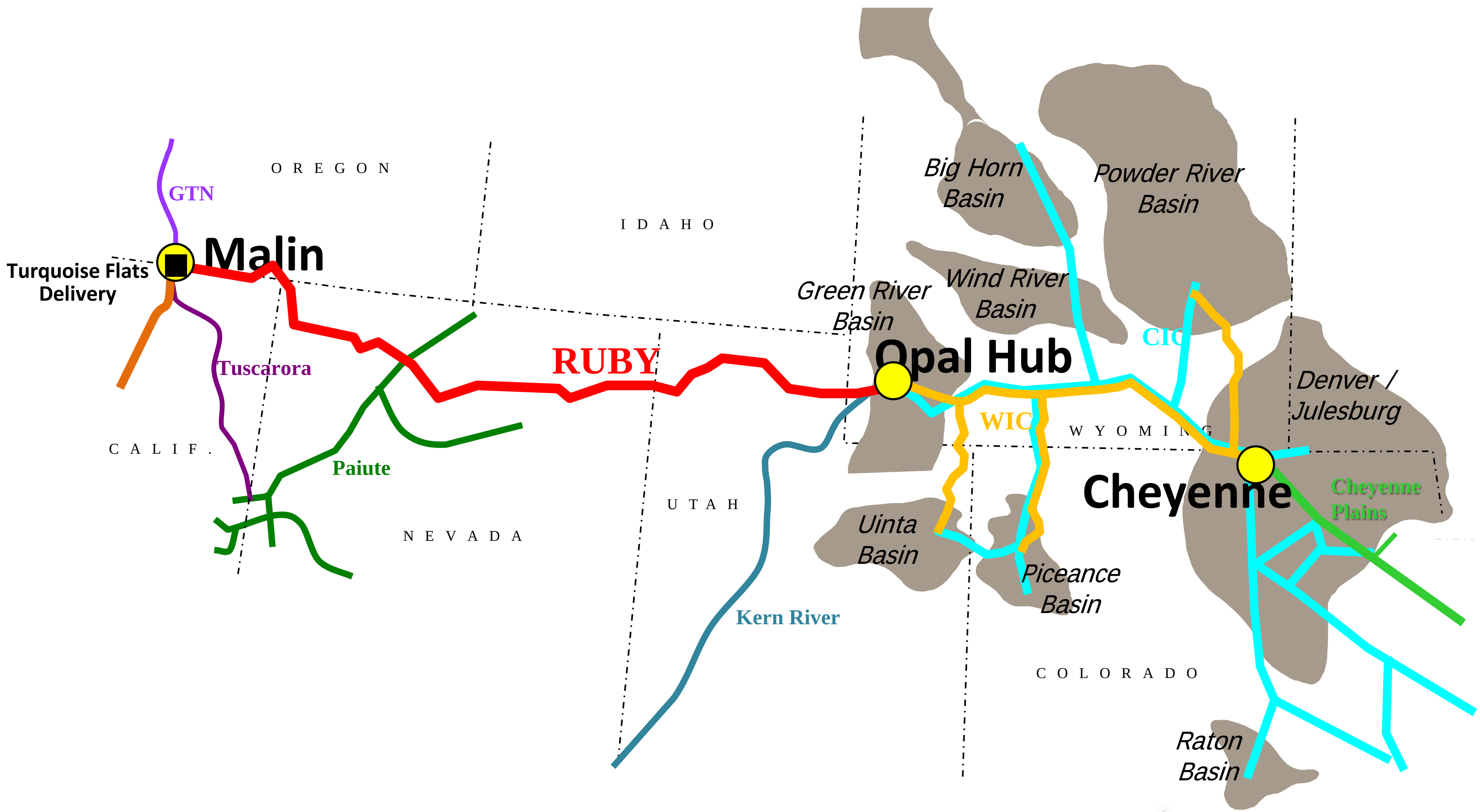
Ruby Supply Basin Access



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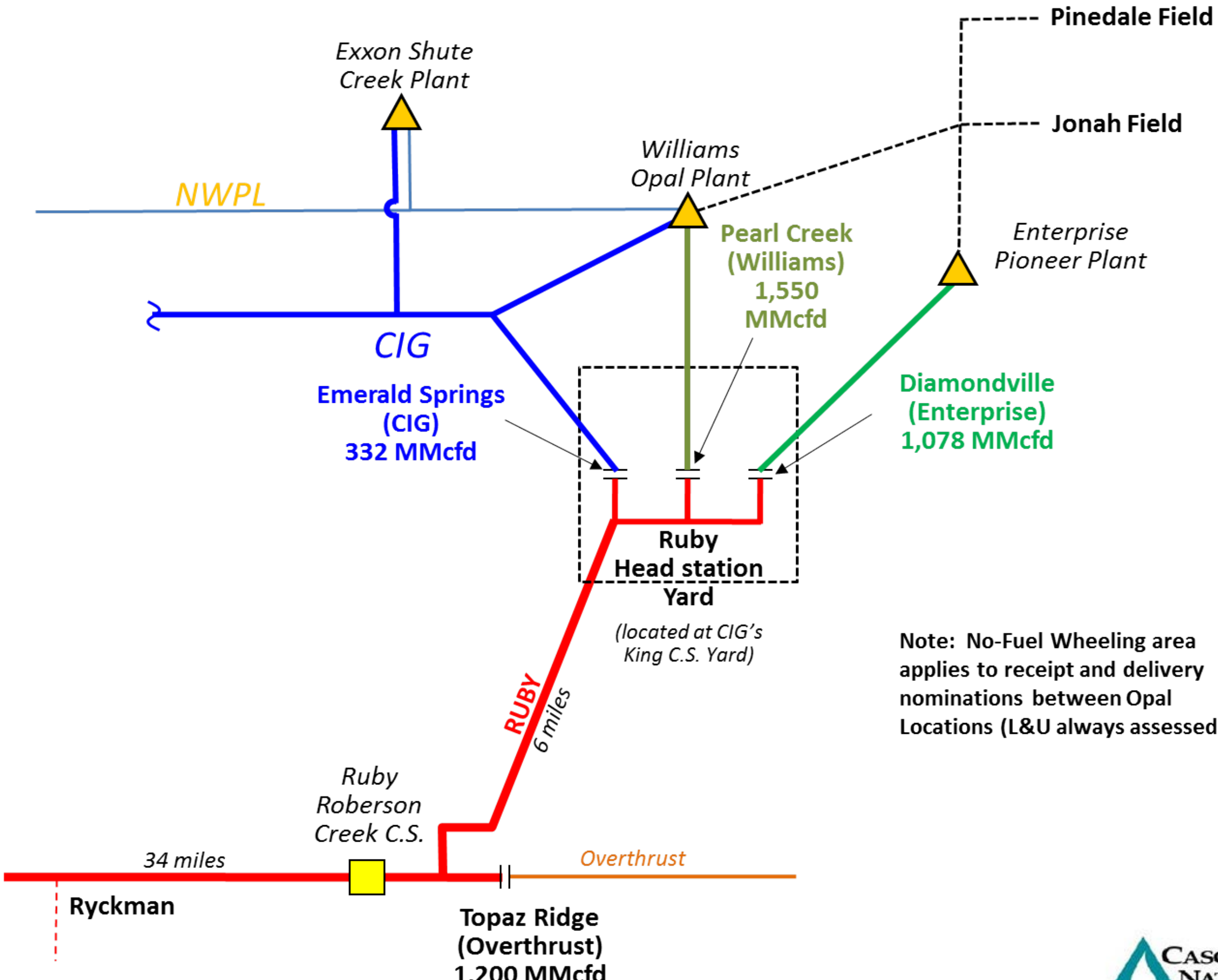
Meter Capacities

LOCATION NAME		AGG	METER CAPACITY MMCF/D	CONNECTING PIPELINE	MEAS PARTY
RECEIPTS					
	DIAMONDVILLE	DMV	1,078	ENTERPRISE	RUBY
	EMERALD SPRINGS	EMS	332	CIG	CIG
	GEMSTONE CANYON	GEM	400	RYCKMAN CREEK	RUBY
	PEARL CREEK	PRL	1,550	WILLIAMS	RUBY
	TOPAZ RIDGE	TPZ	1,200	OVERTHRUST	OVT
DELIVERIES					
	GEMSTONE CANYON	GEM	400	RYCKMAN CREEK	RUBY
	GOLD PAN	GPN	20	PROSPECTOR	RUBY
	ONYX HILL	OXH	1,522	PG&E - CGT	RUBY
	OPAL VALLEY	OPV	223	PAIUTE (SWG)	RUBY
	SAPPHIRE MTN.	SFR	347	TUSCARORA	RUBY
	TURQUOISE FLATS	TQF	1,006	GTN	RUBY

Ruby Opal Connections



Note: No-Fuel Wheeling area applies to receipt and delivery nominations between Opal Locations (L&U always assessed)

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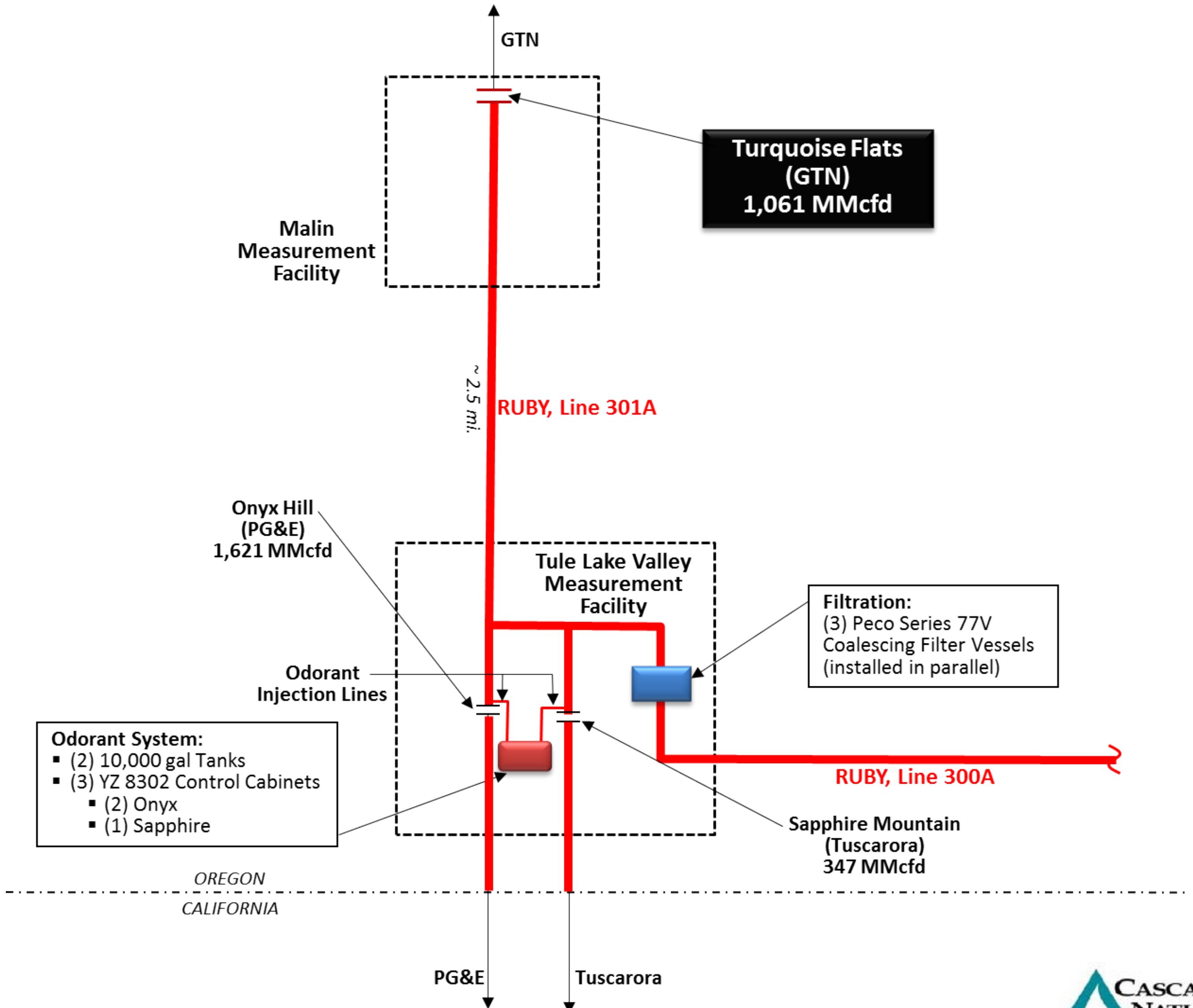
Ruby Malin Connections



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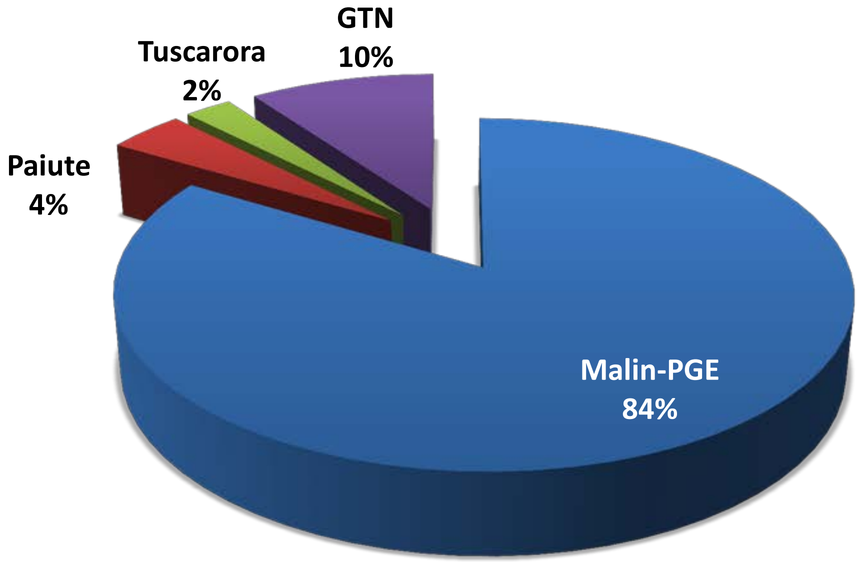
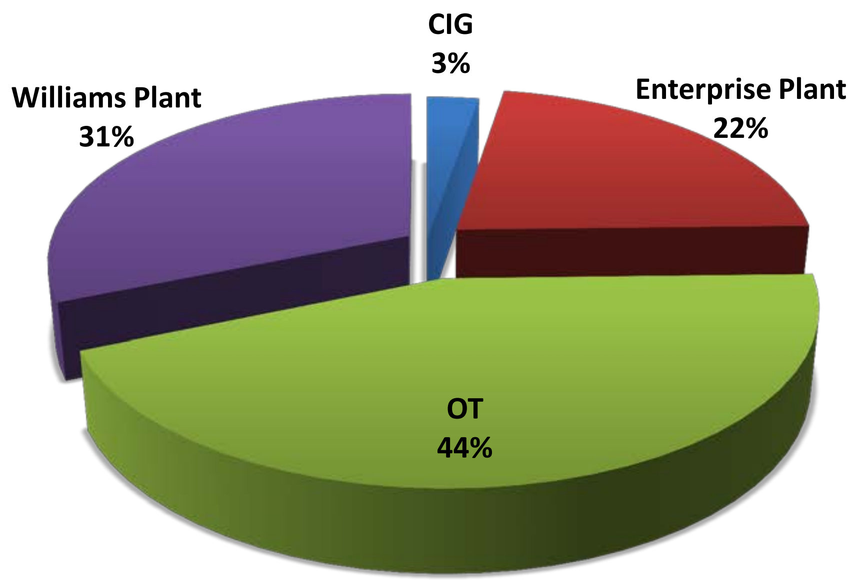
Ruby Flows – February, 2014

Ruby Delivery Breakdown



Ruby Receipt Breakdown



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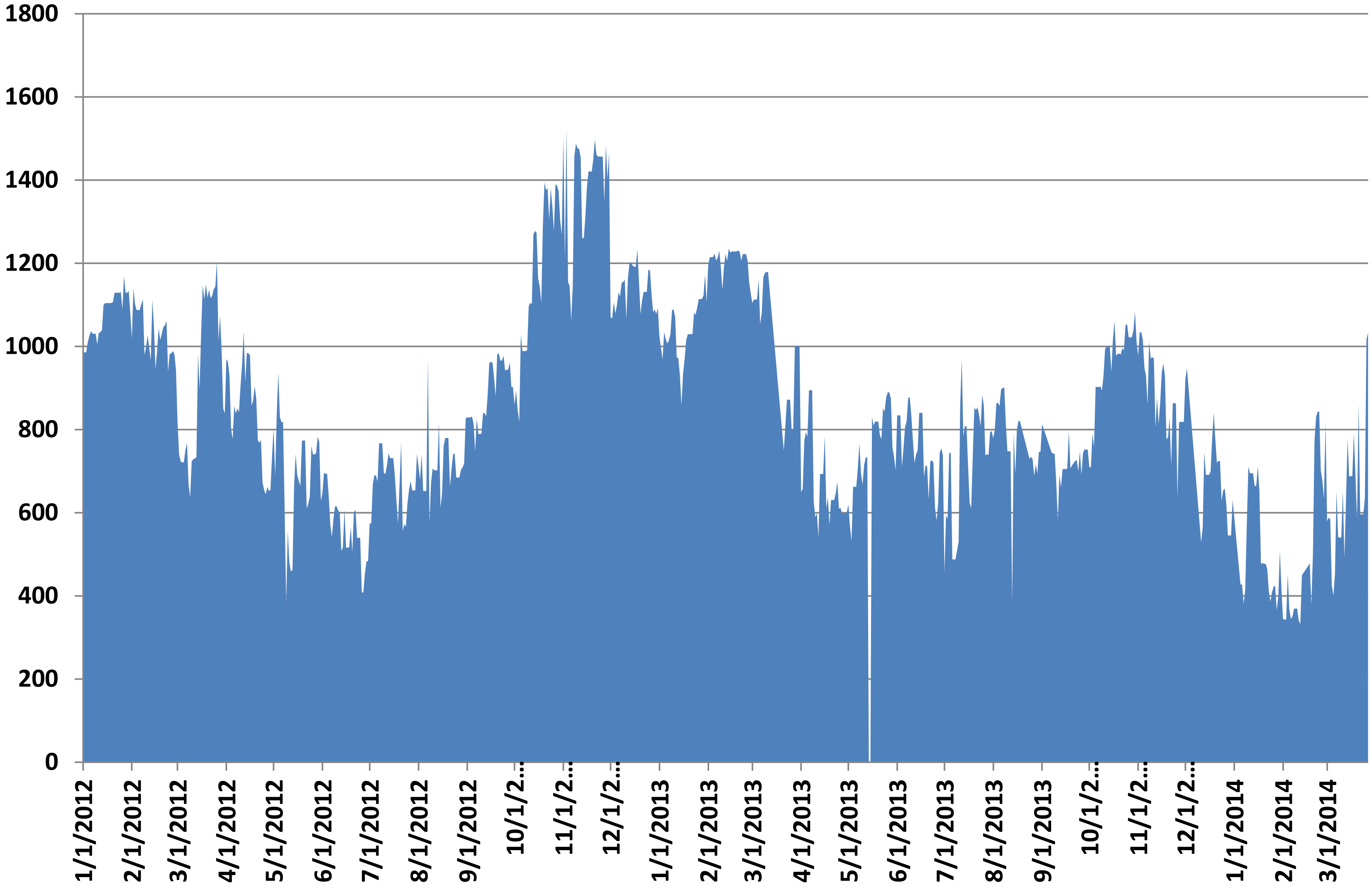
Ruby Flows



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Current Cascade-Ruby Contract

- **Ruby Contract 61036000**
  - 10,000 Dth/d
  - November – April expires 10/31/37
  - Rcpt.- Pearl Creek (Williams) Del. – Turquoise Flats (GTN)
  - R1 - $22.8125 ($.75)
- **GTN Contract 12094**
  - Temporary release from El Paso Ruby Holding Co. LLC
  - 10,000 Dth/d
  - 11/1/12 – 3/31/18
  - 80% of max tariff rate
  - Rcpt.- Turquoise Flats (GTN) Del. – Stanfield

Winter Seasonal Capacity Availability

- Incremental 20,000/Dthd of available winter capacity
  - Can be combined with year round capacity
  - Any time before October 31, 2014
    - 2 months notice
  - Rate – R1 - $22.8125/ month ($.75 per Dthd)
  - 25-year term
- Ruby has additional, but limited, winter seasonal capacity above the 20,000 Dthd.

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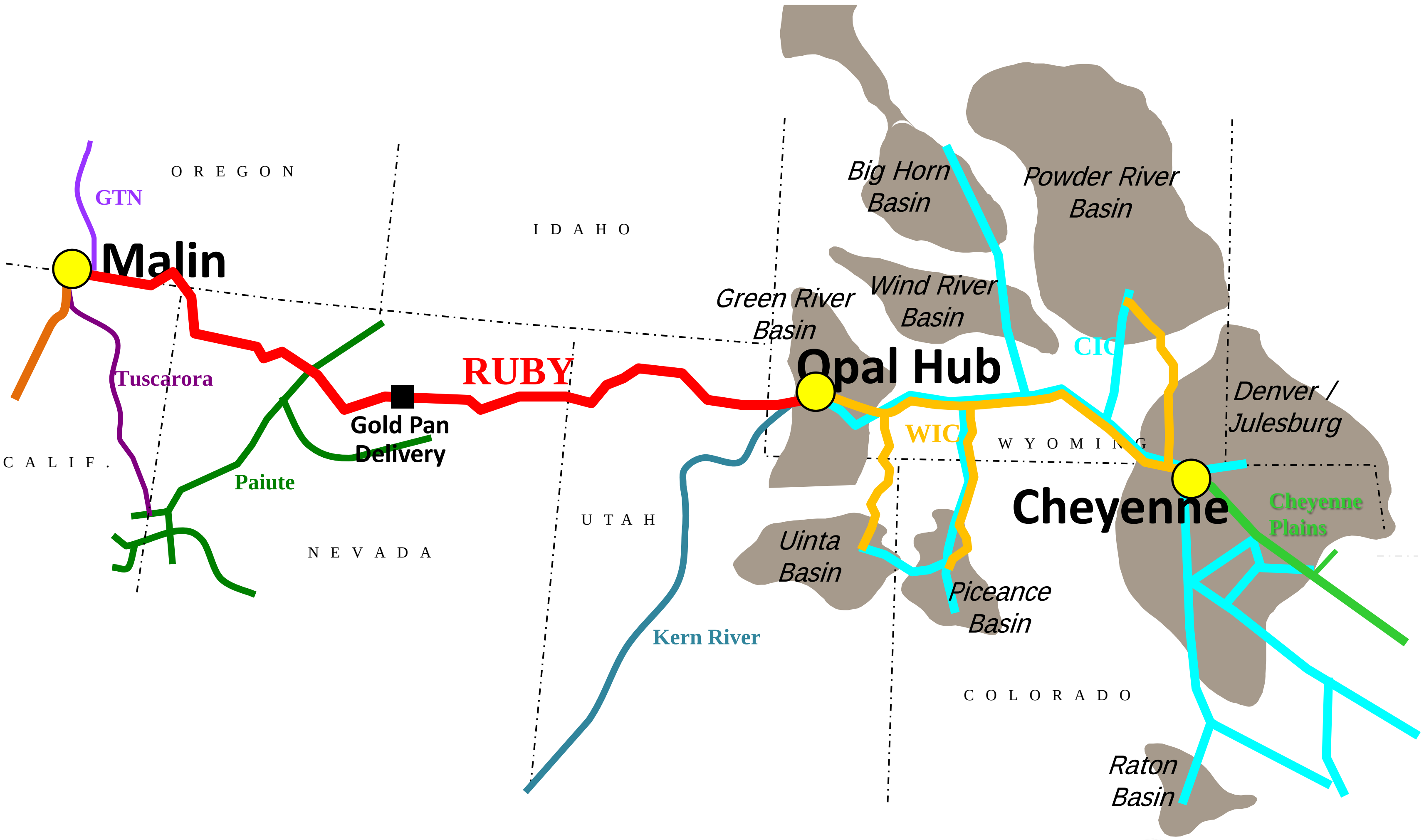
Ruby Supply Basin Access



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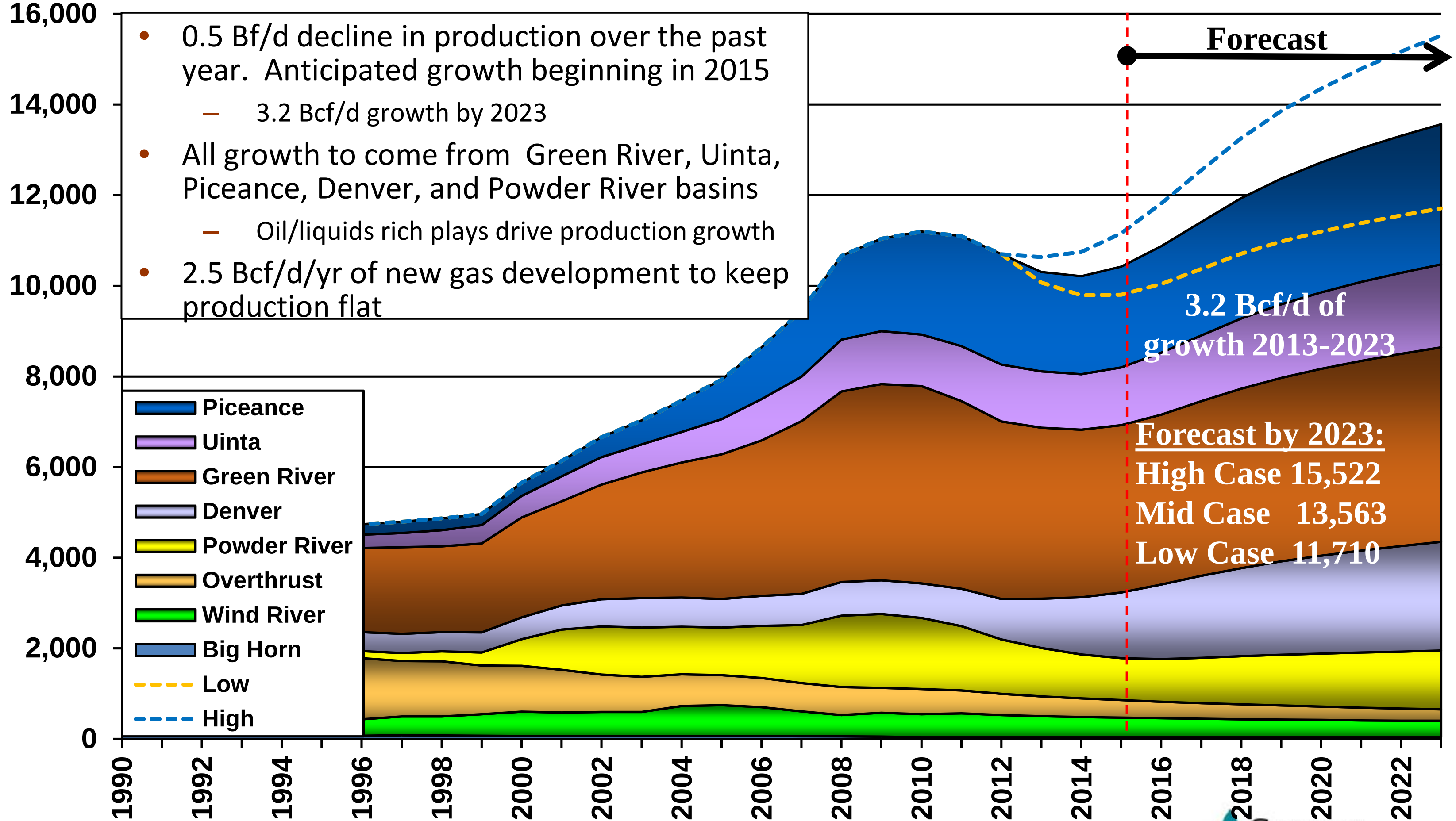
Rockies Supply Summary

- Current Production = 10.3 Bcf/d
- Base case incremental wellhead supply growth from 2013 to 2023 = 3.2 Bcf/d:
  - DJ/Niobrara: 1.3
  - Green River: .5
  - Powder River: .2
  - Unita: .7
  - Piceance: .9
- Anticipate 30+ years of Rockies production growth
- Liquids Rich Gas Upside – Niobrara
- Resource/Production ratio = 100+ Years

Rocky Mountain Production

Volumes are Wellhead – Measured in MMcfd

- 0.5 Bf/d decline in production over the past year. Anticipated growth beginning in 2015
  - 3.2 Bcf/d growth by 2023
- All growth to come from Green River, Uinta, Piceance, Denver, and Powder River basins
  - Oil/liquids rich plays drive production growth
- 2.5 Bcf/d/yr of new gas development to keep production flat



1990-2012: Wellhead total data from DI Desktop
2013-2023: Kinder Morgan forecast

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PGC Regional Resource Assessment

PGC Area	Traditional Gas Resources (Mean Value, Tcf)	Traditional Proportion of Total US	Change From 2010 Report	
Atlantic	741.3	33.4%	+387.7	110%
Gulf Coast	521.0	23.4%	+15.7	3.0%
Rocky Mountain	421.3	19.0%	+77.3	22.5%
Mid-Continent	269.5	12.1%	-2.7	-1.0%
Pacific	54.4	2.5%	+0.4	0.8%
North Central	20.8	0.9%	-0.8	-3.9%
Total Lower 48 U.S.*	**2,011.4**		+486.4	31.5%
Alaska	193.8	8.7%	0	0%
Total U.S. Traditional*	**2,225.6**		+486.4	28.0%

Data source: Potential Gas Committee (2013)

* Separately aggregated total. Area means are not arithmetically additive.

CBM not included

Ruby Pipeline Contacts

- **Tom Dobson**
  - Business Development, Account Director
  - 719-520-4606
  - Tom_dobson@kindermorgan.com
- **Steve Newell**
  - Marketing, Account Director
  - 719-520-4341
  - Stephen_newell@kindermorgan.com

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Some final comments

Gas Supply Oversight Committee

- Committee meets at least four times each calendar year
- GSOC has final approval of the portfolio design
- Minutes of all GSOC meetings must be kept and must be approved by the Chair

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Gas Supply Oversight Committee

Voting Members:

- Exec VP Combined Utility Operations Support (Chair)
- Exec VP and General Manager – Western Region
- VP and Controller – Western Region
- VP, Operations
- Director, Gas Supply – Utility Group
- Director, Gas Supply & Gas Control – Western Region
- Director, Regulatory Affairs – CNGC

Non-Voting member:

- Manager, Supply Resource Planning (secretary) – CNGC

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THE RECEIPT VS DELIVERY "MISMATCH" ON CNGC'S PRINCIPLE NWP CAPACITY

- As a result of FERC Order 636, NWP was required to directly assign upstream capacity on GTN to the shippers that were using that capacity

- This caused NWP and GTN to directly assign GTN capacity to the LDC's upon the final conversion of the old bundled service.

- NWP allowed this direct assignment but refused to lower its capacity contract with Cascade to reflect the amount of direct assignment
  - In effect this increased Cascade's system wide capacity by the amount GTN would be directly providing to Cascade.

- The flexible receipt and delivery point situation that now exists on NWP with the 100002 contract is currently 316,994 dths/day of delivery rights vs. 205,123 dths of receipt rights.

- Cascade has the right to deliver gas supply to any delivery point within the states of Washington and Oregon so long as the Company's total Maximum Daily Delivery Obligation (delivery rights) is not exceeded.

- Cascade and NWP are constantly working together for ways to address Cascade's capacity shortfalls through re-alignment of our contractual rights where possible, which mitigates the need to acquire incremental capacity through expansions.

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RUBY AND GTN northbound CAPACITY

- In the recent past OPUC Staff has expressed concerns about Central Oregon's significant reliance on Alberta gas.
- Ruby capacity was acquired to enhance supply diversity and to address projected peak day capacity shortfalls.
- Utilizing Ruby provides the system with another path to move Rockies gas to serve Washington and Oregon from Stanfield when NWP constrained or operationally limited .
- Positions CNGC to acquire storage service at Ryckman Creek to primarily serve Central Oregon should future resource optimization analysis indicate the storage is a reasonable alternative resource.
- Current load forecasts indicates increasing peak day capacity shortfalls in Central Oregon over the next twenty years. A combination of incremental Ruby and GTN capacity may be a reasonable alternative to deliver Rockies supplies and enhance system flexibility to meet the needs of Central Oregon but Washington as well.

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Next Steps

- Questions?
- Comments?
- Concerns?
- Review Action Items

Next Steps

The Agenda for the Second Meeting on May 1 (note the time change -- 9 a.m. to Noon).

- Introductions (10 min)
- Agenda (5 min)
- Update on Action Items from first workshop (20 min)
- Review of potential Ruby capacity (15 min)
- CNGC Ruby Scenario Runs (60 min)
- Discussion points for OR IRP addendum (30 min)
- Next Steps (10 min)
- Adjournment

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Adjournment

Cascade Natural Gas Corporation

Capacity Workshop #1

Tuesday, April 8, 2014

Cascade Natural Gas Workshop on Capacity Issues
April 8th, 2014 10:00 AM – 3:00 PM

Attachments:
Attachment A – Capacity Workshop 1 slides

I.) **Action Items** – Cascade Natural Gas must provide Oregon peak day load information for December. Cascade must also provide the system load for the entire heating season.

II.) **Introduction** – Mark Sellers-Vaughn opened the meeting with the agenda and background information. A few notes that were stated:
- Updated everyone that Cascade has filed and been granted an extension on the IRP filing date from both OPUC and WUTC.
- It was also mentioned that Cascade is working with MRE and Gelber & Associates on our load forecast modeling.
- Some background on current storage and allocation was given.

III.) **Williams Northwest Pipeline** – Mike Rasmuson presented Northwest Pipeline's information.
- Mike gave some background on the pipeline.
- He showed some weather forecasts and explained that if an extreme cold weather event hit during the latter part of the heating season there could be issues since storage capacities are low.
- Mike stated that NWP has been and will continue to look into expanding Jackson Prairie (JP) capacity.
- Cascade's contractual rights with NWP were summarized.
- 3 business development projects were shortly discussed.
  - Pacific Connector
  - Washington Expansion
  - Wenatchee lateral
    - **Action item:** Cascade needs to follow up and get information on the projects to analyze for the IRP.

IV.) **Closer look at Central Oregon** – Mark shortly discussed the capacity that serves Central Oregon and the shortfall of that capacity on peak day.

V.) **TransCanada** – Jay Story presented TransCanada Pipeline's information.
- Jay gave background information on the GTN system. Including:
  - Interconnecting Pipelines.
  - GTN System Available Capacity.
  - Primary Path Options and Differences.

VI.) **Ruby Pipeline** – Tom Dobson presented Ruby Pipeline information.

- Tom gave a background on the pipeline and showed maps of how the pipeline works and where the pipelines are.
- He summarized our current Cascade-Ruby contract.
- He showed the winter seasonal capacity availability.

VII.) **Final Comments** – Mark Sellers-Vaughn spoke about the final slides giving some information on GSOC and capacity issues.

VIII.) **Wrap-Up** – Mark Sellers-Vaughn noted that the next meeting will move from May 1st to May 5th. The agenda for the second meeting include:

- Update on Action Items from first workshop.
- Review of potential Ruby Capacity.
- CNGC Ruby Scenario Runs.
- Discussion points for OR IRP addendum.

Cascade Natural Gas Capacity Workshop #2
NWN Headquarters in Portland, OR
May 5th, 2014 9:00 AM – 11:30 AM

Attachments:
Attachment A – Capacity Workshop 2 slides
Attachment B – Attendance sheet

I.) **Action Items** – Cascade Natural Gas must provide OPUC with major inputs for non-Ruby alternative resources and possibly provide snapshots for a range of prices.

II.) **Introduction** – Mark Sellers-Vaughn (CNGC) opened the meeting with the agenda and background information. A few notes that were stated:
- Updated everyone that Cascade has filed and been granted an extension on the IRP filing date from both OPUC and WUTC.
- It was also mentioned that Cascade is working with MRE and Gelber & Associates on our load forecast modeling.
- Mark responded to action items from the first workshop meeting.

III.) **Forecast to be used in IRP Update** – Mark presented the forecast that will be used in the 2011 IRP Update.
- Current forecast methodologies were listed.
- Load growths were stated. Julianna Williams (WUTC) asked if the load growths consider conservation. The answer was yes.

IV.) **Recap of Capacity Issues** – Mark discussed conjunctive transportation, the capacity issues that serve Central Oregon and the shortfall of that capacity on peak day.
- Cascade Conjunctive Transportation Contracts were stated. Tamy Linver (NWN) asked if there was special meaning to the word "Conjunctive". The response was yes, conjunctive rights combine multiple imbalances into one imbalance.
- Ryckman Creek was also discussed.
- Teresa Hagins (NWP) also informed Cascade that there are small pockets along NWP near Kemmerer.
- Ryan Bracken (OPUC) asked if GTN was bi-directional. The answer is yes. A follow up question was if the flow was only on paper or if the actual molecules flow both ways. The answer was that GTN has the physical capability to flow natural gas both directions in the pipeline.

V.) **Overview of SENDOUT** – Mark discussed the overview of SENDOUT and SENDOUT inputs.
- He discussed input scenarios for Ruby and the Ruby impact SENDOUT inputs.
- Winter Seasonal Capacity Availability was stated.
- SENDOUT scenario results for Ruby were presented.

VI.) **Gas Supply Oversight Committee** – GSOC decision on current Ruby/GTN alternatives will be made no later than Friday, June 13, 2014.

VII.) **Final Comments** – Mark discussed the final slides.

- The outline of update to OR IRP was discussed.
- Conclusions were discussed.
- Next steps were presented
- Mark asked OPUC what CNGC may need to provide in the IRP update. The response was that it is CNGC's update and CNGC can include anything that needs to be updated.
- Mark asked WUTC if CNGC needs to file this update with the WUTC. Their response (Julianna)was that we did not need to file a formal update but they would like a copy of the update that is filed to OPUC.

VIII.) **Wrap-Up and important dates** – Mark discussed the IRP update process and dates. Mark asked if there needs to be another capacity issues workshop meeting. The decision was that there didn't need to be another meeting.

Sign-in Sheet

(503) 580-7667 CELL
(503) 378-3778 OFFICE

1. LISA GORSUCH OPUC lisa.gorsuch@state.or.us
2. Kelly Fukai Avista Kelly.Fukai@avistacorp.com
3. Ryan Bracken OPUC ryan.bracken@state.or.us
4. Jon Whiting CNGC Jon.whiting@CNGC.com
5. Steve Harper Avista Steve.Harper@AvistaCorp.com
6. Jim Abrahamson CNGC Jim.Abrahamson@cngc.com
7. Tamy S. Linver NNG tsl@nwnatural.com
8. Devin Gilbert NWN drg@nwnatural.com
9. Steve Storm NWN steve.stevestorm@nwnatural.com
10. Nadine Hanhan CUB Nadine@oregoncub.org
11. Teresa Hagins NWP Teresa.L.Hagins@williams.com
12. Ben Hemson NW Gas Assoc. BHemson@NWGA.org
13. Dave Lenar NWN

Call-ins

1. John Klingele Public
2. Joan Wilmotte (CNGC)
3. Julianna Williams (WUTC)
4. Carolyn Stone (CNGC)
5. Amanda Sargent (CNGC)
6. Chris Robbins (CNGC)
7. Bob Morman (MDU)
8. John Cooley (CNGC)
9. Pamela Archer (CNGC)
10. Mike Parvinen (CNGC)
11. Omar Araujo (Fortis BC)
12. Steve from Ruby (didn't catch his last name) Steve Newell (Ruby)
13. Ed Finklea (NWIGU)
14. Micah Robinson (MRE)

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Capacity Workshop #2

Northwest Natural Gas Headquarters
Portland, Oregon

Monday, May 5, 2014

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Agenda

- Introductions
- Agenda
- Response to action items from 1st workshop
- Recap of forecast used for IRP update
- Recap of capacity issues
- Overview of SENDOUT optimization model
- SENDOUT inputs for scenarios for Ruby
- SENDOUT scenario results for Ruby
- GSOC Role in the process
- Review outline of draft update to OR IRP
- Next Steps
- Adjournment

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Why are we here

- OPUC agreed to IRP filing extension subject to having 2 workshops addressing capacity and potential to acquire additional Ruby capacity prior to Oct14
- First workshop on April 8, 2014 covered capacity system-wide
- Second workshop is specific to Ruby and GTN
- CNGC required to file an update to 2011 IRP (LC-54) by June 20th, containing CNGC analysis regarding any acquisition of incremental Ruby capacity which might occur before October 2014

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Response to Action Items

- Total Core peak day this past heating season was Saturday, December 7, 2013
  – Est 2,669,513 therms with 54 System HDD; normal 27 HDD
- Total Non-Core peak day this past heating season was Thursday, December 5, 2013
  – Est 4,291,483 therms
- Total System peak day this past heating season was Sunday, December 8, 2013
  – Est 6,812,672 therms (53 System HDD, normal is 27 HDD)

Response to Action Items

- System peak day in Oregon this past heating season was Sunday, December 8, 2013
  – Est 1,606,690 therms

- System peak day in Washington this past heating season was Sunday, December 8, 2013
  – Est 5,205,982 therms

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Response to Action Items

- Total Core peak day in Oregon this heating season was Sunday, December 8, 2013
  – Est 730,344 therms

- Total Core peak day in Washington this last heating season was Saturday, December 7, 2013
  – Est 1,956,494 therms

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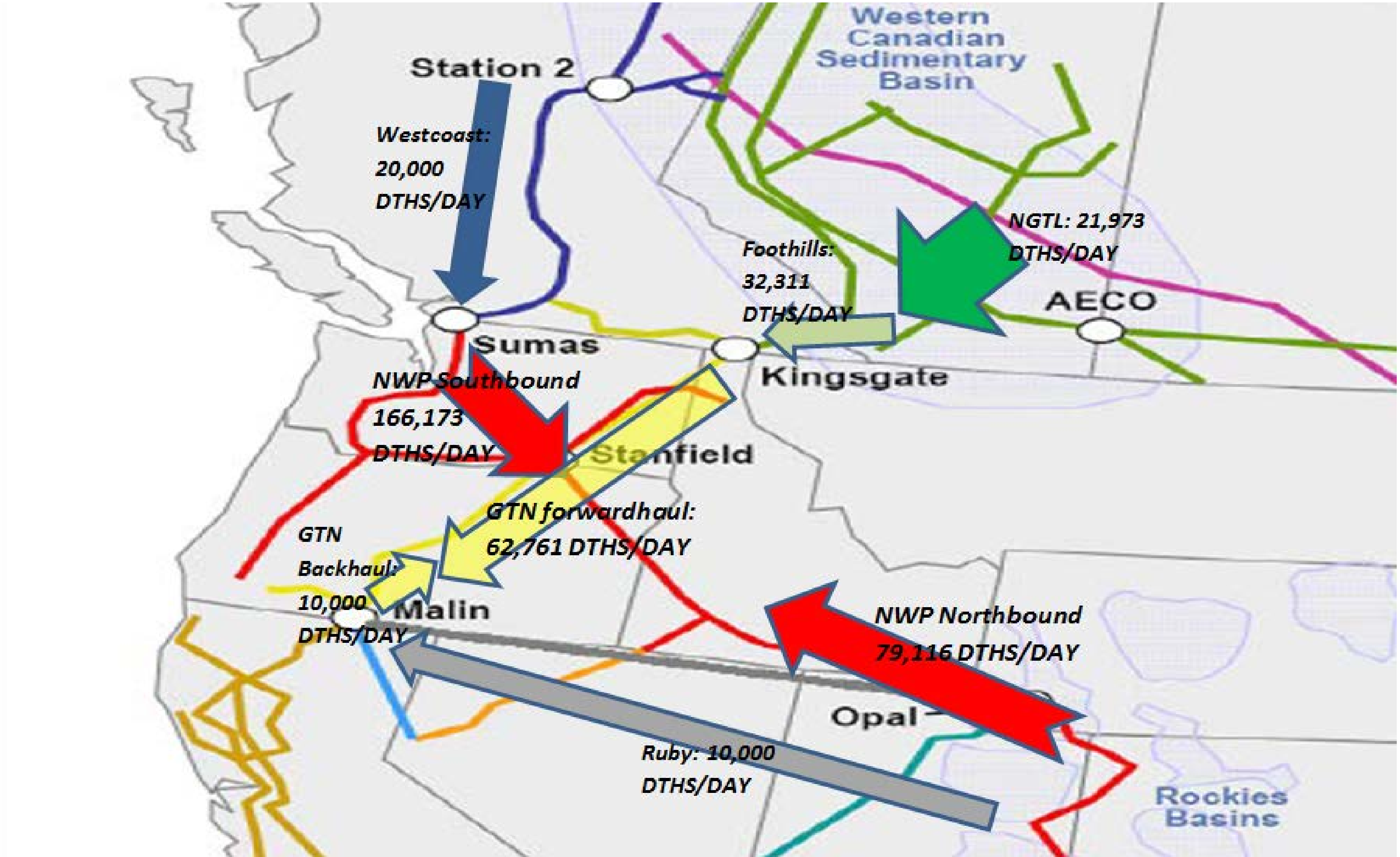
Example Transport Capacity Flow



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STORAGE

1) Goal is to cycle the storage accounts each heating season, dependent on demand and operating conditions
2) Assumes all accounts will be 35% full by June 30, 80% full by August 31, and 100% full by September 30
3) Unless noted, assumes normal weather with peak event
4) SGS01 balances based on historical data with inventory zero by end of April
5) SGS02, SGS622 and SGS626 assumes balance of 80% November, 40% December, 20% January and zero by end of February
6) Jackson Prairie storage and Plymouth LNG are utilized based on weather, market and operational conditions

Jackson Prairie
- SGS01
- SGS02
- SGS622
- SGS626

Plymouth LNG
- LS01

CASCADE STORAGE CONTRACTS		
	Storage Capacity	Withdrawl
Total	(decatherms)	(dths/day)
SGS01	604,351	16,789
SGS02	350,000	30,000
SGS622	102,782	3,500
SGS626	178,460	6,077
LS01	562,200	60,000

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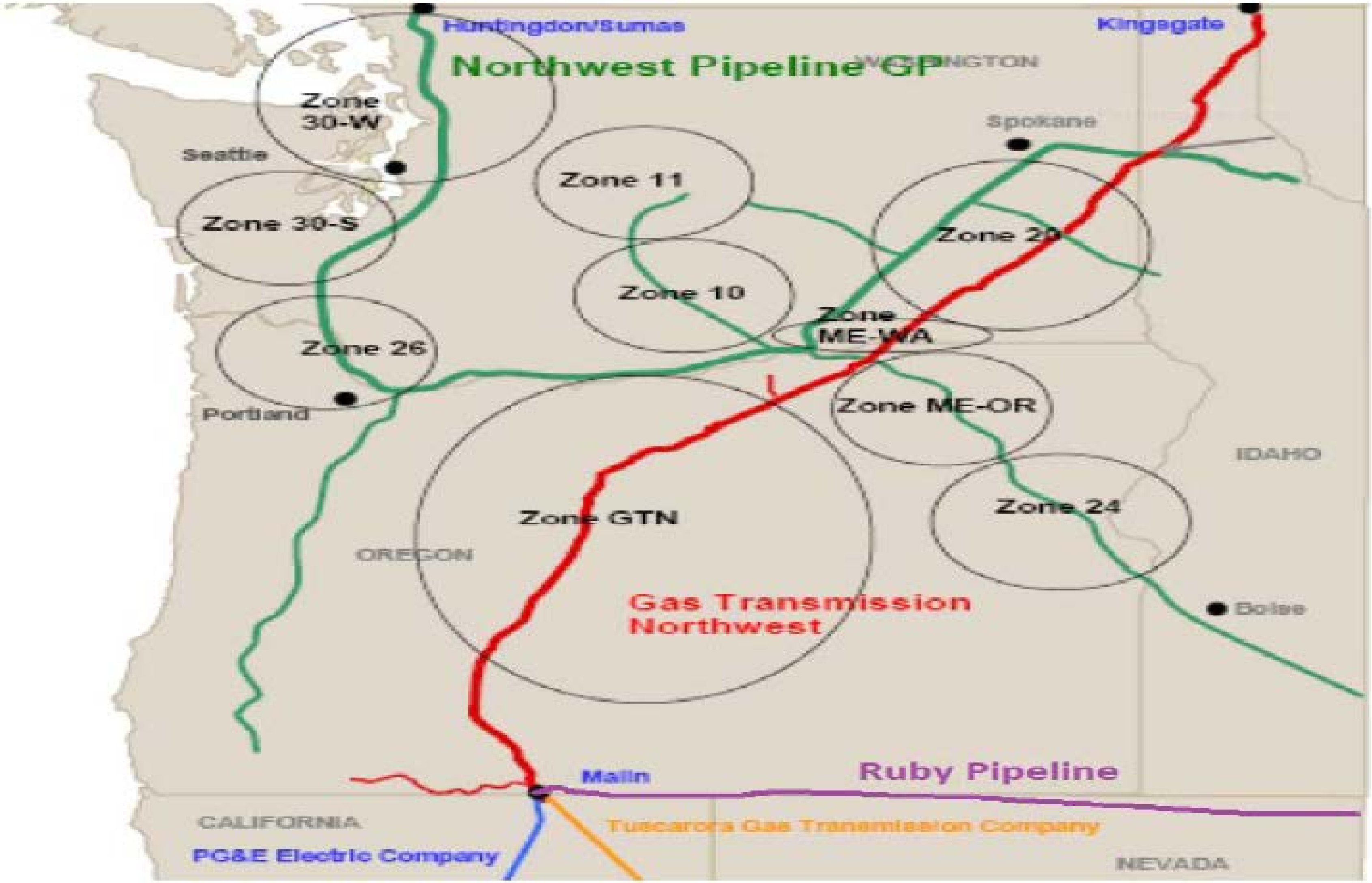
Cascade crosses multiple potential pipeline constraints due to the geographical complexity of our distribution system.



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Forecast to be used in IRP Update

- Update will use the forecast methodology from the 2012 IRP
- Forecast is not materially different than the 2011 Oregon IRP
- Forecast is at zonal level

CURRENT FORECAST METHODOLOGY

- Cascade develops a 20-year forecast of customers, therm sales, and peak requirements Utilized in annual budgeting as well as long-term planning

- Customer counts are built from the district level up and take into account both demographic trends and economic conditions.

- •Usage forecast utilizes median household income, weather, and natural gas prices to determine therms per customer

- •A review of low and high growth scenarios examine load growth under poor and greater than expected improvements in economic conditions –Forecasts by Woods & Poole are altered to examine the strongest and weakest performing decades over thirty years

- •Peak day forecast is implemented in conjunction with a base load forecast, which attempts to ensure demand is met on the coldest days of the year –A 60-year weather history is obtained and peak day is based on the coldest day in the past 30 years , currently identified as 61 HDD

- –Therm usage is adjusted upward based on coldest day in *recent* history (56 HDD January 5, 2004) to 61 HDD to show what usage would have been at 61 HDD

- –Usage is applied to each district at the forecasted therm usage annual growth rate. The allocation rolls up to the IRP load zone level.

- •Various scenarios are developed

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Load Growth

Load growth across Cascade's system through 2032 is expected to fluctuate between 1.4 and 1.7% annually, with lower, recessionary growth in the short term. Load growth consists of a split between residential and commercial demand, with a slow decline in industrial demand.

	Residential	Commercial	Industrial	System
2012 – 2016	1.71%	1.68%	-3.22%	1.48%
2016 – 2021	1.78%	1.81%	-1.85%	1.66%
2021 – 2026	1.74%	1.83%	-1.06%	1.68%
2026 – 2031	1.50%	1.59%	-1.24%	1.46%
2011 – 2032	1.68%	1.73%	-1.84%	1.57%

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Peak Day

- Residential customers have higher temperature sensitivity than commercial or industrial
- Residential profile increases over planning horizon
- Peak Day is projected to increase at a higher rate than annual load

	Peak Growth		Peak Day Therms
2012 - 2013	1.263%	**2013**	3,649,738
2013 - 2020	1.918%	**2020**	4,166,993
2021 - 2025	1.910%	**2025**	4,580,669
2025 - 2032	1.760%	**2032**	5,176,348

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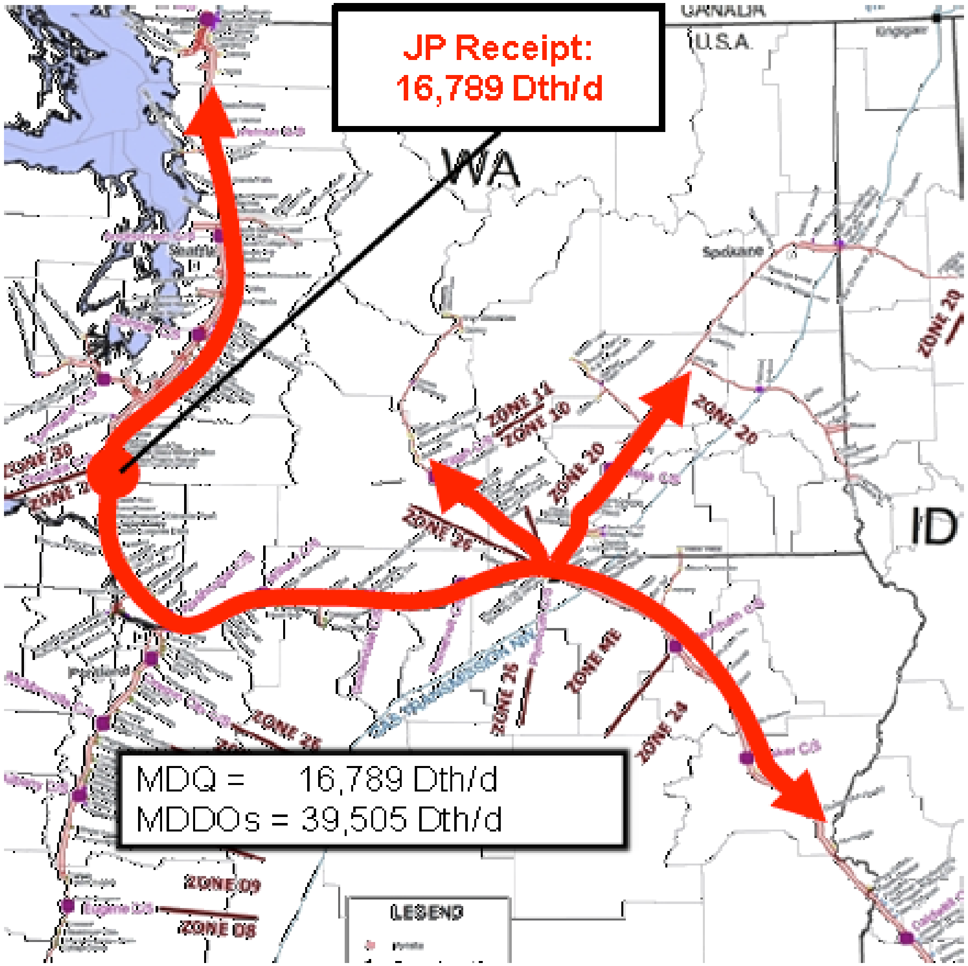
Cascade Conjunctive Storage Contract No.100302



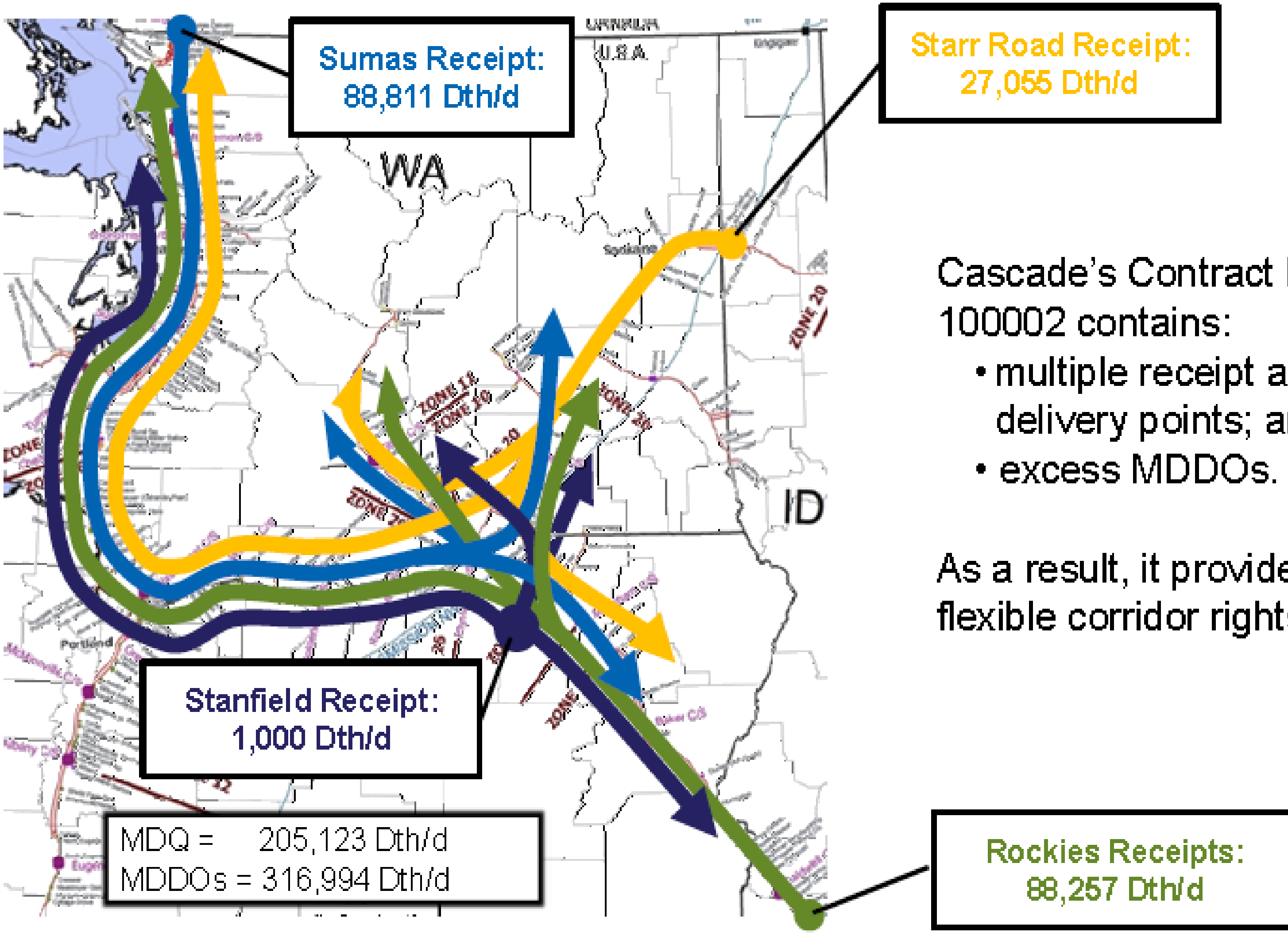
Cascade's Contract No. 100302 contains:

- Multiple delivery points; and
- excess MDDOs.

As a result, it provides flexible corridor rights.

Source: Williams, Companies, Inc.

Cascade Conjunctive Transportation Contract No. 100002



Cascade's Contract No. 100002 contains:

- multiple receipt and delivery points; and
- excess MDDOs.

As a result, it provides flexible corridor rights.

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Capacity Allocation to Meet Peak-Day Demand

Williams
Ingenuity takes energy

- Below are some ideas to help identify potential capacity shortfalls based on peak-day load projections.
  - First, allocate capacity on contracts that have a single receipt point.
  - Second, allocate capacity on conjunctive contracts that provide corridor and delivery point flexibility.

- Allocationy Considerations:
  - Critical deliveries
  - Constrained laterals
  - Maintain Corridor Flexibility (longest-haul contractual rights)

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Using capacity to serve Central Oregon

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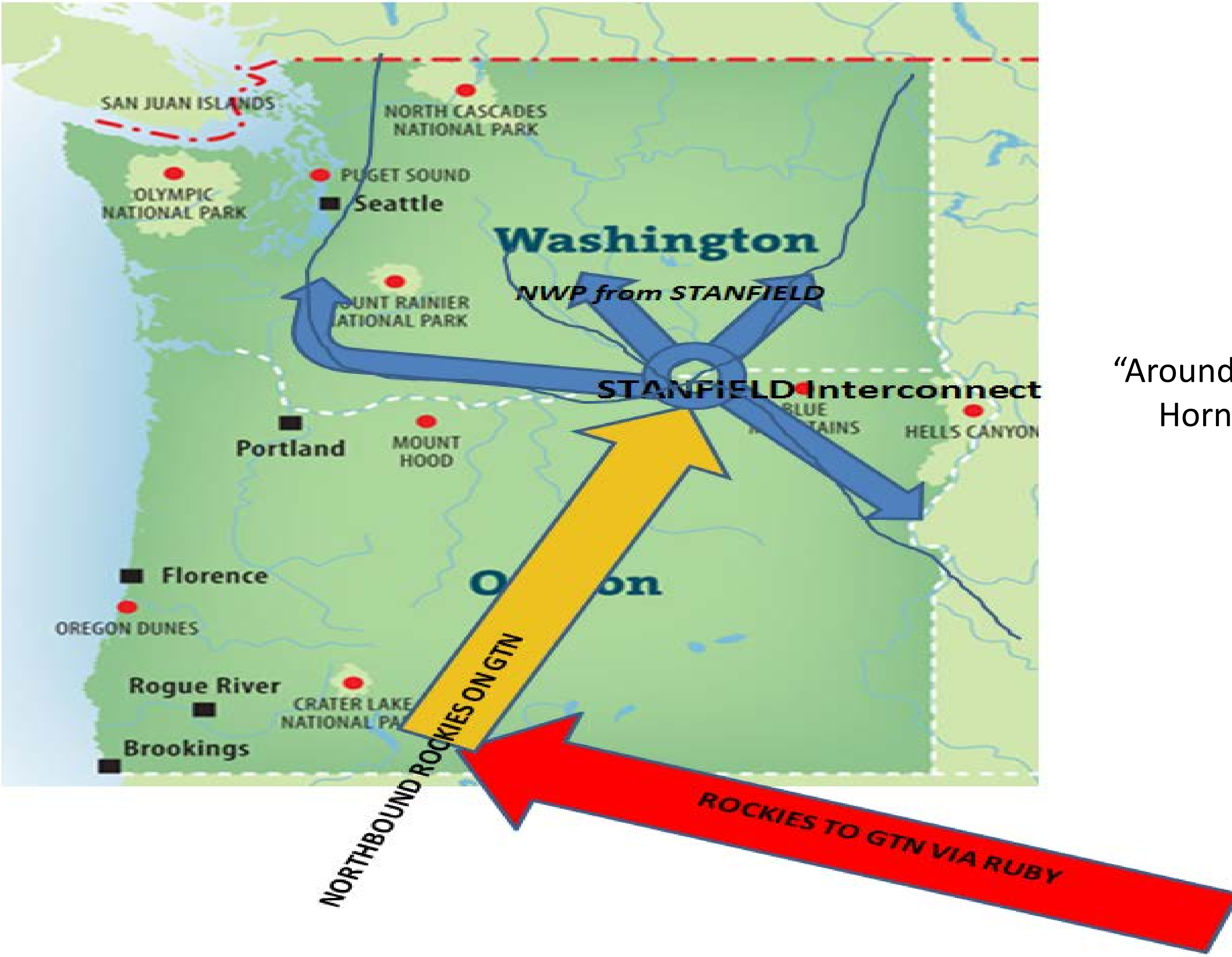

"Around the Horn"

Ryckman Creek Storage

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Ryckman Creek Storage

- Ryckman Creek Resources, LLC, a wholly-owned subsidiary of Peregrine Midstream Partners, LLC
- Ryckman Creek is located in Uinta County, Wyoming, near the Opal Hub.
- Ryckman Creek has converted a partially depleted oil and gas reservoir into a gas storage facility with 35 BCF of working gas and a maximum daily withdrawal rate of 480,000 Dths/d.
- Ryckman Creek Gas Storage Facility is located near the town of Evanston, Wyoming and approximately twenty-five miles southwest of the Opal Hub.
- Ryckman Creek currently has interconnects with Questar Gas Pipeline, Kern River Transmission, Questar Overthrust Pipeline, Ruby Pipeline and Northwest Pipeline.
- Previously conducted a non- binding Open Season to determine the interest of prospective customers in contracting for up to 8 BCF of firm working gas storage capacity beginning April 1, 2013.
- Events have impacted the timeline

Overview of SENDOUT

- Resource integration is the last step in Cascade's IRP process.
- Reasonably least cost mix of demand and supply side resources given the forecasted load requirements of the core customers.
- Optimization model is SENDOUT™.
- This model permits the Company develop and analyze a variety of resource portfolios to help determine the type, size, and timing of resources best matched to forecast requirements.
- SENDOUT™ is very powerful and complex.
- It operates by combining a series of existing and potential demand side and supply side resources and optimizes their utilization, at the lowest net present cost over the entire planning period, for a given demand forecast.

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Overview of SENDOUT

- SENDOUT™'s broad capabilities allow the Company to develop supply and demand relationships that closely mirror Cascade's existing operations.
- Cascade continued to model demand areas grouped by the various pipeline zones, a practice that began with the 2008 IRP.
- Demand centers reflect on a daily basis, the aggregate 20 year load forecasts of Cascade's core market customers being served from either Northwest Pipeline GP (NWP) or Gas Transmission Northwest (GTN) interstate pipeline facilities.
- Individual transportation segments, storage, supply and demand side resources, both existing and potential, are targeted to these pipeline zones.
- SENDOUT™ considers each resource on an individual basis within the portfolio while also recognizing where physical system limitations exist.

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Overview of SENDOUT

- Resource characteristics include:
  - a supply contract's daily delivery capability
  - minimum take requirements
  - maximum daily transport capability by individual segment
  - and storage inventory limitations and withdrawal and injection curve characteristics can be part of each resource's basic model inputs.
  - The ability to model resources in this fashion allows SENDOUT™ to tailor its optimization within envisioned constraints and ensures that the model's optimal solution can work under anticipated operating conditions.
- However, because SENDOUT™ utilizes a linear programming approach, its results are considered "deterministic".
  - For example, the model knows the exact load and price for every day of the planning period
  - Based on the analyst's input and can therefore minimize costs in a way that would not be possible in the real world.
  - Therefore, it is important to acknowledge that provides helpful but not perfect information to guide decisions
  - It informs but does not decide ultimate resource portfolio

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One last disclaimer about optimization model

Decision Making Tool

- Analysis of optimization model results and other operational and contractual constraints allows Cascade to make more informed resource decisions. The IRP optimization model output and Monte-Carlo simulation analysis will provide the quantifiable output from numerous model inputs. The model does not prescribe the ultimate resource portfolio. It can only determine the least cost set of resources given their specific pricing and quantifiable constraint characteristics. However, there are many other combinations of resources that may be available over the planning horizon. Cascade must still make subjective risk judgments about unquantifiable and intangible issues related to resource selections. These will include future flexibility, supplier deliverability risk, pipeline(s) risk, financial risk to the utility and its ratepayers, operational constraints, regulatory risk, etc. The risk judgments are combined with the quantitative IRP analysis to form actual resource decisions.

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SENDOUT INPUTS

- Base Resources (current)

Category	SENDOUT ID	CD	WorkingInv	Inj Rights	WD Rights
Base Supplies		261,684			
Base Storage		56,366	1,235,593	VARIABLE	56,366
Base LS		-	562,200		60,000

- Current non-Ruby Alternative Resources

Category	SENDOUT ID	CD	WorkingInv	Inj Rights	WD Rights	Resv	Comm	Begin	
Incremental Jackson Prairie	INCREM SGS		350,000	10,000	15,000	$ 0.08 (MSQ)		Apr-17	20+
GTN Incremental (Kingsgate South)	INCR-PGT	40,000				$ 1.25	$ 0.0300	Nov-15	20+
NWP Incremental (All System)	INCR-WGPW	50,000				$ 1.50	$ 0.0300	Nov-16	20+
Station 2 to Kingsgate	S XING XPORT	5,000				$ 1.00	$ 0.0500	Nov-14	5 Yrs
Kingsgate to WCT Hunt	SOXING KNG	5,000				$ 1.00	$ 0.0500	Nov-14	5 Yrs
Washington Expansion down I-5	WaEXP-OR LNG	25,000				$ 1.25	$ 0.0300	Nov-16	20+
Mist Storage	MIST		300,000	10,000	10,000	$ 0.165 (MSQ)	$ 0.0600	Nov-18	20+
Biomass	BIOMASS	1,000				$ 6.00	$ -	Mar-17	20+
Satellite LNG	SATL LNG	1,000				$ 7.00	$ -	Nov-18	20+

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SENDOUT inputs for scenarios for Ruby

- 20 yr Increm Ruby Seasonal
- 20 yr increm Ruby Annual, includes Ryckman Creek
- All reasonably avail alternatives
- Ruby without Ryckman Creek
- Ruby with Ryckman parking service of 1 yr
- Ruby 3rd Party Cap Rel 7 yrs

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RUBY IMPACT SENDOUT INPUTS

- Ruby with discount, includes Ryckman Creek

Category	CD	WorkingInv	Inj Rights	WD Rights	Resv	Comm	Begin	
Ruby/GTN 20 Yr Increm Seasonal	Up to 20K (Nov-Mar)				$ 0.75	$ 0.0100	Nov-14	20 +
Ruby/GTN 20 Yr Increm Annual	Variable				$ 0.75	$ 0.0100	Nov-14	20 +
Ruby-BP Release/GTN	Up to 10K				$ 0.35	$ 0.0100	Nov-14	7 years
Ruby/GTN/Ryckman		500,000	10,000	14,000	$ 0.07 (MSQ)		Apr-15	20 +

- Ruby at full recourse tariff rate, includes Ryckman Creek

Category	CD	WorkingInv	Inj Rights	WD Rights	Resv	Comm	Begin	
Ruby/NWP/GTN Ryckman - NWP	2,500				$ 1.00	$ 0.0030	Apr-15	20+
Ruby/NWP/GTN Ryckman -Ruby	11,790				$ 0.95	$ 0.0100	Apr-15	20+
Ruby/GTN Ryckman Parking		250,000	10,000	20,000	$ 0.90	$ 0.0150	Nov-14	1 YR

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Winter Seasonal Capacity Availability

- Incremental 20,000/Dths of available winter capacity
  - Can be combined with year round capacity
  - Any time before October 31, 2014
    - 2 months notice
  - Rate – R1 - $22.8125/ month ($.75 per Dths)
  - 25-year term
- Ruby has additional, but limited, winter seasonal capacity above the 20,000 Dths.

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SENDOUT SCENARIO RESULTS FOR RUBY

- BASE RUBY DEAL
  - MODEL SELECTS RUBY CAPACITY APPROX 10,000 DTHS/DAY
  - MODEL COMBINES THIS WITH APPROX 20,000 DTHS DAY OF GTN TURQ-STAN CAPACITY FOR RYCKMAN DELIVERIES PLUS PEAK DAY
  - MODEL SELECTS RYCKMAN STORAGE AT 500,000 DTHS OR WORKING INVENTORY AND MDQ of APPROXIMATELY 14,000 DTHS/DAY

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SENDOUT SCENARIO RESULTS FOR RUBY

- ALL RESOURCE ALTERNATIVES
  - MODEL SELECTS RUBY CAPACITY APPROX 5,000 DTHS/DAY
  - MODEL COMBINES THIS WITH APPROX 5,000
  - MODEL SELECTS RYCKMAN STORAGE AT 500,000 DTHS OR WORKING INVENTORY AND MDQ of APPROXIMATELY 14,000 DTHS/DAY
  - MODEL ALSO SELECTS A INCREM STORAGE SIMILAR TO THE JP EXPANSION (350,000 DTHS)

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SENDOUT SCENARIO RESULTS FOR RUBY

- NO RYCKMAN STORAGE
  - MODEL SELECTS RUBY CAPACITY APPROX 11,000 DTHS/DAY; combines Annual with 3rd Party Cap Rel
  - MODEL COMBINES THIS WITH APPROX 21,000 DTHS DAY OF GTN TURQ-STAN CAPACITY FOR RYCKMAN DELIVERIES PLUS PEAK DAY
  - MODEL SELECTS CYCLES STORAGE ACCOUNTS MORE THAN ONCE
  - MODEL SELECTS INCREM GTN KINGSGATE-SOUTH OF APPROX 10,000 DTHS

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SENDOUT results for Ruby

- 20 yr Increm Ruby Seasonal - YES
- 20 yr increm Ruby Annual, includes Ryckman Creek - YES
- All reasonably avail alternatives - YES
- Ruby without Ryckman Creek - YES
- Ruby with Ryckman parking service of 1 yr - NO
- Ruby 3rd Party Cap Rel 7 yrs - YES

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Gas Supply Oversight Committee (GSOC) role in Ruby decision

- GSOC has final approval of the portfolio design
- Committee meets at least four times each calendar year
- Gas Supply reviews model results with GSOC
- Gas Supply make recommendation to GSOC
- GSOC considers results, recommendation and authorizes (or not) a action plan
- GSOC decision on current Ruby/GTN alternatives no later than Friday, June 13, 2014

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OUTLINE OF UPDATE TO OR IRP

- Update on discussions with NWP regarding delivery rights re-alignment and incremental vintage capacity acquisition program
- Update on incremental resources affecting Oregon
- Update on GSOC determination regarding securing Ruby capacity to meet load growth and add supply diversity
- Update on GSOC determination regarding securing Incremental Gas Transmission Northwest Pipeline (GTN) firm south-to-north capacity to meet load growth and add supply diversity
- Update on status of efforts to secure incremental storage for Oregon to meet load growth & mitigate price volatility over the planning horizon

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CONCLUSIONS

- NPV 20 YEAR PORTFOLIO COSTS ARE APPROXIMATELY THE SAME ACROSS SCENARIOS
- CASCADE'S BASE RESOURCE BASINS (ROCKIES, BC, AB) ARE STILL BEING UTILIZED ON EQUAL BASIS
- MIX OF ALTERNATIVES HAD LIMITED IMPACT ON THE OVERALL COSTS OF PORTFOLIO

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CONCLUSIONS

- EVEN WITHOUT RYCKMAN CREEK STORAGE, RUBY APPEARS TO BE VIABLE OPTION TO MOVE MORE ROCKIES GAS TO CENTRAL OREGON
- RUBY APPEARS TO CONTINUE TO ADD OPERATIONAL FLEXIBILITY
- MODEL LIKES THE VARIABLE QUANTITIES UNDER THE INCREMENTAL RUBY ANNUAL
  - DEPENDENT ON RUBY AGREEABLE TO LESS THAN 20,000 MAX
  - IN ABSENCE OF ANNUAL, THE SEASONAL DEAL IS AN ALTERNATIVE

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NEXT STEPS

- SOLICIT FEEDBACK FROM STAKEHOLDERS ON ALTERNATIVES
- GAS SUPPLY TO COMPLETE ANALYSIS OF SCENARIOS IN ORDER TO DETERMINE IF A RESOURCE ACQUISITION IS IN APPROPRIATE
- CONTINUE TO KEEP STAKEHOLDERS INFORMED OF PLANS
- PROVIDE GSOC WITH SUFFICIENT INFORMATION TO DETERMINE IF FURTHER ACTION (ACQUISITION) IS NECESSARY

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Does CNGC need to provide an IRP update to OPUC, if any, regarding

- Demand Forecasting
- Distribution System Constraint Analysis
- Demand Side Resources
- Supply Side Resources
- Integration

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Question for WUTC Staff on the OPUC IRP update

- Does Washington Staff want Cascade to file this update also with the WUTC?
- If so, does WUTC Staff have any additional items they expect to be covered in the update?

THE PROCESS CONTINUES…

- Any Action Items?
- As required by OPUC, CNGC will file an update to 2011 IRP (LC-54) by Friday, June 20, 2014 with stakeholders
- Stakeholders comments on IRP update due Friday, July 18, 2014
- CNGC responds to stakeholder comments by Friday, August 1, 2014
- If needed, OPUC Staff issues final comments on IRP update by Friday, August 8, 2014
- If needed, CNGC responds to final comments on IRP update by Friday, August 15, 2014
- OPUC issues Staff Report on IRP update on Tuesday, August 26, 2014
- Public Meeting regarding 2011 OR IRP update (early September, 2014)

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ADJOURNMENT

Cascade Natural Gas Corporation

Capacity Workshop #2

Northwest Natural Gas Headquarters
Portland, Oregon

Monday, May 5, 2014

Oregon Public Utility Commission
Adopted IRP Guidelines

Guideline 1: Substantive Requirements

a. *All resources must be evaluated on a consistent and comparable basis.*

- *All known resources for meeting the utility's load should be considered, including supply-side options which focus on the generation, purchase and transmission of power – or gas purchases, transportation, and storage – and demand-side options which focus on conservation and demand response.*

  Explanation: Cascade made every effort to include all known supply and demand side options. Supply side options studied include not only the gas itself, but also the pipeline capacity required to transport the gas, the Company's gas storage options, and the system enhancements necessary to distribute the gas. The demand side study looked at all the potential energy savings potentially available within the Company's service territory. Section 5 focuses on supply side resources, while Sections 3 and 6 focused on demand side options including conservation and demand response options. The use of a resource integration model allows the utility to compare resources on a consistent and comparable basis. The results of the integration modeling can be found in Section 7.

- *Utilities should compare different resource fuel types, technologies, lead times, in-service dates, durations and locations in portfolio risk modeling.*

  Explanation: Sections 5 and 6 of the text focus on the demand side and supply side alternatives. Section 6 discusses Demand side resources available including an assessment of the conservation potential that would be available over the planning horizon. The complete list of measures available in Cascade's Oregon service territory is provided in Appendix D.

  On the supply side, Section 5 discusses the supply resources available over the planning horizon. The supply-side options range from existing and proposed interstate pipeline capacity options, various storage options, including leased underground storage alternatives, imported LNG, as well as Satellite LNG facilities located at various locations within the Company's service territory, and unconventional supplies such as Bio-gas. Appendix E clearly defines each resource's availability, pricing assumptions, location and assumed in-service date.

- *Consistent assumptions and methods should be used for evaluation of all resources.*

Explanation: To the best of its ability, Cascade evaluated all resources, both supply and demand side, on a consistent basis and objectively applied the same common assumptions, approaches and methodology to each option. The resource integration analysis was accomplished through the use of the SENDOUT model. Section 7 contains the specific descriptions of the resource evaluation methodology.

- *The after-tax marginal weighted-average cost of capital (WACC) should be used to discount all future resource costs.*

Explanation: In the 2014 IRP, the Company uses a real after-tax discount rate of 4.17 percent.

b. *Risk and Uncertainty must be considered.*

- *At a minimum, utilities should address the following sources of risk and uncertainty:*
Natural gas utilities: demand (peak, swing and baseload), commodity supply and price, transportation availability and price, and cost to comply with any regulation of greenhouse gas emissions.

Explanation: This Plan (study) is characterized by risk and uncertainty because the Company cannot perfectly predict the contributing data such as future customer counts, economic conditions, market changes and weather conditions. However, this study analyzes risk-related data such that the Company can make reasonable assumptions. Cascade utilized low, medium, and high demand scenarios with low, medium, and high supply cost and availability scenarios to evaluate a range of potential future environments. These scenarios were run through Monte Carlo analysis in the Sendout program to analyze variations in inputs and subsequent demand sensitivities, pricing, and resource timing and selection. Additionally, the company ran several scenarios that capture the range of costs associated with complying with potential greenhouse gas emissions. The company incorporated a range of scenarios that include varying implementation timelines, ranges of throughput subject to potential cap and trade legislation, along with a range of costs associated with purchasing carbon credits.

- *Utilities should identify in their plans any additional sources of risk and uncertainty.*

Explanation: Various sources of risk and uncertainty are explained in Sections 3 (with respect to the Demand Forecast), 5 (Supply Side Resources), and 6 (Demand Side Resources).

c. *The primary goal must be the selection of a portfolio of resources with the best combination of expected costs and associated risks and uncertainties for the utility and its customers.*

- *The planning horizon for analyzing resource choices should be at least 20 years and account for end effects. Utilities should consider all costs with a reasonable likelihood of being included in rates over the long term, which extends beyond the planning horizon and the life of the resource.*

  Explanation: This IRP contains the Company's long-range analysis of load and resources spanning a 20-year horizon.

- *Utilities should use present value of revenue requirement (PVRR) as the key cost metric. The plan should include analysis of current and estimated future costs for all long-lived resources such as power plants, gas storage facilities, and pipelines, as well as all short-lived resources such as gas supply and short-term power purchases.*

  Explanation: The Company's *SENDOUT*® modeling software uses a PVRR cost metric methodology, which provides resource portfolio costs in both nominal and real (present value) dollars that is applied to resources of varying expected lives.

- *To address risk, the plan should include, at a minimum:*

  1. *Two measures of PVRR risk: one that measures the variability of costs and one that measures the severity of bad outcomes.*

     Explanation: Through application of the SENDOUT® software, the Company modeled 200 scenarios around varying gas price and weather inputs via Monte Carlo iterations thereby developing a distribution of annual cost estimates utilizing SENDOUT®'s PVRR methodology. Section 7 further describes this analysis while Figure 7-J summarizes this analysis graphically. The variability of costs is plotted against the Base case while the scenarios beyond the 95th percentile capture the severity of bad outcomes.

  2. *Discussion of the proposed use and impact on costs and risks of physical and financial hedging.*

     Explanation: Section 5 discusses Cascade's physical and financial hedging methodology.

- *The utility should explain in its plan how its resource choices appropriately balance cost and risk.*

Explanation: Section 7 discusses Cascade's cost/risk trade off analysis.

d. The plan must be consistent with the long-run public interest as expressed in Oregon and federal energy policies.

Explanation: In preparing this plan, Cascade considered the guidelines contained in OPUC Order No. 07-047 as evidenced in this appendix and discussed in greater detail throughout the Plan.

Cascade considered both current and expected state and federal energy policies in portfolio modeling. Section 2 describes the decision making process used to derive portfolios which are consistent with state resource policy directions.

Guideline 2: Procedural Requirements

a. *The public, which includes other utilities, should be allowed significant involvement in the preparation of the IRP. Involvement includes opportunities to contribute information and ideas, as well as to receive information. Parties must have an opportunity to make relevant inquiries of the utility formulating the plan. Disputes about whether information requests are relevant or unreasonably burdensome, or whether a utility is being properly responsive, may be submitted to the Commission for resolution.*

Explanation: The public has been given considerable opportunities to participate in the development of Cascade's 2014 IRP. Section 1 discusses an overview of the public process.

b. *While confidential information must be protected, the utility should make public, in its plan, any non-confidential information that is relevant to its resource evaluation and action plan. Confidential information may be protected through use of a protective order, through aggregation or shielding of data, or through any other mechanism approved by the Commission.*

Explanation: As evidenced by the material included throughout the plan, the Company has put forth all relevant non-confidential information necessary to produce a comprehensive Plan.

c. *The utility must provide a draft IRP for public review and comment prior to filing a final plan with the Commission.*

Explanation: The Company, as identified in its Work Plan(s) was scheduled to provide a draft of the IRP with both the WUTC, OPUC and to all Technical Advisory Group (TAG) members. On May 6, 2015 notified the parties that a medical emergency for a critical member of the team would require Cascade to request an extension from May 29 to July 17, 2015 for filing the IRP. It was anticipated that the team would be back to "full-strength" in mid-June. Unfortunately, the medical leave was not lifted until July necessitating a streamlined process to meet the new filing deadline. Cascade has recently added incremental staff in support of the IRP, which we hope will prevent future problems in this area.

Guideline 3: Plan Filing, Review, and Updates

a. *The utility must file an IRP for within two years of its previous IRP acknowledgement order.*

Explanation: The Company is required by OAR 860-027-0400(3) to file its Integrated Resource Plan within two years after the date the previous plan was acknowledged. Cascade's 2011 Integrated Resource Plan was acknowledged by Order 12-342 on August 14, 2012. Cascade Natural Gas Corporation previously requested and received an extension of its 2014 Integrated Resource Plan from the August 14, 2014 deadline to February 11, 2015, and ultimately to July 17, 2015. The initial extension was requested in order to allow additional time for Cascade to develop, document, build, test and ultimately implement a new demand forecast methodology and model to provide more load demand granularity to its SENDOUT supply resource analysis and preferred portfolio analyses. A similar request was made to the WUTC under docket UG-140181. It was ultimately agreed that Cascade would publish a concurrent Oregon/Washington IRP.

b. *The utility must present the results of its filed plan to the Commission at a public meeting prior to the deadline for written public comment.*

Explanation: Cascade will adhere to this guideline.

c. *Commission Staff and parties should complete their comments and recommendations within six months of IRP filing.*

Explanation: The Company received initial comments from Staff on its published draft plan and looks forward to working with Staff and interested parties in their review of this Plan.

Guideline 4: Plan Components

At a minimum the plan must include the following elements:

a. *An explanation of how the utility met each of the substantive and procedural* *requirements.*

Explanation: This Appendix is intended to comply with this guideline by providing an itemized response to each of the substantive and procedural requirements.

b. *Analysis of high and low load growth scenarios in addition to stochastic load risk analysis with an explanation of major assumptions.*

Explanation: The Base Case demand forecast uses the Company's projected customer growth and projected prices. This IRP considers two departures from the Base Case demand forecast, including low, medium, and high demand growth forecasts, as well as stochastic risk analysis. Section 3 discusses the Demand Forecast scenarios and their assumptions and Section 7 provides the scenario and risk analysis results.

c. *For electric utilities … (Not applicable)*

d. *For natural gas utilities, a determination of the peaking, swing and base-load gas supply and associated transportation and storage expected for each year of the plan, given existing resources; and identification of gas supplies (peak, swing and base-load), transportation and storage needed to bridge the gap between expected loads and resources.*

Explanation: Section 5 details determination of gas supply and associated transportation and storage options, while Section 7 incorporates the forecasted demand load and necessary options to meet that load.

e. *Identification and estimated costs of all supply-side and demand-side resource options, taking into account anticipated advances in technology.*

Explanation: Section 6 along with Appendix D identifies the demand side resources options included in this plan. Section 5 along with Appendix E details all supply-side options included in this plan.

f. *Analysis of measures the utility intends to take to provide reliable service, including cost-risk tradeoffs.*

Explanation: Sections 3 and 4 discusses the modeling tools, customer growth forecasting and cost-risk considerations used to maintain and plan a reliable gas delivery system. Section 5 discusses the diversified infrastructure and multiple supply basin approach that acts to mitigate certain reliability risks.

g. *Identification of key assumptions about the future (e.g., fuel prices and environmental compliance costs) and alternative scenarios considered.*

Explanation: Section 7 details the key assumptions and alternative scenarios considered in the Plan.

h. *Construction of a representative set of resource portfolios to test various operating characteristics, resource types, fuels and sources, technologies, lead times, in-service dates, durations and general locations - system-wide or delivered to a specific portion of the system.*

Explanation: This Plan documents the development and results for resource options evaluated in this IRP See also guideline 1c for further discussion on resource mix alternatives to portfolios.

i. *Evaluation of the performance of the candidate portfolios over the range of identified risks and uncertainties.*

Explanation: The company evaluated its preferred portfolio by performing stochastic analysis using the Monte Carlo functionality within the SENDOUT model. The analysis allowed for varying price and weather scenarios under 200 different scenarios. Additionally the portfolio of options was reviewed under deterministic scenarios where demand and price vary. For resources selected, we considered other risk factors such as varying lead times required and potential changes in costs in order to test the Base case scenario assumptions.

j. *Results of testing and rank ordering of the portfolios by cost and risk metric, and interpretation of those results.*

Explanation: Section 7 describes the resource options evaluated, including discussion on uncertainties in lead times and costs as well as viability and resource availability. Table 7-1 describes the testing and ranks the order of the portfolios and the interpretation of those results.

k. *Analysis of the uncertainties associated with each portfolio evaluated.*

Explanation: See the responses to 1.b above.

l. *Selection of a portfolio that represents the best combination of cost and risk for the utility and its customers.*

Explanation: Cascade evaluated cost/risk tradeoffs for each of the risk analysis portfolios considered. Section 7 shows the company's portfolio risk analysis, as well as the process and determination of the preferred portfolio.

m. *Identification and explanation of any inconsistencies of the selected portfolio with any state and federal energy policies that may affect a utility's plan and any barriers to implementation.*

Explanation: This IRP has presumed no inconsistencies with existing policies. Potential barriers to implementation of the Plan relate to the ultimate availability and timing of certain incremental resources selected (e.g. both Satellite and Import LNG, the Rockies pipeline expansion projects along with Biogas alternatives within CNG's distribution system).

n. *An action plan with resource activities the utility intends to undertake over the next two to four years to acquire the identified resources, regardless of whether the activity was acknowledged in a previous IRP, with the key attributes of each resource specified as in portfolio testing.*

Explanation: Section 8 presents the Company's 2-year action plan, which identifies the short term actions the Company plans to pursue.

Guideline 5: Transmission

Portfolio analysis should include costs to the utility for the fuel transportation and electric transmission required for each resource being considered. In addition, utilities should consider fuel transportation and electric transmission facilities as resource options, taking into account their value for making additional purchases and sales, accessing less costly resources in remote locations, acquiring alternative fuel supplies, and improving reliability.

Explanation: Not applicable to Cascade's gas utility operations

Guideline 6: Conservation

a. *Each utility should ensure that a conservation potential study is conducted periodically for its entire service territory.*

Explanation: As discussed in Section 6, Cascade retained the services of Stellar Processes to analyze the potential energy savings it can cost-effectively procure within its Washington service territory for this IRP and continues to use this model. A similar study was prepared by Stellar Processes for the ETO, in consultation with Cascade, to assess the potential energy savings within Cascade's Oregon service territory. The ETO and Cascade continue to work with Stellar Processes (Stellar) to review existing demographic and energy efficiency measures data sources to identify and quantify technical and achievable resource potential.

b. *To the extent that a utility controls the level of funding for conservation programs in its service territory, the utility should include in its action plan all best cost/risk portfolio conservation resources for meeting projected resource needs, specifying annual savings targets.*

Explanation: Achievable potential DSM savings per customer class in Cascade's Oregon and Washington service territories with cost-effective screening at the Company's Base Case avoided cost is summarized in Section 6.

c. *To the extent that an outside party administers conservation programs in a utility's service territory at a level of funding that is beyond the utility's control, the utility should: 1) determine the amount of conservation resources in the best cost/ risk portfolio without regard to any limits on funding of conservation programs; and 2) identify the preferred portfolio and action plan consistent with the outside party's projection of conservation acquisition.*

Explanation: Because the Company believes funding options are available and understands Staff agrees with this assumption, this guideline is being treated as not applicable.

Guideline 7: Demand Response

Plans should evaluate demand response resources, including voluntary rate programs, on par with other options for meeting energy, capacity, and transmission needs (for electric utilities) or gas supply and transportation needs (for natural gas utilities).

Explanation: Cascade has addressed periodically evaluated conceptual approaches to meeting capacity constraints using demand-response and similar voluntary programs. Interruptible sales service is the most reliable method of achieving demand response (see discussion in Section 6).

Guideline 8: Environmental Costs (As revised in UM1302)

Utilities should include, in their base-case analyses, the regulatory compliance costs they expect for CO2, NOx, SO2, and Hg emissions.

Explanation: Unlike electric utilities, environmental costs rarely impact a gas utility's supply-side resource choices. Section 6 discusses Cascade's assumptions regarding expected environmental costs through a range of possibilities. In Section 7, the Company discusses the impact on system costs based on alternative implementation time lines, cost adders and varying levels of allowances.

Guideline 9: Direct Access Loads

Explanation: Not applicable to natural gas utility.

Guideline 10: Multi-state Utilities

Multi-state utilities should plan their generation and transmission systems, or gas supply and delivery, on an integrated-system basis that achieves a best cost/risk portfolio for all their retail customers.

Explanation: Cascade's 2014 IRP includes its Oregon and Washington service territories and utilizes an integrated approach in determination of demand, supply, and cost/risk portfolios.

Guideline 11: Reliability

Natural gas utilities should analyze, on an integrated basis, gas supply, transportation, and storage, along with demand-side resources, to reliably meet peak, swing, and base-load system requirements. Electric and natural gas utility plans should demonstrate that the utility's chosen portfolio achieves its stated reliability, cost and risk objectives.

Explanation: Cascade analyzes on an integrated basis, gas supply, transportation, and storage along with demand-side resources to reliably meet peak, swing and base-load system requirements. As discussed throughout the Plan, Cascade's strategy is to reliably serve our firm gas sales customers in a way that minimizes costs over the long term and the Company believes that its base case portfolio meets these objectives.

Guideline 12: Distributed Generation

Explanation: Not applicable to natural gas utility.

Guideline 13: Resource Acquisition

a. *Electric utilities … (Not applicable)*

b. *Natural gas utilities should either describe in the IRP their bidding practices for gas supply and transportation, or provide a description of those practices following IRP acknowledgment.*

Explanation: Cascade's gas procurement strategy is outlined in Section 5

WAC 480-90-238 Integrated Resource Planning.

Each natural gas utility regulated by the commission has the responsibility to meet system demand with the least cost mix of natural gas supply and conservation. In furtherance of that responsibility, each natural gas utility must develop an "integrated resource plan."

Content. At a minimum, integrated resource plans must include:

(a) A range of forecasts of future natural gas demand in firm and interruptible markets for each customer class that examine the effect of economic forces on the consumption of natural gas and that address changes in the number, type and efficiency of natural gas end-uses.

Section 3 describes the range of forecast of demand for the 20-year planning horizon. The text provides a range of forecasts that encompass the anticipated forces, both economic and weather-driven, that will impact the load forecasts over the planning horizon. The range of forecasts implicitly incorporates changes in the number, type and efficiency of natural gas end-uses as reflected in the changing use/customer figures over the planning horizon.

(b) An assessment of commercially available conservation, including load management, as well as an assessment of currently employed and new policies and programs needed to obtain the conservation improvements.

Section 6 of the Plan details the company's demand side resource alternatives. The section includes an assessment of technically feasible improvements in the efficient use of natural gas. The detailed list of measures and their savings potential within Cascade's service territory is included in Appendix D of the Plan.

(c) An assessment of conventional and commercially available nonconventional gas supplies.
(d) An assessment of opportunities for using company-owned or contracted storage.
(e) An assessment of pipeline transmission capability and reliability and opportunities for additional pipeline transmission resources.

Section 5, the supply resource section, includes a discussion of the supply side resource options available including an assessment of conventional and commercially available nonconventional gas supplies, an assessment of opportunities for additional company-owned and contracted storage, and assessment of both existing and future pipeline transmission alternatives for meeting Cascade's load requirements. Appendix E contains the detailed list of resources evaluated in the integration model.

(f) A comparative evaluation of the cost of natural gas purchasing strategies, storage options, delivery resources, and improvements in conservation using a consistent method to calculate cost-effectiveness.

Section 7, the integration section, provides a comparative evaluation of the cost of the various resource options on a consistent and comparable method. The company believes that all resources described in this IRP have been evaluated on a consistent and comparable basis through the use of its optimization model.

(g) The integration of the demand forecasts and resource evaluations into a long-range (e.g., at least ten years; longer if appropriate to the life of the resources considered) integrated resource plan describing the mix of resources that is designated to meet current and future needs at the lowest reasonable cost to the utility and its ratepayers.

Explanation: The resource integration section describes the integration of the demand forecast and resource evaluations into a long range resource plan and describes the Company's strategies to reliably meet current and future needs at the lowest reasonable cost to Cascade's ratepayers. According to WAC 480-90-238, "Lowest reasonable cost" means

"the lowest cost mix of resources determined through a detailed and consistent analysis of a wide range of commercially available sources. At a minimum, this analysis must consider resource costs, market-volatility risks, demand-side resource uncertainties, the risks imposed on ratepayers, resource effect on system operations, public policies regarding resource preference adopted by Washington state or the federal government, the cost of risks associated with environmental effects including emissions of carbon dioxide, and the need for security of supply."

Cascade believes all resources described in this IRP have been evaluated on a consistent and comparable basis through the use of its optimization model. Uncertainty has been considered in each component of this plan. The demand forecast includes a reasonable range of uncertainty as quantified in the low, medium and high load growth scenarios along with the additional simulation analysis calculated through the Monte-Carlo functionality that assesses the impacts of weather on the load forecasts. The demand side and supply side resource sections describe relative uncertainties regarding reliability, cost and operating constraints and external costs. Uncertainties associated with the environmental effects of carbon emissions have been discussed in detail and an analysis of the potential impacts of carbon adders on the portfolio has been assessed. The company, through its analysis of limited Canadian supplies has identified alternatives to address concerns regarding security of supply. Price volatility and market risks and their impacts on the Company's long-term resource portfolio have been assessed through the use of the Monte-Carlo functionality of the Sendout model.

(h) A short-term plan outlining the specific actions to be taken by the utility in implementing the long-range integrated resource plan during the two years following submission.

Section 8 includes the 2014 2-Year Action Plan that describes the specific actions the utility will take to implement the long-range integrated resource plan during the next two years

(i) A report on the utility's progress towards implementing the recommendations contained in its previously filed plan.
Through the workshops on capacity and forecast modeling, Cascade was able to provide an update on the Plan.

Timing. Unless otherwise ordered by the commission, each natural gas utility must submit a plan within two years after the date on which the previous plan was filed with the commission. Not later than twelve months prior to the due date of a plan, the utility must provide a work plan for informal commission review. The work plan must outline the content of the integrated resource plan to be developed by the utility and the method for assessing potential resources.

On December 20, 2013, the company submitted its detailed work plan which outlined the content of the plan to be developed and the methods to be used for assessing potential resources.

Cascade's 2014 Integrated Resource Plan will be filed with both the WUTC and OPUC on July 17, 2015.

Public participation. Consultations with commission staff and public participation are essential to the development of an effective plan. The work plan must outline the timing and extent of public participation. In addition, the commission will hear comment on the plan at a public hearing scheduled after the utility submits its plan for commission review.

The Company, as identified in its Work Plan(s) held workshops on the new forecast model, Cascade's unique pipeline capacity situation, and held four TAG meetings. To involve public interests in the development stages of this IRP, Cascade has a Technical Advisory Group (TAG). Four meetings were held, along with two forecast model and two capacity issue meetings, to discuss the major IRP topics including the key inputs demand forecast, distribution system planning, demand side resources, supply side resources, and resource integration and uncertainty analysis.
The Company was scheduled to provide a draft of the IRP with both the WUTC, OPUC and to all Technical Advisory Group (TAG) members. On May 6, 2015 notified the parties

that a medical emergency for a critical member of the team would require Cascade to request an extension from May 29 to July 17, 2015 for filing the IRP. It was anticipated that the team would be back to "full-strength" in mid-June. Unfortunately, the medical leave was not lifted until July necessitating a streamlined process to meet the new filing deadline. Cascade has recently added incremental staff in support of the IRP, which we hope will prevent future problems in this area

The TAG meetings were helpful to Cascade as questions were answered and varying points of view were explored. Appendix A contains an outline of the meeting content and a list of participants.