

# Cascade Natural Gas Corporation

## 2020 OR Integrated Resource Plan Technical Advisory Group Meeting #2

Thursday, September 5th, 2020

Public Utility Commission of Oregon

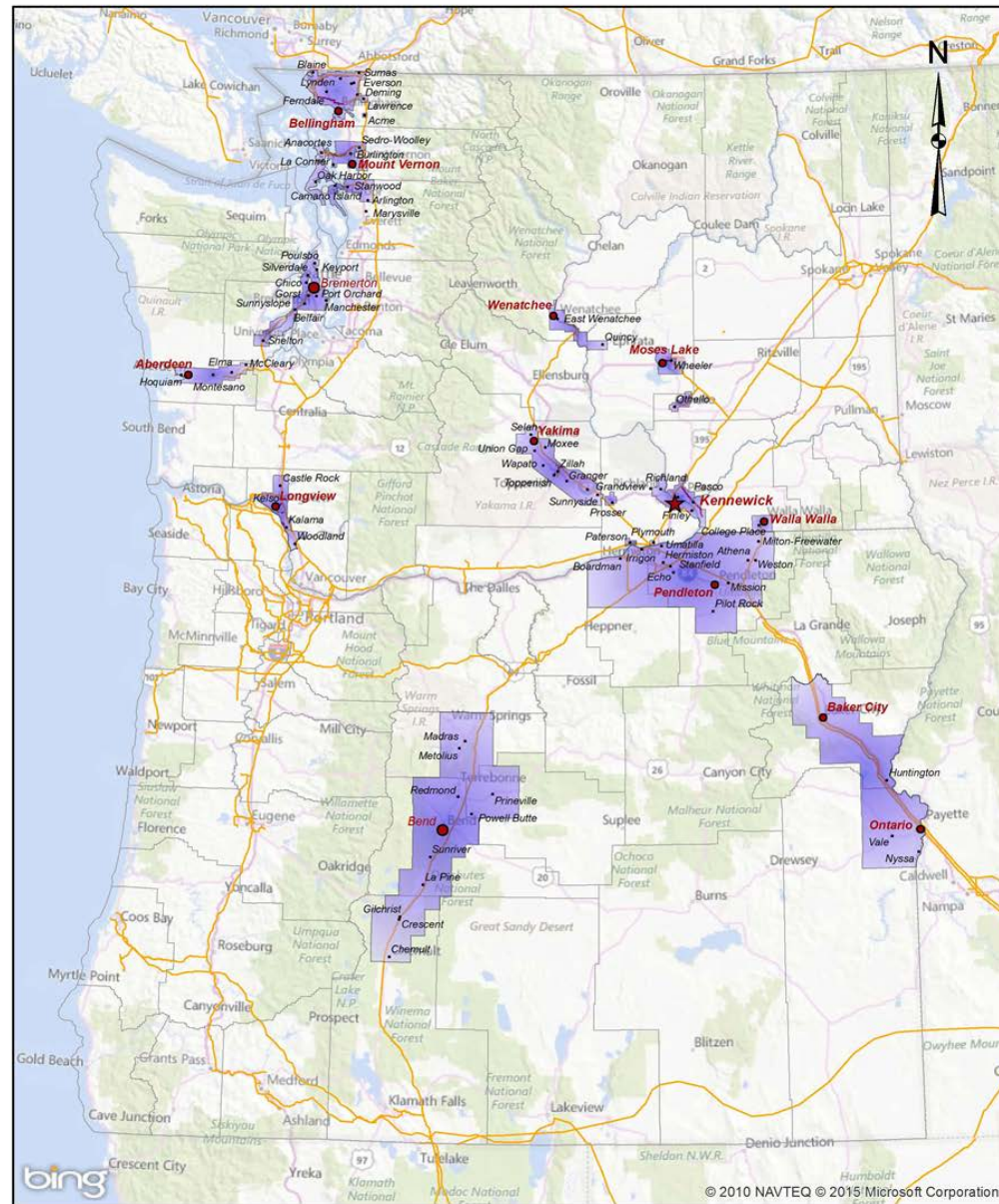
Salem, OR



# Agenda

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

# Demand Forecast



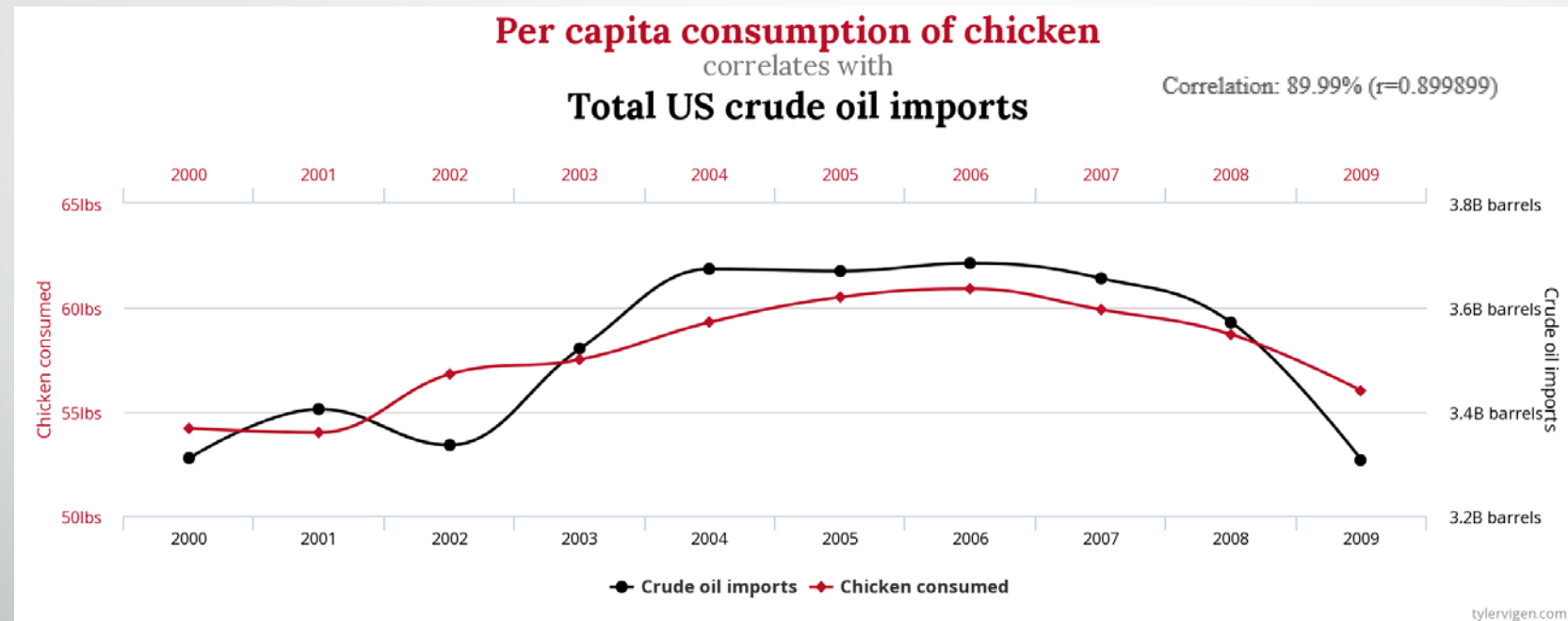
# Service Boundaries

- Communities**
- N
  - District Office
  - Region Office
  - ★ General Office

**CASCADe NATURAL GAS CORPORATION**  
*In the Community to Serve*

A Subsidiary of MDU Resources Group, Inc.

# A Little Fun with Spurious Correlations...



# Demand Forecast

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

# Key Definitions

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

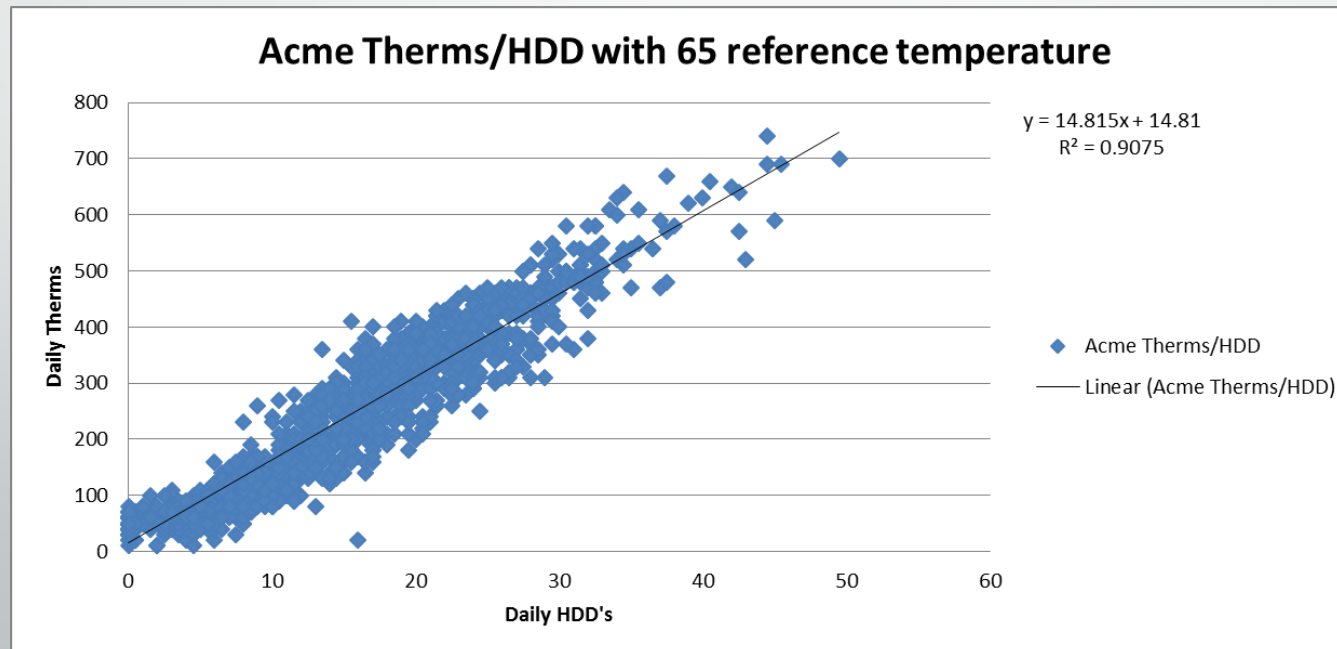
# Key Assumptions

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

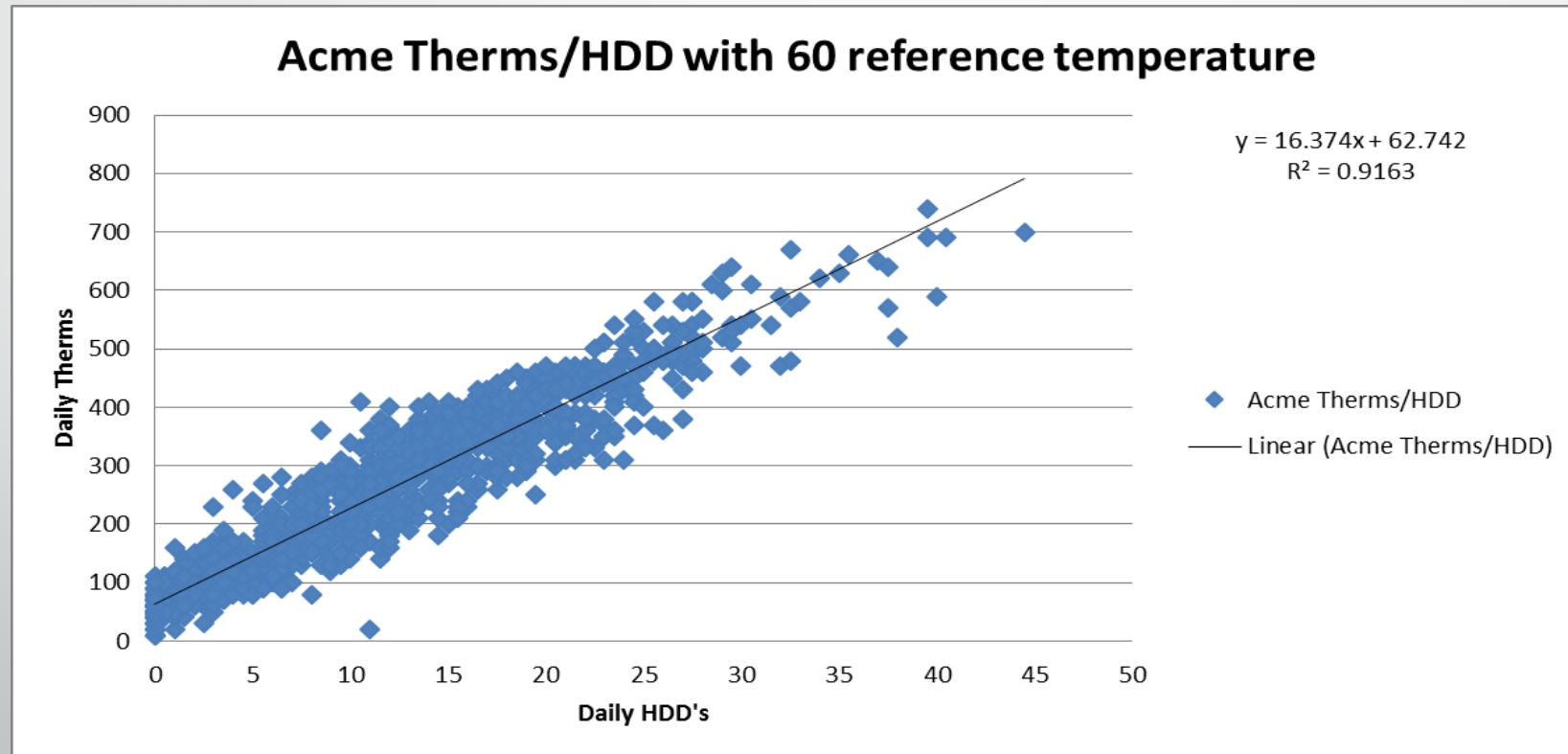


# 65 vs 60 HDD Threshold

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



# Acme Therms/HDD with 60 degree reference temperature

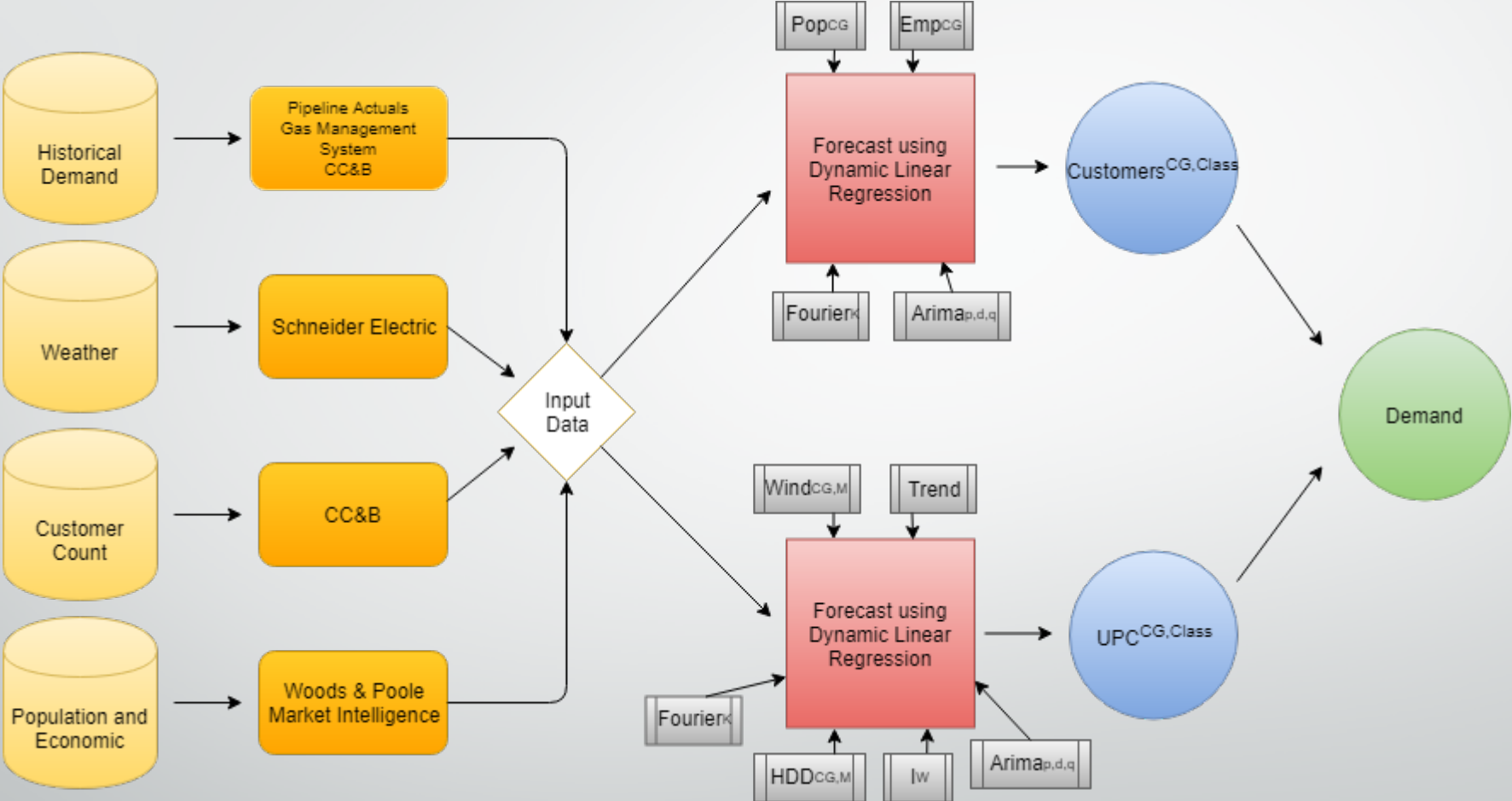


# Weather Stations

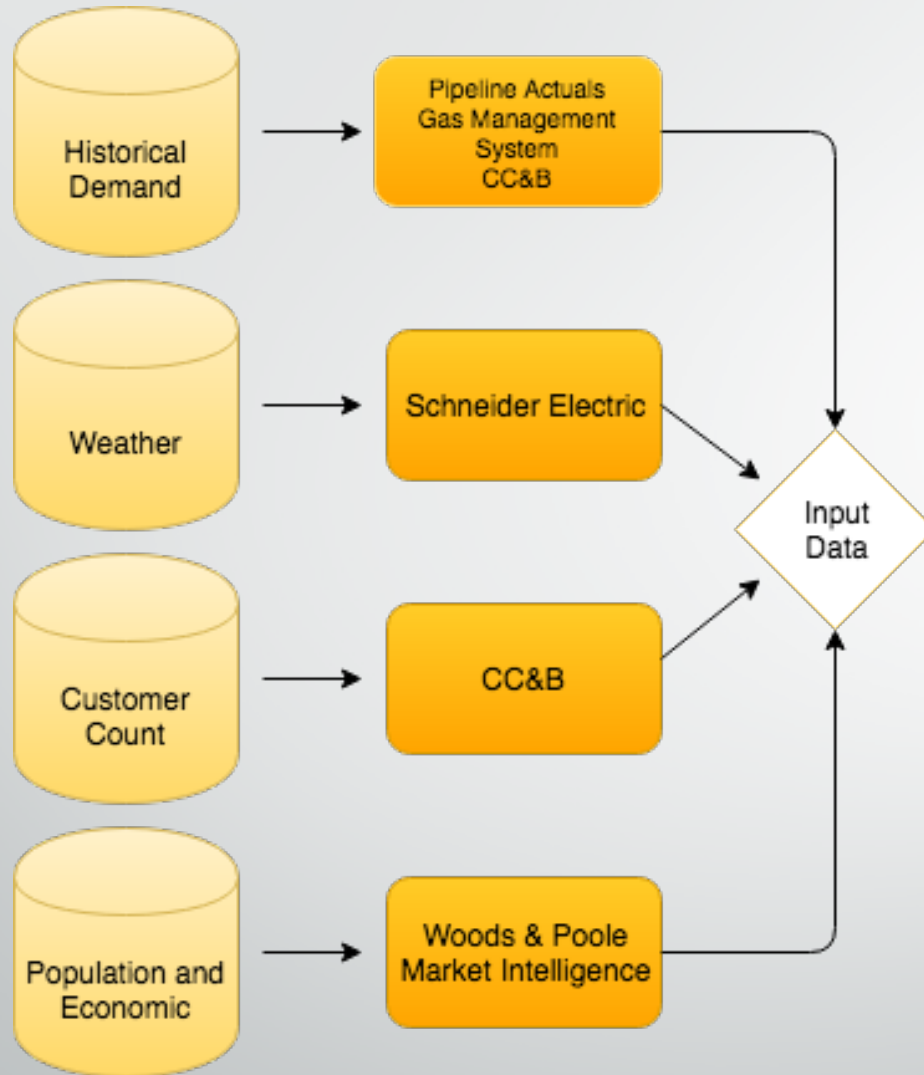


- The seven weather stations are shown on the map.
- Cascade's service territory is shaded in aqua.
- Each Citygate and loop is assigned to a weather station.

# Process

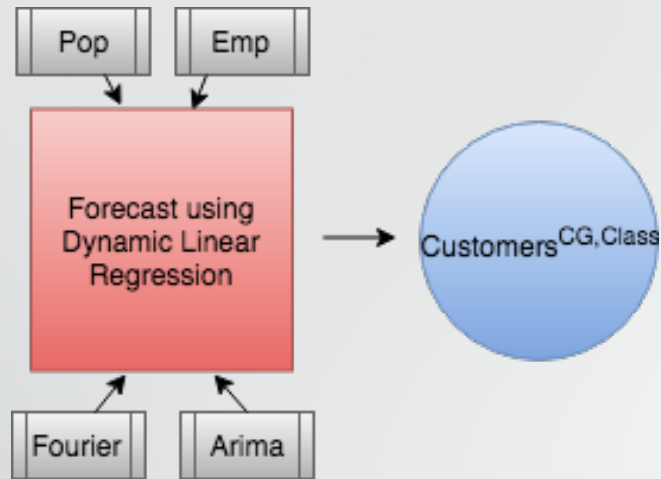


# Inputs



- Cascade uses data from various sources:
  - Pipeline actuals at Citygate level.
  - Woods & Poole at county level.
  - CC&B citygate allocations
- Market intelligence monthly.
- Unifying inputs is an important part of the forecasting process.

# Customer Forecast



# Customer Forecast

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

# Customer Forecast Inputs

Woods & Poole Data

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

CC&B Data

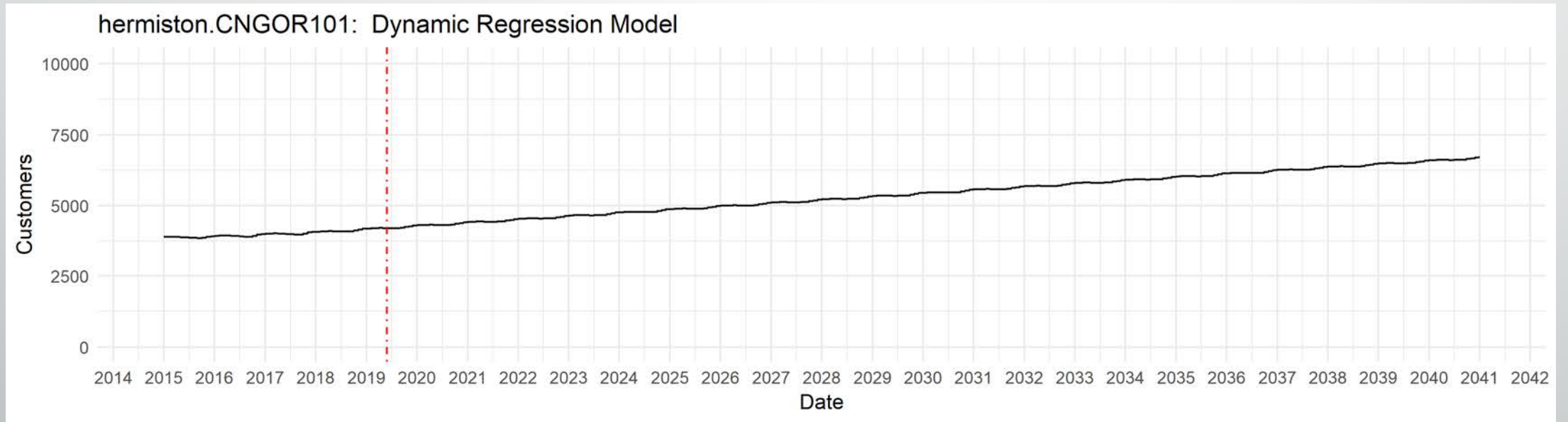
Acctg Year	Acctg Mon	Gate (Loop)	Rate	Number of Prem
2019	2	Bend/South Bend	CNGOR104	144
2015	2	Pendleton/Pilot Rock	CNGOR104	64
2018	8	Ontario/NYSSA/Vale	CNGOR101	5
2015	7	Hermiston	CNGOR101	4
2018	5	Mission	CNGOR104	18
2018	8	Gilchrist Cresent	CNGOR101	78
2016	5	Ontario/NYSSA/Vale	CNGOR104	19

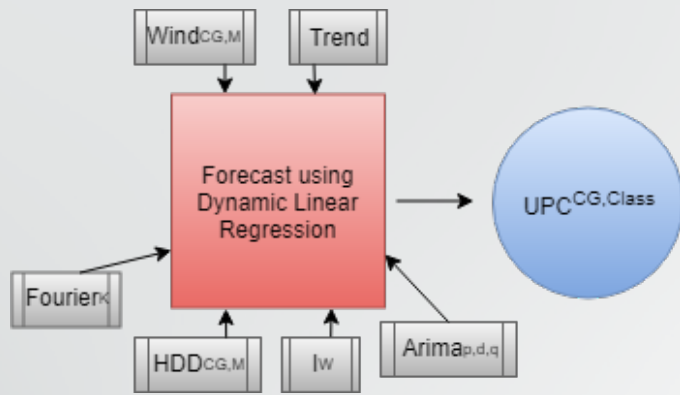
Model Selection

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



# Customer Forecast





# Use Per Customer Forecast

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

# Use Per Customer Forecast Inputs

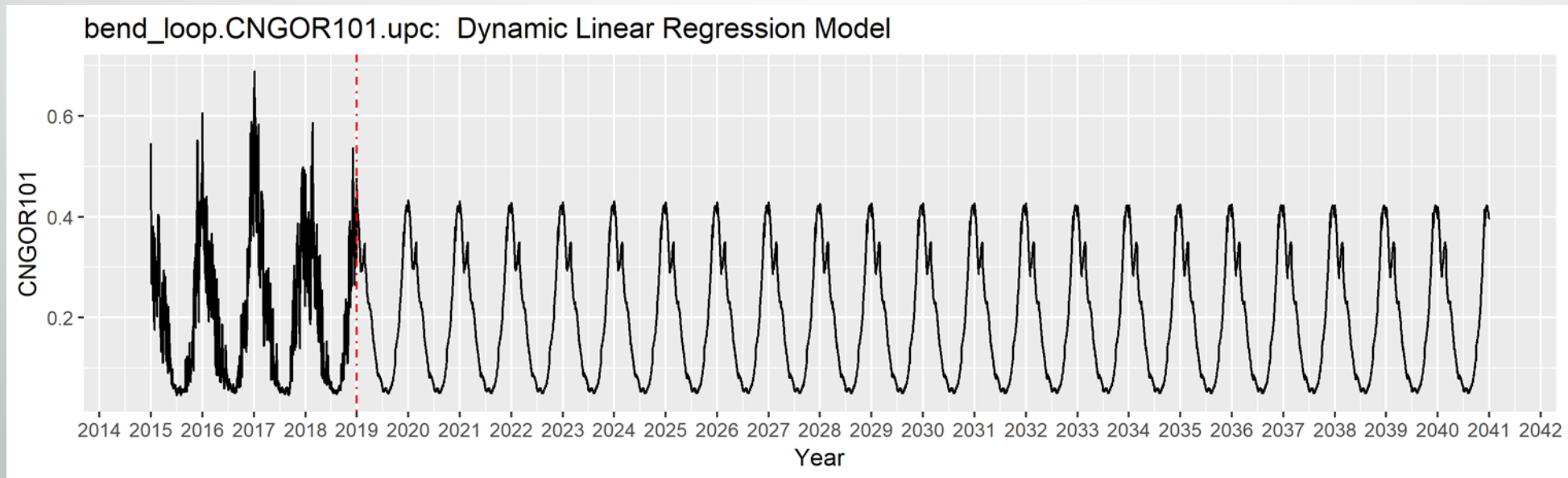
Bend Loop 101:      Bend Loop 101 =  $\alpha_0 + \alpha_1 \text{HDD}^M + \alpha_2 I_w + \alpha_4 \text{WIND}^M + \text{Fourier} + \text{ARIMA}$

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

# UPC Forecast Results

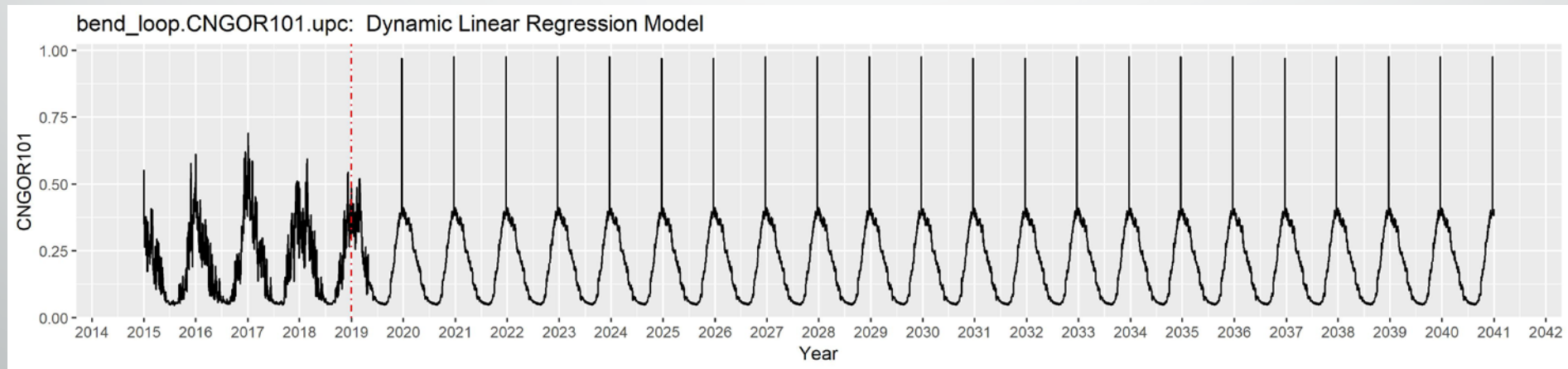
ar1	ar2	ma1	ma2	ma3	intercept	weekend	jan.hdd	feb.hdd	mar.hdd	apr.hdd	may.hdd	jun.hdd	jul.hdd	aug.hdd	sep.hdd
0.3960	0.5076	0.0884	-0.4618	-0.2056	0.1107	-0.0061	0.0068	0.0075	0.0071	0.0063	0.0056	0.0036	0.0027	0.0021	0.0027

oct.hdd	nov.hdd	dec.hdd	jan.wind	feb.wind	mar.wind	apr.wind	may.wind	jun.wind	jul.wind	aug.wind	sep.wind	oct.wind	nov.wind	dec.wind	S1-365	C1-365	S2-365	C2-365
0.0046	0.0065	0.0066	0.0024	0.0034	0.0028	0.0035	0.0013	0.0007	0.0002	0.0005	0.0006	0.0014	0.0003	0.0005	0.0052	0.0686	-0.0089	0.0233



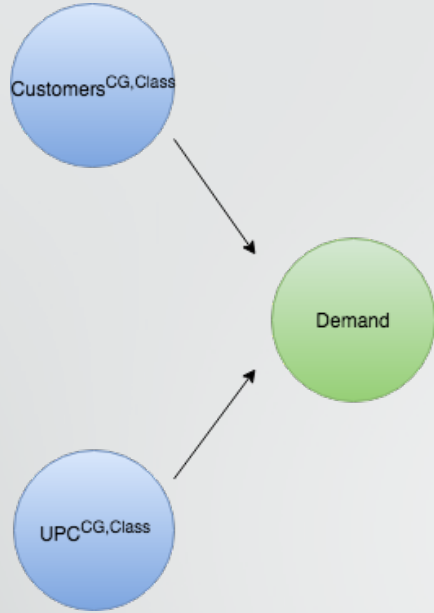
# Peak Day Use-Per-Customer

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



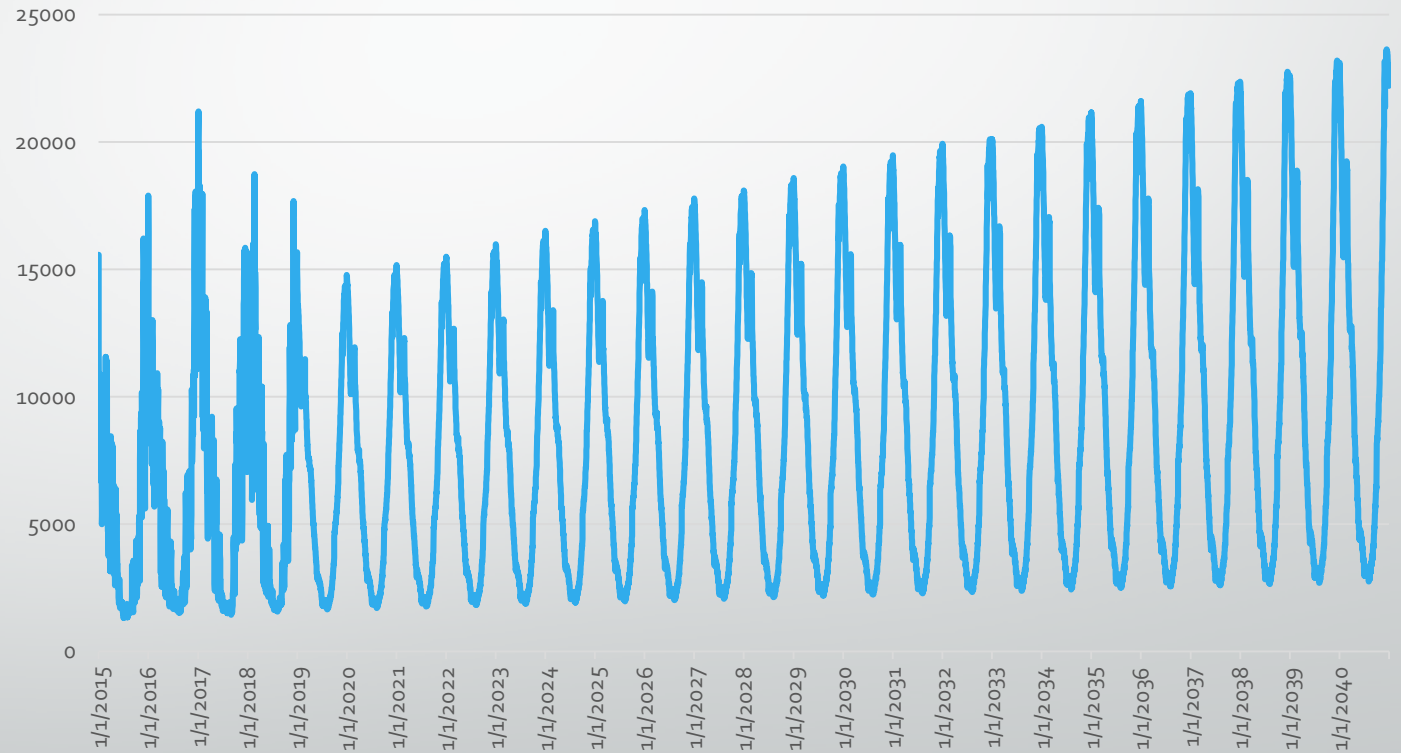
# Forecast Results

# Final Demand Calculation



Gate	Date	UPC	Customers	Demand
Bend Loop	1/1/2020	0.434164028	34044	14780.68017
Bend Loop	1/2/2020	0.432175189	34044	14712.97213
Bend Loop	1/3/2020	0.430100149	34044	14642.32947
Bend Loop	1/4/2020	0.424571854	34044	14454.12419
Bend Loop	1/5/2020	0.42228356	34044	14376.22153
Bend Loop	1/6/2020	0.423215137	34044	14407.93612
Bend Loop	1/7/2020	0.420633918	34044	14320.0611

Bend Loop 101

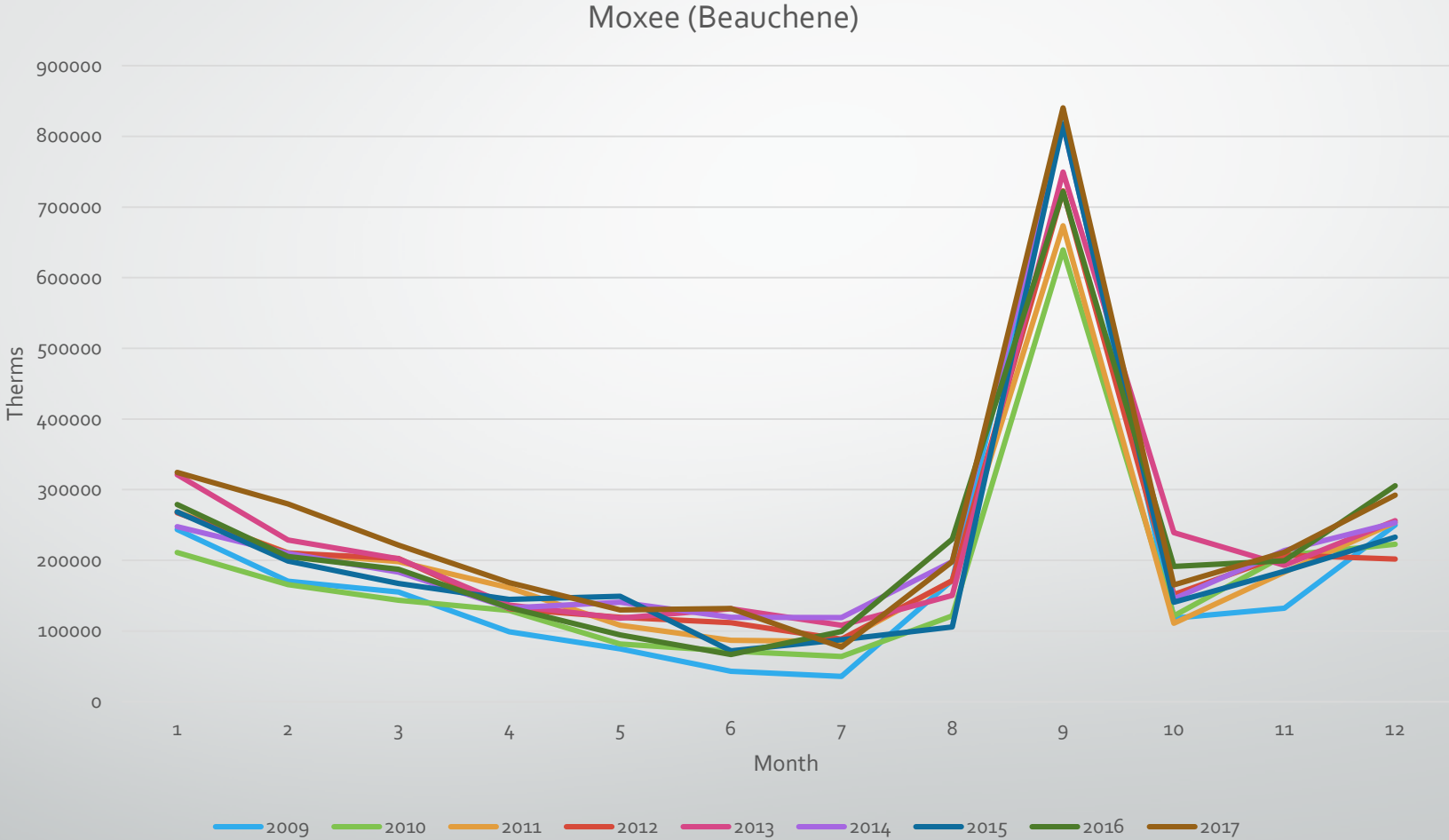


# Non-Weather Dependent Demand

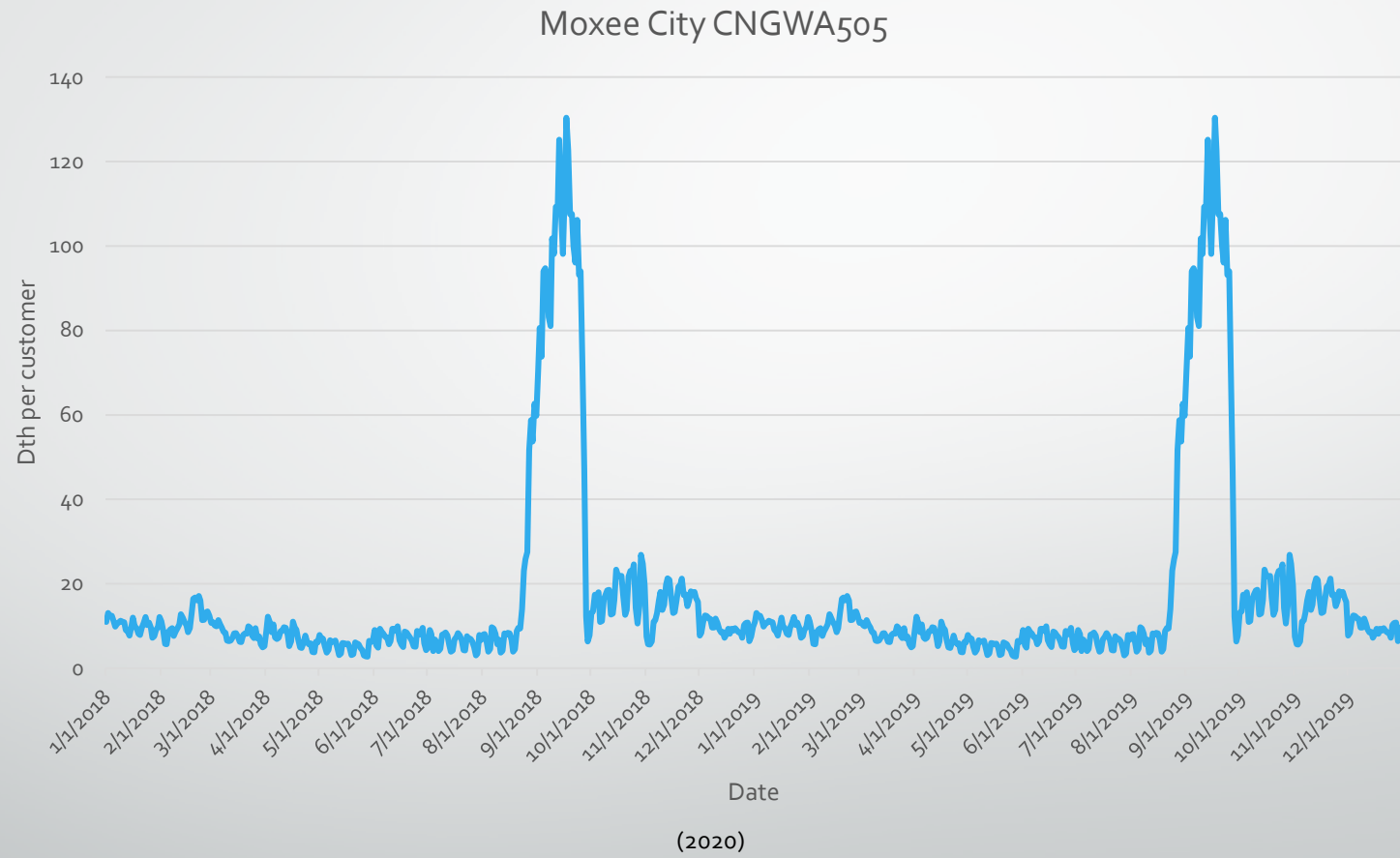
- Demand that is not influenced by weather.
- Typically caused by a customer who ramps up production based on the time of season.
- Previously, demand was removed prior to running the use per customer vs. weather analysis.
- Now using monthly coefficients, Cascade can run the analysis while leaving the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



# Moxee (Beauchene)



# 2020 Forecast: Moxee 505



# Low Customer Growth Areas

Citygate	Growth
milton-freewater	0.00%
mission	0.00%
chemult	0.03%
huntington	0.03%

- Milton-Freewater is a city in Northcentral Oregon. The city has a recent job growth of -0.2%.<sup>1</sup> The city only has 0.3% working in the real estate profession, while the US is at 1.9%. The city has approximately the same number of customers today that it had in 2004.
- Mission is a census designated place in Northcentral Oregon near Pendleton. The area has a recent job growth of -0.18%.<sup>1</sup> The area only has 0% working in the real estate profession, while the US is at 1.9%. The area has seen a growth of .3% over the past 5 years.

# Low Customer Growth Areas (Cont.)

Citygate	Growth
milton-freewater	0.00%
mission	0.00%
chemult	0.03%
huntington	0.03%

- Chemult is a city in Central Oregon approximately 65 miles south of Bend. The area has a recent job growth of -0.36%.<sup>1</sup> The area only has 0% working in the real estate profession, while the US is at 1.9%. Cascade's Chemult customers have fluctuated between 43 and 49 customers since 2004 and currently has the same number of customers as it did in 2005.
- Huntington is a city in Eastern Oregon near Baker City. The city has a recent job growth of -0.64%.<sup>1</sup> The city only has 0% working in the real estate profession, while the US is at 1.9%. Huntington has had a growth rate of 0% since 2007.

<sup>1</sup>According to bestplaces.net

# High Customer Growth Areas

Citygate	Growth
Pronghorn	4.35%
Umatilla	3.53%
North Bend	3.41%
Redmond	2.88%
Prineville	2.45%
Bend Loop	2.27%
La Pine	2.26%

- Bend recently approved an urban growth plan that is projected to allow for the development of 2,380 acres of land. In October 2018, four developers on Bend's westside successfully negotiated a development agreement for the planning and development of more than 1,000 homes on 383 acres.
- The city of Umatilla, in conjunction with the cities of Echo and Stanfield, are in the process of executing the recommendations of their 2019 West Umatilla County Housing Study. During its August 13<sup>th</sup> Planning Commission meeting, the city discussed amending its zoning ordinances to address current future housing needs, as discussed in the Study. In 2018 the city experience a spike in permits for new homes from 17 in 2017 to 56 in 2018, a 329% increase.
- Redmond continues to be one of the strongest housing markets in Central Oregon. Home sales volume in Redmond increased by over 12% in the second quarter of 2019 year over year, while 85 new homes were built in the second quarter. The City's Planning Commission recently completed a Housing Grant Project for the Redmond Housing Needs Analysis and Buildable Lands Inventory. According to the analysis, approximately 7,000 housing units are needed over the next 20 years.

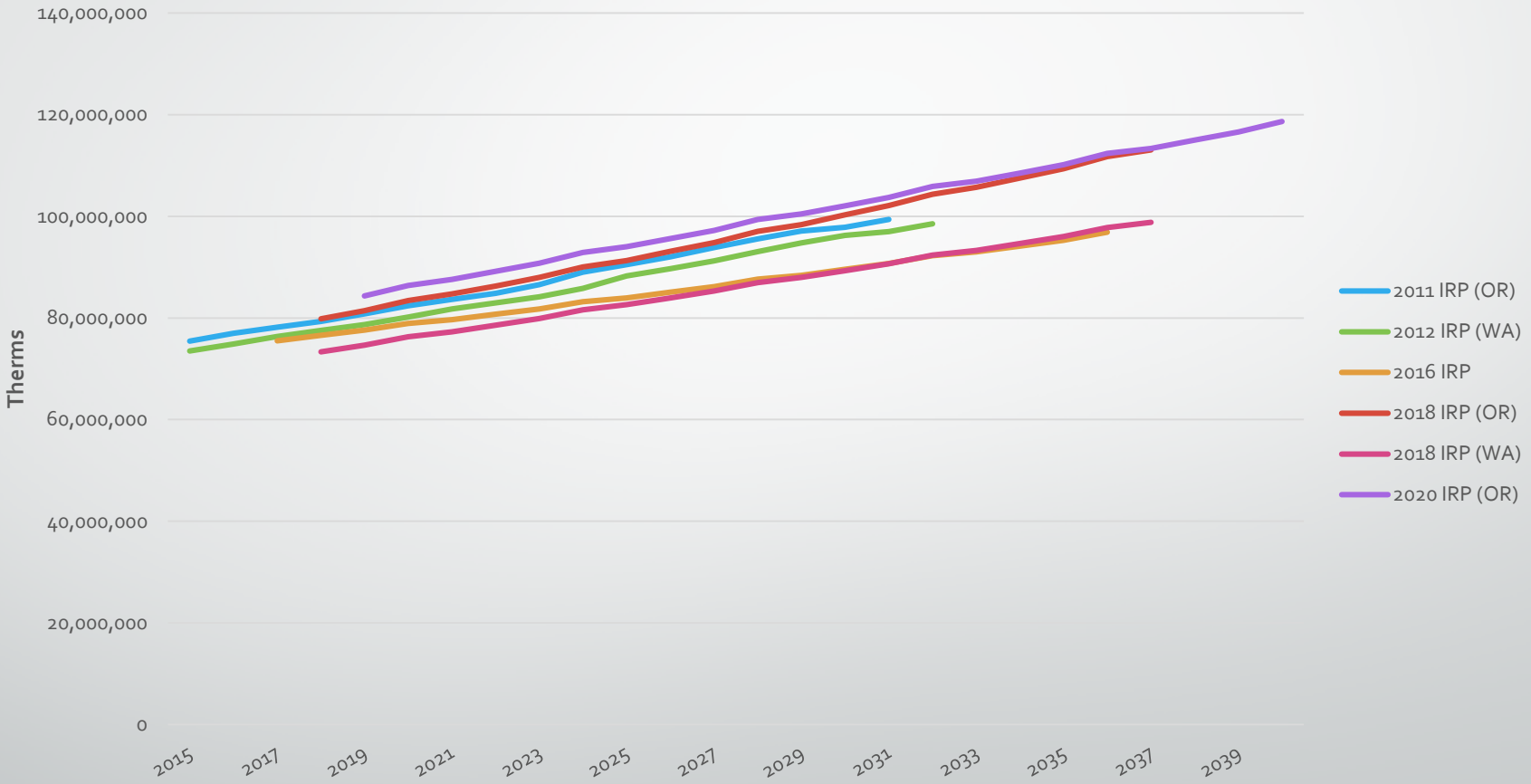
# High Customer Growth Areas (Cont.)

Citygate	Growth
Pronghorn	4.35%
Umatilla	3.53%
North Bend	3.41%
Redmond	2.88%
Prineville	2.45%
Bend Loop	2.27%
La Pine	2.26%

- Prineville is a major tech hub within central Oregon. In a recent ranking of the top 10 micropolitan areas, Prineville ranked 4<sup>th</sup> with 3.5% growth year over year. Additionally, in late September 2018, Facebook announced it will be spending \$750 million to build two more data centers on the outskirts of Prineville. This will add as many as 100 jobs to the city, increasing Facebook's investment in Prineville to around \$2 billion.
- Much of the growth around La Pine is centered around the fact that it has only recently become incorporated as an actual city. After incorporation in late 2007, the region added 400 new jobs from 2010-2017, and approximately 20 to 25 new businesses during the first half of 2018 alone

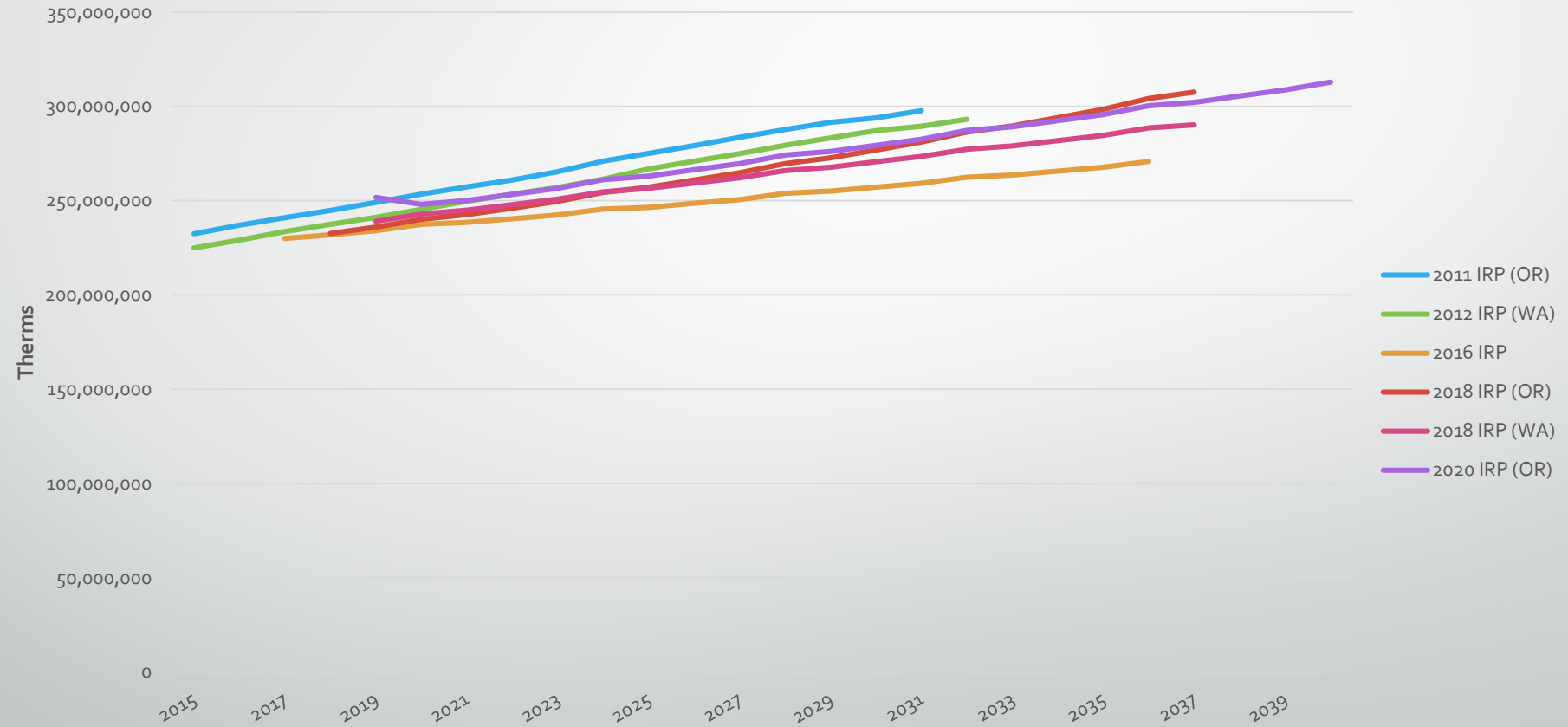
# Oregon Demand

## Oregon Annual Therm Usage



# Washington Demand

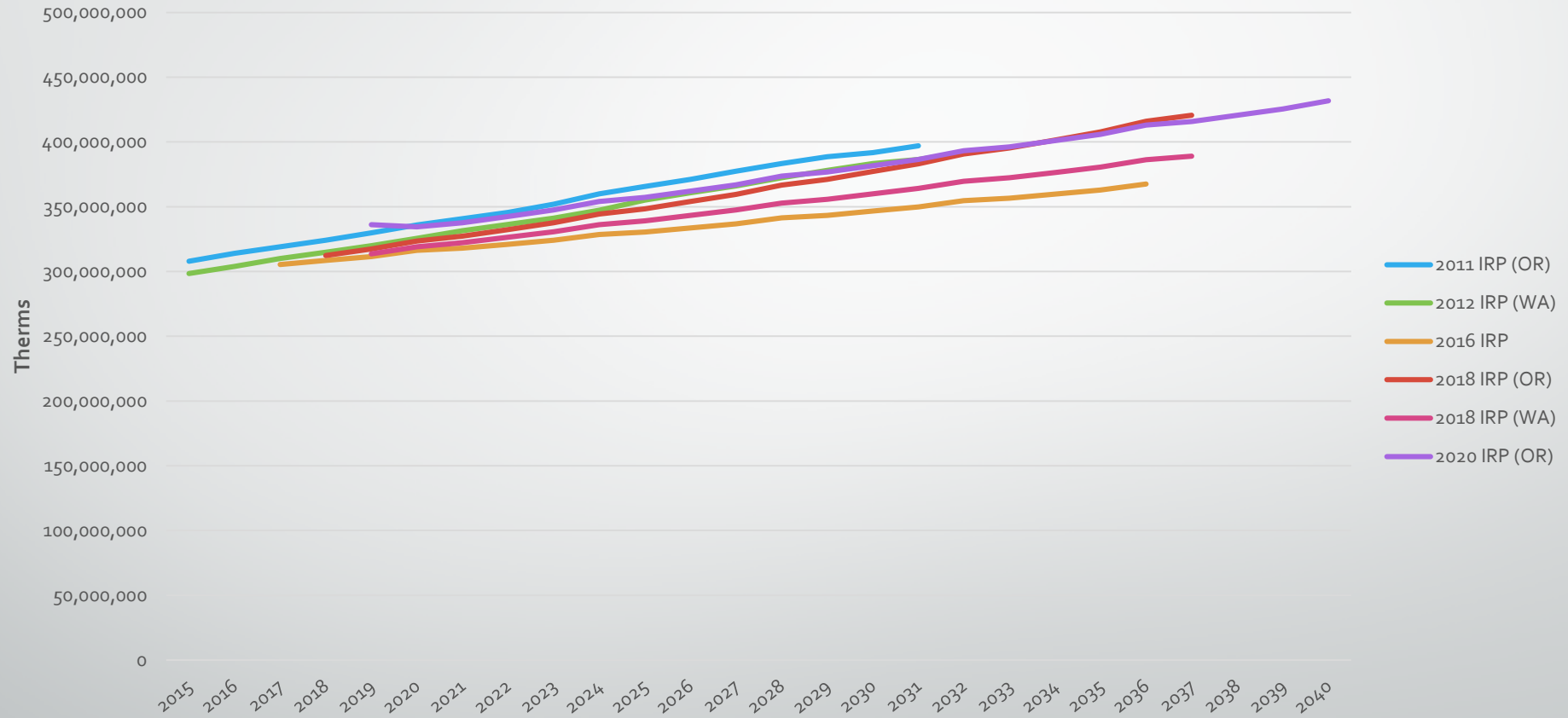
## Washington Annual Therm Usage





# Total System Demand

## Total System Annual Therm Usage



# Non-Core Outlook

# Non-Core Outlook

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

# Transportation Customers

- Cascade's transportation customer forecast increased by three from the previous forecast. The current forecast projects the customer count to be 40 in 2020 with plans to bring on 5-8 new customers over the next five years. Cascade's industrial managers are working closely with potential industrial customers.
- Cascade's projection increased by 2.5 million therms from the previous forecast. The increase is mainly a direct result from the new customers added.
- Cascade projects the transportation customers in Oregon to consume approximately 60 million therms in 2020.

# Electric Generation

- Cascade also serves an electric generation customer in Oregon. Since there is only one customer, the forecast must remain confidential.
- Cascade doesn't anticipate bringing on additional electric generation over the next five years.
- Washington passed SB 5116 which would require that non-emitting electric generation and electricity from renewable resources supply one hundred percent of all sales of electricity to Washington retail electric customers by January 1, 2045. Essentially, this would phase out Washington electric generation customers that Cascade would serve.

# Non-Core Forecast

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

# Market Outlook and Long Range Price Forecast

# Long Range Market Outlook

- Natural gas consumption in the residential and commercial sectors remains largely flat because of efficiency gains and population shifts that counterbalance demand growth.<sup>1</sup>
- Natural gas prices that are relatively low compared with historical prices lead to growing use of natural gas across most end-use sectors.<sup>1</sup>



# Long Range Market Outlook (Cont.)

- Natural gas production from shale gas and tight oil plays as a share of total U.S. natural gas production continues to grow in both share and absolute volume because of the sheer size of the associated resources, which extend over nearly 500,000 square miles, and because of improvements in technology that allow for the development of these resources at lower costs.<sup>1</sup>
- Natural gas prices in the AEO2019 Reference case remain lower than \$4 per million British thermal units (Btu) through 2035 and lower than \$5 per million Btu through 2050 because of an increase in lower-cost resources, primarily in tight oil plays in the Permian Basin, which allows higher production levels at lower prices during the projection period.<sup>1</sup>

# Long Range Price Forecast

- Cascade's long-term planning price forecast is based on a blend of current market pricing along with long-term fundamental price forecasts.
- The fundamental forecasts include sources such as Wood Mackenzie, EIA, the Northwest Power and Conservation Council (NWPCC), Bentek and the Financial Forecast Center's long-term price forecasts.
- While not a guarantee of where the market will ultimately finish, Henry Hub NYMEX is the most current information that provides some direction as to future market prices.
- Wood Mackenzie's long-term forecast is at a monthly level by basin. Cascade uses this to help shape the forecast's monthly basis pricing.
- The Company also relies on EIA's forecast; however, it has its limitations since it is not always as current as the most recent market activity. Further, the EIA forecast provides monthly breakdowns in the short-term, but longer-term forecasts are only by year.

# Long Range Price Forecast (Cont.)

- CNGC assigns a weight to each source to develop the monthly Henry Hub price forecast for the 20-year planning horizon.
- Although it is impossible to accurately estimate the future, for trading purposes the most recent period has been the best indicator of the direction of the market. However, Cascade also considers other factors (historical constraints) which can lead to minor adjustments to the final long-range forecast.

# Price Forecast Weights

- Considerations in weight assignments:
  - Cascade has modified its weighting system based on an analysis of the symmetric mean absolute percentage error (SMAPE) of its sources since 2010;
    - Wood Mackenzie (monthly, covers all basins)
    - EIA (industry barometer, annual long term)
    - NPPC (regional perspective, but recognize it is also a blend)
    - NYMEX Henry Hub
  - EIA is the only source who produces a forecast after 2037.
  - Some sources produce forecasts daily, while others are far less frequent.
    - Cascade uses an age dampening mechanism to account for this in its price forecast, reducing the impact of forecasts that do not account for more current market information.

# SMAPE to Weights

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

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

# Example of SMAPE Calculations by Source

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

# Price Forecast Weights

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

# Example Weights Price Forecast For 2020 IRP (Not Interpolated)

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



# Example Weights Price Forecast For 2020 IRP (Interpolated)

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

# 2020 IRP Remaining Schedule

Wednesday, October 30, 2019	OR	TAG 3 slides distributed to stakeholders	RPT		
Wednesday, November 6, 2019	OR	TAG 3: Distribution System Planning, Planned Scenarios and Sensitivities, Alternative Resources, Price Forecast, Avoided Costs, Current Supply Resources, Transport Issues.	RPT/Linda/Eric W	Kennewick, WA - 9 am to 12 pm	Deschutes Room at Cascade's Kennewick General Office
Wednesday, January 8, 2020	OR	TAG 4 slides distributed to stakeholders	RPT		
Wednesday, January 15, 2020	OR	TAG 4 Carbon Impacts, Conservation (Energy Trust of Oregon), Bio-Natural Gas, Preliminary Resource Integration Results.	RPT/ETO/Al/Chris R/Abbie	Portland, OR - 9 am to 3 pm	Multnomah Room at Portland International Airport
Wednesday, March 4, 2020	OR	TAG 5 slides distributed to stakeholders	RPT		
Wednesday, March 11, 2020	OR	TAG 5: Final Integration Results, finalization of plan components, Proposed new 4-year Action Plan.	RPT	Salem, OR - 9 am to 12 pm	Meadow room at OPUC Offices
Tuesday, May 12, 2020	OR	Draft of 2020 OR IRP distributed	RPT		
Friday, June 12, 2020	OR	Comments due on draft from all stakeholders	RPT		
Tuesday, June 30, 2020	OR	TAG 6, if needed	RPT/Other Parties	WebEx Only	
Friday, July 31, 2020	OR	IRP filing in Oregon	RPT		

# ADDITIONAL QUESTIONS?

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Bruce Folsom - Consultant

# Cascade Natural Gas Corporation

## 2020 OR Integrated Resource Plan Technical Advisory Group Meeting #2

Thursday, September 5th, 2020  
Public Utility Commission of Oregon  
Salem, OR

