CASCADE NATURAL GAS CORPORATION®
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In the Community to Serve®

Washington Integrated Resource Plan Targeted Technical Advisory Group Meeting #5

APRIL 11, 2024

MICROSOFT TEAMS/TELECONFERENCE

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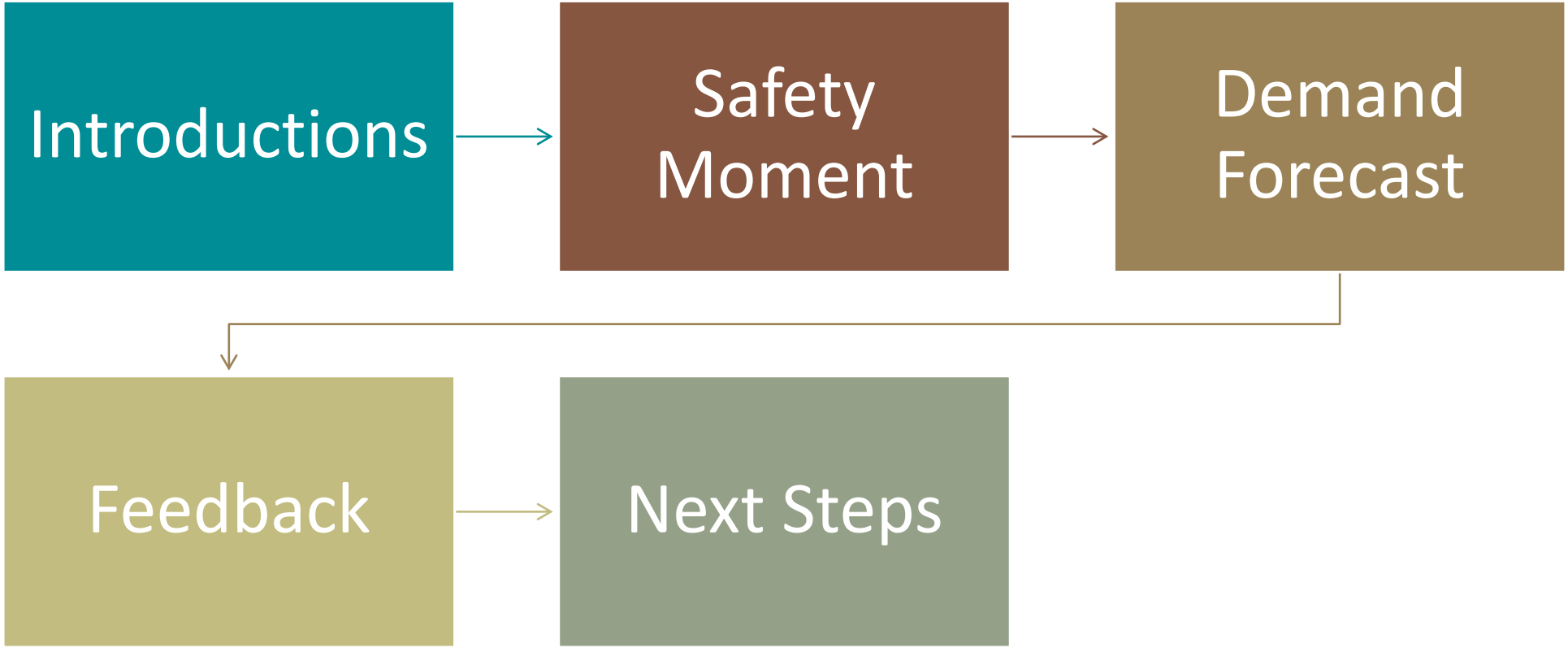
Agenda


Introductions
Safety Moment
Demand Forecast
Feedback
Next Steps

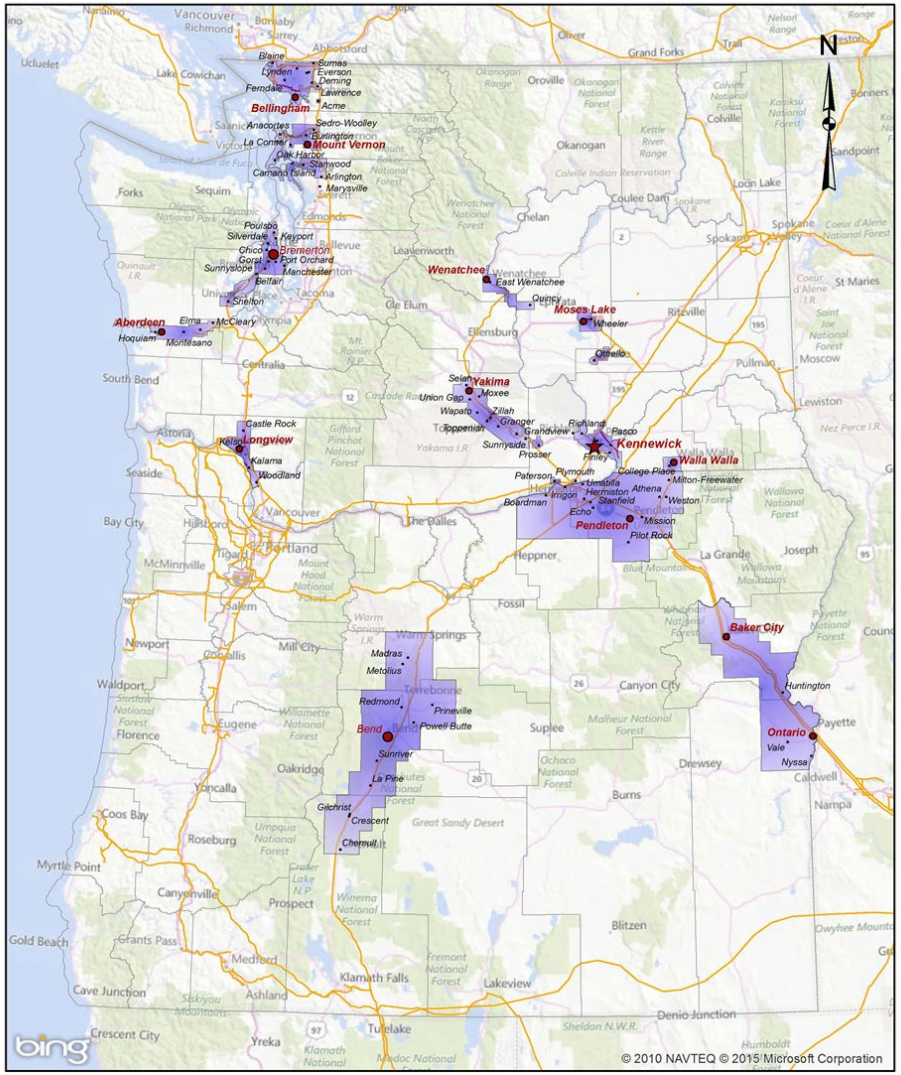
Safety Moment

While hunting, fishing, camping, and enjoying all of the activities the great outdoors has to offer following the tips below are some ways to stay safe:

- Obey applicable hunting laws and make yourself visible to other hunters.
- Watch your footing while traversing through rough terrain and wilderness to avoid sprints and strains.
- Make sure camp fires are fully extinguished before leaving camp sites.
- Wear sunscreen to protect your skin from sunburns.
- Protect yourself from insect bites and stings by using insect repellent methods.
- Drive safety on the road and off-the-road if you plan to use UTV's, ATV's, etc.

Enjoying the Great Outdoors Safely

Demand Forecast



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Service Boundaries

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Demand Forecast

- The Cascade demand forecast developed for the IRP is a forecast of core customers and their usage, including peak demand, for the next 20+ years.
- Demand is forecasted at:
  - the pipeline zone level;
  - the rate schedule level;
  - the daily level; and
  - forecasted out to 2050 for decarbonization planning.

Key Definitions

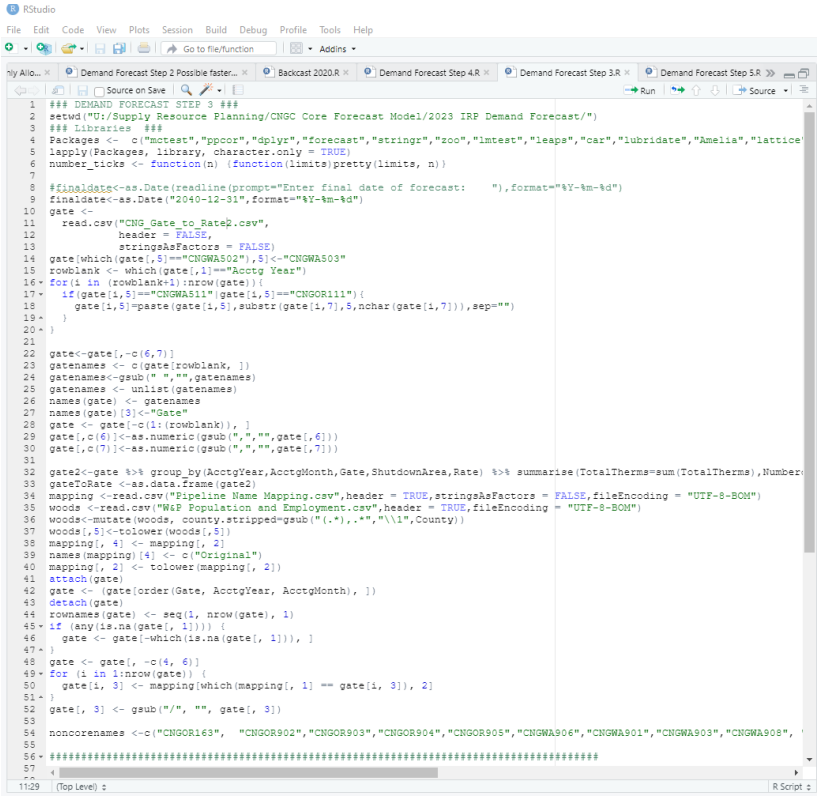
- AIC: The Akaike information criterion (AIC)
  - A measure of the relative quality of statistical models for a given set of data. Given a collection of models for the data, AIC estimates the quality of each model, relative to each of the other models. Hence, AIC provides a means for model selection.
- 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.
- Fourier Terms
  - The decomposition of a time series into a set of sine-waves (or cosine-waves) with differing amplitudes, frequencies, and phase angles. Essentially, these terms help find seasonalities within a time series that wasn't accounted for by regressors.
- Weather in terms of HDDs (Heating Degree Day).
- Wind is average daily wind speed.

R Software

R is a free software environment for statistical computing and graphics.

Thousands of packages: A package bundles together code, data, documentation, and tests, and is easy to share with others.

Allows for large number of complex calculations in reasonable amount of time (i.e., Monte Carlo simulations, entire load forecast, etc…).



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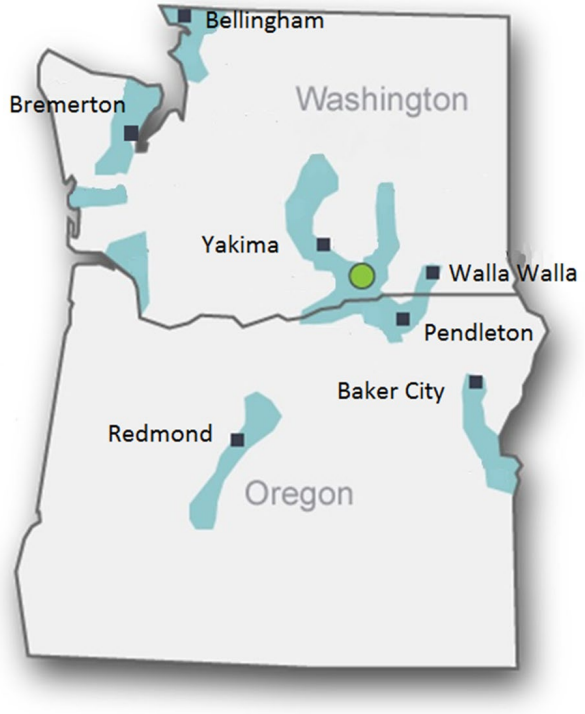
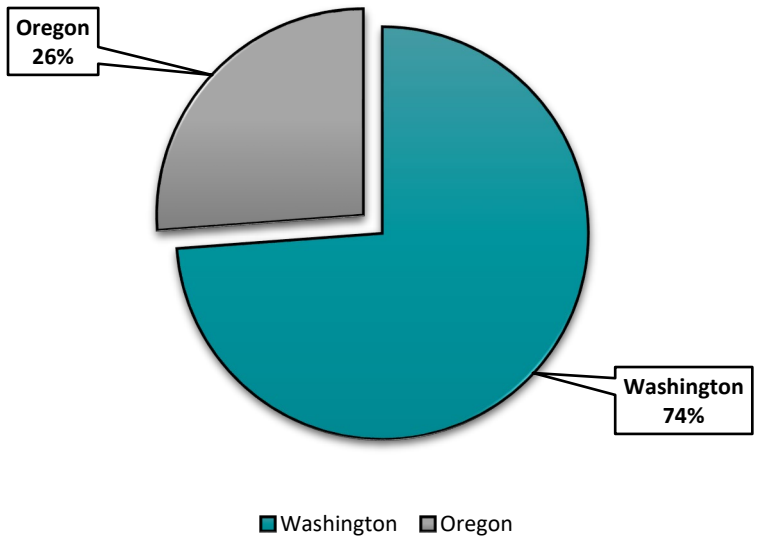
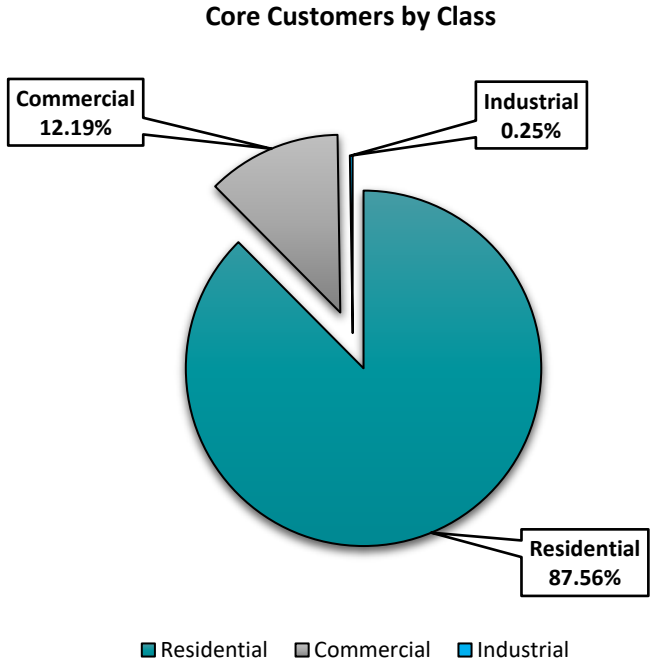
Weather Stations

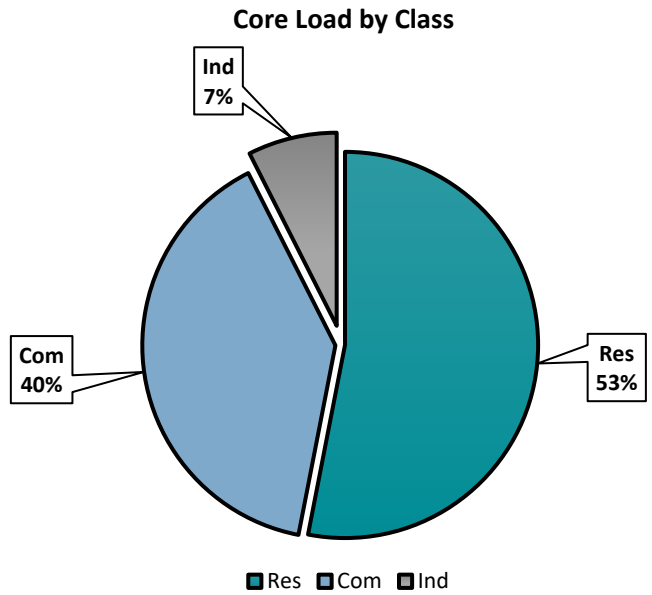


- The seven weather stations are shown on the map.
- Cascade's service territory is shaded in aqua.
- Each citygate and loop is assigned to a weather station.

Core Customers/Load Breakdown - 2021







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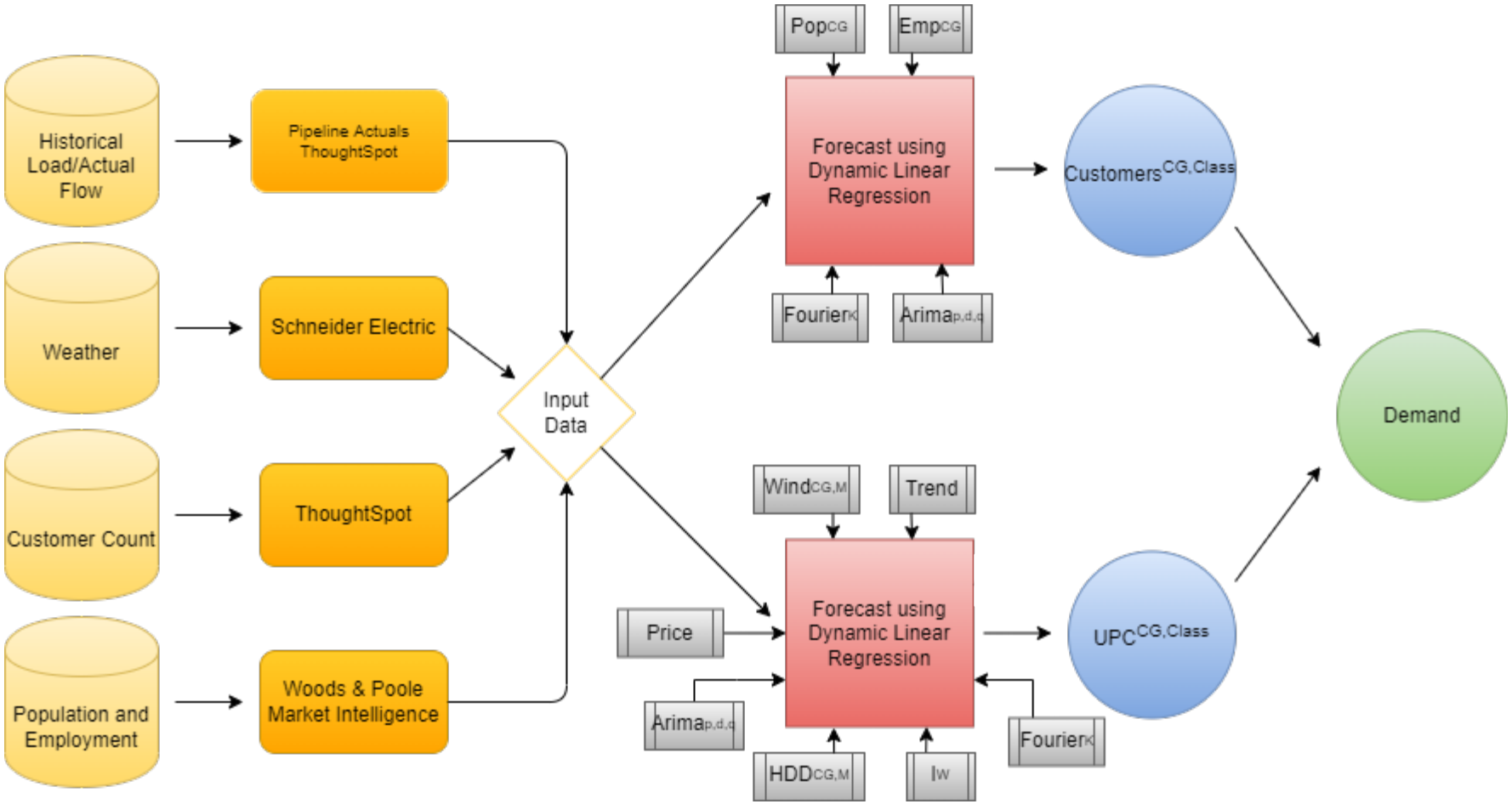
Process



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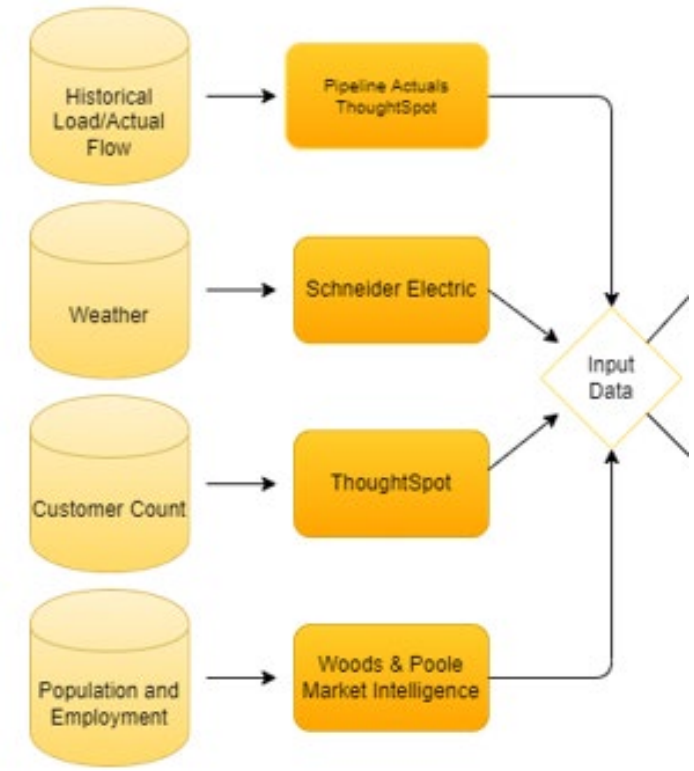
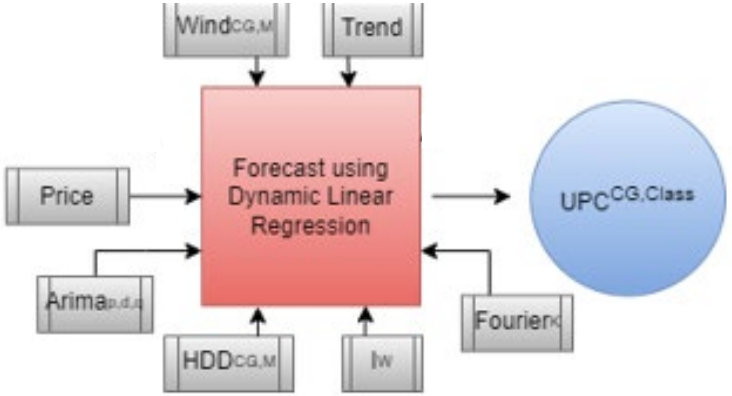
Inputs



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



Use Per Customer Forecast

$$Therms/C^{Z,Class} = \alpha_0 + \alpha_1 HDD^{Z,M} + \alpha_2 I_w + \alpha_3 WIND^{Z,M} + \alpha_4 Retail\ Price + Trend + Fourier(k) + ARIMA \in (p,d,q)$$

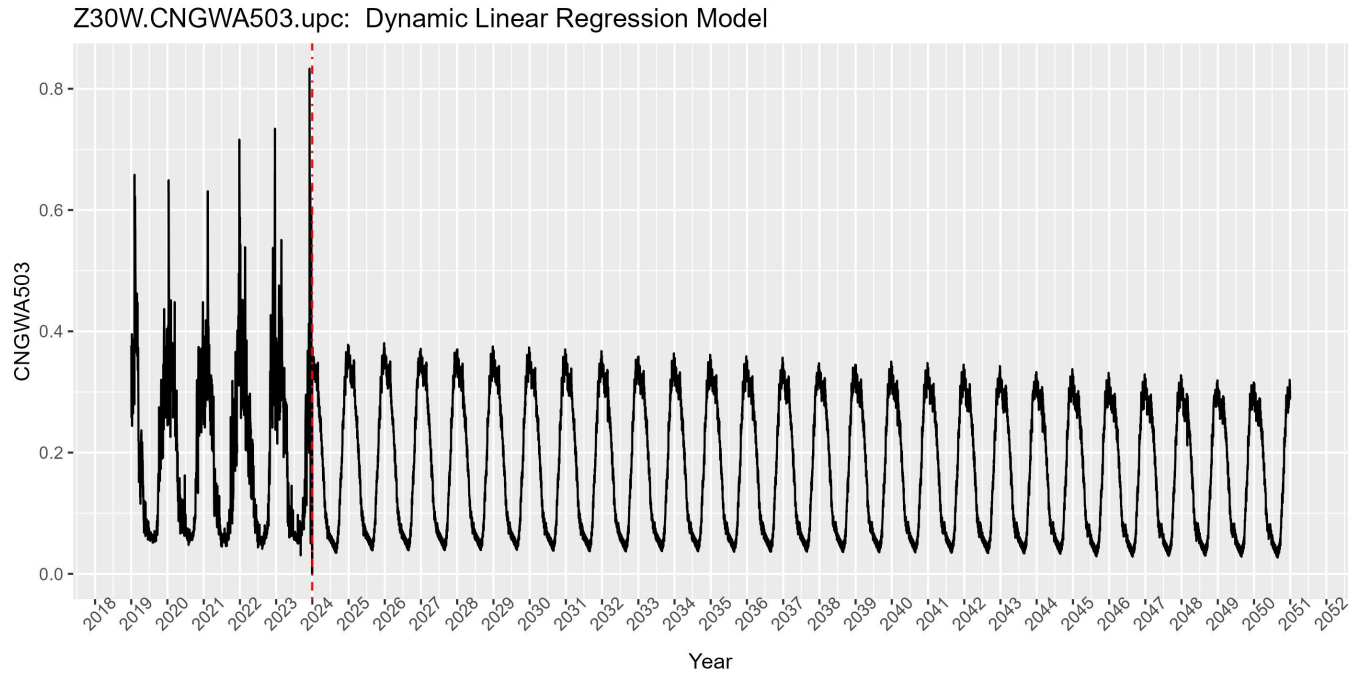
Model Notes:

- Therms/C = Therms per customer; Z = Zone; 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; Retail Price = Price customers see on their bill.

UPC Forecast Results

ar1	ar2	ar3	ar4	ma1	ma2	intercept	weekend	jan.hdd	feb.hdd	mar.hdd	apr.hdd	may.hdd	jun.hdd	jul.hdd	aug.hdd	sep.hdd	oct.hdd	nov.hdd	dec.hdd
1.747599	-1.33344	0.234089	0.144633	-1.34185	0.8385	0.111747	-0.01118	0.01015	0.010387	0.009336	0.008269	0.006909	0.00508	0.006081	0.002623	0.005692	0.007417	0.009028	0.009976

jan.wind	feb.wind	mar.wind	apr.wind	may.wind	jun.wind	jul.wind	aug.wind	sep.wind	oct.wind	nov.wind	dec.wind	p.503	S1-365	C1-365	S2-365	C2-365	S3-365	C3-365
0.003843	0.003158	0.003516	0.003493	0.001329	6.95E-05	-0.00039	6.65E-05	0.001291	0.001669	0.002995	0.002938	-0.19039	0.006442	0.037943	-0.00564	0.008639	-0.00488	-0.00791



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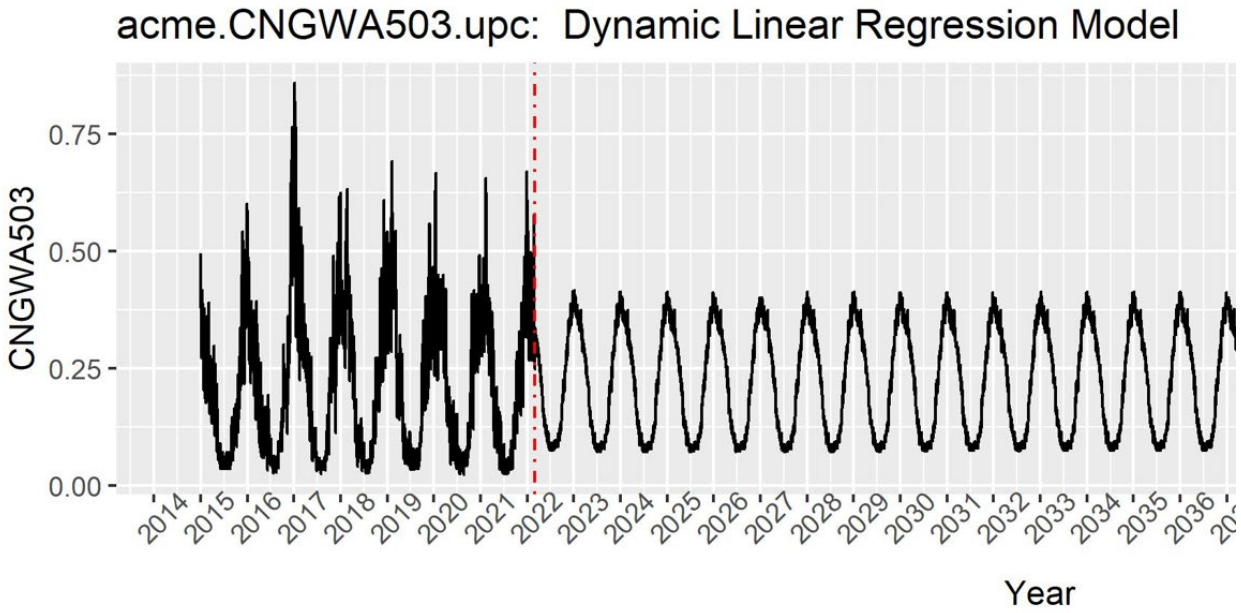
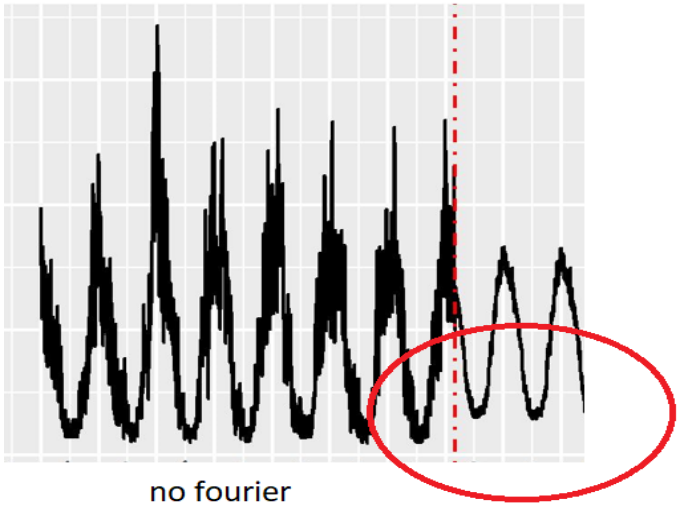
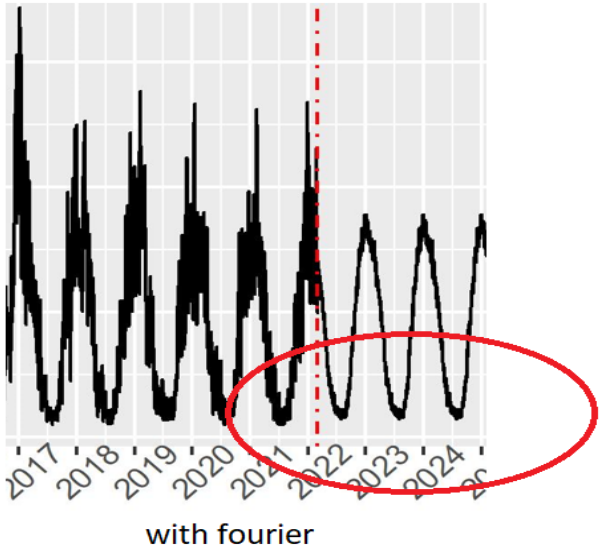
Fourier terms

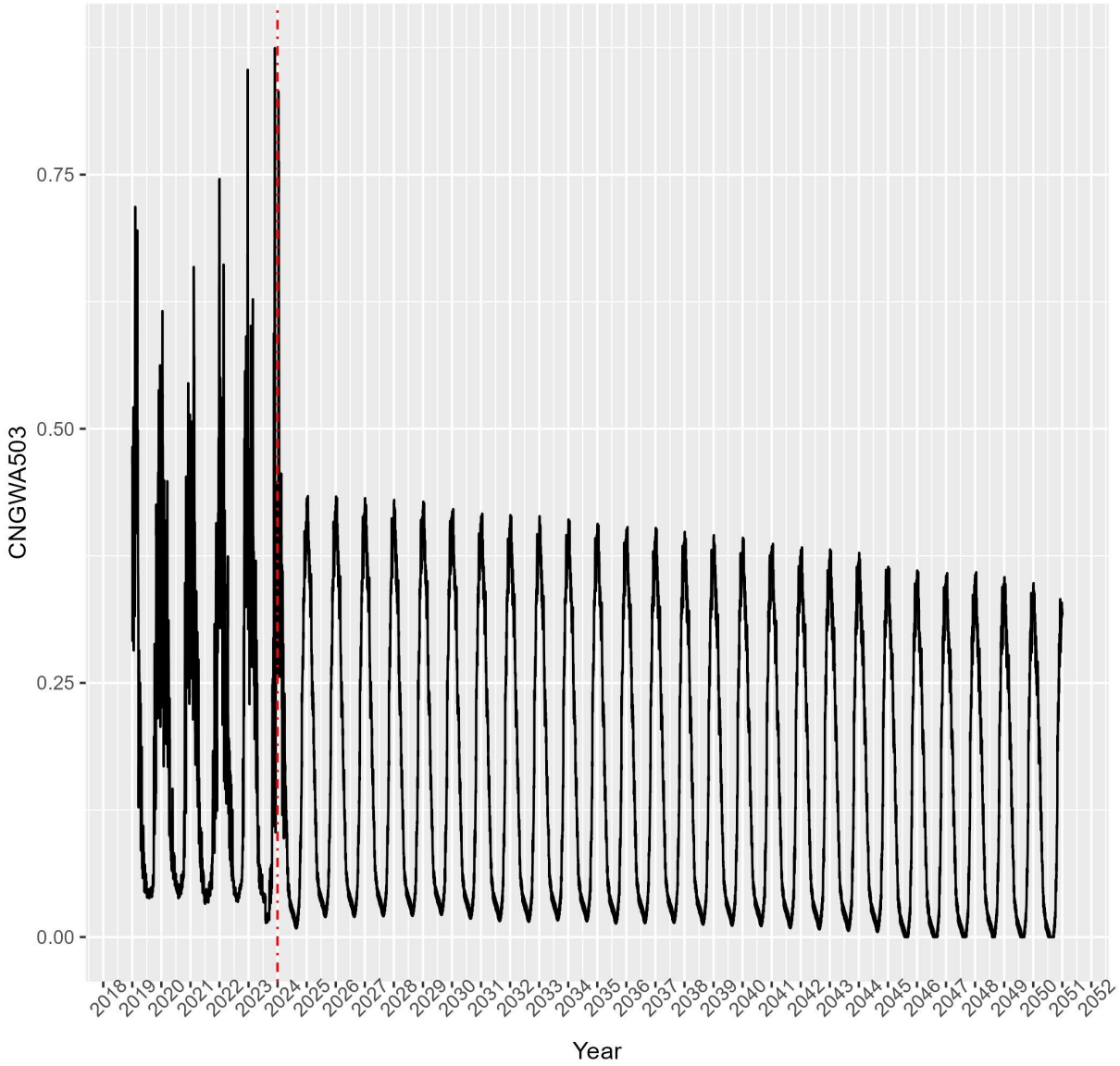
What do they do exactly?



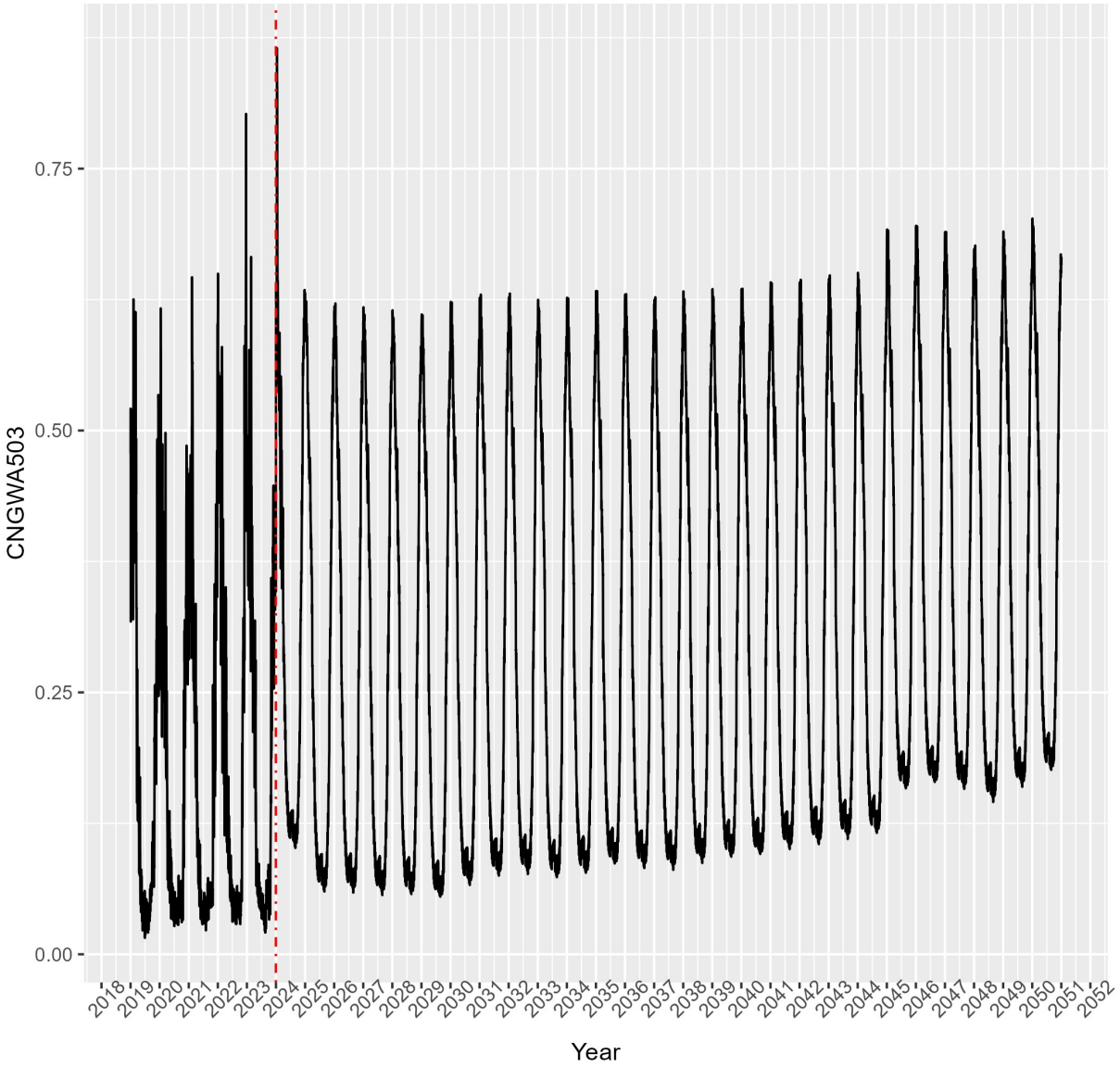




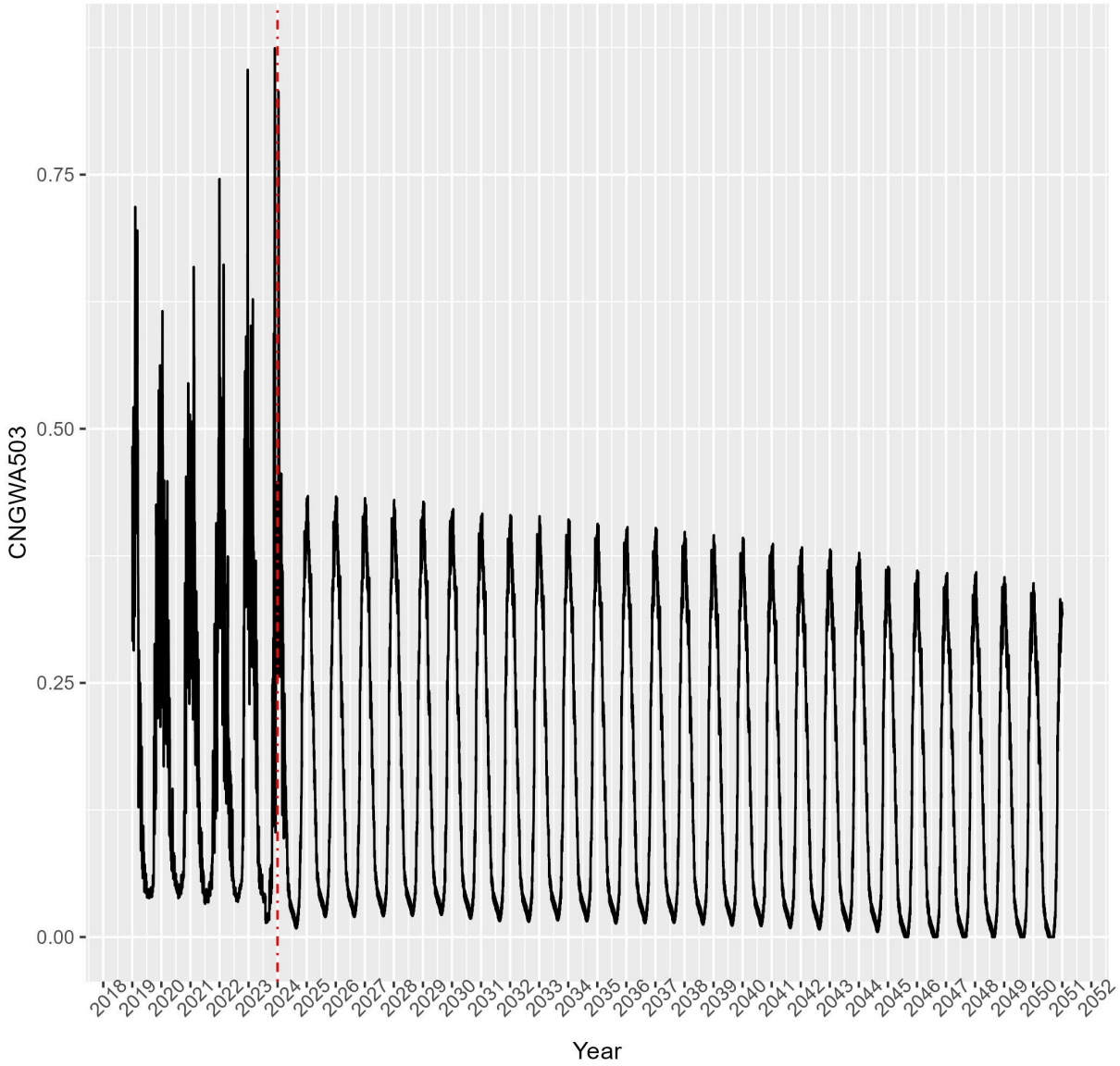
MEWA.CNGWA503.upc: Dynamic Linear Regression Model



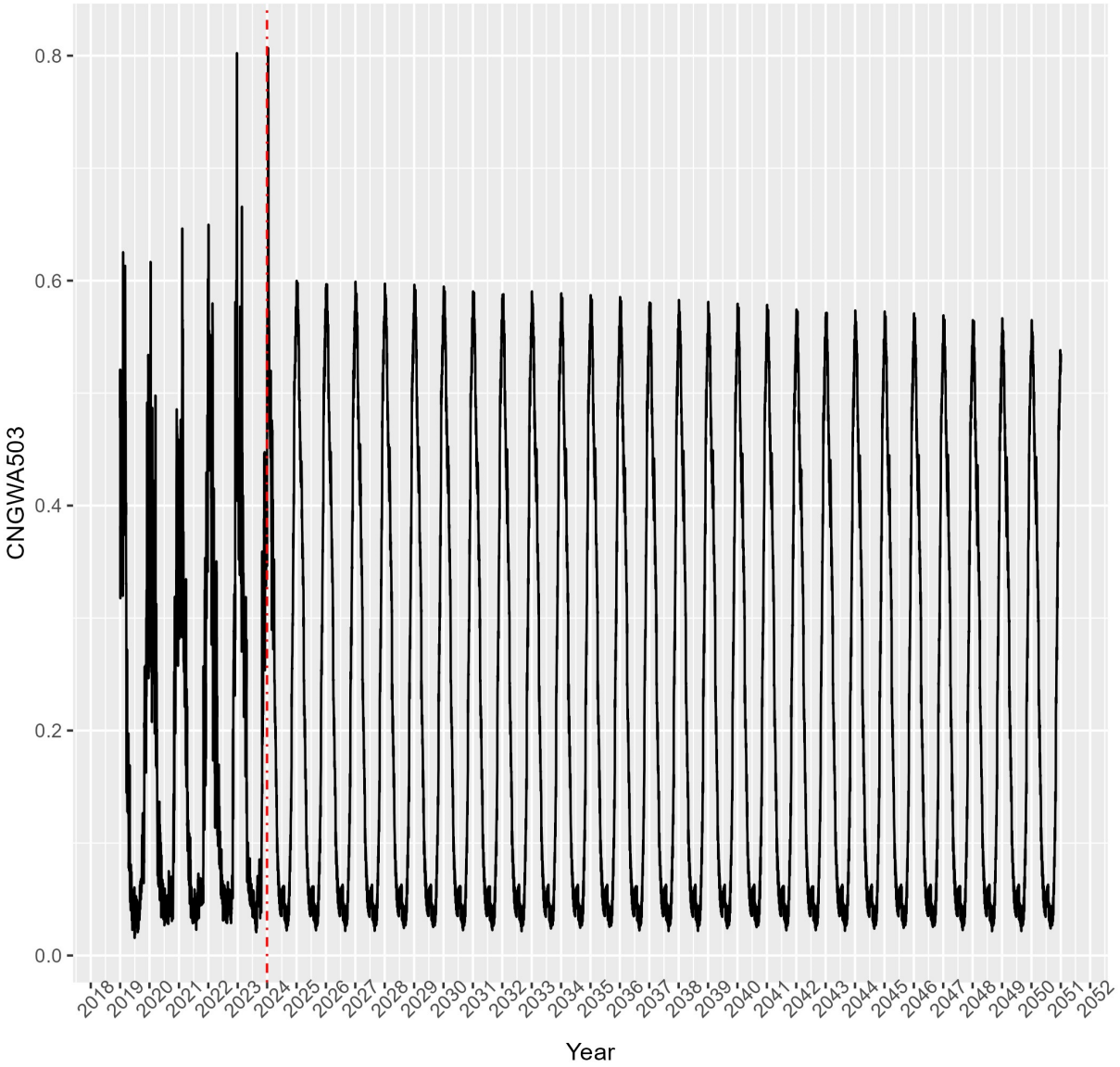
Z10.CNGWA503.upc: Dynamic Linear Regression Model



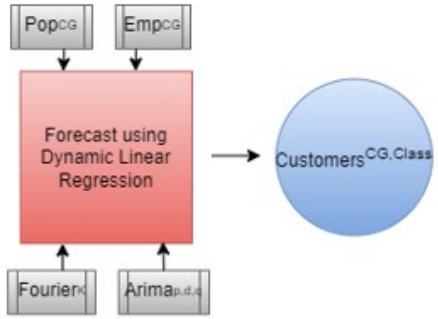
MEWA.CNGWA503.upc: Dynamic Linear Regression Model



Z10.CNGWA503.upc: Dynamic Linear Regression Model



Customer Forecast



Customer Forecast

$C^{Z,Class} = \alpha_0 + \alpha_1 HH^Z + \alpha_2 Emp^Z + \alpha_3 \text{Retail Price} + \alpha_4 \text{Income} + \text{Fourier}(k) + \text{ARIMA} \in (p,d,q)$

Model Notes:

- C = Customers; Z = Zone; 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; HH = Households; Emp = Employment; Retail Price = Price customers see on their bill; Income = Average income at the zonal level; Fourier(k) = Captures seasonality of k number of seasons.

Start with Linear Model

Some are Naïve models

Tests for any collinearity

Customer Forecast Inputs

Woods & Poole Data

County		Populatic	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

ThoughtSpot Data

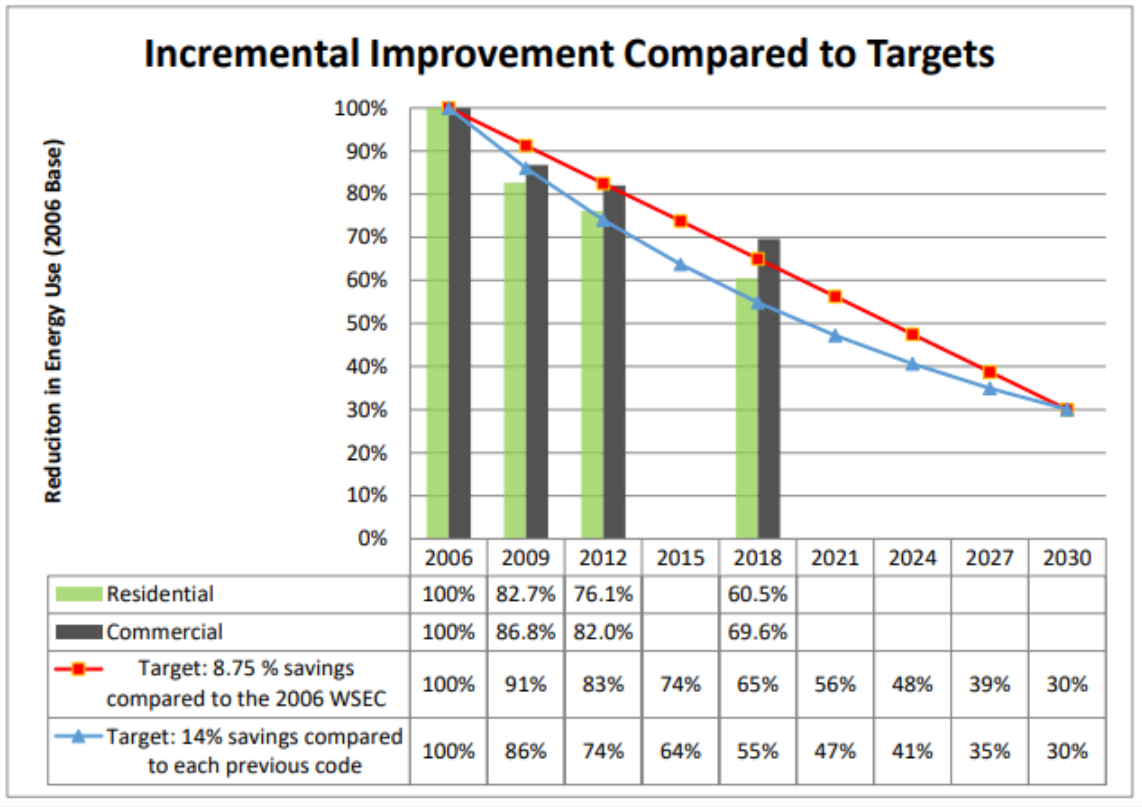
3	Acctg Year	Acctg Month	Gate (Loop)	Shutdown Area	Rate	MR Cycle	SP Type	Total Therms	Number of Prem ID
4	2020	1	Umatilla	56-H011	CNGO11LV	CA00	CNGG-IND	0	1
5	2021	1	Umatilla	56-H011	CNGO11LV	CA00	CNGG-IND	0	1
6	2022	1	Umatilla	56-H011	CNGO11LV	CA00	CNGG-IND	0	1
7	2015	1	Athena	56-H008	CNGOR101	CA06	CNGG-RES	708	3
8	2015	1	Athena	56-I033	CNGOR101	CA06	CNGG-RES	31331	316
9	2015	1	Athena	56-I038	CNGOR101	CA06	CNGG-RES	16611	171
10	2016	1	Athena	56-I033	CNGOR101	CA06	CNGG-RES	27992	321
11	2016	1	Athena	56-H008	CNGOR101	CA06	CNGG-RES	599	3
12	2016	1	Athena	56-I038	CNGOR101	CA06	CNGG-RES	14858	171
13	2017	1	Athena	56-H008	CNGOR101	CA06	CNGG-RES	947	3
14	2017	1	Athena	56-I038	CNGOR101	CA06	CNGG-RES	22870	173

Pipeline Data

	A	B	C	D	E	F	G	H	I	J	K
1	Aggregated Locations	Loop		Year	Month	Day	Year-Month-Day	Date	Actual Dth	None Core	Core
38	ABERDEEN/HOQUIAM/MCCLEARY			2015	1	1	1/1/2015	Thursday	6,315	2,819	3,496
39	ABERDEEN/HOQUIAM/MCCLEARY			2015	2	1	2/1/2015	Sunday	3,243	1,083	2,160
40	ABERDEEN/HOQUIAM/MCCLEARY			2015	3	1	3/1/2015	Sunday	4,424	2,335	2,089
41	ABERDEEN/HOQUIAM/MCCLEARY			2015	4	1	4/1/2015	Wednesday	5,725	3,560	2,165
42	ABERDEEN/HOQUIAM/MCCLEARY			2015	5	1	5/1/2015	Friday	3,721	2,472	1,250
43	ABERDEEN/HOQUIAM/MCCLEARY			2015	6	1	6/1/2015	Monday	4,827	3,748	1,079
44	ABERDEEN/HOQUIAM/MCCLEARY			2015	7	1	7/1/2015	Wednesday	4,076	3,500	576.3
45	ABERDEEN/HOQUIAM/MCCLEARY			2015	8	1	8/1/2015	Saturday	3,106	2,589	517
46	ABERDEEN/HOQUIAM/MCCLEARY			2015	9	1	9/1/2015	Tuesday	4,067	3,393	674.3
47	ABERDEEN/HOQUIAM/MCCLEARY			2015	10	1	10/1/2015	Thursday	4,598	3,705	893.2
48	ABERDEEN/HOQUIAM/MCCLEARY			2015	11	1	11/1/2015	Sunday	4,074	2,752	1,322
49	ABERDEEN/HOQUIAM/MCCLEARY			2015	12	1	12/1/2015	Tuesday	3,444	2,078	1,366
50	ACME			2015	1	1	1/1/2015	Thursday	51	0	51
51	ACME			2015	2	1	2/1/2015	Sunday	29	0	29
52	ACME			2015	3	1	3/1/2015	Sunday	31	0	31
53	ACME			2015	4	1	4/1/2015	Wednesday	28	0	28
54	ACME			2015	5	1	5/1/2015	Friday	12	0	12
55	ACME			2015	6	1	6/1/2015	Monday	6	0	6
56	ACME			2015	7	1	7/1/2015	Wednesday	5	0	5
57	ACME			2015	8	1	8/1/2015	Saturday	6	0	6
58	ACME			2015	9	1	9/1/2015	Tuesday	12	0	12

Customer Forecast Regime Change

Building Code Impacts (Cont'd)



	2006	2009	2012	2015	2018	2021	2024	2027	2030
Residential	100%	82.7%	76.1%		60.5%				
Commercial	100%	86.8%	82.0%		69.6%				
Target: 8.75 % savings compared to the 2006 WSEC	100%	91%	83%	74%	65%	56%	48%	39%	30%
Target: 14% savings compared to each previous code	100%	86%	74%	64%	55%	47%	41%	35%	30%

Chart Source: Final Cost Benefit Analysis for the 2021 WSEC-R

- Under RCW 19.27A.020(2)(a), the SBCC is directed to "…help achieve the broader goal…" of zero emission homes/buildings. Note that this is a goal, not a mandate. Conversely, RCW 19.27A.160 is an explicit direction to the SBCC to move towards a 70% reduction in annual net energy consumption by 2031. This is a mandate and is clear that the goal is a "net" energy.
- Since RCW 19.27A.020(2)(a), the enacting legislation resulted from 2009 SB 5854. Therefore, the 2012, 2015, 2018, and 2021 code cycles were all likely impacted by the legislation. This chart provides an explanation of how the SBCC has addressed the more explicit legislative direction of RCW 19.27A.160.

WA State Building Codes

Effective March 15, 2024, the 2021 Washington State Energy Codes[1] went into effect.

Each new dwelling unit in a residential building must comply to the WSEC. Each dwelling must meet the required number of credits (ex. Small dwellings must have 5 credits).

The new building codes have made it impractical for new residential and commercial buildings to use natural gas.

TABLE R406.2
ENERGY EQUALIZATION CREDITS

System Type	Description of Primary Heating Source	Credits	
		All Other	Group R-2[a]
1	For combustion heating equipment meeting minimum federal efficiency standards for the equipment listed in Table C403.3.2(5) or C403.3.2(6)	0	0
2	For an initial heating system using a heat pump that meets federal standards for the equipment listed in Table C403.3.2(2) and supplemental heating provided by electric resistance or a combustion furnace meeting minimum standards listed in Table C403.3.2(5)[b]	1.5	0
3	For heating system based on electric resistance only (either forced air or Zonal)	0.5	-0.5
4[c]	For heating system using a heat pump that meets federal standards for the equipment listed in Table C403.3.2(2) or C403.3.2(9) **or** Air to water heat pump units that are configured to provide both heating and cooling and are rated in accordance with AHRI 550/590	3.0	2.0
5	For heating system based on electric resistance with: 1. Inverter-driven ductless mini-split heat pump system installed in the largest zone in the dwelling, **or** 2. With 2kW or less total installed heating capacity per dwelling	2.0	0

1 HTTPS://SBCC.WA.GOV/STATE-CODES-REGULATIONS-GUIDELINES/STATE-BUILDING-CODE/ENERGY-CODE

Oregon Customer Count Impacts

- Oregon has signed on with eight other States to create a Nine States Pledge Joint Action to Accelerate Transition to Clean Buildings[1].
- Under the MOU, these states have set a shared goal for heat pumps to meet at least 65% of residential-scale heating, air conditioning and water heating shipments by 2030 and 90% by 2040 across the participating states.
- The MOU is not legally binding, but it does send a signal that these states have strong targets to increase heat pump and electric space and water heating, effectively reducing the use of Natural Gas.

1 HTTPS://WWW.NESCAUM.ORG/DOCUMENTS/2.7.24-NESCAUM-MOU-PRESS-RELEASE.PDF

Weather Normals and Climate Change Impacts

Weather Normals and Climate Change Impact

- Weather Normals have historically been the average HDDs over the past 30 years. Cascade is looking at utilizing a 15-year or 20-year normal instead to capture more recent trends.
- Cascade utilized a conservative approach in the previous IRP where the Company used the RCP4.5. The conservative approach was to avoid under planning for other carbon compliance mitigating options.
- For the 2025 IRP, Cascade has contracted with ICF.
  - ICF will provide projections that represent daily HDD time series data for the planning horizon.
  - HDD projections will use newly released Coupled Model Intercomparison Project Phase 6 (CMIP6) Localized Constructed Analogs version 2 (LOCA2) statistically downscaled global climate models.
  - Projections will use an ensemble of 20+ climate models and two future greenhouse gas emissions scenarios (e.g., Shared Socioeconomic Pathways 2-4.5 and 3-7.0 representing heavily mitigated and largely unabated emissions, respectively) to characterize future climate change uncertainty and facilitate Monte Carlo sampling for Cascade's forecasts or other methods.
- ICF will also provide a Cold Weather Review Relevant to Peak Forecasts.

Non-Core Outlook

Non-Core Outlook

- Cascade forecasts the non-core out to 2050.
- 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 six electric generation customers in Washington and one in Oregon. Those six customers project to use approximately 602,000,000 therms in 2025.

Transportation Customers

- Cascade's transportation customer forecast decreased from the previous forecast. The current forecast projects the customer count to be 241 in 2025. Cascade's industrial managers are working closely with potential industrial customers.
- Cascade projects the transportation customers in Washington and Oregon to consume approximately 513 million therms in 2025.
- Cascade is communicating with the transportation customers on CCA impacts, but it is too early to determine the impact CCA will have on these transport customers.

Feedback for Cascade?

Do you have comments or ideas that Cascade should consider regarding the Customer and Demand Forecast?

2025 WA IRP Schedule

Process Item	Date	Process Element
Targeted-TAG	Thursday, January 25, 2024	What is an IRP and how to get involved
Targeted-TAG	Thursday, February 15, 2024	Avoided Cost
Targeted-TAG	Wednesday, March 6, 2024	Energy Efficiency
Targeted-TAG	Thursday, March 28, 2024	Equity in the IRP
Targeted-TAG	Thursday, April 11, 2024	Customer/Load Forecast
Targeted-TAG	Tuesday, May 7, 2024	CCA/Compliance Modeling
Targeted-TAG	Thursday, May 16, 2024	Distribution System Planning
Targeted-TAG	Thursday, May 30, 2024	Resource Integration
TAG 1	Thursday, June 13, 2024	Process, Key Points, IRP Team, Timeline, Regional Market Outlook, Planned Scenarios and Sensitivities, Stakeholder Engagement, Demand and Customer Forecast and Non-Core Outlook, Drilling down into segments of demand forecast. Upstream Pipeline presentation.
Receive feedback on TAG 1	Friday, June 28, 2024	
TAG 2	Thursday, July 25, 2024	Respond to TAG 1 Feedback, Distribution System Planning, Alternative Resources, Price Forecast, Avoided Costs, Current Supply Resources, Transport Issues, Carbon Impacts, Energy Efficiency, Bio-Natural Gas, Preliminary Resource Integration Results.
Receive feedback on TAG 2	Friday, August 9, 2024	
First Draft	Friday, September 6, 2024	
Comments Due	Friday, October 4, 2024	
TAG 3	Wednesday, October 30, 2024	Respond to TAG 2 feedback, Final Integration Results, finalization of plan components, Proposed new 2- to 4-year Action Plan
Final Draft	Tuesday, December 3, 2024	
Comments Due	Tuesday, January 14, 2025	
TAG 4 (if needed)	Thursday, January 30, 2025	
Final Complete By	Friday, February 14, 2025	
File	Monday, February 24, 2025	

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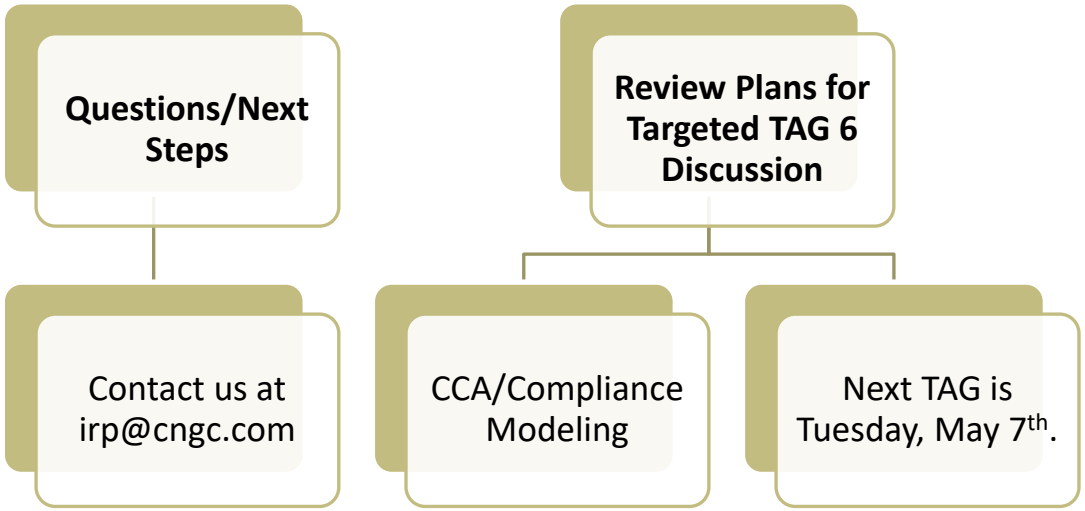

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Washington Integrated Resource Plan Targeted Technical Advisory Group Meeting #5

APRIL 11, 2024

MICROSOFT TEAMS/TELECONFERENCE

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