Northwest **Power** and **Conservation** Council

April 25, 2025

MEMORANDUM

TO: **Council Members**

FROM: **Steven Simmons**

SUBJECT: **Ninth Plan Demand Forecast**

BACKGROUND:

Presenter: Steven Simmons, Tomás Morrissey, Jake Kennedy

Summary: This presentation is the third in a series covering the development of the 9th Power Plan Demand Forecast. The emphasis this presentation is on forecast results – projected energy and peak demand – but this presentation will also provide a summary of the work performed over the past year to re-develop the forecast model which culminated in the 9th Plan Demand Forecast.

The Council's 2021 Northwest Power Plan identified several dynamic changes taking place across the west that impact our power system. In particular the potential for large future load growth from the electrification of buildings and vehicles and emerging data center growth. A complete re-development of the demand forecast model was required to capture these dynamics, along with a significantly more granular locational representation of demand within the region.

The re-developed forecast model was used to develop an informative spread of potential demand futures across the twenty-year power planning horizon. The forecast range was designed to capture the impact of uncertainty in the magnitude and timing of electrification of transportation and buildings, data center demand, hydrogen production, and economic growth.

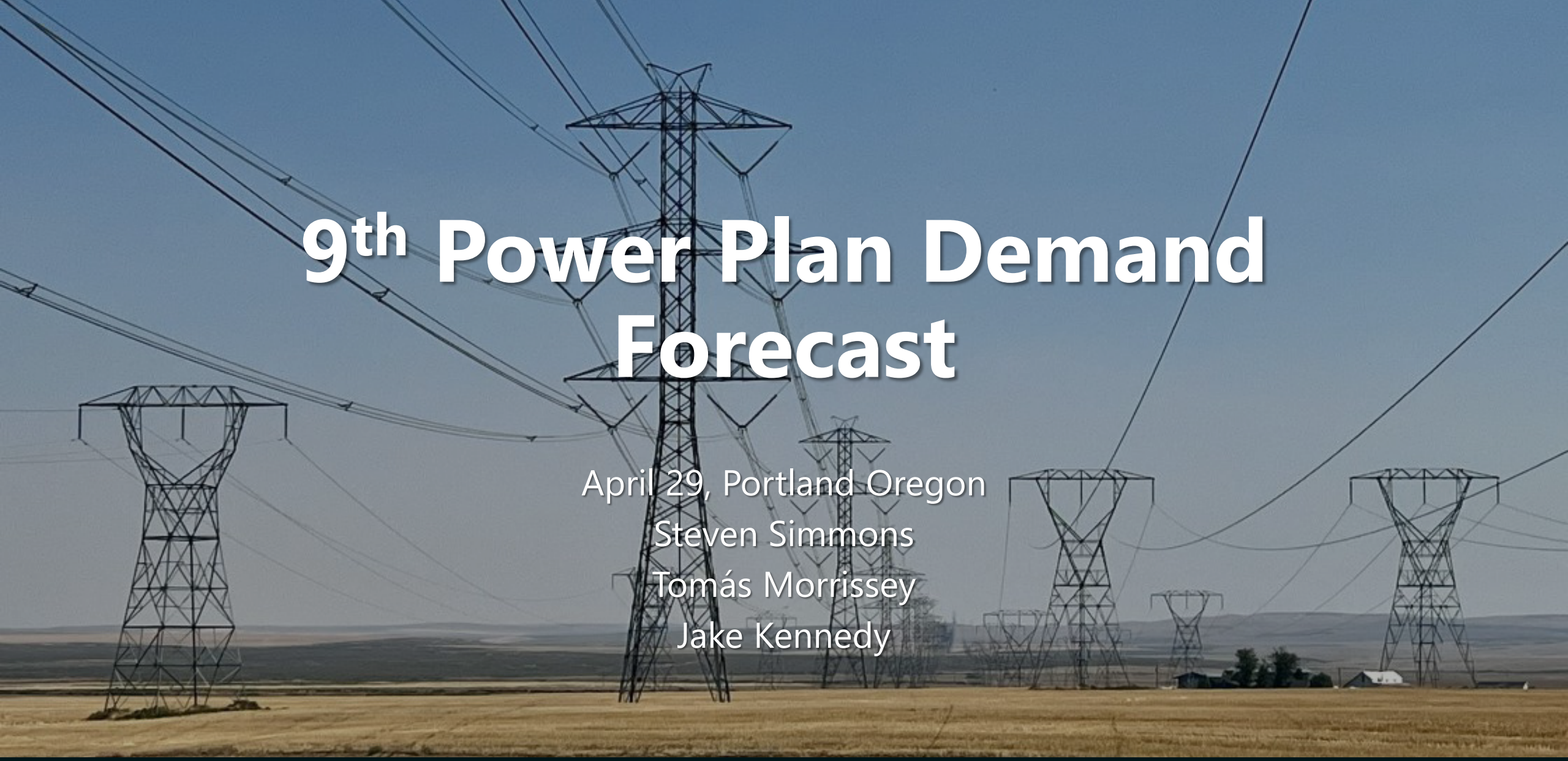
All of the futures point to regional growth in both demand for energy and on peak. The average annual growth in energy and peak across all futures during the planning horizon of 2027 through 2046 is roughly 2.6%. Demand in all sectors is projected to grow. Electric vehicles and data centers show the largest growth; while the residential, commercial and industrial sectors are projected to grow at a lower level.

The forecast presented will be what the Council terms a "frozen efficiency" demand forecast. This means that the forecast does not assume new potential for demand side resources. Rather, the potential for those resources is captured in the supply curves to provide resource options for the model to consider alongside the supply side options.

Relevance: Per the Northwest Power Act, as part of its regional power plan, the Council is required to develop and include "a demand forecast of at least twenty years…". In addition to producing the long-term demand forecast, data from the load forecast is used to inform the energy efficiency and demand response potential assessments, capital expansion modeling, the market price forecast, and the resource adequacy studies.

Workplan: B.2.2. Finalize long-term load forecasts for plan analysis.

Background: For further background, please see the following presentations to the Council:
https://www.nwcouncil.org/fs/18842/2024_0813_8.pdf
https://www.nwcouncil.org/fs/19131/2025_03_03.pdf
https://www.nwcouncil.org/fs/19343/2025_04_03.pdf



9th Power Plan Demand Forecast

April 29, Portland Oregon

Steven Simmons
Tomás Morrissey
Jake Kennedy

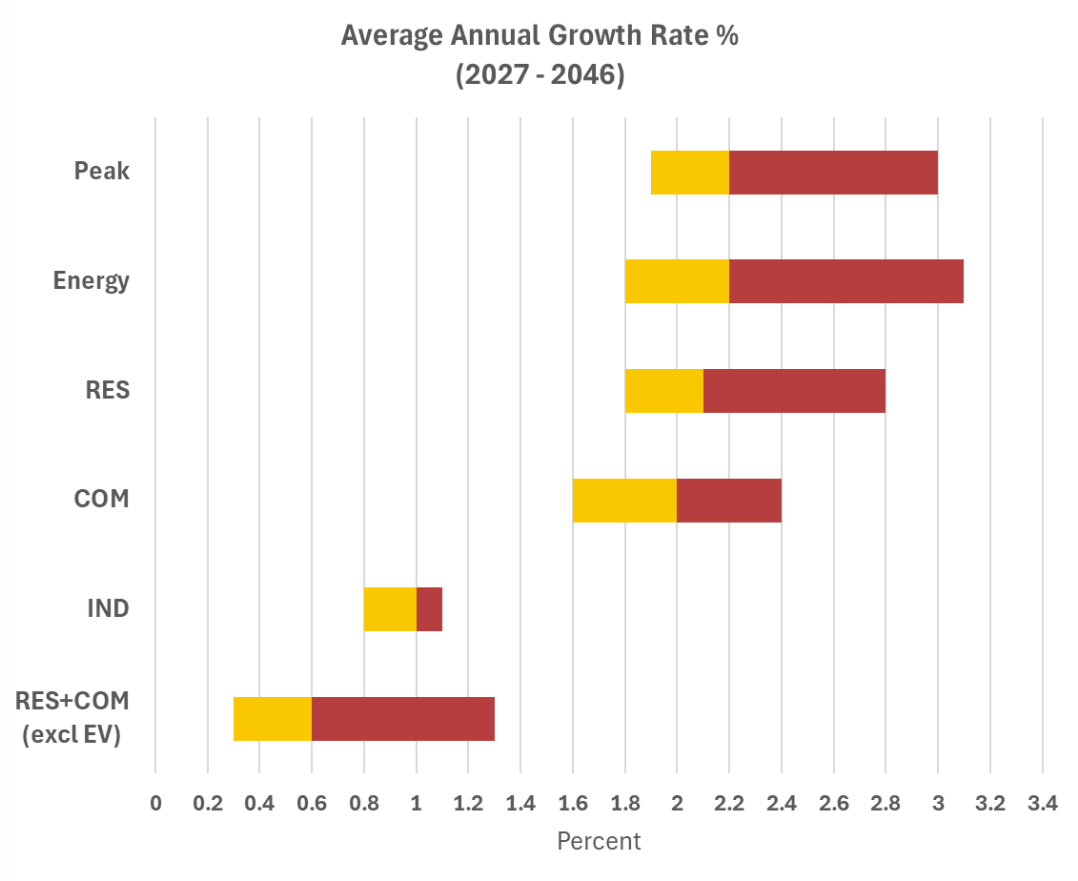
Northwest **Power** and **Conservation** Council

Today's Meeting

1. Demand Forecasting and the Power Plan
2. Model Re-Development Project
3. Model Structure, Flow and Inputs
4. Forecast Futures – Definitions and Derivations
5. Results
6. Wrap up

Regional Demand Forecast

1. Strong demand growth is expected – energy and peak
2. All sectors see some level of growth
3. Primary Residential and Commercial growth driver is demand from electric vehicles
4. Data Centers, Electric Vehicles, Building Electrification and Hydrogen Production – primary growth drivers overall



9th Plan Demand Forecast

Demand Forecasting and the Power Plan

Demand Forecasting & The Power Plan

1. Per the Northwest Power Act, as part of its regional power plan, the Council is required to develop and include "a demand forecast of at least twenty years…."
2. The forecast is used to help evaluate what resources best meet regional needs, with an emphasis on conservation as a resource.
3. The first forecast was published in 1983

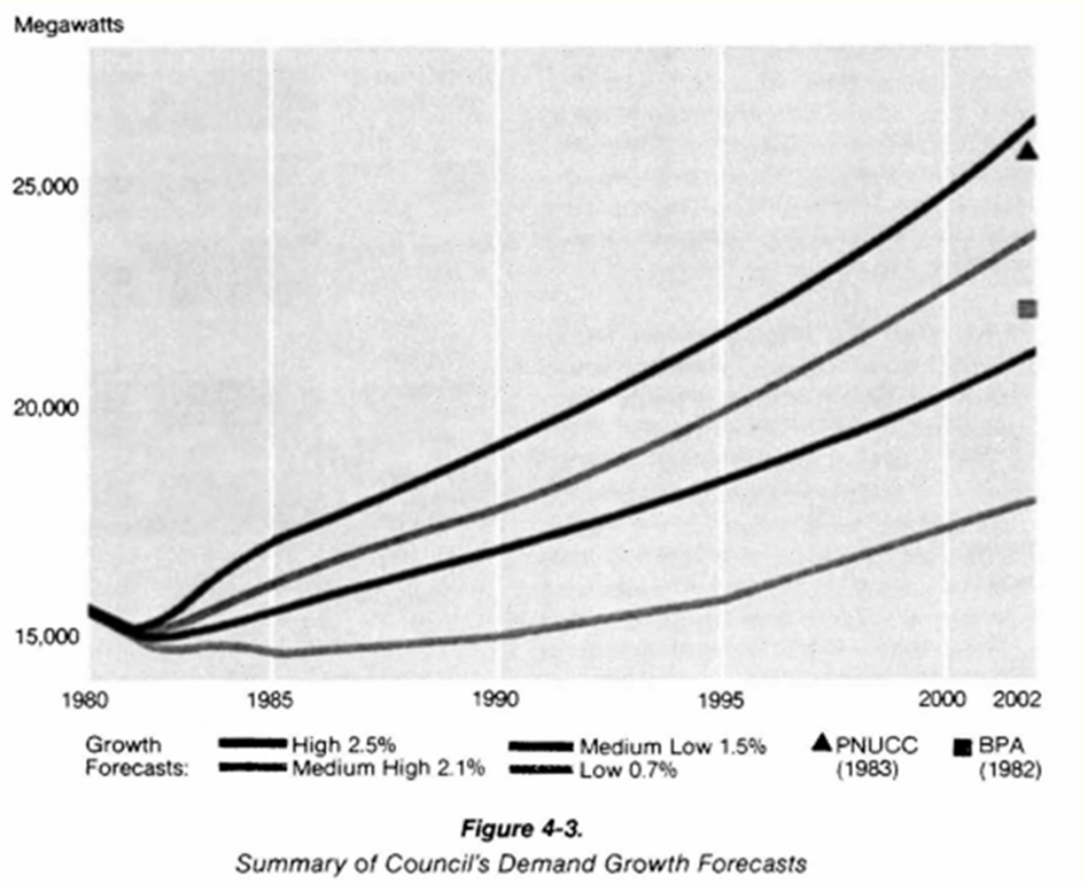


Figure 4-3.
Summary of Council's Demand Growth Forecasts

Demand Forecasting & The Power Plan

a forecast is a prediction of a future outcome; it's a way to anticipate future events or conditions from studying historic information and events

Our goal – create an accurate and comprehensive *forecast* of *demand* for electricity in the region – across twenty years

- When we *forecast* – we also want to learn about the region's energy use – to gain an understanding of what might drive changes to future demand
- To do this – we build a *model*
- The demand forecast is an output from the model, which is highly input data driven – and it's getting more complex

A forecast can also act as an input to a decision-making process. In this case, it differs from the tradition concept of a forecast as purely a prediction tool

Our goal – create an actionable set of demand inputs for the power planning models and tools

- Avoid double-counting the effect of energy efficiency potential by freezing efficiency/saturation levels in the model
- Allow the power planning resource model to evaluate cost-effective efficiency levels in context with other options
- Assumed a relatively *unmanaged* electric vehicle charging shape
- At the end of the power plan cycle, the decisions reached for resources such as EE, rooftop solar, and EV charging programs will be fed back into the model and a final forecast is generated

Demand Forecasting & The Power Plan

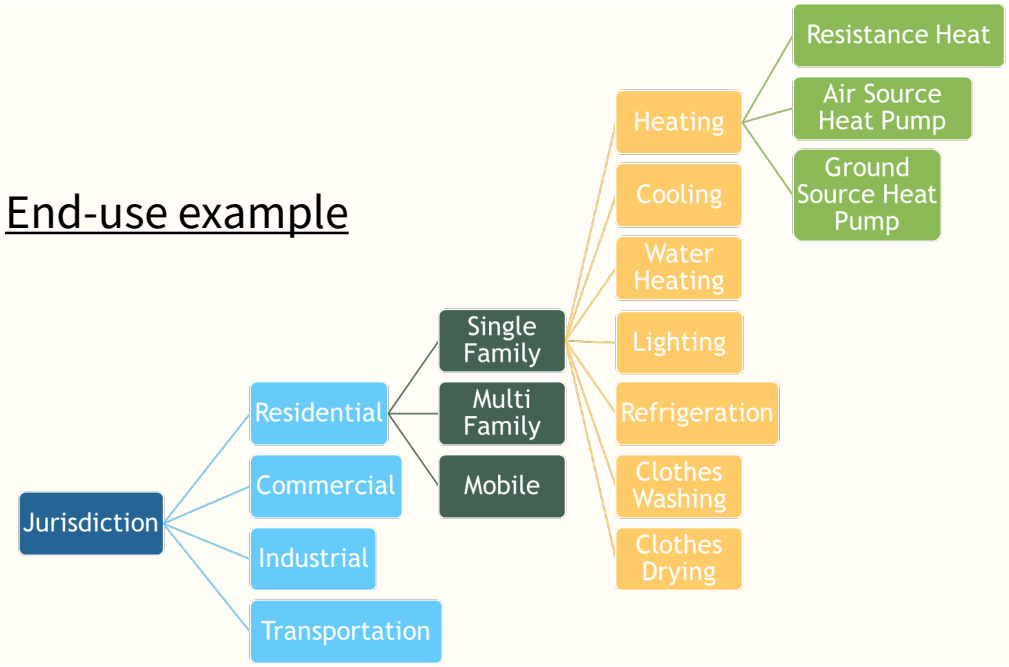
Traditionally the Council has used an *end-use* demand forecast approach

An **End Use Load Model** – sometimes called "bottoms up" modeling relies on summing up individual forecasts of demand for each electric end-use

An **Econometric Model** specifies the **statistical** relationship that is believed to hold between various economic quantities and weather to demand

The 9th Plan Forecast takes a hybrid approach – combining end-use modeling and econometrics

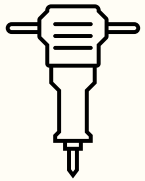
End-use example

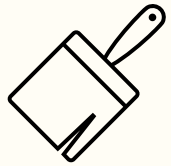


9th Plan Demand Forecast

Model Re-Development Project

Complete RE-MODEL REQUIRED





Due to the increase complexity of power planning and the shifting nature of regional demand – change was needed in our tool set

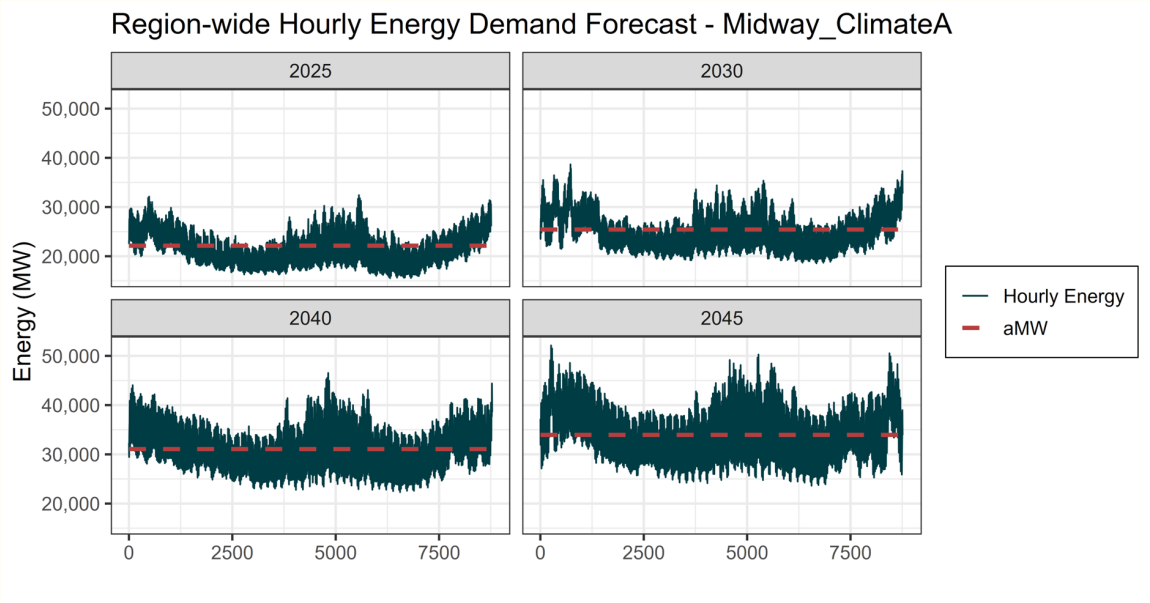
Goals:

- Long-term annual and monthly end-use forecasting with hourly capability
- Ability to model new uses of electricity
- Finer geographic resolution
- Streamlined process and software to allow more frequent forecast cycles and staff sustainability
- Strong technical support and an established user base

March 2023	Completion of the project to identify and select a new forecasting suite
June 2023	Authorization to contract with Itron Inc. to provide a new forecasting framework to support long-term demand forecast at the Council
September 2023	Project kickoff
September 2024	Forecasting suite in place
January 2025	Began complete update and definition of model inputs with the most up to date information as possible

Today

- Tool set with a much more sophisticated approach to demand forecasting
- Ability to forecast demand long-term on an hourly basis for 13 zones using 20+ weather stations
- Sustainability and stability
  - Desktop application with a graphic user interface
  - multiple staff can train on and run
  - customer support, wide user group
  - Ability to turn quicker forecast cycles
  - Grounded in an end-use approach



9th Plan Demand Forecast

Model Structure, Flow, Inputs

Forecast Model

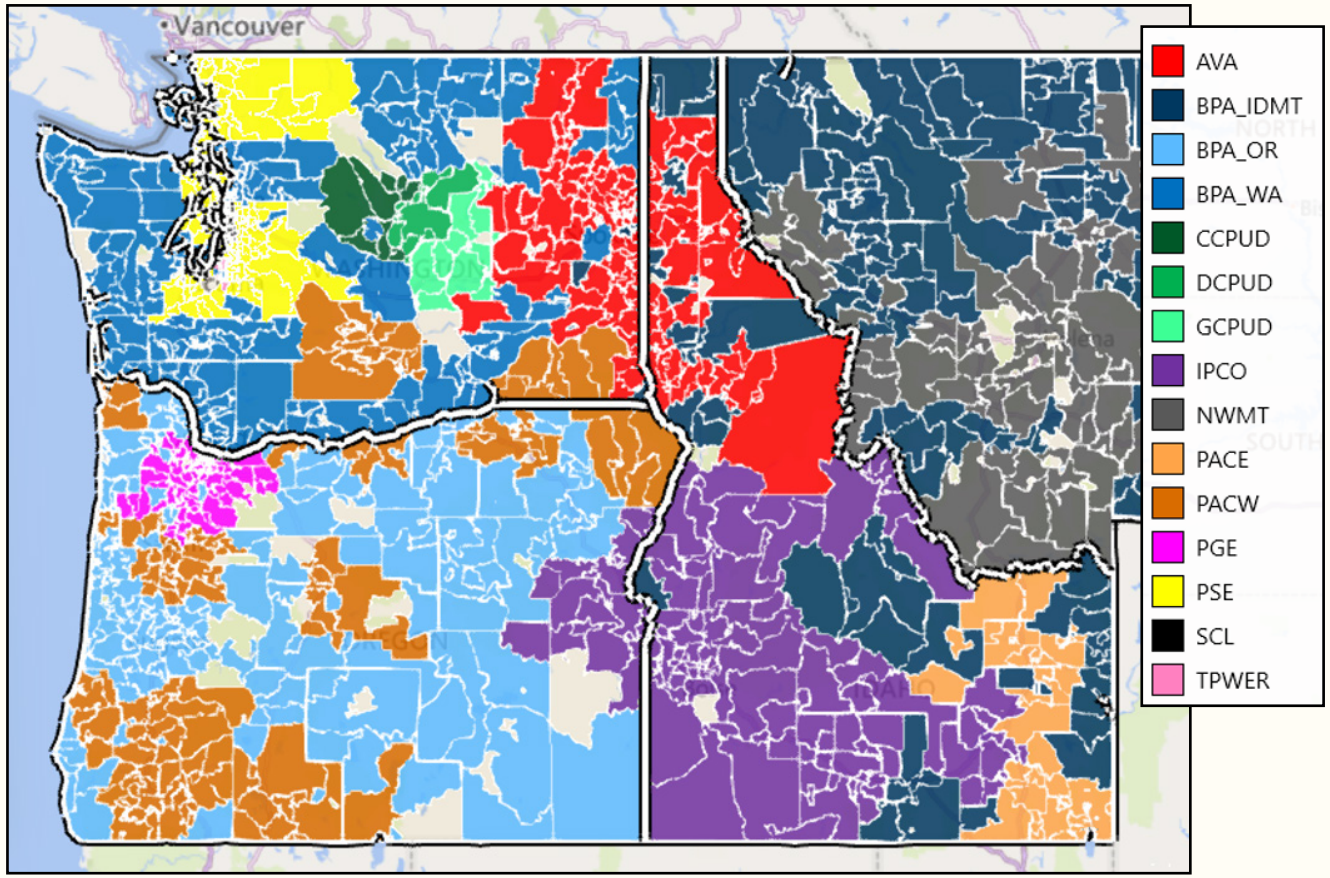
Highly data input driven model

Basic Flow

1. The model calculates a statistically adjusted end use **energy** forecast for the baseline sectors Residential, Commercial and Industrial by BA
2. Individual external demand forecasts are layered in for Data Centers, Electric Vehicles, Rooftop Solar
3. The energy is then shaped using BA and end-use profiles to create an hourly forecast
4. Additional layers for specific scenarios (such as Building Electrification) are added in
5. The forecast is then compiled to report annual, monthly, and hourly energy and peaks

Balancing Authorities

- BPA & 12 BAs
  - Avista
  - Chelan County PUD
  - Douglas County PUD
  - Grant County PUD
  - Idaho Power
  - Northwestern
  - PacifiCorp (East & West)
  - Portland General
  - Puget Sound
  - Seattle City Lights
  - Tacoma Power



*Not an exact representation of BA boundaries. Slight inaccuracies may exist due to overlapping layers

Model Input Data Sets

Historic Load

- Hourly load history for each Balancing Authority (BA)
- Updated through December 2024
- Source – EIA Hourly Grid Monitor

Weather

- Hourly historic weather for 26 weather stations to cover the 13 BAs
- Updated with weather through December 2024
- Typical Weather Pattern – developed for the forecast horizon, developed from 20 years of historic weather 2003-2022)
- 3 Climate Model Weather patterns for the forecast were developed to be cohesive with other planning models

Economic Forecasts

- Population, household size, housing starts
- Real Personal Income (RPI)
- Employment/ unemployment rate
- Gross State Product (GSP)

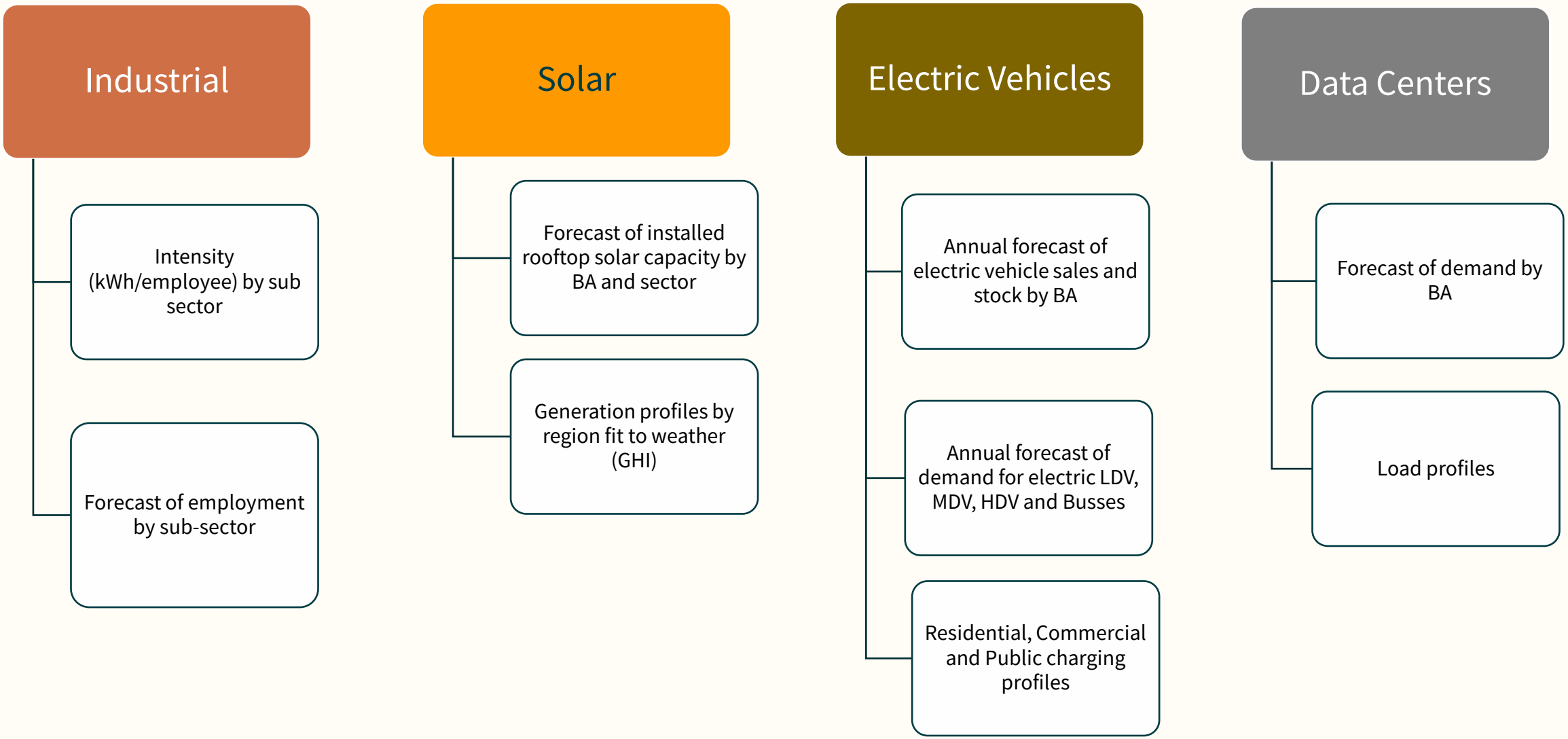
Residential

- SF, MF, Other housing stock – historic and forecast
- End use & Technology unit saturation and efficiency – historic and forecast
- End use shapes and weather response

Commercial

- Building stock square feet – historic and forecast
- End use unit saturation and efficiency – historic and forecast
- End-use shapes and weather response

Model Input Data Sets



Model Input Data Sets

Residential

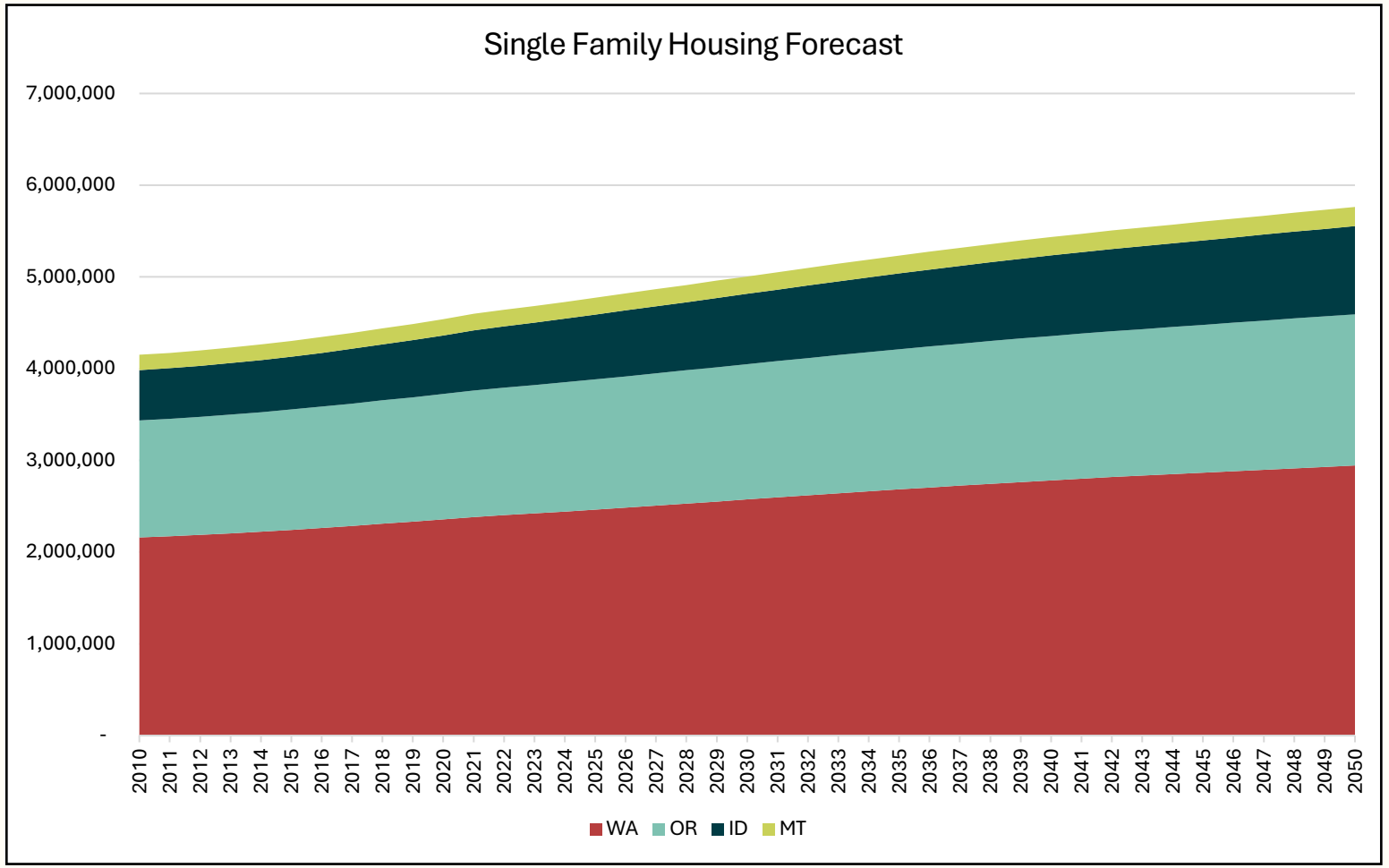
Data Sources

- Census
- S&P
- NWPCC

SF, MF, Other housing stock – historic and forecast

End use & Technology unit saturation and efficiency – historic and forecast

End use shapes and weather response



Model Input Data Sets

Residential

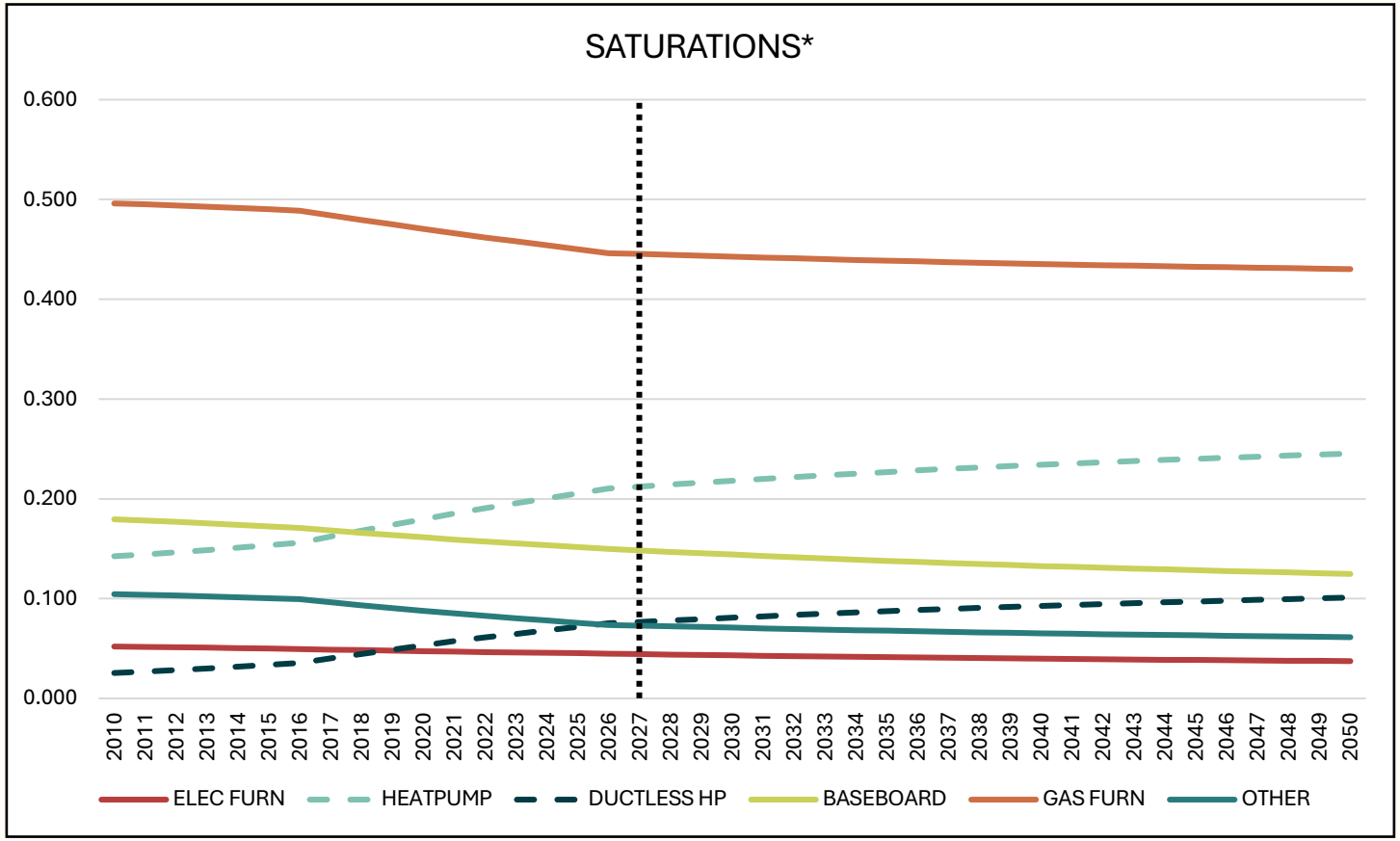
- SF, MF, Other housing stock – historic and forecast
- End use & Technology unit saturation and efficiency – historic and forecast
- End use shapes and weather response

Data Sources

- RBSA (2011, 2017, 2022)
- NWPCC

End Uses

- Space Heating
- Water Heating
- Cooling (Air Conditioning)
- Lighting
- Refrigeration
- Freezer
- Clothes Washer
- Clothes Dryer
- Dishwasher
- Cooking
- Entertainment Center
- Other non-substantials



**Washington Single Family Space Heating Saturations shown as an example*

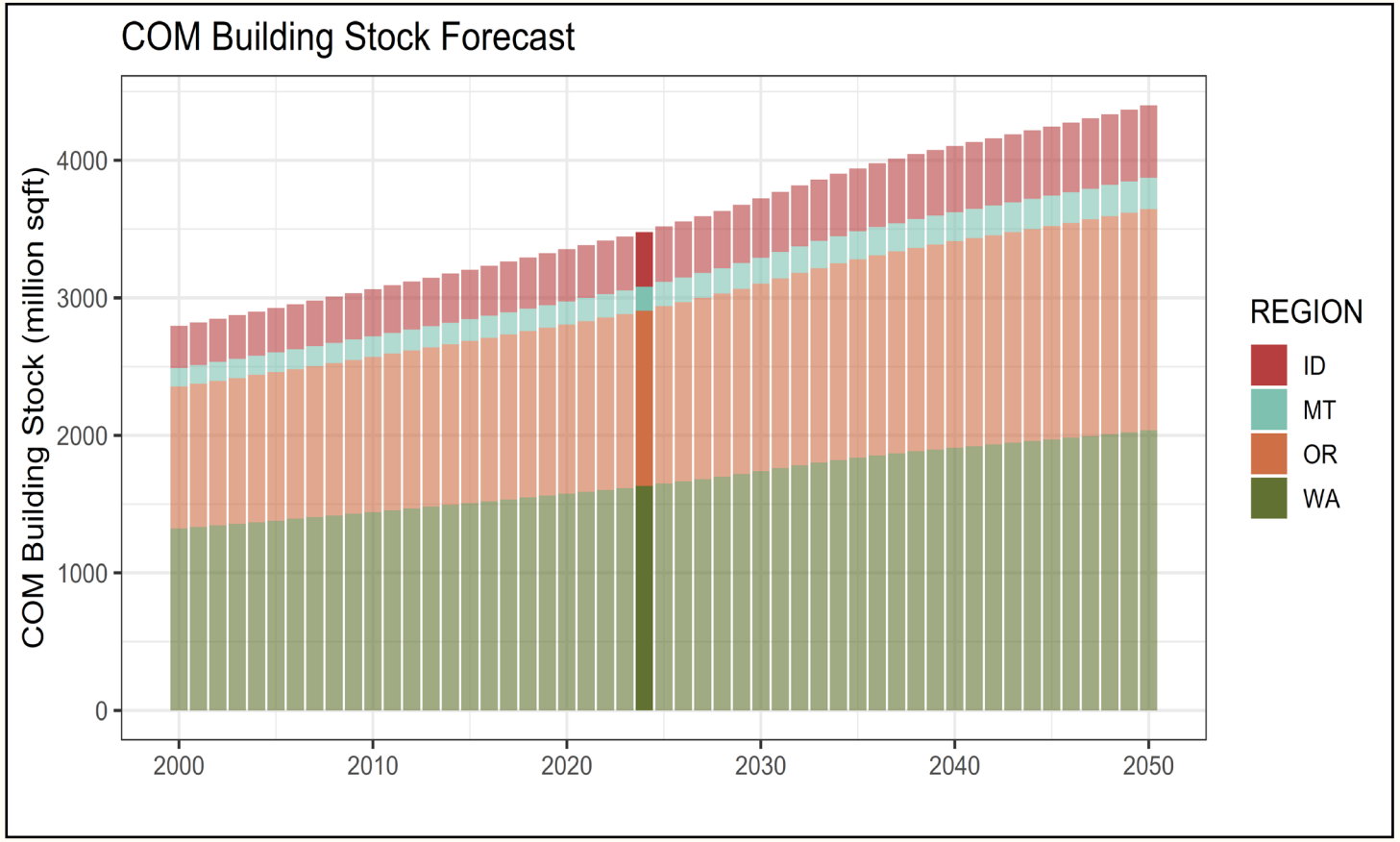
Model Input Data Sets

Commercial

- Building stock square feet – historic and forecast
- End use unit saturation and efficiency – historic and forecast
- End-use shapes and weather response

Data Sources

- 2024 Regional Snapshot
- EIA
- Itron



Model Input Data Sets

Commercial

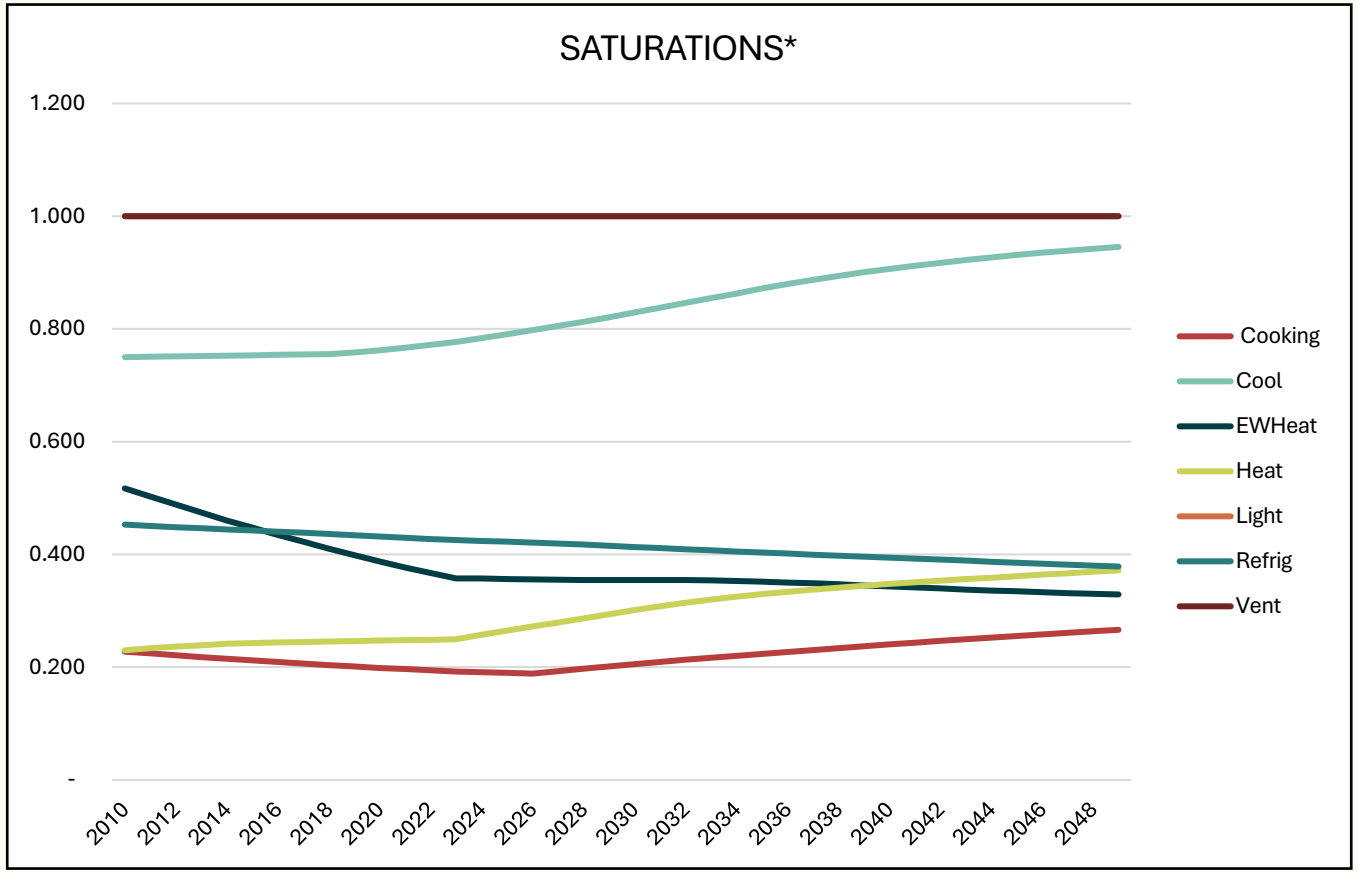
- Building stock square feet – historic and forecast
- End use unit saturation and efficiency – historic and forecast
- End-use shapes and weather response

Data Sources

- CBSA (2009, 2014, 2019
- NWPCC

Building Types

- Assembly
- Education
- Food Sales
- Food Service
- Health Care
- Lodging
- Large Office
- Small Office
- Merc/Service
- Warehouse
- Other



**Washington Saturations (total COM SQFT) shown as an example*

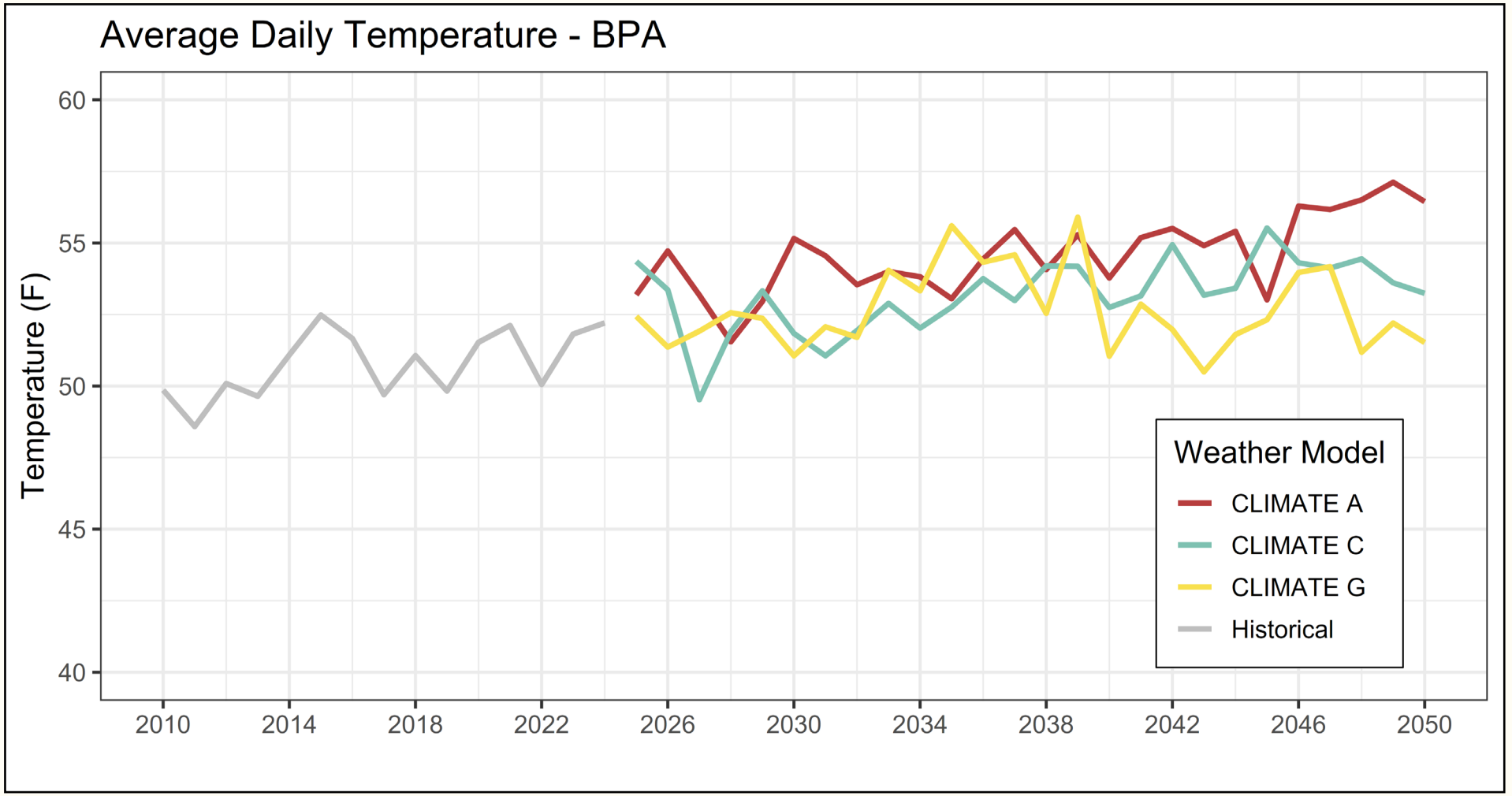
Model Input Data Sets

Weather

BPA Stations

- Omak, WA
- Everett, WA
- Eugene, OR
- Hermiston, OR
- Glacier Park, MT

Warming Trend



Electric Vehicles – 3 basic Inputs to the Model

1. Annual energy demand – MWh – by Balancing Authority from 2025 to 2050 (and historic back to 2010)
2. EV Charging Allocation
3. EV Charging Profiles

These two input sets combine to set the shape of the EV demand that is applied to the energy

Transportation Policies

100% new LDV ZEV by 2035

Advanced Clean Truck (40-70% new ZEV)

IRA Clean Vehicle Credit

Fuel Carbon Intensity reduction

Electric Vehicle Forecast

- We used the EPS Systems Dynamics model by state, developed by Energy Innovations & RMI as a base forecast tool
- This provides a forecast of vehicles and demand by state – which were then allocated among the Balancing Authorities based on estimates of EV registrations by BA
- For a low forecast, we reduced the EV sales and stock by 15% - maintaining policy while reducing the overall transportation need for the region

Data center forecast methodology

- Mid forecast:
  - For utilities with existing data centers, we are using the typical growth over the past four years and pushing this trend forward (typical growth data estimated from EIA form 861)
  - For utilities expecting new data center developments we are assuming growth from large new projects as seen in IRPs/news articles – the growth is derated 20% for possible delays
- Low forecast:
  - For utilities with existing data centers, we are using the typical growth over the past eight years and pushing this trend forward
  - For utilities expecting new data center developments we are assuming growth from large new projects as seen in IRPs/news articles – the growth is derated 60% for possible delays
- High forecast:
  - We are using IRP reference projections when available rather than EIA based projections
  - We are not derating expected new tech development

9th Plan Demand Forecast

Forecast Futures – Definitions and Derivations

Forecast pathways

Pathway	What are we testing	Economics	Transportation	Data Center	Building Electrification	Hydrogen
P1	Persistent high growth	**Medium**	**Higher**	**Higher**	**Higher**	**Higher**
P2	Persistent low growth	**Lower**	**Lower**	**Lower**	**Lower**	**Lower**
P3	Early growth	**Medium**	**Lower**	**Higher**	**Lower**	**Lower**
P4	Late growth	**Medium**	**Higher**	**Medium**	**Higher**	**Higher**
P5	Mixed bag	**Medium**	**Higher**	**Medium**	**Lower**	**Lower**

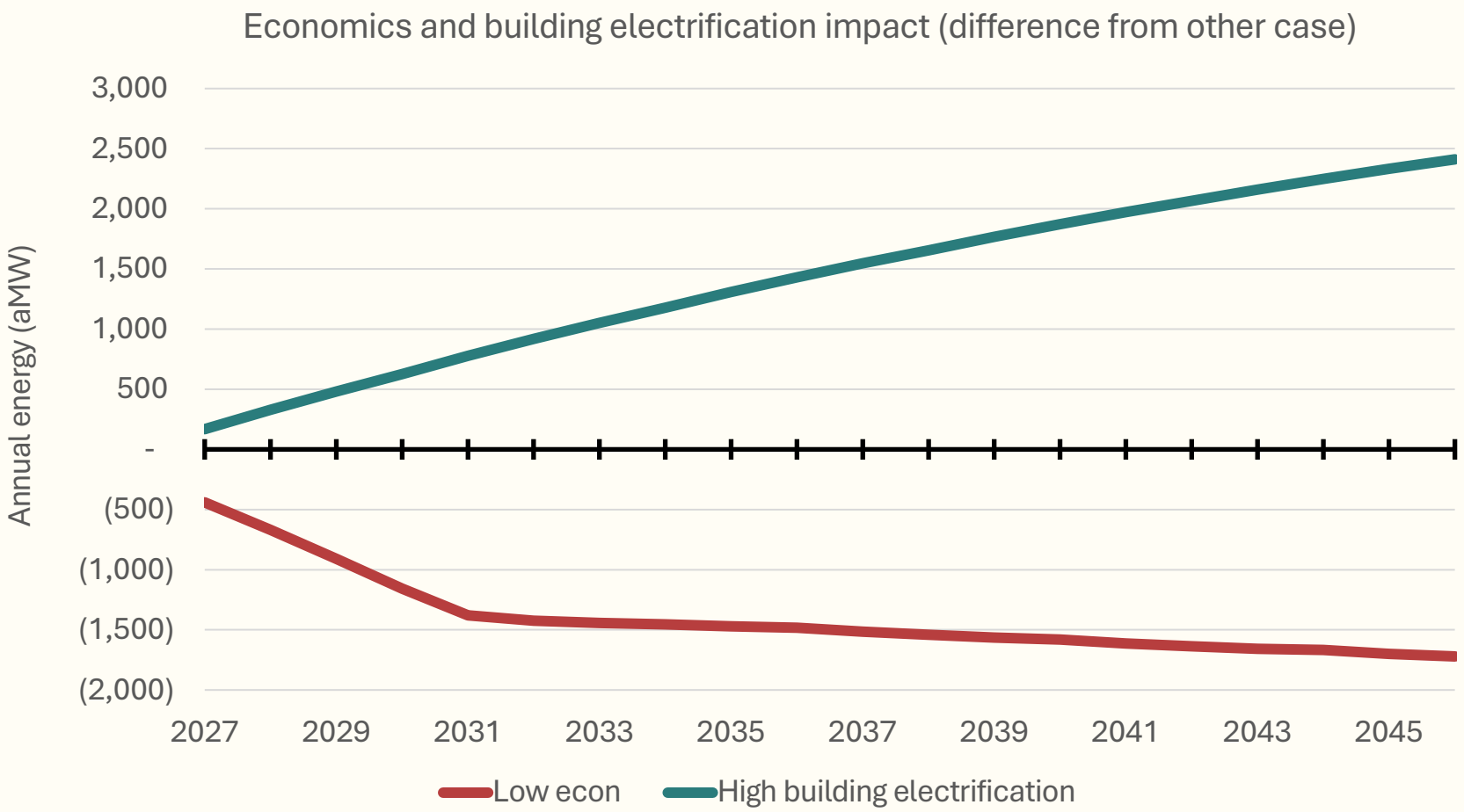
Building Electrification

- A key input for the residential and commercial forecast is end-use saturation projections – in particular space heat and cooling
- For this future, the saturations for electric end-uses were increased for Res and Com for the BAs in Oregon and Washington
- Residential and Commercial
  - Heat pump heat and cool
  - Electric water heat
  - Electric cooking
- The additional building demand was then shaped with the appropriate end use and layered on top of the baseline forecast

Low Economic Case

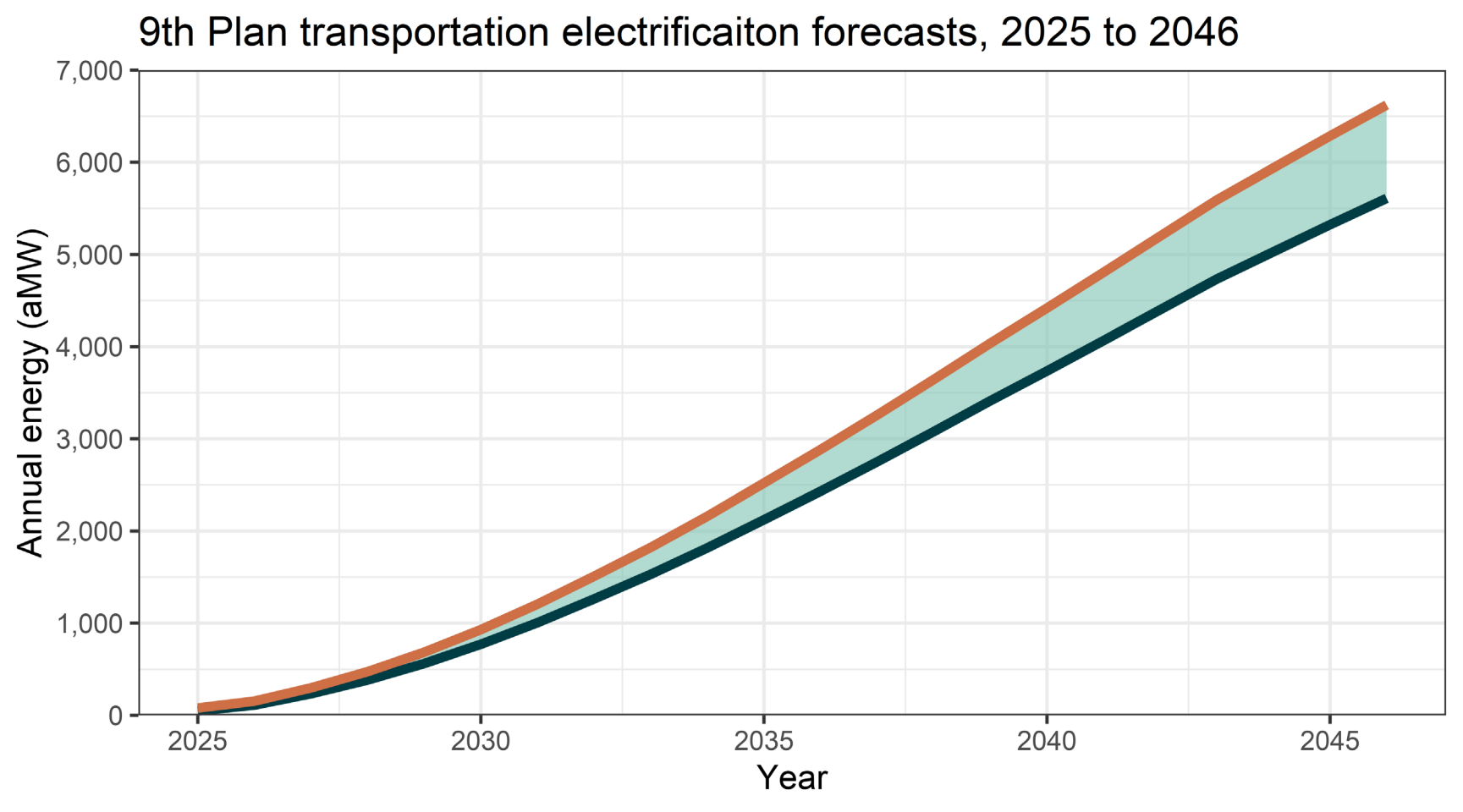
- For this case many of the economic input drivers were reduced by anywhere from 1% to 6% to reflect a persistent subdued economic future
- The economic inputs affected included:
  - Employment
  - Gross State Product
  - Real Personal Income
  - Population, Households and Housing starts

Economics and electrification



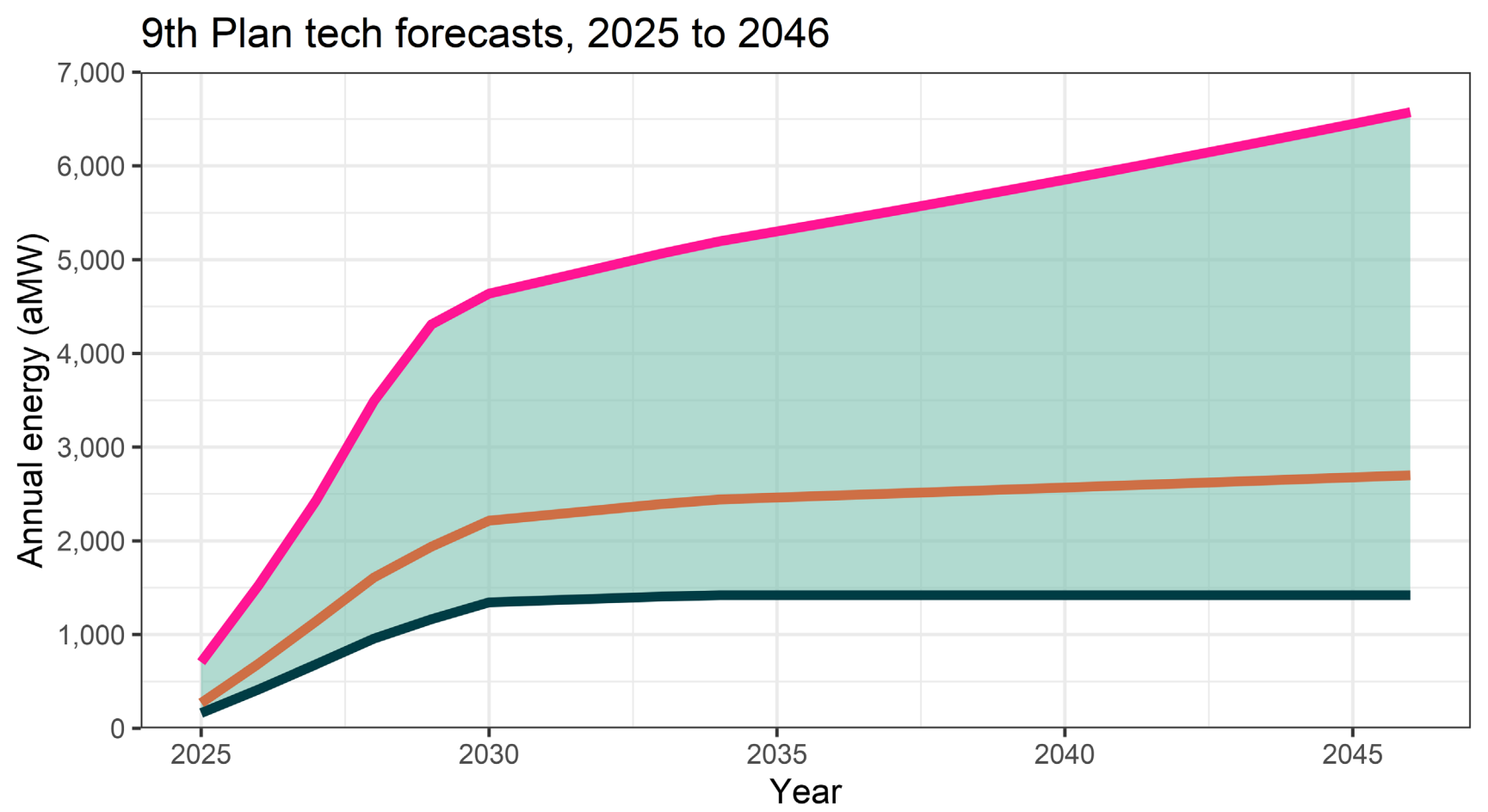
Difference from other case shown (lower BE and medium econ)

Transportation



Both forecasts meet Oregon & Washington clean vehicle policy (which in part drives the tight range)

Tech load forecast (data centers & fabs)



The **high forecast** through 2030 reflects utility and BPA growth expectations

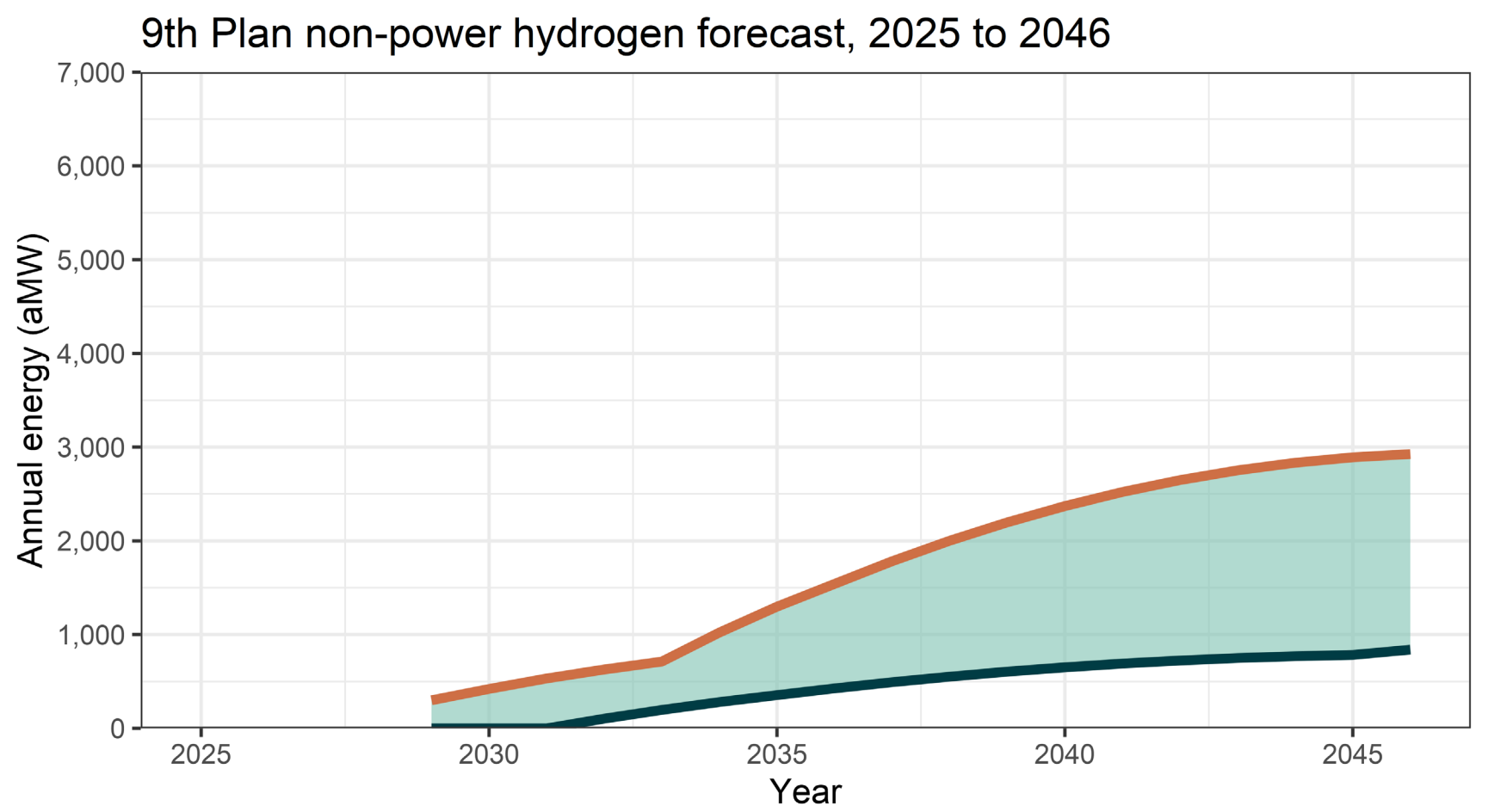
The **mid forecast** through 2030 is a continuation of recent trends

The **low forecast** through 2030 has a slowing of recent trends

Post 2030 growth at a fixed rate depending on forecast

Non power system hydrogen

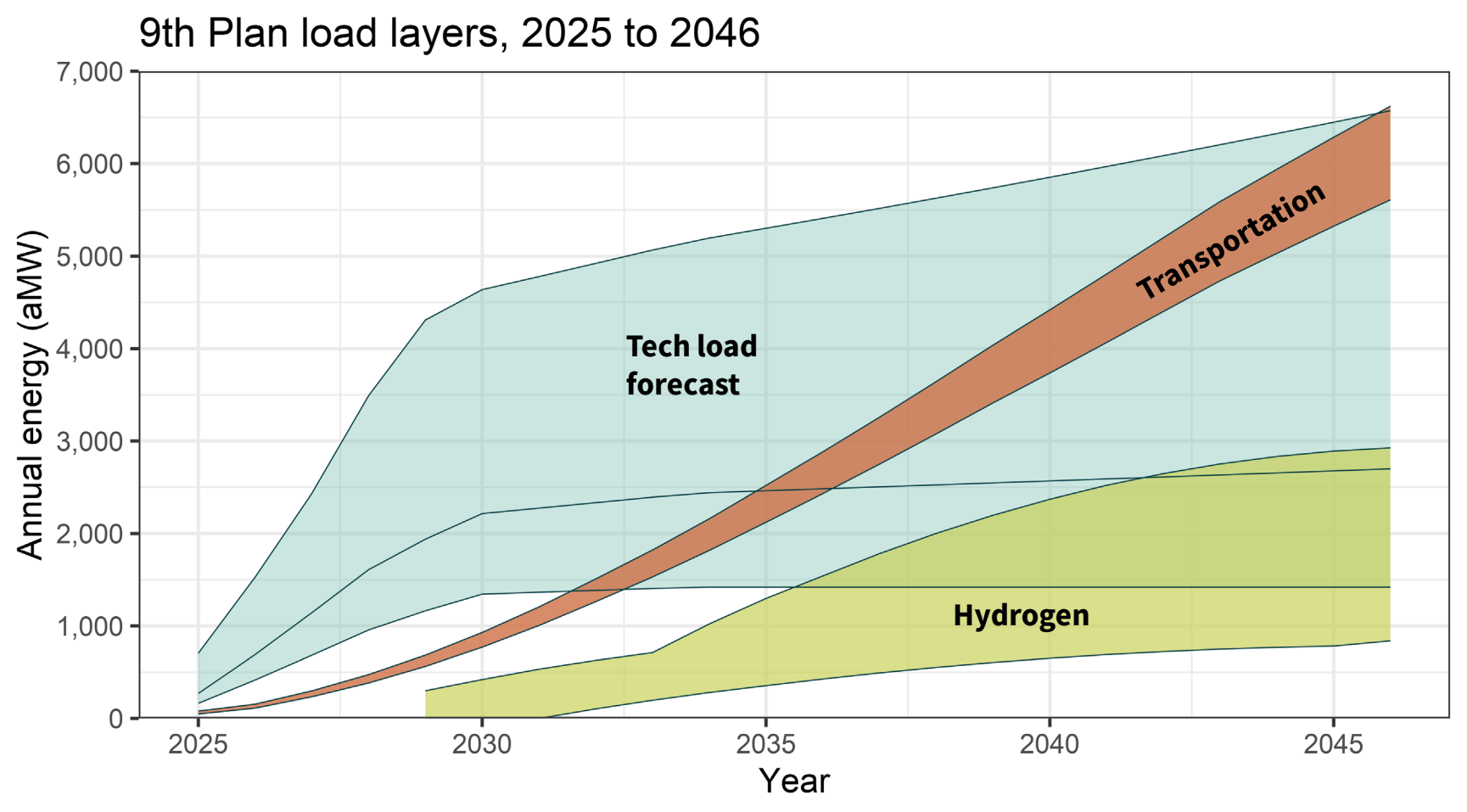
Hydrogen will likely be modeled as an elastic load (it curtails at high market prices), reducing its peak impact on stressful days



The **high forecast** represents the Northwest reaching an assigned portion of a 2023 DOE report by 2050 (with half of the hydrogen needed coming from electricity)

The **low forecast** is roughly based on a delayed version of the PNW Hydrogen hub, with continued growth after hub completion

All together



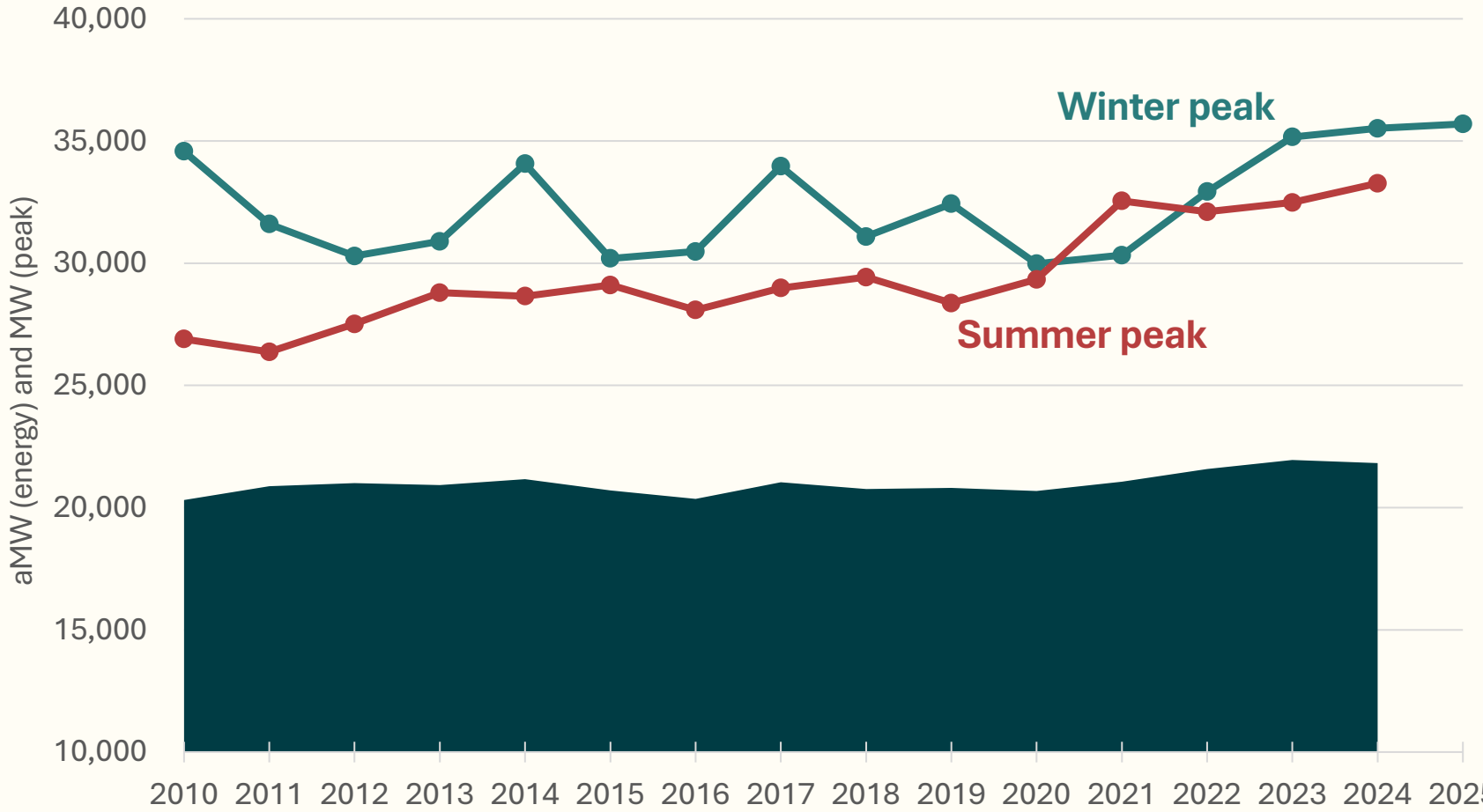
Tech and transportation electrification can reach similar levels by 2046

9th Plan Demand Forecast

Results

Years are operating years (Oct – Sep) to keep winter months together. Data from EIA Form 930, FERC Form 714, and BPA SCADA. Year 2025 data are preliminary.

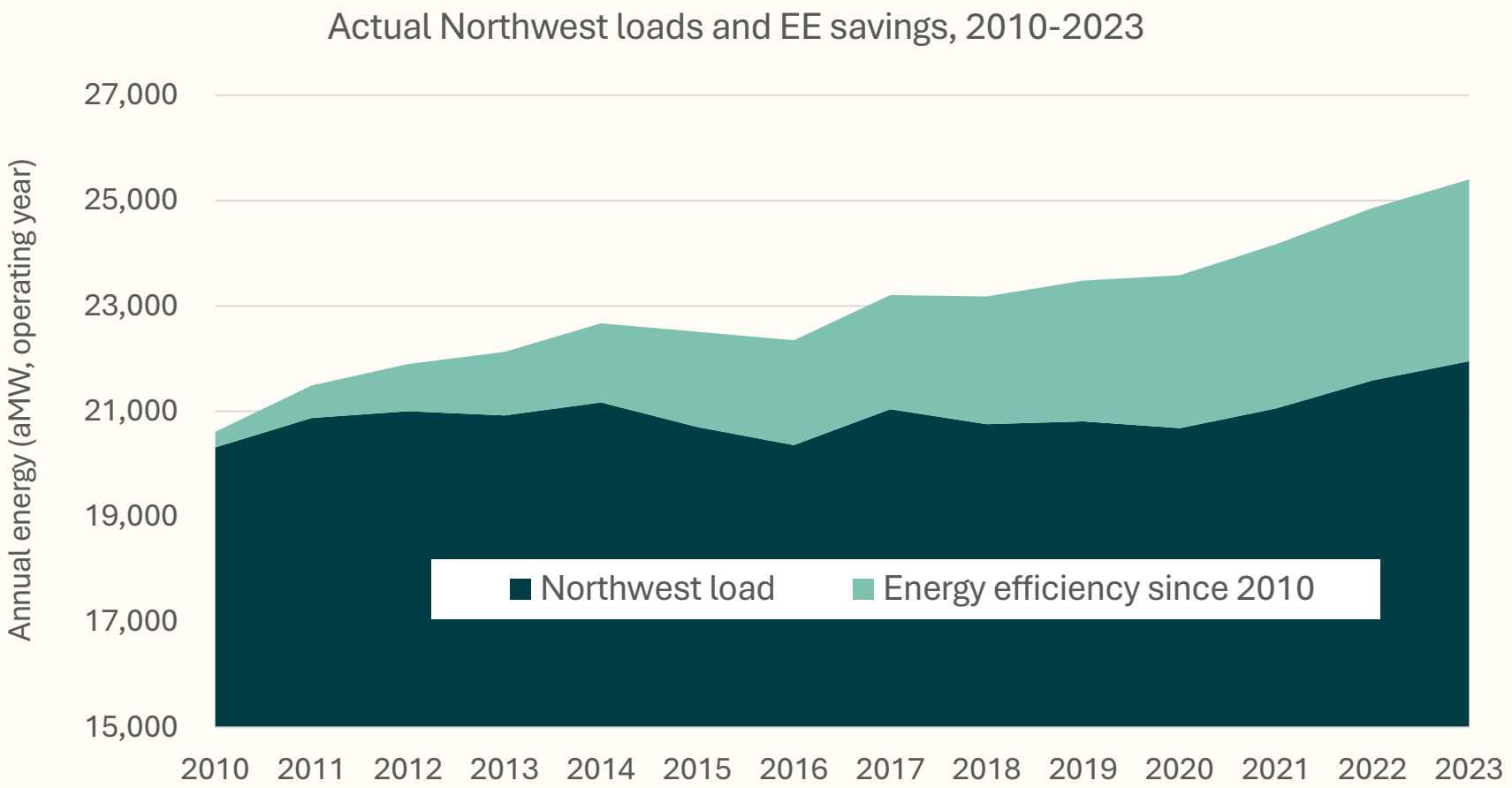
Level setting – actual loads since 2010



The region has hit post-DSI peak load records in recent years

Annual energy loads have moved up in recent years

Level setting – loads net energy efficiency



Load increased around 1,500 aMW from 2010-2023

After netting out energy efficiency, there was around 5,000 aMW of growth in that period

Peaks

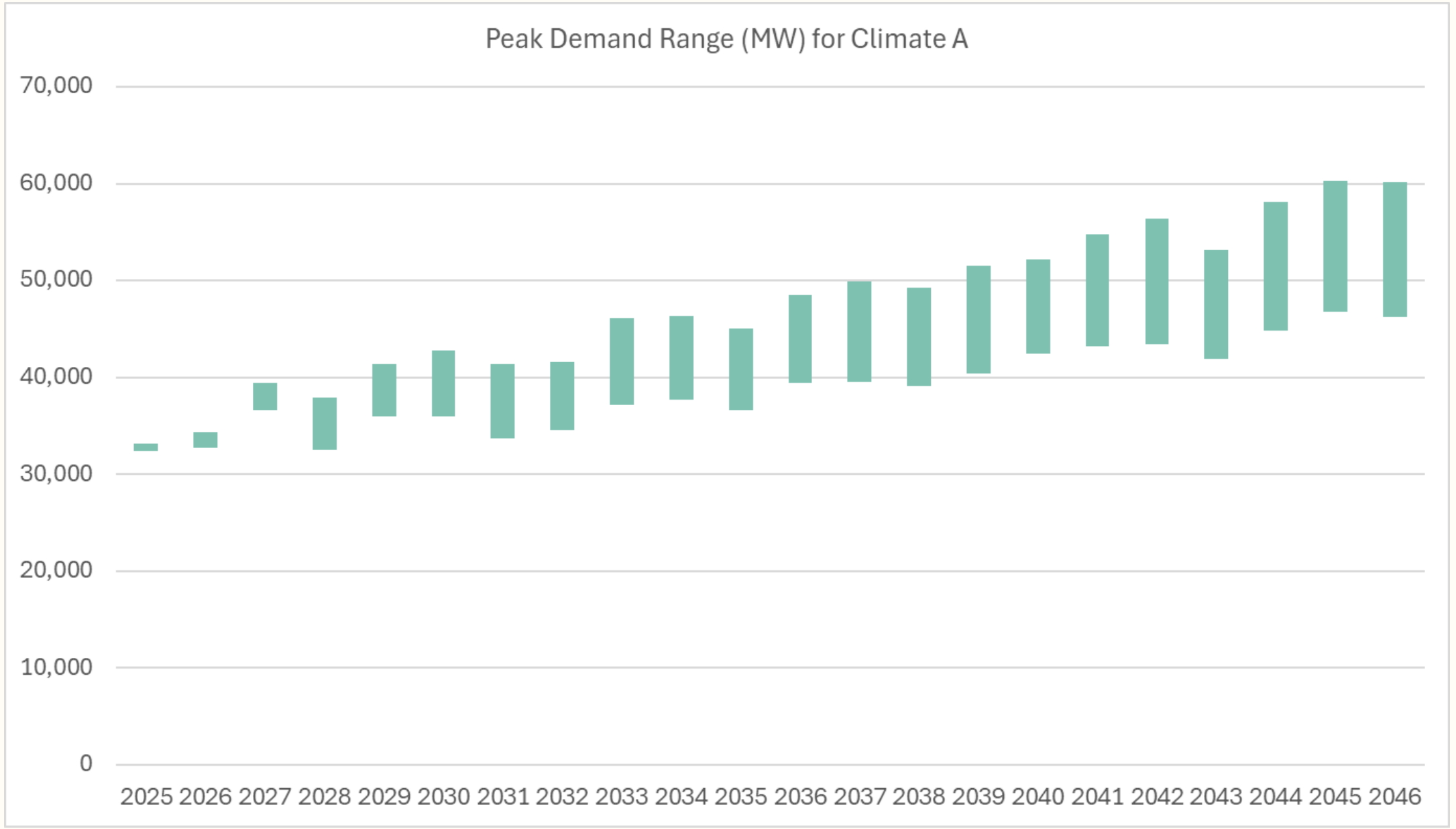
Northwest **Power** and **Conservation** Council

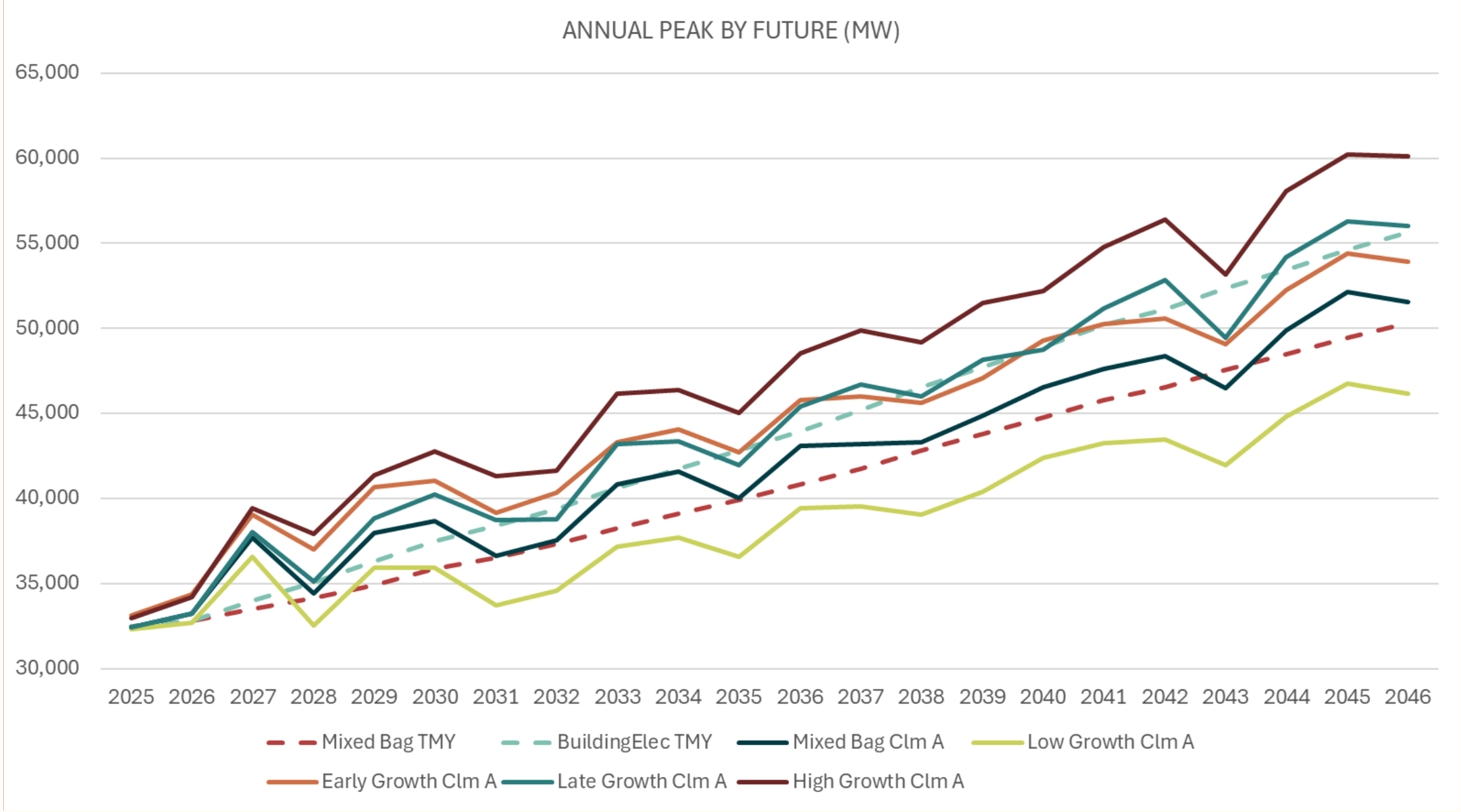
Peak Demand

- The forecast model produces an hourly demand for each of the 13 Balancing Authorities across the 20-year planning horizon
- We also calculate a system-wide coincident peak broken out by demand component
  - Baseline (residential/commercial/industrial) on peak
  - Rooftop solar and EE on peak
  - Electric Vehicle charging on peak
  - Data Center demand
  - Building Electrification (RES and COM) on peak
- Average annual growth rates across all futures range from 1.9 % to 3.0 %

System Peak

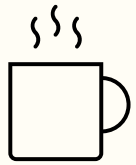
- Seasonal
  - There is a mix of winter and summer peaking Balancing Authorities however historically the region is winter peaking
  - The forecast is showing some occasional summer peaks creeping in
- Time of Day
  - Winter peaks can switch between morning or evening
  - Summer peaks are in late afternoon/early evening
- Weather
  - The baseline sector (Residential, Commercial, Industrial) peak is temperature sensitive and peaks in very cold or very hot weather
  - Additional building electrification end uses are weather sensitive and contribute to peak
- Electric Vehicle demand is not weather sensitive but is time-sensitive and is projected to grow significantly
- Data Centers have a relatively flat load profile that simply raises the floor of the entire demand level


Peak Demand Range (MW) for Climate A
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045 2046


ANNUAL PEAK BY FUTURE (MW)
65,000
60,000
55,000
50,000
45,000
40,000
35,000
30,000
2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045 2046
Mixed Bag TMY
BuildingElec TMY
Mixed Bag Clm A
Low Growth Clm A
Early Growth Clm A
Late Growth Clm A
High Growth Clm A

2027 Peak – 37,728 MW

January 20 - morning



Baseline – 36,453 MW

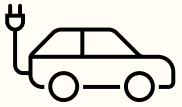
very cold temps, high heating loads

Rooftop Solar – (22) MW

Not much help

EV Charging – 145 MW

Some morning EV charging to get ready for the day, but not much



Data Centers – 1,142

DCs continue to hum away

2029 Peak – 37,973 MW

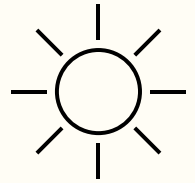
July 23 –late afternoon

Baseline – 35,306 MW

Hot summer day

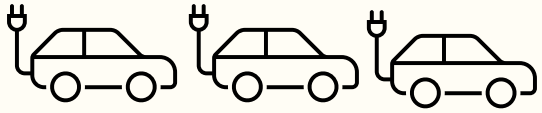
Rooftop Solar – (230) MW

decent peak reduction



EV Charging – 968 MW

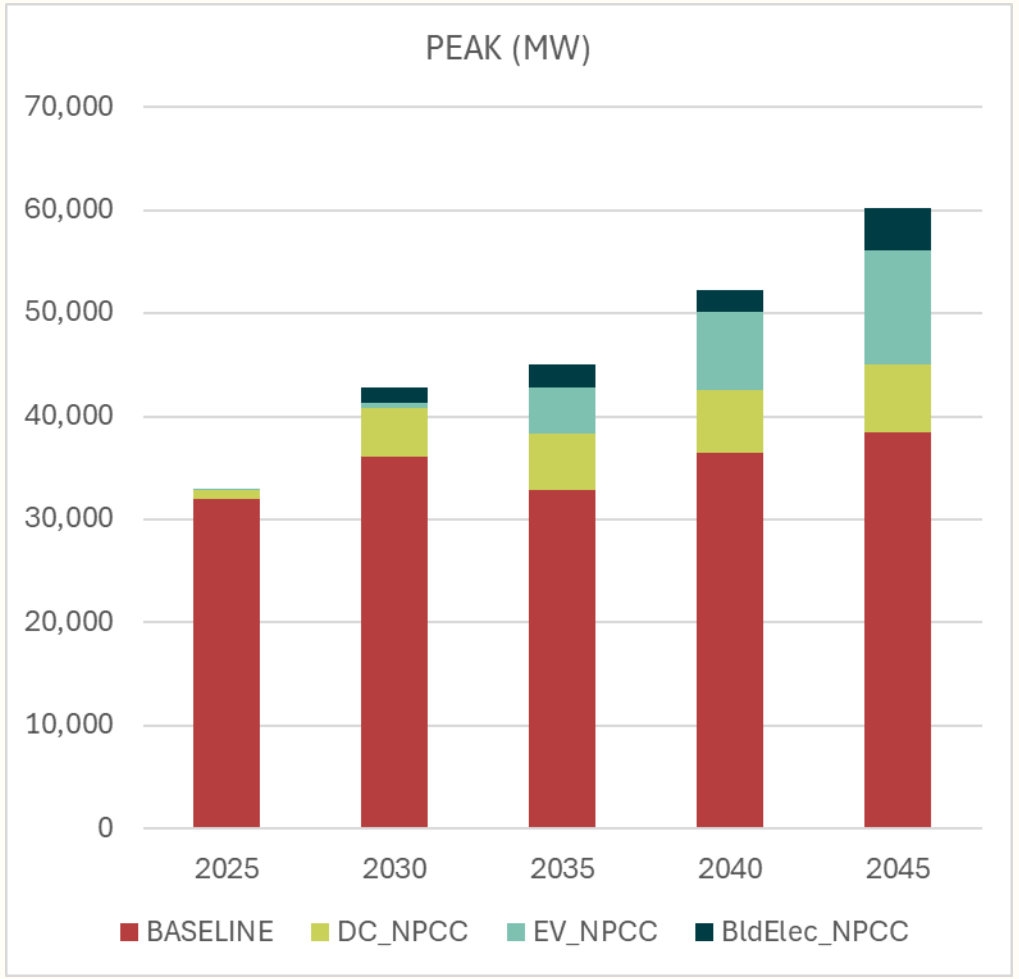
Lots of evening EV charging as folks return home

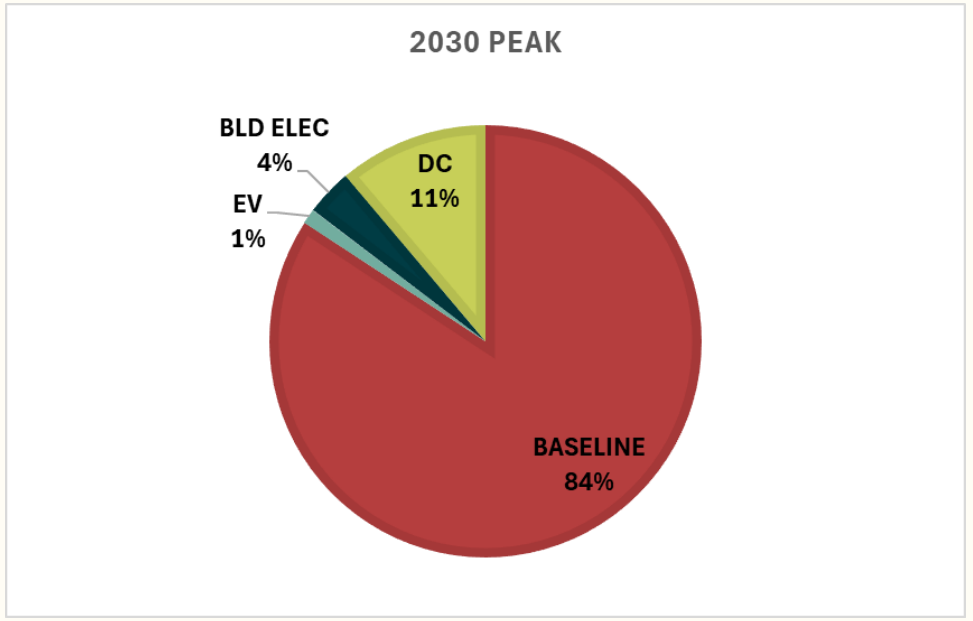


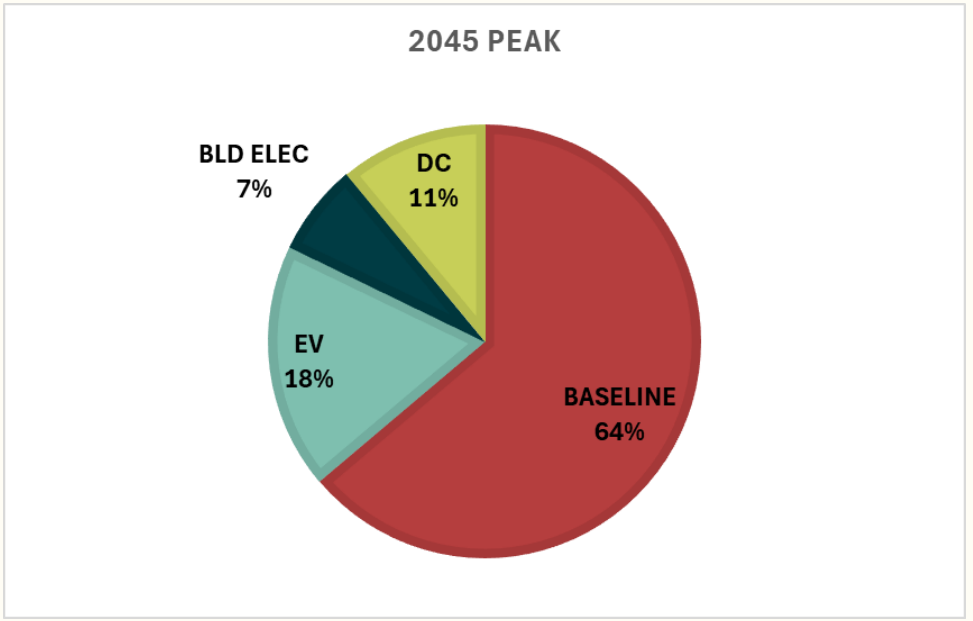
Data Centers – 1,929

2 years later even more DCs hum away

High Growth with Climate A weather

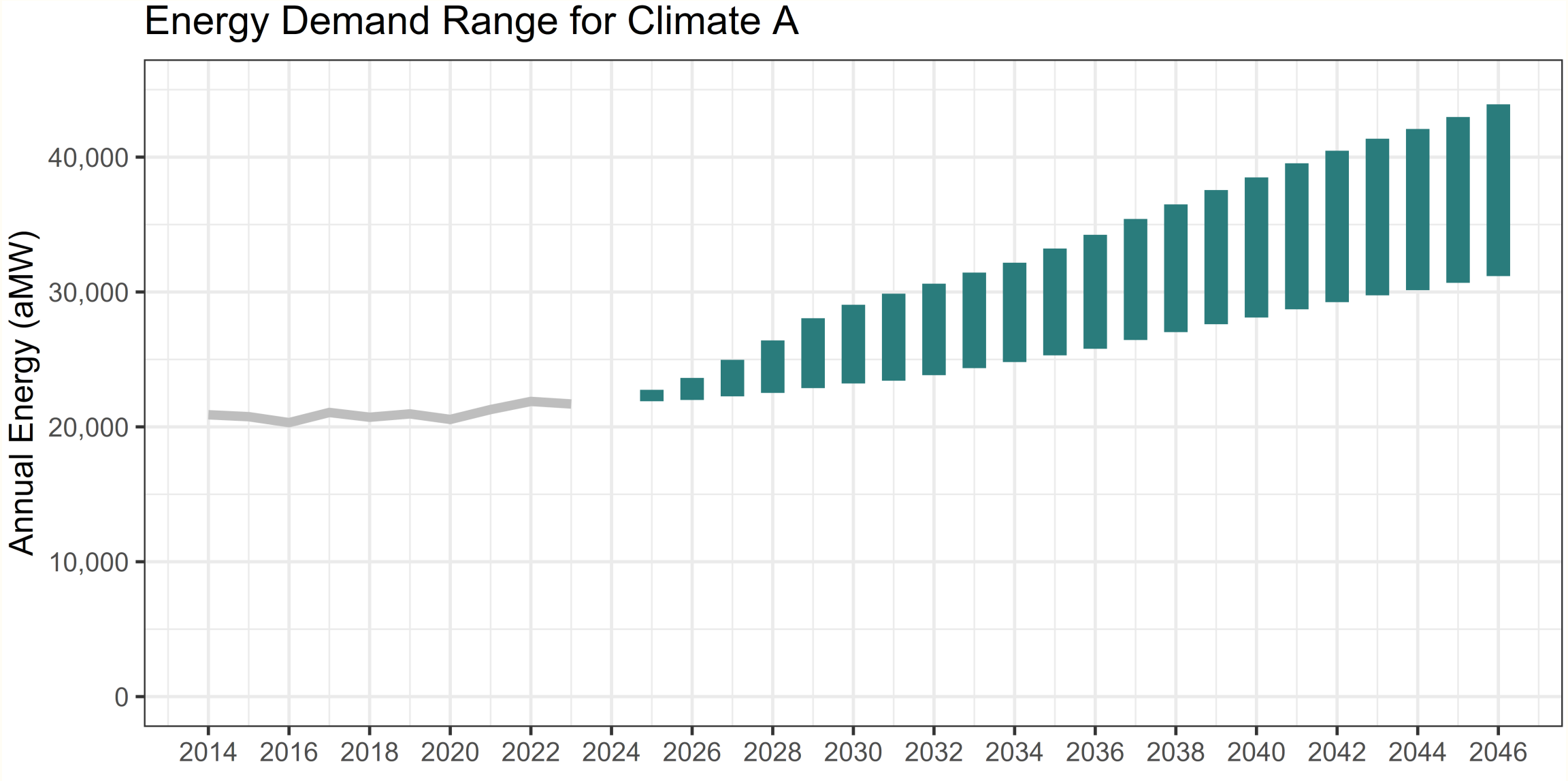




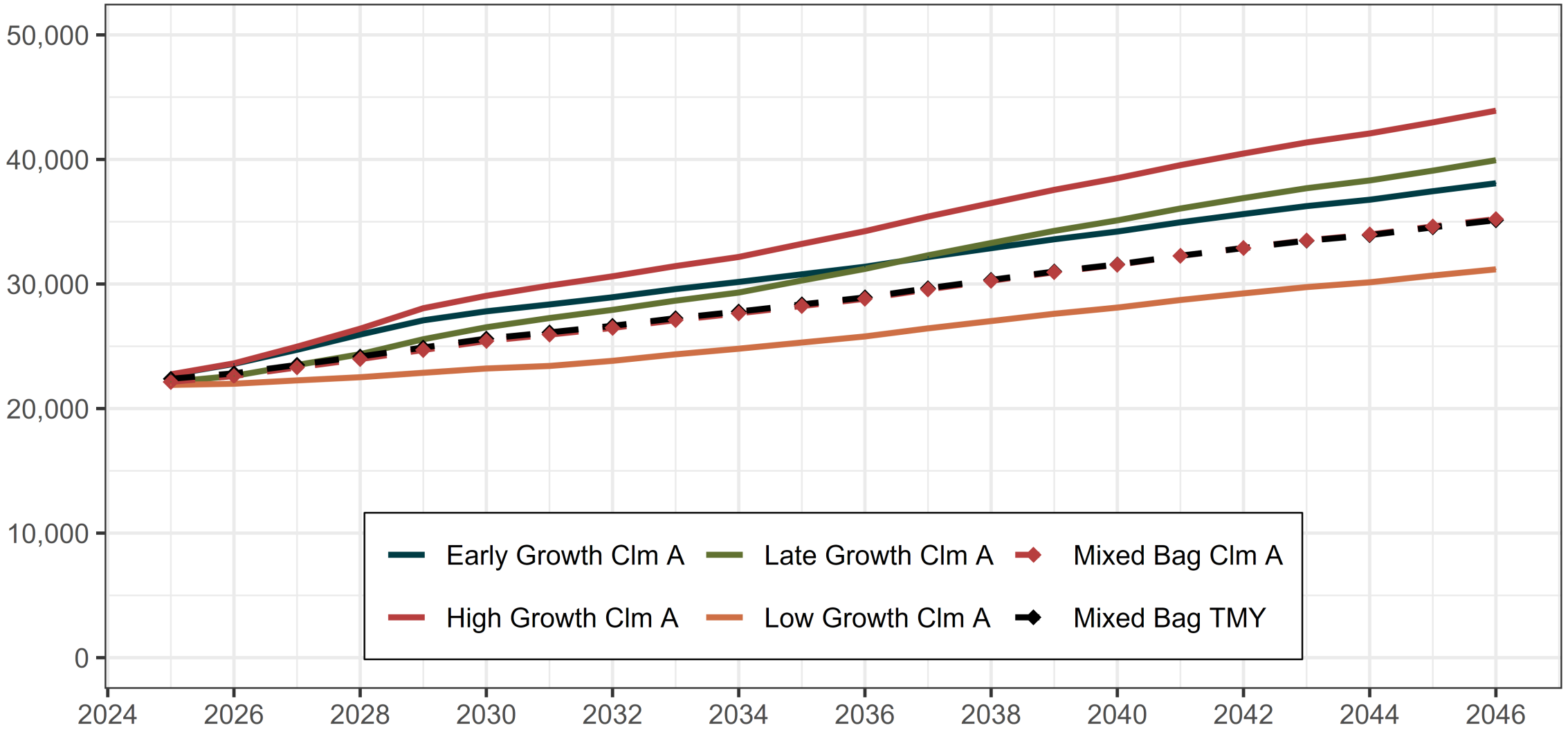


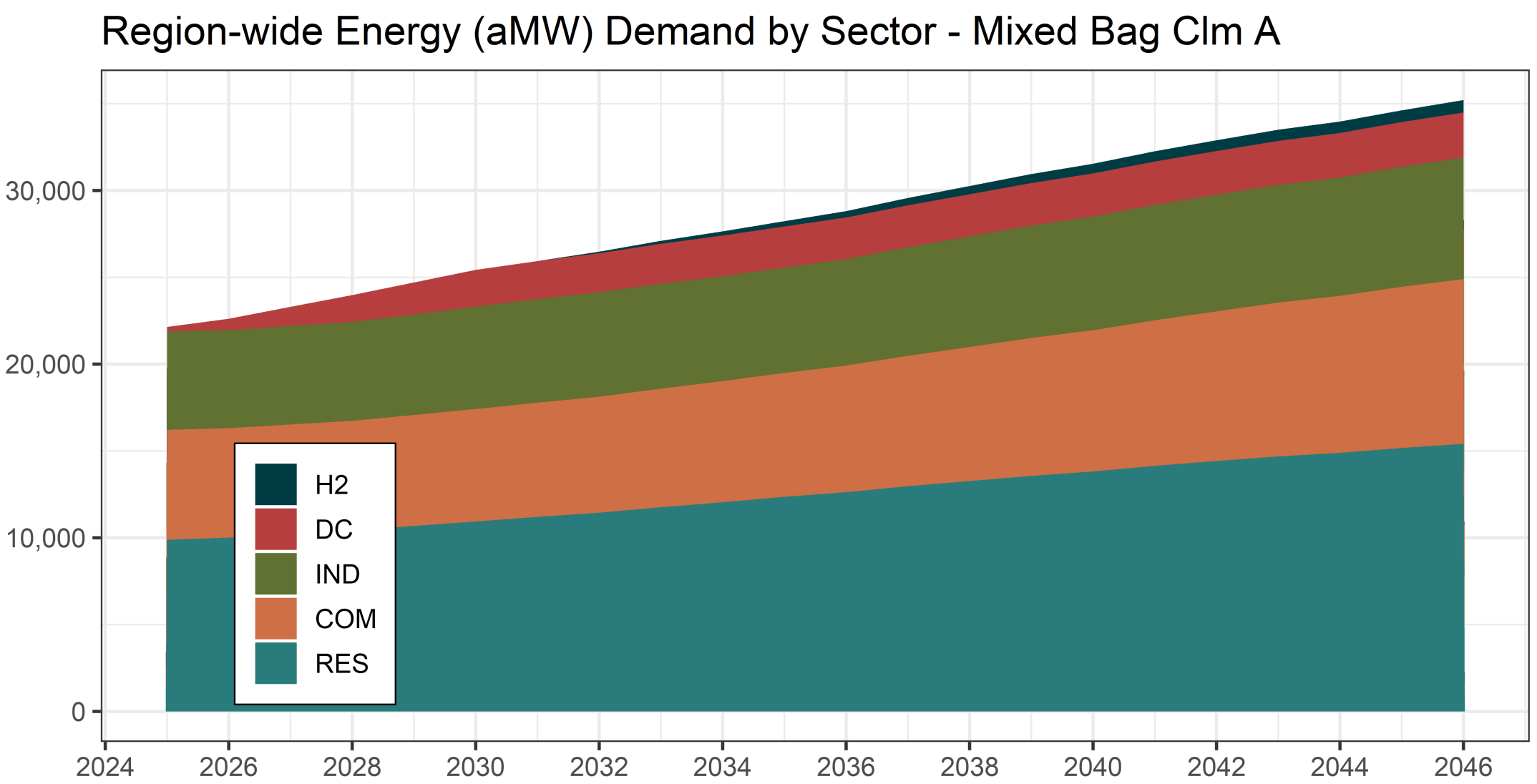
Energy

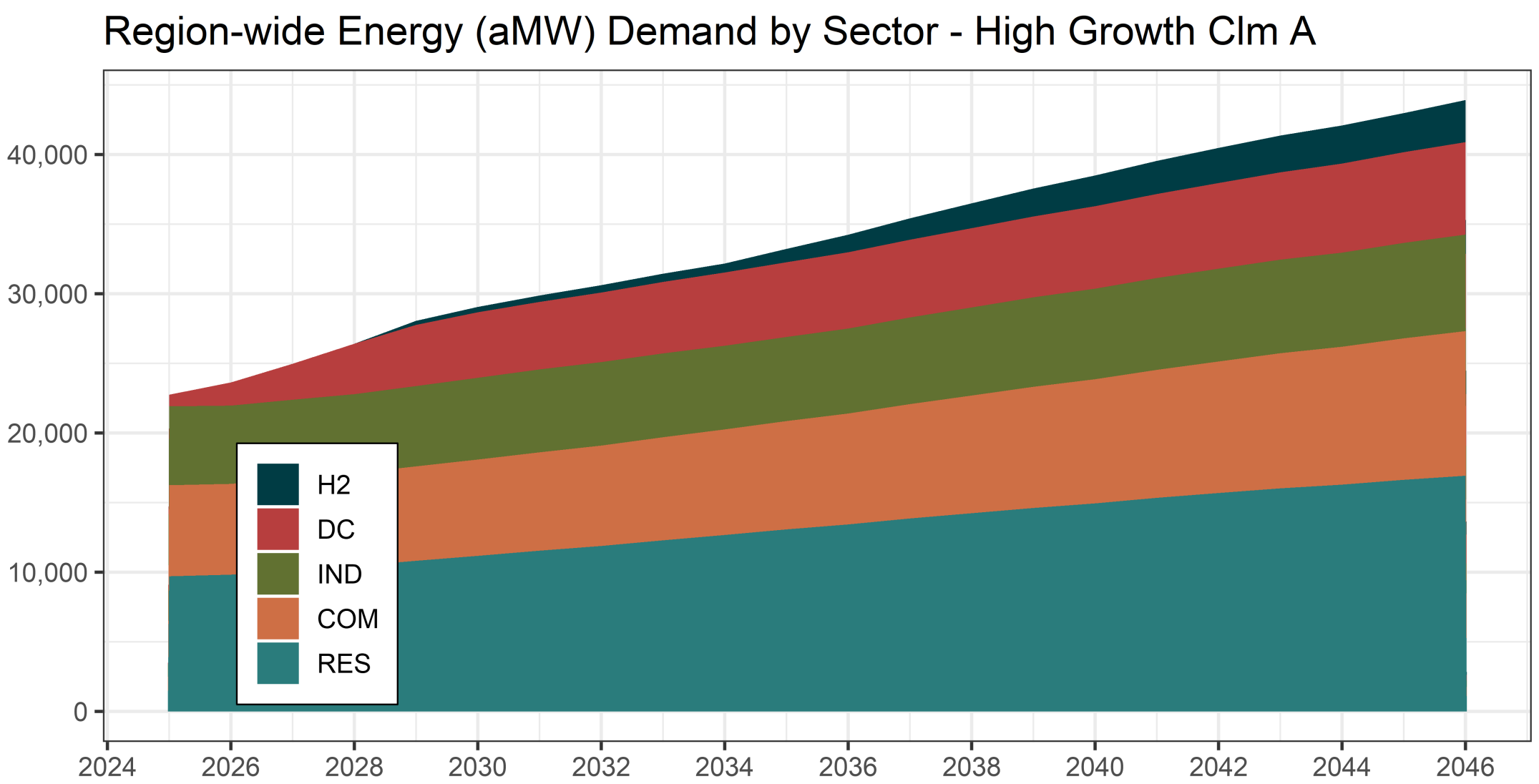
Northwest **Power** and
Conservation Council


Energy Demand Range for Climate A
Annual Energy (aMW)
40,000
30,000
20,000
10,000
0
2014
2016
2018
2020
2022
2024
2026
2028
2030
2032
2034
2036
2038
2040
2042
2044
2046

Region-wide Energy (aMW) Demand Forecast




Region-wide Energy (aMW) Demand by Sector - Mixed Bag Clm A
30,000
20,000
10,000
0
2024
2026
2028
2030
2032
2034
2036
2038
2040
2042
2044
2046
H2
DC
IND
COM
RES


Region-wide Energy (aMW) Demand by Sector - High Growth Clm A
40,000
30,000
20,000
10,000
0
2024
2026
2028
2030
2032
2034
2036
2038
2040
2042
2044
2046
H2
DC
IND
COM
RES

9th Plan Demand Forecast

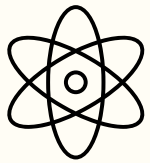
Wrap up

"It's tough to make predictions. Especially about the future."

– Hall of Fame Catcher
Yogi Berra

or possibly…

– Hall of Fame Physicist
Niels Bohr



Thanks for listening today!

- We will be making data sets and results available on the Ninth Plan Elements and Inputs webpage

- Comments, concerns, questions – please reach out to me:

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ssimmons@nwcouncil.org