BPA 2024 Resource Program Public Workshop

November 28, 2023

Today's Workshop

Brian Dombeck

Recap of June 1st 2023 Workshop

- The 2024 Resource Program held its first public workshop in June 2023, which provided an overview of planned scope for RP24, including:
  1. Relationship between 2024 Resource Program, Provider of Choice Long-term Contract Signing Process, 2026 Resource Program, and resource acquisition
  2. Strategy to address specific planning risks via “scenarios” and “sensitivities”
  3. Discussion of key innovations to RP24 such as new solver for producing resource solutions, zonal perspective of Needs Assessment, and climate change informed loads and resources in baseline

Agenda

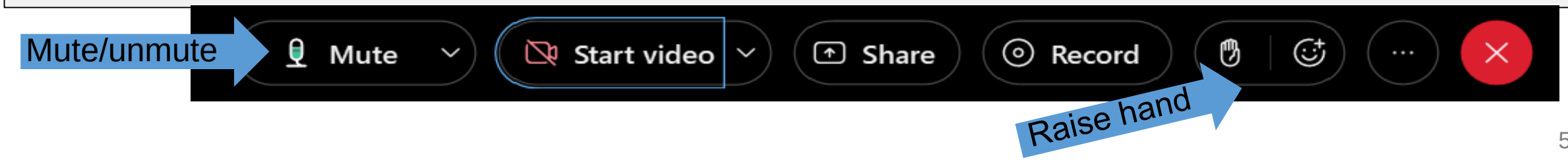
Start	End	Time	Topic	Presenter(s)
9:00 AM	9:15 AM	15	Workshop Agenda and Format	Brian Dombeck
9:15 AM	9:20 AM	5	Introductory Remarks	Michelle Cathcart
9:20 AM	10:30 AM	70	Forecasts of BPA obligations and Total Retail Loads.	Erin Riley
10:30 AM	10:45 AM	15	B R E A K	
10:45 AM	12:00 PM	75	Load Forecasting Methods and Data Inputs	Adela Arguello
12:00 PM	1:30 PM	90	L U N C H	
1:30 PM	2:15 PM	45	RP24 Scope: Scenarios and Sensitivities	Ryan Egerdahl
2:15 PM	2:45 PM	30	Needs Assessment Overview	Erin Riley
2:45 PM	3:00 PM	15	Wrap up and Conclude	Brian Dombeck
3:00 PM			Conclusion	

Format

- Presenters will communicate their preference for taking questions, which will be addressed in the order received
- If a question/opportunity for feedback arises during a presentation, please:
  - In-person: Raise your hand
  - Webex: Write it in the Webex Q&A *or* use the Webex "raise hand" feature; when called on, mute/unmute yourself.
  - Both: State your name and organization
- Webex participants can adjust magnification of shared screen using (-/+) buttons

Note: The "Chat" feature in Webex has been disabled for this meeting. Please type Questions in the "Q&A" box or raise your hand to be recognized.

Webex:



Reminder: Power Planning at BPA

- Each year, BPA publishes the Pacific Northwest Loads and Resources Study – often referred to as the **White Book** - which analyzes BPA's projections of retail loads, contract obligations, contract purchases, and resource capabilities over a 10-year study horizon and describes expected energy and capacity surplus/deficits under varying water conditions.

- On a biennial basis, BPA conducts an IRP-like assessment collectively referred to as the **Resource Program** which examines uncertainty in loads, water supply, natural gas prices, and electricity market prices to develop least-cost portfolios of resources that meet BPA's obligations.

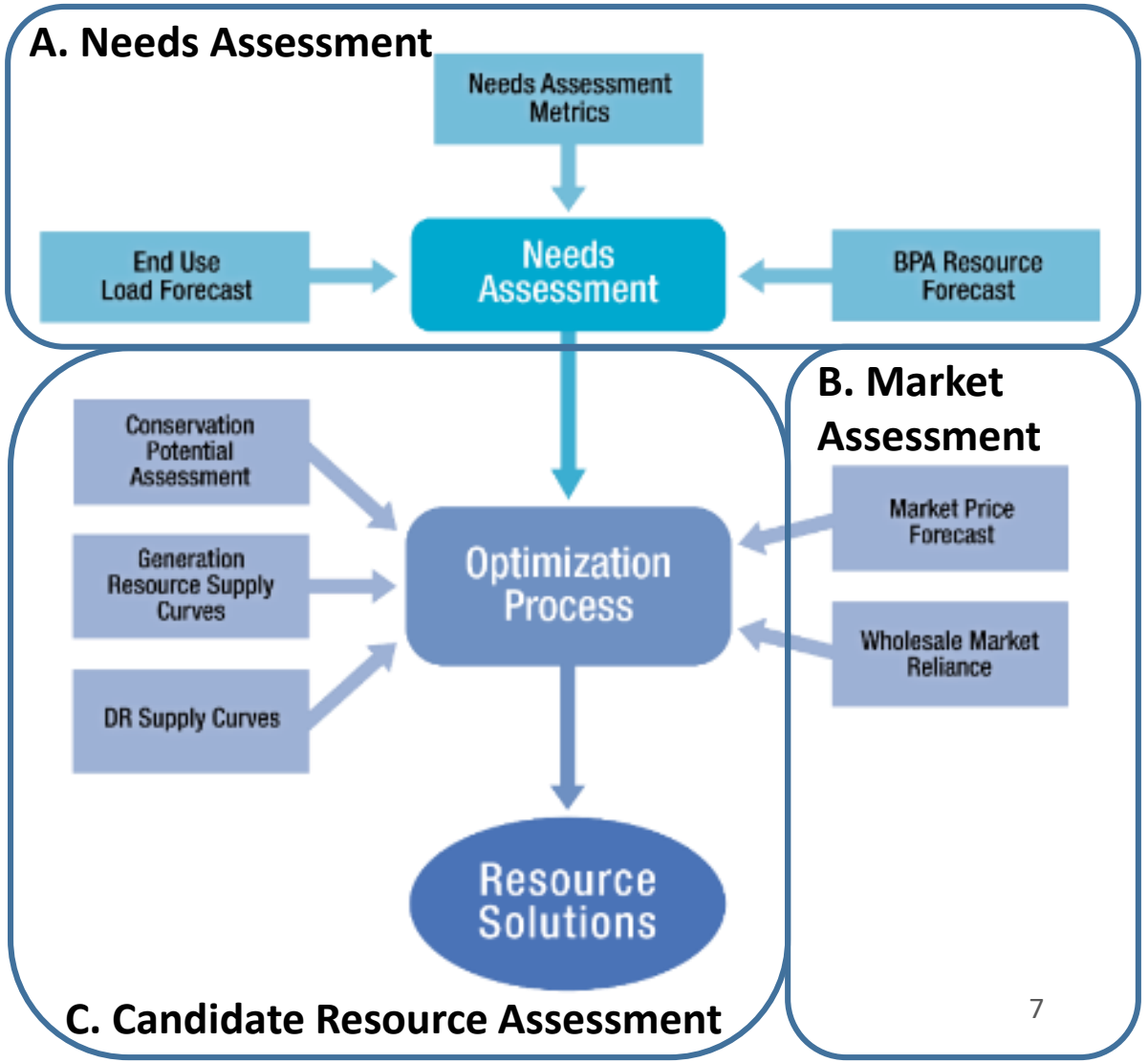
- These processes are voluntarily undertaken to inform acquisition strategies and provide valuable insight into how Bonneville can meet its obligations cost-effectively. They are neither decision documents nor a process required by any external entity.

BPA Resource Program Process Map

A. The **Needs Assessment** measures the federal system's expected generating resource capabilities to meet projected load obligations

B. The **Market Assessment** simulates the evolution of power markets in the Western Interconnect to generate a long-term forecast of Mid-Columbia prices and market availability under a variety of generation, load, and economic conditions

C. The **Candidate Resource Assessment** explores how the varying costs, performance, and availability of candidate demand-and-supply-side resources (including conservation, demand response, market purchases, and generating resources) can be used to provide a least-cost resource strategy for meeting identified needs



Introductory Remarks

Michelle Cathcart
Vice President, Generation Asset Management

RP24 and Related Processes

**For illustrative purposes only. All dates tentative and subject to change*

Load Forecasts

Erin Riley & Adela Arguello

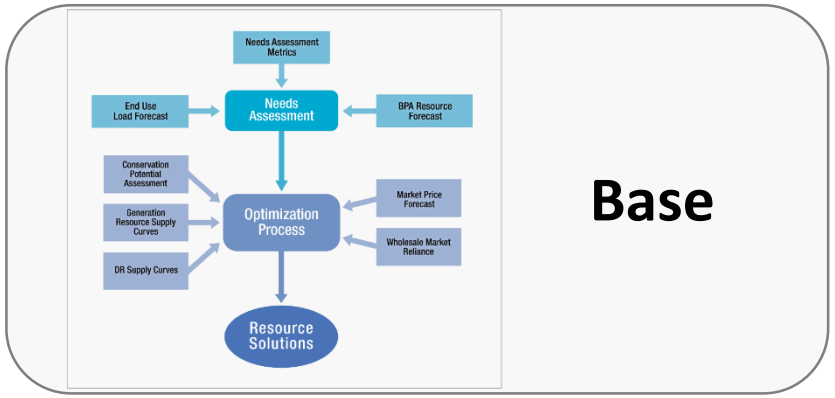
Key Takeaways from Load Forecasting Section

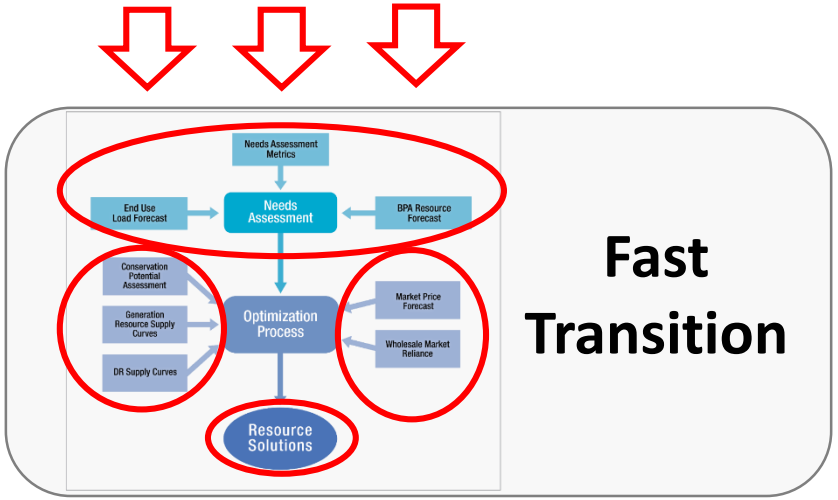
- Largest driver of load growth in the BPA footprint is from large data centers
- Climate change combined with increased AC saturation rates is increasing summer loads, but milder temperatures are decreasing winter load
- Increased electrification (EVs and Heat pumps) are driving up winter loads
- Economic outlook combined with net zero targets drive large changes in growth rates
- BPA Obligations are forecast to increase under current elections
- Customer elections will impact obligations forecast

RP24 Planning Framework

Scenarios

Scenarios are comprised of a set of inputs that are consistently developed for a future outlook

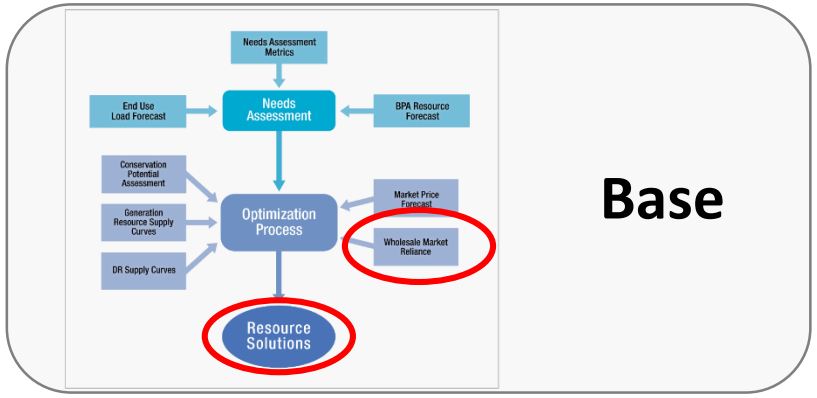




Sensitivities

Changes to individual input assumptions (or smaller subsets of input assumptions) within a given scenario

- Provide BPA decision-makers with additional options to address key strategic interests (PoC / Carbon Vision, etc)
- Evaluate solution sensitivity to specific assumptions
- Assess solution robustness



Load Forecasting Assumptions by Scenario

- The Base scenario takes the expected case forecast – consistent with White Book 2024 methods – and adjusts for:
  1. Climate change
  2. Electrification
  3. Expected conservation gains ("frozen efficiency")

- The Fast Transition (FT) scenario additionally accelerates accomplishment of a decarbonized economy and increases expected economic outlook

- The table below shows the different layers which are incorporated into each key forecast

Scenarios	Climate Adjustment	IRA Adjustment	Electrification (EV)- Solar (PV)	Conservation Frozen	FT Adjustments		
					Higher Econ	Net Zero 2050	More Efficient End-use
WB 24	N	N	N	N	N	N	N
RP24 Base	Y	Y	Y	Y	N	N	N
RP24 FT	Y	Y	Y	Y	Y	Y	Y

Overview of Key Load Forecasting Assumptions

Climate Change

- Climate Trended using 3 Global Circulation Models from the RMJOC-II* RCP 8.5 scenario (highest warming)

Emerging Technology

- Electric vehicles & Behind-the-Meter solar PV consistent with IRA incentives

Conservation (Frozen Efficiency)

- BPA conservation program frozen in time

Fast Transition (FT) adjustments

- Assumes 50% decrease in GHG emissions by 2030 and Net-Zero by 2050 in the U.S.
- Stronger consumer spending growth and higher GDP

*River Management Joint Operating committee, 2nd Climate Change Study (2018-2020)

Forecast Overview

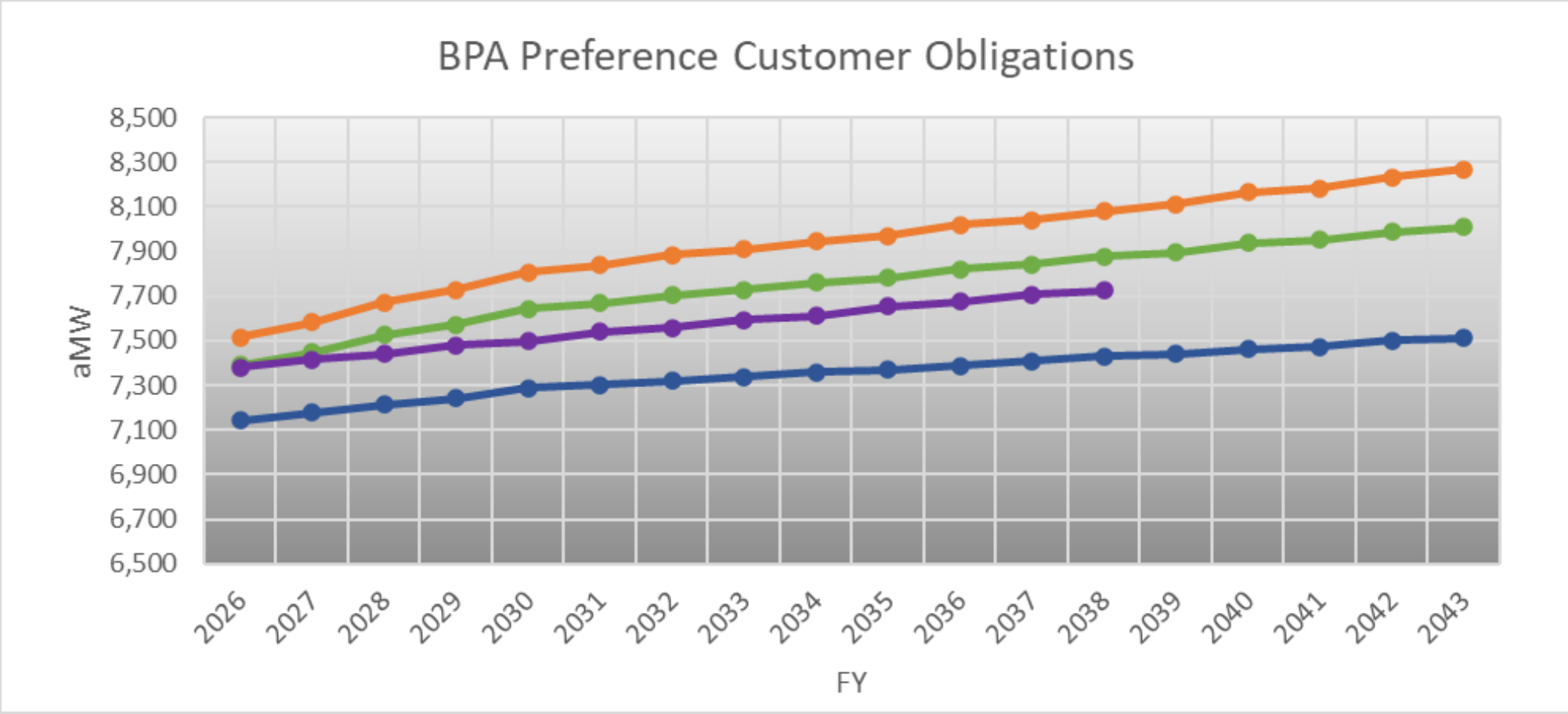
- Total Retail Load (TRL) forecasts are aggregates of customer-level energy projections based on models that are created to fit each customer and that incorporate customer input
- BPA obligations are calculated from the TRL forecast by netting off dedicated resources and applying customer elections
  - Slice right to power is calculated based on the system output
- Obligations assume carryover of current Regional Dialogue products and current customer elections

Key Takeaways from BPA Obligations

- Obligations can increase/decrease depending on customer elections in Provider of Choice. Obligations assume roll over of current elections.

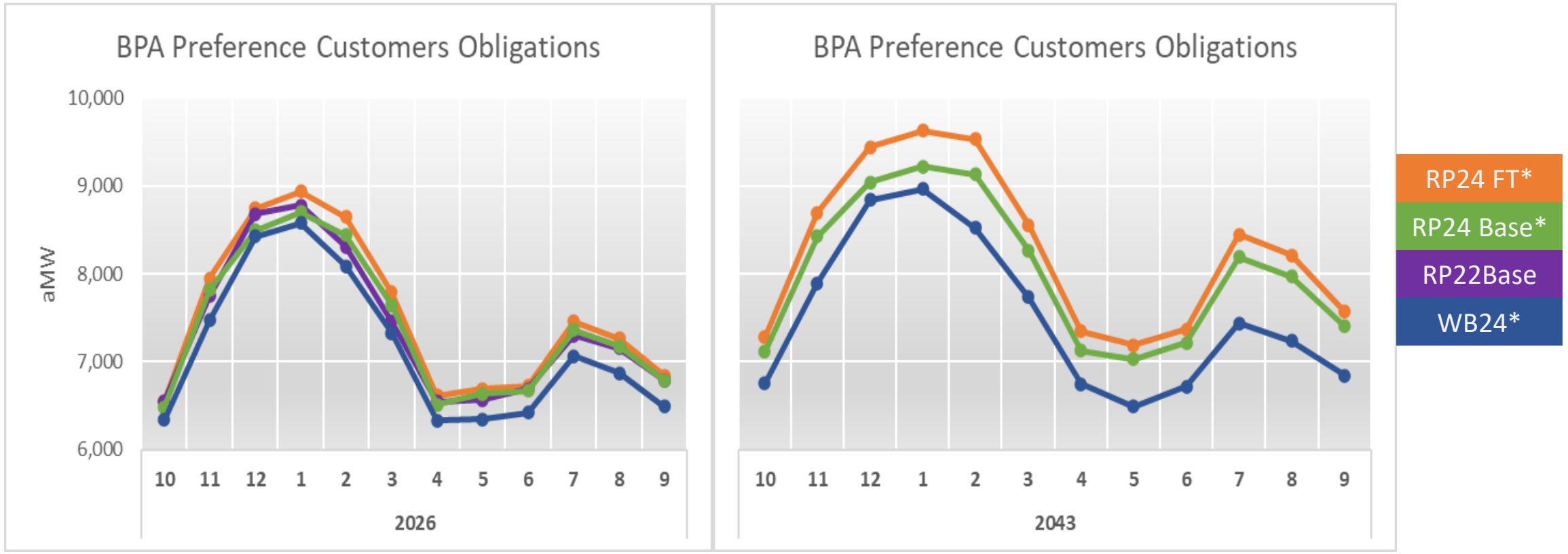
- Obligations are increasing faster due to:
  - Higher AC saturation rates
  - Inflation Reduction Act
  - Transportation electrification
  - Climate change in summer
  - Net-zero by 2050 (Fast Transition scenario)

BPA Preference Customer Obligations (preliminary) - Annual



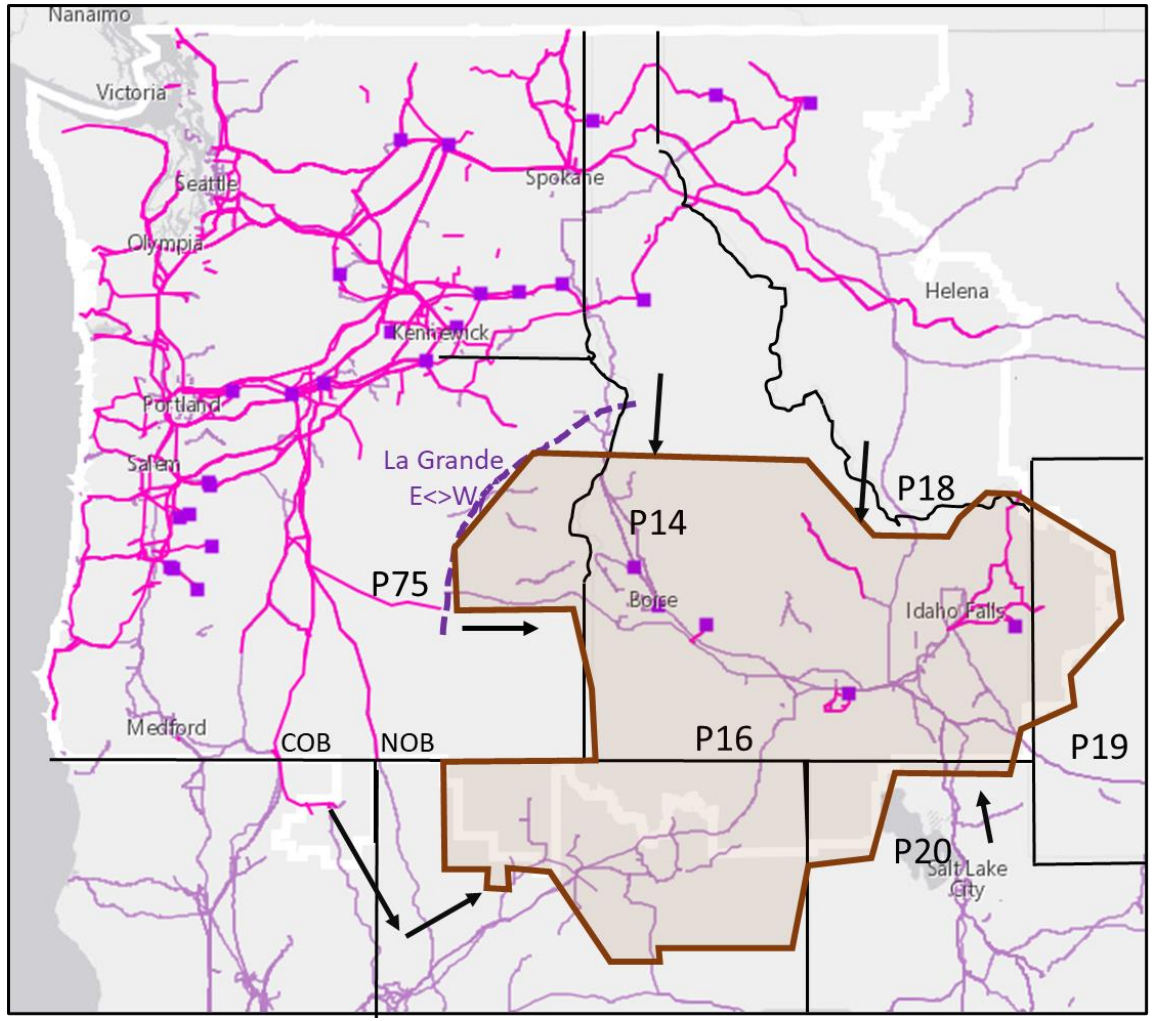
- WB24, RP24 Base & FT use slice right to power proxy. All exclude Contract Deliveries.

BPA Customer Obligations (preliminary) – Monthly 2026 vs. 2043



- Obligations are preliminary, with a proxy slice right to power.

Zone reminder: Mid-C & SWEDE



Western Resource Adequacy Program requires BPA load in each zone to be served with a combination of physical resources (with qualifying capacity) and firm transmission (from resource to the load). Currently (without a B2H build completed) the SWEDE region has heavily constrained transmission paths.

Mid-C (outside of the enclosure)

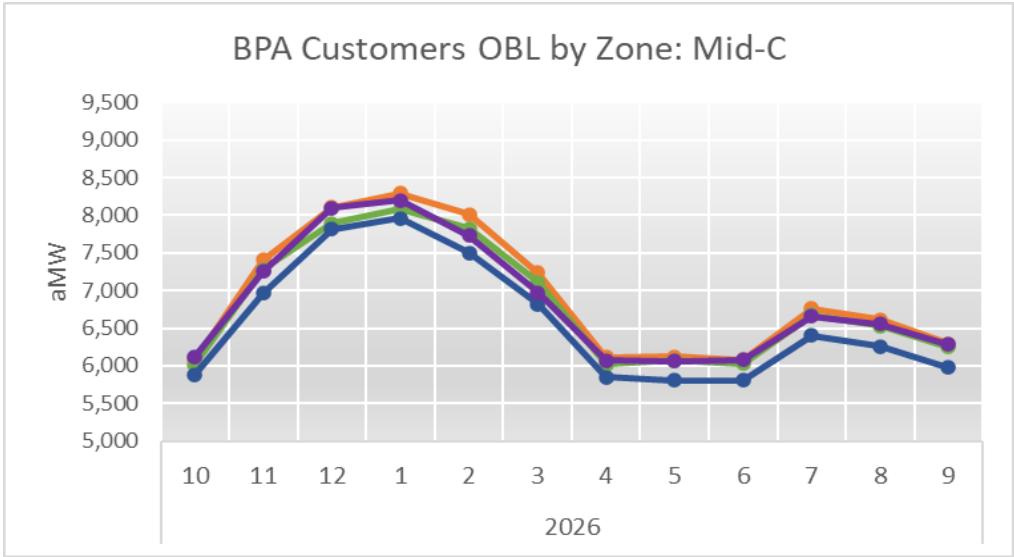
←

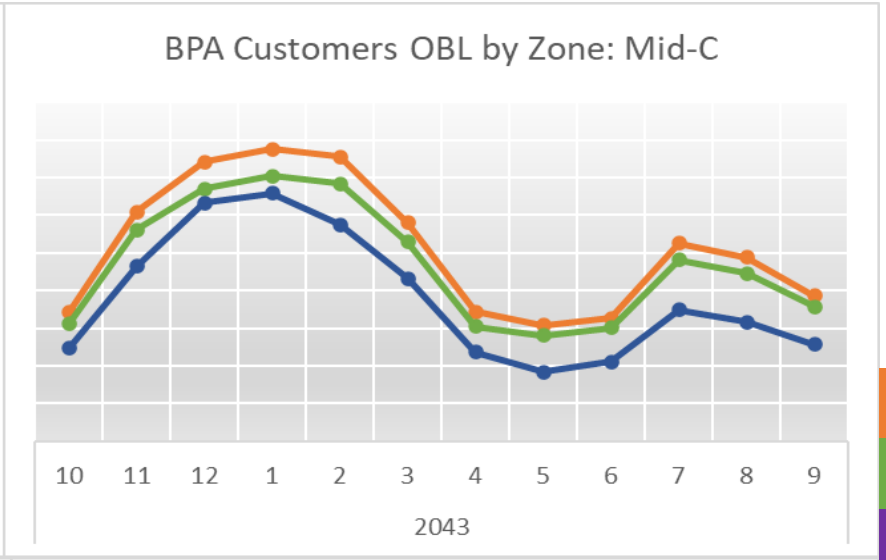
BPA SWEDE

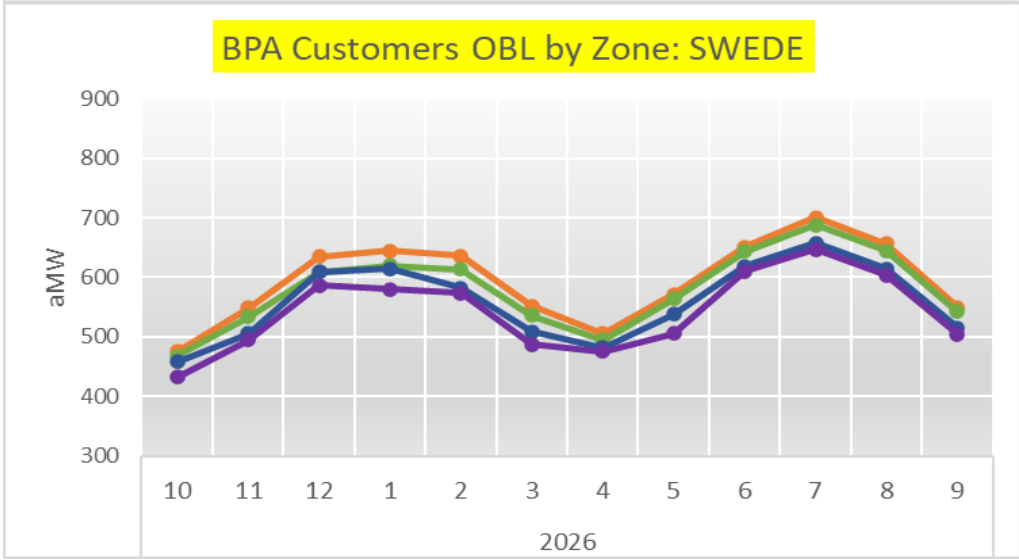
South-**W**est **E**ast **D**iversity **E**xchange.

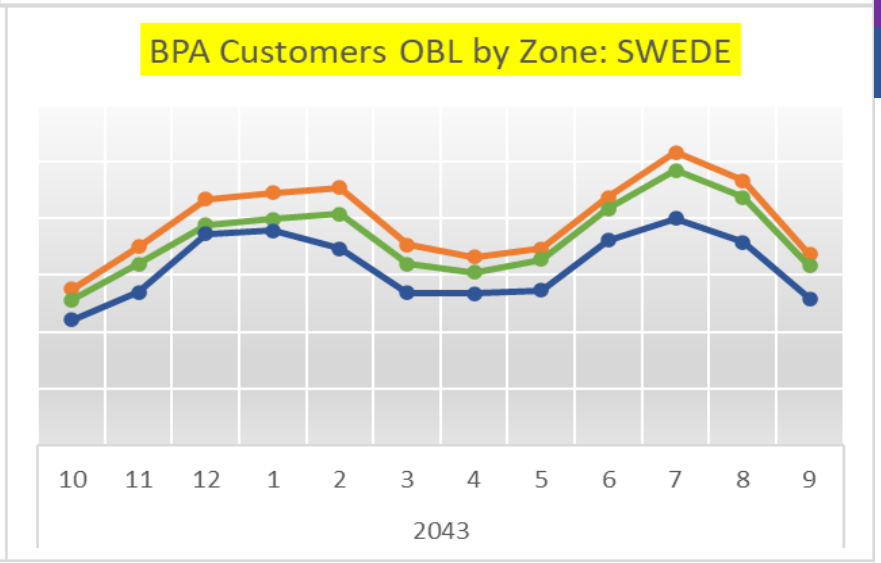
Pink lines are BPAT, purple dots are Hydropower, purple lines are other transmission, P# is a WECC path

BPA Customer Obligations by Zone (preliminary) Monthly 2026 vs. 2043







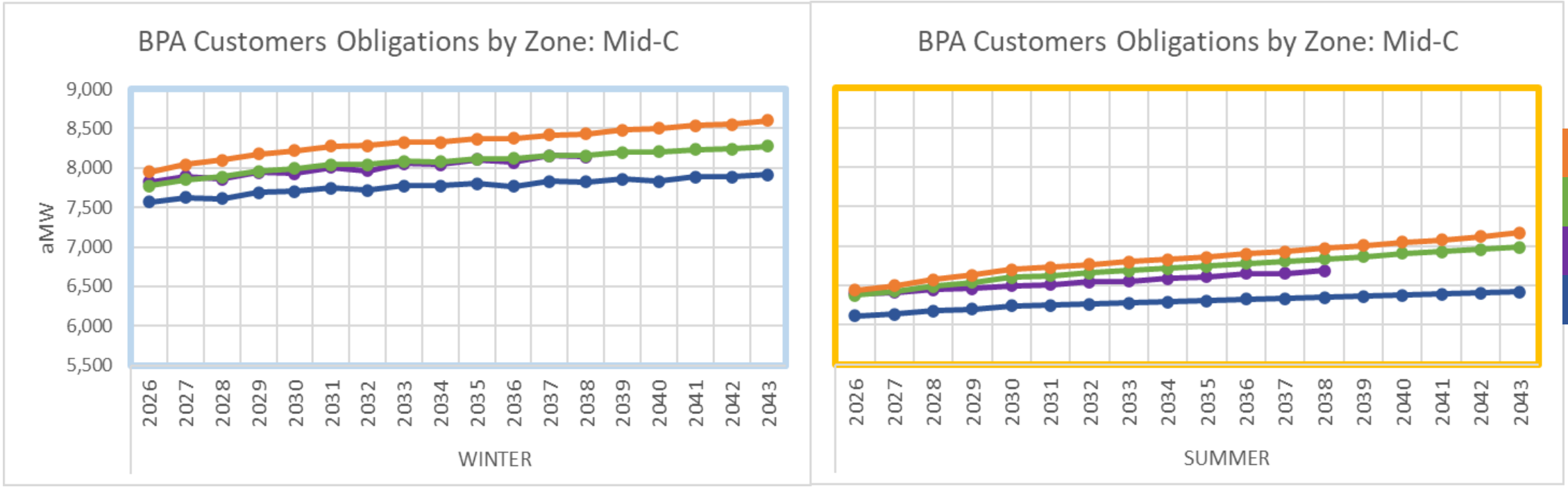


- Mid-C is winter peaking

RP24 FT*
RP24 Base*
RP22Base
WB24*

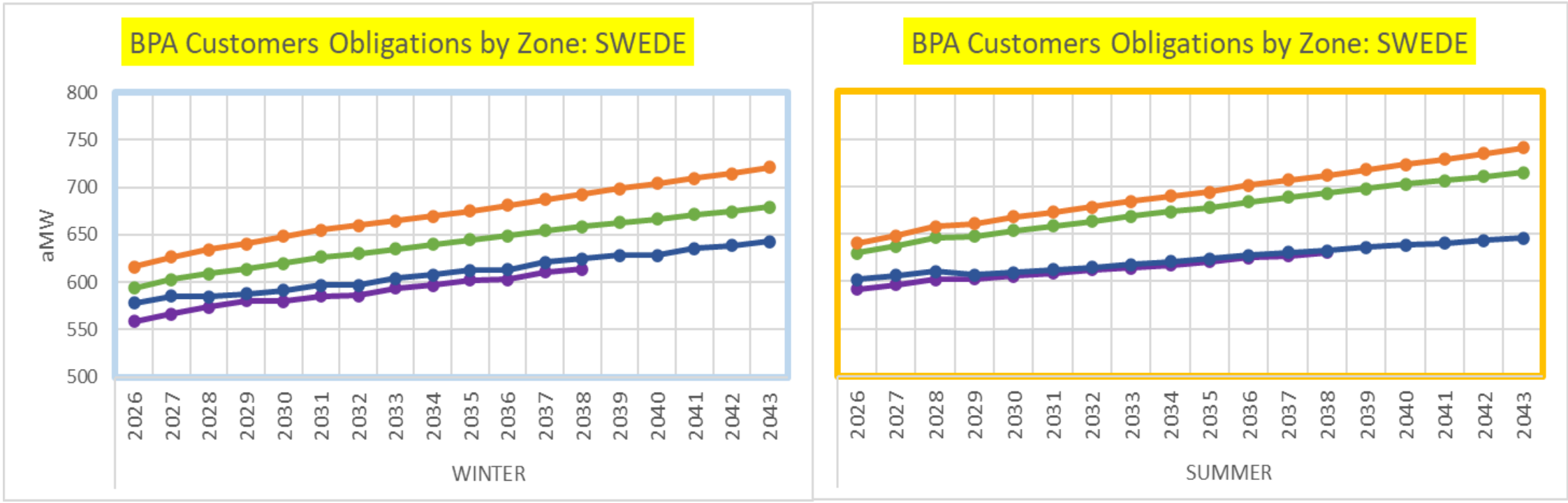
- SWEDE is summer peaking

BPA Customers Obligations (preliminary) Seasonal by Zone: Mid-C



- The Base case has a faster growth rate for summer than winter for MidC due to climate change and increased AC saturation relative to WB24
- Fast Transition has a faster growing winter peak than Base due to higher electrification

BPA Customers Obligations (preliminary) Seasonal by Zone: SWEDE

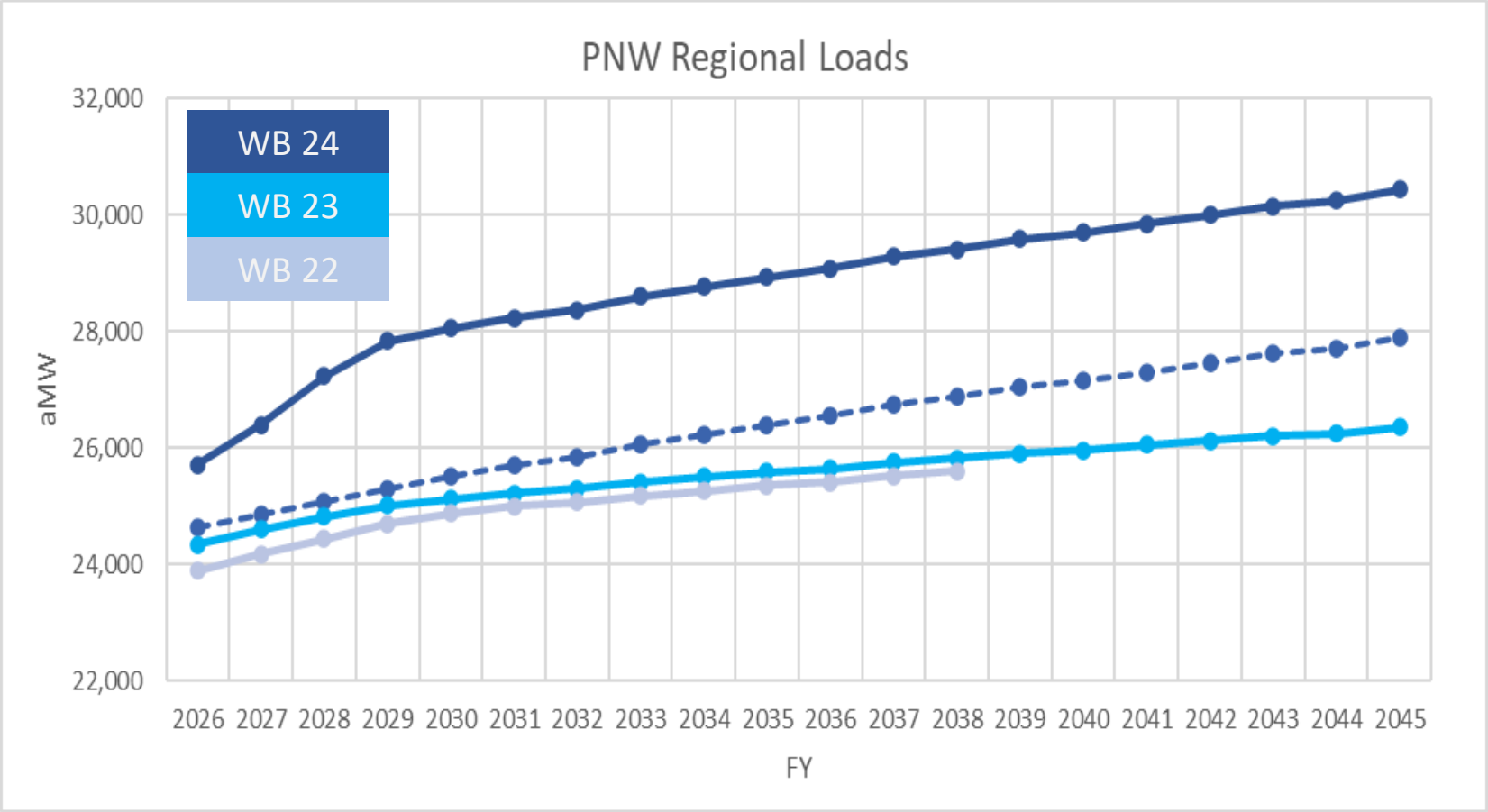


- SWEDE is a summer peaking area, but the growth rates in both seasons are fairly similar in the Base case
- The Fast Transition has a faster growing winter peak compared to the Base

Key Takeaways: TRL Forecasts

- Largest driver of load growth in the BPA footprint is from large data centers
- Climate change combined with increased AC saturation rates is increasing summer loads, but milder temperatures are decreasing winter load
- Increased electrification (EVs and Heat pumps) are driving up winter loads
- Economic outlook combined with net zero targets drive large changes in growth rates

Pacific Northwest Regional Forecast - Expected

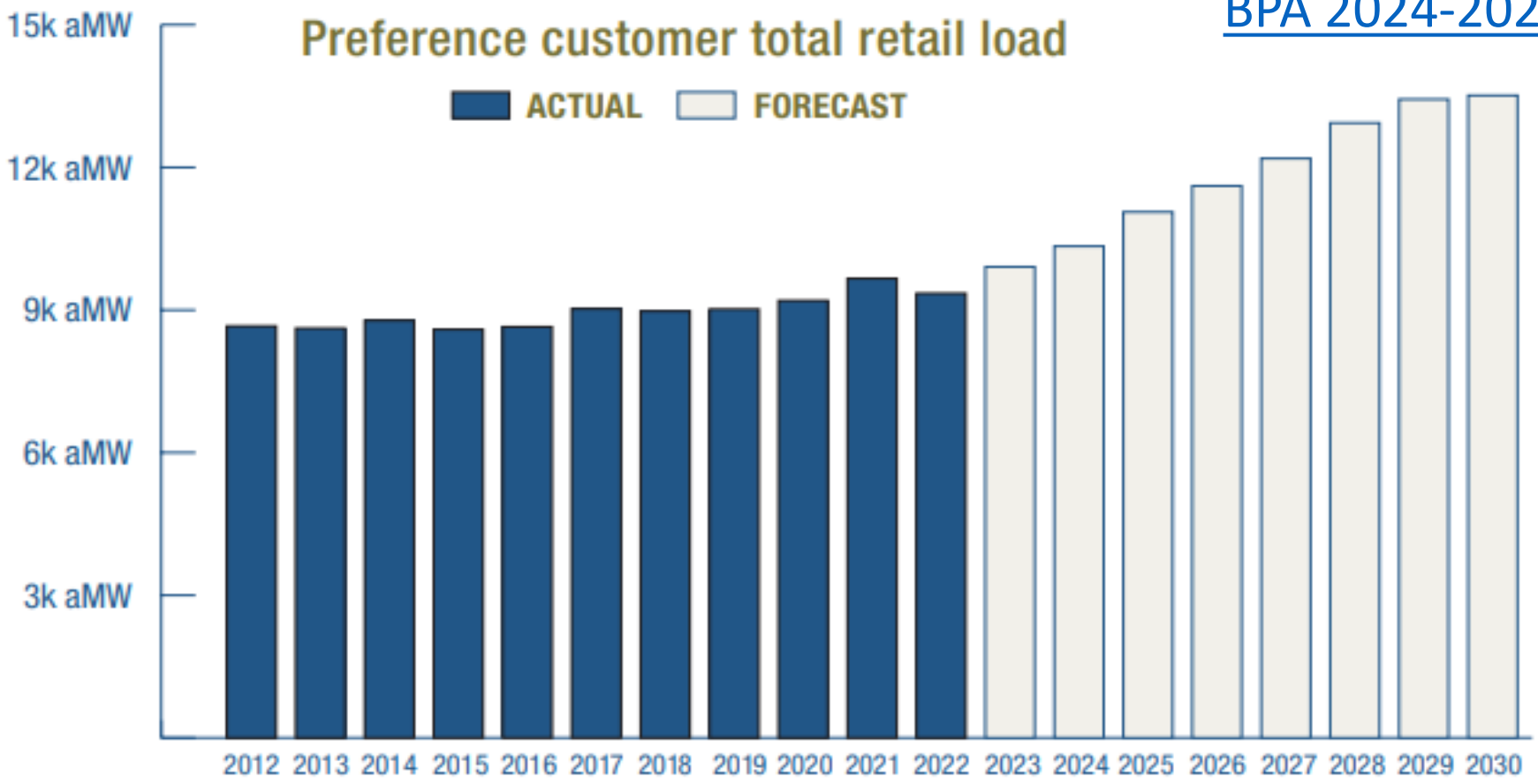


- Expected loads aka White Book (WB) load Forecasts
- Investor-Owned Utilities (IOU) loads included
- Not Include:
  - Inflation Reduction Act (IRA)
  - Climate Change adjustments
  - Exports

- Significant data center load growth through 2029 driving large changes in the RP24 expected forecast. (Dashed trace represents data center loads removed)

Historic Total Retail Loads (TRL)

Source:
BPA 2024-2028 Strategic Plan



Reminder: Scenario key differences

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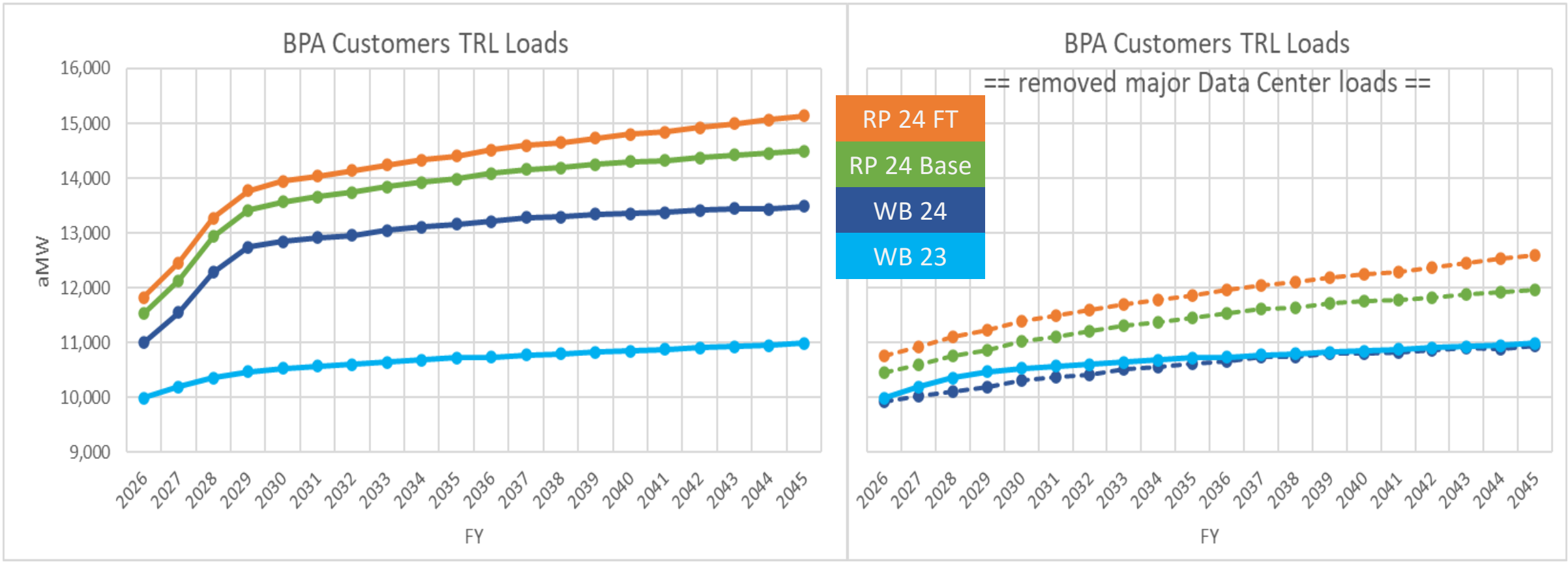
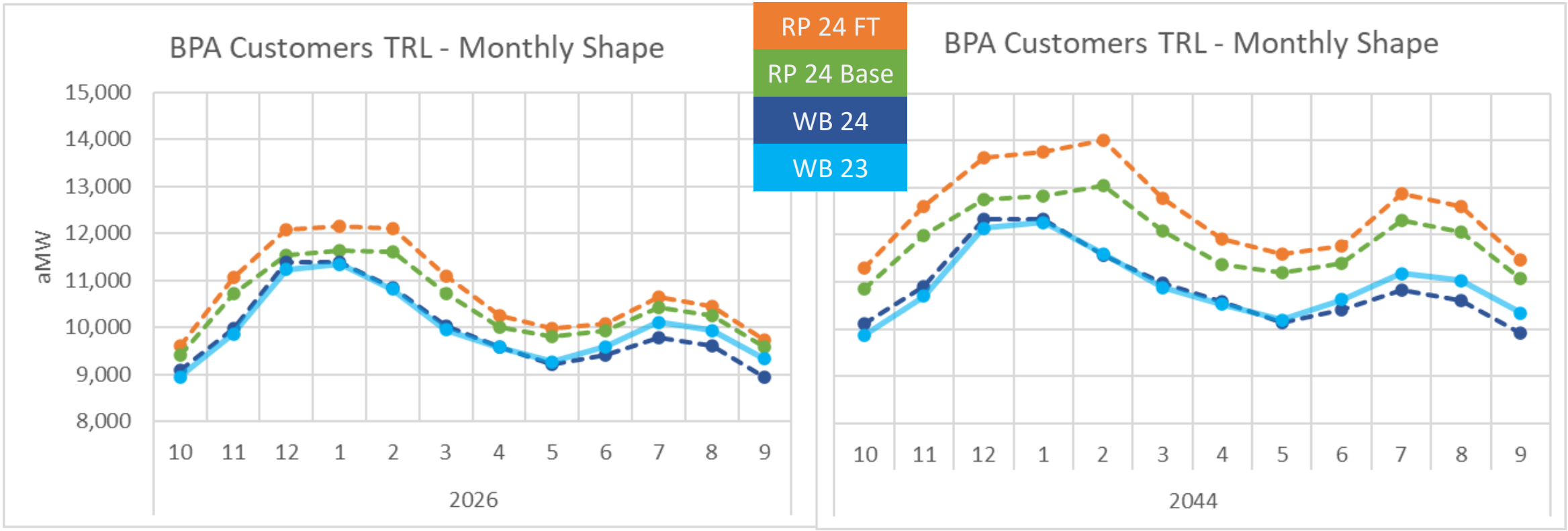
BPA Customer TRL- Annual



- Dashed lines exclude major data center load growth from respective forecasts

BPA Customers TRL Monthly: 2026 vs 2044

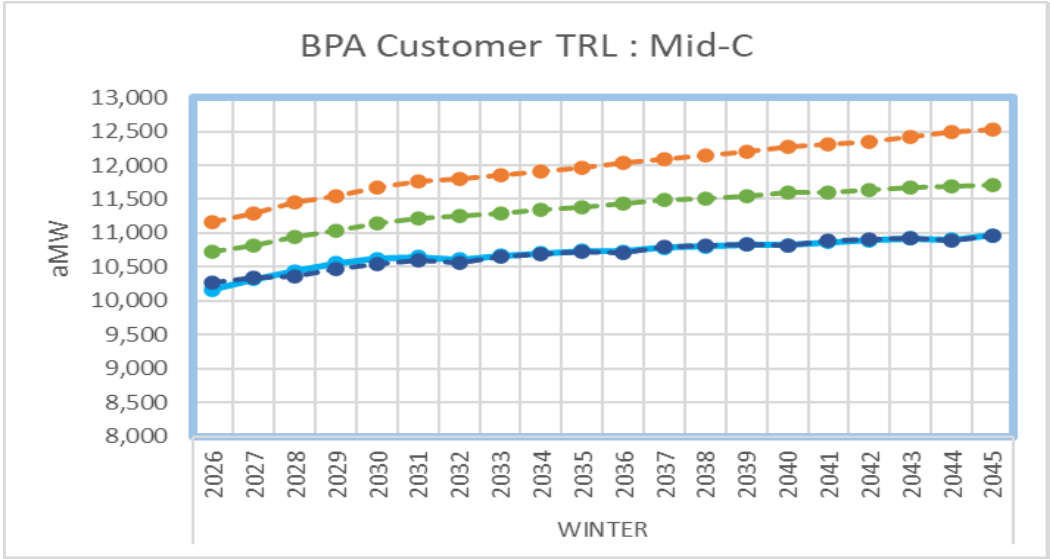
excluding major data center load growth

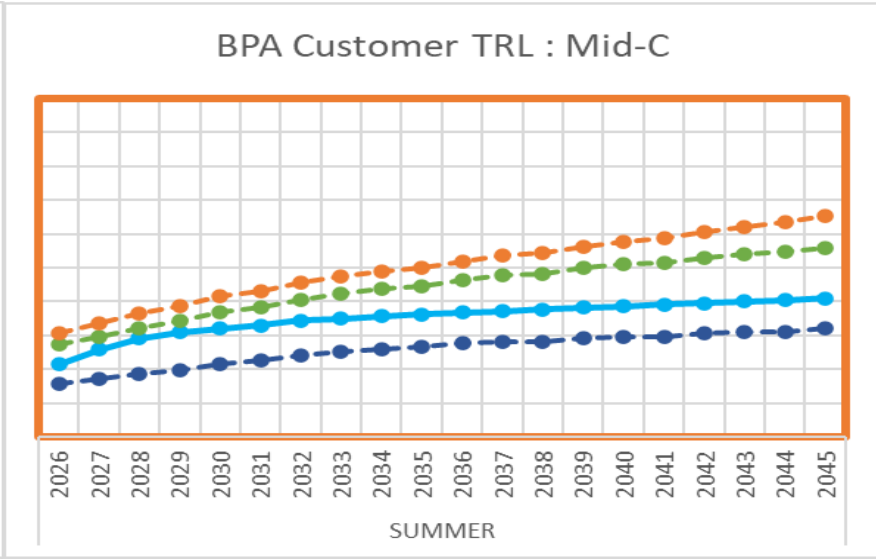


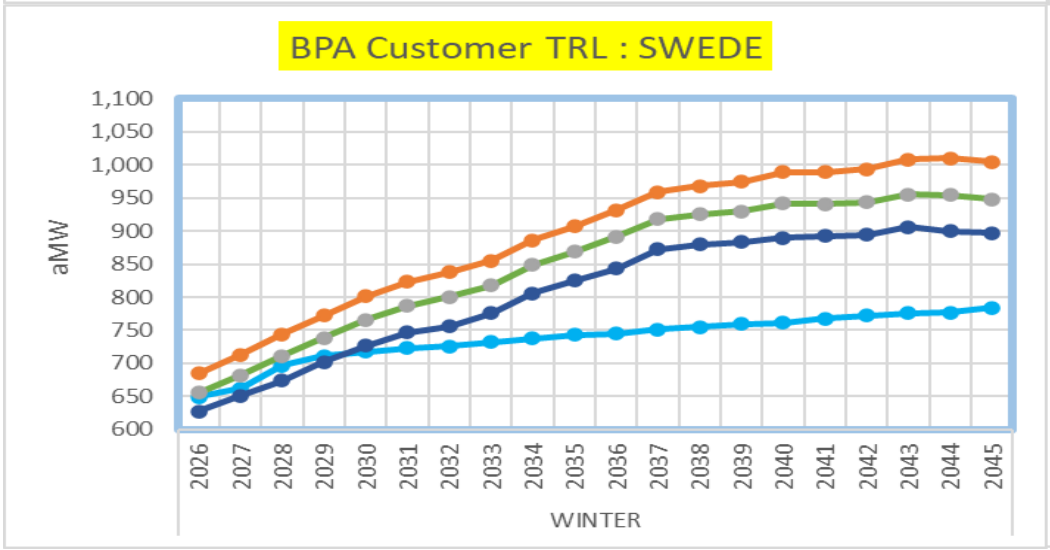
- Excludes data center growth to compare impact of other drivers
- Summer Peaks grow faster than Winter peaks in the Base and FT

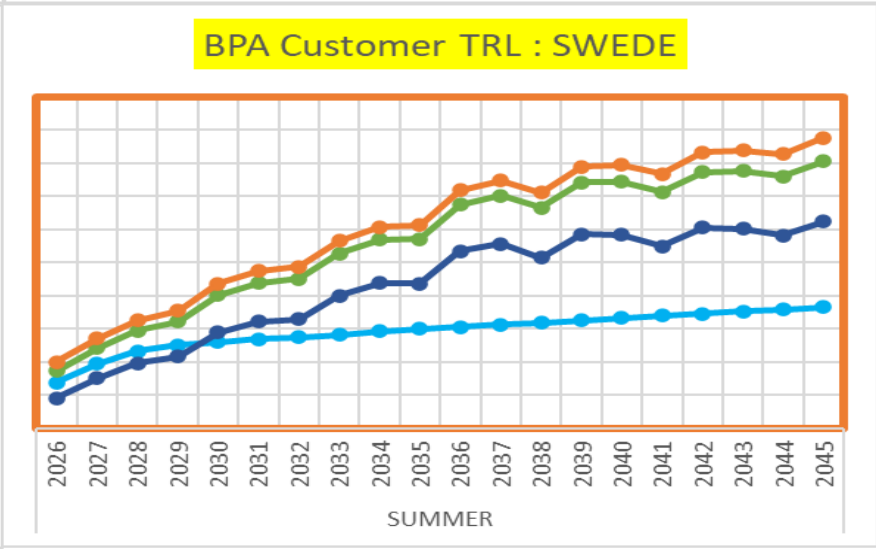
BPA Customers TRL Seasonal by Zone

excluding major data center load growth









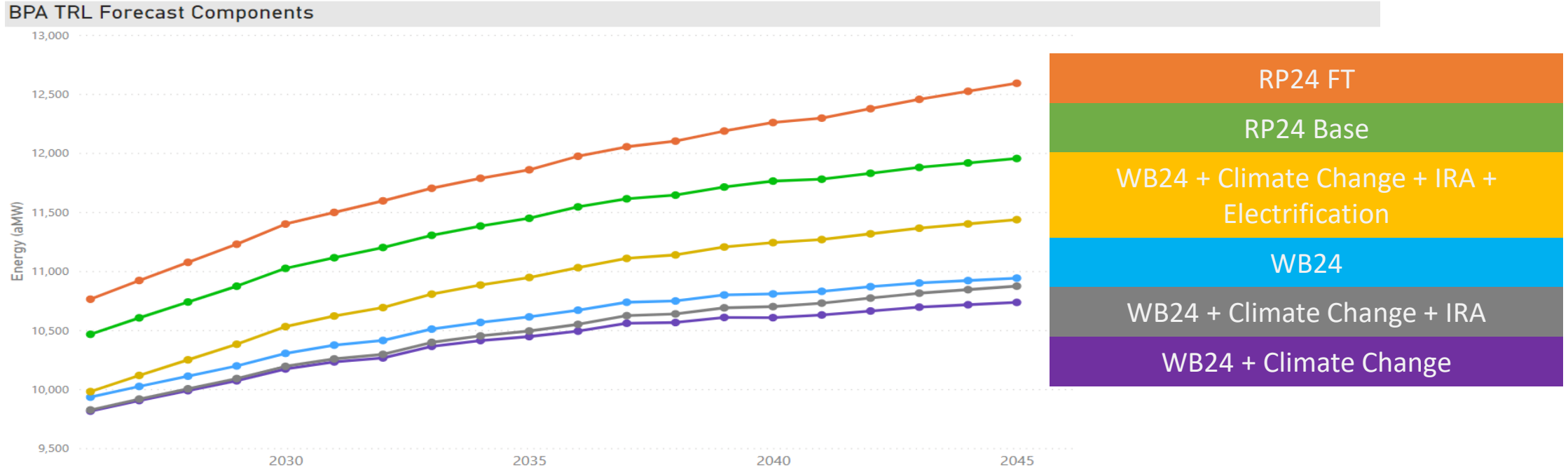
- Mid-C: Excludes data center growth to compare impact of other drivers

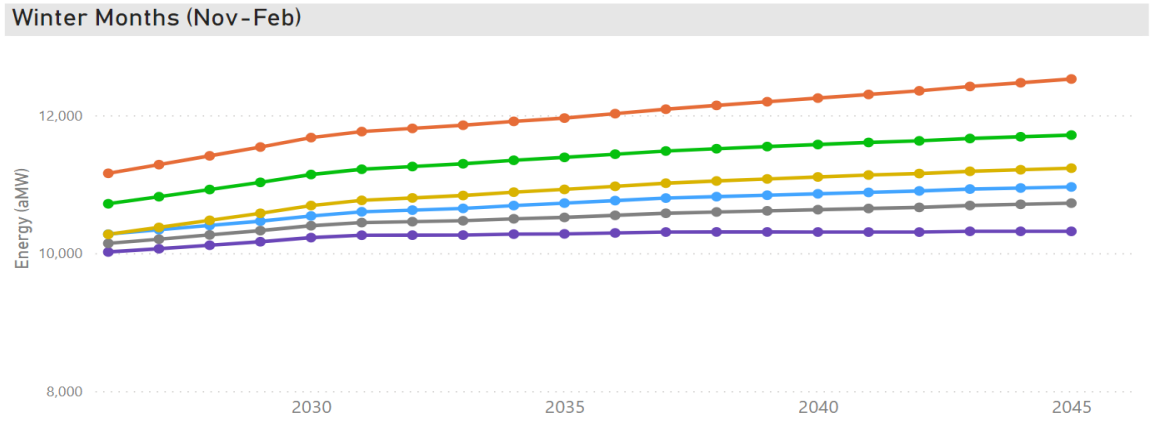
RP 24 FT
RP 24 Base
WB 24
WB 23

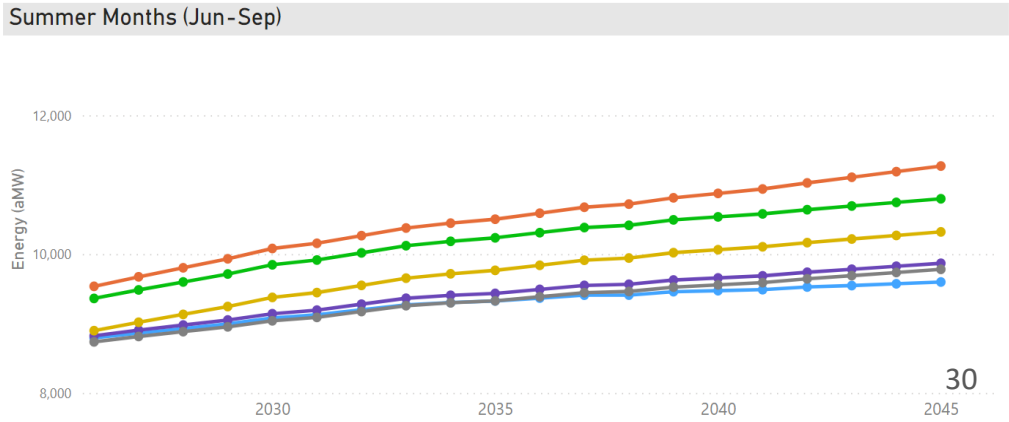
- SWEDE: Summer Peaks grow faster than Winter peaks in the Base and FT

BPA Customers TRL Annual by Forecast

excluding major data center load growth







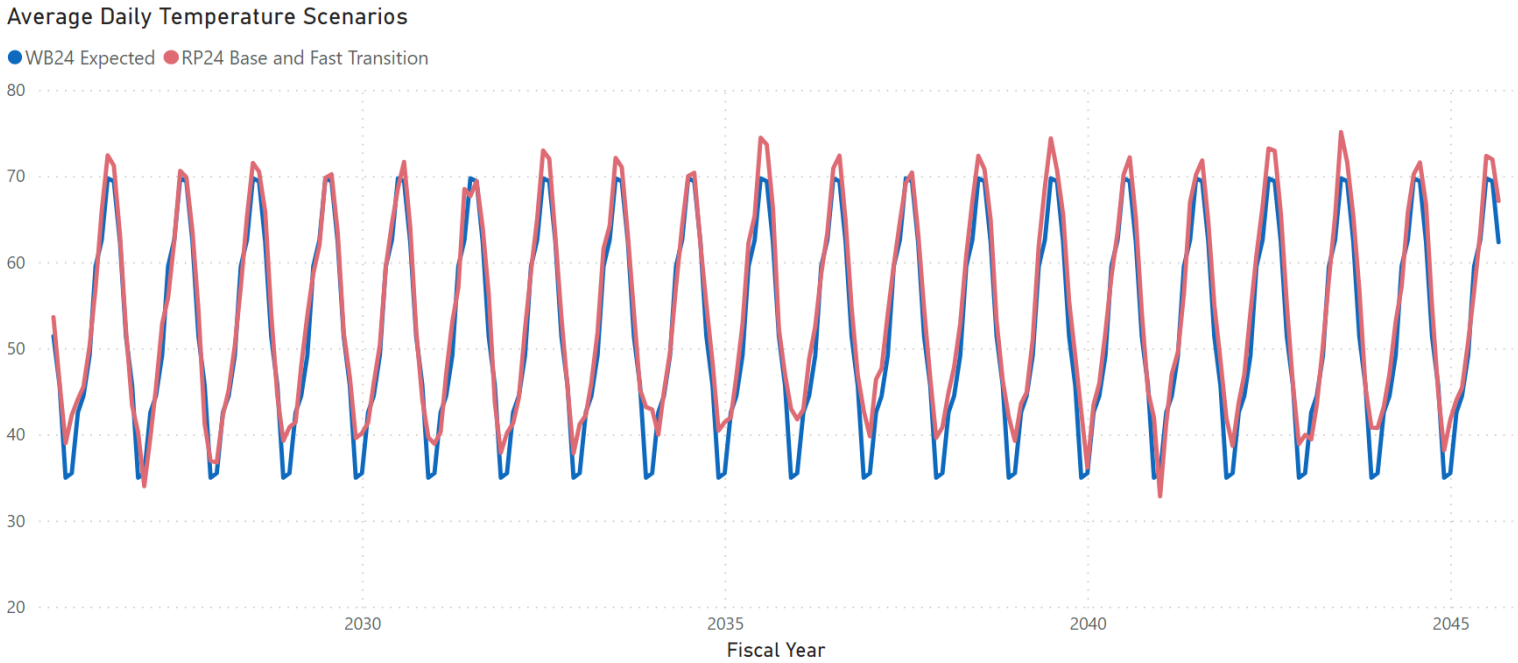
Load Forecast: Overview

- The WB24 Expected forecast is a sum of individual customer forecasts, which are:
  - Developed collaboratively between BPA forecasters and utilities
  - Updated yearly to meet agency requirements and inform rate making processes
- The RP24 Base forecast builds on the WB24 Expected forecast to:
  - Capture medium and long-term trends affecting large portions of BPA's service territory
  - Directly measure changes in saturation and efficiency of electric end-uses
  - Remove Conservation (Energy Efficiency) given its focus on resource planning
- The RP24 Fast Transition forecast builds on the RP24 Base forecast to:
  - Consider an alternative (less likely) outcome for the economy, and for saturation and efficiency of electric end-uses

Load Forecast: Assumptions

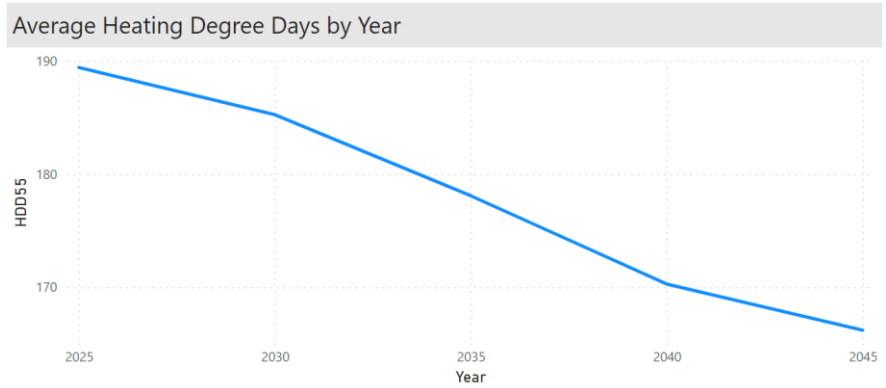
1. Climate is changing:

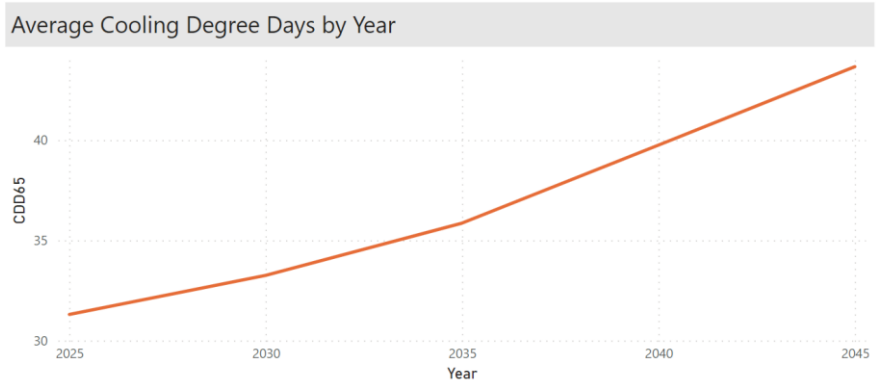
- RP24 assumes a new path for temperatures in line with emerging climate change trends
- The RP24 Base and RP24 Fast Transition forecasts use the same temperature path that reflect increasing temperatures in both summers and winters



Load Forecast: Assumptions

1. Climate is changing:





- Heating and Cooling Degree Days (HDD and CDD) are calculated with a 15-year moving average of the averaged daily temperature of KSEA, KPDX and KGEG for three RMJOCII scenarios (CCSM4, IPSL, RCP85)
- Resulting degree days show a significant decrease in heating degree days and an increase in cooling degree days, with the latter changing at a faster rate

Load Forecast: Assumptions

2. Economic Outlook

Source: IHS S&P Global

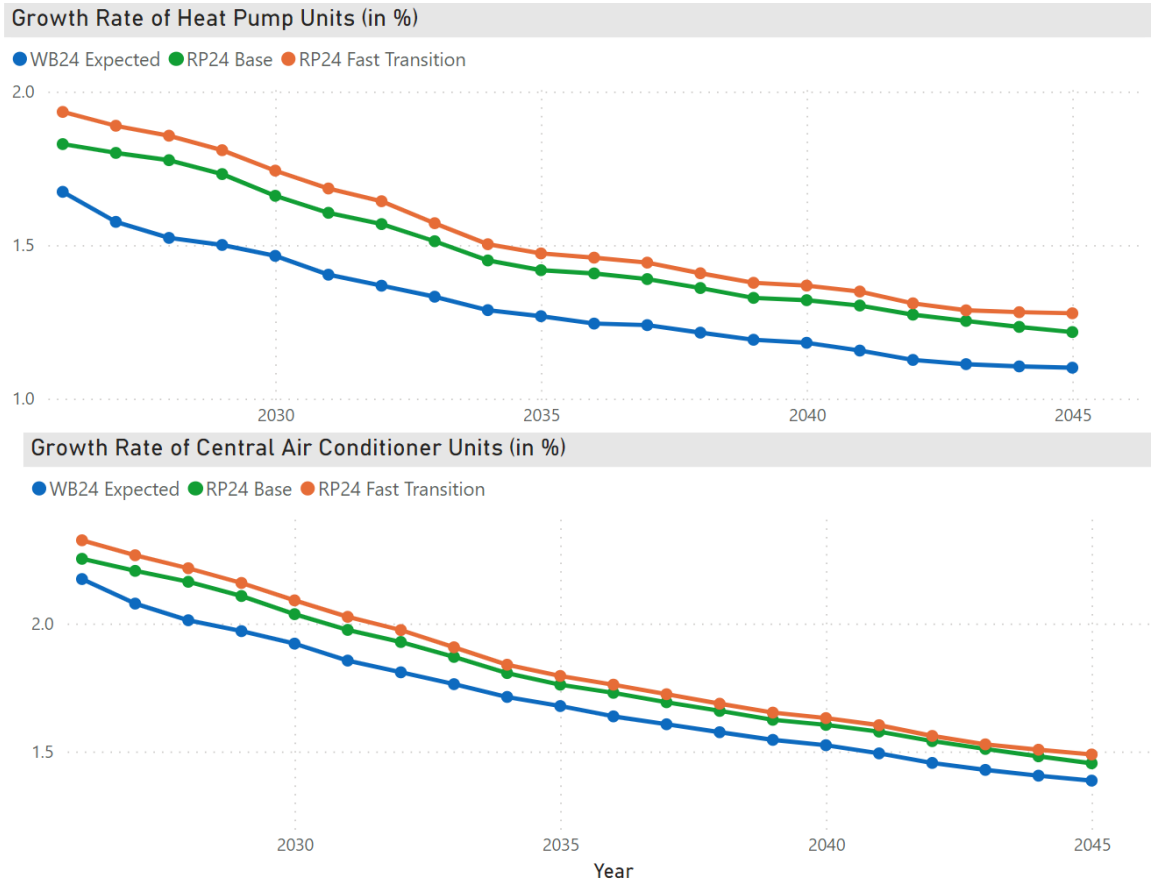
- The RP24 Base forecast assumes economy remains in its pre-pandemic path
- The RP24 Fast Transition assumes stronger consumer spending and productivity relative to the RP24 Base forecast

Load Forecast: Assumptions

3. Saturation and Efficiency

- End-use saturation and efficiency data inputs used for the WB24 Expected forecast are from the Northwest Power and Conservation Council (Council)

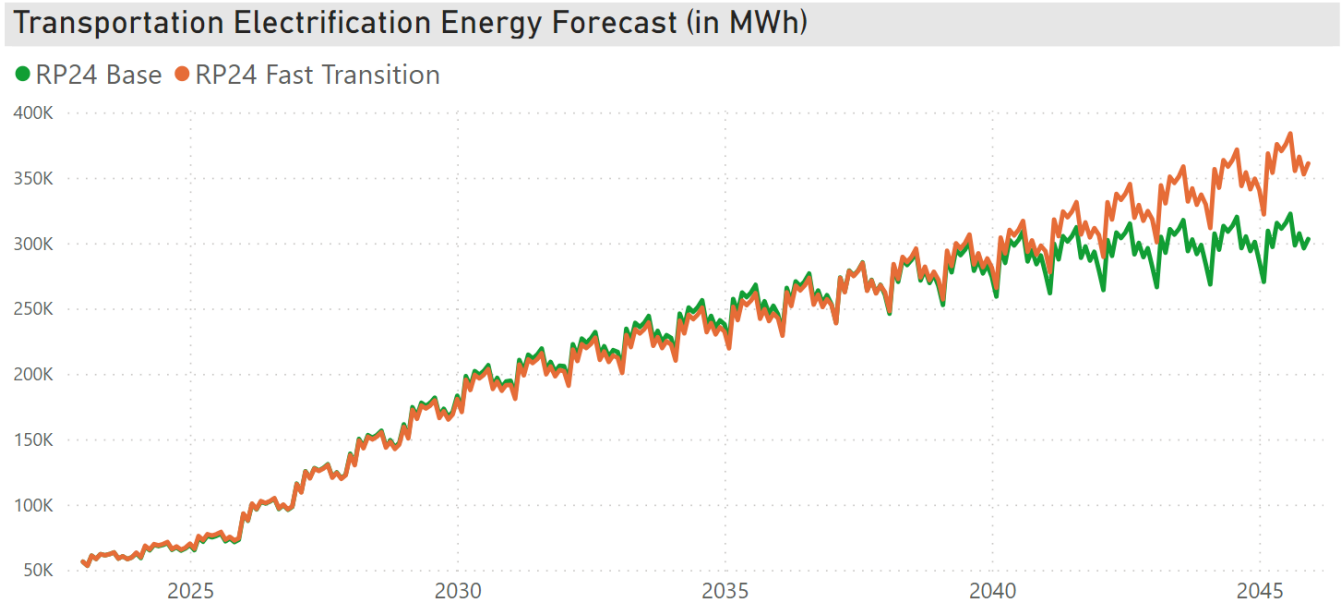
- The saturation rates used for the RP24 Base and RP24 Fast Transition are further adjusted to reflect current laws and regulations, including the Inflation Reduction Act, using the EIA's Annual Economic Outlook 2023 Reference and the High Macro and Low Zero-Carbon Technology cost cases



Load Forecast: Assumptions

4. Transportation Electrification Assumptions

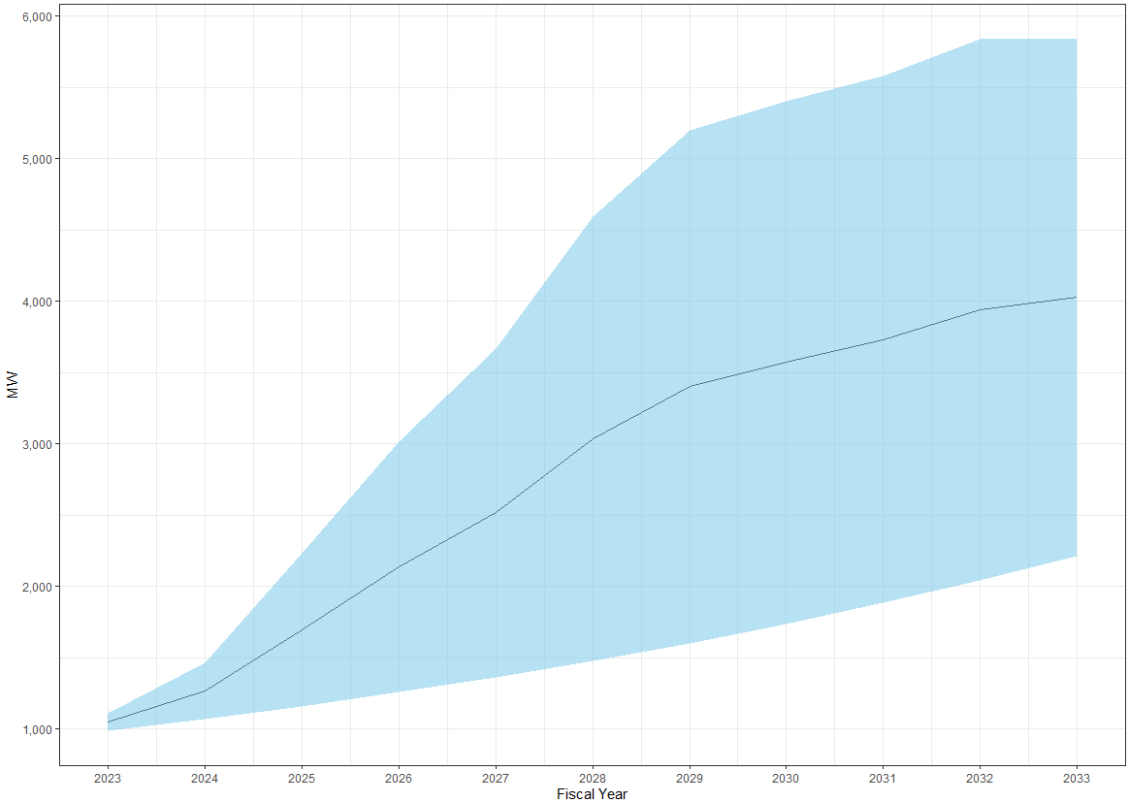
- Current vehicle stock data are from the Oregon Department of Energy, Washington's Department of Licensing, Idaho's Department of Motor Vehicles, and DOE's Alternative Fuels Data Center.
- Forecasts of annual energy demand per vehicle for all four states are from the Council
- The forecasts of the growth path for each of the states are based on projections by the Pacific Northwest National Laboratory (PNNL)



Load Forecast: Assumptions

5. Data Center Load Growth Assumption

- Shaded area indicate the range of potential data center load for the next 10 years
- Upper-bound is determined by an estimate of demand for FY2024 that includes the bulk of projects that have been reported to Transmission Planning, but may not meet the required confidence threshold for inclusion in the Agency forecast
- The solid line shows the Agency data center load forecast

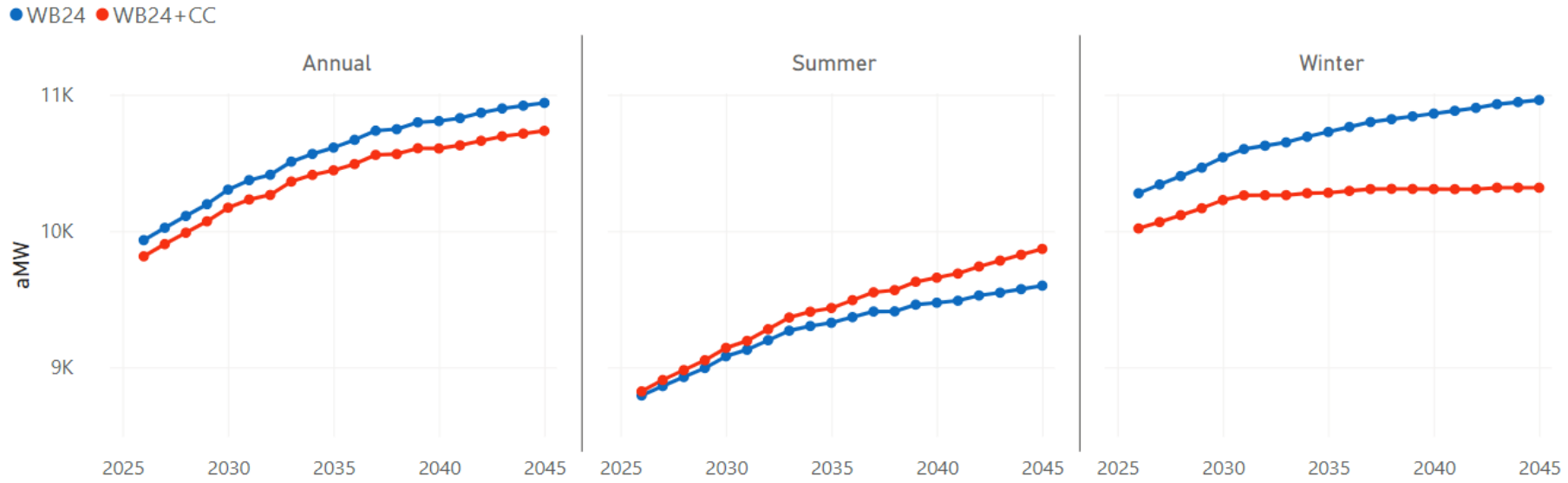


Load Forecast: Results

1. Effect of Climate Change (CC) on Load

Warming temperatures lead to increasingly lower energy demand during winter months and higher energy demand during summer months

The impact of CC is less pronounced at the annual level given the counteracting effects that rising temperatures have on seasonal loads

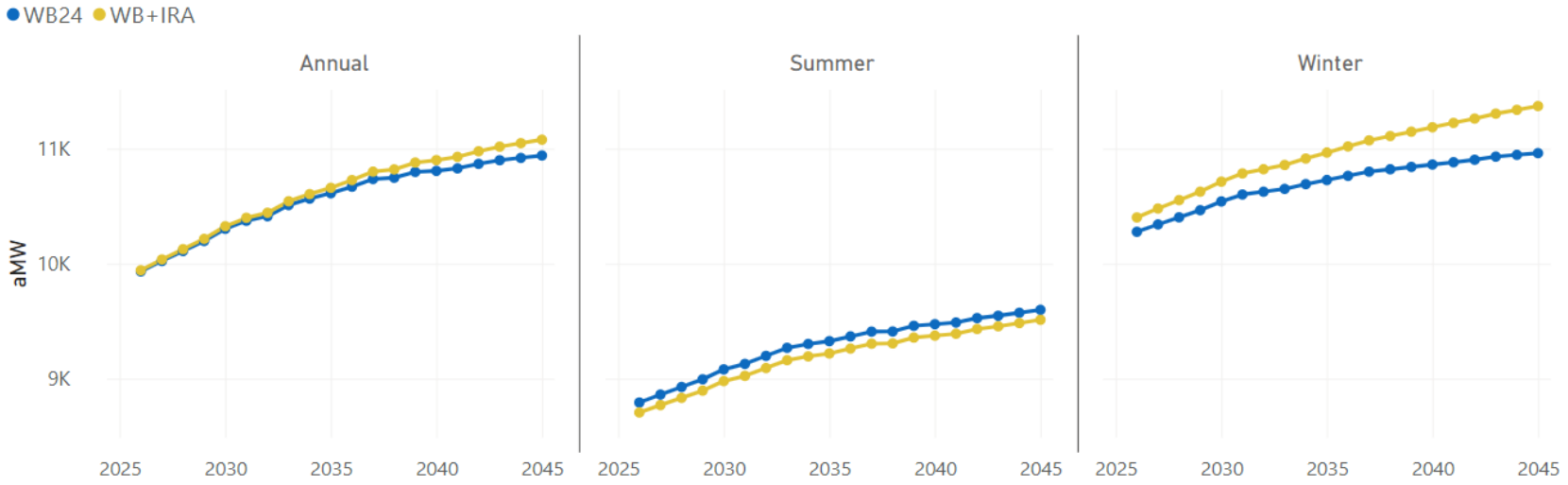


Excluding major data center load growth

Load Forecast: Results

2. Effect of Inflation Reduction Act (IRA)

- Tax credits for higher-efficiency air conditioners have a small and negative effect on energy demand during the summer months
- Rebates for electrification projects, including the High-Efficiency Electric Home Rebate Act (HEEHRA), increase energy demand in the winter months, this effect prevails at the annual level

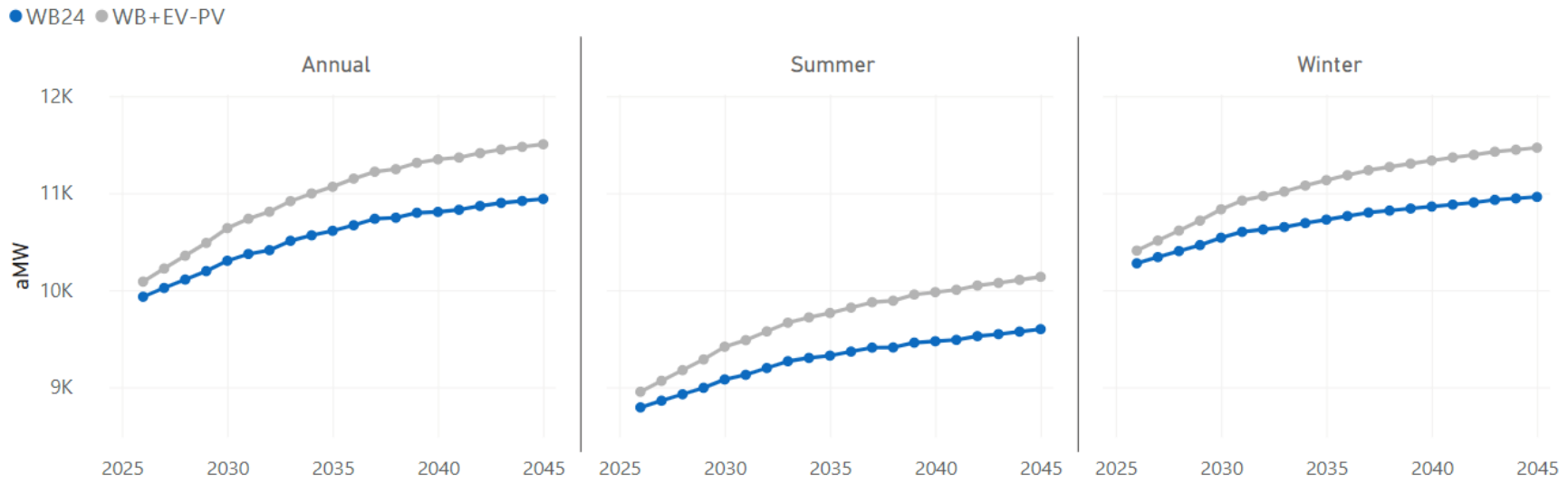


Excluding major data center load growth

Load Forecast: Results

3. Effect of Transportation Electrification

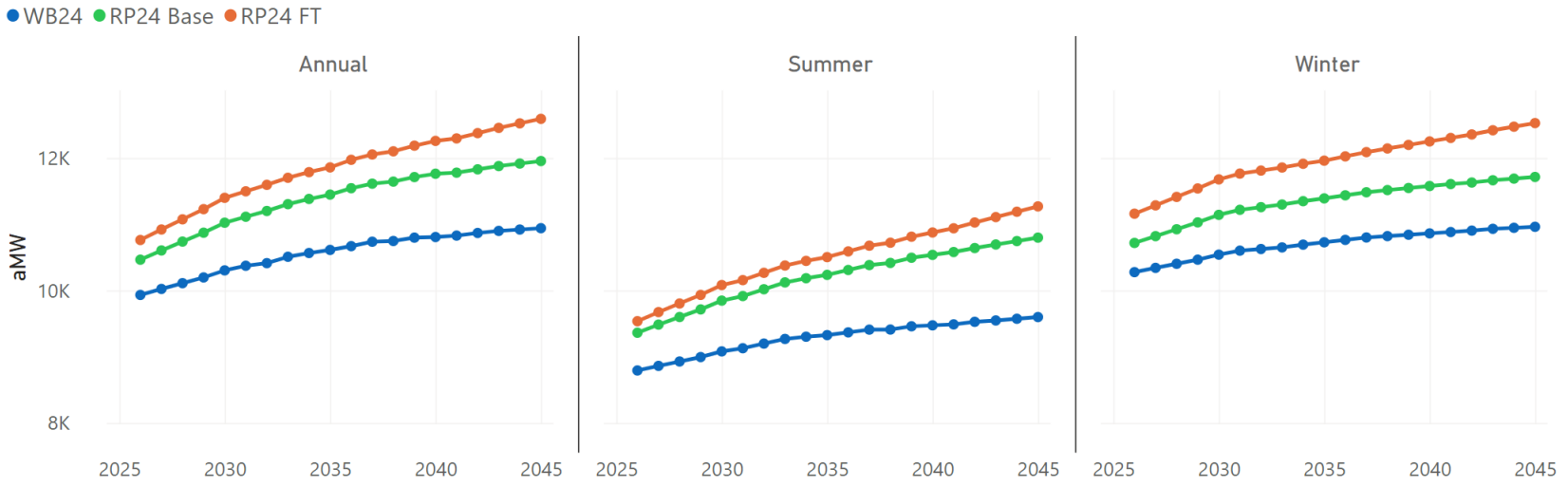
The electrification of the transportation sector will have a relatively greater impact on load during the busy driving season of the summer months



Excluding major data center load growth

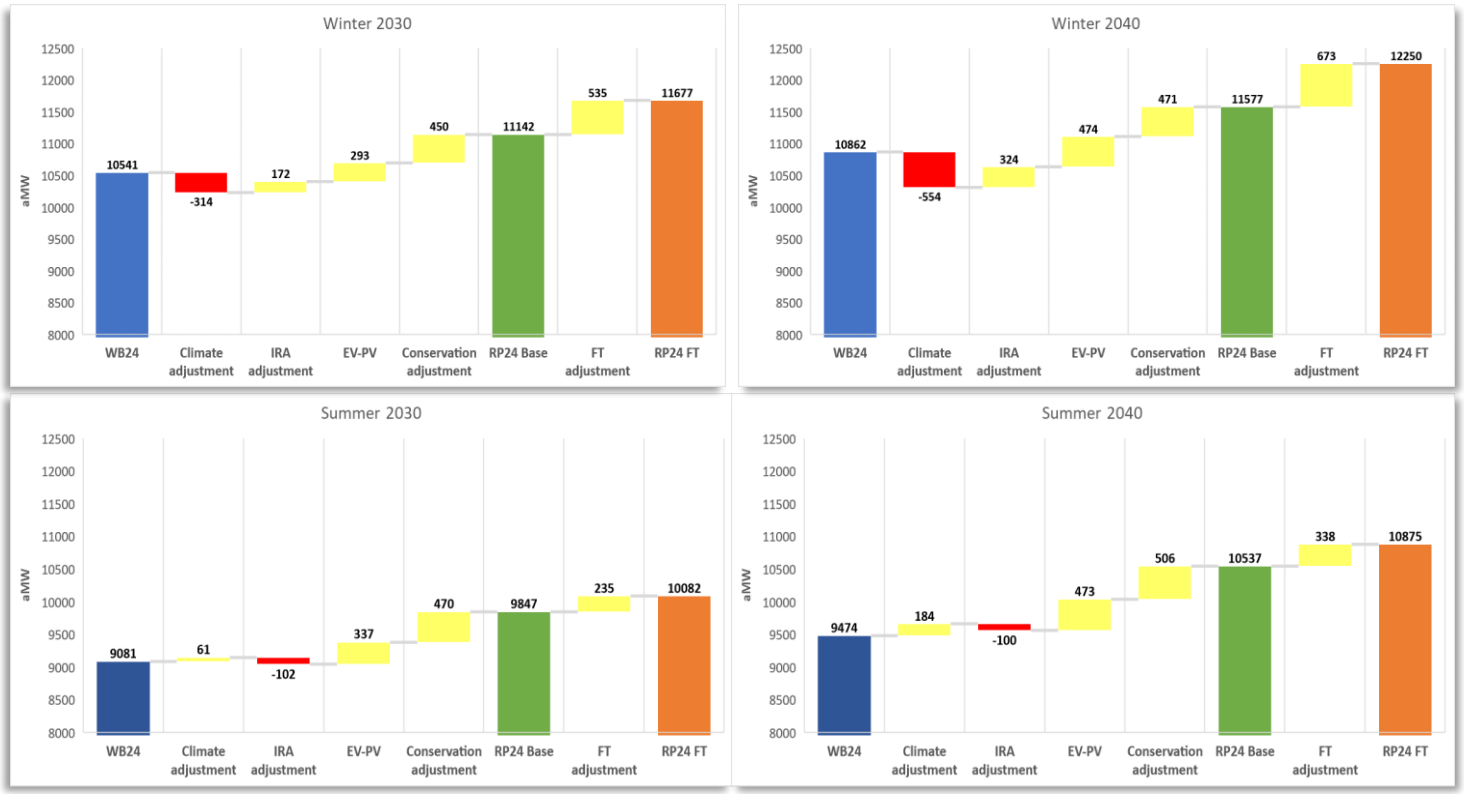
Load Forecast: Conclusions

Recent policy developments, emerging technologies, and the move toward electrification more than offsets the load reduction from rising temperatures and lead to increasing energy demand growth over time



Excluding major data center load growth

Load Forecast: Conclusions



- The speed of the energy transition is uncertain, but the Fast Transition case illustrates its large potential impact on loads, especially as emission target deadlines loom
- Conservation potential remains a large and significant tool in resource planning

Scope of Work and Stakeholder Input: Scenarios and Sensitivities

Ryan Egerdahl

Two Scenarios: Base and Fast Transition (1 of 2)

	BPA Obligation Loads	BPA Resources	Energy Efficiency & Demand Response
RP24 Base	• Expected, Mid-range load growth with economic activities • Electrification/ Behind-The-Meter (BTM) solar PV, current policies. • Frozen Efficiency • Current customer elections • Climate Change Trended • Transportation electrification • Inflation Reduction Act	• Federal hydro under 2020 EIS selected alternative & AOP24 Treaty • Planned FCRPS upgrades. Current CGS (no uprate) • Climate change impacts on hydro generation from RMJOC-II, 2035 and beyond. • Turbine replacement & Libby Unit 6	• Refresh Conservation Potential Assessment (CPA) based on new industry trends and updated study years • Include frequently deployable energy shifting products in the Demand Response Potential Assessment (DRPA) and update study years • Incorporate zonal considerations and updated climate change assumptions
RP24 FT	• Moderately higher load growth, elevated economic activity • Higher electrification/ BTM solar PV, and speculative loads	• Same as Base Scenario	• Adjust potential based on load

Two Scenarios: Base and Fast Transition (2 of 2)

	Market Landscape	Candidate Generating Resource	Solver
RP24 Base	• Mid-range values for all fundamental assumptions • Current Federal/state policies • High likelihood resource additions/retirements over next rate period • Climate change not explicitly accounted for in WECC loads/resources	• High likelihood emerging tech (SMRs), solar, wind, and storage. • Cost and performance characteristics developed from best available estimates using BPA specific assumptions	• Twenty-year study horizon (FY26-FY45) • Mixed-integer programming (MIP) approach solves for single portfolio which meets BPA needs at lowest total system cost (NPV)
RP24 FT	• Higher electrification • WECC-wide carbon allowance pricing • Accelerated decarbonization targets and/or additional ZEM targets in areas currently lacking explicit policies	• Same as Base Scenario	• Same as Base Scenario

BPA Planned Sensitivities

BPA Loads: Traditional Growth	• Higher Tier 2 elections of existing customer base (Above High Water Mark load growth is served by BPA) • Load characteristics set by scenarios
BPA Loads: Block Adder	• Additional flat block obligations placed on BPA e.g. 5(b) contracts from IOUs or NLSL from existing customers
Transmission: B2H Delay	• Delay to energization of B2H and transfer service capability from Mid-C to BPA-SE
Study Horizon	• Consider shorter time horizon (e.g. ten instead of twenty years) to see how near- term resource selections are influenced by long term assumptions

BPA Planned Sensitivities

Market: Price	• Positional shifts in price distribution reflecting sustained changes in energy prices • Changes to shape of price distribution to reflect increased tail risk from additional extreme events or significant renewables buildouts
Market: Availability	• Changes to BPA's ability to meet needs by relying on market purchases
Candidate Resources	• Costs and availability of candidate supply-side resources • Cost/benefits of EE/DR from UCT perspective
Incremental Needs Impact	• Run solver with no needs, only HLH energy, and only capacity to better understand contributors to resource selection
Carbon Price Adder	• Emissions cost adders applied to assumed emissions profile for candidate resources and market purchases • Carbon prices that are currently embedded in the cost of market resources will be netted out

Stakeholder Proposed Sensitivities

- All current PF customers elect load following product
- Increased need for Power Services to hold reserves to support large federal or non-federal buildout
- 100% carbon-free BPA generation portfolio

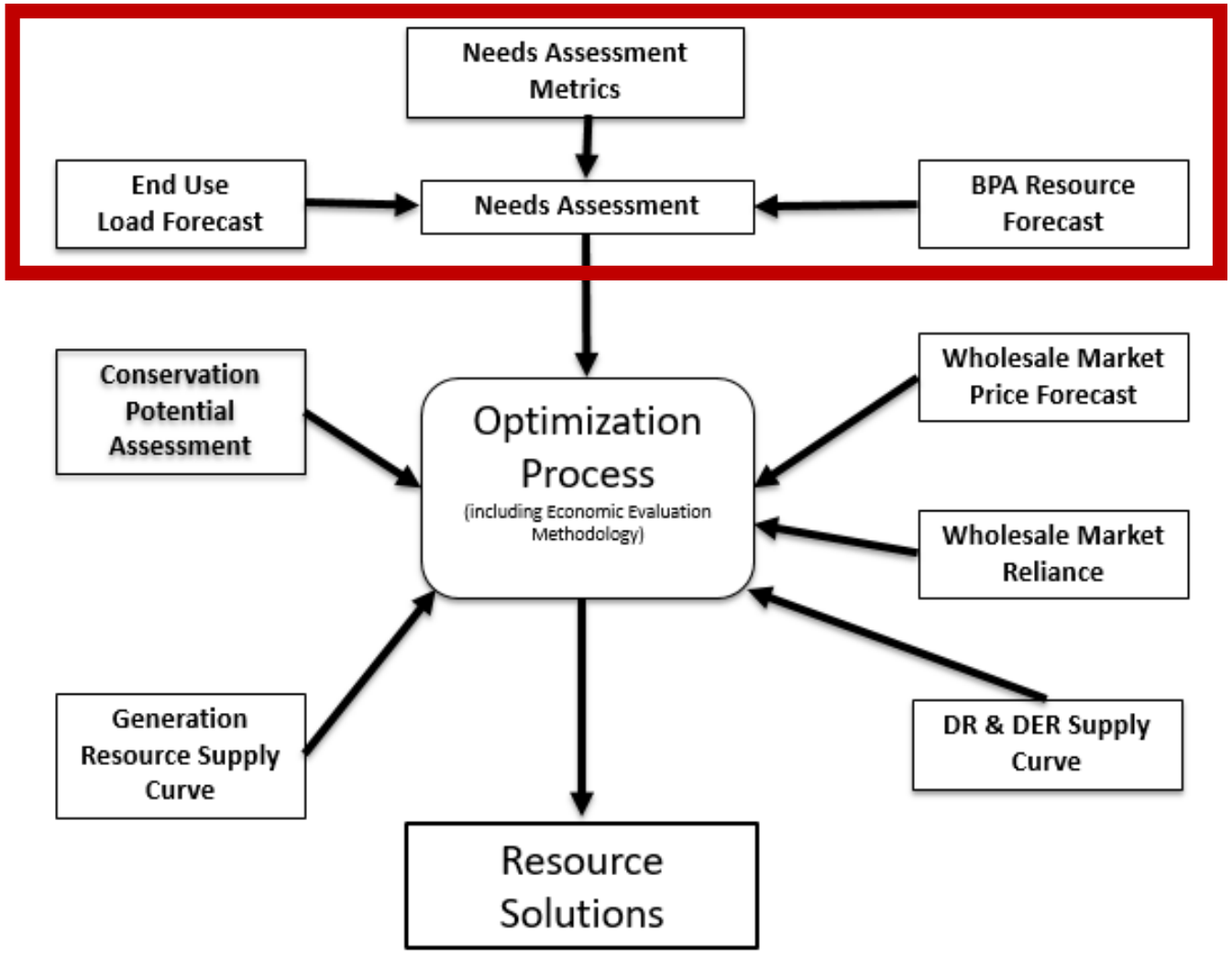
Needs Assessment Overview

Erin Riley

Background

- BPA began its Resource Program after the passage of the Pacific Northwest Electric Power Planning and Conservation Act in 1980 which established:
    - BPA's authority to acquire resources on a long-term basis to assure an adequate supply of power to meet the Administrator's contractual firm power obligations
    - Northwest Power & Conservation Council and the Council's Power Plan
- The Resource Program examines uncertainty in loads, water supply, natural gas prices, and electricity market prices to develop a least-cost portfolio of resources that meet BPA's obligations.

BPA Resource Program Process



BPA Generating Resource Portfolio

- 31 Federal Hydro Projects
  - US Army Corps of Engineers (operator)
  - US Bureau of Reclamation (operator)
  - ~ 22,000 MW nameplate capacity

- Columbia Generating Station
  - Nuclear power plant near Richland, WA
  - Energy Northwest (operator)
  - ~1,169 MW capacity

- Other
  - Small amounts of wind and non-federal hydro

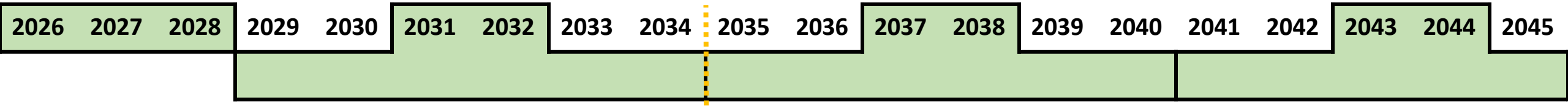
Needs Assessment Overview

- Needs Assessment (NA) forecasts Federal system energy and capacity surplus/deficit positions by assessing generating resources and load obligations for 2026 – 2045 without relying on wholesale power market

- Needs Assessment relies on two models for resources: HYDSIM and Riverware
  - HYDSIM (Hydro System Simulator) is BPA's monthly hydro model
  - Riverware is our hourly hydro model

- Studies include:
  - **Obligations** – new Frozen Efficiency Load Forecasts from BPA's load forecasting group
  - **Resources** – hydro operations based on BP24 Rates Proposal (same as CRSO Final EIS Preferred Alternative)
    - 30 years of historical streamflows modelled independently
    - Climate change projected stream flows for far out years (3 GCMs selected, RCP 8.5 forcing).
    - Spill assumptions may be updated pending long term operational agreement.

RP2024 Time Horizon and Sample Years



Hydro: 2020 Modified Flows (subset 1989-2018) | RMJOC 2 Climate Flows (2021-2050 & 2030-2059)

Sensitivity: Time horizon sensitivity focuses on only the first 9 years

20XX Indicates simulated years:

- 2031 & 2032 represent 6 years, 2029 to 2034
- 2037 & 2038 represent 6 years, 2035 to 2040
- 2043 & 2044 represent 5 years, 2041 to 2045

The sensitivity will be part of our automated checks and will help understand which resources are being selected purely to meet out-year (2035 and beyond) needs

Needs Assessment Metrics

- **Annual Energy**
  - Evaluates the annual energy surplus/deficit under P10 by month-critical water conditions
- **P10 Heavy Load Hour (HLH)**
  - Evaluates the 10th percentile (P10) surplus/deficit over heavy load hours by month, given variability in hydro generation
- **P10 Superpeak**
  - Evaluates the P10 surplus/deficit over the six peak load hours per weekday by month, given variability in hydro generation
- **18-Hour Capacity**
  - Evaluates the ability to meet the six peak load hours per day over three-day extreme weather events assuming median water conditions.

Schedule and Feedback

Brian Dombeck

Reminder: RP24 and Related Processes

**For illustrative purposes only. All dates tentative and subject to change*

Feedback and Future Workshops

- Please send feedback to your Power AE/CAE or ResourceProgram@bpa.gov with your Power AE/CAE cc'ed
- Formal written comments will be posted to Resource Planning (bpa.gov)
- Future workshops will cover results of Market Assessment, Needs Assessment, and Resource Solutions

Get in Touch

Resource Program Contacts:

Ryan Egerdahl, Program Manager, rjegerdahl@bpa.gov
Brian Dombeck, Program Coordinator, bjdombeck@bpa.gov

Find Us:

Email: ResourceProgram@bpa.gov
Web: Resource Planning (bpa.gov)