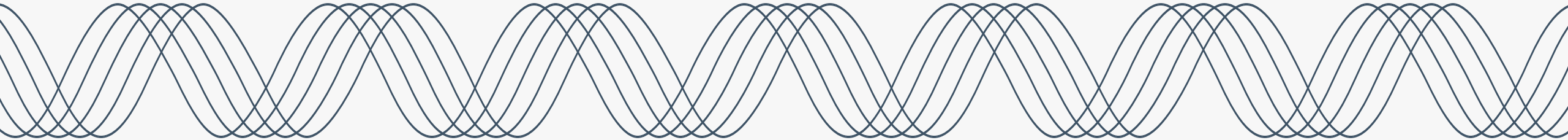
PGE CEP & IRP Roundtable 25-5

Oct 22nd 2025



Meeting Details

1

Electronic version of presentation

https://portlandgeneral.com/about/who-we-are/resource-planning/combined-cep-and-irp/combined-cep-irp-public-meetings

2

Zoom meeting details

- Join Zoom Meeting https://us06web.zoom.us/j/9291862450?pwd=xVXQI4jljt7FdetDzWD0G35FFvayF8.1&omn=84372774388
- Meeting ID: 929 186 2459
- Passcode: 108198

3

Participation

- Use the raise the hand feature to let us know you have a question
- Unmute with microphone icon or *6

Meeting Logistics

Focus on Learning & Understanding

- There will be no chat feature during the meeting to streamline taking feedback
- Team members will take clarifying questions during the presentation, substantive questions will be saved for the end (time permitting)
- Attendees are encouraged to ‘raise’ their hand to ask questions

Follow Up

If we don’t have time to cover all questions, we will rely on the CEP/IRP **feedback form**

October 22, 2025 – Agenda

9:00 | Welcome

9:05 | Corporate Load Forecast - Methodology & Trends

9:55 | Draft AdopDER Forecast

10:35 | Existing Resources & Resource Topology

11:10 | Futures/ Markets

11:55 | Closing Remarks - Next Steps

Upcoming Roundtable Schedule for the 2026 CEP/IRP

Wednesdays from 9 to 12 pm, Online Via Zoom

October 22, 2025	Corporate load forecast, existing resources – resources topology, Future Markets.
December 03, 2025	Transmission options, role of VPP, EE/DR integrations, ETO EE Forecast, drivers of capacity need.
January 14, 2026	Resource options, related economics, CBIs, RFP proxies, CEP emissions reductions
February 25, 2026	Portfolio/scenarios designs, flexibility study results
April 08, 2026	Draft portfolio analysis results
May 20, 2026	Updates prior to filing
July 01, 2026	Office Hours after filing

8 Workshops Total

Topics noted here are subject to change

Sep 2025 – Corporate Load Forecast Methodology & Trends

Amber Riter, PGE
Senior Principal Financial Risk Analyst

Shannon Greene, PGE
Senior Financial Analyst

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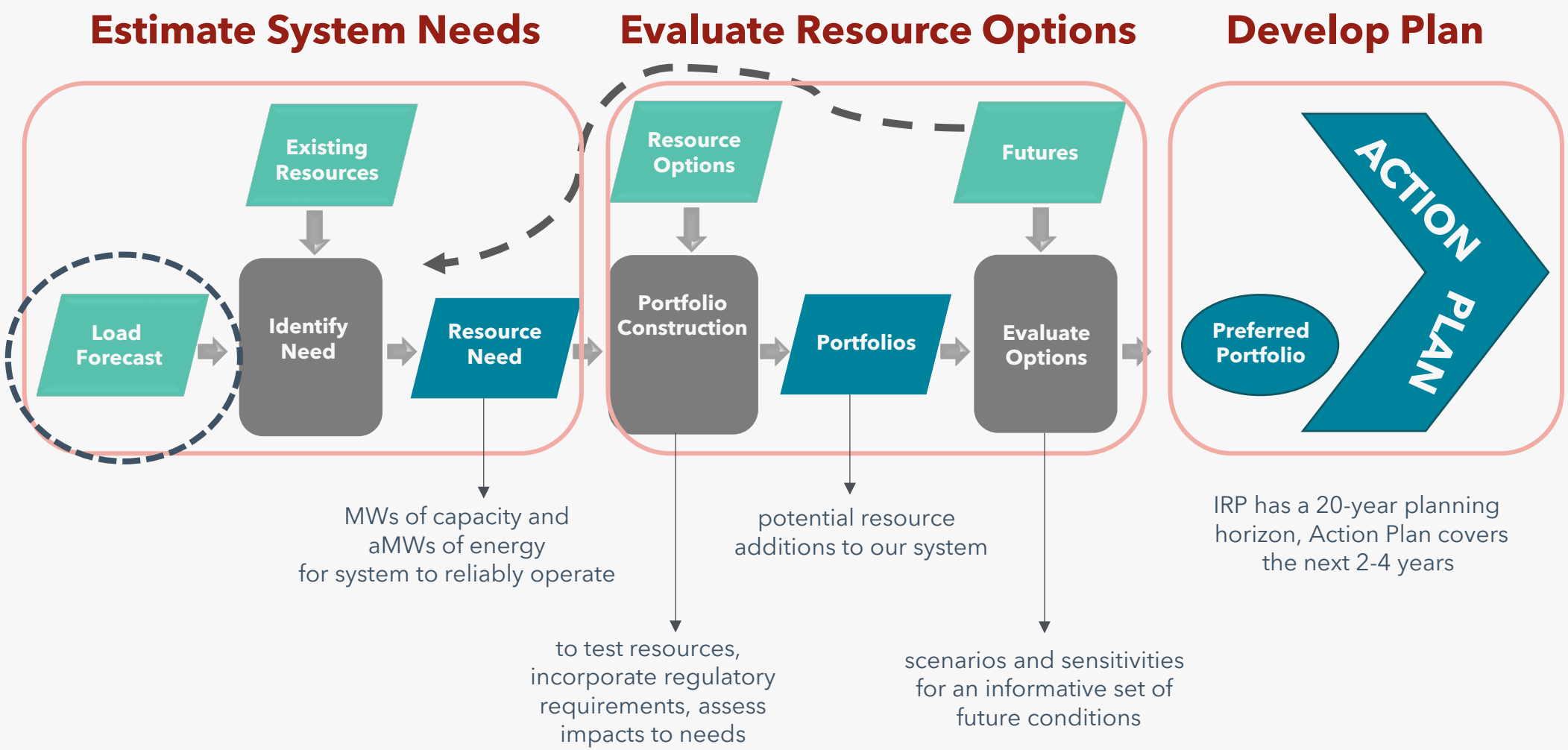
High-Level IRP Analysis Process



Load Forecast Topics

- PGE's load breakout and growth trends
- Review of PGE's load forecast model methodology
- Preliminary forecast results
- Design load scenarios

PGE's 2024 Load – Energy And Demand

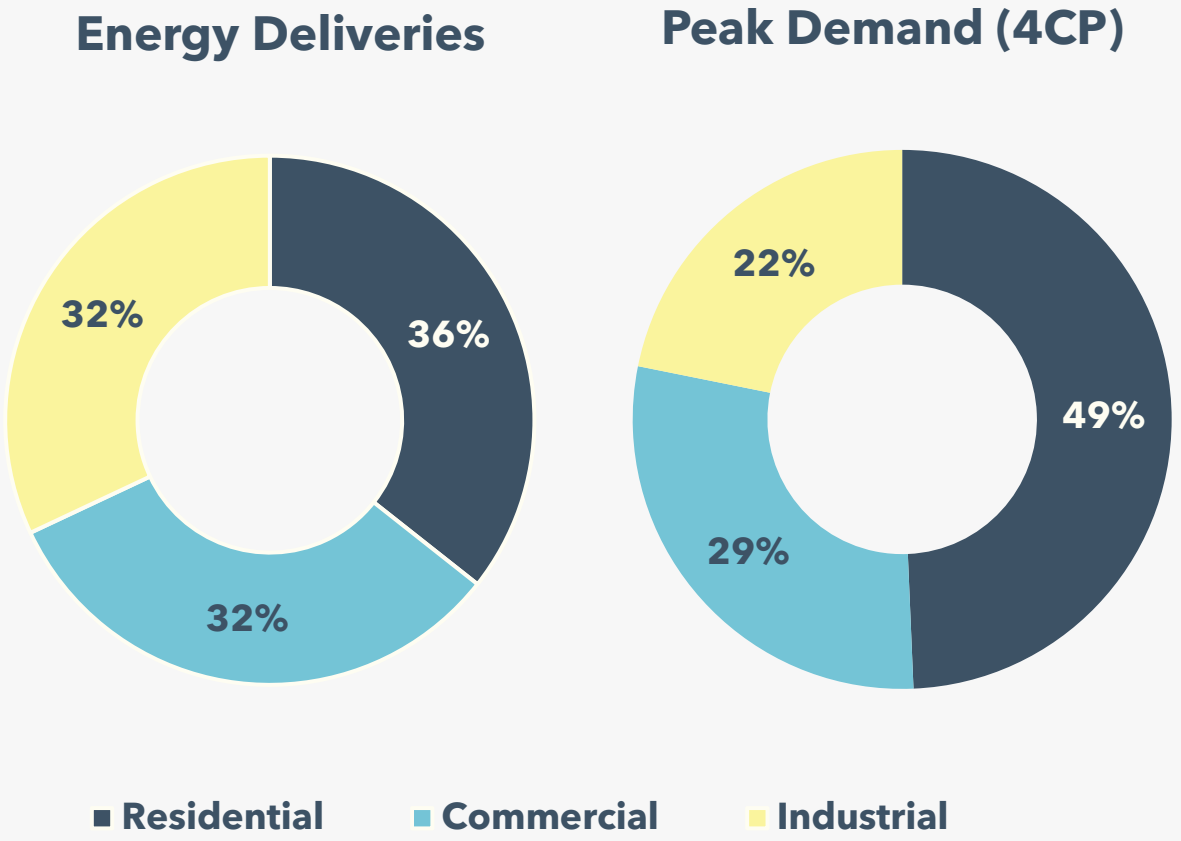
PGE's 2024 energy deliveries were roughly equal across the customer classes (residential, commercial, industrial)

We expect industrial to be the largest share of energy deliveries in the next few years

PGE's system peak demand is more heavily weighted towards the residential class

While the growth rate of industrial load is expected to outpace commercial and residential, residential continues to outsize industrial contribution to peak

Share of 2024 Load by Class



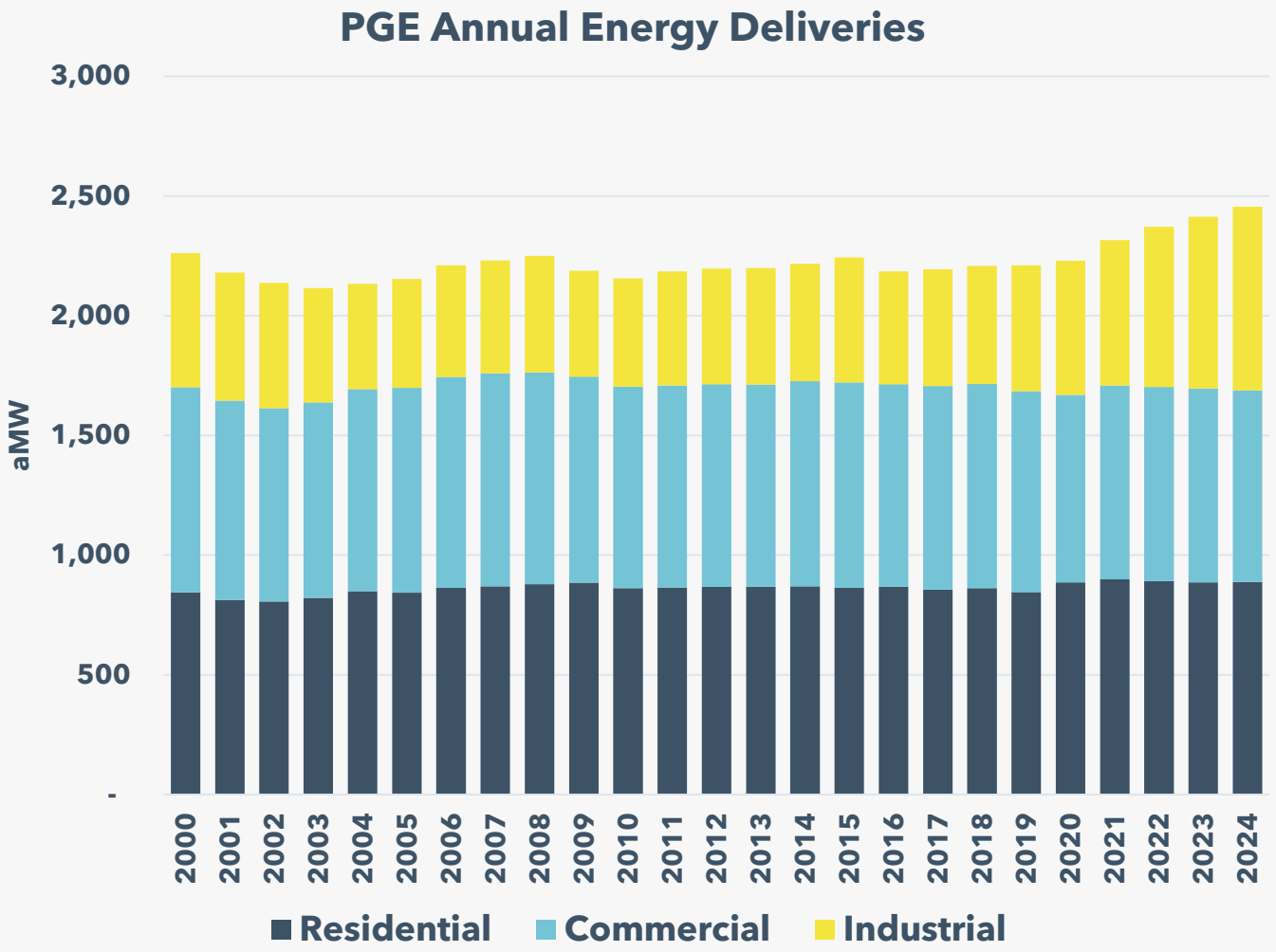
PGE's Load Growth

Lasting COVID-19 impact on residential and commercial

While the initial scale of impact has been offset, residential loads shifted higher and commercial loads lower

Acceleration of industrial growth continues

This is expected to continue as data center demand from cloud and AI uses expands



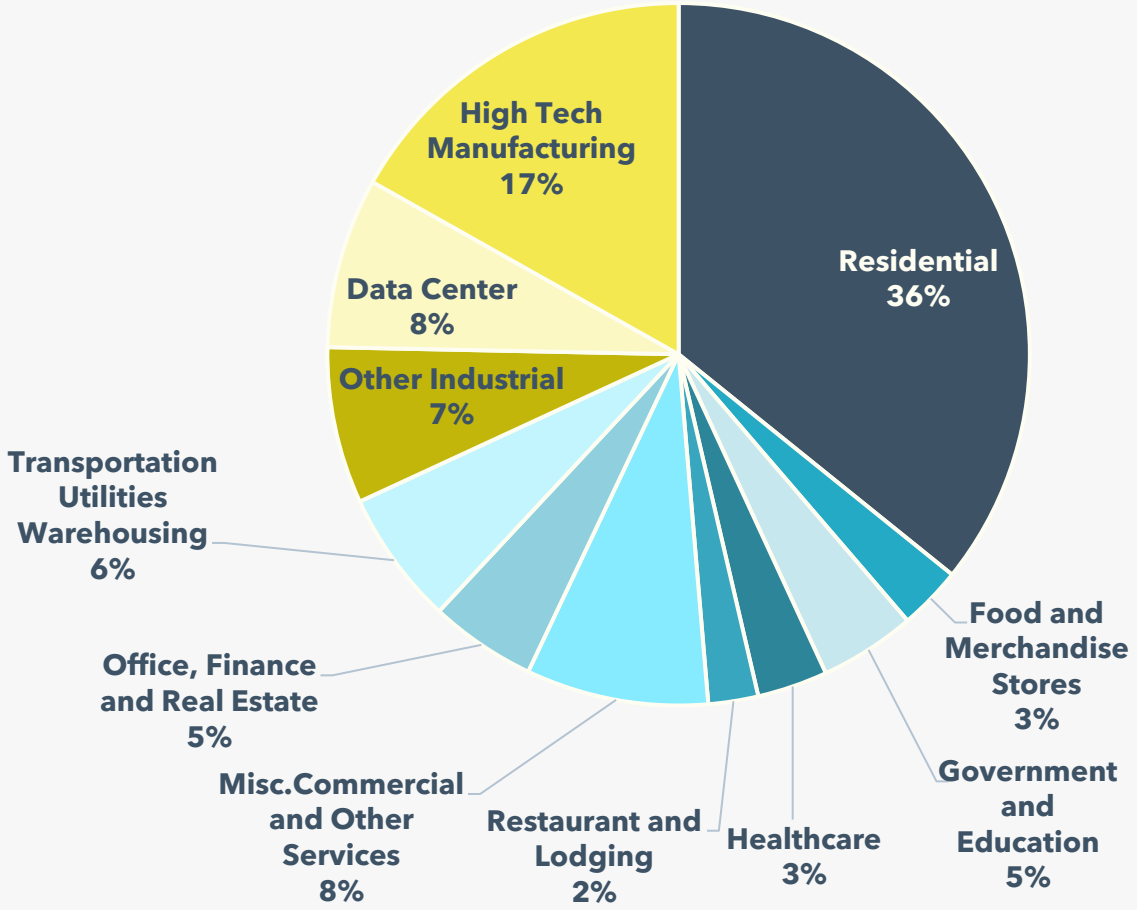
PGE's 2024 Load by Class

PGE's industrial load growth is fueled by rapid development in the Data Center segment

PGE's data center energy deliveries have expanded from under 50 aMW in Q2 2020 to over 300 aMW in Q2 2025

High-Tech manufacturing remains PGE's largest non-residential segment

Share of 2024 Energy Deliveries by Class



Load Growth Trends

A load factor is the ratio of average to peak load, representing the 'peakiness' of a system or class load

Residential customers have a lower load factor as they are more sensitive to changes in temperature

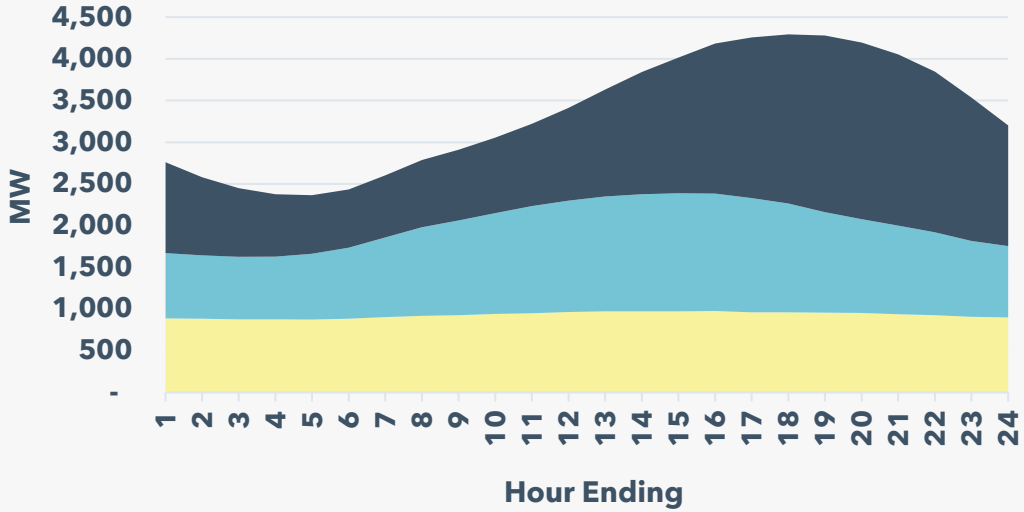
In recent years, increased saturation and utilization of air conditioning has **led to a lower system load factor**

Industrial customers have a higher load factor due to a more stable load shape

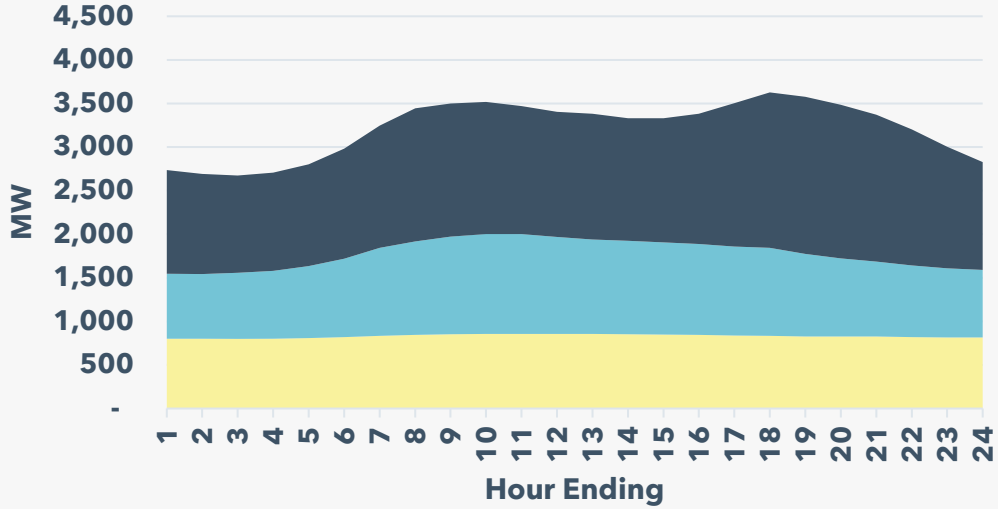
In the future, we expect the **system load factor to increase** as the share of industrial load increases

Our hourly model methodology allow for us to capture these changes

2024 Daily Shape Summer Peak Day



2024 Daily Shape Winter Peak Day



PGE's Load Forecasting Model

- Forecast is based on historical data, inclusive of historical trends, energy efficiency, embedded levels of transportation and building electrification
- 'Add-back' method adjusts for estimated historical rooftop solar generation
- Large customer forecast reflecting reference case realization of customer load requests

Top-Down Econometric Load Forecast

Input from the AdopDER Model

- Load forecast utilizes incremental method to account for market driven transportation and building electrification loads
- Load forecast utilizes 'add-back' method to account for the full impact of rooftop solar

Final load forecast used for IRP analysis

Load Forecast

More detail later in roundtable

DER – Distributed Energy Resource

Energy Deliveries Model
Overview

Based on historical, monthly billing data

- Updated 2-4 times per year
- 3 sets of residential equations based on average usage and customer count
- 6 regression equations based on monthly energy deliveries by rate schedule
- Individual forecasts for large customers

Changes in Method

"Add-back" impact of rooftop solar to regression timeseries

+ accounts for rapid increase in rooftop solar adoption

Energy Deliveries Model
Residential Models

Estimation Period: UPC 2011-2025, Count 2000-2025, Building Permits 2010-2025

Data Frequency and Source: Monthly, billing data

Grouping: Dwelling type

Model Type: ARIMA

Input Assumptions: Normal weather, including warming trend

UPC_s =	fn (HDD, CDD, wind, energy efficiency, monthly indicators, COVID indicator)
Count =	fn (Building Permits, monthly indicators, control indicators)
Building Permits =	fn (Housing starts, construction employment, monthly indicators, control indicators)

Independent right-hand side variables

- **Heating and cooling degree days**
- **Housing Starts**
- **Energy Efficiency Forecast**
- **Indicator Variables (COVID, monthly)**
- **Solar Add-back – Single Family**

ARIMA: Autoregressive Integrated Moving Average
CDD: Cooling Degree Day
HDD: Heating Degree Day
UPC: Usage Per Customer

Energy Deliveries Model

Non-Residential Rate Schedule Models

Estimation Period: 2011-2025

Data Frequency and Source: Monthly, billing data

Grouping: Rate Schedule

Model Type: ARIMA

Input Assumptions: Normal weather, including warming trend

Usage$_s$ = fn (HDD, CDD, energy efficiency, employment, monthly indicators, control indicators)

Independent right-hand side variables

- **Heating and cooling degree days**
- **Oregon Employment**
- **Energy Efficiency Forecast**
- **Indicator Variables (COVID, monthly)**
- **Solar Add-back – (Rates 32, 83, & 85)**

ARIMA: Autoregressive Integrated Moving Average
CCD: Cooling Degree Day
HDD: Heating Degree Day

Energy Deliveries Model

Non-Residential Large Load

Individual customer forecasts for approximately 30 large customers, 26% of 2024 system deliveries

- Focus on large sites with high energy intensity
- Usage is less dependent on regional economic indicators
- Can experience sudden or drastic changes in operations

Customers may be eligible for direct contracting through UM 2377

More on how new large loads will be considered in IRP analysis in future roundtables

Customer requests

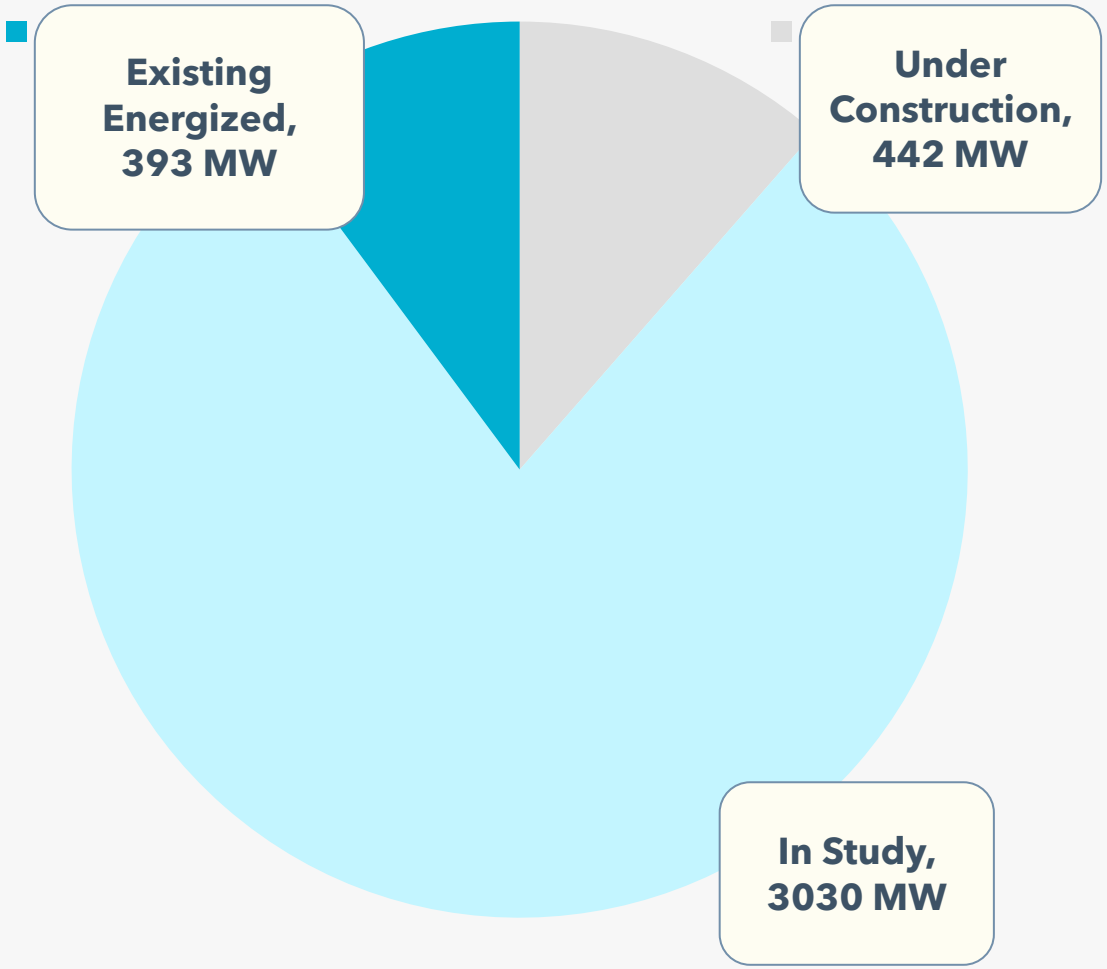
Historic load ramp and comparison to like customer

Segment level industry reports

Company credit review

Energy Deliveries Model

Capacity Request Pipeline Informs the Large Load Forecast



Robust pipeline informs the load forecast

Uncertainty in project realization rate and load ramp timing remain key risks to the outlook

Reference case forecast assumes large load of 1 GW by 2030 and 2 GW by 2040

Existing and Energized

393 MW of capacity from existing and fully energized customers continuing to ramp between 2025 and 2030

Under Construction

442 MW of capacity under construction with energization and ramping occurring in the next several years

In Study

3030 MW from data center applications

Studies underway with initial contracting in Q4

Preliminary Energy Deliveries Forecast

Long term growth rates

Average 20 Year Growth Rate: 3.8%

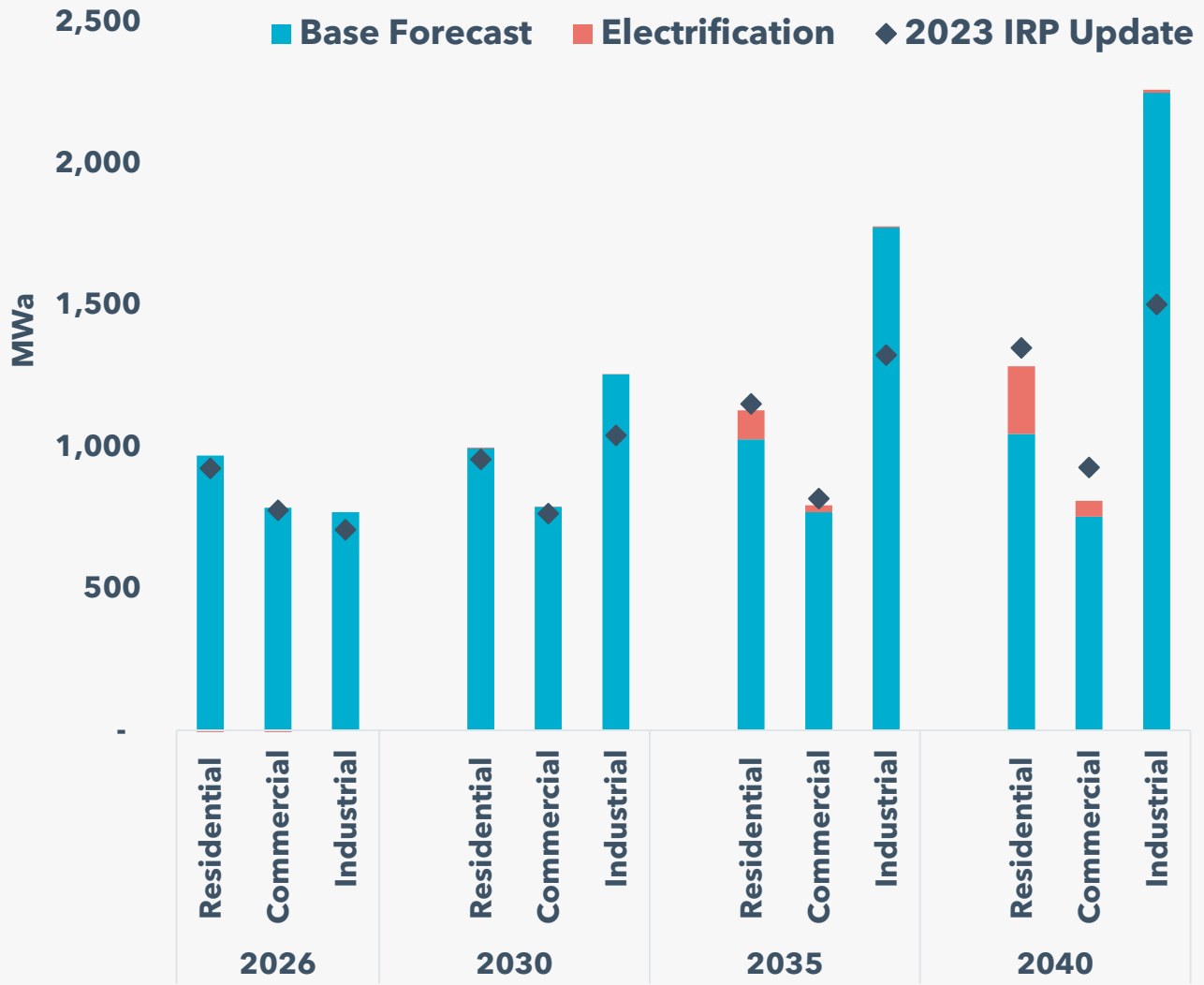
Including the impact of Rooftop Solar, Transportation and Building Electrification

The **residential and commercial** sectors show only modest growth on the five-year horizon. Growth accelerates when electrification begins to outpace rooftop solar

The **industrial** sector is expected to continue to **grow rapidly**, driven primarily by data centers

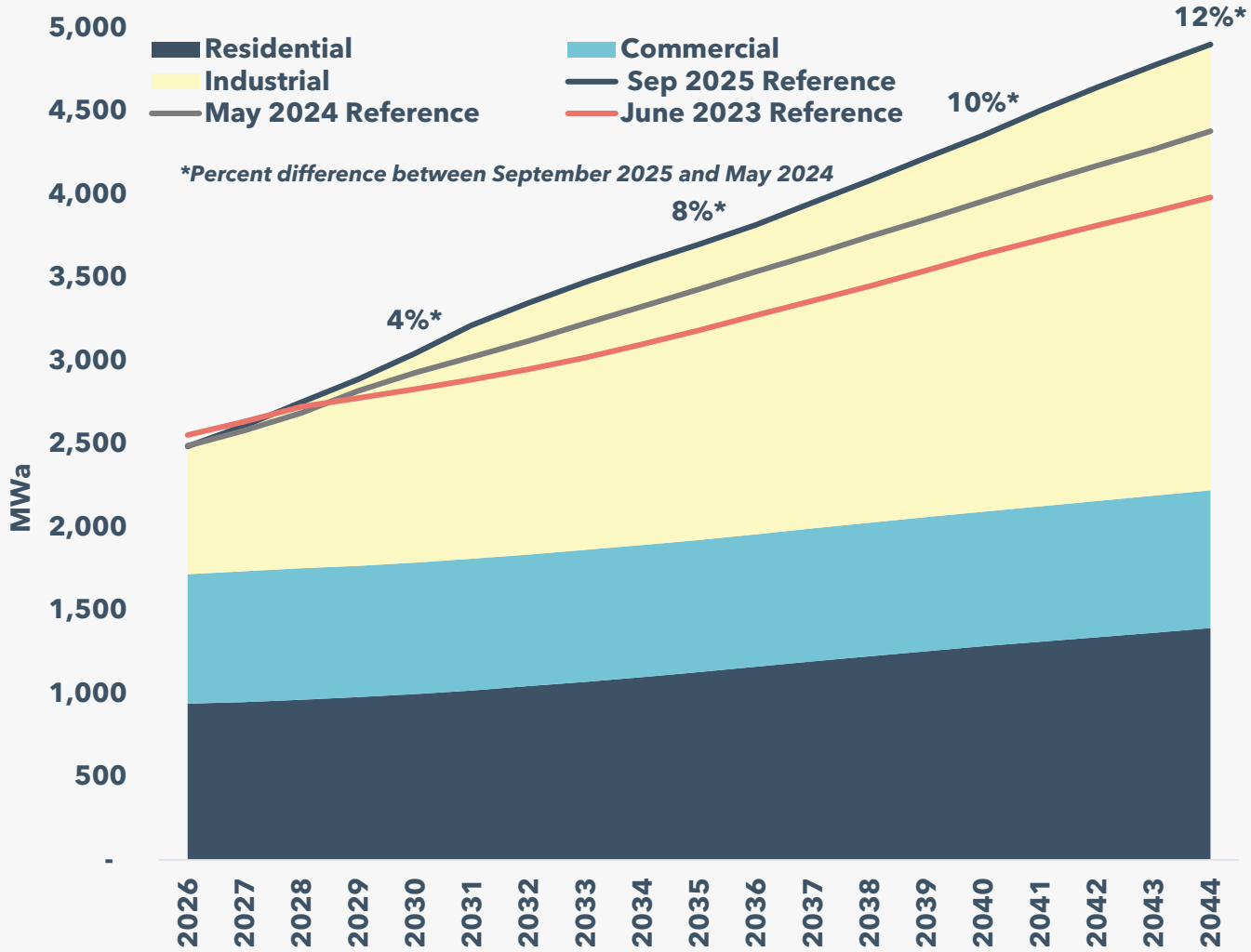
Significant uncertainty remains in the long-term realization of new load requests

The industrial segment **quickly outsizes** residential and commercial segments



Preliminary Energy Deliveries Forecast

Comparison to Prior Vintages



20 Year Average Annual Growth Rates	June 2023 Reference	May 2024 Reference	September 2025 Reference
Total Energy	2.6%	3.2%	3.8%
Residential	2.2%	2.3%	2.2%
Commercial	2.3%	2.3%	0.3%
Industrial	3.4%	5.2%	7.2%

Decreased electrification forecast, specifically for the commercial sector, is more than offset by increased large customer growth

Hourly Load Simulations

Overview

Key output: Hourly Load Simulations over 210 draws and Peak Demand forecast

- Based on historical, hourly load research data
- Updated once per year
- 3 sets of hourly equations by customer class – residential, commercial, industrial
- Simulations using 30 historical weather years * 7 day of week start
- Scaled to align with average energy from the energy deliveries model

Changes in Method

"Add-back" impact of rooftop solar to regression timeseries

+ accounts for rapid increase in rooftop solar adoption

Hourly Load Simulations
Specification

Estimation Period: 2019-2024

Data Frequency and Source: hourly, load research

Grouping: Customer Class

Model Type: Fixed Effect

Input Assumptions: Average usage across simulation compared to monthly forecast to create scale factor

Output: 210 Simulations based on 30 weather years and seven day of week adjustments

Hourly $Usage_{SD}$ = fn (CDD, CDD build up, HDD, HDD build up, wind, trend, indicator variables)

Independent right-hand side variables

- **Heating and cooling degree days, and other weather**
- **Solar Addback**
- **Demand Response Addback**
- **Trend**
- **Indicator Variables (COVID, monthly, DOW, extreme events)**

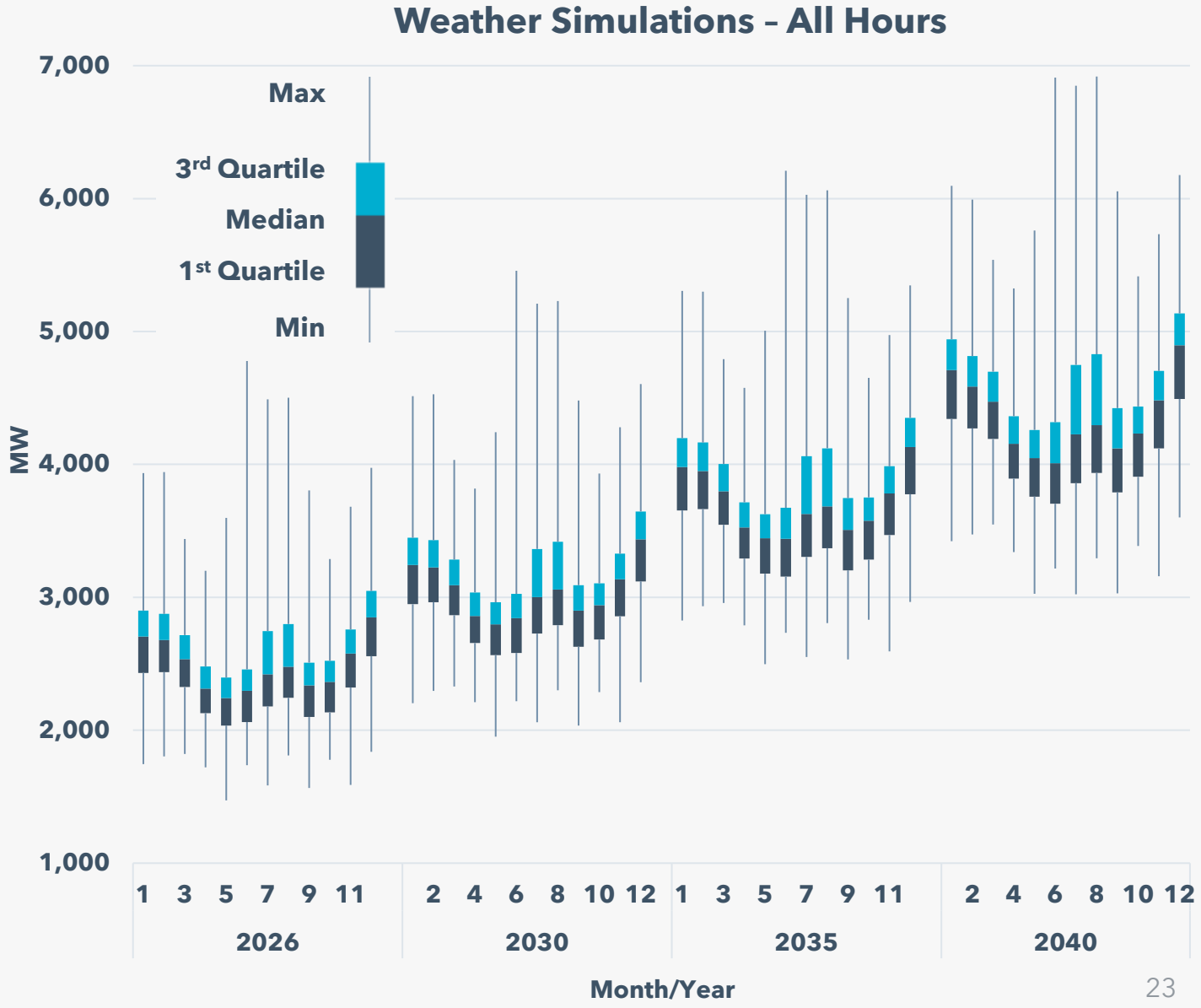
CDD: Cooling Degree Day
HDD: Heating Degree Day

Preliminary Hourly Load Simulations

Results

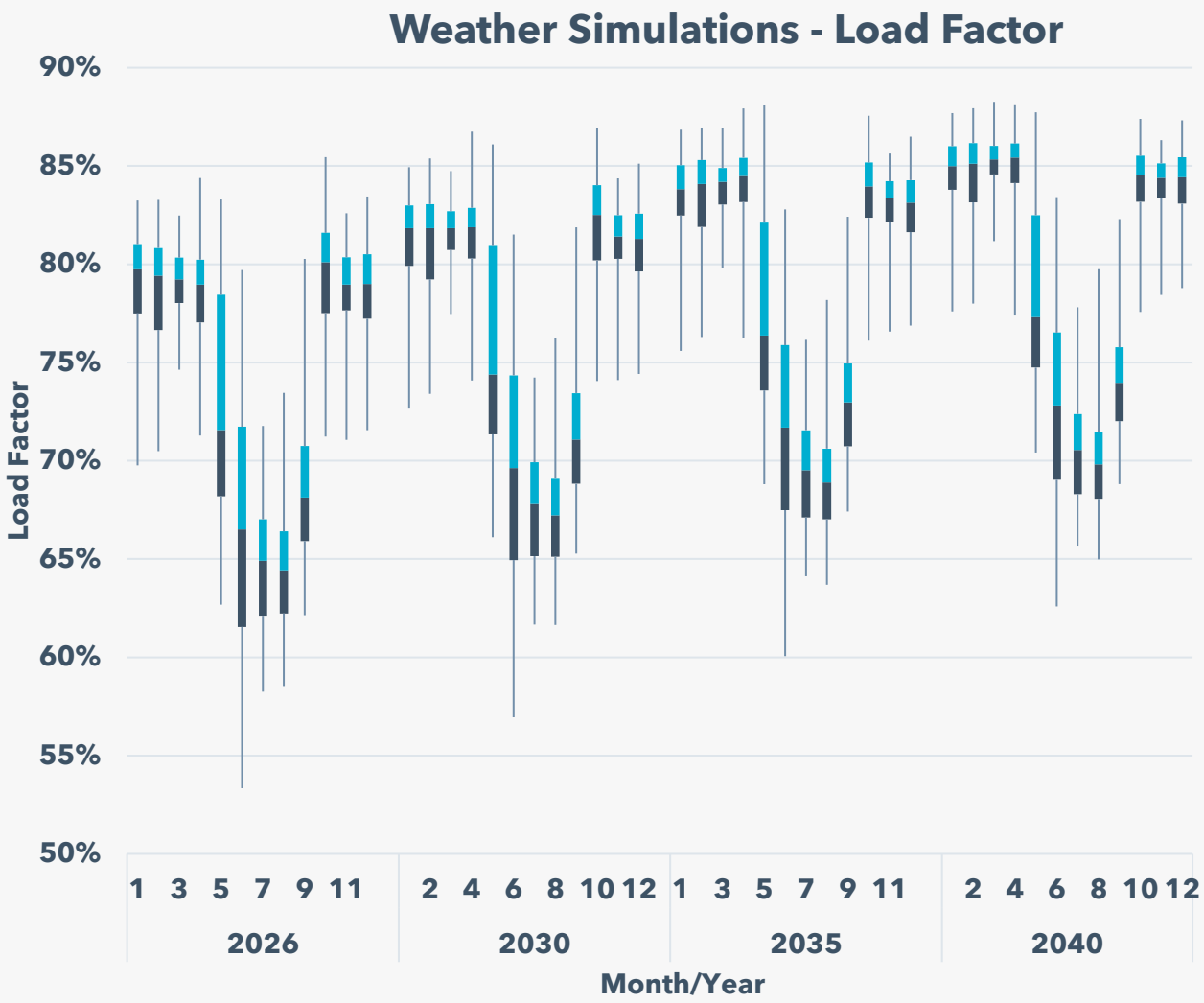
Simulations create 210 future scenarios used to match supply with demand and assess capacity need under different weather conditions

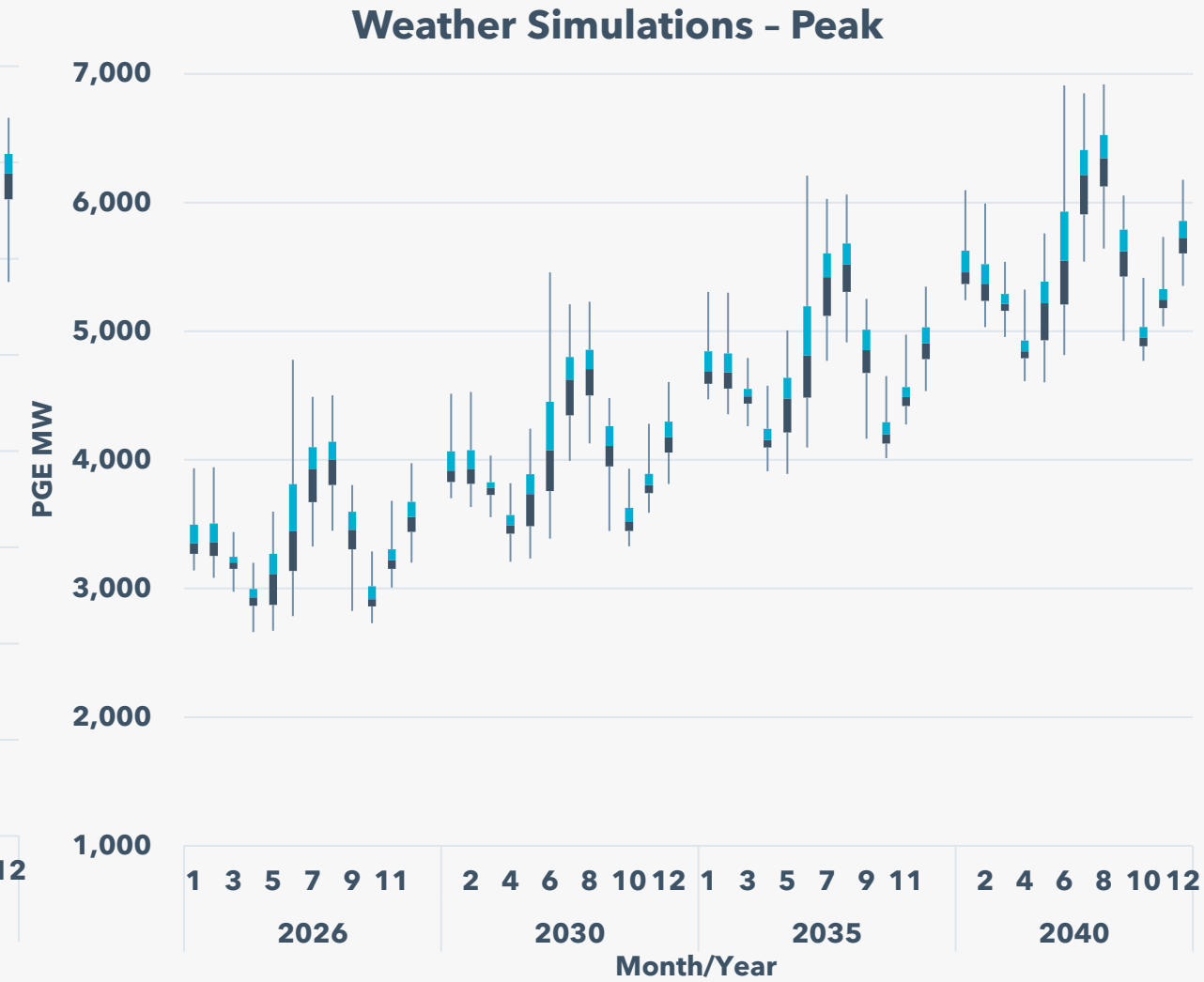
Load factor increases over time driven by increased industrial deliveries flattening total load shapes



Preliminary Hourly Load Simulations

Results





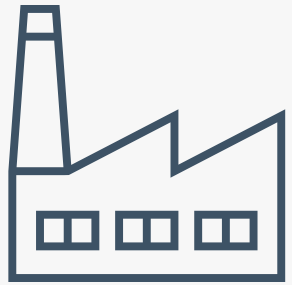
Addressing Uncertainty

The load forecast centers around a reference case point estimate. However, the IRP process considers uncertainty associated with load in several ways

- Forecast updates to account for new information
- High and Low load forecasts are developed based on varying economic inputs
- Weather uncertainty is considered within the resource adequacy model Sequoia

Scenario Development

Key Inputs



	Customer Growth	Economic Conditions	Data Center Expansion	DER Adoption
Reference Case	September 2025 forecast from Oregon's Office of Economic Analysis. 10-year avg customer count growth 1.1%	September 2025 forecast of Oregon Employment from Oregon's Office of Economic Analysis. 10-year AAGR of 0.5%	Existing segment of approx. 400 MW increases to 1 GW in 2030 and 2 GW in 2040	Alignment with today's reference case AdopDER forecast. Current Federal and State policy assumptions
High Case	Policy steps are successful at encouraging increased building. Growth in customer count is 0.5% higher.	Optimistic case, employment in Oregon posts modest gains in the near term 10-year AAGR of 1.0%	Rapid expansion, segment increases to 2 GW in 2030 and 3 GW in 2040	Scenarios to be built out in future sessions
Low Case	Economic conditions weigh on housing. Growth in customer count is 0.5% lower.	Near term recession case, employment growth continues to fall in Oregon before a slow recovery. 10-year AAGR of -0.1%	Constrained growth, 500 MW in 2030 and 600 MW in 2040	Primary driver of residential usage per customer in the forecast period

Summary / Highlights / Next Steps

Preliminary load forecast shows increased total energy outlook, driven by large customer growth

The load forecast that will inform the 2026 IRP will be finalized to include final AdopDER results and Energy Efficiency forecasts from the Energy Trust this Fall

This forecast will inform the 2026 IRP resource need and portfolio/scenario analysis

Details on these topics to be discussed at future roundtables

Guided Feedback – Corporate Load Forecast

- What do you see as the biggest risks to PGE's load forecast?

Questions

Draft AdopDER Forecast

Kyle Billeci, PGE

Principal Strategy & Planning Analyst

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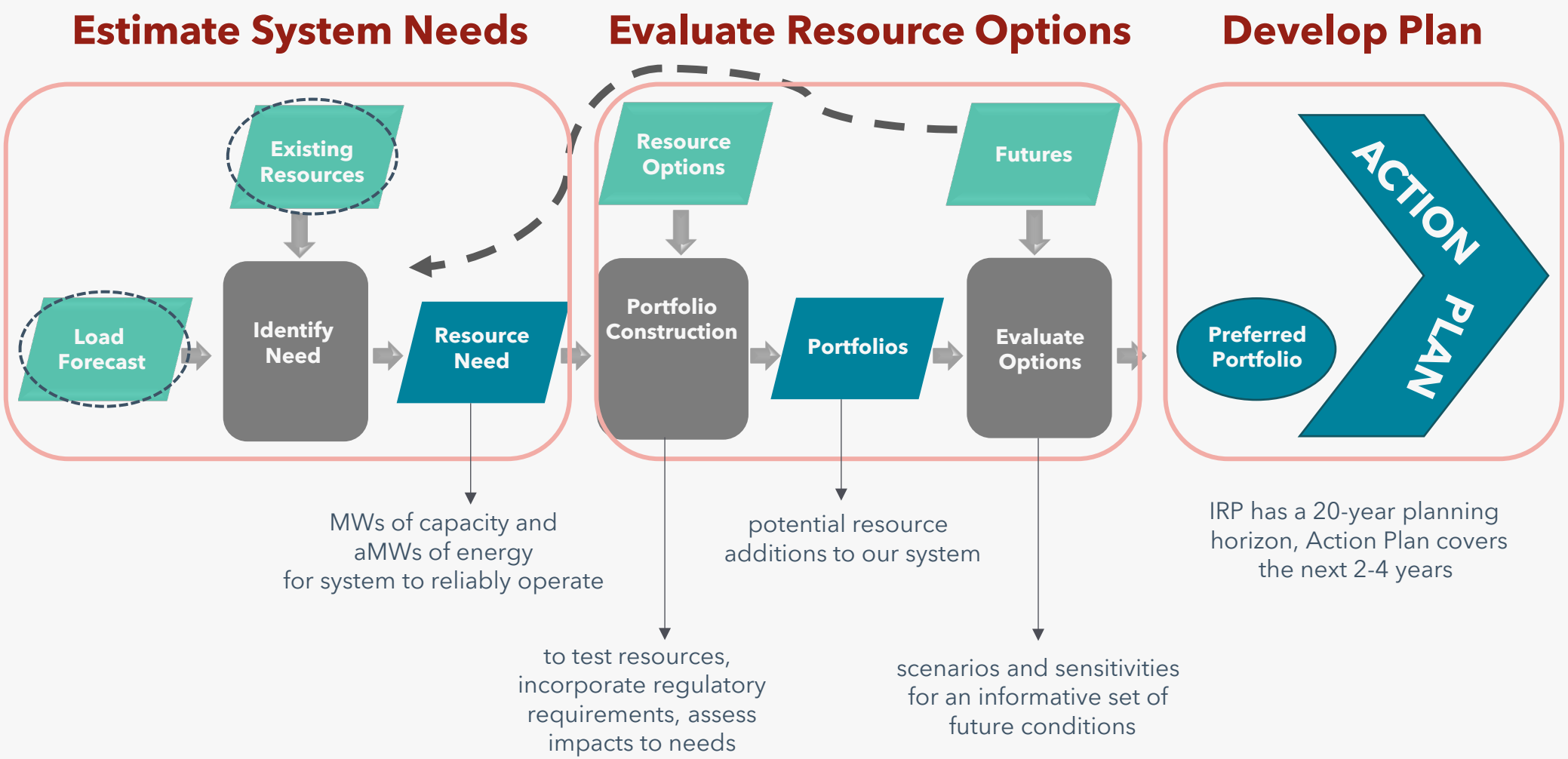
High-Level IRP Analysis Process



DER Forecast Topics

- AdopDER Overview
- Recalibration of Inputs & Assumptions
- Results by Scenario
- Comparison to 2023 IRP Update

AdopDER is…

- Python-based site-level simulation model
- Forecasts the adoption of **50+ distributed energy resources (DER)**
- Simulates **locational, 8760 hourly load impacts** from co-adoption of DERs and electrification
- Supports resource planning and distribution planning processes

**Full methodology & technical details documented in DSP Part 2 (Chapter 3).*

AdopDER's Purpose

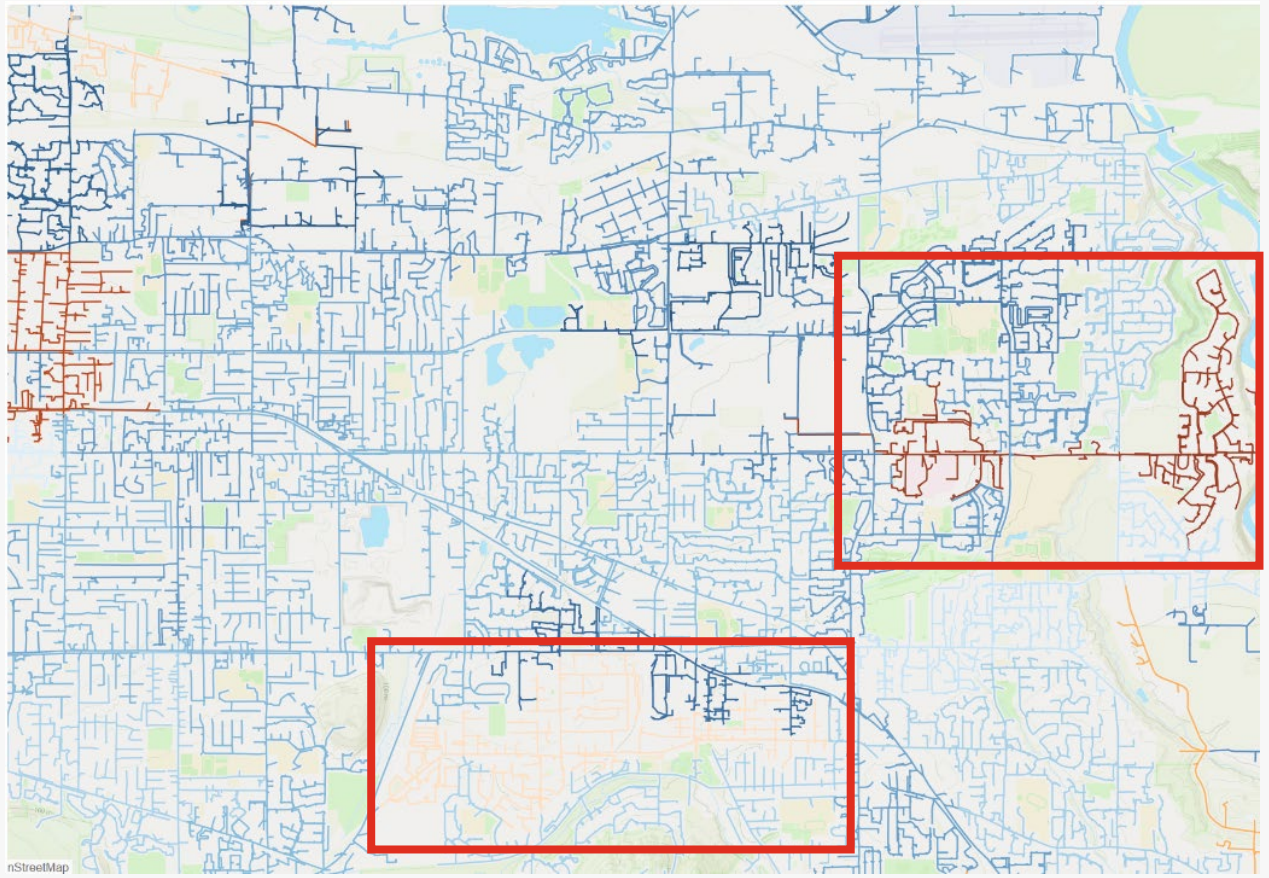
1) Estimate future **total** DER adoption & impacts

2) Forecast **where** DERs will be most impactful

Future load growth is not spread evenly across the distribution system and AdopDER forecasts where those expected trends of DERs will be

DERs included in PGE's forecast include:

- Building Electrification
- Transportation Electrification
- Solar & Battery Storage
- Demand Response/Flex Programs

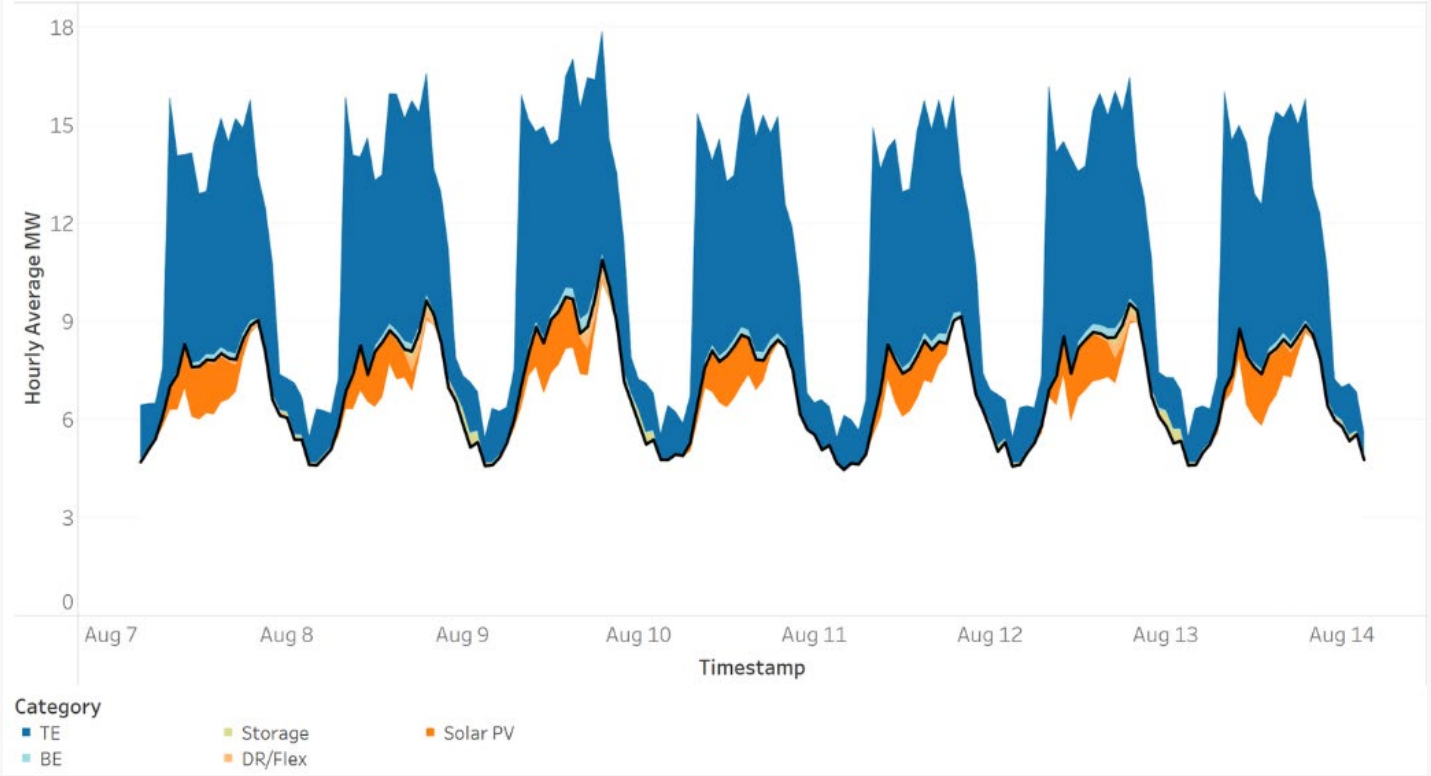


Feeder-level map of constrained feeders

AdopDER's Output

AdopDER produces estimated **8760 hourly load impacts for 20 years** to:

- Estimate feeder-level load growth
- Estimate available resources PGE can implement to mitigate load growth
  - VPP (DSP)
  - Customer Programs (MYP)
- Evaluate the cost effectiveness of individual DER measures and measure bundles
- IRP forecast will cover 2026-2045



Example of feeder-level load profile of DERs during a given week

**Black line is baseline load shape of feeder without DERs*

How AdopDER Informs PGE

Integrated Resource Plan (IRP)

- DER capacity and energy impacts included in load forecasts and resource adequacy

Transportation Electrification Plan (TEP)

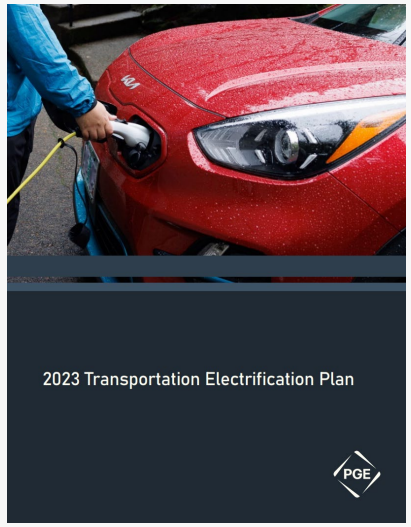
- Forecast of EV adoption and charging load by segment to inform infrastructure needs and program design

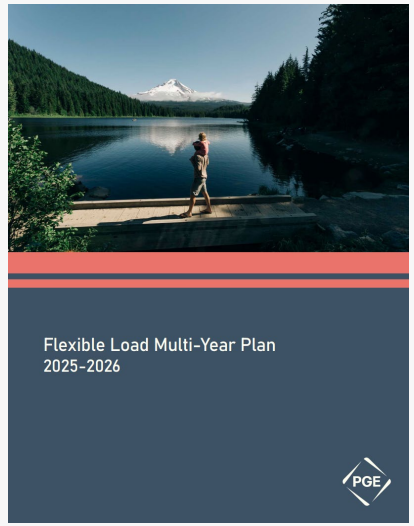
Distribution System Plan (DSP)

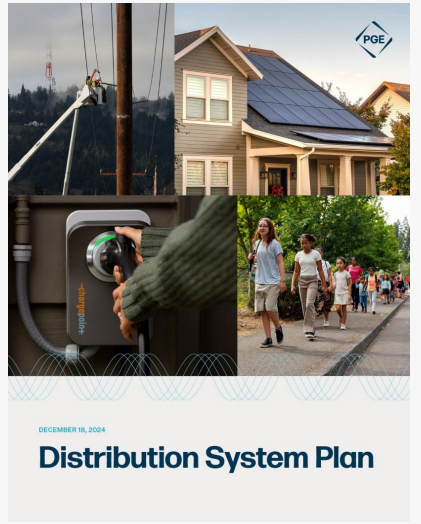
- Locational DER capacity potential and adoption to assess hosting capacity, grid needs, and non-wire solutions

Multi-Year Plan (MYP)

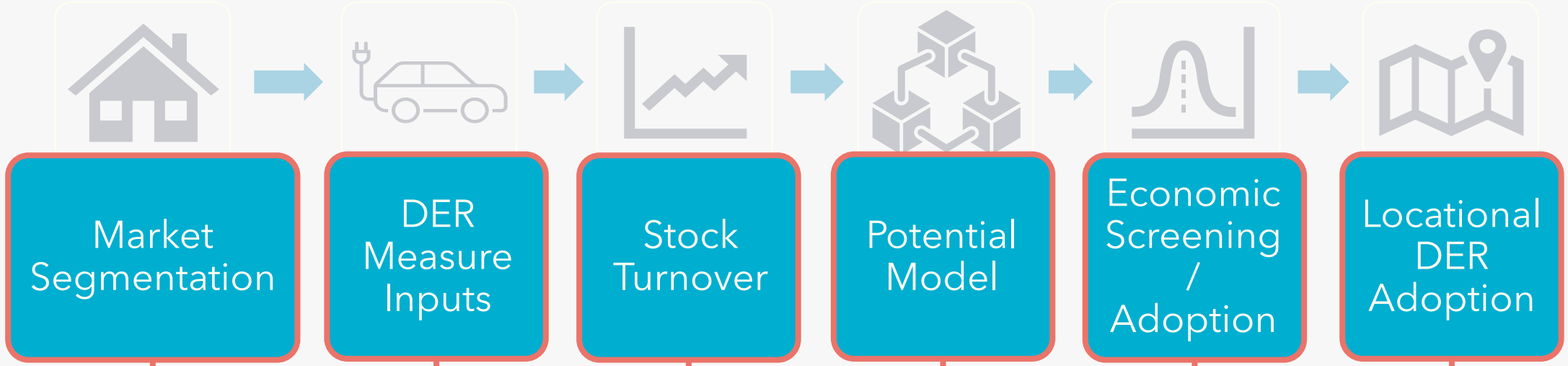
- Inform corporate load forecast and expected system demand trends to reflect net system load after DER growth







AdopDER Simplified



- Allocates DER adoption geographically based on feeder-level characteristics, hosting capacity, and customer distribution.
- Produces locational forecasts aligned with system planning and corporate load forecasts.

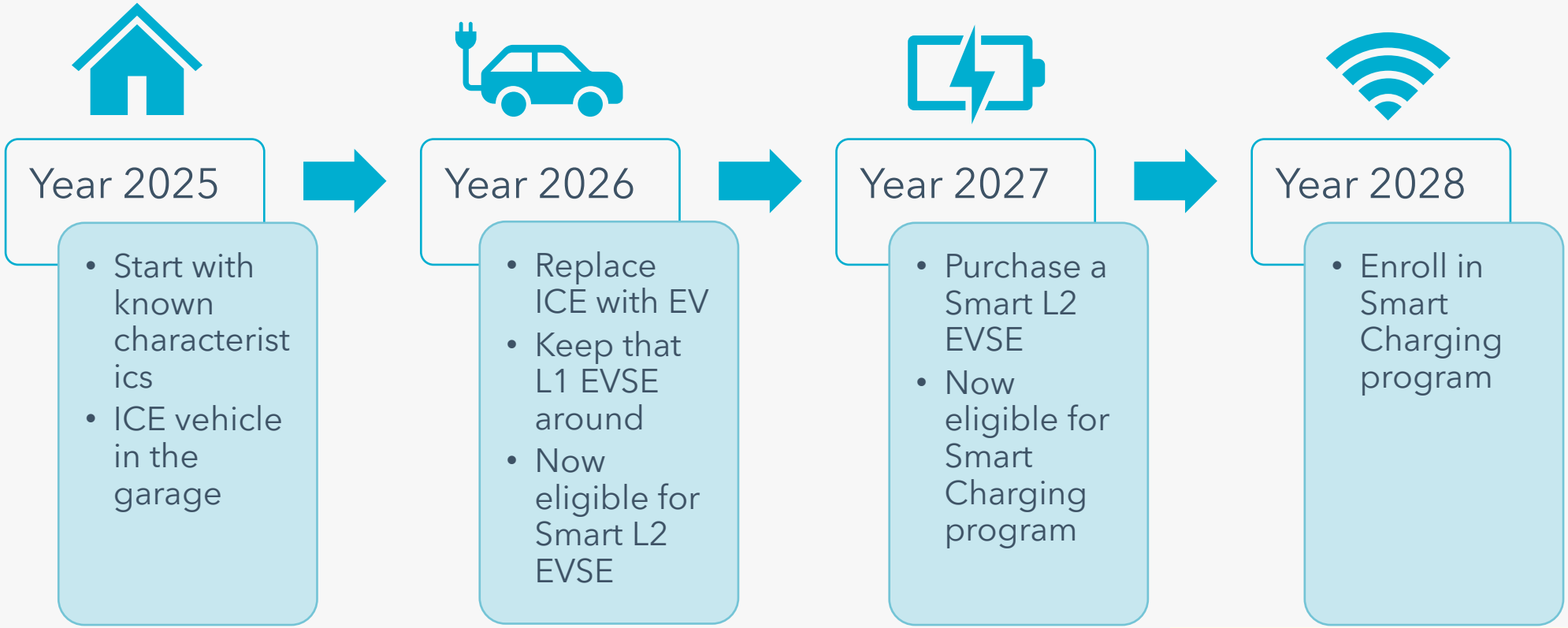
DER Measure Inputs

- **Solar and Storage**
  - Solar PV
  - Battery Energy Storage
  - Single-site Microgrid
  - Campus Microgrid
- **Electric Vehicles**
  - Light-Duty Vehicles
  - Medium-Duty Vehicles
  - Heavy-Duty Vehicles
- **Basic EVSE**
  - Res L1
  - Res L2
  - Non-Res L2
  - Non-Res DCQC
- **Smart Charging**
  - Res Smart EVSE
  - Non-Res Smart EVSE
- **Smart Water Heating**
  - ERWH Retrofit Switch
  - ERWH Smart Controls
  - Smart ERWH
  - HPWH Smart Controls
- **Smart HVAC**
  - Res Smart Tstat Controls
  - Res Line Voltage Tstat
  - Res DHP Controls
- **C&I DR**
  - Commercial Smart Tstat
  - Irrigation Load Control
  - Large C&I Tariff
  - Cold Thermal Storage
- **Non-firm DR**
  - Peak Time Rebates (PTR)
  - Time of Use (TOU) Rates
  - EV-TOU

DER Customer Journey

Step 1: Adoption

Hypothetical Example of DER Adoption



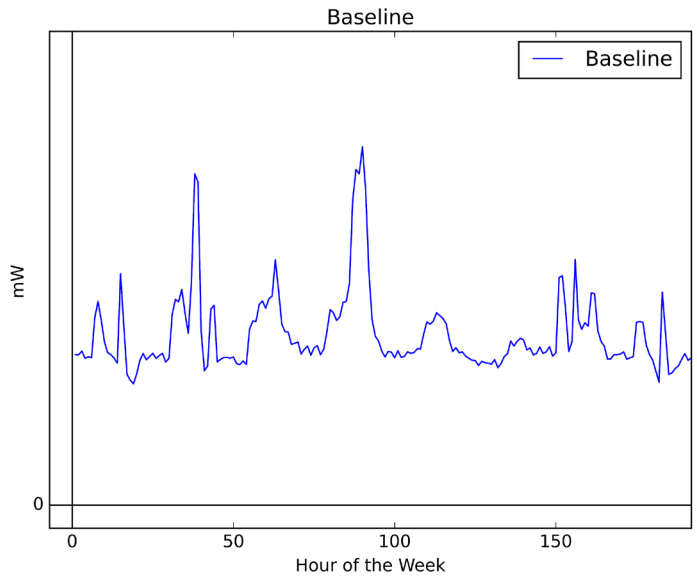
ICE: Internal Combustion Engine
EV: Electrical Vehicle
EVSE: Electric Vehicle Supply Equipment (Charger)
L1: Level 1 Charger
L2: Level 2 Charger

Apply DER Load Impacts

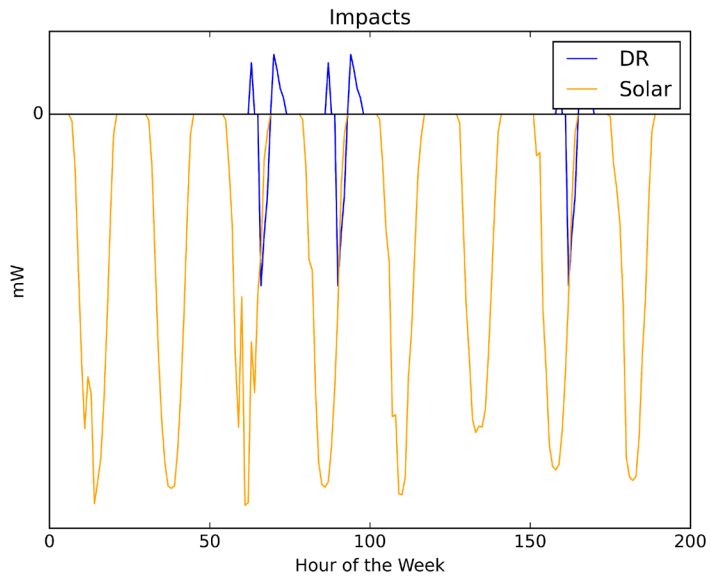
Step 2: Load Impacts

Feeder-Level load, no DER adoption → Apply load impacts for each DER measure → Feeder-level load with DER adoption

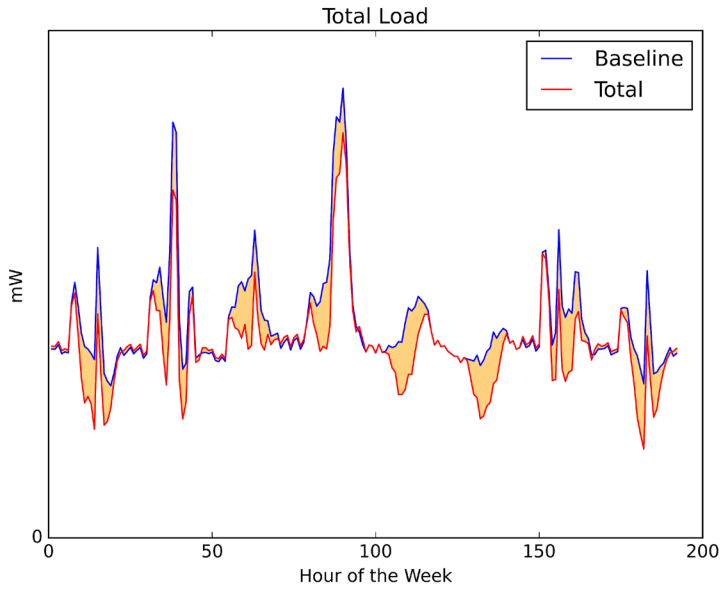
Predicted Hourly Feeder Load (MW, Aug 2030)



Predicted DER Load Impacts (MW, Aug 2030)



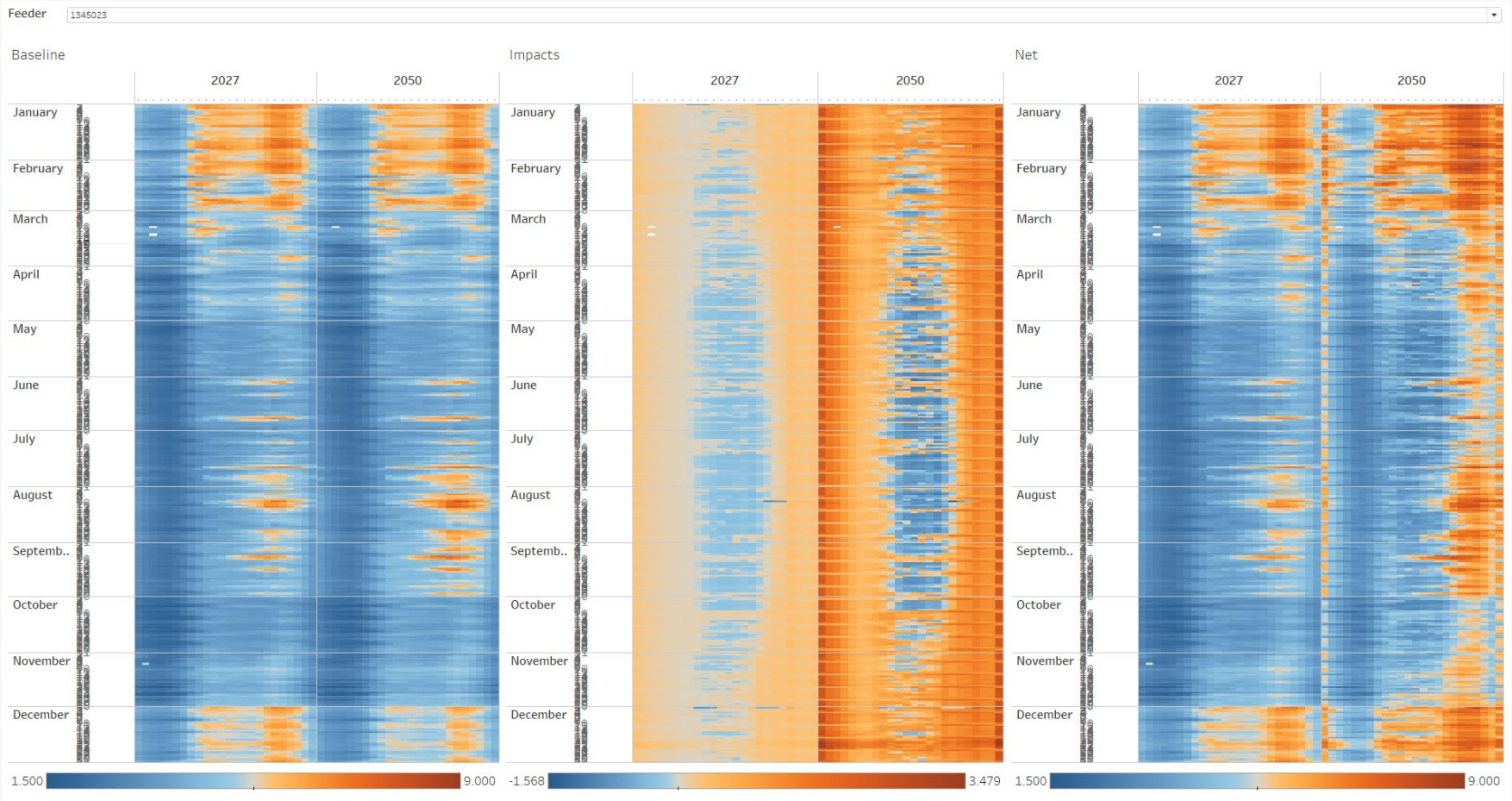
Predicted Hourly Feeder Load (MW, Aug 2030)



Produce Hourly Load Impacts

Step 3: Reporting

Island Substation, Feeder 1345023
Base, Impact, and Gross Load Heatmap



Assumption Updates
(since 2023 IRP Update)

- Refreshed DMV LDV registrations and MDV/HDV counts and locations
- Refreshed public/private EVSE charging infrastructure
- Refreshed solar and storage project additions and corrections
- Updated PGE Flex Program Participants
- Updated known large load additions
- Updated 2024 AMI data
- Updated 2025 corporate load forecast
- Updated light-duty vehicle, rooftop solar, and battery storage adoption curves
- Recalibration of EVSE charging impacts per vehicle
- Adjustment to NREL ATB pricing based on tariffs
- Implementation of "Big Beautiful Bill" impacts on federal incentives

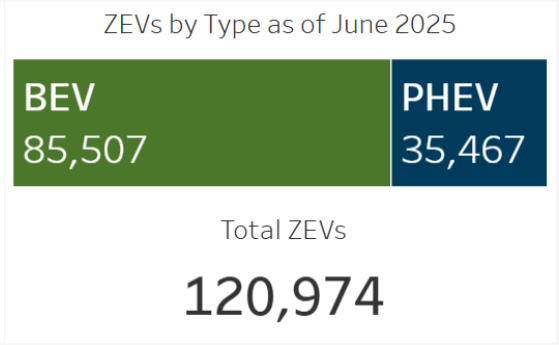
Electric Vehicles

Oregon's ZEV Adoption Targets: SB 1044

In 2019, Senate Bill 1044 outlined new Zero Emission Vehicle adoption targets for Oregon:

- 50,000 registered ZEVs on Oregon roads by 2020
- 250,000 registered ZEVs on Oregon roads by 2025
- At least 25 percent of registered vehicles and at least half of the new vehicles sold annually are ZEVs by 2030
- At least 90 percent of new vehicles sold annually are ZEVs by 2035.

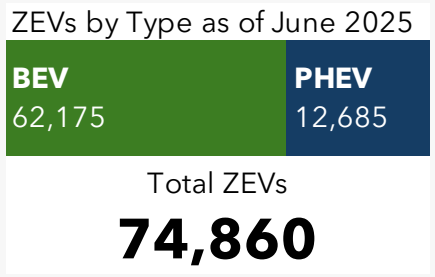
SB 1044 (Page 2)

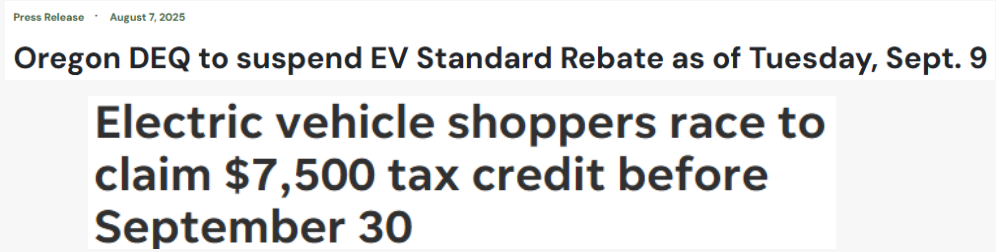


ODOT EV Dashboard (June 2025)

- AdopDER was previously calibrated with aggressive adoption curves given availability of incentives, previous historical success, and state goals.

PGE-Specific Impacts





- Recalibrated adoption curves and level-set with currently registered/operating EVs in PGE territory and available incentives:
  - Removal of any federal EV credits in 2026+
  - Removed $2,500 Oregon Clean Vehicle Rebate for non-low income
  - Recalibrated adoption based on historical trends vs. policy timelines/goals
    - Delay of Advanced Clean Trucks (no enforcement until 2027)

Assumption Updates
(since 2023 IRP Update)

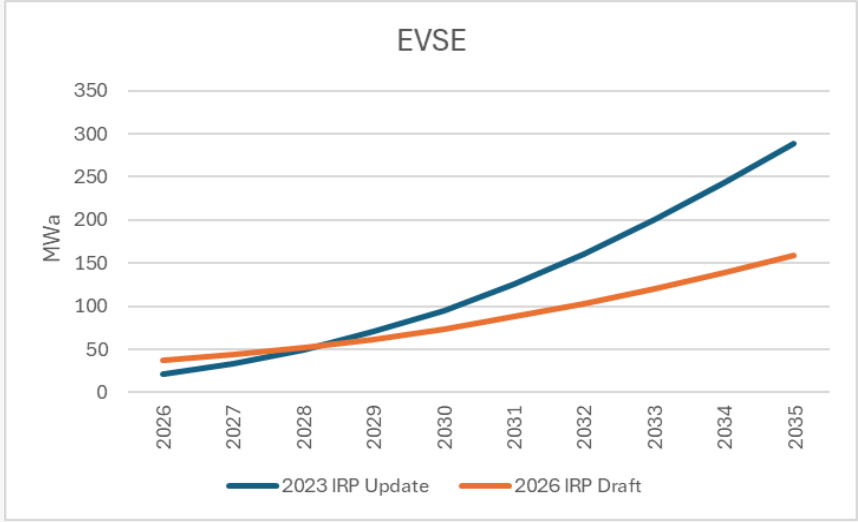
- Refreshed DMV LDV registrations and MDV/HDV counts and locations
- Refreshed public/private EVSE charging infrastructure
- Refreshed solar and storage project additions and corrections
- Updated PGE Flex Program Participants
- Updated known large load additions
- Updated 2024 AMI data
- Updated 2025 corporate load forecast
- Updated light-duty vehicle, rooftop solar, and battery storage adoption curves
- Recalibration of EVSE charging impacts per vehicle
- Adjustment to NREL ATB pricing based on tariffs
- Implementation of "Big Beautiful Bill" impacts on federal incentives

Electric Vehicle Chargers (EVSE)

- Refreshed Alternative Fuels Data Center charger location/type/ports data
  - Now includes locational and charger counts for program and non-program enrolled PGE customers not captured in AFDC

EVSE Charging Impacts Calibration

- Misrepresentation of EV driving patterns and charging trends were causing lower than expected EVSE charging impacts.
- **Goal:** Simplify the process by breaking down the analysis into pieces:
  - Average vehicle miles travelled by weight class
  - kWh charging need per mile
  - Mileage criteria for PHEVs (45% electric)
  - Home vs. Public/Workplace Charging (80% home vs. 20% public)



$$aMW = \frac{kWh\ per\ mile * VMT}{hours\ per\ year}$$

Assumption Updates
(since 2023 IRP Update)

- Refreshed DMV LDV registrations and MDV/HDV counts and locations
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- Updated PGE Flex Program Participants
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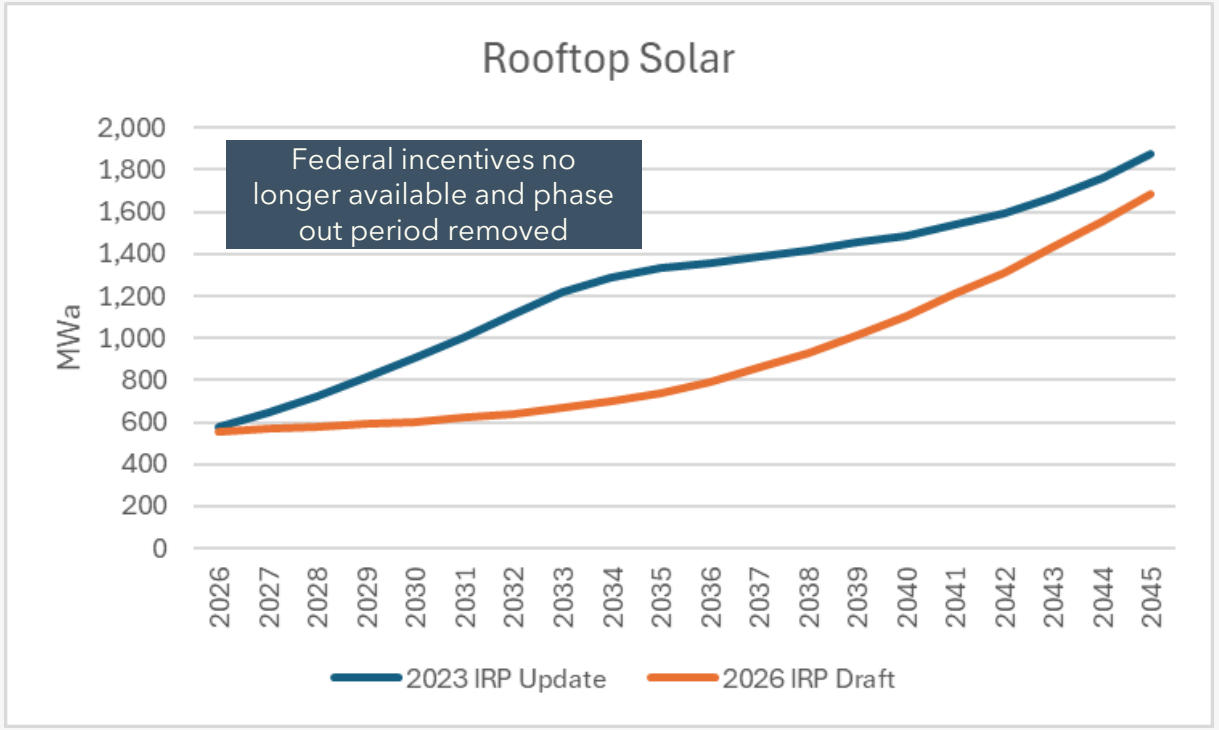
- Adjustment to NREL ATB pricing based on tariffs
- Implementation of "Big Beautiful Bill" impacts on federal incentives

Solar & Storage

- Updated solar and storage projects via PGE's internal data in accordance with OPUC's Order 24-068
  - AC to DC nameplate capacities corrected
  - Accurate project accounting of legacy data

Adoption Impacts via Federal Incentives

- With removal of federal incentives, adoption curves have shifted



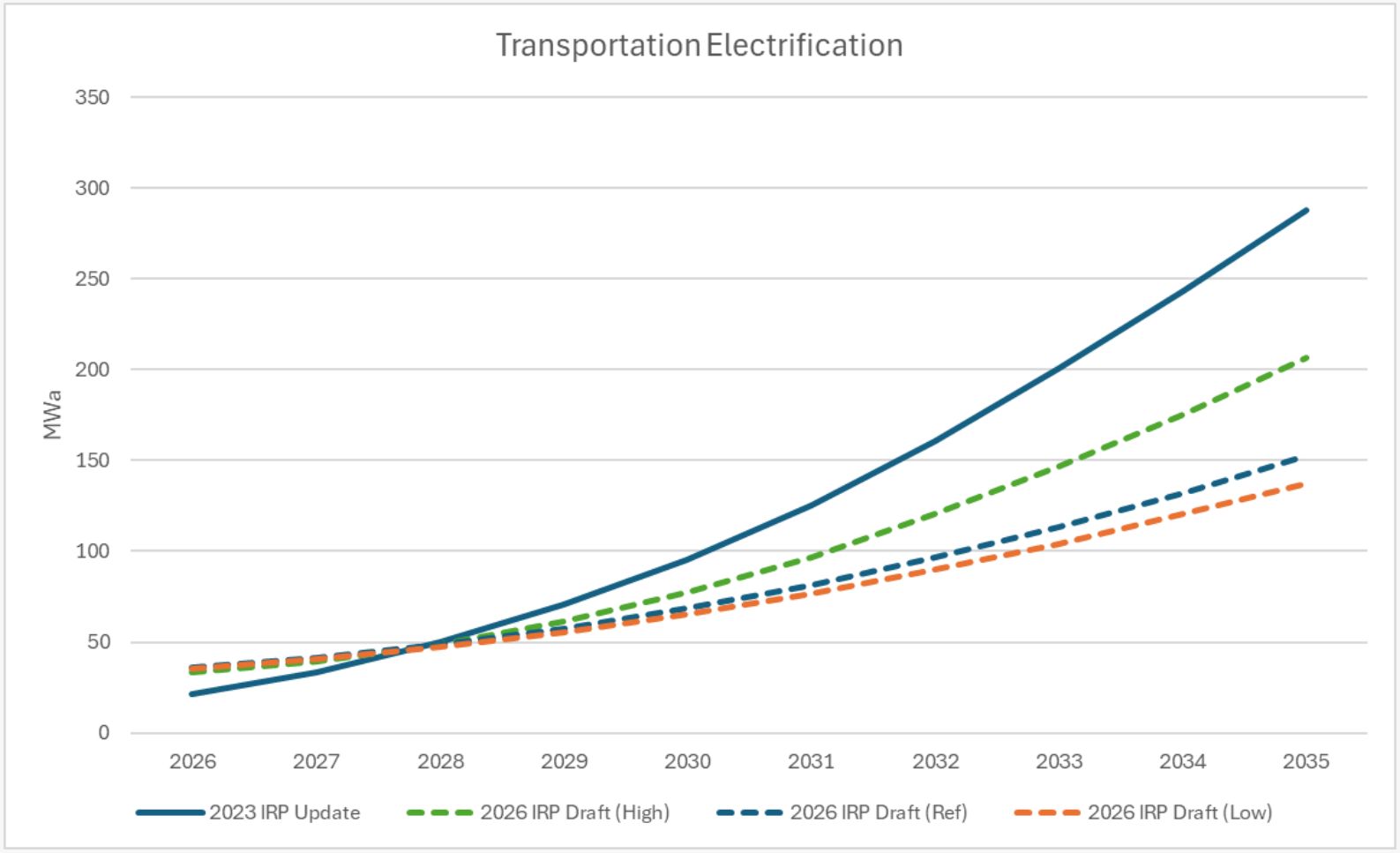
**Similar curve adjustment for storage*

Draft DER Forecast Results

EVSE

Updates:

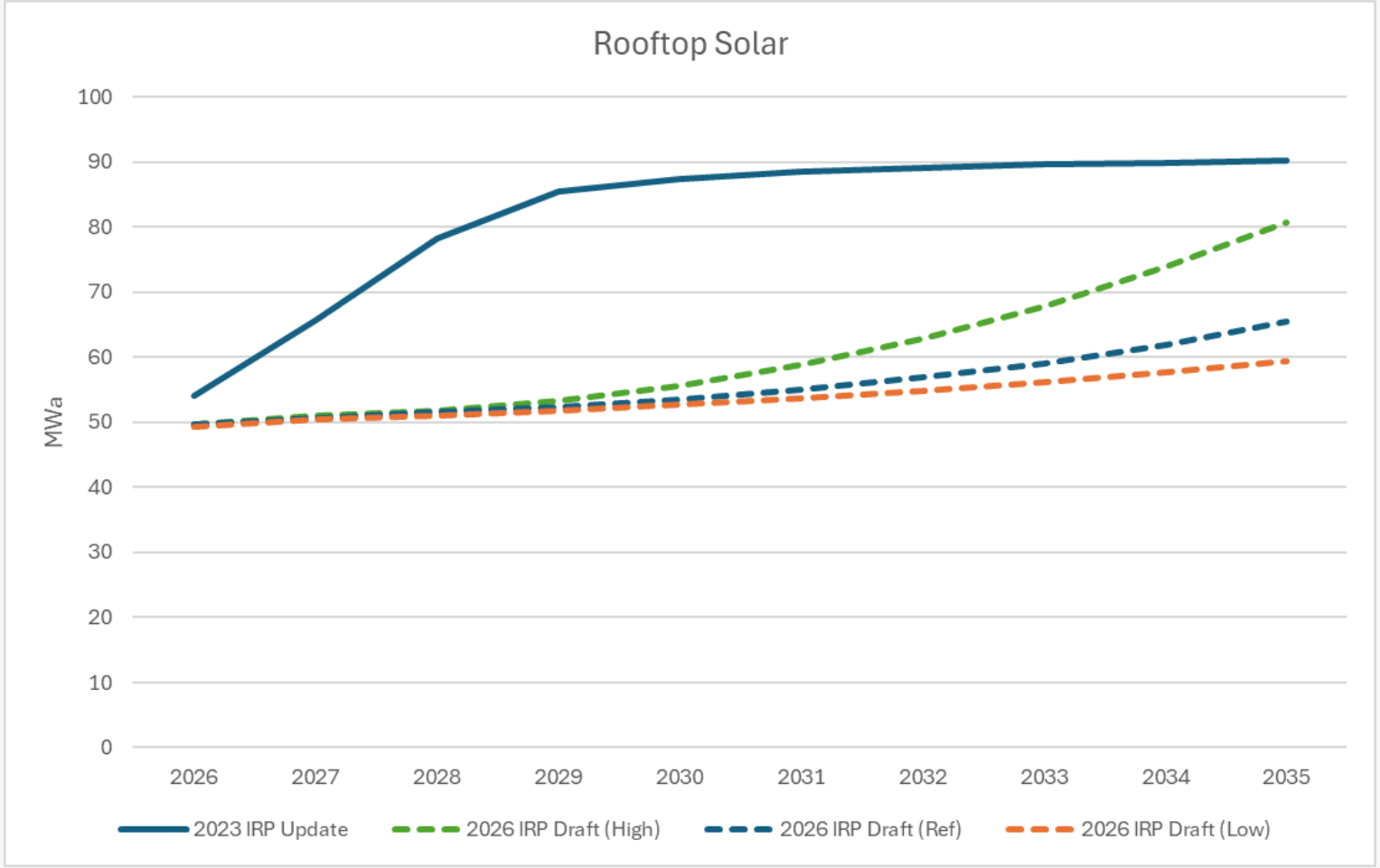
- Refined charging behavior methodology – *early years impact*
- Slower EV/PHEV adoption adjusts market projection & load impacts
- Better alignment with historical adoption trends and removal of federal EV tax credit



Solar

Updates:

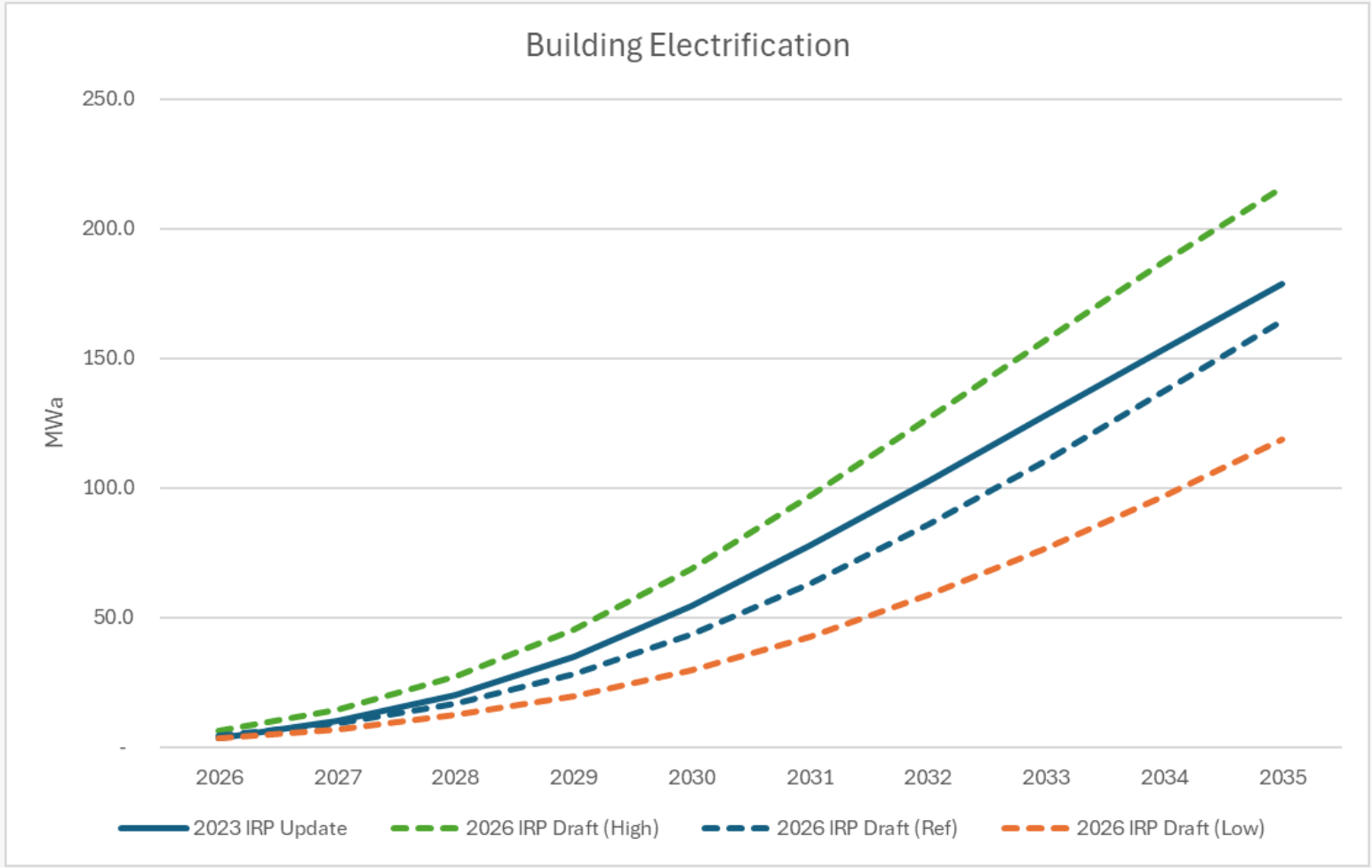
- Removal of duplicative projects and corrected project categorizations via Order 24-068
- Adjusted legacy AC & DC values from prior IRP via Order 24-068
- Forecast no longer includes the federal Investment Tax Credit (ITC) for solar installations



Building Electrification

Updates:

- Reflects current adoption of PGE programs and electrification measures
- Slight reduction of adoption due to removal of Energy Efficiency Home Improvement Credit supporting qualified heat pump installations



Guided Feedback – AdopDER Forecast

- What other data, scenarios, and considerations would help ensure AdopDER continues to serve long-term DER planning?
- Are there specific updated datasets that you think should be included in the AdopDER analysis?
  - Examples such as: NEEA's 2025 CBSA, EIA's most recent Residential Consumption Survey (RECS), etc.

Questions

Existing Resources

Rob Campbell, PGE
Principal Integrated Resource Planning

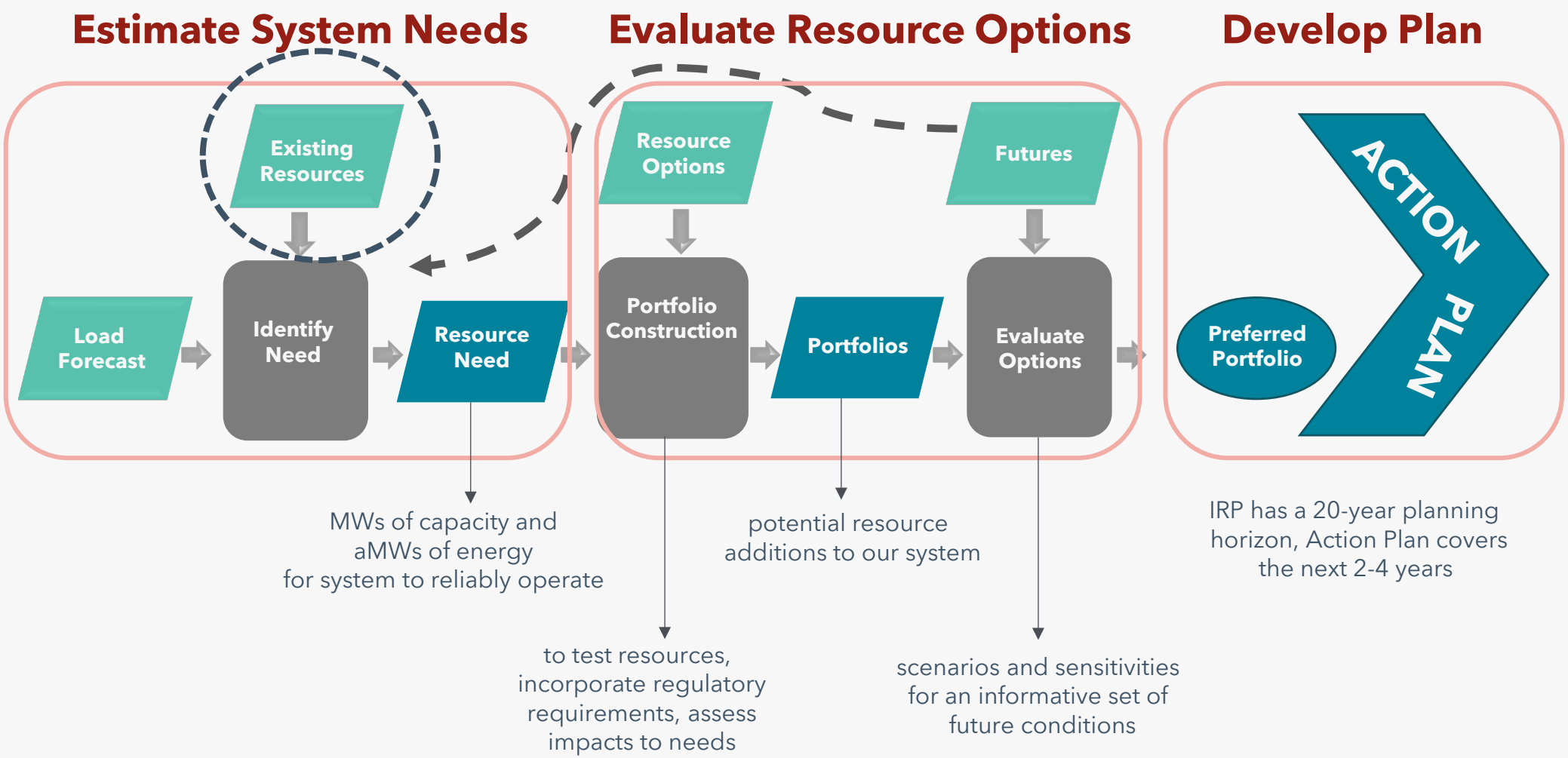
Jarek Oliver, PGE
Principal Integrated Resource Planning

Resource Topology

Robert Brown, PGE
Senior Principal Integrated Resource Planning

PGE An Oregon kind of energy.℠

High-Level IRP Analysis Process

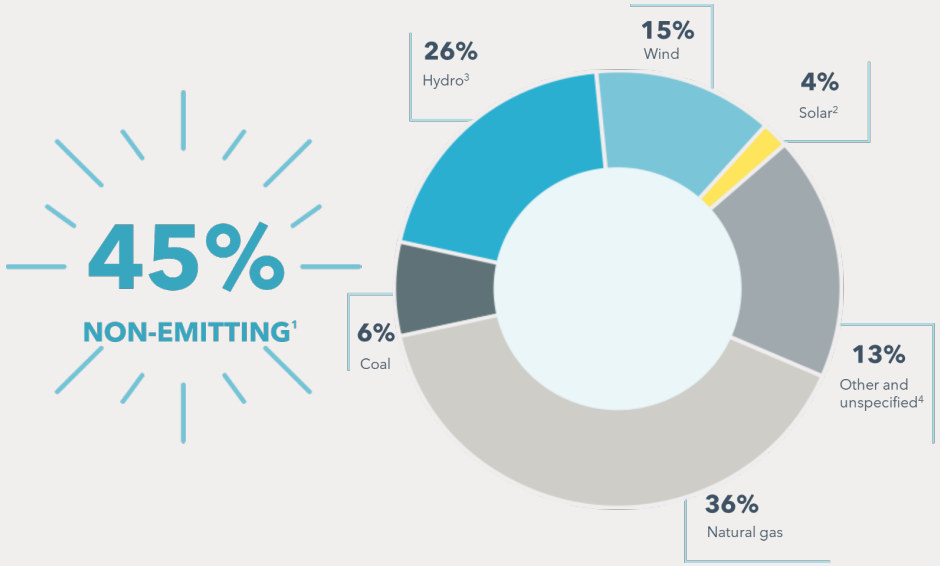


Topics

- Overview of PGE's existing generating resources
- Considerations for representing existing resources in modeling
- Planned existing resource verification/modification for this IRP
- Aurora topology enhancements for resource representation in modeling

PGE's HB 2021 Progress

2024 Resources for PGE's Total System Load



1. Percentages represent 2024 resource mix from PGE's total system load, inclusive of wholesale volumes. The percentage of 2024 retail load, excluding wholesale sales, served by non-emitting resources is 40%.
2. Represents utility-scale solar generated, does not include 279,957 MWh of customer rooftop solar resources.
3. Hydro amounts include purchases from Bonneville Power Administration, which may have an immaterial amount of emissions associated with them, per ODEQ rules.
4. Unspecified is purchased power for which a specific generating resource is not defined and could be any of the generation types (e.g., wind, hydro, gas).

Clean Energy Additions Since 2021*

Achieving emissions reductions requires steadily adding renewable energy, battery storage, energy efficiency and demand response to our portfolio, so we can reliably and affordably reduce fossil fuel generation.

Since PGE implemented its emission targets in 2021, PGE and its customers have committed to adding 2,300+ MW of clean energy.

Wind:
- Clearwater 2024: 311 MW

Utility Scale Solar:
- Wheatridge 2022: 50 MW
- Patchwaywit 2023: 162 MW
- Tower 2026: 120 MW
- Daybreak 2026: 140 MW
- Bakeoven 2026: 60 MW

Small-Scale Solar:
- Community Solar & QFs: 99
- Rooftop Solar: 165

Batteries
- Wheatridge 2022: 30 MW
- Constable 2024: 75 MW
- Sundial 2024: 200 MW
- Coffee Creek 2024: 17 MW
- Seaside 2025: 200 MW
- Other BESS: 8 MW

Hydro Contracts
- Mid-C PPA 2023 (2024-2025): 76 MW
- Mid-C PPA 2023 (2024-2026): 434 MW
- Douglas PUD 2024 (2026-2030): 79 MW

Customer Programs:
- Energy Efficiency: 122 aMW

** Through ownership, PPA, contract, or customer programs.*

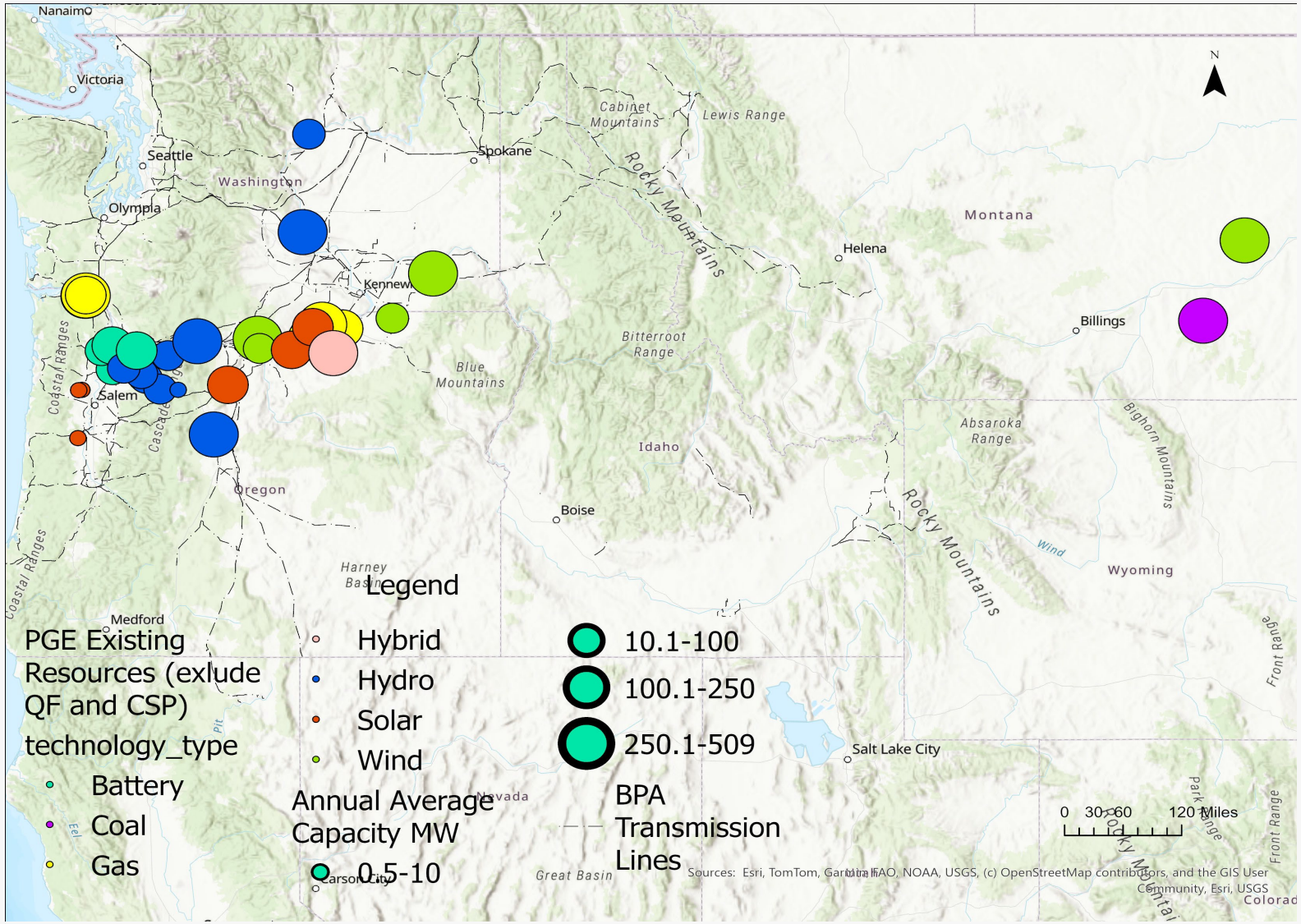
Existing Resources

Utility-Scale

3,868 MW of generating capacity through sole or joint ownership

2,830 MW through long-term utility-scale power purchase agreements including customer driven GFI facilities

Most generating resources are located near our service territory



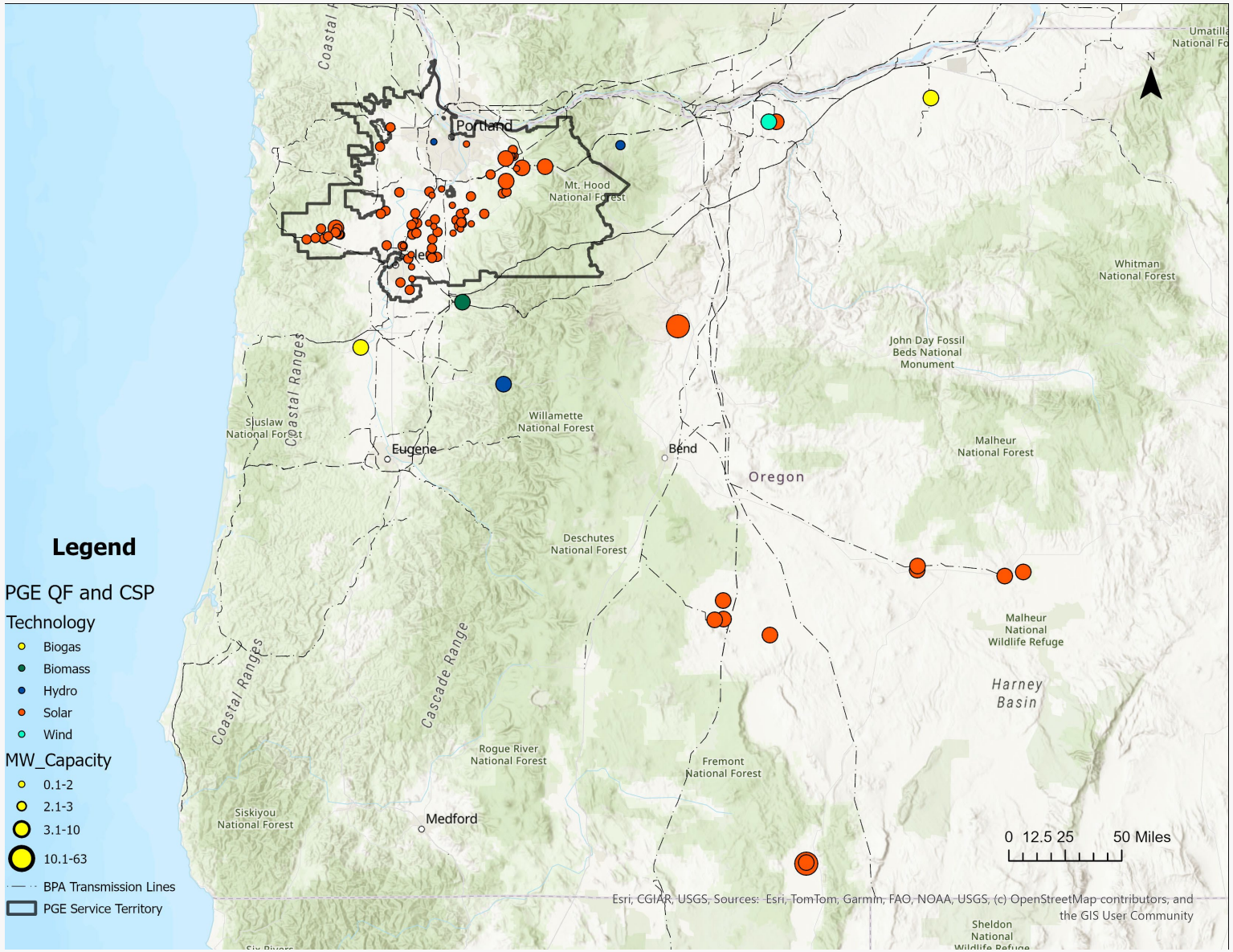
Existing Resources

QF and CSP

528 MW of online and expected Qualifying facilities (QFs) and Community Solar Projects (CSP)

QFs include small, non-utility resources that meet federal Public Utility Regulatory Policies Act (PURPA) requirements from which we purchase power

CSP allow customers to subscribe to a portion of a local project



Existing Resources

Hydro

Real-World Considerations

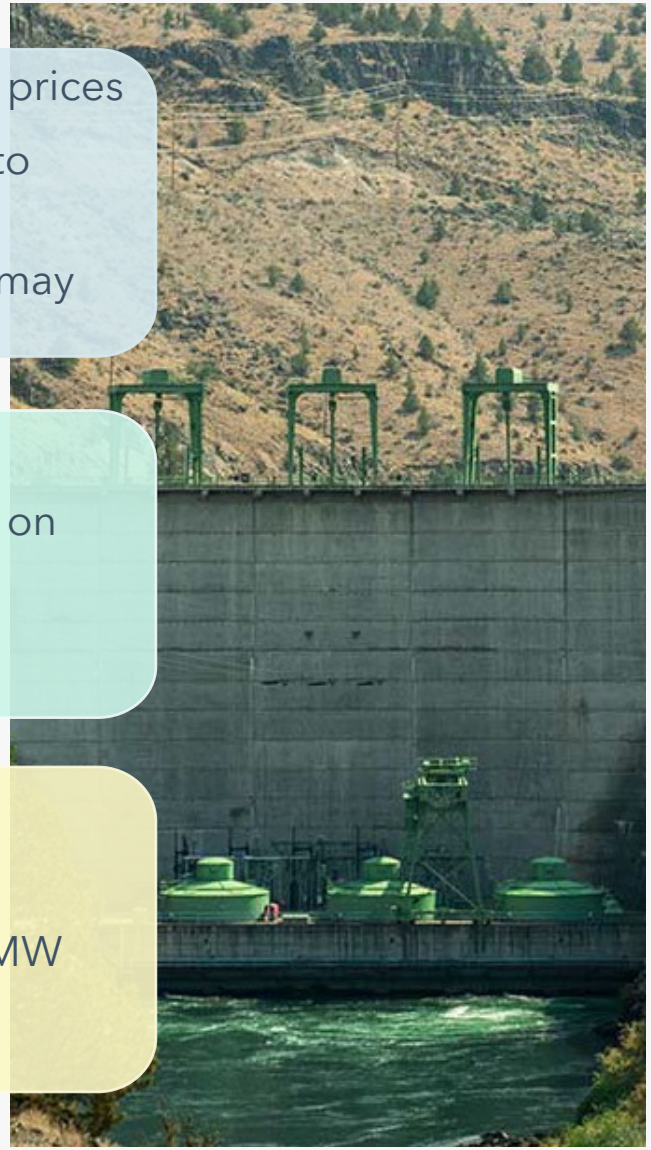
- Generation in the PNW can strongly influence electricity prices
- Uncertainties in water availability from year-to-year due to weather/climate variations
- Changing environment, fish, wildlife, other policies that may impact operations

Treatment in Modeling

- **Aurora**: "Average" hydro year, with condition variations
- **Sequoia**: dispatches weekly energy and capacity based on random hydro draws from 30 years of historical data
- **ROSE-E**: informed by above

Upcoming Expirations

- Douglas AMA (-> 12/31/25); Contract Size: ~57 aMW
- Wells Legacy (-> 9/30/28); Contract Size: ~39 aMW
- PR/Wanapum 20% (-> 12/31/26); Contract Size: ~200 aMW
- **Total Hydro Retirements by 2029: ~296 aMW**



Existing Resources

Thermals

Real-World Considerations

- Baseload electricity resource essential for reliable service, esp. at peak demand times
- Natural gas prices and demand needs drive operations
- Fuel availability and storage constraints

Treatment in Modeling

- **Aurora**: Economic dispatch
- **Sequoia**: dispatches weekly energy and capacity based on random draws from recent historical data plus explicit hourly representation of spin & non-spin reserves by resource based on capability
- **ROSE-E**: informed by above

Upcoming Expirations

- Approximately 500 MWs currently exiting the portfolio by 2030 (245 MW of Colstrip and 250 MW Calpine HRCO)
- Revisiting forward-looking operational parameters impacting availability and dispatch, e.g. constraints at Beaver/PW2

Existing Resources

VERs and Storage

Real-World Considerations

- Variable energy resources (VERs) are intermittent by nature, i.e., only available when the wind blows or sun shines
- Increasing deployment of clean energy resources requires continued analysis of resource capabilities for system reliability

Treatment in Modeling

- **Aurora**: Economic dispatch
- **Sequoia**: dispatches weekly energy and capacity based on random draws from recent historical data; storage not limited to one cycle per day
- **ROSE-E**: informed by above

Upcoming Expirations

- By 2030, 35 MWs of small VERs and other QFs expected to exit the portfolio, along with 200 MW of BPA capacity contracts in 2025
- Revisiting forward-looking operational parameters impacting availability and dispatch, e.g. capacity factors, hourly generation shapes for wind and solar, etc.

Aurora

Modeling tool PGE used for production cost modeling in the IRP

Aurora Prior uses

1. **Market price simulations**
   - WECC-wide dispatch
2. **Resource energy valuation**
   -"PZM" – PGE Zonal Model
   -Simulated prices are inputs
3. **Portfolio energy and emissions evaluation**
   -"iGHG" – spreadsheet model to forecast emissions
   -"mPZM" – modified version of PZM incorporating emissions forecast and composition of incremental portfolio

Aurora Topology Enhancement

Expanding the PZM topology could allow for prior uses #2 and #3 to take place in a single model

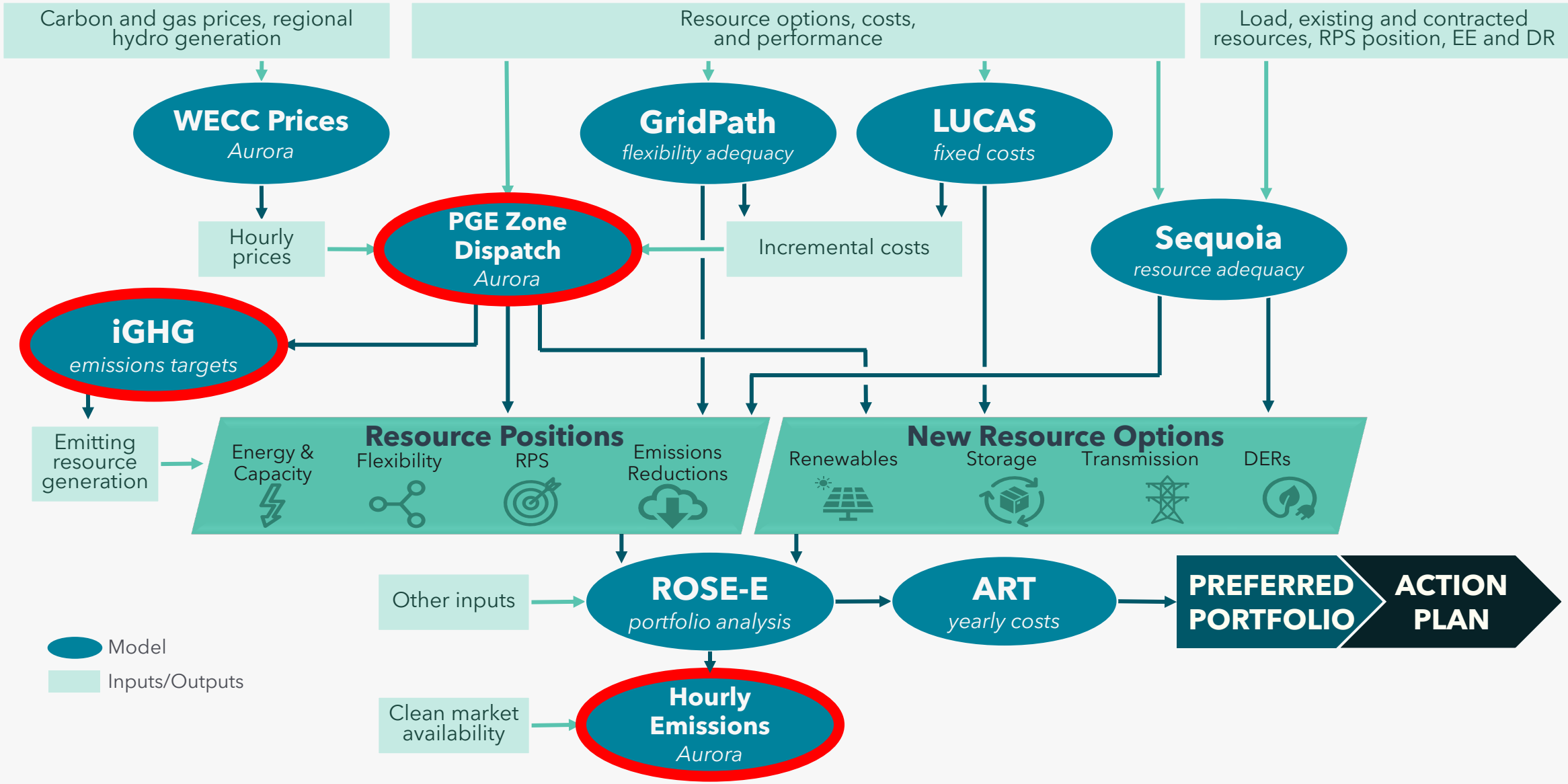
The purpose of this enhancement is to address three needs:

1. **Estimate and forecast portfolio CO_2 emissions within Aurora**
   - Consider CO_2 emissions constraints
2. **Simulate the interaction of resource portfolios with PGE's load and market(s)**
   - Differentiate energy delivered to retail load vs. wholesale sales
3. **Consider the potential effects of CO_2 emissions pricing**

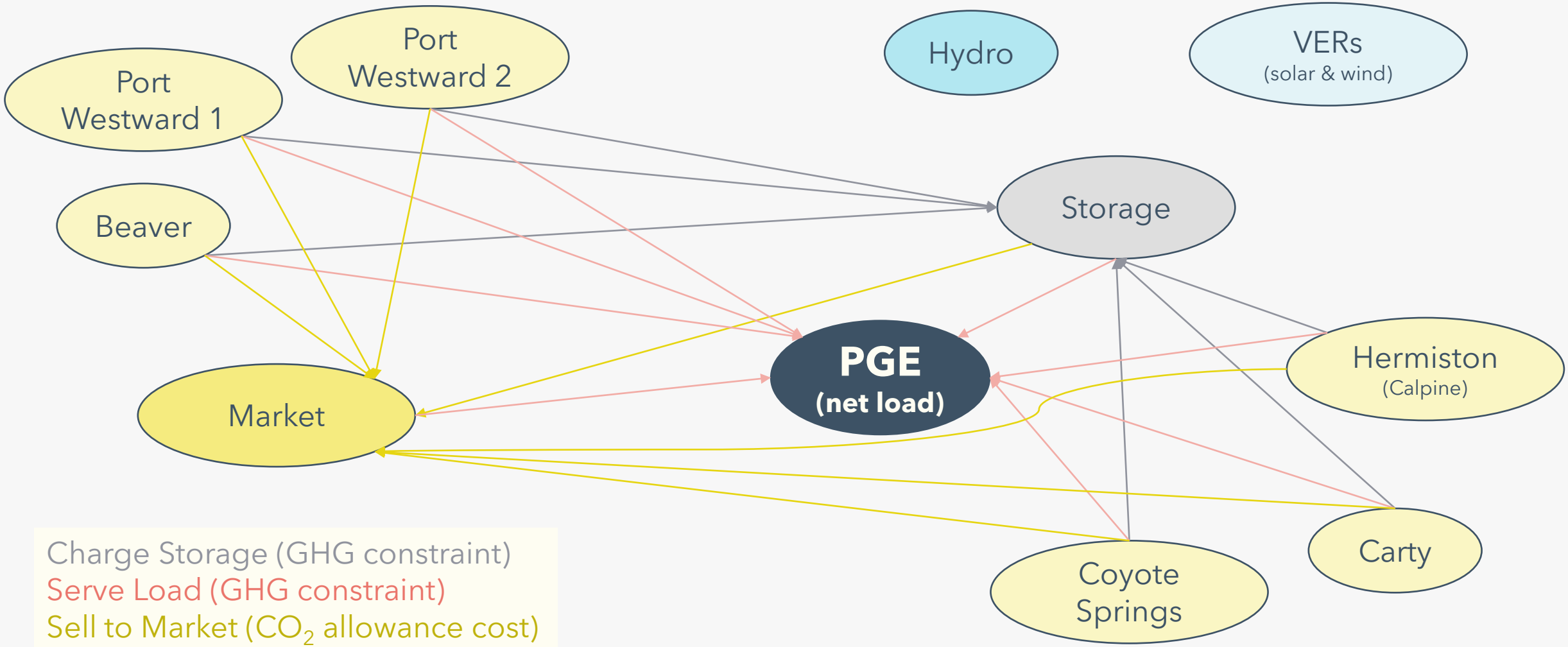
Topology refers to the connection of elements in the system

- Zones contain resources and/or loads
- Links represent the ability for energy to move between Zones

Current IRP Modeling Flow

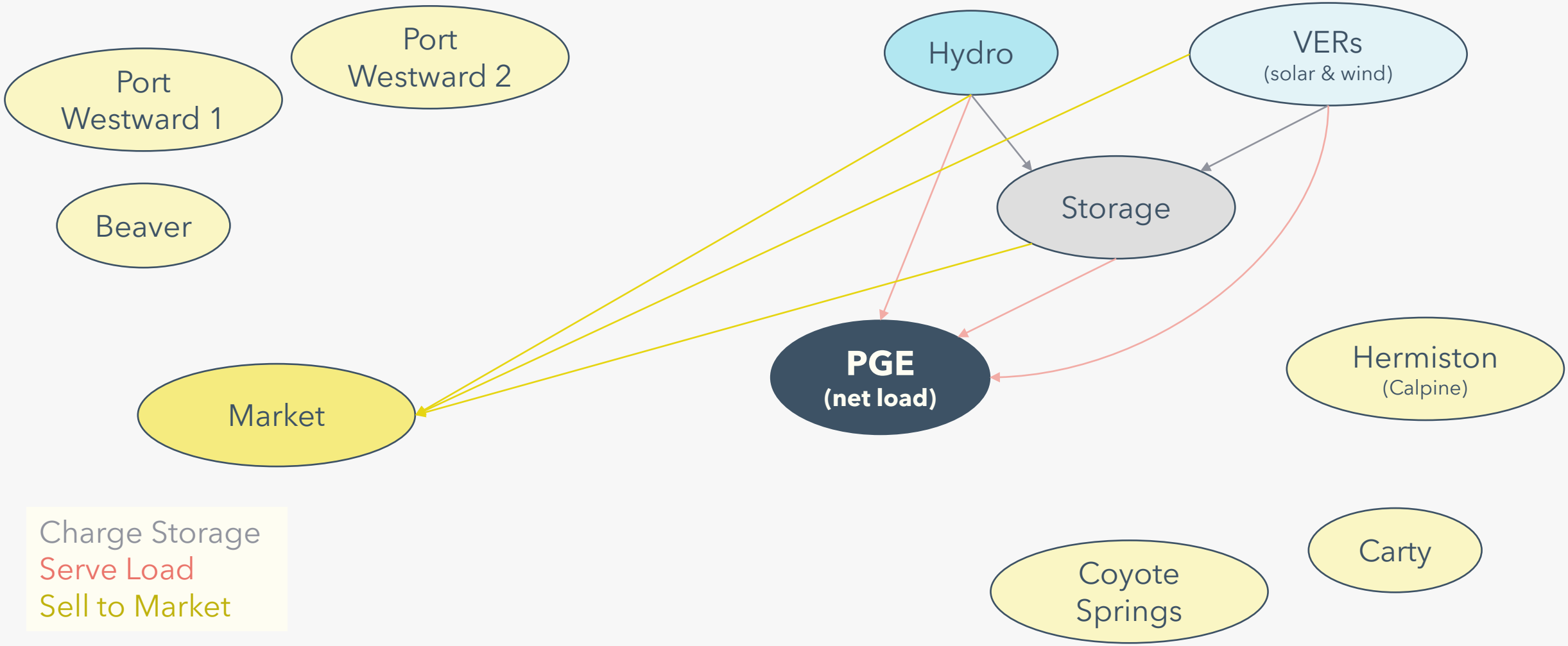


Aurora Topology: Emitting Resources



Charge Storage (GHG constraint)
Serve Load (GHG constraint)
Sell to Market (CO_2 allowance cost)

Aurora Topology: Non-emitting Resources



Guided Feedback – Resource Topology

- Aurora topology: Are the modeling refinements we've described clear to you, and do they make sense?

Questions

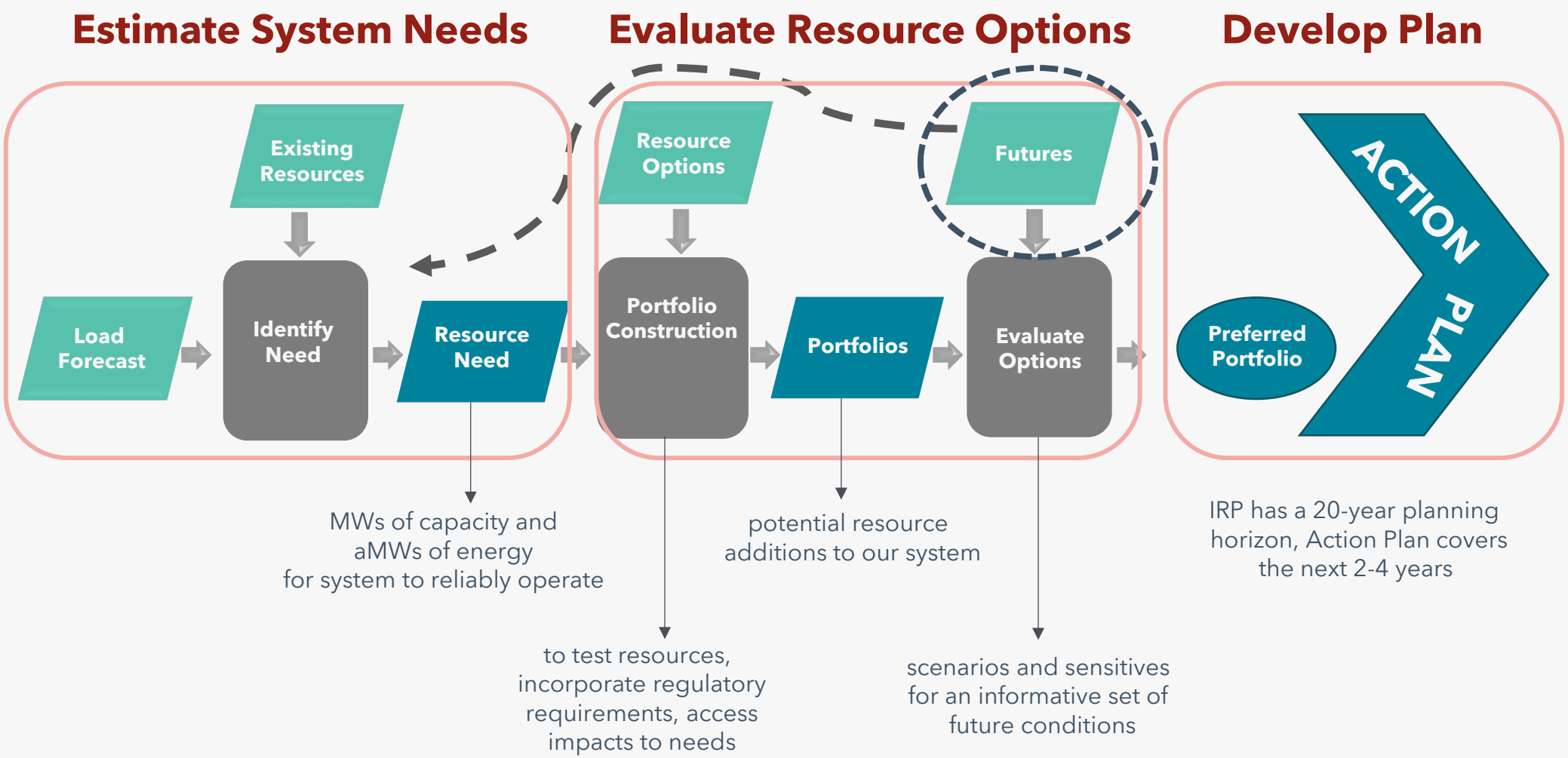
Futures/Markets

Chris White, PGE

Principal Integrated Resource Planning

PGE An Oregon kind of energy.℠

High-Level IRP Analysis Process



Topics

- Updating WECC Model Inputs
- WECC Supply & Demand Assumptions
- Preview IRP Price Forecast in anticipation of 2026 CEP/IRP
- Discussion of Price Futures for 2026 CEP/IRP

Updating WECC Model Inputs

PGE generates its ***IRP fundamentals price forecast*** using the WECC Model. The underlying input data employed in the WECC model is furnished by Wood-Mackenzie Consulting.

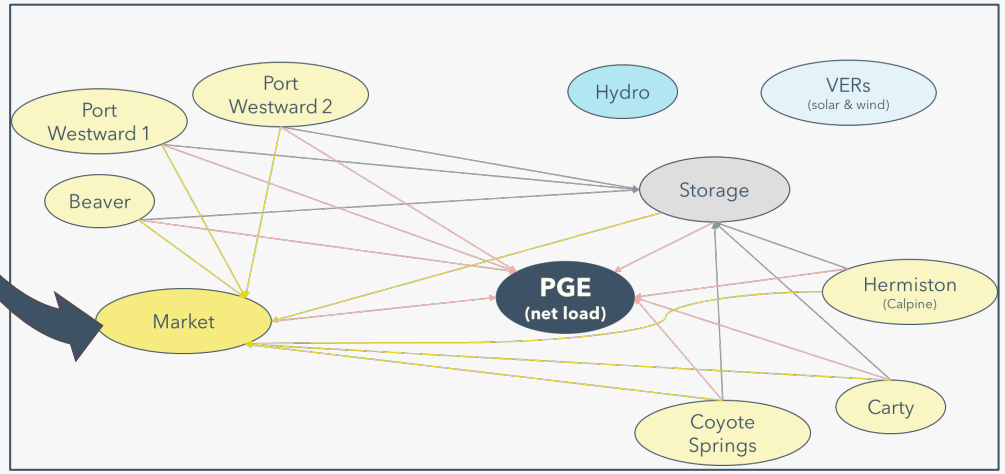
These new inputs represent an updated *worldview of future supply and demand conditions*.

Model inputs change over time relative to macroeconomic conditions, load expectations, resource procurement costs, fuel prices, government policy, etc.

WECC Model

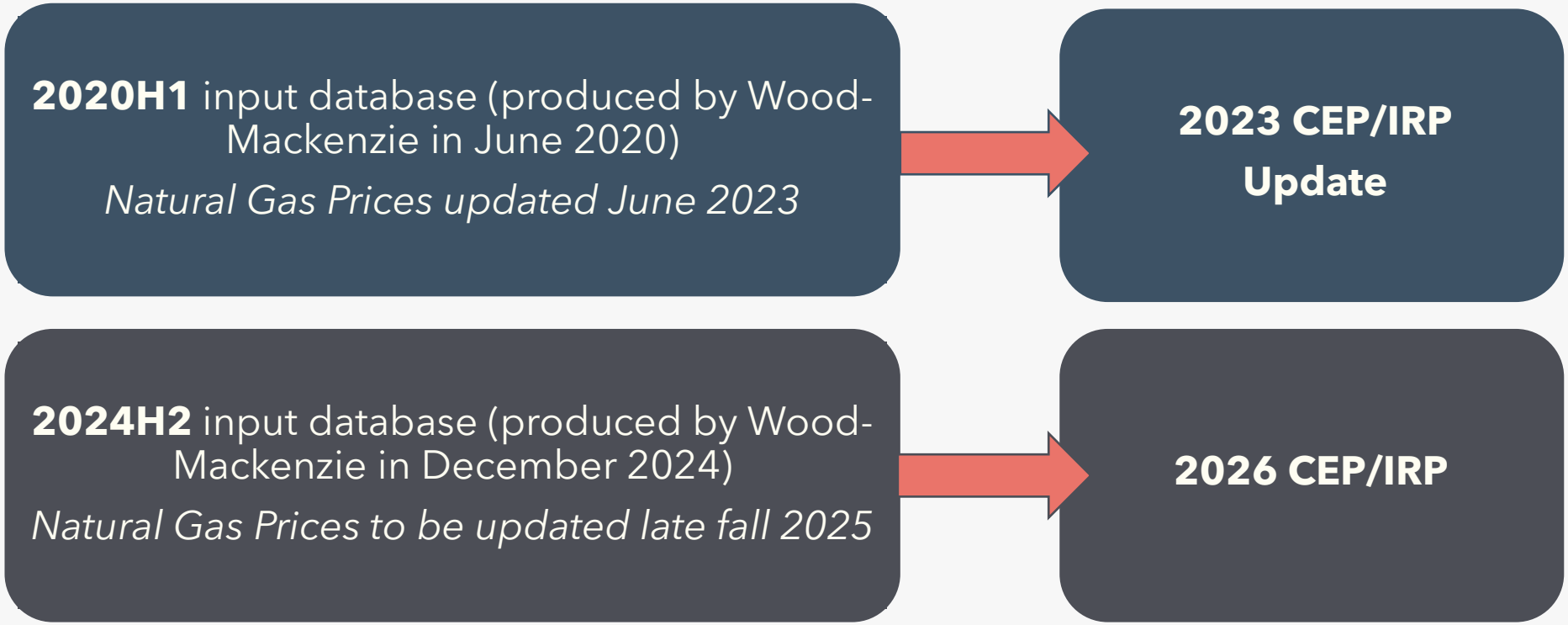
Price forecasts used to populate market prices for **economic** dispatch model

PGE-Zonal Model (PZM)



* Note that this discussion is limited to the IRP fundamentals price forecast and does not incorporate information regarding the electric forward price curve. A discussion of the change in methodology to the IRP price forecast is available in the October 2024 roundtable presentation.

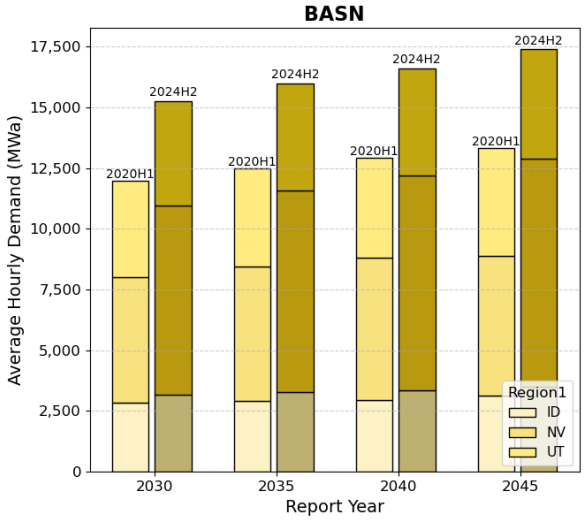
Updating WECC Model Inputs

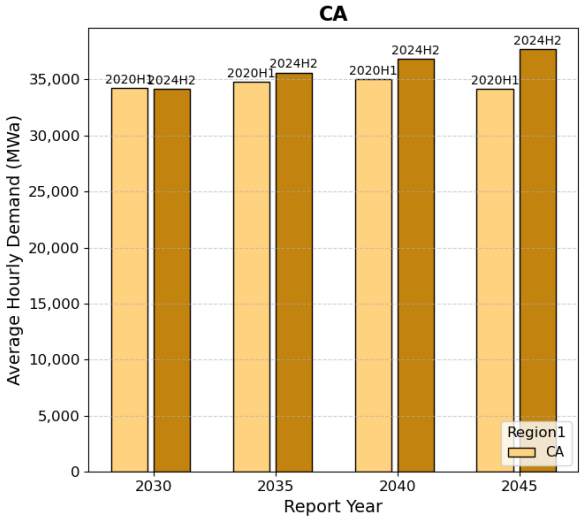


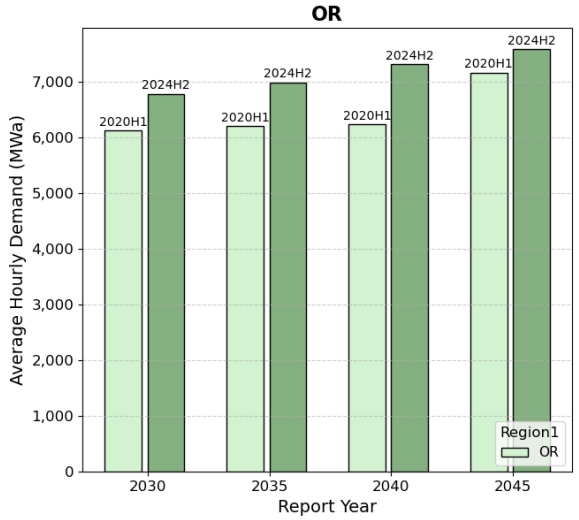
* PGE regularly updates the natural gas price assumptions in the WECC input database.

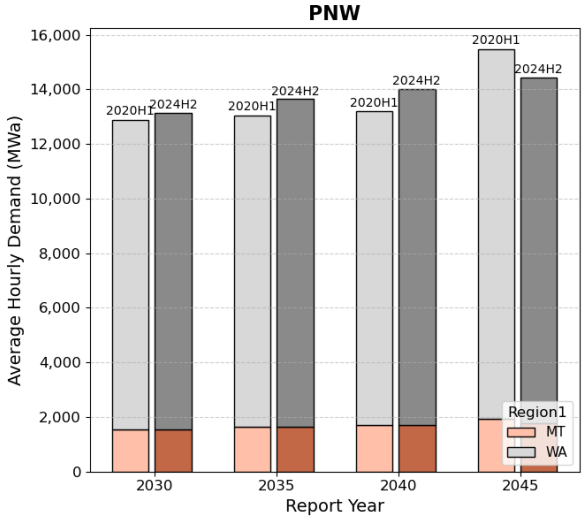
Changes to Demand in WECC Model

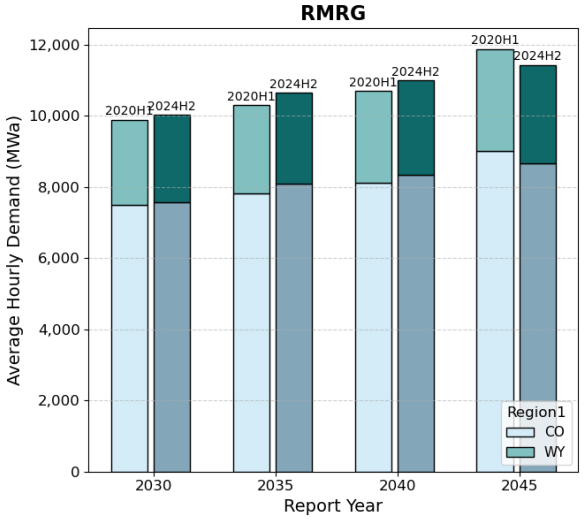
Demand/Load Comparison by State/Region

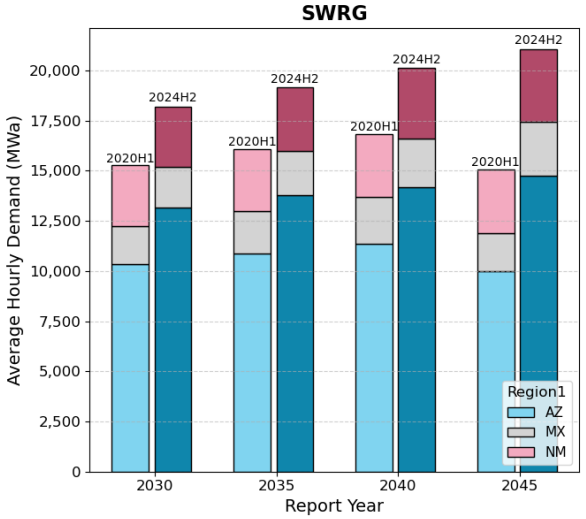










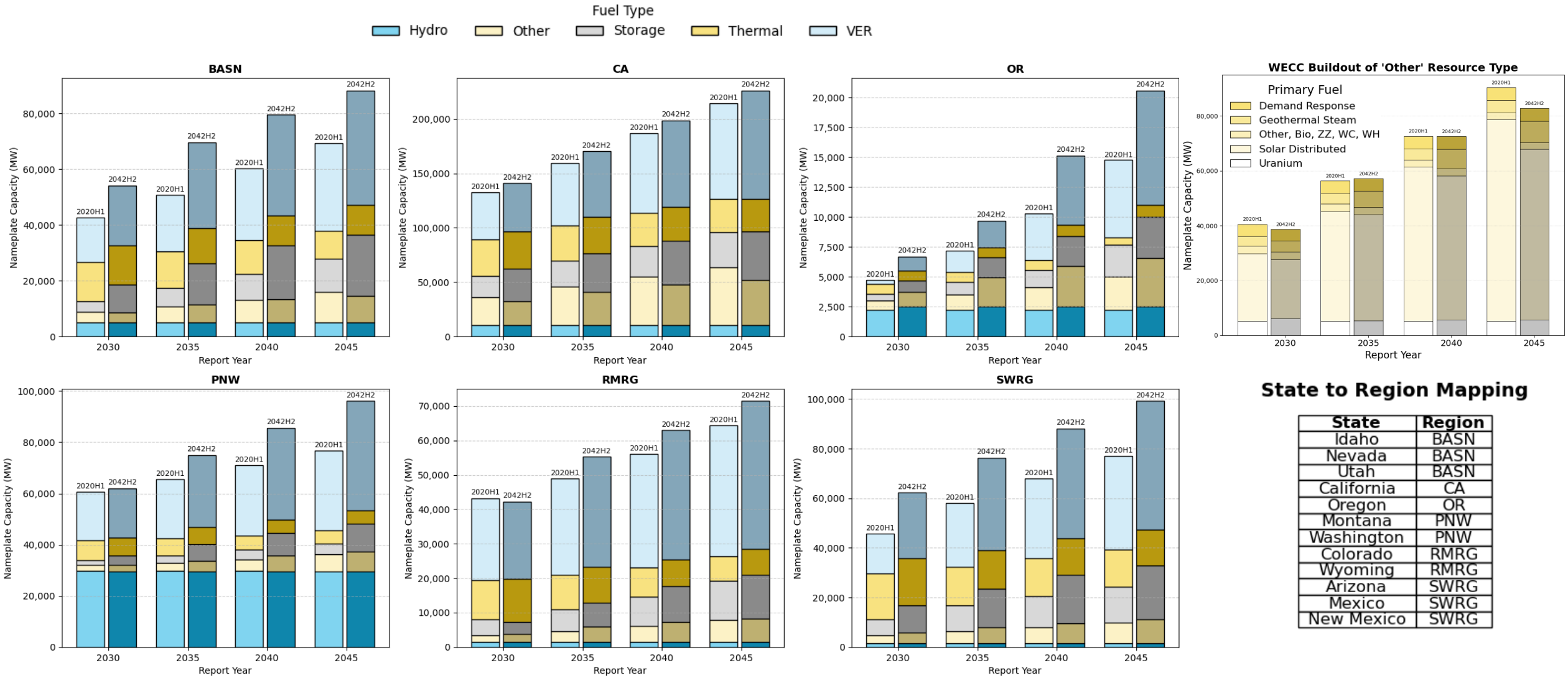


State to Region Mapping

State	Abbrev	Region
Idaho	ID	BASN
Nevada	NV	BASN
Utah	UT	BASN
California	CA	CA
Oregon	OR	OR
Montana	MT	PNW
Washington	WA	PNW
Colorado	CO	RMRG
Wyoming	WY	RMRG
Arizona	AZ	SWRG
Mexico	MX	SWRG
New Mexico	NM	SWRG

Changes to Supply in WECC Model

Resource Buildout Comparison by Region by Fuel Type



State to Region Mapping

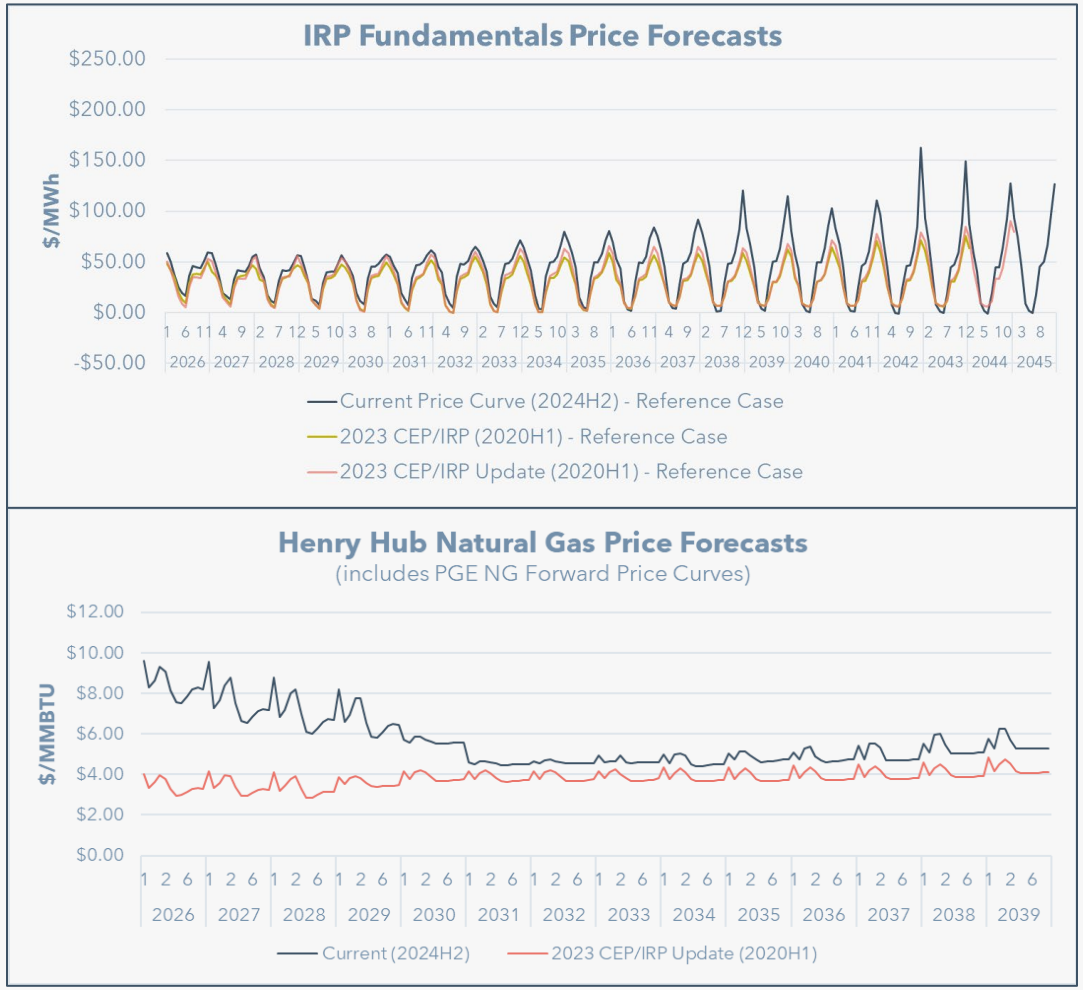
State	Region
Idaho	BASN
Nevada	BASN
Utah	BASN
California	CA
Oregon	OR
Montana	PNW
Washington	PNW
Colorado	RMRG
Wyoming	RMRG
Arizona	SWRG
Mexico	SWRG
New Mexico	SWRG

Preview Changes to IRP Price Forecast

The 2024H2 input database was updated to reflect NG price forecasts produced in June 2025. The revised IRP fundamentals price curve is shown in dark blue.

In comparing the current IRP fundamental price forecast from the 2024H2 input database to prior IRP vintages, we observe:

- Higher average prices due to larger load growth.
- Higher natural gas prices due to increased domestic and international demand.
- Increasing average winter prices due to decreasing proportion of thermal resources to meet to load in winter months.
- Increasing reliance on storage resources to replace other dispatchable resources.



* Note that the reference natural gas and electricity price curves will be updated prior to the 2026 IRP to adapt price forecasts to new price futures (see next slide).

Price Futures – WECC Model Scenarios

Commitment Error–Net Load Uncertainty and Fast Start Pricing incorporated into standard assumptions

2023 CEP/IRP

Commitment Error
- Net Load Uncertainty
- Fast Start Pricing

Carbon Markets Pricing
- Low CEC allowance
- Reference CEC allowance price applied to California & Washington Markets.
- Social Cost of Carbon applied to WECC

Gas Volatility
- Low
- Reference
- High Natural Gas Scenarios

Hydro Conditions
- Low
- Reference
- High Hydro Conditions

Proposed 2026 CEP/IRP

Regional Load Growth
- Low
- Reference
- High load growth

Carbon Markets Pricing
- Low CEC
- Reference CEC
- High CEC applied to generation delivered to CA & WA markets

Gas Volatility
- Low
- Reference
- High Natural Gas Scenarios

Regional Supply Stack
- Reduced clean energy build - decarbonization headwinds
- Reference case resource buildout
- Accelerated advanced technology deployment.

Guided Feedback – Price Futures/Market Assumptions

- What questions do you have about the differences between the use of PGE Zonal Model and the WECC model
- What are your reactions about PGE's proposed WECC price future concepts? What type of information would you like IRP to share and what alternatives would you suggest?

Questions

NEXT STEPS

A recording from today's webinar will be available on our website in one week

Upcoming Roundtable: December 3rd, 2025

Thank you

Contact us at
IRP.CEP@PGN.COM

An

kind of energy

ACRONYMS

ARIMA: autoregressive integrated moving average
ART: annual revenue-requirement tool
ATC available transfer capability
BPA: Bonneville Power Administration
C&I: commercial and industrial
CBI: community benefit indicators
CBIAG: community benefits and impacts advisory group
CBRE: community based renewable energy
CDD: cooling degree day
CEC: California energy commission
CEP: clean energy plan
CF conditional firm
DC: direct current
DER: distributed energy resource
DR: demand response
DSP: distribution system plan
EE: energy efficiency
ELCC: effective load carrying capacity
EJ: environmental justice
ETO: energy trust of Oregon
EUI: energy use intensity
GHG: greenhouse gas
HB2021: House Bill 2021
HDD: heating degree day
HVDC: high-voltage direct current
IE: independent evaluator
IOU: investor-owned utilities
ITE: information technology equipment
ITC: investment tax credit
kW: kilowatt
LOLH: loss of load hours
LT/ST: long term/ short term
LTF long-term firm
MW: megawatt
MWa: mega watt average
NAICS: North American industry classification system
NCE: non-cost effective
NG: natural gas
NPVRR: net present value revenue requirement
OASIS Open Access Same Time Information System
ODOE: Oregon department of energy
PPA: power purchase agreement
PSH: pumped storage hydro
PUC: public utility commission
PURPA: Public Utility Regulatory Policies Act
PV: photovoltaic
REC: renewable energy credit
RLRR: low carbon price future
ROSE-E: resource option strategy engine
RPS: renewable portfolio standard
RRRR: reference case price future
RTO: regional transmission organization
SoA: South of Allston
T&D: transmission and distribution
TSR: transmission service request
TSEP: TSR study and expansion process
Tx: transmission
UPC: usage per customer
UPS: uninterruptible power supply
VER: variable energy resources
VPP: virtual power plant
WECC: western electricity coordinating council