# Distribution System Workshop

Distribution System Plan Workshop # 2 | 24 – May 8, 2024

# Meeting Logistics


Audio


Microphone


Chat box


Video


Raise Hand


Closed Caption

# Operating Agreements

Establishing norms with our communities is foundational to building trust

To create a **safe space**, we established **common agreements** such as **respect, honoring diversity of thought**, and **inclusivity**

**Practice curiosity** and **seek to understand different perspectives**

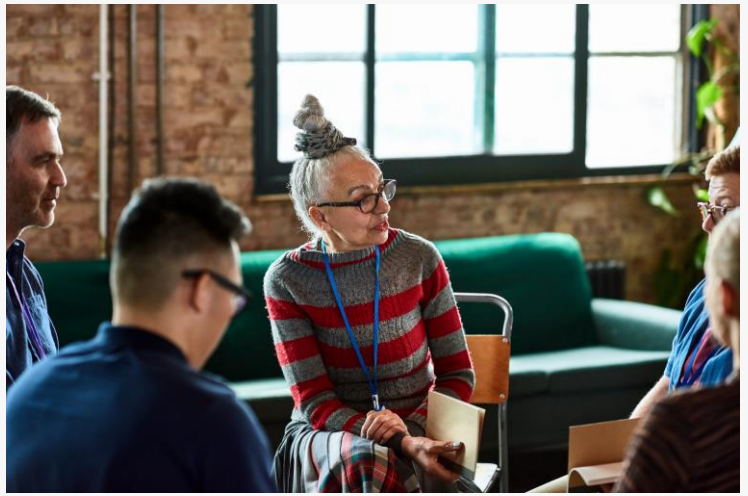
**Stay Engaged**

**Be Willing To Experience Discomfort**

**Speak Your Truth**

**Expect and Accept Non-closure**

**Share the Airtime**



The courageous conversations framework
by Glenn Singleton and Curtis Linton

# Agenda

9:00 – Welcome & Meeting Logistics

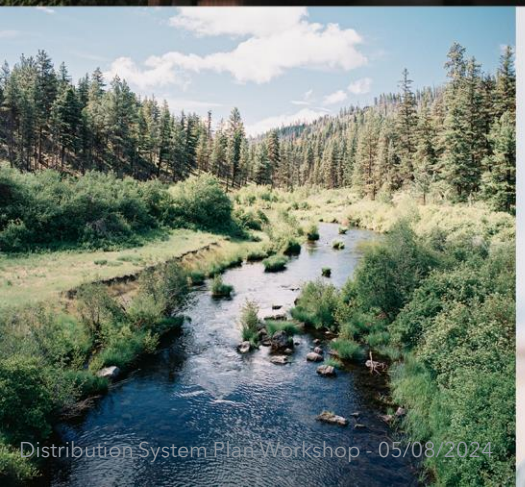
9:05 - Distributed Energy Resources Forecast

9:50 – Distribution System Planning – Grid Needs Analysis

10:25 - Grid Needs Analysis: Supporting DER Integration & Operation

10:55 - Closing Remarks & Next Steps

11:00 - Adjourn



# DSP Distributed Energy Resources Forecast Update

Andy Eiden, Senior Principal Analyst

Distribution System Workshop # 2 | 24 – May 8, 2024

# Outline

Recap PGE's distributed energy resources (DER) forecasting practices & tools

(*link to past DSP partner workshop presentations:* Distribution System Planning Resources & Materials | PGE (portlandgeneral.com))

Share updates initiated since DSP Part 2 was filed

# Forecasting DERs for IRP & DSP

IRP looks at DER forecast in terms of these resource's contributions to bulk system resource needs (i.e., large-scale generation and transmission)

In current iteration, IRP does not factor in locational DER forecast but rather **potential systemwide resource impacts**

We include a low/reference/high DER forecast that contributes to the different resource **"need futures"** assessed by the IRP

***For example:***

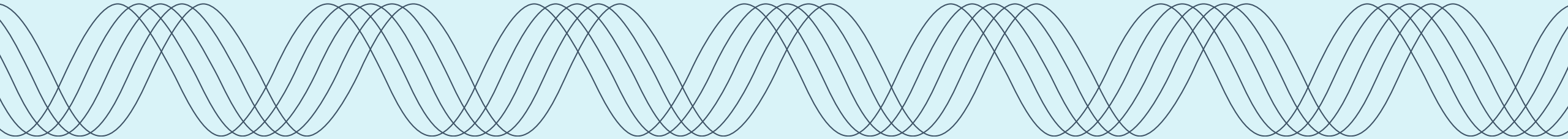
low solar adoption, high EV adoption = "high need"

For DSP, we begun introducing DER forecasting into grid planning workflows

DSP Part 2 included DER forecast at **substation & feeder-level** & results were incorporated into capital portfolio planning

Evolution of DER forecasting for DSP will factor in sensitivities such as **"high EV growth"** & allow planners to assess potential implications

# How does PGE forecast DER growth?



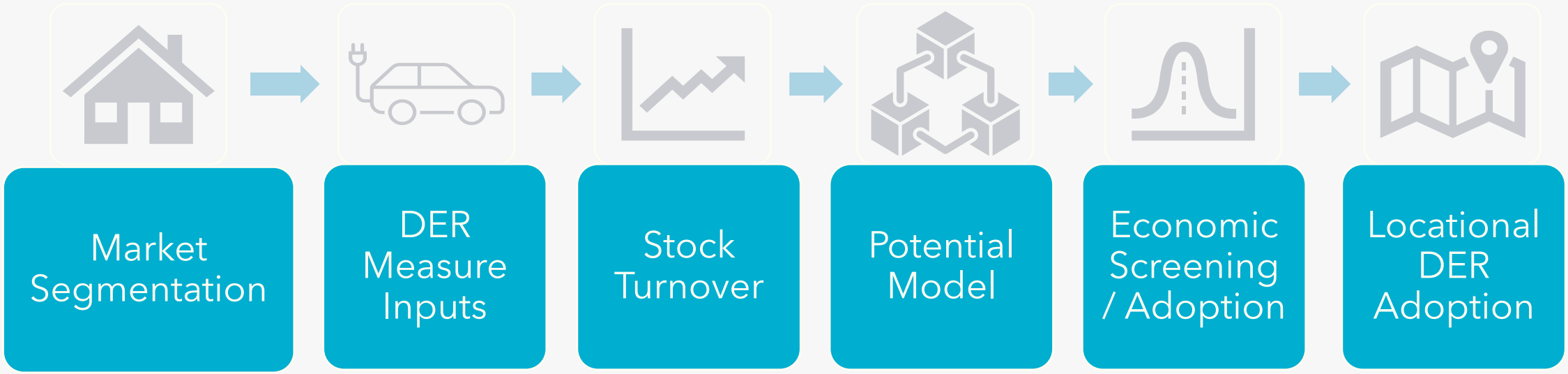
AdopDER is a

site-level simulation model that estimates

locational, hourly annual load impacts from the co-adoption of

40+ distributed energy resources

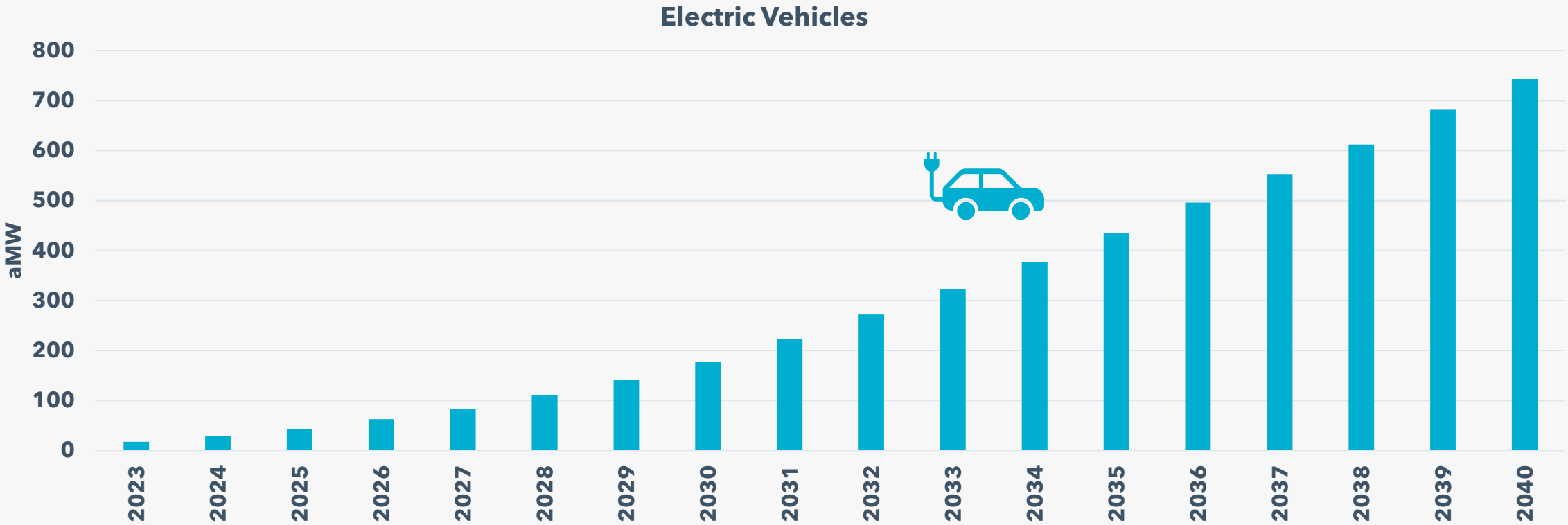
# AdopDER Simplified Workflow



# Example AdopDER Measure Inputs

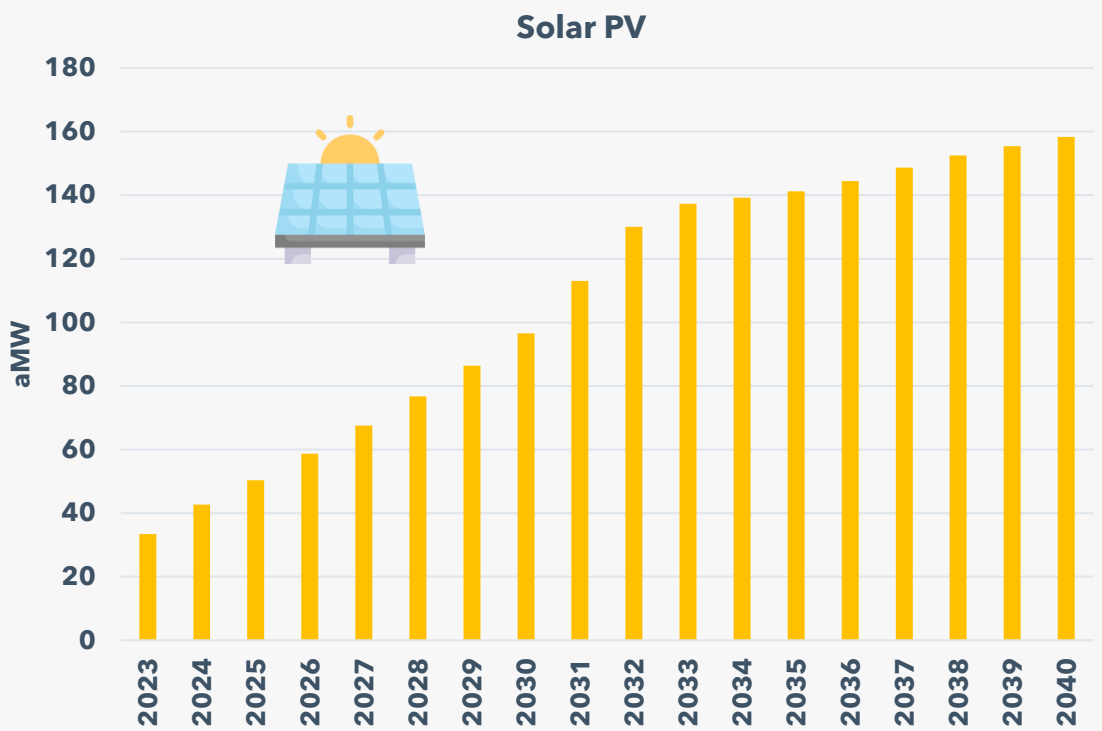
| Solar & Storage | Electric Vehicles | Basic EVSE | Smart Charging | Smart Water Heating | Smart HVAC | C&I DR | Non-firm DR |
|---|---|---|---|---|---|---|---|
| Solar PV | Light-Duty Vehicles | Residential Level 1 charging | Res Smart EV charging | ERWH retrofit switch | Res smart tstat controls | Commercial smart tstat | Peak Time Rebates (PTR) |
| Battery Energy Storage | Medium-Duty Vehicles | Residential Level 2 charging | Non-res Smart EV charging | ERWH smart controls | Res DHP controls | Irrigation load control | Time of Day (TOD) rates |
| Single-site microgrid | Heavy-Duty Vehicles | Non-res Level 2 charging | | New construction Smart ERWH | | Large C&I tariff | EV-TOD |
| Campus microgrid | | Non-res DC Fast Charging | | HPWH smart controls | | Cold thermal storage | |

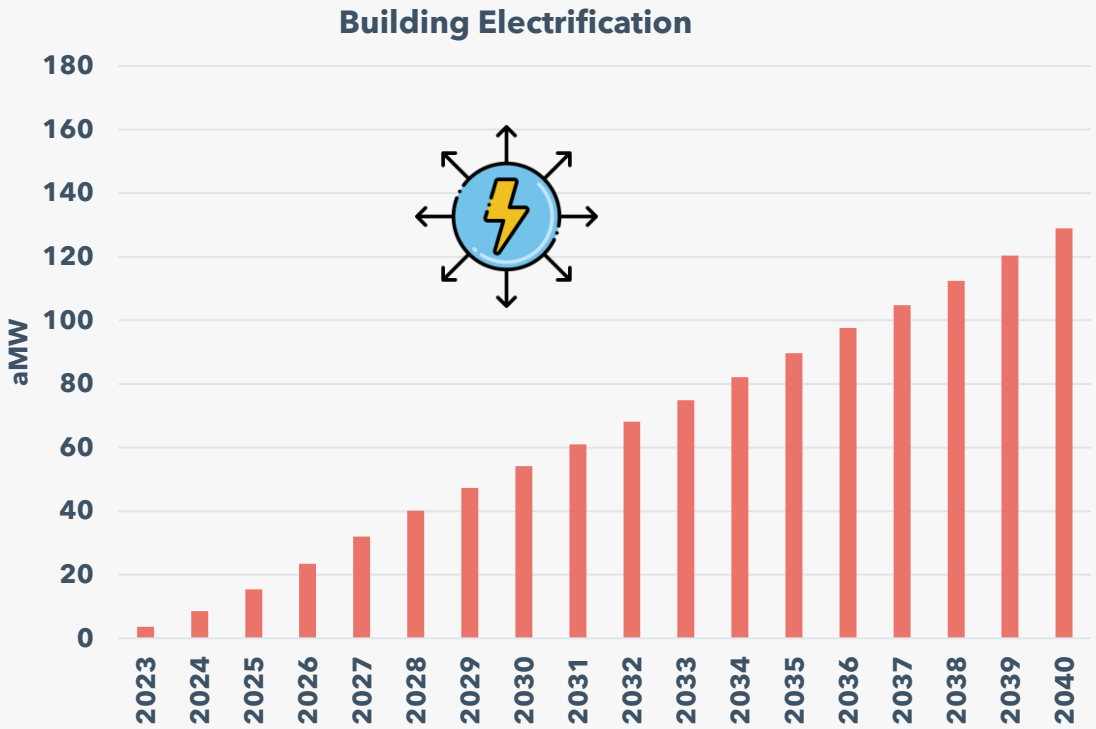
# Long-term Energy Impacts from Distributed Energy Resources (DERs)




**Data source: AdopDER June 2023 vintage (included in PGE 2023 IRP)**

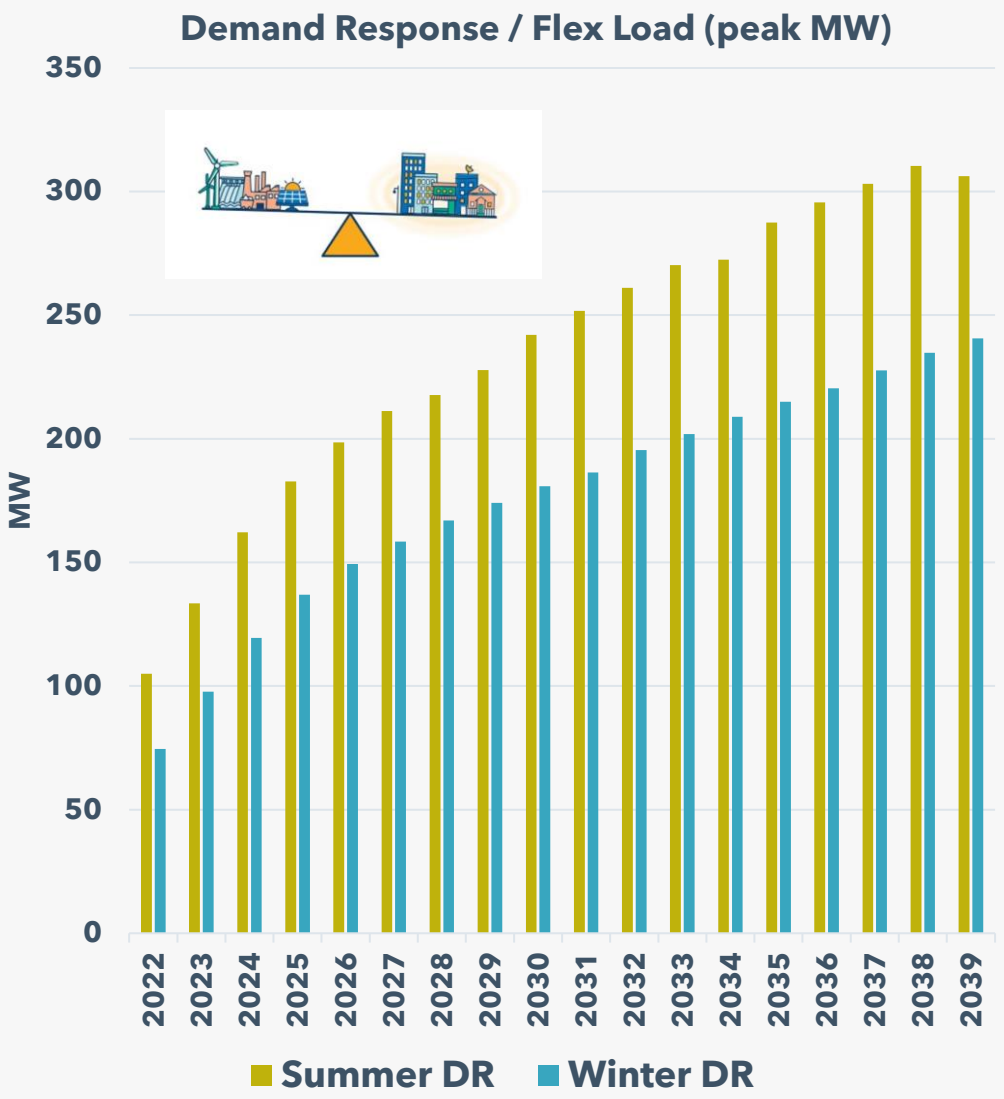
# Long-term Energy Impacts from Distributed Energy Resources (DERs)

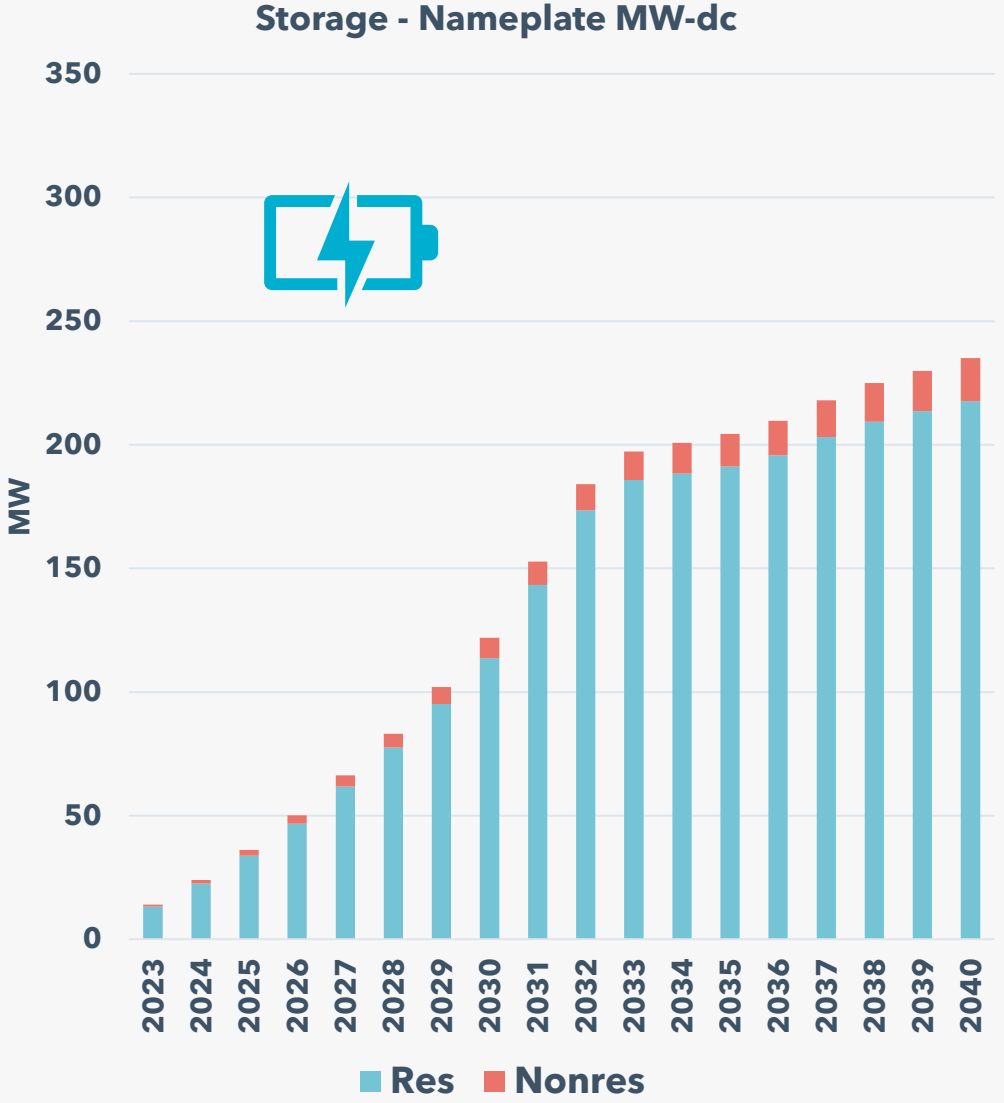



**Data source: AdopDER June 2023 vintage (included in PGE 2023 IRP)**

# Long-term Flexible Load / Capacity Potential from Dispatchable DERs



# Evolution of the DER Forecast for this iteration of DSP

**DER Forecast Update | May (2024)**

- **Solar PV:** calibrating previous forecasts to actual adoption, & improving MWh projections based on more granular system information (e.g., tilt & azimuth)
- **Transportation Electrification:** utilize more real-world charging data (e.g., PGE's Residential Smart Charge program) & incorporate EPRI's EVs2Scale telematics data

**Methodology changes | 2024-25**

- Evolve to site-level forecast curves for DER & Load Feeds into CYME's integrated distribution platform
- Include distribution-connected Qualified Facilities & more granular large customer load additions (1+ MW)
- Increase granularity for CBRE forecasts for IRP Update & CEP

# Locational DER Forecasting Examples

# Assessing Forecast Accuracy & Precision

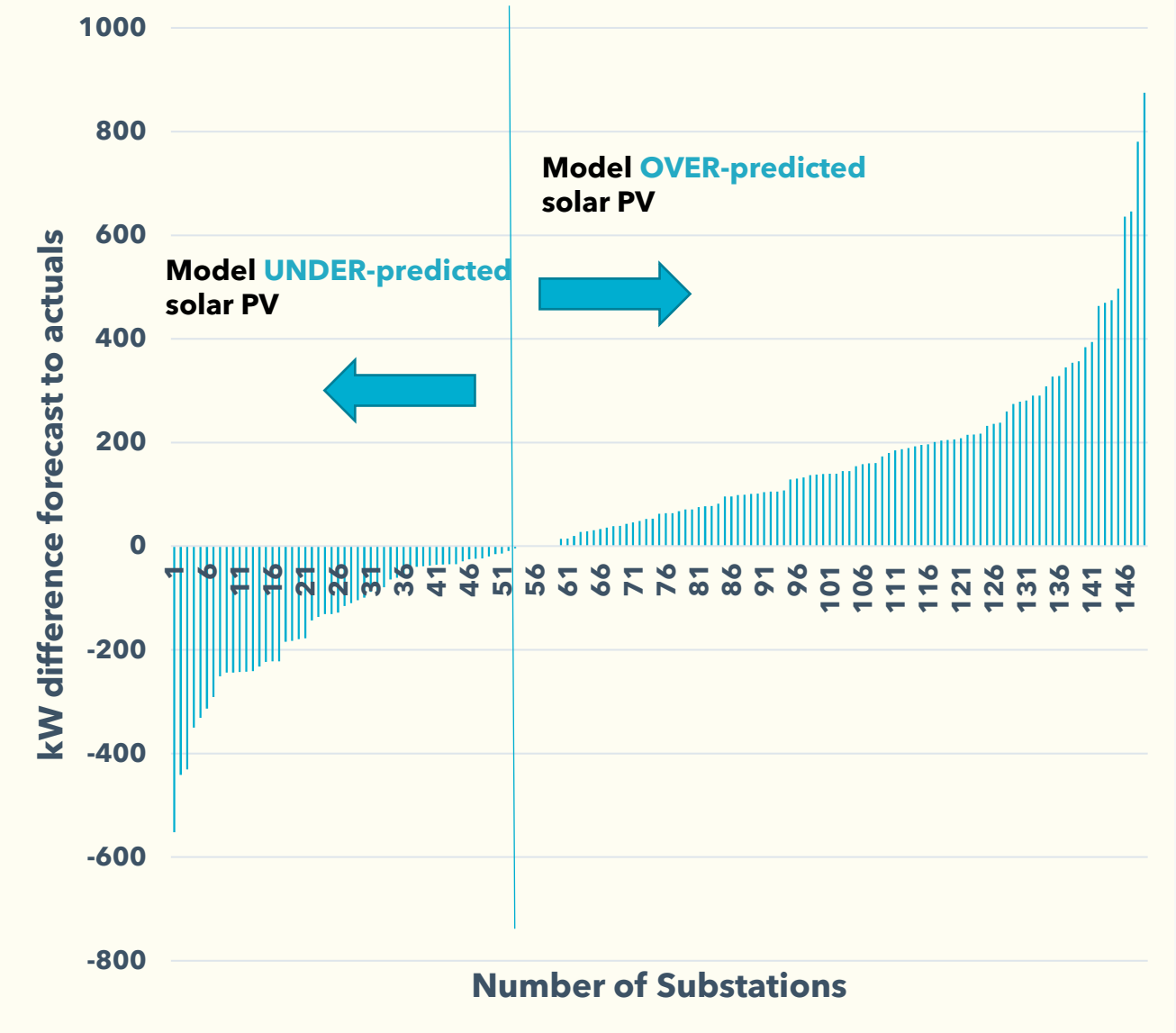
Increasing forecast granularity from system-level to specific geographies – comes with tradeoff of expected accuracy

Chart to the right shows the difference in kW from the forecasted 2023 incremental solar PV additions to actual installs for each substation (n=149)

Overall, 2023 incremental forecasted solar adoption was 18% lower than actuals, but within the low case sensitivity range

At the locational level, the substation level forecast to actuals difference ranged from -550 kW to +875 kW, with an **average of +64 kW** over-forecasted per substation

We are actively investigating potential sources for forecast improvement



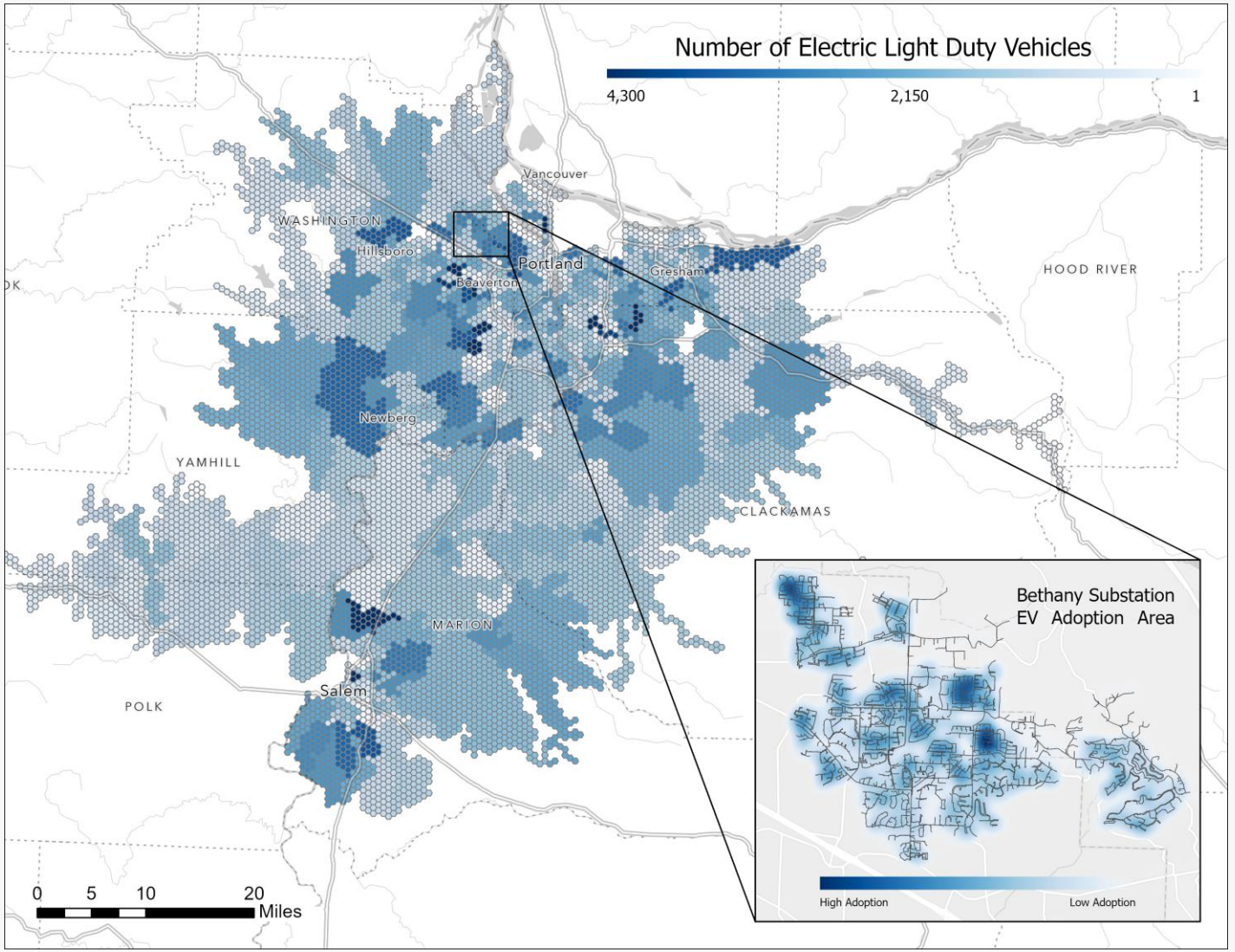
# Forecasted Electric Vehicle Adoption 2030

AdopDER assigns EV purchase decision based on several factors such as

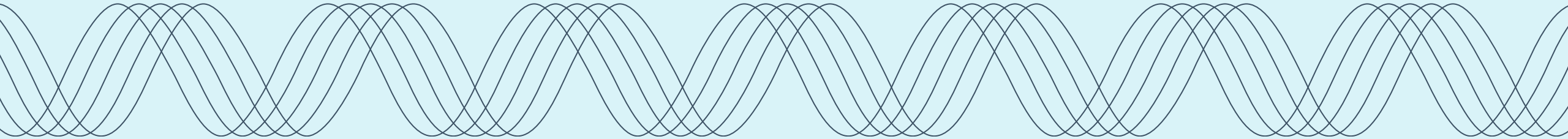
- ***Income***
- ***# of EVs in census tract***
- ***home ownership***

Actual EV adoption tracked by matching DMV registration extracts to PGE customer database at SPID level

Results in address match rate of ~ 95% & remainder are allocated by zip code level apportionment process



# In Process DER Forecasting Updates & Planned Work



# Customer Behavior for Co-adoption of EVs

| | |
|---|---|
| PGE working with EPRI & NREL conducting analysis of customer behavior related to co-adoption of DERs, including combinations of the following: | Solar PV |
| | Battery-electric storage systems |
| | Electric vehicles |

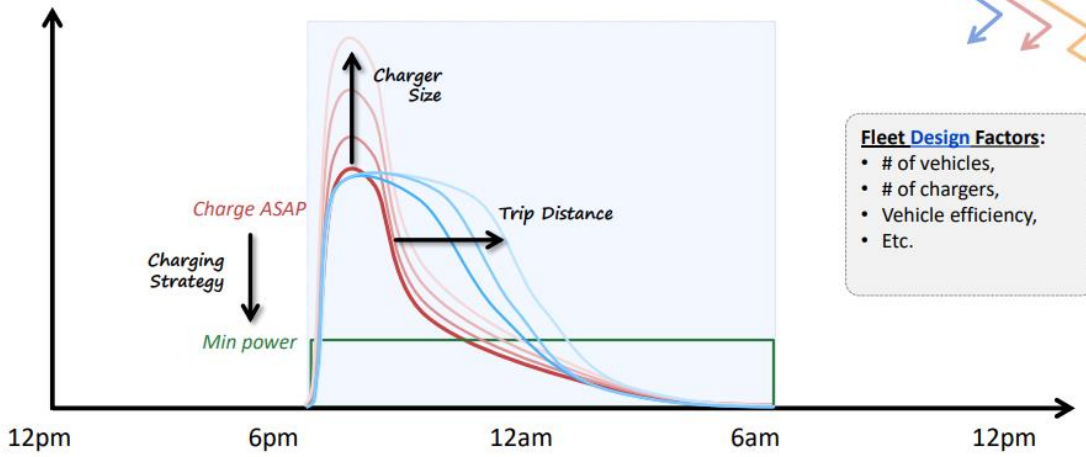
| | |
|---|---|
| Two-Part Methodology | - Conduct customer surveys to inform discrete choice analysis of customer types & propensities (i.e., "stated preferences" approach)<br>- Compare to actual adoption behavior (i.e., "revealed preferences") |
| | - Increase granularity "PGE agents" in dGen, maintained by NREL, allowing for better characterization of PGE customers compared to Oregon statewide aggregates |

# Incorporating EPRI's EVs2Scale & Other Learnings

PGE has been participating in EPRI's Fleet charging study & EVs2Scale Initiative

Will incorporate medium- & heavy-duty fleet vehicle locational energy demand & load profile analysis into future updates

**Goal**: *To better understand how different choices in fleet design and operation factors made by fleet operators and/or utilities at a depot can impact the load profile at the site.*




**Fleet Design Factors:**
- # of vehicles,
- # of chargers,
- Vehicle efficiency,
- Etc.

**Fleet Operation Factors:**
- Charging strategy,
- Rate structure,
- Trip distances,
- Dwell time,
- Etc.

**EPRI eRoadMAP Near Term Electrification Needs (2030)**

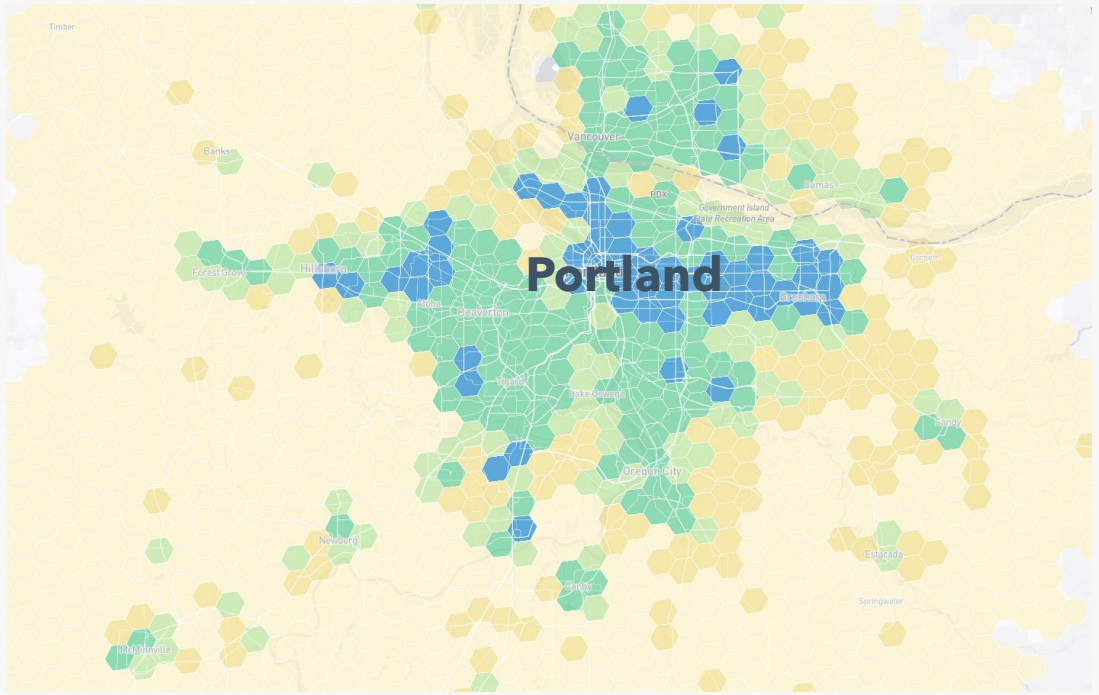



**Image sources:**
https://eroadmap.epri.com/

**Map Legend**

MWh/Day
Cumulative Energy Needs
0 1 3 9 18 2,795
Each hexagon covers about 2 square miles (Hex 7)

# Questions/ Comments

# Distribution System Planning – Grid Needs Assessment

Fatima Colorado, Distribution System Planning Manager

Distribution System Workshop # 2 | 24 – May 8, 2024

PGE An Oregon kind of energy.℠

# Outline

| | |
|---|---|
| Distribution System Planning | Distribution System |
| | Goals for Distribution System Planning |
| Grid Needs Assessment | Grid Assessment Criteria |
| DER Strategy | Types of DERs |
| | DERs Long Term Goal |
| | First Step: Constrained Feeders |
| | Current Issues |
| | DER constrained feeder's strategy |
| Questions & Comments | |

# Distribution Information

**Service Territory**

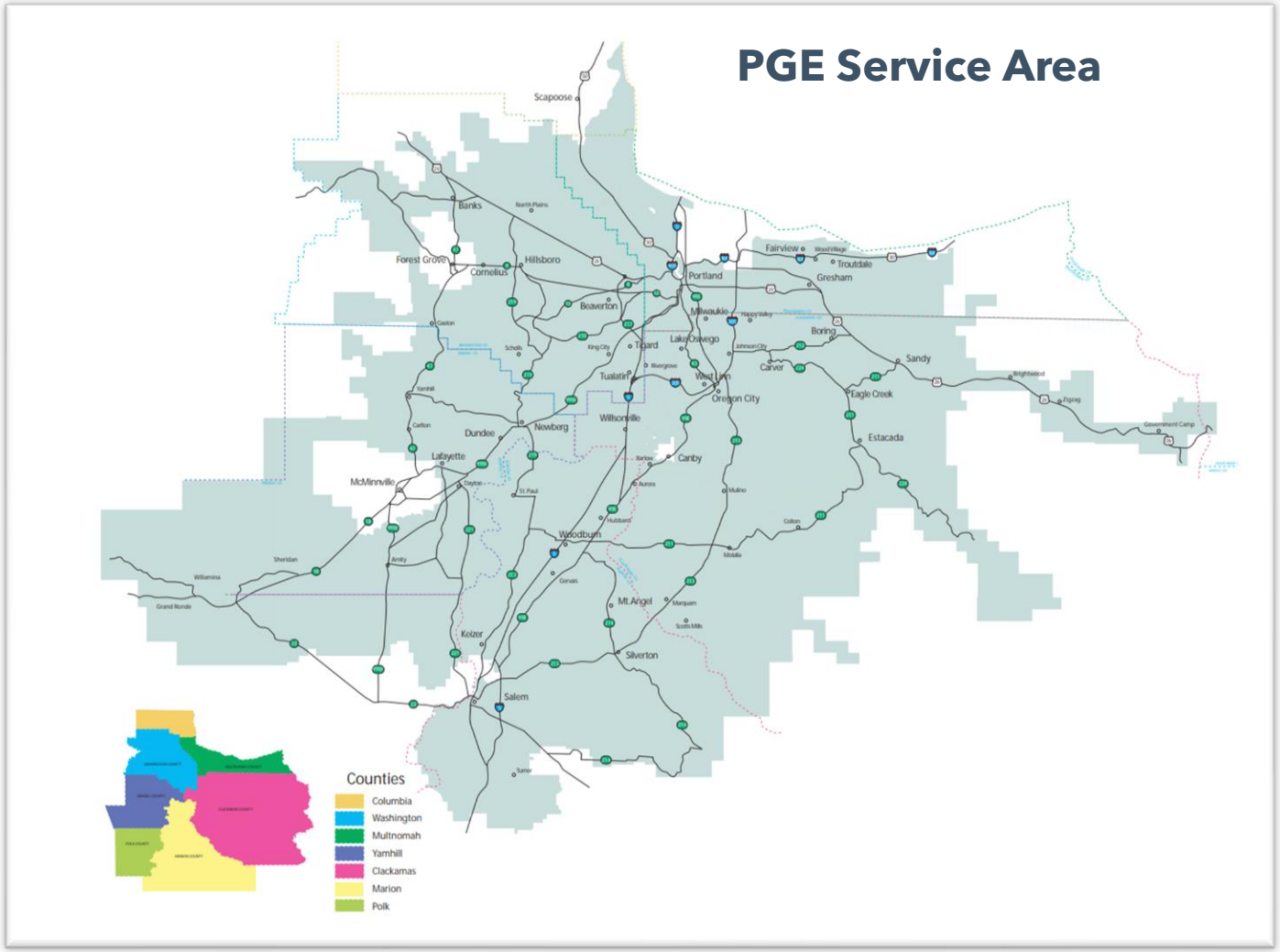
- 1.9 million population
- 4,000 square miles
- ~900,000 customers

**Big Equipment**

- 152 Substations
- 280 Power Transformers
- 707 Feeders

**Net System Peak Load**

- Summer: 4,498 MW
- Winter: 4,113 MW



# Distribution Planning Expected Results

Goals

- Enhance **safety**
- Increase **reliability**
- Meet **customer needs**
- Meet **standards/requirements**
- Recommend best **solutions**
- **Reduce risk** (likelihood x consequence)

# Grid Assessment Criteria

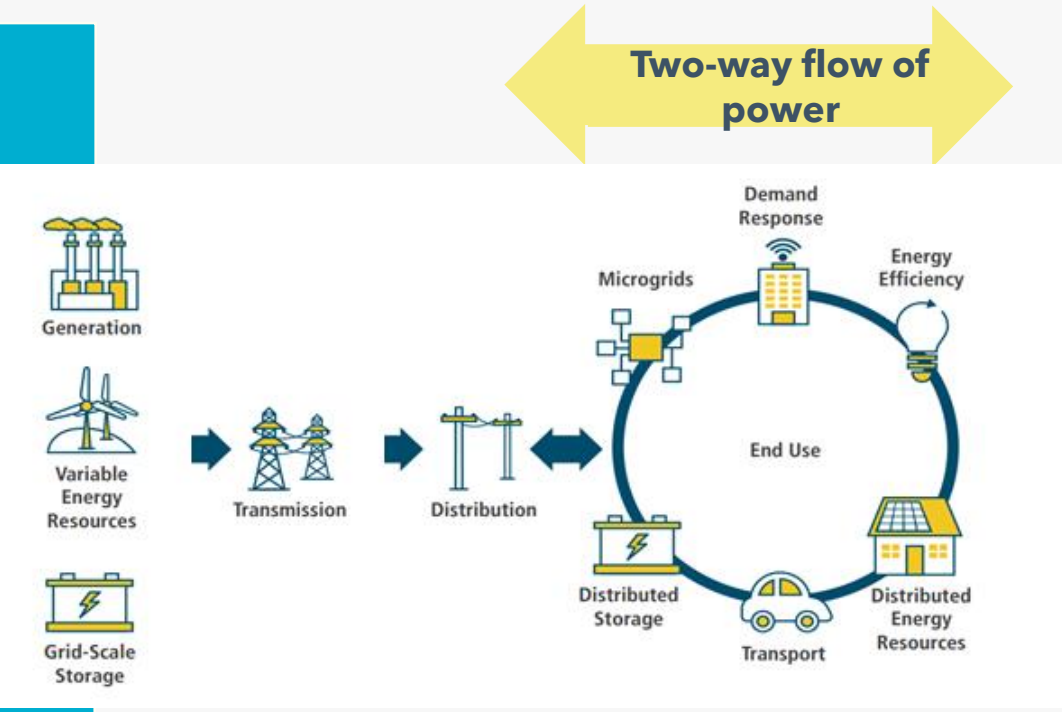
| | |
|---|---|
| **Plan to peak** | PGE plans the distribution system to serve customers even at extreme temperatures, at the largest power demand at a given point during a year |
| **Planning criteria for equipment loading** | target loading is less than 67% for feeders, less than 80% for transformers to have capacity to move load around on the system |
| **Target system flexibility at both the transformer and feeder level** | all load picked up by switching to other equipment for the loss of a single element |
| **Customer-driven projects** | take priority, e.g., large housing development, manufacturing facility, industrial park |
| **Ensure new infrastructure is planned for the long-term forecasted load in the area** | when PGE implements a project, we aim to not have to do another project on the affected equipment for at least 10 years |

# Distributed Energy Resources (DERs)

## DERs Type

- Roof top solar
- Demand response
- Dispatchable standby generators
- Battery Storage

## Bi-directional power flow



# DER Long-Term Goal

## Ultimate Goal: To leverage all tools including DERs

### What do we need to know?

- How many DERs are we adding to our grid
- What kinds of DERs are being added
- Where are these new DERs being installed

### What are we currently doing to achieve our goal?

- Investing in our Test-Bed to be able to scale up
- Forecasting DERs as part of our planning studies
- Investing in feeders to support bi-directional flow ensuring safety & reliability of our system

### What do we need to do?

- Help customers understand their role in our energy future
- Draw lessons from our Test-Bed regarding the reliability of DERs
- Operate DERs optimized in the grid of the future
  - ✓Data & technology intensive effort (a new team of analysts is needed)
  - ✓Real time DER operations

# First Step: Constrained Feeders

## What does it mean?

A feeder (or substation transformer) where we have or where we will be exceeding certain **generation** to load ratio thresholds where the system does not allow for bi-directional flow

| Example | |
|---|---|
| | A feeder where generation is > 90% of the daytime minimum load (DML) |
| | A transformer with single feeder where generation is >80% of the daytime minimum load |
| | Line or substation voltage regulator/LTC not able to function during reverse power flow |

**Why do we have constrained feeders?**

- New feeders are built to accept bi-directional flow
- 27% of our distribution feeders are fully ready for bi-directional power flow
- Most of our existing feeders are built to accommodate load
- Our feeders are in flex, new customers/disconnects, new generation etc.
- Minimum loads (and Peaks) change and we review them twice a year
- High penetration rooftop solar
- Strategy in place to mitigate existing constrained feeders
- Monitoring DER/Load forecast to proactively address constraints

# Current Issues: Constrained Feeder List

| # | Feeder | Transformer | Installed kW | Largest | Gen/DML Ratio | Upgrades Needed | Back-feed Hours |
|---|---|---|---|---|---|---|---|
| 1 | **Scoggins-Laurelwood** | BR2 | 2525 | 2200 | 116% | Lack of Transformer 3V0 Protection | 538 |
| 2 | **Yamhill - Yamhill-13** | BR1 | 3825 | 2505 | 93% | Lack of Transformer 3V0 Protection | 239 |
| 3 | **Scotts Mills-Scotts Mills-13** | BR1 | 1091 | 313 | 94% | Lack of Feeder Hot Line Blocking and Transformer 3V0 Protection | 186 |
| 4 | **Liberal - Liberal-13** | BR1 | 4639 | 2200 | 123% | Lack of Transformer 3V0 Protection | 181 |
| 5 | **Canby-Zimmerman** | BR3 | 1705 | 498 | 91% | Lack of Feeder Hot Line Blocking and Transformer 3V0 Protection | 82 |
| 6 | **Dayton-SouthWest** | BR1 | 5070 | 2200 | 88% | Lack of Feeder Hot Line Blocking and Transformer 3V0 Protection | 63 |
| 7 | **Dayton-Lafayette** | | 1050 | 37 | | | |
| 10 | **Colton-Dhooghe** | BR2 | 2385 | 2200 | 83% | Lack of Feeder Hot Line Blocking and Transformer 3V0 Protection | 6 |
| 11 | **Colton-GrayHill** | | 161 | 18 | | | |
| 12 | **Bethel-Geer** | WR5 | 2673 | 1750 | 93% | Lack of Feeder Hot Line Blocking | 4 |

# Constrained Feeder Strategy

**Prioritize**

Top 3 critical feeder upgrades

**Fund**

Propose projects for funding internally

**DER Forecast**

Utilize forecast to Prioritize Proactive upgrades

**Execute**

Execute projects based on framework

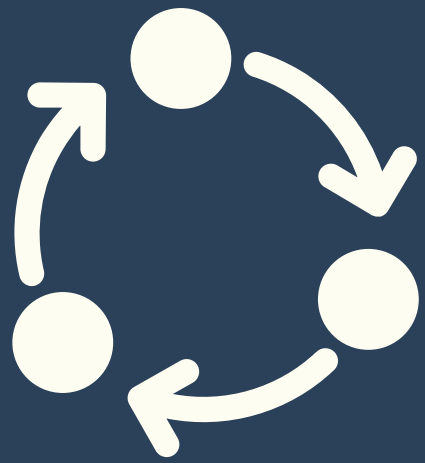
# Grid Needs

**Identified grid needs in 2024**

**Prioritized grid needs**

**Emergent grid needs**

**Distribution Planning Engineers conducting studies on the prioritized grid needs for 2025 capital cycle**



# Prioritized List of Grid Needs – Submitted for Internal Funding

| Ranking | Grid Need | Type of Need/Constraint | Size of Need/Constraint | Timing/Duration of Need/Constraint | Total |
|---|---|---|---|---|---|
| 1 | New manufacturing load growth in Hillsboro | Overload, Load Growth | 300 MVA of Industrial load starting 2027 | 24/7 due to the nature of customer operations | 149 |
| 2 | Commercial load growth in Woodburn area and 57 kV system constraints | Overload (Distribution and Sub-Transmission), Voltage Issues (Sub-Transmission), DER Readiness, Load Growth | 7 MVA on the distribution system | Approximately 5-11 PM, summer for distribution. Summer and Winter seasons for Sub-Transmission. | 102 |
| 3 | Existing loading issues and industrial load growth in Silverton | Overload, Load Growth | 8 MVA on the distribution system | Afternoon through late evening, summer | 96 |
| 4 | Aging infrastructure, heavily loaded transformer and feeders, lack of telemetry east of Oregon City | Overload, Aging Infrastructure, Lack of SCADA Telemetry | 10 MVA | Summer and Winter seasons, evenings for overload; 24/7 for aging infrastructure, lack of telemetry | 84 |
| 5 | Capacity load growth in SW Beaverton, western Tigard, and western King | Aging Infrastructure, Safety, Lack of Facilities to serve new load | 20 MVA | Summer and Winter seasons | 83 |
| 6 | DER Constrained Feeders | DER constrain feeders | Transformer Protection | Based on hours of backfeed | 81 |

# Questions/ Comments





# Grid Needs Analysis: Supporting DER Integration & Operation

Joe Boyles, Resource Planning Project Manager

Distribution System Workshop # 2 | 24 – May 8, 2024

*"The grid is the most complicated machine we've ever built. It's gigantic, it is complex, and to get the most efficient use out of the system, we have to use it in the most coordinated way that we can."*

– **Carl Zichella**, environmental consultant focusing on climate change and the clean energy transition

# Key Takeaways

- Pressure on the grid is increasing
- DERs contribute to that pressure
- Orchestration of DERs through a Virtual Power Plant (VPP) can relieve some pressure

# Overview

## Building capabilities to enable Non-wires Solutions and Virtual Power Plants

### Background

- DSP guidelines requested submission of two NWS concept proposals. We submitted:
  - Eastport substation: > 3 MW load relief
  - Dayton substation: >1.5 MW load relief
- Conceptualized how different combinations of DERs could cost-effectively provide load relief and defer capital investment
- Determined that there was not a pathway to execution due lack of:
  - project management,
  - regulatory approval,
  - capability to deploy, and
  - capability to call on/control DERs

### Proposed direction for next iteration of DSP – develop a plan to do the following in 2025

- Demonstrate capabilities necessary to deliver an NWS and a VPP that involves customer-sited DERs
- Demonstrate delivery and measurement of community benefits
- Investigate how CBREs can deliver an NWS or otherwise address grid needs

# What is driving the need for grid modernization?

Customer expectations for increasingly clean energy, without compromising reliability and keeping costs as low as possible, require increased integration of Distributed Energy Resources and Flexible Loads

**RESIDENTIAL**
(SINGLE-, MULTI-FAMILY)

- Rooftop Solar
- Distributed Batteries
- Smart Devices
- Vehicle charging
- Heat pumps
- Thermostats
- Hot water

**IOC**
(INTEGRATED OPERATIONS CENTER)

- Uniform standards
- Open-source API
- Plug-and-play connectivity

**COMMERCIAL & INDUSTRIAL**

- Heating Systems
- Building Management Systems
- Industrial Processes
- Warehouse automation
- Chillers
- Data Center
- Back up batteries & generation

**MUNICIPALITY, SCHOOL, UNIVERSITY, HOSPITAL**

- Community-based renewables
- Microgrids
- School bus V2G
- Advanced Heating/Cooling

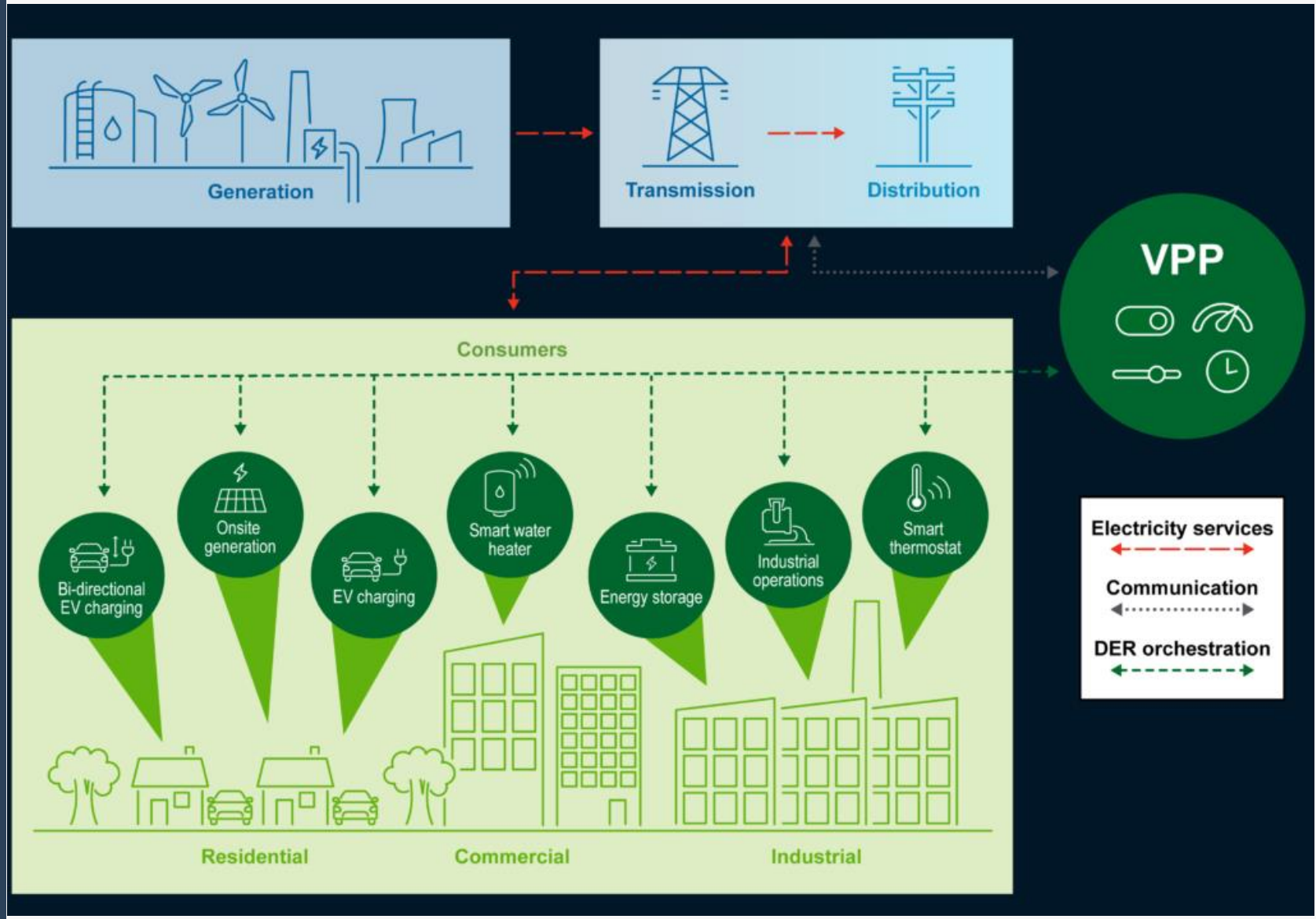
As Virtual Power Plant capabilities increase, customers have more choice and control of the energy that powers their home, work, life and community

**TRANSPORTATION ELECTRIFICATION**

- Transit & Freight
- Fleet charging
- Public charging
- Rental Properties
- OEM V2G and V2X

# What is a Virtual Power Plant (VPP?

Aggregations of distributed energy resources (DERs) such as smart appliances, rooftop solar with batteries, EVs and chargers, and commercial and industrial loads that can balance electricity demand and supply and provide grid services like a traditional power plant.

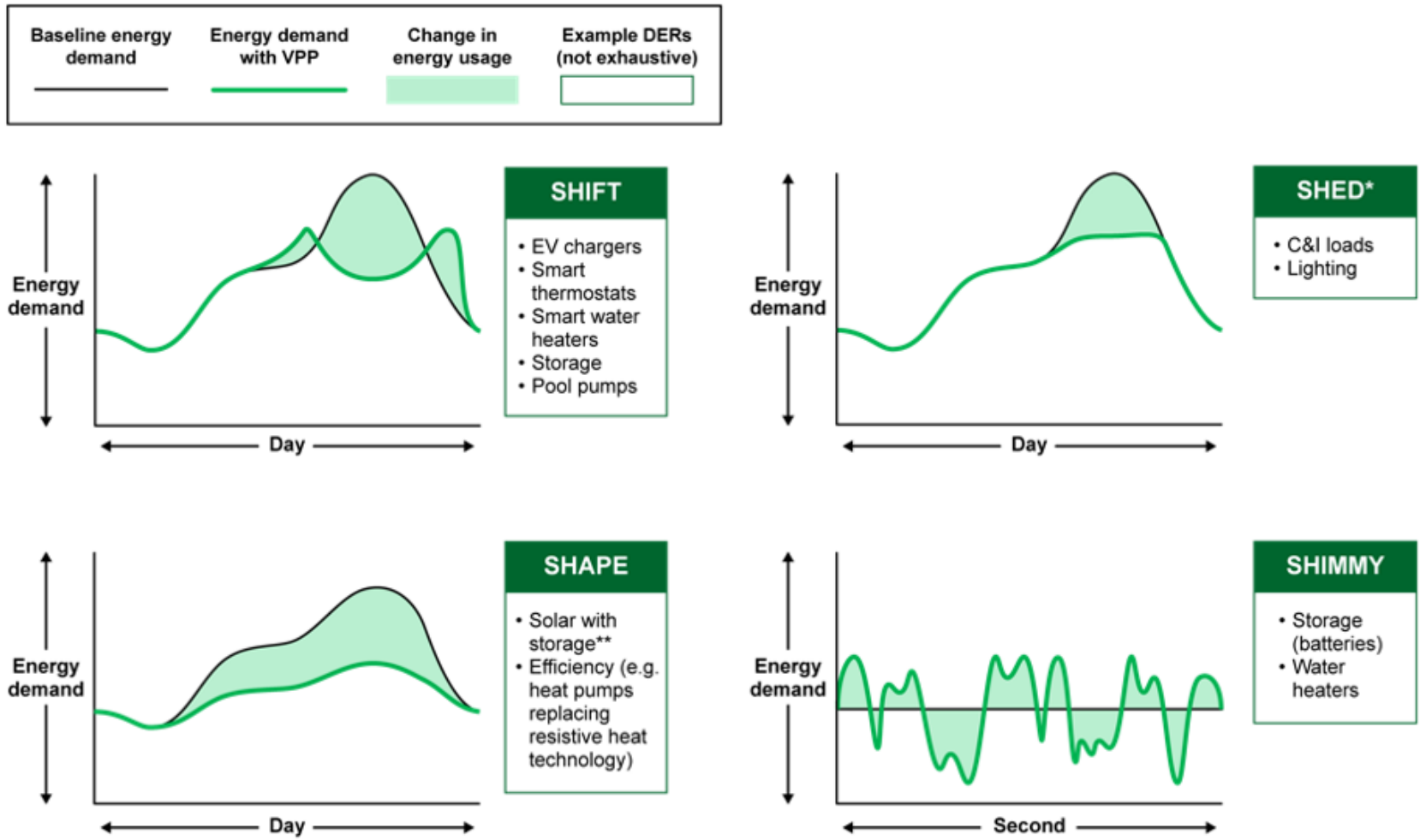



Source: https://liftoff.energy.gov/vpp/

# VPPs function in different ways to meet needs

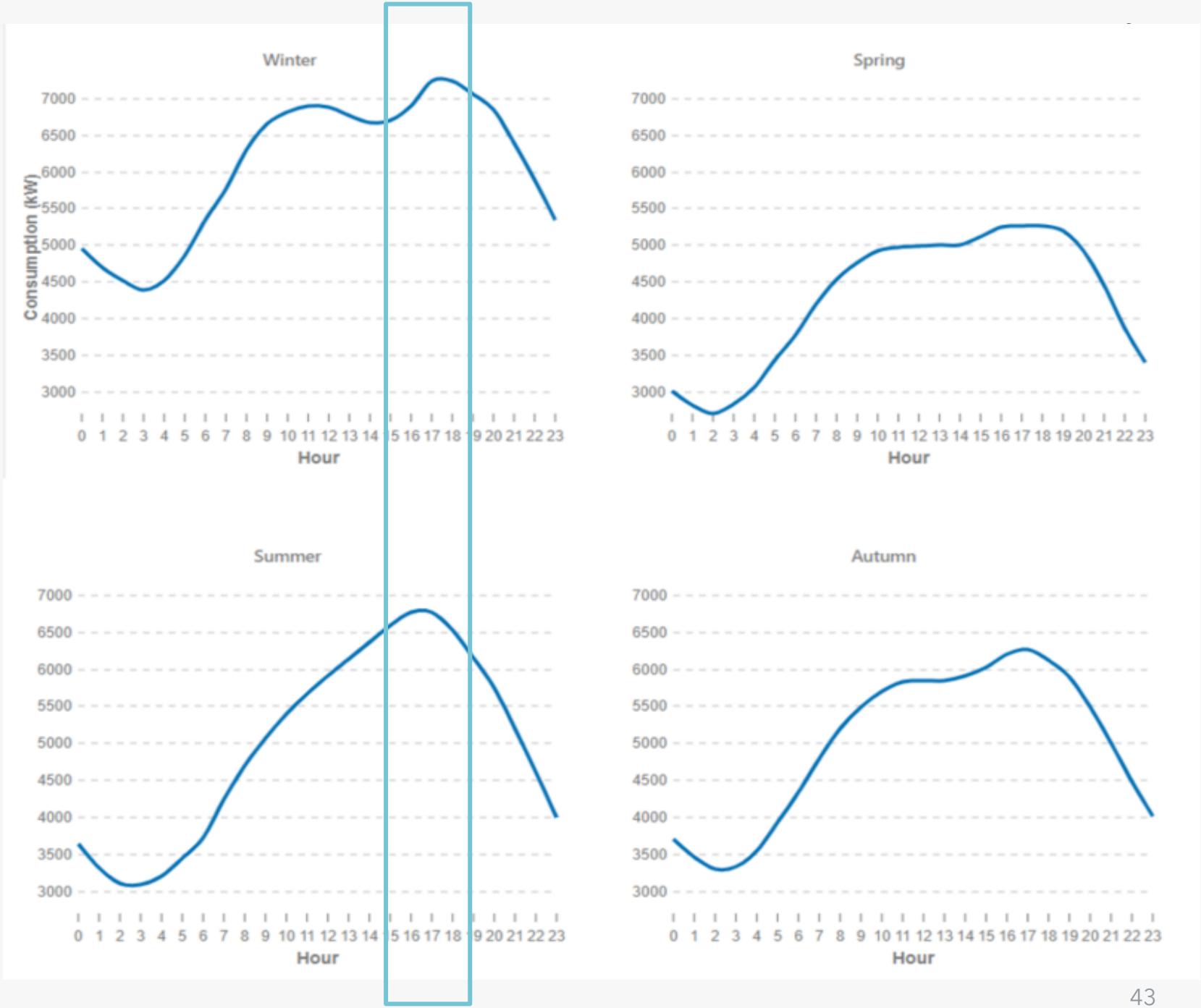
## For example

- Supplying homes with energy from on-site solar-plus-storage systems during peak hours when bulk power generation is scarce
- Shifting the timing of EV charging to avoid overloading local distribution system equipment
- Charging distributed batteries (increasing demand) when clean electricity is abundant to reduce curtailment, for example, of utility-scale solar

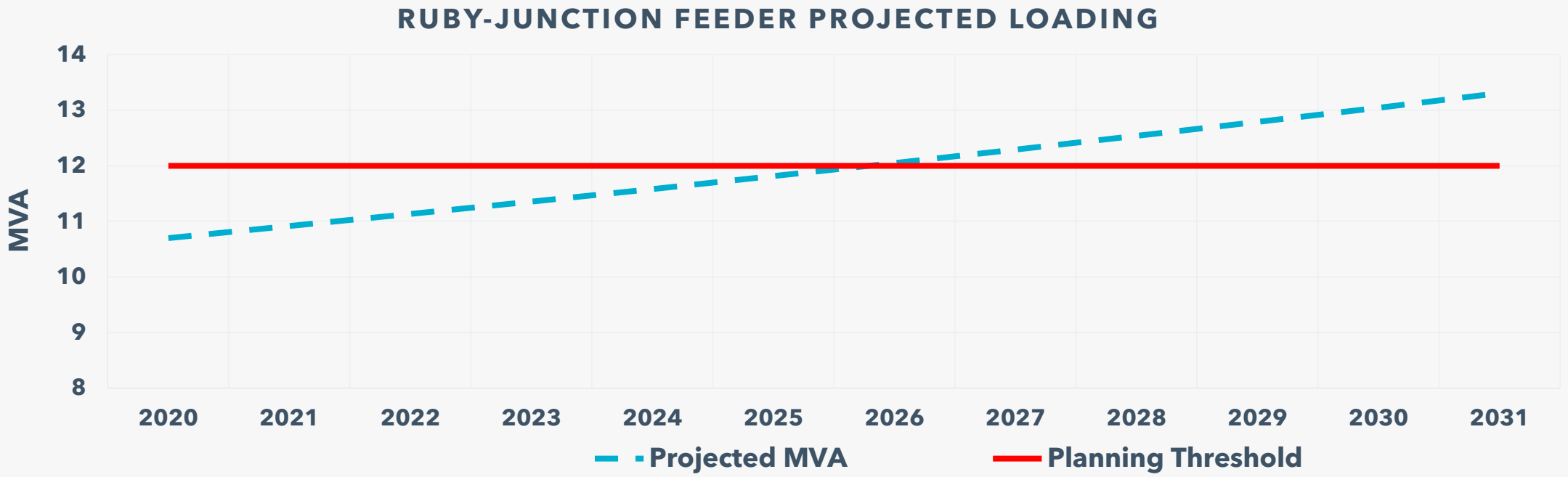



Source: https://liftoff.energy.gov/vpp/

# Ruby Substation average seasonal load profiles



# Load Growth vs Planning Threshold



# Collectively, VPPs Can Deliver a Range of Benefits

| Cost Control | Reliability & Resilience | Decarbonization | T&D Infrastructure Relief | Community Benefit |
|---|---|---|---|---|
| • Defer grid capex (generation, T & D)<br>• Avoid fuel costs<br>• Compensate consumers and businesses | • Integrate back-up power<br>• Eliminate single-point-of-failure | • Add distributed renewable generation<br>• Reduce curtailment of renewables<br>• Reduce reliance on fossil fuels | • Increase efficiency by smoothing peaks<br>• Alleviate congestion with local dispatch | • Enable consumers to optimize energy cost, use, and source<br>• Retain and create good jobs |

Source: https://liftoff.energy.gov/vpp/

# Capabilities Required for NWS/VPP

| Capability | Description |
|---|---|
| **Grid Modeling & Analysis** | Digital twin/network model development, including analysis of SCADA and field sensor data, typology models and control settings, and DER performance data. |
| **DER Control & Dispatch** | Design and implement DER controls, including DERMS alignment, lab simulation, hardware-interoperability and testing, OEM communication and coordination. |
| **Product Design & Marketing** | Analyze customer composition of chosen locations, assess customer preferences/needs, customize product offerings to maximize participation/adoption, incorporate considerations for disadvantaged populations, design and implement measurement and evaluation framework. |
| **Contractor Training & Management** | Identify installers who are willing to add NWS requirements to the install process, work with installers to design efficient installation processes, prepare installers to configure DERs to integrate with PGE systems/controls. |
| **ADMS/DERMS Controls Integration** | Configure ADMS/DERMS to recognize and operate NWS DERs, develop operations procedures to cover NWS use cases. |
| **Equity Lens** | Apply environmental justice principles in the deployment of DER-based solutions |

**Decarbonize**

**Electrify**

**Perform**

# Virtual Power Plant

**PGE will enable customers to shift their power usage from peak times while providing reliable and affordable energy**

## Virtual Power Plant

The orchestration of
Distributed Energy Resources and Flexible Load,
through technology platforms,
to provide grid and power operations services.

| Customer Programs | Distributed Solar | Distributed Thermal | Distributed Storage | Utility Storage |
|---|---|---|---|---|

**Technology Platforms**

**Policy and Regulation**

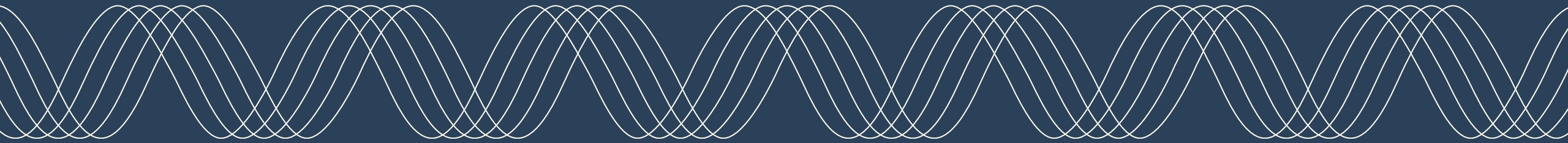
**To achieve a 25% peak usage offset while serving 100% of customer energy needs**
**PGE is targeting 2,000 VPP-enabled megawatts by 2030**

# Key Takeaways

- Pressure on the grid is increasing
- DERs contribute to that pressure
- Orchestration of DERs through a VPP can relieve some pressure

# Questions/ Comments

# Next Steps and Closing Remarks



# Next Steps & Closing Remarks

- Wednesday May 22 | 10a-12p | Zoom | CBIAG Meeting
- Wednesday June 5 | 9-1a | Zoom | CEP/IRP Roundtable
- Wednesday June 19 | 9-11a | Zoom | Distribution System Workshop

Meeting materials and recording will be posted to our Plan's Engagement webpage at Plan's Engagement | Portland General Electric

For more information or if you have questions, please email us at dsp@pgn.com

Thank You for your participation in our plans

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