Forecasting Locational EV Adoption for Distribution Planning

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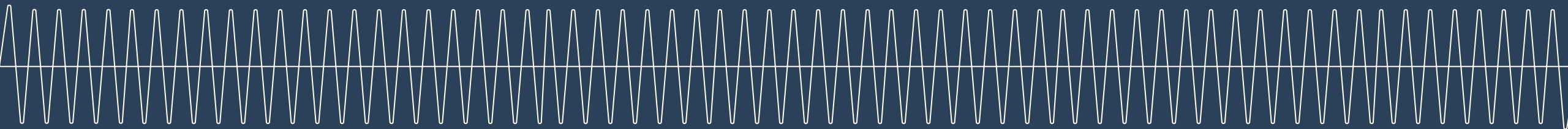


PGE

PGE at a Glance

Quick Facts

Vertically integrated electric utility

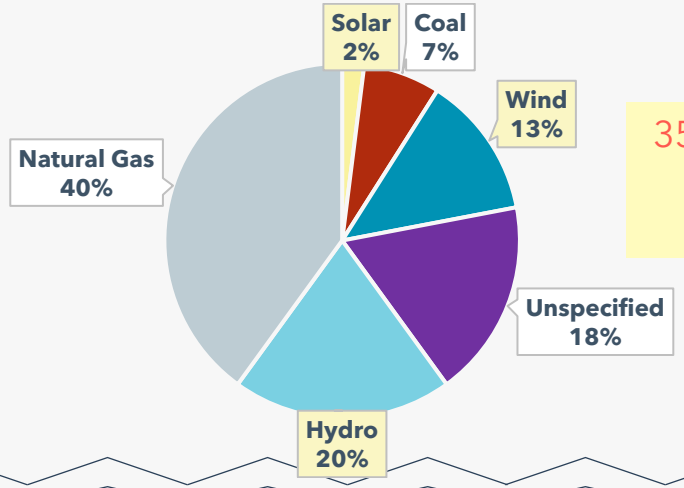
- Generation
- Transmission
- Distribution

~ 900K retail customers (2 million residents)

~ 75% state's commercial & industrial

~ 50% state's pop. (51 incorp. cities)

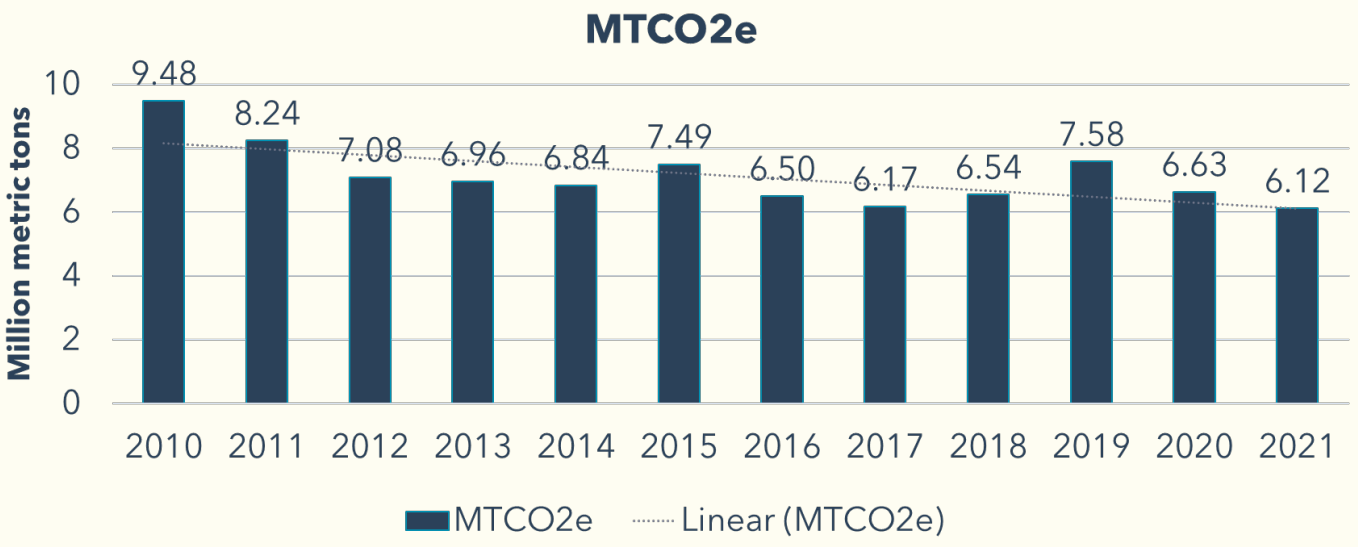
2021 Resource Mix



35% of power served to customers came from non-emitting energy resources

3,300+ MWs of Generation

PGE's Annually Reported Emissions to DEQ*



*Anthropogenic emissions from power generated and purchased to serve Oregon retail customers.

Emissions Targets

HB 2021 Requirements

	MMTCO2e	Reduction
Baseline	8.1	per DEQ
2030 Target	8.1 to 1.62	80%
2035 Target	1.62 to 0.81	90%
2040 Target	0.81 to 0	100%

What is PGE doing to get ready for TE?

78th OREGON LEGISLATIVE ASSEMBLY--2016 Regular Session

Enrolled

Senate Bill 1547

Sponsored by Senator BEYER; Senators BATES, BURDICK, DEMBROW, DEVLIN, GELSER, HASS, MONNES ANDERSON, MONROE, RILEY, ROSENBAUM, SHIELDS, STEINER HAYWARD, Representatives VEGA PEDERSON, WILLIAMSON (Presession filed.)

CHAPTER .....

AN ACT

Relating to public utilities; creating new provisions; amending ORS 469A.005, 469A.020, 469A.052, 469A.055, 469A.060, 469A.075, 469A.100, 469A.120, 469A.135, 469A.140, 469A.145, 469A.210 and 757.375; repealing ORS 757.370; and declaring an emergency.

Be It Enacted by the People of the State of Oregon:

ELIMINATION OF COAL FROM ELECTRICITY SUPPLY

SECTION 1. (1) As used in this section:

(a) "Allocation of electricity" means, for the purpose of setting electricity rates, the costs and benefits associated with the resources used to provide electricity to an electric company's retail electricity consumers that are located in this state.

(b)(A) "Coal-fired resource" means a facility that uses coal-fired generating units, or that uses units fired in whole or in part by coal as feedstock, to generate electricity.

(B) "Coal-fired resource" does not include a facility generating electricity that is included as part of a limited duration wholesale power purchase made by an electric company for immediate delivery to retail electricity consumers that are located in this state for which the source of the power is not known.

(c) "Electric company" has the meaning given that term in ORS 757.600.

(d) "Retail electricity consumer" has the meaning given that term in ORS 757.600.

(2) On or before January 1, 2030, an electric company shall eliminate coal-fired resources from its allocation of electricity.

(3)(a) The Public Utility Commission shall adjust any schedule of depreciation approved by the commission for an electric company's coal-fired resource if:

(A) The electric company holds a minority ownership share in only one coal-fired resource, with no more than four generating units; and

(B) The electric company serves at least 800,000 retail electricity consumers and only retail electricity consumers that are located in this state.

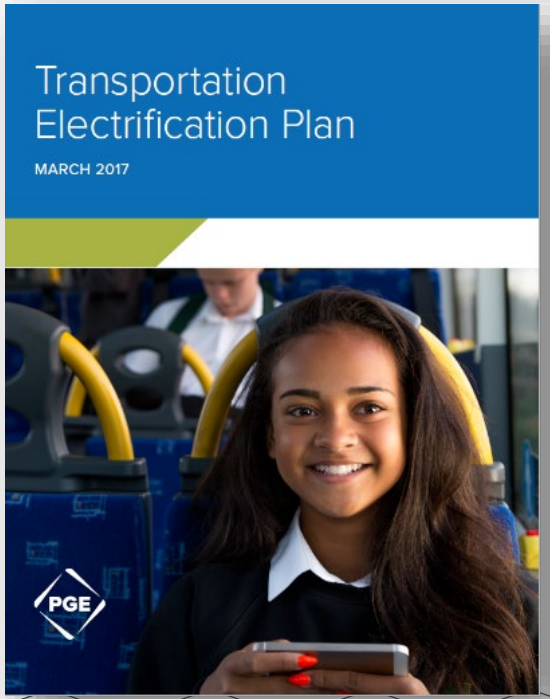
(b) The adjusted depreciation schedule described in paragraph (a) of this subsection must require the coal-fired resource described in paragraph (a)(A) of this subsection to be fully depreciated on or before December 31, 2030.

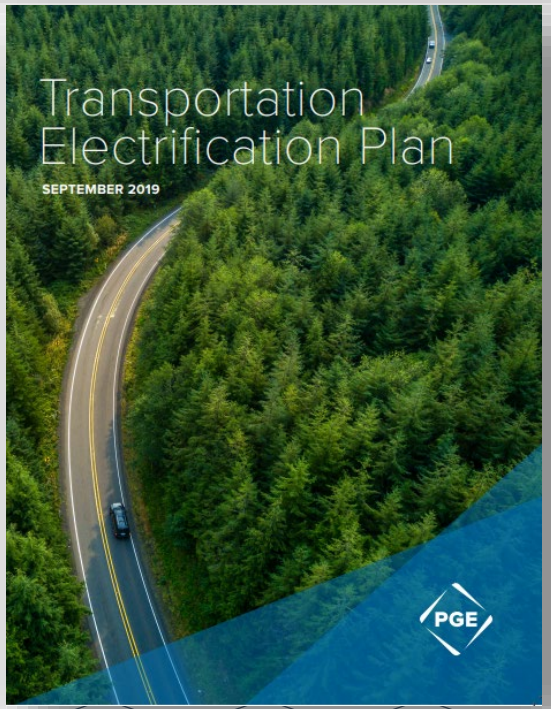
(4) Notwithstanding subsections (2) and (3) of this section, for the number of years requested by the electric company, not to exceed five years after the coal-fired resource is fully

Enrolled Senate Bill 1547 (SB 1547-B) Page 1

(a) Transportation electrification is necessary to reduce petroleum use, achieve optimum levels of energy efficiency and carbon reduction, meet federal and state air quality standards, meet this state's greenhouse gas emissions reduction goals described in ORS 468A.205 and improve the public health and safety;

(b) Widespread transportation electrification requires that electric companies increase access to the use of electricity as a transportation fuel;





Electric Avenue Network

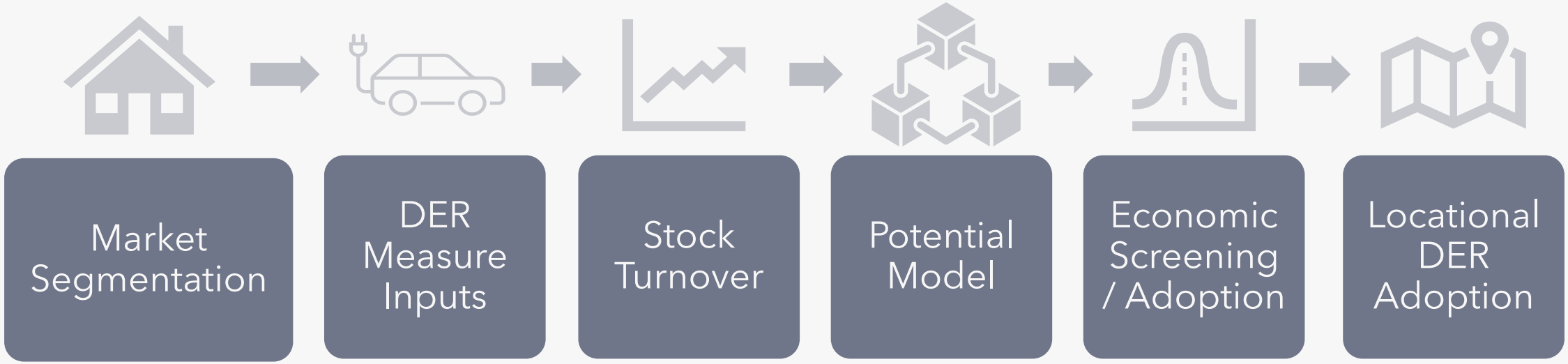
Electric School Bus Fund

Electrified Mass Transit

Electric Island

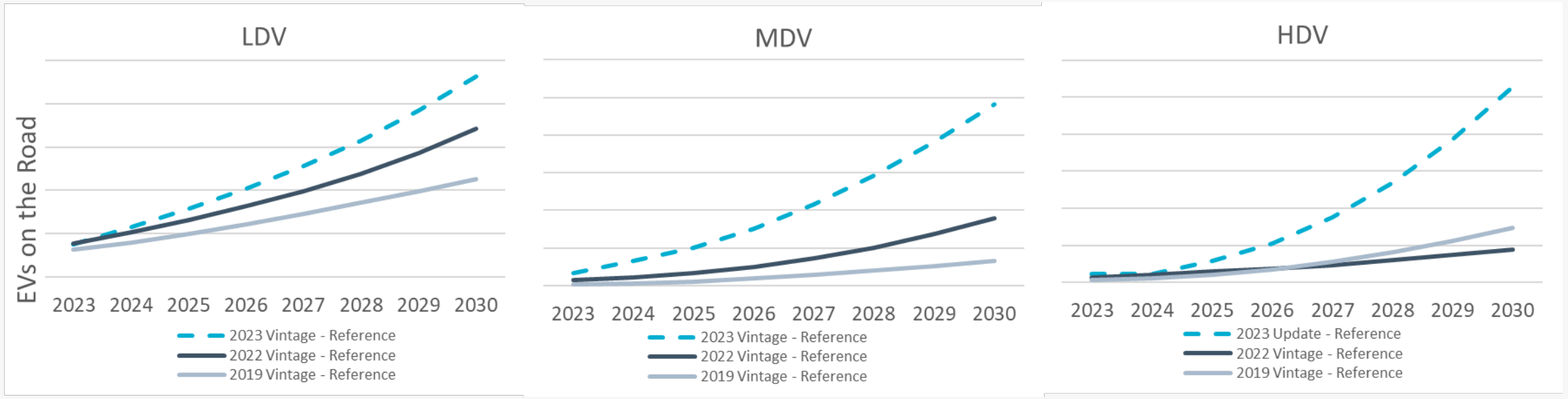
Locational DER Forecasting at Circuit Level

Overall DER Forecasting Workflow



Not if, but when…(and where, and how much)

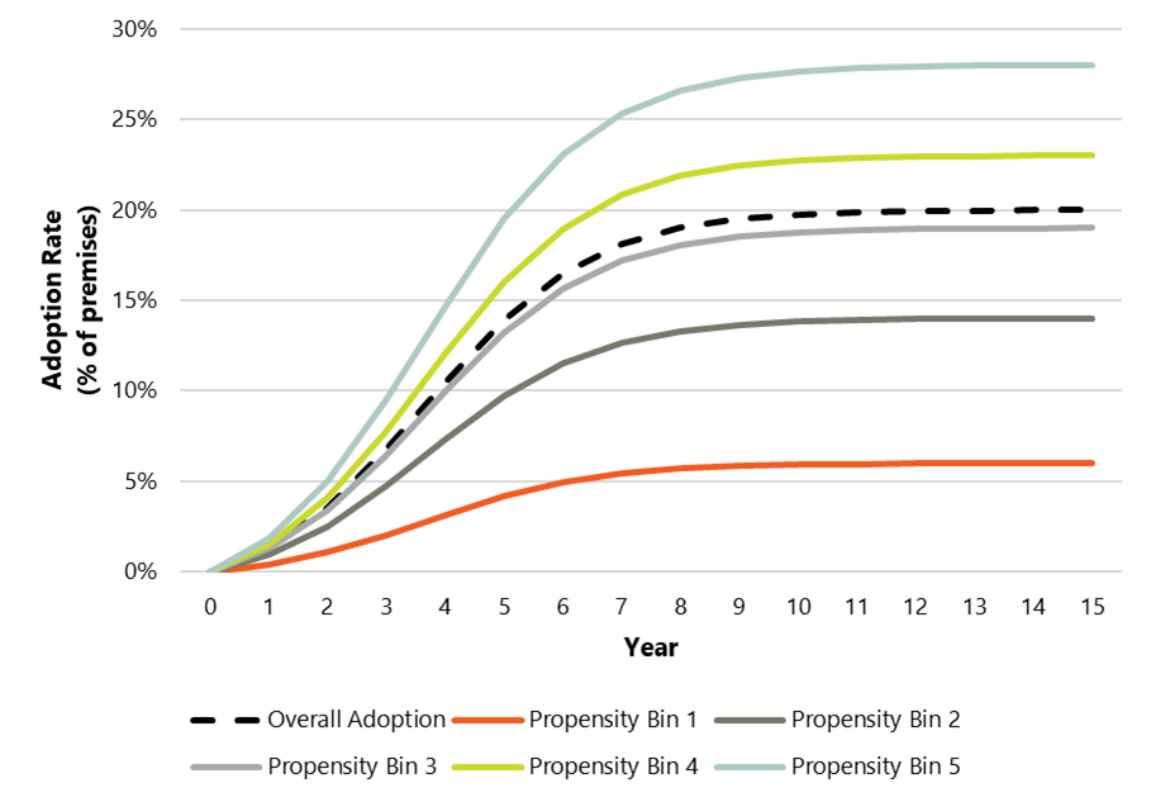
- Steady increases in reference case forecasts for EV adoption in PGE service area for light-duty vehicles
- MDHDV are more nascent, but they are beginning to arrive and will accelerate
- Dotted lines show recent (draft) findings



AdopDER uses scorecards to adjust adoption probability

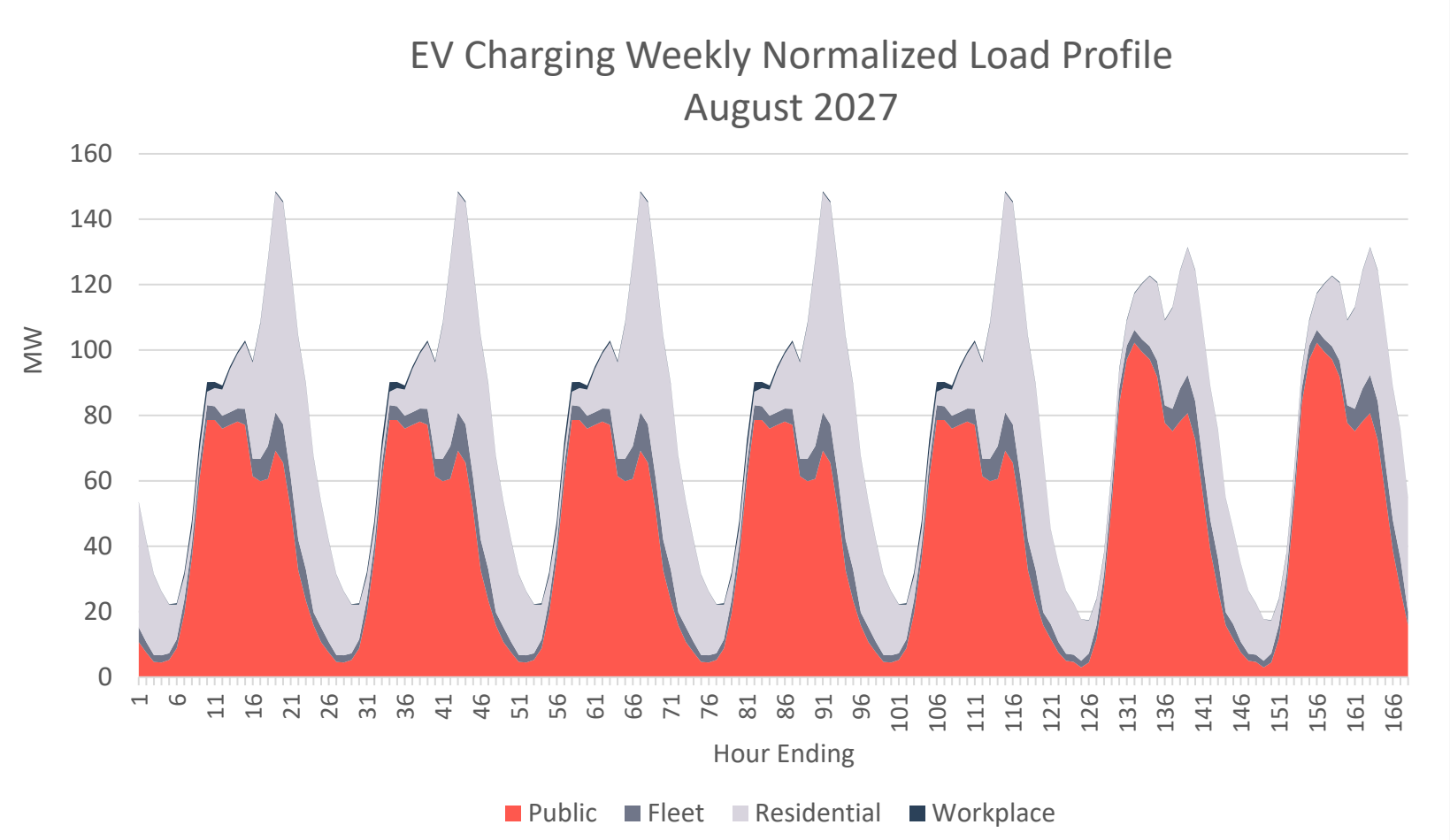
- Add variables (statistical and heuristic) to AdopDER at premise-level
- For each year, premise, and measure, we use a function to
  - Calculate score from scorecard
  - Assign each score to a quantile-based bin
  - Adjust adoption probability

Illustration: Scorecard-based Adjustment to Adoption Rate



EV total system weekly load profile

- Model weekday/weekend shapes by season for each major EV charging type
- Relied on EVI-Pro Lite for residential & workplace, and PGE customer data for fleet and public charging
- Need more realistic data for different fleet use cases (charge speed, fleet type, etc.)



Locational Impacts at Feeder Level

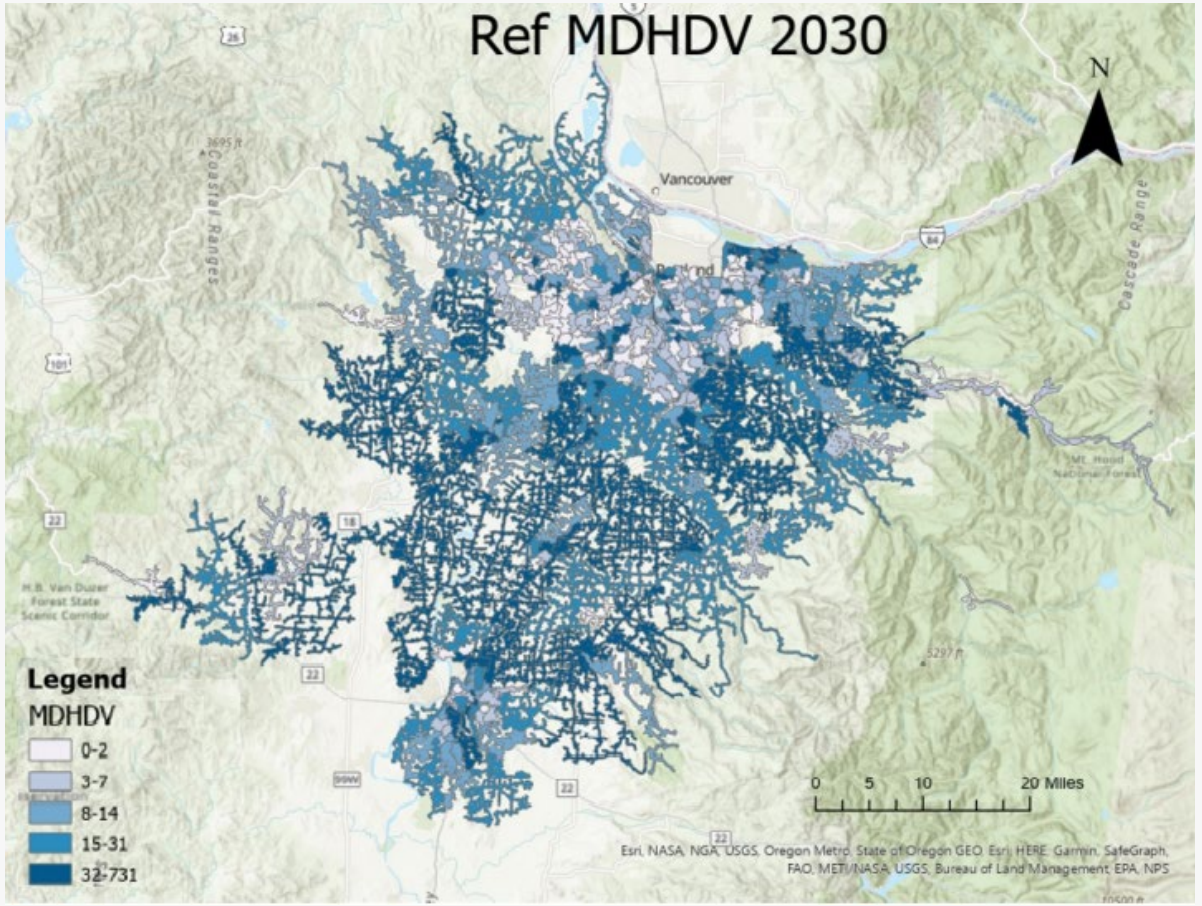
MDHDV penetrations at feeder level

Apply top-down curves for vehicle class from Delphi panel S-Curves

Result driven by combination of:

- DMV fleet data
- Top-down stock turnover modeling
- Known fleet plans

Results in 8760 load shapes and summer/winter coincident peak MW

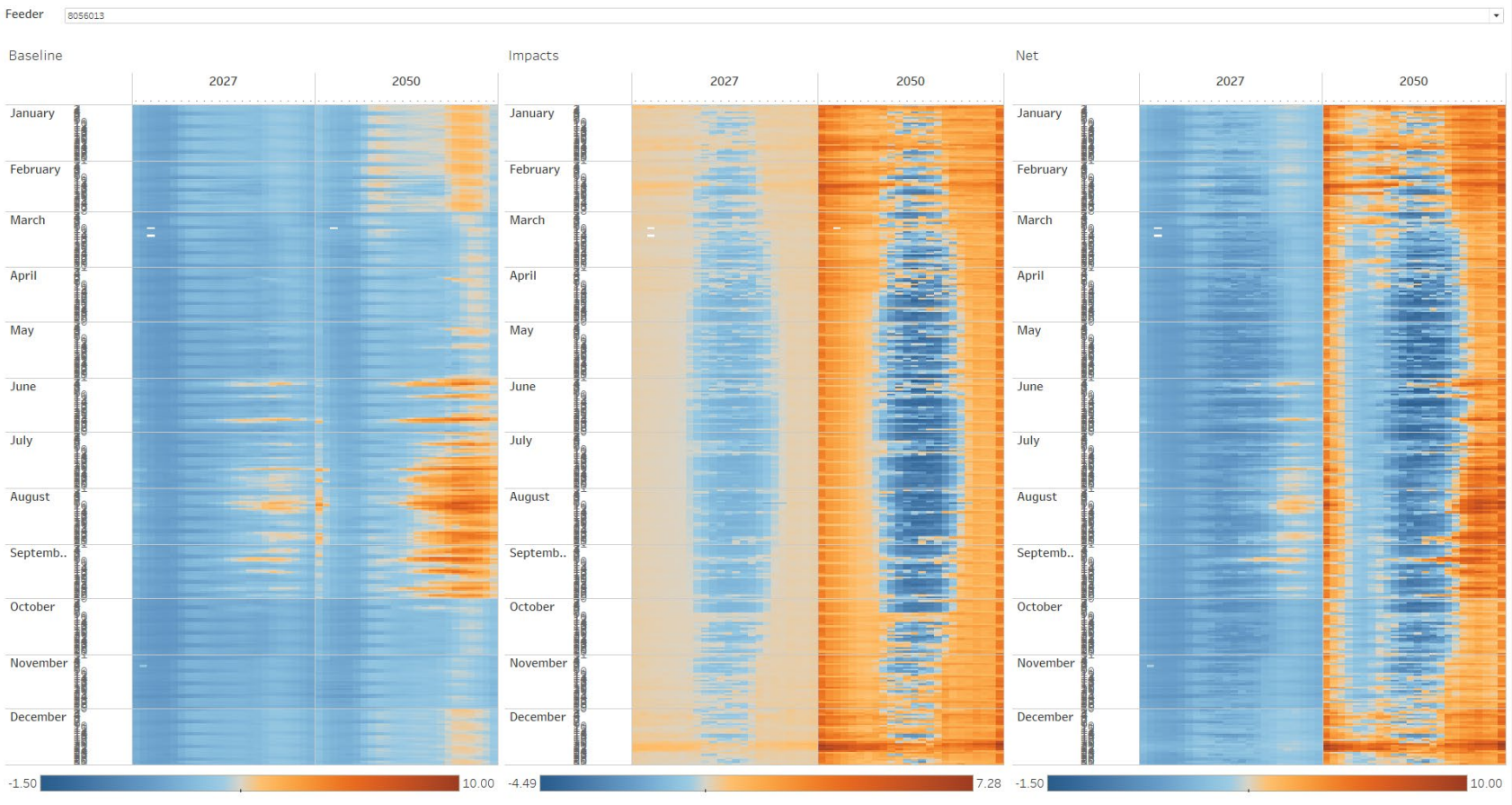


Source: PGE analysis, DSP Part II, Ch 3. Available at: Distribution System Planning Resources & Materials | PGE (portlandgeneral.com)

Baseline, DER, and net load impacts

Chart to the right shows the annual hourly (8760) load at the feeder-level for a feeder in Hillsboro

Baseline load growth (left), DER impact (center), and net load (right) for years 2027 and 2050



Translating forecast into action on T&D side

Distribution Planning Challenges

- High customer interest in electrifying fleets, but low certainty on exact timing
  - PGE's Fleet Partner charging rebate program seen 43 customer applications
  - Applications cover > 21 MW of connected charging load (50 kW – 3.5 MW, 600 kW per site on average)
- Oregon adopted CA Advanced Clean Trucks rule in 2021
  - By 2035 requires ZEV sales increasing from 2024-2035 of:
    - 75% Class 4-8 (non-tractor)
    - 55% Class 2b-3 pickup trucks and vans
    - 40% Class 7-8 tractor trucks
- West Coast Clean Transit Corridor sites – 3.5 MW and 23.5 MW facility loads
- DMV registration data for fleets is not 1:1 with where the vehicles will be charging
  - HQ registrations versus site-level operations, service area boundaries, etc.
  - PGE leveraged DMV dataset due to comprehensive coverage, but need to fill in gaps for MDHDV and fleets specifically

Advancing Locational Planning for TE

- Working to integrate fleet telematics to better ID possible charging hotspots
- Partnership with EPRI to study MDHDV impacts on sample of 200 distribution circuits

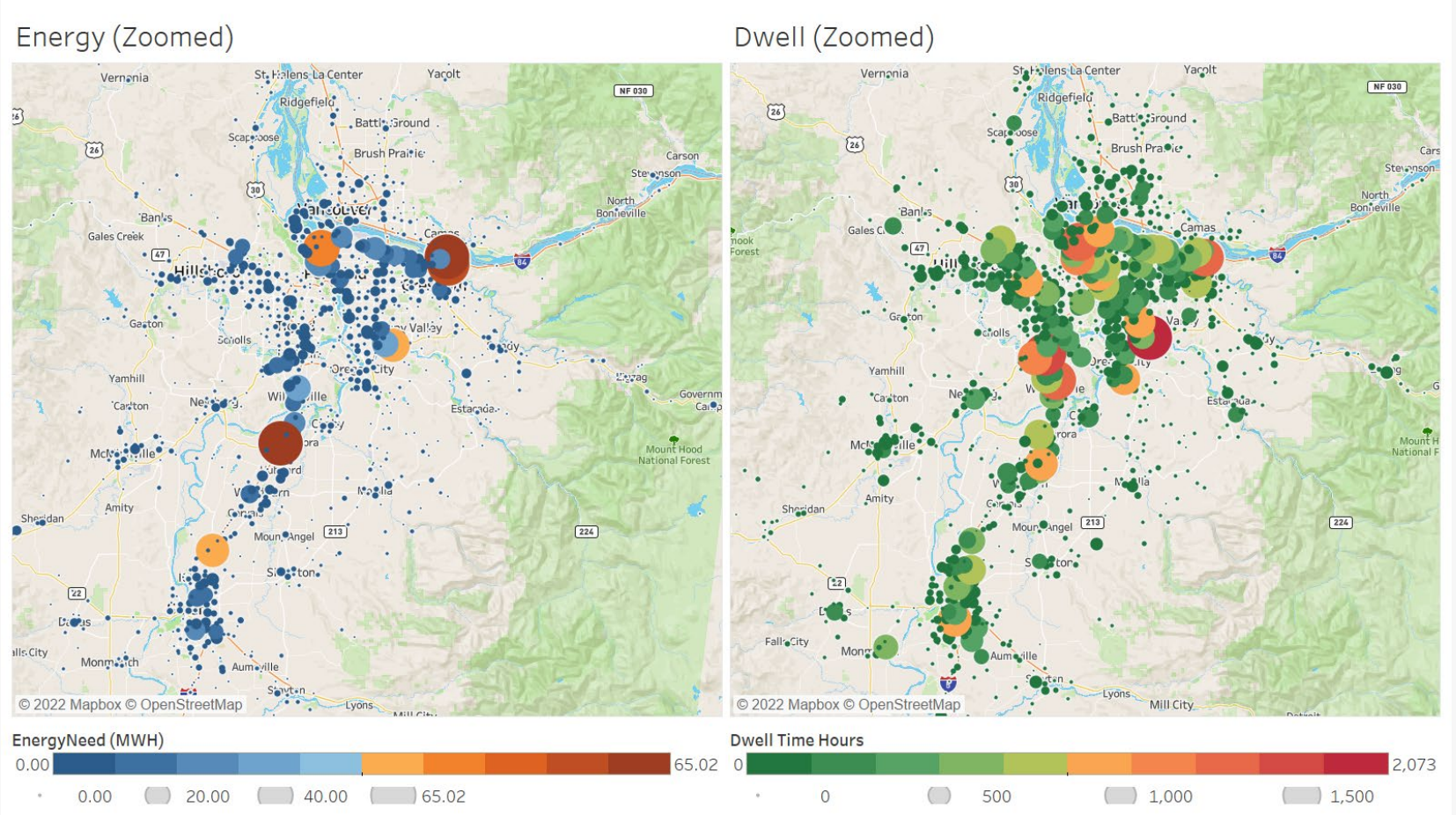


Image and analysis source: EPRI

Regulatory Challenges, Risk & and Uncertainty

- Regulatory challenges related to TE investment framework
  - I.e., "What is the role of the electric utility in accelerating Transportation Electrification"
- Much of the discussion thus far has focused on the role of customer programs
  - Recognition that larger fleet additions can impact distribution investment needs
- "Distribution Infrastructure" identified as appropriate use of utility funds to accelerate EV transition per Oregon Legislation (HB2168)
- Still a lot of uncertainty related to:
  - **Cost allocation** rules **might** need to be updated (but how?)
  - What is the role of non-wire solutions to mitigate EV charging on distribution system?
  - How should utilities consider **forward-looking or "DER-ready"** grid investments to improve hosting capacity for EVs?
  - Cost recovery and prudency risk
- **What is the value of EV managed charging?**
  - How will customer charging behavior respond to price signals?
  - What kind of tariffs and programs are needed?
  - How will changes in vehicle and charging technology impact future load shape?

An

Oregon

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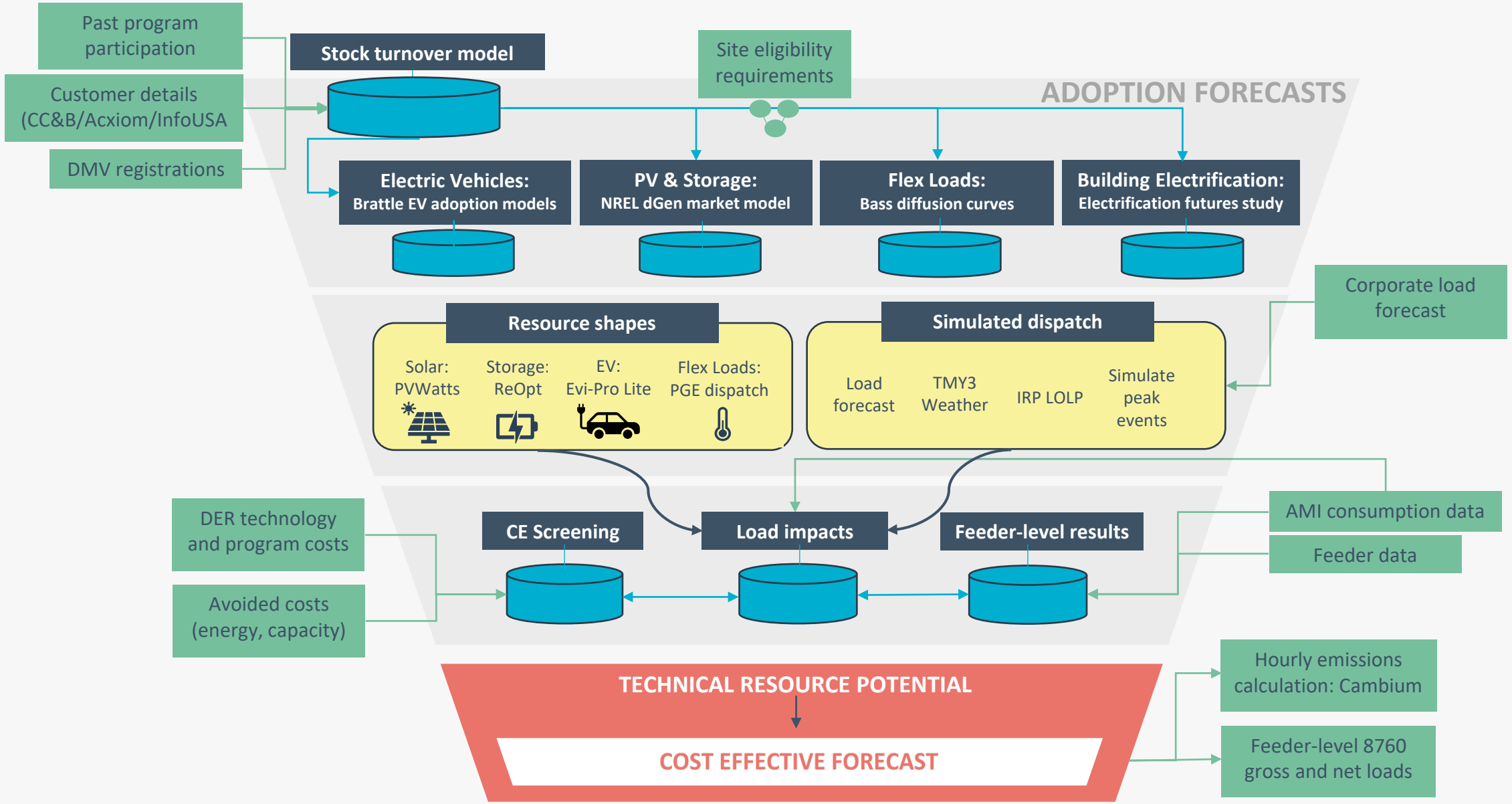
kind of energy

Thank you.

Contact: Andy.eiden@pgn.com

AdopDER Flow Diagram



Modeling Electric Vehicles

- **Light-duty vehicles (LDV)**
  - Regression-based approach formulated on:
    - EV purchase price incentives
    - Relative price of electricity versus gasoline
    - State policies that are favorable to transportation electrification
    - Battery costs
    - High Occupancy Vehicle (HOV) lane access (combined with traffic density)
    - Vehicle model availability*
    - Range anxiety / charger coverage*
- **Medium- and Heavy-duty vehicle (MDHDV)**
  - Multi-round expert panel (Delphi approach) to estimate market adoption for short/medium/long term
  - Outputs fit to Bass diffusion using historical IHS Markit data and customer insights
- **EV charging requirements**
  - Using NREL's EVI-Pro Lite tool to analyze charging requirements of expected EV adoption

* Note: out of model adjustments

Distribution planning current practice

System-wide load updates occur annually in April, and informs continuous planning efforts to monitor new load requests, local developments, etc.

Planners track and integrate a variety of information that informs locational load growth assumptions, including:

- Local building permit activity
- Zoning policy changes
- New service requests
- Existing customer expansion plans

Bottom-up load additions tracked and associated with existing equipment that could serve the load

- If new load growth would exceed existing capacity, we investigate options to reconfigure the loading on existing equipment to reliably accommodate the new load
- Potentially would initiate a new project to add system capacity

Current load growth disaggregation

Currently, we calibrate the **corporate load forecast** to the historic trends and past peak loads of each substation, adjusting for any known customer additions.

After accounting for **known/anticipated customer growth**, we allocate the remaining top-down load growth from the corporate load forecast on a proportional basis according to a 5-year historical trend of load growth on each feeder.

We are currently **reviewing** this **process** and aiming **to make some improvements** that increase our accuracy and ability to pair the expected load growth with a granular DER forecast.

Key updates we are working through:

- Improving the characterization of bottom-up known load additions to capture customer segment, and number of new customers (e.g., assigning 8760 load shapes to residential versus just peak MW)
- Calibrating growth from corporate load forecast based on specific customer mix on each feeder, as opposed to evenly across all feeders
- Adding weather normalization to the disaggregated load forecast to enhance ability to test constraints and potential solutions weather-based planning scenarios

Example of top-down calibration

Key improvement here is to **establish connection** between granular, revenue-class level forecast at Corporate load forecast level, with the bottom-up known additions captured by distribution planning

In the past, we were looking at peak MW added to the distribution system and did not capture 8760 new load additions (didn't need to)

- New process is moving towards an integrated approach with the DER forecast
- We assign new known customer additions in AdopDER specific to each feeder
- Spread the remainder of top-down customer forecast proportionally across other feeders

Illustration of Spot Load Allocation