

Planning for new loads

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NARUC/NASEO Comprehensive Electricity Planning Initiative for Load Growth

June 3, 2025

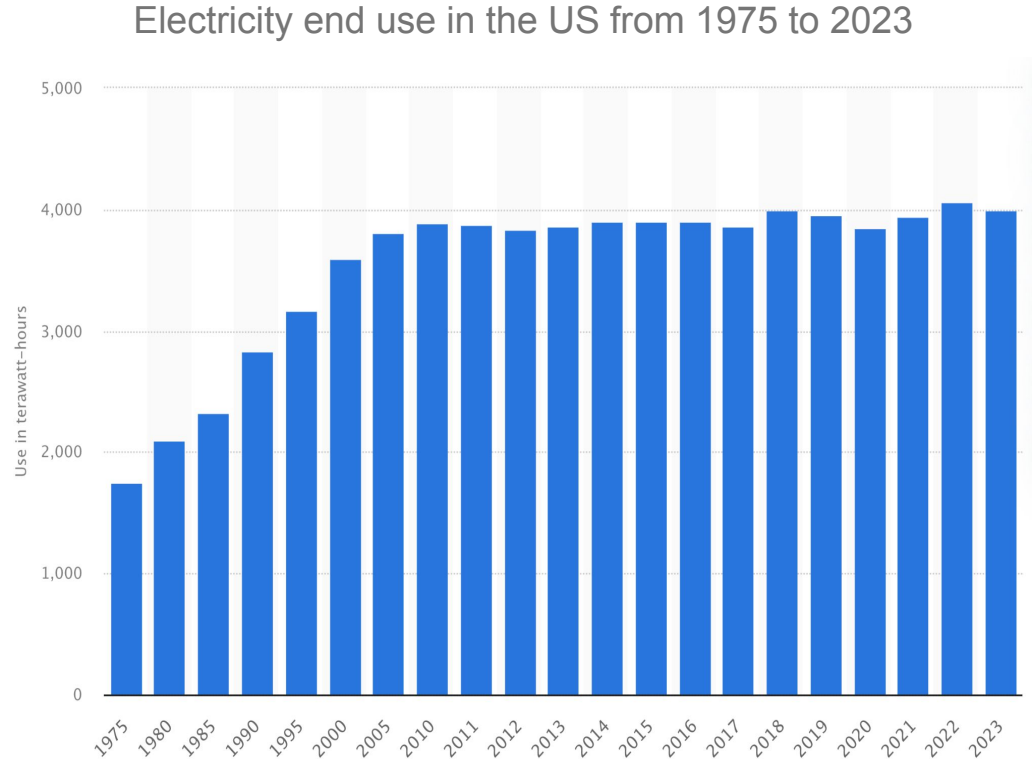
kevala⁺

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Context - Electricity Consumption Since 1975

- **US demand** has been **flat** for the past 20 years
- Load growth is returning (2% YoY growth in 2024, per [EIA](#))
- New loads tend to be:
 - Clustered
 - Controllable
 - Policy sensitive

What can we reasonably expect from utilities to plan for these new loads?



Context - Why Proper Planning for DERs Is Important

Rate Design

DERs provide a unique opportunity to drive customer behavior with complementary price signals

Distribution System Planning

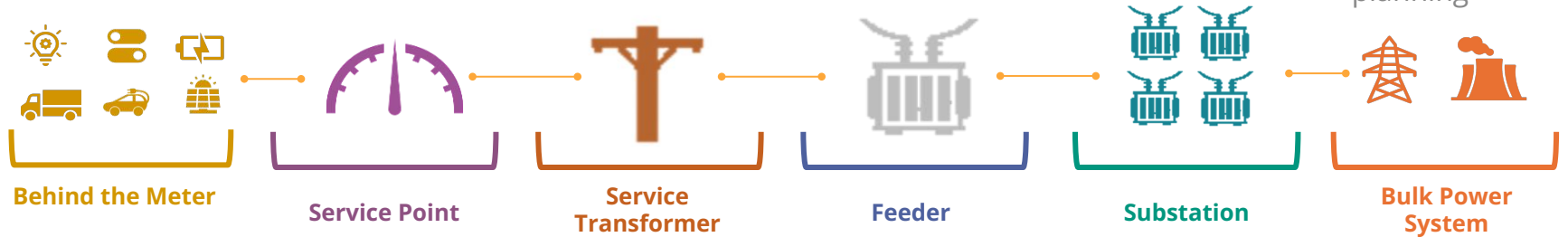
DER clustering impacts hosting capacity and upgrade needs

Transmission Planning

DERs shift load shapes, which can both relieve and cause system constraints

Integrated Resource Planning

DERs act as both load modifiers and resource alternatives, adding complexity to resource planning



DERs are generally adopted behind-the-meter, but impact every level of grid planning

Context - Load Forecasting vs DG Forecasting

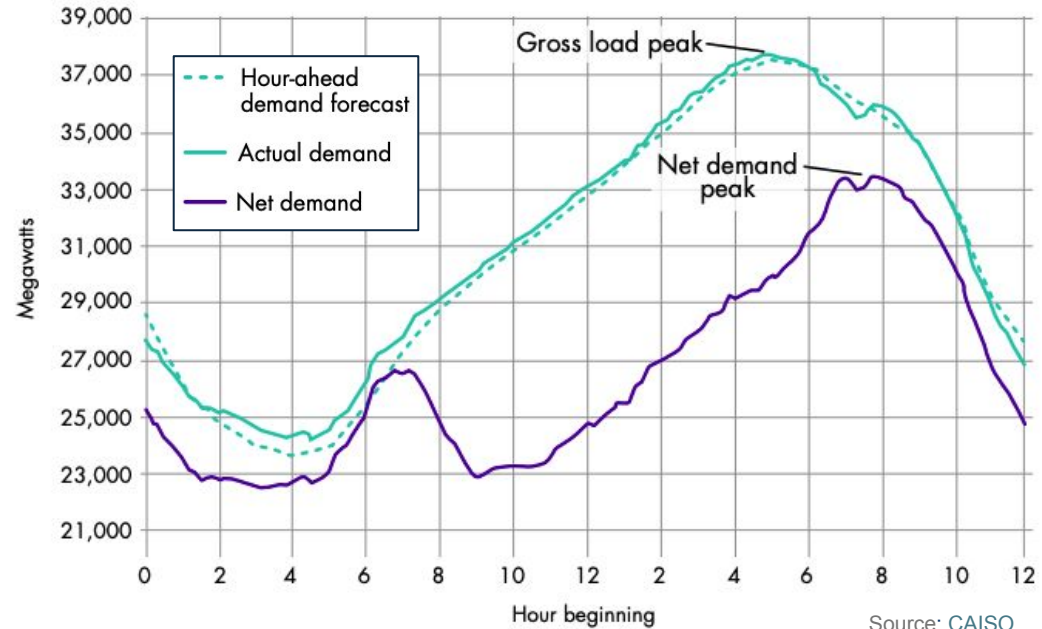
Load forecasts

- Traditional techniques rely on extrapolating **historic load**, and do not directly account for DERs and DG
- It is common for load forecasts to **normalize for weather** and account for some year-on-year **% load growth**

DG & DER forecasts

- Techniques vary significantly depending on data availability, use case and modelling sophistication (more info in this [NREL forecasting primer](#))
- NREL's [dGen](#) and [PVWatts](#) are commonly used tools for DG forecasting

Example: ISO N.E. forecasts [DG](#) independently from base [load](#)



Source: [CAISO](#)

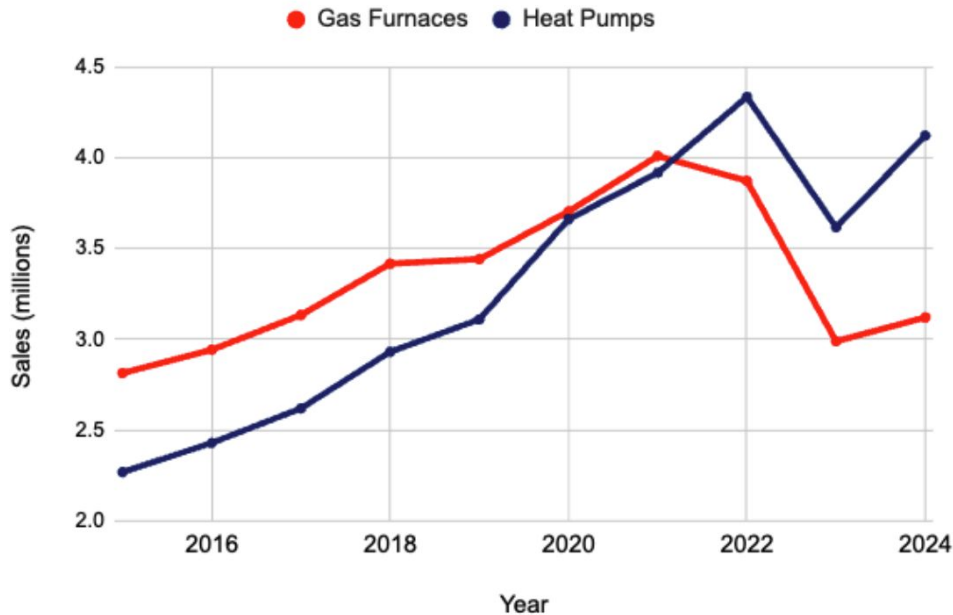
DG does not participate in wholesale markets, but can significantly reduce the system load observed by utilities / ISOs

DERs are Reshaping the Grid

- **How** are utilities preparing for new loads?
 - Rates of technology adoption
 - Policy drivers
 - Hosting capacity constraints
- **Where & when** will new loads pop up?
 - Sizing
 - Timing & magnitude of peak load
 - Weather effects



Heat Pumps — Adoption Trends



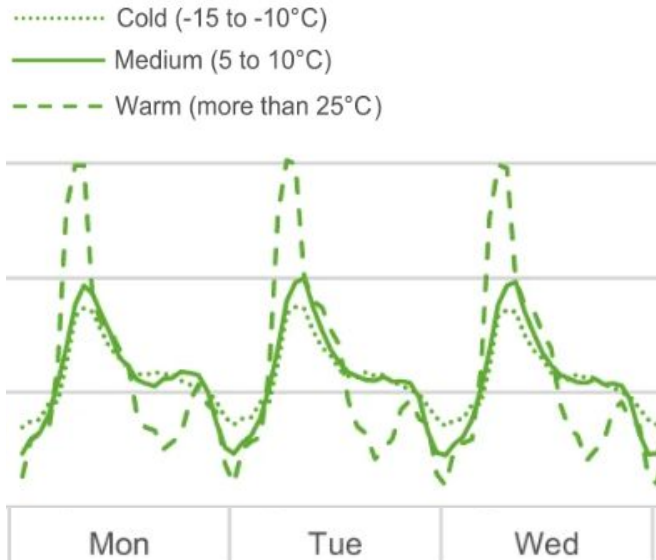
Heat pumps are outselling gas furnaces in the US

Source: [RMI](#)

Questions to consider:

- What set of technologies are being forecast?
 - Residential & commercial?
 - Cold climate?
 - Air & ground source?
 - Water heaters?
- What policy scenarios are being accounted for?
 - Federal, state & local level — e.g. [Comfort365](#) in Boulder CO
- In what way(s) are these policy scenarios reflected in the forecast(s)?
- Where are heat pumps being modeled for adoption?

Heat Pumps — Load Curves (1)



HP load is highly responsive to temperature & time of day

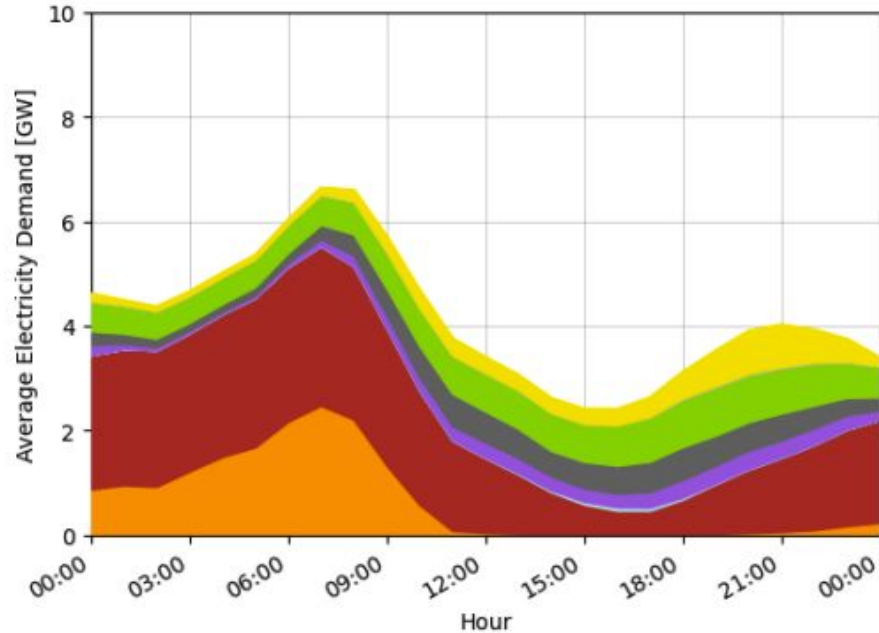
Questions to consider:

- What kind of model is being used to forecast load curves?
 - What are the inputs to the model?
 - How has the model been validated?
- What types of behavior are being considered?
 - “Unmanaged” vs “managed” (e.g VPPs)
 - Impact of energy-efficiency retrofits
- What weather scenarios are being considered?
 - Typical vs extreme weather conditions
 - How granular are the weather data?

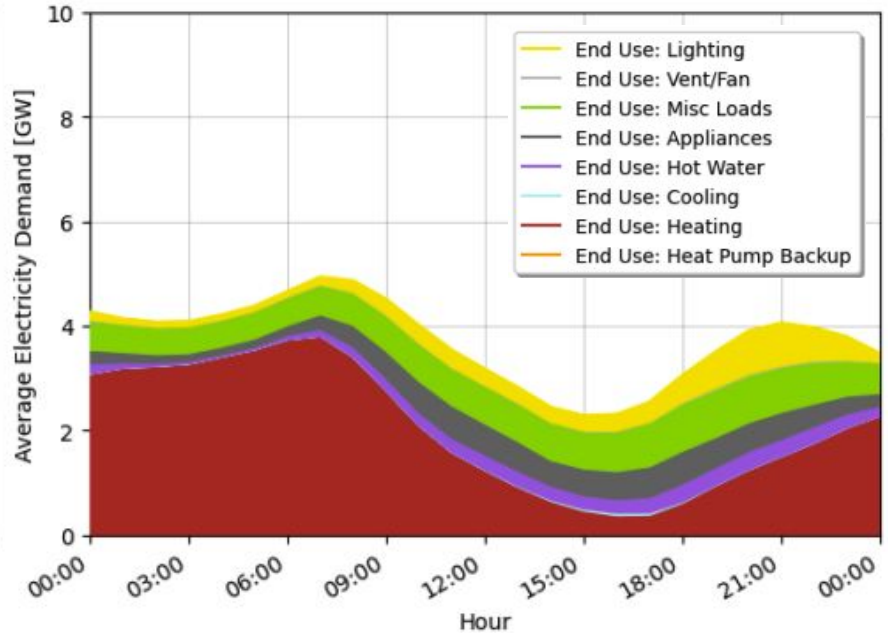
Heat Pumps — Load Curves (2)

February Residential Electricity Demand Forecast — Colorado

Standard Air Source Heat Pump



High Efficiency Cold-Climate Heat Pump



Heat Pumps — Impacts

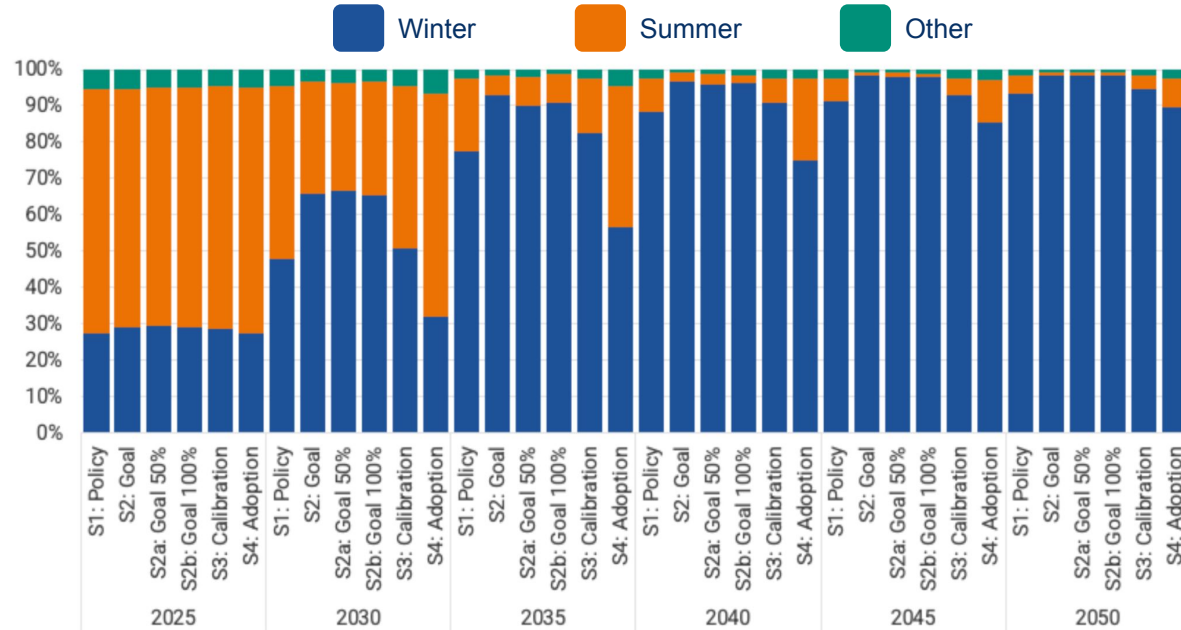
Kevala study in Colorado

Heat pump adoptions shift systemwide peak from summer to winter by the 2030s

Studies are consistently finding winter peaking challenges due to heat pump adoption, for example:

- [IEA](#), also investigates the benefits of EE retrofits
- [PNNL](#), also investigates the benefits of high-efficiency technologies

Percentage of Feeder Peaks by Season

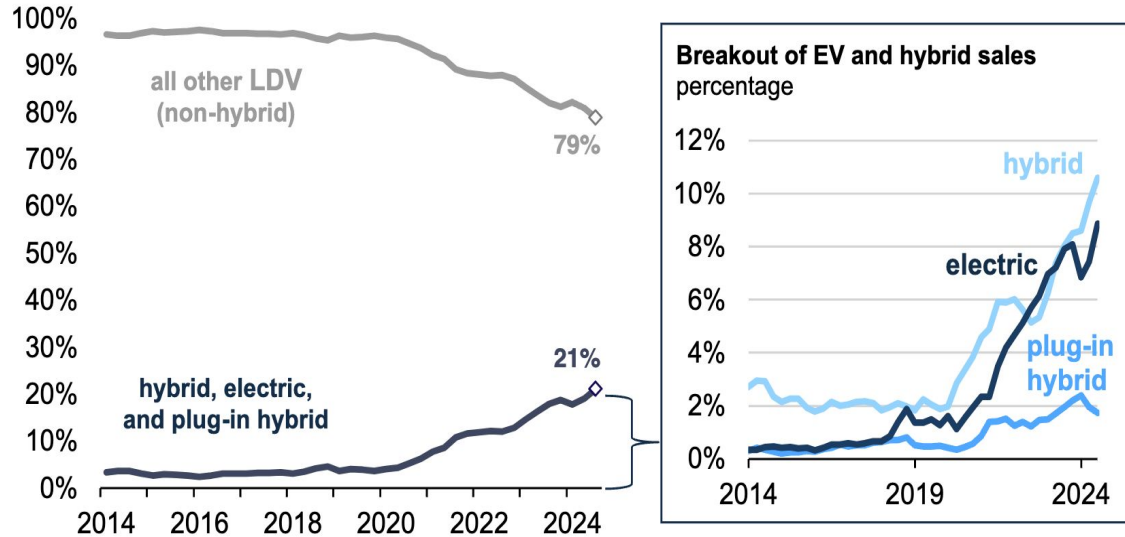


Full report [here](#)

Filing Materials → Attachment ZDP-1 (PDF)

EV & EVSE — Adoption Trends

Quarterly U.S. light-duty vehicle (LDV) sales by powertrain (Jan 2014-Sept 2024)
percentage of sales



Source: [EIA](#)

In 2024, plug-in vehicles accounted for 10% of all light-duty vehicle sales in the U.S.

Questions to consider:

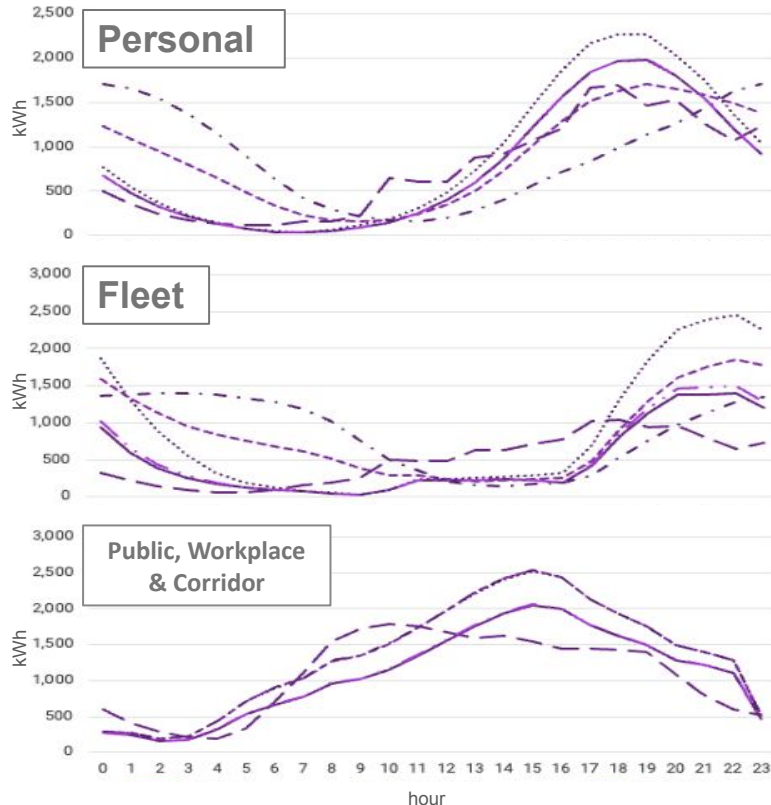
- What set of EVs & EVSE are being forecast?
 - Personal & fleet EVs?
 - Public charging?
 - Level 1, level 2 and DCFC?

- How are the proportions of different EVs and EVSE being determined?

- What policy scenarios are being accounted for?
 - [NEVI program](#)
 - [\\$7500 federal tax credit](#)

- Where are EVs being modeled for adoption?

EVSE Behavior — Load Curves (1)



Source: [Kevala, XCEL DSP](#)

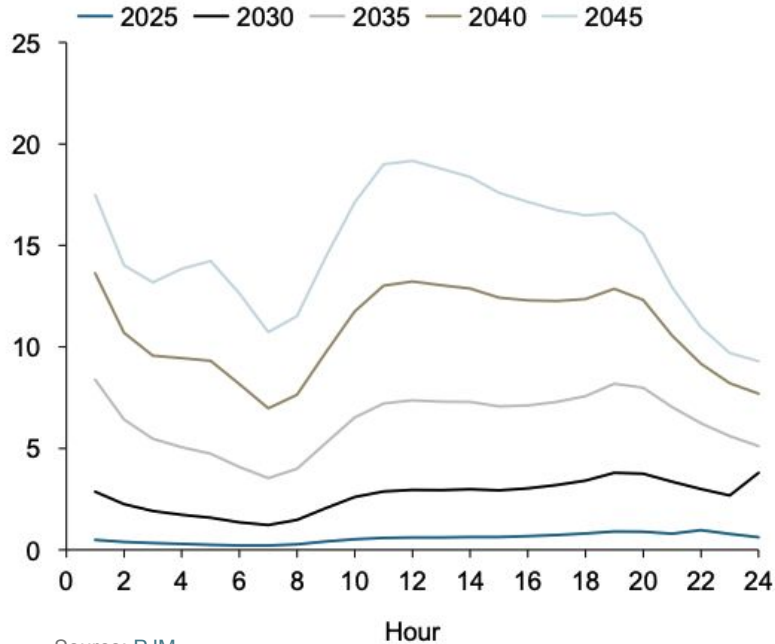
EV load shapes vary significantly by **use case, policies & incentives** (e.g TOU rates, managed charging)

Questions to consider:

- What kind of model is being used to forecast behavior?
 - What are the inputs to this model?
 - How was the model validated?
- What behaviors are being considered
 - Unmanaged vs managed charging?
 - Vehicle-to-grid?
- What weather scenarios are being considered?

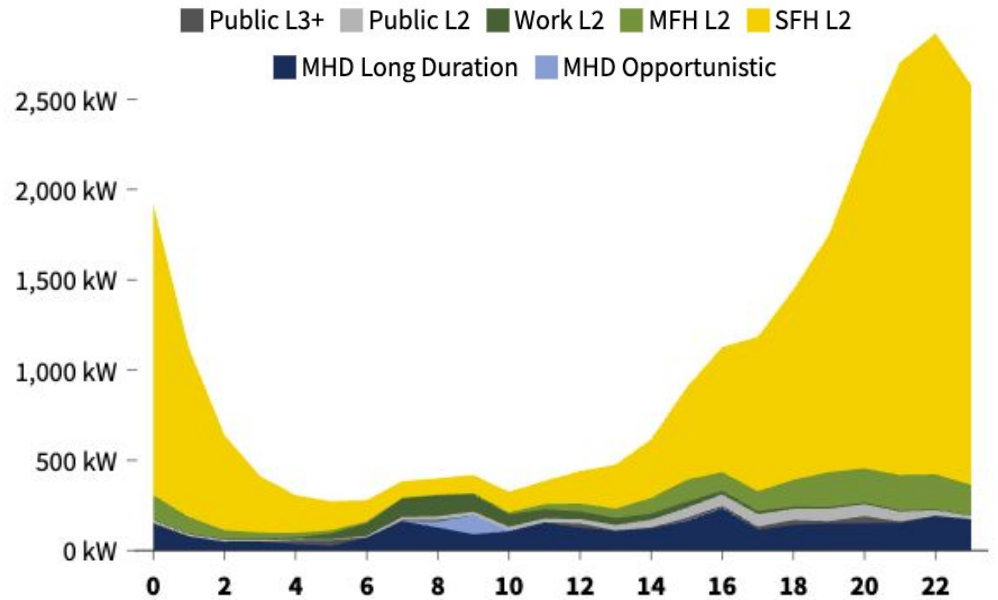
EVSE Behavior — Load Curves (2)

Heavily Managed
Average EV Load (GW) Per Hour - PJM



Source: [PJM](#)

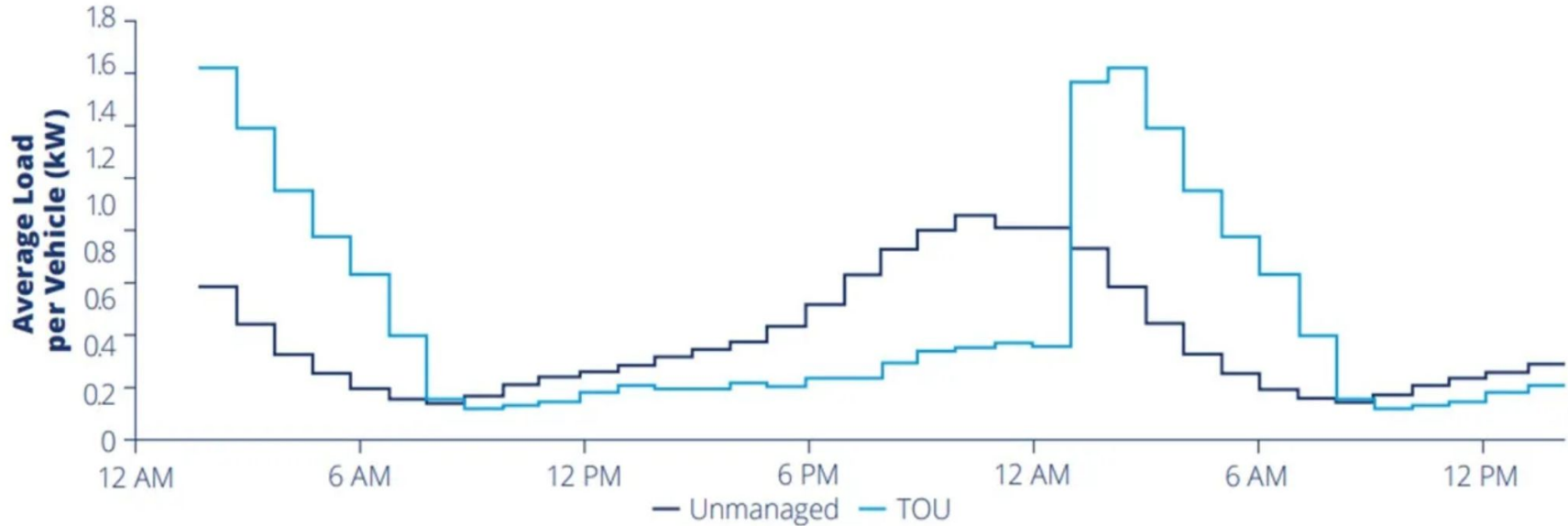
Fully Unmanaged
Average EV Load (2035) - National Grid, NY



Source: [RMI, National Grid](#)

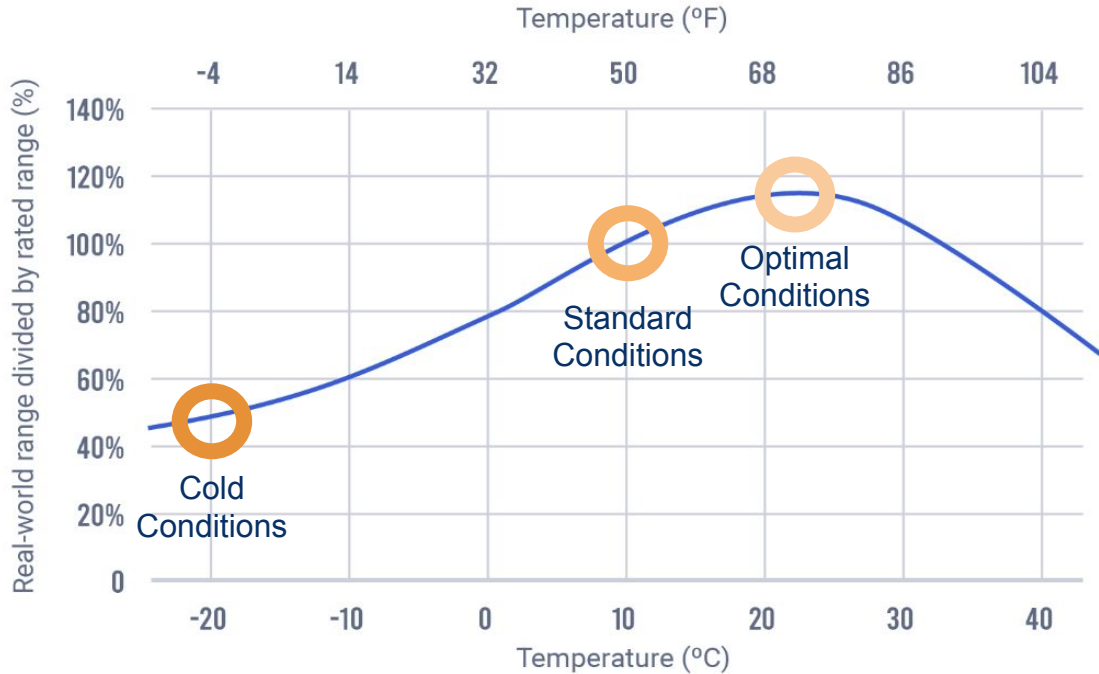
EVSE Behavior — Managed Charging

Average Load per Vehicle (Bulk Level)

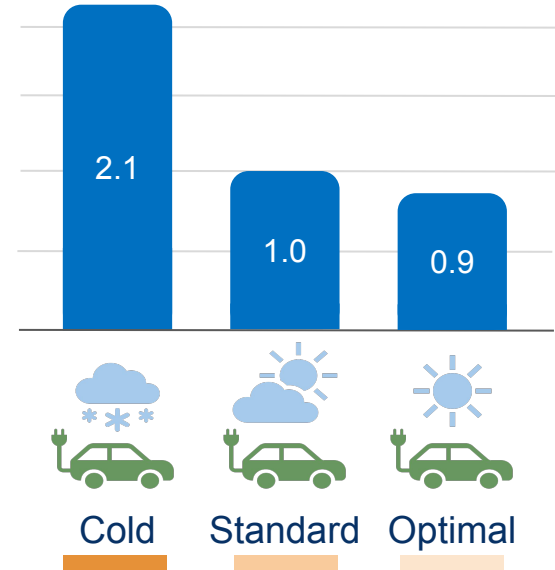


EVSE Behavior — Impact of Temperature

Real-world range vs. rated range



Units of Energy Used To Travel 1 Mile



Source: [GeoTab](#)

Leading Practices for DER Planning



Granular Forecasting of DER Adoption

Forecasts must account for **where** and **when** DERs will be adopted, as well as the **timing** and **magnitude** of their associated load.

DERs are not adopted evenly. **Clusters** can cause major grid impacts even with **low adoption rates**.

Examples:
[Eversource \(MA\)](#)
[XCEL \(CO\)](#) [Ameren \(IL\)](#)



Data Access & Sharing

Improved data access can **streamline** stakeholder assessments of grid plans and help project developers make **more informed** siting decisions.

“*Data*” here could include hosting capacity (HC) maps, interconnection queue (IQ) and even entire load/DER forecasts.

Examples:
[ConEd HC map \(NY\)](#) [National Grid HC map \(NY\)](#) [Hawaiian Electric IQ](#), [PG&E GRIP \(CA\)](#)



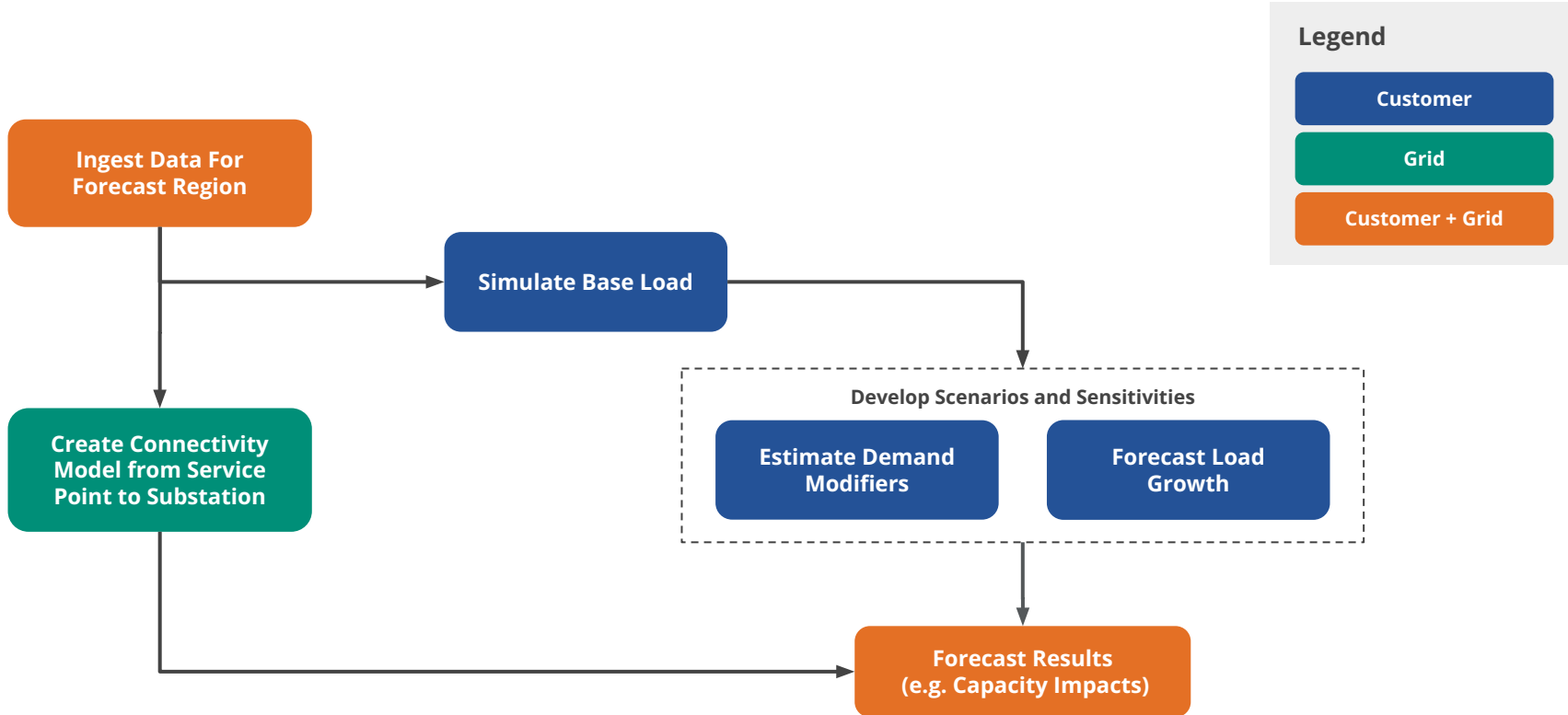
Scenario & Probabilistic Analyses

Utilities should assess a **variety of future conditions** in grid plans to support more **robust decision making**.

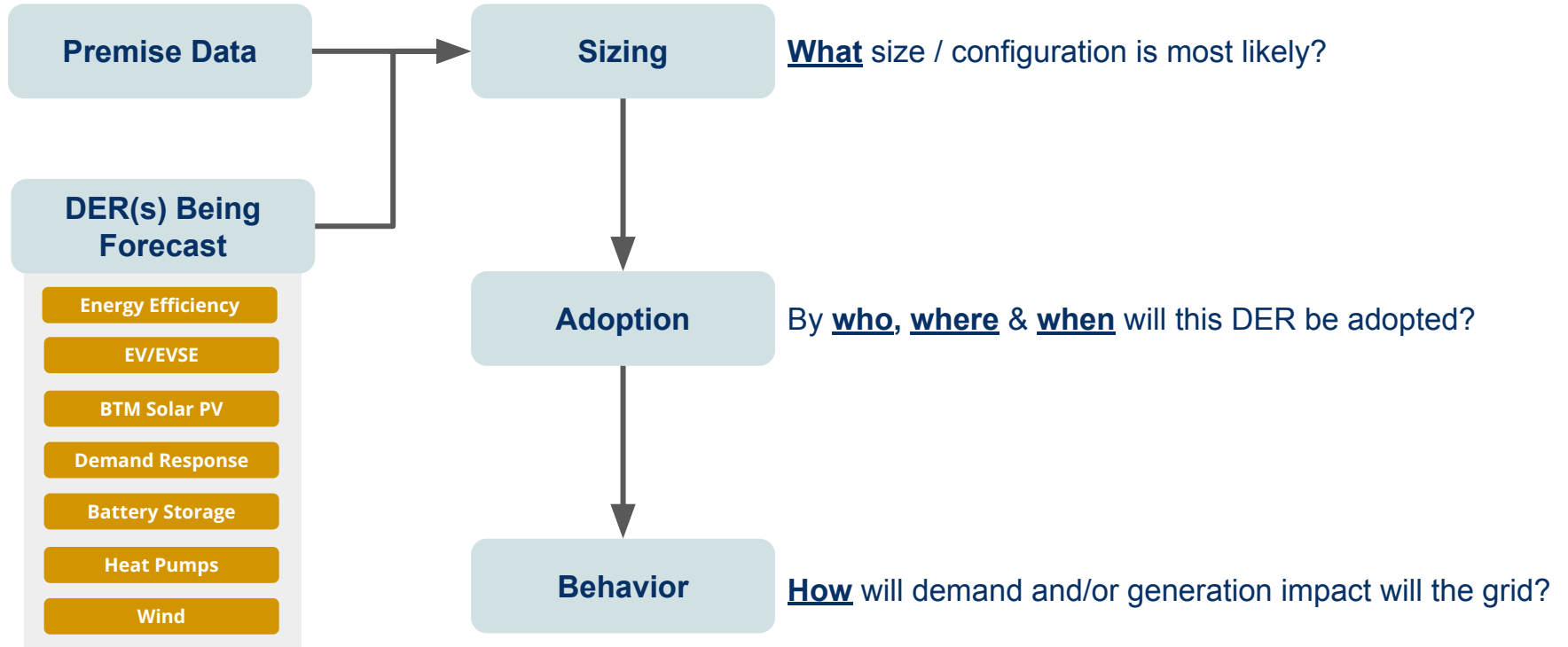
Deterministic planning can **underestimate future risk** and miss opportunities to **optimize** for **resilience** and **affordability**.

Examples:
[National Grid DSIP \(NY\)](#), [CPUC Electrification Impacts Study \(CA\)](#)

Bottom Up Forecasting — Process



Bottom Up Forecasting — DERs



Actions States Can Take

Public Utility Commissions

- Provide guidance to ensure utility DER forecasts include **scenarios** which are aligned with **state policy goals**, including **electrification targets** and **emissions reductions**.
- Consider requiring utilities to publish transparent and regularly updated data including **hosting capacity maps** and **interconnection queues**.
- Ensure forecasts are reasonable, including filing and review of **forecasting error metrics** and supporting **stakeholder participation** in reviewing forecasting methods, assumptions, and inputs.

State energy offices, utility consumer advocates and other stakeholders

- Actively participate in technical meetings & regulatory proceedings to ensure DER planning reflects **state policy priorities** and **customer needs**.
- Support **public education** efforts to raise awareness of the **impacts**, including the **benefits**, of DERs.
- Provide feedback on the usefulness of provided **interconnection tools**, **educational materials**, and **data sets**.
- Advocate for **interpretable forecasting methodologies** and **open access** to forecasting assumptions, methods, and results.

Additional Questions States Can Ask

- **Which DERs** are accounted for in your forecast?
- At what level of **resolution** are you forecasting DERs?
- How are you determining **when** & **where** DERs will be adopted?
- How do you determine the **load profiles** of new DERs?
- Do you perform a **single point forecast**, or do you consider a range of **scenarios** and **probabilistic methods** to determine future needs?
- How do you account for **weather data** in your forecast?
 - Does your weather data account for impacts due to climate change?
 - Do you use **typical** or **extreme weather** in your forecast?
- What **data** do you use to develop your assumptions?
- What **policy scenarios** & **incentives** are considered?

Reading List & Additional Resources

Forecasting Methodology References

- [NREL Electricity Modeling Guide](#): a great general primer on load forecasting
- [Eversource \(MA\)](#): advanced modeling used for demand forecasting
- [Ameren \(IL\)](#): modelling for an integrated grid Plan
- [California PUC Study](#): modelling for large scale system upgrade requirements
- [XCEL \(CO\)](#): modeling for distribution system plan (Filing Materials → Attachment ZDP-1)

Exemplar Data Sources

- [PG&E GRIP Portal \(CA\)](#): data and forecast results to support DER planning
- [ConEd Hosting Capacity Map \(NY\)](#): public data on DER hosting limits by feeder and substation
- [National Grid System Data Portal \(NY\)](#): hosting capacity & interconnection queue data
- [Hawaiian Interconnection Queue Portal](#): a variety of data including interconnection queues

DER Impact

Heat pumps:

- [ACEEE Guide to Building Electrification](#)
- [The Economics of Electrifying Buildings \(RMI\)](#)
- NREL [ResStock](#) & [ComStock](#) documentation
(these notes are more technical)

EVs:

- [CEC AB 2127 Report \(Executive Summary\)](#)
- [PJM Electric Vehicle Charging Power Demand Forecast](#)
- [GeoTab study: Impact of Temperature on EV range](#)

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