Behind-the-meter PV and Storage Adoption

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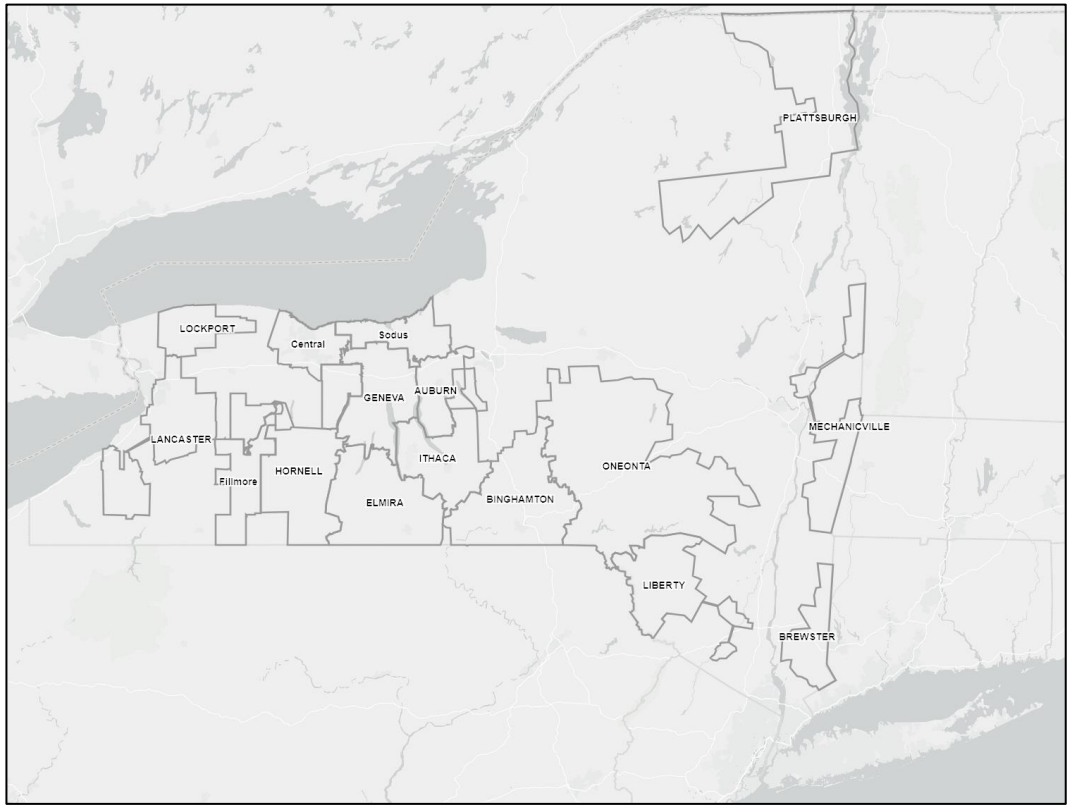
Energy Systems Researcher
Clean Power Research

6/14/2023

Clean Power Research®

Big picture: understand load

Spatially | Temporally



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Images from NYSEG/RGE PV Hosting Capacity maps:
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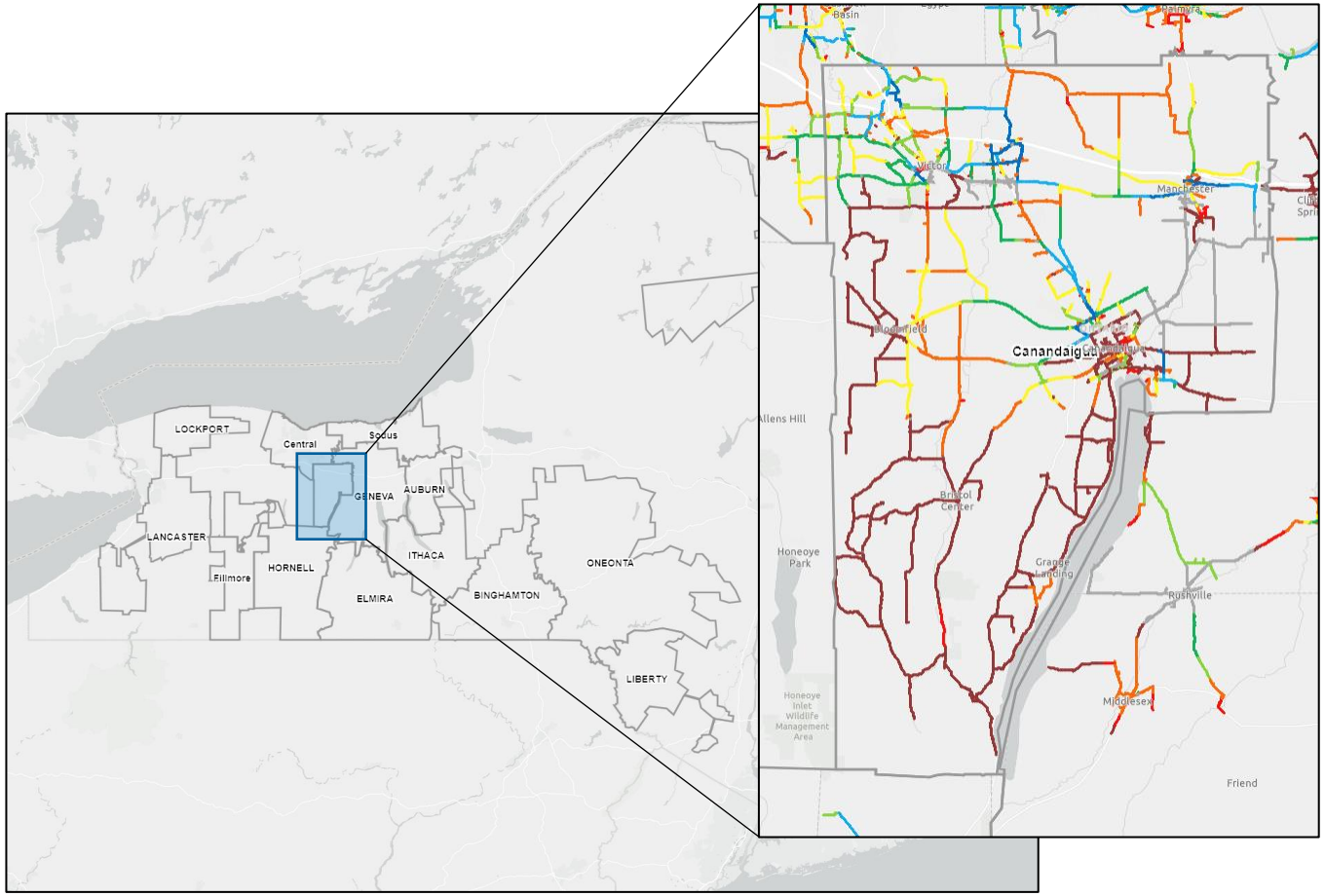

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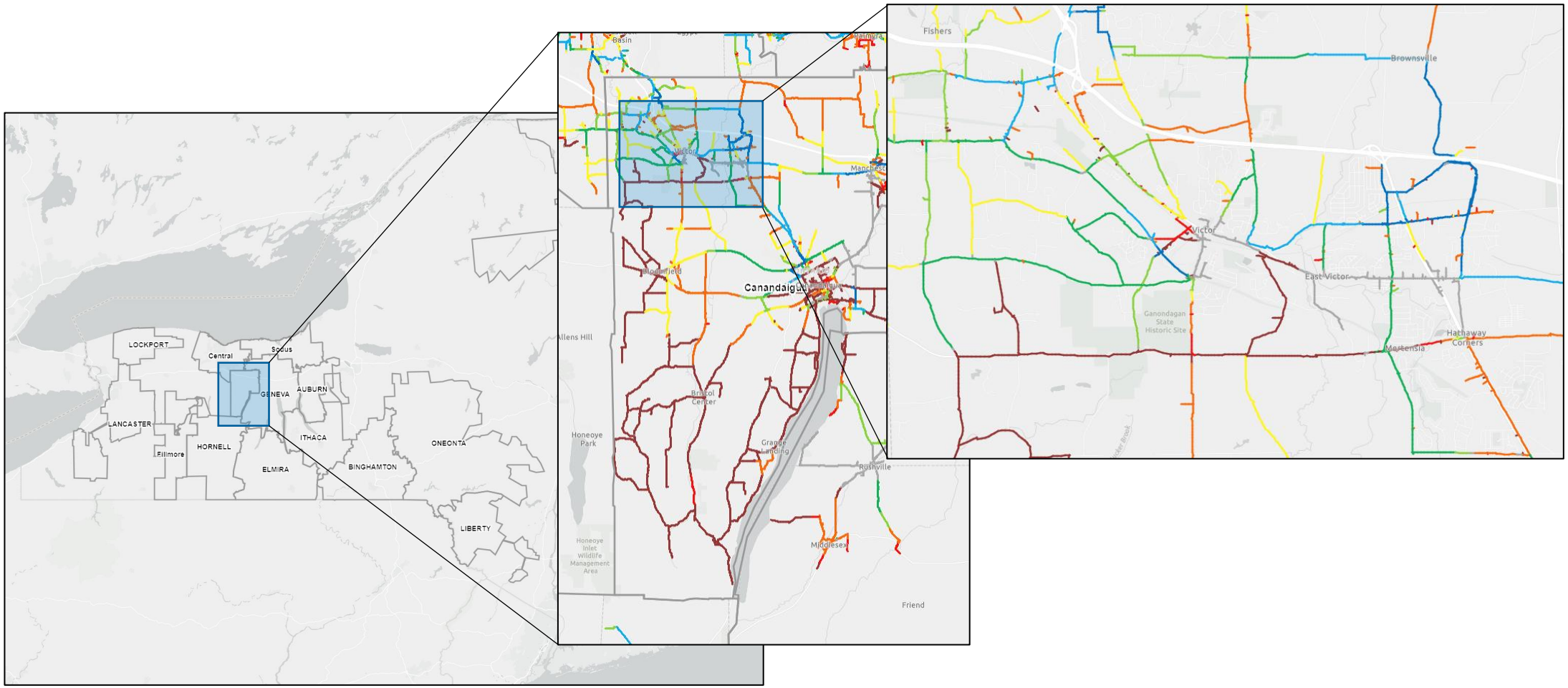

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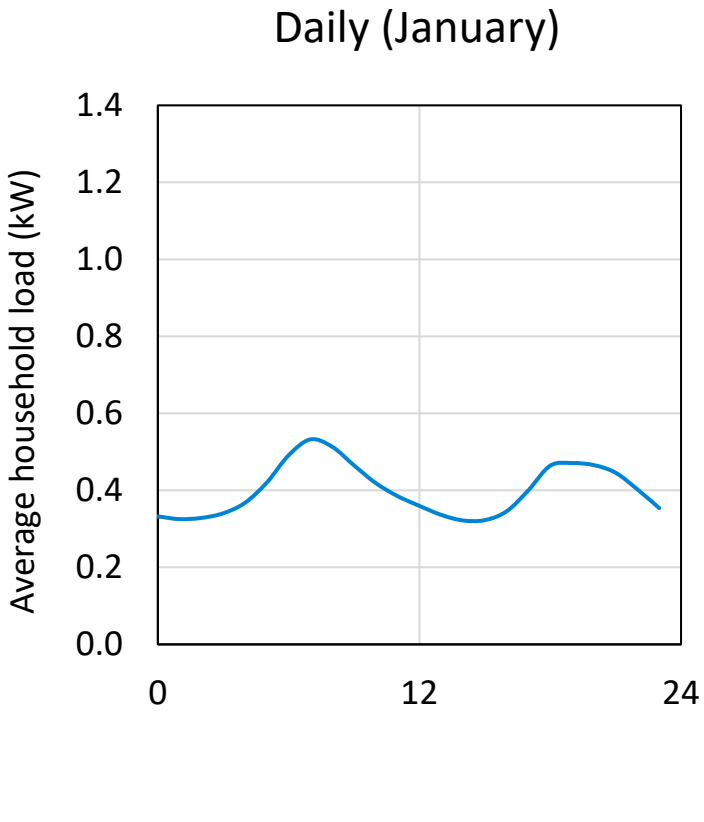

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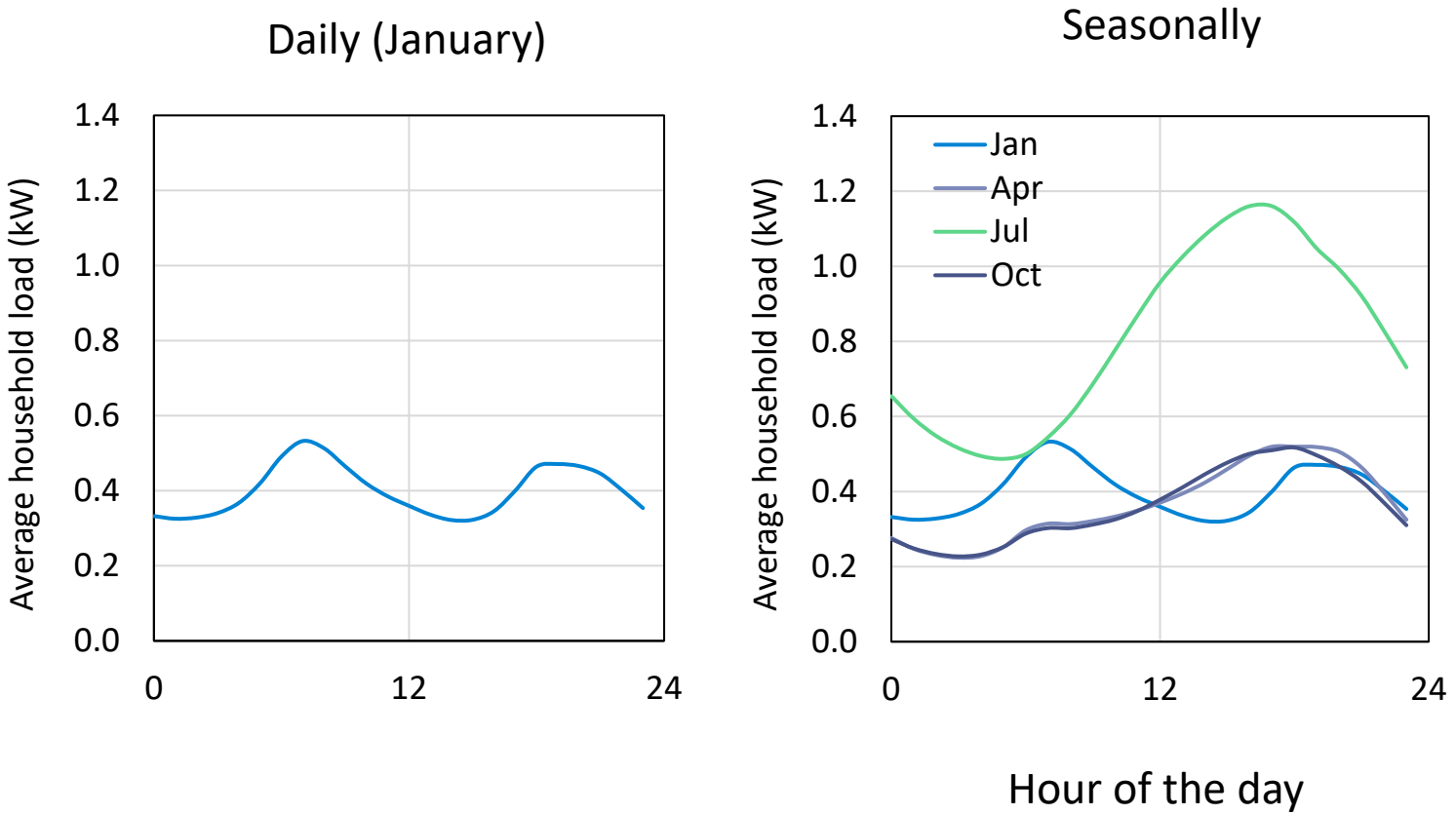

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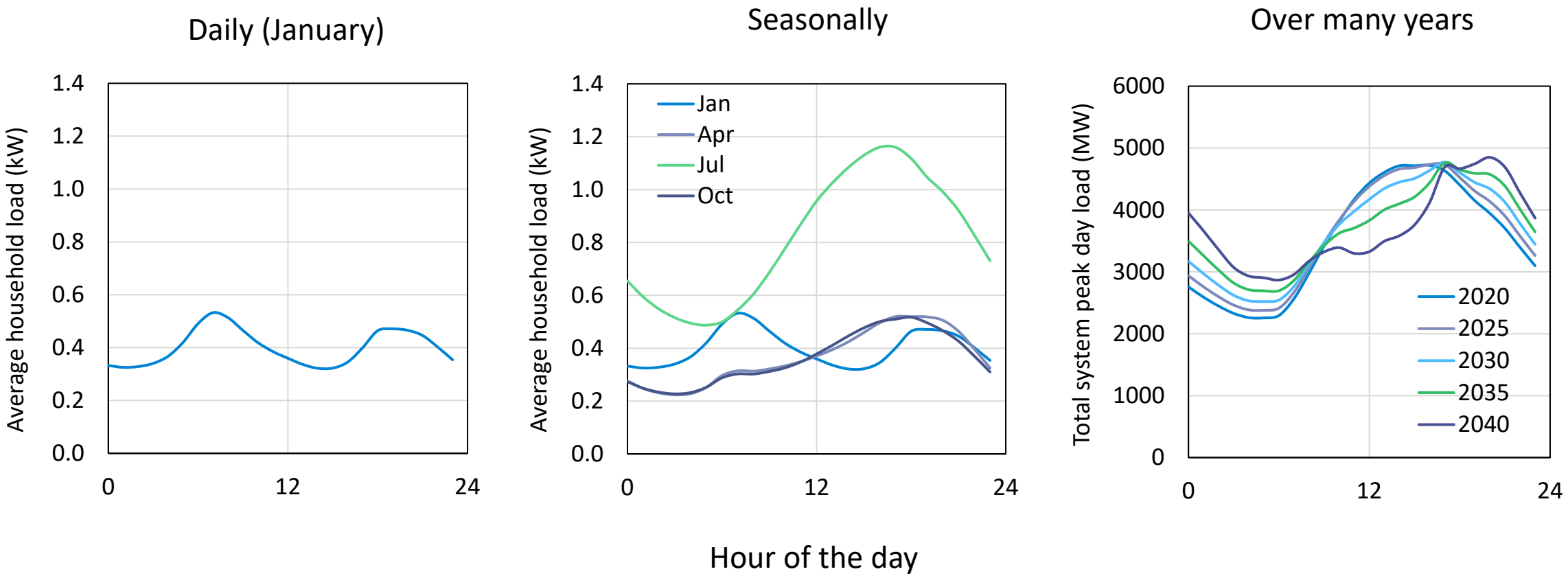

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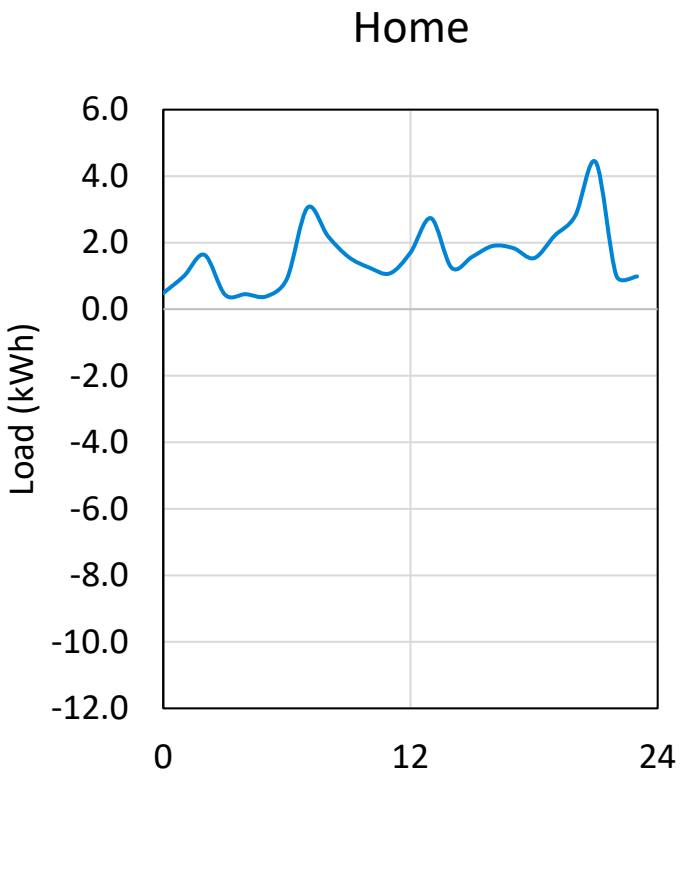
The effects of solar and storage

Individual home load effects



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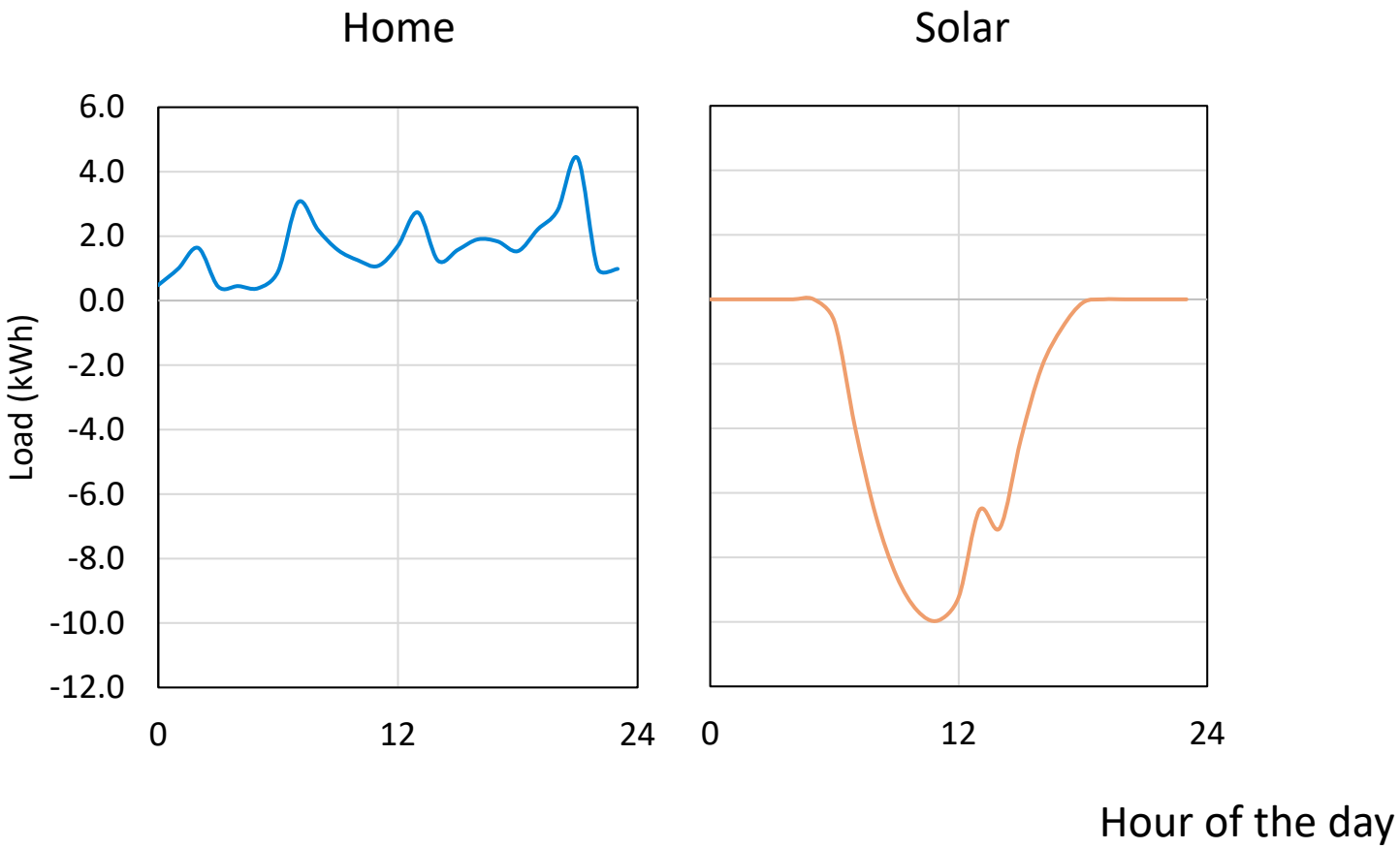

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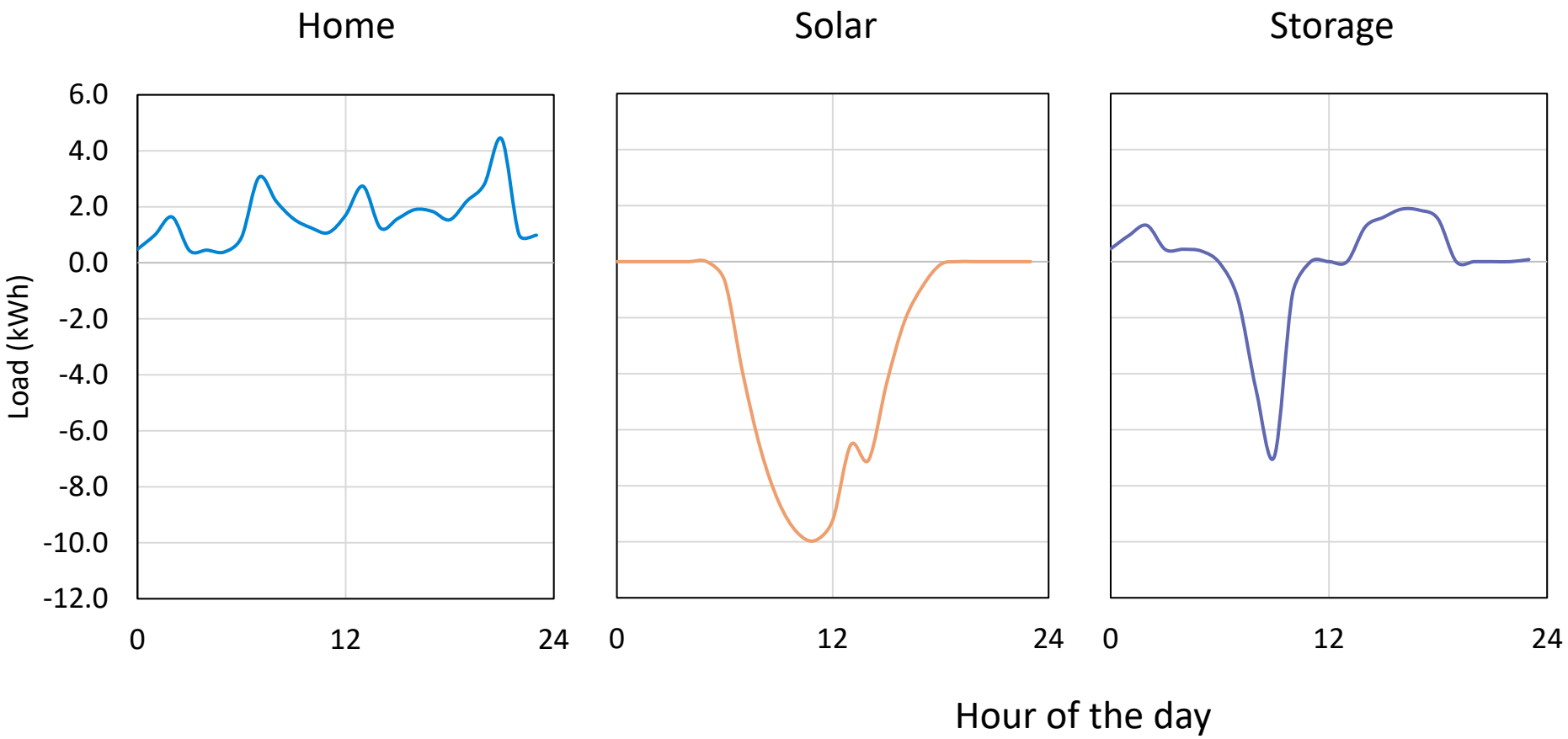

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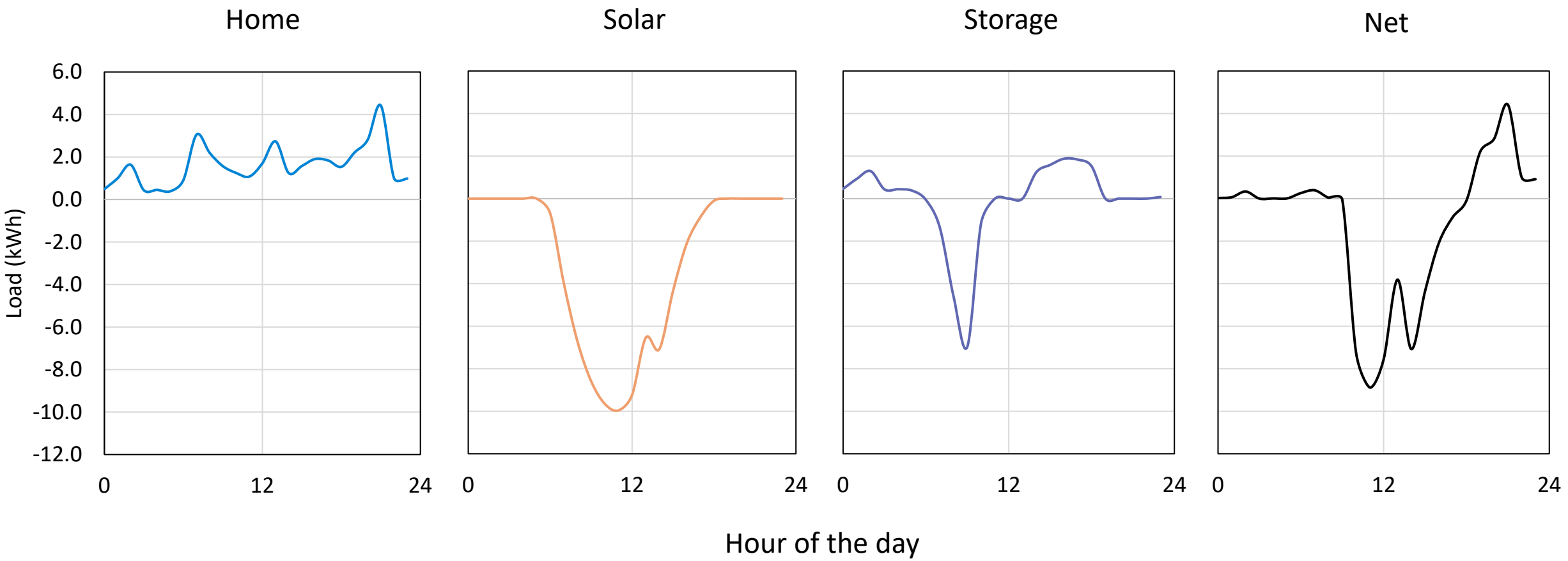
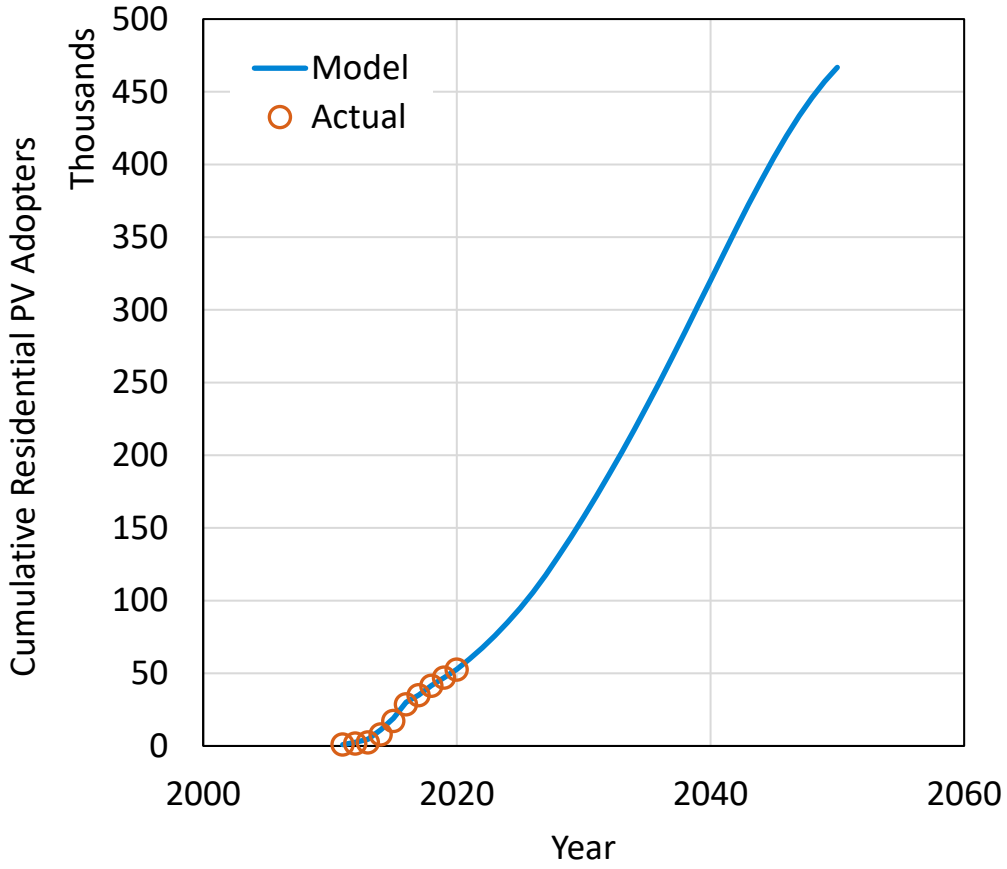
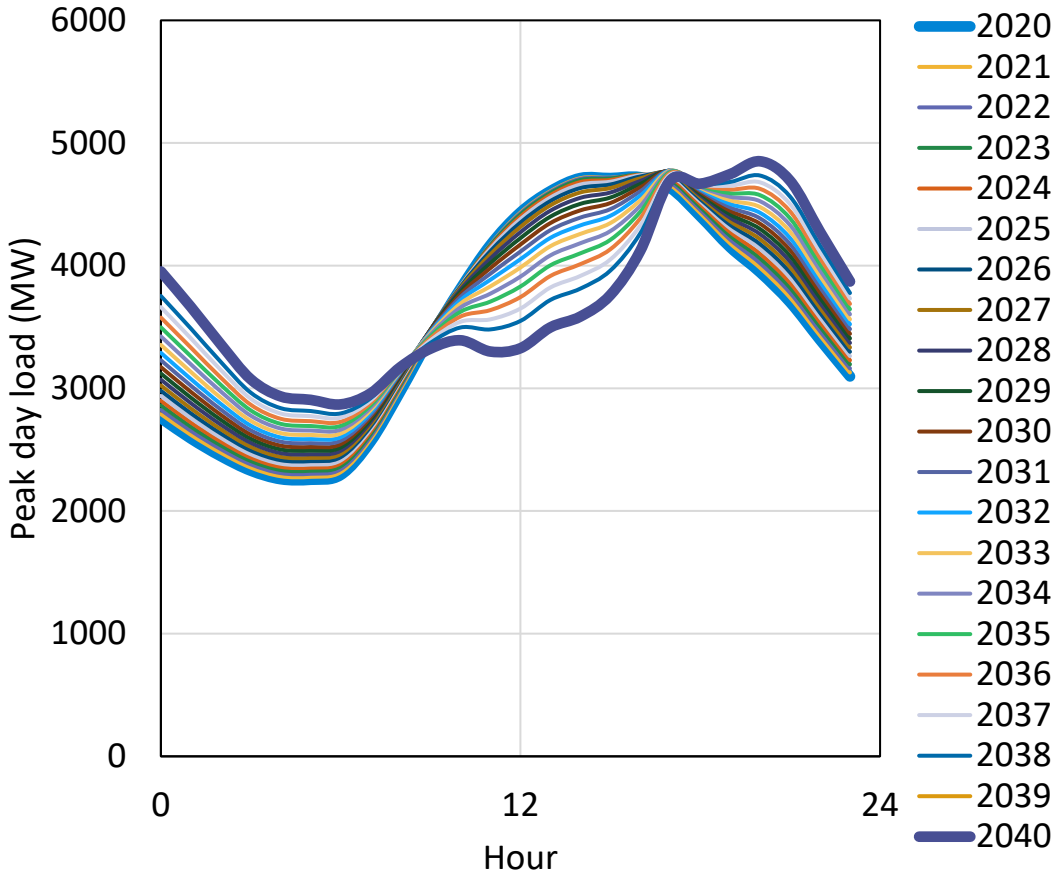


The effects of solar and storage

Aggregate load effects: peak day system load over time with adoption





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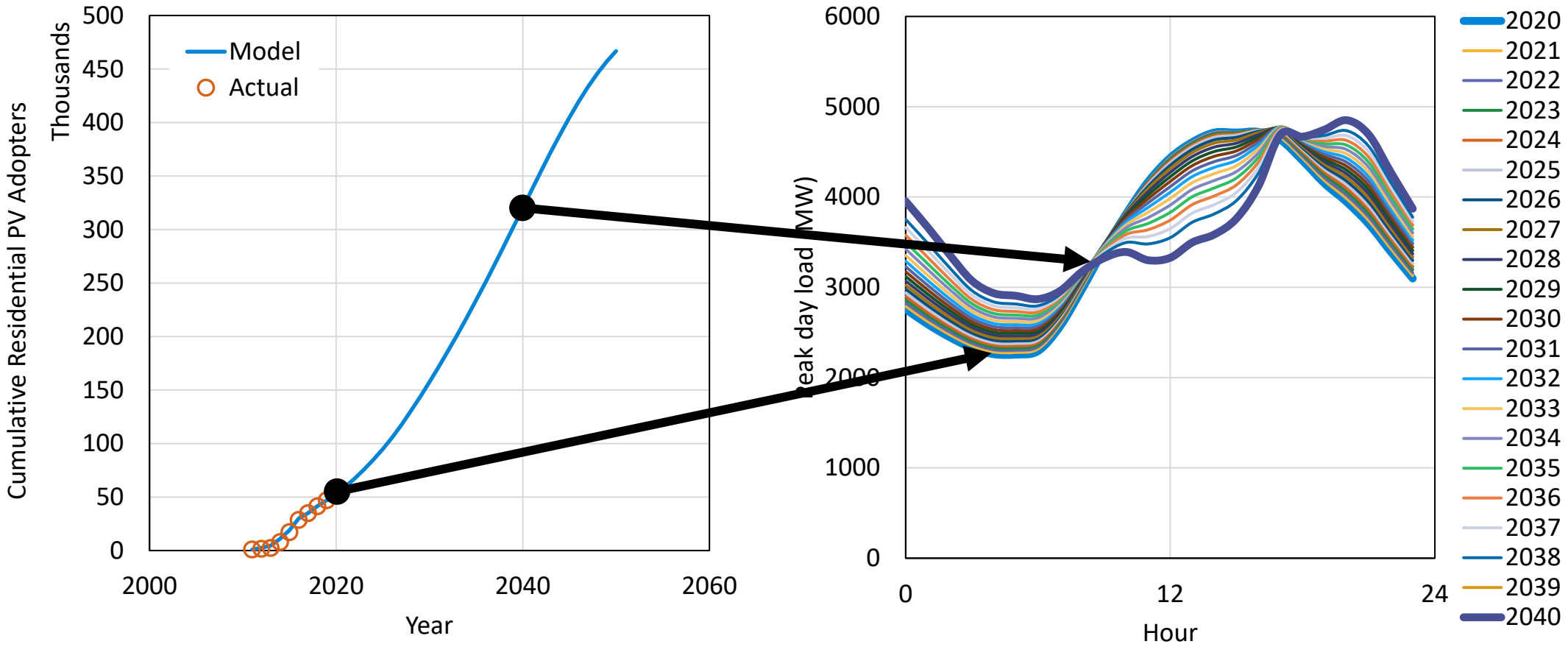

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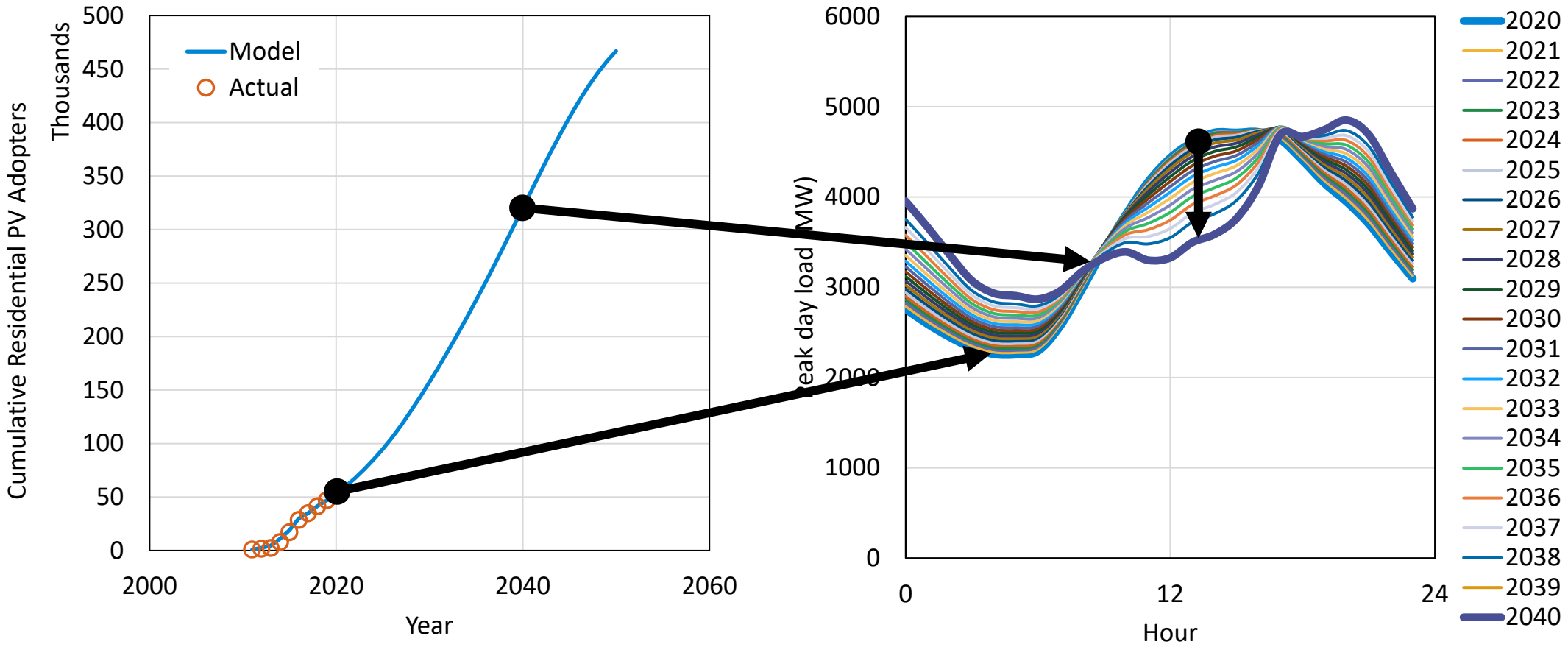
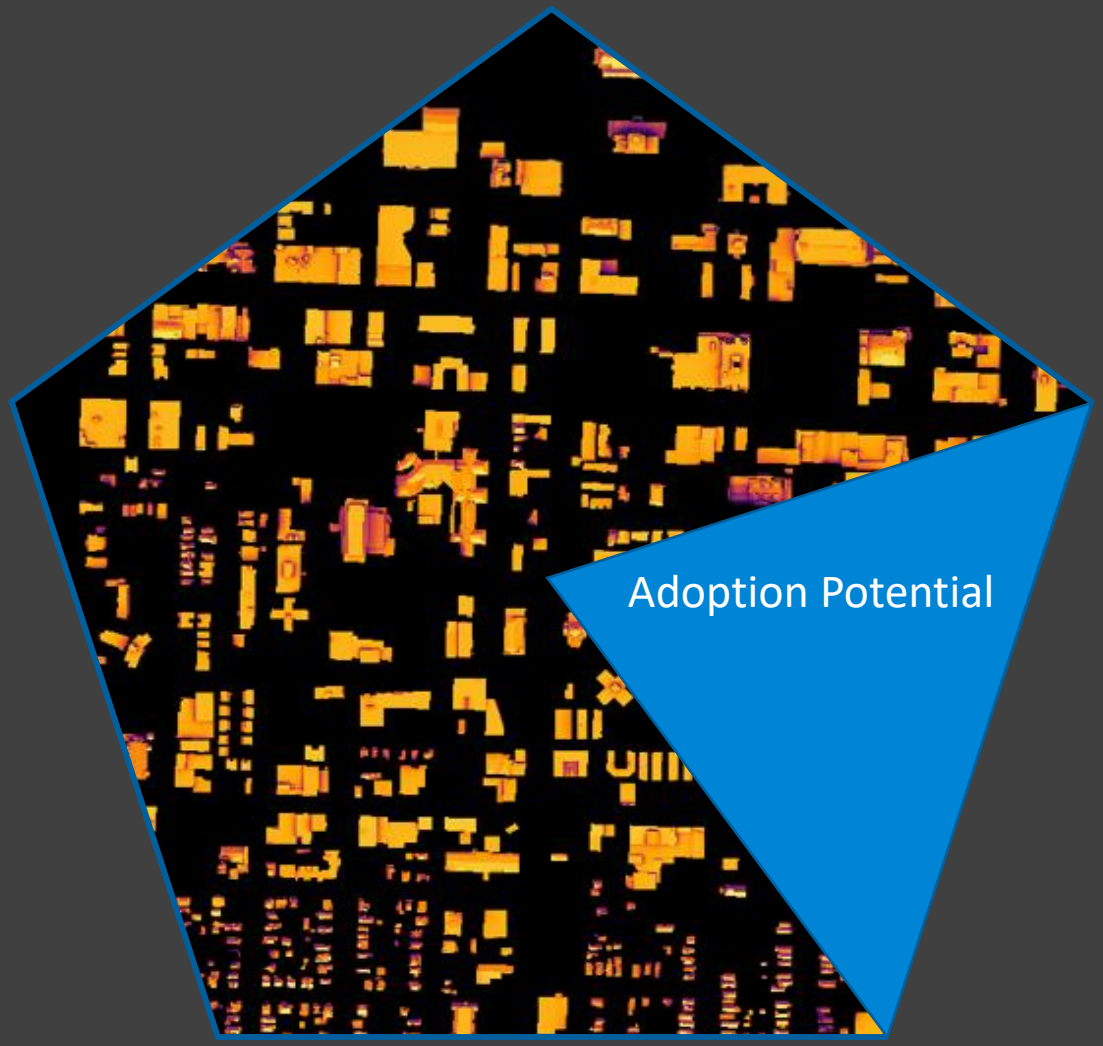


- How many buildings already have solar/storage?
- How many buildings could have solar/storage?
- How fast will buildings adopt solar/storage?
- How will those buildings be distributed?
- How does that solar/storage affect the local grid?



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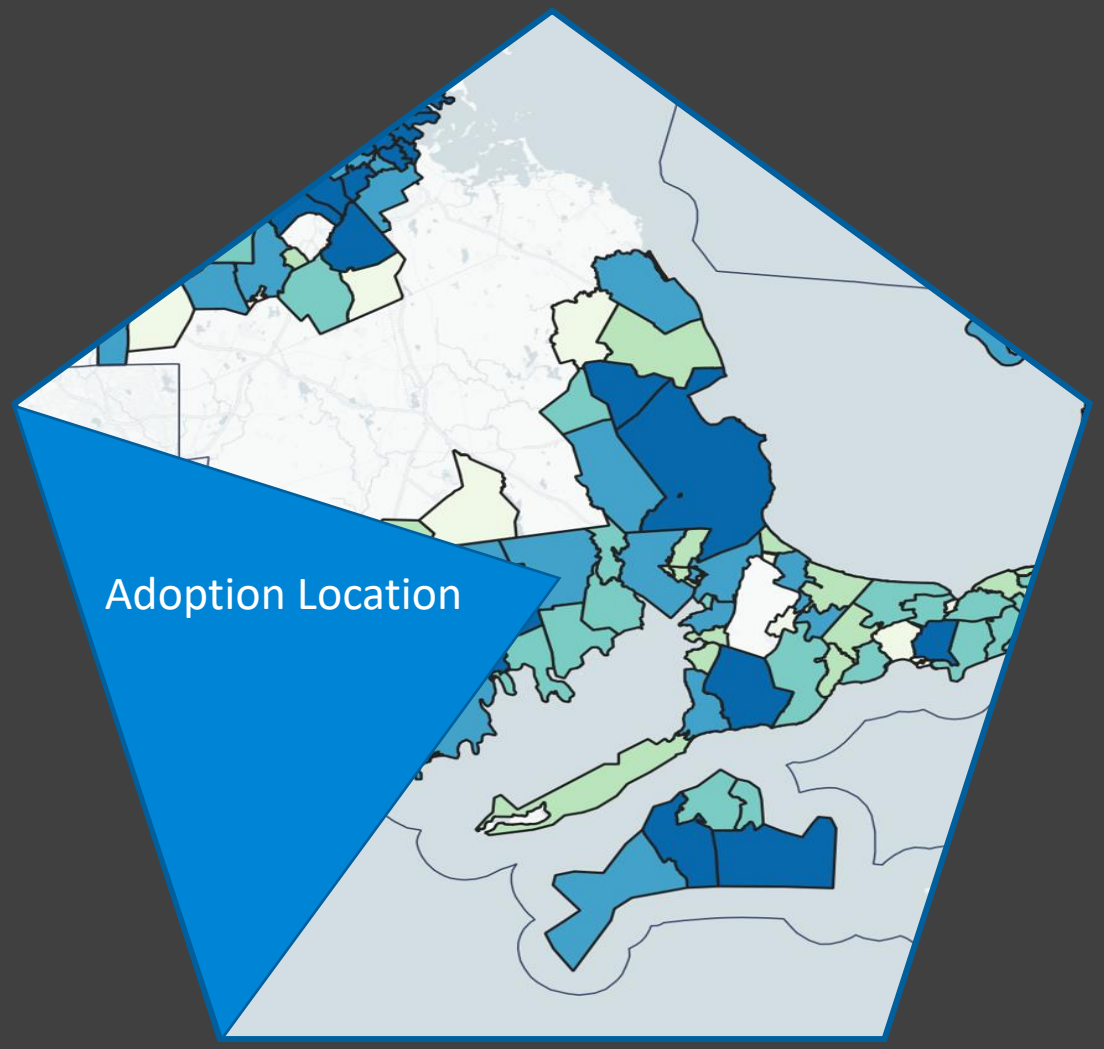

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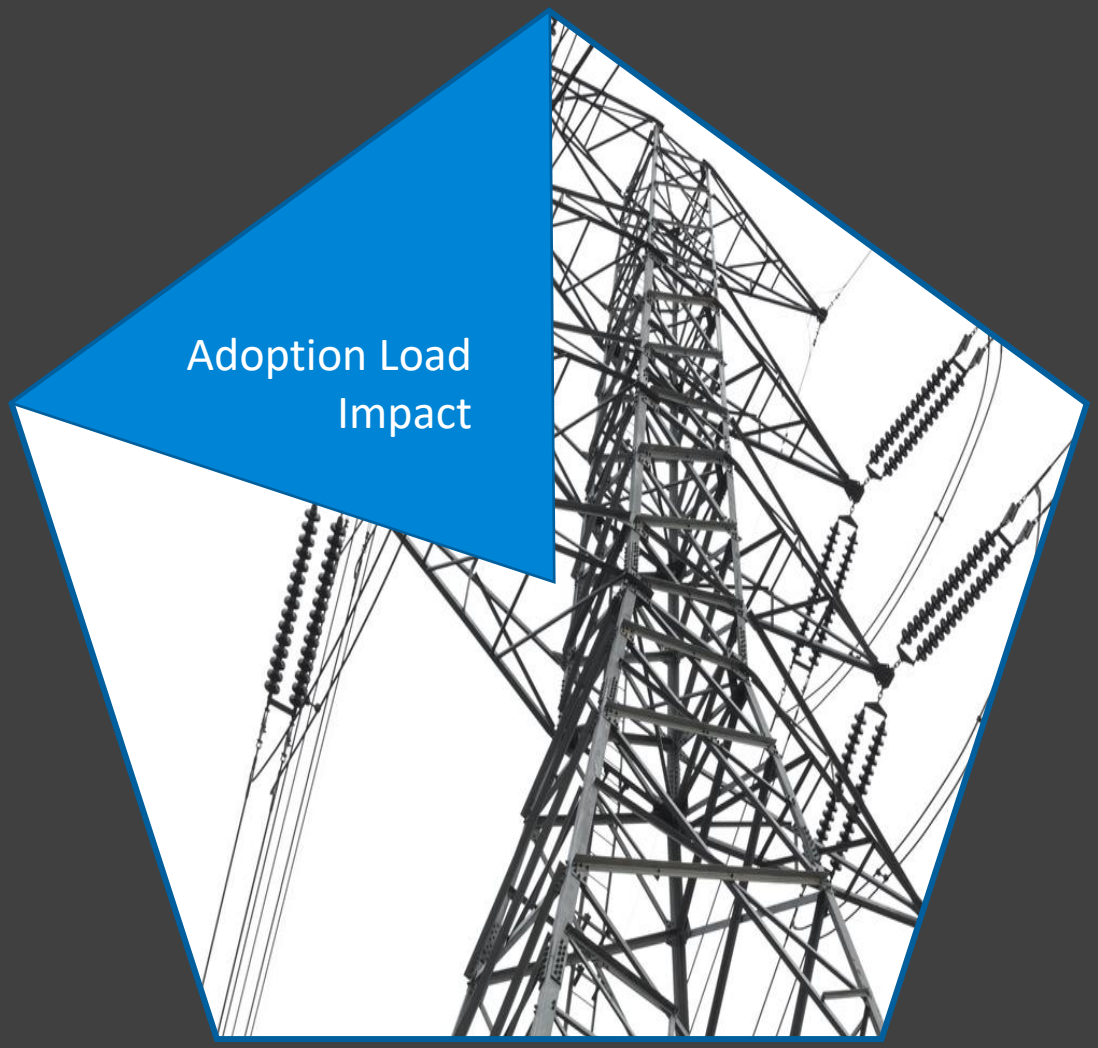

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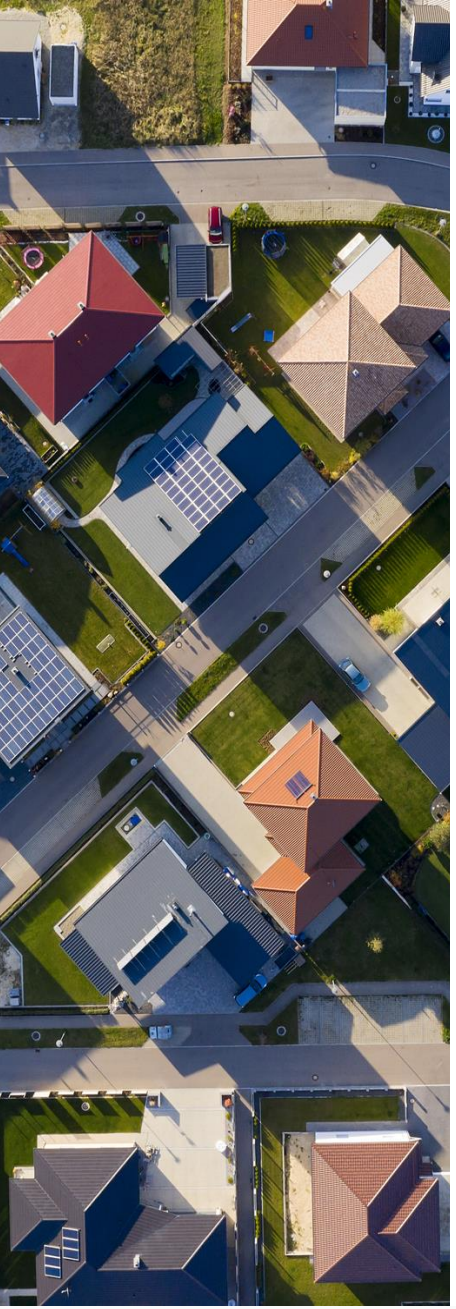
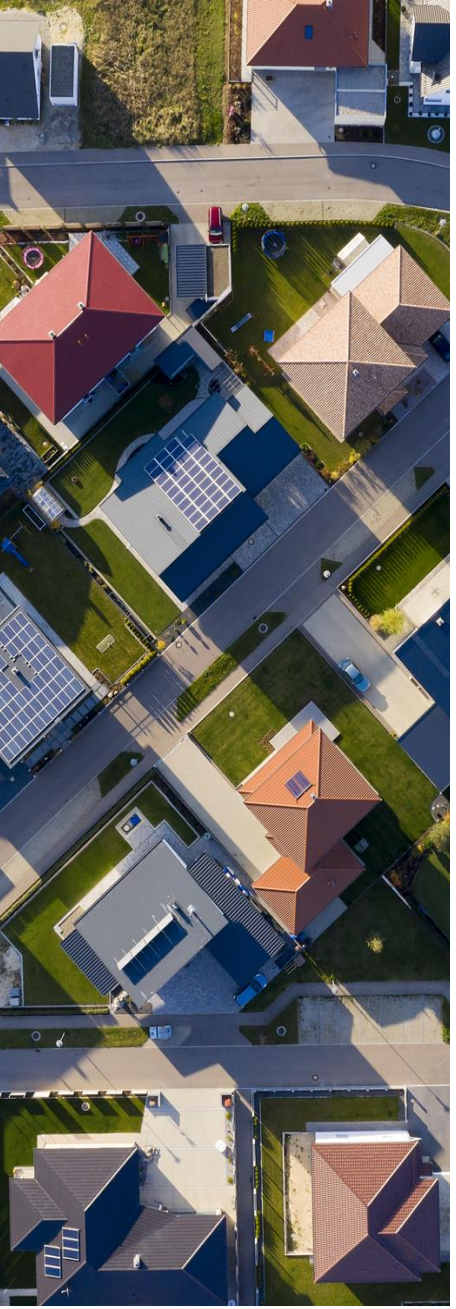
Historical Adoption



Historical Adoption

Why do we need historical adoption data?

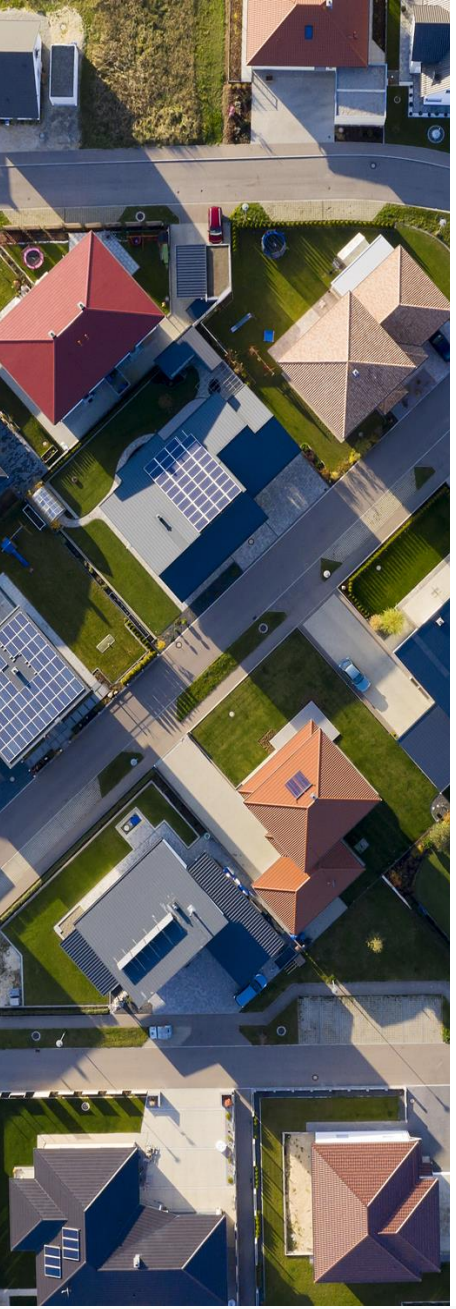
- Train the adoption model
- Rule out future adoption for premises that have already adopted
- Model current grid conditions



Historical Adoption

What data is needed?

Data type	Adoption modeling	Load modeling
System location (coordinates, address)	✓	✓
Installation date	✓	
System size (kW)	✓	✓
Array configuration (tilt, azimuth)		✓
Equipment specifications (inverters, modules)		✓
External effects (shading, soiling)		✓



Historical Adoption

Where does the data come from?

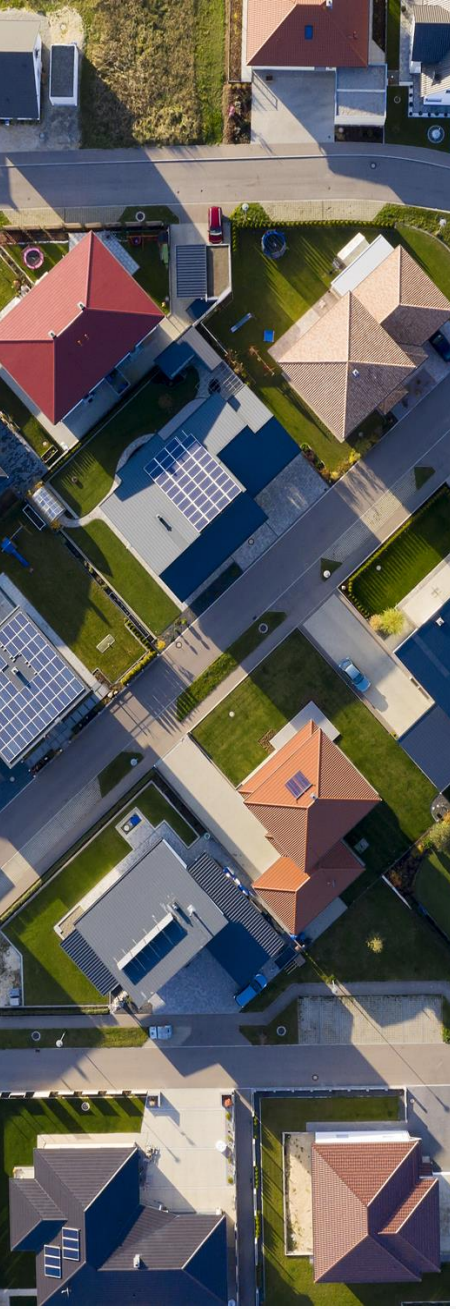
Utility interconnection records

PowerClerk®

Synchronize your PowerClerk interconnection program

Custom Import

Send Clean Power Research a custom file format containing required information

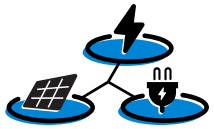


Historical Adoption

What if the data doesn't contain enough detail?

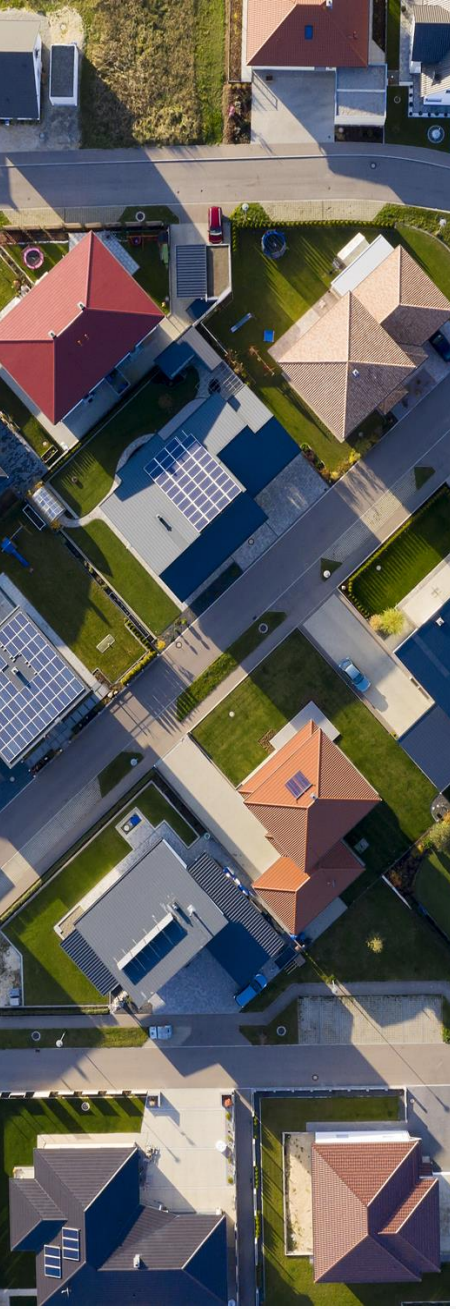
Building footprints

CPR can match addresses to building footprints to infer some specifications



Spec Inference

Infer battery and PV adoption and PV system specifications using NET load data (AMI data)



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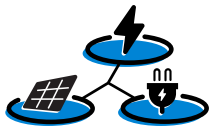

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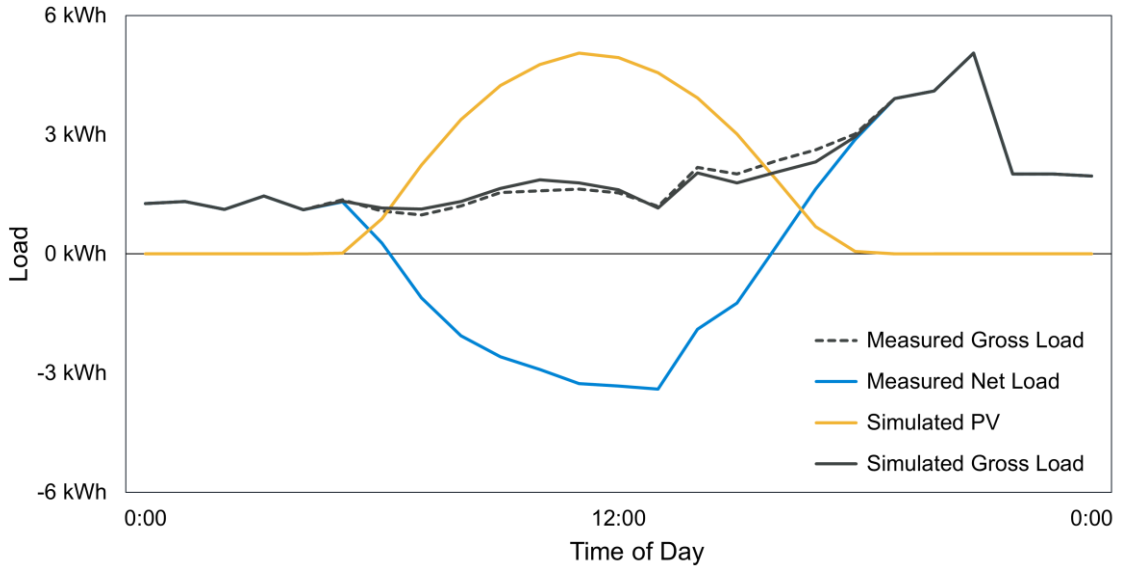
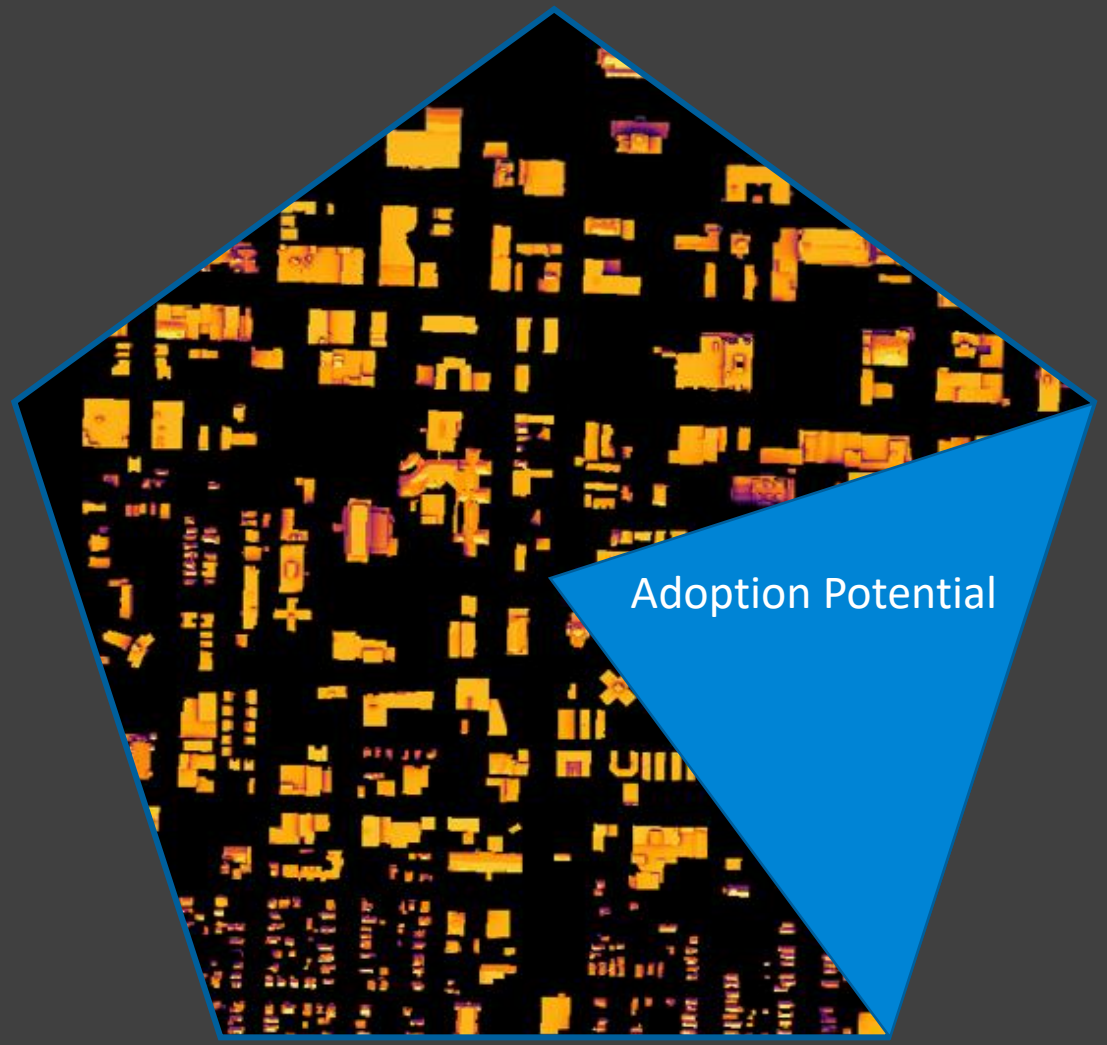
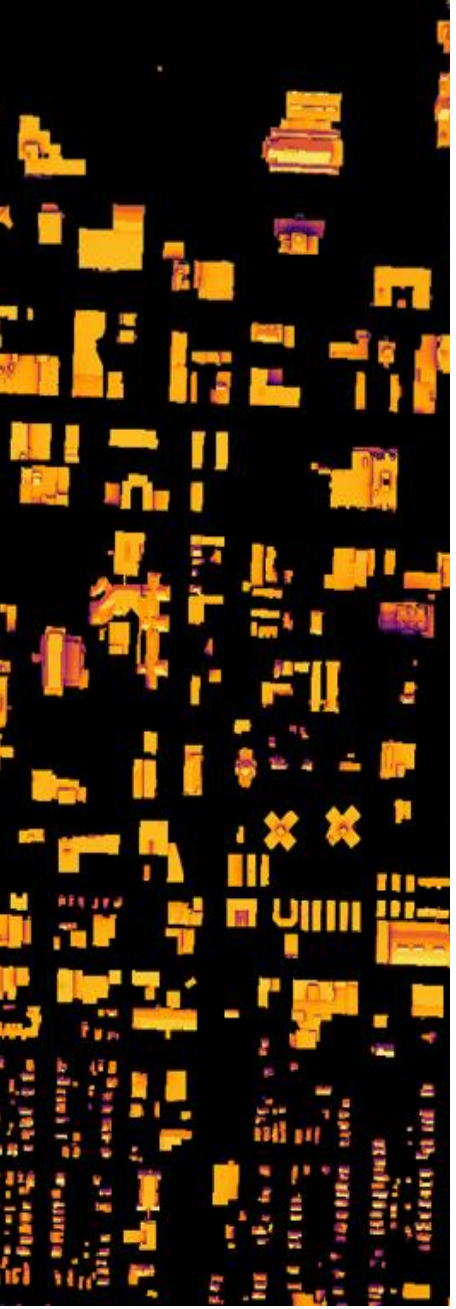
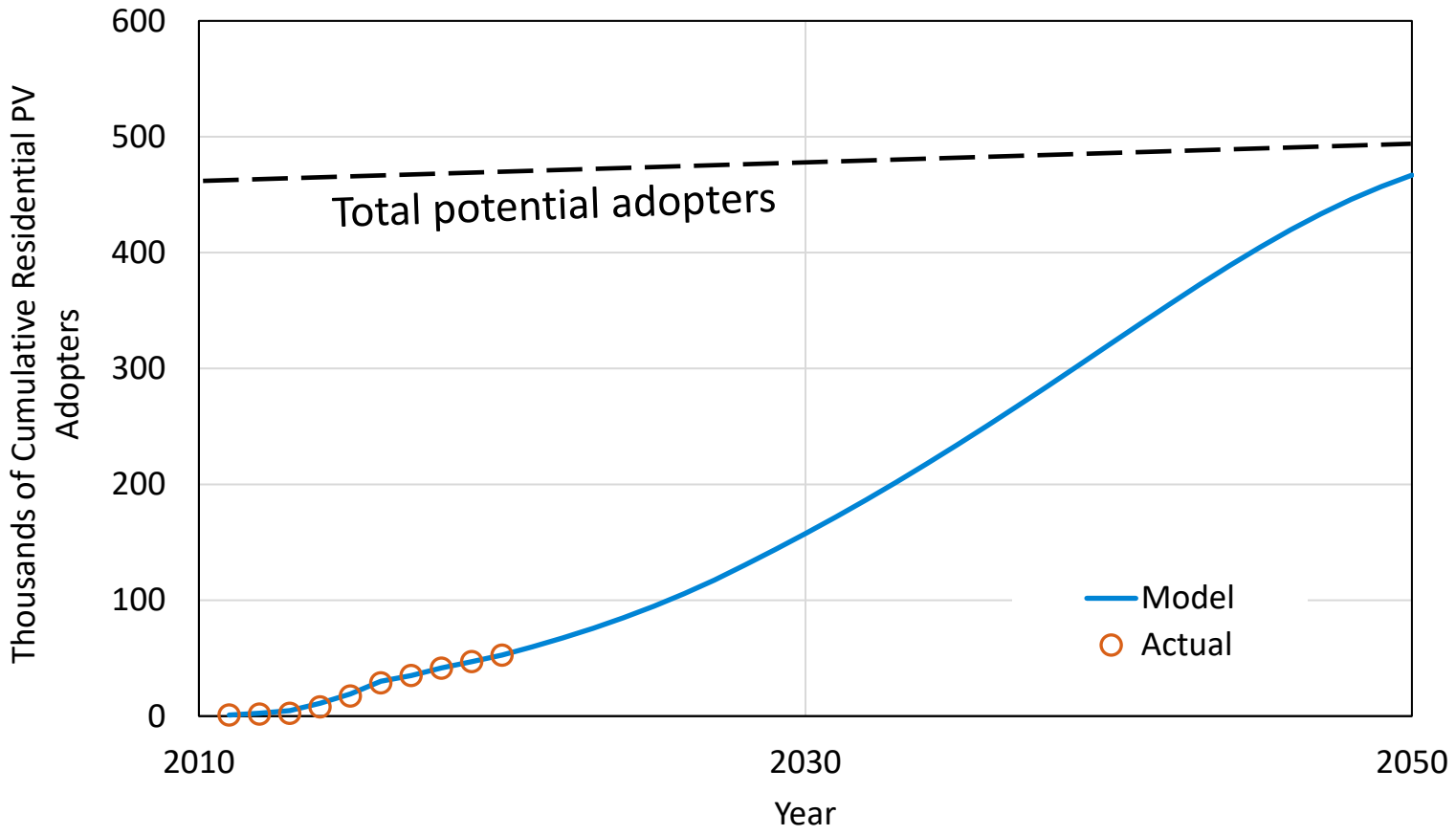


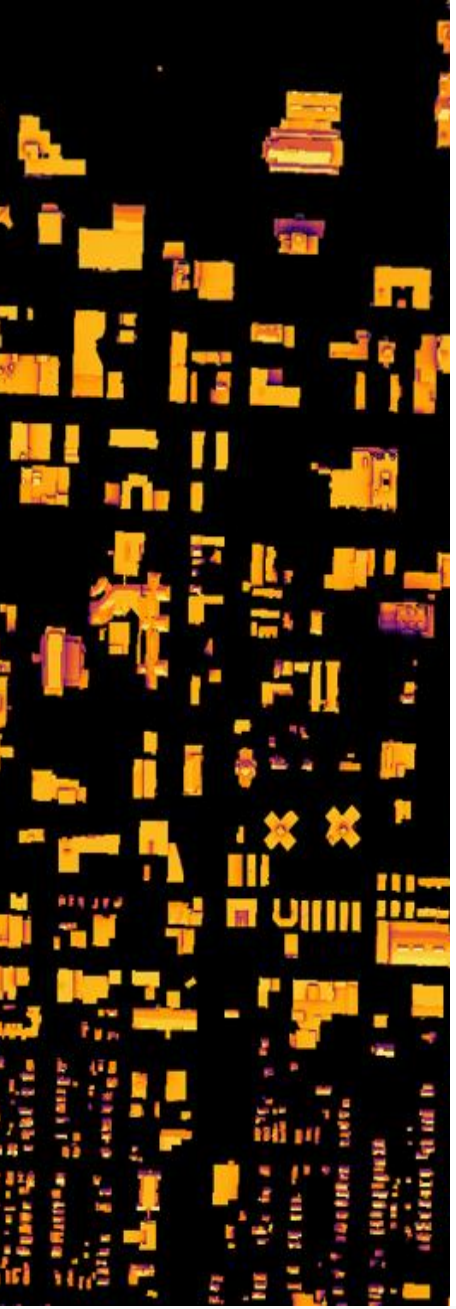

Adoption Potential



Adoption potential

What is the upper bound of adoption?

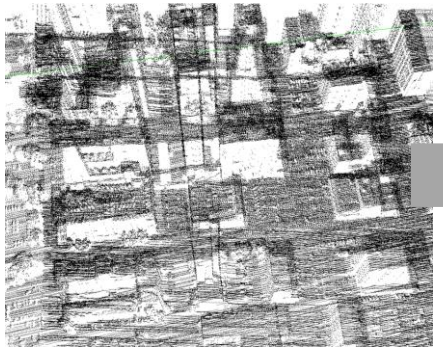




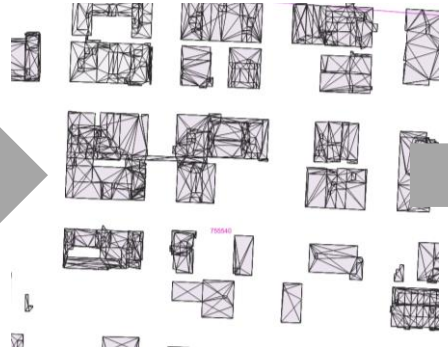
Adoption potential

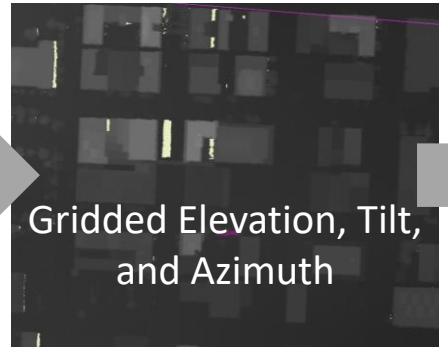
Detailed solar resource potential study process overview

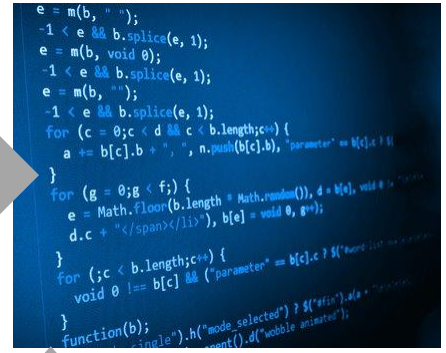
3d LiDAR Data



3d Building Models







Shading Analysis and Hourly PV Output Simulation for Every Roof Surface

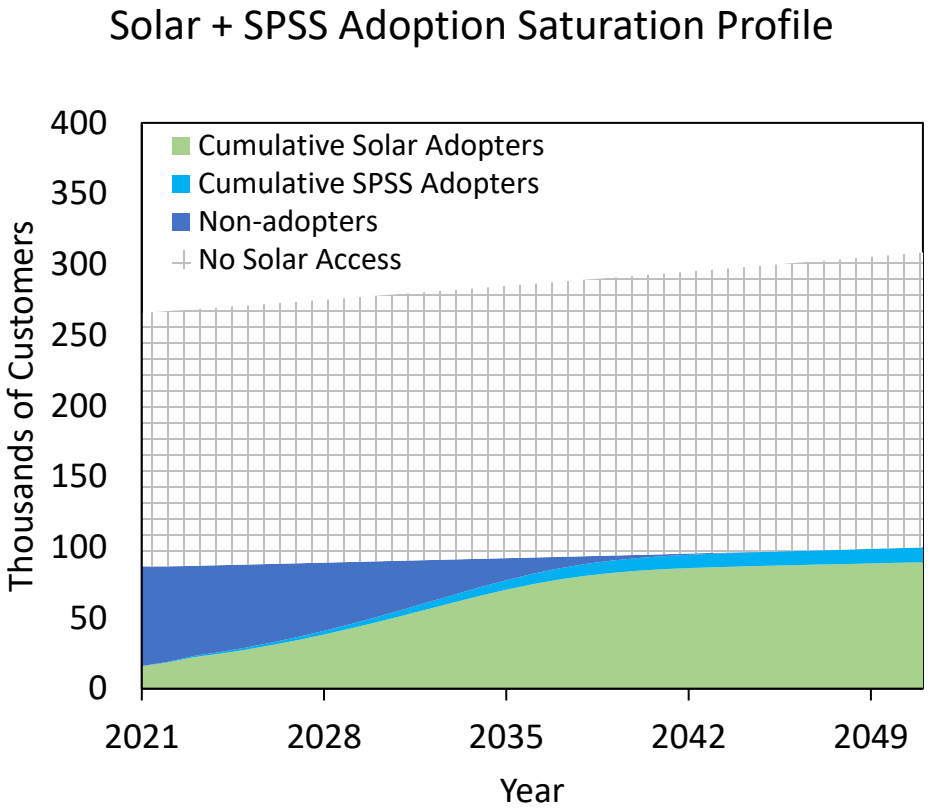
Adoption potential

- Solar resource potential can be used to determine an upper bound of power from rooftop systems
- For adoption modeling, we also use the idea of customers with "solar access" to set the upper bound
  - Data from utilities about businesses and households
  - Census data
    - Owner-occupied single-family homes often makes a good proxy

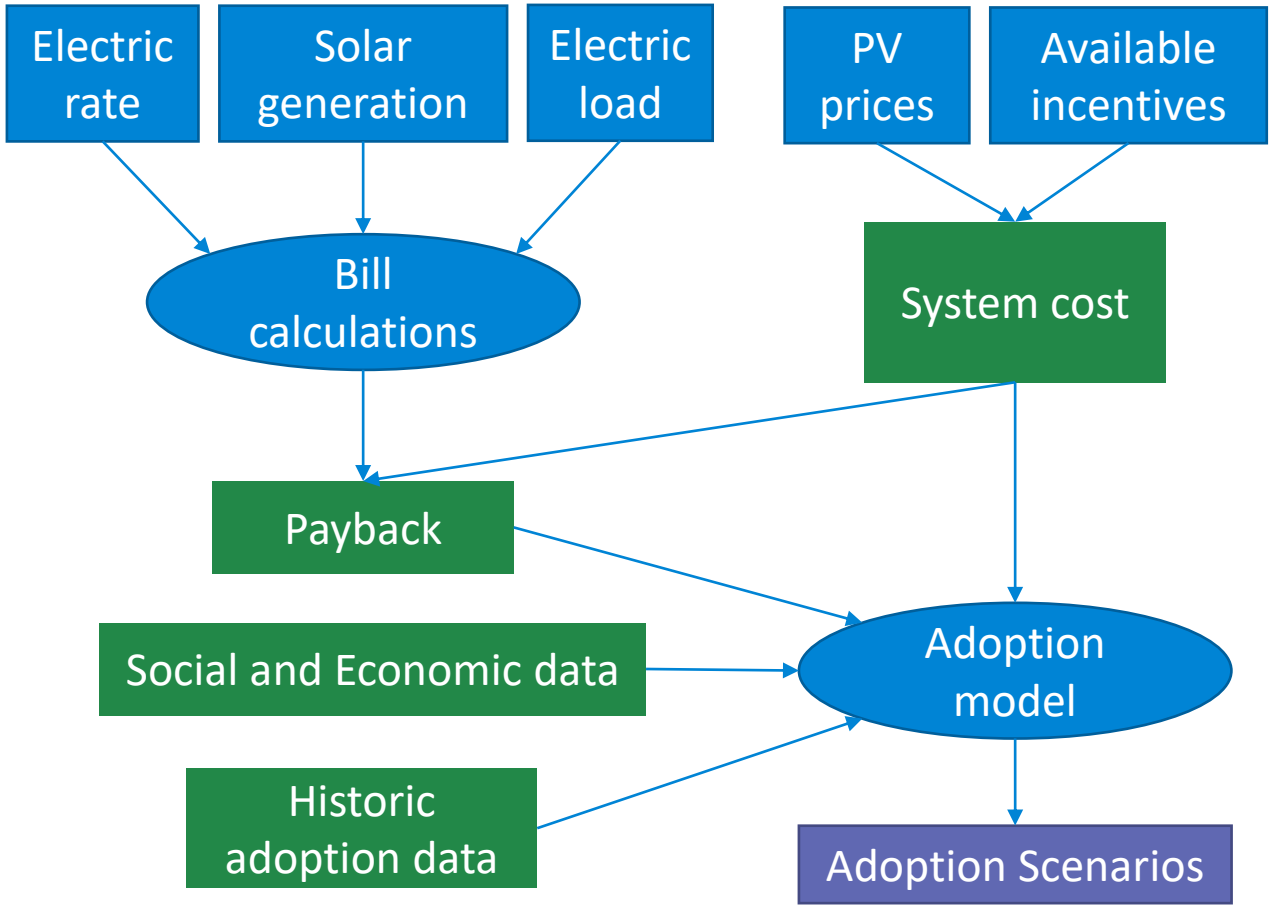

Adoption Rate

Flex Forecast: Behind-the-Meter PV Adoption Modeling

- Top-down adoption modeling at the service territory level (optional geographic breakdown)
- Combines historical adoption, technological cost, and socioeconomic data to model adoption
- Provides utility planners with the ability to build forecasts based on dozens of scenarios
- Developed in partnership with SMUD and deployed for Eversource Massachusetts
- Utilizes CPR's trusted SolarAnywhere® irradiance modeling and state of the art solar rates database
- Connects with Integral Analytics' LoadSEER to forecast adoption load impacts into the future



Solar and Solar + Storage adoption model



- The logistic regression model is based on historical adoption and results in a probabilistic forecast of solar adopters based on a number of predictive factors which can include:
  - Market penetration
  - Total system cost
  - Incentives
  - Payback
  - Social and economic data
- Solar + Storage adopters are then determined as a subset of solar adopters based on an attachment rate

Scenarios

Running scenarios

- Scenarios are defined using an Excel template
- Scenarios can be run on demand through PowerClerk

Scenario results

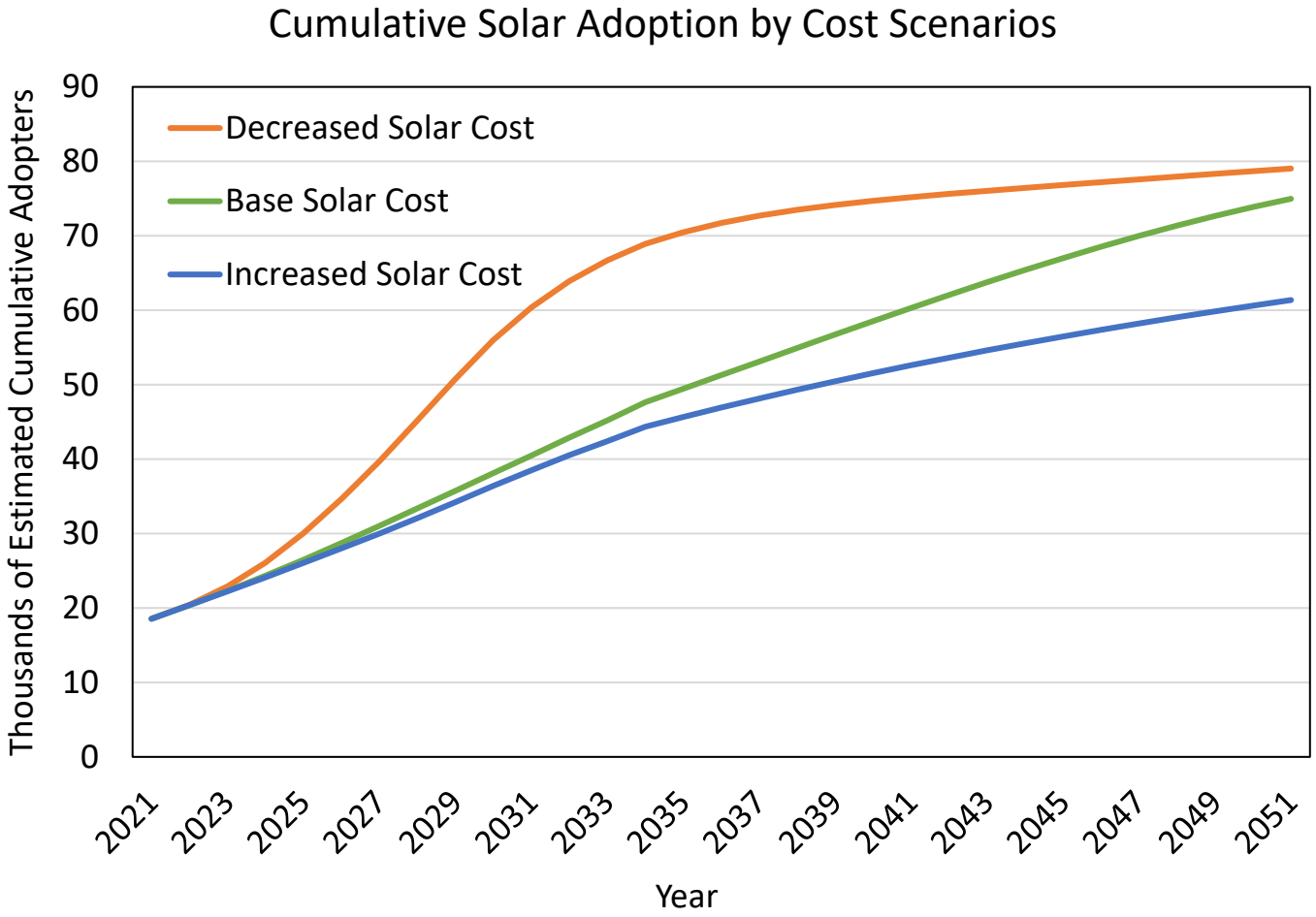
- Typically takes a few minutes per scenario
- Results available in Excel and CSV formats with special formatting options available for integration with Integral Analytics LoadSEER

Common scenarios:

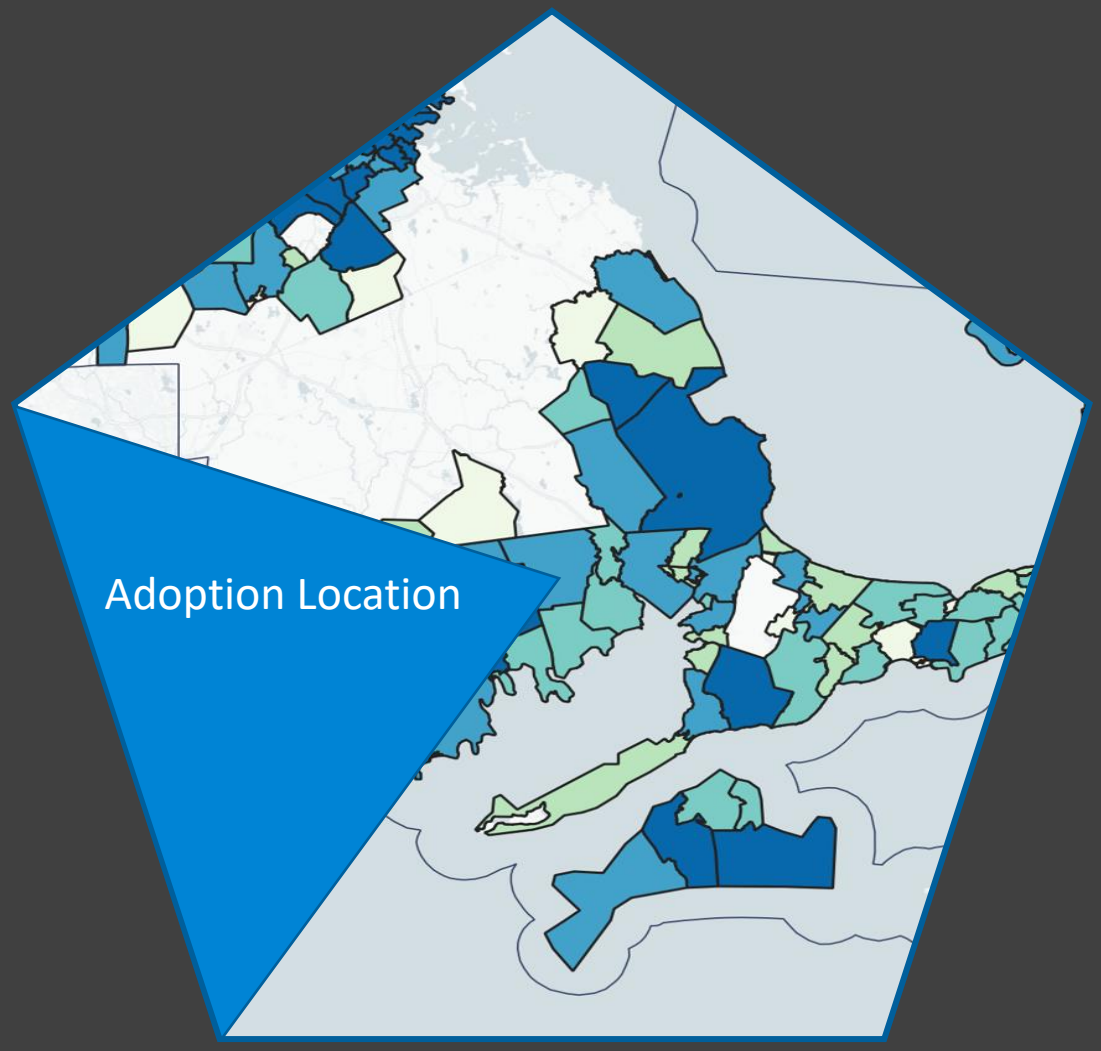
- **Solar or storage pricing**
- **Incentive introduction or retirement**
- **Rate pricing or structure changes**
- **Solar tariff changes**
- **Customer interest in DERs**
- **Valuation of reliability**

Flex Forecast Scenario Comparisons

Solar installed cost



Modeled PV Adoption Rates for Residential Customers in the Boston Area


Adoption Location

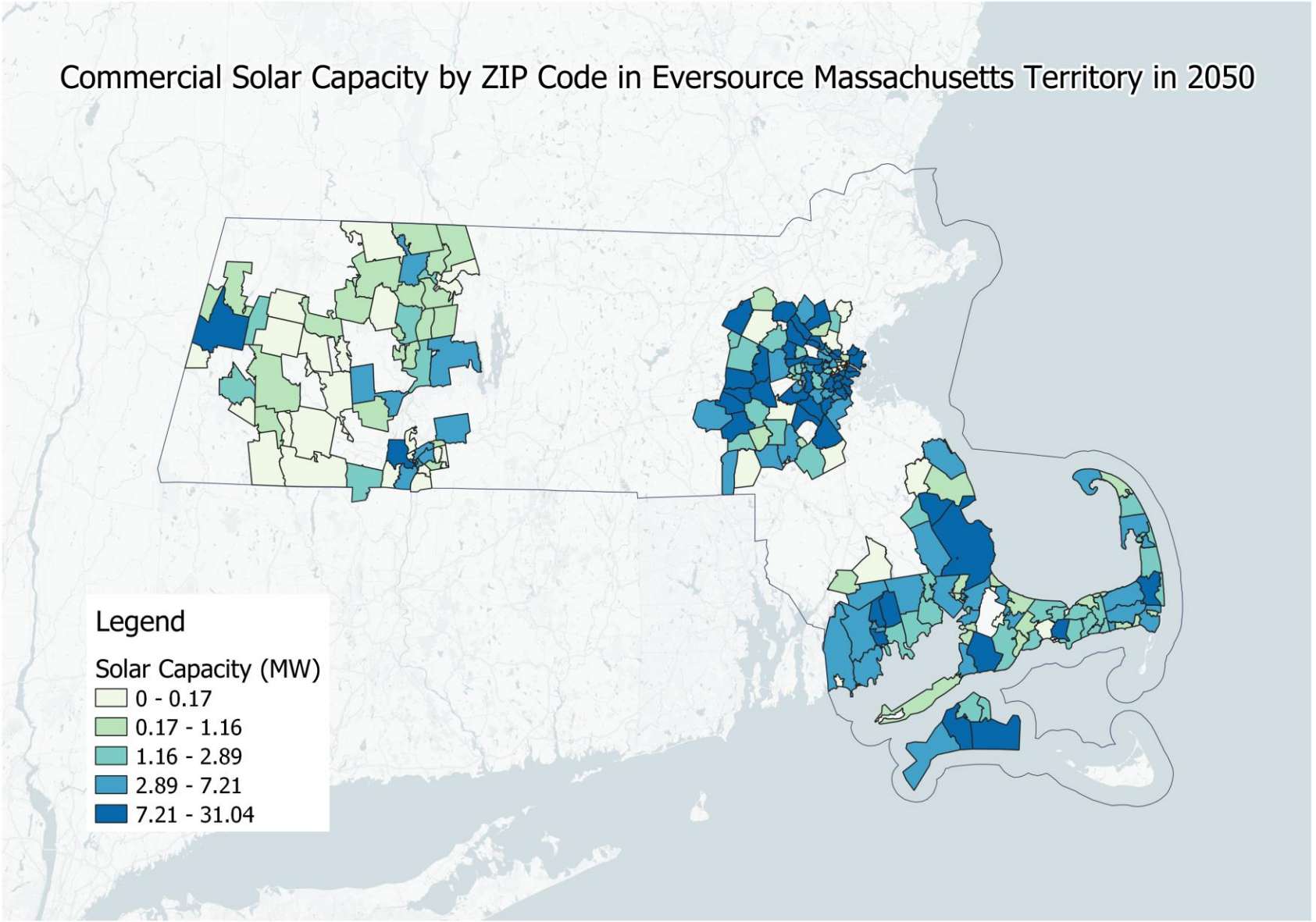
Optional Forecast Geographic Breakdown

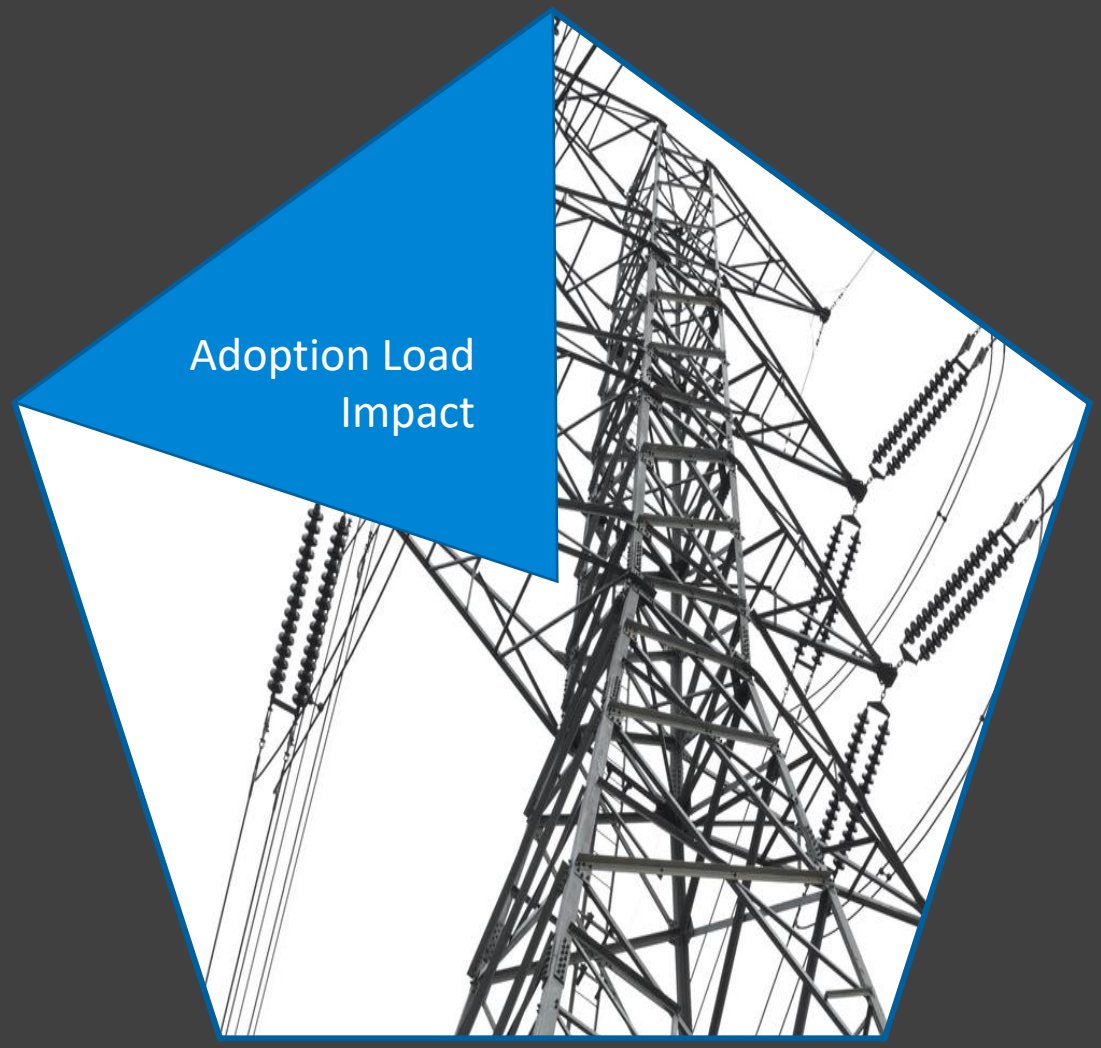
Flex Forecast Results

Demographic Data by Geographic Area

Density, Housing, Land Cover, and Economic Characteristics

Annual Predicted Adopters by Geographic Area



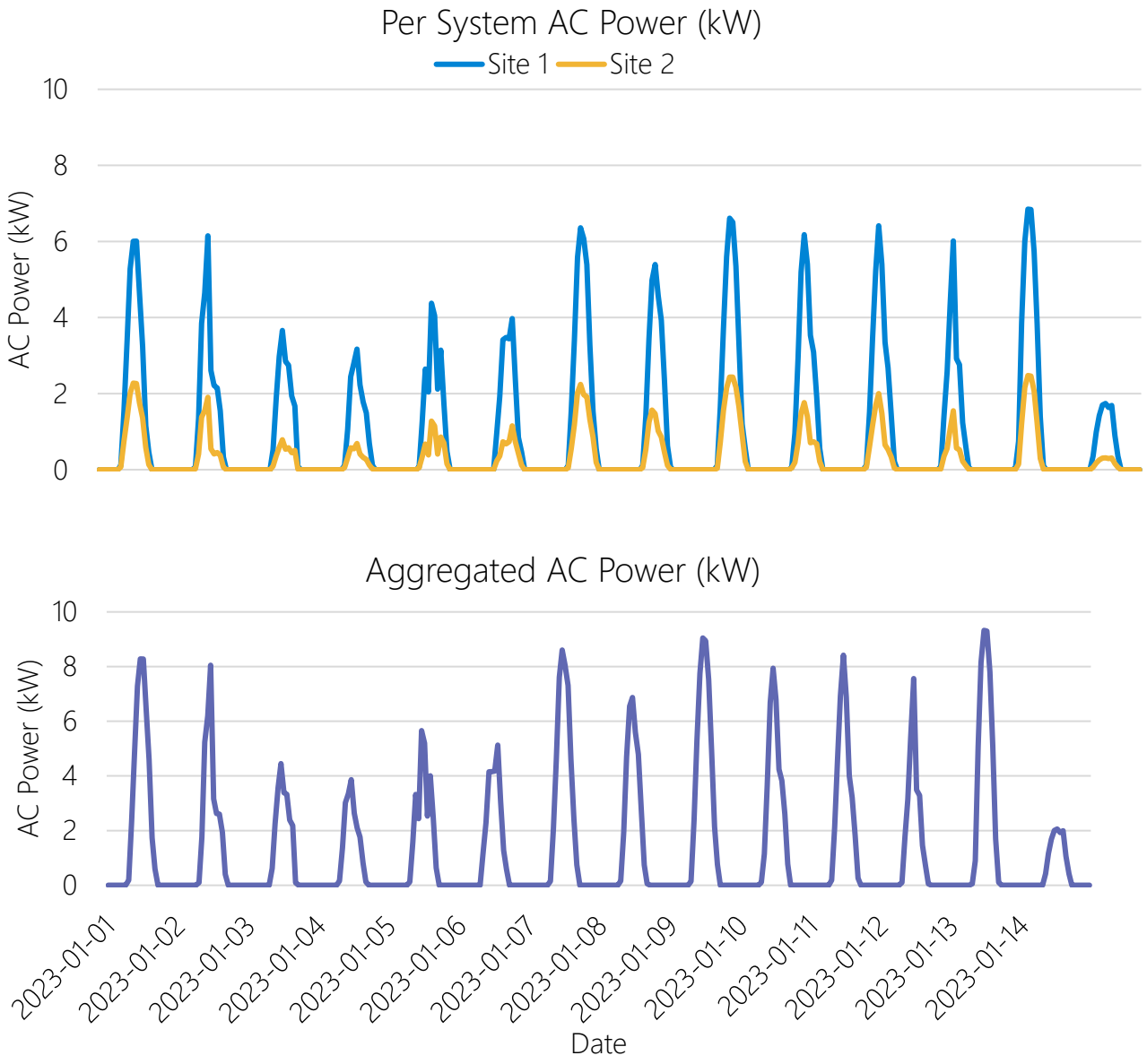

Adoption Load
Impact

Adoption Load Impact

Bulk PV fleet power estimations

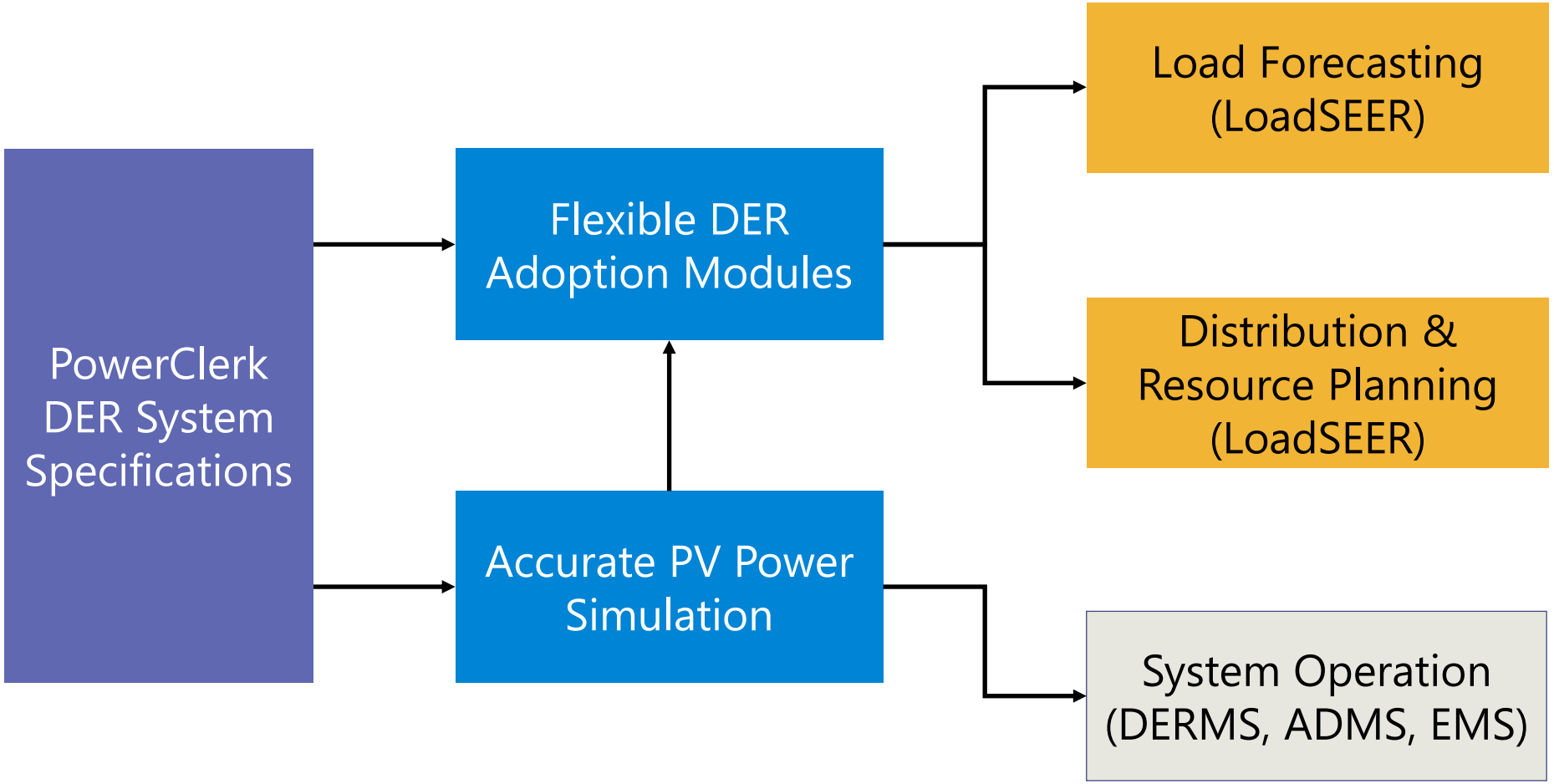
- Model individual PV systems or aggregate systems to the circuit, feeder, or substation level
- System specific weather data that can be time correlated to real net loads back to 1998, or used with TGY data
- Can also provide real time and forecasted production

SolarAnywhere® FleetView®



Adoption Load Impact

Eversource MA data flow



Utility Function

PowerClerk Analytics

PowerClerk DER System Specifications

Integral Analytics LoadSEER

Brittany Farrell | brittanyf@cleanpower.com

Clean Power Research®

Clean Power Research: Advancing the Energy Transformation

25 years working towards a clean-powered planet

Expertise

Secure, enterprise-grade cloud software

Focus: Renewable energy, DERs / EVs, Solar data & intelligence

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Partnered with Dr Perez @ SUNY Albany

Industries Served

70+ Electric Utilities & Energy Agencies

- Munis/IOUs/Co-ops

100+ Solar Industry Partners

- Independent engineers, Solar financiers, operators, installers; Utility planners

Team

100+ employees

- HQ: Bellevue, WA
- Research: Napa, CA
- Satellites: NY & MA

20+ people with advanced degrees:

- Meteorology/Atmospheric Science/Engineering/Environment/Resources/Business

Trusted, adaptable and efficient cloud software solutions ***Cloud-Based Services*** | ***Web Browser & API Enabled*** | ***Secure with High Availability***

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Utility Industry's Leading Business Process Automation Software for DERs and Beyond

WattPlan®

Customer Engagement and Adoption Modeling Software for Utilities

SolarAnywhere®

Bankable Solar Data and Intelligence for Financial Planning, Operations & Forecasting