ESIG Load Forecasting Workshop EV Session

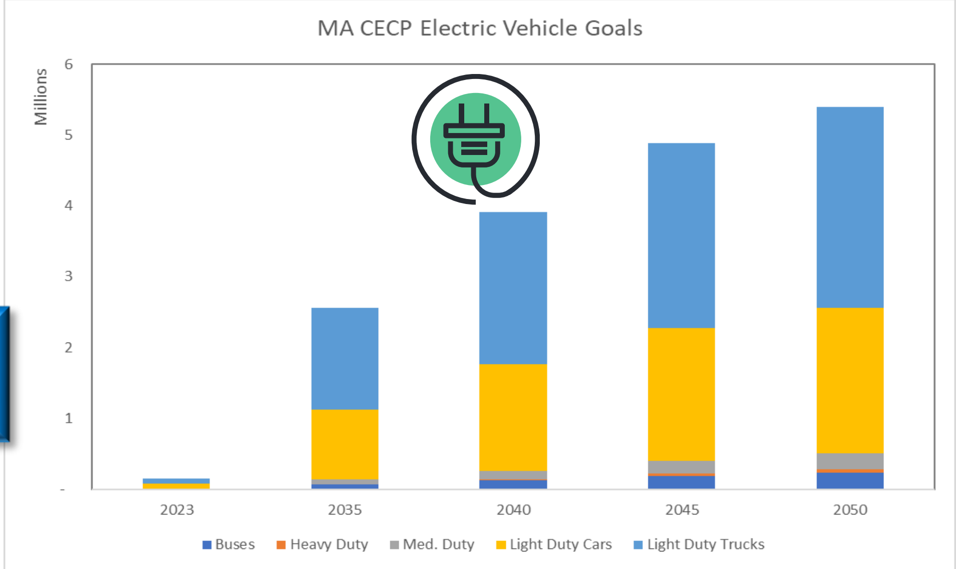
VEHICLE ELECTRIFICATION AND GRID IMPACT MODELING

Electric grid must be transformed to achieve Decarbonization Goals

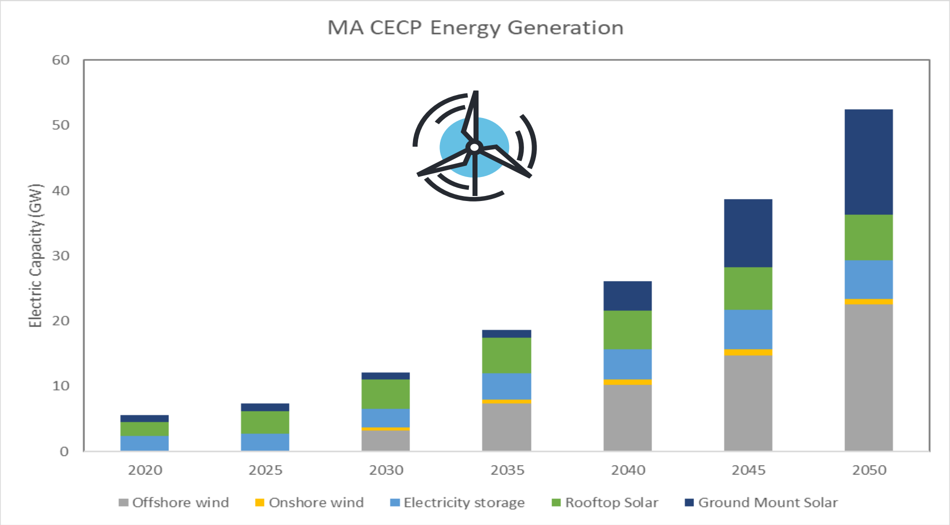
The MA Clean Energy & Climate Plan (CECP) and the Decarbonization Roadmap outline actions the Commonwealth will undertake over the next few decades to ensure the Commonwealth's ability to achieve **Net Zero in 2050**

9 Million Electric Vehicles, 144 TWh Electric Heating alone drives New England from a 25 GW system (119 TWh) to 43 GW system by 2040

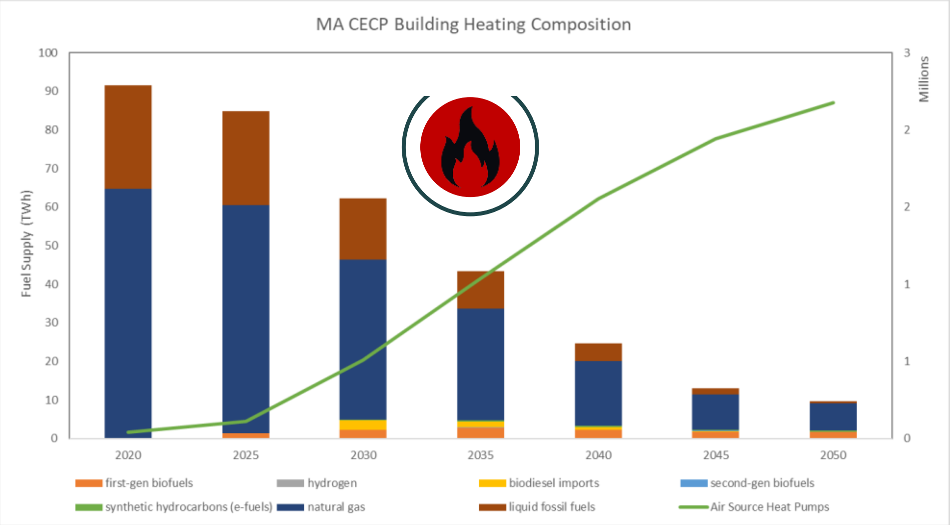
Dramatic increases in **electric vehicles** with 93% of vehicles electrified



Installation of **53 GW of Energy Generation** by 2050 in MA



Removal of almost **all fossil fuel consumption** in the building sector



Eversource is taking the initiative

<u>Strategic Investment into Advanced Forecasting and Modeling</u>

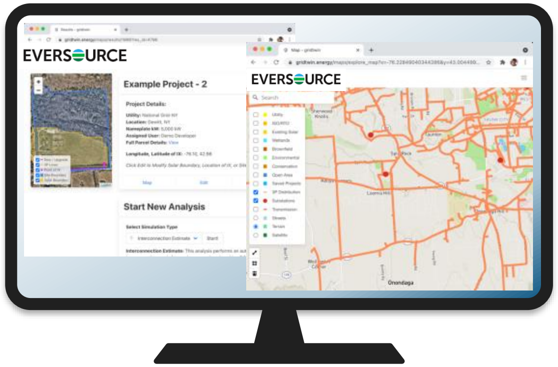
Dedicated team to transition forecasting from load centric, single value forecasts to advanced forecasting with multiple variables based on policy objectives.

- New Software Solutions such as LoadSeer, GridTwin, and Microsoft DataBricks allow for forecasting far ahead of industry standards across North America ($3+ Million in GridMod 1.5 Funding)
- Key Talent investments by introducing data scientists into System Planning with a team of three data scientists and one forecasting engineer

Dedicated Synergi Modeling Function to allow incorporation of forecasts into models and transition planning into 8760 models

- Centralized Model Management to ensure consistent model quality and to provide models as a service to all DSP, DER, and DE departments
- Development of Planning Models which represent the build out state of the system till 2050, including all forecasts

Whats Next? Expected approval of ~$5 Million GridMod funding to introduce significant automation in Synergi, as well as probabilistic power flow capabilities.



Developing a Path Forward

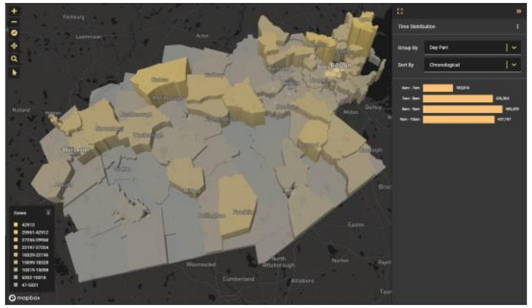
Developing Data Driven Approaches

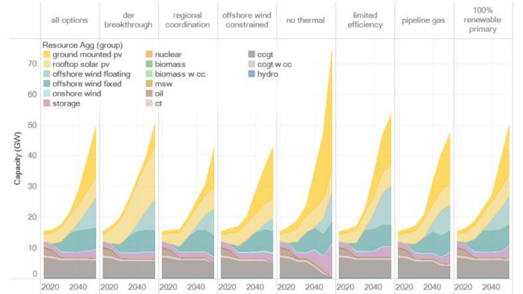
Forecasting models for key technologies provide data driven inputs to strategic decision-making processes;

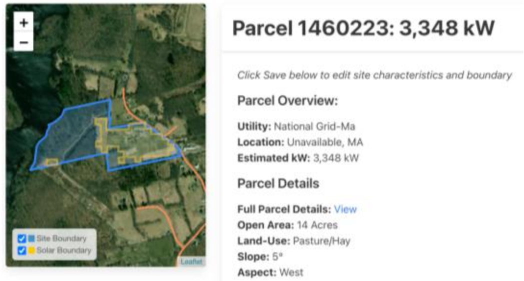
- Optimal Capital Investment based on data driven adoption rate models and state policy objectives to ensure power systems are up to the task
- Policy Coordination to inform rate and policy makers of costs associated with clean energy objectives and collaboratively develop the best course of action
- Reliability Planning to secure the Company’s central role in ensuring a safe and reliable power supply while growing the asset base

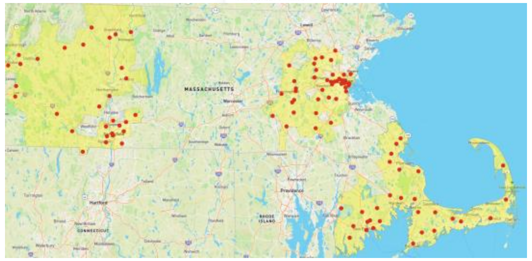
And allow Eversource to take the lead when coordinating with other entities through advanced data analytics;

- State Entities such as the DOER, DOT, DPU, AGO, and MassCEC to drive infrastructure investments and design programs
- Developer Communities to drive solar development in optimal locations
- Strategic Customers to support electrification in a sustainable manner









Forecasting 101 – Why do we Forecast

Utilities must forecast because infrastructure takes years to plan, site, and build

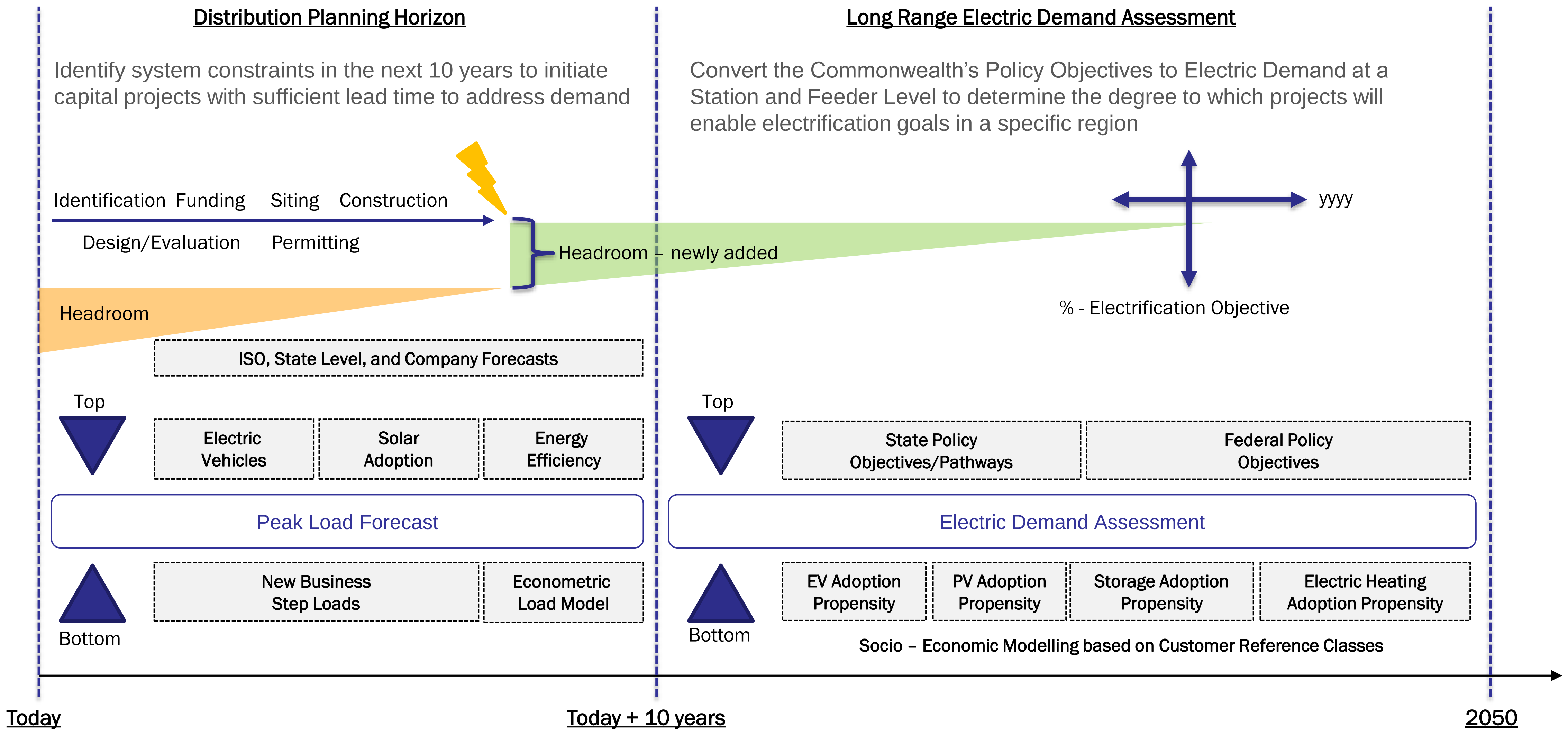
- Transmission → 10+ years
- Substations → 5-8 years
- Distribution → weeks for service upgrades, 2-3 years for circuit re-designs

The bigger the project, the longer it takes, the longer range the forecast

- Bigger Projects also have larger areas they service
- Forecasts over larger areas are significantly more accurate
- Geographically granular forecasts have significant uncertainties

Forecasts are created by geographic region or bulk station

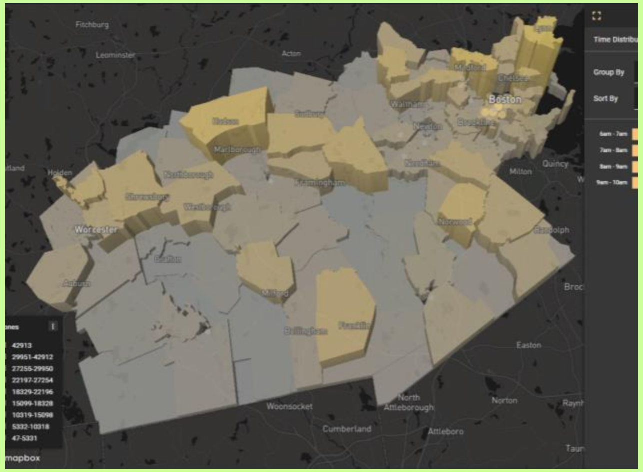
Forecasting 101 – Forecasting Framework



Long Term Electrification Impact Assessment

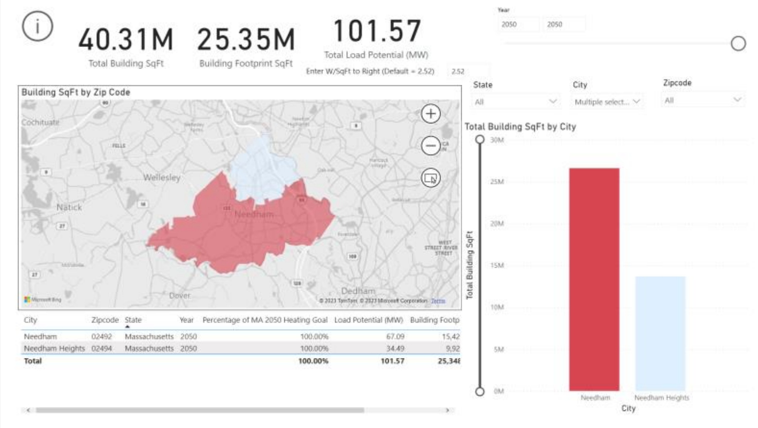
Electric Vehicles

- Customer Specific Adoption Models
- GPS Tracking of Vehicle Movement
- Fleet Electrification tracking



Heat Pumps

- Customer Specific Adoption Models
- Detailed property data based
- Service Level impacts

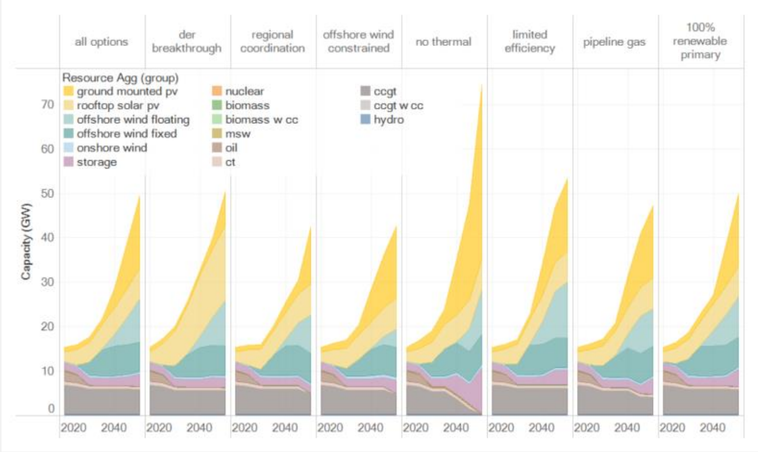


Solar

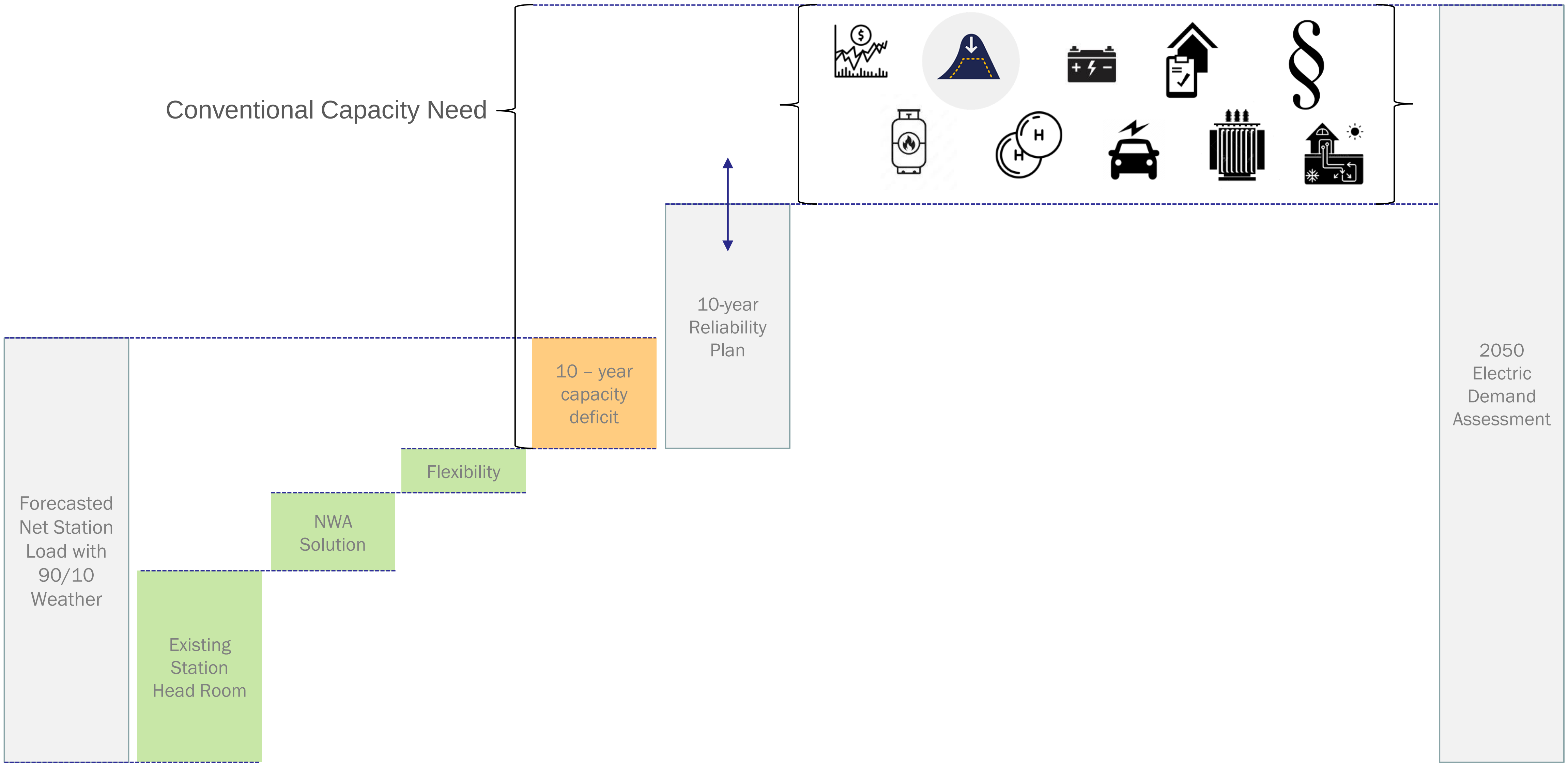
- Territory wide parcel data base
- Econometric models for rooftop and ground mounted solar

2050 Decarbonization Roadmap

- Scenario Evaluation
- Policy Sensitivity Analysis

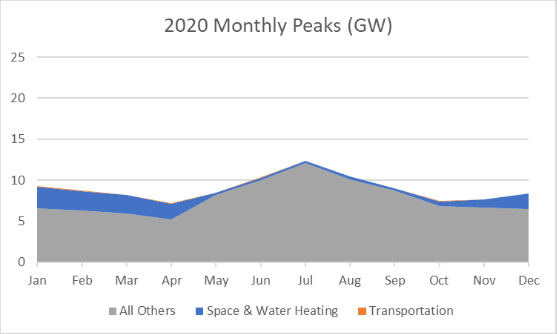


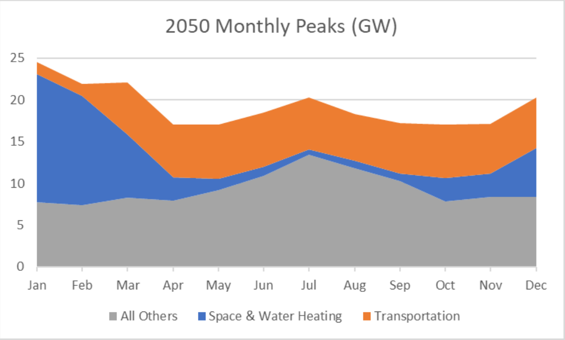
Solving for the Decarbonized Grid

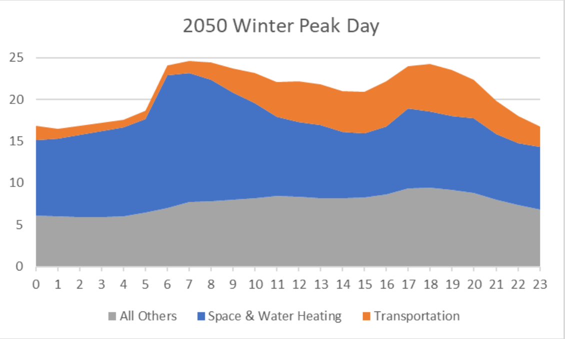


Electrifying Massachusetts

- Transition to Winter Peaks
- Heating Drives New System Design Peak
- With ~25 GW of Winter Peak, Massachusetts peaks higher than the NE-ISO today
- Summer will be driven by electrification of transportation
- Transportation and heating will peak at different times of day, providing dual peak conditions for the power system
- System will peak in the early morning hours (no solar offset can be expected)







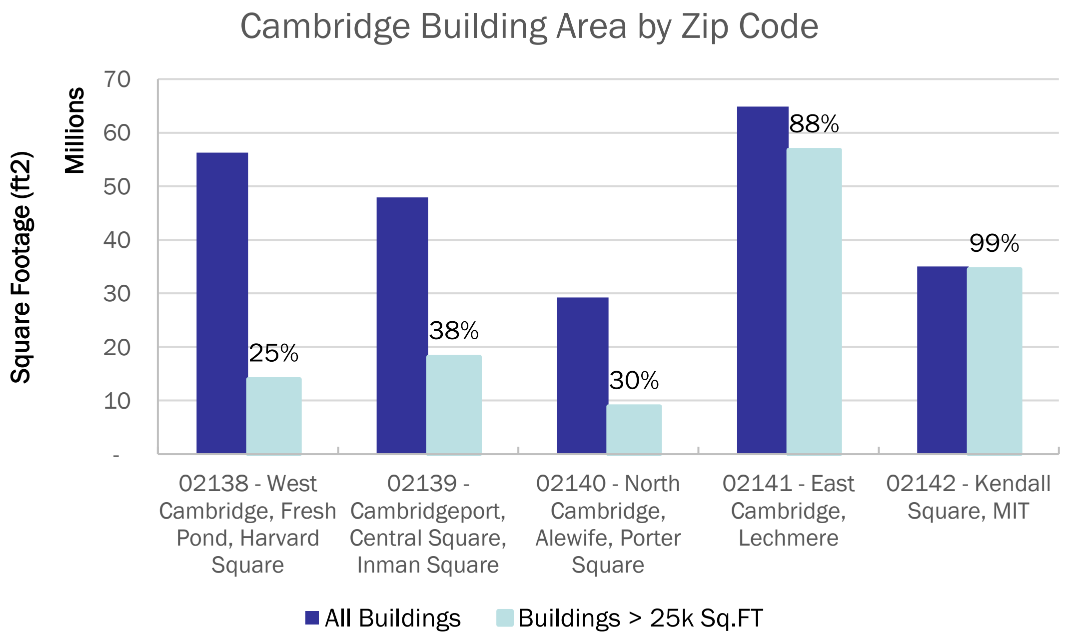
Under ideal Synergetic conditions, an additional $27B of distribution capital investments are needed to achieve the system capacity required for full electrification; in a worst-case scenario, this number can be as high as $46B.

Sample Findings – City of Cambridge

Heating Projections

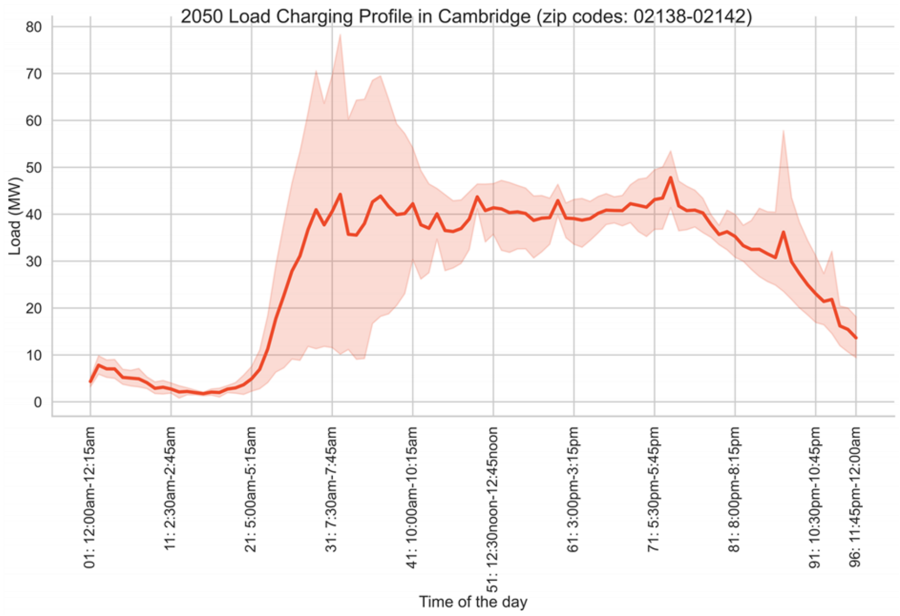
- Cambridge consumes at peak around ~5,100 MMBTU/hr gas which represents about 1.5 GW electric resistive equivalent
- Using ASHP or GSHP demand is reduced to 1 GW and 540 MW respectively

*Heating potential estimated based on building square footage and peak heating assumptions



Transportation Projections

- During peak morning rush hour if all inbound traffic is electrified and given an option to charge a peak of up to 78 MW can be expected
- As a commuter heavy city, inbound traffic collides with winter morning heating peaks
- Winter traffic is ~10% higher than summer traffic



More than 1300 MW of winter peak demand projected for 2050 @ 100% gas displacement

Compared to a 585 MW summer Peak 2022

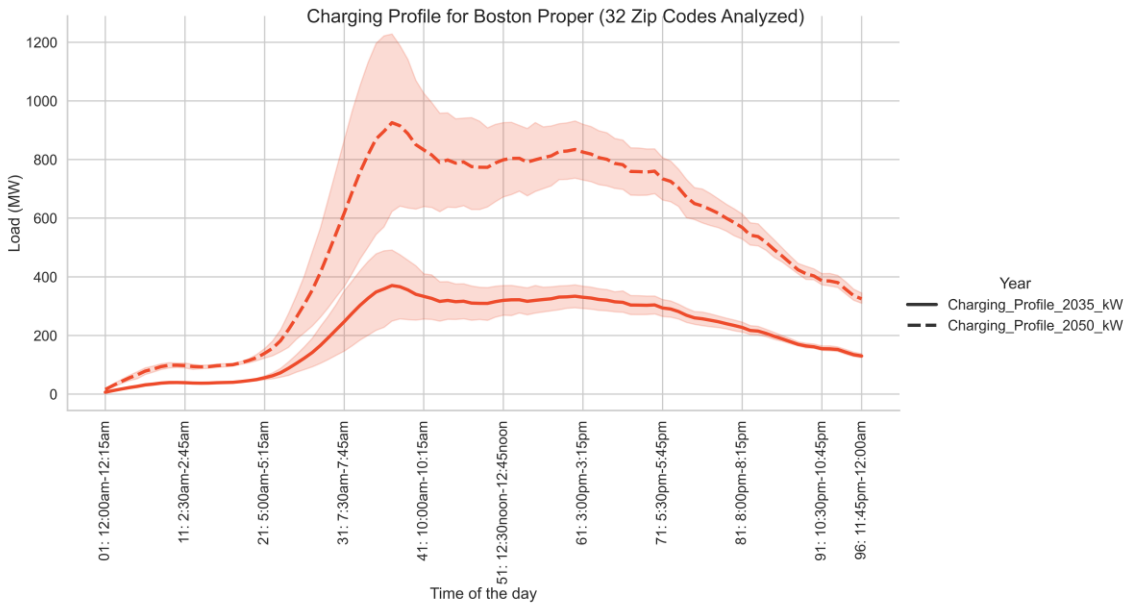
Developing EV Charging Rates

TOU Volumetric Rate

- **Rate EV-**2 will be available as optional rate to stand-alone charging stations **greater than 100 kW**

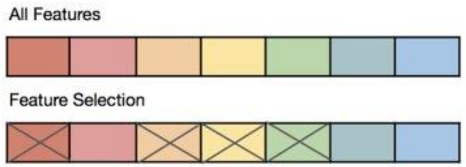
- Pricing will have a sliding scale demand based on assignment to one of four load factor brackets

Based on Expected Profiles



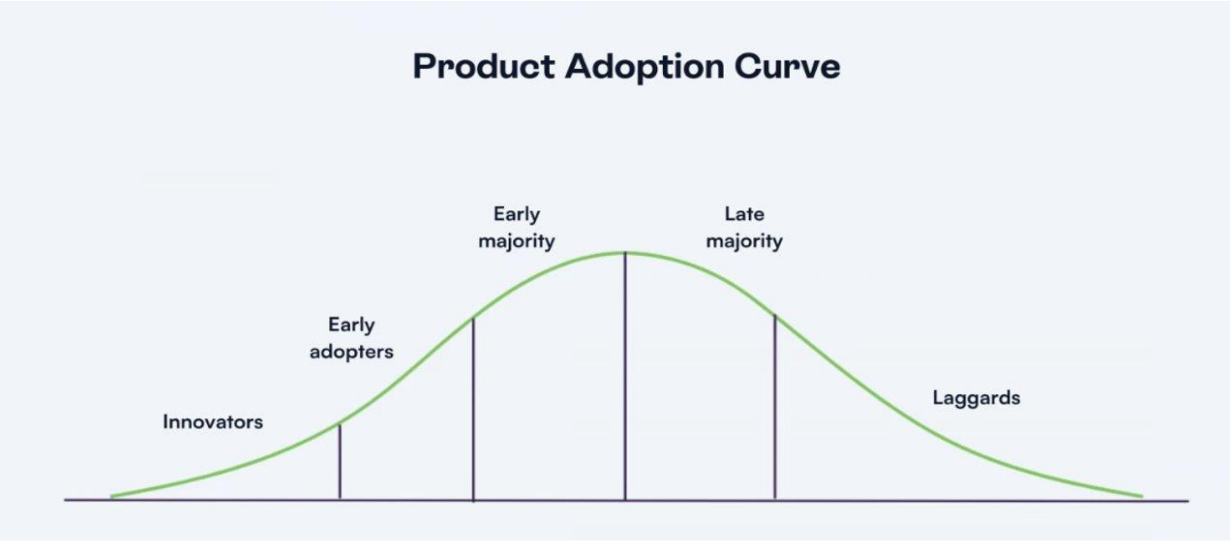
Circuit Level Risk Assessments

- Customer Level Adoption model through Clustering by key features



- Customer Cluster Types (6 EV, 5 Heating) created and sorted by circuit

- Circuit Prioritization and Redesign Criteria



Adoption Clusters	Heat pump adopters	EV Adopters
Innovators	174,462	268,016
Early Adopters	431,038	335,258
Early Majority	196,670	551,227
Late Majority	240,881	307,927
No Gas, No others	390,290	N/A
Laggards	256,229	227,142

QUESTIONS

Dr. Gerhard Walker
Manager Advanced Forecasting and Modeling
gerhard.walker@eversource.com

10 – Year Forecast – Peak Reporting

Final reported peak

Reported Net Station Peak

Transfer Correction

Any other generation

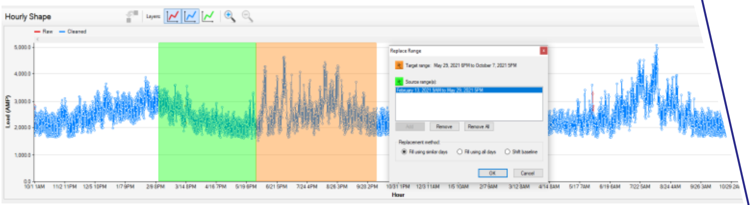
Large Solar Generation at time of peak

Small Solar Generation at time of peak

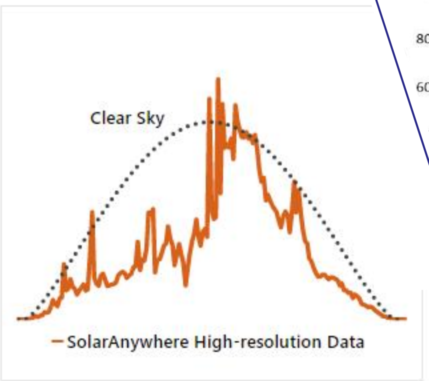
90/10 weather adjustment

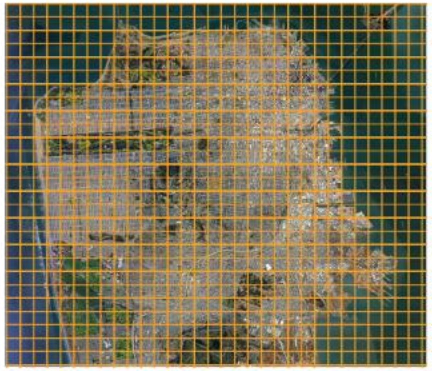
Reported Weather Normalized 90/10 Gross Station Peak

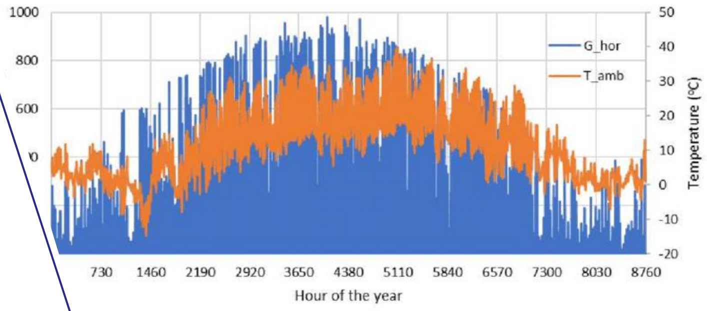
Historic SCADA readings on all large generation installations



Historic, satellite-based weather data to calculate non-metered solar output







Historic, satellite-based weather data to calculate non-metered solar output

10 Year Forecast – Coincident Components

Econometric Trend Load Model

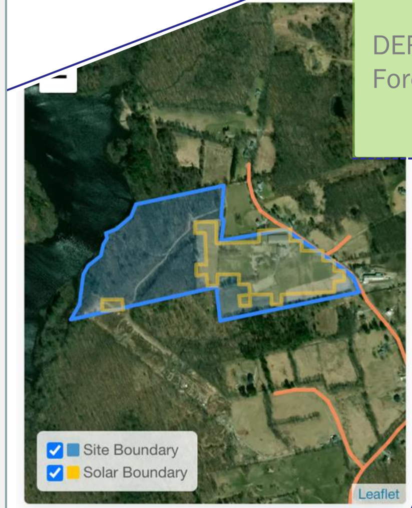
Forecasted Weather Normalized 90/10 Gross Station Peak

Energy Efficiency

DER Forecast

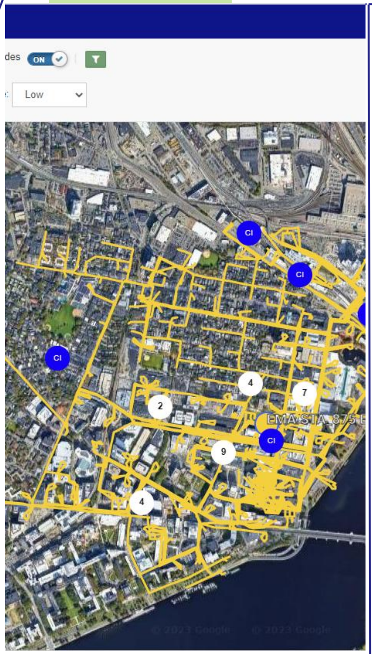
Existing

Forecasted



Adoption propensity modeling using service territory wide parcel data base and geospatial forecasting

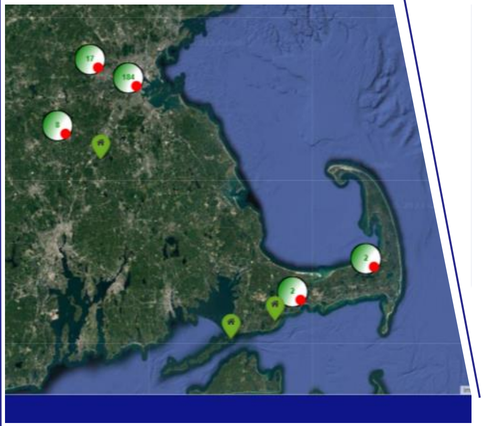
Permanent Load Transfers



Strategic system reconfiguration for load shifting

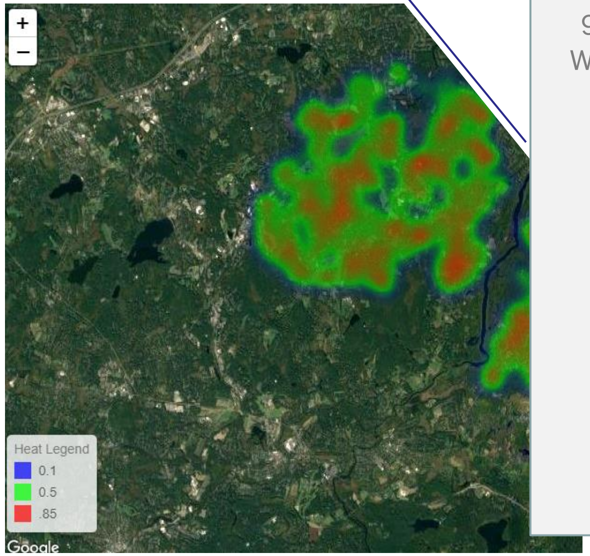
Step Loads

Tracking of every national and strategic account, bulk electrification efforts, and forecasting of potential areas of electrification

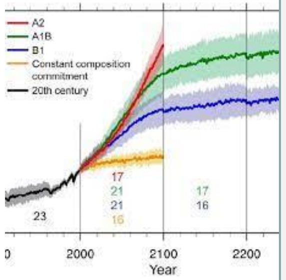


EV Growth

Adoption propensity model based on customer cluster classifications and GPS mobility tracking data



Climate



Climate impact with probability of future heatwaves

Forecasted Net Station Load with 90/10 Weather