BUILDINGENERGY BOSTON

Grid-Interactive Solutions for Sustainable Electrification

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BuildingEnergy Boston 2025

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Learning Objectives

1. Examine the effect of grid-interactivity measures on buildings' net impact to the electrical grid
2. Assess the feasibility of implementing the measures at the building level and the costs/benefits of scaling these practices at the grid level
3. Identify barriers to adopting grid-interactive solutions
4. Explore strategies to improve the value proposition of large-scale electrification and address barriers to adoption

Agenda

PRIORITIZING GRID INTERACTIVITY

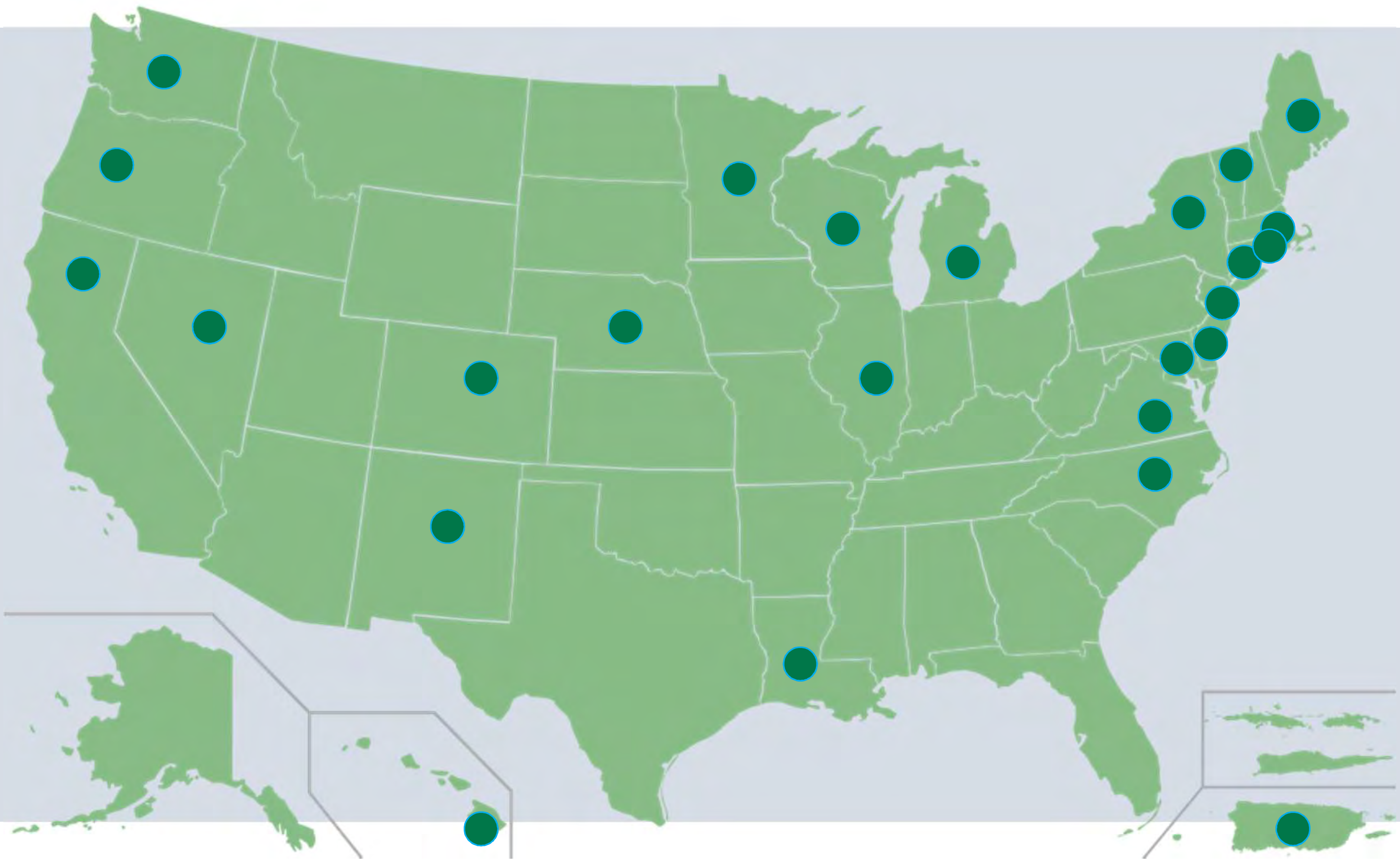
COMBINING ENERGY EFFICIENCY AND DECARBONIZATION MEASURES BARRIERS AND SCALABILITY

CASE STUDY EXAMPLE

Prioritizing Grid Interactivity

A Decarbonized Grid Requires Large-Scale Electrification

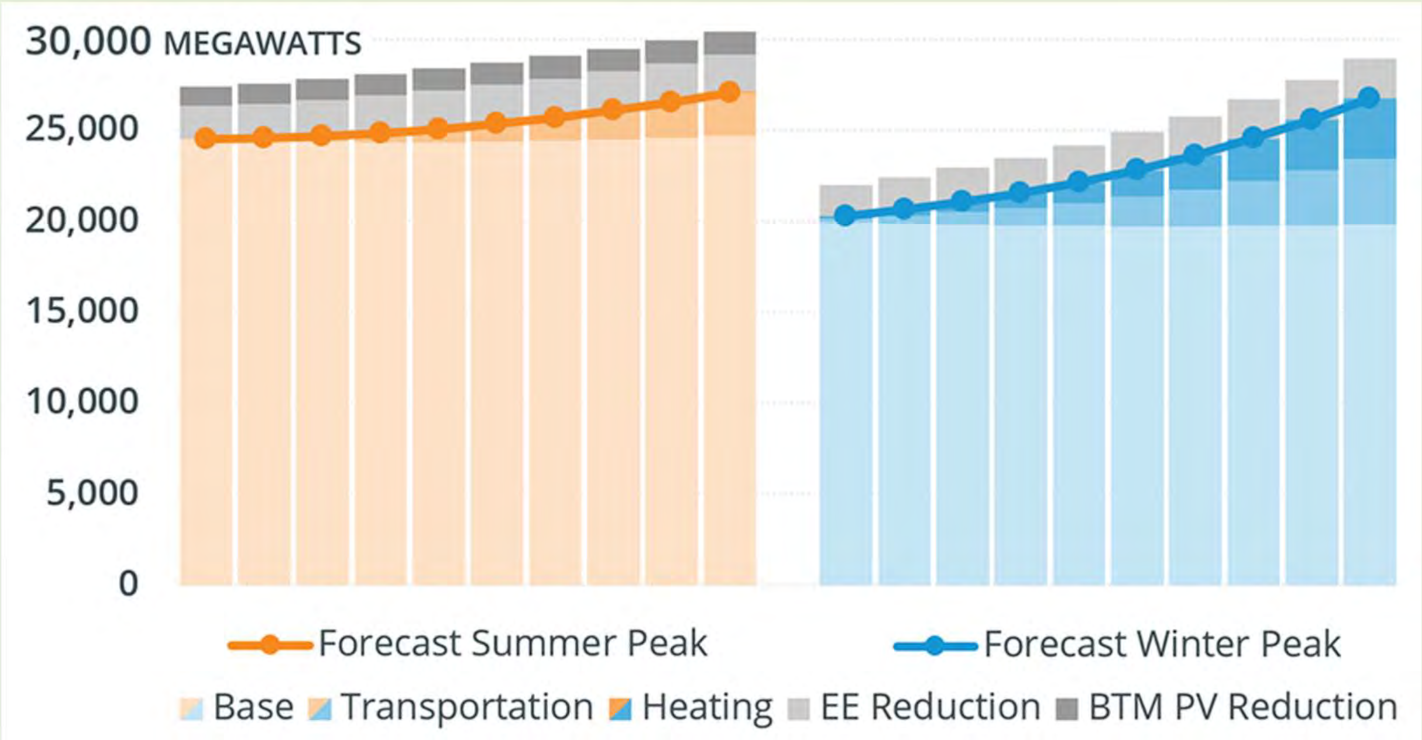
26 states and territories have a 100% “clean” or decarbonized energy goal between now and 2050



https://www.cesa.org/projects/100-clean-energy-collaborative/guide/table-of-100-clean-energy-states/

Impacts of Large-Scale Electrification

Electrifying heating and transportation could add up to 3,000 terawatt-hours to demand by 2050.[1]

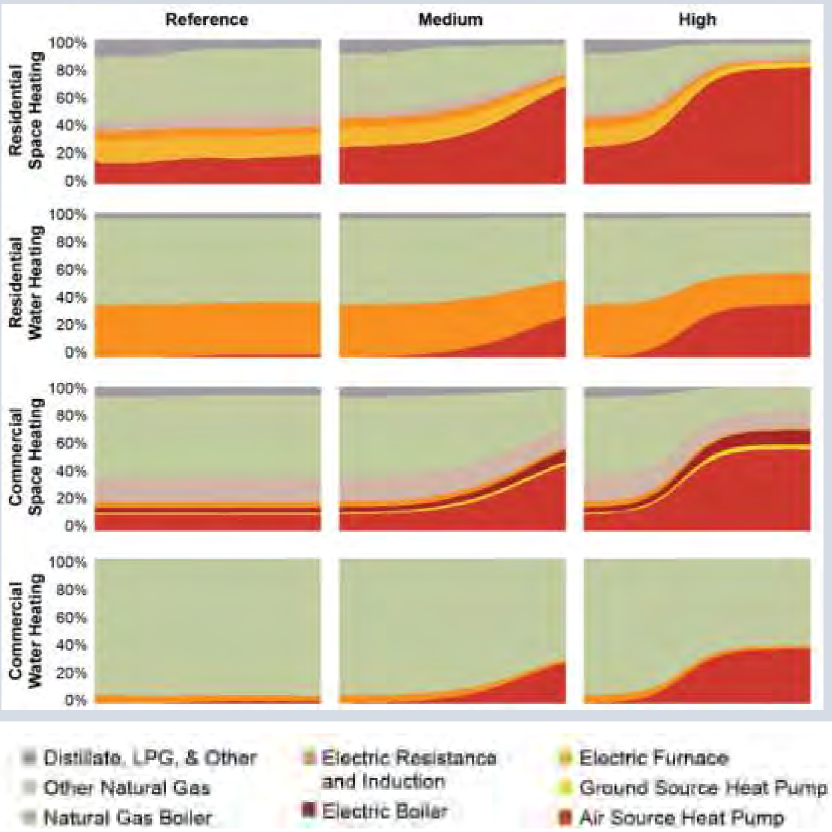


Source: https://www.iso-ne.com/about/key-stats/electricity-use

[1]ACEEE, 2015, *Energy Efficiency in the United States: 35 Years and Counting*

Economics of Electrification

Building Technology Sales Shares by Electrification Scenario
National Renewable Energy Laboratory



Economic benefits to electrification and decarbonization:

- Connecting decentralized resources
- Mitigating damage related to climate change
- Clean energy investments
- State and local building performance standards
- Cost-effectiveness for new projects

Value Proposition of Grid Interactivity

Increasing reliance on electricity will impose new demands on the power system. Grid-interactivity measures can meet the demand with:

- Avoiding the need for extra infrastructure capacity
- Economically feasible renewable connection
- Improved comfort
- Lower utility bills

Image credit: Pervaz

Initiatives & Action

Grid Interactive Buildings for Decarbonization

Design and Operation Resource Guide

A National Roadmap

for Grid-Interactive Efficient Buildings

Grid-Interactive Credit

O+M & BD&C


Stakeholder Feedback and
Concerns

Stakeholder Feedback: Building-Level Interest

Benefits for individuals

- Reduced utility bills, greater control of demand & usage, real-time data, course correction
- Better use of onsite renewables during demand peaks
- Resilience & recovery from disruption.[2]

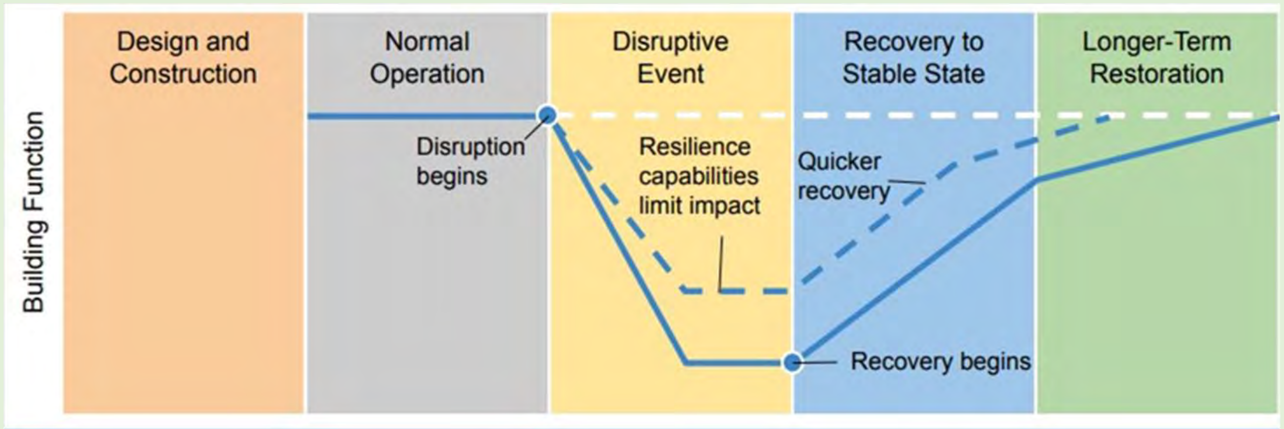


Figure 1. The resilience trapezoid shows a grid outage and the subsequent recovery process. *Illustration adapted from NRELs Resilience Roadmap: A Collaborative Approach to Multi-Jurisdictional Resilience Planning.*[1]

[2]NREL (2024). Best Practices for Resilience in Smart Grid-Interactive Efficient Buildings. National Renewable Energy Laboratory (NREL). https://www.nrel.gov/docs/fy25osti/91473.pdf

Stakeholder Feedback: Building-Level Concerns

Demand management without interruption of daily operations

- Focus should be on outliers
- Is there a role for AI?

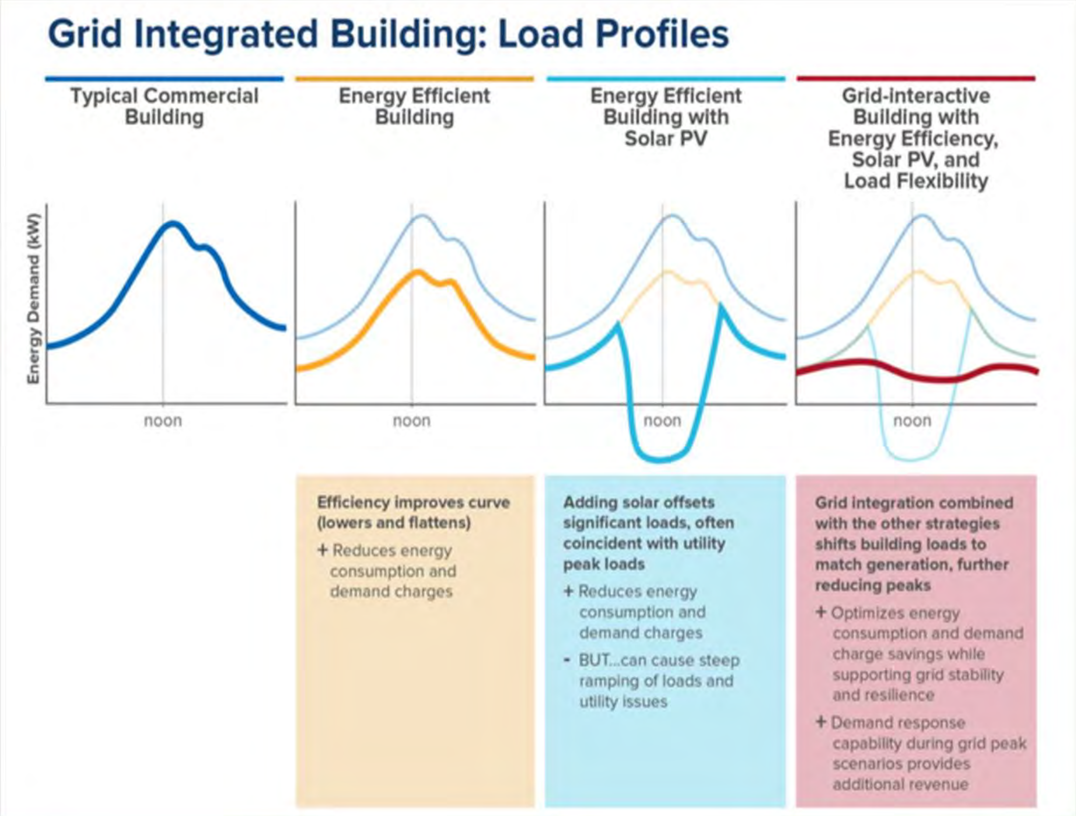
Stakeholder Feedback: Building-Level Concerns

Difficulty and cost planning for complex strategies and stakeholder engagement

- Grid interactivity starts in conceptual design: sufficient space, structure, and measure interactivity

Who can provide this technical assistance?

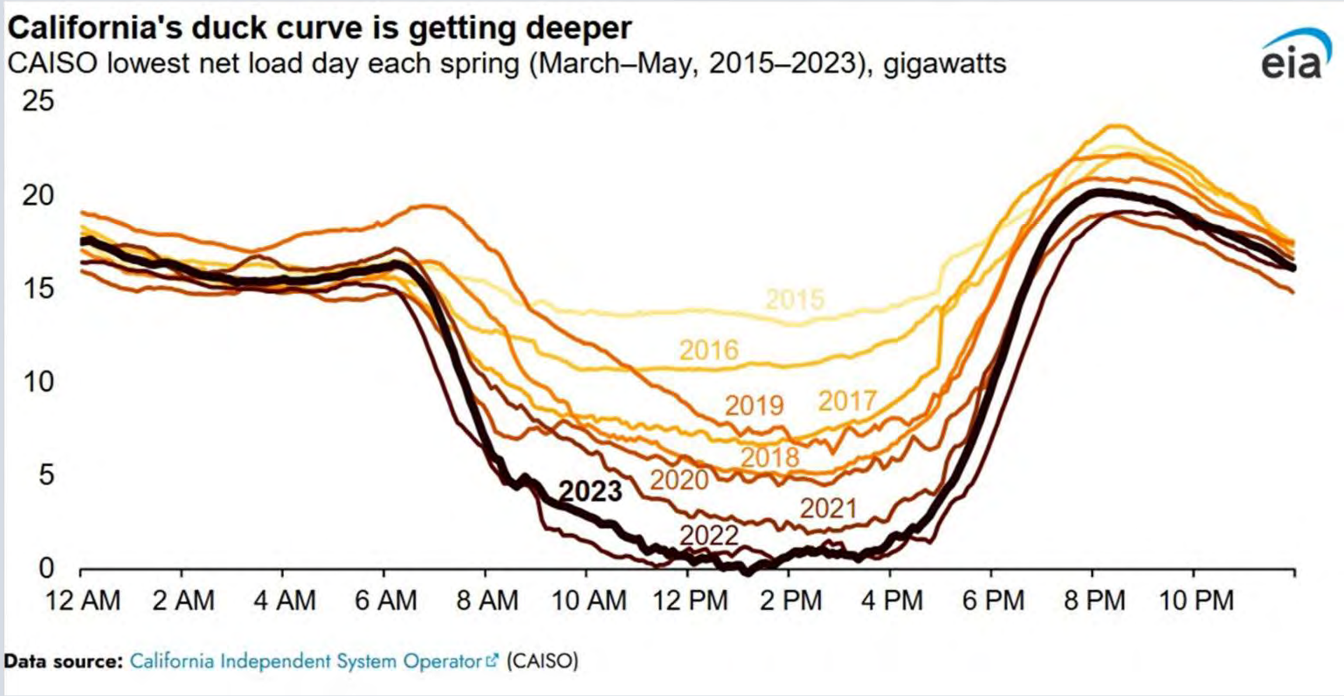
- Need for further education to close the skills gap



https://rmi.org/insight/value-potential-for-grid-interactive-efficient-buildings-in-the-gsa-portfolio-a-cost-benefit-analysis/

Stakeholder Feedback: Grid & Community-Level Interest

- Contribution to community sustainability goals
- Distributed generation requires demand response & storage to bridge gaps between generation and consumption
- Less infrastructure required to meet lower peak demand



https://www.eia.gov/todayinenergy/detail.php?id=56880

Stakeholder Feedback: Grid & Community-Level Concerns

Level of investment

- Cost of inaction: outages may cost US businesses up $150 billion*

Can grid interactive strategies be deployed at scale?

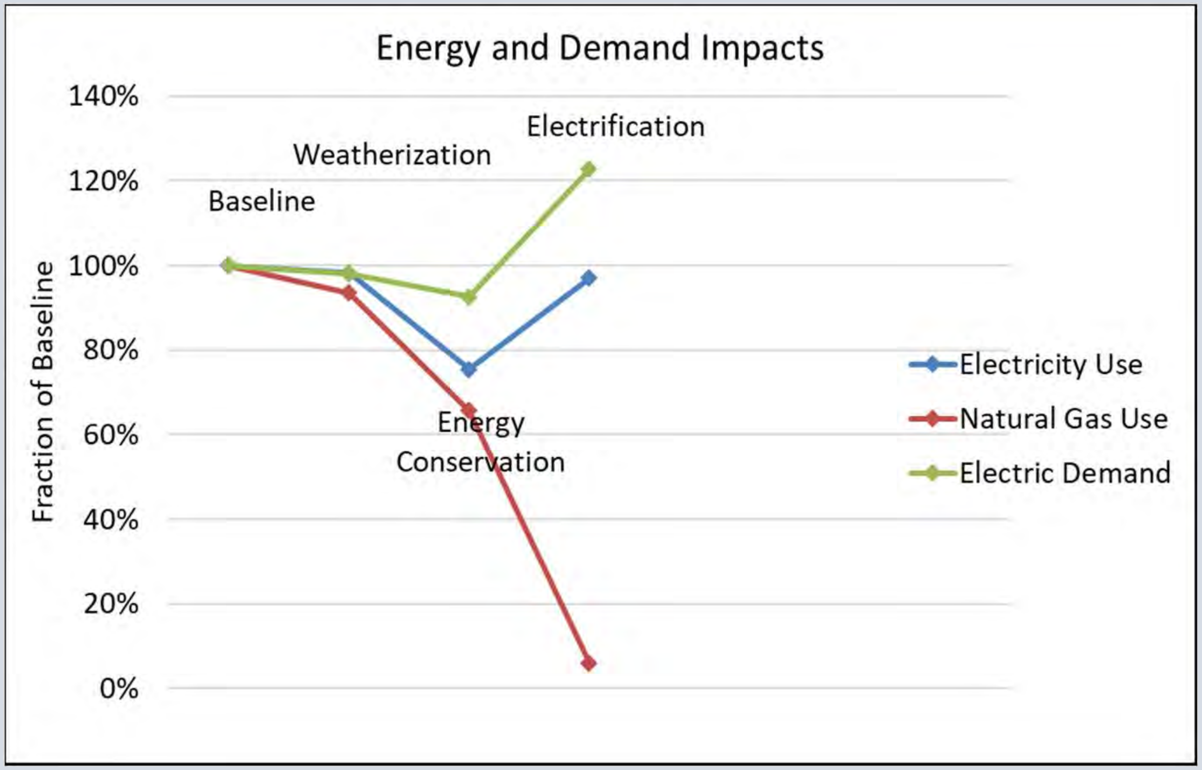
- Predicting peak load periods in advance
- Plan for peak demand as we employ demand management, distributed generation, and storage

*Litos Strategic Communication, "The Smart Grid: An Introduction," U.S. Department of Energy, http://energy.gov/sites/prod/files/oeprod/DocumentsandMedia/DOE_SG_Book_Single_Pages%281%29.pdf

Combining Energy Efficiency And Decarbonization Measures Barriers And Scalability

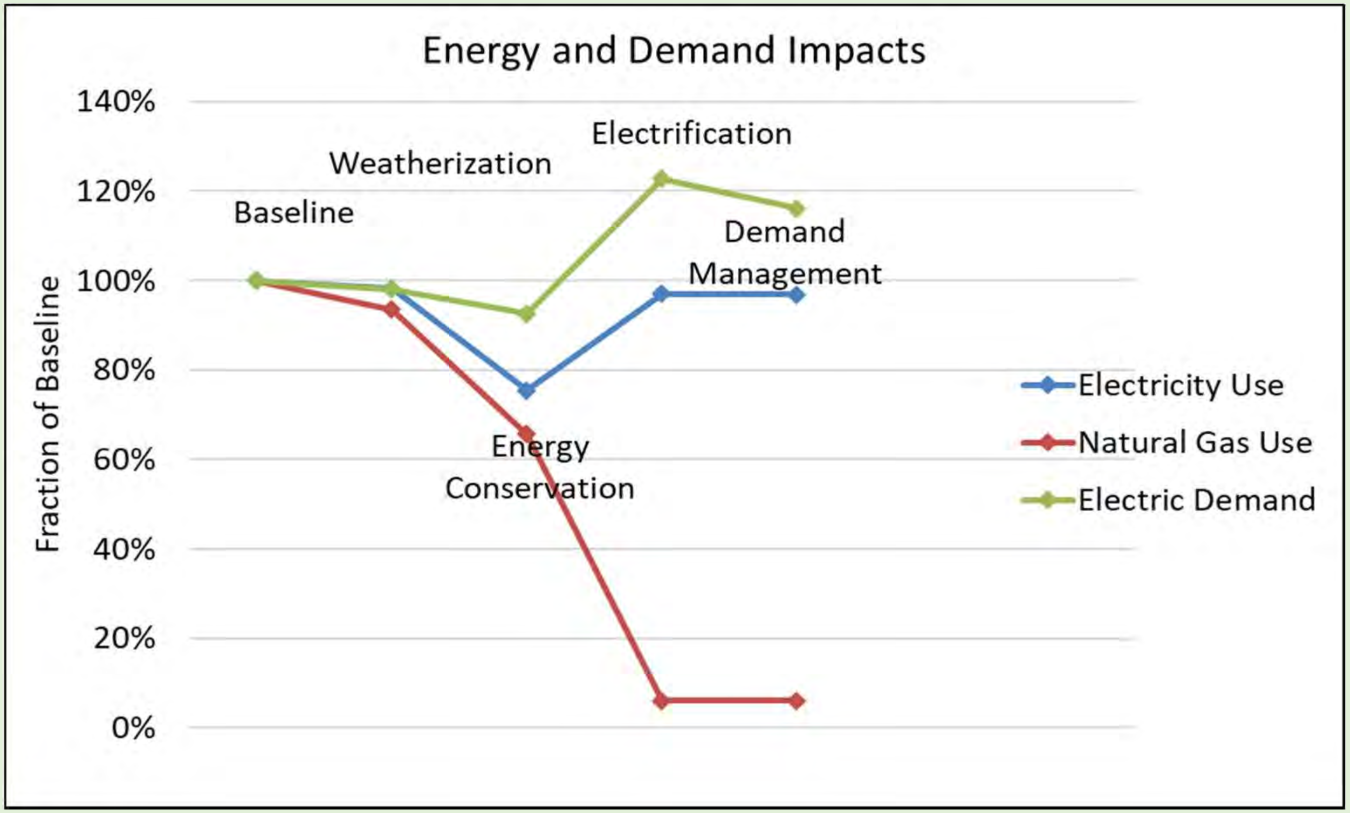
Strategies

Electrification



Even with concurrent conservation efforts, adding electrified heating increases a building's peak demand relative to a similar baseline building

Demand Management



Scaling Demand Management

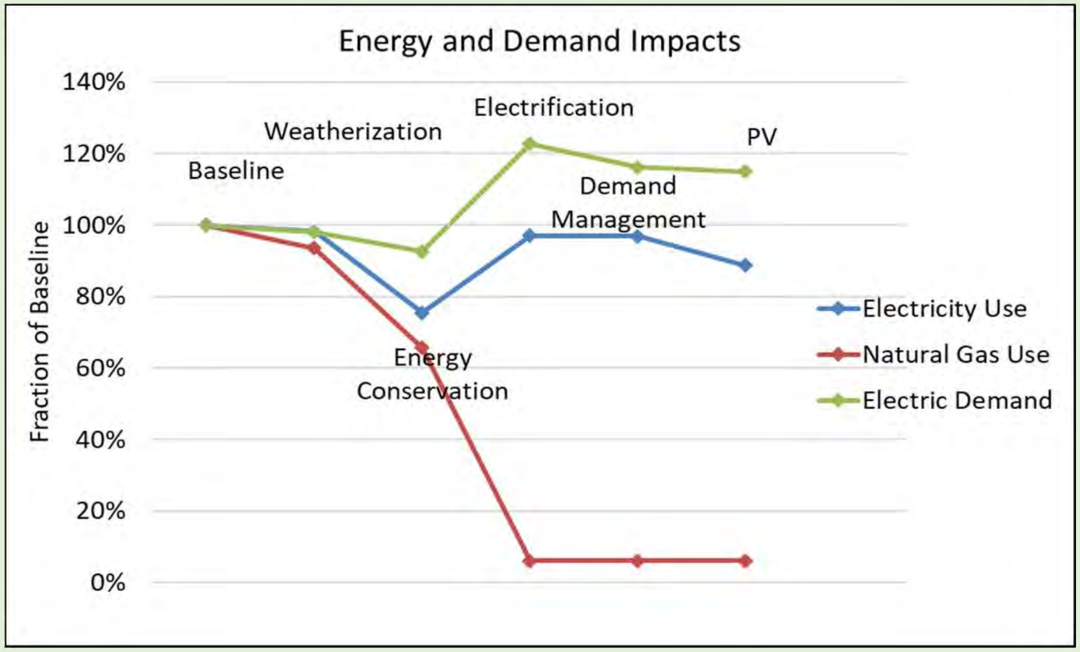
Barrier	Mitigation Measure
Occupant hesitancy to temporarily sacrifice comfort	Education on economic benefits (e.g. demand response revenue), inclusive/proactive communication
Building operator training	Unavoidable for transitions to modern electrified equipment anyway, limited extra knowledge required
Integration with smart metering and/or grid peak alerting systems	Continued technological advancement in standard communication protocols and integrated service offerings from manufacturers

On-Site Generation

Generating more energy onsite will reduce usage (kWh) but has a limited impact on demand (kW) for electrified sites

The new peak will be winter mornings/evenings when the sun is down

Generation remains important to provide an energy source for load-shifting and grid resiliency



Scaling On-Site Generation

Barrier	Mitigation Measure
Insufficient roof/outdoor space	TBD – capture as much as is feasible
Economic impact of exporting to grid at wholesale vs retail rates	Utilities, state agencies, and aggregators continue to develop programs and models that improve clarity and flexibility
Operations and maintenance training/budgeting	Education on required preventative maintenance, encourage proactive service agreements

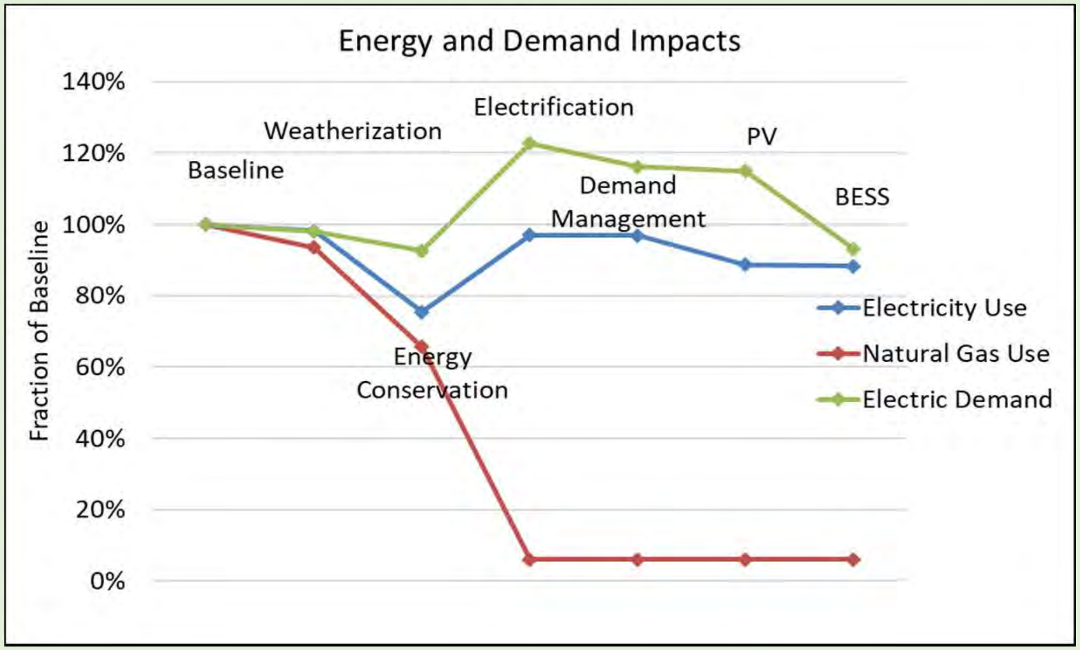
Energy Storage

Storage solutions could be battery **and/or** thermal storage

Storage allows for demand load shifting/peak shaving WITHOUT having to sacrifice comfort during peak periods

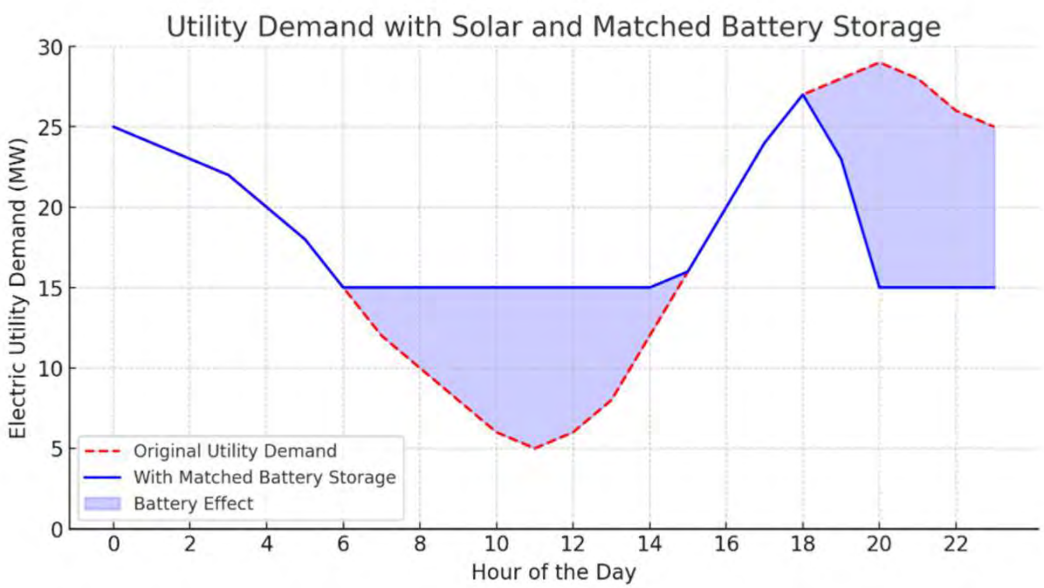
Building using storage solutions might be able to receive more demand response revenue or reduce electricity supply costs (ICAP charge)

Storage also offers resiliency for operation in grid outages



On-Site Generation California Duck Curve with Battery Storage

What if battery storage fully matches the amount of solar generation?

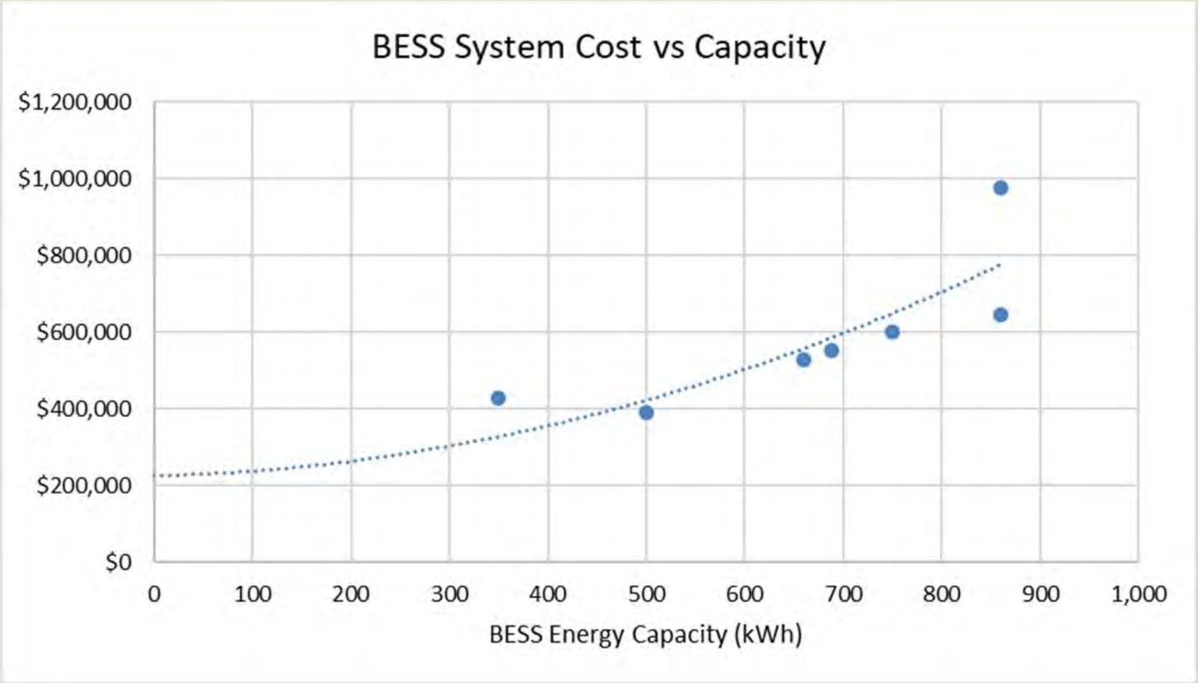


Scaling Energy Storage

Barrier	Mitigation Measure
High equipment costs	Costs will lower as volume increases – reaching economies of scale, continue to expand utility, state agency, federal grants and incentives
Lack of education/ comfort among owners, designers, installers	Encourage subject matter experts to share lessons learned in settings like NESEA, work with utility partners to educate their customers
Increased complexity to operate and maintain	Leverage control automation to reduce demands on facilities staff (energy management systems)

Battery Cost Economies of Scale

- Costs decrease non-linearly
- Costs increase slower than capacity as capacity increases



Energy Management Systems
NEC 705.28

Where not elsewhere required or permitted in this Code, the maximum current for power sources shall be calculated using one of the following methods:

- The sum of the continuous output current ratings of the power production equipment at the circuit nominal system voltage
- For **power production equipment controlled by an EMS**, the current setpoint of the EMS

Power Control Systems
NEC 705.13

A power control system (PCS) shall be listed and evaluated to control the output of one or more power production sources, energy storage systems (ESS), and other equipment.

The PCS shall limit current and loading on the busbars and conductors supplied by the PCS.


Case Study

Case Study: Manchester Public Library

Library Design Highlights

- Three-story, 75k sq.ft.
- High-performance Building Envelope
- 395 kW total PV capacity for Net Zero Energy
- Geothermal Wellfield: 40 - 500 ft wells
- Geothermal Ground Source Heat Pumps
- Submetering: HVAC, Lighting, Plug Loads, PV Production

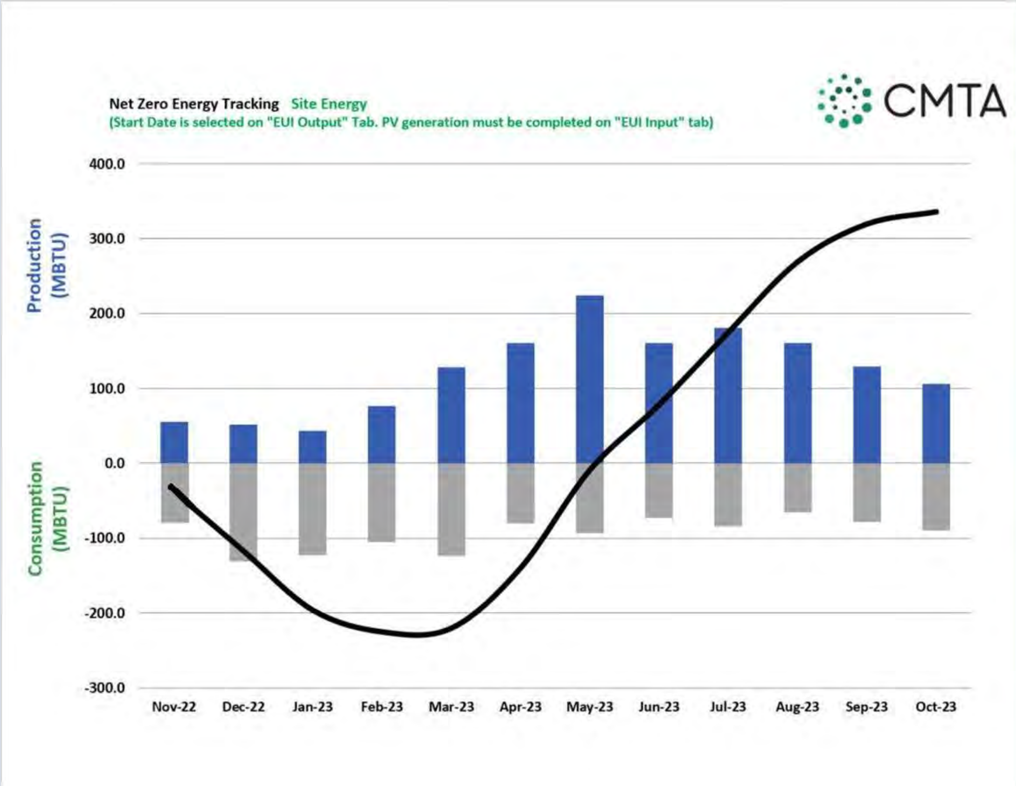
Energy Efficiency Design Programs

Grid-Interactive Efficient Buildings (GEB)

- Funding for BES Feasibility Study

Eversource Path 1 New Construction Program

- Design target Low Energy Use Intensity (EUI)
- Tight Building Envelope
- Energy Model EUI: 19 kBtu/ft²
- Energy Benchmark - Three Net Zero Energy School Projects



Demand Management: Grid-Interactive Building

GIB Lowers Grid Impact: BES Peak Demand Reduction

- Daily Passive Discharge
- Utility-driven Active Discharge

Enhanced Energy Management

- Advanced Load Prioritization
- Integration with Building Automation Systems (BAS)

Solar PV & Battery Electric Storage Benefits

Provides resiliency in grid outages.

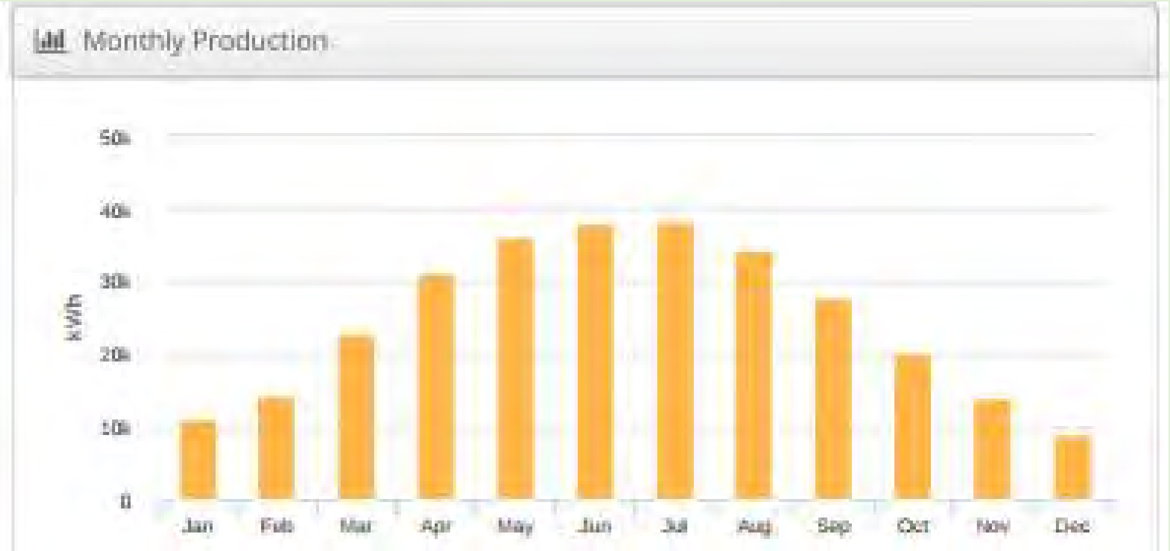
Demand reduction provides utility bill savings

Enables peak load shifting

Microgrid/islanding with BES

Cost Avoidance

- Avoids the need for an emergency generator
- Lighting inverter



Cost-Benefit Analysis - Economic Metrics

2022 IRA Investment Tax Credits

$2.48M Total: Bowers Elementary figures - similar project scope

$1.87M Geothermal

$0.43M Solar PV

$0.18M Battery Electric Storage

$740,000 Eversource Path 1 New Construction

Manchester Public Library

$300,000 Implementation + Verification

$440,000 Geothermal GSHP $4,000/ton, 110 tons

Cost-Benefit Analysis - Economic Metrics
Battery Storage Incentives

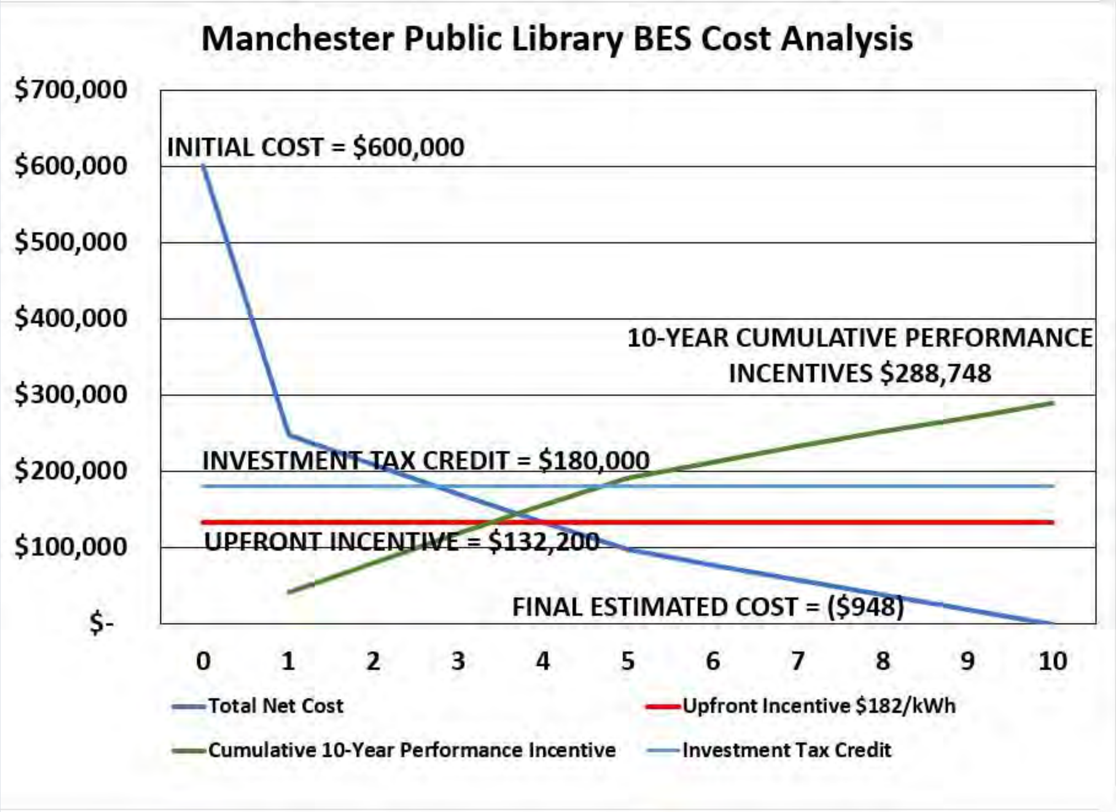
70% Incentive of BES Total Cost

- 22% Upfront
- 48% Active 10 Years

30% 2022 IRA ITC

Cost Avoidances

- Emergency Lighting Inverter
- Emergency Generator



BES Adoption Barriers

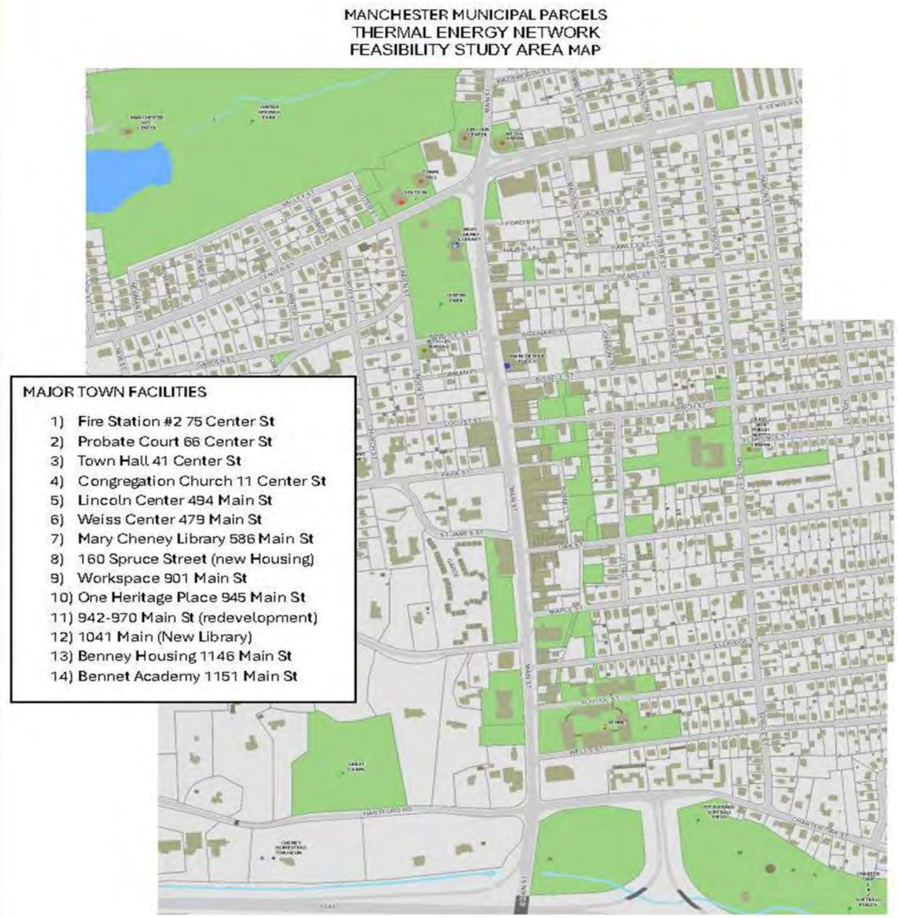
1. Limited Industry BES Design Experience
2. Product Evolution: Understanding available options
3. Choosing the Right System
4. Economic Justification

Replicability/ Scalability in Manchester

Demonstrating performance and efficiency through this project

Sharing lessons learned with town policymakers, local businesses, residents, and regional stakeholders

Main Street Thermal Energy Network (TEN)



Library Case Study Takeaways

Manchester Library exemplifies scalable, high-performance building design.

NZE an economical approach with available incentive programs

Blueprint for future municipal construction projects

BES/Microgrid benefits

- Peak grid demand reduction
- Lower operational costs
- Enhanced resilience
- Environmental leadership

Charting the Way Forward

Grid interactivity: the next frontier beyond efficiency and electrification

Need for early planning, comprehensive design, and technical assistance

Collaboration between customers, utilities, and design firms

- Eversource Grid-Interactive Efficient Buildings (GEB) Offer

Flexible strategies to meet customer needs

Importance of sharing knowledge on both wins and challenges

Questions

EVERSOURCE

Thanks
for listening.