
FRIDAY, NOVEMBER 15, 2024
LET'S DISCUSS GEOTHERMAL FOR HEATING & COOLING
PINE HILL ELEMENTARY SCHOOL
PINE HILL ELEMENTARY SCHOOL
WESTWOOD

PROGRAM SCHEDULE

8:30 AM **Welcome and Introduction**

90 minutes **Panel Presentation & Discussion**

Part I. Basics of Geothermal Technology
Part II. Siting & Constructing your Well Field

10 minutes **Break**

Part III. Skillsets for System Operations
Part IV. Occupant Behavior
Part V. System Maintenance
Part VI. Budget Planning
Part VII. Tips for Success
Part VIII. Cost Incentives

45 minutes **Building Tour of Pine Hill Elementary School**

Q&A Session

10 minutes **Closing Remarks**



Massachusetts School Building Authority

Funding Affordable, Sustainable, and Efficient Schools in Partnership with Local Communities

Jim MacDonald

Chief Executive Officer &
First Deputy Treasurer of the Commonwealth

Massachusetts School Building Authority (MSBA)

WESTWOOD Public Schools

Tim Piwowar

Superintendent

Westwood Public Schools



Massachusetts School Building Authority

Funding Affordable, Sustainable, and Efficient Schools in Partnership with Local Communities

Mary Pichetti

Executive Director

Massachusetts School Building Authority (MSBA)

Kim Cullinane

Manager, New Construction Energy Efficiency

Eversource





Part I. Basics of Geothermal Technology

Joel Mooney

Member, Belmont Permanent Building Committee
Member, Belmont Middle High School Building Committee

P.E., L.S.P.

Ground Source Heat Exchange
"Geothermal 101"
for Heating and Cooling





Joel S. Mooney, P.E., L.S.P.
Town of Belmont
Permanent Building Committee/
Middle and High School Building Committee

Ground Source is **Not**:

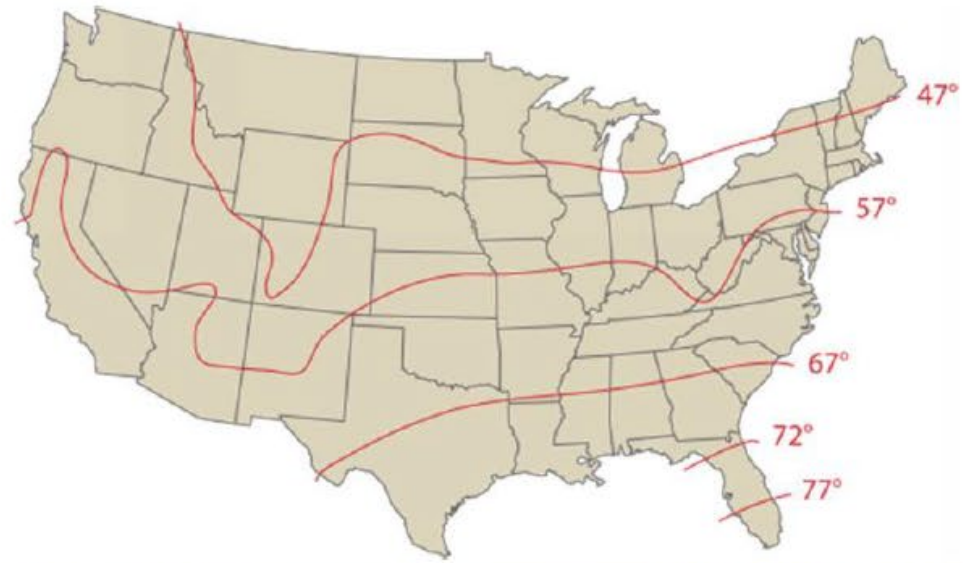
- "Hot Rocks" energy: in regions with high subsurface temps at shallow depths (Iceland, western U.S.)
- Steam collected from the subsurface drive turbines for power
- Very deep boreholes into the earth's crust ~5,000 to 6,000 ft





Ground Source Heating and Cooling

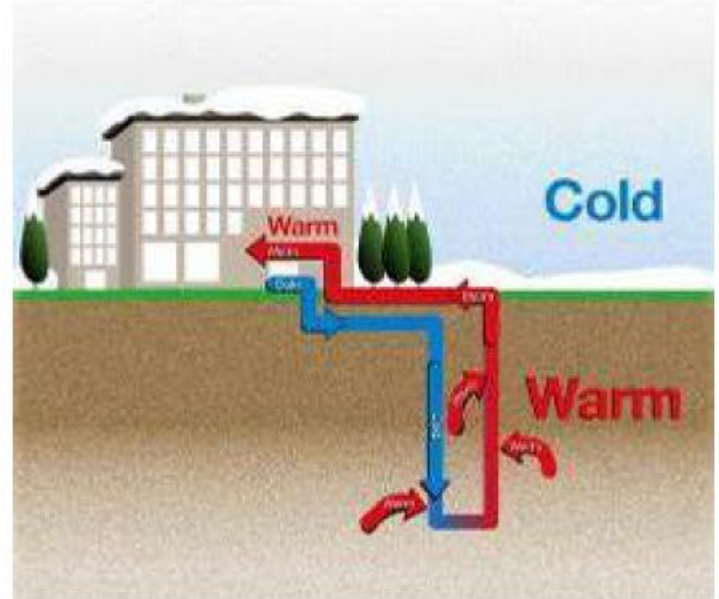
- Available energy from existing shallow earth conditions
- Northeastern US: Stable subsurface temperatures, 50 to 55°F
- Shallow rock: 4±X better thermal exchange in rock than soil
- Most structures have both heating and cooling demands, which promotes well field balance

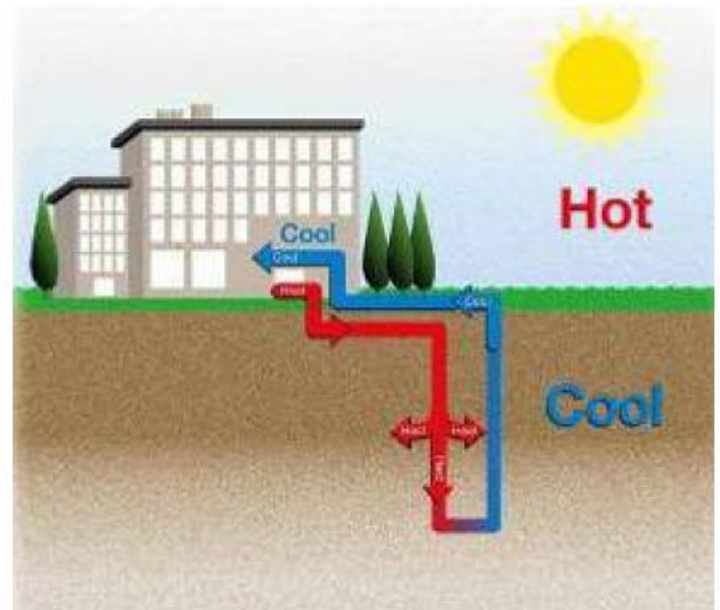




Ground Source Heating and Cooling

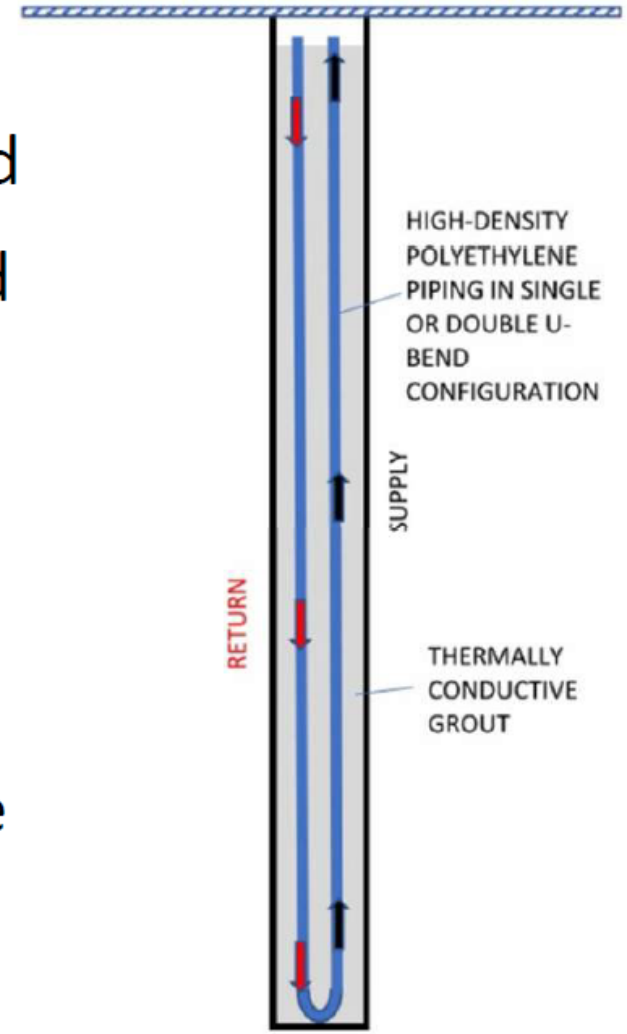
- Conceptually, these systems utilize the ground as a battery
- Using pumps (to recirculate fluid, water/glycol mix), heat exchangers, and compressors:
  - Draw heat from the ground in the winter
  - Reject heat to the ground in the summer
- Need to continuously monitor system and temperature of well field





Ground Source – Closed Loop Well in Bedrock

- Closed systems are stable and do not have long term environmental impacts, groundwater is not impacted
- Wells (boreholes) are cased through soil and grouted into bedrock, thermal transfer best in bedrock
- Supply and return lines circulate water/glycol mix to the mechanical room inside the building
- “Standard” well is 500-ft deep single U-bend
- Increasing the well depth or adjusting piping (double U bend) can increase thermal exchange/well



Ground Source – Feasible?

- Input to Feasibility Study and go/no-go decision making:
  - Site geology – contamination present?, depth to bedrock
  - Spatial constraints – utilities, trees/ landscape, building footprints
  - Permitting – aquifer protection, water and spoils management
  - Size of well field/Estimated costs
- Ground Source may not be viable at every site, identify deal breakers early

Soil Properties

Soil Description	Conductivity Btu/(hr*ft*°F)
Average Rock	1.400
Dense Rock	2.000
Heavy Soil, Damp	0.750
Heavy Soil, Dry	0.517
Heavy Soil, Sat.	1.400
Light Soil, Damp	0.500
Light Soil, Dry	0.199
Black Cotton Soil	0.634
Red Soil	0.578
Sand - Gypsum	0.601



Ground Source – Test Well

- When Ground Source is a “GO”
- Installation of test well(s) to define design assumptions
- Basis of Design
  - Thermal properties of bedrock
  - Thermal exchange per well
  - Layout/spacing
- Constructability
  - Rock quality, drilling methods
  - Spoils management
  - Water volume, treatment
  - Production → cost



Ground Source – Design

- Ground Source needs to planned, designed, and integrated into the Project like any other system
- Need to define contribution of ground source to building's heating and cooling, and design other systems to provide remainder of building's heating and cooling needs and meet project energy goals.
- Planning, Planning, Planning
- Coordination with Architect and MEP to define goals and objectives of system
  - Ground source's fit into overall HVAC system?
  - Heating and Cooling loads/well field balance
  - How to reject heat to keep system balanced?



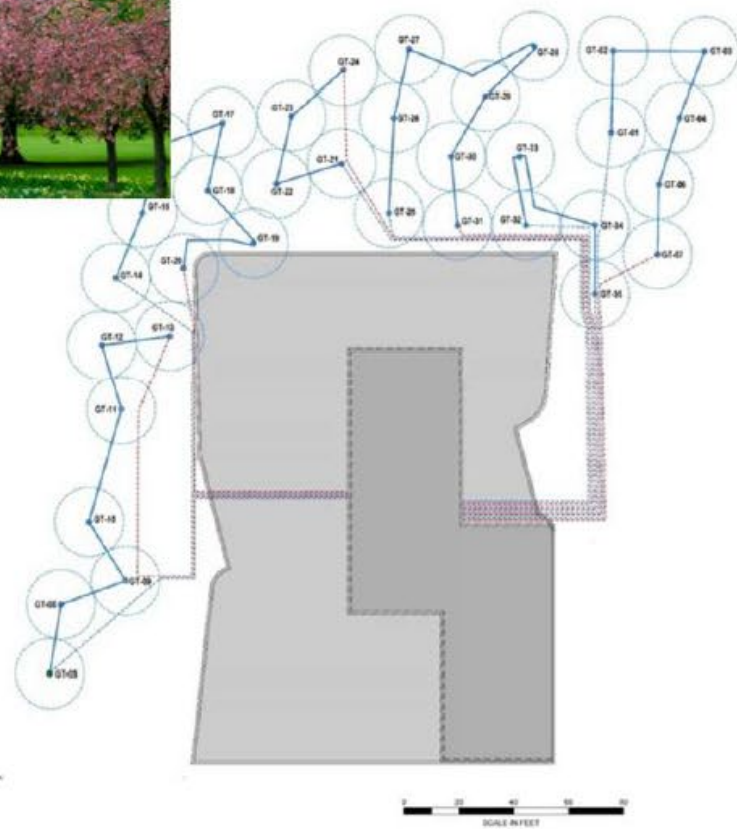


Ground Source – Design

- Site, Civil, and Landscape Design coordination:
  - to avoid conflicts with utilities, trees/landscape, property lines
  - Allow for future access and maintenance
- What controls and operational actions are required to support the ground source system?
- The system will evolve as you work through the design process.

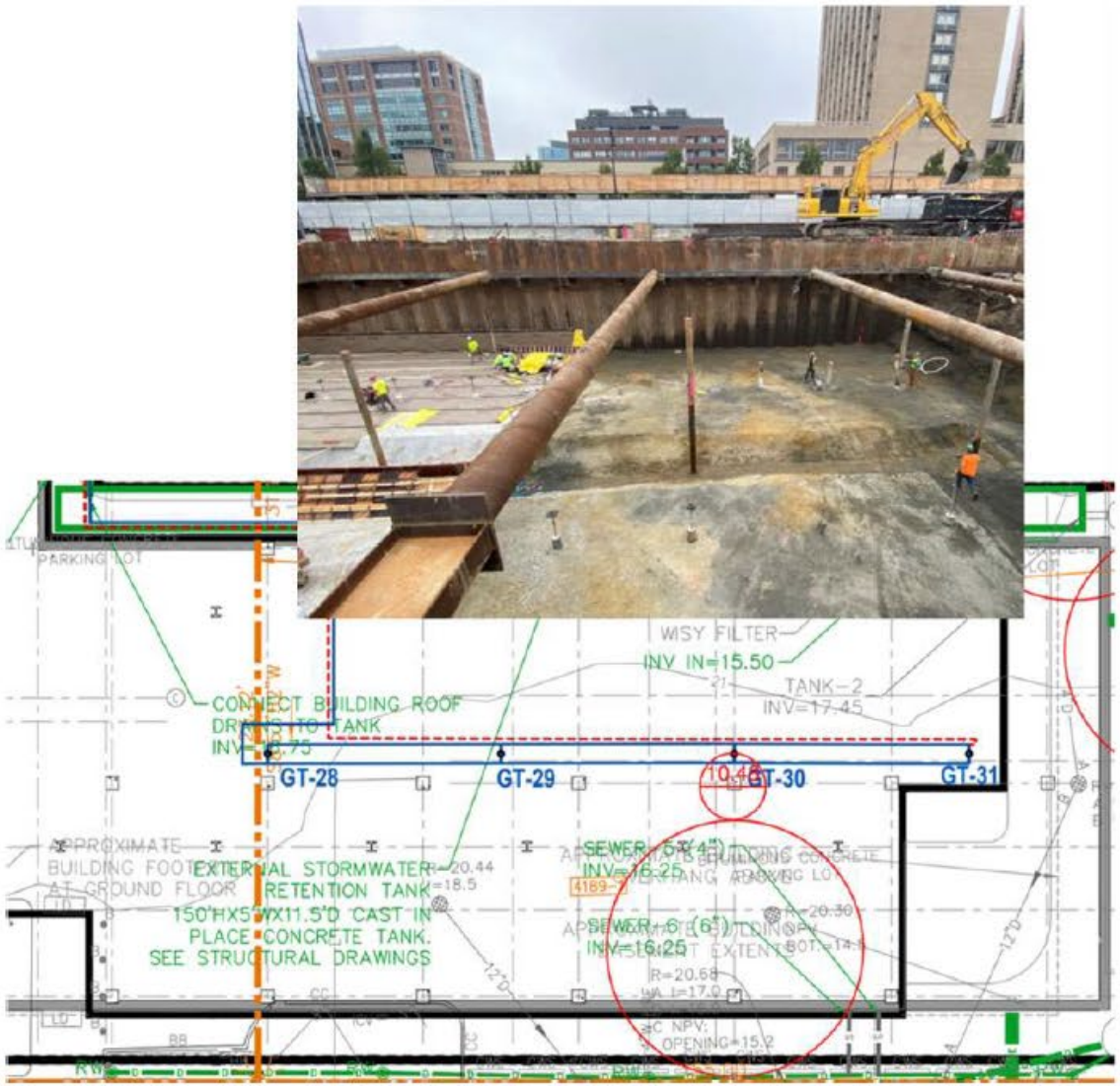






Ground Source – Design

- Boreholes beneath buildings
  - Field must be configured around utilities, column lines, support of excavation
  - Install before or after excavation?
  - Schedule impacts – drilling within footprint limits other activities
  - Drilling after excavation – need plan to protect subgrade
- ***Not typically recommended!***



Q&A



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45 minutes **Building Tour of Pine Hill Elementary School**

Q&A Session

10 minutes **Closing Remarks**

Part II. Siting & Constructing your Well Field



DORE + WHITTIER
Architecture · Project Management

Rob Fitzgerald

Senior Associate

Dore + Whittier

Bill Lovallo

Chair, Belmont Middle and School Building Committee
Member, Belmont Permanent Building Committee

P.E., Managing Principal, LeMessurier.

Kate Crosby

Energy Manager

Acton-Boxborough Regional School District

Shawn Newell

Assistant Director, Department of Public Facilities

Town of Lexington

Christy Murphy

AVP, Project Executive, Project Advisory

The Vertex Companies, LLC

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Chin Lin

Senior Project Manager

The Vertex Companies, LLC

Added Steps for Ground Source HP

Design

Well Designer
Automation Consultant
Envelop Consultant

Construction

Well Installation Monitoring
Additional Envelop Cx
Automation Consultant

Start Up / Occupancy

Automation Consultant
Energy Use Review Mtgs

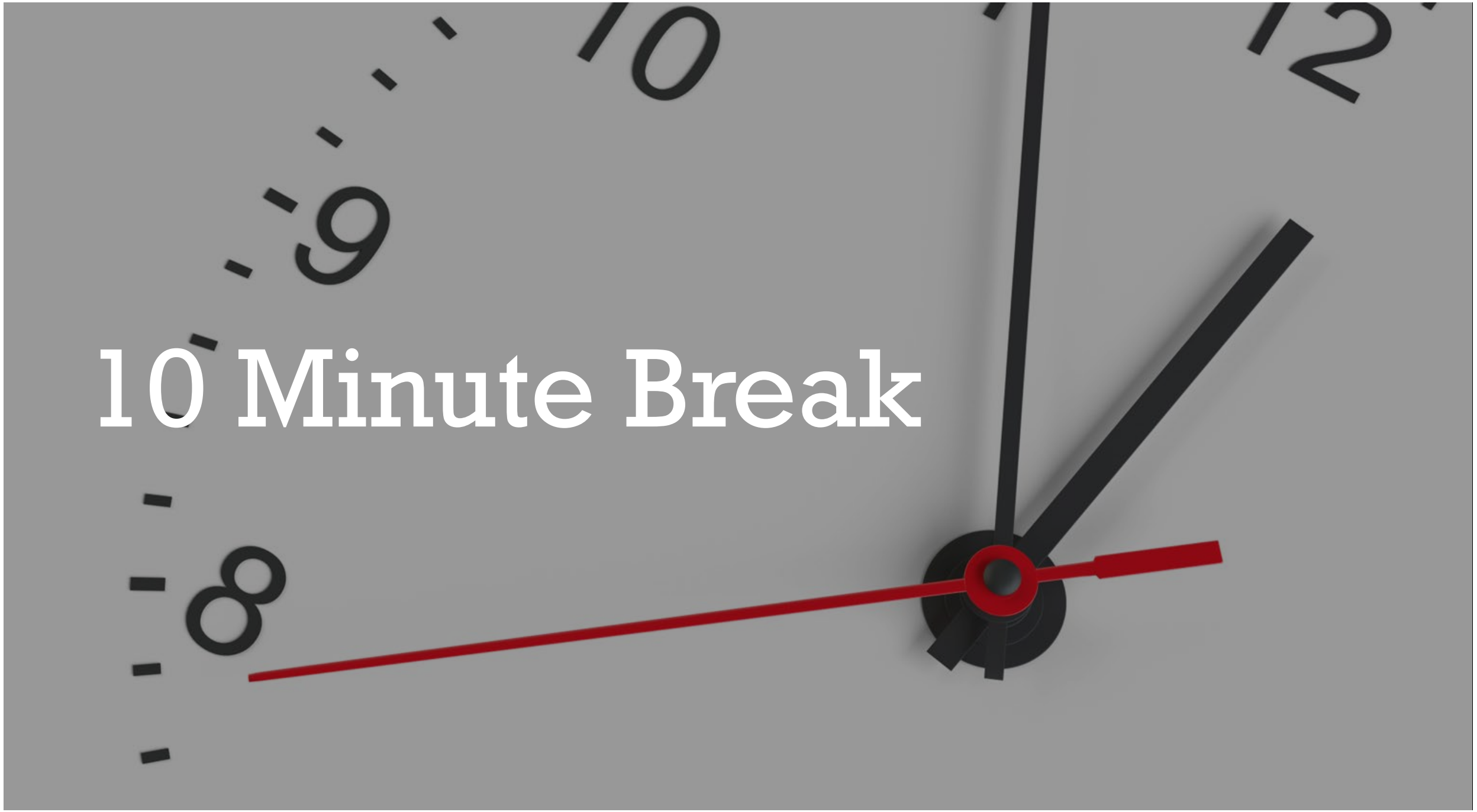
Verification

Regular Energy Use Review Mtgs

Have a team with proper expertise to take over the building operation

Q&A




10 Minute Break

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Part III. Skillsets for System Operation



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"Founded in Peace"
WATERTOWN
MASSACHUSETTS

Silas Fyler

Assistant Director of Energy Management

City of Watertown

Q&A





Part IV. Occupant Behavior

Kate Crosby

Energy Manager

Acton-Boxborough Regional School District

Chin Lin

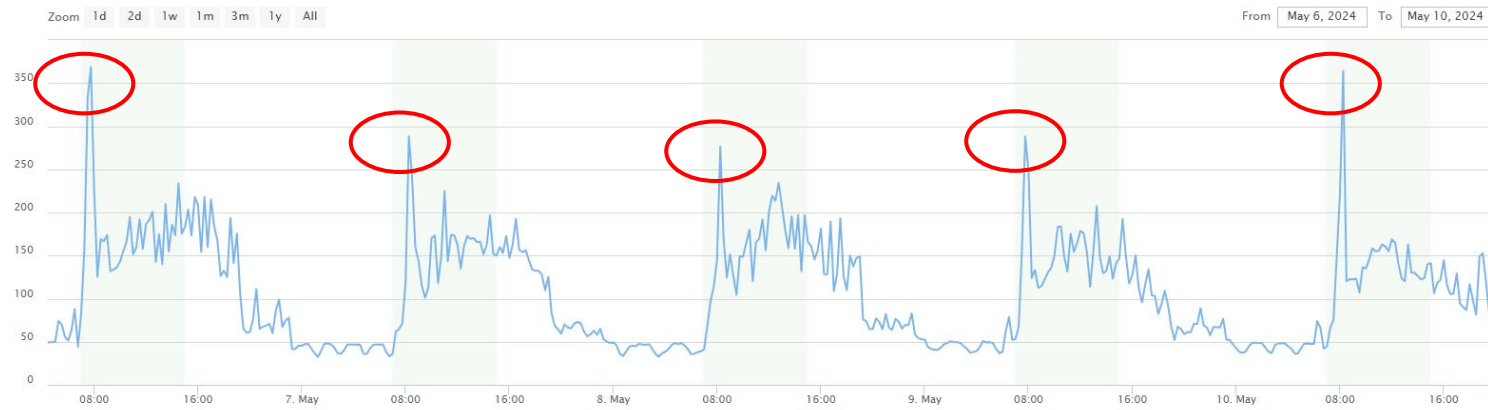
Senior Project Manager

The Vertex Companies, LLC

Kitchen Equipment Startup

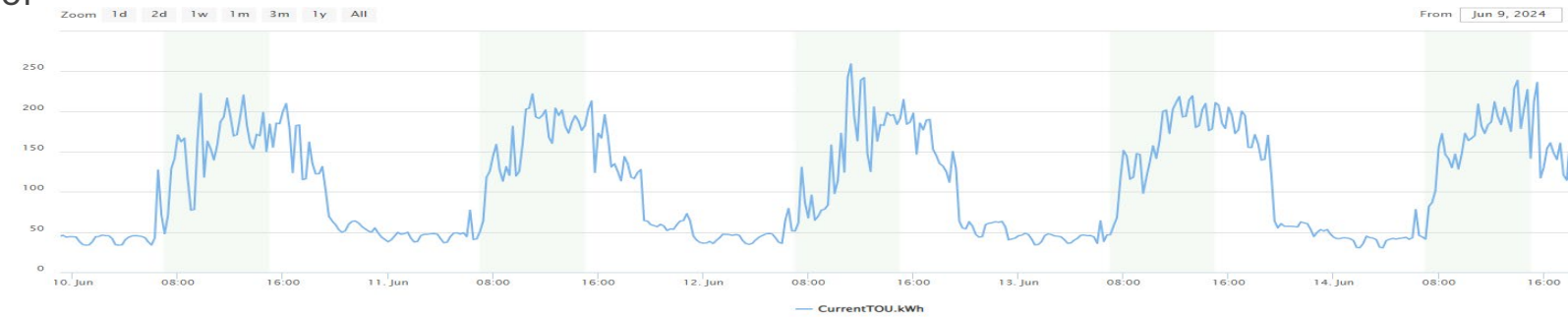
- IDS routinely reviews hourly energy data from the utility and noticed the peak electric demand consistently occurred at 8:45AM each morning during May 2024.
- Review of BAS operational data determined the time of peak did not coincide with peak HVAC operation.
- Reported findings to facility director who surmised that cafeteria staff were starting all kitchen cooking equipment at the same time (8:45AM each morning)
- Next day Kitchen staff staggered start of kitchen equipment IDS confirmed the change was implemented successfully the following day
- Excess cost was approximately $2,300 per month (assuming 75 kW savings at peak demand rate of $31/kW)

May '24 peak demand exceeds 300-350 kW each morning at 8AM when kitchen cooking equipment is started

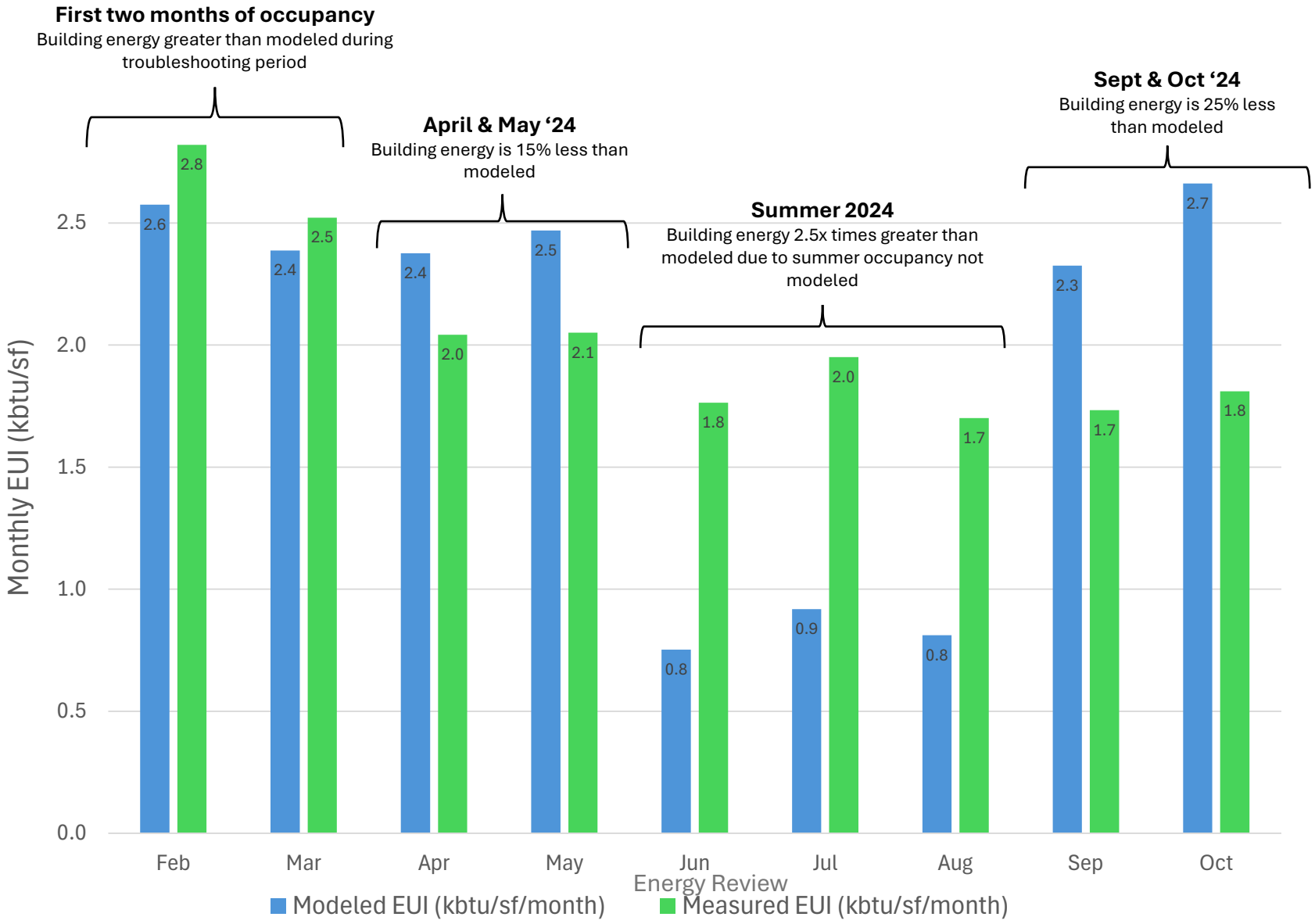


Kitchen Equipment Startup

June '24 peak demand does not occur during morning as staggered start of Kitchen equipment was implemented



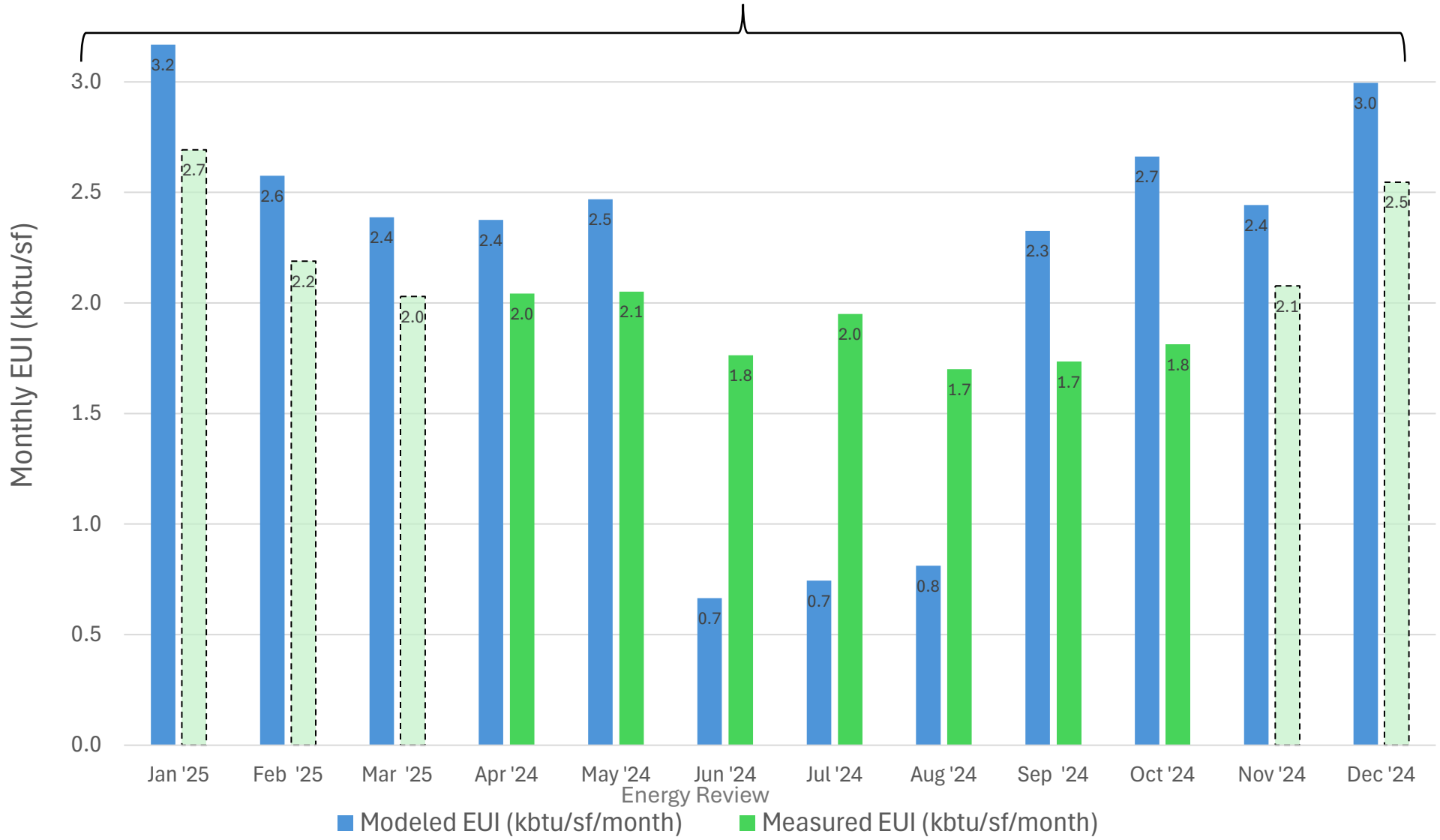
Measured vs Modeled EUI



Predicted EUI (April ‘24 to March ‘25)

Predicted EUI = 24.6

If building performs 15% better than modeled from Sept ‘24 to March ‘25



Bill Lovallo

Chair, Belmont Middle and School Building Committee
Member, Belmont Permanent Building Committee

P.E., Managing Principal, LeMessurier.

Q&A





Part V. System Maintenance

Tom Gatzunis

Section Manager

CHA Consulting Inc.

Shawn Newell

Assistant Director, Department of Public Facilities,

Town of Lexington

Q&A



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Part VI. Budget Planning



WESTWOOD Public Schools

Lemma Jn-baptiste

Director of Finance and Operations

Westwood Public Schools

Q&A





Part VII. Tips for Success

WESTWOOD Public Schools

Lemma Jn-baptiste

Director of Finance and Operations

Westwood Public Schools

Q&A





Part VIII. Cost Incentives

Kim Cullinane

Manager, New Construction Energy Efficiency

Eversource

mass save®

Together, we make good happen for Massachusetts.

Your local electric and natural gas utilities and energy efficiency service provider are taking strides in energy efficiency: Berkshire Gas, Cape Light Compact, Eversource, Liberty, National Grid and Unitil.

As one, we form Mass Save®, with the common goal of helping residents and businesses across Massachusetts save money and energy, leading our state to a clean and energy efficient future.

WE ARE MASS SAVE®:

Berkshire Gas
An Avangrid company

Cape Light Compact

EVERSOURCE

Liberty®

nationalgrid

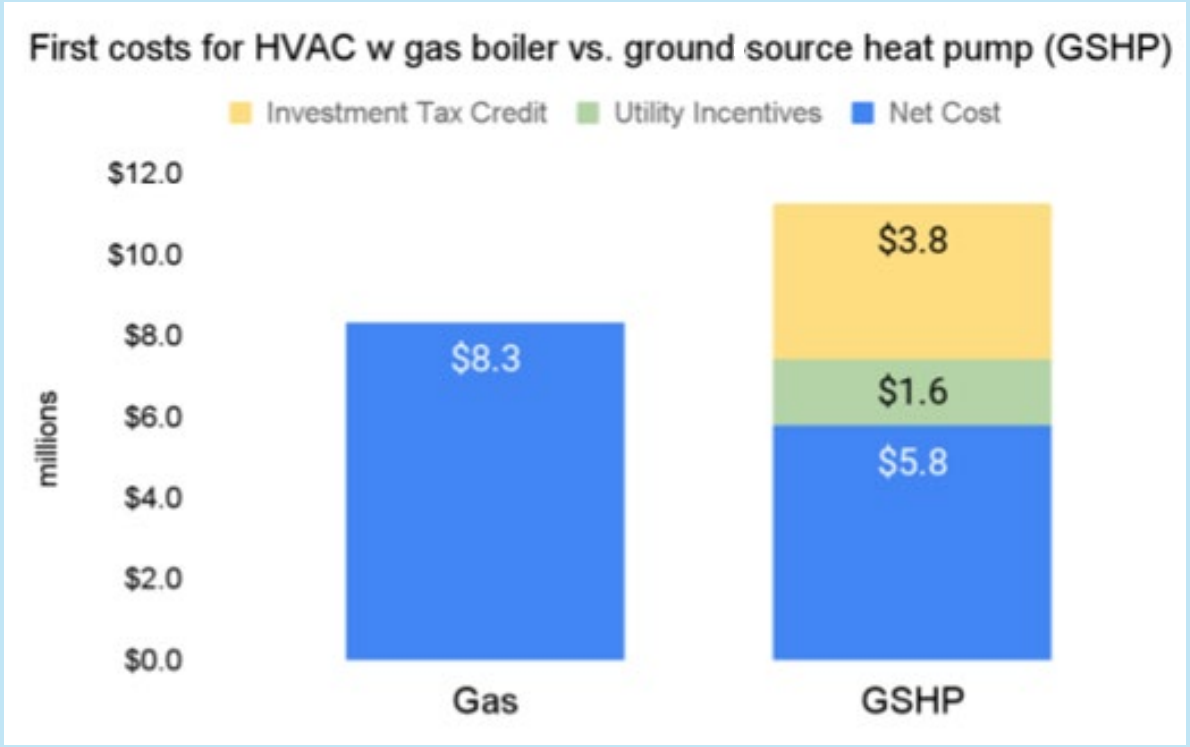
Unitil



Fully Decarbonized New Buildings/Major Renovations are Good Investments

Path 1 Projects	Project Count	Square Footage
K-12 Schools*	37	6,269,562
Public Safety	6	168,736
Library	8	252,377
Office	2	114,280
College or University	5	610,200
Other	18	1,295,641
Total	**76**	**8,710,796**

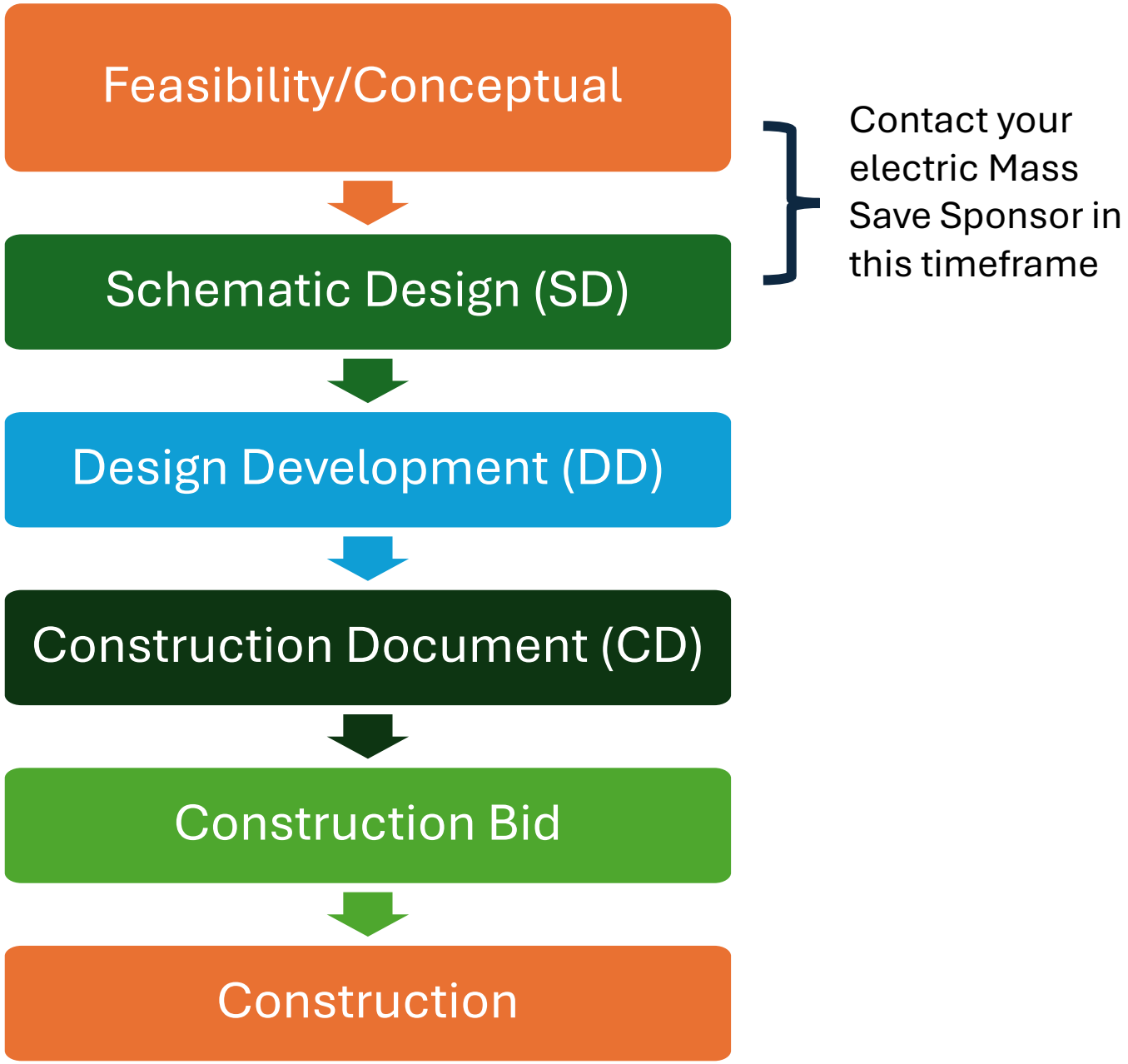
***23 Path 1 K-12 schools are planning to use ground source heat pump technology**



Undaunted K-12: https://www.undauntedk12.org/massachusetts/our-schools-cant-afford-fossil-fuels-lets-spread-the-word

What Can You Do?

1. Add your low carbon, net zero, under 25 EUI goals into your Request for Design Services
2. Engage Mass Save Sponsors on projects early, during project feasibility. Visit: https://www.masssave.com/cincmr
3. Learn about IRA tax credits



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Building Tour

Please check your **nametag** and meet your assigned **group tour guide** outside of the media center.

After the tour, all groups will return to the media center.





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Mary Pichetti

Executive Director

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Thank you for joining us!

We hope you enjoyed learning more about Geothermal Heating & Cooling.

