January 29th, 2021

Heating Electrification Strategies to Decarbonize BU's Charles River Campus: Phase 2 Focus on Key Existing Buildings

1. Problem Definition & Overview of Approach
2. Phase 1 Findings
3. Peak Electrical Demand Estimate
4. Strategies to Reduce Peak Electrical Demand & GHG Emissions

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Overview

- BU's Climate Action Plan aims to eliminate BU CRC's carbon emissions by 2040
- 40% of BU's CRC Greenhouse gas emissions stem from heating its buildings

Why *Electrify* Heating Systems?

- Electric heating reduces 100% of the carbon emissions from existing fossil heating systems

Why Retrofit *Existing* Buildings?

- BU's campus only grows by 0.75% each year[1]
- We cannot wait to construct new buildings to reduce BU's carbon emissions

Scope of Problem

- 211 buildings[2] | 10 M ft^2 CRC[2] | $12M/yr of NG use[2,3] | 20-year timeframe

Driving Question: How can we electrify the greatest % of BU's fossil heating systems in the shortest time given limited capital and operating budgets?

1. From Energy Section of BU CAP
2. 2016 Utility Data, excludes rentals
3. NG Price of $13.83/MMBtu

Phase 1 Findings

1

Focus on retrofitting 15 key buildings

Reduce 44% of CRC's fossil heating energy use with only 15/211 buildings

2

Air-Source vs Ground-Source Heat Pumps

GSHPs' higher efficiency does not offset it's greater capital cost and disruption when compared to ASHPs.

3

Install Hybrid Systems of Heat Pumps & Boilers

Minimize capital cost, maximize utilization of heat pumps

4

Explore High-Temp Heat Pumps

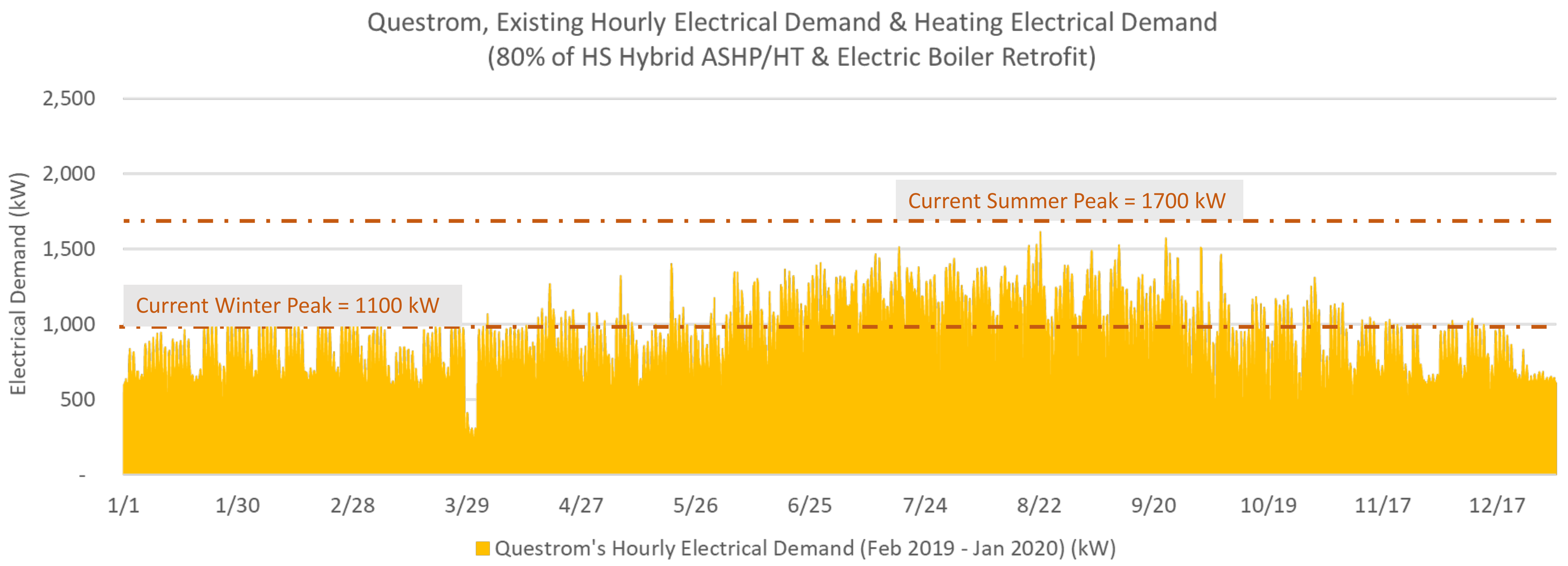
More compatible with existing equipment thus requiring less extensive renovations

<u>Phase 2 Focus:</u>

- Feedback from MEP companies: Is our retrofit feasible given existing electric capacity?
- Tailoring retrofit strategy to key buildings → start with Questrom!

Higher Peak Electrical Demand

- Peak Electrical Demand: max electrical power (kW) drawn from electrical service in a 15-min interval
- Increase in capital cost and complexity b/c of need to upgrade electrical service



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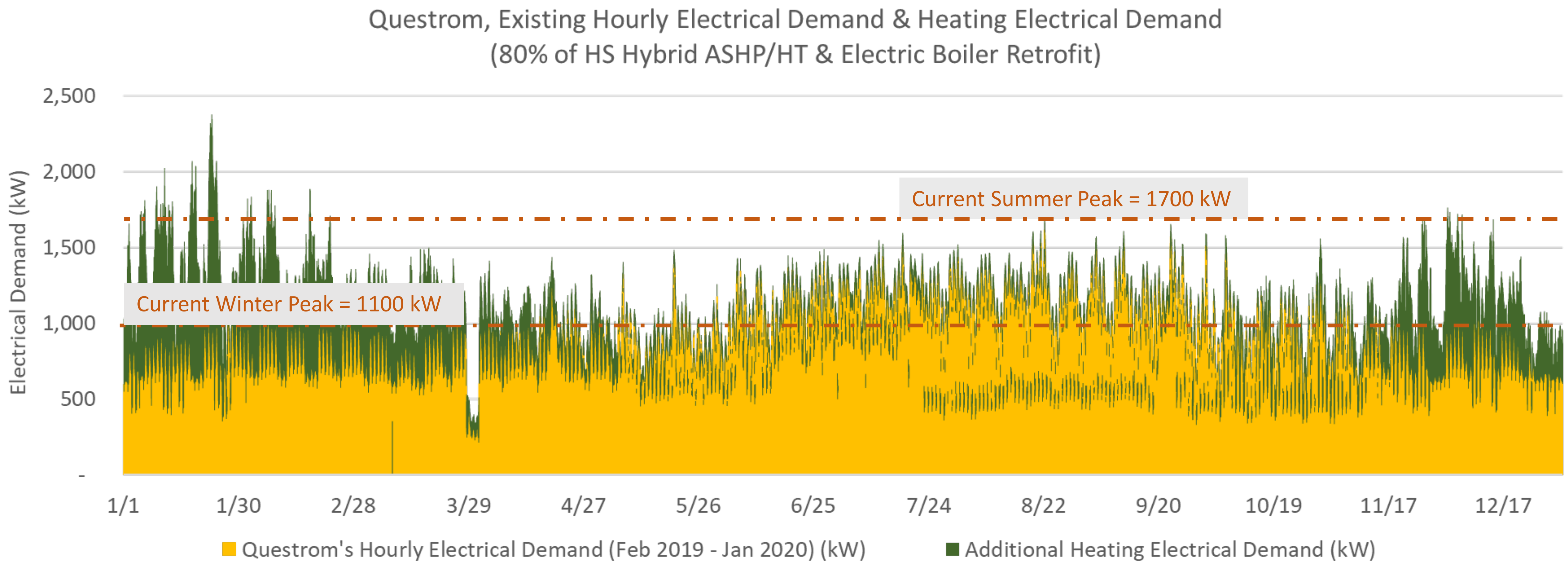

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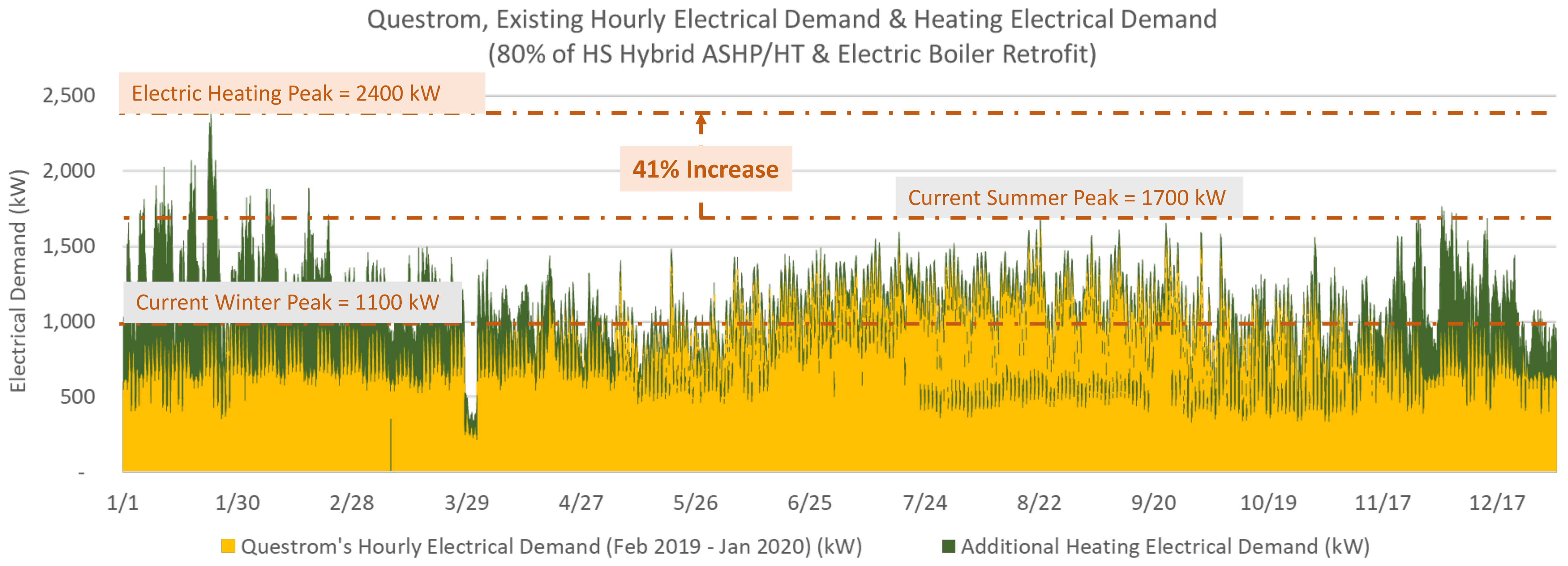


Research Questions

1. Cost of upgrading building's electrical capacity?
2. What hot water temperature is needed for perimeter heat and AHUs?
3. What equipment design minimizes capital cost, operating cost, greenhouse gas emissions, and peak electrical demand?

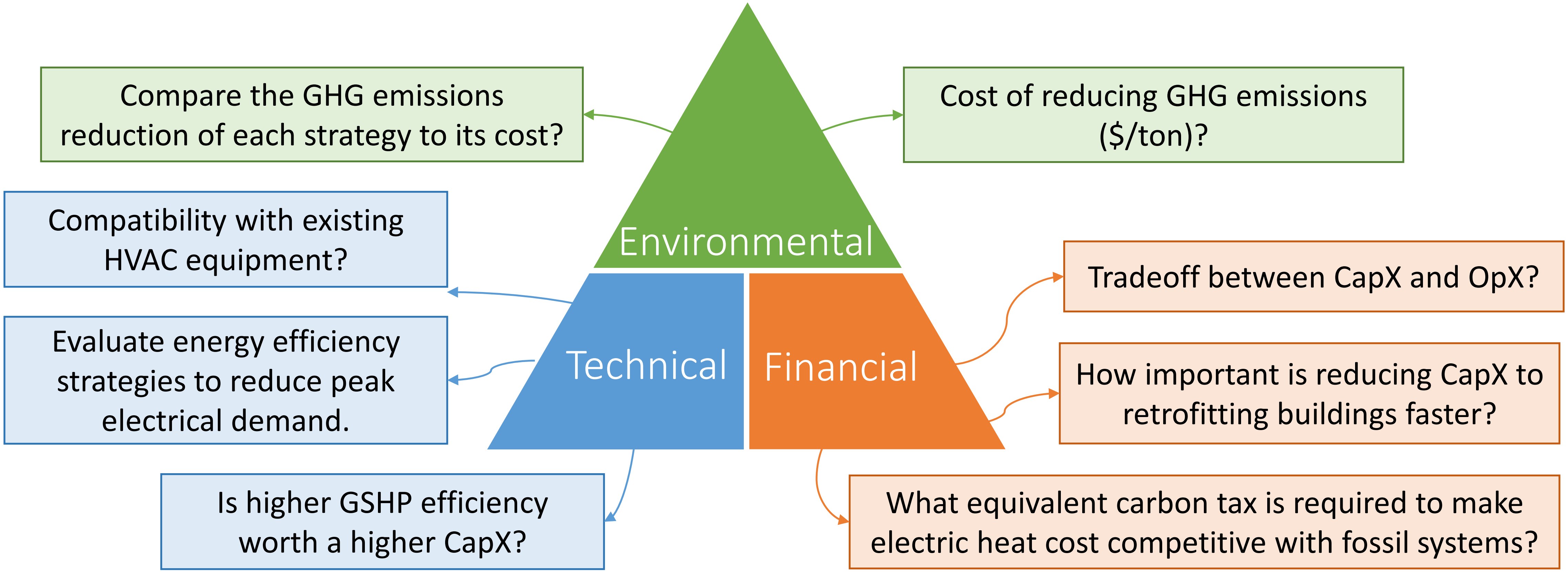
Strategies to Decrease Peak Electrical Demand

1. Decrease peak heating load: optimize economizer and airflow[1]
2. Reduce electricity used for heating:
   a) Use existing fossil-fuel boilers for supplemental heat on coldest days (only 4-13% of year)
   b) Use more efficient electric heating equipment: GSHPs vs ASHPs
3. Store electricity in off-peak hours: Explore building energy storage

1. Less air flow also decreases the electrical demand by reducing the fan power required to move air throughout the building

Summary of Phase 2 Analysis

- **Driving Question:** How can we most quickly reduce the greatest % of BU's GHG emissions given limited capital and operating budgets?
- **Objective:** Refine heating electrification strategy
- **Reality Check:** Present to BU Staff & Admin and MEP companies for feedback



Acknowledgements

We'd like to sincerely thank the following individuals for their insight & time:

Boston University Student Researchers
Author of "BU CRC Electrification" Analysis (Jan 2018)
David Staller (ME '18)
Authors of "Energy Efficiency Opportunities on CRC" Analysis (May 2017)
Gabriella Henkels, Charles Bradley Miller, Ryan Peters, Carly Baracco, Anthony Graziano, Cole Ashman Paul Chiampa Jr., Jessica Gimbel, Cristian Morales

Estimating Costs & Financing Large CapX Projects	
Judith Judson	VP of Distributed Energy Systems, Ameresco
Paul Lyons	President, Zapotec Energy Inc
Domenic Armano	President, Guardian Energy Management
Michael Gibbs	Former Assistant Executive Officer, CARB; Former Deputy Secretary of Climate Action, CalEPA; Former Senior Vice-President, ICF International
Robert Kaufmann	Founding Partner, First Fuel Software; Earth & Environment Professor, Boston University
Nalin Kulatilaka	Founding Partner, First Fuel Software; Business Professor, Boston University

Understanding Boston University's Project Planning & Implementation	
Paul Rinaldi	Assistant VP for Planning, Boston University
	Business Professor, Boston University,
Robb Dixon	Former Chair, Boston University Faculty Council
Dennis Carlberg	Director of Sustainability, Boston University

Understanding Building HVAC Design & Heat Pumps	
Jacob Knowles	Director of Sustainable Design, BR+A
Cris Copley	Principal of HVAC & Mechanical Design, BR+A
Joshua Michaud	Associate Principal of HVAC, BR+A
Carolyn Meadows	Director of Strategic Initiatives, Boston Arts Academy
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Geothermal: Heating & District Heating	
Tracey Ogden	Principal, TAO Consulting
Jarred Mullen	Skillings and Sons
T.J. Bernier	Gap Mountain Drilling