

Plan: 100% Decarbonization of MIT Campus by 2035 via 6th Generation District Heating & Cooling with Advanced Thermal Storage

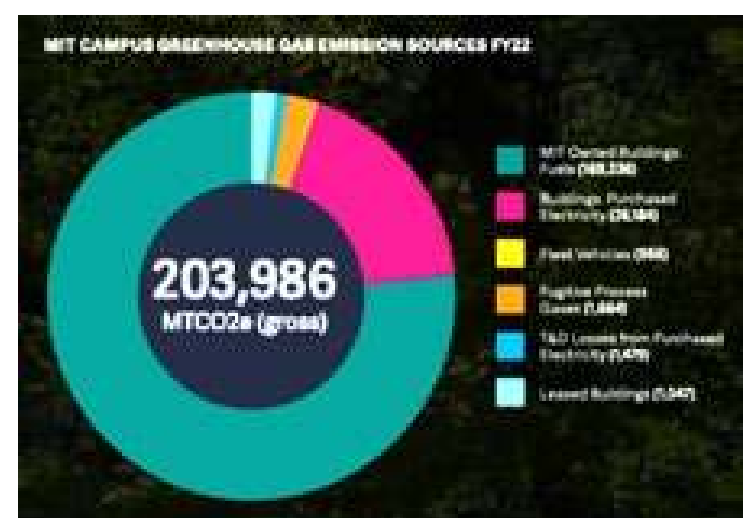
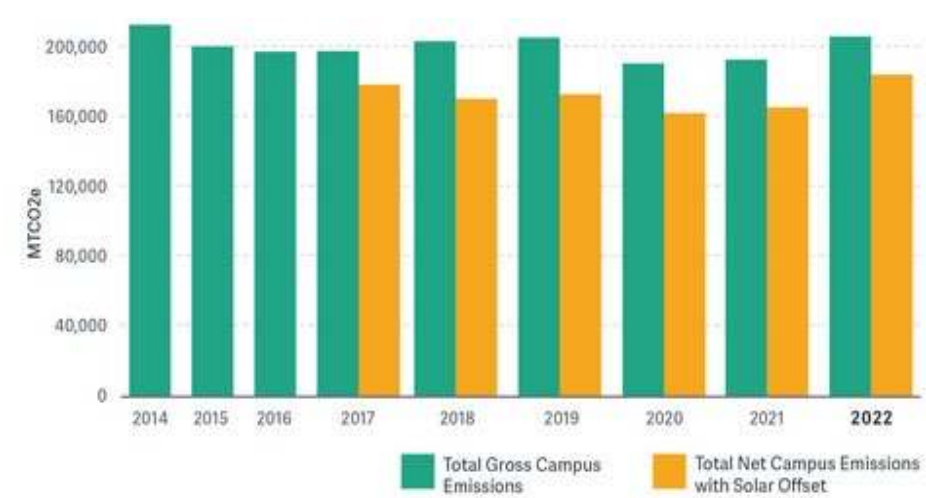
MIT Alumni for Climate Action (MACA) - MIT Campus Team: Rick Clemenzi, John Dabels, Susan Murcott, Herb Zien, Judy Siglin, David Williams 10/20/2023

Global Climate Emergency

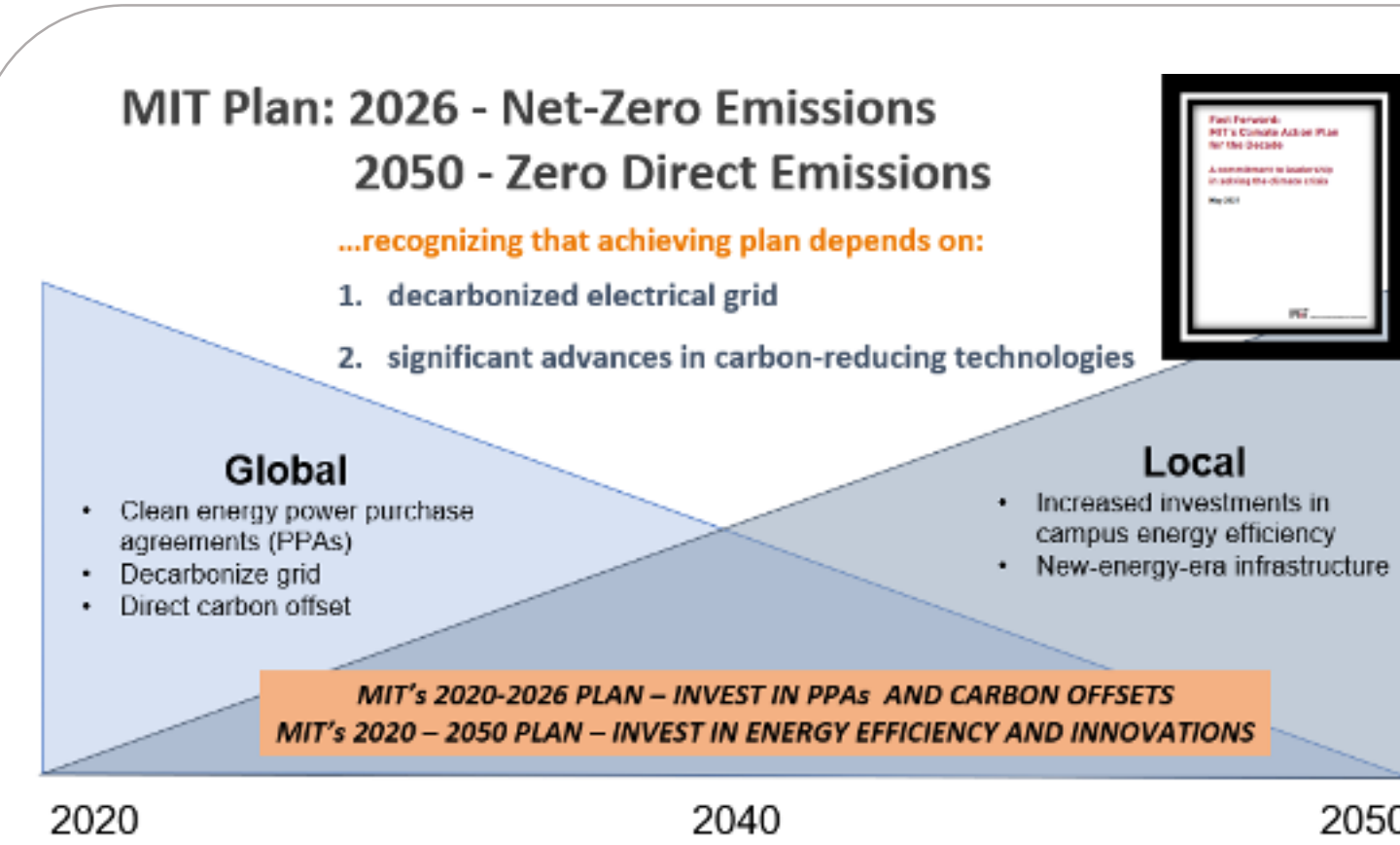
- In 2023, we experienced extreme weather events in Massachusetts, across the U.S. and around the world.
- September 2023 exceeded the previous record for that month by 0.5°C, marking the largest jump ever observed.
- Temperatures are approximately 1.8°C warmer than pre-industrial levels with carbon dioxide driving the extreme heat.
- It is now highly likely 2023 will become the hottest year on record, with 2024 potentially surpassing it.

Local Challenge

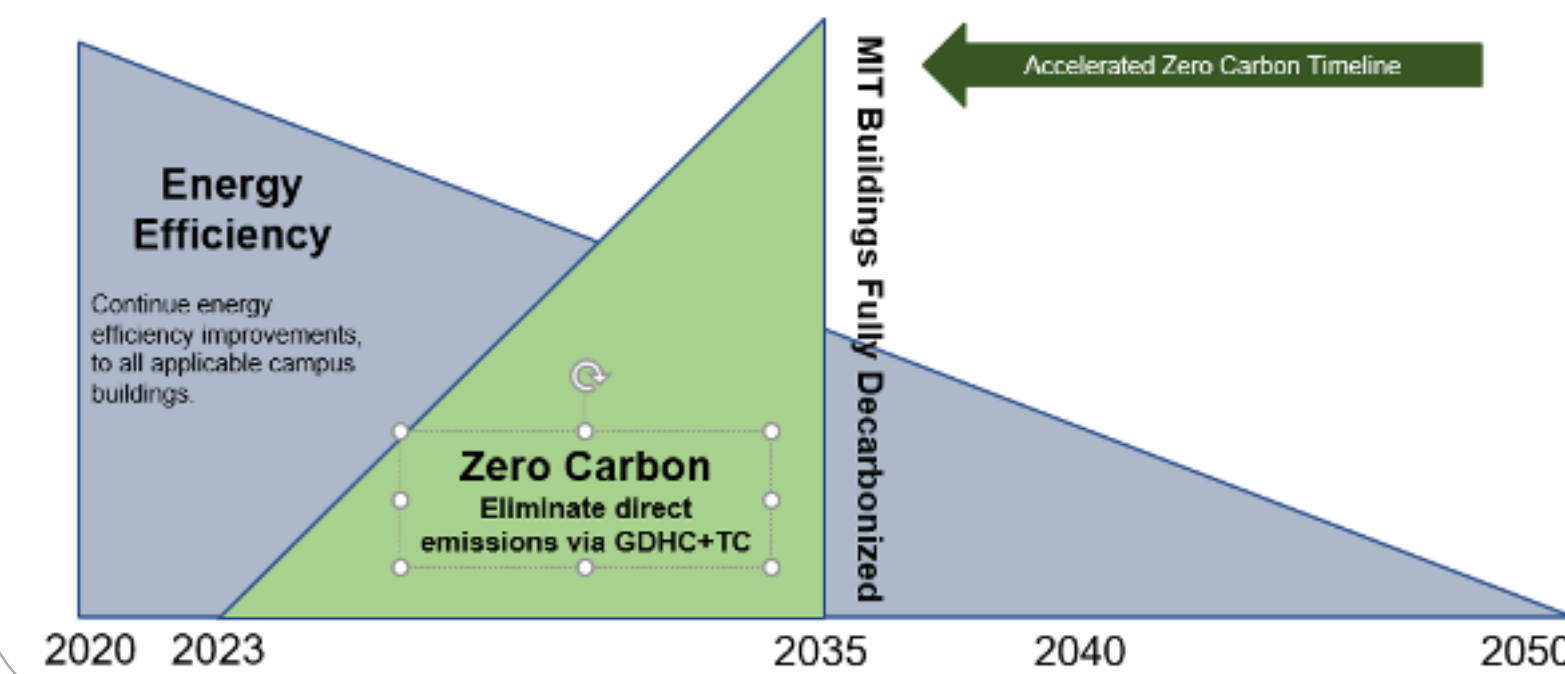
- 97% of MIT's greenhouse emissions are currently associated with the operation of campus building facilities.
- MIT's 2022 greenhouse gas emissions of 203,968 metric tons CO2 equivalent, the latest year for which we have complete data, were 15% reduced relative to the 2014 baseline



MIT's Plan, MACA's Accelerated Plan



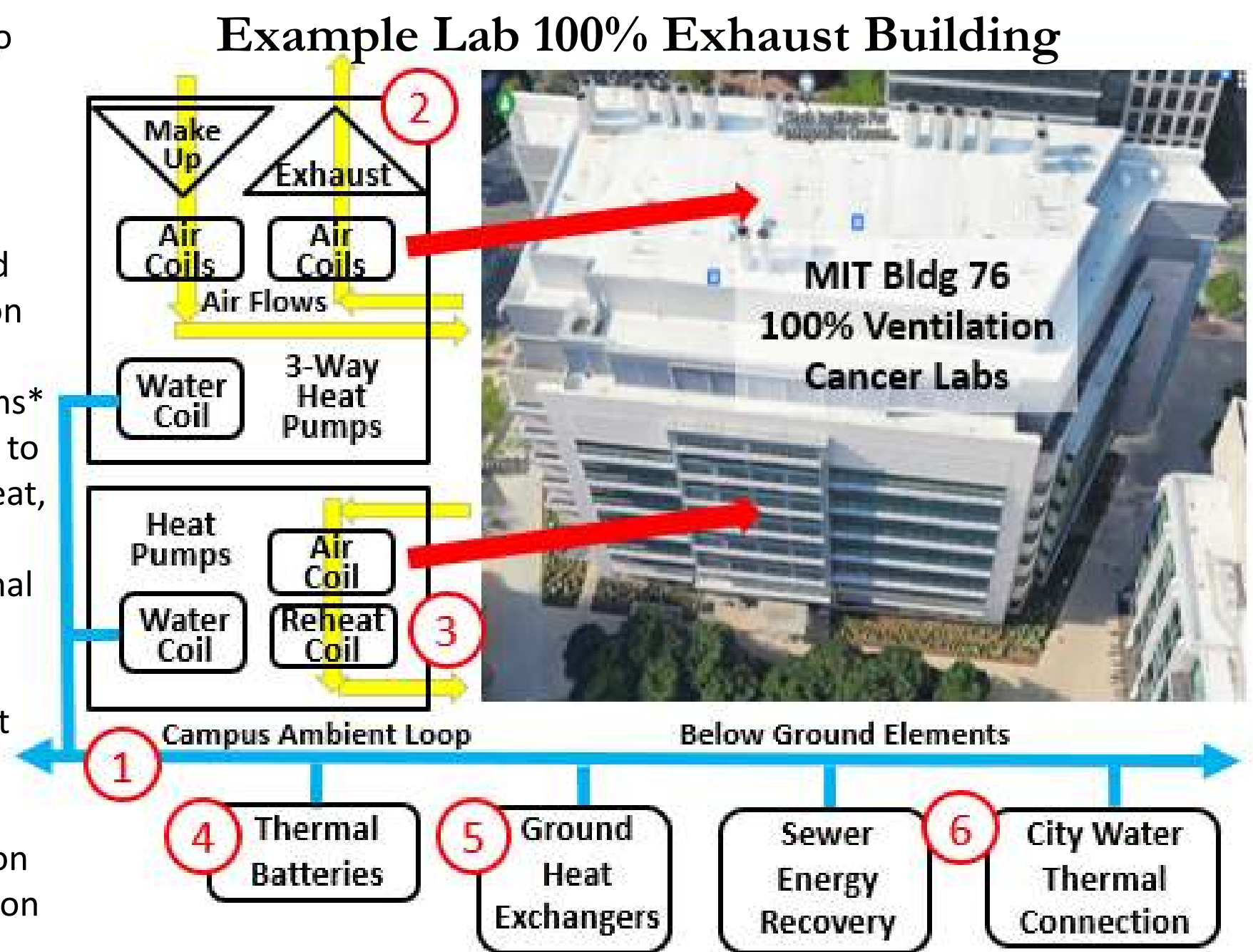
MACA Proposal: Helping Accelerate MIT's Plan



Our Technology Proposal

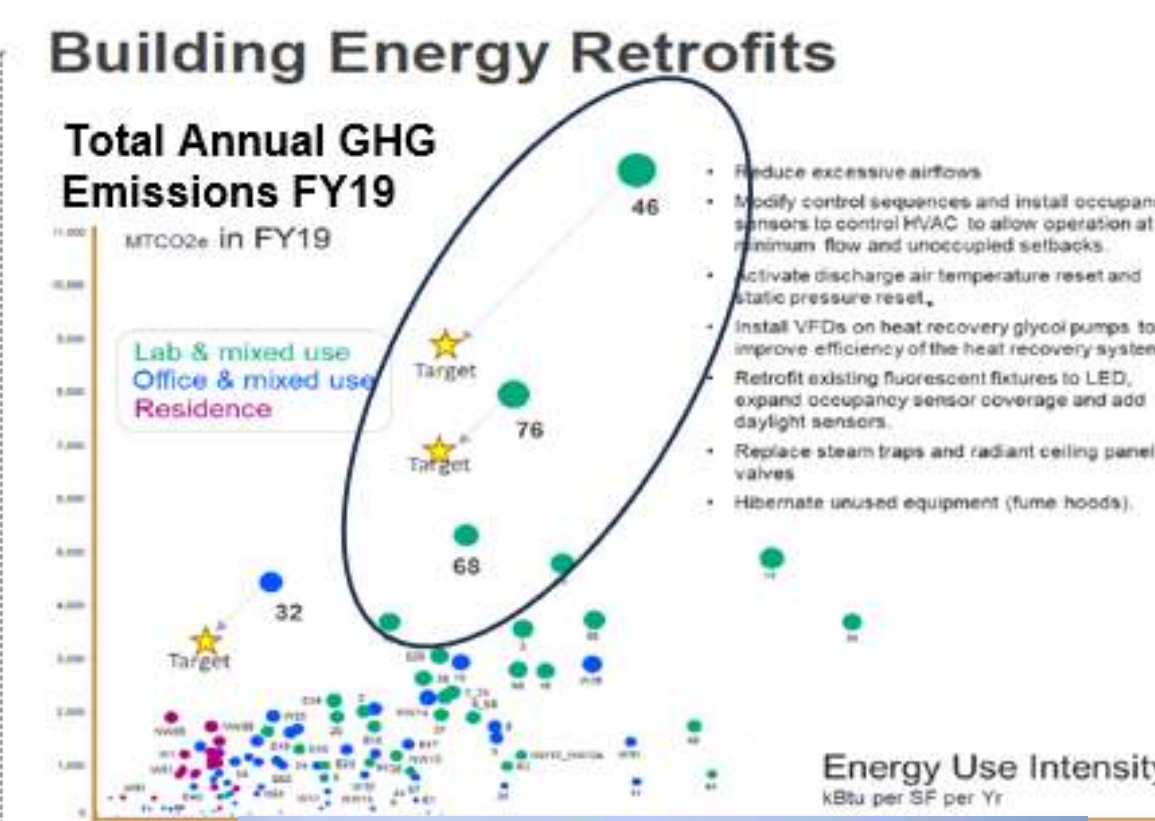
6th Generation District Heating & Cooling with Advanced Thermal Storage

- Existing Chiller Loop Transitioned to "Active" Ambient Heat Pump Loop operating 45°F-85°F with Bi-Directional Optimized Heat Pump Connections
 - Maximal "Active" Heat Pump based Exhaust Energy Recovery Ventilation scaled for each building, seamless upgrades to existing Exhaust Systems*
 - Existing Cooling Systems Upgraded to Efficient Heat Pumps w/Active Reheat, Minimized Terminal Reheat*
 - Distributed Ground Coupled Thermal Battery Energy Storage for Daily, Weekly, and Grid-Cost Load Tuning
 - Distributed Additional Ground Heat Exchangers
 - Optional: Municipal Water Distribution Thermal Interconnection and Sewer Energy Recovery/Rejection
- * Heat Pump compressors in buried vaults where needed



Where to Start – How to Proceed

Energy Efficiency + Demo: Select Retrofits w/ Max ROI



Ref: Joe Higgins, Campus Climate Commitments Lecture 2/22/23 Slides 11 & 13

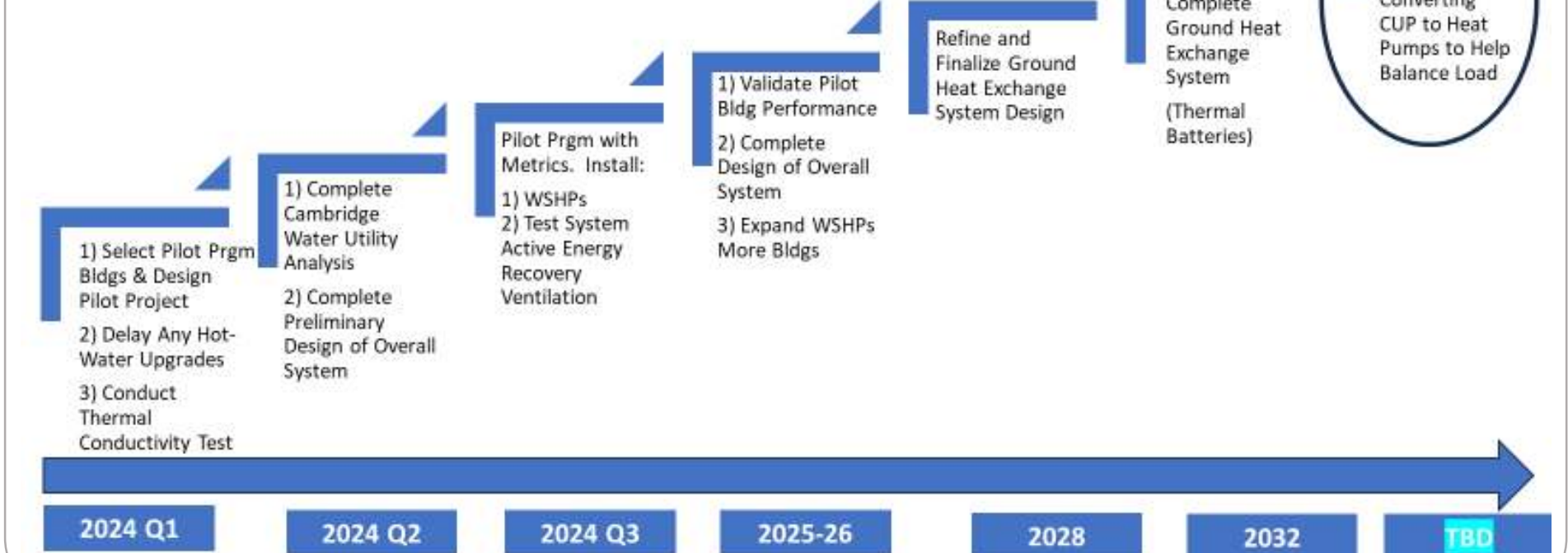
High GHG + Low Risk = Max ROI



Schedule: 2023-2035

Goal: Zero Carbon MIT Campus by 2035
Incremental Approach to MIT Campus Buildings Decarbonization

Note: Plan assumes Thermal Energy Waste Recovery everywhere appropriate.



How a Heat Pump Works

