Alumni/Student Team Successfully Completes "Test Fit" Showing Cost-Effective Campus Decarbonization by 2035

Susan Murcott, Kevin Johnson, Rick Clemenzi, Judy Siglin, John Dabels, David Williams, Herb Zien, Megan Lim, Jason Chen, Olivia Chen

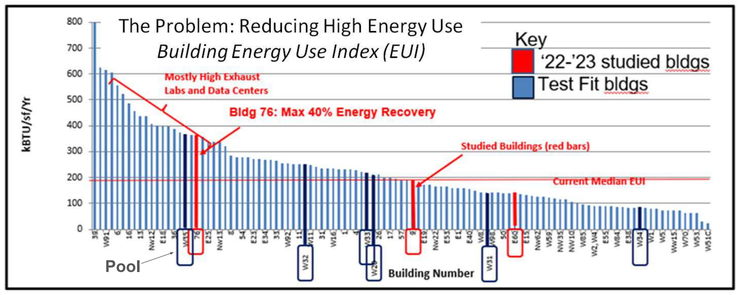
Project Overview

Thermal Energy Networks (TENs) are gaining in popularity as a high performance, cost-effective way to decarbonize HVAC. MIT's HVAC is responsible for about 70% of MIT's CO2 emissions, with the fossil generated power causing the rest of the 97% of all MIT emissions which are due to buildings.

In 2016, a TEN was proposed for and won the MIT Climate CoLab prize for "How to Decarbonize MIT's Campus." That milestone has been furthered by two 2023-2024 DOE awards to our MACA/Geo@MIT team. Cognizant of these successes, MIT offered a MOU to the MACA/Geo@MIT Team proposing that we perform a "Test Fit" of TEN on 6 MIT buildings.

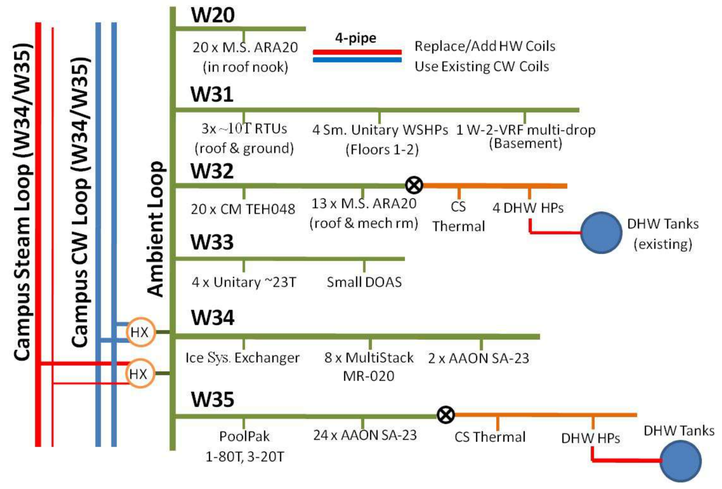
Understanding the MIT Decarbonization Challenge

MIT's Buildings consume very large amounts of energy. Our multi-year analysis indicates that most of this energy is lost to exhaust, especially in the many Labs on campus. The graph below shows the energy consumed per sq ft in most campus buildings, with the labeled ones in black showing the 6-building Test Fit Cluster and how well these compare to all of the buildings on campus.

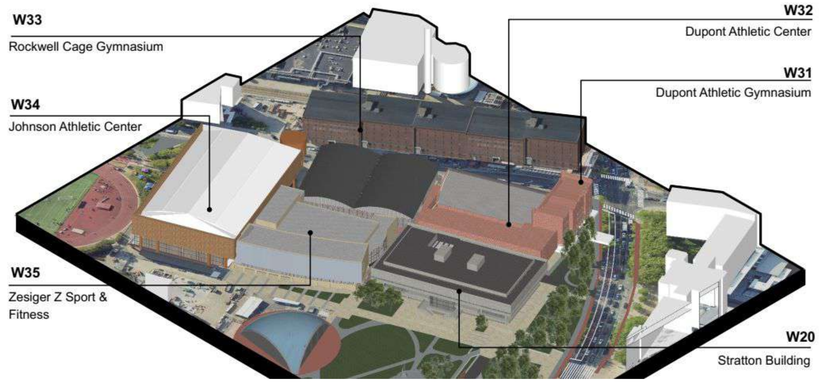


6 Test Fit Buildings: W35 W32 W33 W20 W31 W34

Test-Fit "Pilot" Project "1-Line" Workup

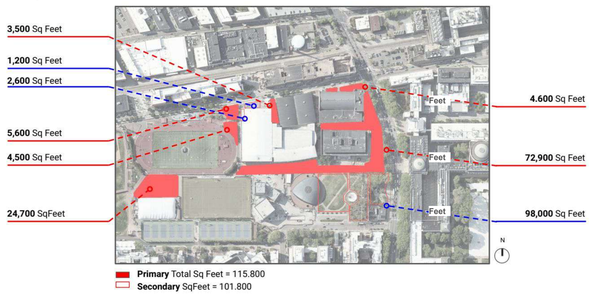


6 Building West Campus Pilot Project Proposal



Each of these 6 buildings would be fully decarbonized upon conversion to the proposed Thermal Energy Network. Below shows Solar Thermal on W32 roof and air source heat pumps in the existing roof nook on the Student Center:

The areas around the cluster will have a 600'-800' deep geothermal heat exchanger drilled from only 5-6 locations meaning limited campus disruption:



Learn More and Get Involved

- Read the "Test-Fit" Summary Report, request the Full Report
- Contact or Join the Campus Decarbonization Team
- Ask Questions – Get Answers
- Do a UROP helping complete the Interactive Decarbonization Decision Support Tool
- Help MIT Decarbonize
- Get involved to help Stop Global Warming!

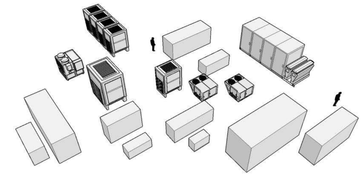
Discover More

Technology

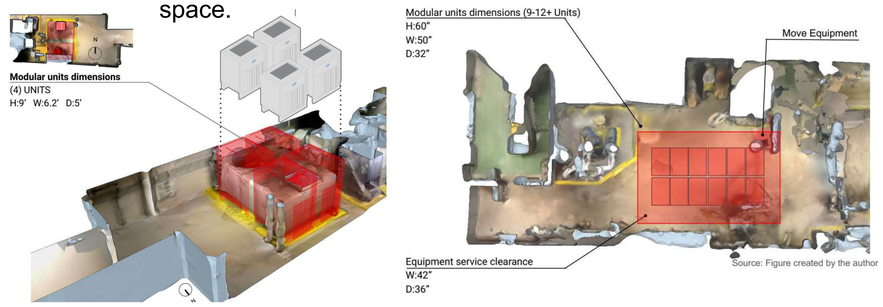
The proposed Test Fit technologies are all off-the-shelf and include: 1) Water Source Heat Pumps (WSHPs), 2) Ambient Loop overbuild using existing campus Chilled Water Piping, 3) Advanced Exhaust Energy Recovery, 4) Solar Thermal and Solar PV, 5) a balanced set of Air Source Heat Pumps and 6) Ground Heat Exchangers.

The Test Fit proved that all proposed elements will readily fit in the current 'non-programmed' spaces and below ground in some grassy areas surrounding the 6 buildings.

The graphic at right shows the individual Heat Pump types proposed:

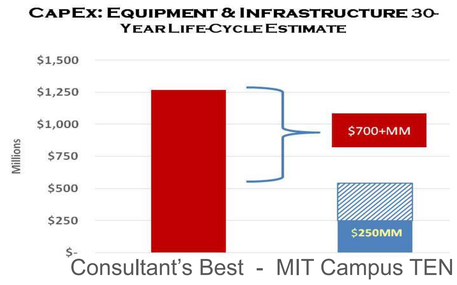


We used LIDAR to create detailed 3D workups of key spaces to show how these heat pumps fit in the available space, giving MIT Campus Engineering a new tool for future upgrades. These LIDAR scans with the new Heat Pump equipment in place (red) visually demonstrates that the equipment fits in the existing space.



$500M CapEx Savings!

The CAPEx cost of $250 MM for the MIT Campus-wide TEN Project is based on a preliminary budget and the Test-Fit analysis provided to Facilities. The difference in CapEx is startling. The $250MM estimate includes: (i) water-source heat pumps distributed in all buildings; (ii) equipment to capture a higher percentage of energy currently being wasted; (iii) converting existing chilled water piping into an ambient loop and extending it to some buildings as needed.



Next Steps

MIT could immediately start Campus Decarbonization and reliably complete it by 2035 very cost-effectively. We urge that MIT immediately proceed with this 6-Building Pilot Demonstration.