Decarbonization Case Studies

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Mixed Use Building

Goal: 20% EUI Reduction (DC BEPS Target)
Location: Washington, DC
Size: 550,000 SF
Decarb Strategy: Facility Diagnostics
Opened: 2015
Program: Mixed-Use residential/commercial
Existing Gas Service: Natural Gas Boiler and Service Water Heaters

KEY METRICS

BASELINE		POST-FDS		
Direct Emissions (kg CO2e/SF)	Site EUI (kbtu/SF)	Direct Emissions (kg CO2e/SF)	Site EUI (kbtu/SF)	% Reduction
1.6	69.3	0.8	49.5	29% EUI / 50% CO2e

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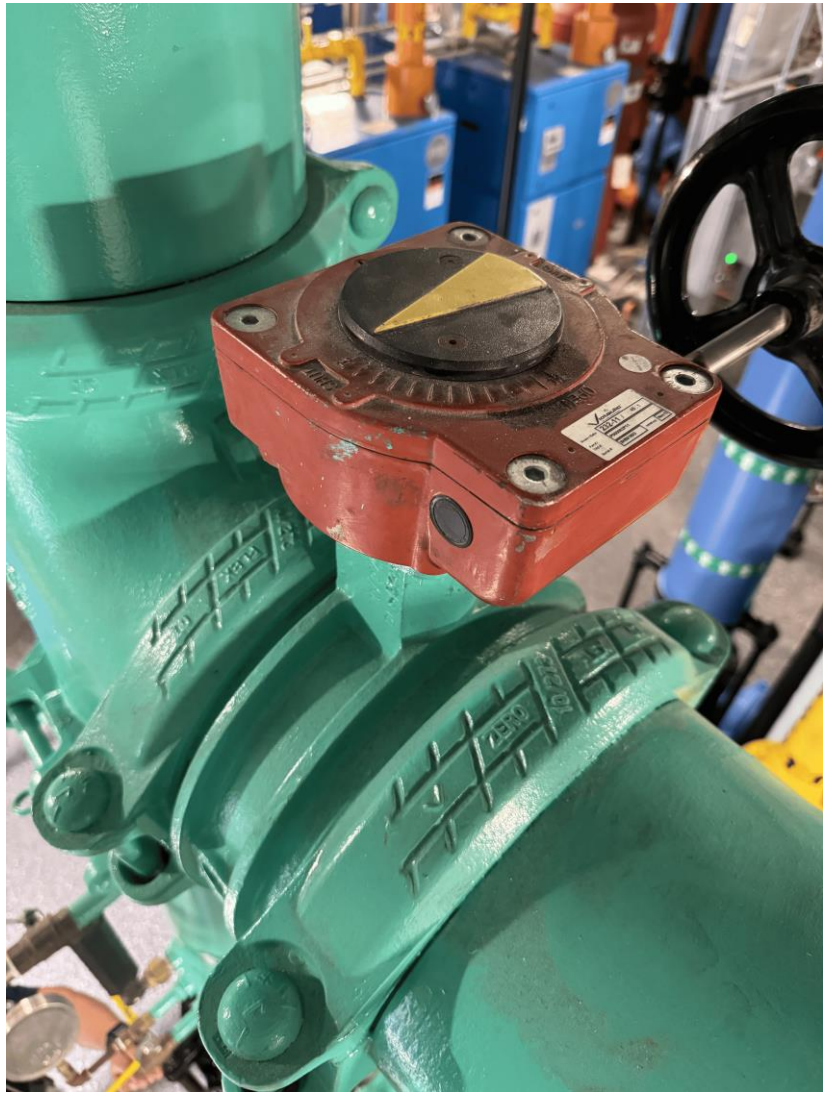
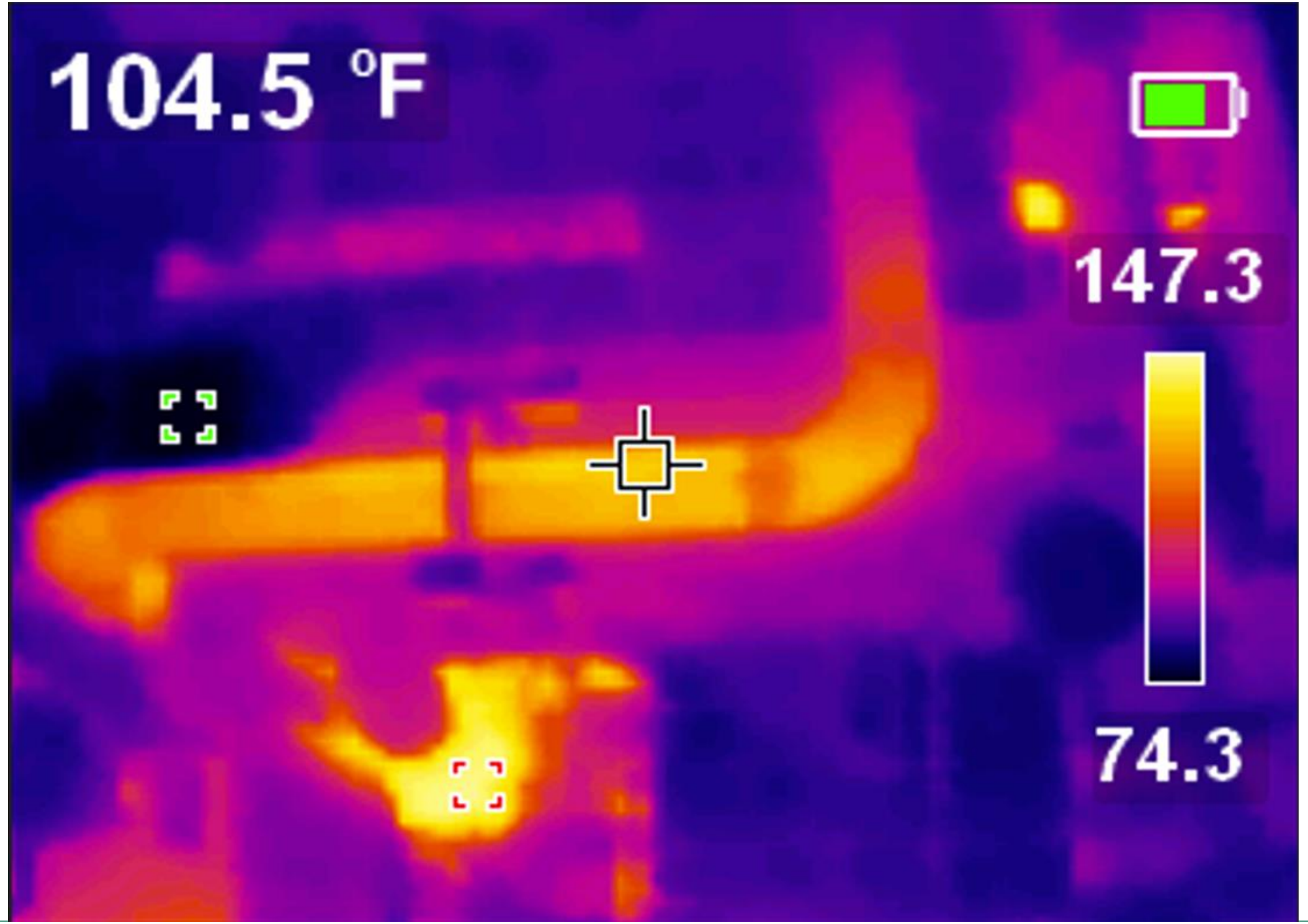
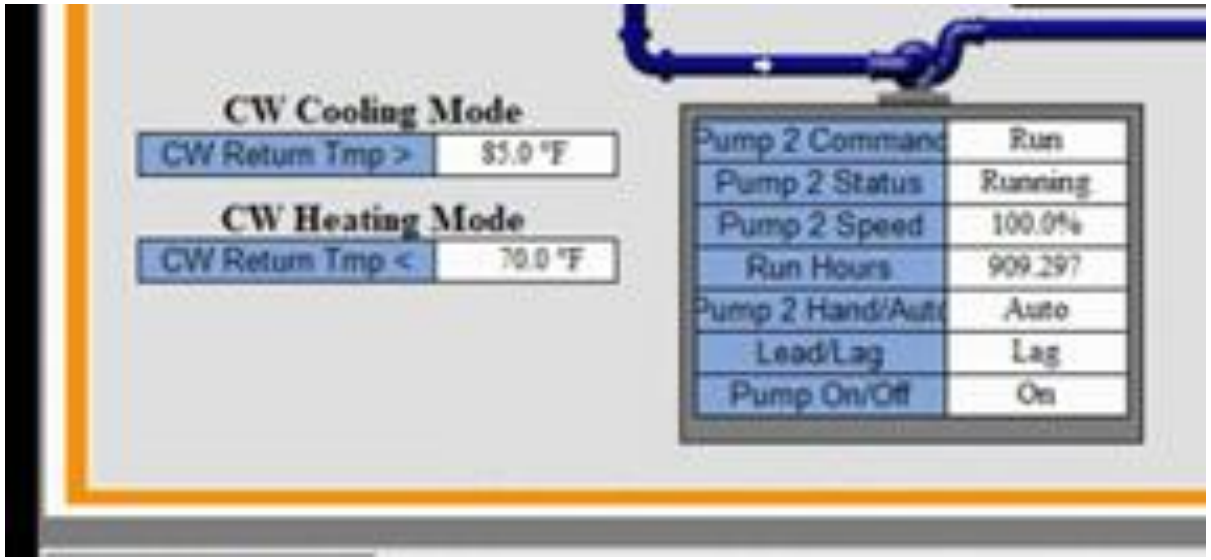
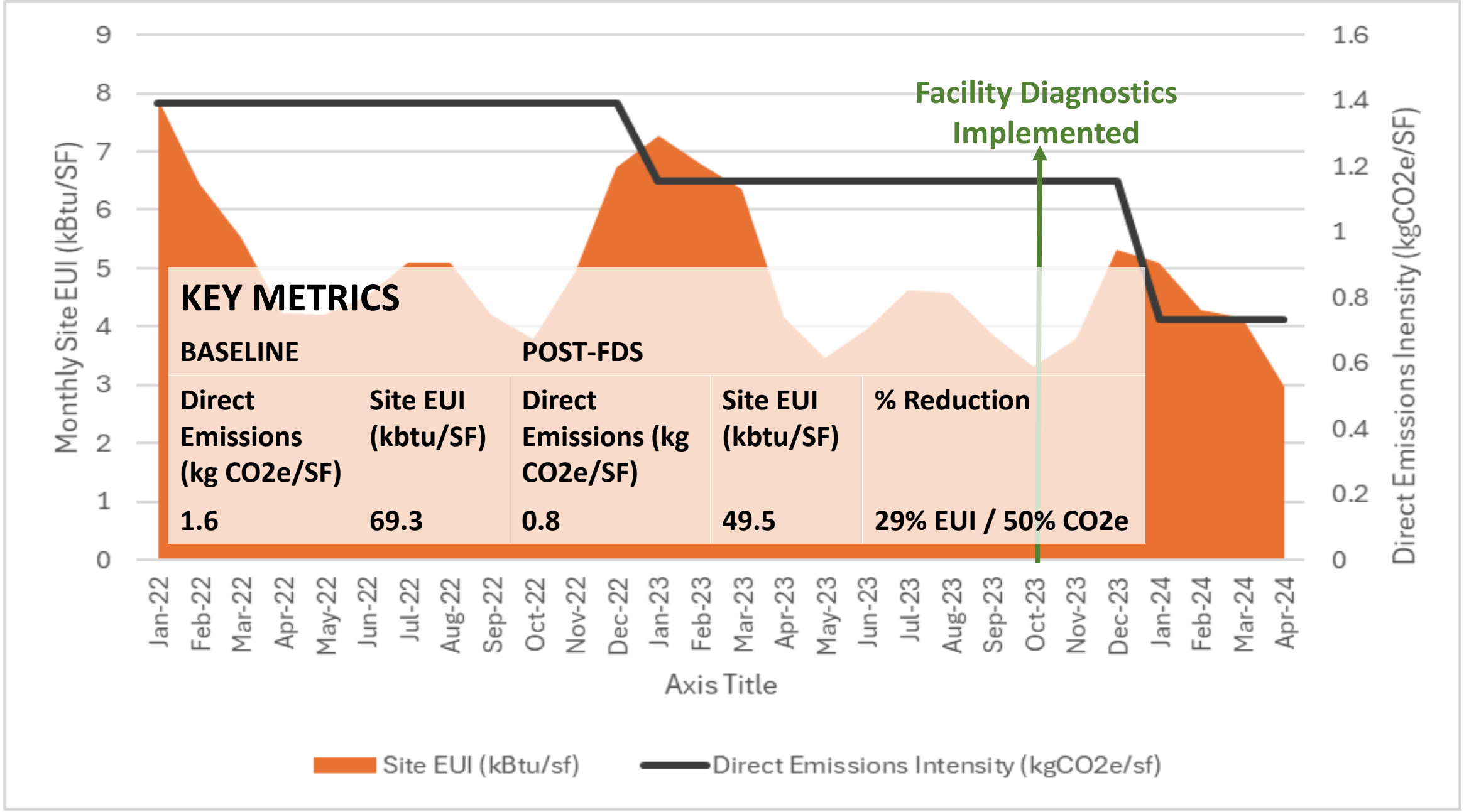



104.5 °F
147.3
74.3


CW Cooling Mode
CW Return Tmp >
85.0 °F
CW Heating Mode
CW Return Tmp <
70.0 °F
Pump 2 Command
Run
Pump 2 Status
Running
Pump 2 Speed
100.0%
Run Hours
909.297
Pump 2 Hand/Auto
Auto
Lead/Lag
Lag
Pump On/Off
On



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DCPS Raymond Elementary School

Goal: Retrofit for zero direct carbon emissions, net zero site EUI (equivalent to MD BEPS 2040 Final Standard)
Location: Washington, DC
Size: 96,000 SF
Decarb Strategy: Major Whole-Building Retrofit
Opened: August 2023
Program: K12 School
Existing Gas Service: Gas-fired steam boilers and service water heaters

KEY METRICS

BASELINE		POST-DECARB STRATEGY IMPLEMENTATION		
Direct Emissions (kg CO2e/SF)	Site EUI (kbtu/SF)	Direct Emissions (kg CO2e/SF)	Site EUI (kbtu/SF)	% Reduction
1.35	84.8	0	25.9	69% EUI/ 100% CO2e

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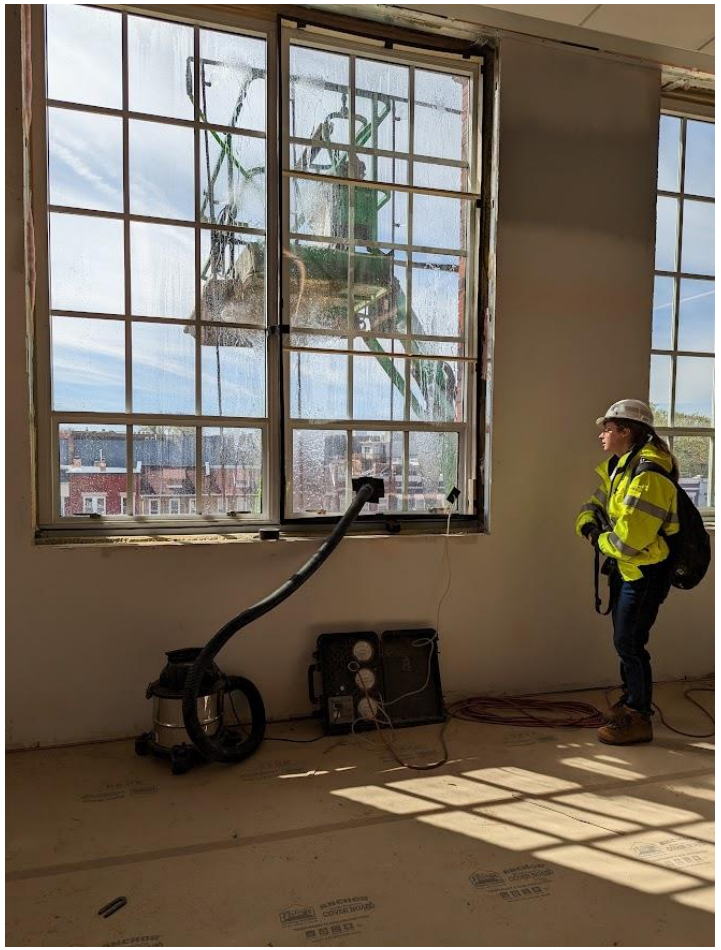
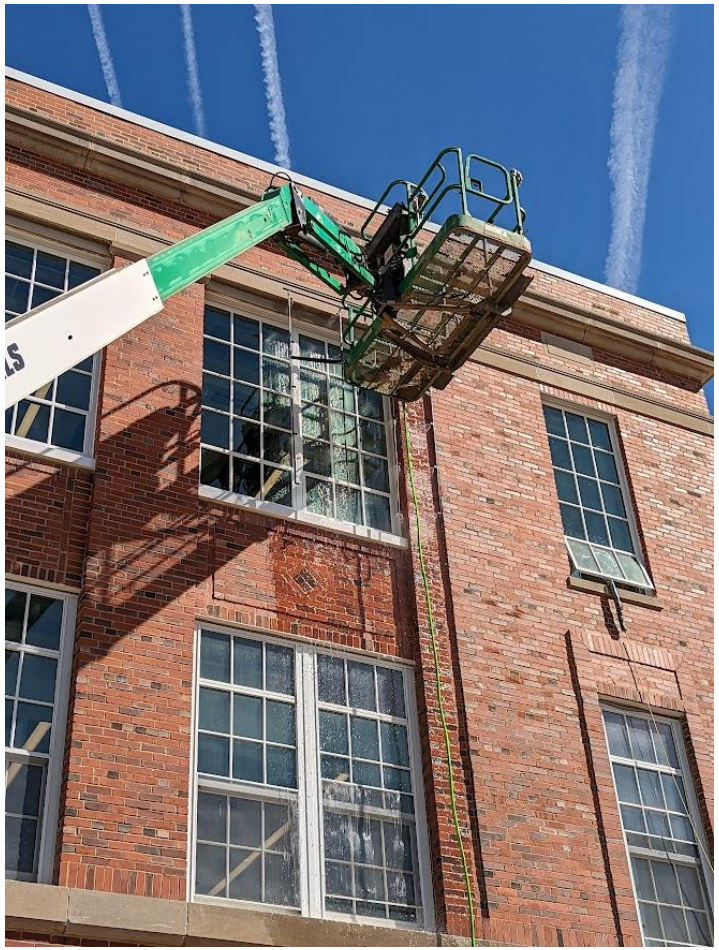
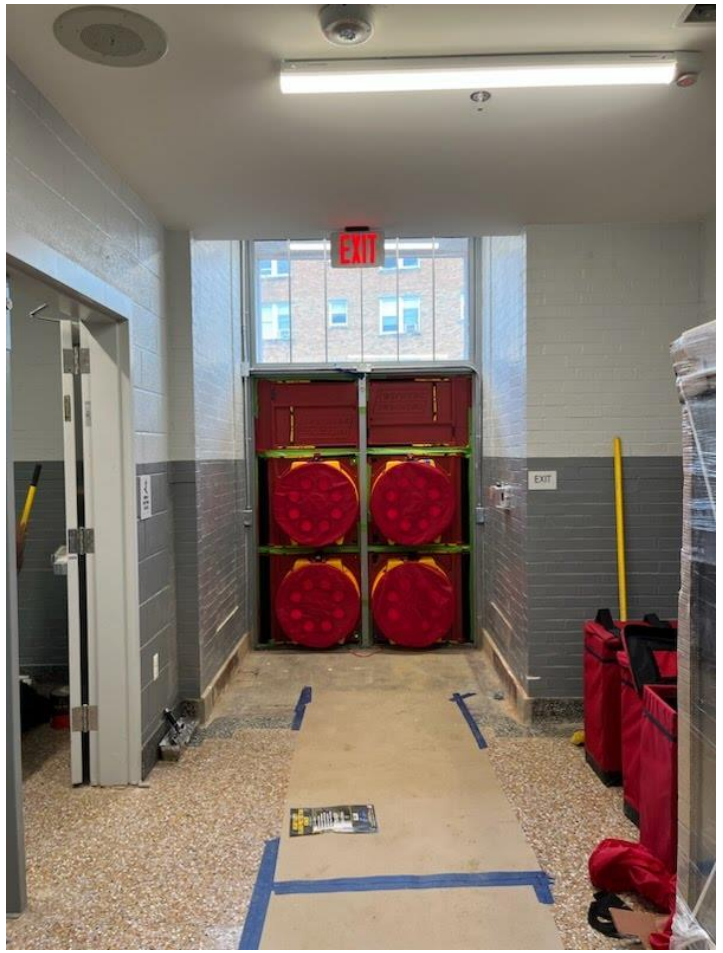
EXISTING BUILDING CONDITIONS







Air-and-Water tight envelope with newly insulated walls, roofs, and windows minimizes thermal heating and cooling demand

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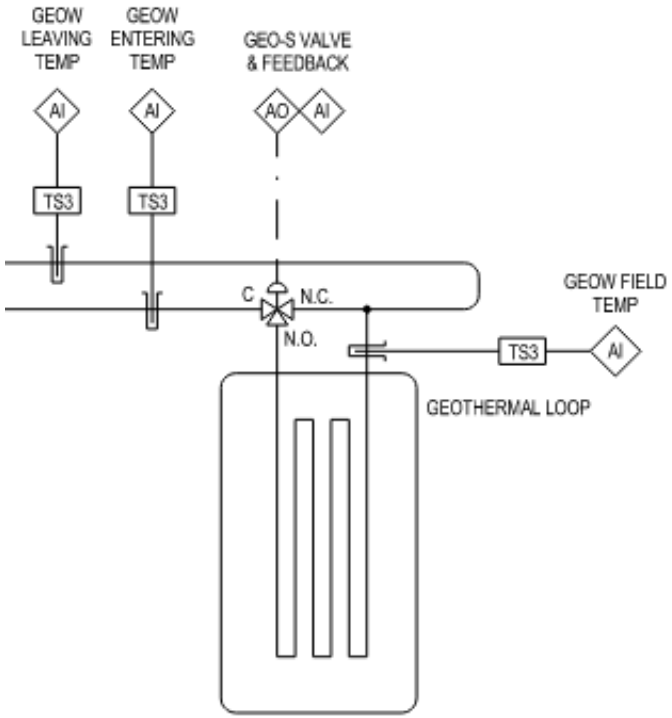
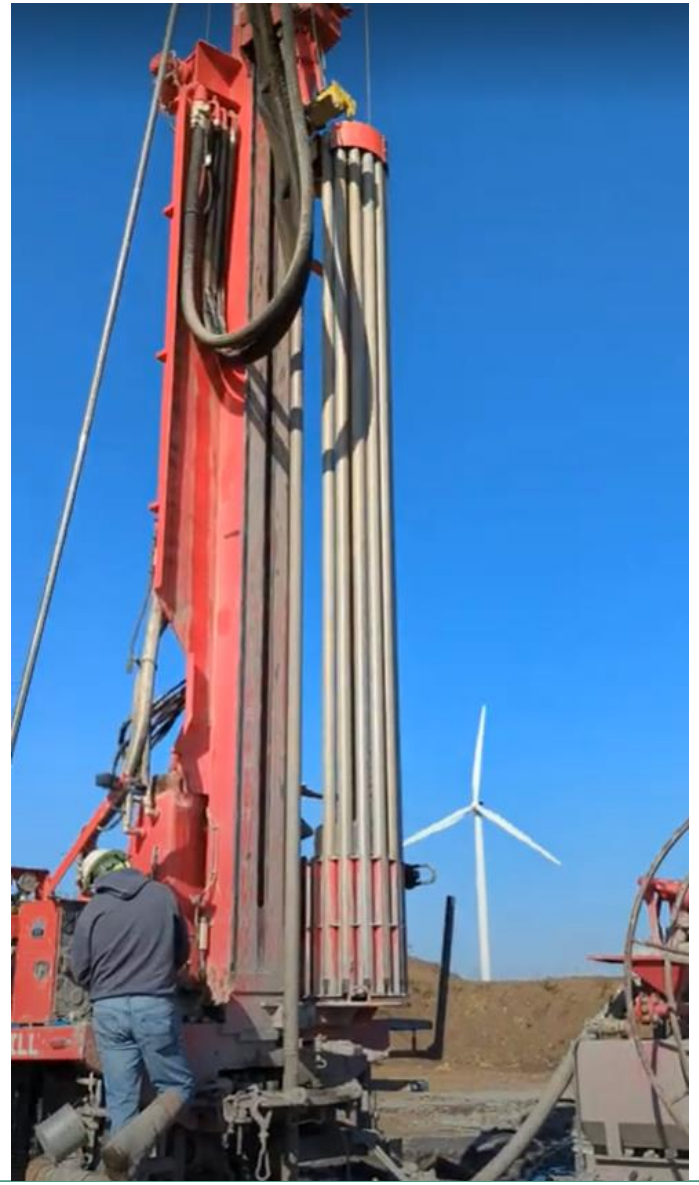
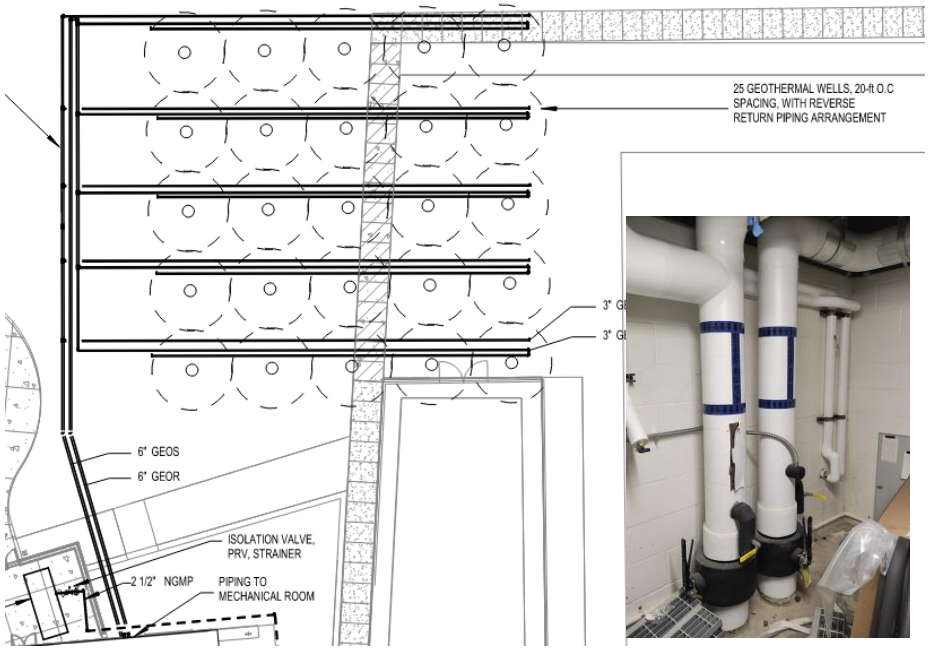


Geo-exchange borefield uses ground as a battery to store heat rejected by air conditioning for the winter, eliminating direct emissions from gas boilers and furnaces





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Water leaving the borefield is 40F-90F all year and distributed by pumps to electric water source heat pumps controlled by thermostats – all technology DCPS is experienced with and comfortable operating

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All Electric cafeteria kitchen with demand-controlled kitchen exhaust is expensive but unavoidable to eliminate direct emissions – and kitchen staff loved it

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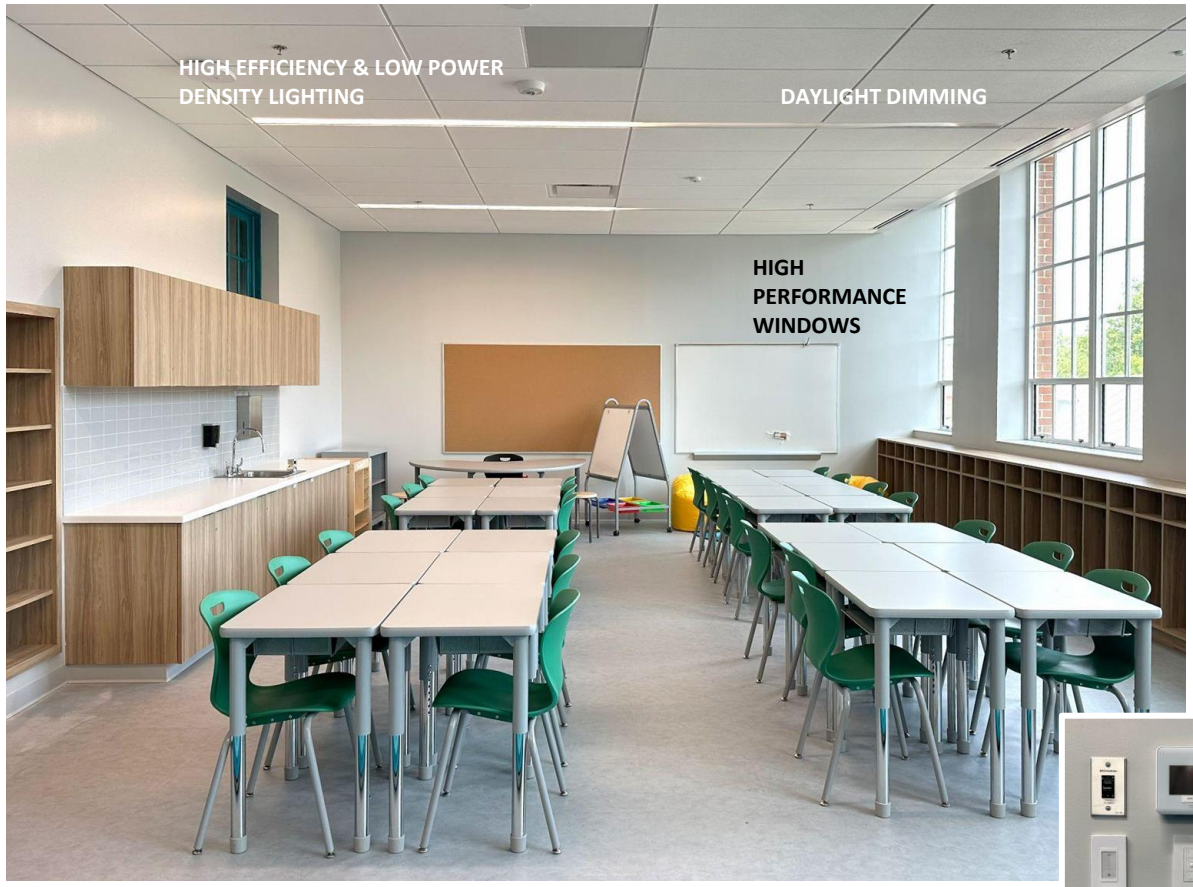
HIGH PERFORMANCE
MOTORIZED SHADES



OCCUPANCY CONTROLLED
PLUG LOADS

OCCUPANCY CONTROLS,
EVERYWHERE!

Automatic occupancy controls on outlets, and light switches, daylight controls on window shades and light levels minimize lighting and thermal demand

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Heat pump water heaters and low flow fixtures minimize demand and eliminate direct emissions from service water heating

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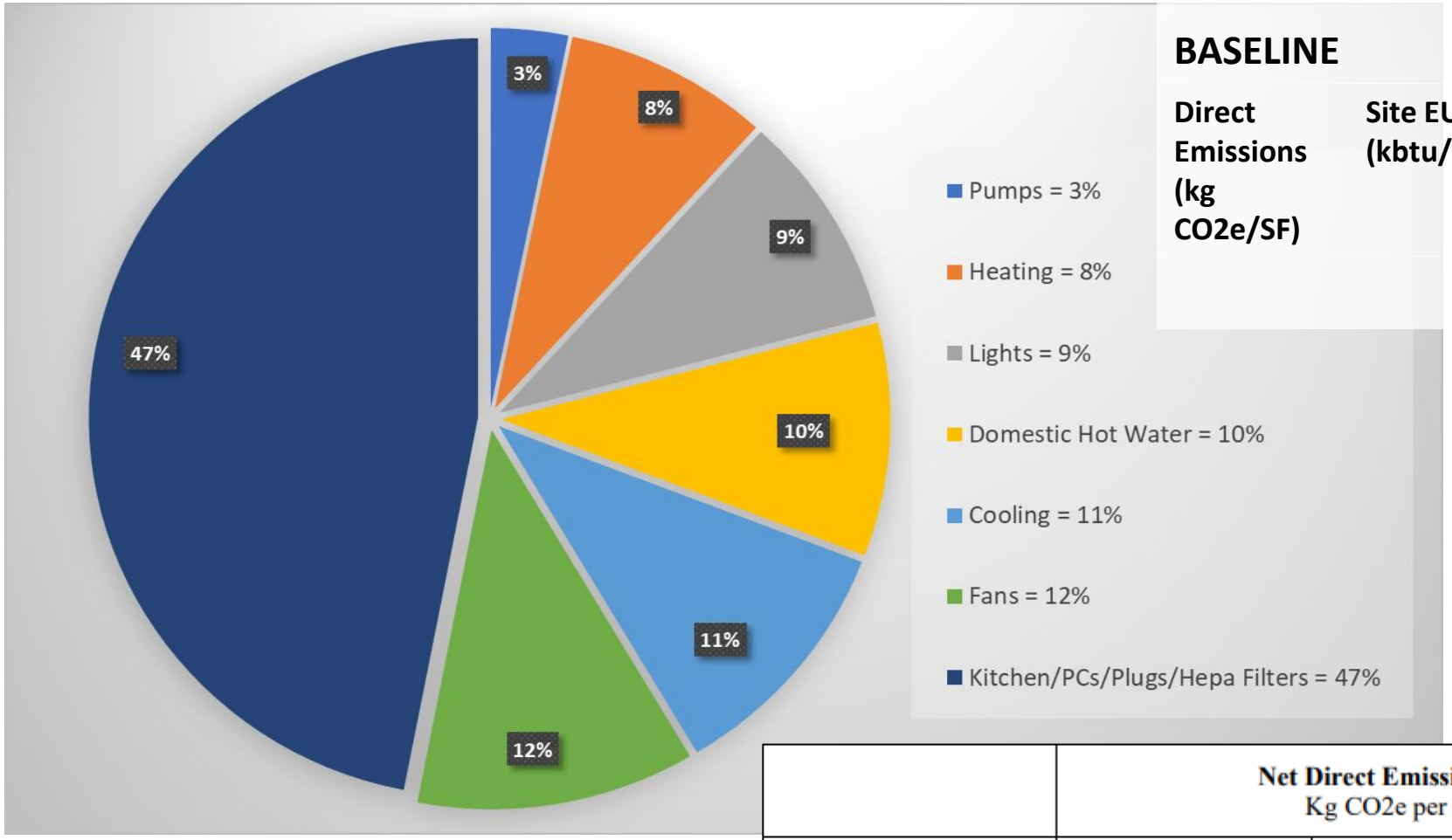
POST-RENOVATION OUTCOME



KEY METRICS

BASELINE		RENOVATED		
Direct Emissions (kg CO2e/SF)	Site EUI (kbtu/SF)	Direct Emissions (kg CO2e/SF)	Site EUI (kbtu/SF)	% Reduction
		0	25.9	

	Net Direct Emissions Standards Kg CO2e per square foot			Site EUI Standards kBTU per square foot
Property Type	Interim Standard for 2030-2034	Interim Standard for 2035-2039	Final Standard for 2040 and beyond	Final Standard for 2040 and beyond
Adult Education	2.34	1.17	0	46

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Henry Ford College

Goal: Reduce GHG emissions, site energy, and water use by 60% by 2040 targeting 8% IRR.
Location: Dearborn, MI
Size: 75 acre, 23-building campus
Decarb Strategy: Integrated Energy Campus Master Planning; ESCO Implementation
Opened: 1960s
Program: Higher Education
Existing Gas Service: Gas-fired campus steam boiler plant, and distributed gas-fired water heaters

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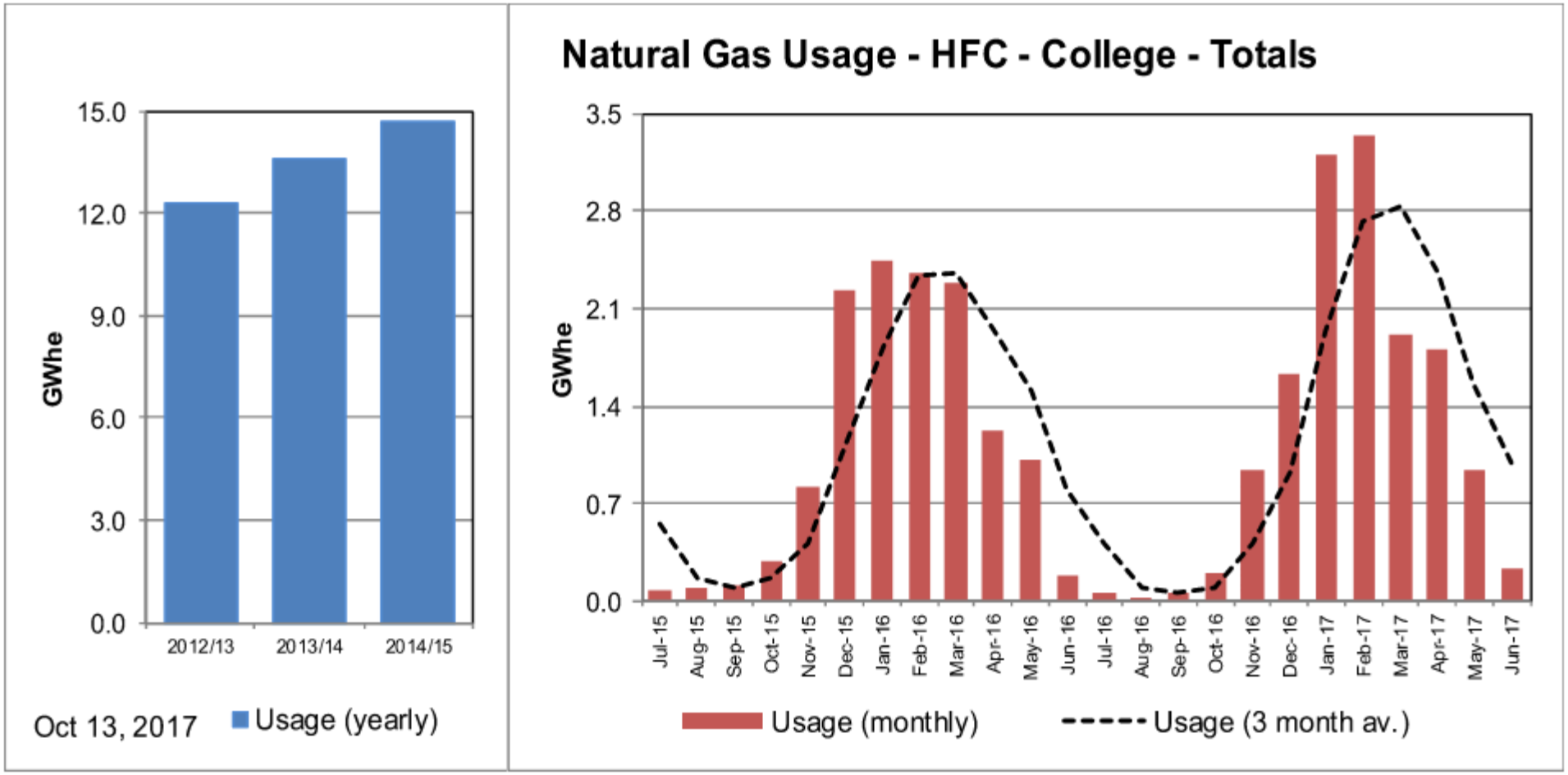


Figure 3-1 Natural Gas Usage from 2013 to 2017 (Seasonally adjusted)

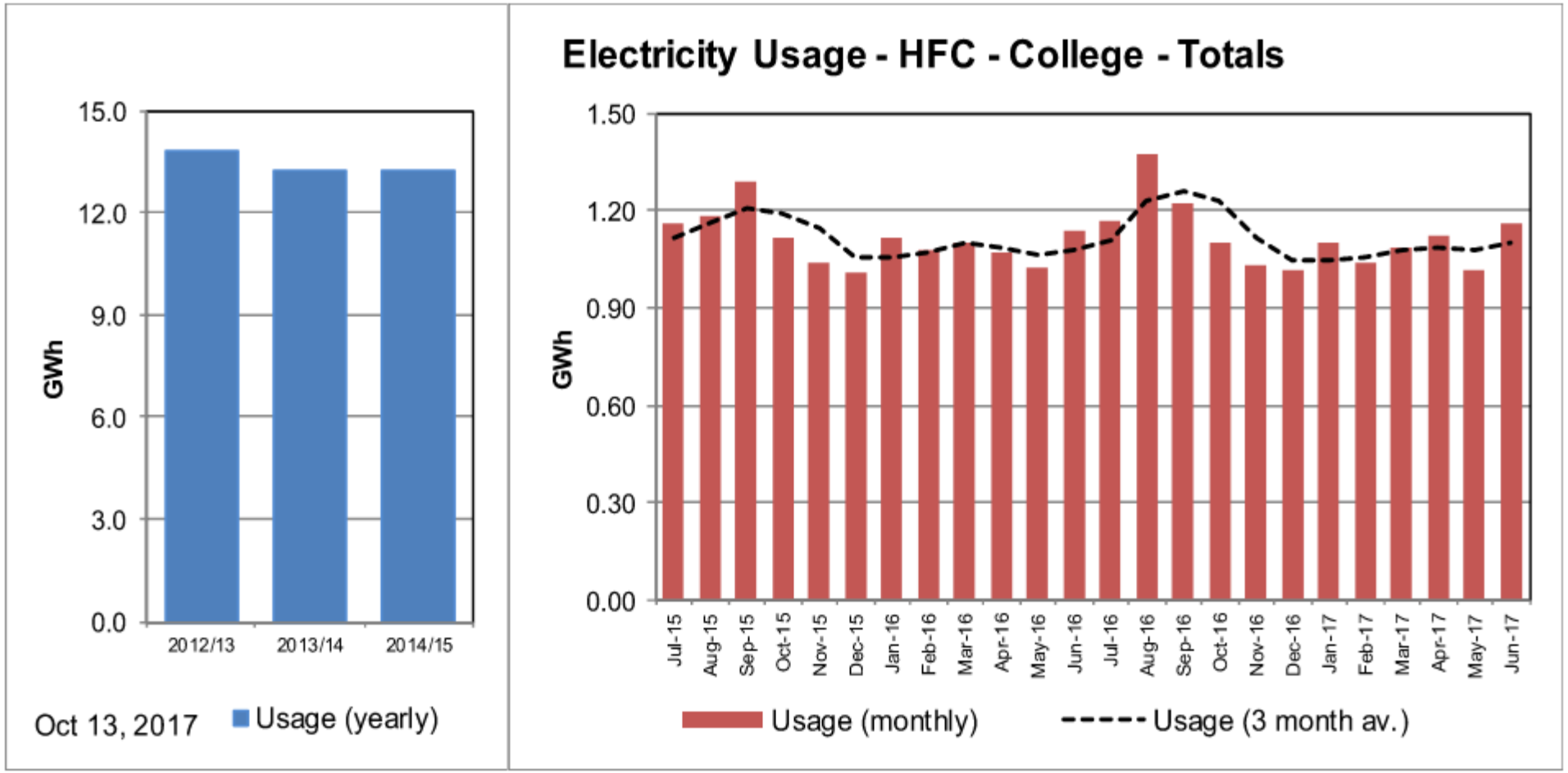
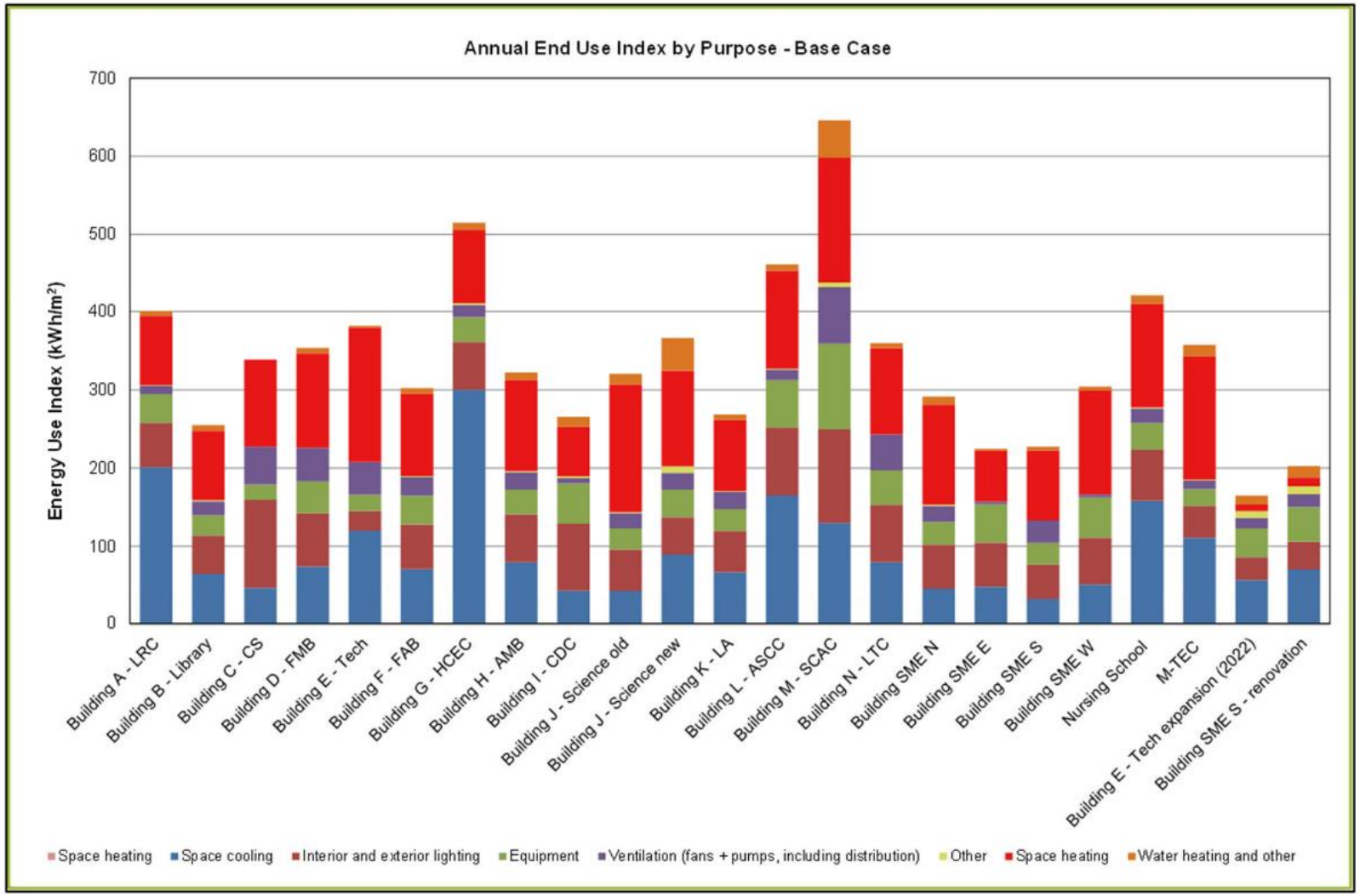


Figure 3-2 Electricity Usage from 2013 to 2017



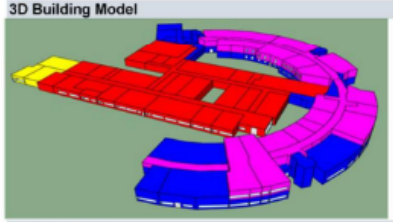
Technology Building E

		Energy Use Intensity	324 kWh/m2/yr

Building Summary

Location and Climate		Building Details	
Location	Dearborn, MI	Project Type	IEMP
Climatezone	5A	Number of Floors	2
Description	Cool humid	Building footprint	10,776 m²
Weather File	Detroit Metropolitan Airport TMY3	Exisiting Building Floor area	14,511 m²

3D Building Model



Building Envelope		Internal Gains	
Construction Overview	Different constructions for 1964 area, 1986, 1993: metal panel, 1993: face brick, 1993: curtain wall	Lighting	Base: Mostly T-8, with some spaces LED or halides; mostly manual switches with some occupancy sensors; W/m2 based on room type Efficiency: 30% reduction to model LED with occupancy sensor and daylighting, per ASHRAE 90.1 allowed assumptions
Window distribution	1/4" glass + 1/2" air gap + 1/4" glass	People	Avg 123 W/per with varying m2/per
Infiltration	Base: 0.25 ACH Efficiency: 0.1 ACH	Equipment	Base: 4.95 W/m2 for classrooms; 2.15 W/m2 for offices Efficiency: 15% reduction

Summary of HVAC

Zone Conditioning	1964: dual duct AHU fed from central system; 1986: rooftop units; 1993: rooftop AC units fed from central system and specialty HVAC units with VAV

Notes

Figure 15-1 Technology Building E IESVE Model

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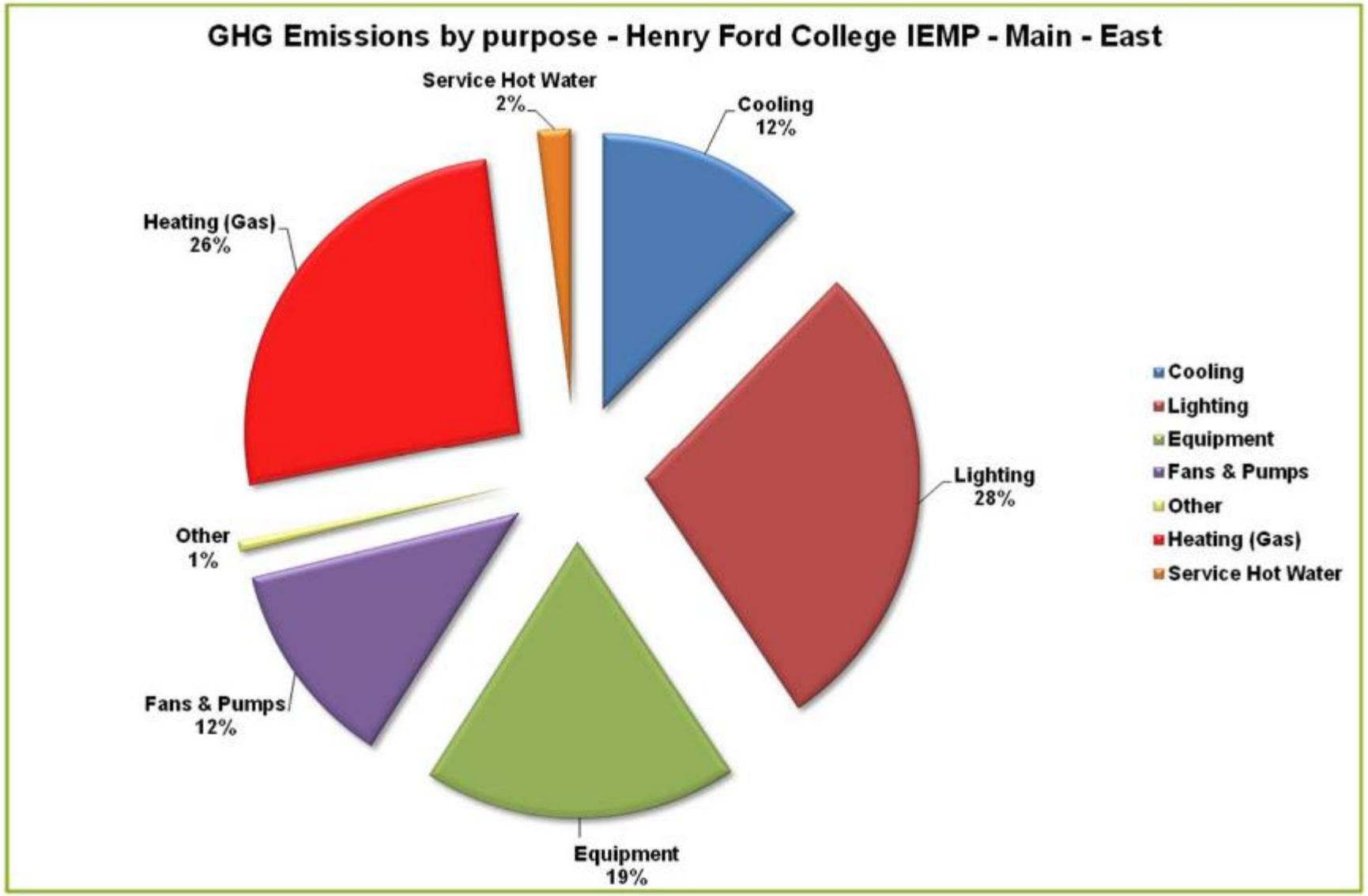

Figure 3-6 GHG Emissions by Purpose

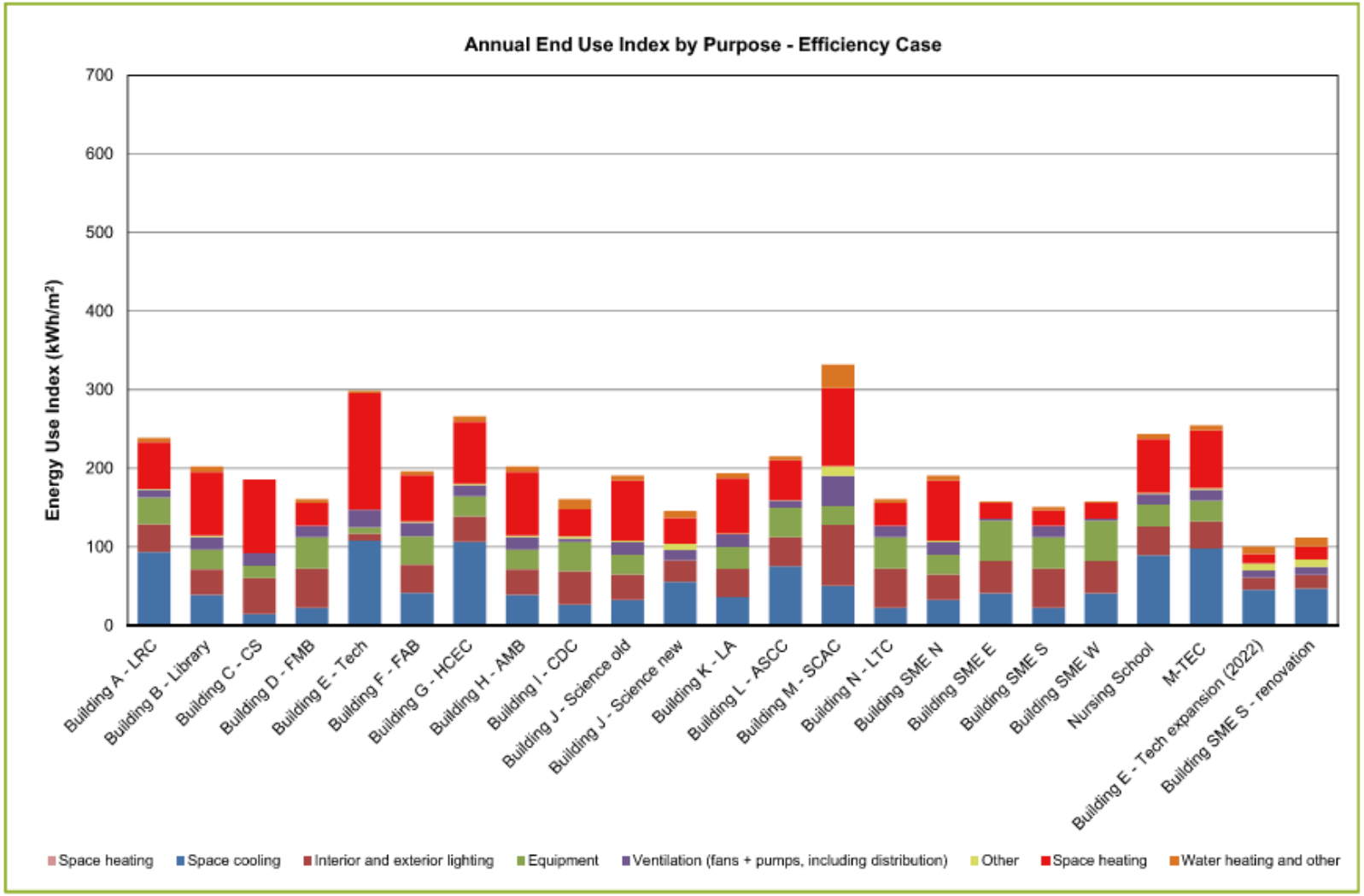

Figure 16-4 Efficiency Case End-Use Index per Building - College

Technology Building E

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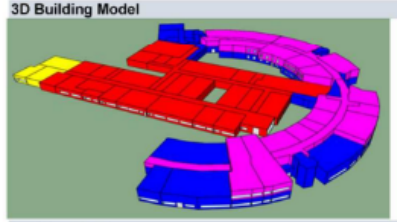

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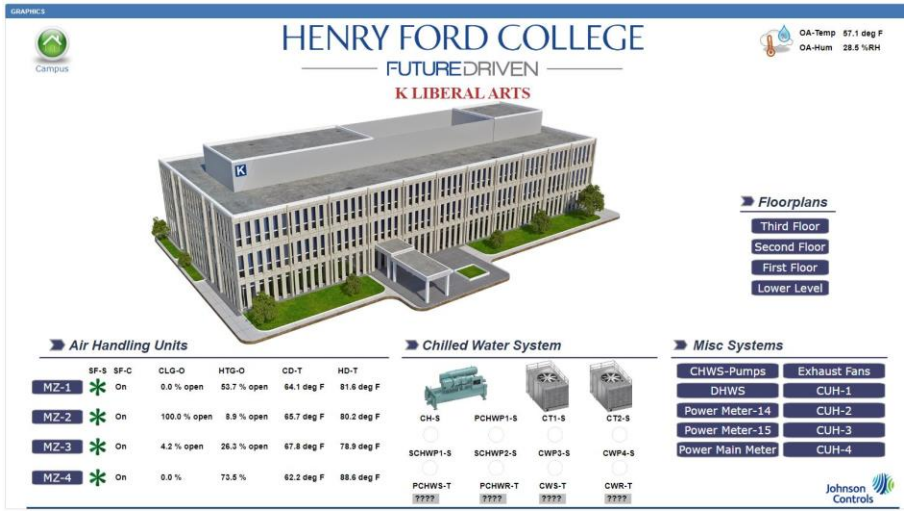

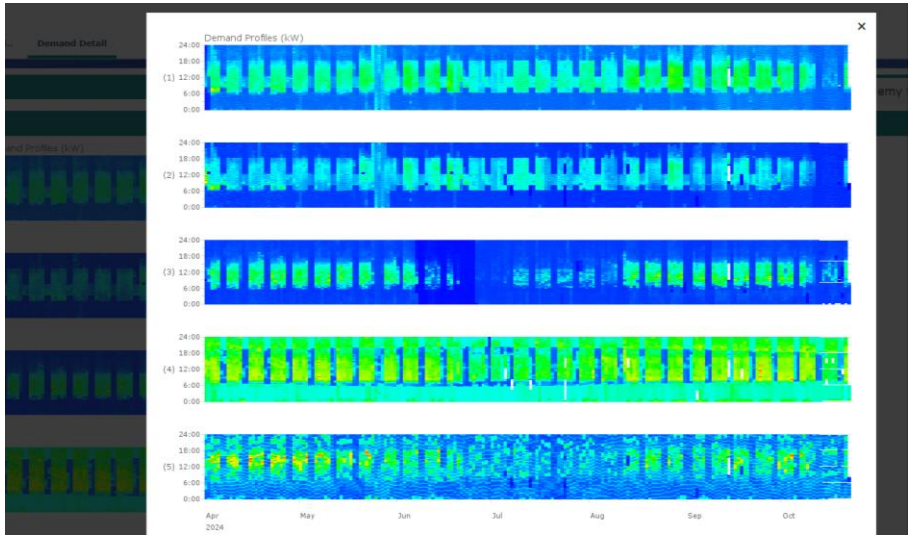

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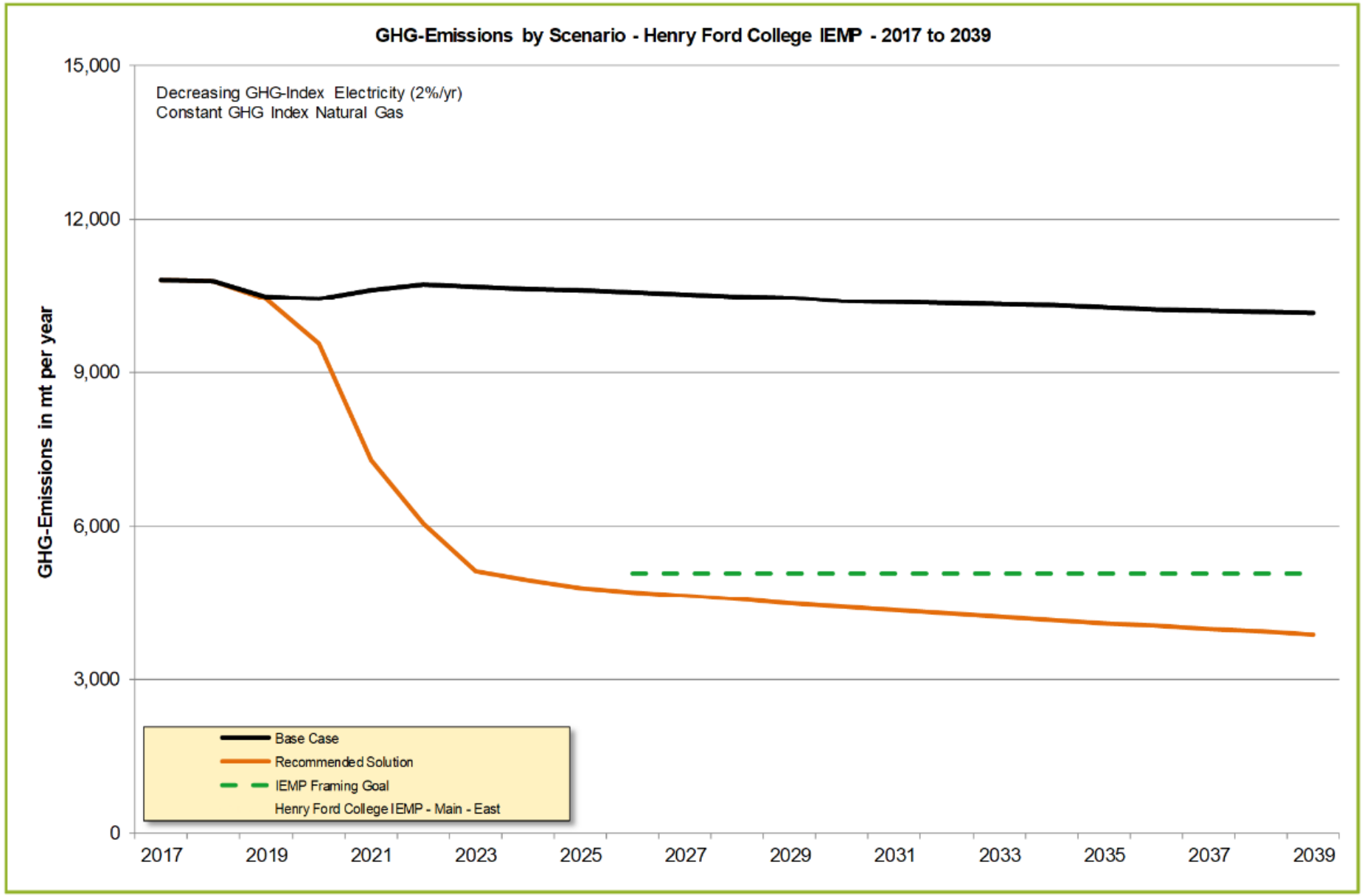

Figure 5-4 CO_2 Emissions Reduction – Recommended Solution against Base Case

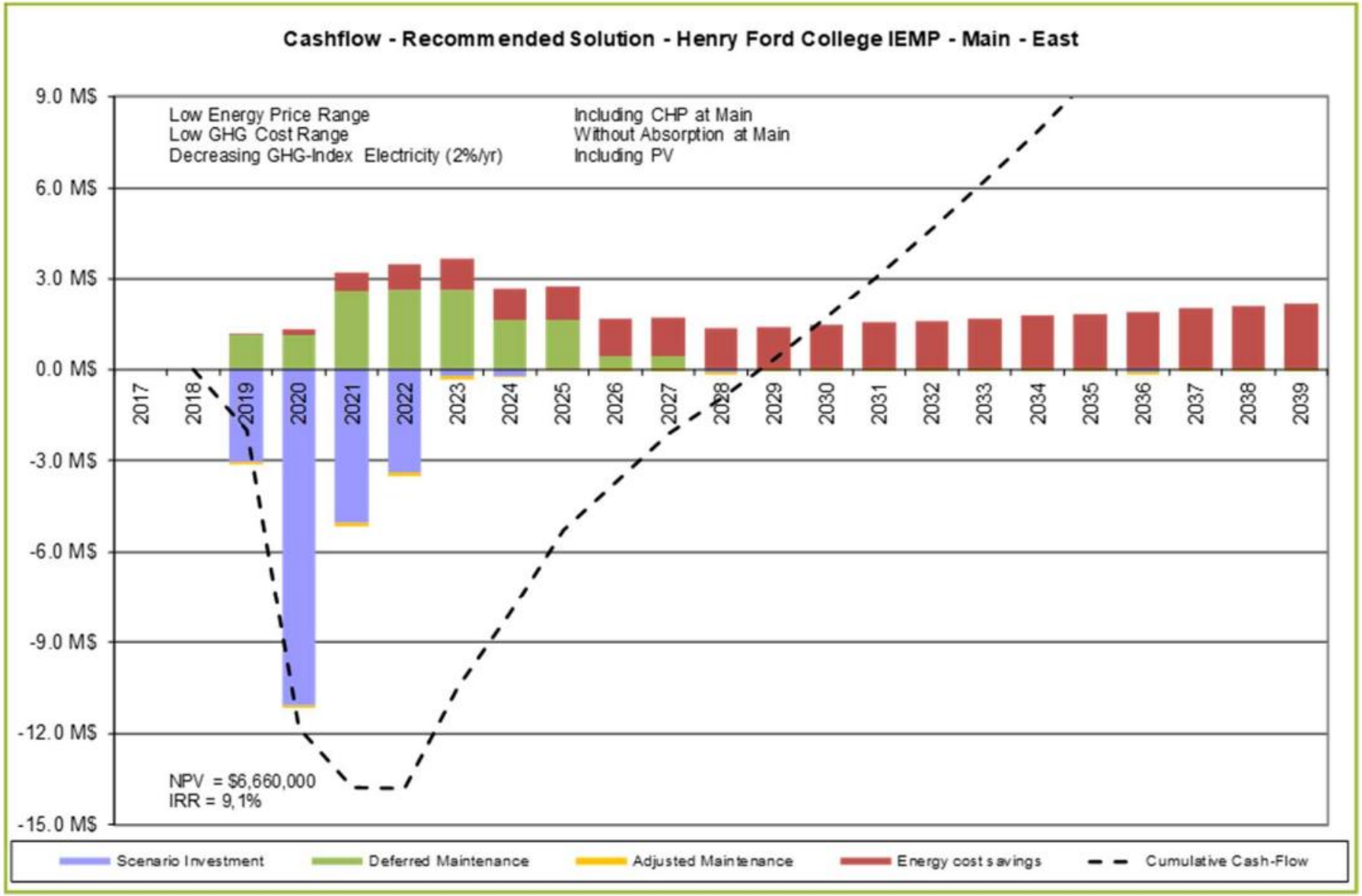

Figure 0-3 Cash Flow and NPV with Lower Price Outlook

Questions?

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