

An aerial photograph of the Georgia Institute of Technology campus, showing various brick buildings, green spaces, and parking lots. A white rectangular text box is centered over the image, containing the title text.

DEEP ENERGY RETROFITTING WITH INNOVATIVE HVAC TECHNOLOGY FOR THE GEORGIA TECH CAMPUS

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OVERVIEW



BACKGROUND

- Building energy consumption is a major contributor to carbon emissions globally
- Heating, ventilation, and air conditioning (HVAC) systems represent a significant portion of the energy load in most commercial buildings
- Heating for comfort and domestic water use often requires combustion of natural gas, which contributes directly to Scope 1 emissions for Georgia Tech

MAJOR BENEFITS



**ENERGY
SAVINGS**



**CARBON
REDUCTION**



**COST
SAVINGS**

The background is a detailed architectural blueprint, likely a floor plan, rendered in a light blue color. It shows various rooms, corridors, and structural elements with fine lines and some handwritten or printed text. A central white rectangular box with a thin black border contains the text 'PROJECT DETAILS' in a bold, white, sans-serif font. The text is centered within the box and stands out against the blue background of the blueprint.

PROJECT DETAILS

CURRENT STATE

- Different types of HVAC equipment on campus
- Central plants are most efficient
- Small remote buildings cannot be connected to central plants
- Unlikely that these buildings will have major renovations in the next 5-10 years



HVAC SYSTEM EFFICIENCY COMPARISON

System	Description	Nominal Efficiency
Central Chilled Water Plant	Chillers use a compressor to generate large amounts of cooling for buildings all over campus	0.75 kW (electricity) per ton of cooling
Central Steam Plant	Boilers use combustion from natural gas to create steam, which carries substantial amounts of energy to buildings all over campus	80% (steam energy / combustion energy)
Direction Expansion (DX) Cooling	Local systems on the roof or mechanical spaces of the building use smaller compressors to generate cooling	1.0 to 2.0 kW (electricity) per ton of cooling
Hot Water Generators	Local systems that use combustion of natural gas to generate hot water for heating in HVAC systems and domestic hot water for the building	80% to 95% (output energy / combustion energy)
Electric Heat	Electrical resistors in the HVAC ducts heat the air directly	1.0 Coefficient of Performance (COP)
New HVAC Innovation (Cooling)	Optimized local system provides cooling only when needed	Less than 0.5 kW (electricity) per ton of cooling
New HVAC Innovation (Heating)	Optimized local system provides heating only when needed	Greater than 5.0 COP

RESULTS



Sales Figures in Total Units



ANALYSIS

- Five buildings were reviewed as candidates to pilot the new HVAC technology
- Buildings with a variety of attributes (system type, square footage, building performance, and other factors) selected for analysis
- On average, the optimized system **reduced annual energy consumption by 60%** for each building

Include?	Bldg #	Total Energy Consumption kBtu	Energy Use Index (EUI) kBtu/sq ft	Energy Savings kBtu	Energy Savings %	Carbon Emissions		Implement Cost USD	Simple Payback years	Net Present Value (NPV) ³ USD	Internal Rate of Return (IRR) %
						Reduction ¹ lbs of CO2	Cost Savings ² USD				
Yes	123	5,145,165	120.8	3,032,707	58.9	371,621	33,857	273,935	8.1	292,136	13.5
Yes	137	1,067,218	36.6	459,378	43.0	109,055	13,464	209,026	15.5	16,075	3.9
Yes	155	1,556,511	44.1	1,087,125	69.8	258,081	31,862	268,707	8.4	263,999	12.8
Yes	187	5,061,787	267.6	3,079,955	60.8	284,201	48,186	186,546	3.8	641,418	30.5
No	191	54,273,551	56.2	24,448,683	45.0	2,578,792	334,706	6,363,835	19.0	(767,804)	1.5
TOTAL		12,830,682	117.3	7,659,165	59.7	1,022,958	127,369	938,214	7.4	1,213,628	15.2

1) Based on emissions data from Georgia Power and EPA Greenhouse Gases Equivalencies Calculator

2) Based \$0.10/kWh for electricity and \$1.20/therm for natural gas

3) Based on 5% escalation in utility costs and 3% discount factor for estimated life of equipment (minimum 15 years)

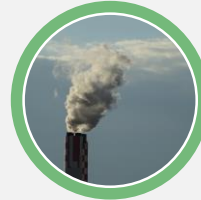
KEY RESULTS

Estimated Energy Savings:
7,659,165 kBTU



Projected Financial Benefits:

- \$127,369 annual cost savings
- \$1.2M net present value
- 15.2% internal rate of return



Estimated Carbon Emissions Reduction:
1,022,958 lbs of CO₂





CO-BENEFITS

- **Increased comfort** in buildings with more effective temperature control
- **Improved overall air quality** around the Georgia Tech campus because of less combustion of natural gas
- **Allows climate technologies to grow** by championing innovation in the facilities of a well-known institution



NEXT STEPS

A group of diverse people are gathered around a whiteboard in a meeting room. The whiteboard has several sticky notes and handwritten notes, including the number '200,000' and some illegible text. The people are looking at the whiteboard and talking to each other. The room has a brick wall and a potted plant.

PILOT

DECIDE BUILDING SUITABLE FOR PILOT

COSTS

DEVELOP BETTER COST ESTIMATES

PLAN

DISCUSS IMPLEMENTATION WITH STAKEHOLDERS