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

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**


Sales Figures in Total Units
March
April
May
June
July
August

RESULTS

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 Reduction[1] lbs of CO2	Cost Savings[2] USD	Implement Cost USD	Simple Payback years	Net Present Value (NPV)[3] USD	Internal Rate of Return (IRR) %
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**

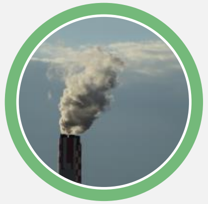
1) Based on emissions data from Georgia Power and EPA Greenhouse Gases Equivalencies Calculator
2) Based $0.10/kWh for electricity and $1.20/therm for natural gas
3) Based on 5% escalation in utility costs and 3% discount factor for estimated life of equipment (minimum 15 years)

KEY RESULTS

Projected Financial Benefits:

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

Estimated Energy Savings:
7,659,165 kBTU



Estimated Carbon Emissions Reduction:
1,022,958 lbs of CO_2

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

PILOT	DECIDE BUILDING SUITABLE FOR PILOT
COSTS	DEVELOP BETTER COST ESTIMATES
PLAN	DISCUSS IMPLEMENTATION WITH STAKEHOLDERS