City of Manchester Energy Program
Survey Report
April, 2011

Introduction:

ARAMARK has been retained by the City of Manchester to implement an Energy Management Program to reduce the City's energy costs by implementing economical energy efficiency improvements. As the first step in implementing the energy management program ARAMARK has performed an energy survey of the City's major buildings.

ARAMARK completed the energy survey of 35 building totaling about 2.6 million gross square feet which accounts for well over 90% of the energy budget for the City and Manchester School District. The product of the energy survey is a comprehensive Energy Project List. This list provides a description of each measure identified, the estimated annual energy related savings and the estimated capital cost to implement the measure. Overall nearly two hundred projects were identified on the energy project list.

After review with the Highway Department and the Facilities Division the list was narrowed down based on the following criteria:

1) Available Funding
2) Quickest Return on Investment
3) Reducing Deferred Maintenance

Refined Energy Project List:

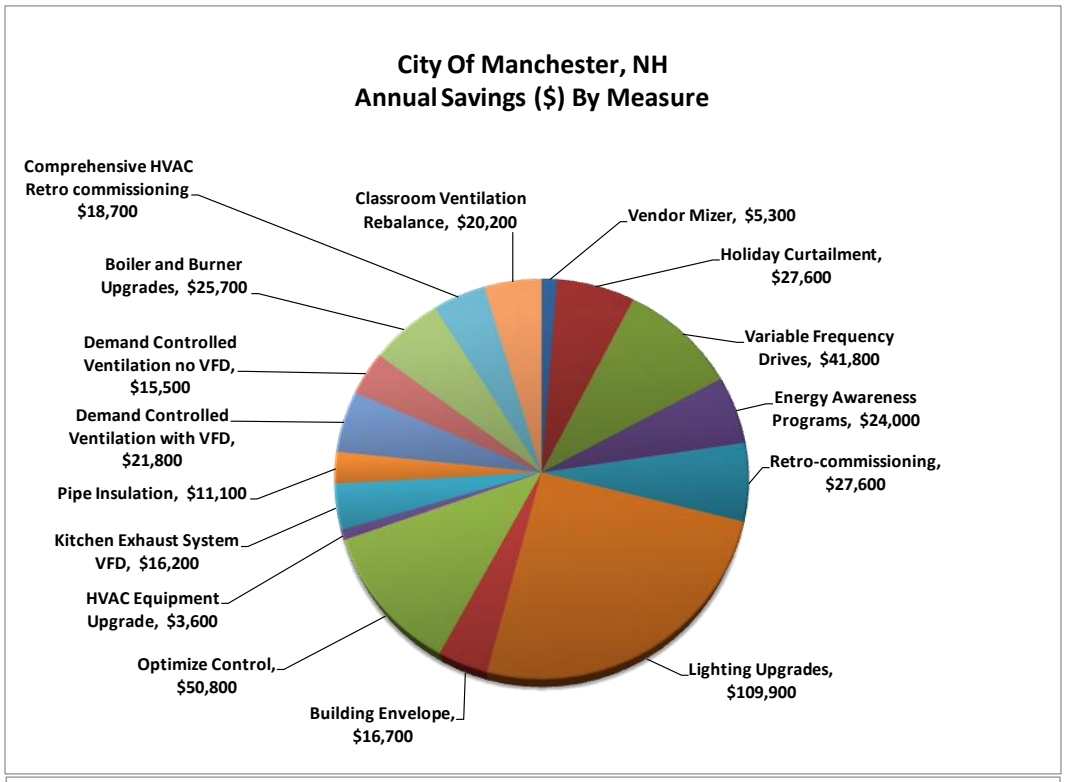
Annual Energy Savings:	$ 441,600
Total Capital Cost of all Measures:	$2,322,800
Overall Simple Payback of Projects:	5.3 years

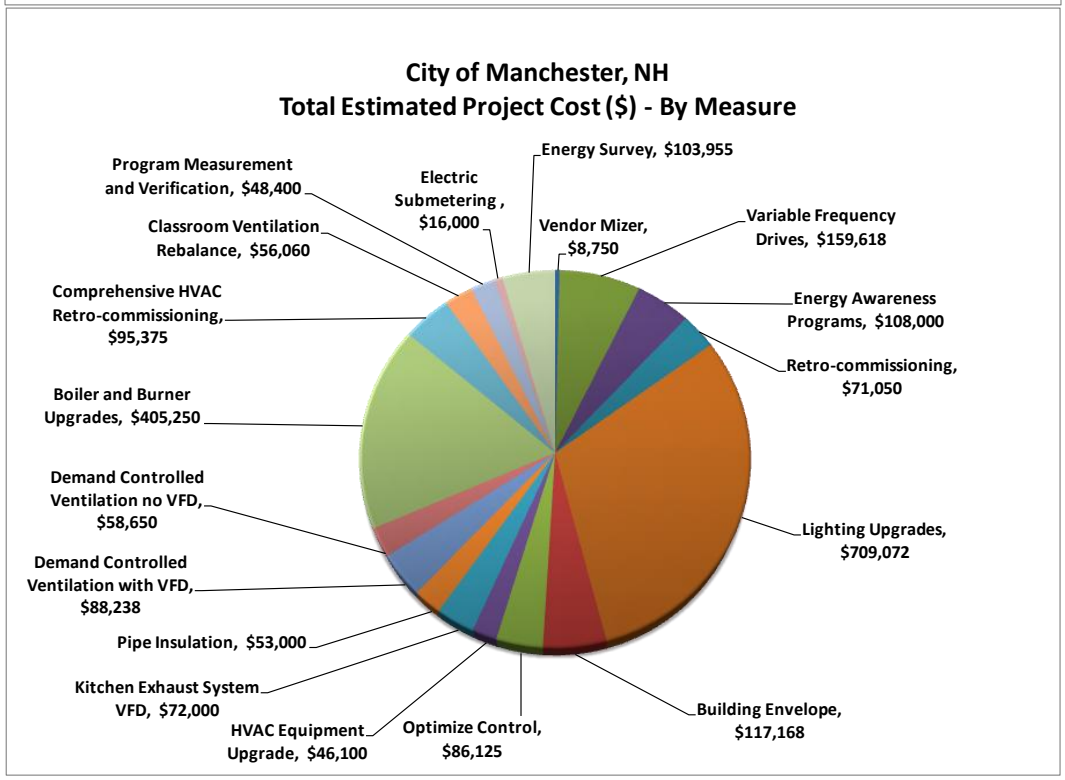
The energy projects identified are spread across the City and School District and several different types of measures and technologies. The tables and graphs on the following pages illustrate the distribution of energy savings and project costs across the City's buildings and by energy efficiency measure.

City-wide Measures includes lighting controls, holiday curtailment and vending machine controllers as well as the cost for the energy audit, the energy awareness program and program measurement and verification.

Projected Energy Saving and Capital Cost by Building

Building	Estimated Annual Cost Savings	Estimated Capital Costs	Payback
City Wide Measures	$ 84,600	$ 490,400	5.8
Energy Aware Program			
Energy Optim/Comiss			
Energy Audit Schools			
Energy Audits Municipal			
City Hall	$ 24,100	$ 263,200	10.9
Carpenter Library	$ 8,300	$ 231,200	27.9
West Library	$ 2,400	$ 45,800	19.1
Rines Building	$ 12,800	$ 77,300	6.0
Central Fire	$ 2,300	$ 5,500	2.4
South Willow Fire	$ 2,400	$ 7,800	3.3
JFK Ice Arena	$ 25,300	$ 120,900	4.8
Westside Ice Arena	$ 20,700	$ 96,800	4.7
Waterworks Building	$ 1,300	$ 10,900	8.4
Parks and Rec Garage	$ -	$ -	
Central HS	$ 55,500	$ 155,100	2.8
Memorial HS	$ 26,400	$ 85,600	3.2
West HS	$ 55,700	$ 264,000	4.7
Hillside MS	$ 9,600	$ 24,600	2.6
Parkside MS	$ 18,200	$ 78,500	4.3
McLaughlin MS	$ 10,100	$ 48,500	4.8
Southside MS	$ 15,800	$ 53,200	3.4
Bakersville ES	$ 1,700	$ 7,900	4.6
Beech St. ES	$ 16,400	$ 62,500	3.8
Gossler Park ES	$ 7,300	$ 46,300	6.3
Green Acres ES	$ 6,900	$ 10,800	1.6
Hallsville ES	$ 4,300	$ 15,300	3.6
Highland Goffs ES	$ -	$ -	
Jewett ES	$ 6,200	$ 24,600	4.0
McDonough ES	$ 1,300	$ 8,800	6.8
Parker Varney ES	$ 8,100	$ 31,300	3.9
Smyth Rd ES	$ 2,400	$ 15,600	6.5
Webster ES	$ 7,000	$ 24,300	3.5
Weston ES	$ -	$ -	
Wilson ES	$ 1,200	$ 3,800	3.2
Northwest ES	$ 600	$ 3,100	5.2
MST	$ 2,700	$ 9,200	3.4
Total	$ 441,600	$ 2,322,800	5.3


City Of Manchester, NH
Annual Savings ($) By Measure
Comprehensive HVAC Retro commissioning $18,700
Classroom Ventilation Rebalance, $20,200
Vendor Mizer, $5,300
Holiday Curtailment, $27,600
Boiler and Burner Upgrades, $25,700
Variable Frequency Drives, $41,800
Demand Controlled Ventilation no VFD, $15,500
Energy Awareness Programs, $24,000
Demand Controlled Ventilation with VFD, $21,800
Retro-commissioning, $27,600
Pipe Insulation, $11,100
Kitchen Exhaust System VFD, $16,200
HVAC Equipment Upgrade, $3,600
Optimize Control, $50,800
Lighting Upgrades, $109,900
Building Envelope, $16,700


City of Manchester, NH
Total Estimated Project Cost ($) - By Measure
Energy Survey, $103,955
Program Measurement and Verification, $48,400
Electric Submetering , $16,000
Vendor Mizer, $8,750
Variable Frequency Drives, $159,618
Classroom Ventilation Rebalance, $56,060
Energy Awareness Programs, $108,000
Comprehensive HVAC Retro-commissioning, $95,375
Retro-commissioning, $71,050
Boiler and Burner Upgrades, $405,250
Demand Controlled Ventilation no VFD, $58,650
Lighting Upgrades, $709,072
Demand Controlled Ventilation with VFD, $88,238
Pipe Insulation, $53,000
Kitchen Exhaust System VFD, $72,000
Building Envelope, $117,168
HVAC Equipment Upgrade, $46,100
Optimize Control, $86,125

Project Funding Strategy

Costs of the Energy Management Program and the energy project capital investment will be provided from several sources including:

Source	Amount Available or Expected Funding
American Revitalization and Reinvestment Act funds - Energy Efficiency Community Block Grants (EECBG)	$ 380,000
City Bond Funds dedicated for energy efficiency	$ 1,130,000
PSNH SmartStart Project funding	$200,000 - 300,000
NH Pay for Performance Program Funding (P4P)	$ 100,000 – 200,000
State Energy Program Funding	$400,000 – 1,000,000
Enterprise Funding – Project with attractive paybacks are expected to be funded by the enterprise organization as a strategy to reduce long term operating costs.	TBD
Rebate money available for re-investment	$230,000 - $325,000
Total	$2,440,000 to $ 2,640,000

Funding will also be sought from PSNH and National Grid prescriptive programs wherever possible and capital investment projects implemented in school buildings are eligible for matching funding from the state. Each project on the list has been allocated to a specific finding source to develop the potential funding matrix below.

	Projected Cost	*Estimated Rebate*	*Annual Savings*	*Simple Payback*
PSNH SmartStart	$ 189,362	$ 35,290	$ 37,287	4.1
Bond -School	$ 922,020	$ 46,475	$ 246,067	3.6
Bond - Municipal	$ 111,384	$ -	$ 15,000	7.4
EECBG	$ 464,545	$ 1,200	$ 81,352	5.7
Enterprise	$ 85,989	$ 1,939	$ 19,400	4.3
P4P	$ 170,027	$ 10,597	$ 28,106	5.7
State Energy Loan Fund	$ 379,370	$ -	$ 14,283	26.6
Totals	$ 2,322,696	$ 95,501	$ 441,494	5.0

The following table provides a building by building breakdown of the preliminary allocation of funds.

Building	Estimated Annual Cost Savings	Estimated Capital Costs	Payback	Percent Energy Reduction Projected	RGGI P4P	EECBG	Bond	Enterprise	PSNH SmartStart	State Energy Loan Fund	State Building Aid	Net Payback to City
City Wide Measures	$ 84,600	$ 490,400	5.8	n/a	$ -	$ 112,649		$ -	$ -	$ -		4.5
Energy Aware Program						$ 54,000	$ 54,000					
Energy Optim/Comiss						$ 82,500	$ 82,500					
Energy Audit Schools						$ 17,468	$ 71,400					
Energy Audits Municipal						$ 15,883						
City Hall	$ 24,100	$ 263,200	10.9	20%	$ 112,200	$ -	$ -	$ -	$ -	$ 151,000		6.3
Carpenter Library	$ 8,300	$ 231,200	27.9	6%	$ -	$ 2,900	$ -	$ -	$ -	$ 228,400		27.5
West Library	$ 2,400	$ 45,800	19.1	18%	$ -	$ 45,800	$ -	$ -	$ -	$ -		-
Rines Building	$ 12,800	$ 77,300	6.0	15%	$ 57,900	$ -	$ -	$ -	$ 19,400	$ -		1.5
Central Fire	$ 2,300	$ 5,500	2.4	4%	$ -	$ 5,500	$ -	$ -	$ -	$ -		-
South Willow Fire	$ 2,400	$ 7,800	3.3	8%	$ -	$ 7,800	$ -	$ -	$ -	$ -		-
JFK Ice Arena	$ 25,300	$ 120,900	4.8	11%	$ -	$ 23,500	$ -	$ 27,400	$ 70,000	$ -		3.8
Westside Ice Arena	$ 20,700	$ 96,800	4.7	11%	$ -	$ -	$ -	$ 47,700	$ 49,100	$ -		4.7
Waterworks Building	$ 1,300	$ 10,900	8.4	n/a	$ -	$ -	$ -	$ 10,900	$ -	$ -		8.4
Parks and Rec Garage	$ -	$ -			$ -	$ -	$ -	$ -	$ -	$ -		
Central HS	$ 55,500	$ 155,100	2.8	14%	$ -	$ -	$ 155,100	$ -	$ -	$ -	$ 77,550	1.4
Memorial HS	$ 26,400	$ 85,600	3.2	9%	$ -	$ -	$ 64,400	$ -	$ 21,300	$ -	$ 42,800	1.6
West HS	$ 55,700	$ 264,000	4.7	15%	$ -	$ -	$ 264,000	$ -	$ -	$ -	$ 132,000	2.4
Hillside MS	$ 9,600	$ 24,600	2.6	12%	$ -	$ -	$ 23,100	$ -	$ 1,500	$ -	$ 11,070	1.4
Parkside MS	$ 18,200	$ 78,500	4.3	17%	$ -	$ -	$ 70,000	$ -	$ 8,500	$ -	$ 35,325	2.4
McLaughlin MS	$ 10,100	$ 48,500	4.8	4%	$ -	$ -	$ 39,000	$ -	$ 9,500	$ -	$ 21,825	2.6
Southside MS	$ 15,800	$ 53,200	3.4	14%	$ -	$ -	$ 43,000	$ -	$ 10,200	$ -	$ 23,940	1.9
Bakersville ES	$ 1,700	$ 7,900	4.6	2%	$ -	$ -	$ 7,900	$ -	$ -	$ -	$ 3,555	2.6
Beech St. ES	$ 16,400	$ 62,500	3.8	18%	$ -	$ -	$ 62,500	$ -	$ -	$ -	$ 28,125	2.1
Gossler Park ES	$ 7,300	$ 46,300	6.3	17%	$ -	$ -	$ 46,300	$ -	$ -	$ -	$ 20,835	3.5
Green Acres ES	$ 6,900	$ 10,800	1.6	9%	$ -	$ -	$ 10,800	$ -	$ -	$ -	$ 4,860	0.9
Hallsville ES	$ 4,300	$ 15,300	3.6	10%	$ -	$ -	$ 15,300	$ -	$ -	$ -	$ 6,885	2.0
Highland Goffs ES	$ -	$ -		0%	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
Jewett ES	$ 6,200	$ 24,600	4.0	13%	$ -	$ -	$ 24,600	$ -	$ -	$ -	$ 11,070	2.2
McDonough ES	$ 1,300	$ 8,800	6.8	3%	$ -	$ -	$ 8,800	$ -	$ -	$ -	$ 3,960	3.7
Parker Varney ES	$ 8,100	$ 31,300	3.9	10%	$ -	$ -	$ 31,300	$ -	$ -	$ -	$ 14,085	2.1
Smyth Rd ES	$ 2,400	$ 15,600	6.5	4%	$ -	$ -	$ 15,600	$ -	$ -	$ -	$ 7,020	3.6
Webster ES	$ 7,000	$ 24,300	3.5	8%	$ -	$ -	$ 24,300	$ -	$ -	$ -	$ 10,935	1.9
Weston ES	$ -	$ -		0%	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
Wilson ES	$ 1,200	$ 3,800	3.2	4%	$ -	$ -	$ 3,800	$ -	$ -	$ -	$ 1,710	1.7
Northwest ES	$ 600	$ 3,100	5.2	2%	$ -	$ -	$ 3,100	$ -	$ -	$ -	$ 1,395	2.8
MST	$ 2,700	$ 9,200	3.4	1%	$ -	$ -	$ 9,200	$ -	$ -	$ -	$ 4,600	1.7
Total	$ 441,600	$ 2,322,800	5.3		$ 170,100	$ 368,000	$ 1,130,000	$ 86,000	$ 189,500	$ 379,400	$ 463,545	3.0
State Building Aid Calculated at 45% for K-8 and 50% for High Schools												
Net payback to the City subtracts P4P, EECBG and State Aid funds from the Estimated Capital Cost												

General Description of Energy Conservation Measures

Computer Power Management: Install a power management software that will automatically set computers into a low power sleep mode when not being used and turn them off at night based on a programmed schedule. This software can be controlled by IT to allow regular system upgrades and software patches to take place. Software will automatically wake up the computer, make the required changes, and then put it back to sleep when complete. This can be applied across the entire City to include both school and city computers.

Vending Machines: Install "Vending Miser" type vending machine occupancy sensors which reduce energy consumption when consumers are not present by turning down into a low power mode. This will save energy at night and over weekends, holidays, and vacations. During unoccupied conditions, "Vending Miser" controls will cycle operation as necessary to maintain product temperatures and turn off the machine's lighting. Ultimately, vending machines could be emptied and unplugged over summer vacation resulting in more savings.

Holiday Schedule Override: Create an override button on the main EMS control page that will override existing schedules and put equipment into an unoccupied setback mode temporarily when activated. This will provide a one touch place to shut down multiple buildings at once during snow days, holidays, vacations, and summer breaks. Multiple buttons can be created for each scenario based on desired duration and whether or not to include or exclude different municipal buildings to customize each event.

Variable Frequency Drive: Install a Variable Frequency Drive on pumps or fan motors that are currently constant speed. External sensors would be used to vary the speed of the motor based on the demand of the system. This reduces motor energy consumption while adequately satisfying system loads. Drives should be incorporated into the EMS to provide proper control. Some other measures include adding or controlling Variable Frequency Drives.

Retro-commissioning: Retro-Commissioning involves inspecting current equipment operation both through the EMS and in the field, and testing the functionality of the equipment to verify whether or not it is operating as intended. From this starting point, set points and parameters will be modified to optimize the efficiency of each piece of equipment individually. This is different from the Optimize Controls measure because optimizing controls typically requires a controller or some type of equipment to be added, whereas under Retro-Commissioning, the controls already exist.

Comprehensive HVAC System Retro-commissioning: Comprehensive HVAC system retro-Commissioning involves a comprehensive review of the entire building heating, ventilation and air conditioning system to reduce energy use, increase occupant comfort and improve system reliability and performance. This type of retro commissioning includes functional testing of key system equipment and control systems as well as evaluation of the system ability to meet current occupant needs and potential modifications

available based on changes in space use since the system was originally installed. Comprehensive HVAC System Retro-commissioning is typically performed in buildings with long histories comfort problems, operation problems and high energy use. All system inadequacies are cataloged in a system deficiency list. Low or no cost corrective measures are typically performed via work order to by the on-site team. Measures requiring greater planning, capital or detailed design work are logged for follow up and estimated costs and potential energy savings are calculated.

Lighting and Controls: Upgrade or replace existing fixtures with high efficiency fixtures that consume less energy and install occupancy or timer based controls to minimize operating hours. This measure also includes reducing light levels to acceptable industry standards in some areas where light levels are considered excessive.

Domestic Hot Water: Replace existing Domestic Hot Water heaters with high efficiency replacements that will have higher efficiency burners and less stand-by losses. Schedule heaters to operate during occupied hours only and allow circulating pumps to turn off during unoccupied periods where applicable to reduce stand-by losses and pump energy consumption.

Buildings Envelope: Add insulation and weatherstripping to the building exterior where infiltration and heat loss occur. This is primarily around exterior doors, at roof joints where the roof meets the exterior wall, in attics above drop ceilings, and at penetrations where rooftop equipment has been mounted. Insulation will also be added in some locations where outside overhangs are open to spaces above the ceiling. Window replacements are also included in this category.

Optimize Control: This measure will primarily focus on scheduling equipment to operate only during occupied hours. Time-clocks and EMS schedules will be installed, created, or altered to minimize unnecessary operation. Existing optimum start/stop capabilities will be activated in the EMS system to allow HVAC systems to “learn” when to turn on or off based on a trended relationship of how long the unit typically takes to satisfy set points, and at what time it is expected to be at that set point. This measure is different than retro- commissioning, although retro-commissioning does include some controls optimization.

HVAC Equipment Upgrade: Retrofit or replace existing equipment such as exhaust fans, controls, or compressors. Many measures in this category do not have attractive paybacks and were considered but not recommended at this time.

Pipe Insulation: Replace or install new pipe and blanket type insulation on steam, heating hot water, and domestic hot water piping and fittings to reduce thermal losses from the system with particular attention to steam piping because of its high temperature.

Demand Controlled Ventilation with VFD: Install Variable Frequency Drives to control both the supply and return fans (if applicable) and a CO2 or occupancy sensor to determine space occupancy. Reduce fan speed and modulate the outdoor air intake based on CO2 levels/occupancy in the space. For Manchester projects, this strategy is used primarily on heat recovery unit serving spaces with highly variable occupancy such as cafeterias, gymnasiums, auditoriums, etc. It may also be applied to larger single zone air handling units that serve spaces such as band or chorus rooms with the concept of slowing down the fan if either the C02 levels and space temperature are both satisfied.

Demand Controlled Ventilation no VFD: Install a CO2 sensor or occupancy sensor to determine space occupancy. Generally this is used on spaces where either a VFD already exists or where application of a VFD is not appropriate. In most cases this strategy will simply vary the amount of outside air using outside air, mixed air and return air dampers. The control will modulate the outdoor air intake based on CO2 levels/occupancy in the space.

Boiler and Burner Upgrades: Replace existing boilers with premium efficiency condensing type gas fired units with high turn down ratios or upgrade the burner and control system only with a fully modular type that will allow boilers to modulate firing rates based on space loads. In some cases the recommendation may be to continue using the boiler and replace the burner with unti with greater turn down to allow for more efficient low load operation.

Classroom Heat Recovery Unit Rebalancing: The Heat Recovery Units (HRU's) were originally sized on providing a ventilation rate of 25 CFM of outside air per student. Per the latest ASHRAE 62.1 ventilation standard the acceptable rate for ventilation is 15 CFM per student. Under this measure selected HRU's will be rebalanced and the fans slowed down to provide the ASHRAE required airflow. Reducing the fan speed will be done by replacing the sheaves (pulleys) and balancing the airflow to the required amount. This will save considerable energy in the form of both fan horsepower and heating energy required to warm the fresh air during the heating months.