ENERGY AUDIT
REPORT

TOWN OF NEEDHAM
Department of Public Facilities
1471 Highland Avenue
Needham, Massachusetts 02492
Kate Fitzpatrick

ENERGY AUDIT REPORT

of

POLICE STATION/FIRE STATION #1
99 School Street / 88 Chestnut Street
Needham, Massachusetts 02492

PREPARED BY:

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EMG Project #: 98515.11R-008.268
Date of Report: October 12, 2011
On site Date: September 8, 2011

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1. CERTIFICATION

EMG has completed an Energy Audit of Police Station/Fire Station #1 located at 99 School Street / 88 Chestnut Street in Needham, Massachusetts. EMG visited the site on September 8, 2011.

The assessment was performed at the Client's request using methods and procedures consistent with ASHRAE Level II Energy Audit and using methods and procedures as outlined in EMG's Proposal.

This report is exclusively for the use and benefit of the Client identified on the first page of this report. The purpose for which this report shall be used shall be limited to the use as stated in the contract between the client and EMG.

This report is not for the use or benefit of, nor may it be relied upon by any other person or entity, for any purpose without the advance written consent of EMG.

Estimated installation costs are based on EMG's experience on similar projects and industry standard cost estimating tools including *RS Means*. In developing the installed costs, EMG also considered the area correction factors for labor rates for Needham, MA. Since actual installed costs may vary widely for particular installation based on labor & material rates at time of installation, EMG does not guarantee installed cost estimates and shall in no event be liable should actual installed costs vary from the estimated costs herein. We strongly encourage the owner to confirm these cost estimates independently. EMG does not guarantee the costs savings estimated in this report. EMG shall in no event be liable should the actual energy savings vary from the savings estimated herein.

EMG certifies that EMG has no undisclosed interest in the subject property and that EMG's employment and compensation are not contingent upon the findings or estimated costs to remedy any deficiencies due to deferred maintenance and any noted component or system replacements.

Any questions regarding this report should be directed to Kalyana Vadala at 800.733.0660, ext. 6236.

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Energy Auditor
Project Manager

Reviewed by: Brett Byers, Reviewer for
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Program Manager

2. EXECUTIVE SUMMARY

The purpose of this Energy Audit is to provide Town of Needham and Police Station/Fire Station #1 with a baseline of energy usage and the relative energy efficiency of the facility and specific recommendations for Energy Conservation Measures. Information obtained from these analyses may be used to support a future application to an Energy Conservation Program, Federal & Utility grants towards energy conservation, support performance contracting, justify a municipal bond funded improvement program, or as a basis for replacement of equipment or systems.

The public administration building is a, three-story building containing 29,625 square feet. The building is used for three purposes: first, as a police station and police administrative offices; second, as the fire headquarters and administration; and third, as a fire station. One side of the building is considered the police section and the other side of the building is considered the fire section. However, the building only has one cooling, one heating, and one domestic water system that are used for the entire building. There is one cooling loop, heating loop, and domestic hot water loop.

The site area is approximately 1.8 acres. The original construction of the property was completed in 1931. Significant renovations to the mechanical system were performed in 2011 with the installation of a new chiller and new Roof Top Unit (RTU); the roof was renovated in 2010.

The study included a review of the building's construction features, historical energy and water consumption and costs, review of the building envelope, HVAC equipment, heat distribution systems, lighting, and the building's operational and maintenance practices.

Some of the recommended Energy Conservation Measures include improving building weather sealing, upgrade to high efficiency lighting and adding automatic lighting controls and adding DDC controls to add the building into the Energy management System. Some of the measures recommended for consideration include adding VFD for hot water pumps and installing high efficiency condensing boiler.

Summary of Existing Energy Performance

Building's Annual Energy Consumption	2,602,553 kBtu
Total Annual Energy Costs	$73,376

EMG has identified a total of 14 Energy Conservation Measures (ECMs) for this property. Following the financial evaluation, only 10 of the 14 are recommended for implementation. The savings for each measure are calculated using standard engineering methods followed in the industry, and detailed calculations for ECM are provided in Appendix G for reference. A 10% discount in energy savings was applied to account for the interactive effects amongst the ECMs. In addition to the consideration of the interactive effects, EMG has applied a 15% contingency to the implementation costs to account for potential cost overruns during the implementation of the ECMs.

The following table summarizes the recommended ECMs in terms of description, investment cost, energy consumption reduction, and cost savings.

Summary of Financial Information for Recommended Energy Conservation Measures

Item	Estimate
Total Initial ECM Investment *(Current Dollars Only)*	$146,351
Estimated Annual Cost Savings Related to ECMs *(Current Dollars Only)*	$9,147
ECM Effective Payback (years)	16
Estimated Annual Energy Savings	12%
Estimated Annual Energy Cost Savings	12%

List of Recommended Energy Conservation Measures Fire Station #1/Police Station #1								
ECM #	Description of ECM	Projected Initial Investment	Estimated Annual Energy Savings		Estimated Annual Water Savings	Total Energy Savings	Total Estimated Annual Cost Savings	Simple Payback
			Natural Gas	Electricity				
		$	Therms	kWh	kgal	MMBtu	$	Years
No/Low Cost Recommendations								
1	Reduce Light Levels By Delamping of Lamps Details: Delamp Fixtures in Police section Hallway, Garage and Kitchen Area	$15	0	2765	0	9	$445	0.03
2	Replace Incandescent Lamps With CFL's Details: Replace Incandescent Exterior Building Lights with CFLs	$19	0	1362	0	5	$234	0.08
3	Lower Domestic Hot water Temperature Set-Points Details: Lower Domestic Hot Water Temperature to 125 degrees F	$50	212	0	0	21	$231	0.22
4	Automatically Control Rooftop Exhaust Fans Details: Control Rooftop fans with Lighting Occupancy Sensors	$190	0	760	0	3	$122	1.55
5	Control External Air Leakage In The Building Details: Install Weather-Stripping on Entrance Doors	$395	155	153	0	16	$203	1.95
6	Install Energy Savers on Vending, Snack Machines Details: Install Energy Savers on Vending and Soda Machines	$455	0	3727	0	13	$600	0.76
Totals for No/Low Cost Items		**$1,124**	**366**	**8,767**	**0**	**67**	**$1,835**	**0.61**
Capital Cost Recommendations								
1	Install Automatic Lighting Controls Details: Install Motion Sensors in Office and Common Areas	$1,390	0	2830	0	10	$455	3.05
2	Add the Building to Needham's BMS and Install DDC controls Details: Replace pneumatic controls with DDC; add remotely monitored digital room thermostats	$120,750	1374	35117	0	257	$7,150	16.89
3	Replace Existing Refrigerator(s) With Energy Star Certified Refrigerator(s) Details: Replace Refrigerators in Police Department with Energy Star Systems	$1,600	0	1580	0	5	$254	6.29
4	Replace High Intensity Discharge Lamp (HID) with Induction Lighting Details: Replace Exterior and Parking Lights with Induction Lights	$2,398	0	2721	0	9	$468	5.12
Total For Capital Cost		**$126,138**	**1374**	**42248**	**0**	**282**	**$8,328**	**15.15**
	Interactive Savings Discount @ 10%		-174	-5,102		-35	-$1,016	
	Total Contingency Expenses @ 15%	$19,089						
Total for Improvements		**$146,351**	**1,567**	**45,914**	**0**	**313**	**$9,147**	**16.00**

Apart from the above recommended measures, EMG has analyzed the following measures for consideration and long term capital planning. These measures are not recommended at the current time due to high initial investment and long payback yielding negative life cycle savings, but are recommended either at the time of equipment replacement or renovation.

Detailed List of Measures Evaluated For Consideration		Fire Station #1/Police Station #1						
ECM #	Description of ECM	Initial Investment	Annual Energy Savings		Annual Water Savings	Total Energy Savings	Total Estimated Annual Cost Savings	Payback
		$	Therms	kWh	kgal	MMBtu	$	Years
1	Replace Existing Dishwashers With High Efficiency Dishwashers Details: Replace Dishwasher with High Efficiency Dishwasher	$445	12	90	0	2	$27	16.74
2	Replace Existing Washing Machines With Energy Star Certified Washing Machines Details: Replace Washing Machine in Fire Department with Energy Star Washing Machine	$550	11	39	2	1	$35	15.78
3	Install Variable Frequency Drives (VFD) Details: Install VFD on Hot Water Circulation Pumps	$3,465	0	4,956	0	17	$798	4.34
4	Replace Inefficient Heating Plant Details: Replace Heating Boiler with High Efficiency Condensing Boiler	$44,705	1,936	0	0	194	$2,033	$22
Total for Improvements		**$49,164**	**1,959**	**5,085**	**2**	**213**	**$2,892**	**17.00**

3. BENCHMARKING/ENERGY PERFORMANCE SUMMARY

3.1. ENERGY STAR PORTFOLIO MANAGER FACILITY SUMMARY

EMG uses the Portfolio Manager tool developed by the Federal Environmental Protection Agency to track relative energy uses of buildings by property type. This tool allows the input of a facility's historic utility data to be compared with normalized data of a large database of its peer facilities.

More than 50% of the facility is defined as Fire Station/Police Station. This building is currently ineligible for a rating.

3.2. EPA ENERGY STAR RATING

The national energy performance rating is a type of external benchmark that helps energy managers to assess how efficiently their buildings use energy, relative to similar buildings nationwide. The rating system's 1-100 scale allows everyone to understand quickly how a building is performing. For example, a rating of 50 indicates an average energy performance, while a rating of 75 or better indicates top performance. The higher the rating, the better the building is performing. Organizations can evaluate energy performance among the buildings in their portfolio, while also comparing their performance with other similar buildings nationwide. Additionally, building owners and managers can use the performance ratings to help identify buildings that offer the best opportunity for energy improvement and recognition.

To receive the energy performance rating, facility-related data entered into the Portfolio Manager, must adhere to a series of operating and energy use conditions. If one or more of these conditions are not met, the facility will receive "N/A" (Not Available) as a rating. "NA" means that the Portfolio Manager is unable to calculate a rating for that particular period ending date, given the operating and energy use conditions provided.

A building must obtain a rating of 75 or better to be eligible to apply for the Energy Star Certification. However, a rating of 75 does not necessarily mean that a building will qualify.

3.3. SOURCE ENERGY AND SITE ENERGY

Buildings use a variety of forms of energy, including electricity, natural gas, fuel oil, and district steam. In order to provide an un-biased rating, the methodology must add together all of the energy used in a building. To combine energy in an equitable way, the ratings use source energy. Source energy is the energy that is consumed at the site, in addition to the energy used in generation and transmission.

The purpose of the conversion from site energy to source energy is to provide an equitable assessment of building-level energy efficiency. Because billed site energy use includes a combination of primary and secondary forms of energy, a comparison using site energy does not provide an equivalent thermodynamic assessment for buildings with different fuel mixes. In contrast, source energy incorporates all transmission, delivery, and production losses, which accounts for all primary fuel consumption and enables a complete assessment of energy efficiency in a building. When source energy is used to evaluate energy performance, an individual building's performance does not receive either a credit or a penalty for using any particular fuel type. The building's Statement of Energy Performance follows. Associated energy performance documents may be found in Appendix H.

Facility
Needham: Police Station/Fire Station
99 School Street
Needham, MA 02492

Facility Owner
N/A

Primary Contact for this Facility
N/A

General Information

Needham: Police Station/Fire Station	
Gross Floor Area Excluding Parking: (ft²)	29,625
Year Built	1931
For 12-month Evaluation Period Ending Date:	June 30, 2011

Facility Space Use Summary

Police Department	
Space Type	Other - Fire Station/Police Station
Gross Floor Area(ft²)	29,625
Number of PCs[e]	N/A
Weekly operating hours[e]	N/A
Workers on Main Shift[e]	N/A

Energy Performance Comparison

	Evaluation Periods		Comparisons		
Performance Metrics	**Current** (Ending Date 06/30/2011)	**Baseline** (Ending Date 06/30/2011)	**Rating of 75**	**Target**	**National Median**
Energy Performance Rating	N/A	N/A	75	N/A	N/A
Energy Intensity					
Site (kBtu/ft²)	90	90	0	N/A	82
Source (kBtu/ft²)	191	191	0	N/A	146
Energy Cost					
$/year	$ 72,852.39	$ 72,852.39	N/A	N/A	$ 66,207.43
$/ft²/year	$ 2.46	$ 2.46	N/A	N/A	$ 2.24
Greenhouse Gas Emissions					
$MtCO_2e$/year	214	214	0	N/A	194
$kgCO_2e$/ft²/year	7	7	0	N/A	6

4. INTRODUCTION

The purpose of this Energy Audit is to provide Police Station/Fire Station #1 with a baseline of energy usage, the relative energy efficiency of the facility, and specific recommendations for Energy Conservation Measures. Information obtained from these analyses may be used to support a future application to an Energy Conservation Program, Federal and Utility grants towards energy conservation, as well as support performance contracting, justify a municipal bond-funded improvement program, or as a basis for replacement of equipment or systems.

The energy audit consisted of an on site visual assessment to determine current conditions, itemize the energy consuming equipment (i.e. boilers, Make-Up Air Units, DHW equipment); review lighting systems both exterior and interior; and review efficiency of all such equipment. The study also included interviews and consultation with operational and maintenance personnel. The following is a summary of the tasks and reporting that make up the Energy Audit portion of the report.

The following is a summary of the tasks and reporting that make up the Energy Audit portion of the report.

ENERGY AND WATER USING EQUIPMENT

- EMG has surveyed the common areas, office areas, garages and mechanical rooms to document utility-related equipment, including heating systems, cooling systems, air handling systems and lighting systems.

BUILDING ENVELOPE

- EMG has reviewed the characteristics and conditions of the building envelope, checking insulation values and conditions. This review also includes an inspection of the condition of walls, windows, doors, roof areas, insulation and special use areas. Where we anticipated significant losses, we utilized infrared thermographs to analyze heat loss across the envelope.

RECOMMENDATIONS FOR ENERGY SAVINGS OPPORTUNITIES

- Based on the information gathered during the on site assessment, the utility rates, as well as recent consumption data and engineering analysis, EMG has identified opportunities to save energy and provide probable construction costs, projected energy/utility savings and provide a simple payback analysis.

ANALYSIS OF ENERGY CONSUMPTION

- Based on the information gathered during the on site assessment and a minimum of one year of utility billing history, EMG has conducted an analysis of the energy usage of all equipment, and identified which equipment is using the most energy and what equipment upgrades may be necessary. As a result, equipment upgrades or replacements are identified that may provide a reasonable return on the investment and improve maintenance reliability.

ENERGY AUDIT PROCESS

- Interviewing staff and review plans and past upgrades
- Performing an energy audit for each use type
- Performing a preliminary evaluation of the utility system
- Analyzing findings, utilizing ECM cost-benefit worksheets
- Making preliminary recommendations for system energy improvements and measures
- Estimating initial cost and changes in operating and maintenance costs based on implementation of energy efficiency measures
- Ranking recommended cost measures, based on the criticality of the project and the largest payback

REPORTING

The EMG Energy Audit Report includes:

- A comprehensive study identifying all applicable Energy Conservation Measures (ECMs) and priorities, based on initial cost and payback
- A narrative discussion of building systems/components considered and a discussion of energy improvement options;
- A summary of ECMs including initial costs and simple paybacks based on current utility rates and expected annual savings.

5. FACILITY OVERVIEW AND EXISTING CONDITIONS

5.1. BUILDING OCCUPANCY

The police station has about 15 staff during the day and 3 individuals during the night. The fire station has 18 staff during the day and 10 staff during the night (for night shifts). Both parts of the building are open 24 hours a day. Thus, the total staff in the building during the day is 33 and 13 during the night.

Facility Occupancy (avg. people/day)	25
Standard Operating Hours/day	24
Maintenance/ Staff Hours/day	24

Summary of Facility Operating Hours

	Hours Open to the Public	Hours Open to Employees
Monday-Friday	24	24
Saturday	24	24
Sunday	24	24

5.2. BUILDING ENVELOPE

The building envelope consists of the exterior shell, made up of the walls, windows, roof, and floor. The envelope provides building integrity and separates the exterior from the interior conditioned space.

According to the structural drawings, the foundations consist of a conventional, reinforced concrete, slab-on-grade foundation. The primary roof is classified as flat. The roofs are finished with gravel. There is a segment of the roof that is sloped and has asphalt shingles. The roof appeared to be in good condition.

The exterior walls are 4" exterior brick with 8" CMU block. Based on the on site visit, the walls appeared to be in good condition.

Item	Construction Type
Foundation	Slab concrete
Structure	Concrete, CMU

Item	Construction Type
Exterior Walls	Brick
Roof	Flat with gravel and sloped with asphalt shingles

The following table describes the observed or reported insulation levels at the property:

Building Element	Type Observed	Observed R-values
Roof	None	R - 25
Floors	Not Accessible	
Exterior Walls Above Grade	Rigid	R - 9
Basement Walls	None	
Windows	Double Pane	R-3
Exterior Doors	Insulated Metal	R-15

The windows are aluminum-framed double-pane units. The caulking was in good condition. A minimal amount of air infiltration was reported near the some of the windows.

The main entrance doors are fully glazed, solid wood entry doors set in frames. The glazing is double-paned. Weather stripping was around the door openings; however some of the rear entrance doors have weather stripping missing. The weather stripping was observed to be in fair to good condition.

The additional entrance doors and service doors are insulated metal.

5.3. BUILDING HEATING, VENTILATION AND AIR-CONDITIONING (HVAC)

Currently, both the heating and cooling systems are controlled by a pneumatic system and are not connected to the Town of Needham's building management system. However, it is planned for this building to be converted over to incorporate the current building management system.

The building is heated by a natural gas-fired boiler (Weil McLain, model # 6FF-1BWF, 1703 MBH input, year – 1990) that generates hot water to circulate through the building to baseboard radiators in the office areas and hallways. The boiler and circulation pumps are located in the fire section basement. There are individual thermostats that control zones within the building. For example, there is one zone that controls the training room on the second floor; another zone is the rotunda room and cells on the first floor police station area. The boiler is controlled by an outside air temperature sensor that will turn the boiler on when the temperature drops below 65 degrees F. The thermostats control pneumatic actuated valves within the radiator systems. There are two circulation pumps (Baldor, model # JMM3218T, 5hp) for the hot water system; only one circulation pump runs at a given time. It is recommended that the circulation pumps have variable frequency drive controls installed.

The building is cooled by an air-cooled chiller (Carrier, model # 30RAP0455K, 45 tons, year 2011) located on the roof. The chiller provides chilled water to fan coil units that are located throughout the building. The chiller uses R-410A refrigerant. Each fan coil unit serves a zone within the building; and there are 20 fan coil units serving 20 zones. Chilled water is circulated through the buildings with a circulation pump (model #VVE184TTD, 5hp); similar to the hot water circulation pumps, only one pump operates at a given time. The chilled water circulation pumps are located in the police section basement. A thermostat controls each fan coil unit and throttles the valve to the amount of cooling that is desired. Because the chiller already has VFD controls, VFDs are not needed on the circulation pumps. In addition, each fan coil unit has a fan control that allows the staff to switch the fan to a low, medium or high setting. Most of the fan coil units are located in a closet; two units are located in the ceiling. According to the architectural drawings provided by the client, the fan coil units range in size from 250 to 1,400 cfm.

In addition to the central heating and cooling systems, there are two window units; one in the computer room – not accessible, and the second unit is in an upstairs office area. There are also hydronic unit heaters in the garage areas that are fed from the central boiler system. On the police section there is an exhaust system to remove pollutants from an indoor firing range (1/3 hp exhaust motor). Also, there is a 100% make-up air unit (Carrier, model #39MW06D020) located on the roof.

During the site visit, the average indoor temperature was 60 degrees F and 59% relative humidity. Further, measurements taken at supply vents in several different areas averaged out to 1.84 cubic feet/square foot. The amount of supply air can be controlled at a low, medium, or high rating. The measurement was obtained while the fan was set at medium, and the measurements were taken in office areas and conference room areas.

The stair wells, bathrooms, and other areas are ventilated by mechanical exhaust fans. Large capacity ventilation fans are mounted on the roof and are connected by concealed ducts to each ventilated space.

Item	Measured Values
Major Heating system type/capacity	Hot Water Boiler, 1703 MBH input
Major Cooling System type/capacity	Air Cooled Chiller/45-tons nominal
Heating hot water supply temperature	160 degrees supply
Chilled water supply/return temperatures	50 degree supply
Condenser water supply/return temperatures	Unknown – not running during on site visit
Outside Air temperature & Relative Humidity (%) at time of audit	62 degrees F, 60% RH
Interior space temperatures & Relative Humidity (RH%)	68 degrees F, 59% RH
Supply Air Temperature (SAT)/Return Air Temperature (RAT)	SAT - 58 degrees F, RAT - unknown
Avg. Supply Air rate (CFM/Sq.ft)	1.84
Avg. Interior space thermostat set-point	70-75 degrees F

Item	Measured Values
Avg. Outside Air rate (% & CFM/Sq.ft or CFM/person)	Make up Unit provides 100% outside air

The Mechanical Equipment Schedule in Appendix E contains a summary of the HVAC Equipment at the property.

5.4. BUILDING LIGHTING

The interior building lighting is a mix of T-8 linear and u-tube lights, and 60 watt flood lights. The majority of interior lighting is controlled with light switches. The restrooms on the police section are controlled with timers. Light levels in most areas were normal and within the acceptable light level range. There were several areas, such as some offices and hallways, where there were excessive light levels; one would recommend in this situation the de-lamping of some of the fixtures. Also, several lights in the garage areas can be turned off or removed since the lights are not used at night and during the day there are sufficient light levels. The day of the on site visit was cloudy and raining, but had enough light to not need lighting near the garage door entrance ways.

Property-owned metal light poles provide site lighting. The poles are spaced along the drive aisles throughout the parking areas.

Surface-mounted light fixtures on the exterior walls provide the exterior building with site illumination. This includes wall packs and also incandescent candle shaped lights. Both of these types of lights can be replaced with high efficiency fluorescent lighting.

Exterior lighting remains on from dusk till dawn.

Space type	Measured Light Levels (Lux/foot candles)	ASHRAE/IESNA Recommended Levels (foot candles)*
Ground Floor Hallway	240 Lux/22 FC	15
Kitchen – Police	1050 Lux/98 FC	20
Booking Room	1100 Lux/102 FC	75
Garage Area	400 Lux/37 FC	20
Offices	400-600 Lux/46 FC	30
Avg. Building Lighting Density, W/Sq.Ft	0.446 W/Sq.Ft	1.2 W/Sq.Ft

Note: 1 foot candle = 10.764 Lux

*Approximate values based on anticipated tasks, not accounting for surface reflectivity or other factors that may affect recommended levels.

The Lighting Systems Schedules in Appendix F contain a summary of the Existing Lighting Systems at the property, along with proposed Lighting Energy Conservation Measures.

5.5. BUILDING ELEVATORS AND CONVEYING SYSTEMS

The facility has one wheel chair car lift. There are currently no passenger elevators in the building.

5.6. BUILDING DOMESTIC HOT WATER

The water meters are located in vaults adjacent to the public streets.

There are two 76-gallon gas-fired water heaters (Ruud, model # RF76-200, 199,000 BTUH) that supply domestic hot water. Both water heaters are located in the basement of the police section. Normally, only one water heater is needed to supply domestic hot water.

During the on site visit, a temperature reading of 138 degrees F was measured at a faucet. It is recommended that the supply temperature of the domestic water be reduced to 115 degrees F. This may be accomplished by installing a main tempering valve.

The common area restrooms have commercial-grade fixtures and accessories, including water closets and lavatories. The toilets consist of flush valves. The typical flush volume was 1.6 GPF. The lavatories are equipped with aerators rated at 2.2 GPM. The lavatories are operated by manual controls. The shower heads have a rated capacity of 2.5 GPM.

DHW type	Gas-fired water heater
Storage Tank Capacity	76 gallons
Heating/tank set-point	140 degrees F
DHW temperature at faucet	138 degrees F
Building faucets, GPM	2.2
Water closets/toilets, GPF	1.6

5.7. BUILDING NATURAL GAS AND ELECTRICITY

The building is connected to the natural gas utility (NStar). The gas main on the adjacent public street supplies the natural gas service. The gas meter and regulator are located along the exterior walls of the building. The gas distribution piping within the building is malleable steel (black iron). The facility is master-metered for natural gas. There is one natural gas meters at the property.

The electrical supply lines run underground from a pad-mounted transformer to interior-mounted electrical meters.

The main electrical service size is 800 amps, 480/277-volt, three-phase, four-wire alternating current (AC). The electrical wiring is copper, installed in metallic conduit. Circuit breaker panels are located throughout the building.

The facility is master-metered for electricity. There is one electric meter at the property.

A diesel-engine-driven 45 kVA emergency electrical generator is located in the basement of the fire section. The generator provides back-up power for elements of the fire and life safety systems. The fuel tank is 275 gallon capacity located in the basement.

Electrical Transformer Type (Wye, Delta)	Wye
Mounting	Pad-mounted//pole-mounted
Location	Front of building
Main Building Electric service	Yes
Primary Volts	480
Secondary Volts	277
Phase	3
Wire	4
Amp	800
On site Generator (Y/N)	Y
Generator Capacity, kVA	45
Generator Fuel Type	Diesel

Electric Meter type (Master/Sub/Direct)	Master	Natural Gas Meter type (Master/Sub/Direct)	Master
Meter Location	Police section basement	Meter Location	Outside building
Main meter number	5106579	Main meter number	P142376

6. UTILITY ANALYSIS

Establishing the energy baseline begins with an analysis of the utility cost and consumption of the building. Utilizing the historical energy data and local weather information, we evaluate the existing utility consumption and assign it to the various end-uses throughout the buildings. The Historical Data Analysis breaks down utilities by consumption, cost and annual profile.

This data is analyzed, using standard engineering assumptions and practices. The analysis serves the following functions:

- Allows our engineers to benchmark the energy and water consumption of the facilities against consumption of efficient buildings of similar construction, use and occupancy.
- Generates the historical and current unit costs for energy and water
- Provides an indication of how well changes in energy consumption correlate to changes in weather.
- Reveals potential opportunities for energy consumption and/or cost reduction. For example, the analysis may indicate that there is excessive, simultaneous heating and cooling, which may mean that there is an opportunity to improve the control of the heating and cooling systems.

By performing this analysis and leveraging our experience, our engineers prioritize buildings and pinpoint systems for additional investigation during the site visit, thereby maximizing the benefit of their time spent on site and minimizing time and effort by the customer's personnel.

Based upon the utility information provided about the Police Station/Fire Station #1, the following energy rates are utilized in determining existing and proposed energy costs.

Utility Rates used for Cost Analysis

Electricity (Blended Rate)	Natural Gas
$0.16/kWh	$1.00/therm

The data analyzed provides the following information: 1) breakdown of utilities by consumption, 2) cost and annual profile, 3) baseline consumption in terms of energy/utility at the facility, 4) the Energy Use Index, or Btu/sq ft, and cost/sq ft. For multiple water meters, the utility data is combined to illustrate annual consumption for each utility type.

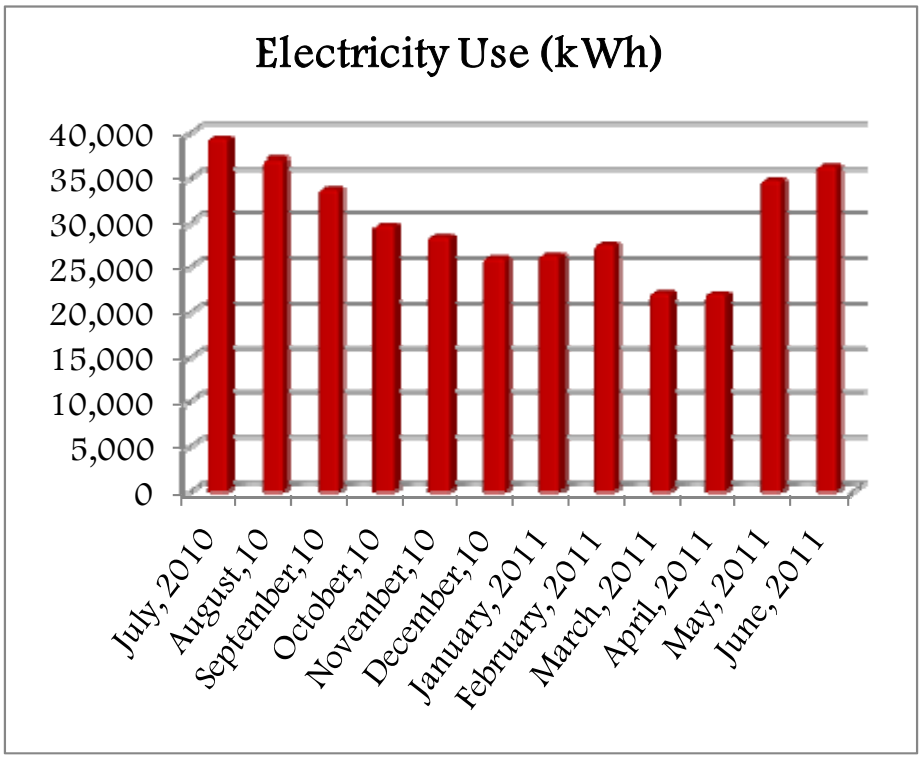
6.1. ELECTRICITY

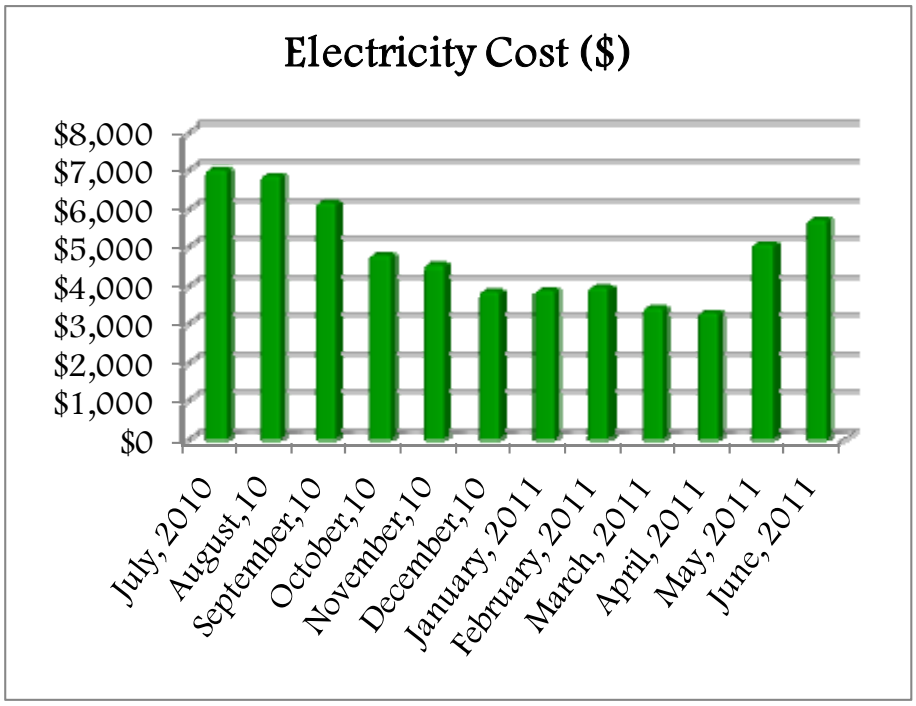
NStar satisfies the electricity requirements of the facility. Based on the electric usage information, there is an increase in electric usage during the summer months due to the use of the air cooled chiller.

Based on the 2010-2011 electric usage & costs, the average price paid during the year was $0.16 per kWh. The total annual electricity consumption for the 12-month period analyzed is 363,644 for a total cost of $58,529.

Electricity Consumption and Cost Data

Billing Month	Electricity Consumption (kWh)	Unit Cost/kWh	Total Cost
July, 10	39,367	$0.18	$7,002.56
August,10	37,087	$0.18	$6,841.92
September,10	33,703	$0.18	$6,178.24
October,10	29,791	$0.16	$4,772.37
November,10	28,439	$0.16	$4,524.84
December,10	25,991	$0.15	$3,858.27
January,11	26,311	$0.15	$3,885.68
February,11	27,535	$0.14	$3,965.40
March,11	22,207	$0.15	$3,421.41
April,11	22,119	$0.15	$3,287.75
May, 11	34,735	$0.15	$5,069.39
June,11	36,359	$0.16	$5,720.96
Total	**363,644**	**$0.16**	**$58,528.79**


Electricity Use (kWh)
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
July, 2010
August, 10
September, 10
October, 10
November, 10
December, 10
January, 2011
February, 2011
March, 2011
April, 2011
May, 2011
June, 2011


Electricity Cost ($)
$8,000
$7,000
$6,000
$5,000
$4,000
$3,000
$2,000
$1,000
$0
July, 2010
August, 10
September, 10
October, 10
November, 10
December, 10
January, 2011
February, 2011
March, 2011
April, 2011
May, 2011
June, 2011

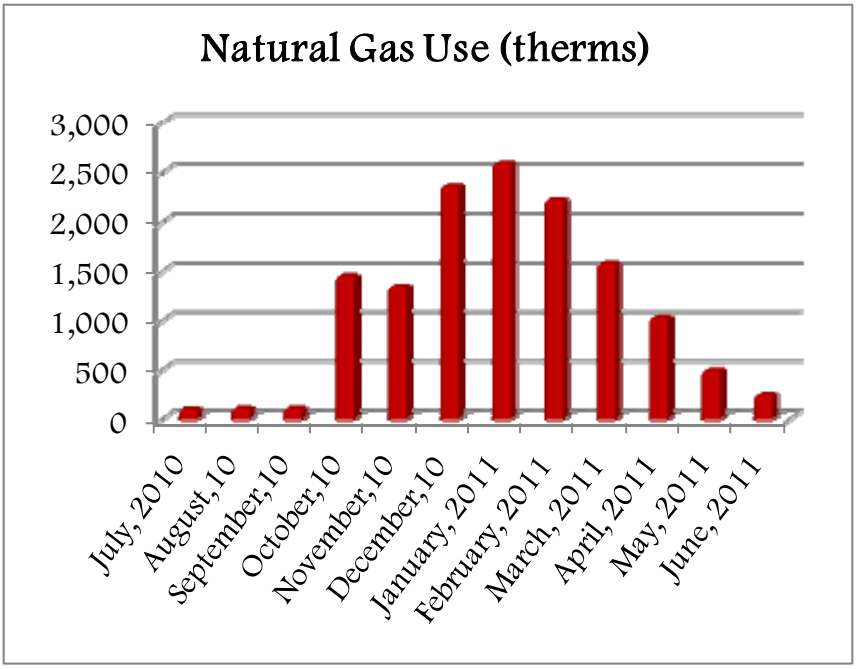
6.2. NATURAL GAS

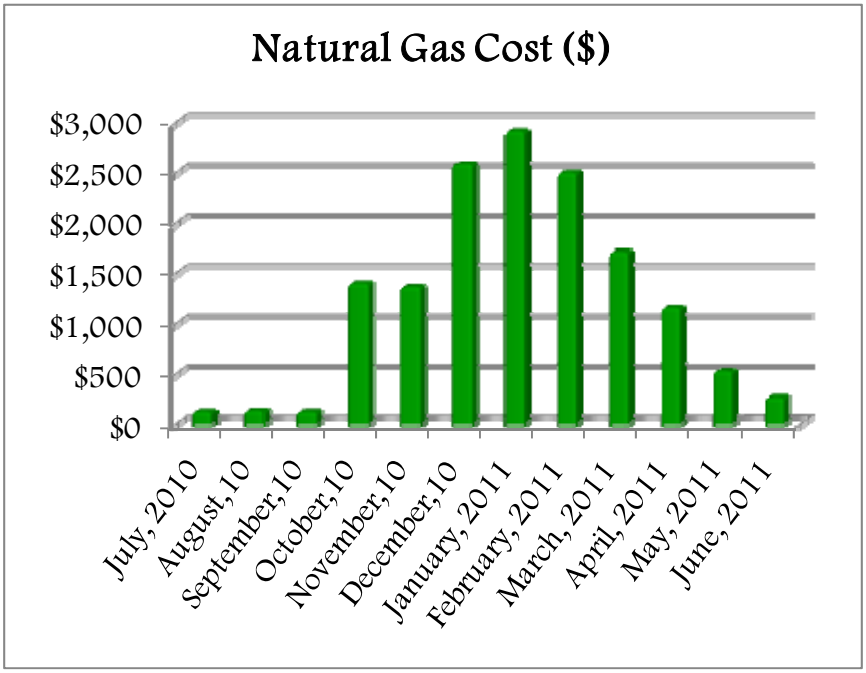
NStar satisfies the natural gas requirements of the facility are satisfied by.

Based on the 2010-2011 natural gas usage & costs, the average price paid during the year was $1.09 per therm. The total annual natural gas consumption for the 12-month period analyzed is 13,618 for a total cost of $14,864.

Natural Gas Consumption and Cost Data

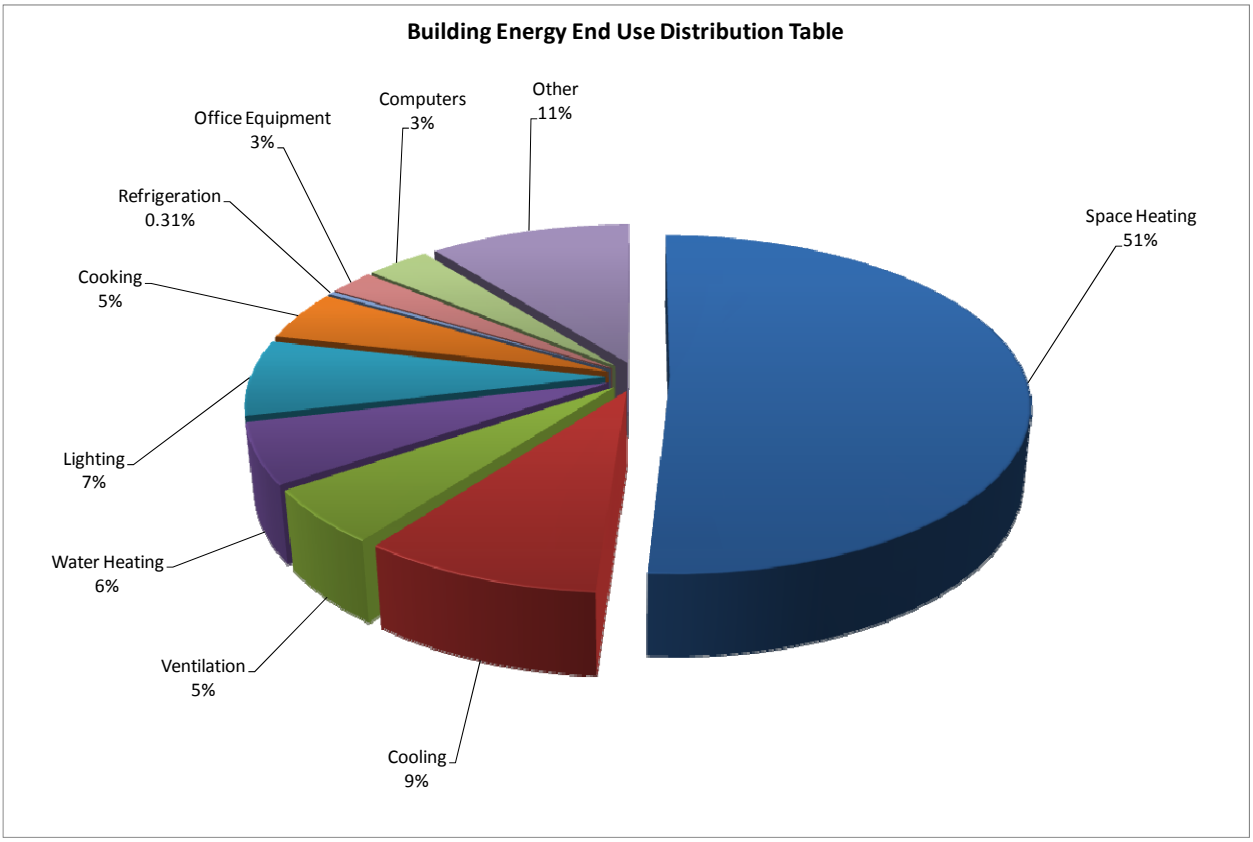
Billing Month	Natural gas Consumption (Therms)	Unit Cost/therm	Total Cost
July, 2010	99	$1.33	$131.51
August,10	107	$1.30	$139.35
September,10	108	$1.19	$128.84
October,10	1,457	$0.96	$1,396.89
November,10	1,334	$1.02	$1,360.45
December,10	2,352	$1.10	$2,591.28
January, 2011	2,595	$1.12	$2,911.77
February, 2011	2,219	$1.13	$2,503.09
March, 2011	1,579	$1.09	$1,717.29
April, 2011	1,033	$1.13	$1,166.20
May, 2011	496	$1.07	$530.15
June, 2011	239	$1.13	$270.17
Total	**13,618**	**$1.09**	**$14,846.99**


Natural Gas Use (therms)
3,000
2,500
2,000
1,500
1,000
500
0
July, 2010
August,10
September,10
October,10
November,10
December,10
January, 2011
February, 2011
March, 2011
April, 2011
May, 2011
June, 2011


Natural Gas Cost ($)
$3,000
$2,500
$2,000
$1,500
$1,000
$500
$0
July, 2010
August,10
September,10
October,10
November,10
December,10
January, 2011
February, 2011
March, 2011
April, 2011
May, 2011
June, 2011

7. END USE ENERGY DISTRIBUTION

Components of Annual Energy Use												
	Electricity (1 kWh = 3.412 kBtu)				Natural Gas				Total Energy		Total Cost	
	%	kWh	kBtu	Cost	%	therms	kBtu	Cost	MBtu	% Total	Total- $	% Total
Space Heating	***7.5%***	27,296	93,134	$4,393.31	***90.8%***	*12,365*	1,236,020	13,476	1329.2	***51.1%***	$17,869	***24.4%***
Cooling	***19.4%***	70,436	240,328	$11,336.73			0	0	240.3	***9.2%***	$11,337	***15.5%***
Ventilation	***11.0%***	40,001	136,483	$6,438.17			0	0	136.5	***5.2%***	$6,438	***8.8%***
Water Heating	***2.0%***	7,273	24,815	$1,170.58	***9.2%***	*1,253*	125,235	1,365	150.1	***5.8%***	$2,536	***3.5%***
Lighting	***15.2%***	55,205	188,359	$8,885.29			0	0	188.4	***7.2%***	$8,885	***12.1%***
Cooking	***10.0%***	36,364	124,075	$5,852.88			0	0	124.1	***4.8%***	$5,853	***8.0%***
Refrigeration	***0.7%***	2,400	8,189	$386.28			0	0	8.2	***0.3%***	$386	***0.5%***
Office Equipment	***5.0%***	18,182	62,038	$2,926.44			0	0	62.0	***2.4%***	$2,926	***4.0%***
Computers	***7.0%***	25,455	86,853	$4,097.02			0	0	86.9	***3.3%***	$4,097	***5.6%***
Other	***22.3%***	81,031	276,477	$13,041.97			0	0	276.5	***10.6%***	$13,042	***17.8%***
Total	100.0%	**363,643**	1,240,751	$58,528.7	*100.0%*	***13,618***	1,361,255	14,841	**2602.0**	100.0%	**$73,370**	100.0%



8. ENERGY CONSERVATION MEASURES (ECM)

EMG has identified a total of 11 Energy Conservation Measures (ECMs) for this property. All the ECMs are broken into two major categories:

1. **No/Low Cost Recommendations**: No/Low cost is defined as any project with initial investment of less than $1,000.
2. **Capital Cost Recommendations**: Capital cost defined as any project with initial investment equal to or greater than $1,000.

EMG screens ECMs using two financial methodologies. ECMs which are considered financially viable must meet both criteria.

1. Simple Payback Period –The number of years required for the cumulative value of energy or water cost savings less future non-fuel or non-water costs to equal the investment costs of the building energy or water system, without consideration of discount rates. ECMs with a payback period greater than the Expected Useful Life (EUL) of the project are not typically recommended, as the cost of the project will not be recovered during the lifespan of the equipment. These ECMs are recommended for implementation during future system replacement. At that time, replacement may be evaluated based on the premium cost of installing energy efficient equipment.

$$Simple\ Payback = \frac{Initial\ Cost}{Annual\ Savings}$$

2. Savings-to-Investment Ratio (SIR) – The savings-to-investment ratio is the ratio of the present value savings to the present value costs of an energy or water conservation measure. The numerator of the ratio is the present value over the estimated useful life (EUL) of net savings in energy or water and non-fuel or non-water operation and maintenance costs attributable to the proposed energy or water conservation measure. The denominator of the ratio is the present value of the net increase in investment and replacement costs less salvage value attributable to the proposed energy or water conservation measure. It is recommended that energy efficiency recommendations should be based on a calculated SIR, with larger SIRs receiving a higher priority. A project is typically only recommended if SIR is greater than or equal to 1.0, unless other factors outweigh the financial benefit.

$$SIR = \frac{Present\ Value\ (Annual\ Savings, i\%, EUL)}{Initial\ Cost}$$

Key Metrics to Benchmark the Subject Property's Energy Usage Profile

- Building Site Energy Use Intensity - The sum of the total site energy use in thousand of Btu per unit of gross building area. Site energy accounts for all energy consumed at the building location only not the energy consumed during generation and transmission of the energy to the site.
- Building Source Energy Use Intensity – The sum of the total source energy use in thousand of Btu per unit of gross building area. Source energy is the energy consumed during generation and transmission in supplying the energy to your site.
- Building Cost Intensity - This metric is the sum of all energy use costs in dollars per unit of gross building area.
- Greenhouse Gas Emissions - Although there are numerous gases that are classified as contributors to the total for Greenhouse Emissions, the scope of this energy audit focuses on carbon dioxide (CO_2). Carbon dioxide enters the atmosphere through the burning of fossil fuels (oil, natural gas, and coal), solid waste, trees and wood products, and also as a result of other chemical reactions (e.g., manufacture of cement).

Site Energy Use Intensity (EUI)	Rating	
Current Site Energy Use Intensity (EUI)	88	kBtu/ft2
Post ECM Site Energy Use Intensity (EUI)	77	kBtu/ft2
Source Energy Use Intensity (EUI)	Rating	
Current Source Energy Use Intensity (EUI)	188	kBtu/ft2
Post ECM Source Energy Use Intensity (EUI)	165	kBtu/ft2
Building Cost Intensity (BCI)	Rating	
Current Building Cost Intensity	$2.48	/ft2
Post ECM Building Cost Intensity	$2.17	/ft2

Summary of the Greenhouse Gas Reductions from Recommended Energy Conservation Measures

The following table provides a summary of the projected Greenhouse Gas Emissions reductions as a result of the recommended Energy Conservation Measures:

Greenhouse Gas Emissions Reduction	Rating	
Estimated kWh Reduction	45,914	kWh
Estimated Annual Thermal Energy Reduction	1,567	Therms
Total CO_2 Emissions Reduced	19	$MtCO_2/yr$
Total Cars Off The Road (Equivalent)*	4	
Total Acres of Pine Trees Planted (Equivalent)*	4	

*Equivalent reductions per DOE emissions calculation algorithms.

The following table describes each recommended ECM in terms of initial investment, electricity and natural gas savings, water savings, annual energy cost and maintenance savings, payback and SIR.

List of Recommended Energy Conservation Measures Fire Station #1/Police Station #1													
ECM #	Description of ECM	Projected Initial Investment	Estimated Annual Energy Savings		Estimated Annual Water Savings	Total Energy Savings	Estimated Cost Savings	Estimated Annual O&M Savings	Total Estimated Annual Cost Savings	Simple Payback	S.I.R.	Life Cycle Savings	Expected Useful Life (EUL)
			Natural Gas	Electricity									
		$	Therms	kWh	kgal	MMBtu	$	$	$	Years		$	Years
No/Low Cost Recommendations													
1	Reduce Light Levels By Delamping of Lamps Details: Delamp Fixtures in Police section Hallway, Garage and Kitchen Area	$15	0	2765	0	9	$445	$0	$445	0.03	344.87	$5,297	15
2	Replace Incandescent Lamps With CFL's Details: Replace Incandescent Exterior Building Lights with CFLs	$19	0	1362	0	5	$219	$15	$234	0.08	72.79	$1,347	7
3	Lower Domestic Hot water Temperature Set-Points Details: Lower Domestic Hot Water Temperature to 125 degrees F	$50	212	0	0	21	$231	$0	$231	0.22	55.12	$2,706	15
4	Automatically Control Rooftop Exhaust Fans Details: Control Rooftop fans with Lighting Occupancy Sensors	$190	0	760	0	3	$122	$0	$122	1.55	7.70	$1,271	15
5	Control External Air Leakage In The Building Details: Install Weather-Stripping on Entrance Doors	$395	155	153	0	16	$193	$10	$203	1.95	4.17	$1,252	10
6	Install Energy Savers on Vending, Snack Machines Details: Install Energy Savers on Vending and Soda Machines	$455	0	3727	0	13	$600	$0	$600	0.76	15.73	$6,705	15
Totals for No/Low Cost Items		**$1,124**	**366**	**8,767**	**0**	**67**	**$1,810**	**$25**	**$1,835**	**0.61**			
Capital Cost Recommendations													
1	Install Automatic Lighting Controls Details: Install Motion Sensors in Office and Common Areas	$1,390	0	2830	0	10	$455	$0	$455	3.05	3.91	$4,047	15
2	Add the Building to Needham's BMS and Install DDC controls Details: Replace pneumatic controls with DDC; add remotely monitored digital room thermostats	$120,750	1374	35117	0	257	$7,150	$0	$7,150	16.89	0.71	-$35,388	15
3	Replace Existing Refrigerator(s) With Energy Star Certified Refrigerator(s) Details: Replace Refrigerators in Police Department with Energy Star Systems	$1,600	0	1580	0	5	$254	$0	$254	6.29	1.90	$1,436	15
4	Replace High Intensity Discharge Lamp (HID) with Induction Lighting Details: Replace Exterior and Parking Lights with Induction Lights	$2,398	0	2721	0	9	$438	$30	$468	5.12	2.18	$2,831	15
Total For Capital Cost		**$126,138**	**1374**	**42248**	**0**	**282**	**$8,298**	**$30**	**$8,328**	**15.15**			
	Interactive Savings Discount @ 10%		-174	-5,102		-35	-$1,011	-$5	-$1,016				
	Total Contingency Expenses @ 15%	$19,089											
Total for Improvements		**$146,351**	**1,567**	**45,914**	**0**	**313**	**$9,098**	**$49**	**$9,147**	**16.00**			

If all of the above mentioned ECM's are implemented, Police Station/Fire Station #1 could potentially save approximately $9,147 per year with an investment of $146,351, yielding a net effective payback of 16 years.

8.1. ECM CALCULATION ASSUMPTIONS

EMG has made the following assumptions in calculation of the Energy Conservation Measures.

- Building operating hours, as detailed in section 5.1 are assumed to be 168 hours per week.
- The facility occupancy is assumed to be 33 people.
- Annual Heating Equipment Operating Hours are derived from actual consumption and equipment input rates to be 2,500 hours/year
- Annual Cooling Equipment Operating Hours are derived from actual consumption and equipment input rates to be 600 hours/year
- Typical lighting operating hours are assumed to be 10 per day or 12 hours per year.

8.2. NO/LOW COST ECM DESCRIPTIONS

EMG has identified six No/Low Cost Energy Conservation Measures (ECMs) for this property. This includes all measures which can be implemented below the cost threshold of $1,000. The following paragraphs describe each of these ECMs.

8.2.1. Remove Lighting in Kitchen, Garage, and Office Areas in Police Department

The lighting in office and common areas often tends to warm and bright. Whereas when the Lux readings taken at these locations, are compared to the IESNA lighting standard, it is often observed that the lighting levels are over the prescribed levels. In such circumstances EMG advises to go for de-lamping of individual light fixtures, such that the LUX levels post de-lamping would be in a close range to that of the prescribed limit. The result of de-lamping is reduction in the brightness in the specific areas, but would always be slightly above the recommended IESNA levels. The light readings are taken by hand held light meter, at an approximately table top height from the floor. The advantage of de-lamping is reduction in the demand load as well as the annual lighting energy consumption. EMG recommends taking de-lamping trials at different locations before implementing it across the entire space. When removing fluorescent or HID lamps, also remove or disconnect the ballast to prevent them from continuing to consume energy.

For this building, the lighting levels were observed to be above the prescribed levels in the following locations: 1) Booking Room 110); 2) Rear Police hallway – 1000; and 3) Police kitchen – 1050. EMG recommends de-lamping of lamps in all the above mentioned zones. The details of the de-lamping can be found in the lighting ECM worksheet attached in the Appendix. Based on the calculations done using the EMG lighting worksheet, it is estimated that the proposed de-lamping would result in an annual energy savings of 2,765 kWh.

8.2.2. Replace Exterior Building Incandescent Lighting with Fluorescent Lighting

Fluorescent lighting is recommended for areas where color sensitivity is an important criterion (e.g., offices or small parts assembly rooms). Screw-in fluorescent lamps are available to replace incandescent lamps. Power savings are typically 60%. Screw-in self-contained lamps, with a 10,000-hour life, can replace flood lights that have a 7,000-hour life. Screw-in circle light fixtures are also available.

Screw-in fluorescent lamps are generally not compatible with dimmers. New energy-efficient fluorescent lamps are continually being introduced. It is important to stay abreast of this technology so that the most efficient products may be used.

The property has five 60-watt incandescent lamps used for exterior building lighting. EMG recommends replacing all the incandescent lamps with CFL lamps as specified in the lighting ECM work sheet attached in the Appendix. Based on the calculations from the EMG lighting work sheet, it is estimated that the proposed retrofit of the specified incandescent lamps shall result in an annual energy savings of 1,362 kWh.

8.2.3. Lower Domestic Water Temperature from 140 degrees to 125 degrees

Lowering the hot water temperature decreases the amount of energy required to heat the water. In addition, distribution piping losses, which are proportional to the temperature difference between the hot water and its surroundings, will be reduced.

Set the water heater thermostat at the lowest temperature at which hot water will meet the occupants' needs. If the demand for hot water fluctuates and a lowered tank temperature will not meet the peak demand, install a mixing valve rather than lowering the tank temperature. If the entire system is set at a high supply temperature to serve the needs of a piece of equipment, consider reducing the tank temperature and installing a booster heater to serve that specific piece of equipment. Note that water in excess of 138°F can cause skin burns.

The police/fire station has two water heaters, located in the basement floor of the facility. The water heater/s is/are electric/gas-fired. The current settings on the water heater/s, sets the hot water set point at 140°F. EMG recommends reducing the set point to 125°F, which shall supply hot water at just appropriate temperature after being mixed with cold water, at the same time it will result in an annual thermal savings of 212 therms.

8.2.4. Automatically control Roof top exhaust fans

Currently the roof fans run during the building occupied times based on HAVC schedule from BMS. These fans mainly exhaust restrooms and during the times when the restroom is not being used, the fans could be shut down saving energy. EMG recommends connecting the roof fans with lighting occupancy sensors so the fans come simultaneously with the lights when room is occupied and turned off with lights.

8.2.5. Install Weather Stripping on Building Entrance Doors

One of the most commonly used methods for reducing air leakage through building structures is caulking and weather stripping.

Particularly effective measures include caulking cracks around windows and door frames and weather stripping around windows and doors. Weather-stripping and caulking of doors and windows, helps in thermally isolating of the building with the outside atmosphere. This prevents the infiltration of external un-conditioned air along with moisture and humidity into the conditioned space at the same time, prevents the conditioned air from escaping out. A precisely thermally isolated building directly affects the cooling and heating load on the facilities HVAC system as it has to put in less effort in maintaining the desired temperature inside the facility. As per ASHRAE a well insulated and ventilated building should have an air change rate not more than 0.35 per hour.

It is recommended that some of the entrance doors (rear and side entrance doors) have minimal weather stripping that needs to be replaced. This action will save the property 155 therms and 153 kWh annually.

8.2.6. Install Controls on Vending and Soda Machines

Vending machines are usually designed to operate all day round irrespective of the occupancy level in the office. This means that the vending machines operate for more than 12 hours a day when not required in case of commercial establishments.

There are 2 vending machines and one snack machine located in the police garage area and in the kitchen are of which all are non-energy star certified. EMG recommends installing vend misers on these vending machines, which will automatically reduce the running time of these machines during weekends and unoccupied hours. There are two types of vend misers; one has a timer in it, which is programmed to turn off or tune down the vending machines after the office hours and bring it back up an hour before the office opens. The other is a motion sensor based system that tunes down the machines upon detecting no-occupancy for a pre-programmed duration of time. In the case of vending machines storing chilled products, the vend miser does not turn off the machine entirely, but reduces the operating time of the compressor, such that the machine maintains the products at a minimum tolerable temperature.

Implementation of this ECM could save approximately 3,727 kWh annually.

8.3. CAPITAL COST ECM DESCRIPTIONS

EMG has identified five Capital Cost Energy Conservation Measures (ECMs) for this property. This list includes recommended measures which have an estimated implementation cost equal to or greater than $1,000. The following paragraphs describe each of these ECMs.

8.3.1. Install Motion Sensors in Offices and Common Areas

One of the best ways to save energy is to turn off lights that are not needed. This saves energy, as well as extends the replacement time on lamps. (While frequent switching may in some cases shorten lamp life, the savings in electrical power will more than compensate).

The operating time of lighting systems can be reduced either automatically or manually. Automated controls are more reliable for ensuring that energy savings are achieved. Local switches can be labeled to encourage occupants to turn off lights when leaving an area. Individual switches in perimeter offices permit occupants to reduce lighting levels on sunny days. Sophisticated lighting control systems are available, but they are costly to retrofit. They should be considered when the lighting system is being replaced. With the exception of security lights, storeroom lighting can be placed on timed switches that shut off after the selected interval. All exterior lighting, as well as interior lighting in glass-enclosed vestibules, should be placed on photocell and/or timer control.

EMG recommends installing motion sensors in offices, kitchen areas, conference rooms and other common areas to reduce energy consumption. The anticipated reduction in energy consumption is 2,830 kWh.

8.3.2. Add the buildng to BMS and install DDC

Currently the Public Safety building is not connected to Needham's BMS system. Also the existing HAVC controls are also pneumatic. EMG recommends converting all the HVAC controls to DDC and connecting and controlling the building from Town of Needham's BMS. This will optimize the HAVC operation, building heating and cooling set points.

8.3.3. Replace Refrigerators with Energy Star Refrigerators

One of the highest 'silent' energy consuming devices in any home/office is the refrigerator, which runs all year long. Having a low energy consuming refrigerator thus results in a considerable reduction in the annual energy costs. On an average a useful life of any refrigerator is approximately 19 years and hence EMG recommends replacing the current refrigerator at the end of its useful life with a new energy star certified low energy consuming refrigerator.

The facility currently has two refrigerators that are over 30 years old. The current refrigerators have auto defrost function, with twin door configuration, with freezer on the top in one refrigerator and a freezer on the side in the second refrigerator. Both refrigerators have a storage volume of 20 CF, and are estimated to have been manufactured in 1980. EMG recommends replacing the existing refrigerator with energy star certified, twin door and freezer with a top configuration, auto defrost refrigerator. EMG recommends that the current refrigerator should be disposed off in an environmentally friendly manner. Annual energy savings are expected to be approximately 1,580 kWh.

8.3.4. Replace Exterior Building and Parking Lighting with Induction Lighting

An induction light is similar to a fluorescent light in that mercury in a gas fill inside the bulb is excited; emitting UV radiation that in turn is converted into visible white light by the phosphor coating on the bulb. Like fluorescent, the phosphor coating determines the color qualities of the light. Fluorescent lamps use electrodes to strike the arc and initiate the flow of current through the lamp, which excites the gas fill. Each time voltage is supplied by the ballast and the arc is struck, the electrodes degrade a little, eventually causing the lamp to fail. Induction lamps do not use electrodes. Instead of a ballast, the system uses a high-frequency generator with a power coupler.

The generator produces a radio frequency magnetic field to excite gas fill. With no electrodes, the lamp lasts longer. Induction lamps, in fact, last up to 100,000 hours, with the lamp producing 70% of its light output at 60,000 hours. In other words, their rated life is 5-13 times longer than metal halide (7,500 to 20,000 hours at 10 hours/start).

Induction lamps are ideally suited for high-ceiling applications where the lamps are difficult, costly or hazardous to access. They are also ideally suited for such applications where the advantages of fluorescent lighting are sought but a light source is needed that can start and operate efficiently in extremely cold temperatures. As a result, induction lighting is a suitable for a wide range of applications, including not only warehouses, industrial buildings, cafeterias, gymnasiums, etc., but also signage, tunnels, bridges, roadways, outdoor area and security fixtures, parking garages, public spaces, and freezer and cold storage lighting.

The increased costs occurs in the induction systems themselves – which could be 5 to 6 times more than metal halide systems, and also in new fixtures, which can inflate payback periods and reduce return on investment. But you also generally get a 30% reduction in capital and operating costs immediately from the reduced number of fixtures made possible by the higher light output. You also get 15% more efficiency just because the induction system (lamp and electronic ballast) is more efficient. Apply that over ten years plus reduced replacement and maintenance costs compared to metal halide and other HID lamps and suddenly it makes a lot of sense to go into induction lighting systems.

- Long Service Life: up to 100,000hrs (5 times the lamp life of Metal Halides)
- Energy Saving: save up to 40% compared to metal halides, 13 times more efficient than incandescent light bulbs, and up to twice as efficient as compact fluorescent lights
- Instant On/Off: no waiting time between re-strike
- High Efficiency: lighting efficiency >80lm/w
- High Lumens Maintenance: $>70\%$ after 60,000 hrs
- Wide Selection of Color Temperature:2720K- 6500K
- High Power Factor Ballast: $\lambda > 0.95$

- Flicker-free : high frequency (250KHz) creates a better and more comfortable light for users and prevents eye injury when viewed directly
- Optional Dimmable Ballast for Integrated Control: linearly dimmable to 30%

EMG recommends that the parking lighting and the exterior building wall packs should be replaced with induction lighting. The new lighting should save approximately 2,721 kWh.

8.3.5. Install VFD on Hot Water Circulation Pump Motors

There are two types of variable frequency drives (VFD): mechanical and electronic. Mechanical variable frequency drives consist of either magnetic clutches or variable ratio belt drives that allow the motor to run at a constant speed, while the motor-driven equipment speed varies. Electronic variable frequency drives adjust the speed of the motors they control by electronically varying the input voltage and frequency to the motor. Both systems have enormous conservation potential. The electronic drives are more energy efficient than the mechanical, but are also more costly. Centrifugal devices are the best candidates for variable frequency drives. Centrifugal fans and pumps for water, sewage, refrigerant, and air are typical applications.

Centrifugal devices whose flow rates and pressures are normally controlled by throttling can be replaced with variable frequency drives. The more operating time below full load, the greater the payback potential of variable.

EMG recommends installing VFD controls on the hot water heating pumps. Each pump is rated at 5hp and is located in the fire department basement. The VFDs should save approximately 4,956 kWh.

8.4. ECMs Evaluated For Consideration

EMG has identified three Energy Conservation Measures (ECMs) which were evaluated for this property but not recommended based on the financial criteria detailed at the beginning of Section 8. EMG screens ECMs using two financial methodologies. ECMs which are considered financially viable must meet both criteria.

The following paragraphs describe each of these ECMs.

8.4.1. Replace Dishwasher with Energy Star Dishwasher

The facility currently has one dishwasher that is over 30 years old. The current dishwasher is used for five loads per week and consumes an estimated 2,860 gallons of water along with 390 kWh of energy annually. The average life of a dishwasher is 15 years and since the existing dishwasher is close its useful life, EMG recommends replacing it with a new Energy Star certified energy efficient dishwasher.

8.4.2. Replace Fire Department Washing Machine with Energy Star Unit

The current facility has one washing machine with a top load configuration of 2000 make. The average useful lives of a washing machine being 14 years, the current machine is close to the end of its useful life. Even though the machine might be functionally sound, the technology has advanced over the time and the newer machines have a comparatively lower water and energy usage, thus reducing the annual operating cost.

EMG recommends replacing the washing machine used by the fire department (located in the garage area) with an energy star rated machine.

8.4.3. Replace Heating Boiler with High Efficiency Condensing Boiler

Standard boilers on the market generally attain operating efficiencies around 80% (Output MBH / Input MBH). The operating efficiencies for condensing boilers are above 90% and reduce the energy requirements for heating significantly. Condensing boilers utilize the latent heat of condensing exhaust gasses to extract additional heat from the input fuel, thus achieving a significantly higher operating efficiency. Additionally, many condensing boilers have the ability to modulate the input rate to meet a reduced heating demand, which boiler cycling on days of moderate temperature.

There is one boiler for heating in the facility. The existing boilers at the property have a rated operating efficiency of 80%. The existing boilers have a rated input capacity of 1,703 MBH each. Replacement with high efficiency, modulating condensing boilers of similar output size is recommended. A properly-sized modulating condensing boiler (90% rated efficiency) will reduce the input energy required for heating and will provide ability for the boiler to turn-down the firing rate during periods of reduced heating load, further conserving heating energy. Sizing analysis and design for replacement by a local professional engineer is recommended prior to replacement of the heating equipment. This step will ensure that the new boilers are properly sized and configured to meet the building hot water demands and operate in the most efficient manner. In addition to reducing the energy consumption, the increased efficiency may also allow for a decrease in the required input capacity.

9. IMPLEMENTION OF AN OPERATIONS AND MAINTENANCE PLAN

The quality of the maintenance and the operation of the facility's energy systems have a direct effect on its overall energy efficiency. Energy-efficiency needs to be a consideration when implementing facility modifications, equipment replacements, and general corrective actions. The following is a list of activities that should be performed as part of the routine maintenance program for the property. These actions, which have been divided into specific and general recommendations, will insure that the energy conservation measures identified in this report will remain effective. The following general recommendations should be continued or implemented.

Building Envelope

1. Caulking and weather stripping mostly functional and effective at all times. There were several entrance doors that require a minimal amount of new weather-stripping.
2. Walls observed weekly and holes patched in the building envelope as required
3. Windows inspected monthly for damaged panes and failed thermal seals

Heating and Cooling

1. The chiller was installed this year and the hot water heating boiler is well maintained (cleaning of gas burner system and other internal parts of the boiler)
2. The burners cleaned and fuel/air ratios optimized during routine maintenance checks
3. Boiler and Chiller tubes are inspected and cleaned annually
4. Currently, space temperatures and fan speed are determined by the staff of both the fire and police departments.
5. Control valves and dampers are checked for functionality monthly and repaired, when needed
6. Equipment is inspected for worn or damaged parts as part of a monthly maintenance check
7. Evaporator coils and condenser coils are regularly checked and cleaned
8. Air filters are inspected monthly and replaced prior to excessive visual buildup (May increase filter costs, but will reduce fan energy costs)

Domestic Hot Water

1. The domestic hot water heater temperature are not set to the minimum temperature required (currently set at 140 degrees F); this is due to possible temperature requirements for the kitchens located in the building. However, if this is not the case then the hot water should be set at 120 degrees F.
2. Hot water piping checked routinely for damaged insulated and leaks

Lighting

1. Only energy-efficient replacement lamps used and in-stock for replacement
2. Lighting fixture reflective surfaces and translucent covers clean
3. Walls clean and bright to maximize lighting effectiveness
4. Timers and/or photocells operating correctly on exterior lighting
5. Interior lighting in most of the building is controlled by light switches, except some of the bathrooms use timers. It is recommended that motion sensors should be installed throughout the building.

Existing Equipment and Replacements

1. Refrigerator and freezer doors closed and sealed correctly
2. Kitchen exhaust fans only used when needed or timers installed to limit operation
3. Office/ computer equipment either in the "sleep" or "off" mode when not used
4. All other recommended equipment specific preventive maintenance actions conducted

10. APPENDICES

APPENDIX A: Photographic Record
APPENDIX B: Site Plan
APPENDIX C: Records of Communication
APPENDIX D: Glossary of Terms
APPENDIX E: Mechanical Equipment Inventory
APPENDIX F: Lighting Systems Schedules
APPENDIX G: ECM Calculations
APPENDIX H: Supporting Documents

APPENDIX A:
PHOTOGRAPHIC RECORD

EMG PHOTOGRAPHIC RECORD

Project No.: 98515.11R-008.268 **Project Name: Police Station/Fire Station #1**

Photo #1:	Fire department front entrance – facing north

Photo #2:	Fire department – garages facing north

Photo #3:	Side of building – facing east

Photo #4:	Side of building – police garages facing east

Photo #5:	Fire department – facing west

Photo #6:	Building facing west

EMG PHOTOGRAPHIC RECORD

Project No.: 98515.11R-008.268 **Project Name: Police Station/Fire Station #1**

Photo #7:	Police department front entrance – facing south

Photo #8:	Roof of building

Photo #9:	Lobby of police department

Photo #10:	Hot water radiator used in both police and fire departments

Photo #11:	Aluminum framed double pane windows in office

Photo #12:	Restroom – have 2.2 gm faucets, 1.6 gpf toilets and timers on lights

EMG PHOTOGRAPHIC RECORD

Project No.: 98515.11R-008.268 **Project Name: Police Station/Fire Station #1**

Photo #13:	Rotunda room in police department

Photo #14:	Lighting in hallway in police department

Photo #15:	LED exit lighting

Photo #16:	Booking room – recommend installing motion sensors

Photo #17:	Restroom lighting

Photo #18:	Garage with T-8 lighting – recommend removing some lights

EMG PHOTOGRAPHIC RECORD

Project No.: 98515.11R-008.268 **Project Name: Police Station/Fire Station #1**

Photo #19:	Upper level hallway – police department

Photo #20:	Dishwasher in kitchen in police department – recommend new dishwasher

Photo #21:	Training room in police department – recommend motion sensors

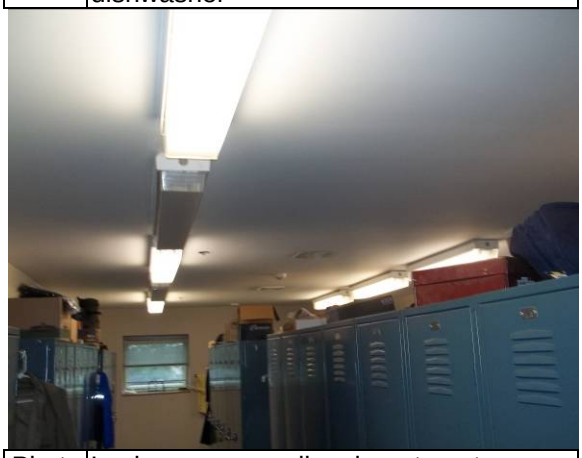


Photo #22:	Locker room – police department

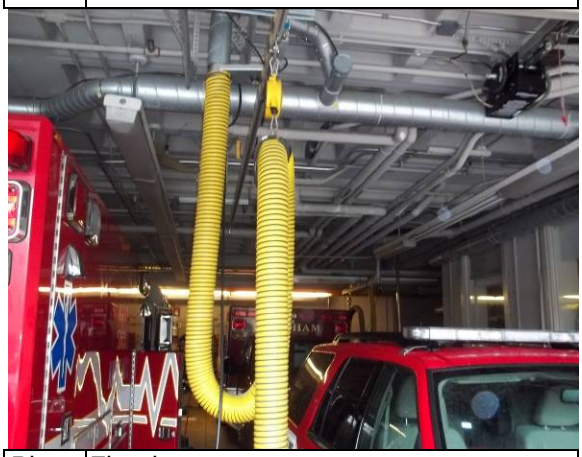


Photo #23:	Fire department - garage

Photo #24:	Fire department - kitchen

EMG PHOTOGRAPHIC RECORD

Project No.: 98515.11R-008.268 **Project Name: Police Station/Fire Station #1**

Photo #25:	Fire department hallway

Photo #26:	Chilled water circulation pumps – 5hp

Photo #27:	Domestic water heaters for entire building

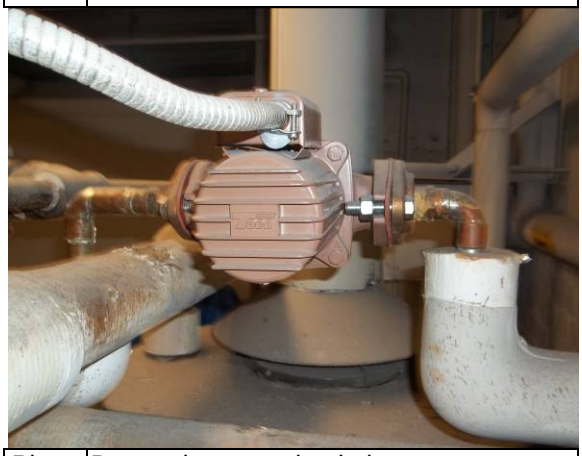


Photo #28:	Domestic water circulation pump

Photo #29:	Air handling unit – cooling only

Photo #30:	Control for blower in air handling unit

EMG PHOTOGRAPHIC RECORD

Project No.: 98515.11R-008.268 **Project Name: Police Station/Fire Station #1**

Photo #31:	Cooling control

Photo #32:	Heating control

Photo #33:	Hydronic unit heater – used in garages

Photo #34:	Hot water based radiator

Photo #35:	Make-up air unit

Photo #36:	Chiller for building

EMG PHOTOGRAPHIC RECORD

Project No.: 98515.11R-008.268 **Project Name: Police Station/Fire Station #1**

Photo #37:	Chiller

Photo #38:	Compressor for pneumatic control system

Photo #39:	Hot water circulation pumps – 5hp, recommend VFD

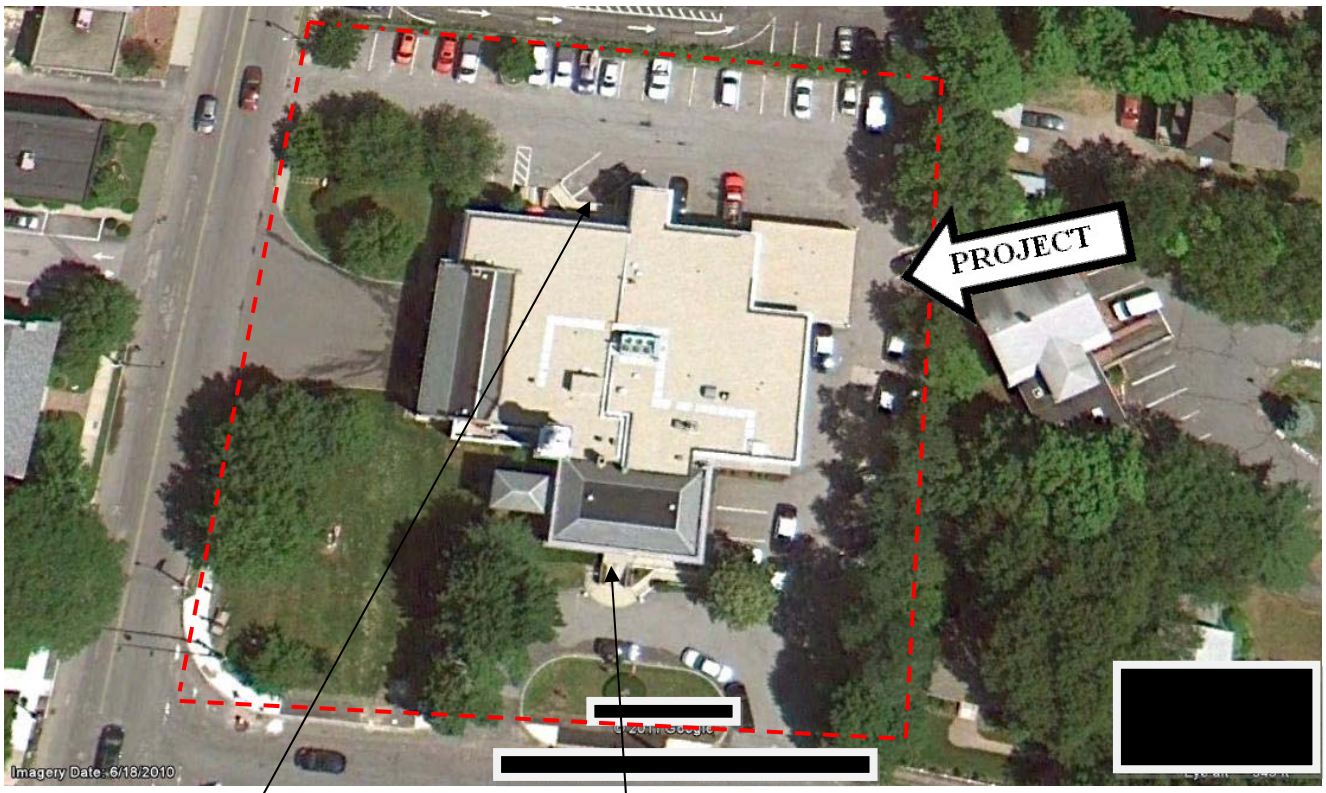
Photo #40:	Boiler (1703 MBH) for hot water heating

Photo #41:	Hot water heating temperature gages

Photo #42:	Inside of air handling unit. Has two 1/5 hp blower motors. Note standing water below the evaporator coil

APPENDIX B:
SITE PLAN

Site Plan



Fire Station Entrance

Police Station Entrance

EMG

Source:

Boundary

The north arrow indicator is an approximation of 0° North.

Project Number:

98515.11R-008.268

Project Name:

Police Station/Fire Station #1

On-Site Date:

September 8, 2011

APPENDIX C:
RECORDS OF COMMUNICATION

RECORD OF COMMUNICATION

Date:	**September 8, 2011**	**Time:**	**9 AM**
Project Number:	**98515.11R-008.268**	**Recorded by:**	**Abdul Basit, Field Observer/Project Manager**
Project Name:	**Police Station/Fire Station #1**		

Communication with: **John Gass and Wayne Whisler**
of: **Town of Needham**
Phone: **781 727 0010**

Communication via:

- **Telephone Conversation**
- **X** **Discussions During Site Assessment**
- **Office Visitation/Meeting at:**
- **Other:**

RE:

Summary of Communication:
On site discussions

APPENDIX D:
GLOSSARY OF TERMS

Glossary of Terms and Acronyms

ECM – Energy Conservation Measures are projects recommended to reduce energy consumption. These can be No/Low cost items implemented as part of routine maintenance or Capital Cost items to be implemented as a capital improvement project.

Initial Investment – The estimated cost of implementing an ECM project. Estimates typically are based on R.S. Means Construction cost data and Industry Standards.

Annual Energy Savings – The reduction in energy consumption attributable to the implementation of a particular ECM. These savings values do not include the interactive effects of other ECMs.

Cost Savings – The expected reduction in utility or energy costs achieved through the corresponding reduction in energy consumption by implementation of an ECM.

Simple Payback Period –The number of years required for the cumulative value of energy or water cost savings less future non-fuel or non-water costs to equal the investment costs of the building energy or water system, without consideration of discount rates.

EUL – Expected Useful Life is the estimated lifespan of a typical piece of equipment based on industry accepted standards.

RUL – Remaining Useful Life is the EUL minus the effective age of the equipment and reflects the estimated number of operating years remaining for the item.

SIR - The savings-to-investment ratio is the ratio of the present value savings to the present value costs of an energy or water conservation measure. The numerator of the ratio is the present value of net savings in energy or water and non-fuel or non-water operation and maintenance costs attributable to the proposed energy or water conservation measure. The denominator of the ratio is the present value of the net increase in investment and replacement costs less salvage value attributable to the proposed energy or water conservation measure. It is recommended that energy-efficiency recommendations be based on a calculated SIR, with larger SIRs receiving a higher priority. A project typically is recommended only if the SIR is greater than or equal to 1.0, unless other factors outweigh the financial benefit.

Life Cycle Cost - The sum of the present values of (a) **I**nvestment costs, less salvage values at the end of the study period; (b) Non-fuel operation and maintenance costs: (c) Replacement costs less salvage costs of replaced building systems; and (d) Energy and/or water costs.

Life Cycle Savings – The sum of the estimated annual cost savings over the EUL of the recommended ECM, expressed in present value dollars.

Building Site Energy Use Intensity - The sum of the total site energy use in thousand of Btu per unit of gross building area. Site energy accounts for all energy consumed at the building location only not the energy consumed during generation and transmission of the energy to the site.

Building Source Energy Use Intensity – The sum of the total source energy use in thousand of Btu per unit of gross building area. Source energy is the energy consumed during generation and transmission in supplying the energy to your site.

Building Cost Intensity - This metric is the sum of all energy use costs in dollars per unit of gross building area.

Greenhouse Gas Emissions - Although there are numerous gases that are classified as contributors to the total for Greenhouse Emissions, the scope of this energy audit focuses on carbon dioxide (CO_2). Carbon dioxide enters the atmosphere through the burning of fossil fuels (oil, natural gas, and coal), solid waste, trees and wood products, and also as a result of other chemical reactions (e.g., manufacture of cement).

APPENDIX E:
MECHANICAL EQUIPMENT INVENTORY

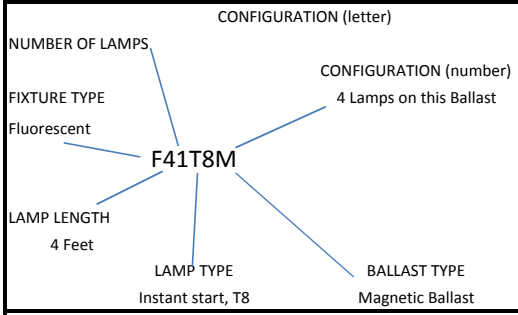
Mechanical Equipment Inventory								
Equipment	**Manufacturer**	**Age**	**Location**	**Model/ Type**	**Capacity**	**Serves**	**Operating Hours / Year**	**Remarks**
Heating Boiler	Weil McLain	1990	Fire section Boiler		1703 MBH	Heating for entire building	2,500 hours	
Circulation Pumps for heating	Baldor		Fire section Boiler	JMM3218T	5 hp	Heating for entire building	2,500 hours	
Chiller	Carrier	2011	Roof	30RAP0455K		Cooling for entire building	600 hours	
Circulation Pumps for cooling				VVE184TTDR7	5hp	Cooling	600 hours	
Make up Air Unit	Carrier	2011		39MW06D020		Outside air for building	3,100 hours	
Firing range exhaust system	Unknown			Plate info not available	1/3 hp blower motor	Firing range	300 hours	
Window Units				Plate info not available	8,000 and 12,000 BTUH	Computer Room and Office	600 hours	
Fan coil units (20 total)	Carrier	Varies	Various locations in building	42DDA14BRDY5AYYY	Two 1/5 hp blower motors	Building	600 hours	
Domestic Water Heaters	Ruud		Basement – Police section	RF76-200	199,000 BTUH, 76 gallons	Building	800 hours	
Domestic Water Heater Circulation Pump	Taco		Basement- Police Section		1/3 hp	Domestic water circulation	800 hours	
Refrigerator 1	Hotpoint		Kitchens – Police Section	CTX414	20 cu ft			

Refrigerator 2	Hotpoint		Kitchen – Police section	CTX414	20 cu ft			
Power Generator	Onan		Fire - Basement		45 KVA	Emergency Generator for Building	10	

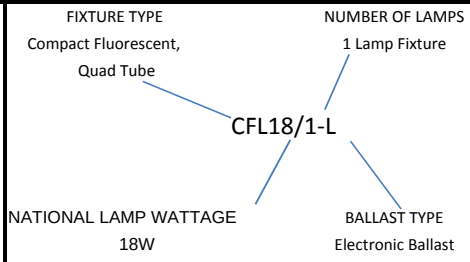
APPENDIX F:
LIGHTING SYSTEMS SCHEDULES

Fixture Code Legend and Notes

Sample Linear Fluorescent Fixture Code



Sample of Other Fixture Code:



Code Explanations

Fixture Type

CF	Compact Fluorescent
CFD	Compact Fluorescent, double-D shape
CFS	Compact Fluorescent, Spiral
CFT	Compact Fluorescent, Twin tube (including "Biaxial" fixtures)
CFQ	Compact Fluorescent, Quad tube
ECF	Exit sign, Compact Fluorescent
EI	Exit sign, Incandescent
ELED	Exit sign, LED
F	Fluorescent, linear
FC	Fluorescent, Circline
FU	Fluorescent, U-tube
H	Halogen
HLV	Halogen, Low Voltage
HPS	High Pressure Sodium
I	Incandescent
LED	Light Emitting Diode (LED) traffic signal
MH	Metal Halide
MHPS	Metal Halide, Pulse Start
MV	Mercury Vapor
QL	Induction

Lamp Type

for fluorescent fixtures

A	"F25T12" - 25 watt, 4ft, T12 lamp
IL or T8	T8, Instant start
SIL	T8, Instant start, Super 30 watt
SSIL or T8N	T8, rapid start, Super 28 watt
L	T8, rapid start
T5	T5, standard
T5HO	T5, standard, High output lamp
T12	T12, Energy efficient
EH	T12, Energy efficient, High output lamp
EI	T12, Energy efficient, Instant start
EV	T12, Energy efficient, Very high output
T12M	T12, Standard magnetic
SIL	T12, Standard, Instant start
HO	T12, Standard, High output lamp
SV	T12, Standard, Very high output lamp
T	T10, Standard

Ballast Type

for fluorescent fixtures

E	Electronic
M	Standard magnetic

Configuration (letter)

T	Tandem wired fixture
DL	Delamped fixture, i.e. some lamps permanently removed but ballasts remain

Configuration (number)

for delamped fixtures

Number signifies the total number of ballasts in the fixture: e.g. An "F42EEID2" is an "F44EE" with two lamps removed so that there is one extaneous ballast

for tandem wired ballasts

Number signifies the total number of lamps being run by the ballast: e.g. An "F42LLIT4" would indicate that a four-lamp ballast is wired to run two-lamp fixtures.

with no preceding letter

Number indicates the number of ballasts in an ambiguous multiple ballast fixture: e.g. An "F43ILU2" indicates a three-lamp fixture with two ballasts (as is often the case if there is A/B switching).

Notes:

1) The column labeled Watts/Fixtures in the data table includes ballast loads.

2) The fixture wattage values represent an average value, rounded to the nearest whole watt.

Existing Facilities Program Lighting Form:

Performance Based

Project Number:	98515.11R-008.268
Facility Name:	Police Station/Fire Station #1
Project Manager	Abdul Basit
Date: 9/8/2011	Square Footage (ft2): 34500

Existing Control Legend	
LS	Light Switch
PS	Photosensor
TM	Timer
MS	Motion/Occupancy Sensor
EC	Emergency Control

INSTRUCTIONS Coding Legend		
CF	Compact Fluorescent	I
F	Fluorescent, linear	LED
H	Halogen	MH
HPS	High Pressure Sodium	MV
I	Incandescent	QL

PRE-INSTALLATION

Line Item	ECM	Type of ECM Code (Refer to ECM Code Worksheet)	Additional ECM Code (if applicable)	Floor	Area Description	Light Reading (Record if ECM)	Usage	Existing Control	Pre Fixt. No.	Pre Fixt Code (Refer to Wattable Table Worksheet)	Pre Watts / Fixt	Pre kW / Space	Baseline Annual Hours	Annual kWh Consumed	Notes
Integer line number	(Type 'ECM' for lighting retrofit)	ECM CODE Worksheet Link	For two ECMs in one line item	Floor fixture is on	Description of location that matches site map	Lux	hrs/ week	control device (refer to legend above)	# of existing fixtures	TypWattage Table	Watts/Fixt from Wattage Table	(Pre Watts/Fixt) * (Pre Fixt No.)	Existing annual hours used	(PreFixt #*PreWatts/Fixt * Baseline Hrs)	
1					Lobby Entrance - Police		168	LS	14	I60/1	60	0.84	8,736	7,338	
2					Ground Floor Hallway - Police		168	LS	2	F44T8	112	0.22	8,736	1,957	
3					Rotunda Room - Police		80	LS	12	I60/1	60	0.72	4,160	2,995	
4					Cells - Police		10	LS	6	F21T8	20	0.12	520	62	
5	ECM	DL			Ground Floor Hallway - Police		168	LS	2	F44T8	112	0.22	8,736	1,957	
6	ECM	DL			Ground Floor Kitchen - Police	1050	80	LS	2	F44T8	112	0.22	4,160	932	
7	ECM	DL			Booking Room - Police	1100	80	LS	3	F44T8	112	0.34	4,160	1,398	
8					Dispatch Room - Police		168	LS	3	F43T8	89	0.27	8,736	2,333	
9					Garage Area - Police	400	20	LS	14	F44T8	112	1.57	1,040	1,631	
10					Vehicle Wash Area - Police		30	LS	4	F81T8	58	0.23	1,560	362	
11					Repair Area - Police		30	LS	12	F42T8	59	0.71	1,560	1,104	
12					Upper Level Hallway- Police		80	LS	7	FU2T8	59	0.41	4,160	1,718	
13					Upper Level Hallway - Police		80	LS	22	F21T8	20	0.44	4,160	1,830	
14	ECM	MS			Training Room - Police	300	30	LS	12	F42T8	59	0.71	1,560	1,104	
15	ECM	MS			Offices - Police	600	50	LS	13	F42T8	59	0.77	2,600	1,994	
16	ECM	MS			Locker Rooms - Police		20	TM	12	F42T8	59	0.71	1,040	736	
17					Basement/Boiler Rm - Police		10	LS	8	F42T8	59	0.47	520	245	
18	ECM	MS			Restrooms - Police		5	TM	5	F41T8	31	0.16	260	40	
19					Stairwells - Police		168	LS	6	F42T8	59	0.35	8,736	3,093	
20	ECM	RB			Lobby Entrance - Fire		168	LS	1	I60/1	60	0.06	8,736	524	
21	ECM	MS			Ground Floor Hallway - Fire	240	168	LS	4	I60/1	60	0.24	8,736	2,097	
22					Reception - Fire		168	LS	1	F42T8	59	0.06	8,736	515	
23	ECM	MS			Conference Room - Fire		30	LS	3	FU2T8	59	0.18	1,560	276	
24	ECM	MS			Offices - Fire		40	LS	18	F42T8	59	1.06	2,080	2,209	
25					Weight Room - Fire		10	LS	4	F41T8	31	0.12	520	64	
26					Dispatch - Fire	100	168	LS	2	F42T8	59	0.12	8,736	1,031	
27					Stairwells - Fire	200	168	LS	6	F42T8	59	0.35	8,736	3,093	
28					Basement/Storage Rms - Fire		10	LS	8	F41T8	31	0.25	520	129	
29					Upper Level Hallway - Fire	230	80	LS	6	FU2T8	59	0.35	4,160	1,473	
30					Upper Level Hallway - Fire		80	LS	3	F42T8	59	0.18	4,160	736	
31	ECM	MS			Offices - Fire	240	50	LS	3	FU2T8	59	0.18	2,600	460	
32	ECM	MS			Restrooms - Fire		5	LS	3	F41T8	31	0.09	260	24	
33	ECM	MS			Kitchen - Fire		60	LS	3	F42T8	59	0.18	3,120	552	
34	ECM	MS			Locker Rooms - Fire		30	LS	11	F42T8	59	0.65	1,560	1,012	
35					Exit Lighting		168	EC	12	ELED5/2	10	0.12	8,736	1,048	
36	ECM	RB			Exterior Lighting		80	TM	3	I60/1	60	0.18	4,160	749	
37	ECM	RB			Exterior Lighting		80	TM	3	MH100	128	0.38	4,160	1,597	
38	ECM	RB			Exterior Lighting		80	TM	2	I100/1	100	0.20	4,160	832	
39	ECM	RB			Parking Lighting		80	TM	5	MH150	190	0.95	4,160	3,952	
								Total Pre Fixt.	**260**		**Total Pre kW**	**15**	**kWh Consumed**	**55,205**	

Light Intensity	0.446	Watt/ ft2	**Usage Intensity**	1.60 KWh / ft2

Existing Facilities Program Lighting Form:

Performance Based

Project Name: 98515.11R-008.268

Facility Name: Police Station/Fire Station #1

Date: 9/8/2011 Project Manager Abdul Basit

Existing Control Legend	
LS	Light Switch
PS	Photosensor
T	Timer
MS	Motion Sensor
EC	Emergency Control

INSTRUCTIONS Coding Legend			
CF	Compact Fluorescent	I	Incandescent
F	Fluorescent, linear	LED	Light Emitting Diode
H	Halogen	MH	Metal Halide
HPS	High Pressure Sodium	MV	Mercury Vapor
I	Incandescent	QL	Induction

	PRE-INSTALLATION											POST-INSTALLATION						
Line Item	**ECM**	**Type of ECM Code** (Refer to ECM Code Worksheet)	**Additional ECM Code (if applicable)**	**Floor**	**Area Description**	**Light Reading** (Record if ECM)	**Usage**	**Baseline Annual Hours**	**Existing Control**	**Pre Fixt. No.**	**Pre Fixt Code**	**Post Fixt No.**	**Post Fixt Code** (Refer to Wattable Table Worksheet)	**Post Watts/ Fixt**	**Proposed Weekly Hours**	**Proposed Control**	**kW Saved**	**Annual kWh Saved**
Integer line number	(Type 'ECM" if applied)	ECM CODE Worksheet Link	For two ECMs in one line item	Floor fixture is on	Description of location that matches site map	Lux (link to light standards)	hrs/ week	Existing annual hours for the usage group	Pre-installation control device	# of existing fixtures	TypWattage Table Link	# of existing fixtures	TypWattage Table	Watts/Fixt from Wattage Table	hrs / wk	Post-installation control device	Pre kW/Space - Post kW/Space	(PreFixt #*PreWatts/Fixt * Baseline Hrs) - (PostFixt#*PostWatts/Fixt * Proposed Hours)
Ex.		*RB*		*10*	*Men's Room*		*5*	*3,000*	*Light Switch*	*3*	*F44T12*	*3*	*F42T8*	*59*		*Motion Sensor*	*0.26*	*765*
5	ECM	DL - Delamping		-	Ground Floor Hallway - Police	-	168	8,736	LS	2	F44T8	2	F42T8	59	168.00	LS	0.11	926
6	ECM	DL - Delamping		-	Ground Floor Kitchen - Police	1,050	80	4,160	LS	2	F44T8	2	F42T8	59	50.00	MS	0.11	625
7	ECM	DL - Delamping		-	Booking Room - Police	1,100	80	4,160	LS	3	F44T8	3	F42T8	59	20.00	MS	0.16	1,214
14	ECM	MS - Install Motion Sensors		-	Training Room - Police	300	30	1,560	LS	12	F42T8	12	F42T8	59	20.00	MS	0.00	368
15	ECM	MS - Install Motion Sensors		-	Offices - Police	600	50	2,600	LS	13	F42T8	13	F42T8	59	30.00	MS	0.00	798
16	ECM	MS - Install Motion Sensors		-	Locker Rooms - Police	-	20	1,040	TM	12	F42T8	12	F42T8	59	15.00	MS	0.00	184
18	ECM	MS - Install Motion Sensors		-	Restrooms - Police	-	5	260	TM	5	F41T8	5	F41T8	31	3.00	MS	0.00	16
20	ECM	RB - Replace Bulb		-	Lobby Entrance - Fire	-	168	8,736	LS	1	I60/1	1	CFL13	17	80.00	MS	0.04	453
21	ECM	MS - Install Motion Sensors		-	Ground Floor Hallway - Fire	240	168	8,736	LS	4	I60/1	4	CFL13	17	168.00	LS	0.17	1,503
23	ECM	MS - Install Motion Sensors		-	Conference Room - Fire	-	30	1,560	LS	3	FU2T8	3	FU2T8	59	25.00	MS	0.00	46
24	ECM	MS - Install Motion Sensors		-	Offices - Fire	-	40	2,080	LS	18	F42T8	18	F42T8	59	30.00	MS	0.00	552
31	ECM	MS - Install Motion Sensors		-	Offices - Fire	240	50	2,600	LS	3	FU2T8	3	FU2T8	59	40.00	MS	0.00	92
32	ECM	MS - Install Motion Sensors		-	Restrooms - Fire	-	5	260	LS	3	F41T8	3	F41T8	31	5.00	MS	0.00	0
33	ECM	MS - Install Motion Sensors		-	Kitchen - Fire	-	60	3,120	LS	3	F42T8	3	F42T8	59	60.00	MS	0.00	0
34	ECM	MS - Install Motion Sensors		-	Locker Rooms - Fire	-	30	1,560	LS	11	F42T8	11	F42T8	59	20.00	MS	0.00	337
36	ECM	RB - Replace Bulb		-	Exterior Lighting	-	80	4,160	TM	3	I60/1	3	CFL13	17	80.00	TM	0.13	537
37	ECM	RB - Replace Bulb		-	Exterior Lighting	-	80	4,160	TM	3	MH100	3	QL85	85	80.00	TM	0.13	537
38	ECM	RB - Replace Bulb		-	Exterior Lighting	-	80	4,160	TM	2	I100/1	2	CFL26	33	2.00	TM	0.13	825
39	ECM	RB - Replace Bulb		-	Parking Lighting	-	80	4,160	TM	5	MH150	5	QL85	85	80.00	TM	0.53	2,184
									Total Pre Fixt.	**108**		**108**	**Total Post kW**	**965.00**		**Total kW Saved**	**1.50**	**11,197.00**

APPENDIX G:
ECM CALCULATIONS

UIC	Control External Air Leakage In The Building
EAE4	Details: Install Weather-Stripping on Entrance Doors

ENTER EXISTING CONDITION

Insert Existing Estimated Air Change Rate/Hr (ACH 1): *(Existing Air Changes Per Hour, 3 is very leaky and 0.35 ideal)*	1.25		Cubic Feet/Min (CFM 1):	416.67
Insert Proposed Estimated Air Change Rate/Hr (ACH 2):	1.00		Cubic Feet/Min (CFM 2):	333.33
Estimated Space Volume Under Consideration	20000.00	Cu.Ft	Is The Building Cooled?	Yes (Select)

WINTER			SUMMER		
Select Type of Heating Fuel	Natural Gas (Select)		Select Type of Cooling Fuel	**ELECTRICITY** (Default)	
Estimated Annual Heating Plant Efficiency	80.00	**%**	Estimated Annual Cooling Plant Efficiency	14	EER
Annual Heating Degree Days(HDD):	5724		Annual Cooling Degree Days(CDD):	992	
Estimated Total Annual Input Heating Energy Savings	154.55	Therms	Estimated Total Annual Input Cooling Energy Savings	153.05	kWh
Cost/Unit of Heating Fuel: Therms	$1.09	$$	Cost/Unit For Electricity	$0.16	$$
Estimated Annual Heating Cost Savings	168.50	$$	Estimated Annual Cooling Cost Savings	24.63	$$

Cost Analysis

Estimated Annual O&M Savings	$9.66	Estimated Installation Cost (Including Labor)	$500.00
Total Estimated Annual Cost Savings	202.7857799	Total Cost For Controlling Air Leakage	$395
Simple Pay Back Period	1.947868338	*Type of Recommendation*	No/Low Cost ECM Recommendation

UIC	Add the Building to Needham's BMS and Install DDC controls
EAC3	Details: Replace pneumatic controls with DDC; add remotely monitored digital room thermostats

No of Programmable Thermostats To Be Installed : 14 Qty.

Select Type of Programmable Thermostat Recommended: 7-Day Programmable Thermostat *(Select)*

(Selection Based on Type of Property)

Heating Load Calculation

Select Type of Heating Fuel: Natural Gas *(Select)*

Estimated Total Current Annual Consumption of Energy For Winter Heating: 13000 Therm

	Weekdays	Weekends
Day Time Set Back Hours	9.00	4.00
Night Time Set Back Hours	8.00	8.00
Hours Without Set Back	7.00	12.00

Typical Indoor Temp	68.00 °F
Temp Set Point With Set Back During Day Time	60.00 °F
Temp Set Point With Set Back During Night Time	65.00 °F
Average Heating Set Point	64.48 °F
Savings Per Degree Set Back For Heating Season *(Industry Standard, 2004)*	3%
Estimated Annual Heating Energy Consumption	1300000.00 kBtu
Estimated New Annual Heating Energy Consumption	1162571.43 kBtu
Estimated Annual Heating Energy Savings	1374.29 Therm

Cooling Load Calculation

Select Type of Cooling Fuel: Electric *(Default)*

Estimated Total Current Annual Energy Consumption For Summer Cooling: 70436 kWh

	Weekdays	Weekends
Day Time Set Back Hours	9.00	4.00
Night Time Set Back Hours	8.00	8.00
Hours Without Set Back	7.00	12.00

Typical Indoor Temp	75.00 °F
Temp Set Point With Set Back During Day Time	85.00 °F
Temp Set Point With Set Back During Night Time	78.00 °F
Average Cooling Set Point	79.15 °F
Savings Per Degree Set Back For Cooling Season *(Industry Standard, 2004)*	12%
Estimated Annual Cooling Energy Consumption	240327.63 kBtu
Estimated New Annual Cooling Energy Consumption	120507.14 kbtu
Estimated Annual Cooling Energy Savings	35117.38 kWh

Cost Analysis

Average Annual Cost of Heating Fuel: ($$/Unit)	$1.09 $/Therm	Estimated Instalation Cost Per Thermostats: *(Includes Material, Labor & Installation Costs)*	$138 $$
Average Annual Cost of Electricity: ($$/kWh)	$0.16 $/kWh	Total Estimated Cost For DDC conversion and BMS connectivity	$120,750 $$
Estimated Annual Heating Cost Savings:	$1,498.31 $$	Total Estimated Cost Savings From DDC Conversion and BMS connectivity	$7,150
Estimated Annual Cooling Cost Savings:	$5,652.17 $$	Estimated Simple Pay Back Period	16.89 Yrs

Type of Recommendation: Capital Cost ECM Recommendation

UIC	Install Variable Frequency Drives (VFD)
EAC4	Details: Install VFD on Hot Water Circulation Pumps

Cost/kWh: $0.16

Install VFD on

No. of Motors:	2		No. of VFD To Be Installed	2
Individual Motor HP:	5	HP	Motor Efficeincy:	80.00%
Load Factor:	85%		Annual hrs of operation:	2500.00
Full load input power:	3.96	kW	Cost Per VFD (Excluding Installation)	$1,250.00
			Estimated Labor cost/VFD:	$943.00

% Load	% hours	Hours	VFD Factor	Full Load kW	Fraction of full load power (kW) with VFD	kW Reduction with VFD	kWh Savings with VFD
0%	0%	-	-	3.96	0.00	3.96	-
10%	1%	25	0.03	3.96	0.12	3.84	96
20%	2%	50	0.07	3.96	0.28	3.69	184
30%	2%	50	0.13	3.96	0.52	3.45	172
40%	5%	125	0.21	3.96	0.83	3.13	391
50%	20%	500	0.30	3.96	1.19	2.77	1,387
60%	20%	500	0.41	3.96	1.62	2.34	1,169
70%	20%	500	0.54	3.96	2.14	1.82	912
80%	15%	375	0.68	3.96	2.69	1.27	476
90%	10%	250	0.83	3.96	3.29	0.67	168
100%	5%	125	1.00	3.96	3.96	-	-
Total		**2,500**					**4,956**

Total Instalation Cost:	$3,465	
Average kW Reduction:	3.01	
Annual kWh Savings Per Motor:	4955.89	per VFD

Select Type Of Motor Configuration: Motors Run In Lead Lag Configuration

Total Savings From All Motors: 4955.89 kWh (total for all VFDs)

Estimated annual cost savings: $798 $$

Simple payback: 4.34 years

Type of Recommendation: Capital Cost ECM Recommendation

UIC	Automatically Control Rooftop Exhaust Fans
EAC7A	Details: Control Rooftop fans with Lighting Occupancy Sensors

EXISTING CONDITION		
No. of Fan Motors:	4.00	Qty
Total HP of Fans	0.50	HP
Total kW:	0.373	kW
Existing Annual hours of operation:	6000.00	Hr
Annual kWh:	2238.00	kWh

PROPOSED CONDITION		
New Annual Hours With Timers:	4000.00	Hr
New Annual kWh:	1492.00	kWh
Annual kWh Savings:	760.01	kWh

COST ANALYSIS		
Cost/kWh:	**$0.16**	$$
Annual Cost savings:	$122	$$
Installed cost/timer:	$60.00	$$
Total Cost of Installment of Timers	$190	$$
Simple Payback:	1.55	Yrs

Type of Recommendation — No/Low Cost ECM Recommendation

UIC	Install Energy Savers on Vending, Snack Machines
EAC8	Details: Install Energy Savers on Vending and Soda Machines

No. of Vending Machines: 2.00 Qty

No. of Beverage Cooling Machines: 0.00 Qty

No. of Snack Machines 1.00 Qty

Vending Machines (Cold Beverage Vending Machines)

Estimated Annual kWh Consumption of Vending Machine:	3500.00	kWh
Estimated Annual kWh of Vending Machine With VendMiser:	1890.00	kWh
Total annual kWh savings:	1610.00	kWh
Total Annual kWh Savings for All Vending Machines:	3220.00	kWh

Beverage Cooling Machines

Estimated Annual kWh Consumption of Beverage Cooling Machine:	2300.00	kWh
Estimated Annual kWh of Cooling Machine With CoolerMiser:	1610.00	kWh
Total Annual kWh savings:	690.00	kWh
Total Annual kWh Savings For All Cooling Machines:	0.00	kWh

Snack Vending Machines

Estimated Annual kWh Consumption of Individual Snack Machine:	873.60	kWh
Estimated Annual kWh of Individual Snack Machines With VendMiser:	366.91	kWh
Total Annual kWh savings:	506.69	kWh
Total Annual kWh Savings For All Water Fountain Coolers:	506.69	kWh

Cost Analysis

Total estimated annual kWh savings withEnergy Misers:	**3726.69**	kWh
Cost/kWh:	**$0.16**	
Estimated Cost of Vendmiser/ Vending Machine:	$200	
Estimated Cost of Coolermiser/ Water cooler:	$190	
Estimated Cost of Vendmiser/ Snack Machine:	$70	
Estimated total installed cost of all VendMisers:	**$455**	
Estimated Total Annual Electricity Savings Using VendingMisers and CoolerMisers:	**$600**	
Simple Payback:	0.76	years

Type of Recommendation No/Low Cost ECM Recommendation

UIC	Replace Inefficient Heating Plant
EAH 1A	Details: Replace Heating Boiler with High Efficiency Condensing Boiler

Select Type of Heating Fuel	Natural Gas	(Select)	
No. of Heating Units To Be Replaced:	1	Qty	
Estimated Actual Heating Fuel Used For Heating:	13,000	Therms	
Existing Average Annual Heating Plant Efficiency:	80%	%	
Improved/New Heating Plant Efficiency:	94%	%	
Estimated New Heating Fuel Consumption With Improved Efficiency:	11063.83	Therms	
Estimated Heating Fuel Savings:	1936.17	Therms	
Average Cost/Unit For Heating Fuel: $$/ Therms	$1	$$	
Estimated Annual Cost Savings:	$2,111	$$	
Estimated Annual O&M Savings:	$106	$$	
Removal of Existing Heating Equipment Cost:	$10,500		
Installation Labor Cost of Installing New Equipment:	$3,231		
Material Cost of New Equipment:	$32,357		
Overhead, Profit, and Contingency Costs:	$10,500		
Estimated Cost of New Heating Plant (or Cost of Improvement)	$56,588	$$	
Estimated Total Cost For Replacing All Heating Plants:	$44,705		
Simple Payback:	20.17	years	
Type of Recommendation	Capital Cost ECM Recommendation		

UIC	**Lower Domestic Hot water Temperature Set-Points**
EAD1	**Details: Lower Domestic Hot Water Temperature to 125 degrees F**

Type of Water Heater Fuel	Natural Gas	(Select)	
Insert No. of Domestic Hot Water Heaters To Be Reset:	2	Qty	
Estimated/Actual Annual Domestic Water Heating Fuel Supply:	1,200	Therms	
Name Plate System Effficiency:	80.00%		
Supply Water Temperature:	55	°F	
Current Water Heater Setpoint Temperature:	140	°F	
The Proposed Water Heater Setpoint Temperature:	125	°F	
Estimated New Annual Energy Consumption At Supply With Reduced Domestic Hot Water Temperature Set Point	988.24	Therms	
Estimated Annual Heating Fuel Savings:	211.76	Therms	
Average Cost/Unit of Heating Fuel	$1.09	$$/ Therms	$$
Estimated Annual Cost Savings:	$230.88	$$	
Does The HoT Water Heater Have A Manual Temperature Control?	Yes		
Installed Cost of All Programmable Aquastat:	$50.00	$$	
Simple Payback:	0.22	years	
Type of Recommendation	No/Low Cost ECM Recommendation		

UIC	Replace Incandescent Lamps With CFL's			
EAL 1A	Details: Replace Incandescent Exterior Building Lights with CFLs			
Step:1	Number of Lamps to Be Replaced		5	
Step:2	Current Wattage of Lamp		60.00	watt
Step:3	Proposed Replacement		13.00	watt
Step:4	Total labor Cost For Replacing lamps *Estimated Rate of $35/hr To Replace 20 Lamps/Hr*		$8.75	
Step:5	Estimated Cost Per Lamp	*(Select)*	$3.00	$$
Step:6	**Total Cost For Retrofit**		$18.76	
Step:7	Estimated Annual Energy Savings		1362.00	kwh
Step:8	Current Electric Tarriff Per kWh		**$0.16**	$$
Step:9	Existing Annual Usage *(For O&M Savings)*		4000	hrs
	Proposed Annual Usage Post Retrofit *(For O&M Savings)*		4000	hrs
	Estimated Annual O&M Savings		$15.01	$$
Step:10	Estimated Annual Cost Savings		$234.22	
Step:11	Simple Pay back Period		0.08	Yrs
Type of Recommendation	No/Low Cost ECM Recommendation			

UIC	**Install Automatic Lighting Controls**		
EAL5	**Details: Install Motion Sensors in Office and Common Areas**		
	Type of Sensor	Internal Photosensors	
Step: 1	Total Number of Sensors	22	
Step: 2	Purchase Cost/Lighting Control Sensors	$15	
Step: 3	Installation Cost /Sensor	$65	
Step:4	Total Installation Costs	$1,390.40	
Step:5	Total Energy Savings	2830.00	kWh
Step:6	Electric Tariff Rate	**$0.16**	$
Step:7	Total Cost Savings	$455.49	
Step:8	Simple Pay Back Period	3.05	Years
Type of Recommendation		Capital Cost ECM Recommendation	

UIC	**Reduce Light Levels By Delamping of Lamps**
EAL8	**Details: Delamp Fixtures in Police section Hallway, Garage and**

No of Incandescent lamps to be removed	0	Qty
No. of Linear Fluroscent Lamps To Be Removed	6	Qty
No. of Fixtures To Be Delamped	0	Qty
Estimated Cost of Delamping		
(Assuming Labor Charge of $65/hr)		
Delamping of Incandescent Lamps *($65/30 Lamps)*	$0.00	$
(Assuming Lamp Location at a 8-10' Ceiling Height)		
Delamping of Linear Fluroscent Lamps *($65/20 Lamps)*	$19.50	$
(Assuming Lamp Location at a 8-10' Ceiling Height)		
Install Parabolic Reflectors?	**Yes**	
No of Fixturs To be Installed With Reflectors?	0	
($90/Fixture(Includes instalation)		
Total Estimated Delamping Cost	$15	$
Total Energy Saved	2765.00	kWh
Existing Electric Tariff per kWH	**$0.16**	$
Estimated Annual Cost Savings	$445.03	$
Estimated Return on Investment	0.03	Years
Type of Recommendation	No/Low Cost ECM Recommendation	

UIC	Replace High Intensity Discharge Lamp (HID) with Induction Lighting
EAL9	Details: Replace Exterior and Parking Lights with Induction Lights

Step:1	Number of 60-100W HID Lamps Replaced by 40W Induction	0	
	Number of 100-150W HID Lamps Replaced by 70W Induction	3	
	Number of 150-200W HID Lamps Replaced by 85W Induction	**5**	
	Number of 200-250W HID Lamps Replaced by 120W Induction	**0**	
	Number of 250-300W HID Lamps Replaced by 165W Induction	**0**	
	Number of 300-400W HID Lamps Replaced by 250W Induction	**0**	
	Number of 1000W HID Lamps Replaced by (2)300W Induction Lamps	**0**	
	Installation Cost Analysis		
Step:2	Subtotal Cost of 40 Watt Induction Self Ballast Retrofit	$0	
Step:3	Subtotal Cost of 70 Watt Induction Retrofit	$1,110	
Step:4	Subtotal Cost of 85 Watt Induction Retrofit	$1,925	
Step:5	Subtotal Cost of 120 Watt Induction Retrofit	$0	
Step:6	Subtotal Cost of 165 Watt Induction Retrofit	$0	
Step:7	Subtotal Cost of 250 Watt Induction Retrofit	$0	
Step:8	Subtotal Cost of 300 Watt Induction Retrofit	$0	
Step:9	**Total Cost For Retrofit**	$2,398	
	Energy & Cost Saving Analysis		
Step:10	Estimated Annual Energy Savings	2721.00	kwh
Step:11	Current Electric Price Per kWh	$0.16	$
Step:12	Estimated Annual Cost Savings	$438	
Step:13	Existing Annual Usage *(For O&M Savings)*	4000	hrs
	Proposed Annual Usage Post Retrofit *(For O&M Savings)*	4000	hrs
	Estimated Annual O&M Savings	$30	$$
Step:14	Total Estimated Annual Cost Savings *(Energy & O&M Savings)*	$468	$$
Step:15	Simple Pay back Period	5.12	Yrs

Type of Recommendation Capital Cost ECM Recommendation

NOTE: Induction Lamps contain 3 to 4 times the life of HID lamps where significant Operation and Maintanence Savings are attained through minimizing frequency of bulb and ballast replacements

UIC	Replace Existing Refrigerator(s) With Energy Star Certified Refrigerator(s)
EAA1	Details: Replace Refrigerators in Police Department with Energy Star Systems

Number of Refrigerators To Be Replaced			2 Qty	
Details of Existing Refrigerator:				
	20 CF	1980 YEAR	1200.00 Kwh/Year	
Proposed New Refrigerator				
	20 CF	Y Energy Star (Y/N)	410.00 Kwh/Year	
Annual Kwh Savings Per Unit (Kwh/year)			790	kWh
Total Annual Kwh Savings (Kwh/year)			1580	kWh
Current Electrical Tariff ($/Kwh)			**$0.16**	$$
Annual Cost Savings From All Refrigerators ($$)			$254.30	$$

Total Installation Cost Including, Eco Friendly Disposal Of Existing Refrigerator ($$)

2 No. of Units	$50.00 Disposal Tax	$750.00 Unit Cost	$1,600.00 Total Cost	$$

Simple Return on Investment: 6.29 Yrs

Note- *Average Life of a Refrigerator is 15 Years*

Type of Recommendation: Capital Cost ECM Recommendation

UIC	Replace Existing Dishwashers With High Efficiency Dishwashers
EAA3	Details: Replace Dishwasher with High Efficiency Dishwasher

Number of Dishwashers To Be Replaced: 1 Qty

Enter Estimated Loads/ Week / Washer: 5 Qty

Existing

Select Type of Existing Model: 1994 or Older Model (Select)

Estimated Annual kWh Consumption / Unit: 390.00 (Kwh)

Estimated Annual Hot Water Consumption/ Unit: 2860.00 (Gal)

Proposed Energy Star Qualified DishWasher

Estimated Annual kWh Consumption of Proposed Machine: 300.00 (Kwh)

Estimated Annual Hot Water Consumption of Proposed Machine: 1300.00 (Gal)

Energy, Water & Cost Saving

Water Savings

Annual Hot Water Savings Per Unit: 1560.00 Gal

Total Annual Hot Water Savings: 1.56 Kgal

Current Water Tariff: $11.50 $/Kgal

Total Annual Water Cost Savings: $17.94 $$

Energy Savings

Annual Kwh Savings Per Unit: 90 kWh

Total Annual Kwh Savings: 90 kWh

Current Electrical Tariff: **$0.16** $$

Total Annual Electric Cost Savings: $14.49 $$

Hot Water Based Energy Savings

Select Type of Hot Water Heating Fuel: Natural Gas

Efficiency of Hot Water Heater: 80.00% %

Cost of Heating Fuel ($$/Unit): $1.09 $$

Hot Water Supply Temperature *(140F in Most Cases)*: 140.00 F

Energy Savings From Hot Water: 1209.89 kBtu

Energy Savings From Hot Water: 12.10 Therms

Total Cost Savings From Hot Water: $13.19 $$

COST ANALYSIS

Total Annual Cost Savings: $45.62 $$

Total Installation Cost Including, Eco Friendly Disposal Of Existing Dishwashers ($$)

No. of Units	Disposal Tax	Unit Cost	Total Cost
1	$50.00	$395.00	$445.00 $$

Simple Return on Investment: 9.76 Yrs

Note- *Average Life of a Dishwasher is 10-15 Years*

Type of Recommendation: No/Low Cost ECM Recommendation

UIC	**Replace Existing Washing Machines With Energy Star Certified Washing Machines**
EAA4	**Details: Replace Washing Machine in Fire Department with Energy Star Washing Machine**

Number of washers to be replaced: 1
Number of loads per week/washer: 3
Are The Machines Rented? No

Water Tariff ($/1000 Gal) $11.50

Cost of Replacing one Machine $550

Cost savings per Washer:

	Existing		Recommended		Energy & Water Savings		Cost
Total annual water consumption:	4,025	gal	2,480	gal	1,544	gal	$17.76
Select Type of Water Heater Fuel	Natural Gas	(Select)					
Total annual electricity consumption:	78.00	kWh	39.00	kWh	39.00	kWh	$6.28
Total Annual Water Heater Fuel Consumption:	28.21	Therms	17.38	Therms	10.82	Therms	$11.80

Total Cost Savings per Washer: $35.84

Total Cost Savings From All Washers $35.84

Total Installed Cost For All Machines $550

Simple Pay Back Period: 15.35

Type of Recommendation No/Low Cost ECM Recommendation

APPENDIX H:
SUPPORTING DOCUMENTS

OMB No. 2060-0347

STATEMENT OF ENERGY PERFORMANCE
Needham: Police Station/Fire Station

Building ID: 2857469
For 12-month Period Ending: June 30, 2011[1]
Date SEP becomes ineligible: N/A
Date SEP Generated: October 11, 2011

Facility
Needham: Police Station/Fire Station
99 School Street
Needham, MA 02492

Facility Owner
N/A

Primary Contact for this Facility
N/A

Year Built: 1990
Gross Floor Area (ft²): 34,500

Energy Performance Rating[2] (1-100) N/A

Site Energy Use Summary[3]

Electricity - Grid Purchase(kBtu)	1,240,753
Natural Gas (kBtu)[4]	1,432,400
Total Energy (kBtu)	2,673,153

Energy Intensity[5]

Site (kBtu/ft²/yr)	77
Source (kBtu/ft²/yr)	164

Emissions (based on site energy use)

Greenhouse Gas Emissions ($MtCO_2e$/year)	214

Electric Distribution Utility
NSTAR Electric Co

National Average Comparison

National Average Site EUI	78
National Average Source EUI	157
% Difference from National Average Source EUI	4%
Building Type	Fire Station/Police Station

Stamp of Certifying Professional

Based on the conditions observed at the time of my visit to this building, I certify that the information contained within this statement is accurate.

Certifying Professional
N/A

Meets Industry Standards[6] **for Indoor Environmental Conditions:**

Ventilation for Acceptable Indoor Air Quality	**N/A**
Acceptable Thermal Environmental Conditions	**N/A**
Adequate Illumination	**N/A**

Notes:
1. Application for the ENERGY STAR must be submitted to EPA within 4 months of the Period Ending date. Award of the ENERGY STAR is not final until approval is received from EPA.
2. The EPA Energy Performance Rating is based on total source energy. A rating of 75 is the minimum to be eligible for the ENERGY STAR.
3. Values represent energy consumption, annualized to a 12-month period.
4. Values represent energy intensity, annualized to a 12-month period.
5. Based on Meeting ASHRAE Standard 62 for ventilation for acceptable indoor air quality, ASHRAE Standard 55 for thermal comfort, and IESNA Lighting Handbook for lighting quality.

ENERGY STAR® Data Checklist for Commercial Buildings

In order for a building to qualify for the ENERGY STAR, a Professional Engineer (PE) or a Registered Architect (RA) must validate the accuracy of the data underlying the building's energy performance rating. This checklist is designed to provide an at-a-glance summary of a property's physical and operating characteristics, as well as its total energy consumption, to assist the PE or RA in double-checking the information that the building owner or operator has entered into Portfolio Manager.

Please complete and sign this checklist and include it with the stamped, signed Statement of Energy Performance.
NOTE: You must check each box to indicate that each value is correct, OR include a note.

CRITERION	VALUE AS ENTERED IN PORTFOLIO MANAGER	VERIFICATION QUESTIONS	NOTES	☑
Building Name	Needham: Police Station/Fire Station	Is this the official building name to be displayed in the ENERGY STAR Registry of Labeled Buildings?		☐
Type	Fire Station/Police Station	Is this an accurate description of the space in question?		☐
Location	99 School Street, Needham, MA 02492	Is this address accurate and complete? Correct weather normalization requires an accurate zip code.		☐
Single Structure	Single Facility	Does this SEP represent a single structure? SEPs cannot be submitted for multiple-building campuses (with the exception of acute care or children's hospitals) nor can they be submitted as representing only a portion of a building		☐
Police Department (Other)				
CRITERION	**VALUE AS ENTERED IN PORTFOLIO MANAGER**	**VERIFICATION QUESTIONS**	**NOTES**	☑
Gross Floor Area	34,500 Sq. Ft.	Does this square footage include all supporting functions such as kitchens and break rooms used by staff, storage areas, administrative areas, elevators, stairwells, atria, vent shafts, etc. Also note that existing atriums should only include the base floor area that it occupies. Interstitial (plenum) space between floors should not be included in the total. Finally gross floor area is not the same as leasable space. Leasable space is a subset of gross floor area.		☐
Number of PCs	N/A(Optional)	Is this the number of personal computers in the space?		☐
Weekly operating hours	N/A(Optional)	Is this the total number of hours per week that the space is 75% occupied? This number should exclude hours when the facility is occupied only by maintenance, security, or other support personnel. For facilities with a schedule that varies during the year, "operating hours/week" refers to the total weekly hours for the schedule most often followed.		☐
Workers on Main Shift	N/A(Optional)	Is this the number of employees present during the main shift? Note this is not the total number of employees or visitors who are in a building during an entire 24 hour period. For example, if there are two daily 8 hour shifts of 100 workers each, the Workers on Main Shift value is 100.		☐

ENERGY STAR® Data Checklist for Commercial Buildings

Energy Consumption

Power Generation Plant or Distribution Utility: NSTAR Electric Co

Fuel Type: Electricity

Meter: 26769471009 (kWh (thousand Watt-hours))
Space(s): Entire Facility
Generation Method: Grid Purchase

Start Date	End Date	Energy Use (kWh (thousand Watt-hours))
06/01/2011	06/30/2011	103.00
05/01/2011	05/31/2011	103.00
04/01/2011	04/30/2011	103.00
03/01/2011	03/31/2011	103.00
02/01/2011	02/28/2011	103.00
01/01/2011	01/31/2011	103.00
12/01/2010	12/31/2010	103.00
11/01/2010	11/30/2010	103.00
10/01/2010	10/31/2010	103.00
09/01/2010	09/30/2010	103.00
08/01/2010	08/31/2010	103.00
07/01/2010	07/31/2010	103.00
26769471009 Consumption (kWh (thousand Watt-hours))		**1,236.00**
26769471009 Consumption (kBtu (thousand Btu))		**4,217.23**

Meter: 25921551005 (kWh (thousand Watt-hours))
Space(s): Entire Facility
Generation Method: Grid Purchase

Start Date	End Date	Energy Use (kWh (thousand Watt-hours))
06/01/2011	06/30/2011	25,616.00
05/01/2011	05/31/2011	24,632.00
04/01/2011	04/30/2011	12,096.00
03/01/2011	03/31/2011	12,664.00
02/01/2011	02/28/2011	16,792.00
01/01/2011	01/31/2011	15,248.00
12/01/2010	12/31/2010	15,568.00
11/01/2010	11/30/2010	18,096.00
10/01/2010	10/31/2010	20,648.00
09/01/2010	09/30/2010	25,680.00
08/01/2010	08/31/2010	29,384.00
07/01/2010	07/31/2010	31,504.00
25921551005 Consumption (kWh (thousand Watt-hours))		**247,928.00**

25921551005 Consumption (kBtu (thousand Btu))	**845,930.34**

Meter: 28273110016 (kWh (thousand Watt-hours))
Space(s): Entire Facility
Generation Method: Grid Purchase

Start Date	End Date	Energy Use (kWh (thousand Watt-hours))
06/01/2011	06/30/2011	10,640.00
05/01/2011	05/31/2011	10,000.00
04/01/2011	04/30/2011	9,920.00
03/01/2011	03/31/2011	9,440.00
02/01/2011	02/28/2011	10,640.00
01/01/2011	01/31/2011	10,960.00
12/01/2010	12/31/2010	10,320.00
11/01/2010	11/30/2010	10,240.00
10/01/2010	10/31/2010	9,040.00
09/01/2010	09/30/2010	7,920.00
08/01/2010	08/31/2010	7,600.00
07/01/2010	07/31/2010	7,760.00

28273110016 Consumption (kWh (thousand Watt-hours))	**114,480.00**
28273110016 Consumption (kBtu (thousand Btu))	**390,605.76**
Total Electricity (Grid Purchase) Consumption (kBtu (thousand Btu))	**1,240,753.33**
Is this the total Electricity (Grid Purchase) consumption at this building including all Electricity meters?	☐

Fuel Type: Natural Gas

Meter: Nat Gas (therms)
Space(s): Entire Facility

Start Date	End Date	Energy Use (therms)
06/01/2011	06/30/2011	742.00
05/01/2011	05/31/2011	503.00
04/01/2011	04/30/2011	1,048.00
03/01/2011	03/31/2011	1,601.00
02/01/2011	02/28/2011	2,250.00
01/01/2011	01/31/2011	2,631.00
12/01/2010	12/31/2010	2,385.00
11/01/2010	11/30/2010	1,353.00
10/01/2010	10/31/2010	1,489.00
09/01/2010	09/30/2010	111.00
08/01/2010	08/31/2010	110.00
07/01/2010	07/31/2010	101.00

Nat Gas Consumption (therms)	**14,324.00**
Nat Gas Consumption (kBtu (thousand Btu))	**1,432,400.00**
Total Natural Gas Consumption (kBtu (thousand Btu))	**1,432,400.00**
Is this the total Natural Gas consumption at this building including all Natural Gas meters?	☐

Additional Fuels

Do the fuel consumption totals shown above represent the total energy use of this building? Please confirm there are no additional fuels (district energy, generator fuel oil) used in this facility.	☐

On-Site Solar and Wind Energy	
Do the fuel consumption totals shown above include all on-site solar and/or wind power located at your facility? Please confirm that no on-site solar or wind installations have been omitted from this list. All on-site systems must be reported.	☐

Certifying Professional

(When applying for the ENERGY STAR, the Certifying Professional must be the same PE or RA that signed and stamped the SEP.)

Name: _____ Date: _____

Signature: _____

Signature is required when applying for the ENERGY STAR.

FOR YOUR RECORDS ONLY. DO NOT SUBMIT TO EPA.

Please keep this Facility Summary for your own records; do not submit it to EPA. Only the Statement of Energy Performance (SEP), Data Checklist and Letter of Agreement need to be submitted to EPA when applying for the ENERGY STAR.

Facility
Needham: Police Station/Fire Station
99 School Street
Needham, MA 02492

Facility Owner
N/A

Primary Contact for this Facility
N/A

General Information

Needham: Police Station/Fire Station	
Gross Floor Area Excluding Parking: (ft^2)	34,500
Year Built	1990
For 12-month Evaluation Period Ending Date:	June 30, 2011

Facility Space Use Summary

Police Department	
Space Type	Other - Fire Station/Police Station
Gross Floor Area(ft^2)	34,500
Number of PCs[o]	N/A
Weekly operating hours[o]	N/A
Workers on Main Shift[o]	N/A

Energy Performance Comparison

	Evaluation Periods		Comparisons		
Performance Metrics	**Current** (Ending Date 06/30/2011)	**Baseline** (Ending Date 06/30/2011)	**Rating of 75**	**Target**	**National Average**
Energy Performance Rating	N/A	N/A	75	N/A	N/A
Energy Intensity					
Site (kBtu/ft^2)	77	77	0	N/A	78
Source (kBtu/ft^2)	164	164	0	N/A	157
Energy Cost					
$/year	$ 72,852.39	$ 72,852.39	N/A	N/A	$ 73,341.33
$/$ft^2$/year	$ 2.11	$ 2.11	N/A	N/A	$ 2.12
Greenhouse Gas Emissions					
$MtCO_2e$/year	214	214	0	N/A	215
$kgCO_2e/ft^2$/year	6	6	0	N/A	6

More than 50% of your building is defined as Fire Station/Police Station. This building is currently ineligible for a rating. Please note the National Average column represents the CBECS national average data for Fire Station/Police Station. This building uses X% less energy per square foot than the CBECS national average for Fire Station/Police Station.

Notes:
o - This attribute is optional.
d - A default value has been supplied by Portfolio Manager.