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Local Government Energy Program
Energy Audit Draft Report

City of Northfield

Public Works
W. Mill Rd. and Burton Avenue
Northfield, New Jersey 08225

Project Number: LGEA71

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EXECUTIVE SUMMARY

The Northfield Public Works is a single-story building, without basement, comprising a total conditioned floor area of 4,824 square feet. The original structure was built in 1938 with the Mechanics' Bay added in 1969. The following chart provides an overview of current energy usage in the building based on the analysis period of April 2009 through March 2010:

Table 1: State of Building-Energy Usage

	Electric Usage, kWh/yr	Gas Usage, therms/yr	Other fuel usage, gal/yr	Current Annual Cost of Energy, $	Site Energy Use Intensity, kBtu/sq ft yr	Joint Energy Consumption, MMBtu/yr
Current	33,795	5,457	N/A	13,030	137.0	661
Proposed	2,277	4,207	N/A	6,123	88.8	429
Savings	31,518*	1,250	N/A	6,907	48.2	232
% Savings	93%	23%	N/A	53%	35%	35%

*Includes 23,608 kWh savings from a proposed 20 kW PV Renewable System

There may be energy procurement opportunities for the Northfield Public Works to reduce annual utility costs, which are $504 higher, when compared to the average estimated NJ commercial utility rates.

SWA has also entered energy information about the Northfield Public Works in the U.S. Environmental Protection Agency's (EPA) ENERGY STAR® Portfolio Manager energy benchmarking system. This service facility is categorized as a non-eligible ("Other") space type for which no national energy performance rating is available at this time. The Site Energy Use Intensity is 137.0kBtu/sq ft yr compared to the national average of "Other" building consuming 104.0kBtu/ sq ft yr. See ECM section for guidance on how to improve the building's rating.

Based on the current state of the building and its energy use, SWA recommends implementing various energy conservation measures from the savings detailed in Table 1. The measures are categorized by payback period in Table 2 below:

Table 2: Energy Conservation Measure Recommendations

ECMs	First Year Savings ($)	Simple Payback Period (years)	Initial Investment, $	CO2 Savings, lbs/yr
0-5 Year	3,280	1.5	4,969	16,958
5-10 Year	1,374	7.8	10,696	10,980
Renewable PV	17,695	7.6	134,000	42,270
Total	22,348	6.7	149,665	70,208

SWA estimates that implementing the recommended ECMs is equivalent to removing approximately 6 cars from the roads each year or avoiding the need of 171 trees to absorb the annual CO_2 generated.

Further Recommendations: Other recommendations to increase building efficiency pertaining to capital improvements and operations and maintenance are (with additional information in the Proposed Further Recommendations section):

- Capital Improvements
  - Add insulation to all the ceilings; SWA suggests applying closed-cell spray-foam
  - Replace Vehicle Shop office two (2) electric baseboard heaters

    - Replace toilet and Vehicle Shop exhaust fans
    - Install CO detectors/alarms in the garage bays and nearby spaces
- Operations and Maintenance
    - SWA recommends regular roof maintenance to verify water is draining correctly
    - Provide weather-stripping/air-sealing
    - Repair/seal wall cracks and penetrations
    - Insulate un-insulated hot piping throughout the building to efficiently deliver hot water

The recommended ECMs and the list above are cost-effective energy efficiency measures and building upgrades that will reduce operating expenses for the City of Northfield. Based on the requirements of the LGEA program, the City of Northfield must commit to implementing some of these measures, and must submit paperwork to the Local Government Energy Audit program within one year of this report's approval to demonstrate that they have spent, net of other NJCEP incentives, at least 25% of the cost of the audit (per building). The minimum amount to be spent for the Public Work building, net of other NJCEP incentives, is $1,268.

Financial Incentives and Other Program Opportunities

The table below summarizes the recommended next steps that the City of Northfield can take to achieve greater energy efficiency and reduce operating expenses.

Table 3: Next Steps for the Public Works

Recommended ECMs	Incentive Program (Please refer to Appendix F)
Replace 3 Old Ceiling Hung Gas Fired Heaters with Infrared ENERGY STAR® Efficient Models	Smart Start, Direct Install
Install two (2) new Pulse Start Metal Halide fixtures	Smart Start, Direct Install
Replace 1 Standard Efficiency Natural Gas DHW Heater With ENERGY STAR® Natural Gas Condensing Type	Smart Start, Direct Install
Install twenty-eight (28) new T8 fluorescent fixtures	Smart Start, Direct Install

There are various incentive programs that the City of Northfield could apply to lower the installed ECM costs. SWA recommends the following programs, contingent upon available funding:

- **New Jersey Clean Energy Pay for Performance** - Three phase incentive plan:

1. Develop plan to reduce current energy use by 15%: receive up to 50% of annual energy costs
2. Install measures per plan: receive up to $0.13 per kWh saved and $1.45 per therm saved
3. Benchmark energy savings for a year: receive up to $0.09 per kWh saved and $1.05 per therm.

- **Direct Install 2010 Program**: Commercial buildings with peak electric demand below 200kW can receive up to 60% of installed cost of energy saving upgrades.
- **Smart Start**: Majority of energy saving equipment and design measures have moderate incentives under this program.
- **Renewable Energy Incentive Program**: Receive up to $0.8/Watt toward installation cost for PV panels upon available funding. For each 1,000 kWh generated by renewable energy, receive a credit between $475 and $600.
- **Utility Sponsored Programs**: Look for available programs with Atlantic City Electric and South Jersey Gas Co.
- **Energy Efficiency and Conservation Block Grant Rebate Program**: Provides up to $20,000 per local government toward energy saving measures.

Please refer to Appendix F for further details.

INTRODUCTION

Launched in 2008, the Local Government Energy Audit (LGEA) Program provides subsidized energy audits for municipal and local government-owned facilities, including offices, courtrooms, town halls, police and fire stations, sanitation buildings, transportation structures, schools and community centers. The Program will subsidize up to 100% of the cost of the audit. The Board of Public Utilities (BPUs) Office of Clean Energy has assigned TRC Energy Services to administer the Program.

Steven Winter Associates, Inc. (SWA) is a 38-year-old architectural/engineering research and consulting firm, with specialized expertise in green technologies and procedures that improve the safety, performance, and cost effectiveness of buildings. SWA has a long-standing commitment to creating energy-efficient, cost-saving and resource-conserving buildings. As consultants on the built environment, SWA works closely with architects, developers, builders, and local, state, and federal agencies to develop and apply sustainable, 'whole building' strategies in a wide variety of building types: commercial, residential, educational and institutional.

SWA performed an energy audit and assessment for the Public Works at W. Mill Rd. and Burton Avenue. The process of the audit included facility visits on May 13 and June 1, 2010, benchmarking and energy bills analysis, assessment of existing conditions, energy modeling, energy conservation measures and other recommendations for improvements. The scope of work includes providing a summary of current building conditions, current operating costs, potential savings, and investment costs to achieve these savings. The facility description includes energy usage, occupancy profiles and current building systems along with a detailed inventory of building energy systems, recommendations for improvement and recommendations for energy purchasing and procurement strategies.

The goal of this Local Government Energy Audit is to provide sufficient information to the City of Northfield to make decisions regarding the implementation of the most appropriate and most cost-effective energy conservation measures for the City of Northfield.

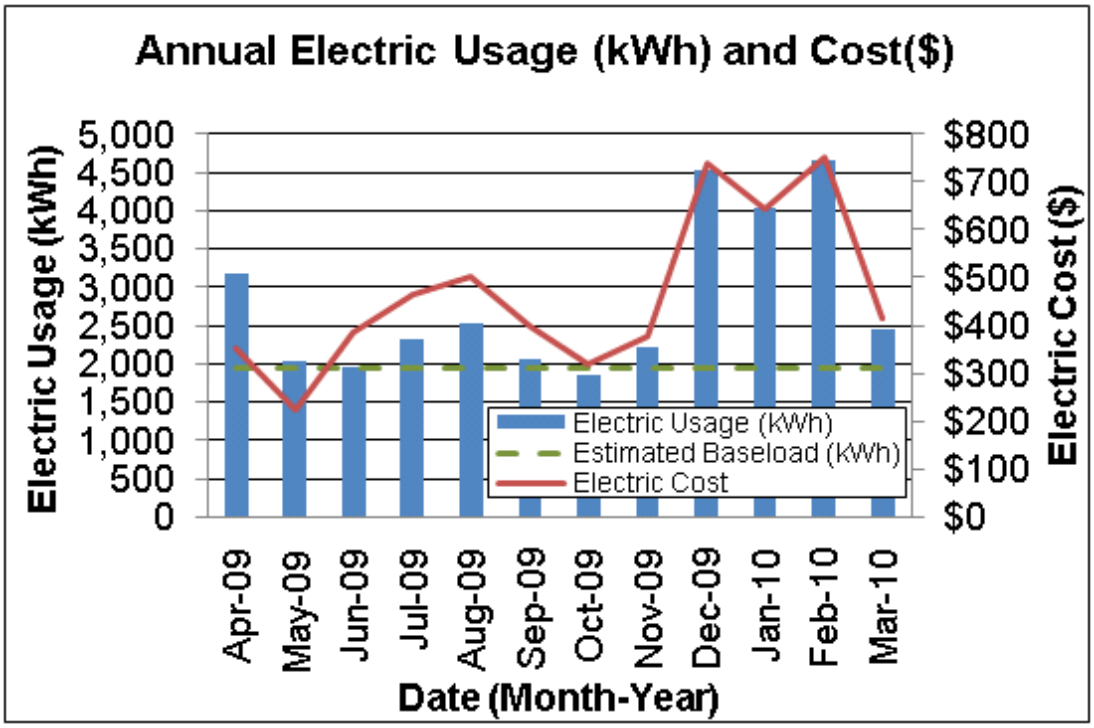
HISTORICAL ENERGY CONSUMPTION

Energy usage, load profile and cost analysis

SWA reviewed utility bills from April 2008 through March 2010 that were received from the utility companies supplying the Northfield Public Works with electric and natural gas. A 12 month period of analysis from April 2009 through March 2010 was used for all calculations and for purposes of benchmarking the building.

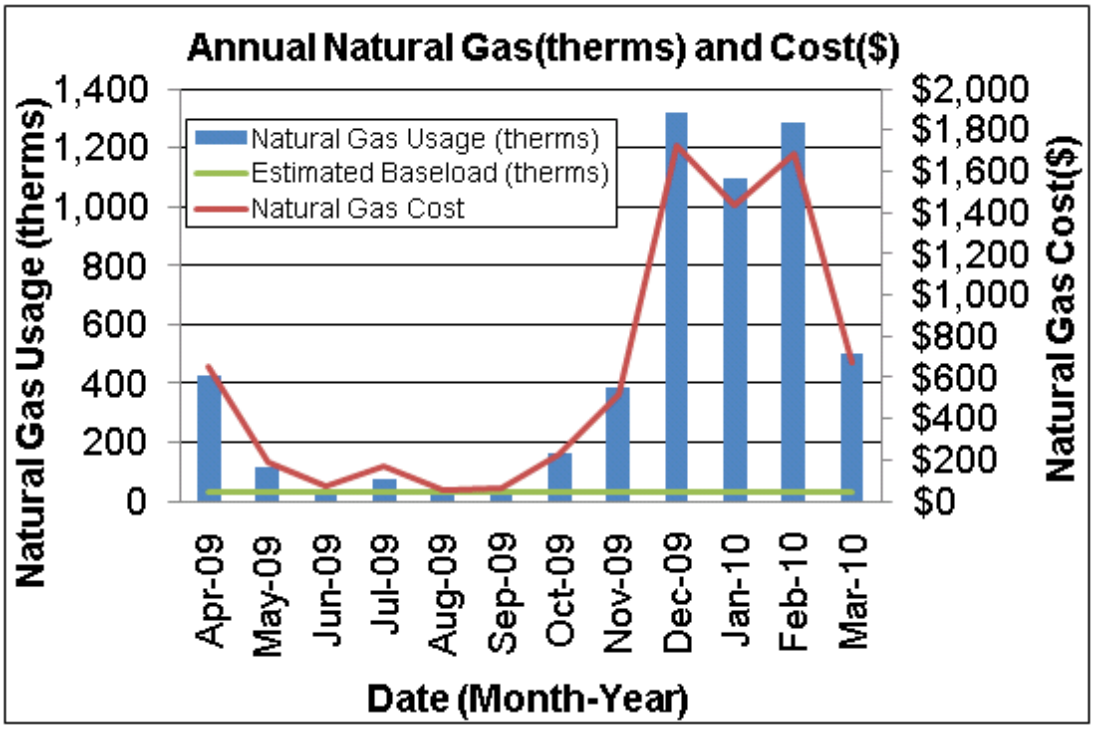
Electricity - The Northfield Public Works is currently served by one electric meter. The Northfield Public Works currently buys electricity from Atlantic City Electric at **an average aggregated rate of $0.165/kWh**. The Northfield Public Works purchased **approximately 33,795 kWh, or $5,573 worth of electricity,** in the previous year. The average monthly demand was 11.6 kW and the annual peak demand was 14.3 kW.

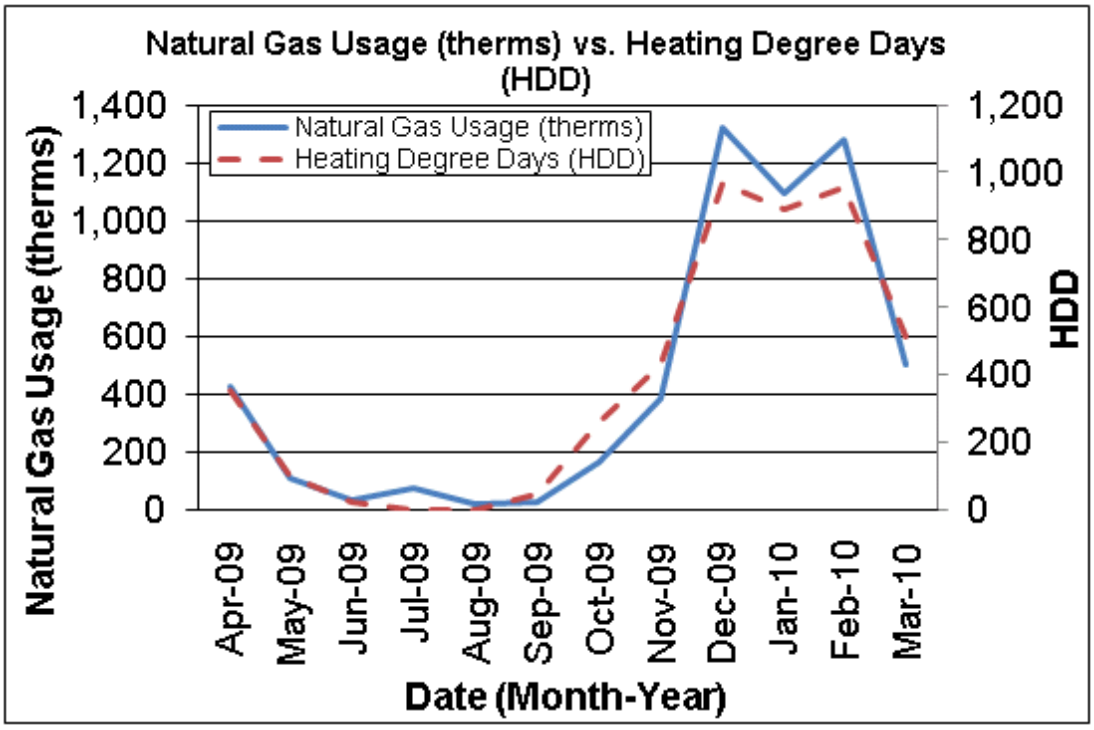
The chart below shows the monthly electric usage and costs. The dashed green line represents the approximate base-load or minimum electric usage required to operate the Northfield Public Works.



Natural gas - The Northfield Public Works is currently served by one meter for natural gas. The Northfield Public Works currently buys natural gas from South Jersey Gas Co. at **an average aggregated rate of $1.366/therm**. The Northfield Public Works purchased **approximately 5,457 therms, or $7,457 worth of natural gas,** in the previous year.

The following chart shows the monthly natural gas usage and costs. The green line represents the approximate base-load or minimum natural gas usage required to operate the Northfield Public Works.

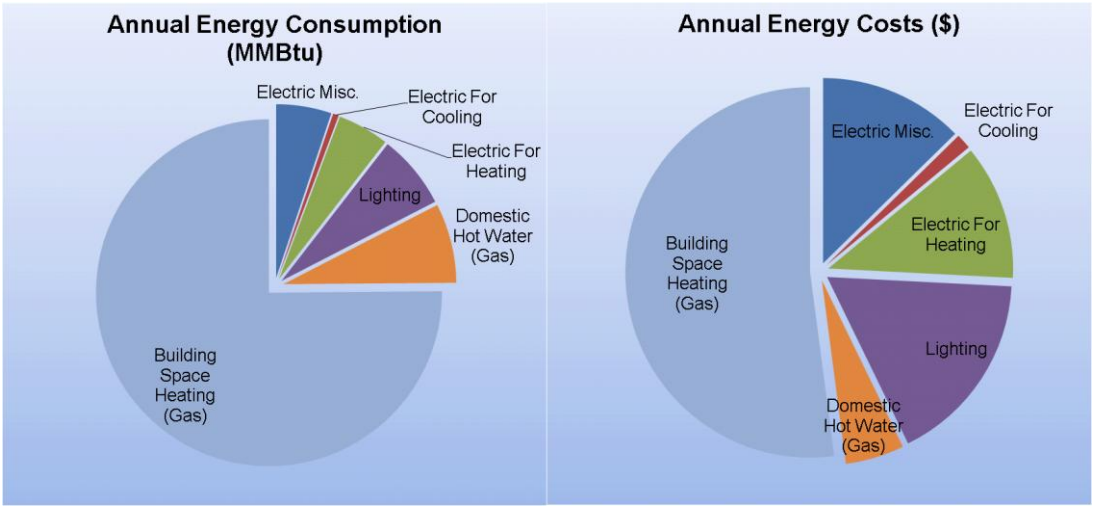




The chart above shows the monthly natural gas usage along with the heating degree days or HDD. Heating degree days is the difference of the average daily temperature and a base temperature, on a particular day. The heating degree days are zero for the days when the average temperature exceeds the base temperature. SWA's analysis used a base temperature of 65 degrees Fahrenheit.

The following graphs, pie charts, and table show energy use for the Northfield Public Works based on utility bills for the 12 month period. Note: electrical cost at $48/MMBtu of energy is more than three times as expensive as natural gas at $14MMBtu

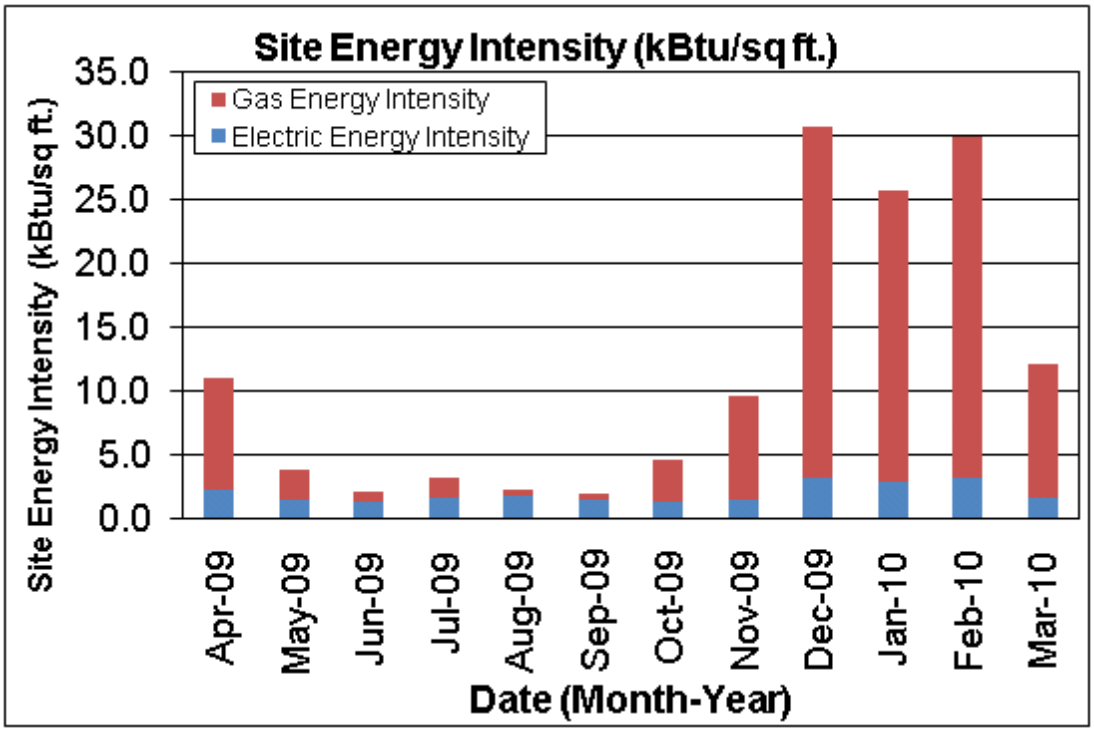
Annual Energy Consumption / Costs					
	MMBtu	% MMBtu	$	% $	$/MMBtu
Electric Miscellaneous	34	5%	$1,652	13%	48
Electric For Cooling	4	1%	$174	1%	48
Electric For Heating	32	5%	$1,537	12%	48
Lighting	46	7%	$2,210	17%	48
Domestic Hot Water (Gas)	49	7%	$671	5%	14
Building Space Heating	497	75%	$6,786	52%	14
Totals	661	100%	$13,030	100%	
Total Electric Usage	115	17%	$5,573	43%	48
Total Gas Usage	546	83%	$7,457	57%	14
Totals	661	100%	$13,030	100%	



Energy benchmarking

SWA has also entered energy information about the Northfield Public Works in the U.S. Environmental Protection Agency's (EPA) ENERGY STAR® Portfolio Manager energy benchmarking system. This service facility is categorized as a non-eligible ("Other") space type. Because it is an "Other" space type, there is no rating available. Consequently, the Northfield Public Works is not eligible to receive a national energy performance rating at this time. The Site Energy Use Intensity is 137.0 kBtu/ft^2-yr compared to the national average of "Other" building consuming 104.0 kBtu/ft^2-yr. See ECM section for guidance on how to improve the building's rating.

Due to the nature of its calculation based upon a survey of existing buildings of varying usage, the national average for "Other" space types is very subjective, and is not an absolute bellwether for gauging performance. Additionally, should the Municipality desire to reach this average there are other large scale and financially less advantageous improvements that can be made, such as envelope window, door and insulation upgrades that would help the building reach this goal.



Per the LGEA program requirements, SWA has assisted the City of Northfield to create an *ENERGY STAR® Portfolio Manager* account and share the Northfield Public Works facilities information to allow future data to be added and tracked using the benchmarking tool. SWA has shared this Portfolio Manager account information with the Municipality (user name of "cityofnorthfield" with a password of "cityofnorthfield") and TRC Energy Services (user name of "TRC-LGEA").

Tariff analysis

As part of the utility bill analysis, SWA evaluated the current utility rates and tariffs. Tariffs are typically assigned to buildings based on size and building type.

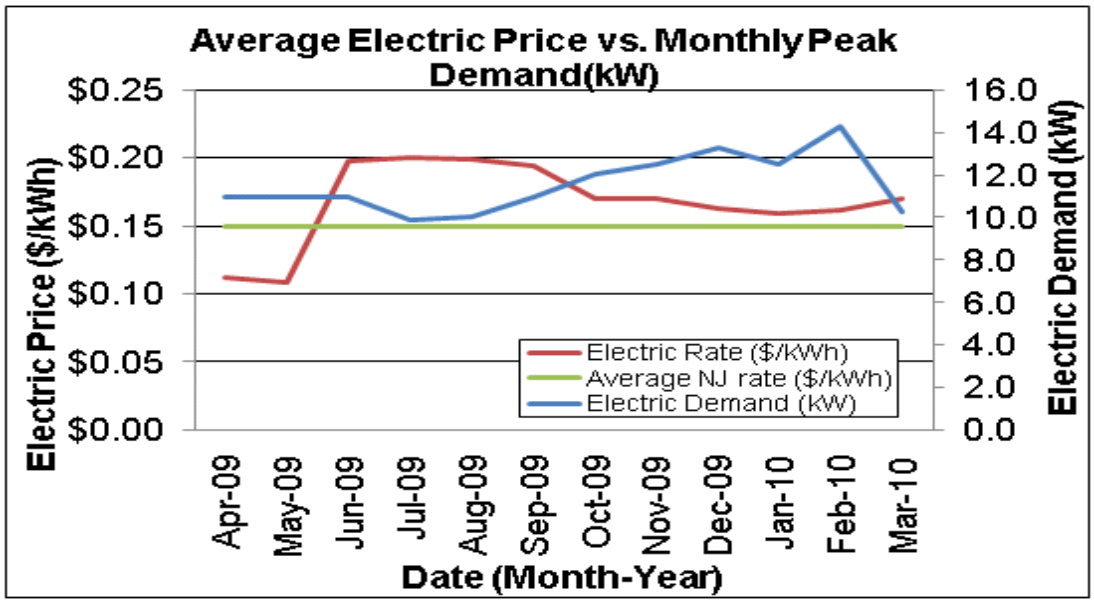
Tariff analysis is performed to determine if the rate that a municipality is contracted to pay with each utility provider is the best rate possible resulting in the lowest costs for electric and gas provision. Typically, the natural gas prices increase during the heating months when natural gas is used by the hot water boiler units. Some high gas price per therm fluctuations in the summer may be due to high energy costs that recently occurred and low use caps for the non-heating months. Typically, electricity prices also increase during the cooling months when electricity is used by the HVAC air conditioning equipment.

The supplier charges a market-rate price based on use, and the billing does not break down demand costs for all periods because usage and demand are included in the rate. Currently, the City of Northfield is paying a general service rate for natural gas. Demand is not broken out in the bill. Thus the building pays for fixed costs such as meter reading charges during the summer months. The building is direct metered and currently purchases electricity at a general service rate for usage with an additional charge for electrical demand factored into each monthly bill. The general service rate for electric charges is market-rate based on usage and demand. Demand prices are reflected in the utility bills and can be verified by observing the price fluctuations throughout the year.

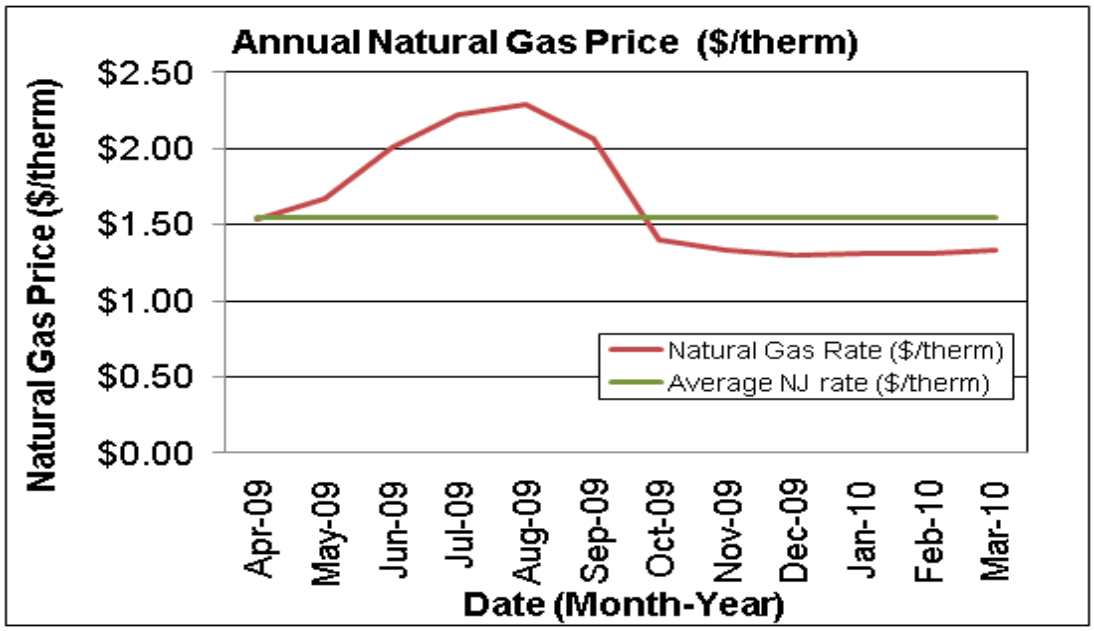
Energy Procurement strategies

Billing analysis is conducted using an average aggregated rate that is estimated based on the total cost divided by the total energy usage per utility per 12 month period. Average aggregated rates do not separate demand charges from usage, and instead provide a metric of inclusive cost per unit of energy. Average aggregated rates are used in order to equitably compare building utility rates to average utility rates throughout the state of New Jersey.

The average estimated NJ commercial utility rates for electric are $0.150/kWh, while Northfield Public Works pays a rate of $0.165/kWh. The Northfield Public Works annual electric utility costs are $504 higher, when compared to the average estimated NJ commercial utility rates. Electric bill analysis shows fluctuations up to 46% over the most recent 12 month period.



The average estimated NJ commercial utility rates for gas are $1.550/therm, while the Northfield Public Works pays a rate of $1.366/therm. Natural gas bill analysis shows fluctuations up to 44% over the most recent 12 month period.



Utility rate fluctuations may have been caused by adjustments between estimated and actual meter readings; others may be due to unusual high and recent escalating energy costs.

SWA recommends that the Northfield Public Works further explore opportunities of purchasing both natural gas and electricity from third-party suppliers in order to reduce rate fluctuation and ultimately reduce the annual cost of energy for the Northfield Public Works. Appendix C contains a complete list of third-party energy suppliers for the City of Northfield service area.

EXISTING FACILITY AND SYSTEMS DESCRIPTION

This section gives an overview of the current state of the facility and systems. Please refer to the Proposed Further Recommendations section for recommendations for improvement.

Based on visits from SWA on Tuesday, June 01, 2010, the following data was collected and analyzed.

Building Characteristics

The Northfield Public Works is a single-story building, without basement, comprising a total conditioned floor area of 4,824 square feet. The original structure was built in 1938 with the Mechanics' Bay added in 1969. It houses two garage spaces, storage rooms and offices.

Partial South Façade


Partial North Façade


Partial East Façade


Partial West Façade

Building Occupancy Profiles

Its occupancy is approximately six employees daily during weekdays from 7:30 AM to 3:30 PM.

Building Envelope

Due to unfavorable weather conditions (min. 18 deg. F delta-T in/outside and no/low wind), no exterior envelope infrared (IR) images were taken during the field audit.

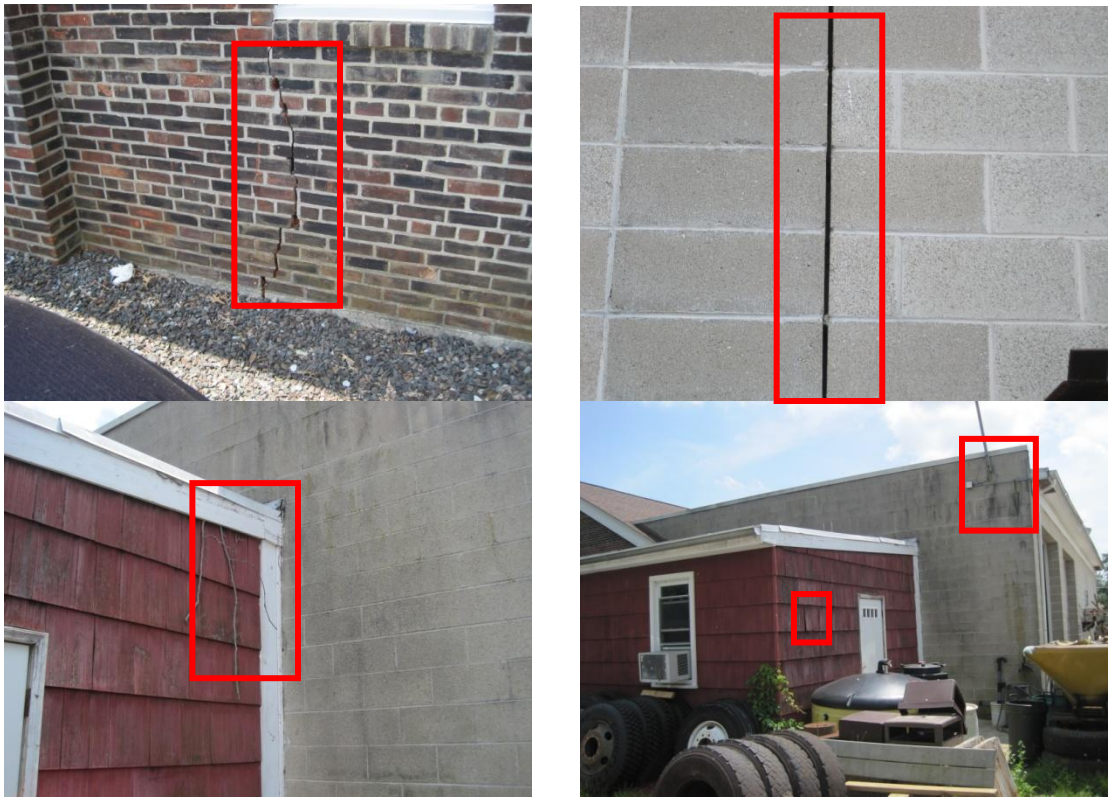
Exterior Walls

The exterior wall envelope is mostly constructed of exposed CMU (Concrete Masonry Unit) and some concrete block. Other areas are constructed of some wood clapboard siding accents, over 3-1/2" framing with no assumed insulation. The interior is mostly unfinished exposed CMU (Concrete Masonry Unit) and exposed concrete block, as well as some unfinished gypsum wall board.

Note: Wall insulation levels could not be verified in the field or on construction plans, and are based upon similar wall types and time of construction.

Exterior and interior wall surfaces were inspected during the field audit. They were found to be in overall acceptable, age-appropriate condition with some signs of uncontrolled moisture, air-leakage and other energy-compromising issues detected on all facades.

The following specific exterior wall problem spots and areas were identified:



Cracked/aged caulk, damaged shingles and brick, overgrown vegetation and signs of water damage

Roof

The building's roof is predominantly a medium-pitch gable type over a wood structure, with a asphalt shingle finish. It was installed in 1969 and re-shingled last year and has no assumed roof insulation. Other parts of the building are also covered by a flat, no parapet type over wood decking with a built-up asphalt finish and no assumed roof insulation. There is also a low-pitch shed type over a wood structure, with a built-up asphalt finish.

Note: Roof insulation levels could not be verified in the field, and are based on reports from building management.

Roofs, related flashing, gutters and downspouts were inspected during the field audit. They were reported to be in overall acceptable, age-appropriate condition, with only a few signs of uncontrolled moisture, air-leakage or other energy-compromising issues detected on all roof areas.

The following specific roof problem spots were identified:


Typical Roof Surfaces. Water pooling on the flat roof

Base

The building's base is composed of a slab-on-grade floor with a perimeter foundation and no detectable slab edge/perimeter insulation.

Slab/perimeter insulation levels could not be verified in the field or on construction plans, and are based upon similar wall types and time of construction.

The building's base and its perimeter were inspected for signs of uncontrolled moisture or water presence and other energy-compromising issues. Overall the base was reported to be in good/age appropriate condition with no signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues.

Windows

The building contains predominantly one type of window.

1. Double-hung type windows with a vinyl clad frame, clear double glazing, not Low-E and no interior or exterior shading devices. The windows are located throughout the building.

Windows, shading devices, sills, related flashing and caulking were inspected as far as accessibility allowed for signs of moisture, air-leakage and other energy compromising issues. Overall, the windows were found to be in good/ age appropriate condition with only a few signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues.

The following specific window problem spots were identified:

Cracked or aged caulk around frame/sill on the exterior, exterior water damage signs on areas around windows, exposed lintels creating a thermal bridge and air-leakage at sleeved window/wall air-conditioning units

Exterior doors

The building contains several different types of exterior doors.

1. Solid metal type exterior doors. They are located in the front of the building.
2. Wood type exterior doors. They are located at the entrance to the shed.
3. Overhead type metal exterior doors with glass panels. They are located on the south and west side of the building

All exterior doors, thresholds, related flashing, caulking and weather-stripping were inspected for signs of moisture, air-leakage and other energy-compromising issues. Overall, the doors were found to be in acceptable/age appropriate condition with only a few signs of uncontrolled moisture, air-leakage and/or other energy-compromising issues.

The following specific door problem spots were identified:

Missing/worn weather-stripping and damaged door frame

Building air-tightness

Overall the field auditors found the building not adequately air-tight which is consistent with the building's use and occupancy, as described in more detail earlier in this chapter.

The air tightness of buildings helps maximize all other implemented energy measures and investments, and minimizes potentially costly long-term maintenance, repair and replacement expenses.

Mechanical Systems

Heating Ventilation Air Conditioning

The building is primarily conditioned by three (3) ceiling hung Modine gas fired heaters, two (2) in the Vehicle Maintenance shop and one in the Mechanics' Bay. There are electric baseboard heaters in the Vehicle shop office and two (2) window air conditioners in each of the two offices. There is one (1) 18" wall fan in the Vehicle Maintenance shop. All temperature control is via manual thermostats.

Equipment

Each of the two (2) Modine gas fired heaters in the Vehicle Maintenance shop have 150,000 Btu/hr input and 120,000 Btu/hr output capacity, or an 80% thermal efficiency. They were installed in 1973 and are operating beyond their expected service lives. The one (1) Modine gas fired heater in the Mechanics' Bay has 130,000 Btu/hr input and 104,000 Btu/hr output capacity, or an 80% thermal efficiency. It was also installed in 1973 and is operating beyond its expected service life. The Public Works should consider replacements with ceiling hung gas fired infrared heaters of greater than 95% thermal efficiency. Infrared heat is considered the most comfortable and economical method for warming a garage. Infrared garage heaters only heat objects and people (not the air). If one stands underneath the radiant heater, one will be warmed, regardless of what's going on around them.


Modine gas fired heater in the Mechanics' Bay; Baseboard electric heat - Vehicle shop office

There are two (2) electric baseboard heaters in the Vehicle shop office. They have integral knob operated thermostats on them, are in fair condition and operating beyond their expected service lives.

The Vehicle shop and Public Works offices are each cooled by window mounted air conditioners of low efficiency, 9.0-9.8 EER (Btu/hr-Watt). The AC in the Public Works offices is newer and has approximately 70% expected service life left. The AC in the Vehicle shop is operating beyond its expected service life. Energy Star rated window units are now available with EER of 11 and mini split ductless systems have EER of 15.


Public Works office window AC; Vehicle Maintenance shop wall exhaust fan

There is a small exhaust fan in the bathroom and one (1) 18" Patton wall exhaust fan in the Vehicle Maintenance shop. Its outside louvers are stuck semi-open. The fan is operated by a fractional horsepower motor and is beyond its expected service life.

Distribution Systems

There isn't any heating/cooling distribution ducting in the Public Works building. All heating/cooling is conveyed by fans/blowers integral to heating/cooling equipment.

Controls

The ceiling hung gas fired units are controlled by manual thermostats. One thermostat in the Vehicle Maintenance shop controlling the forward heater is located on the outer west wall

and should be located on an inner garage column for better temperature representation. The garage thermostats are generally set at 60 deg F. Programmable thermostats should be considered for improved and efficient space temperature control.

Vehicle Maint. shop thermostat; Vehicle Maint. office baseboard heat thermostat

Domestic Hot Water

There is one (1) 30-gallon Bradford White domestic hot water (DHW) heater, 30,000 Btu/hr input capacity, located next to the bathroom which serves the bathroom sink and area counter sink. It was installed in 1993 and is operating beyond its expected service life left. The distribution piping should be insulated to deliver hot water readily to the sink taps. The Public Works should consider replacing this unit with a gas fired condensing type DHW heater of approximately 95% efficiency.

DHW heater and associated un-insulated piping

Electrical systems

Lighting

See attached lighting schedule in Appendix B for a complete inventory of lighting throughout the building including estimated power consumption and proposed lighting recommendations.

As of July 1, 2010 magnetic ballasts most commonly used for the operation of T12 lamps will no longer be produced for commercial and industrial applications. Also, many T12 lamps will be phased out of production starting July 2012.

Interior Lighting - The Northfield Public Works currently contains mostly inefficient fixtures with magnetically ballasted T12 lights, and self-ballasted incandescent bulbs. Based on measurements of lighting levels for each space, there are no vastly over-illuminated areas.

Exterior Lighting - The exterior lighting surveyed during the building audit was found to be a mix of Metal Halide lamp, incandescent and CFL fixtures. Exterior lighting is controlled by photocells.

Appliances and process

SWA has conducted a general survey of larger, installed equipment. Appliances and other miscellaneous equipment account for a significant portion of electrical usage within the building. Typically, appliances are referred to as “plug-load” equipment, since they are not inherent to the building’s systems, but rather plug into an electrical outlet. Equipment such as process motors, computers, computer servers, radio and dispatch equipment, refrigerators, vending machines, printers, etc. all create an electrical load on the building that is hard to separate out from the rest of the building’s energy usage based on utility analysis.

Elevators

The Northfield Public Works does not have an installed elevator.

Other electrical systems

There are not currently any other significant energy-impacting electrical systems installed at the Northfield Public Works.

Three refrigerators were installed at the Northfield Public Works Building. One of the refrigerators is a large residential unit and the other two are small compact units. All of them are older model units and should be replaced with ENERGY STAR® labeled units. There is also a refrigerated vending machine installed at the building as well as an older model Kenmore manufactured electric dryer, model # 86983110.

Existing electric dryer and refrigerated vending machine

RENEWABLE AND DISTRIBUTED ENERGY MEASURES

Renewable energy is defined as any power source generated from sources which are naturally replenished, such as sunlight, wind and geothermal. Technology for renewable energy is improving, and the cost of installation is decreasing, due to both demand and the availability of state and federal government-sponsored funding. Renewable energy reduces the need for using either electricity or fossil fuel, therefore lowering costs by reducing the amount of energy purchased from the utility company. Technology such as photovoltaic panels or wind turbines, use natural resources to generate electricity on the site. Geothermal systems offset the thermal loads in a building by using water stored in the ground as either a heat sink or heat source. Solar thermal collectors heat a specified volume of water, reducing the amount of energy required to heat water using building equipment. Cogeneration or CHP allows you to generate electricity locally, while also taking advantage of heat wasted during the generation process.

Existing systems

Currently there are no renewable energy systems installed in the building.

Evaluated Systems

Solar Photovoltaic

Photovoltaic panels convert light energy received from the sun into a usable form of electricity. Panels can be connected into arrays and mounted directly onto building roofs, as well as installed onto built canopies over areas such as parking lots, building roofs or other open areas. Electricity generated from photovoltaic panels is generally sold back to the utility company through a net meter. Net-metering allows the utility to record the amount of electricity generated in order to pay credits to the consumer that can offset usage and demand costs on the electric bill. In addition to generation credits, there are incentives available called Solar Renewable Energy Credits (SRECs) that are subsidized by the state government. Specifically, the New Jersey State government pays a market-rate SREC to facilities that generate electricity in an effort to meet state-wide renewable energy requirements.

Based on utility analysis and a study of roof conditions, the Northfield Public Works is a good candidate for a 20 kW Solar Panel installation. See ECM#11 for details.

Solar Thermal Collectors

Solar thermal collectors are not cost-effective for this building and would not be recommended due to the insufficient and intermittent use of domestic hot water throughout the building to justify the expenditure.

Geothermal

The Northfield Public Works is not a good candidate for geothermal installation since it would require a major installation and replacement of the entire existing HVAC system with a payback in excess of 20 years.

Combined Heat and Power

The Northfield Public Works is not a good candidate for CHP installation and would not be cost-effective due to the size and operations of the building. Typically, CHP is best suited for buildings with a high electrical base-load to accommodate the electricity generated, as well as a means for using waste heat generated. Typical applications include buildings with an absorption chiller, where waste heat would be used efficiently.

PROPOSED ENERGY CONSERVATION MEASURES

Energy Conservation Measures (ECMs) are recommendations determined for the building based on improvements over current building conditions. ECMs have been determined for the building based on installed cost, as well as energy and cost-savings opportunities.

Recommendations: Energy Conservation Measures

ECM#	Description of Recommended 0-5 Year Payback ECMs
1	Upgrade Space Temperature Control with Four (4) Programmable Thermostats
2	Install Two (2) New CFL Fixtures
3	Retrofit One (1) Refrigerated Vending Machines with VendingMiser™ Device
4	Replace Three (3) Old Ceiling Hung Gas Fired Heaters with Infrared ENERGY STAR® Efficient Models
ECM#	**Description of Recommended 5-10 Year Payback ECMs**
5	Install Two (2) New Pulse Start Metal Halide Fixtures
6	Replace One (1) Large Refrigerator with a 17 cu. ft. ENERGY STAR® Model
7	Replace Two (2) Compact Refrigerators with 2.7 cu. ft. ENERGY STAR® Models
8	Replace One (1) Standard Efficiency Natural Gas DHW Heater with ENERGY STAR® Natural Gas Condensing Type
9	Replace One (1) Window Air Conditioning Unit with ENERGY STAR® Efficient Type
10	Install Twenty-eight (28) New T8 Fluorescent Fixtures
ECM#	**Description of Recommended Renewable ECMs**
11	Install a 20 kW Solar Photovoltaic Rooftop System

Note: In order to clearly present the overall energy opportunities for the building and ease the decision and choice of which ECM to implement, SWA calculated each ECM independently and did not incorporate slight/potential interactions between some of the listed ECM retrofits (i.e. lighting change influence on heating/cooling).

ECM#1: Upgrade Space Temperature Control with Four (4) Programmable Thermostats

During the field audit, SWA completed a building HVAC controls analysis and observed spaces in the building where temperature is manually controlled without setbacks to reduce energy consumption during unoccupied periods of time, such as evenings and weekends. Programmable thermostats offer an easy way to save energy when correctly used. By turning the thermostat setback 10-15 degrees F for eight hours at a stretch (at night), the heating bill can be reduced substantially (by a minimum of 10% per year). In the summer, the cooling bill can be reduced by keeping the conditioned space warmer when unoccupied, and cooling it down only when using the space. The savings from using a programmable thermostat is greater in milder climates than in more extreme climates. The labor for the recommended installations is evaluated using prevailing electrical contractor wages. The building owner may decide to perform this work with in-house resources from the Maintenance Department on a scheduled, longer timeline than otherwise performed by a contractor.

Installation cost:

Estimated installed cost: $668 (includes $301 of labor)
Source of cost estimate: RS Means; Published and established costs; Similar projects

Economics:

ECM #	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
1	668	none at this time	668	932	0.3	497	11.0	1,167	1,999	12	23,985	0.3	3,491	291	299	18,404	7,143

Assumptions: SWA calculated the savings for this measure using measurements taken during the field audit and using the billing analysis. SWA also assumed an aggregated 40 min/wk to make manual adjustments vs. an installed programmable thermostat. SWA assumed that temperatures would be setback based on the operation schedule of the building and used Energy Star site: http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=TH, Excel spreadsheet for Savings Calculator as well as assumed a conservative 1/2% savings of heating/cooling loads when systems are operating per pre-agreed settings.

Rebates/financial incentives:

- There is no incentive available for this measure at this time.

Please see Appendix F for more information on Incentive Programs.

ECM#2: Install Two (2) New CFL Fixtures

On the day of the site visit, SWA completed a lighting inventory of the City of Northfield Public Works (see Appendix B). The existing lighting inventory contained a total of 2 inefficient incandescent lamps. SWA recommends that each incandescent lamp is replaced with a more efficient, Compact Fluorescent Lamp (CFL). CFLs are capable of providing equivalent or better light output while using less power.

Installation cost:

Estimated installed cost: $52 (includes $32 of labor)
Source of cost estimate: RS Means; Published and established costs, NJ Clean Energy Program

Economics:

ECM #	Net est. cost with incentives, $	kWh, 1st year savings	kW, demand reduction	therms, 1st year savings	kBtu/sq ft, 1st year savings	Est. operating cost, 1st year savings, $	Total 1st year savings, $	Life of measure, years	Est. lifetime energy cost savings, $	Simple payback, years	Lifetime return-on-investment, %	Annual return-on-investment, %	Internal rate of return, %	Net present value, $	CO_2 reduced, lbs/year
2	52	326	0.1	0	0.2	97	151	5	754	0.3	1,359	272	291	635	584

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis.

Rebates/financial incentives:

- There is no incentive available for this measure at this time.

Please see Appendix F for more information on Incentive Programs.

ECM#3: Retrofit One (1) Refrigerated Vending Machines with VendingMiser™ Device

A simple plug and play device the VendingMiser™ device is compatible with refrigerated vending machines. It utilizes Passive Infrared Sensors (PIR) to help the vending machine save power. This unit is to be installed on the existing refrigerated vending machines. See Appendix G for more detail.

Installation cost:

Estimated installed cost: $199 (Includes $20 of labor)
Source of cost estimate: Manufacturers information

Economics:

ECM #	Net est. cost with incentives, $	kWh, 1st year savings	kW, demand reduction	therms, 1st year savings	kBtu/sq ft, 1st year savings	Est. operating cost, 1st year savings, $	Total 1st year savings, $	Life of measure, years	Est. lifetime energy cost savings, $	Simple payback, years	Lifetime return-on-investment, %	Annual return-on-investment, %	Internal rate of return, %	Net present value, $	CO_2 reduced, lbs/year
3	199	555	0.1	0	0.4	0	92	15	1,374	2.2	590	39	46	879	994

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis. Average weekly operating hours = 40.

Rebates/financial incentives:

- There is no incentive available for this measure at this time.

Please see Appendix F for more information on Incentive Programs.

ECM#4: Replace Three (3) Old Ceiling Hung Gas Fired Heaters with Infrared ENERGY STAR® Efficient Models

During the field audit, SWA inspected old ceiling hung gas fired heaters which were not Energy Star rated, nor high efficiency models. SWA recommends the replacement of existing old and inefficient heaters.

The standard hanging garage heater is designed for a garage with limited working spaces. This type of heater can be attached or suspended in the garage ceiling or they can be fixed to a sidewall. Using the least amount of floor space, these hanging units can save more space and can provide added mobility when personnel is working. Some of the beneficial features of a hanging heater include simplistic and stable mounting to the ceiling or wall, and an eye catching and decorative way to supply comfortable heat to your workspace. Generally, an integral fan in the back of the heater pushes air through the gas heating area to generate space heat.

SWA recommends replacement with ceiling mounted infrared gas fired heaters. Gas fired infrared heaters are sometimes called mini suns because they rely on gas consumption to generate heat. Infrared heat warms people and objects at occupancy level, not the air in the room. This is a major advantage because warmed air rises to the ceiling where it is not needed, and wastes the fuel dollars spent to heat it. Most infrared heaters employ gas combustion to heat a steel tube (tube heater) or ceramic surface (luminous (high intensity) heater), which subsequently emits infrared heat. It's important to note how much infrared heat is emitted. An infrared heater produces both infrared radiant heat (that is directed at people and objects) and convection heat that rises and is for the most part lost. Even so, these infrared heaters generally have efficiencies greater than 90%.

Installation cost:

Estimated installed cost: $4,050 (includes $ 1,185 of labor)
Source of cost estimate: Manufacturer and Store established costs, NJ Clean Energy Program, Similar Projects

Economics (with incentives):

ECM #	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
	Replace 3 old 80% efficient garage gas fired heaters - 130-150 MBH input in kind																
	3,900	0	3,900	0	0.0	0	0.0	70	70	20	1,400	55.7	-64	-3	-8	-2,788	0
	Incremental difference to replace 3 old 80% efficient ceiling hung gas fired heaters with Infrared gas fired heaters																
	1,050	900	150	932	0.3	596	13.0	0	968	20	19,356	0.2	12,804	640	645	13,552	8,237
	Replace 3 old 80% efficient garage gas fired heaters - with 90% efficient Infrared gas fired heaters																
4	**4,950**	**900**	**4,050**	**932**	**0.3**	**596**	**13.0**	**70**	**1,038**	**20**	**20,756**	**3.9**	**412**	**21**	**25**	**10,764**	**8,237**

Assumptions: SWA calculated the savings for this measure using measurements taken during the field audit and using the billing analysis. In order to estimate savings for this measure, SWA assumed in the model an energy reduction based on the difference in efficiencies of existing vs. the proposed equipment. SWA also assumed that the existing unit requires additional annual repairs vs. a new heater.

Rebates/financial incentives:

- NJ Clean Energy - SmartStart - Gas Furnace ($300 per furnace, >92% AFUE) - Maximum incentive amount is $900.

Please see Appendix F for more information on Incentive Programs.

ECM#5: Install Two (2) New Pulse Start Metal Halide Fixtures

On the day of the site visit, SWA completed a lighting inventory of the City of Northfield Public Works (see Appendix B). The existing lighting inventory contained two inefficient metal halide fixtures. SWA recommends replacing them with more efficient, Pulse Start Metal Halide fixtures with electronic ballasts. Pulse Start Metal Halide fixtures with electronic ballasts provide equivalent or better light output while reducing energy consumption by 30% when compared to metal halide or high pressure sodium fixtures. .

Installation cost:

Estimated installed cost: $2,360 (includes $520 of labor)
Source of cost estimate: RS Means; Published and established costs, NJ Clean Energy Program

Economics:

ECM #	Net est. cost with incentives, $	kWh, 1st year savings	kW, demand reduction	therms, 1st year savings	kBtu/sq ft, 1st year savings	Est. operating cost, 1st year savings, $	Total 1st year savings, $	Life of measure, years	Est. lifetime energy cost savings, $	Simple payback, years	Lifetime return-on-investment, %	Annual return-on-investment, %	Internal rate of return, %	Net present value, $	CO_2 reduced, lbs/year
5	2,360	1,857	0.4	0	1.3	43	349	15	5,241	6.8	122	8	12	1,752	3,325

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis. SWA also assumed an aggregated 1 hr/yr to replace aging burnt out lamps vs. newly installed.

Rebates/financial incentives:

- NJ Clean Energy - Smart Start - Pulse Start Metal Halide Fixtures ($25 per fixture)

Please see Appendix F for more information on Incentive Programs.

ECM#6: Replace One (1) Large Refrigerator with a 17 cu. ft. ENERGY STAR® Model

On the day of the site visit, SWA observed that there was an older refrigerator, 17 cu. ft. model in the building which was not Energy Star rated (using approximately 773 kWh/year). Appliances, such as refrigerators, that are over 10 years of age should be replaced with newer efficient models with the Energy Star label. SWA recommends the replacement of the existing refrigerator with a 17 cu. ft. top freezer ENERGY STAR® refrigerator. Besides saving energy, the replacement will also keep their surroundings cooler. When compared to the average electrical consumption of older equipment, Energy Star equipment results in large savings. Look for the Energy Star label when replacing appliances and equipment, including: window air conditioners, refrigerators, printers, computers, copy machines, etc. More information can be found in the "Products" section of the Energy Star website at: http://www.energystar.gov.

Installation cost:
Estimated installed cost: $525 (Includes $50 in labor cost)
Source of cost estimate: Manufacturer and Store established costs

Economics:

ECM #	Net est. cost with incentives, $	kWh, 1st year savings	kW, demand reduction	therms, 1st year savings	kBtu/sq ft, 1st year savings	Est. operating cost, 1st year savings, $	Total 1st year savings, $	Life of measure, years	Est. lifetime energy cost savings, $	Simple payback, years	Lifetime return-on-investment, %	Annual return-on-investment, %	Internal rate of return, %	Net present value, $	CO_2 reduced, lbs/year
6	525	425	0.1	0	0.3	0	70	15	1,052	7.5	100	7	10	300	761

Assumptions: SWA calculated the savings for this measure using measurements taken the day of the field visit and using the billing analysis aggregate utility rate.

Rebates/financial incentives:

- There is no incentive available for this measure at this time.

Please see Appendix F for more information on Incentive Programs.

ECM#7: Replace Two (2) Compact Refrigerators with 2.7 cu. ft. ENERGY STAR® Models

On the day of the site visit, SWA observed that there were two older 2.7 cu. ft. model refrigerators that are not ENERGY STAR® rated (using approximately 254 kWh/year). Appliances, such as refrigerators, that are over 10 years of age should be replaced with newer efficient models with the Energy Star label. SWA recommends the replacement of the older model compact refrigerators with a 2.7 cf. ft. ENERGY STAR® model or equivalent. Besides saving energy, the replacement will also keep their surroundings cooler. When compared to the average electrical consumption of older equipment, Energy Star equipment results in large savings. Look for the Energy Star label when replacing appliances and equipment, including: window air conditioners, refrigerators, printers, computers, copy machines, etc. More information can be found in the "Products" section of the Energy Star website at: http://www.energystar.gov.

Installation cost:

Estimated installed cost: $198 (Includes $45 in labor cost)
Source of cost estimate: Manufacturer and Store established costs

Economics:

ECM #	Net est. cost with incentives, $	kWh, 1st year savings	kW, demand reduction	therms, 1st year savings	kBtu/sq ft, 1st year savings	Est. operating cost, 1st year savings, $	Total 1st year savings, $	Life of measure, years	Est. lifetime energy cost savings, $	Simple payback, years	Lifetime return-on-investment, %	Annual return-on-investment, %	Internal rate of return, %	Net present value, $	CO_2 reduced, lbs/year
7	198	160	0.0	0	0.1	0	26	15	396	7.5	100	7	10	113	286

Assumptions: SWA calculated the savings for this measure using measurements taken the day of the field visit and using the billing analysis aggregate utility rate.

Rebates/financial incentives:

- There is no incentive available for this measure at this time.

Please see Appendix F for more information on Incentive Programs.

ECM#8: Replace One (1) Standard Efficiency Natural Gas DHW Heater with ENERGY STAR® Natural Gas Condensing Type

During the field audit, SWA inspected the existing Domestic Hot Water (DHW) heater. There is one standard efficiency heater that produces DHW for the entire year. The water heater utilizes an external storage tank. The expected service life of a DHW heater is 10-13 years. Consideration should be given to replace the existing heater, which is operating beyond its expected service life, with a more efficient type and tank as part of a capital improvement plan.

The most efficient DHW systems available are generally gas-fired. The estimated Energy Factor (a measure of overall efficiency) for the existing heater is 0.63.

The capacity of a water heater is an important consideration. The water heater should provide enough hot water at the busiest time of the day. For a storage water heater, this capacity is indicated by its "first hour rating" (found on Energy Guide label alongside efficiency rating) which accounts for the effects of tank size and the speed by which cold water is heated.

DHW heaters range in size from 20 to 80 gallons (or larger) and fueled by electricity, natural gas, propane, or oil, storage water heaters transfer heat from a burner or coil to water in an insulated tank. Because heat is lost through the flue (except in electric models) and through the walls of the storage tank, energy is consumed even when no hot water is being used.

New energy-efficient gas-fired storage water heaters are a good, cost-effective replacement option for old water heaters. They have higher levels of insulation around the tank and one-way valves where pipes connect to the tank, substantially reducing standby heat loss. Newer super-efficient "condensing" and "near-condensing" gas water heaters save much more energy compared to traditional models. For safety as well as energy efficiency, fuel-burning water heaters should be installed with sealed combustion ("direct-vented" or "power-vented). Sealed combustion means that outside air is brought in directly to the water heater and exhaust gases are vented directly outside, keeping combustion totally separate from the house air.

Installation cost:

Estimated installed cost: $2,100 (includes $623 of labor)
Source of cost estimate: Manufacturer and Store established costs, NJ Clean Energy Program, Similar Projects

Economics (with incentives):

ECM #	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
	Replace 1 existing standard efficiency natural gas DHW heater in kind																
	650	0	650	0	0.0	25	0.5	50	84	12	1,002	7.8	54	5	7	166	271
	Incremental difference to replace 1 existing std efficiency gas DHW heater with an Energy Star gas condensing model																
	1,500	50	1,450	0	0.0	133	2.7	0	181	12	2,173	8.0	50	4	7	321	1,461
	Replace 1 standard efficiency natural nas DHW heater with Energy Star natural gas condensing model																
8	**2,150**	**50**	**2,100**	**0**	**0.0**	**157**	**3.3**	**50**	**265**	**12**	**3,176**	**7.9**	**51**	**4**	**7**	**487**	**1,732**

Assumptions: SWA calculated the savings for this measure using measurements taken during the field audit and using the billing analysis. SWA assumed annual labor and parts insurance for existing DHW heater. The estimated overall efficiency of the existing DHW is in the 58% range (estimating 5% degradation), and a new high efficiency DHW heater would operate with an overall efficiency of approximately 90%.

Rebates/financial incentives:

- NJ Clean Energy - SmartStart - Gas Water Heaters <50 gal ($50 per water heater) - Maximum incentive amount is $50

Please see Appendix F for more information on Incentive Programs.

ECM#9: Replace One (1) Window Air Conditioning Unit with ENERGY STAR® Efficient Type

During the field audit, SWA completed the building HVAC equipment inventory and observed spaces cooled by window air conditioning units. Room air conditioners (sometimes referred to as window air conditioners) cool rooms rather than the entire building. If they provide cooling only where they're needed, room air conditioners are less expensive to operate than central units, even though their efficiency is generally lower than that of central air conditioners. A room air conditioner features a condenser on the end that faces the outside and a condenser fan behind it that blows air through it, helping to remove the heat from the condenser. On the end facing the room is the evaporator, with an evaporator fan behind that to push the cool air into the room. The filter is mounted in the front grill. When buying a new room air conditioner, look for units with an EER of 10.0 or above. Check the EnergyGuide label for the unit, and also look for room air conditioners with the ENERGY STAR® label. The labor for the recommended installations is evaluated using prevailing mechanical/electrical contractor wages. The building owner may decide to perform this work with in-house resources from the Maintenance Department on a scheduled, longer timeline than otherwise performed by a contractor. The Maintenance office window AC is operating beyond its expected service life.

The main office window AC is operating beyond its expected service life.

Installation cost:

Estimated installed cost: $570 (includes $70 of labor)
Source of cost estimate: RS Means, Published and established costs, NJ Clean Energy Program, Similar projects

Economics (with incentives):

ECM #	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
9	570	none at this time	570	224	0.1	0	0.2	35	72	15	1,079	7.9	89	6	9	268	401

Assumptions: SWA calculated the savings for this measure using measurements taken during the field audit and using the billing analysis. SWA also used Energy Star site: http://www.energystar.gov/index.cfm?c=bulk_purchasing.bus_purchasing , Excel spreadsheet for Room Air Conditioners Savings Calculator.

Rebates/financial incentives:

- There are currently no incentives for this measure at this time.

Please see Appendix F for more information on Incentive Programs.

ECM#10: Install Twenty-eight (28) New T8 Fluorescent Fixtures

On the day of the site visit, SWA completed a lighting inventory of the City of Northfield Public Works (see Appendix B). The existing lighting inventory contained twenty-eight inefficient T12 fluorescent fixtures with magnetic ballasts. SWA recommends replacing each existing fixture with more efficient T8 fluorescent fixtures with electronic ballasts. T8 fixtures with electronic ballasts provide equivalent or better light output while reducing energy consumption by 30% when compared to a T12 fixture with magnetic ballast.

Installation cost:

Estimated installed cost: $4,943 (includes $1,226 of labor)
Source of cost estimate: RS Means; Published and established costs, NJ Clean Energy Program

Economics:

ECM #	Net est. cost with incentives, $	kWh, 1st year savings	kW, demand reduction	therms, 1st year savings	kBtu/sq ft, 1st year savings	Est. operating cost, 1st year savings, $	Total 1st year savings, $	Life of measure, years	Est. lifetime energy cost savings, $	Simple payback, years	Lifetime return-on-investment, %	Annual return-on-investment, %	Internal rate of return, %	Net present value, $	CO_2 reduced, lbs/year
10	4,943	2,499	0.5	0	1.8	180	592	15	8,881	8.3	80	5	8	2,023	4,475

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis. SWA also assumed an aggregated 4 hrs/yr to replace aging burnt out lamps vs. newly installed.

Rebates/financial incentives:

- NJ Clean Energy - Smart Start - T8 fixtures with electronic ballasts ($15 per fixture)

Please see Appendix F for more information on Incentive Programs.

ECM#11: Install a 20 kW Solar Photovoltaic Rooftop System

Currently, the building does not use any renewable energy systems. Renewable energy systems such as photovoltaic (PV) panels can be mounted on the building roof facing south which can offset a portion of the purchased electricity for the building. Power stations generally have two separate electrical charges: usage and demand. Usage is the amount of electricity in kilowatt-hours that a building uses from month to month. Demand is the amount of electrical power that a building uses at any given instance in a month period. During the summer periods, electric demand at a power station is high, due to the amount of air conditioners, lights, and other equipment being used within the region. Demand charges increase to offset the utility's cost to provide enough electricity at that given time. Photovoltaic systems offset the amount of electricity used by a building and help to reduce the building's electric demand, resulting in a higher cost savings. Installing a PV system will offset electric demand and reduce annual electric consumption, while utilizing available state incentives. PV systems are modular and readily allow for future expansions.

The size of the system was determined considering the available roof surface area, without compromising service space for roof equipment and safety, as well as the facilities' annual base load and mode of operation. A PV system could be installed on a portion of the roof with panels facing south. A commercial multi-crystalline 230 watt panel has 17.5 square feet of surface area (providing 13.1 watts per square foot). A 20 kW system needs approximately 87 panels which would take up 1,522 square feet.

A PV system would reduce the building's electric load and allow more capacity for surrounding buildings as well as serve as an example of energy efficiency for the community. The building is not eligible for a residential 30% federal tax credit. The building owner may want to consider applying for a grant and / or engage a PV generator / leaser who would install the PV system and then sell the power at a reduced rate. Typically, a major utility provides the ability to buy SREC's at $600/MWh or best market offer. However, this option is not available from the local utility. Please see below for more information.

Please note that this analysis did not consider the structural capability of the existing building to support the above recommended system. SWA recommends that the City of Northfield contract with a structural engineer to determine if additional building structure is required to support the recommended system and what costs would be associated with incorporating the additional supports prior to system installation. Should additional costs be identified, the City of Northfield should include these costs in the financial analysis of the project.

Installation cost:

Estimated installed cost: $134,000 (includes $53,600 of labor)
Source of cost estimate: Similar projects

Economics (with incentives):

est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
150,000	16,000	134,000	23,608	20.0	0	16.7	0	17,695	25	304,383	7.6	127	5	11	91,791	42,270

Cash flow:

cash flow yr 0	cash flow yr 1	cash flow yr 2	cash flow yr 3	cash flow yr 4	cash flow yr 5	cash flow yr 6	cash flow yr 7	cash flow yr 8	cash flow yr 9	cash flow yr 10	cash flow yr 11	cash flow yr 12	cash flow yr 13
-134,000	17,695	17,695	17,695	17,695	17,695	17,695	17,695	17,695	17,695	17,695	17,695	17,695	17,695

cash flow yr 14	cash flow yr 15	cash flow yr 16	cash flow yr 17	cash flow yr 18	cash flow yr 19	cash flow yr 20	cash flow yr 21	cash flow yr 22	cash flow yr 23	cash flow yr 24	cash flow yr 25
17,695	17,695	3,895	3,895	3,895	3,895	3,895	3,895	3,895	3,895	3,895	3,895

Assumptions: SWA estimated the cost and savings of the system based on past PV projects. SWA projected physical dimensions based on a typical Polycrystalline Solar Panel (230 Watts, model #ND-U230C1). PV systems are sized based on Watts and physical dimensions for an array will differ with the efficiency of a given solar panel (W/sq ft).

Rebates/financial incentives:

NJ Clean Energy - Renewable Energy Incentive Program, Incentive based on $0.80 / watt Solar PV application for systems 50 kW or less. Incentive amount for this application is $16,000 for the proposed option. http://www.njcleanenergy.com/renewable-energy/programs/renewable-energy-incentive-program

NJ Clean Energy - Solar Renewable Energy Certificate Program. Each time a solar electric system generates 1,000kWh (1MWh) of electricity, a SREC is issued which can then be sold or traded separately from the power. The buildings must also become net-metered in order to earn SRECs as well as sell power back to the electric grid. A total annual SREC credit of $13,800 has been incorporated in the above costs however it requires proof of performance, application approval and negotiations with the utility.

Options for funding ECM:

This project may benefit from enrolling in NJ SmartStart program with Technical Assistance to offset a portion of the cost of implementation.

http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/nj-smartstart-buildings

PROPOSED *FURTHER RECOMMENDATIONS*

Capital Improvements

Capital Improvements are recommendations for the building that may not be cost-effective at the current time, but that could yield a significant long-term payback. These recommendations should typically be considered as part of a long-term capital improvement plan. Capital improvements should be considered if additional funds are made available, or if the installed costs can be shared with other improvements, such as major building renovations. SWA recommends the following capital improvements for the Northfield Public Works:

- Install premium motors when replacements are required - Select NEMA Premium motors when replacing motors that have reached the end of their useful operating lives.

- Add insulation to all the ceilings. SWA suggests applying closed-cell spray-foam (R-19 min.) to the underside of rafters.

- Replace Vehicle Shop office two (2) electric baseboard heaters in kind. The existing units have integral knob operated thermostats on them, are in fair condition and operating beyond their expected service lives. The new units should be set up to be controlled by a programmable room thermostat. There is negligible energy savings associated with this replacement.

- Replace toilet and Vehicle Shop exhaust fans - this equipment is run by fractional horsepower motors and the run hours are not significant, so the replacements cannot be justified by energy savings alone and there are no NJ Clean Energy rebates available. However, due to the age and condition of the equipment, replacement is recommended.

- Install CO detectors/alarms in the garage bays and nearby spaces. Connect high level signals to nearby exhaust fans wherever possible.

- Replace dryer with energy efficient unit - Although there is no ENERGY STAR® certification for dryers, energy efficiency should be considered when replacing this equipment. Due to its advanced age and high energy consumption, it is recommended that this unit be replaced.

Operations and Maintenance

Operations and Maintenance measures consist of low/no cost measures that are within the capability of the current building staff to handle. These measures typically require little investment, and they yield a short payback period. These measures may address equipment settings or staff operations that, when addressed will reduce energy consumption or costs.

- Openings around window air-conditioning units need airtight gaskets/sealants for optimal all year performance. Insulated hoods should be installed during winter months if removing the units is not an option.

- Replace/repair and maintain damaged door units.

- Maintain roofs - SWA recommends regular maintenance to verify water is draining correctly.

- Provide weather-stripping/air-sealing - SWA observed that exterior door weather-stripping was beginning to deteriorate in places. Doors and vestibules should be observed annually for deficient weather-stripping and replaced as needed. The perimeter of all window frames should also be regularly inspected, and any missing or deteriorated caulking should be re-caulked to provide an unbroken seal around the window frames. Any other accessible gaps or penetrations in the thermal envelope penetrations should also be sealed with caulk or spray foam.

- Repair/seal wall cracks and penetrations - SWA recommends as part of the maintenance program installing weep holes, and sealing wall cracks and penetrations wherever necessary in order to keep insulation dry and effective.

- Provide water-efficient fixtures and controls - Adding controlled on/off timers on all lavatory faucets is a cost-effective way to reduce domestic hot water demand and save water. Building staff can also easily install faucet aerators and/or low-flow fixtures to reduce water consumption. There are many retrofit options, which can be installed now or incorporated as equipment is replaced. Routine maintenance practices that identify and quickly address water leaks are a low-cost way to save water and energy. Retrofitting with more efficient water-consumption fixtures/appliances will reduce energy consumption for water heating, while also decreasing water/sewer bills.

- SWA recommends that the building considers purchasing the most energy-efficient equipment, including ENERGY STAR® labeled common appliances, when common equipment is installed or replaced. More information can be found in the "Products" section of the ENERGY STAR® website at: http://www.energystar.gov.

- Use smart power electric strips - in conjunction with occupancy sensors to power down computer equipment when left unattended for extended periods of time.

- Create an energy educational program - that teaches how to minimize energy use. The U.S. Department of Energy offers free information for hosting energy efficiency educational programs and plans. For more information please visit: http://www1.eere.energy.gov/education/.

- Insulate un-insulated hot piping throughout the building to efficiently deliver hot water from the DHW heater where required while at the same time providing personnel protection.

Note: The recommended ECMs and the list above are cost-effective energy efficiency measures and building upgrades that will reduce operating expenses for the Northfield Public Works. Based on the requirements of the LGEA program, the Northfield Public Works must commit to implementing some of these measures, and must submit paperwork to the Local Government Energy Audit program within one year of this report's approval to demonstrate that they have spent, net of other NJCEP incentives, at least 25% of the cost of the audit (per building). The Northfield Public Works should spend a minimum of $1,268 (or 25% of $5,070) worth of ECMs, net of other NJCEP incentives, to fulfill the obligations.

APPENDIX A: EQUIPMENT LIST

Inventory

Building System	Description	Model #	Fuel	Location	Space Served	Date Installed	Estimated Remaining Useful Life %
Heating	2 ceiling hung Modine - 150,000 BTH input, 120,000 BTH output (manual thermostat, one on outer west wall); 80% eff	PA150A, Serial # 01011170R	Natural Gas / Electric for fractional HP fan	Vehicle Shop - ceiling mounted	Vehicle Shop Maintenance shop	1973	0
Heating	1 ceiling hung Modine - 130,000 BTH input, 104,000 BTH output; 80% eff	PA130A, Serial # 01010470R	Natural Gas / Electric for fractional HP fan	Mechanics' side - ceiling mounted	Mechanics' shop	1973	0
Heating	2 electric baseboard perimeter heaters (with knob operated thermostats)	Missing nametag	Electric	Vehicle Shop office	Vehicle Shop office	1973	0
Cooling	Comfort Air Conditioner (additional room cooling) - 8,000 Btu/hr - EER 9.8 - R22 refrigerant (needs improved window sealing)	RAD-81A	Electric	Public Works (window mounted AC)	Public Works office	2007	70
Cooling	Crosley (additional room cooling) – est 12,000 Btu/hr - est EER 9 - R22 refrigerant (removed from window during winter)	Tag missing	Electric	Main Office (window mounted AC)	Main Office	1995	0
DHW	1 Bradford White, 30 gal storage, 30,000 BTH input, est eff 63% (evaluate tankless heating!)	M130S5LN10, Series # MQ5018789	Natural Gas	Outside Bathroom	Garage counter sink and bathroom	1993	0
Ventilation	One 18" Patton wall exhaust fan, fractional HP motor (outside louvers stuck partially open)	LPED-16, Serial #821161107P	Electric	Vehicle Shop outer wall	Vehicle Shop	1973	0
Lighting	See details - Appendix B	-	Electric	See details - Appendix B	Public Works	varies	avg 15

Note: The remaining useful life of a system (in %) is an estimate based on the system date of built and existing conditions derived from visual inspection.

Appendix B: Lighting Study

Location			Existing Fixture Information											Retrofit Information												Annual Savings		
Marker	Floor	Room Identification	Fixture Type	Ballast	Lamp Type	# of Fixtures	# of Lamps per Fixture	Watts per Lamp	Controls	Operational Hours per Day	Operational Days per Year	Ballast Wattage	Total Watts	Energy Use kWh/year	Category	Fixture Type	Lamp Type	Ballast	Controls	# of Fixtures	# of Lamps per Fixture	Watts per Lamp	Operational Hours per Day	Operational Days per Year	Ballast Watts	Total Watts	Energy Use kWh/year	Fixture Savings (kWh)	Controls Savings (kWh)	Total Savings (kWh)
1	GF	Garage	Parabolic Ceiling Suspended	M	8'T12	5	2	80	Sw	8	260	20	900	1,872	T8	Parabolic Ceiling Suspended	8'T8	E	Sw	5	2	59	8	260	7	625	1300	572	0	572
2	GF	Garage	Ceiling Mounted	M	8'T12	4	2	80	Sw	8	260	20	720	1,498	T8	Ceiling Mounted	8'T8	E	Sw	4	2	59	8	260	7	500	1040	458	0	458
3	GF	Office	Recessed	M	4'T12	4	2	40	Sw	8	260	12	368	765	T8	Recessed	4'T8	E	Sw	4	2	32	8	260	5	276	574	191	0	191
4	GF	Storage Room	Ceiling Suspended	M	8'T12	2	2	80	Sw	2	260	20	360	187	T8	Ceiling Suspended	8'T8	E	Sw	2	2	59	2	260	7	250	130	57	0	57
5	GF	Garage - Road Department	Parabolic Ceiling Suspended	M	8'T12	4	2	80	Sw	8	260	20	720	1,498	T8	Parabolic Ceiling Suspended	8'T8	E	Sw	4	2	59	8	260	7	500	1040	458	0	458
6	GF	Garage - Road Department	Ceiling Mounted	M	8'T12	4	2	80	Sw	8	260	20	720	1,498	T8	Ceiling Mounted	8'T8	E	Sw	4	2	59	8	260	7	500	1040	458	0	458
7	GF	Kitchen	Ceiling Suspended	M	8'T12	1	2	80	Sw	8	260	20	180	374	T8	Ceiling Suspended	8'T8	E	Sw	1	2	59	8	260	7	125	260	114	0	114
8	GF	Bathroom	Ceiling Mounted	S	Inc	1	1	60	Sw	4	260	0	60	62	CFL	Ceiling Mounted	CFL	S	Sw	1	1	20	4	260	0	20	21	42	0	42
9	GF	Main Office	Recessed	M	4'T12	2	2	40	Sw	8	260	12	184	383	T8	Recessed	4'T8	E	Sw	2	2	32	8	260	5	138	287	96	0	96
10	GF	Office	Recessed	M	4'T12	2	2	40	Sw	8	260	12	184	383	T8	Recessed	4'T8	E	Sw	2	2	32	8	260	5	138	287	96	0	96
11	Ext	Exterior	Wall Mounted	S	Inc	1	1	100	T	12	365	0	100	438	CFL	Wall Mounted	CFL	S	T	1	1	35	12	365	0	35	153	285	0	285
12	Ext	Exterior	Wall Mounted	S	CFL	1	1	23	T	12	365	0	23	101	N/A	Wall Mounted	CFL	S	T	1	1	23	12	365	0	23	101	0	0	0
13	Ext	Exterior	Pole Mounted Off Building	S	MH	1	1	400	PC	12	365	112	512	2,243	PSMH	Pole Mounted Off Building	PSMH	S	PC	1	1	250	12	365	50	300	1314	929	0	929
14	Ext	Roof	Flood	S	MH	1	1	400	PC	12	365	112	512	2,243	PSMH	Flood	PSMH	S	PC	1	1	250	12	365	50	300	1314	929	0	929
Totals:						33	23	1,583				380	5,543	13,544						33	23	1,028			157	3,730	8,861	4,683	0	4,683
Rows Highlighed Yellow Indicate an Energy Conservation Measure is recommended for that space																													

Proposed Lighting Summary Table			
Total Gross Floor Area (SF)	4,824		
Average Power Cost ($/kWh)	0.1650		
Exterior Lighting	**Existing**	**Proposed**	**Savings**
Exterior Annual Consumption (kWh)	5,024	2,882	**2,142**
Exterior Power (watts)	1,147	658	**489**
Total Interior Lighting	**Existing**	**Proposed**	**Savings**
Annual Consumption (kWh)	8,520	5,979	**2,541**
Lighting Power (watts)	4,396	3,072	**1,324**
Lighting Power Density (watts/SF)	0.91	0.64	**0.27**
Estimated Cost of Fixture Replacement ($)	7,355		
Estimated Cost of Controls Improvements ($)	0		
Total Consumption Cost Savings ($)	**1,092**		

Legend							
Fixture Type		**Lamp Type**			**Control Type**	**Ballast Type**	**Retrofit Category**
Ceiling Suspended	Recessed	CFL	3'T12	8'T5	Autom. Timer (T)	S (Self)	N/A (None)
Exit Sign	Sconce	Inc	3'T12 U-Shaped	8'T5 U-Shaped	Bi-Level (BL)	E (Electronic)	T8 (Install new T8)
High Bay	Spotlight	LED	3'T5	8'T8	Contact (Ct)	M (Magnetic)	T5 (Install new T5)
Parabolic Ceiling Mounted	Track	HPS	3'T5 U-Shaped	8'T8 U-Shaped	Daylight & Motion (M)		CFL (Install new CFL)
Parabolic Ceiling Suspended	Vanity	MH	3'T8	Circline - T5	Daylight & Switch (DLSw)		LEDex (Install new LED Exit)
Pendant	Wall Mounted	MV	3'T8 U-Shaped	Circline - T8	Daylight Sensor (DL)		LED (Install new LED)
Recessed Parabolic	Wall Suspended	1'T12	4'T5	Circline - T12	Delay Switch (DSw)		D (Delamping)
Ceiling Mounted	Wallpack	1'T12 U-Shaped	4'T5 U-Shaped	FI.	Dimmer (D)		C (Controls Only)
Chandelier		1'T5	6'T12	Hal	Motion Sensor (MS)		PSMH (Install new Pulse-Start Metal Halide)
Equipment / Fume Hood		1'T5 U-Shaped	6'T12 U-Shaped	Induction	Motion& Switch (MSw)		
Flood		1'T8	6'T5	Infrared	None (N)		
Landscape		1'T8 U-Shaped	6'T5 U-Shaped	LPS	Occupancy Sensor (OS)		
Low Bay		2'T12 U-Shaped	6'T8	Mixed Vapor	Occupancy Sensor - CM (OSCM)		
Parabolic Wall Mounted		2'T5	6'T8 U-Shaped	Neon	Photocell (PC)		
Pole Mounted		2'T5 U-Shaped	8'T12	Quartz Halogen	Switch (Sw)		
Pole Mounted Off Building		2'T8 U-Shaped	8'T12 U-Shaped				

APPENDIX C: THIRD PARTY ENERGY SUPPLIERS

http://www.state.nj.us/bpu/commercial/shopping.html

Third Party Electric Suppliers for Atlantic City Electric Service Territory	Telephone & Web Site
Hess Corporation 1 Hess Plaza Woodbridge, NJ 07095	(800) 437-7872 www.hess.com
American Powernet Management, LP 437 North Grove St. Berlin, NJ 08009	(877) 977-2636 www.americanpowernet.com
BOC Energy Services, Inc. 575 Mountain Avenue Murray Hill, NJ 07974	(800) 247-2644 www.boc.com
Commerce Energy, Inc. 4400 Route 9 South, Suite 100 Freehold, NJ 07728	(800) 556-8457 www.commerceenergy.com
ConEdison Solutions 535 State Highway 38 Cherry Hill, NJ 08002	(888) 665-0955 www.conedsolutions.com
Constellation NewEnergy, Inc. 900A Lake Street, Suite 2 Ramsey, NJ 07446	(888) 635-0827 www.newenergy.com
Direct Energy Services, LLC 120 Wood Avenue, Suite 611 Iselin, NJ 08830	(866) 547-2722 www.directenergy.com
FirstEnergy Solutions 300 Madison Avenue Morristown, NJ 07926	(800) 977-0500 www.fes.com
Glacial Energy of New Jersey, Inc. 207 LaRoche Avenue Harrington Park, NJ 07640	(877) 569-2841 www.glacialenergy.com
Integrys Energy Services, Inc. 99 Wood Ave, South, Suite 802 Iselin, NJ 08830	(877) 763-9977 www.integrysenergy.com
Liberty Power Delaware, LLC Park 80 West Plaza II, Suite 200 Saddle Brook, NJ 07663	(866) 769-3799 www.libertypowercorp.com
Liberty Power Holdings, LLC Park 80 West Plaza II, Suite 200 Saddle Brook, NJ 07663	(800) 363-7499 www.libertypowercorp.com
Pepco Energy Services, Inc. 112 Main St. Lebanon, NJ 08833	(800) 363-7499 www.pepco-services.com
PPL EnergyPlus, LLC 811 Church Road Cherry Hill, NJ 08002	(800) 281-2000 www.pplenergyplus.com
Sempra Energy Solutions 581 Main Street, 8th Floor Woodbridge, NJ 07095	(877) 273-6772 www.semprasolutions.com
South Jersey Energy Company One South Jersey Plaza, Route 54 Folsom, NJ 08037	(800) 756-3749 www.southjerseyenergy.com
Strategic Energy, LLC 55 Madison Avenue, Suite 400 Morristown, NJ 07960	(888) 925-9115 www.sel.com
Suez Energy Resources NA, Inc. 333 Thornall Street, 6th Floor Edison, NJ 08837	(888) 644-1014 www.suezenergyresources.com

Third Party Gas Suppliers for South Jersey Gas Service Territory	Telephone & Web Site
Cooperative Industries 412-420 Washington Avenue Belleville, NJ 07109	(800) 628-9427 www.cooperativenet.com
Direct Energy Services, LLC 120 Wood Avenue, Suite 611 Iselin, NJ 08830	(866) 547-2722 www.directenergy.com
Gateway Energy Services Corp. 44 Whispering Pines Lane Lakewood, NJ 08701	(800) 805-8586 www.gesc.com
UGI Energy Services, Inc. 704 East Main Street, Suite 1 Moorestown, NJ 08057	(856) 273-9995 www.ugienergyservices.com
Great Eastern Energy 116 Village Riva, Suite 200 Princeton, NJ 08540	(888) 651-4121 www.greateastern.com
Hess Corporation 1 Hess Plaza Woodbridge, NJ 07095	(800) 437-7872 www.hess.com
Intelligent Energy 2050 Center Avenue, Suite 500 Fort Lee, NJ 07024	(800) 724-1880 www.intelligentenergy.org
Metromedia Energy, Inc. 6 Industrial Way Eatontown, NJ 07724	(877) 750-7046 www.metromediaenergy.com
MxEnergy, Inc. 510 Thornall Street, Suite 270 Edison, NJ 08837	(800) 375-1277 www.mxenergy.com
NATGASCO (Mitchell Supreme) 532 Freeman Street Orange, NJ 07050	(800) 840-4427 www.natgasco.com
Pepco Energy Services, Inc. 112 Main Street Lebanon, NJ 08833	(800) 363-7499 www.pepco-services.com
PPL EnergyPlus, LLC 811 Church Road Cherry Hill, NJ 08002	(800) 281-2000 www.pplenergyplus.com
South Jersey Energy Company One South Jersey Plaza, Route 54 Folsom, NJ 08037	(800) 756-3749 www.southjerseyenergy.com
Woodruff Energy 73 Water Street Bridgeton, NJ 08302	(800) 557-1121 www.woodruffenergy.com

APPENDIX D: GLOSSARY AND METHOD OF CALCULATIONS

Net ECM Cost: The net ECM cost is the cost experienced by the customer, which is typically the total cost (materials + labor) of installing the measure minus any available incentives. Both the total cost and the incentive amounts are expressed in the summary for each ECM.

Annual Energy Cost Savings (AECS): This value is determined by the audit firm based on the calculated energy savings (kWh or Therm) of each ECM and the calculated energy costs of the building.

Lifetime Energy Cost Savings (LECS): This measure estimates the energy cost savings over the lifetime of the ECM. It can be a simple estimation based on fixed energy costs. If desired, this value can factor in an annual increase in energy costs as long as the source is provided.

Simple Payback: This is a simple measure that displays how long the ECM will take to break-even based on the annual energy and maintenance savings of the measure.

ECM Lifetime: This is included with each ECM so that the owner can see how long the ECM will be in place and whether or not it will exceed the simple payback period. Additional guidance for calculating ECM lifetimes can be found below. This value can come from manufacturer's rated lifetime or warranty, the ASHRAE rated lifetime, or any other valid source.

Operating Cost Savings (OCS): This calculation is an annual operating savings for the ECM. It is the difference in the operating, maintenance, and / or equipment replacement costs of the existing case versus the ECM. In the case where an ECM lifetime will be longer than the existing measure (such as LED lighting versus fluorescent) the operating savings will factor in the cost of replacing the units to match the lifetime of the ECM. In this case or in one where one-time repairs are made, the total replacement / repair sum is averaged over the lifetime of the ECM.

Return on Investment (ROI): The ROI is expresses the percentage return of the investment based on the lifetime cost savings of the ECM. This value can be included as an annual or lifetime value, or both.

Net Present Value (NPV): The NPV calculates the present value of an investment's future cash flows based on the time value of money, which is accounted for by a discount rate (assumes bond rate of 3.2%).

Internal Rate of Return (IRR): The IRR expresses an annual rate that results in a break-even point for the investment. If the owner is currently experiencing a lower return on their capital than the IRR, the project is financially advantageous. This measure also allows the owner to compare ECMs against each other to determine the most appealing choices.

Gas Rate and Electric Rate ($/therm and $/kWh): The gas rate and electric rate used in the financial analysis is the total annual energy cost divided by the total annual energy usage for the 12 month billing period studied. The graphs of the monthly gas and electric rates reflect the total monthly energy costs divided by the monthly usage, and display how the average rate fluctuates throughout the year. The average annual rate is the only rate used in energy savings calculations.

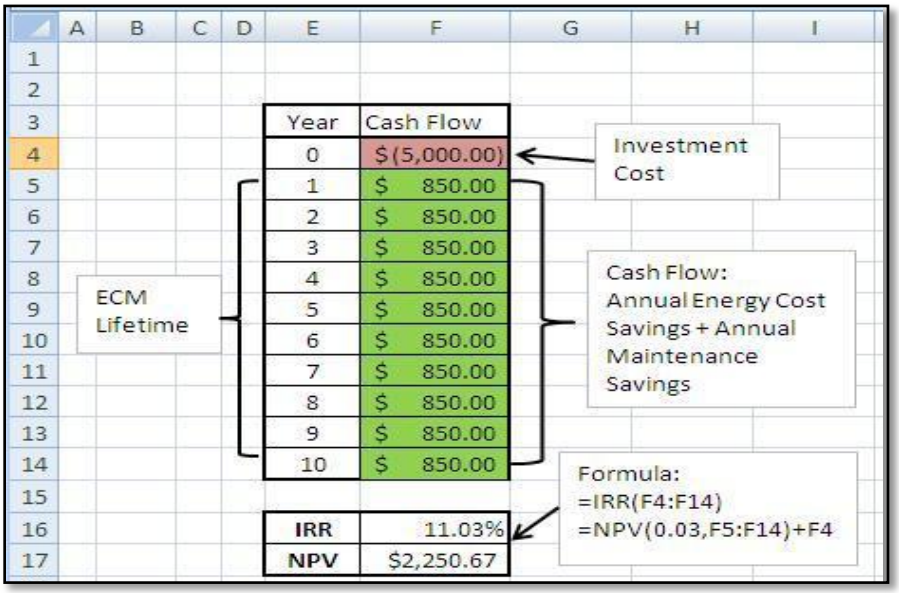
Calculation References

Term	Definition
ECM	Energy Conservation Measure
AOCS	Annual Operating Cost Savings
AECS	Annual Energy Cost Savings
LOCS*	Lifetime Operating Cost Savings
LECS	Lifetime Energy Cost Savings
LCS	Lifetime Cost Savings
NPV	Net Present Value
IRR	Internal Rate of Return
DR	Discount Rate
Net ECM Cost	Total ECM Cost – Incentive
LECS	AECS X ECM Lifetime
AOCS	LOCS / ECM Lifetime
LCS	LOCS+LECS
Simple Payback	Net ECM Cost / (AECS + AOCS)
Lifetime ROI	(LECS + LOCS – Net ECM Cost) / Net ECM Cost
Annual ROI	(Lifetime ROI / Lifetime) = [(AECS + OCS) / Net ECM Cost – (1 / Lifetime)]

* The lifetime operating cost savings are all avoided operating, maintenance, and/or component replacement costs over the lifetime of the ECM. This can be the sum of any annual operating savings, recurring or bulk (i.e. one-time repairs) maintenance savings, or the savings that comes from avoiding equipment replacement needed for the existing measure to meet the lifetime of the ECM (e.g. lighting change outs).

Excel NPV and IRR Calculation

In Excel, function =IRR (values) and =NPV(rate, values) are used to quickly calculate the IRR and NPV of a series of annual cash flows. The investment cost will typically be a negative cash flow at year 0 (total cost - incentive) with years 1 through the lifetime receiving a positive cash flow from the annual energy cost savings and annual maintenance savings. The calculations in the example below are for an ECM that saves $850 annually in energy and maintenance costs (over a 10 year lifetime) and takes $5,000 to purchase and install after incentives:



Solar PV ECM Calculation

There are several components to the calculation:

Costs:	Material of PV system including panels, mounting and net-metering + Labor
Energy Savings:	Reduction of kWh electric cost for life of panel, 25 years
Incentive 1:	NJ Renewable Energy Incentive Program (REIP), for systems of size 50kW or less, $1/Watt incentive subtracted from installation cost
Incentive 2:	Solar Renewable Energy Credits (SRECs) – Market-rate incentive. Calculations assume $600/Megawatt hour consumed per year for a maximum of 15 years; added to annual energy cost savings for a period of 15 years. (Megawatt hour used is rounded to nearest 1,000 kWh)
Assumptions:	A Solar Pathfinder device is used to analyze site shading for the building and determine maximum amount of full load operation based on available sunlight. When the Solar Pathfinder device is not implemented, amount of full load operation based on available sunlight is assumed to be 1,180 hours in New Jersey.

Total lifetime PV energy cost savings =
kWh produced by panel * [$/kWh cost * 25 years + $600/Megawatt hour /1000 * 15 years]

ECM and Equipment Lifetimes

Determining a lifetime for equipment and ECM's can sometimes be difficult. The following table contains a list of lifetimes that the NJCEP uses in its commercial and industrial programs. Other valid sources are also used to determine lifetimes, such as the DOE, ASHRAE, or the manufacturer's warranty.

Lighting is typically the most difficult lifetime to calculate because the fixture, ballast, and bulb can all have different lifetimes. Essentially the ECM analysis will have different operating cost savings (avoided equipment replacement) depending on which lifetime is used.

When the bulb lifetime is used (rated burn hours / annual burn hours), the operating cost savings is just reflecting the theoretical cost of replacing the existing case bulb and ballast over the life of the recommended bulb. Dividing by the bulb lifetime will give an annual operating cost savings.

When a fixture lifetime is used (e.g. 15 years) the operating cost savings reflects the avoided bulb and ballast replacement cost of the existing case over 15 years minus the projected bulb and ballast replacement cost of the proposed case over 15 years. This will give the difference of the equipment replacement costs between the proposed and existing cases and when divided by 15 years will give the annual operating cost savings.

New Jersey Clean Energy Program Commercial & Industrial Lifetimes

Measure	Life Span
Commercial Lighting — New	15
Commercial Lighting — Remodel/Replacement	15
Commercial Custom — New	18
Commercial Chiller Optimization	18
Commercial Unitary HVAC — New - Tier 1	15
Commercial Unitary HVAC — Replacement - Tier 1	15
Commercial Unitary HVAC — New - Tier 2	15
Commercial Unitary HVAC — Replacement Tier 2	15
Commercial Chillers — New	25
Commercial Chillers — Replacement	25
Commercial Small Motors (1-10 HP) — New or Replacement	20
Commercial Medium Motors (11-75 HP) — New or Replacement	20
Commercial Large Motors (76-200 HP) — New or Replacement	20
Commercial VSDs — New	15
Commercial VSDs — Retrofit	15
Commercial Comprehensive New Construction Design	18
Commercial Custom — Replacement	18
Industrial Lighting — New	15
Industrial Lighting — Remodel/Replacement	15
Industrial Unitary HVAC — New - Tier 1	15
Industrial Unitary HVAC — Replacement - Tier 1	15
Industrial Unitary HVAC — New - Tier 2	15
Industrial Unitary HVAC — Replacement Tier 2	15
Industrial Chillers — New	25
Industrial Chillers — Replacement	25
Industrial Small Motors (1-10 HP) — New or Replacement	20
Industrial Medium Motors (11-75 HP) — New or Replacement	20
Industrial Large Motors (76-200 HP) — New or Replacement	20
Industrial VSDs — New	15
Industrial VSDs — Retrofit	15
Industrial Custom — Non-Process	18
Industrial Custom — Process	10
Small Commercial Gas Furnace — New or Replacement	20
Small Commercial Gas Boiler — New or Replacement	20
Small Commercial Gas DHW — New or Replacement	10
C&I Gas Absorption Chiller — New or Replacement	25
C&I Gas Custom — New or Replacement (Engine Driven Chiller)	25
C&I Gas Custom — New or Replacement (Gas Efficiency Measures)	18
O&M savings	3
Compressed Air (GWh participant)	8

APPENDIX E: STATEMENT OF ENERGY PERFORMANCE FROM ENERGY STAR®

OMB No. 2060-0347

STATEMENT OF ENERGY PERFORMANCE
City of Northfield - Public Works

Building ID: 2363605
For 12-month Period Ending: March 31, 2010[1]
Date SEP becomes ineligible: N/A

Date SEP Generated: June 23, 2010

Facility
City of Northfield - Public Works
775 West Mill Road
Northfield, NJ 08225

Facility Owner
N/A

Primary Contact for this Facility
N/A

Year Built: 1938
Gross Floor Area (ft^2): 4,824

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

Site Energy Use Summary[3]	
Electricity - Grid Purchase(kBtu)	116,392
Natural Gas (kBtu)[4]	543,516
Total Energy (kBtu)	659,908

Energy Intensity[5]	
Site (kBtu/ft^2/yr)	137
Source (kBtu/ft^2/yr)	199

Emissions (based on site energy use)	
Greenhouse Gas Emissions ($MtCO_2e$/year)	47

Electric Distribution Utility
Pepco - Atlantic City Electric Co

National Average Comparison	
National Average Site EUI	104
National Average Source EUI	213
% Difference from National Average Source EUI	-7%
Building Type	Other

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. Natural Gas values in units of volume (e.g. cubic feet) are converted to kBtu with adjustments made for elevation based on Facility zip code.
5. Values represent energy intensity, annualized to a 12-month period.
6. 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.

EPA Form 5900-16

APPENDIX F: INCENTIVE PROGRAM

New Jersey Clean Energy Pay for Performance

The NJ Clean Energy Pay for Performance (P4P) Program relies on a network of Partners who provide technical services to clients. LGEA participating clients who are not receiving Direct Energy Efficiency and Conservation Block Grants are eligible for P4P. SWA is an eligible Partner and can develop an Energy Reduction Plan for each project with a whole-building traditional energy audit, a financial plan for funding the energy measures and an installation construction schedule.

The Energy Reduction Plan must define a comprehensive package of measures capable of reducing a building's energy consumption by 15+%. P4P incentives are awarded upon the satisfactory completion of three program milestones: submittal of an Energy Reduction Plan prepared by an approved Program Partner, installation of the recommended measures and completion of a Post-Construction Benchmarking Report. The incentives for electricity and natural gas savings will be paid based on actual savings, provided that the minimum 15%performance threshold savings has been achieved.

For further information, please see: http://www.njcleanenergy.com/commercial-industrial/programs/pay-performance/existing-buildings .

Direct Install 2010 Program

Direct Install is a division of the New Jersey Clean Energy Programs' Smart Start Buildings. It is a turn-key program for small to mid-sized facilities to aid in upgrading equipment to more efficient types. It is designed to cut overall energy costs by upgrading lighting, HVAC and other equipment with energy efficient alternatives. The program pays **up to 60%** of the retrofit costs, including equipment cost and installation costs.

Eligibility:

- Existing small and mid-sized commercial and industrial facilities with peak electrical demand **below 200 kW** within 12 months of applying
- Must be located in New Jersey
- Must be served by one of the state's public, regulated or natural gas companies
    - Electric: Atlantic City Electric, Jersey Central Power & Light, Orange Rockland Electric, PSE&G
    - Natural Gas: Elizabethtown Gas, New Jersey Natural Gas, PSE&G, South Jersey Gas

For the most up to date information on contractors in New Jersey who participate in this program, go to: http://www.njcleanenergy.com/commercial-industrial/programs/direct-install

Smart Start

New Jersey's SmartStart Building Program is administered by New Jersey's Office of Clean Energy. The program also offers design support for larger projects and technical assistance for smaller projects. If your project specifications do not fit into anything defined by the program, there are even incentives available for custom projects.

There are a number of improvement options for commercial, industrial, institutional, government, and agricultural projects throughout New Jersey. Alternatives are designed to enhance quality while building in energy efficiency to save money. Project categories included in this program are New Construction and Additions, Renovations, Remodeling and Equipment Replacement.

For the most up to date information on how to participate in this program, go to: http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/nj-smartstart-buildings.

Renewable Energy Incentive Program

The Renewable Energy Incentive Program (REIP) provides incentives that reduce the upfront cost of installing renewable energy systems, including solar, wind, and sustainable biomass. Incentives vary depending upon technology, system size, and building type. Current incentive levels, participation information, and application forms can be found at the website listed below.

Solar Renewable Energy Credits (SRECs) represent all the clean energy benefits of electricity generated from a solar energy system. SRECs can be sold or traded separately from the power, providing owners a source of revenue to help offset the cost of installation. All solar project owners in New Jersey with electric distribution grid-connected systems are eligible to generate SRECs. Each time a system generates 1,000 kWh of electricity an SREC is earned and placed in the customer's account on the web-based SREC tracking system.

For the most up to date information on how to participate in this program, go to: http://www.njcleanenergy.com/renewable-energy/home/home.

Utility Sponsored Programs

Check with your local utility companies for further opportunities that may be available.

Energy Efficiency and Conservation Block Grant Rebate Program

The Energy Efficiency and Conservation Block Grant (EECBG) Rebate Program provides supplemental funding up to $20,000 for eligible New Jersey local government entities to lower the cost of installing energy conservation measures. Funding for the EECBG Rebate Program is provided through the American Recovery and Reinvestment Act (ARRA).

For the most up to date information on how to participate in this program, go to: http://njcleanenergy.com/EECBG

Other Federal and State Sponsored Programs

Other federal and state sponsored funding opportunities may be available, including BLOCK and R&D grant funding. For more information, please check http://www.dsireusa.org/.

APPENDIX G: VendingMiser™ Energy Savings Calculations

EnergyMisers

VendingMiser® CoolerMiser™ SnackMiser™ PlugMiser™ VM2iQ® CM2iQ®

Savings Calculator

Please replace the default values in the table below with your location's unique information and then click on the "calculate savings" button.
Note: To calculate for CoolerMiser, use the equivalent VendingMiser results. To calculate for PlugMiser, use the equivalent SnackMiser results.

Energy Costs ($0.000 per kWh)	$0.165
Facility Occupied Hours per Week	40
Number of Cold Drink Vending Machines	1
Number of Non-refrigerated Snack Machines	0
Power Requirements of Cold Drink Machine (Watts; 400 typical)	100
Power Requirements of Snack Machine (Watts; 80 typical)	0
VendingMiser® Sale Price (for cold drink machines)	199
SnackMiser™ Sale Price (for snack machines)	0

Calculate Savings!

Results of your location's projected savings with VendingMiser® installed:

COLD DRINK MACHINES	Current	Projected	Total Savings	% Savings
kWh	874	319	555	63%
Cost of Operation	$144.14	$52.62	$91.52	63%

SNACK MACHINES	Current	Projected	Total Savings	% Savings
kWh	0	0	0	NaN%
Cost of Operation	$0	$0	$0	NaN%

Location's Total Annual Savings

	Current	Projected	Total Savings	% Savings
kWh	874	319	555	64%
Cost of Operation	$144.14	$52.62	$91.52	63%

Total Project Cost	Break Even (Months)
$199	26.09

Estimated Five Year Savings on ALL Machines = $457.60

APPENDIX H: ENERGY CONSERVATION MEASURES

Recommended 0-5 Year Payback ECMs																		
ECM #	ECM description		est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
1	Upgrade Space Temperature Control with 4 Programmable Thermostats		668	none at this time	668	932	0.3	497	11.0	1,167	1,999	12	23,985	0.3	3,491	291	299	18,404	7,143
2	Install two (2) new CFL fixtures		52	0	52	326	0.1	0	0.2	97	151	5	754	0.3	1,359	272	291	635	584
3	Retrofit one (1) refrigerated vending machines with VendingMiser™ device		199	0	199	555	0.1	0	0.4	0	92	15	1,374	2.2	590	39	46	879	994
4	Replace 3 Old Ceiling Hung Gas Fired Heaters with Infrared ENERGY STAR® Efficient Models		4,950	900	4,050	932	0.3	596	13.0	70	1,038	20	20,756	3.9	412	21	25	10,764	8,237
	Totals		**5,869**	**900**	**4,969**	**2,745**	**0.8**	**1,093**	**24.6**	**1,334**	**3,280**	**-**	**46,869**	**1.5**	**843**	**-**	**-**	**30,681**	**16,958**

Assumptions: Discount Rate: 3.2% per DOE FEMP; Energy Price Escalation Rate: 0% per DOE FEMP Guidelines
Note: A 0.0 electrical demand reduction/month indicates that it is very low/negligible

Recommended 5-10 Year Payback ECMs																		
ECM #	ECM description		est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
5	Install two (2) new Pulse Start Metal Halide fixtures		2,410	50	2,360	1,857	0.4	0	1.3	43	349	15	5,241	6.8	122	8	12	1,752	3,325
6	Replace one (1) large refrigerator with a 17 cu. ft. ENERGY STAR® model		525	0	525	425	0.1	0	0.3	0	70	15	1,052	7.5	100	7	10	300	761
7	Replace two (2) compact refrigerators with 2.7 cu. ft. ENERGY STAR® models		198	0	198	160	0	0	0.1	0	26	15	396	7.5	100	7	10	113	286
8	Replace 1 Standard Efficiency Natural Gas DHW Heater With ENERGY STAR® Natural Gas Condensing Type		2,150	50	2,100	0	0.0	157	3.3	50	265	12	3,176	7.9	51	4	7	487	1,732
9	Replace 1 Window Air Conditioning Unit With ENERGY STAR® Efficient Type		570	none at this time	570	224	0.1	0	0.2	35	72	15	1,079	7.9	89	6	9	268	401
10	Install twenty-eight (28) new T8 fluorescent fixtures		5,363	420	4,943	2,499	0.5	0	1.8	180	592	15	8,881	8.3	80	5	8	2,023	4,475
	Totals		**11,216**	**520**	**10,696**	**5,165**	**1.1**	**157**	**6.9**	**308**	**1,374**	**-**	**19,825**	**7.8**	**85**	**-**	**-**	**4,943**	**10,980**

Recommended Renewable ECMs																			
ECM #	ECM description		est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
11	Install a 20 kW Solar Photovoltaic Rooftop System		150,000	16,000	134,000	23,608	20.0	0	16.7	0	17,695	25	304,383	7.6	127	5	11	91,791	42,270

APPENDIX H: METHOD OF ANALYSIS

Assumptions and tools

Energy modeling tools:	Established/standard industry assumptions, E-Quest
Cost estimates:	RS Means 2009 (Facilities Maintenance & Repair Cost Data) RS Means 2009 (Building Construction Cost Data) RS Means 2009 (Mechanical Cost Data) Published and established specialized equipment material and labor costs Cost estimates also based on utility bill analysis and prior experience with similar projects

Disclaimer

This engineering audit was prepared using the most current and accurate fuel consumption data available for the site. The estimates that it projects are intended to help guide the owner toward best energy choices. The costs and savings are subject to fluctuations in weather, variations in quality of maintenance, changes in prices of fuel, materials, and labor, and other factors. Although we cannot guarantee savings or costs, we suggest that you use this report for economic analysis of the building and as a means to estimate future cash flow.

THE RECOMMENDATIONS PRESENTED IN THIS REPORT ARE BASED ON THE RESULTS OF ANALYSIS, INSPECTION, AND PERFORMANCE TESTING OF A SAMPLE OF COMPONENTS OF THE BUILDING SITE. ALTHOUGH CODE-RELATED ISSUES MAY BE NOTED, SWA STAFF HAVE NOT COMPLETED A COMPREHENSIVE EVALUATION FOR CODE-COMPLIANCE OR HEALTH AND SAFETY ISSUES. THE OWNER(S) AND MANAGER(S) OF THE BUILDING(S) CONTAINED IN THIS REPORT ARE REMINDED THAT ANY IMPROVEMENTS SUGGESTED IN THIS SCOPE OF WORK MUST BE PERFORMED IN ACCORDANCE WITH ALL LOCAL, STATE, AND FEDERAL LAWS AND REGULATIONS THAT APPLY TO SAID WORK. PARTICULAR ATTENTION MUST BE PAID TO ANY WORK WHICH INVOLVES HEATING AND AIR MOVEMENT SYSTEMS, AND ANY WORK WHICH WILL INVOLVE THE DISTURBANCE OF PRODUCTS CONTAINING MOLD, ASBESTOS, OR LEAD.