Rochester School District
Primary Schools Space Study

January 2012
Comprehensive Report

LAVALLEE I BRENSINGER ARCHITECTS

APPENDIX

-Pre-school Programming

-Energy Benchmarking Reports
New Hampshire EnergySmart Schools

Rochester Pre-school

Programming / Space Needs Calculations

Room Type	Max Persons/	Min NSF/ Person	NSF/ Area	Adjusted	# Req'd	Total Area	Comments
Pre School							
Classrooms	12	36	432	650	8	5,200	
Student Restroom	1			85	4	340	Shared between classrooms Accessible w/ Changing Area
Entry / Check-in	12	15	180	180	1	180	
Staff Restroom	1			60	1	60	
Pre-School Coordinator Office	3			150	1	150	1 Staff w/ space to meet w/ 2
Staff Offices	3			120	7	840	
Staff Break / Work Room	12			180	1	180	w/ Kitchenette
Occupational / Physical Therapy	2			400	1	400	
Speech Therapy / Testing Area	2			100	2	200	
Observation Area	1			80	1	80	
Conference Room	12			450	1	450	
Storage				800	1	800	
Outdoor Play Space	96	75	7,200	7,200	1	7,200	National Standard of 75sf/child Outdoor Fenced play space for 96 kids onsite any given day
			Total Pre-School			8,880	Net Square Feet of Building Space
						11,840	Gross Square feet (at 75% efficient). 75% net-gross accounts for corridors, Mechanical and Electrical spaces, and wall/structure thicknesses.

NEW HAMPSHIRE ENERGYSMART SCHOOLS PROGRAM

Energy Benchmarking Report for:

William Allen Elementary School

Rochester, NH

Period: ***July 1, 2010*** through ***June 30, 2011***

PREPARED BY:

TRC

155 Fleet Street, Suite #305

Portsmouth, NH 03801

(603) 766-1913

www.trcsolutions.com

Table of Contents

I. Introduction

The Sustainable Energy Division of the New Hampshire Public Utilities Commission, with support from the New Hampshire Department of Education has sponsored TRC to develop the New Hampshire ***EnergySmart Schools Program*** to support New Hampshire K-12 public and private schools in the pursuit of energy efficiency and sustainability initiatives.

Energy efficiency has become an increasingly important issue for schools due to tightening budgets and rising energy costs. Since 2003, the prices of natural gas, fuel oil and electricity have increased by 123%, 107% and 32% respectively. Schools that have participated in energy benchmarking programs have shown a decrease in overall energy use by approximately 22% through the adoption of energy efficiency measures.

Tracking and documenting the energy use and associated carbon emissions in the state's K-12 schools will allow New Hampshire to account for the impact of its energy efficiency and renewable energy programs and determine which have the greatest effect. The analysis in this report, provided by the ***EnergySmart Schools Program*** is designed to help you:

- Understand the energy consumption and cost trends at each of your school buildings.
- Learn how your buildings are performing compared to other schools locally and nationally.
- Identify opportunities for improving operations and reducing costs.
- Take advantage of resources to implement efficiency improvements and save money.

The analysis was based on the information provided on the *Building Data Request Form* submitted, which included building descriptions, energy suppliers and other information. The building's utility bills were also used to assess its electricity and heating fuel consumption for the year(s) provided.

The energy performance for your school has been compared to national data for similar school facilities through EPA's ENERGY STAR® Portfolio Manager. Also shown are the five major benchmarks used to analyze building performance, which include: electricity use; heating fuel use; weather-normalized heating fuel use; total cost; and total cost per student, all of which have been normalized for comparison by square footage and weather. As part of the program's focus on sustainability, your school's carbon footprint is also presented.

II. Benchmarking Analysis and Review Results

Building and energy usage of your school was analyzed to assess the basic nature of your energy consumption and utility costs. The Building Data Summary table shown below summarizes this information.

Table 1: Building Data Summary for William Allen Elementary School

Building Data			
District	SAU 54 Rochester School Department	**School Name**	William Allen Elementary School
City	Rochester	**Zip Code**	03867
Year Built	1964	**Floor Area (sq.ft.)**	57,000
Number of Students	339	**Number of PCs**	79
Weekly Operating Hours	60	**Months School Used**	12
Cooking?	YES	**% AC**	10
Pool Size?	N/A	**Months Pool Used**	0

Utility Data			
Data End Point	6/30/2011	**Total Cost ($)**	50,989
Electric Provider	PSNH	**Natural Gas Provider**	Unitil
Electricity Usage (kWh)	184,856	**Electricity Cost ($)**	30,248
Natural Gas Usage (therms)	17,470	**Natural Gas Cost ($)**	20,740
Fuel Oil Usage (gal)	0	**Fuel Oil Cost ($)**	0
Other Fuel Usage (gal)	0	**Other Fuel Cost ($)**	0

Energy Indicators			
EPA Score	89	**Electric Usage (kWh/sq.ft.)**	3.2
Heating Fuel Usage (kBtu/sq.ft.)	30.6	**Weather Adjusted Heating Usage Btu/sq.ft./HDD)**	4.2
Site Energy (kBtu/sq.ft.)	41.7	**Source Energy (kBtu/sq.ft.)**	69

Environmental Impact Indicators			
Greenhouse Gas Emissions			
Last Year Heating Fuel CO_2e (Mt)	92.8	**Last Year Total CO_2e (Mt)**	150.1
Last Year Electricity CO_2e (Mt)	57.3	**CO_2e Efficiency Savings Over Previous Year**	-2.8
EPA Target Score			
Target Score	Reached	**Site Energy Reduction Needed (kBtu/sq.ft.)**	N/A - Reached

Figures 1a, 1b, 2a and 2b display the energy use, demand and cost data tracked on a monthly basis. This demonstrates the energy consumption of your building over the course of the year. As a part of the program's focus on sustainability, your school's carbon footprint was also measured and is presented in Figure 3.

Figure 1a. Monthly Electric Use & Max Demand for William Allen Elementary

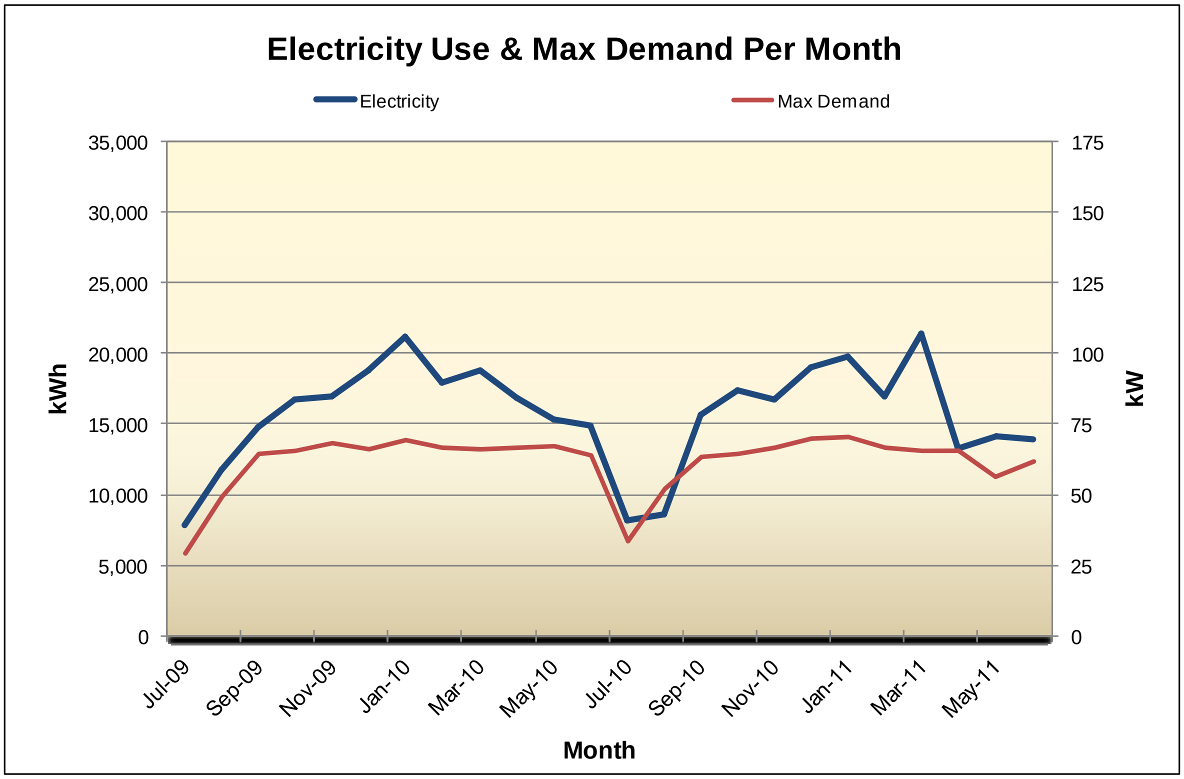
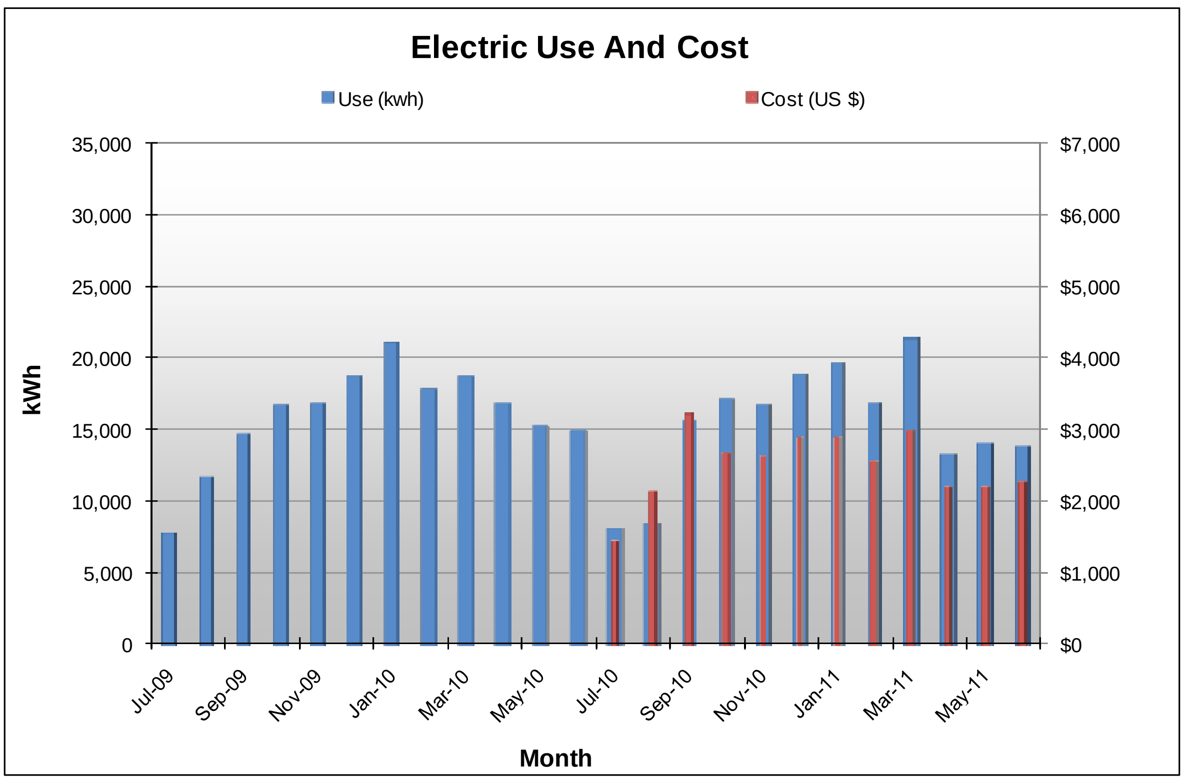


Figure 1b. Monthly Electric Use vs. Cost for William Allen Elementary



Note: Electric Cost was only available for the most recent 12 month period.

Figure 2a. Monthly Natural Gas Use for William Allen Elementary

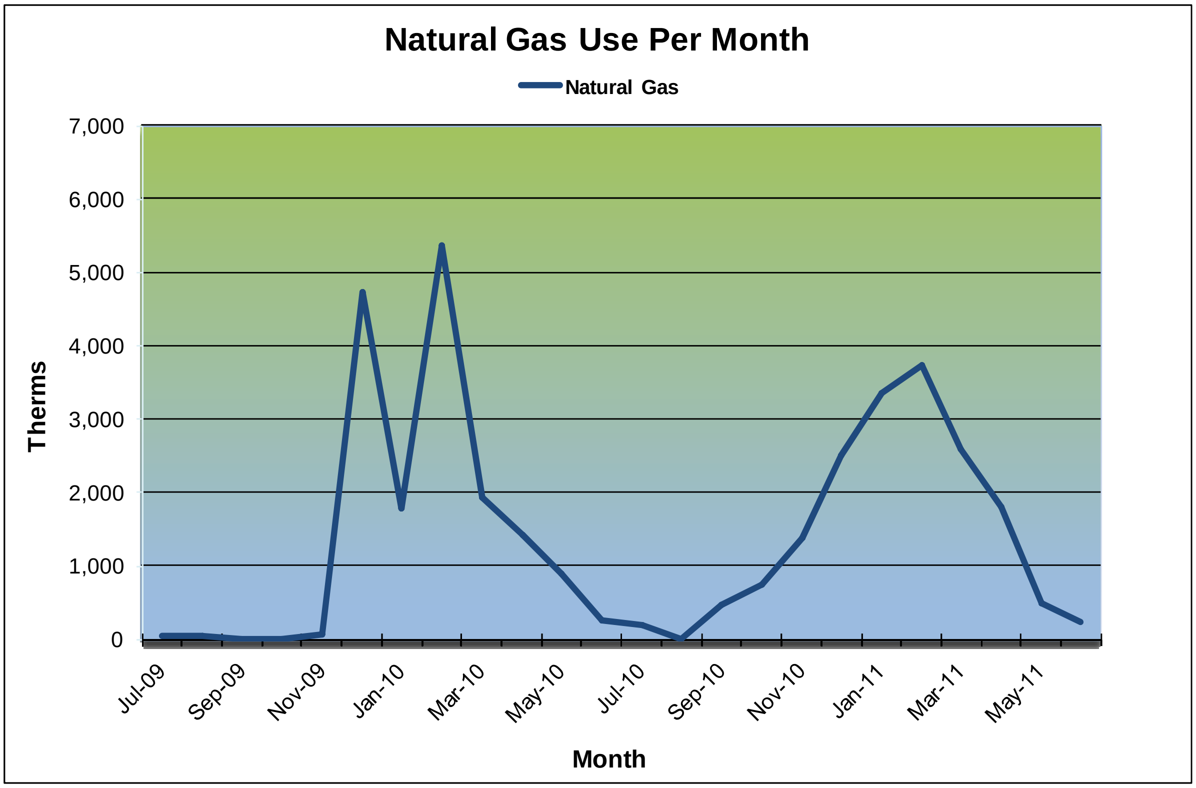


Figure 2b. Monthly Heating Fuel Use vs Cost for William Allen Elementary

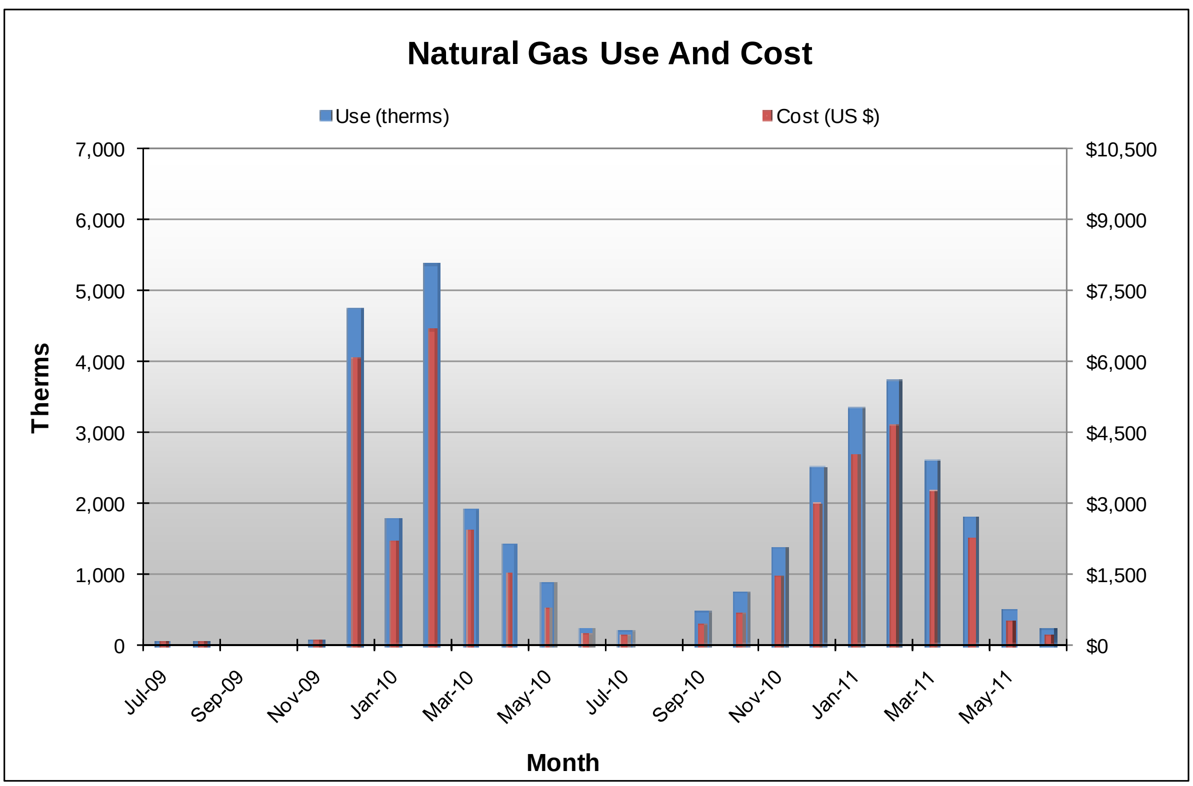
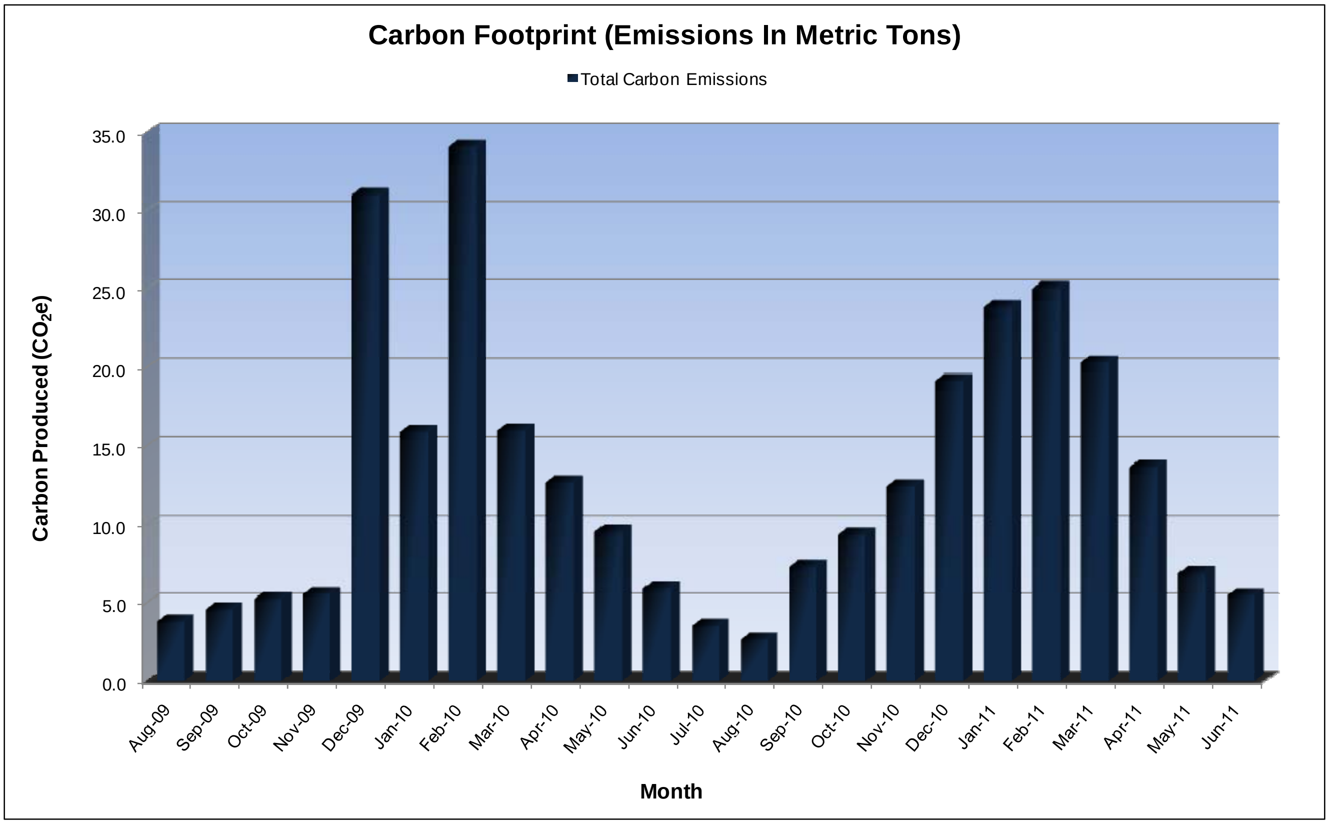


Figure 3. Monthly Greenhouse Gas Emissions for William Allen Elementary



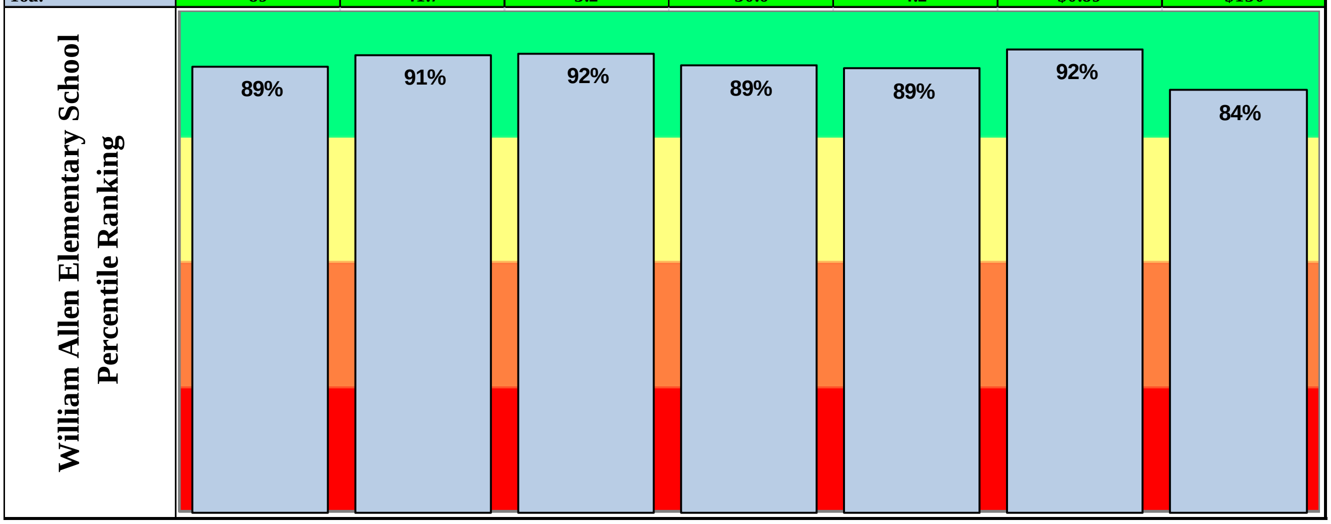
Benchmarking Data

To evaluate the energy and environmental performance of your school, the building data collected above has been compared against two different sets of school energy data: the U.S. Environmental Protection Agency's national data and New Hampshire specific state data. The results are illustrated in Figure 4 on the following page.

This will allow you to assess your building's performance relative to other buildings designed and constructed to the same codes and standards, operating under the same regulations and schedules and similar weather conditions. The indicators are calculated on a *per square foot* or *per student* basis, so you can compare your school to different sized schools.

Figure 4. EnergySmart Schools Benchmarks for William Allen Elementary School

Schools	U.S. EPA Portfolio Manager Score	New Hampshire State Schools (Annual Data)					
		Total Energy Use (kBtu/sq.ft.)	Electric Use (kWh/sq.ft.)	Heating Fuel Use (kBtu/sq.ft.)	Weather Adjusted Heating Fuel Use (Btu/sq.ft./HDD)	Total Energy Cost ($/sq.ft.)	Total Energy Cost ($/student)
NH Average:	50	60.3	5.2	41.7	5.7	$1.42	$256
You:	89	41.7	3.2	30.6	4.2	$0.89	$150



Major Benchmark Indicators

1. Total Energy Use, kBtu/sq.ft.

This indicator shows how much total energy your school consumes each year. It includes the energy used for heating, cooling (if any), lights, cooking, computers, etc.

Your school's total energy use of 41.7 kBtu per square foot per year (kBtu/sq.ft.) is better than the New Hampshire K-12 schools state average of 60.3 kBtu/sq.ft. Your total energy use figure is lower than 91% of New Hampshire K-12 schools. The EnergySmart School Report is weather normalized so fuel consumption for heating takes the difference in climate between northern and southern New Hampshire into account.

This is a good indicator of how well, overall, your school is performing. However, it doesn't help you find ***where*** in your building to look for improvement opportunities. Multiple factors included on the following pages can help with that. Analysis of energy consumption for this program does not control for operational variations. An example is an improperly ventilated school may appear to have lower energy consumption. Ventilation systems that are not operating properly result in lower indoor air quality.

2. Electricity Data

Most electric utilities use the following two factors to estimate your electricity bill – Electric Use and Electric Demand.

a. Electric Use, kWh/sq.ft.

This shows how well the building does with its lights, cooling/air conditioners and cafeteria systems (if any), and what's referred to as "plug load." Plug load is anything that plugs into a socket. The major plug loads are generally computers (including monitors, printers and copiers), refrigerators, coffee machines, fans, shop equipment and projectors. If electric consumption is much higher than average, but heating fuel use (see below) is average or better, then focus your efforts on the electric-powered elements.

New Hampshire schools state average electric use is 5.2 kWh per square foot. Your school's electric consumption of 3.2 kWh per square foot this year is lower than 92% of New Hampshire schools benchmarked through the New Hampshire EnergySmart Schools Program.

b. Electric Demand, Watts/sq.ft.

Demand is a measure of the maximum electric draw in kW that your building places on the grid and is measured by adding up the kW draw for a 15 minute period. To give an analogy, if electricity usage is the amount of water going through a hose in gallons, electric demand would be how fast that water flows expressed in gallons per minute. Whichever 15 minute period during your monthly billing cycle places the highest kW demand on the grid is the demand factor applied to your bill. The best way to improve this demand factor is to stagger the times when your electrical systems draw at their maximum or reduce unnecessary electric load altogether.

The average electric demand for New Hampshire schools is 1.9 watts per square foot. Your school's electric demand is 1.2 watts per square foot and is lower than 91% of New Hampshire Schools benchmarked through the New Hampshire EnergySmart Schools Program.

3. Heating Fuel Use, kBtu/sq.ft.

Reviewing these indicators is relatively straightforward. If your school's heating fuel use is much higher than average, an audit of your heating system along with your building envelope - doors, windows, roof - is recommended. This factor is 'fuel-neutral' as it works for either fuel oil or natural gas heating systems.

New Hampshire K-12 schools state average heating fuel use is 41.7 kBtu/sq.ft. or 5.7 Btu/sq.ft./HDD. Your school's heating fuel use of 30.6 kBtu/sq.ft. per year is lower than 89% of other New Hampshire schools in the database. Your school's weather adjusted heating fuel use of 4.2 Btu/sq.ft./HDD is also lower than 89% of other New Hampshire schools benchmarked through the New Hampshire EnergySmart Schools Program.

4. Energy Cost, $/sq.ft. & $/student

Cost is the bottom line. These numbers help you understand, in terms of budget, the gain through energy efficiency improvements. New Hampshire K-12 schools state averages $1.42/sq.ft. and $256/student.

Your school's annual energy cost of $0.89 per square foot is lower than 92% of other New Hampshire benchmarked schools. Your school's cost expressed on a per student basis of $150 is lower than 84% of other New Hampshire schools benchmarked through the New Hampshire EnergySmart Schools Program.

5. U.S. EPA *Portfolio Manager* Score

Portfolio Manager is a benchmarking model based on a national set of data from K-12 schools. It is provided by the U.S. Environmental Protection Agency's ENERGY STAR® Program. The impact of factors outside of your control (such as location, occupancy and operating hours) are removed, providing a 1-100 ranking of a school's energy performance relative to the national school building market. A score of 50 represents the national average and a score of 100 is best. Schools that achieve a score of 75 or higher are eligible for EPA's ENERGY STAR® Building Label, the national symbol for protecting the environment through energy efficiency. Districts can achieve ENERGY STAR® Leader Awards in recognition if their buildings, on average, improve by 10%, 20%, 30%, etc. over their baseline year of reported energy use or if the district's overall weighted average *Portfolio Manager* Score is at least a 75.

Your school's *Portfolio Manager* Score of 89 places it higher than 89% of K-12 schools nationwide. As noted above, this rating potentially qualifies your school for the prestigious ENERGY STAR® Label for Buildings.

III. Potential Energy Saving Opportunities

Based on the preceding analysis of your school's energy performance, implementation of the following recommendations can help you save energy and money. The first step is to look at reducing electrical lighting and HVAC consumption (burners, circulators and fans) which typically account for 67% of a building's electric consumption.

- **Perform an Energy Audit on the Building**

An energy audit involves a comprehensive analysis of the building's general characteristics, its energy use and allocation of that use amongst the facility's energy end uses. The goal is to identify sources of potential energy savings. Your auditor should develop a list of recommendations that will result in substantial energy and operational cost savings. These may include, building envelope improvement and mechanical systems, lighting upgrades, equipment replacement and installation of lighting and HVAC control mechanisms, among others.

A good audit should include information specific to each recommendation which *at least* includes approximate annual energy unit and cost savings, demand reduction, installation cost, lifetime cost savings and information related to cost-effectiveness. This will help to prioritize the recommendations based on their energy efficiency and shortest payback.

The recommendations provided in an energy audit report may reduce facility energy bills by 20% or more in addition to improving occupant health and comfort. Following this report, an energy audit is the next step in realizing the full potential of energy savings opportunities.

- **Request Retro-Commissioning**

Retro-commissioning is a detailed process applied to existing facilities aimed at correcting many of the degradations and inefficiencies that are indicative of older and/or poorly performing buildings. Many older buildings tend to be less comfortable and operate less efficiently when not properly commissioned. Retro-commissioning includes a detailed energy audit and focuses on not only potential energy savings but also the interaction of the building's equipments and mechanical systems with an eye toward restoring it to optimal performance.

In contrast to an energy audit, this optimization focuses on operational improvements to existing equipment, rather than replacement. Apart from energy savings, other improvements and benefits include substantial operation and maintenance (O&M) cost savings, improved air quality, occupant comfort, health and safety, equipment controls, and improved system interactivity.

In addition to providing recommendations, retro-commissioning includes implementation of the recommended improvements and hence the cost for retro-commissioning is higher than an audit. However, when the costs of improvements are added to the energy audit cost, prices may be comparable. If high O&M costs or occupant health, comfort and safety are concerns in addition to reduction in energy use, retro-commissioning may be a suitable strategy.

- **Upgrade Lighting Systems**

Lighting typically accounts for 30-60% of all energy consumed in school buildings. Additionally, the electrical energy consumed by lights during the summer creates heat and increases cooling costs.

William Allen Elementary School's electricity consumption is significantly low (better) compared to other schools in the State. Even so, upgraded lighting systems in high consumption areas like classrooms, gymnasiums, libraries, offices, etc. can reduce costs, improve the lighting quality and increase occupant comfort and productivity.

Over-lit Spaces: Light levels should be recorded in classrooms and hallways to ensure they are not over-lit, 40-50 foot candles are adequate light levels for an instructional space. If classroom light levels are much higher than 50 foot candles, William Allen Elementary School should consider de-lamping classrooms or installing dimming ballasts, which dim the lights when outdoor light levels are adequate. In over-lit hallway spaces photo sensors can be installed to turn lights off completely when light levels exceed a pre-set threshold.

In over-lit spaces a T8 to Super T8 lighting retro-fit can reduce the number of light fixtures needed. Super T8 lamps use between 4 and 7 Watts less electricity than standard T8 lamps, but they produce more light per Watt. In some cases this increase in light per Watt can allow for the removal of an entire lamp, saving 32 Watts. The room characteristics must be factored in before this type of retro-fit. The shape of the space, ceiling height, color of the walls, etc. all need to be taken into account when exploring a de-lamping project. We recommend that before retro-fitting the entire facility, begin by changing one classroom and monitor the comfort level of the occupants at William Allen Elementary School.

Another proven energy reduction measure with a short payback period is to identify any areas where your school may still be using metal halide lighting. Typically metal halide lights are found in gymnasiums or cafeteria areas, many districts have been very satisfied by replacing these lights with high bay T5 lighting fixtures. In addition to the reduced operational wattage, high bay T5 lights turn on instantly, as opposed to metal halide fixtures which have an extended warm up period. The long warm up period associated with metal halides typically leads to the lights being left on all day, at 250 to 400 watts a fixture; the costs begin to add up. Adding occupancy sensors to high bay T5 fixtures further reduces the payback period.

Occupancy Sensors: We recommend that you explore the use of occupancy sensors to ensure that lights are turned off in unoccupied spaces. Lights controlled by occupancy sensors typically run a third of the time when compared with manually controlled lighting. Reduced runtime leads to decreases in both energy usage and operation and maintenance costs. Additionally, a study conducted in Massachusetts found that controlling the security lighting with occupancy sensors reduced vandalism; neighbors and police recognized something wrong when the lights were on in a building that was typically dark and investigated.

To summarize and add a few ways in which William Allen Elementary School may be able to conserve energy and cost through lighting upgrades is to:

- Design light quantity and quality for the task and occupants' needs in that area.
- Maximize lamp and ballast efficiency.
- Activate the power saving features on office equipment such as copiers, printers and fax machines and ensure that they are turned off at the end of the day.
- Use automatic controls to turn lights off or dim lights in unoccupied spaces.
- Establish a maintenance schedule for group re-lamping and fixture cleaning.
- Replace T12 fixtures with the most efficient fixtures which may include T8/super T8/T5 fixtures.
- Replace incandescent lighting with compact fluorescent technology.

- Replace incandescent exit lighting which consumes 30 Watts with LED type exit lights with 1.5 Watts consumption. LED units last up to 10 years, which is a maintenance advantage.

- Install daylight sensors in areas with significant natural light.

- Install occupancy sensors in areas that are often unoccupied.

- Lighting retrofits reduce maintenance costs associated with lighting that is close to end of life.

- Establish a regular cleaning schedule particularly for areas where student safety of low light levels may be a concern, such as shop classes.

- Look to make lamp and fixture selection as uniform as possible to reduce maintenance and inventory overhead.

- Educate students and staff to turn off lights when rooms are unoccupied.

Lighting upgrades seek to reduce the connected electrical load (kW) and energy consumption (kWh) of lighting equipment. Lighting controls can also significantly reduce operating hours and costs by turning off lighting when spaces are unoccupied or sufficiently lit by natural light.

- **Install NEMA Premium Motors and VFDs**

Commercial and industrial electric motor-driven systems consume approximately 23% of all electricity in the U.S., making it the single largest category contributor to electric use in the country. With very high operating hours, the annual energy cost to run a system is more than its installation cost. Even a small increase in the efficiency of an electric motor can result in substantial energy cost savings. Typical opportunities for motor upgrades in schools include: ventilation fans, and heating and cooling system pumps and fans.

Motors with efficiency up to 90% are available to replace the older ones with efficiency less than 75%. Although standards for efficiency of new equipment are set by the Energy Policy Act, motor efficiency can be further increased by selecting Premium Efficiency motors as specified by the National Electrical Manufacturers Association (NEMA). This can cut the electric motor system demand by as much as 18%.

Savings can be increased further by optimizing system performance through the use of variable frequency drives (VFDs). When system load is known to vary substantially, these flow control systems can be utilized to match system output to system demand, significantly reducing energy usage during partial load hours. By employing high-efficiency motors and VFDs, facility owners can improve environmental conditions, utilize better control of motor-driven processes, and reduce waste output.

- **Install Demand Control Ventilation**

Demand control ventilation (DCV) monitors indoor air CO_2 content as a result of occupancy production levels and uses this data to regulate the amount of outdoor air that is permitted for ventilation. In order to ensure adequate air quality, standard ventilation systems permit outside air based on estimated occupancy levels in CFM, cubic feet per minute/occupant. However, during low occupancy hours, the space may become over ventilated due to decreased CO_2 levels and unnecessary ventilation results in wasted energy. DCV reduces unnecessary outdoor air intake by regulating ventilation based on actual CO_2 levels, saving energy. DCV is most suited for areas where occupancy levels are known to fluctuate considerably such as auditoriums, cafeterias, and gymnasiums.

Install Energy Recovery Ventilators. According to energy recovery equipment manufacturer's typical paybacks are less than 5 years for schools without cooling. The keys to success with ventilation retrofits are going with fewer larger units with long run hours as opposed to several small units with limited run time. Equipment with moisture recovery capabilities would cut humidity up to 50% during the cooling season.

- **Improve/Replace Inefficient Heating Systems**

Replacing an old boiler that is < 70% efficient with a modern 85-90% efficient natural gas-fired furnace alone will reduce heating costs by 15-20%. This combined with additional system improvements and installation of advanced HVAC control mechanisms can result in up to 20%+ heating load reduction.

Because of the high capital cost of new heating systems, some financial analysis should be performed to assess the cost-effectiveness of immediate replacement. If the current system is fairly new, replacement may not be immediately justifiable from a financial standpoint. However, as is the case with cooling systems, early replacement may prove to be a more cost-effective solution than waiting until existing systems fail or reach the end of their estimated useful life.

- **Improve/Replace Inefficient Air Conditioning Systems**

The useful life of a rooftop A/C unit is generally 12-18 years. However, depending on the efficiency, early replacement of outdated, inefficient, split, or packaged rooftop air conditioning units with new A/C systems that are 15% more efficient than 10-15 year old equipments can considerably reduce annual energy consumption. The energy cost savings and maintenance savings offset the high installation cost of a more efficient system. Installing thermostats and/or economizers on new or existing A/C systems will further reduce the cooling demand.

Economizers provide "free" cooling by using controllable dampers that bring in outside air to cool the space when the outdoor temperature or enthalpy is below the building's return air conditions. Although they require operation by a well calibrated and maintained control system, economizers have impressive energy-saving capabilities.

Install Occupancy Controlled/Programmable Thermostats

Combining efficient HVAC equipment with occupancy controlled and programmable thermostats can save a facility up to 10% of its annual heating and cooling costs:

- Areas with unpredictable occupancy on a daily/weekly basis - gym, bathrooms, outdoors: Use an *occupancy controlled thermostat* - a thermostat paired with a sensor and/or door detector to identify movement/occupancy. If occupancy is sensed by the sensor, the thermostat goes into an occupied mode (i.e. programmed set point). If a pre-programmed time frame elapses (i.e. 30 minutes) and no occupancy is sensed during that time, the thermostat goes into an unoccupied mode (e.g., setback set point or off) until occupancy is sensed again. This reduces the overall time the heating or cooling system is running, saving energy.

- Areas with predictable occupancy: e.g.: classrooms, cafeteria, offices: A *programmable thermostat* is recommended. This device is programmed on a schedule to reduce the heating or cooling output of the facility's HVAC systems in relation to its predetermined occupancy schedule. In this way, the thermostat acts to set-back or set-up the facility temperature during unoccupied hours, and re-establish a comfortable facility temperature during business hours. By employing programmable thermostat technology, the heating and cooling system demand coincides with occupancy level, reducing energy usage.

- **Install Vending Misers on Vending Machines**

Vending misers for refrigerated and non-refrigerated vending machines is an often overlooked source of potential savings. Uncontrolled, vending machine lights remain on 24/7, consuming a constant amount of energy year round. By controlling these lights with an occupancy sensor, energy consumption attributed to vending machines can be reduced considerably, in many cases, by as much as 50% and can save up to $150 per machine per year.

In the case of refrigerated vending machines, electric demand can be further reduced by controlling the machines' refrigeration systems. In a manner similar to programmable thermostats, vending misers for refrigerated machines act on a pre-set occupancy schedule to allow a marginal increase in operating temperature during non-business hours. Although products in the machine are delivered to the customer at the same temperature as in an uncontrolled vending machine, products are not being cooled unnecessarily when the machine is not in use, significantly reducing the machine's energy consumption. Because of the relatively low vending miser installation cost and high operating hours of vending machines, this improvement is typically cost-effective with a very short payback period.

- **Install ENERGY STAR® Rated Equipment / Plug Load Control**

Plug loads (computers, televisions, coffee makers, etc.) account for, on average, about 10% of total energy consumption. One of the easiest and most cost-effective energy saving strategies is the reduction of electric usage through installation of efficient appliances and the control of plug loads. In addition to utilizing ENERGY STAR® qualified appliances, greater savings can be realized through the various devices available that control every day plug loads.

By connecting non-critical loads (coffee makers, fans, microwave ovens, etc.) to an occupancy or timer controlled power strip, significant energy savings can be achieved. These savings result not only from the neglect of the user to turn the device off manually, but also from reduction of "phantom load". Phantom load is the small but constant energy draw from many plug-in devices when not in use. By connecting certain appliances to an occupancy controlled power strip, phantom load can be eliminated by cutting power supply to those devices. When replacing or ordering new equipment, emphasize ENERGY STAR® devices when they are available. Also, purchase controlled power strips and connect appropriate devices to those strips to reduce unnecessary consumption due to phantom load and appliances left on. The EPA offers free computer power management software which has saved some districts as much as $75 per computer per year, the software can be found at http://www.energystar.gov/index.cfm?c=power_mgt.pr_power_mgt_low_carbon_join.

IV. Resources:

The State of New Hampshire along with the utility companies offer multiple programs designed to improve the energy efficiency of schools through financial incentives and technical support, including:

Northeast Energy Efficiency Partnerships:

- **Northeast Collaborative for High Performance Schools (NE-CHPS)**
  NE-CHPS is a set of building and design standards for all schools from pre-K through community colleges tailored specifically for NH state code requirements, the New England climate, and the environmental priorities of the region. NH Department of Education offers up to a 3% re-imbursement for New Construction School projects. To learn more about NE-CHPS and incentive programs please visit: http://neep.org/public-policy/hpse/hpse-nechps.

New Hampshire Public Utilities Commission:

- **New Hampshire Pay for Performance**
  This program addresses the energy efficiency improvement needs of the commercial and industrial sector. The Program is implemented through a network of qualified Program Partners. Incentives will be paid out on the following three payment schedule: Incentive #1: Is based on the area of conditioned space in square feet. Incentive #2: Per/kWh saved and Per/MMBTU saved based on projected savings and paid at construction completion. Incentive #3: Per/kWh saved and Per/MMBTU saved based on actual energy savings performance one year post construction. Total performance incentives (#2 and #3) will be capped at $200,000 or 50% of project cost on a per project basis. For more information visit http://nhp4p.com.

- **New Hampshire Public Utilities Commission's Renewable Energy Rebates**
  The Sustainable Energy Division provides an incentive program for solar electric (photovoltaic or PV) arrays and solar thermal systems for domestic hot water, space and process heat, with a capacity of 100 kW or equivalent thermal output or less. The rebate for PV systems as follows: $1.00 per Watt, capped at 25% of the costs of the system or $50,000, whichever is less. For solar hot water (SHW) systems, the base rebate is $0.07 per rated or modeled kBtu/year, capped at 25% of the cost of the facility or $50,000, whichever is less, as a one-time incentive payment. http://www.puc.state.nh.us/Sustainable%20Energy/RenewableEnergyRebates-CI.html.

New Hampshire Community Development Finance Authority:

- **New Hampshire Community Development Finance Authority Revolving Loan Fund**
  The Enterprise Energy Fund is a low-interest loan and grant program available to businesses and nonprofit organizations to help finance energy improvements and renewable energy projects in their buildings. The loans will range from $10,000 to $500,000. Larger amounts will be considered on a case by case basis. The program is available to finance improvements to the overall energy-efficiency performance of buildings owned by businesses and nonprofits, thereby lowering their overall energy costs and the associated carbon emissions. More information about the program can be found on their website www.nhcdfa.org. These activities may include:

  - Improvements to the building's envelope, including air sealing and insulation in the walls, attics and foundations;
  - Improvements to HVAC equipment and air exchange;
  - Installation of renewable energy systems;
  - Improvements to lighting, equipment, and other electrical systems; and
  - Conduction of comprehensive, fuel-blind energy audits.

Public Service of New Hampshire (PSNH):

- **Commercial (Electric) Energy Efficiency Incentive Programs**
  This program targets any commercial/industrial member building a new facility, undergoing a major renovation, or replacing failed (end-of-life) equipment. The program offers prescriptive and custom rebates for lighting and lighting controls, motors, VFDs, HVAC systems, chillers and custom projects. http://www.psnh.com/SaveEnergyMoney/For-Business/Energy-Saving-Programs-and-Incentives.aspx

- **SmartSTART**
  The SmartSTART (Savings Through Affordable Retrofit Technologies) advantage is simple - pay nothing out of pocket to have energy efficiency products and services installed in your building. The Smart Start program is limited to PSNH's municipal customers only and includes schools. The program is available on a first-come, first served basis to projects which have been pre-qualified by PSNH. The cost of the improvements is fronted by PSNH which is then repaid over time by the municipality or school using the savings generated by the products themselves! This program is for lighting and lighting controls, air sealing, insulation and other verifiable energy savings measures which have sufficient kilowatt-hour savings. For more information on this program visit:
  http://www.psnh.com/SaveEnergyMoney/For-Business/Municipal-Smart-Start-Program.aspx

- **Schools Program**
  For major renovation or equipment replacement projects, this program offers prescriptive and custom rebates for energy efficient lighting, motors, HVAC, chillers, and variable frequency drives to towns or cities that install energy efficient equipment at their schools. Financial incentives are available for qualifying energy efficient equipment. Technical assistance is also offered through the Schools Program. http://www.psnh.com/SaveEnergyMoney/Large-Power/Schools-Program.aspx

Unitil:

- **Commercial and Industrial Energy Efficiency Programs**
  Subject to program qualifications and availability of funding - Unitil offers different programs for its commercial, industrial, and institutional customers in New Hampshire: the Small Business Energy Efficiency Program, the Small Commercial and Industrial Program, the Large Commercial and Industrial Program, the Large Commercial and Industrial (C&I) Retrofit Program, and the Large C&I New Construction Program. Rebates are available for various technologies including water heaters, lighting, lighting controls/sensors, chillers, furnaces, boilers, central air conditioners, compressed air, programmable thermostats, energy management systems/building controls, motors, motor VFDs, processing and manufacturing equipment, LED exit signs, commercial cooking and refrigeration equipment. http://www.unitil.com/.

Clean Air – Cool Planet:

- **Community Energy Efficiency**
  CA-CP works with communities throughout the Northeast to find solutions to climate change and build constituencies for effective climate policies and actions. Much of their work focuses on successful models for energy efficiency and renewable energy planning. They advise and partner with citizens, educators, faith groups, small businesses, municipal governments, and other local leaders. They explore cost-effective opportunities that exist for communities to reduce their emissions as well as their vulnerability to climate impacts. One such example is CA-CP's partnership with the University of NH, NH Sustainable Energy Association and UNH Cooperative Extension to create www.myenergyplan.net, a groundbreaking suite of web and outreach tools for individual action used by households, schools and community groups around the northeast. http://www.cleanair-coolplanet.org/for_communities/index.php.

Environmental Protection Agency (EPA):

- **ENERGY STAR Challenge for Schools**
  EPA is challenging school administrators and building managers to improve energy efficiency throughout their facilities. More than 500 school districts across the country are helping to fight climate change by committing to reducing their energy use with help from ENERGY STAR. Schools that take the ENERGY STAR Challenge can use energy tracking tools, technical guidance, case studies and other ENERGY STAR tools and resources to help them improve their energy efficiency. More information can be found at:
  http://yosemite.epa.gov/opa/admpress.nsf/d985312f6895893b852574ac005f1e40/d74f768ecfa9e11f8525762500522260!OpenDocument

For additional assistance in helping you save money and improve school conditions, please call TRC at (603) 766-1913 or (877) 442-9181.

NEW HAMPSHIRE ENERGYSMART SCHOOLS PROGRAM

Energy Benchmarking Report for:

Spaulding High School

Rochester, NH

Period: ***July 1, 2010*** through ***June 30, 2011***

PREPARED BY:

TRC

155 Fleet Street, Suite #305

Portsmouth, NH 03801

(603) 766-1913

www.trcsolutions.com

Table of Contents

I. Introduction

The Sustainable Energy Division of the New Hampshire Public Utilities Commission, with support from the New Hampshire Department of Education has sponsored TRC to develop the New Hampshire ***EnergySmart Schools Program*** to support New Hampshire K-12 public and private schools in the pursuit of energy efficiency and sustainability initiatives.

Energy efficiency has become an increasingly important issue for schools due to tightening budgets and rising energy costs. Since 2003, the prices of natural gas, fuel oil and electricity have increased by 123%, 107% and 32% respectively. Schools that have participated in energy benchmarking programs have shown a decrease in overall energy use by approximately 22% through the adoption of energy efficiency measures.

Tracking and documenting the energy use and associated carbon emissions in the state's K-12 schools will allow New Hampshire to account for the impact of its energy efficiency and renewable energy programs and determine which have the greatest effect. The analysis in this report, provided by the ***EnergySmart Schools Program*** is designed to help you:

- Understand the energy consumption and cost trends at each of your school buildings.
- Learn how your buildings are performing compared to other schools locally and nationally.
- Identify opportunities for improving operations and reducing costs.
- Take advantage of resources to implement efficiency improvements and save money.

The analysis was based on the information provided on the *Building Data Request Form* submitted, which included building descriptions, energy suppliers and other information. The building's utility bills were also used to assess its electricity and heating fuel consumption for the year(s) provided.

The energy performance for your school has been compared to national data for similar school facilities through EPA's ENERGY STAR® Portfolio Manager. Also shown are the five major benchmarks used to analyze building performance, which include: electricity use; heating fuel use; weather-normalized heating fuel use; total cost; and total cost per student, all of which have been normalized for comparison by square footage and weather. As part of the program's focus on sustainability, your school's carbon footprint is also presented.

II. Benchmarking Analysis and Review Results

Building and energy usage of your school was analyzed to assess the basic nature of your energy consumption and utility costs. The Building Data Summary table shown below summarizes this information.

Table 1: Building Data Summary for Spaulding High School

Building Data			
District	SAU 54 Rochester School Department	**School Name**	Spaulding High School
City	Rochester	**Zip Code**	03867
Year Built	1939	**Floor Area (sq.ft.)**	246,000
Number of Students	1,496	**Number of PCs**	493
Weekly Operating Hours	80	**Months School Used**	12
Cooking?	YES	**% AC**	20
Pool Size?	N/A	**Months Pool Used**	0

Utility Data			
Data End Point	6/30/2011	**Total Cost ($)**	236,499
Electric Provider	PSNH	**Natural Gas Provider**	Unitil
Electricity Usage (kWh)	1,027,000	**Electricity Cost ($)**	144,331
Natural Gas Usage (therms)	90,954	**Natural Gas Cost ($)**	92,168
Fuel Oil Usage (gal)	0	**Fuel Oil Cost ($)**	0
Other Fuel Usage (gal)	0	**Other Fuel Cost ($)**	0

Energy Indicators			
EPA Score	96	**Electric Usage (kWh/sq.ft.)**	4.2
Heating Fuel Usage (kBtu/sq.ft.)	37.0	**Weather Adjusted Heating Usage Btu/sq.ft./HDD)**	5.1
Site Energy (kBtu/sq.ft.)	51.2	**Source Energy (kBtu/sq.ft.)**	86

Environmental Impact Indicators			
Greenhouse Gas Emissions			
Last Year Heating Fuel CO_2e (Mt)	483.9	**Last Year Total CO_2e (Mt)**	802.5
Last Year Electricity CO_2e (Mt)	318.6	**CO_2e Efficiency Savings Over Previous Year**	-216.3
EPA Target Score			
Target Score	Reached	**Site Energy Reduction Needed (kBtu/sq.ft.)**	N/A - Reached

Figures 1a, 1b, 2a and 2b display the energy use, demand and cost data tracked on a monthly basis. This demonstrates the energy consumption of your building over the course of the year. As a part of the program's focus on sustainability, your school's carbon footprint was also measured and is presented in Figure 3.

Figure 1a. Monthly Electric Use & Max Demand for Spaulding High School

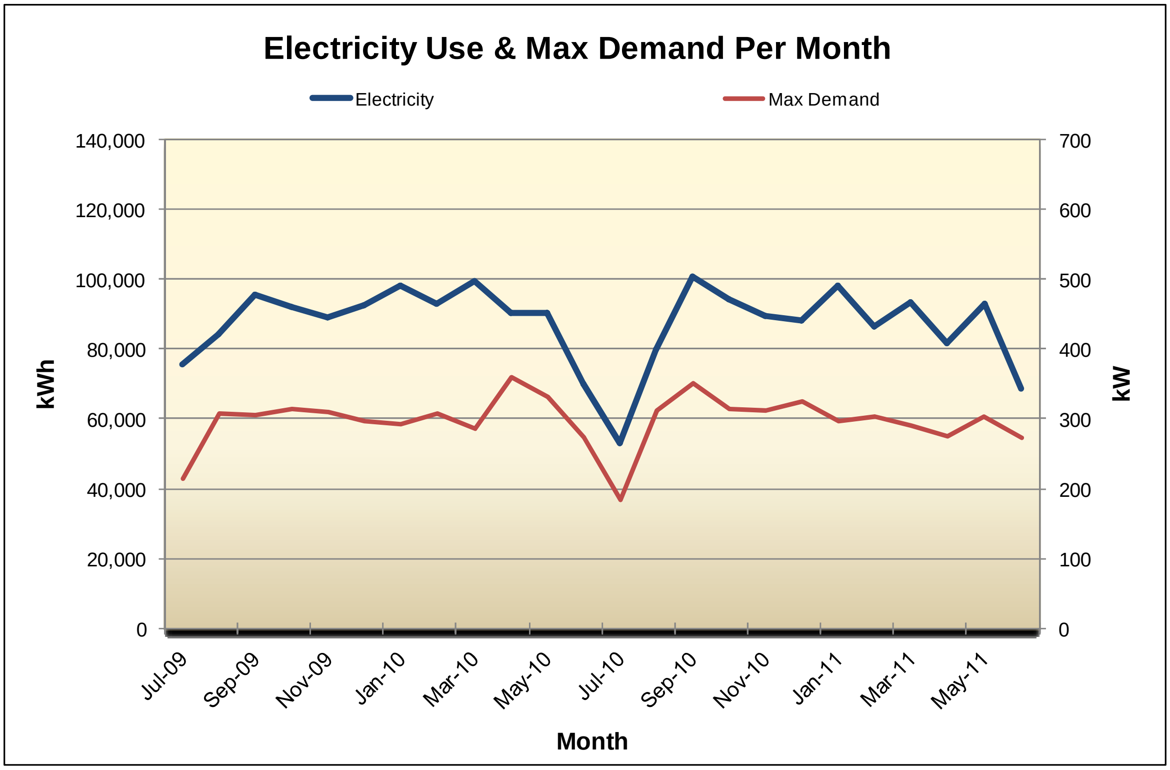
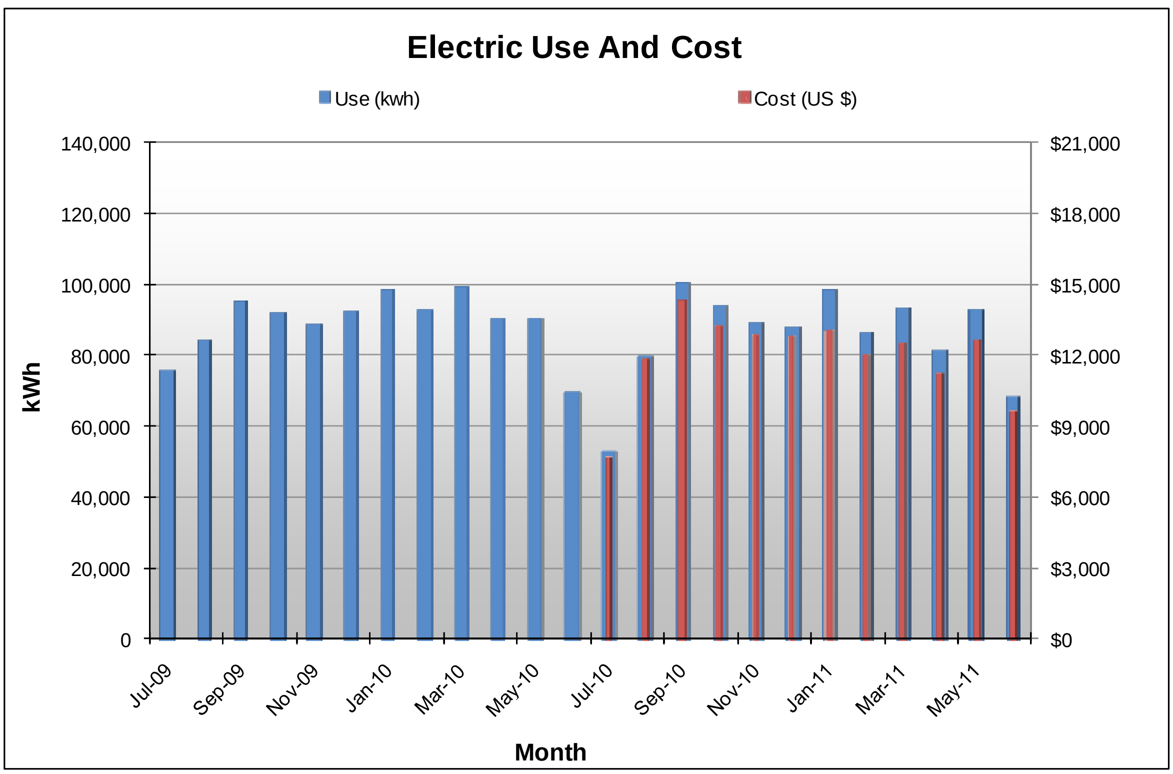


Figure 1b. Monthly Electric Use vs. Cost for Spaulding High School



Note: Electric Cost was only available for the most recent 12 month period.

Figure 2a. Monthly Natural Gas Use for Spaulding High School

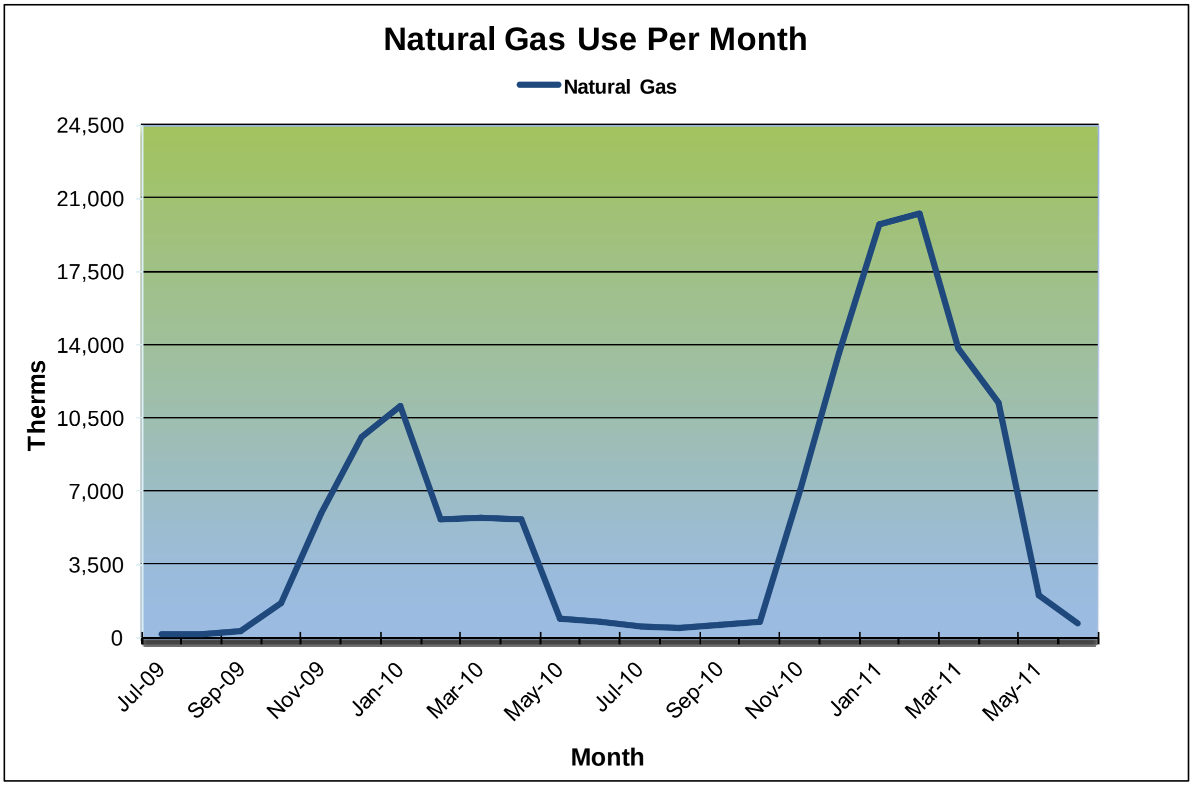


Figure 2b. Monthly Natural Gas Use vs Cost for Spaulding High School

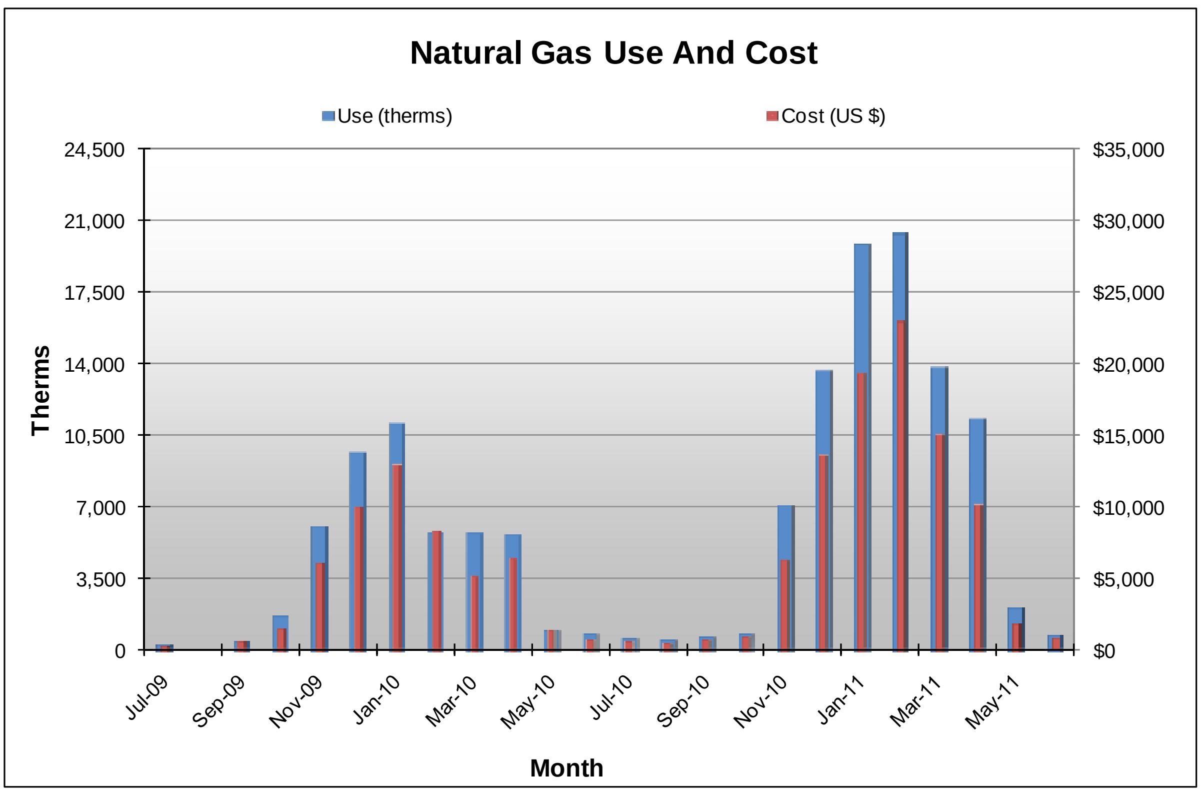
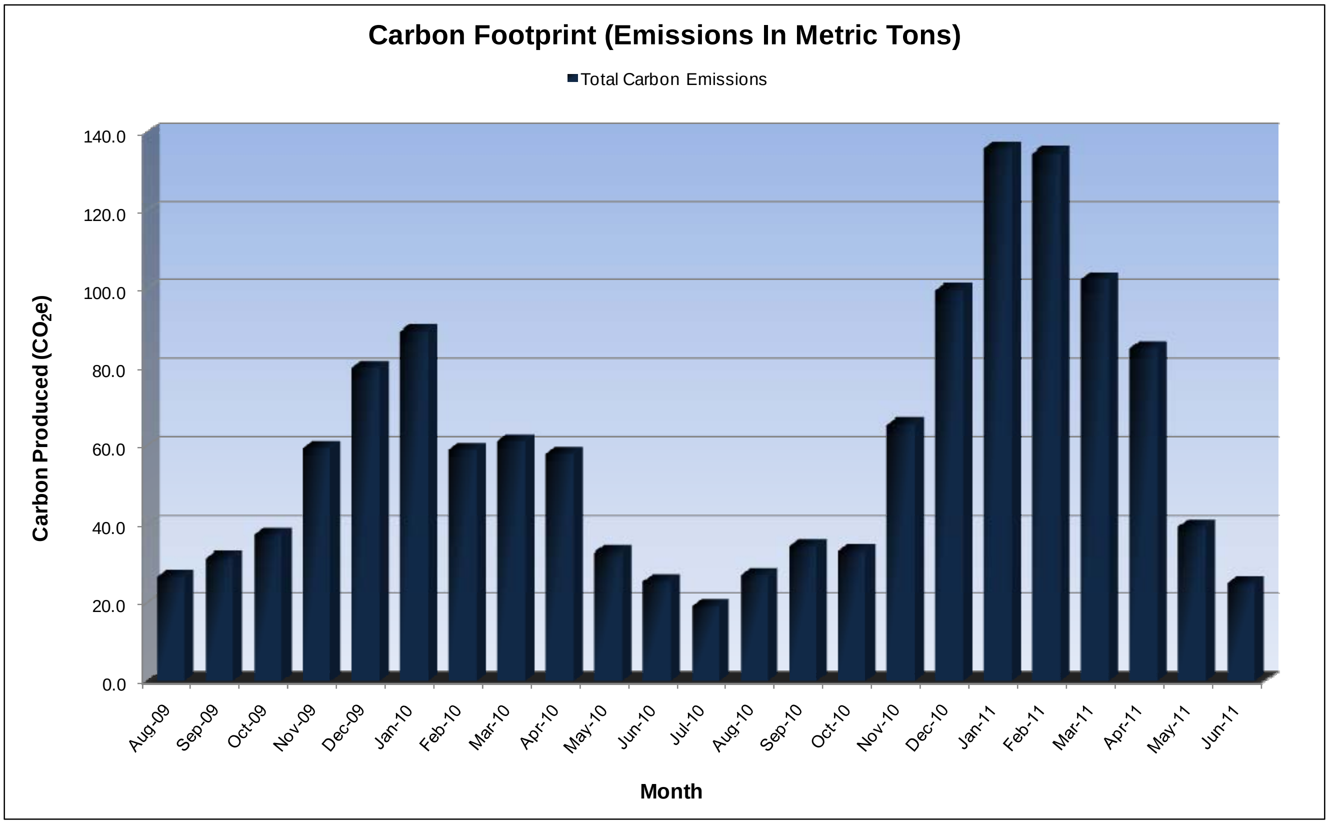


Figure 3. Monthly Greenhouse Gas Emissions for Spaulding High School



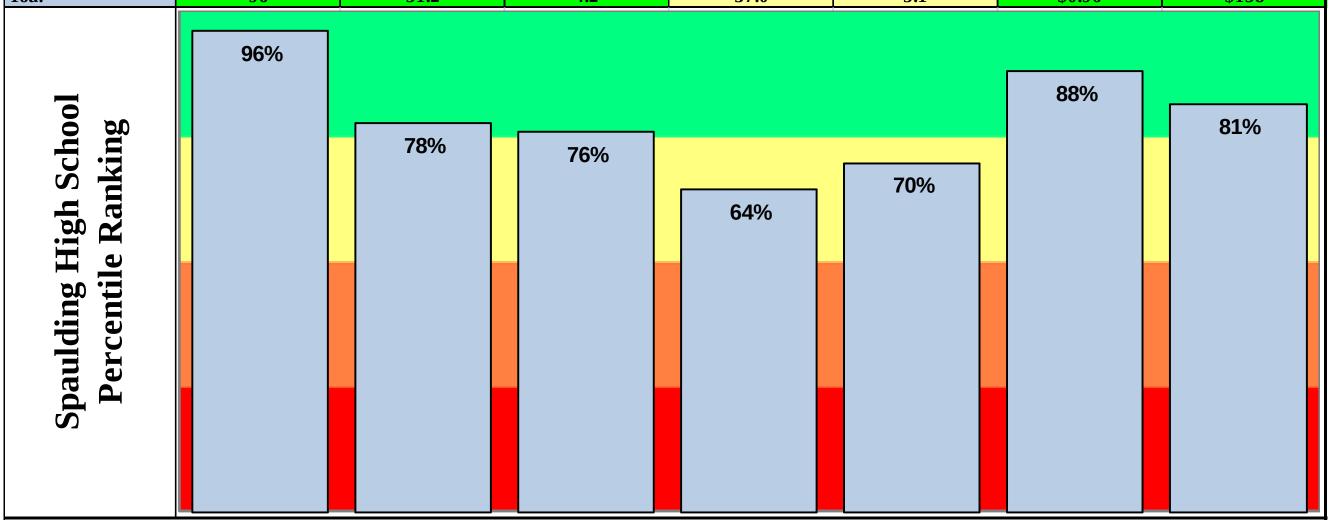
Benchmarking Data

To evaluate the energy and environmental performance of your school, the building data collected above has been compared against two different sets of school energy data: the U.S. Environmental Protection Agency's national data and New Hampshire specific state data. The results are illustrated in Figure 4 on the following page.

This will allow you to assess your building's performance relative to other buildings designed and constructed to the same codes and standards, operating under the same regulations and schedules and similar weather conditions. The indicators are calculated on a *per square foot* or *per student* basis, so you can compare your school to different sized schools.

Figure 4. EnergySmart Schools Benchmarks for Spaulding High School

Schools	U.S. EPA Portfolio Manager Score	New Hampshire State Schools (Annual Data)					
		Total Energy Use (kBtu/sq.ft.)	Electric Use (kWh/sq.ft.)	Heating Fuel Use (kBtu/sq.ft.)	Weather Adjusted Heating Fuel Use (Btu/sq.ft./HDD)	Total Energy Cost ($/sq.ft.)	Total Energy Cost ($/student)
NH Average:	50	60.3	5.2	41.7	5.7	$1.42	$256
You:	96	51.2	4.2	37.0	5.1	$0.96	$158



Major Benchmark Indicators

1. Total Energy Use, kBtu/sq.ft.

This indicator shows how much total energy your school consumes each year. It includes the energy used for heating, cooling (if any), lights, cooking, computers, etc.

Your school's total energy use of 51.2 kBtu per square foot per year (kBtu/sq.ft.) is better than the New Hampshire K-12 schools state average of 60.3 kBtu/sq.ft. Your total energy use figure is lower than 78% of New Hampshire K-12 schools. The EnergySmart School Report is weather normalized so fuel consumption for heating takes the difference in climate between northern and southern New Hampshire into account.

This is a good indicator of how well, overall, your school is performing. However, it doesn't help you find ***where*** in your building to look for improvement opportunities. Multiple factors included on the following pages can help with that. Analysis of energy consumption for this program does not control for operational variations. An example is an improperly ventilated school may appear to have lower energy consumption. Ventilation systems that are not operating properly result in lower indoor air quality.

2. Electricity Data

Most electric utilities use the following two factors to estimate your electricity bill – Electric Use and Electric Demand.

a. Electric Use, kWh/sq.ft.

This shows how well the building does with its lights, cooling/air conditioners and cafeteria systems (if any), and what's referred to as "plug load." Plug load is anything that plugs into a socket. The major plug loads are generally computers (including monitors, printers and copiers), refrigerators, coffee machines, fans, shop equipment and projectors. If electric consumption is much higher than average, but heating fuel use (see below) is average or better, then focus your efforts on the electric-powered elements.

New Hampshire schools state average electric use is 5.2 kWh per square foot. Your school's electric consumption of 4.2 kWh per square foot this year is lower than 76% of New Hampshire schools benchmarked through the New Hampshire EnergySmart Schools Program.

b. Electric Demand, Watts/sq.ft.

Demand is a measure of the maximum electric draw in kW that your building places on the grid and is measured by adding up the kW draw for a 15 minute period. To give an analogy, if electricity usage is the amount of water going through a hose in gallons, electric demand would be how fast that water flows expressed in gallons per minute. Whichever 15 minute period during your monthly billing cycle places the highest kW demand on the grid is the demand factor applied to your bill. The best way to improve this demand factor is to stagger the times when your electrical systems draw at their maximum or reduce unnecessary electric load altogether.

The average electric demand for New Hampshire schools is 1.9 watts per square foot. Your school's electric demand is 1.4 watts per square foot and is lower than 85% of New Hampshire Schools benchmarked through the New Hampshire EnergySmart Schools Program.

3. Heating Fuel Use, kBtu/sq.ft.

Reviewing these indicators is relatively straightforward. If your school's heating fuel use is much higher than average, an audit of your heating system along with your building envelope - doors, windows, roof - is recommended. This factor is 'fuel-neutral' as it works for either fuel oil or natural gas heating systems.

New Hampshire K-12 schools state average heating fuel use is 41.7 kBtu/sq.ft. or 5.7 Btu/sq.ft./HDD. Your school's heating fuel use of 37.0 kBtu/sq.ft. per year is lower than 64% of other New Hampshire schools in the database. Your school's weather adjusted heating fuel use of 5.1 Btu/sq.ft./HDD is lower than 70% of other New Hampshire schools benchmarked through the New Hampshire EnergySmart Schools Program.

4. Energy Cost, $/sq.ft. & $/student

Cost is the bottom line. These numbers help you understand, in terms of budget, the gain through energy efficiency improvements. New Hampshire K-12 schools state averages $1.42/sq.ft. and $256/student.

Your school's annual energy cost of $0.96 per square foot is lower than 88% of other New Hampshire benchmarked schools. Your school's cost expressed on a per student basis of $158 is lower than 81% of other New Hampshire schools benchmarked through the New Hampshire EnergySmart Schools Program.

5. U.S. EPA *Portfolio Manager* Score

Portfolio Manager is a benchmarking model based on a national set of data from K-12 schools. It is provided by the U.S. Environmental Protection Agency's ENERGY STAR® Program. The impact of factors outside of your control (such as location, occupancy and operating hours) are removed, providing a 1-100 ranking of a school's energy performance relative to the national school building market. A score of 50 represents the national average and a score of 100 is best. Schools that achieve a score of 75 or higher are eligible for EPA's ENERGY STAR® Building Label, the national symbol for protecting the environment through energy efficiency. Districts can achieve ENERGY STAR® Leader Awards in recognition if their buildings, on average, improve by 10%, 20%, 30%, etc. over their baseline year of reported energy use or if the district's overall weighted average *Portfolio Manager* Score is at least a 75.

Your school's *Portfolio Manager* Score of 96 places it higher than 96% of K-12 schools nationwide. As noted above, this rating potentially qualifies your school for the prestigious ENERGY STAR® Label for Buildings.

III. Potential Energy Saving Opportunities

Based on the preceding analysis of your school's energy performance, implementation of the following recommendations can help you save energy and money. The first step is to look at reducing electrical lighting and HVAC consumption (burners, circulators and fans) which typically account for 67% of a building's electric consumption.

- **Perform an Energy Audit on the Building**

An energy audit involves a comprehensive analysis of the building's general characteristics, its energy use and allocation of that use amongst the facility's energy end uses. The goal is to identify sources of potential energy savings. Your auditor should develop a list of recommendations that will result in substantial energy and operational cost savings. These may include, building envelope improvement and mechanical systems, lighting upgrades, equipment replacement and installation of lighting and HVAC control mechanisms, among others.

A good audit should include information specific to each recommendation which *at least* includes approximate annual energy unit and cost savings, demand reduction, installation cost, lifetime cost savings and information related to cost-effectiveness. This will help to prioritize the recommendations based on their energy efficiency and shortest payback.

The recommendations provided in an energy audit report may reduce facility energy bills by 20% or more in addition to improving occupant health and comfort. Following this report, an energy audit is the next step in realizing the full potential of energy savings opportunities.

- **Request Retro-Commissioning**

Retro-commissioning is a detailed process applied to existing facilities aimed at correcting many of the degradations and inefficiencies that are indicative of older and/or poorly performing buildings. Many older buildings tend to be less comfortable and operate less efficiently when not properly commissioned. Retro-commissioning includes a detailed energy audit and focuses on not only potential energy savings but also the interaction of the building's equipments and mechanical systems with an eye toward restoring it to optimal performance.

In contrast to an energy audit, this optimization focuses on operational improvements to existing equipment, rather than replacement. Apart from energy savings, other improvements and benefits include substantial operation and maintenance (O&M) cost savings, improved air quality, occupant comfort, health and safety, equipment controls, and improved system interactivity.

In addition to providing recommendations, retro-commissioning includes implementation of the recommended improvements and hence the cost for retro-commissioning is higher than an audit. However, when the costs of improvements are added to the energy audit cost, prices may be comparable. If high O&M costs or occupant health, comfort and safety are concerns in addition to reduction in energy use, retro-commissioning may be a suitable strategy.

- **Upgrade Lighting Systems**

Lighting typically accounts for 30-60% of all energy consumed in school buildings. Additionally, the electrical energy consumed by lights during the summer creates heat and increases cooling costs.

Spaulding High School's electricity consumption is low (better) compared to other schools in the State. Even so, upgraded lighting systems in high consumption areas like classrooms, gymnasiums, libraries, offices, etc. can reduce costs, improve the lighting quality and increase occupant comfort and productivity.

Over-lit Spaces: Light levels should be recorded in classrooms and hallways to ensure they are not over-lit, 40-50 foot candles are adequate light levels for an instructional space. If classroom light levels are much higher than 50 foot candles, Spaulding High School should consider de-lamping classrooms or installing dimming ballasts, which dim the lights when outdoor light levels are adequate. In over-lit hallway spaces photo sensors can be installed to turn lights off completely when light levels exceed a pre-set threshold.

In over-lit spaces a T8 to Super T8 lighting retro-fit can reduce the number of light fixtures needed. Super T8 lamps use between 4 and 7 Watts less electricity than standard T8 lamps, but they produce more light per Watt. In some cases this increase in light per Watt can allow for the removal of an entire lamp, saving 32 Watts. The room characteristics must be factored in before this type of retro-fit. The shape of the space, ceiling height, color of the walls, etc. all need to be taken into account when exploring a de-lamping project. We recommend that before retro-fitting the entire facility, begin by changing one classroom and monitor the comfort level of the occupants at Spaulding High School.

Another proven energy reduction measure with a short payback period is to identify any areas where your school may still be using metal halide lighting. Typically metal halide lights are found in gymnasiums or cafeteria areas, many districts have been very satisfied by replacing these lights with high bay T5 lighting fixtures. In addition to the reduced operational wattage, high bay T5 lights turn on instantly, as opposed to metal halide fixtures which have an extended warm up period. The long warm up period associated with metal halides typically leads to the lights being left on all day, at 250 to 400 watts a fixture; the costs begin to add up. Adding occupancy sensors to high bay T5 fixtures further reduces the payback period.

Occupancy Sensors: We recommend that you explore the use of occupancy sensors to ensure that lights are turned off in unoccupied spaces. Lights controlled by occupancy sensors typically run a third of the time when compared with manually controlled lighting. Reduced runtime leads to decreases in both energy usage and operation and maintenance costs. Additionally, a study conducted in Massachusetts found that controlling the security lighting with occupancy sensors reduced vandalism; neighbors and police recognized something wrong when the lights were on in a building that was typically dark and investigated.

To summarize and add a few ways in which Spaulding High School may be able to conserve energy and cost through lighting upgrades is to:

- Design light quantity and quality for the task and occupants' needs in that area.
- Maximize lamp and ballast efficiency.
- Activate the power saving features on office equipment such as copiers, printers and fax machines and ensure that they are turned off at the end of the day.
- Use automatic controls to turn lights off or dim lights in unoccupied spaces.
- Establish a maintenance schedule for group re-lamping and fixture cleaning.
- Replace T12 fixtures with the most efficient fixtures which may include T8/super T8/T5 fixtures.
- Replace incandescent lighting with compact fluorescent technology.

- Replace incandescent exit lighting which consumes 30 Watts with LED type exit lights with 1.5 Watts consumption. LED units last up to 10 years, which is a maintenance advantage.
- Install daylight sensors in areas with significant natural light.
- Install occupancy sensors in areas that are often unoccupied.
- Lighting retrofits reduce maintenance costs associated with lighting that is close to end of life.
- Establish a regular cleaning schedule particularly for areas where student safety of low light levels may be a concern, such as shop classes.
- Look to make lamp and fixture selection as uniform as possible to reduce maintenance and inventory overhead.
- Educate students and staff to turn off lights when rooms are unoccupied.

Lighting upgrades seek to reduce the connected electrical load (kW) and energy consumption (kWh) of lighting equipment. Lighting controls can also significantly reduce operating hours and costs by turning off lighting when spaces are unoccupied or sufficiently lit by natural light.

- **Install NEMA Premium Motors and VFDs**

Commercial and industrial electric motor-driven systems consume approximately 23% of all electricity in the U.S., making it the single largest category contributor to electric use in the country. With very high operating hours, the annual energy cost to run a system is more than its installation cost. Even a small increase in the efficiency of an electric motor can result in substantial energy cost savings. Typical opportunities for motor upgrades in schools include: ventilation fans, and heating and cooling system pumps and fans.

Motors with efficiency up to 90% are available to replace the older ones with efficiency less than 75%. Although standards for efficiency of new equipment are set by the Energy Policy Act, motor efficiency can be further increased by selecting Premium Efficiency motors as specified by the National Electrical Manufacturers Association (NEMA). This can cut the electric motor system demand by as much as 18%.

Savings can be increased further by optimizing system performance through the use of variable frequency drives (VFDs). When system load is known to vary substantially, these flow control systems can be utilized to match system output to system demand, significantly reducing energy usage during partial load hours. By employing high-efficiency motors and VFDs, facility owners can improve environmental conditions, utilize better control of motor-driven processes, and reduce waste output.

- **Install Demand Control Ventilation**

Demand control ventilation (DCV) monitors indoor air CO_2 content as a result of occupancy production levels and uses this data to regulate the amount of outdoor air that is permitted for ventilation. In order to ensure adequate air quality, standard ventilation systems permit outside air based on estimated occupancy levels in CFM, cubic feet per minute/occupant. However, during low occupancy hours, the space may become over ventilated due to decreased CO_2 levels and unnecessary ventilation results in wasted energy. DCV reduces unnecessary outdoor air intake by regulating ventilation based on actual CO_2 levels, saving energy. DCV is most suited for areas where occupancy levels are known to fluctuate considerably such as auditoriums, cafeterias, and gymnasiums.

Install Energy Recovery Ventilators. According to energy recovery equipment manufacturer's typical paybacks are less than 5 years for schools without cooling. The keys to success with ventilation retrofits are going with fewer larger units with long run hours as opposed to several small units with limited run time. Equipment with moisture recovery capabilities would cut humidity up to 50% during the cooling season.

- **Improve/Replace Inefficient Heating Systems**

Replacing an old boiler that is < 70% efficient with a modern 85-90% efficient natural gas-fired furnace alone will reduce heating costs by 15-20%. This combined with additional system improvements and installation of advanced HVAC control mechanisms can result in up to 20%+ heating load reduction.

Because of the high capital cost of new heating systems, some financial analysis should be performed to assess the cost-effectiveness of immediate replacement. If the current system is fairly new, replacement may not be immediately justifiable from a financial standpoint. However, as is the case with cooling systems, early replacement may prove to be a more cost-effective solution than waiting until existing systems fail or reach the end of their estimated useful life.

- **Improve/Replace Inefficient Air Conditioning Systems**

The useful life of a rooftop A/C unit is generally 12-18 years. However, depending on the efficiency, early replacement of outdated, inefficient, split, or packaged rooftop air conditioning units with new A/C systems that are 15% more efficient than 10-15 year old equipments can considerably reduce annual energy consumption. The energy cost savings and maintenance savings offset the high installation cost of a more efficient system. Installing thermostats and/or economizers on new or existing A/C systems will further reduce the cooling demand.

Economizers provide "free" cooling by using controllable dampers that bring in outside air to cool the space when the outdoor temperature or enthalpy is below the building's return air conditions. Although they require operation by a well calibrated and maintained control system, economizers have impressive energy-saving capabilities.

Install Occupancy Controlled/Programmable Thermostats

Combining efficient HVAC equipment with occupancy controlled and programmable thermostats can save a facility up to 10% of its annual heating and cooling costs:

- Areas with unpredictable occupancy on a daily/weekly basis - gym, bathrooms, outdoors: Use an *occupancy controlled thermostat* - a thermostat paired with a sensor and/or door detector to identify movement/occupancy. If occupancy is sensed by the sensor, the thermostat goes into an occupied mode (i.e. programmed set point). If a pre-programmed time frame elapses (i.e. 30 minutes) and no occupancy is sensed during that time, the thermostat goes into an unoccupied mode (e.g., setback set point or off) until occupancy is sensed again. This reduces the overall time the heating or cooling system is running, saving energy.

- Areas with predictable occupancy: e.g.: classrooms, cafeteria, offices: A *programmable thermostat* is recommended. This device is programmed on a schedule to reduce the heating or cooling output of the facility's HVAC systems in relation to its predetermined occupancy schedule. In this way, the thermostat acts to set-back or set-up the facility temperature during unoccupied hours, and re-establish a comfortable facility temperature during business hours. By employing programmable thermostat technology, the heating and cooling system demand coincides with occupancy level, reducing energy usage.

- **Install Vending Misers on Vending Machines**

Vending misers for refrigerated and non-refrigerated vending machines is an often overlooked source of potential savings. Uncontrolled, vending machine lights remain on 24/7, consuming a constant amount of energy year round. By controlling these lights with an occupancy sensor, energy consumption attributed to vending machines can be reduced considerably, in many cases, by as much as 50% and can save up to $150 per machine per year.

In the case of refrigerated vending machines, electric demand can be further reduced by controlling the machines' refrigeration systems. In a manner similar to programmable thermostats, vending misers for refrigerated machines act on a pre-set occupancy schedule to allow a marginal increase in operating temperature during non-business hours. Although products in the machine are delivered to the customer at the same temperature as in an uncontrolled vending machine, products are not being cooled unnecessarily when the machine is not in use, significantly reducing the machine's energy consumption. Because of the relatively low vending miser installation cost and high operating hours of vending machines, this improvement is typically cost-effective with a very short payback period.

- **Install ENERGY STAR® Rated Equipment / Plug Load Control**

Plug loads (computers, televisions, coffee makers, etc.) account for, on average, about 10% of total energy consumption. One of the easiest and most cost-effective energy saving strategies is the reduction of electric usage through installation of efficient appliances and the control of plug loads. In addition to utilizing ENERGY STAR® qualified appliances, greater savings can be realized through the various devices available that control every day plug loads.

By connecting non-critical loads (coffee makers, fans, microwave ovens, etc.) to an occupancy or timer controlled power strip, significant energy savings can be achieved. These savings result not only from the neglect of the user to turn the device off manually, but also from reduction of "phantom load". Phantom load is the small but constant energy draw from many plug-in devices when not in use. By connecting certain appliances to an occupancy controlled power strip, phantom load can be eliminated by cutting power supply to those devices. When replacing or ordering new equipment, emphasize ENERGY STAR® devices when they are available. Also, purchase controlled power strips and connect appropriate devices to those strips to reduce unnecessary consumption due to phantom load and appliances left on. The EPA offers free computer power management software which has saved some districts as much as $75 per computer per year, the software can be found at http://www.energystar.gov/index.cfm?c=power_mgt.pr_power_mgt_low_carbon_join.

IV. Resources:

The State of New Hampshire along with the utility companies offer multiple programs designed to improve the energy efficiency of schools through financial incentives and technical support, including:

Northeast Energy Efficiency Partnerships:

- **Northeast Collaborative for High Performance Schools (NE-CHPS)**
  NE-CHPS is a set of building and design standards for all schools from pre-K through community colleges tailored specifically for NH state code requirements, the New England climate, and the environmental priorities of the region. NH Department of Education offers up to a 3% re-imbursement for New Construction School projects. To learn more about NE-CHPS and incentive programs please visit: http://neep.org/public-policy/hpse/hpse-nechps.

New Hampshire Public Utilities Commission:

- **New Hampshire Pay for Performance**
  This program addresses the energy efficiency improvement needs of the commercial and industrial sector. The Program is implemented through a network of qualified Program Partners. Incentives will be paid out on the following three payment schedule: Incentive #1: Is based on the area of conditioned space in square feet. Incentive #2: Per/kWh saved and Per/MMBTU saved based on projected savings and paid at construction completion. Incentive #3: Per/kWh saved and Per/MMBTU saved based on actual energy savings performance one year post construction. Total performance incentives (#2 and #3) will be capped at $200,000 or 50% of project cost on a per project basis. For more information visit http://nhp4p.com.

- **New Hampshire Public Utilities Commission's Renewable Energy Rebates**
  The Sustainable Energy Division provides an incentive program for solar electric (photovoltaic or PV) arrays and solar thermal systems for domestic hot water, space and process heat, with a capacity of 100 kW or equivalent thermal output or less. The rebate for PV systems as follows: $1.00 per Watt, capped at 25% of the costs of the system or $50,000, whichever is less. For solar hot water (SHW) systems, the base rebate is $0.07 per rated or modeled kBtu/year, capped at 25% of the cost of the facility or $50,000, whichever is less, as a one-time incentive payment. http://www.puc.state.nh.us/Sustainable%20Energy/RenewableEnergyRebates-CI.html.

New Hampshire Community Development Finance Authority:

- **New Hampshire Community Development Finance Authority Revolving Loan Fund**
  The Enterprise Energy Fund is a low-interest loan and grant program available to businesses and nonprofit organizations to help finance energy improvements and renewable energy projects in their buildings. The loans will range from $10,000 to $500,000. Larger amounts will be considered on a case by case basis. The program is available to finance improvements to the overall energy-efficiency performance of buildings owned by businesses and nonprofits, thereby lowering their overall energy costs and the associated carbon emissions. More information about the program can be found on their website www.nhcdfa.org. These activities may include:

  - Improvements to the building's envelope, including air sealing and insulation in the walls, attics and foundations;
  - Improvements to HVAC equipment and air exchange;
  - Installation of renewable energy systems;
  - Improvements to lighting, equipment, and other electrical systems; and
  - Conduction of comprehensive, fuel-blind energy audits.

Public Service of New Hampshire (PSNH):

- **Commercial (Electric) Energy Efficiency Incentive Programs**
  This program targets any commercial/industrial member building a new facility, undergoing a major renovation, or replacing failed (end-of-life) equipment. The program offers prescriptive and custom rebates for lighting and lighting controls, motors, VFDs, HVAC systems, chillers and custom projects. http://www.psnh.com/SaveEnergyMoney/For-Business/Energy-Saving-Programs-and-Incentives.aspx

- **SmartSTART**
  The SmartSTART (Savings Through Affordable Retrofit Technologies) advantage is simple - pay nothing out of pocket to have energy efficiency products and services installed in your building. The Smart Start program is limited to PSNH's municipal customers only and includes schools. The program is available on a first-come, first served basis to projects which have been pre-qualified by PSNH. The cost of the improvements is fronted by PSNH which is then repaid over time by the municipality or school using the savings generated by the products themselves! This program is for lighting and lighting controls, air sealing, insulation and other verifiable energy savings measures which have sufficient kilowatt-hour savings. For more information on this program visit:
  http://www.psnh.com/SaveEnergyMoney/For-Business/Municipal-Smart-Start-Program.aspx

- **Schools Program**
  For major renovation or equipment replacement projects, this program offers prescriptive and custom rebates for energy efficient lighting, motors, HVAC, chillers, and variable frequency drives to towns or cities that install energy efficient equipment at their schools. Financial incentives are available for qualifying energy efficient equipment. Technical assistance is also offered through the Schools Program. http://www.psnh.com/SaveEnergyMoney/Large-Power/Schools-Program.aspx

Unitil:

- **Commercial and Industrial Energy Efficiency Programs**
  Subject to program qualifications and availability of funding - Unitil offers different programs for its commercial, industrial, and institutional customers in New Hampshire: the Small Business Energy Efficiency Program, the Small Commercial and Industrial Program, the Large Commercial and Industrial Program, the Large Commercial and Industrial (C&I) Retrofit Program, and the Large C&I New Construction Program. Rebates are available for various technologies including water heaters, lighting, lighting controls/sensors, chillers, furnaces, boilers, central air conditioners, compressed air, programmable thermostats, energy management systems/building controls, motors, motor VFDs, processing and manufacturing equipment, LED exit signs, commercial cooking and refrigeration equipment. http://www.unitil.com/.

Clean Air – Cool Planet:

- **Community Energy Efficiency**
  CA-CP works with communities throughout the Northeast to find solutions to climate change and build constituencies for effective climate policies and actions. Much of their work focuses on successful models for energy efficiency and renewable energy planning. They advise and partner with citizens, educators, faith groups, small businesses, municipal governments, and other local leaders. They explore cost-effective opportunities that exist for communities to reduce their emissions as well as their vulnerability to climate impacts. One such example is CA-CP's partnership with the University of NH, NH Sustainable Energy Association and UNH Cooperative Extension to create www.myenergyplan.net, a groundbreaking suite of web and outreach tools for individual action used by households, schools and community groups around the northeast. http://www.cleanair-coolplanet.org/for_communities/index.php.

Environmental Protection Agency (EPA):

- **ENERGY STAR Challenge for Schools**
  EPA is challenging school administrators and building managers to improve energy efficiency throughout their facilities. More than 500 school districts across the country are helping to fight climate change by committing to reducing their energy use with help from ENERGY STAR. Schools that take the ENERGY STAR Challenge can use energy tracking tools, technical guidance, case studies and other ENERGY STAR tools and resources to help them improve their energy efficiency. More information can be found at:
  http://yosemite.epa.gov/opa/admpress.nsf/d985312f6895893b852574ac005f1e40/d74f768ecfa9e11f8525762500522260!OpenDocument

For additional assistance in helping you save money and improve school conditions, please call TRC at (603) 766-1913 or (877) 442-9181.

NEW HAMPSHIRE ENERGYSMART SCHOOLS PROGRAM

Energy Benchmarking Report for:

School Street Elementary School
Rochester, NH

Period: ***July 1, 2010*** through ***June 30, 2011***

PREPARED BY:

TRC

155 Fleet Street, Suite #305

Portsmouth, NH 03801

(603) 766-1913

www.trcsolutions.com

Table of Contents

I. Introduction

The Sustainable Energy Division of the New Hampshire Public Utilities Commission, with support from the New Hampshire Department of Education has sponsored TRC to develop the New Hampshire ***EnergySmart Schools Program*** to support New Hampshire K-12 public and private schools in the pursuit of energy efficiency and sustainability initiatives.

Energy efficiency has become an increasingly important issue for schools due to tightening budgets and rising energy costs. Since 2003, the prices of natural gas, fuel oil and electricity have increased by 123%, 107% and 32% respectively. Schools that have participated in energy benchmarking programs have shown a decrease in overall energy use by approximately 22% through the adoption of energy efficiency measures.

Tracking and documenting the energy use and associated carbon emissions in the state's K-12 schools will allow New Hampshire to account for the impact of its energy efficiency and renewable energy programs and determine which have the greatest effect. The analysis in this report, provided by the ***EnergySmart Schools Program*** is designed to help you:

- Understand the energy consumption and cost trends at each of your school buildings.
- Learn how your buildings are performing compared to other schools locally and nationally.
- Identify opportunities for improving operations and reducing costs.
- Take advantage of resources to implement efficiency improvements and save money.

The analysis was based on the information provided on the *Building Data Request Form* submitted, which included building descriptions, energy suppliers and other information. The building's utility bills were also used to assess its electricity and heating fuel consumption for the year(s) provided.

The energy performance for your school has been compared to national data for similar school facilities through EPA's ENERGY STAR® Portfolio Manager. Also shown are the five major benchmarks used to analyze building performance, which include: electricity use; heating fuel use; weather-normalized heating fuel use; total cost; and total cost per student, all of which have been normalized for comparison by square footage and weather. As part of the program's focus on sustainability, your school's carbon footprint is also presented.

II. Benchmarking Analysis and Review Results

Building and energy usage of your school was analyzed to assess the basic nature of your energy consumption and utility costs. The Building Data Summary table shown below summarizes this information.

Table 1: Building Data Summary for School Street Elementary School

Building Data			
District	SAU 54 Rochester School Department	**School Name**	School Street Elementary School
City	Rochester	**Zip Code**	03867
Year Built	1911	**Floor Area (sq.ft.)**	16,000
Number of Students	89	**Number of PCs**	34
Weekly Operating Hours	60	**Months School Used**	12
Cooking?	YES	**% AC**	10
Pool Size?	N/A	**Months Pool Used**	0

Utility Data			
Data End Point	6/30/2011	**Total Cost ($)**	20,468
Electric Provider	PSNH	**Natural Gas Provider**	N/A
Electricity Usage (kWh)	56,350	**Electricity Cost ($)**	9,024
Natural Gas Usage (therms)	0	**Natural Gas Cost ($)**	0
Fuel Oil Usage (gal)	5,551	**Fuel Oil Cost ($)**	11,444
Other Fuel Usage (gal)	0	**Other Fuel Cost ($)**	0

Energy Indicators			
EPA Score	89	**Electric Usage (kWh/sq.ft.)**	3.5
Heating Fuel Usage (kBtu/sq.ft.)	48.1	**Weather Adjusted Heating Usage Btu/sq.ft./HDD)**	6.6
Site Energy (kBtu/sq.ft.)	60.1	**Source Energy (kBtu/sq.ft.)**	89

Environmental Impact Indicators			
Greenhouse Gas Emissions			
Last Year Heating Fuel CO_2e (Mt)	56.6	**Last Year Total CO_2e (Mt)**	74.1
Last Year Electricity CO_2e (Mt)	17.5	**CO_2e Efficiency Savings Over Previous Year (Mt)**	-8.5
EPA Target Score			
Target Score	Reached	**Site Energy Reduction Needed (kBtu/sq.ft.)**	N/A - Reached

Figures 1a, 1b, 2a and 2b display the energy use, demand and cost data tracked on a monthly basis. This demonstrates the energy consumption of your building over the course of the year. As a part of the program's focus on sustainability, your school's carbon footprint was also measured and is presented in Figure 3.

Figure 1a. Monthly Electric Use & Max Demand for School Street Elementary

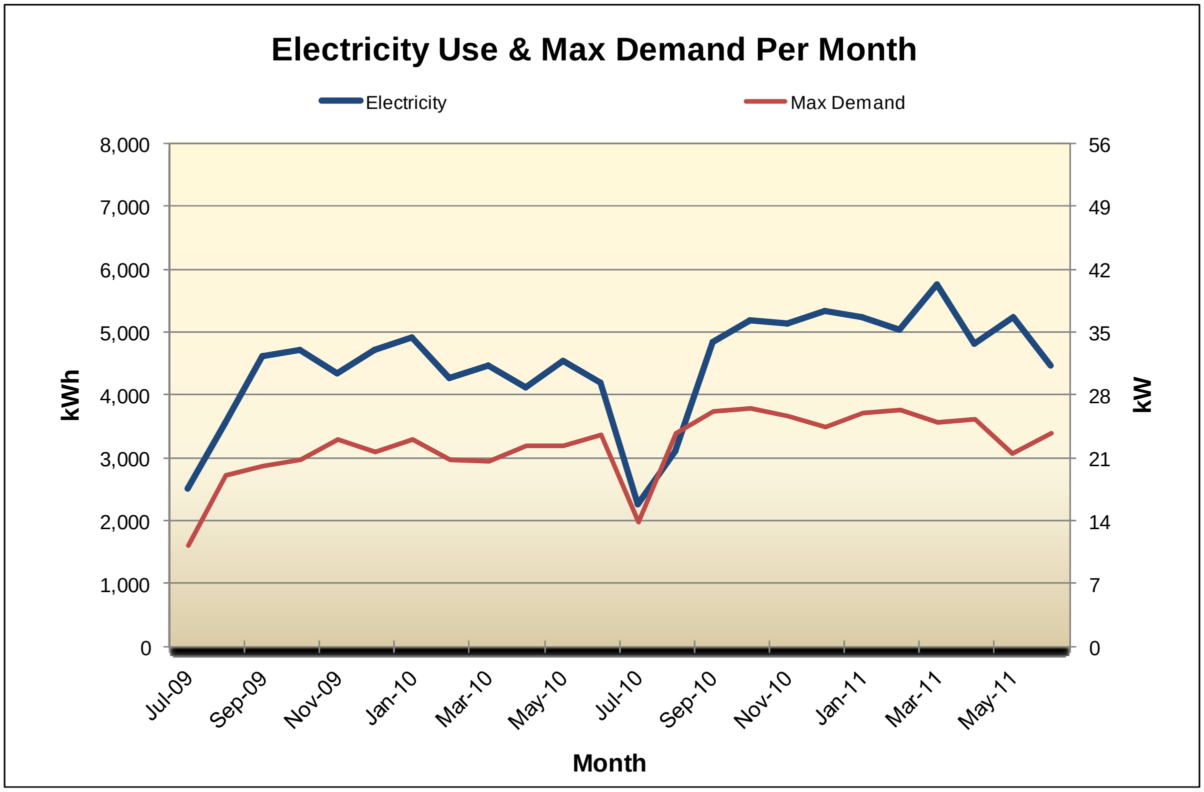


Figure 1b. Monthly Electric Use vs. Cost for School Street Elementary

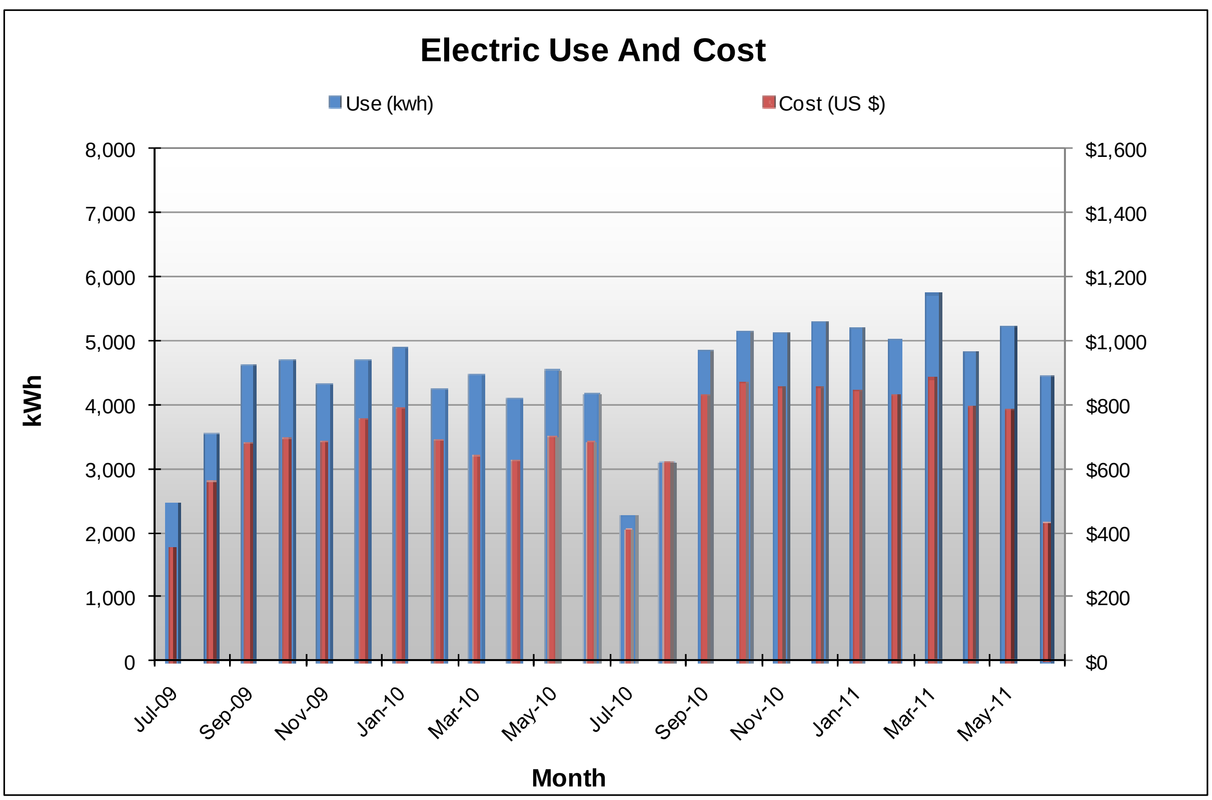


Figure 2a. Monthly Heating Fuel Use for School Street Elementary

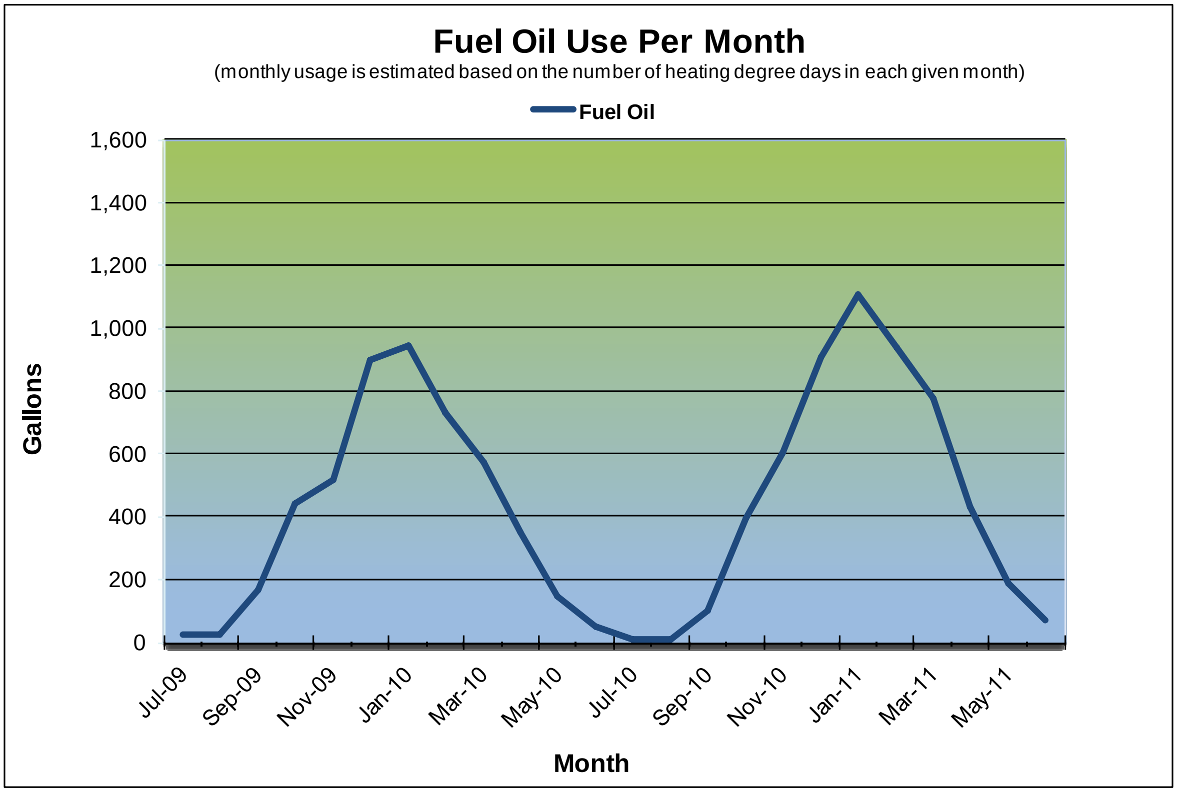


Figure 2b. Monthly Heating Fuel Use vs Cost for School Street Elementary

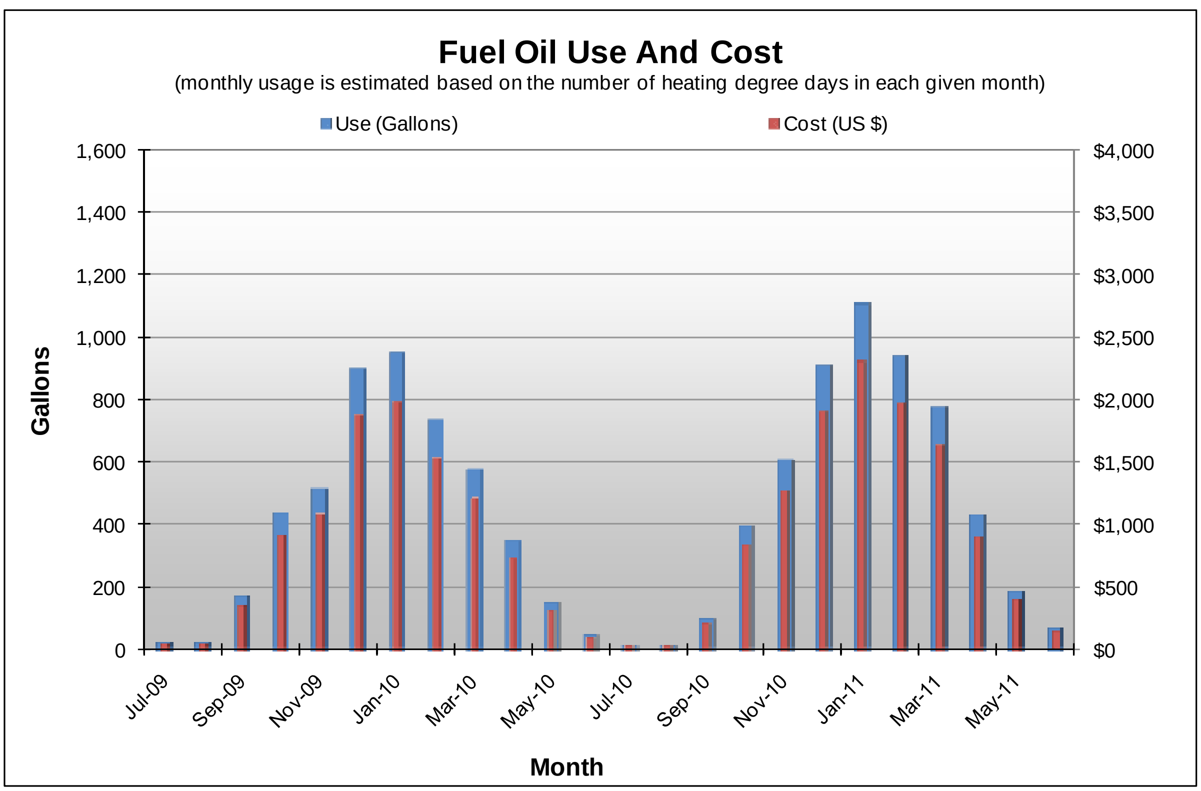
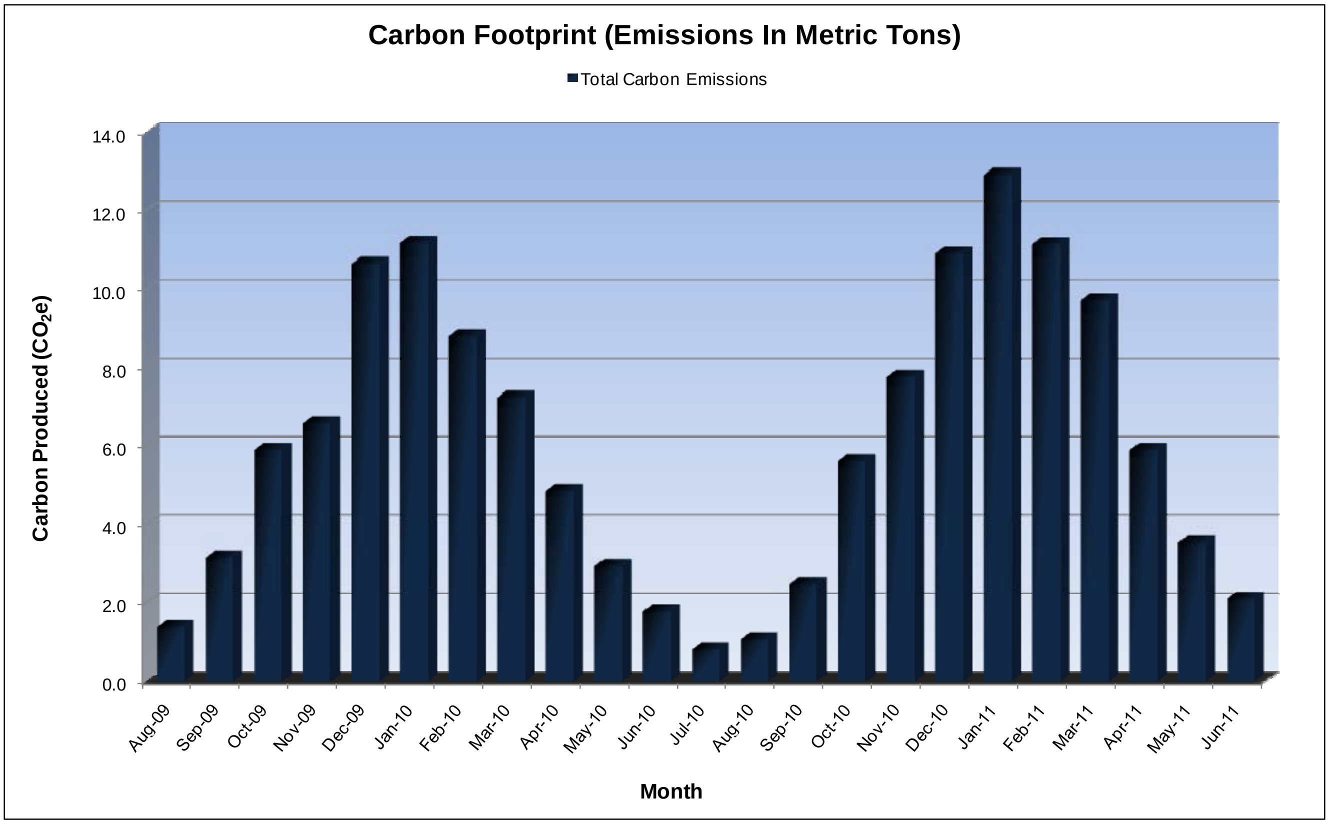


Figure 3. Monthly Greenhouse Gas Emissions for School Street Elementary School



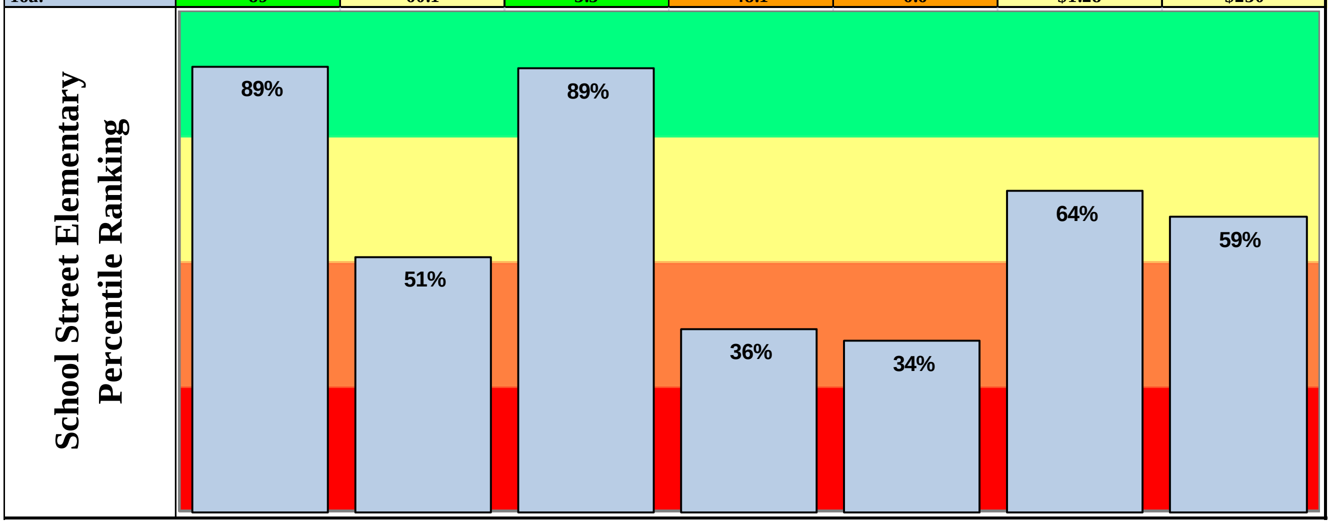
Benchmarking Data

To evaluate the energy and environmental performance of your school, the building data collected above has been compared against two different sets of school energy data: the U.S. Environmental Protection Agency's national data and New Hampshire specific state data. The results are illustrated in Figure 4 on the following page.

This will allow you to assess your building's performance relative to other buildings designed and constructed to the same codes and standards, operating under the same regulations and schedules and similar weather conditions. The indicators are calculated on a *per square foot* or *per student* basis, so you can compare your school to different sized schools.

Figure 4. EnergySmart Schools Benchmarks for School Street Elementary School

Schools	U.S. EPA Portfolio Manager Score	New Hampshire State Schools (Annual Data)					
		Total Energy Use (kBtu/sq.ft.)	Electric Use (kWh/sq.ft.)	Heating Fuel Use (kBtu/sq.ft.)	Weather Adjusted Heating Fuel Use (Btu/sq.ft./HDD)	Total Energy Cost ($/sq.ft.)	Total Energy Cost ($/student)
NH Average:	50	60.3	5.2	41.7	5.7	$1.42	$256
You:	89	60.1	3.5	48.1	6.6	$1.28	$230



Major Benchmark Indicators

1. Total Energy Use, kBtu/sq.ft.

This indicator shows how much total energy your school consumes each year. It includes the energy used for heating, cooling (if any), lights, cooking, computers, etc.

Your school's total energy use of 60.1 kBtu per square foot per year (kBtu/sq.ft.) is average compared to the New Hampshire K-12 schools state average of 60.3 kBtu/sq.ft. Your total energy use figure is lower than 51% of New Hampshire K-12 schools. The EnergySmart School Report is weather normalized so fuel consumption for heating takes the difference in climate between northern and southern New Hampshire into account.

This is a good indicator of how well, overall, your school is performing. However, it doesn't help you find ***where*** in your building to look for improvement opportunities. Multiple factors included on the following pages can help with that. Analysis of energy consumption for this program does not control for operational variations. An example is an improperly ventilated school may appear to have lower energy consumption. Ventilation systems that are not operating properly result in lower indoor air quality.

2. Electricity Data

Most electric utilities use the following two factors to estimate your electricity bill – Electric Use and Electric Demand.

a. Electric Use, kWh/sq.ft.

This shows how well the building does with its lights, cooling/air conditioners and cafeteria systems (if any), and what's referred to as "plug load." Plug load is anything that plugs into a socket. The major plug loads are generally computers (including monitors, printers and copiers), refrigerators, coffee machines, fans, shop equipment and projectors. If electric consumption is much higher than average, but heating fuel use (see below) is average or better, then focus your efforts on the electric-powered elements.

New Hampshire schools state average electric use is 5.2 kWh per square foot. Your school's electric consumption of 3.5 kWh per square foot this year is lower than 89% of New Hampshire schools benchmarked through the New Hampshire EnergySmart Schools Program.

b. Electric Demand, Watts/sq.ft.

Demand is a measure of the maximum electric draw in kW that your building places on the grid and is measured by adding up the kW draw for a 15 minute period. To give an analogy, if electricity usage is the amount of water going through a hose in gallons, electric demand would be how fast that water flows expressed in gallons per minute. Whichever 15 minute period during your monthly billing cycle places the highest kW demand on the grid is the demand factor applied to your bill. The best way to improve this demand factor is to stagger the times when your electrical systems draw at their maximum or reduce unnecessary electric load altogether.

The average electric demand for New Hampshire schools is 1.9 watts per square foot. Your school's electric demand is 1.7 watts per square foot and is lower than 68% of New Hampshire Schools benchmarked through the New Hampshire EnergySmart Schools Program.

3. Heating Fuel Use, kBtu/sq.ft.

Reviewing these indicators is relatively straightforward. If your school's heating fuel use is much higher than average, an audit of your heating system along with your building envelope - doors, windows, roof - is recommended. This factor is 'fuel-neutral' as it works for either fuel oil or natural gas heating systems.

New Hampshire K-12 schools state average heating fuel use is 41.7 kBtu/sq.ft. or 5.7 Btu/sq.ft./HDD. Your school's heating fuel use of 48.1 kBtu/sq.ft. per year is higher than 64% of other New Hampshire schools in the database. Your school's weather adjusted heating fuel use of 6.6 Btu/sq.ft./HDD is higher than 66% of other New Hampshire schools benchmarked through the New Hampshire EnergySmart Schools Program.

4. Energy Cost, $/sq.ft. & $/student

Cost is the bottom line. These numbers help you understand, in terms of budget, the gain through energy efficiency improvements. New Hampshire K-12 schools state averages $1.42/sq.ft. and $256/student.

Your school's annual energy cost of $1.28 per square foot is lower than 64% of other New Hampshire benchmarked schools. Your school's cost expressed on a per student basis of $230 is lower than 59% of other New Hampshire schools benchmarked through the New Hampshire EnergySmart Schools Program.

5. U.S. EPA *Portfolio Manager* Score

Portfolio Manager is a benchmarking model based on a national set of data from K-12 schools. It is provided by the U.S. Environmental Protection Agency's ENERGY STAR® Program. The impact of factors outside of your control (such as location, occupancy and operating hours) are removed, providing a 1-100 ranking of a school's energy performance relative to the national school building market. A score of 50 represents the national average and a score of 100 is best. Schools that achieve a score of 75 or higher are eligible for EPA's ENERGY STAR® Building Label, the national symbol for protecting the environment through energy efficiency. Districts can achieve ENERGY STAR® Leader Awards in recognition if their buildings, on average, improve by 10%, 20%, 30%, etc. over their baseline year of reported energy use or if the district's overall weighted average *Portfolio Manager* Score is at least a 75.

Your school's *Portfolio Manager* Score of 89 places it higher than 89% of K-12 schools nationwide. As noted above, this rating potentially qualifies your school for the prestigious ENERGY STAR® Label for Buildings.

III. Potential Energy Saving Opportunities

Based on the preceding analysis of your school's energy performance, implementation of the following recommendations can help you save energy and money. The first step is to look at reducing electrical lighting and HVAC consumption (burners, circulators and fans) which typically account for 67% of a building's electric consumption.

- **Perform an Energy Audit on the Building**

An energy audit involves a comprehensive analysis of the building's general characteristics, its energy use and allocation of that use amongst the facility's energy end uses. The goal is to identify sources of potential energy savings. Your auditor should develop a list of recommendations that will result in substantial energy and operational cost savings. These may include, building envelope improvement and mechanical systems, lighting upgrades, equipment replacement and installation of lighting and HVAC control mechanisms, among others.

A good audit should include information specific to each recommendation which *at least* includes approximate annual energy unit and cost savings, demand reduction, installation cost, lifetime cost savings and information related to cost-effectiveness. This will help to prioritize the recommendations based on their energy efficiency and shortest payback.

The recommendations provided in an energy audit report may reduce facility energy bills by 20% or more in addition to improving occupant health and comfort. Following this report, an energy audit is the next step in realizing the full potential of energy savings opportunities.

- **Request Retro-Commissioning**

Retro-commissioning is a detailed process applied to existing facilities aimed at correcting many of the degradations and inefficiencies that are indicative of older and/or poorly performing buildings. Many older buildings tend to be less comfortable and operate less efficiently when not properly commissioned. Retro-commissioning includes a detailed energy audit and focuses on not only potential energy savings but also the interaction of the building's equipments and mechanical systems with an eye toward restoring it to optimal performance.

In contrast to an energy audit, this optimization focuses on operational improvements to existing equipment, rather than replacement. Apart from energy savings, other improvements and benefits include substantial operation and maintenance (O&M) cost savings, improved air quality, occupant comfort, health and safety, equipment controls, and improved system interactivity.

In addition to providing recommendations, retro-commissioning includes implementation of the recommended improvements and hence the cost for retro-commissioning is higher than an audit. However, when the costs of improvements are added to the energy audit cost, prices may be comparable. If high O&M costs or occupant health, comfort and safety are concerns in addition to reduction in energy use, retro-commissioning may be a suitable strategy.

- **Upgrade Lighting Systems**

Lighting typically accounts for 30-60% of all energy consumed in school buildings. Additionally, the electrical energy consumed by lights during the summer creates heat and increases cooling costs.

School Street Elementary School's electricity consumption is low (better) compared to other schools in the State. Even so, upgraded lighting systems in high consumption areas like classrooms, gymnasiums, libraries, offices, etc. can reduce costs, improve the lighting quality and increase occupant comfort and productivity.

Over-lit Spaces: Light levels should be recorded in classrooms and hallways to ensure they are not over-lit, 40-50 foot candles are adequate light levels for an instructional space. If classroom light levels are much higher than 50 foot candles, School Street Elementary School should consider de-lamping classrooms or installing dimming ballasts, which dim the lights when outdoor light levels are adequate. In over-lit hallway spaces photo sensors can be installed to turn lights off completely when light levels exceed a pre-set threshold.

In over-lit spaces a T8 to Super T8 lighting retro-fit can reduce the number of light fixtures needed. Super T8 lamps use between 4 and 7 Watts less electricity than standard T8 lamps, but they produce more light per Watt. In some cases this increase in light per Watt can allow for the removal of an entire lamp, saving 32 Watts. The room characteristics must be factored in before this type of retro-fit. The shape of the space, ceiling height, color of the walls, etc. all need to be taken into account when exploring a de-lamping project. We recommend that before retro-fitting the entire facility, begin by changing one classroom and monitor the comfort level of the occupants at School Street Elementary School.

Another proven energy reduction measure with a short payback period is to identify any areas where your school may still be using metal halide lighting. Typically metal halide lights are found in gymnasiums or cafeteria areas, many districts have been very satisfied by replacing these lights with high bay T5 lighting fixtures. In addition to the reduced operational wattage, high bay T5 lights turn on instantly, as opposed to metal halide fixtures which have an extended warm up period. The long warm up period associated with metal halides typically leads to the lights being left on all day, at 250 to 400 watts a fixture; the costs begin to add up. Adding occupancy sensors to high bay T5 fixtures further reduces the payback period.

Occupancy Sensors: We recommend that you explore the use of occupancy sensors to ensure that lights are turned off in unoccupied spaces. Lights controlled by occupancy sensors typically run a third of the time when compared with manually controlled lighting. Reduced runtime leads to decreases in both energy usage and operation and maintenance costs. Additionally, a study conducted in Massachusetts found that controlling the security lighting with occupancy sensors reduced vandalism; neighbors and police recognized something wrong when the lights were on in a building that was typically dark and investigated.

To summarize and add a few ways in which School Street Elementary School may be able to conserve energy and cost through lighting upgrades is to:

- Design light quantity and quality for the task and occupants' needs in that area.
- Maximize lamp and ballast efficiency.
- Activate the power saving features on office equipment such as copiers, printers and fax machines and ensure that they are turned off at the end of the day.
- Use automatic controls to turn lights off or dim lights in unoccupied spaces.
- Establish a maintenance schedule for group re-lamping and fixture cleaning.
- Replace T12 fixtures with the most efficient fixtures which may include T8/super T8/T5 fixtures.
- Replace incandescent lighting with compact fluorescent technology.

- Replace incandescent exit lighting which consumes 30 Watts with LED type exit lights with 1.5 Watts consumption. LED units last up to 10 years, which is a maintenance advantage.
- Install daylight sensors in areas with significant natural light.
- Install occupancy sensors in areas that are often unoccupied.
- Lighting retrofits reduce maintenance costs associated with lighting that is close to end of life.
- Establish a regular cleaning schedule particularly for areas where student safety of low light levels may be a concern, such as shop classes.
- Look to make lamp and fixture selection as uniform as possible to reduce maintenance and inventory overhead.
- Educate students and staff to turn off lights when rooms are unoccupied.

Lighting upgrades seek to reduce the connected electrical load (kW) and energy consumption (kWh) of lighting equipment. Lighting controls can also significantly reduce operating hours and costs by turning off lighting when spaces are unoccupied or sufficiently lit by natural light.

- **Install NEMA Premium Motors and VFDs**

Commercial and industrial electric motor-driven systems consume approximately 23% of all electricity in the U.S., making it the single largest category contributor to electric use in the country. With very high operating hours, the annual energy cost to run a system is more than its installation cost. Even a small increase in the efficiency of an electric motor can result in substantial energy cost savings. Typical opportunities for motor upgrades in schools include: ventilation fans, and heating and cooling system pumps and fans.

Motors with efficiency up to 90% are available to replace the older ones with efficiency less than 75%. Although standards for efficiency of new equipment are set by the Energy Policy Act, motor efficiency can be further increased by selecting Premium Efficiency motors as specified by the National Electrical Manufacturers Association (NEMA). This can cut the electric motor system demand by as much as 18%.

Savings can be increased further by optimizing system performance through the use of variable frequency drives (VFDs). When system load is known to vary substantially, these flow control systems can be utilized to match system output to system demand, significantly reducing energy usage during partial load hours. By employing high-efficiency motors and VFDs, facility owners can improve environmental conditions, utilize better control of motor-driven processes, and reduce waste output.

- **Install Demand Control Ventilation**

Demand control ventilation (DCV) monitors indoor air CO_2 content as a result of occupancy production levels and uses this data to regulate the amount of outdoor air that is permitted for ventilation. In order to ensure adequate air quality, standard ventilation systems permit outside air based on estimated occupancy levels in CFM, cubic feet per minute/occupant. However, during low occupancy hours, the space may become over ventilated due to decreased CO_2 levels and unnecessary ventilation results in wasted energy. DCV reduces unnecessary outdoor air intake by regulating ventilation based on actual CO_2 levels, saving energy. DCV is most suited for areas where occupancy levels are known to fluctuate considerably such as auditoriums, cafeterias, and gymnasiums.

Install Energy Recovery Ventilators. According to energy recovery equipment manufacturer's typical paybacks are less than 5 years for schools without cooling. The keys to success with ventilation retrofits are going with fewer larger units with long run hours as opposed to several small units with limited run time. Equipment with moisture recovery capabilities would cut humidity up to 50% during the cooling season.

- **Improve/Replace Inefficient Heating Systems**

Replacing an old boiler that is < 70% efficient with a modern 85-90% efficient natural gas-fired furnace alone will reduce heating costs by 15-20%. This combined with additional system improvements and installation of advanced HVAC control mechanisms can result in up to 20%+ heating load reduction.

Because of the high capital cost of new heating systems, some financial analysis should be performed to assess the cost-effectiveness of immediate replacement. If the current system is fairly new, replacement may not be immediately justifiable from a financial standpoint. However, as is the case with cooling systems, early replacement may prove to be a more cost-effective solution than waiting until existing systems fail or reach the end of their estimated useful life.

- **Improve/Replace Inefficient Air Conditioning Systems**

The useful life of a rooftop A/C unit is generally 12-18 years. However, depending on the efficiency, early replacement of outdated, inefficient, split, or packaged rooftop air conditioning units with new A/C systems that are 15% more efficient than 10-15 year old equipments can considerably reduce annual energy consumption. The energy cost savings and maintenance savings offset the high installation cost of a more efficient system. Installing thermostats and/or economizers on new or existing A/C systems will further reduce the cooling demand.

Economizers provide "free" cooling by using controllable dampers that bring in outside air to cool the space when the outdoor temperature or enthalpy is below the building's return air conditions. Although they require operation by a well calibrated and maintained control system, economizers have impressive energy-saving capabilities.

Install Occupancy Controlled/Programmable Thermostats

Combining efficient HVAC equipment with occupancy controlled and programmable thermostats can save a facility up to 10% of its annual heating and cooling costs:

- Areas with unpredictable occupancy on a daily/weekly basis - gym, bathrooms, outdoors: Use an *occupancy controlled thermostat* - a thermostat paired with a sensor and/or door detector to identify movement/occupancy. If occupancy is sensed by the sensor, the thermostat goes into an occupied mode (i.e. programmed set point). If a pre-programmed time frame elapses (i.e. 30 minutes) and no occupancy is sensed during that time, the thermostat goes into an unoccupied mode (e.g., setback set point or off) until occupancy is sensed again. This reduces the overall time the heating or cooling system is running, saving energy.

- Areas with predictable occupancy: e.g.: classrooms, cafeteria, offices: A *programmable thermostat* is recommended. This device is programmed on a schedule to reduce the heating or cooling output of the facility's HVAC systems in relation to its predetermined occupancy schedule. In this way, the thermostat acts to set-back or set-up the facility temperature during unoccupied hours, and re-establish a comfortable facility temperature during business hours. By employing programmable thermostat technology, the heating and cooling system demand coincides with occupancy level, reducing energy usage.

- **Install Vending Misers on Vending Machines**

Vending misers for refrigerated and non-refrigerated vending machines is an often overlooked source of potential savings. Uncontrolled, vending machine lights remain on 24/7, consuming a constant amount of energy year round. By controlling these lights with an occupancy sensor, energy consumption attributed to vending machines can be reduced considerably, in many cases, by as much as 50% and can save up to $150 per machine per year.

In the case of refrigerated vending machines, electric demand can be further reduced by controlling the machines' refrigeration systems. In a manner similar to programmable thermostats, vending misers for refrigerated machines act on a pre-set occupancy schedule to allow a marginal increase in operating temperature during non-business hours. Although products in the machine are delivered to the customer at the same temperature as in an uncontrolled vending machine, products are not being cooled unnecessarily when the machine is not in use, significantly reducing the machine's energy consumption. Because of the relatively low vending miser installation cost and high operating hours of vending machines, this improvement is typically cost-effective with a very short payback period.

- **Install ENERGY STAR® Rated Equipment / Plug Load Control**

Plug loads (computers, televisions, coffee makers, etc.) account for, on average, about 10% of total energy consumption. One of the easiest and most cost-effective energy saving strategies is the reduction of electric usage through installation of efficient appliances and the control of plug loads. In addition to utilizing ENERGY STAR® qualified appliances, greater savings can be realized through the various devices available that control every day plug loads.

By connecting non-critical loads (coffee makers, fans, microwave ovens, etc.) to an occupancy or timer controlled power strip, significant energy savings can be achieved. These savings result not only from the neglect of the user to turn the device off manually, but also from reduction of “phantom load”. Phantom load is the small but constant energy draw from many plug-in devices when not in use. By connecting certain appliances to an occupancy controlled power strip, phantom load can be eliminated by cutting power supply to those devices. When replacing or ordering new equipment, emphasize ENERGY STAR® devices when they are available. Also, purchase controlled power strips and connect appropriate devices to those strips to reduce unnecessary consumption due to phantom load and appliances left on. The EPA offers free computer power management software which has saved some districts as much as $75 per computer per year, the software can be found at http://www.energystar.gov/index.cfm?c=power_mgt.pr_power_mgt_low_carbon_join.

IV. Resources:

The State of New Hampshire along with the utility companies offer multiple programs designed to improve the energy efficiency of schools through financial incentives and technical support, including:

Northeast Energy Efficiency Partnerships:

- **Northeast Collaborative for High Performance Schools (NE-CHPS)**
  NE-CHPS is a set of building and design standards for all schools from pre-K through community colleges tailored specifically for NH state code requirements, the New England climate, and the environmental priorities of the region. NH Department of Education offers up to a 3% re-imbursement for New Construction School projects. To learn more about NE-CHPS and incentive programs please visit: http://neep.org/public-policy/hpse/hpse-nechps.

New Hampshire Public Utilities Commission:

- **New Hampshire Pay for Performance**
  This program addresses the energy efficiency improvement needs of the commercial and industrial sector. The Program is implemented through a network of qualified Program Partners. Incentives will be paid out on the following three payment schedule: Incentive #1: Is based on the area of conditioned space in square feet. Incentive #2: Per/kWh saved and Per/MMBTU saved based on projected savings and paid at construction completion. Incentive #3: Per/kWh saved and Per/MMBTU saved based on actual energy savings performance one year post construction. Total performance incentives (#2 and #3) will be capped at $200,000 or 50% of project cost on a per project basis. For more information visit http://nhp4p.com.

- **New Hampshire Public Utilities Commission’s Renewable Energy Rebates**
  The Sustainable Energy Division provides an incentive program for solar electric (photovoltaic or PV) arrays and solar thermal systems for domestic hot water, space and process heat, with a capacity of 100 kW or equivalent thermal output or less. The rebate for PV systems as follows: $1.00 per Watt, capped at 25% of the costs of the system or $50,000, whichever is less. For solar hot water (SHW) systems, the base rebate is $0.07 per rated or modeled kBtu/year, capped at 25% of the cost of the facility or $50,000, whichever is less, as a one-time incentive payment. http://www.puc.state.nh.us/Sustainable%20Energy/RenewableEnergyRebates-CI.html.

New Hampshire Community Development Finance Authority:

- **New Hampshire Community Development Finance Authority Revolving Loan Fund**
  The Enterprise Energy Fund is a low-interest loan and grant program available to businesses and nonprofit organizations to help finance energy improvements and renewable energy projects in their buildings. The loans will range from $10,000 to $500,000. Larger amounts will be considered on a case by case basis. The program is available to finance improvements to the overall energy-efficiency performance of buildings owned by businesses and nonprofits, thereby lowering their overall energy costs and the associated carbon emissions. More information about the program can be found on their website www.nhcdfa.org. These activities may include:

  - Improvements to the building's envelope, including air sealing and insulation in the walls, attics and foundations;
  - Improvements to HVAC equipment and air exchange;
  - Installation of renewable energy systems;
  - Improvements to lighting, equipment, and other electrical systems; and
  - Conduction of comprehensive, fuel-blind energy audits.

Public Service of New Hampshire (PSNH):

- **Commercial (Electric) Energy Efficiency Incentive Programs**
  This program targets any commercial/industrial member building a new facility, undergoing a major renovation, or replacing failed (end-of-life) equipment. The program offers prescriptive and custom rebates for lighting and lighting controls, motors, VFDs, HVAC systems, chillers and custom projects. http://www.psnh.com/SaveEnergyMoney/For-Business/Energy-Saving-Programs-and-Incentives.aspx

- **SmartSTART**
  The SmartSTART (Savings Through Affordable Retrofit Technologies) advantage is simple - pay nothing out of pocket to have energy efficiency products and services installed in your building. The Smart Start program is limited to PSNH's municipal customers only and includes schools. The program is available on a first-come, first served basis to projects which have been pre-qualified by PSNH. The cost of the improvements is fronted by PSNH which is then repaid over time by the municipality or school using the savings generated by the products themselves! This program is for lighting and lighting controls, air sealing, insulation and other verifiable energy savings measures which have sufficient kilowatt-hour savings. For more information on this program visit:
  http://www.psnh.com/SaveEnergyMoney/For-Business/Municipal-Smart-Start-Program.aspx

- **Schools Program**
  For major renovation or equipment replacement projects, this program offers prescriptive and custom rebates for energy efficient lighting, motors, HVAC, chillers, and variable frequency drives to towns or cities that install energy efficient equipment at their schools. Financial incentives are available for qualifying energy efficient equipment. Technical assistance is also offered through the Schools Program. http://www.psnh.com/SaveEnergyMoney/Large-Power/Schools-Program.aspx

Unitil:

- **Commercial and Industrial Energy Efficiency Programs**
  Subject to program qualifications and availability of funding - Unitil offers different programs for its commercial, industrial, and institutional customers in New Hampshire: the Small Business Energy Efficiency Program, the Small Commercial and Industrial Program, the Large Commercial and Industrial Program, the Large Commercial and Industrial (C&I) Retrofit Program, and the Large C&I New Construction Program. Rebates are available for various technologies including water heaters, lighting, lighting controls/sensors, chillers, furnaces, boilers, central air conditioners, compressed air, programmable thermostats, energy management systems/building controls, motors, motor VFDs, processing and manufacturing equipment, LED exit signs, commercial cooking and refrigeration equipment. http://www.unitil.com/.

Clean Air – Cool Planet:

- **Community Energy Efficiency**
  CA-CP works with communities throughout the Northeast to find solutions to climate change and build constituencies for effective climate policies and actions. Much of their work focuses on successful models for energy efficiency and renewable energy planning. They advise and partner with citizens, educators, faith groups, small businesses, municipal governments, and other local leaders. They explore cost-effective opportunities that exist for communities to reduce their emissions as well as their vulnerability to climate impacts. One such example is CA-CP's partnership with the University of NH, NH Sustainable Energy Association and UNH Cooperative Extension to create www.myenergyplan.net, a groundbreaking suite of web and outreach tools for individual action used by households, schools and community groups around the northeast. http://www.cleanair-coolplanet.org/for_communities/index.php.

Environmental Protection Agency (EPA):

- **ENERGY STAR Challenge for Schools**
  EPA is challenging school administrators and building managers to improve energy efficiency throughout their facilities. More than 500 school districts across the country are helping to fight climate change by committing to reducing their energy use with help from ENERGY STAR. Schools that take the ENERGY STAR Challenge can use energy tracking tools, technical guidance, case studies and other ENERGY STAR tools and resources to help them improve their energy efficiency. More information can be found at:
  http://yosemite.epa.gov/opa/admpress.nsf/d985312f6895893b852574ac005f1e40/d74f768ecfa9e11f8525762500522260!OpenDocument

For additional assistance in helping you save money and improve school conditions, please call TRC at (603) 766-1913 or (877) 442-9181.

NEW HAMPSHIRE
ENERGYSMART SCHOOLS PROGRAM

Energy Benchmarking Report for:

Rochester Middle School

Rochester, NH

Period: ***July 1, 2010*** through ***June 30, 2011***

PREPARED BY:

155 Fleet Street, Suite #305

Portsmouth, NH 03801

(603) 766-1913

www.trcsolutions.com

Table of Contents

I. Introduction

The Sustainable Energy Division of the New Hampshire Public Utilities Commission, with support from the New Hampshire Department of Education has sponsored TRC to develop the New Hampshire ***EnergySmart Schools Program*** to support New Hampshire K-12 public and private schools in the pursuit of energy efficiency and sustainability initiatives.

Energy efficiency has become an increasingly important issue for schools due to tightening budgets and rising energy costs. Since 2003, the prices of natural gas, fuel oil and electricity have increased by 123%, 107% and 32% respectively. Schools that have participated in energy benchmarking programs have shown a decrease in overall energy use by approximately 22% through the adoption of energy efficiency measures.

Tracking and documenting the energy use and associated carbon emissions in the state's K-12 schools will allow New Hampshire to account for the impact of its energy efficiency and renewable energy programs and determine which have the greatest effect. The analysis in this report, provided by the ***EnergySmart Schools Program*** is designed to help you:

- Understand the energy consumption and cost trends at each of your school buildings.
- Learn how your buildings are performing compared to other schools locally and nationally.
- Identify opportunities for improving operations and reducing costs.
- Take advantage of resources to implement efficiency improvements and save money.

The analysis was based on the information provided on the *Building Data Request Form* submitted, which included building descriptions, energy suppliers and other information. The building's utility bills were also used to assess its electricity and heating fuel consumption for the year(s) provided.

The energy performance for your school has been compared to national data for similar school facilities through EPA's ENERGY STAR® Portfolio Manager. Also shown are the five major benchmarks used to analyze building performance, which include: electricity use; heating fuel use; weather-normalized heating fuel use; total cost; and total cost per student, all of which have been normalized for comparison by square footage and weather. As part of the program's focus on sustainability, your school's carbon footprint is also presented.

II. Benchmarking Analysis and Review Results

Building and energy usage of your school was analyzed to assess the basic nature of your energy consumption and utility costs. The Building Data Summary table shown below summarizes this information.

Table 1: Building Data Summary for Rochester Middle School

Building Data			
District	SAU 54 Rochester School Department	**School Name**	Rochester Middle School
City	Rochester	**Zip Code**	03867
Year Built	1992	**Floor Area (sq.ft.)**	168,736
Number of Students	967	**Number of PCs**	388
Weekly Operating Hours	80	**Months School Used**	12
Cooking?	YES	**% AC**	20
Pool Size?	N/A	**Months Pool Used**	0

Utility Data			
Data End Point	6/30/2011	**Total Cost ($)**	169,907
Electric Provider	PSNH	**Natural Gas Provider**	Unitil
Electricity Usage (kWh)	767,000	**Electricity Cost ($)**	108,341
Natural Gas Usage (therms)	44,725	**Natural Gas Cost ($)**	61,566
Fuel Oil Usage (gal)	0	**Fuel Oil Cost ($)**	0
Other Fuel Usage (gal)	0	**Other Fuel Cost ($)**	0

Energy Indicators			
EPA Score	89	**Electric Usage (kWh/sq.ft.)**	4.5
Heating Fuel Usage (kBtu/sq.ft.)	26.5	**Weather Adjusted Heating Usage Btu/sq.ft./HDD)**	3.7
Site Energy (kBtu/sq.ft.)	42.0	**Source Energy (kBtu/sq.ft.)**	80

Environmental Impact Indicators			
Greenhouse Gas Emissions			
Last Year Heating Fuel CO_2e (Mt)	237.9	**Last Year Total CO_2e (Mt)**	475.9
Last Year Electricity CO_2e (Mt)	238.0	**CO_2e Efficiency Savings Over Previous Year (Mt)**	-7.8
EPA Target Score			
Target Score	Reached	**Site Energy Reduction Needed (kBtu/sq.ft.)**	N/A - Reached

Figures 1a, 1b, 2a and 2b display the energy use, demand and cost data tracked on a monthly basis. This demonstrates the energy consumption of your building over the course of the year. As a part of the program's focus on sustainability, your school's carbon footprint was also measured and is presented in Figure 3.

Figure 1a. Monthly Electric Use & Max Demand for Rochester Middle School

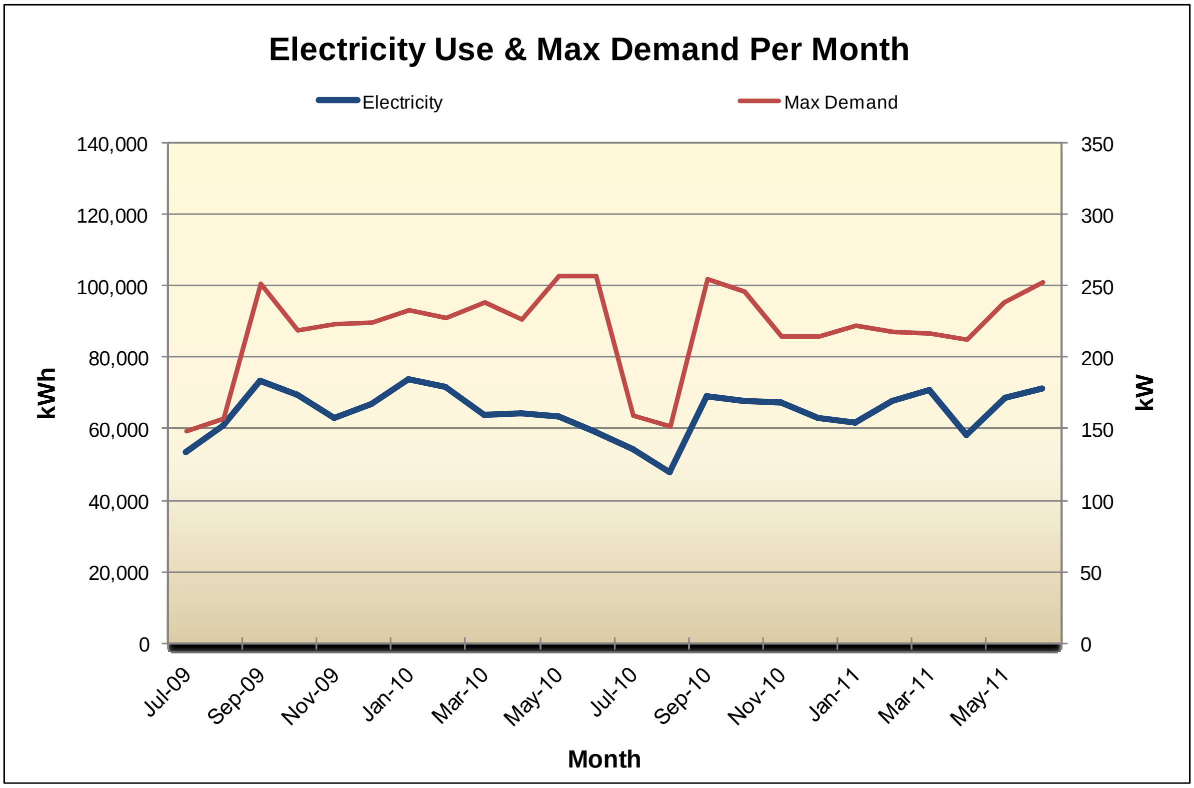


Figure 1b. Monthly Electric Use vs. Cost for Rochester Middle School

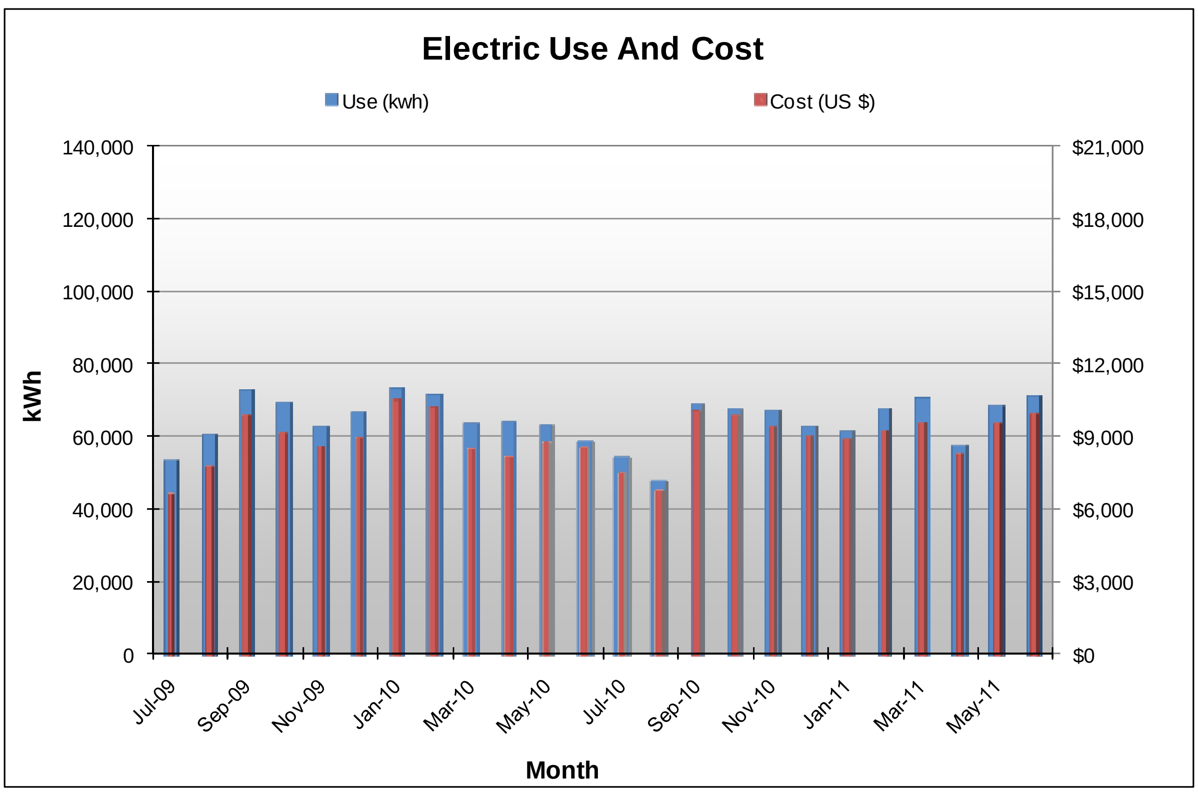


Figure 2a. Monthly Natural Gas Use for Rochester Middle School

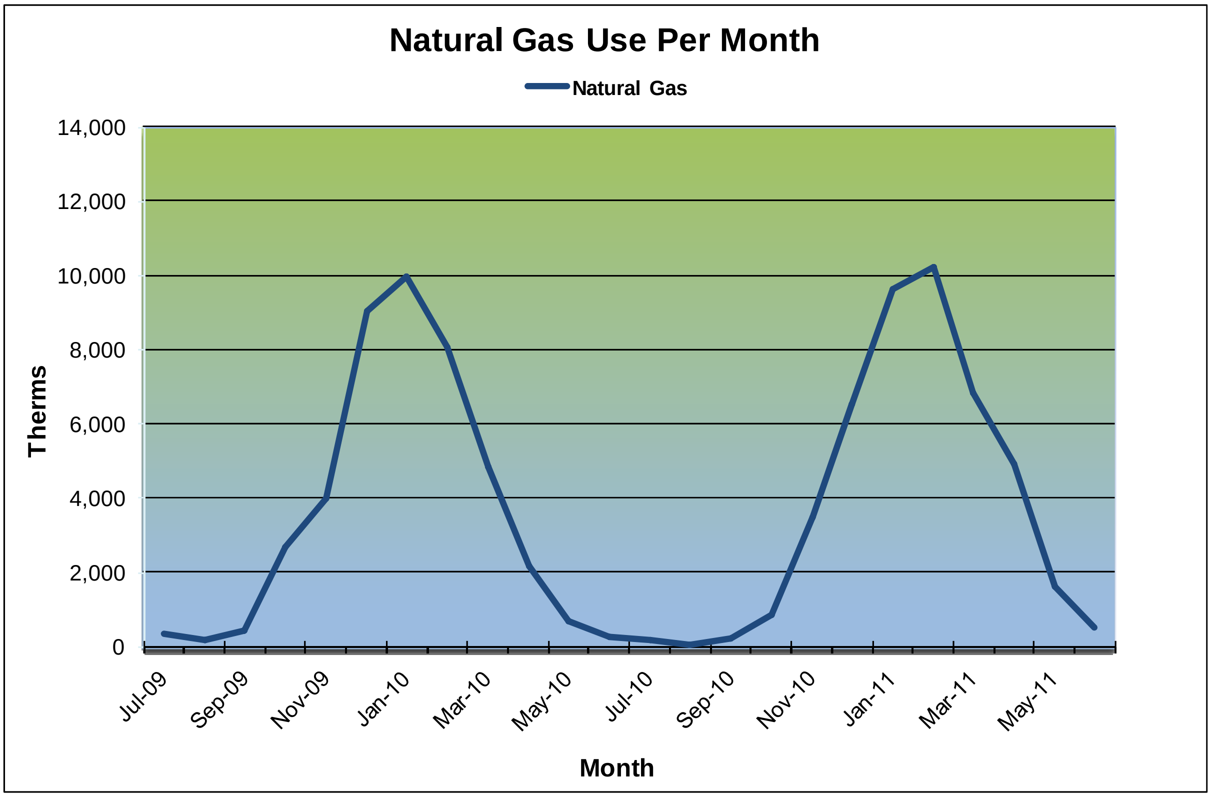


Figure 2b. Monthly Natural Gas Use vs Cost for Rochester Middle School

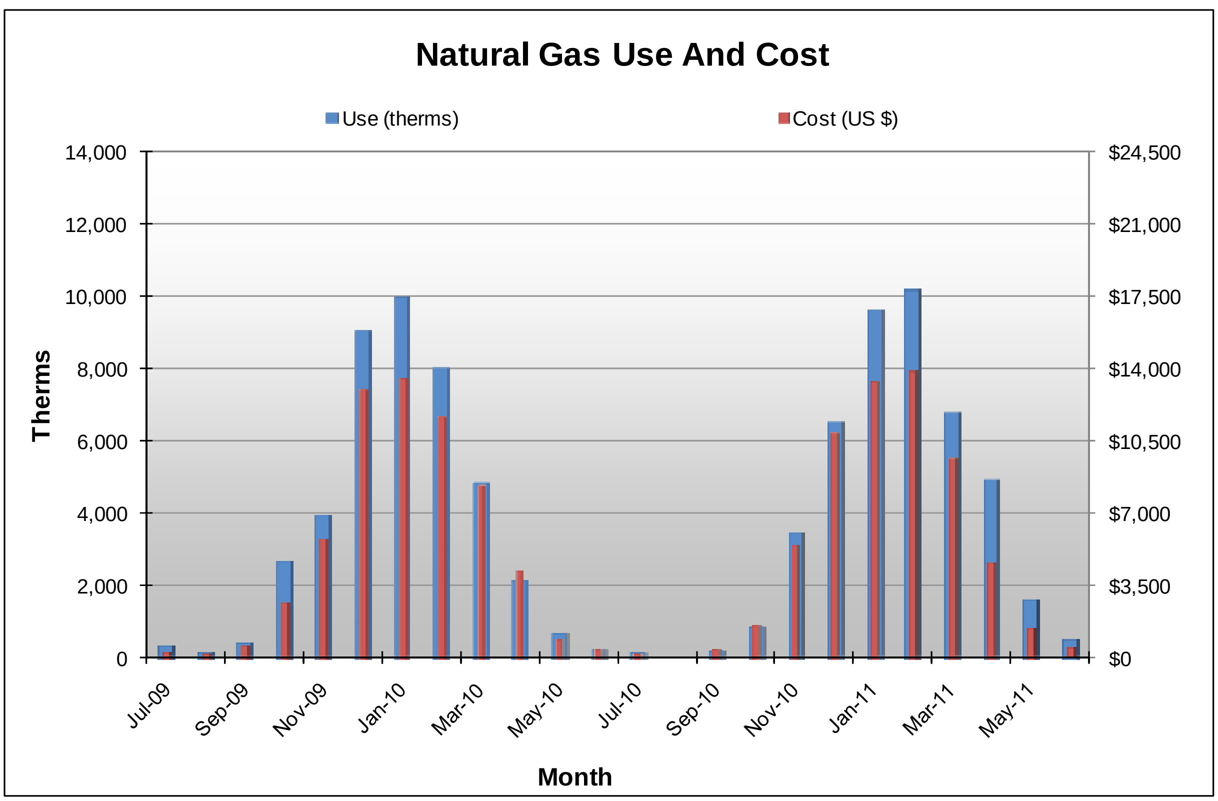
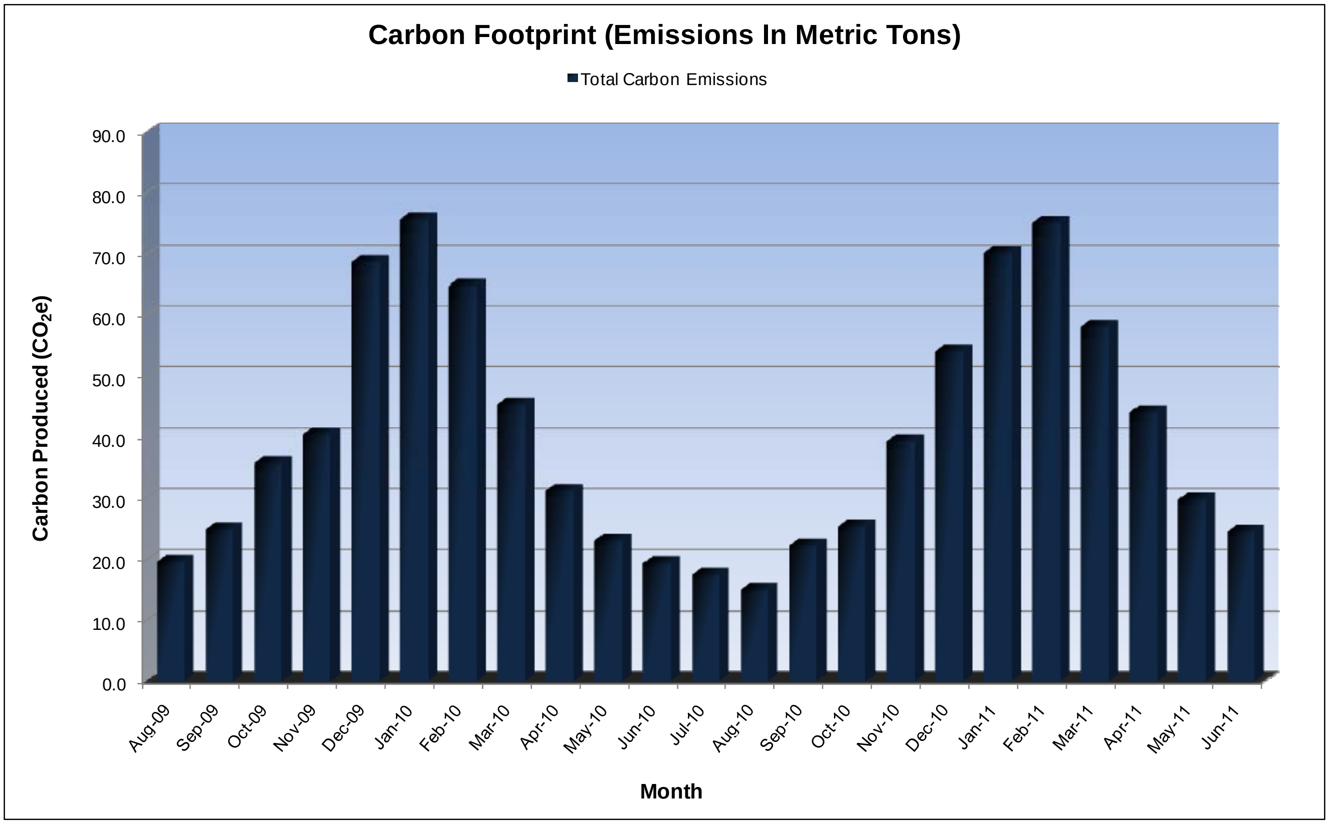


Figure 3. Monthly Greenhouse Gas Emissions for Rochester Middle School



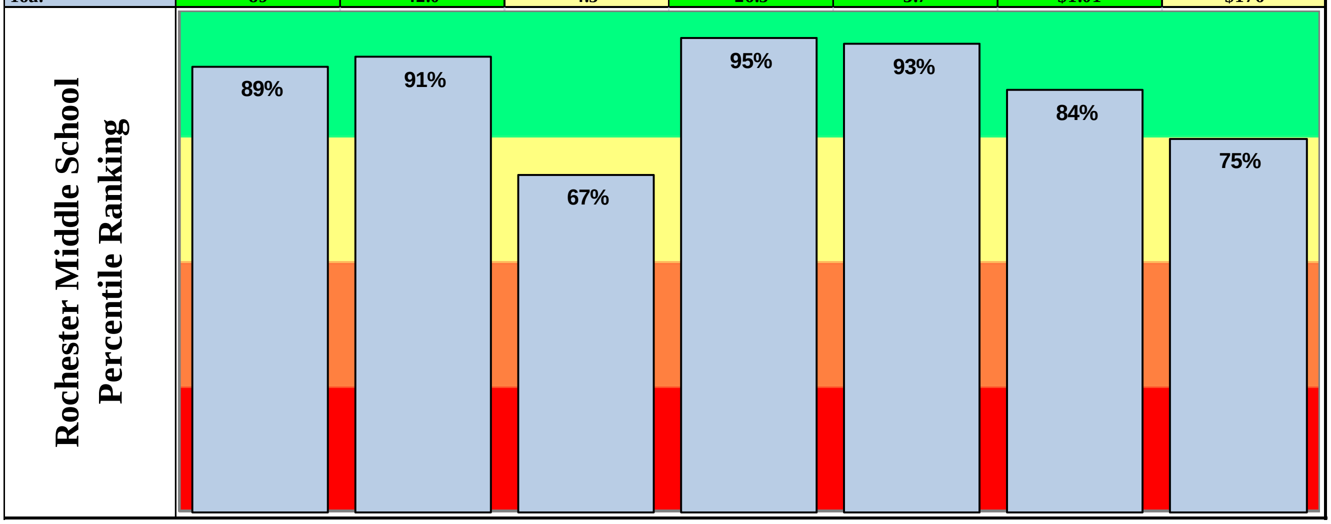
Benchmarking Data

To evaluate the energy and environmental performance of your school, the building data collected above has been compared against two different sets of school energy data: the U.S. Environmental Protection Agency's national data and New Hampshire specific state data. The results are illustrated in Figure 4 on the following page.

This will allow you to assess your building's performance relative to other buildings designed and constructed to the same codes and standards, operating under the same regulations and schedules and similar weather conditions. The indicators are calculated on a *per square foot* or *per student* basis, so you can compare your school to different sized schools.

Figure 4. EnergySmart Schools Benchmarks for Rochester Middle School

Schools	U.S. EPA Portfolio Manager Score	New Hampshire State Schools (Annual Data)					
		Total Energy Use (kBtu/sq.ft.)	Electric Use (kWh/sq.ft.)	Heating Fuel Use (kBtu/sq.ft.)	Weather Adjusted Heating Fuel Use (Btu/sq.ft./HDD)	Total Energy Cost ($/sq.ft.)	Total Energy Cost ($/student)
NH Average:	50	60.3	5.2	41.7	5.7	$1.42	$256
You:	89	42.0	4.5	26.5	3.7	$1.01	$176



Major Benchmark Indicators

1. Total Energy Use, kBtu/sq.ft.

This indicator shows how much total energy your school consumes each year. It includes the energy used for heating, cooling (if any), lights, cooking, computers, etc.

Your school's total energy use of 42.0 kBtu per square foot per year (kBtu/sq.ft.) is better than the New Hampshire K-12 schools state average of 60.3 kBtu/sq.ft. Your total energy use figure is lower than 91% of New Hampshire K-12 schools. The EnergySmart School Report is weather normalized so fuel consumption for heating takes the difference in climate between northern and southern New Hampshire into account.

This is a good indicator of how well, overall, your school is performing. However, it doesn't help you find ***where*** in your building to look for improvement opportunities. Multiple factors included on the following pages can help with that. Analysis of energy consumption for this program does not control for operational variations. An example is an improperly ventilated school may appear to have lower energy consumption. Ventilation systems that are not operating properly result in lower indoor air quality.

2. Electricity Data

Most electric utilities use the following two factors to estimate your electricity bill – Electric Use and Electric Demand.

a. Electric Use, kWh/sq.ft.

This shows how well the building does with its lights, cooling/air conditioners and cafeteria systems (if any), and what's referred to as "plug load." Plug load is anything that plugs into a socket. The major plug loads are generally computers (including monitors, printers and copiers), refrigerators, coffee machines, fans, shop equipment and projectors. If electric consumption is much higher than average, but heating fuel use (see below) is average or better, then focus your efforts on the electric-powered elements.

New Hampshire schools state average electric use is 5.2 kWh per square foot. Your school's electric consumption of 4.5 kWh per square foot this year is lower than 67% of New Hampshire schools benchmarked through the New Hampshire EnergySmart Schools Program.

b. Electric Demand, Watts/sq.ft.

Demand is a measure of the maximum electric draw in kW that your building places on the grid and is measured by adding up the kW draw for a 15 minute period. To give an analogy, if electricity usage is the amount of water going through a hose in gallons, electric demand would be how fast that water flows expressed in gallons per minute. Whichever 15 minute period during your monthly billing cycle places the highest kW demand on the grid is the demand factor applied to your bill. The best way to improve this demand factor is to stagger the times when your electrical systems draw at their maximum or reduce unnecessary electric load altogether.

The average electric demand for New Hampshire schools is 1.9 watts per square foot. Your school's electric demand is 1.5 watts per square foot and is lower than 82% of New Hampshire Schools benchmarked through the New Hampshire EnergySmart Schools Program.

3. Heating Fuel Use, kBtu/sq.ft.

Reviewing these indicators is relatively straightforward. If your school's heating fuel use is much higher than average, an audit of your heating system along with your building envelope - doors, windows, roof - is recommended. This factor is 'fuel-neutral' as it works for either fuel oil or natural gas heating systems.

New Hampshire K-12 schools state average heating fuel use is 41.7 kBtu/sq.ft. or 5.7 Btu/sq.ft./HDD. Your school's heating fuel use of 26.5 kBtu/sq.ft. per year is lower than 95% of other New Hampshire schools in the database. Your school's weather adjusted heating fuel use of 3.7 Btu/sq.ft./HDD is lower than 93% of other New Hampshire schools benchmarked through the New Hampshire EnergySmart Schools Program.

4. Energy Cost, $/sq.ft. & $/student

Cost is the bottom line. These numbers help you understand, in terms of budget, the gain through energy efficiency improvements. New Hampshire K-12 schools state averages $1.42/sq.ft. and $256/student.

Your school's annual energy cost of $1.01 per square foot is lower than 84% of other New Hampshire benchmarked schools. Your school's cost expressed on a per student basis of $176 is lower than 75% of other New Hampshire schools benchmarked through the New Hampshire EnergySmart Schools Program.

5. U.S. EPA *Portfolio Manager* Score

Portfolio Manager is a benchmarking model based on a national set of data from K-12 schools. It is provided by the U.S. Environmental Protection Agency's ENERGY STAR® Program. The impact of factors outside of your control (such as location, occupancy and operating hours) are removed, providing a 1-100 ranking of a school's energy performance relative to the national school building market. A score of 50 represents the national average and a score of 100 is best. Schools that achieve a score of 75 or higher are eligible for EPA's ENERGY STAR® Building Label, the national symbol for protecting the environment through energy efficiency. Districts can achieve ENERGY STAR® Leader Awards in recognition if their buildings, on average, improve by 10%, 20%, 30%, etc. over their baseline year of reported energy use or if the district's overall weighted average *Portfolio Manager* Score is at least a 75.

Your school's *Portfolio Manager* Score of 89 places it higher than 89% of K-12 schools nationwide. As noted above, this rating potentially qualifies your school for the prestigious ENERGY STAR® Label for Buildings.

III. Potential Energy Saving Opportunities

Based on the preceding analysis of your school's energy performance, implementation of the following recommendations can help you save energy and money. The first step is to look at reducing electrical lighting and HVAC consumption (burners, circulators and fans) which typically account for 67% of a building's electric consumption.

- **Perform an Energy Audit on the Building**

An energy audit involves a comprehensive analysis of the building's general characteristics, its energy use and allocation of that use amongst the facility's energy end uses. The goal is to identify sources of potential energy savings. Your auditor should develop a list of recommendations that will result in substantial energy and operational cost savings. These may include, building envelope improvement and mechanical systems, lighting upgrades, equipment replacement and installation of lighting and HVAC control mechanisms, among others.

A good audit should include information specific to each recommendation which *at least* includes approximate annual energy unit and cost savings, demand reduction, installation cost, lifetime cost savings and information related to cost-effectiveness. This will help to prioritize the recommendations based on their energy efficiency and shortest payback.

The recommendations provided in an energy audit report may reduce facility energy bills by 20% or more in addition to improving occupant health and comfort. Following this report, an energy audit is the next step in realizing the full potential of energy savings opportunities.

- **Request Retro-Commissioning**

Retro-commissioning is a detailed process applied to existing facilities aimed at correcting many of the degradations and inefficiencies that are indicative of older and/or poorly performing buildings. Many older buildings tend to be less comfortable and operate less efficiently when not properly commissioned. Retro-commissioning includes a detailed energy audit and focuses on not only potential energy savings but also the interaction of the building's equipments and mechanical systems with an eye toward restoring it to optimal performance.

In contrast to an energy audit, this optimization focuses on operational improvements to existing equipment, rather than replacement. Apart from energy savings, other improvements and benefits include substantial operation and maintenance (O&M) cost savings, improved air quality, occupant comfort, health and safety, equipment controls, and improved system interactivity.

In addition to providing recommendations, retro-commissioning includes implementation of the recommended improvements and hence the cost for retro-commissioning is higher than an audit. However, when the costs of improvements are added to the energy audit cost, prices may be comparable. If high O&M costs or occupant health, comfort and safety are concerns in addition to reduction in energy use, retro-commissioning may be a suitable strategy.

- **Upgrade Lighting Systems**

Lighting typically accounts for 30-60% of all energy consumed in school buildings. Additionally, the electrical energy consumed by lights during the summer creates heat and increases cooling costs.

Rochester Middle School's electricity consumption is slightly lower (better) compared to other schools in the State. Upgraded lighting systems in high consumption areas like classrooms, gymnasiums, libraries, offices, etc. can reduce costs even further, improve the lighting quality and increase occupant comfort and productivity.

Over-lit Spaces: Light levels should be recorded in classrooms and hallways to ensure they are not over-lit, 40-50 foot candles are adequate light levels for an instructional space. If classroom light levels are much higher than 50 foot candles, Rochester Middle School should consider de-lamping classrooms or installing dimming ballasts, which dim the lights when outdoor light levels are adequate. In over-lit hallway spaces photo sensors can be installed to turn lights off completely when light levels exceed a pre-set threshold.

In over-lit spaces a T8 to Super T8 lighting retro-fit can reduce the number of light fixtures needed. Super T8 lamps use between 4 and 7 Watts less electricity than standard T8 lamps, but they produce more light per Watt. In some cases this increase in light per Watt can allow for the removal of an entire lamp, saving 32 Watts. The room characteristics must be factored in before this type of retro-fit. The shape of the space, ceiling height, color of the walls, etc. all need to be taken into account when exploring a de-lamping project. We recommend that before retro-fitting the entire facility, begin by changing one classroom and monitor the comfort level of the occupants at Rochester Middle School.

Another proven energy reduction measure with a short payback period is to identify any areas where your school may still be using metal halide lighting. Typically metal halide lights are found in gymnasiums or cafeteria areas, many districts have been very satisfied by replacing these lights with high bay T5 lighting fixtures. In addition to the reduced operational wattage, high bay T5 lights turn on instantly, as opposed to metal halide fixtures which have an extended warm up period. The long warm up period associated with metal halides typically leads to the lights being left on all day, at 250 to 400 watts a fixture; the costs begin to add up. Adding occupancy sensors to high bay T5 fixtures further reduces the payback period.

Occupancy Sensors: We recommend that you explore the use of occupancy sensors to ensure that lights are turned off in unoccupied spaces. Lights controlled by occupancy sensors typically run a third of the time when compared with manually controlled lighting. Reduced runtime leads to decreases in both energy usage and operation and maintenance costs. Additionally, a study conducted in Massachusetts found that controlling the security lighting with occupancy sensors reduced vandalism; neighbors and police recognized something wrong when the lights were on in a building that was typically dark and investigated.

To summarize and add a few ways in which Rochester Middle School may be able to conserve energy and cost through lighting upgrades is to:

- Design light quantity and quality for the task and occupants' needs in that area.
- Maximize lamp and ballast efficiency.
- Activate the power saving features on office equipment such as copiers, printers and fax machines and ensure that they are turned off at the end of the day.
- Use automatic controls to turn lights off or dim lights in unoccupied spaces.
- Establish a maintenance schedule for group re-lamping and fixture cleaning.
- Replace T12 fixtures with the most efficient fixtures which may include T8/super T8/T5 fixtures.
- Replace incandescent lighting with compact fluorescent technology.

- Replace incandescent exit lighting which consumes 30 Watts with LED type exit lights with 1.5 Watts consumption. LED units last up to 10 years, which is a maintenance advantage.
- Install daylight sensors in areas with significant natural light.
- Install occupancy sensors in areas that are often unoccupied.
- Lighting retrofits reduce maintenance costs associated with lighting that is close to end of life.
- Establish a regular cleaning schedule particularly for areas where student safety of low light levels may be a concern, such as shop classes.
- Look to make lamp and fixture selection as uniform as possible to reduce maintenance and inventory overhead.
- Educate students and staff to turn off lights when rooms are unoccupied.

Lighting upgrades seek to reduce the connected electrical load (kW) and energy consumption (kWh) of lighting equipment. Lighting controls can also significantly reduce operating hours and costs by turning off lighting when spaces are unoccupied or sufficiently lit by natural light.

- **Install NEMA Premium Motors and VFDs**

Commercial and industrial electric motor-driven systems consume approximately 23% of all electricity in the U.S., making it the single largest category contributor to electric use in the country. With very high operating hours, the annual energy cost to run a system is more than its installation cost. Even a small increase in the efficiency of an electric motor can result in substantial energy cost savings. Typical opportunities for motor upgrades in schools include: ventilation fans, and heating and cooling system pumps and fans.

Motors with efficiency up to 90% are available to replace the older ones with efficiency less than 75%. Although standards for efficiency of new equipment are set by the Energy Policy Act, motor efficiency can be further increased by selecting Premium Efficiency motors as specified by the National Electrical Manufacturers Association (NEMA). This can cut the electric motor system demand by as much as 18%.

Savings can be increased further by optimizing system performance through the use of variable frequency drives (VFDs). When system load is known to vary substantially, these flow control systems can be utilized to match system output to system demand, significantly reducing energy usage during partial load hours. By employing high-efficiency motors and VFDs, facility owners can improve environmental conditions, utilize better control of motor-driven processes, and reduce waste output.

- **Install Demand Control Ventilation**

Demand control ventilation (DCV) monitors indoor air CO_2 content as a result of occupancy production levels and uses this data to regulate the amount of outdoor air that is permitted for ventilation. In order to ensure adequate air quality, standard ventilation systems permit outside air based on estimated occupancy levels in CFM, cubic feet per minute/occupant. However, during low occupancy hours, the space may become over ventilated due to decreased CO_2 levels and unnecessary ventilation results in wasted energy. DCV reduces unnecessary outdoor air intake by regulating ventilation based on actual CO_2 levels, saving energy. DCV is most suited for areas where occupancy levels are known to fluctuate considerably such as auditoriums, cafeterias, and gymnasiums.

Install Energy Recovery Ventilators. According to energy recovery equipment manufacturer's typical paybacks are less than 5 years for schools without cooling. The keys to success with ventilation retrofits are going with fewer larger units with long run hours as opposed to several small units with limited run time. Equipment with moisture recovery capabilities would cut humidity up to 50% during the cooling season.

- **Improve/Replace Inefficient Heating Systems**

Replacing an old boiler that is < 70% efficient with a modern 85-90% efficient natural gas-fired furnace alone will reduce heating costs by 15-20%. This combined with additional system improvements and installation of advanced HVAC control mechanisms can result in up to 20%+ heating load reduction.

Because of the high capital cost of new heating systems, some financial analysis should be performed to assess the cost-effectiveness of immediate replacement. If the current system is fairly new, replacement may not be immediately justifiable from a financial standpoint. However, as is the case with cooling systems, early replacement may prove to be a more cost-effective solution than waiting until existing systems fail or reach the end of their estimated useful life.

- **Improve/Replace Inefficient Air Conditioning Systems**

The useful life of a rooftop A/C unit is generally 12-18 years. However, depending on the efficiency, early replacement of outdated, inefficient, split, or packaged rooftop air conditioning units with new A/C systems that are 15% more efficient than 10-15 year old equipments can considerably reduce annual energy consumption. The energy cost savings and maintenance savings offset the high installation cost of a more efficient system. Installing thermostats and/or economizers on new or existing A/C systems will further reduce the cooling demand.

Economizers provide "free" cooling by using controllable dampers that bring in outside air to cool the space when the outdoor temperature or enthalpy is below the building's return air conditions. Although they require operation by a well calibrated and maintained control system, economizers have impressive energy-saving capabilities.

Install Occupancy Controlled/Programmable Thermostats

Combining efficient HVAC equipment with occupancy controlled and programmable thermostats can save a facility up to 10% of its annual heating and cooling costs:

- Areas with unpredictable occupancy on a daily/weekly basis - gym, bathrooms, outdoors: Use an *occupancy controlled thermostat* - a thermostat paired with a sensor and/or door detector to identify movement/occupancy. If occupancy is sensed by the sensor, the thermostat goes into an occupied mode (i.e. programmed set point). If a pre-programmed time frame elapses (i.e. 30 minutes) and no occupancy is sensed during that time, the thermostat goes into an unoccupied mode (e.g., setback set point or off) until occupancy is sensed again. This reduces the overall time the heating or cooling system is running, saving energy.

- Areas with predictable occupancy: e.g.: classrooms, cafeteria, offices: A *programmable thermostat* is recommended. This device is programmed on a schedule to reduce the heating or cooling output of the facility's HVAC systems in relation to its predetermined occupancy schedule. In this way, the thermostat acts to set-back or set-up the facility temperature during unoccupied hours, and re-establish a comfortable facility temperature during business hours. By employing programmable thermostat technology, the heating and cooling system demand coincides with occupancy level, reducing energy usage.

- **Install Vending Misers on Vending Machines**

Vending misers for refrigerated and non-refrigerated vending machines is an often overlooked source of potential savings. Uncontrolled, vending machine lights remain on 24/7, consuming a constant amount of energy year round. By controlling these lights with an occupancy sensor, energy consumption attributed to vending machines can be reduced considerably, in many cases, by as much as 50% and can save up to $150 per machine per year.

In the case of refrigerated vending machines, electric demand can be further reduced by controlling the machines' refrigeration systems. In a manner similar to programmable thermostats, vending misers for refrigerated machines act on a pre-set occupancy schedule to allow a marginal increase in operating temperature during non-business hours. Although products in the machine are delivered to the customer at the same temperature as in an uncontrolled vending machine, products are not being cooled unnecessarily when the machine is not in use, significantly reducing the machine's energy consumption. Because of the relatively low vending miser installation cost and high operating hours of vending machines, this improvement is typically cost-effective with a very short payback period.

- **Install ENERGY STAR® Rated Equipment / Plug Load Control**

Plug loads (computers, televisions, coffee makers, etc.) account for, on average, about 10% of total energy consumption. One of the easiest and most cost-effective energy saving strategies is the reduction of electric usage through installation of efficient appliances and the control of plug loads. In addition to utilizing ENERGY STAR® qualified appliances, greater savings can be realized through the various devices available that control every day plug loads.

By connecting non-critical loads (coffee makers, fans, microwave ovens, etc.) to an occupancy or timer controlled power strip, significant energy savings can be achieved. These savings result not only from the neglect of the user to turn the device off manually, but also from reduction of "phantom load". Phantom load is the small but constant energy draw from many plug-in devices when not in use. By connecting certain appliances to an occupancy controlled power strip, phantom load can be eliminated by cutting power supply to those devices. When replacing or ordering new equipment, emphasize ENERGY STAR® devices when they are available. Also, purchase controlled power strips and connect appropriate devices to those strips to reduce unnecessary consumption due to phantom load and appliances left on. The EPA offers free computer power management software which has saved some districts as much as $75 per computer per year, the software can be found at http://www.energystar.gov/index.cfm?c=power_mgt.pr_power_mgt_low_carbon_join.

IV. Resources:

The State of New Hampshire along with the utility companies offer multiple programs designed to improve the energy efficiency of schools through financial incentives and technical support, including:

Northeast Energy Efficiency Partnerships:

- **Northeast Collaborative for High Performance Schools (NE-CHPS)**
  NE-CHPS is a set of building and design standards for all schools from pre-K through community colleges tailored specifically for NH state code requirements, the New England climate, and the environmental priorities of the region. NH Department of Education offers up to a 3% re-imbursement for New Construction School projects. To learn more about NE-CHPS and incentive programs please visit: http://neep.org/public-policy/hpse/hpse-nechps.

New Hampshire Public Utilities Commission:

- **New Hampshire Pay for Performance**
  This program addresses the energy efficiency improvement needs of the commercial and industrial sector. The Program is implemented through a network of qualified Program Partners. Incentives will be paid out on the following three payment schedule: Incentive #1: Is based on the area of conditioned space in square feet. Incentive #2: Per/kWh saved and Per/MMBTU saved based on projected savings and paid at construction completion. Incentive #3: Per/kWh saved and Per/MMBTU saved based on actual energy savings performance one year post construction. Total performance incentives (#2 and #3) will be capped at $200,000 or 50% of project cost on a per project basis. For more information visit http://nhp4p.com.

- **New Hampshire Public Utilities Commission's Renewable Energy Rebates**
  The Sustainable Energy Division provides an incentive program for solar electric (photovoltaic or PV) arrays and solar thermal systems for domestic hot water, space and process heat, with a capacity of 100 kW or equivalent thermal output or less. The rebate for PV systems as follows: $1.00 per Watt, capped at 25% of the costs of the system or $50,000, whichever is less. For solar hot water (SHW) systems, the base rebate is $0.07 per rated or modeled kBtu/year, capped at 25% of the cost of the facility or $50,000, whichever is less, as a one-time incentive payment. http://www.puc.state.nh.us/Sustainable%20Energy/RenewableEnergyRebates-CI.html.

New Hampshire Community Development Finance Authority:

- **New Hampshire Community Development Finance Authority Revolving Loan Fund**
  The Enterprise Energy Fund is a low-interest loan and grant program available to businesses and nonprofit organizations to help finance energy improvements and renewable energy projects in their buildings. The loans will range from $10,000 to $500,000. Larger amounts will be considered on a case by case basis. The program is available to finance improvements to the overall energy-efficiency performance of buildings owned by businesses and nonprofits, thereby lowering their overall energy costs and the associated carbon emissions. More information about the program can be found on their website www.nhcdfa.org. These activities may include:

  - Improvements to the building's envelope, including air sealing and insulation in the walls, attics and foundations;
  - Improvements to HVAC equipment and air exchange;
  - Installation of renewable energy systems;
  - Improvements to lighting, equipment, and other electrical systems; and
  - Conduction of comprehensive, fuel-blind energy audits.

Public Service of New Hampshire (PSNH):

- **Commercial (Electric) Energy Efficiency Incentive Programs**
  This program targets any commercial/industrial member building a new facility, undergoing a major renovation, or replacing failed (end-of-life) equipment. The program offers prescriptive and custom rebates for lighting and lighting controls, motors, VFDs, HVAC systems, chillers and custom projects. http://www.psnh.com/SaveEnergyMoney/For-Business/Energy-Saving-Programs-and-Incentives.aspx

- **SmartSTART**
  The SmartSTART (Savings Through Affordable Retrofit Technologies) advantage is simple - pay nothing out of pocket to have energy efficiency products and services installed in your building. The Smart Start program is limited to PSNH's municipal customers only and includes schools. The program is available on a first-come, first served basis to projects which have been pre-qualified by PSNH. The cost of the improvements is fronted by PSNH which is then repaid over time by the municipality or school using the savings generated by the products themselves! This program is for lighting and lighting controls, air sealing, insulation and other verifiable energy savings measures which have sufficient kilowatt-hour savings. For more information on this program visit:
  http://www.psnh.com/SaveEnergyMoney/For-Business/Municipal-Smart-Start-Program.aspx

- **Schools Program**
  For major renovation or equipment replacement projects, this program offers prescriptive and custom rebates for energy efficient lighting, motors, HVAC, chillers, and variable frequency drives to towns or cities that install energy efficient equipment at their schools. Financial incentives are available for qualifying energy efficient equipment. Technical assistance is also offered through the Schools Program. http://www.psnh.com/SaveEnergyMoney/Large-Power/Schools-Program.aspx

Unitil:

- **Commercial and Industrial Energy Efficiency Programs**
  Subject to program qualifications and availability of funding - Unitil offers different programs for its commercial, industrial, and institutional customers in New Hampshire: the Small Business Energy Efficiency Program, the Small Commercial and Industrial Program, the Large Commercial and Industrial Program, the Large Commercial and Industrial (C&I) Retrofit Program, and the Large C&I New Construction Program. Rebates are available for various technologies including water heaters, lighting, lighting controls/sensors, chillers, furnaces, boilers, central air conditioners, compressed air, programmable thermostats, energy management systems/building controls, motors, motor VFDs, processing and manufacturing equipment, LED exit signs, commercial cooking and refrigeration equipment. http://www.unitil.com/.

Clean Air – Cool Planet:

- **Community Energy Efficiency**
  CA-CP works with communities throughout the Northeast to find solutions to climate change and build constituencies for effective climate policies and actions. Much of their work focuses on successful models for energy efficiency and renewable energy planning. They advise and partner with citizens, educators, faith groups, small businesses, municipal governments, and other local leaders. They explore cost-effective opportunities that exist for communities to reduce their emissions as well as their vulnerability to climate impacts. One such example is CA-CP's partnership with the University of NH, NH Sustainable Energy Association and UNH Cooperative Extension to create www.myenergyplan.net, a groundbreaking suite of web and outreach tools for individual action used by households, schools and community groups around the northeast. http://www.cleanair-coolplanet.org/for_communities/index.php.

Environmental Protection Agency (EPA):

- **ENERGY STAR Challenge for Schools**
  EPA is challenging school administrators and building managers to improve energy efficiency throughout their facilities. More than 500 school districts across the country are helping to fight climate change by committing to reducing their energy use with help from ENERGY STAR. Schools that take the ENERGY STAR Challenge can use energy tracking tools, technical guidance, case studies and other ENERGY STAR tools and resources to help them improve their energy efficiency. More information can be found at:
  http://yosemite.epa.gov/opa/admpress.nsf/d985312f6895893b852574ac005f1e40/d74f768ecfa9e11f8525762500522260!OpenDocument

For additional assistance in helping you save money and improve school conditions, please call TRC at (603) 766-1913 or (877) 442-9181.

NEW HAMPSHIRE
ENERGYSMART SCHOOLS PROGRAM

Energy Benchmarking Report for:

Richard Creteau Regional Technology Center

Rochester, NH

Period: ***July 1, 2010*** through ***June 30, 2011***

PREPARED BY:

155 Fleet Street, Suite #305
Portsmouth, NH 03801
(603) 766-1913
www.trcsolutions.com

Table of Contents

I. Introduction

The Sustainable Energy Division of the New Hampshire Public Utilities Commission, with support from the New Hampshire Department of Education has sponsored TRC to develop the New Hampshire ***EnergySmart Schools Program*** to support New Hampshire K-12 public and private schools in the pursuit of energy efficiency and sustainability initiatives.

Energy efficiency has become an increasingly important issue for schools due to tightening budgets and rising energy costs. Since 2003, the prices of natural gas, fuel oil and electricity have increased by 123%, 107% and 32% respectively. Schools that have participated in energy benchmarking programs have shown a decrease in overall energy use by approximately 22% through the adoption of energy efficiency measures.

Tracking and documenting the energy use and associated carbon emissions in the state's K-12 schools will allow New Hampshire to account for the impact of its energy efficiency and renewable energy programs and determine which have the greatest effect. The analysis in this report, provided by the ***EnergySmart Schools Program*** is designed to help you:

- Understand the energy consumption and cost trends at each of your school buildings.
- Learn how your buildings are performing compared to other schools locally and nationally.
- Identify opportunities for improving operations and reducing costs.
- Take advantage of resources to implement efficiency improvements and save money.

The analysis was based on the information provided on the *Building Data Request Form* submitted, which included building descriptions, energy suppliers and other information. The building's utility bills were also used to assess its electricity and heating fuel consumption for the year(s) provided.

The energy performance for your school has been compared to national data for similar school facilities through EPA's ENERGY STAR® Portfolio Manager. Also shown are the five major benchmarks used to analyze building performance, which include: electricity use; heating fuel use; weather-normalized heating fuel use; total cost; and total cost per student, all of which have been normalized for comparison by square footage and weather. As part of the program's focus on sustainability, your school's carbon footprint is also presented.

II. Benchmarking Analysis and Review Results

Building and energy usage of your school was analyzed to assess the basic nature of your energy consumption and utility costs. The Building Data Summary table shown below summarizes this information.

Table 1: Building Data Summary for Richard Creteau Technology Center

Building Data			
District	SAU 54 Rochester School Department	**School Name**	Richard Creteau Regional Technology Center
City	Rochester	**Zip Code**	03867
Year Built	1990	**Floor Area (sq.ft.)**	88,000
Number of Students	400	**Number of PCs**	323
Weekly Operating Hours	60	**Months School Used**	12
Cooking?	YES	**% AC**	30
Pool Size?	N/A	**Months Pool Used**	0

Utility Data			
Data End Point	6/30/2011	**Total Cost ($)**	107,960
Electric Provider	PSNH	**Natural Gas Provider**	Unitil
Electricity Usage (kWh)	546,800	**Electricity Cost ($)**	77,845
Natural Gas Usage (therms)	29,735	**Natural Gas Cost ($)**	30,115
Fuel Oil Usage (gal)	0	**Fuel Oil Cost ($)**	0
Other Fuel Usage (gal)	0	**Other Fuel Cost ($)**	0

Energy Indicators			
EPA Score	81	**Electric Usage (kWh/sq.ft.)**	6.2
Heating Fuel Usage (kBtu/sq.ft.)	33.8	**Weather Adjusted Heating Usage Btu/sq.ft./HDD)**	4.7
Site Energy (kBtu/sq.ft.)	55.0	**Source Energy (kBtu/sq.ft.)**	106

Environmental Impact Indicators			
Greenhouse Gas Emissions			
Last Year Heating Fuel CO_2e (Mt)	158.1	**Last Year Total CO_2e (Mt)**	327.8
Last Year Electricity CO_2e (Mt)	169.7	**CO_2e Efficiency Savings Over Previous Year**	-30.4
EPA Target Score			
Target Score	Reached	**Site Energy Reduction Needed (kBtu/sq.ft.)**	N/A - Reached

Figures 1a, 1b, 2a and 2b display the energy use, demand and cost data tracked on a monthly basis. This demonstrates the energy consumption of your building over the course of the year. As a part of the program's focus on sustainability, your school's carbon footprint was also measured and is presented in Figure 3.

Figure 1a. Monthly Electric Use & Max Demand for Richard Creteau Tech Center

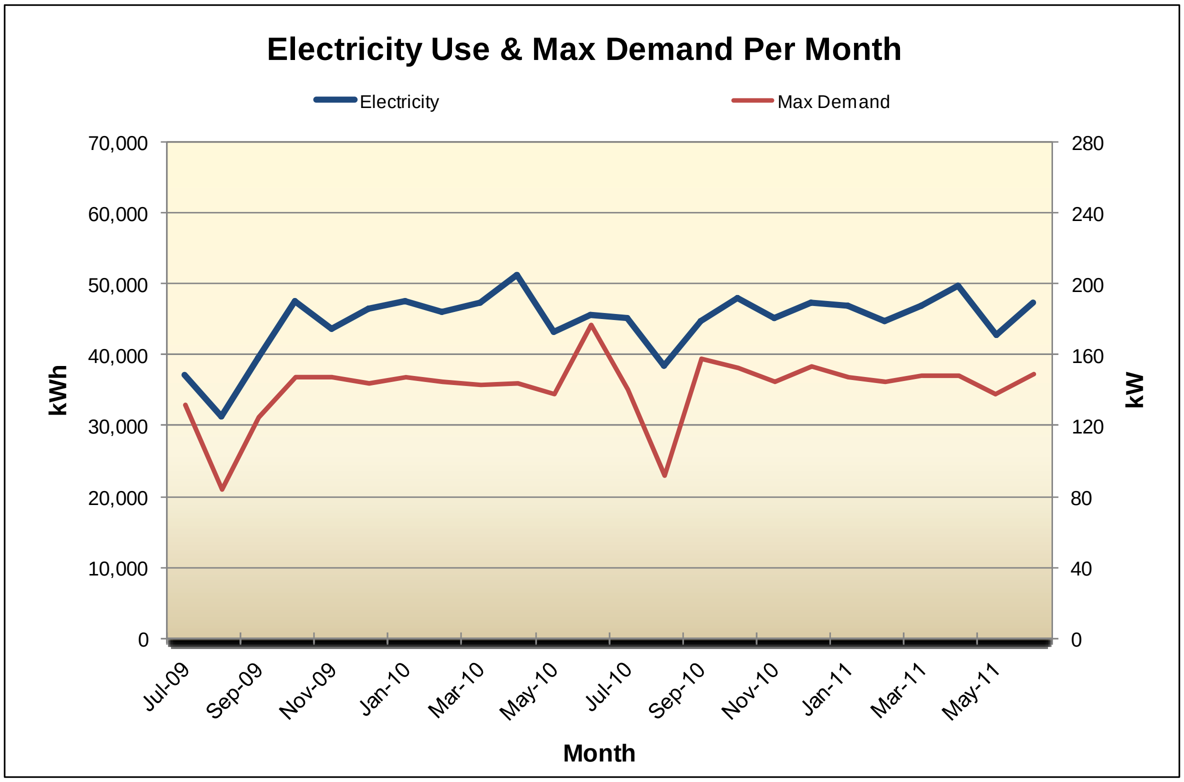
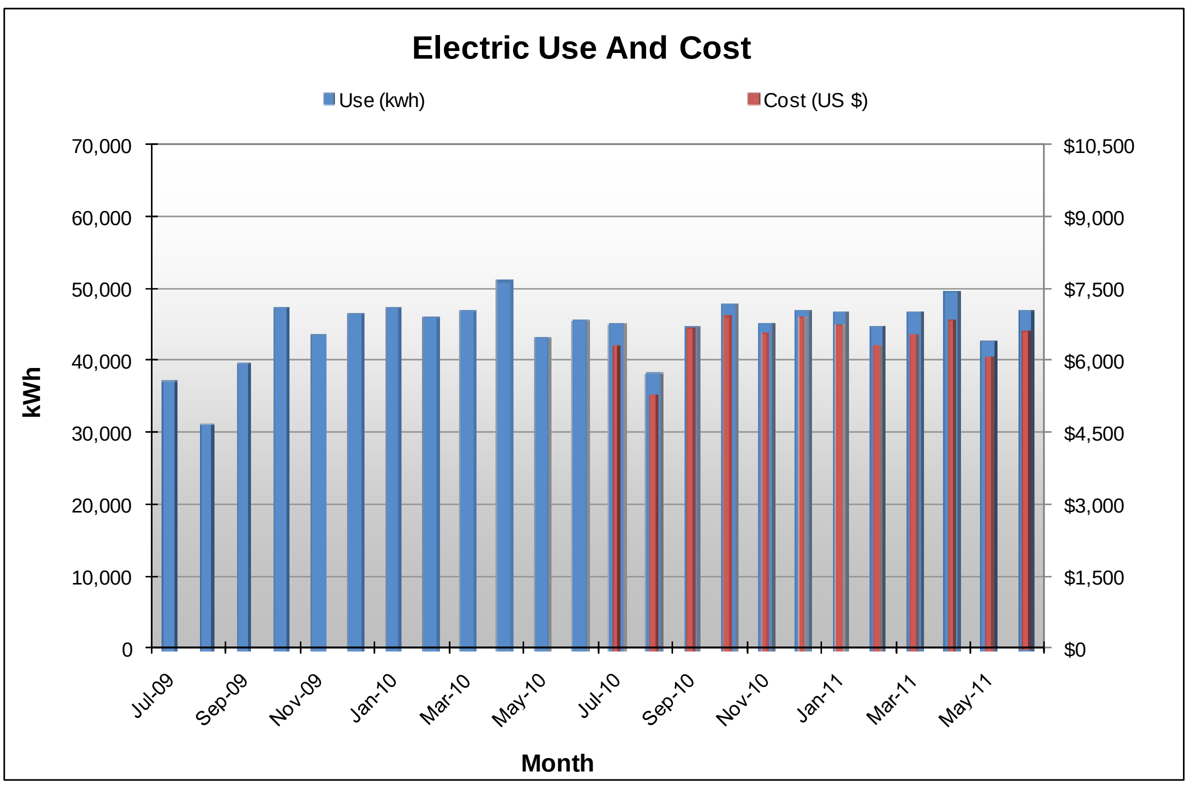


Figure 1b. Monthly Electric Use vs. Cost for Richard Creteau Tech Center



Note: Electric Cost was only available for the most recent 12 month period.

Figure 2a. Monthly Natural Gas Use for Richard Creteau Tech Center

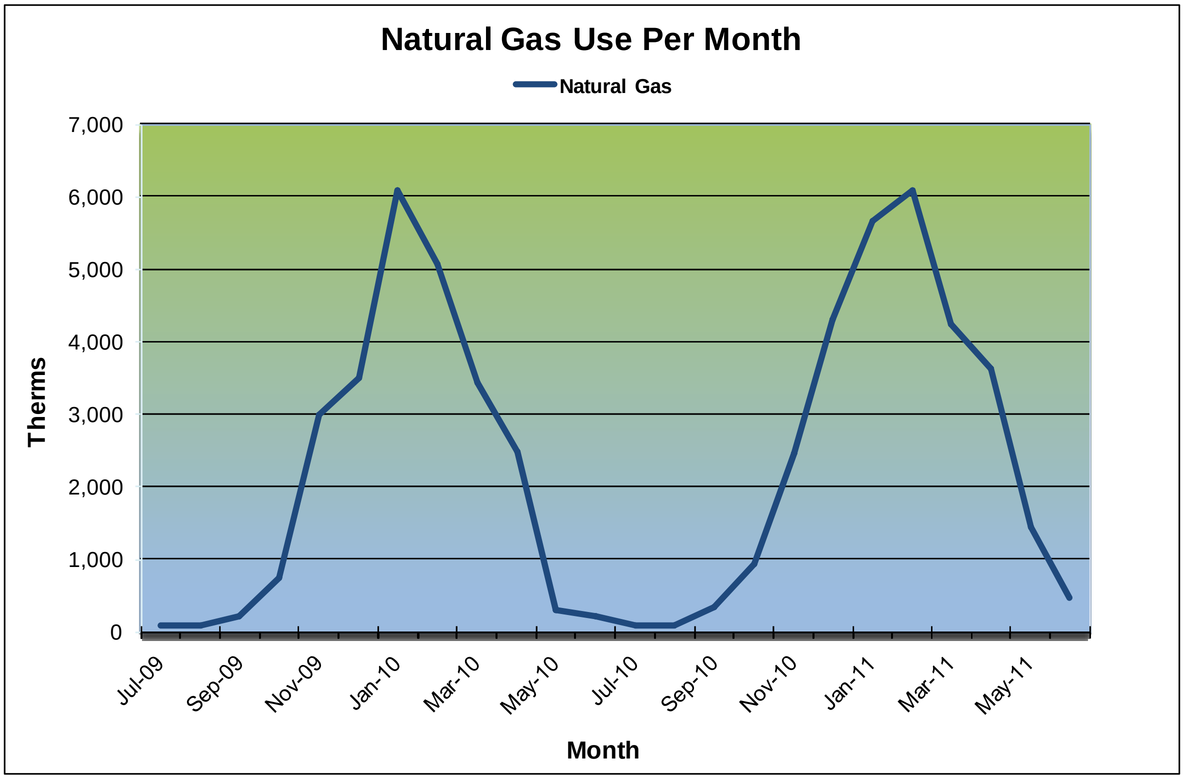


Figure 2b. Monthly Natural Gas Use vs Cost for Richard Creteau Tech Center

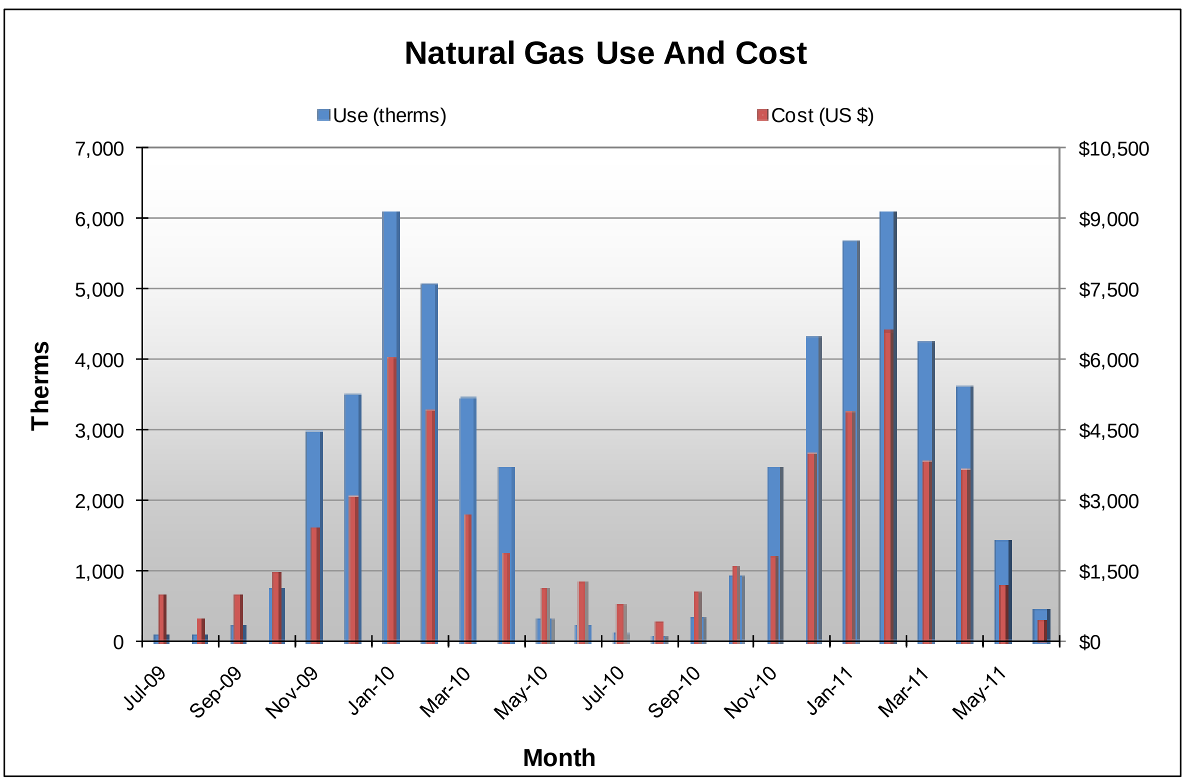
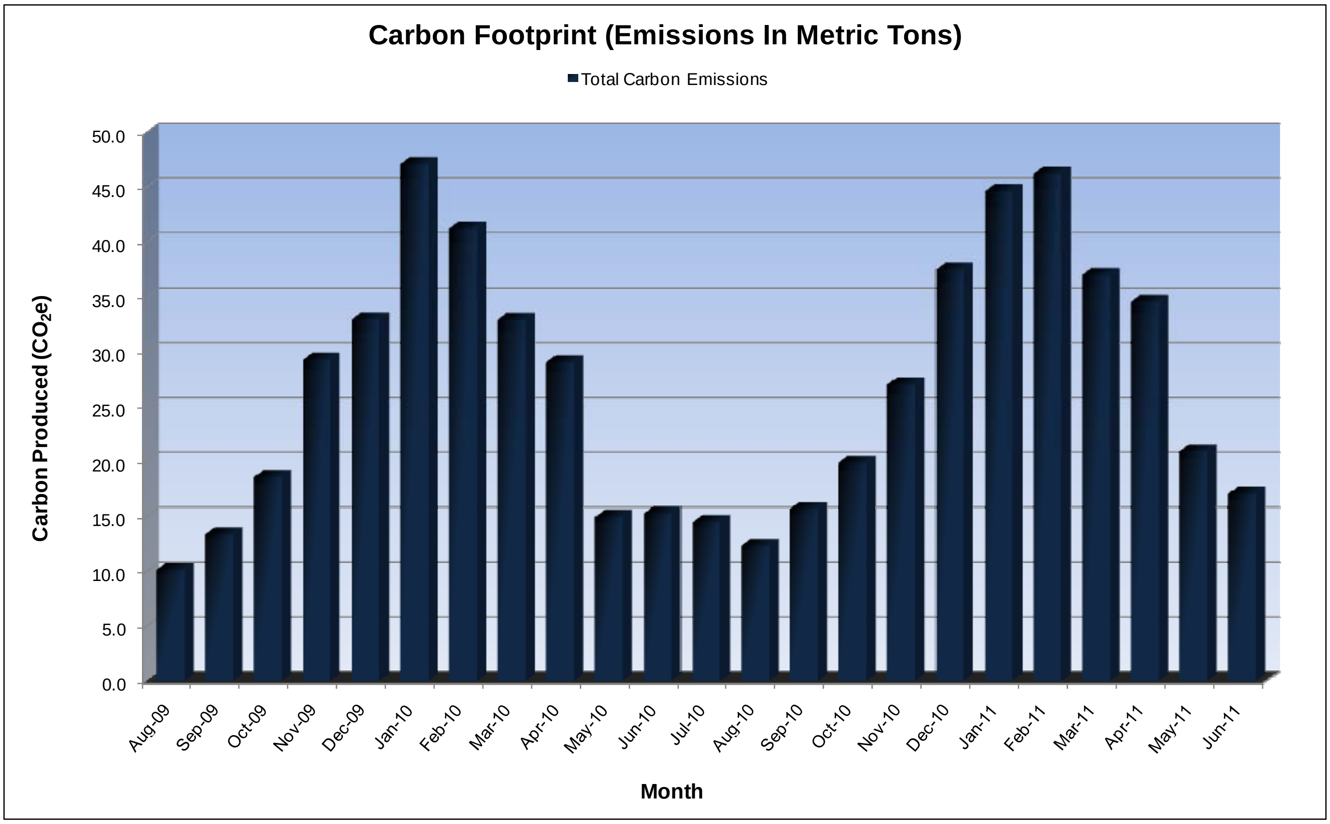


Figure 3. Monthly Greenhouse Gas Emissions for Richard Creteau Tech Center



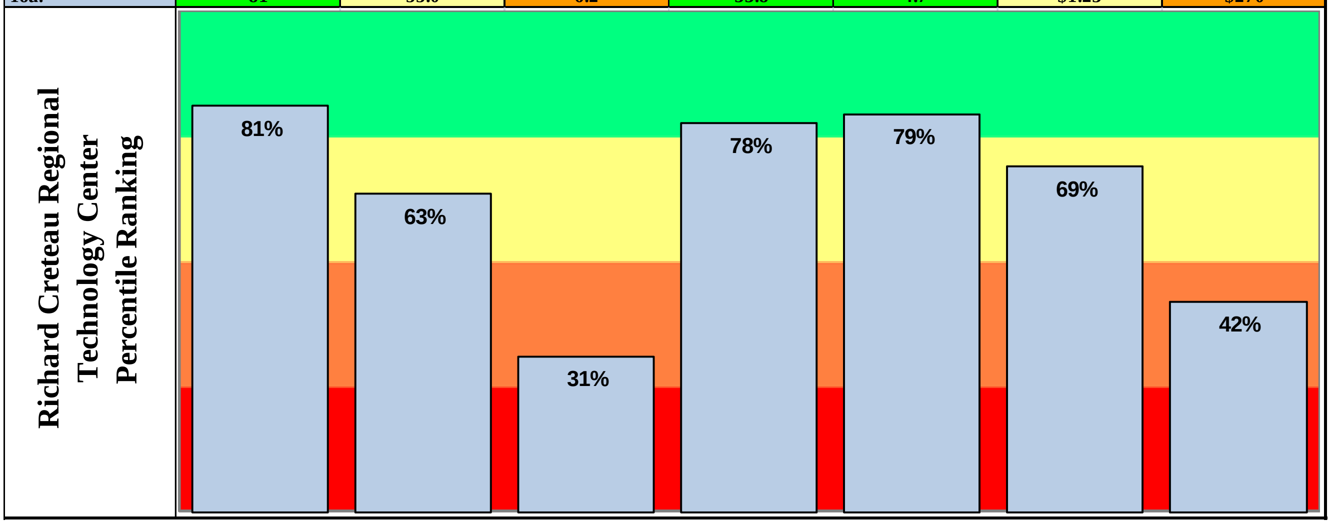
Benchmarking Data

To evaluate the energy and environmental performance of your school, the building data collected above has been compared against two different sets of school energy data: the U.S. Environmental Protection Agency's national data and New Hampshire specific state data. The results are illustrated in Figure 4 on the following page.

This will allow you to assess your building's performance relative to other buildings designed and constructed to the same codes and standards, operating under the same regulations and schedules and similar weather conditions. The indicators are calculated on a *per square foot* or *per student* basis, so you can compare your school to different sized schools.

Figure 4. EnergySmart Schools Benchmarks for Richard Creteau Tech Center

Schools	U.S. EPA Portfolio Manager Score	New Hampshire State Schools (Annual Data)					
		Total Energy Use (kBtu/sq.ft.)	Electric Use (kWh/sq.ft.)	Heating Fuel Use (kBtu/sq.ft.)	Weather Adjusted Heating Fuel Use (Btu/sq.ft./HDD)	Total Energy Cost ($/sq.ft.)	Total Energy Cost ($/student)
NH Average:	50	60.3	5.2	41.7	5.7	$1.42	$256
You:	81	55.0	6.2	33.8	4.7	$1.23	$270



Major Benchmark Indicators

1. Total Energy Use, kBtu/sq.ft.

This indicator shows how much total energy your school consumes each year. It includes the energy used for heating, cooling (if any), lights, cooking, computers, etc.

Your school's total energy use of 55.0 kBtu per square foot per year (kBtu/sq.ft.) is better than the New Hampshire K-12 schools state average of 60.3 kBtu/sq.ft. Your total energy use figure is lower than 63% of New Hampshire K-12 schools. The EnergySmart School Report is weather normalized so fuel consumption for heating takes the difference in climate between northern and southern New Hampshire into account.

This is a good indicator of how well, overall, your school is performing. However, it doesn't help you find ***where*** in your building to look for improvement opportunities. Multiple factors included on the following pages can help with that. Analysis of energy consumption for this program does not control for operational variations. An example is an improperly ventilated school may appear to have lower energy consumption. Ventilation systems that are not operating properly result in lower indoor air quality.

2. Electricity Data

Most electric utilities use the following two factors to estimate your electricity bill – Electric Use and Electric Demand.

a. Electric Use, kWh/sq.ft.

This shows how well the building does with its lights, cooling/air conditioners and cafeteria systems (if any), and what's referred to as "plug load." Plug load is anything that plugs into a socket. The major plug loads are generally computers (including monitors, printers and copiers), refrigerators, coffee machines, fans, shop equipment and projectors. If electric consumption is much higher than average, but heating fuel use (see below) is average or better, then focus your efforts on the electric-powered elements.

New Hampshire schools state average electric use is 5.2 kWh per square foot. Your school's electric consumption of 6.2 kWh per square foot this year is higher than 69% of New Hampshire schools benchmarked through the New Hampshire EnergySmart Schools Program.

b. Electric Demand, Watts/sq.ft.

Demand is a measure of the maximum electric draw in kW that your building places on the grid and is measured by adding up the kW draw for a 15 minute period. To give an analogy, if electricity usage is the amount of water going through a hose in gallons, electric demand would be how fast that water flows expressed in gallons per minute. Whichever 15 minute period during your monthly billing cycle places the highest kW demand on the grid is the demand factor applied to your bill. The best way to improve this demand factor is to stagger the times when your electrical systems draw at their maximum or reduce unnecessary electric load altogether.

The average electric demand for New Hampshire schools is 1.9 watts per square foot. Your school's electric demand is 1.8 watts per square foot and is lower than 58% of New Hampshire Schools benchmarked through the New Hampshire EnergySmart Schools Program.

3. Heating Fuel Use, kBtu/sq.ft.

Reviewing these indicators is relatively straightforward. If your school's heating fuel use is much higher than average, an audit of your heating system along with your building envelope - doors, windows, roof - is recommended. This factor is 'fuel-neutral' as it works for either fuel oil or natural gas heating systems.

New Hampshire K-12 schools state average heating fuel use is 41.7 kBtu/sq.ft. or 5.7 Btu/sq.ft./HDD. Your school's heating fuel use of 33.8 kBtu/sq.ft. per year is lower than 78% of other New Hampshire schools in the database. Your school's weather adjusted heating fuel use of 4.7 Btu/sq.ft./HDD is lower than 79% of other New Hampshire schools benchmarked through the New Hampshire EnergySmart Schools Program.

4. Energy Cost, $/sq.ft. & $/student

Cost is the bottom line. These numbers help you understand, in terms of budget, the gain through energy efficiency improvements. New Hampshire K-12 schools state averages $1.42/sq.ft. and $256/student.

Your school's annual energy cost of $1.23 per square foot is lower than 69% of other New Hampshire benchmarked schools. Your school's cost expressed on a per student basis of $270 is higher than 58% of other New Hampshire schools benchmarked through the New Hampshire EnergySmart Schools Program.

5. U.S. EPA *Portfolio Manager* Score

Portfolio Manager is a benchmarking model based on a national set of data from K-12 schools. It is provided by the U.S. Environmental Protection Agency's ENERGY STAR® Program. The impact of factors outside of your control (such as location, occupancy and operating hours) are removed, providing a 1-100 ranking of a school's energy performance relative to the national school building market. A score of 50 represents the national average and a score of 100 is best. Schools that achieve a score of 75 or higher are eligible for EPA's ENERGY STAR® Building Label, the national symbol for protecting the environment through energy efficiency. Districts can achieve ENERGY STAR® Leader Awards in recognition if their buildings, on average, improve by 10%, 20%, 30%, etc. over their baseline year of reported energy use or if the district's overall weighted average *Portfolio Manager* Score is at least a 75.

Your school's *Portfolio Manager* Score of 81 places it higher than 81% of K-12 schools nationwide. As noted above, this rating potentially qualifies your school for the prestigious ENERGY STAR® Label for Buildings.

III. Potential Energy Saving Opportunities

Based on the preceding analysis of your school's energy performance, implementation of the following recommendations can help you save energy and money. The first step is to look at reducing electrical lighting and HVAC consumption (burners, circulators and fans) which typically account for 67% of a building's electric consumption.

- **Perform an Energy Audit on the Building**

An energy audit involves a comprehensive analysis of the building's general characteristics, its energy use and allocation of that use amongst the facility's energy end uses. The goal is to identify sources of potential energy savings. Your auditor should develop a list of recommendations that will result in substantial energy and operational cost savings. These may include, building envelope improvement and mechanical systems, lighting upgrades, equipment replacement and installation of lighting and HVAC control mechanisms, among others.

A good audit should include information specific to each recommendation which *at least* includes approximate annual energy unit and cost savings, demand reduction, installation cost, lifetime cost savings and information related to cost-effectiveness. This will help to prioritize the recommendations based on their energy efficiency and shortest payback.

The recommendations provided in an energy audit report may reduce facility energy bills by 20% or more in addition to improving occupant health and comfort. Following this report, an energy audit is the next step in realizing the full potential of energy savings opportunities.

- **Request Retro-Commissioning**

Retro-commissioning is a detailed process applied to existing facilities aimed at correcting many of the degradations and inefficiencies that are indicative of older and/or poorly performing buildings. Many older buildings tend to be less comfortable and operate less efficiently when not properly commissioned. Retro-commissioning includes a detailed energy audit and focuses on not only potential energy savings but also the interaction of the building's equipments and mechanical systems with an eye toward restoring it to optimal performance.

In contrast to an energy audit, this optimization focuses on operational improvements to existing equipment, rather than replacement. Apart from energy savings, other improvements and benefits include substantial operation and maintenance (O&M) cost savings, improved air quality, occupant comfort, health and safety, equipment controls, and improved system interactivity.

In addition to providing recommendations, retro-commissioning includes implementation of the recommended improvements and hence the cost for retro-commissioning is higher than an audit. However, when the costs of improvements are added to the energy audit cost, prices may be comparable. If high O&M costs or occupant health, comfort and safety are concerns in addition to reduction in energy use, retro-commissioning may be a suitable strategy.

- **Upgrade Lighting Systems**

Lighting typically accounts for 30-60% of all energy consumed in school buildings. Additionally, the electrical energy consumed by lights during the summer creates heat and increases cooling costs.

Richard Creteau Regional Technology Center's electricity consumption is high compared to other schools in the State. Upgraded lighting systems in high consumption areas like classrooms, gymnasiums, libraries, offices, etc. can reduce these costs, improve the lighting quality and increase occupant comfort and productivity.

Over-lit Spaces: Light levels should be recorded in classrooms and hallways to ensure they are not over-lit, 40-50 foot candles are adequate light levels for an instructional space. If classroom light levels are much higher than 50 foot candles, Richard Creteau Regional Technology Center should consider de-lamping classrooms or installing dimming ballasts, which dim the lights when outdoor light levels are adequate. In over-lit hallway spaces photo sensors can be installed to turn lights off completely when light levels exceed a pre-set threshold.

In over-lit spaces a T8 to Super T8 lighting retro-fit can reduce the number of light fixtures needed. Super T8 lamps use between 4 and 7 Watts less electricity than standard T8 lamps, but they produce more light per Watt. In some cases this increase in light per Watt can allow for the removal of an entire lamp, saving 32 Watts. The room characteristics must be factored in before this type of retro-fit. The shape of the space, ceiling height, color of the walls, etc. all need to be taken into account when exploring a de-lamping project. We recommend that before retro-fitting the entire facility, begin by changing one classroom and monitor the comfort level of the occupants at Richard Creteau Regional Technology Center.

Another proven energy reduction measure with a short payback period is to identify any areas where your school may still be using metal halide lighting. Typically metal halide lights are found in gymnasiums or cafeteria areas, many districts have been very satisfied by replacing these lights with high bay T5 lighting fixtures. In addition to the reduced operational wattage, high bay T5 lights turn on instantly, as opposed to metal halide fixtures which have an extended warm up period. The long warm up period associated with metal halides typically leads to the lights being left on all day, at 250 to 400 watts a fixture; the costs begin to add up. Adding occupancy sensors to high bay T5 fixtures further reduces the payback period.

Occupancy Sensors: We recommend that you explore the use of occupancy sensors to ensure that lights are turned off in unoccupied spaces. Lights controlled by occupancy sensors typically run a third of the time when compared with manually controlled lighting. Reduced runtime leads to decreases in both energy usage and operation and maintenance costs. Additionally, a study conducted in Massachusetts found that controlling the security lighting with occupancy sensors reduced vandalism; neighbors and police recognized something wrong when the lights were on in a building that was typically dark and investigated.

To summarize and add a few ways in which Richard Creteau Regional Technology Center may be able to conserve energy and cost through lighting upgrades is to:

- Design light quantity and quality for the task and occupants' needs in that area.
- Maximize lamp and ballast efficiency.
- Activate the power saving features on office equipment such as copiers, printers and fax machines and ensure that they are turned off at the end of the day.
- Use automatic controls to turn lights off or dim lights in unoccupied spaces.
- Establish a maintenance schedule for group re-lamping and fixture cleaning.
- Replace T12 fixtures with the most efficient fixtures which may include T8/super T8/T5 fixtures.
- Replace incandescent lighting with compact fluorescent technology.

- Replace incandescent exit lighting which consumes 30 Watts with LED type exit lights with 1.5 Watts consumption. LED units last up to 10 years, which is a maintenance advantage.

- Install daylight sensors in areas with significant natural light.

- Install occupancy sensors in areas that are often unoccupied.

- Lighting retrofits reduce maintenance costs associated with lighting that is close to end of life.

- Establish a regular cleaning schedule particularly for areas where student safety of low light levels may be a concern, such as shop classes.

- Look to make lamp and fixture selection as uniform as possible to reduce maintenance and inventory overhead.

- Educate students and staff to turn off lights when rooms are unoccupied.

Lighting upgrades seek to reduce the connected electrical load (kW) and energy consumption (kWh) of lighting equipment. Lighting controls can also significantly reduce operating hours and costs by turning off lighting when spaces are unoccupied or sufficiently lit by natural light.

- **Install NEMA Premium Motors and VFDs**

Commercial and industrial electric motor-driven systems consume approximately 23% of all electricity in the U.S., making it the single largest category contributor to electric use in the country. With very high operating hours, the annual energy cost to run a system is more than its installation cost. Even a small increase in the efficiency of an electric motor can result in substantial energy cost savings. Typical opportunities for motor upgrades in schools include: ventilation fans, and heating and cooling system pumps and fans.

Motors with efficiency up to 90% are available to replace the older ones with efficiency less than 75%. Although standards for efficiency of new equipment are set by the Energy Policy Act, motor efficiency can be further increased by selecting Premium Efficiency motors as specified by the National Electrical Manufacturers Association (NEMA). This can cut the electric motor system demand by as much as 18%.

Savings can be increased further by optimizing system performance through the use of variable frequency drives (VFDs). When system load is known to vary substantially, these flow control systems can be utilized to match system output to system demand, significantly reducing energy usage during partial load hours. By employing high-efficiency motors and VFDs, facility owners can improve environmental conditions, utilize better control of motor-driven processes, and reduce waste output.

- **Install Demand Control Ventilation**

Demand control ventilation (DCV) monitors indoor air CO_2 content as a result of occupancy production levels and uses this data to regulate the amount of outdoor air that is permitted for ventilation. In order to ensure adequate air quality, standard ventilation systems permit outside air based on estimated occupancy levels in CFM, cubic feet per minute/occupant. However, during low occupancy hours, the space may become over ventilated due to decreased CO_2 levels and unnecessary ventilation results in wasted energy. DCV reduces unnecessary outdoor air intake by regulating ventilation based on actual CO_2 levels, saving energy. DCV is most suited for areas where occupancy levels are known to fluctuate considerably such as auditoriums, cafeterias, and gymnasiums.

Install Energy Recovery Ventilators. According to energy recovery equipment manufacturer's typical paybacks are less than 5 years for schools without cooling. The keys to success with ventilation retrofits are going with fewer larger units with long run hours as opposed to several small units with limited run time. Equipment with moisture recovery capabilities would cut humidity up to 50% during the cooling season.

- **Improve/Replace Inefficient Heating Systems**

Replacing an old boiler that is < 70% efficient with a modern 85-90% efficient natural gas-fired furnace alone will reduce heating costs by 15-20%. This combined with additional system improvements and installation of advanced HVAC control mechanisms can result in up to 20%+ heating load reduction.

Because of the high capital cost of new heating systems, some financial analysis should be performed to assess the cost-effectiveness of immediate replacement. If the current system is fairly new, replacement may not be immediately justifiable from a financial standpoint. However, as is the case with cooling systems, early replacement may prove to be a more cost-effective solution than waiting until existing systems fail or reach the end of their estimated useful life.

- **Improve/Replace Inefficient Air Conditioning Systems**

The useful life of a rooftop A/C unit is generally 12-18 years. However, depending on the efficiency, early replacement of outdated, inefficient, split, or packaged rooftop air conditioning units with new A/C systems that are 15% more efficient than 10-15 year old equipments can considerably reduce annual energy consumption. The energy cost savings and maintenance savings offset the high installation cost of a more efficient system. Installing thermostats and/or economizers on new or existing A/C systems will further reduce the cooling demand.

Economizers provide "free" cooling by using controllable dampers that bring in outside air to cool the space when the outdoor temperature or enthalpy is below the building's return air conditions. Although they require operation by a well calibrated and maintained control system, economizers have impressive energy-saving capabilities.

Install Occupancy Controlled/Programmable Thermostats

Combining efficient HVAC equipment with occupancy controlled and programmable thermostats can save a facility up to 10% of its annual heating and cooling costs:

- Areas with unpredictable occupancy on a daily/weekly basis - gym, bathrooms, outdoors: Use an *occupancy controlled thermostat* - a thermostat paired with a sensor and/or door detector to identify movement/occupancy. If occupancy is sensed by the sensor, the thermostat goes into an occupied mode (i.e. programmed set point). If a pre-programmed time frame elapses (i.e. 30 minutes) and no occupancy is sensed during that time, the thermostat goes into an unoccupied mode (e.g., setback set point or off) until occupancy is sensed again. This reduces the overall time the heating or cooling system is running, saving energy.

- Areas with predictable occupancy: e.g.: classrooms, cafeteria, offices: A *programmable thermostat* is recommended. This device is programmed on a schedule to reduce the heating or cooling output of the facility's HVAC systems in relation to its predetermined occupancy schedule. In this way, the thermostat acts to set-back or set-up the facility temperature during unoccupied hours, and re-establish a comfortable facility temperature during business hours. By employing programmable thermostat technology, the heating and cooling system demand coincides with occupancy level, reducing energy usage.

- **Install Vending Misers on Vending Machines**

Vending misers for refrigerated and non-refrigerated vending machines is an often overlooked source of potential savings. Uncontrolled, vending machine lights remain on 24/7, consuming a constant amount of energy year round. By controlling these lights with an occupancy sensor, energy consumption attributed to vending machines can be reduced considerably, in many cases, by as much as 50% and can save up to $150 per machine per year.

In the case of refrigerated vending machines, electric demand can be further reduced by controlling the machines' refrigeration systems. In a manner similar to programmable thermostats, vending misers for refrigerated machines act on a pre-set occupancy schedule to allow a marginal increase in operating temperature during non-business hours. Although products in the machine are delivered to the customer at the same temperature as in an uncontrolled vending machine, products are not being cooled unnecessarily when the machine is not in use, significantly reducing the machine's energy consumption. Because of the relatively low vending miser installation cost and high operating hours of vending machines, this improvement is typically cost-effective with a very short payback period.

- **Install ENERGY STAR® Rated Equipment / Plug Load Control**

Plug loads (computers, televisions, coffee makers, etc.) account for, on average, about 10% of total energy consumption. One of the easiest and most cost-effective energy saving strategies is the reduction of electric usage through installation of efficient appliances and the control of plug loads. In addition to utilizing ENERGY STAR® qualified appliances, greater savings can be realized through the various devices available that control every day plug loads.

By connecting non-critical loads (coffee makers, fans, microwave ovens, etc.) to an occupancy or timer controlled power strip, significant energy savings can be achieved. These savings result not only from the neglect of the user to turn the device off manually, but also from reduction of "phantom load". Phantom load is the small but constant energy draw from many plug-in devices when not in use. By connecting certain appliances to an occupancy controlled power strip, phantom load can be eliminated by cutting power supply to those devices. When replacing or ordering new equipment, emphasize ENERGY STAR® devices when they are available. Also, purchase controlled power strips and connect appropriate devices to those strips to reduce unnecessary consumption due to phantom load and appliances left on. The EPA offers free computer power management software which has saved some districts as much as $75 per computer per year, the software can be found at http://www.energystar.gov/index.cfm?c=power_mgt.pr_power_mgt_low_carbon_join.

IV. Resources:

The State of New Hampshire along with the utility companies offer multiple programs designed to improve the energy efficiency of schools through financial incentives and technical support, including:

Northeast Energy Efficiency Partnerships:

- **Northeast Collaborative for High Performance Schools (NE-CHPS)**
  NE-CHPS is a set of building and design standards for all schools from pre-K through community colleges tailored specifically for NH state code requirements, the New England climate, and the environmental priorities of the region. NH Department of Education offers up to a 3% re-imbursement for New Construction School projects. To learn more about NE-CHPS and incentive programs please visit: http://neep.org/public-policy/hpse/hpse-nechps.

New Hampshire Public Utilities Commission:

- **New Hampshire Pay for Performance**
  This program addresses the energy efficiency improvement needs of the commercial and industrial sector. The Program is implemented through a network of qualified Program Partners. Incentives will be paid out on the following three payment schedule: Incentive #1: Is based on the area of conditioned space in square feet. Incentive #2: Per/kWh saved and Per/MMBTU saved based on projected savings and paid at construction completion. Incentive #3: Per/kWh saved and Per/MMBTU saved based on actual energy savings performance one year post construction. Total performance incentives (#2 and #3) will be capped at $200,000 or 50% of project cost on a per project basis. For more information visit http://nhp4p.com.

- **New Hampshire Public Utilities Commission's Renewable Energy Rebates**
  The Sustainable Energy Division provides an incentive program for solar electric (photovoltaic or PV) arrays and solar thermal systems for domestic hot water, space and process heat, with a capacity of 100 kW or equivalent thermal output or less. The rebate for PV systems as follows: $1.00 per Watt, capped at 25% of the costs of the system or $50,000, whichever is less. For solar hot water (SHW) systems, the base rebate is $0.07 per rated or modeled kBtu/year, capped at 25% of the cost of the facility or $50,000, whichever is less, as a one-time incentive payment. http://www.puc.state.nh.us/Sustainable%20Energy/RenewableEnergyRebates-CI.html.

New Hampshire Community Development Finance Authority:

- **New Hampshire Community Development Finance Authority Revolving Loan Fund**
  The Enterprise Energy Fund is a low-interest loan and grant program available to businesses and nonprofit organizations to help finance energy improvements and renewable energy projects in their buildings. The loans will range from $10,000 to $500,000. Larger amounts will be considered on a case by case basis. The program is available to finance improvements to the overall energy-efficiency performance of buildings owned by businesses and nonprofits, thereby lowering their overall energy costs and the associated carbon emissions. More information about the program can be found on their website www.nhcdfa.org. These activities may include:

  - Improvements to the building's envelope, including air sealing and insulation in the walls, attics and foundations;
  - Improvements to HVAC equipment and air exchange;
  - Installation of renewable energy systems;
  - Improvements to lighting, equipment, and other electrical systems; and
  - Conduction of comprehensive, fuel-blind energy audits.

Public Service of New Hampshire (PSNH):

- **Commercial (Electric) Energy Efficiency Incentive Programs**
  This program targets any commercial/industrial member building a new facility, undergoing a major renovation, or replacing failed (end-of-life) equipment. The program offers prescriptive and custom rebates for lighting and lighting controls, motors, VFDs, HVAC systems, chillers and custom projects. http://www.psnh.com/SaveEnergyMoney/For-Business/Energy-Saving-Programs-and-Incentives.aspx

- **SmartSTART**
  The SmartSTART (Savings Through Affordable Retrofit Technologies) advantage is simple - pay nothing out of pocket to have energy efficiency products and services installed in your building. The Smart Start program is limited to PSNH's municipal customers only and includes schools. The program is available on a first-come, first served basis to projects which have been pre-qualified by PSNH. The cost of the improvements is fronted by PSNH which is then repaid over time by the municipality or school using the savings generated by the products themselves! This program is for lighting and lighting controls, air sealing, insulation and other verifiable energy savings measures which have sufficient kilowatt-hour savings. For more information on this program visit:
  http://www.psnh.com/SaveEnergyMoney/For-Business/Municipal-Smart-Start-Program.aspx

- **Schools Program**
  For major renovation or equipment replacement projects, this program offers prescriptive and custom rebates for energy efficient lighting, motors, HVAC, chillers, and variable frequency drives to towns or cities that install energy efficient equipment at their schools. Financial incentives are available for qualifying energy efficient equipment. Technical assistance is also offered through the Schools Program. http://www.psnh.com/SaveEnergyMoney/Large-Power/Schools-Program.aspx

Unitil:

- **Commercial and Industrial Energy Efficiency Programs**
  Subject to program qualifications and availability of funding - Unitil offers different programs for its commercial, industrial, and institutional customers in New Hampshire: the Small Business Energy Efficiency Program, the Small Commercial and Industrial Program, the Large Commercial and Industrial Program, the Large Commercial and Industrial (C&I) Retrofit Program, and the Large C&I New Construction Program. Rebates are available for various technologies including water heaters, lighting, lighting controls/sensors, chillers, furnaces, boilers, central air conditioners, compressed air, programmable thermostats, energy management systems/building controls, motors, motor VFDs, processing and manufacturing equipment, LED exit signs, commercial cooking and refrigeration equipment. http://www.unitil.com/.

Clean Air – Cool Planet:

- **Community Energy Efficiency**
  CA-CP works with communities throughout the Northeast to find solutions to climate change and build constituencies for effective climate policies and actions. Much of their work focuses on successful models for energy efficiency and renewable energy planning. They advise and partner with citizens, educators, faith groups, small businesses, municipal governments, and other local leaders. They explore cost-effective opportunities that exist for communities to reduce their emissions as well as their vulnerability to climate impacts. One such example is CA-CP's partnership with the University of NH, NH Sustainable Energy Association and UNH Cooperative Extension to create www.myenergyplan.net, a groundbreaking suite of web and outreach tools for individual action used by households, schools and community groups around the northeast. http://www.cleanair-coolplanet.org/for_communities/index.php.

Environmental Protection Agency (EPA):

- **ENERGY STAR Challenge for Schools**
  EPA is challenging school administrators and building managers to improve energy efficiency throughout their facilities. More than 500 school districts across the country are helping to fight climate change by committing to reducing their energy use with help from ENERGY STAR. Schools that take the ENERGY STAR Challenge can use energy tracking tools, technical guidance, case studies and other ENERGY STAR tools and resources to help them improve their energy efficiency. More information can be found at:
  http://yosemite.epa.gov/opa/admpress.nsf/d985312f6895893b852574ac005f1e40/d74f768ecfa9e11f8525762500522260!OpenDocument

For additional assistance in helping you save money and improve school conditions, please call TRC at (603) 766-1913 or (877) 442-9181.

NEW HAMPSHIRE ENERGYSMART SCHOOLS PROGRAM

Energy Benchmarking Report for:

Nancy Loud Elementary School

East Rochester, NH

Period: ***July 1, 2010*** through ***June 30, 2011***

PREPARED BY:

TRC

155 Fleet Street, Suite #305

Portsmouth, NH 03801

(603) 766-1913

www.trcsolutions.com

Table of Contents

I. Introduction

The Sustainable Energy Division of the New Hampshire Public Utilities Commission, with support from the New Hampshire Department of Education has sponsored TRC to develop the New Hampshire ***EnergySmart Schools Program*** to support New Hampshire K-12 public and private schools in the pursuit of energy efficiency and sustainability initiatives.

Energy efficiency has become an increasingly important issue for schools due to tightening budgets and rising energy costs. Since 2003, the prices of natural gas, fuel oil and electricity have increased by 123%, 107% and 32% respectively. Schools that have participated in energy benchmarking programs have shown a decrease in overall energy use by approximately 22% through the adoption of energy efficiency measures.

Tracking and documenting the energy use and associated carbon emissions in the state's K-12 schools will allow New Hampshire to account for the impact of its energy efficiency and renewable energy programs and determine which have the greatest effect. The analysis in this report, provided by the ***EnergySmart Schools Program*** is designed to help you:

- Understand the energy consumption and cost trends at each of your school buildings.
- Learn how your buildings are performing compared to other schools locally and nationally.
- Identify opportunities for improving operations and reducing costs.
- Take advantage of resources to implement efficiency improvements and save money.

The analysis was based on the information provided on the *Building Data Request Form* submitted, which included building descriptions, energy suppliers and other information. The building's utility bills were also used to assess its electricity and heating fuel consumption for the year(s) provided.

The energy performance for your school has been compared to national data for similar school facilities through EPA's ENERGY STAR® Portfolio Manager. Also shown are the five major benchmarks used to analyze building performance, which include: electricity use; heating fuel use; weather-normalized heating fuel use; total cost; and total cost per student, all of which have been normalized for comparison by square footage and weather. As part of the program's focus on sustainability, your school's carbon footprint is also presented.

II. Benchmarking Analysis and Review Results

Building and energy usage of your school was analyzed to assess the basic nature of your energy consumption and utility costs. The Building Data Summary table shown below summarizes this information.

Table 1: Building Data Summary for Nancy Loud Elementary School

Building Data			
District	SAU 54 Rochester School Department	**School Name**	Nancy Loud Elementary School
City	East Rochester	**Zip Code**	03868
Year Built	1980	**Floor Area (sq.ft.)**	16,000
Number of Students	92	**Number of PCs**	21
Weekly Operating Hours	60	**Months School Used**	12
Cooking?	YES	**% AC**	0
Pool Size?	N/A	**Months Pool Used**	0

Utility Data			
Data End Point	6/30/2011	**Total Cost ($)**	21,675
Electric Provider	PSNH	**Natural Gas Provider**	N/A
Electricity Usage (kWh)	54,060	**Electricity Cost ($)**	8,256
Natural Gas Usage (therms)	0	**Natural Gas Cost ($)**	0
Fuel Oil Usage (gal)	6,509	**Fuel Oil Cost ($)**	13,419
Other Fuel Usage (gal)	0	**Other Fuel Cost ($)**	0

Energy Indicators			
EPA Score	79	**Electric Usage (kWh/sq.ft.)**	3.4
Heating Fuel Usage (kBtu/sq.ft.)	56.4	**Weather Adjusted Heating Usage Btu/sq.ft./HDD)**	7.8
Site Energy (kBtu/sq.ft.)	67.9	**Source Energy (kBtu/sq.ft.)**	96

Environmental Impact Indicators			
Greenhouse Gas Emissions			
Last Year Heating Fuel CO_2e (Mt)	66.4	**Last Year Total CO_2e (Mt)**	83.2
Last Year Electricity CO_2e (Mt)	16.8	**CO_2e Efficiency Savings Over Previous Year (Mt)**	-5.9
EPA Target Score			
Target Score	Reached	**Site Energy Reduction Needed (kBtu/sq.ft.)**	N/A - Reached

Figures 1a, 1b, 2a and 2b display the energy use, demand and cost data tracked on a monthly basis. This demonstrates the energy consumption of your building over the course of the year. As a part of the program's focus on sustainability, your school's carbon footprint was also measured and is presented in Figure 3.

Figure 1a. Monthly Electric Use & Max Demand for Nancy Loud Elementary

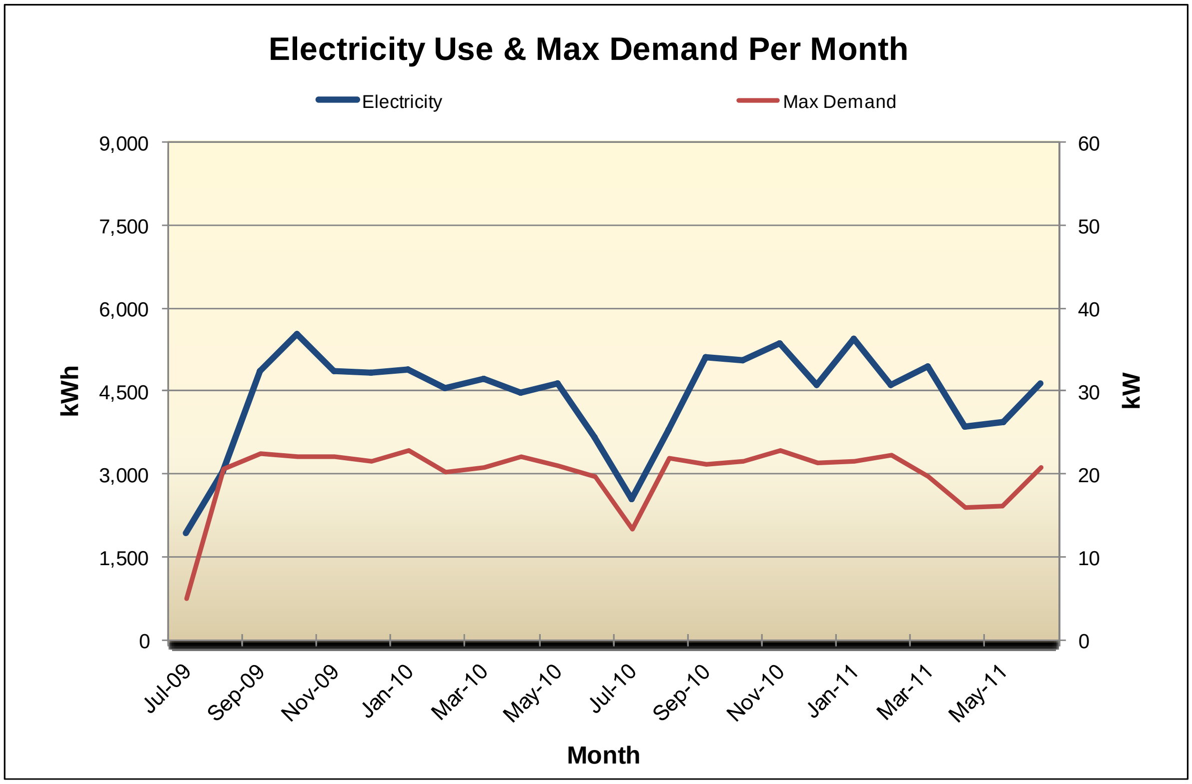


Figure 1b. Monthly Electric Use vs. Cost for Nancy Loud Elementary

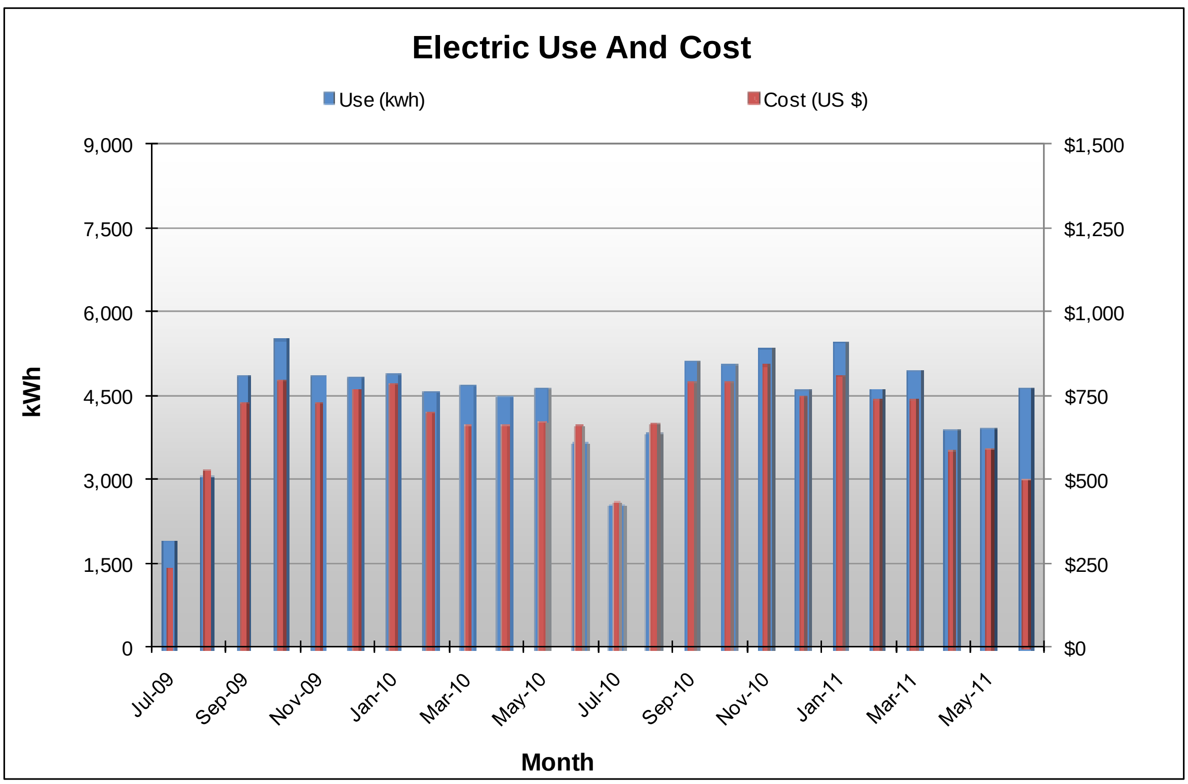


Figure 2a. Monthly Heating Fuel Use for Nancy Loud Elementary

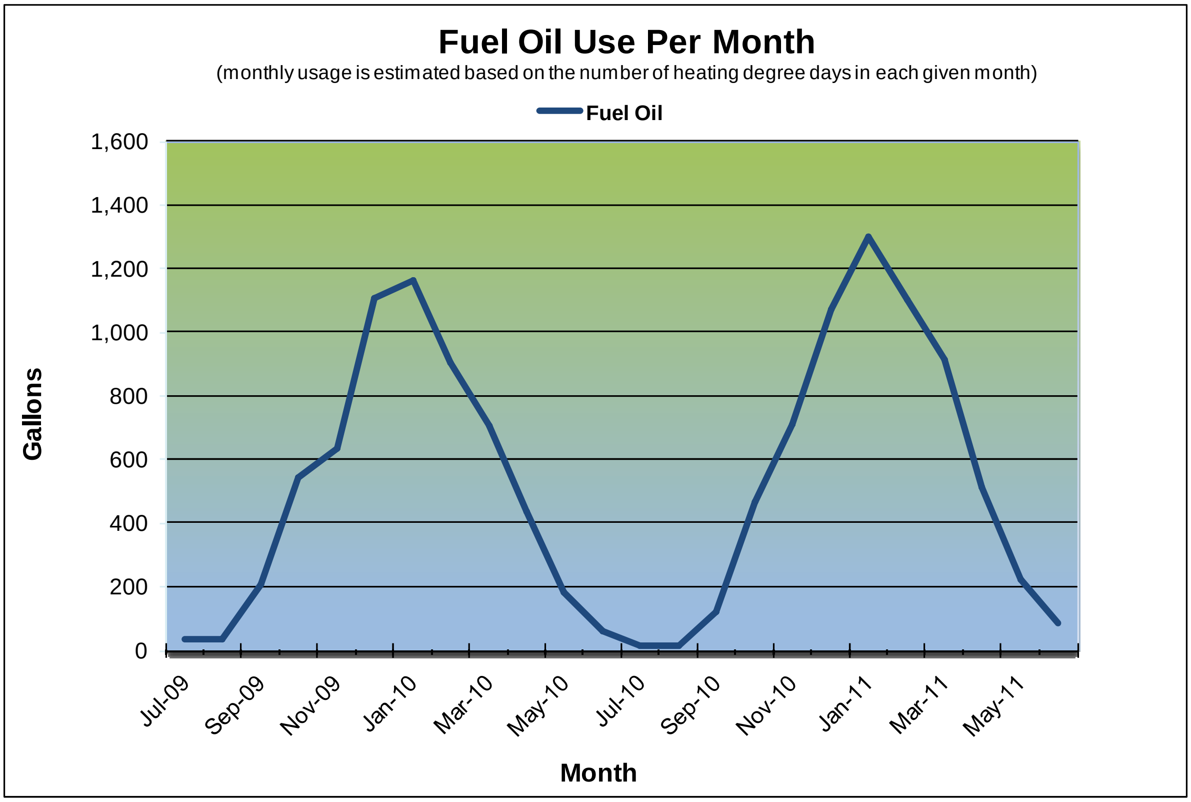


Figure 2b. Monthly Heating Fuel Use vs Cost for Nancy Loud Elementary

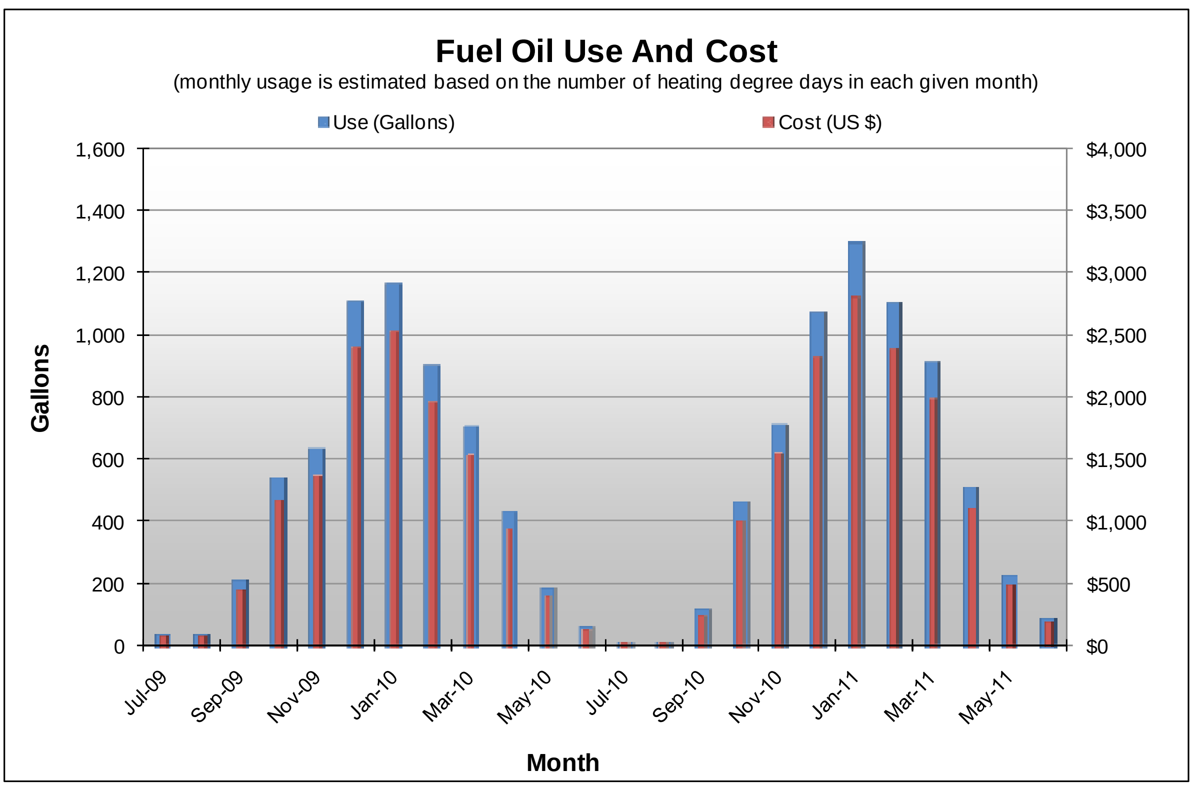
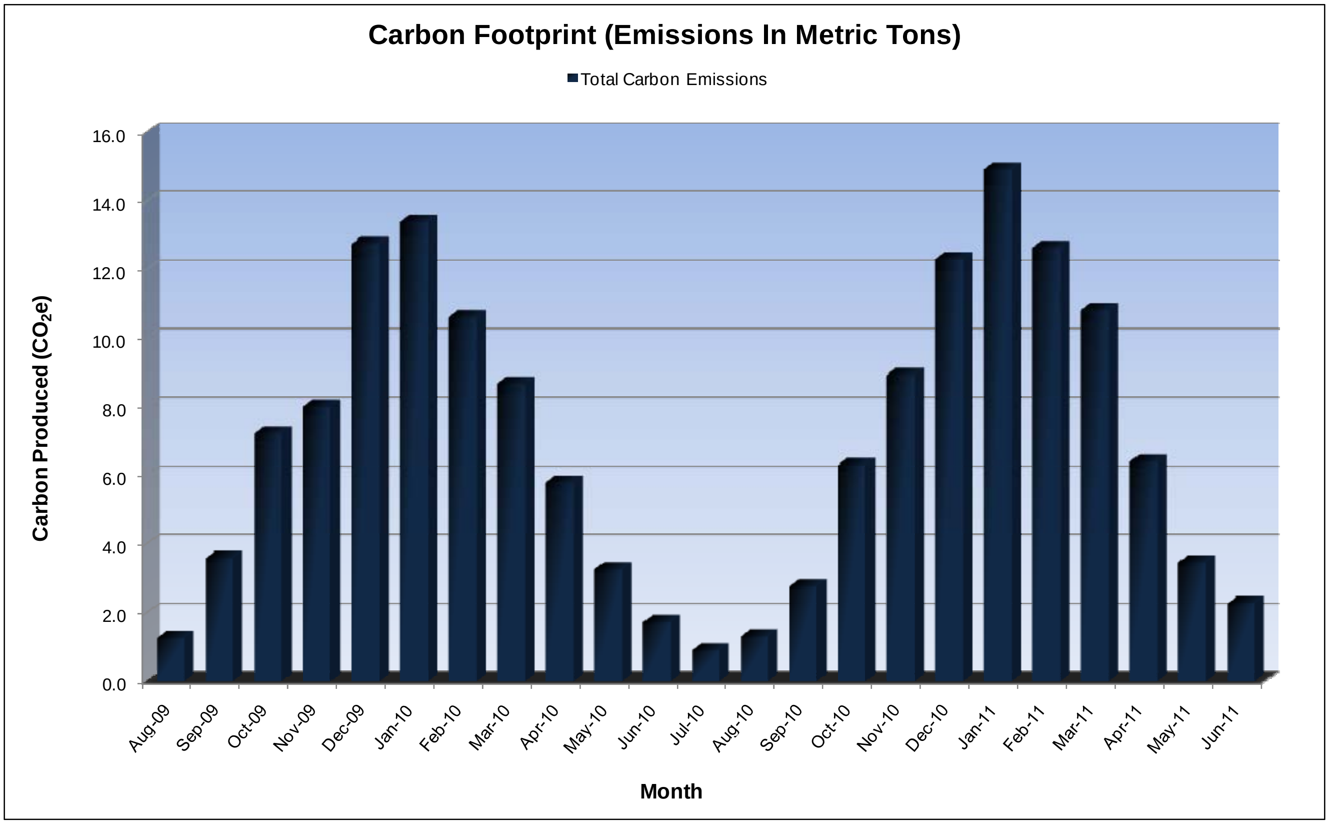


Figure 3. Monthly Greenhouse Gas Emissions for Nancy Loud Elementary



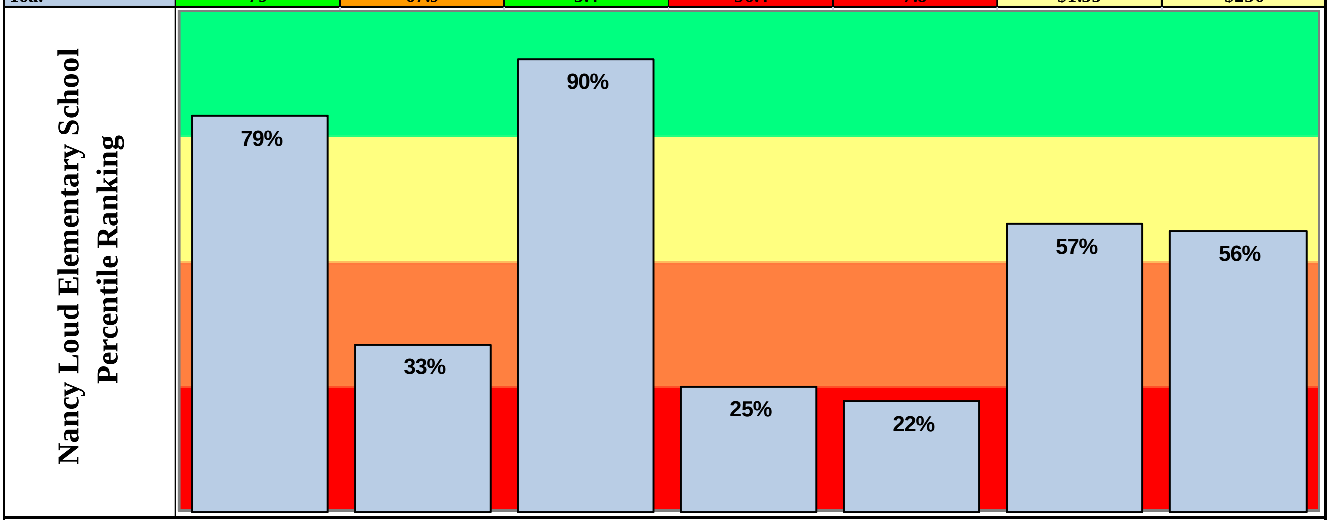
Benchmarking Data

To evaluate the energy and environmental performance of your school, the building data collected above has been compared against two different sets of school energy data: the U.S. Environmental Protection Agency's national data and New Hampshire specific state data. The results are illustrated in Figure 4 on the following page.

This will allow you to assess your building's performance relative to other buildings designed and constructed to the same codes and standards, operating under the same regulations and schedules and similar weather conditions. The indicators are calculated on a *per square foot* or *per student* basis, so you can compare your school to different sized schools.

Figure 4. EnergySmart Schools Benchmarks for Nancy Loud Elementary School

Schools	U.S. EPA Portfolio Manager Score	New Hampshire State Schools (Annual Data)					
		Total Energy Use (kBtu/sq.ft.)	Electric Use (kWh/sq.ft.)	Heating Fuel Use (kBtu/sq.ft.)	Weather Adjusted Heating Fuel Use (Btu/sq.ft./HDD)	Total Energy Cost ($/sq.ft.)	Total Energy Cost ($/student)
NH Average:	50	60.3	5.2	41.7	5.7	$1.42	$256
You:	79	67.9	3.4	56.4	7.8	$1.35	$236



Major Benchmark Indicators

1. Total Energy Use, kBtu/sq.ft.

This indicator shows how much total energy your school consumes each year. It includes the energy used for heating, cooling (if any), lights, cooking, computers, etc.

Your school's total energy use of 67.9 kBtu per square foot per year (kBtu/sq.ft.) is higher (worse) than the New Hampshire K-12 schools state average of 60.3 kBtu/sq.ft. Your total energy use figure is higher than 67% of New Hampshire K-12 schools. The EnergySmart School Report is weather normalized so fuel consumption for heating takes the difference in climate between northern and southern New Hampshire into account.

This is a good indicator of how well, overall, your school is performing. However, it doesn't help you find ***where*** in your building to look for improvement opportunities. Multiple factors included on the following pages can help with that. Analysis of energy consumption for this program does not control for operational variations. An example is an improperly ventilated school may appear to have lower energy consumption. Ventilation systems that are not operating properly result in lower indoor air quality.

2. Electricity Data

Most electric utilities use the following two factors to estimate your electricity bill – Electric Use and Electric Demand.

a. Electric Use, kWh/sq.ft.

This shows how well the building does with its lights, cooling/air conditioners and cafeteria systems (if any), and what's referred to as "plug load." Plug load is anything that plugs into a socket. The major plug loads are generally computers (including monitors, printers and copiers), refrigerators, coffee machines, fans, shop equipment and projectors. If electric consumption is much higher than average, but heating fuel use (see below) is average or better, then focus your efforts on the electric-powered elements.

New Hampshire schools state average electric use is 5.2 kWh per square foot. Your school's electric consumption of 3.4 kWh per square foot this year is lower than 90% of New Hampshire schools benchmarked through the New Hampshire EnergySmart Schools Program.

b. Electric Demand, Watts/sq.ft.

Demand is a measure of the maximum electric draw in kW that your building places on the grid and is measured by adding up the kW draw for a 15 minute period. To give an analogy, if electricity usage is the amount of water going through a hose in gallons, electric demand would be how fast that water flows expressed in gallons per minute. Whichever 15 minute period during your monthly billing cycle places the highest kW demand on the grid is the demand factor applied to your bill. The best way to improve this demand factor is to stagger the times when your electrical systems draw at their maximum or reduce unnecessary electric load altogether.

The average electric demand for New Hampshire schools is 1.9 watts per square foot. Your school's electric demand is 1.4 watts per square foot and is lower than 86% of New Hampshire Schools benchmarked through the New Hampshire EnergySmart Schools Program.

3. Heating Fuel Use, kBtu/sq.ft.

Reviewing these indicators is relatively straightforward. If your school's heating fuel use is much higher than average, an audit of your heating system along with your building envelope - doors, windows, roof - is recommended. This factor is 'fuel-neutral' as it works for either fuel oil or natural gas heating systems.

New Hampshire K-12 schools state average heating fuel use is 41.7 kBtu/sq.ft. or 5.7 Btu/sq.ft./HDD. Your school's heating fuel use of 56.4 kBtu/sq.ft. per year is higher than 75% of other New Hampshire schools in the database. Your school's weather adjusted heating fuel use of 7.8 Btu/sq.ft./HDD is higher than 78% of other New Hampshire schools benchmarked through the New Hampshire EnergySmart Schools Program.

4. Energy Cost, $/sq.ft. & $/student

Cost is the bottom line. These numbers help you understand, in terms of budget, the gain through energy efficiency improvements. New Hampshire K-12 schools state averages $1.42/sq.ft. and $256/student.

Your school's annual energy cost of $1.35 per square foot is lower than 57% of other New Hampshire benchmarked schools. Your school's cost expressed on a per student basis of $236 is lower than 56% of other New Hampshire schools benchmarked through the New Hampshire EnergySmart Schools Program.

5. U.S. EPA *Portfolio Manager* Score

Portfolio Manager is a benchmarking model based on a national set of data from K-12 schools. It is provided by the U.S. Environmental Protection Agency's ENERGY STAR® Program. The impact of factors outside of your control (such as location, occupancy and operating hours) are removed, providing a 1-100 ranking of a school's energy performance relative to the national school building market. A score of 50 represents the national average and a score of 100 is best. Schools that achieve a score of 75 or higher are eligible for EPA's ENERGY STAR® Building Label, the national symbol for protecting the environment through energy efficiency. Districts can achieve ENERGY STAR® Leader Awards in recognition if their buildings, on average, improve by 10%, 20%, 30%, etc. over their baseline year of reported energy use or if the district's overall weighted average *Portfolio Manager* Score is at least a 75.

Your school's *Portfolio Manager* Score of 79 places it higher than 79% of K-12 schools nationwide. As noted above, this rating potentially qualifies your school for the prestigious ENERGY STAR® Label for Buildings.

III. Potential Energy Saving Opportunities

Based on the preceding analysis of your school's energy performance, implementation of the following recommendations can help you save energy and money. The first step is to look at reducing electrical lighting and HVAC consumption (burners, circulators and fans) which typically account for 67% of a building's electric consumption.

- **Perform an Energy Audit on the Building**

An energy audit involves a comprehensive analysis of the building's general characteristics, its energy use and allocation of that use amongst the facility's energy end uses. The goal is to identify sources of potential energy savings. Your auditor should develop a list of recommendations that will result in substantial energy and operational cost savings. These may include, building envelope improvement and mechanical systems, lighting upgrades, equipment replacement and installation of lighting and HVAC control mechanisms, among others.

A good audit should include information specific to each recommendation which *at least* includes approximate annual energy unit and cost savings, demand reduction, installation cost, lifetime cost savings and information related to cost-effectiveness. This will help to prioritize the recommendations based on their energy efficiency and shortest payback.

The recommendations provided in an energy audit report may reduce facility energy bills by 20% or more in addition to improving occupant health and comfort. Following this report, an energy audit is the next step in realizing the full potential of energy savings opportunities.

- **Request Retro-Commissioning**

Retro-commissioning is a detailed process applied to existing facilities aimed at correcting many of the degradations and inefficiencies that are indicative of older and/or poorly performing buildings. Many older buildings tend to be less comfortable and operate less efficiently when not properly commissioned. Retro-commissioning includes a detailed energy audit and focuses on not only potential energy savings but also the interaction of the building's equipments and mechanical systems with an eye toward restoring it to optimal performance.

In contrast to an energy audit, this optimization focuses on operational improvements to existing equipment, rather than replacement. Apart from energy savings, other improvements and benefits include substantial operation and maintenance (O&M) cost savings, improved air quality, occupant comfort, health and safety, equipment controls, and improved system interactivity.

In addition to providing recommendations, retro-commissioning includes implementation of the recommended improvements and hence the cost for retro-commissioning is higher than an audit. However, when the costs of improvements are added to the energy audit cost, prices may be comparable. If high O&M costs or occupant health, comfort and safety are concerns in addition to reduction in energy use, retro-commissioning may be a suitable strategy.

- **Upgrade Lighting Systems**

Lighting typically accounts for 30-60% of all energy consumed in school buildings. Additionally, the electrical energy consumed by lights during the summer creates heat and increases cooling costs.

Nancy Loud Elementary School's electricity consumption is high compared to other schools in the State. Upgraded lighting systems in high consumption areas like classrooms, gymnasiums, libraries, offices, etc. can reduce these costs, improve the lighting quality and increase occupant comfort and productivity.

Over-lit Spaces: Light levels should be recorded in classrooms and hallways to ensure they are not over-lit, 40-50 foot candles are adequate light levels for an instructional space. If classroom light levels are much higher than 50 foot candles, Nancy Loud Elementary School should consider de-lamping classrooms or installing dimming ballasts, which dim the lights when outdoor light levels are adequate. In over-lit hallway spaces photo sensors can be installed to turn lights off completely when light levels exceed a pre-set threshold.

In over-lit spaces a T8 to Super T8 lighting retro-fit can reduce the number of light fixtures needed. Super T8 lamps use between 4 and 7 Watts less electricity than standard T8 lamps, but they produce more light per Watt. In some cases this increase in light per Watt can allow for the removal of an entire lamp, saving 32 Watts. The room characteristics must be factored in before this type of retro-fit. The shape of the space, ceiling height, color of the walls, etc. all need to be taken into account when exploring a de-lamping project. We recommend that before retro-fitting the entire facility, begin by changing one classroom and monitor the comfort level of the occupants at Nancy Loud Elementary School.

Another proven energy reduction measure with a short payback period is to identify any areas where your school may still be using metal halide lighting. Typically metal halide lights are found in gymnasiums or cafeteria areas, many districts have been very satisfied by replacing these lights with high bay T5 lighting fixtures. In addition to the reduced operational wattage, high bay T5 lights turn on instantly, as opposed to metal halide fixtures which have an extended warm up period. The long warm up period associated with metal halides typically leads to the lights being left on all day, at 250 to 400 watts a fixture; the costs begin to add up. Adding occupancy sensors to high bay T5 fixtures further reduces the payback period.

Occupancy Sensors: We recommend that you explore the use of occupancy sensors to ensure that lights are turned off in unoccupied spaces. Lights controlled by occupancy sensors typically run a third of the time when compared with manually controlled lighting. Reduced runtime leads to decreases in both energy usage and operation and maintenance costs. Additionally, a study conducted in Massachusetts found that controlling the security lighting with occupancy sensors reduced vandalism; neighbors and police recognized something wrong when the lights were on in a building that was typically dark and investigated.

To summarize and add a few ways in which Nancy Loud Elementary School may be able to conserve energy and cost through lighting upgrades is to:

- Design light quantity and quality for the task and occupants' needs in that area.
- Maximize lamp and ballast efficiency.
- Activate the power saving features on office equipment such as copiers, printers and fax machines and ensure that they are turned off at the end of the day.
- Use automatic controls to turn lights off or dim lights in unoccupied spaces.
- Establish a maintenance schedule for group re-lamping and fixture cleaning.
- Replace T12 fixtures with the most efficient fixtures which may include T8/super T8/T5 fixtures.
- Replace incandescent lighting with compact fluorescent technology.

- Replace incandescent exit lighting which consumes 30 Watts with LED type exit lights with 1.5 Watts consumption. LED units last up to 10 years, which is a maintenance advantage.

- Install daylight sensors in areas with significant natural light.

- Install occupancy sensors in areas that are often unoccupied.

- Lighting retrofits reduce maintenance costs associated with lighting that is close to end of life.

- Establish a regular cleaning schedule particularly for areas where student safety of low light levels may be a concern, such as shop classes.

- Look to make lamp and fixture selection as uniform as possible to reduce maintenance and inventory overhead.

- Educate students and staff to turn off lights when rooms are unoccupied.

Lighting upgrades seek to reduce the connected electrical load (kW) and energy consumption (kWh) of lighting equipment. Lighting controls can also significantly reduce operating hours and costs by turning off lighting when spaces are unoccupied or sufficiently lit by natural light.

- **Install NEMA Premium Motors and VFDs**

Commercial and industrial electric motor-driven systems consume approximately 23% of all electricity in the U.S., making it the single largest category contributor to electric use in the country. With very high operating hours, the annual energy cost to run a system is more than its installation cost. Even a small increase in the efficiency of an electric motor can result in substantial energy cost savings. Typical opportunities for motor upgrades in schools include: ventilation fans, and heating and cooling system pumps and fans.

Motors with efficiency up to 90% are available to replace the older ones with efficiency less than 75%. Although standards for efficiency of new equipment are set by the Energy Policy Act, motor efficiency can be further increased by selecting Premium Efficiency motors as specified by the National Electrical Manufacturers Association (NEMA). This can cut the electric motor system demand by as much as 18%.

Savings can be increased further by optimizing system performance through the use of variable frequency drives (VFDs). When system load is known to vary substantially, these flow control systems can be utilized to match system output to system demand, significantly reducing energy usage during partial load hours. By employing high-efficiency motors and VFDs, facility owners can improve environmental conditions, utilize better control of motor-driven processes, and reduce waste output.

- **Install Demand Control Ventilation**

Demand control ventilation (DCV) monitors indoor air CO_2 content as a result of occupancy production levels and uses this data to regulate the amount of outdoor air that is permitted for ventilation. In order to ensure adequate air quality, standard ventilation systems permit outside air based on estimated occupancy levels in CFM, cubic feet per minute/occupant. However, during low occupancy hours, the space may become over ventilated due to decreased CO_2 levels and unnecessary ventilation results in wasted energy. DCV reduces unnecessary outdoor air intake by regulating ventilation based on actual CO_2 levels, saving energy. DCV is most suited for areas where occupancy levels are known to fluctuate considerably such as auditoriums, cafeterias, and gymnasiums.

Install Energy Recovery Ventilators. According to energy recovery equipment manufacturer's typical paybacks are less than 5 years for schools without cooling. The keys to success with ventilation retrofits are going with fewer larger units with long run hours as opposed to several small units with limited run time. Equipment with moisture recovery capabilities would cut humidity up to 50% during the cooling season.

- **Improve/Replace Inefficient Heating Systems**

Replacing an old boiler that is < 70% efficient with a modern 85-90% efficient natural gas-fired furnace alone will reduce heating costs by 15-20%. This combined with additional system improvements and installation of advanced HVAC control mechanisms can result in up to 20%+ heating load reduction.

Because of the high capital cost of new heating systems, some financial analysis should be performed to assess the cost-effectiveness of immediate replacement. If the current system is fairly new, replacement may not be immediately justifiable from a financial standpoint. However, as is the case with cooling systems, early replacement may prove to be a more cost-effective solution than waiting until existing systems fail or reach the end of their estimated useful life.

- **Improve/Replace Inefficient Air Conditioning Systems**

The useful life of a rooftop A/C unit is generally 12-18 years. However, depending on the efficiency, early replacement of outdated, inefficient, split, or packaged rooftop air conditioning units with new A/C systems that are 15% more efficient than 10-15 year old equipments can considerably reduce annual energy consumption. The energy cost savings and maintenance savings offset the high installation cost of a more efficient system. Installing thermostats and/or economizers on new or existing A/C systems will further reduce the cooling demand.

Economizers provide "free" cooling by using controllable dampers that bring in outside air to cool the space when the outdoor temperature or enthalpy is below the building's return air conditions. Although they require operation by a well calibrated and maintained control system, economizers have impressive energy-saving capabilities.

Install Occupancy Controlled/Programmable Thermostats

Combining efficient HVAC equipment with occupancy controlled and programmable thermostats can save a facility up to 10% of its annual heating and cooling costs:

- Areas with unpredictable occupancy on a daily/weekly basis - gym, bathrooms, outdoors: Use an *occupancy controlled thermostat* - a thermostat paired with a sensor and/or door detector to identify movement/occupancy. If occupancy is sensed by the sensor, the thermostat goes into an occupied mode (i.e. programmed set point). If a pre-programmed time frame elapses (i.e. 30 minutes) and no occupancy is sensed during that time, the thermostat goes into an unoccupied mode (e.g., setback set point or off) until occupancy is sensed again. This reduces the overall time the heating or cooling system is running, saving energy.

- Areas with predictable occupancy: e.g.: classrooms, cafeteria, offices: A *programmable thermostat* is recommended. This device is programmed on a schedule to reduce the heating or cooling output of the facility's HVAC systems in relation to its predetermined occupancy schedule. In this way, the thermostat acts to set-back or set-up the facility temperature during unoccupied hours, and re-establish a comfortable facility temperature during business hours. By employing programmable thermostat technology, the heating and cooling system demand coincides with occupancy level, reducing energy usage.

- **Install Vending Misers on Vending Machines**

Vending misers for refrigerated and non-refrigerated vending machines is an often overlooked source of potential savings. Uncontrolled, vending machine lights remain on 24/7, consuming a constant amount of energy year round. By controlling these lights with an occupancy sensor, energy consumption attributed to vending machines can be reduced considerably, in many cases, by as much as 50% and can save up to $150 per machine per year.

In the case of refrigerated vending machines, electric demand can be further reduced by controlling the machines' refrigeration systems. In a manner similar to programmable thermostats, vending misers for refrigerated machines act on a pre-set occupancy schedule to allow a marginal increase in operating temperature during non-business hours. Although products in the machine are delivered to the customer at the same temperature as in an uncontrolled vending machine, products are not being cooled unnecessarily when the machine is not in use, significantly reducing the machine's energy consumption. Because of the relatively low vending miser installation cost and high operating hours of vending machines, this improvement is typically cost-effective with a very short payback period.

- **Install ENERGY STAR® Rated Equipment / Plug Load Control**

Plug loads (computers, televisions, coffee makers, etc.) account for, on average, about 10% of total energy consumption. One of the easiest and most cost-effective energy saving strategies is the reduction of electric usage through installation of efficient appliances and the control of plug loads. In addition to utilizing ENERGY STAR® qualified appliances, greater savings can be realized through the various devices available that control every day plug loads.

By connecting non-critical loads (coffee makers, fans, microwave ovens, etc.) to an occupancy or timer controlled power strip, significant energy savings can be achieved. These savings result not only from the neglect of the user to turn the device off manually, but also from reduction of "phantom load". Phantom load is the small but constant energy draw from many plug-in devices when not in use. By connecting certain appliances to an occupancy controlled power strip, phantom load can be eliminated by cutting power supply to those devices. When replacing or ordering new equipment, emphasize ENERGY STAR® devices when they are available. Also, purchase controlled power strips and connect appropriate devices to those strips to reduce unnecessary consumption due to phantom load and appliances left on. The EPA offers free computer power management software which has saved some districts as much as $75 per computer per year, the software can be found at http://www.energystar.gov/index.cfm?c=power_mgt.pr_power_mgt_low_carbon_join.

IV. Resources:

The State of New Hampshire along with the utility companies offer multiple programs designed to improve the energy efficiency of schools through financial incentives and technical support, including:

Northeast Energy Efficiency Partnerships:

- **Northeast Collaborative for High Performance Schools (NE-CHPS)**
  NE-CHPS is a set of building and design standards for all schools from pre-K through community colleges tailored specifically for NH state code requirements, the New England climate, and the environmental priorities of the region. NH Department of Education offers up to a 3% re-imbursement for New Construction School projects. To learn more about NE-CHPS and incentive programs please visit: http://neep.org/public-policy/hpse/hpse-nechps.

New Hampshire Public Utilities Commission:

- **New Hampshire Pay for Performance**
  This program addresses the energy efficiency improvement needs of the commercial and industrial sector. The Program is implemented through a network of qualified Program Partners. Incentives will be paid out on the following three payment schedule: Incentive #1: Is based on the area of conditioned space in square feet. Incentive #2: Per/kWh saved and Per/MMBTU saved based on projected savings and paid at construction completion. Incentive #3: Per/kWh saved and Per/MMBTU saved based on actual energy savings performance one year post construction. Total performance incentives (#2 and #3) will be capped at $200,000 or 50% of project cost on a per project basis. For more information visit http://nhp4p.com.

- **New Hampshire Public Utilities Commission's Renewable Energy Rebates**
  The Sustainable Energy Division provides an incentive program for solar electric (photovoltaic or PV) arrays and solar thermal systems for domestic hot water, space and process heat, with a capacity of 100 kW or equivalent thermal output or less. The rebate for PV systems as follows: $1.00 per Watt, capped at 25% of the costs of the system or $50,000, whichever is less. For solar hot water (SHW) systems, the base rebate is $0.07 per rated or modeled kBtu/year, capped at 25% of the cost of the facility or $50,000, whichever is less, as a one-time incentive payment. http://www.puc.state.nh.us/Sustainable%20Energy/RenewableEnergyRebates-CI.html.

New Hampshire Community Development Finance Authority:

- **New Hampshire Community Development Finance Authority Revolving Loan Fund**
  The Enterprise Energy Fund is a low-interest loan and grant program available to businesses and nonprofit organizations to help finance energy improvements and renewable energy projects in their buildings. The loans will range from $10,000 to $500,000. Larger amounts will be considered on a case by case basis. The program is available to finance improvements to the overall energy-efficiency performance of buildings owned by businesses and nonprofits, thereby lowering their overall energy costs and the associated carbon emissions. More information about the program can be found on their website www.nhcdfa.org. These activities may include:

  - Improvements to the building's envelope, including air sealing and insulation in the walls, attics and foundations;
  - Improvements to HVAC equipment and air exchange;
  - Installation of renewable energy systems;
  - Improvements to lighting, equipment, and other electrical systems; and
  - Conduction of comprehensive, fuel-blind energy audits.

Public Service of New Hampshire (PSNH):

- **Commercial (Electric) Energy Efficiency Incentive Programs**
  This program targets any commercial/industrial member building a new facility, undergoing a major renovation, or replacing failed (end-of-life) equipment. The program offers prescriptive and custom rebates for lighting and lighting controls, motors, VFDs, HVAC systems, chillers and custom projects. http://www.psnh.com/SaveEnergyMoney/For-Business/Energy-Saving-Programs-and-Incentives.aspx

- **SmartSTART**
  The SmartSTART (Savings Through Affordable Retrofit Technologies) advantage is simple - pay nothing out of pocket to have energy efficiency products and services installed in your building. The Smart Start program is limited to PSNH's municipal customers only and includes schools. The program is available on a first-come, first served basis to projects which have been pre-qualified by PSNH. The cost of the improvements is fronted by PSNH which is then repaid over time by the municipality or school using the savings generated by the products themselves! This program is for lighting and lighting controls, air sealing, insulation and other verifiable energy savings measures which have sufficient kilowatt-hour savings. For more information on this program visit:
  http://www.psnh.com/SaveEnergyMoney/For-Business/Municipal-Smart-Start-Program.aspx

- **Schools Program**
  For major renovation or equipment replacement projects, this program offers prescriptive and custom rebates for energy efficient lighting, motors, HVAC, chillers, and variable frequency drives to towns or cities that install energy efficient equipment at their schools. Financial incentives are available for qualifying energy efficient equipment. Technical assistance is also offered through the Schools Program. http://www.psnh.com/SaveEnergyMoney/Large-Power/Schools-Program.aspx

Unitil:

- **Commercial and Industrial Energy Efficiency Programs**
  Subject to program qualifications and availability of funding - Unitil offers different programs for its commercial, industrial, and institutional customers in New Hampshire: the Small Business Energy Efficiency Program, the Small Commercial and Industrial Program, the Large Commercial and Industrial Program, the Large Commercial and Industrial (C&I) Retrofit Program, and the Large C&I New Construction Program. Rebates are available for various technologies including water heaters, lighting, lighting controls/sensors, chillers, furnaces, boilers, central air conditioners, compressed air, programmable thermostats, energy management systems/building controls, motors, motor VFDs, processing and manufacturing equipment, LED exit signs, commercial cooking and refrigeration equipment. http://www.unitil.com/.

Clean Air – Cool Planet:

- **Community Energy Efficiency**
  CA-CP works with communities throughout the Northeast to find solutions to climate change and build constituencies for effective climate policies and actions. Much of their work focuses on successful models for energy efficiency and renewable energy planning. They advise and partner with citizens, educators, faith groups, small businesses, municipal governments, and other local leaders. They explore cost-effective opportunities that exist for communities to reduce their emissions as well as their vulnerability to climate impacts. One such example is CA-CP's partnership with the University of NH, NH Sustainable Energy Association and UNH Cooperative Extension to create www.myenergyplan.net, a groundbreaking suite of web and outreach tools for individual action used by households, schools and community groups around the northeast. http://www.cleanair-coolplanet.org/for_communities/index.php.

Environmental Protection Agency (EPA):

- **ENERGY STAR Challenge for Schools**
  EPA is challenging school administrators and building managers to improve energy efficiency throughout their facilities. More than 500 school districts across the country are helping to fight climate change by committing to reducing their energy use with help from ENERGY STAR. Schools that take the ENERGY STAR Challenge can use energy tracking tools, technical guidance, case studies and other ENERGY STAR tools and resources to help them improve their energy efficiency. More information can be found at:
  http://yosemite.epa.gov/opa/admpress.nsf/d985312f6895893b852574ac005f1e40/d74f768ecfa9e11f8525762500522260!OpenDocument

For additional assistance in helping you save money and improve school conditions, please call TRC at (603) 766-1913 or (877) 442-9181.

NEW HAMPSHIRE ENERGYSMART SCHOOLS PROGRAM

Energy Benchmarking Report for:

McClelland Elementary School
Rochester, NH

Period: ***July 1, 2010*** through ***June 30, 2011***

PREPARED BY:

TRC

155 Fleet Street, Suite #305

Portsmouth, NH 03801

(603) 766-1913

www.trcsolutions.com

Table of Contents

I. Introduction

The Sustainable Energy Division of the New Hampshire Public Utilities Commission, with support from the New Hampshire Department of Education has sponsored TRC to develop the New Hampshire ***EnergySmart Schools Program*** to support New Hampshire K-12 public and private schools in the pursuit of energy efficiency and sustainability initiatives.

Energy efficiency has become an increasingly important issue for schools due to tightening budgets and rising energy costs. Since 2003, the prices of natural gas, fuel oil and electricity have increased by 123%, 107% and 32% respectively. Schools that have participated in energy benchmarking programs have shown a decrease in overall energy use by approximately 22% through the adoption of energy efficiency measures.

Tracking and documenting the energy use and associated carbon emissions in the state's K-12 schools will allow New Hampshire to account for the impact of its energy efficiency and renewable energy programs and determine which have the greatest effect. The analysis in this report, provided by the ***EnergySmart Schools Program*** is designed to help you:

- Understand the energy consumption and cost trends at each of your school buildings.
- Learn how your buildings are performing compared to other schools locally and nationally.
- Identify opportunities for improving operations and reducing costs.
- Take advantage of resources to implement efficiency improvements and save money.

The analysis was based on the information provided on the *Building Data Request Form* submitted, which included building descriptions, energy suppliers and other information. The building's utility bills were also used to assess its electricity and heating fuel consumption for the year(s) provided.

The energy performance for your school has been compared to national data for similar school facilities through EPA's ENERGY STAR® Portfolio Manager. Also shown are the five major benchmarks used to analyze building performance, which include: electricity use; heating fuel use; weather-normalized heating fuel use; total cost; and total cost per student, all of which have been normalized for comparison by square footage and weather. As part of the program's focus on sustainability, your school's carbon footprint is also presented.

II. Benchmarking Analysis and Review Results

Building and energy usage of your school was analyzed to assess the basic nature of your energy consumption and utility costs. The Building Data Summary table shown below summarizes this information.

Table 1: Building Data Summary for McClelland Elementary School

Building Data			
District	SAU 54 Rochester School Department	**School Name**	McClelland Elementary School
City	Rochester	**Zip Code**	03867
Year Built	1957	**Floor Area (sq.ft.)**	83,800
Number of Students	407	**Number of PCs**	66
Weekly Operating Hours	60	**Months School Used**	12
Cooking?	YES	**% AC**	10
Pool Size?	N/A	**Months Pool Used**	0

Utility Data			
Data End Point	6/30/2011	**Total Cost ($)**	58,033
Electric Provider	PSNH	**Natural Gas Provider**	Unitil
Electricity Usage (kWh)	219,840	**Electricity Cost ($)**	31,227
Natural Gas Usage (therms)	18,709	**Natural Gas Cost ($)**	26,806
Fuel Oil Usage (gal)	0	**Fuel Oil Cost ($)**	0
Other Fuel Usage (gal)	0	**Other Fuel Cost ($)**	0

Energy Indicators			
EPA Score	96	**Electric Usage (kWh/sq.ft.)**	2.6
Heating Fuel Usage (kBtu/sq.ft.)	22.3	**Weather Adjusted Heating Usage Btu/sq.ft./HDD)**	3.1
Site Energy (kBtu/sq.ft.)	31.3	**Source Energy (kBtu/sq.ft.)**	53

Environmental Impact Indicators			
Greenhouse Gas Emissions			
Last Year Heating Fuel CO_2e (Mt)	99.6	**Last Year Total CO_2e (Mt)**	167.7
Last Year Electricity CO_2e (Mt)	68.1	**CO_2e Efficiency Savings Over Previous Year**	-9.3
EPA Target Score			
Target Score	Reached	**Site Energy Reduction Needed (kBtu/sq.ft.)**	N/A - Reached

Figures 1a, 1b, 2a and 2b display the energy use, demand and cost data tracked on a monthly basis. This demonstrates the energy consumption of your building over the course of the year. As a part of the program's focus on sustainability, your school's carbon footprint was also measured and is presented in Figure 3.

Figure 1a. Monthly Electric Use & Max Demand for McClelland Elementary

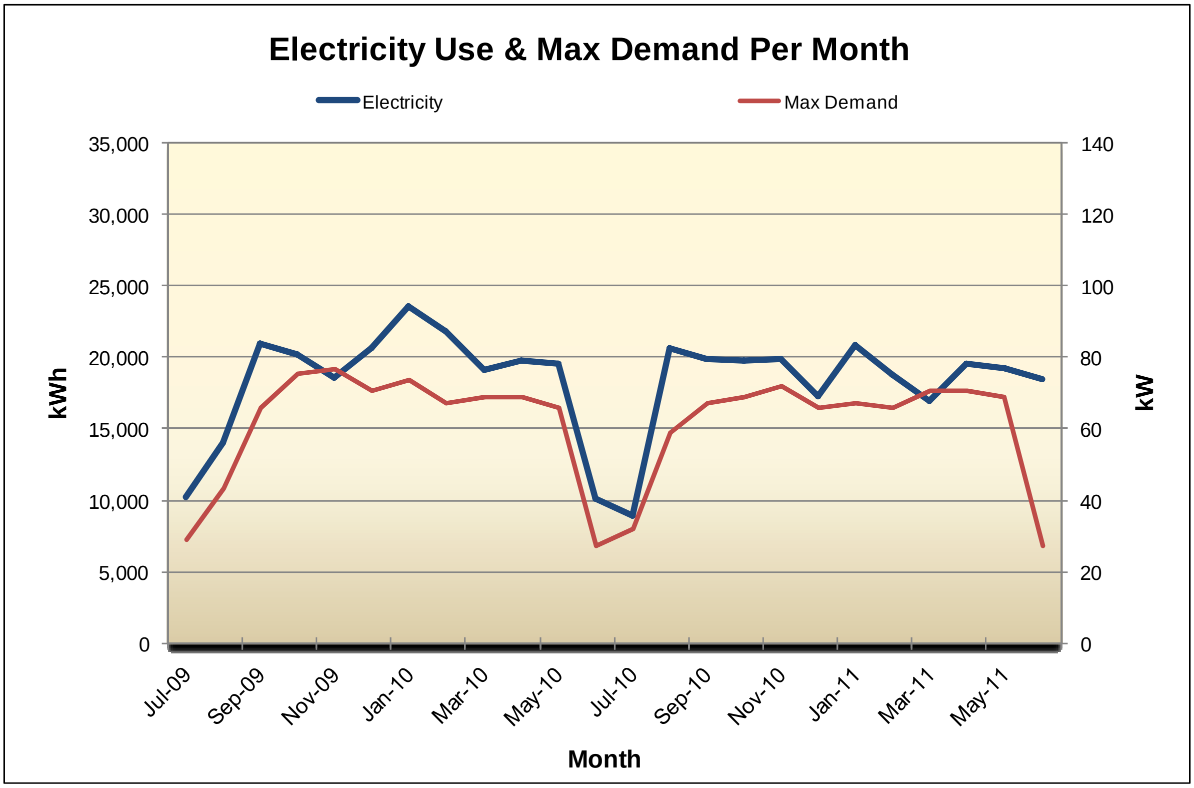


Figure 1b. Monthly Electric Use vs. Cost for McClelland Elementary

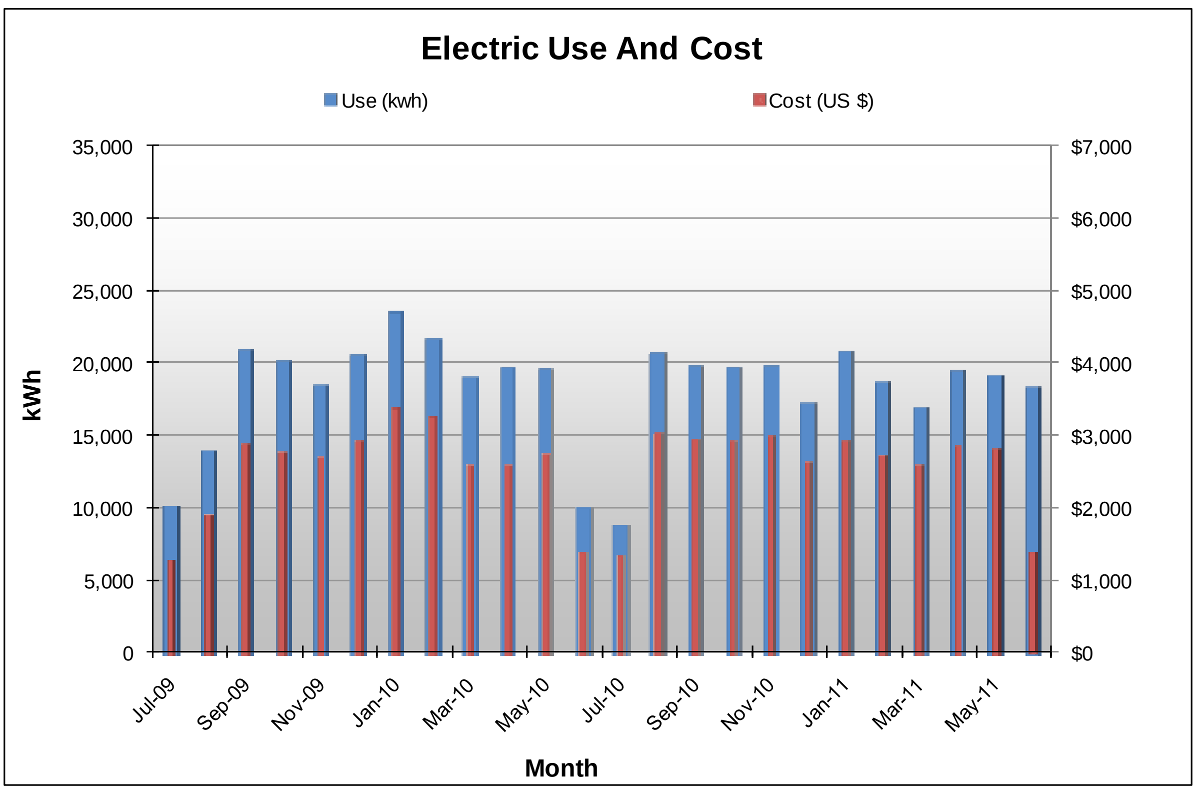


Figure 2a. Monthly Natural Gas Use for McClelland Elementary

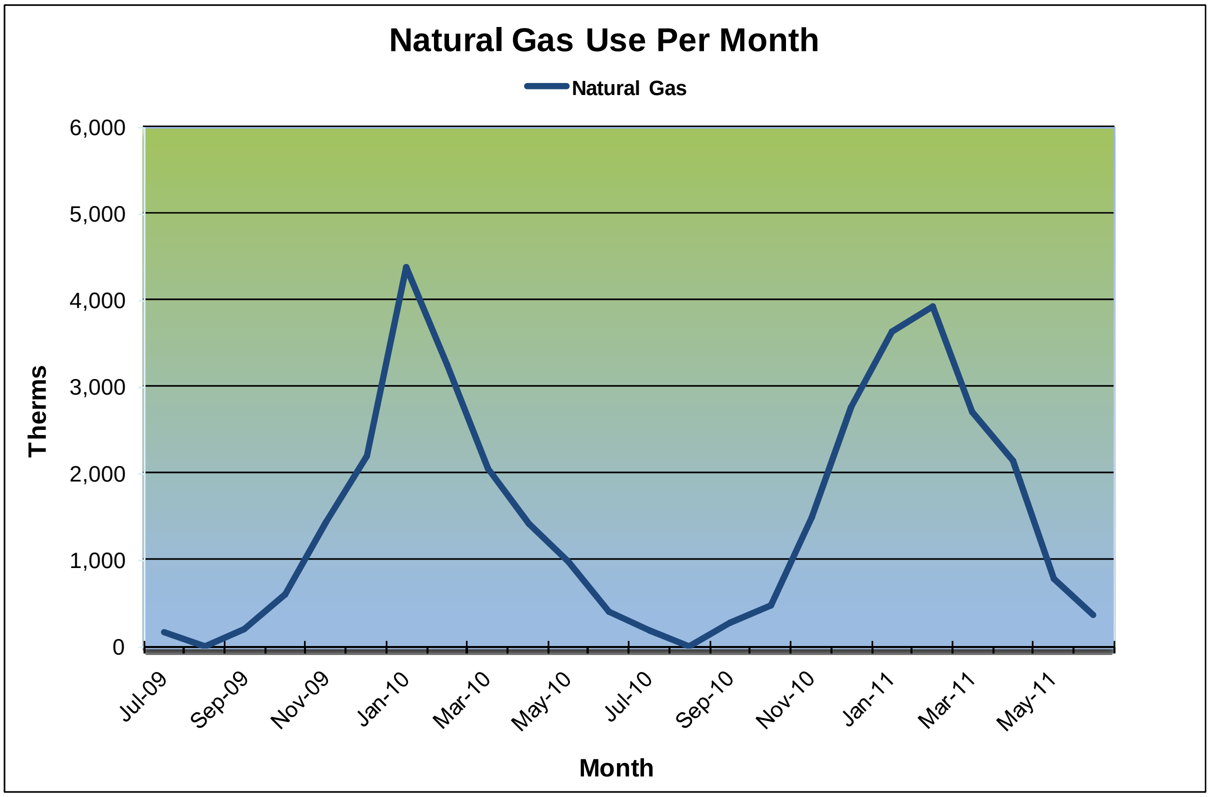


Figure 2b. Monthly Natural Gas Use vs Cost for McClelland Elementary

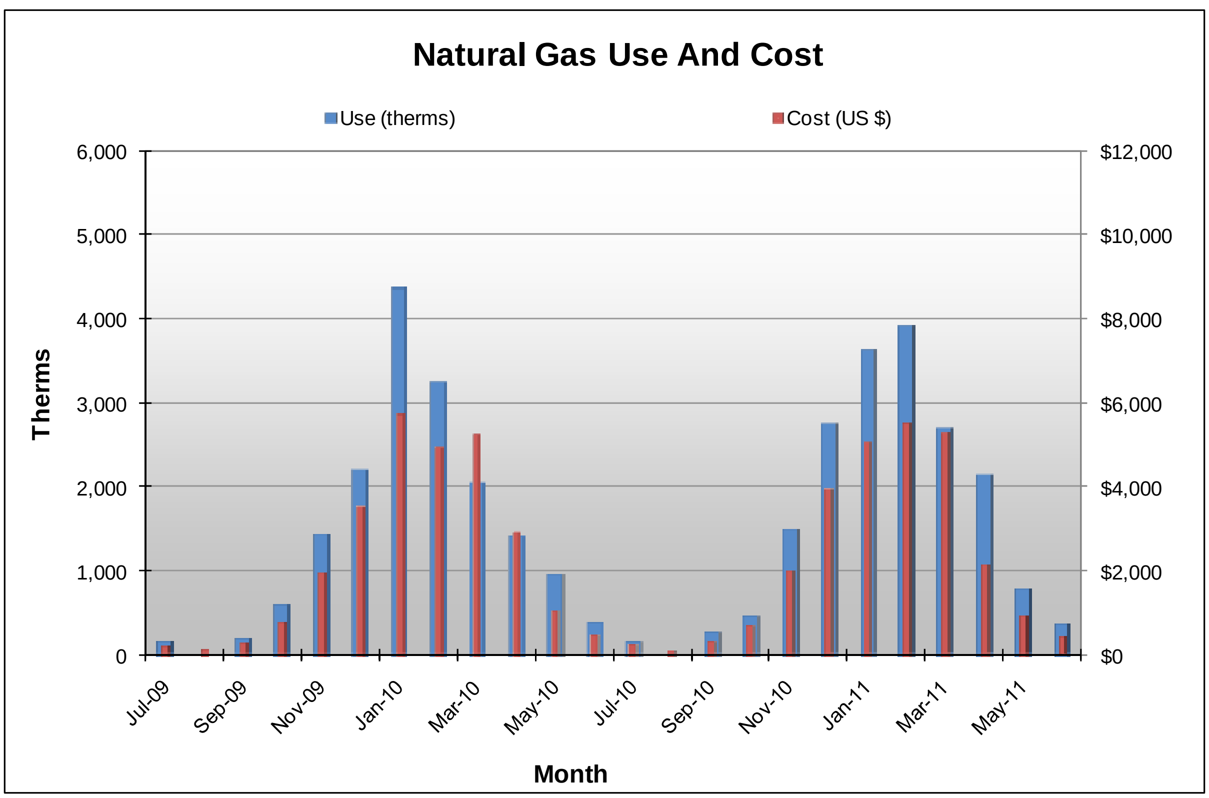
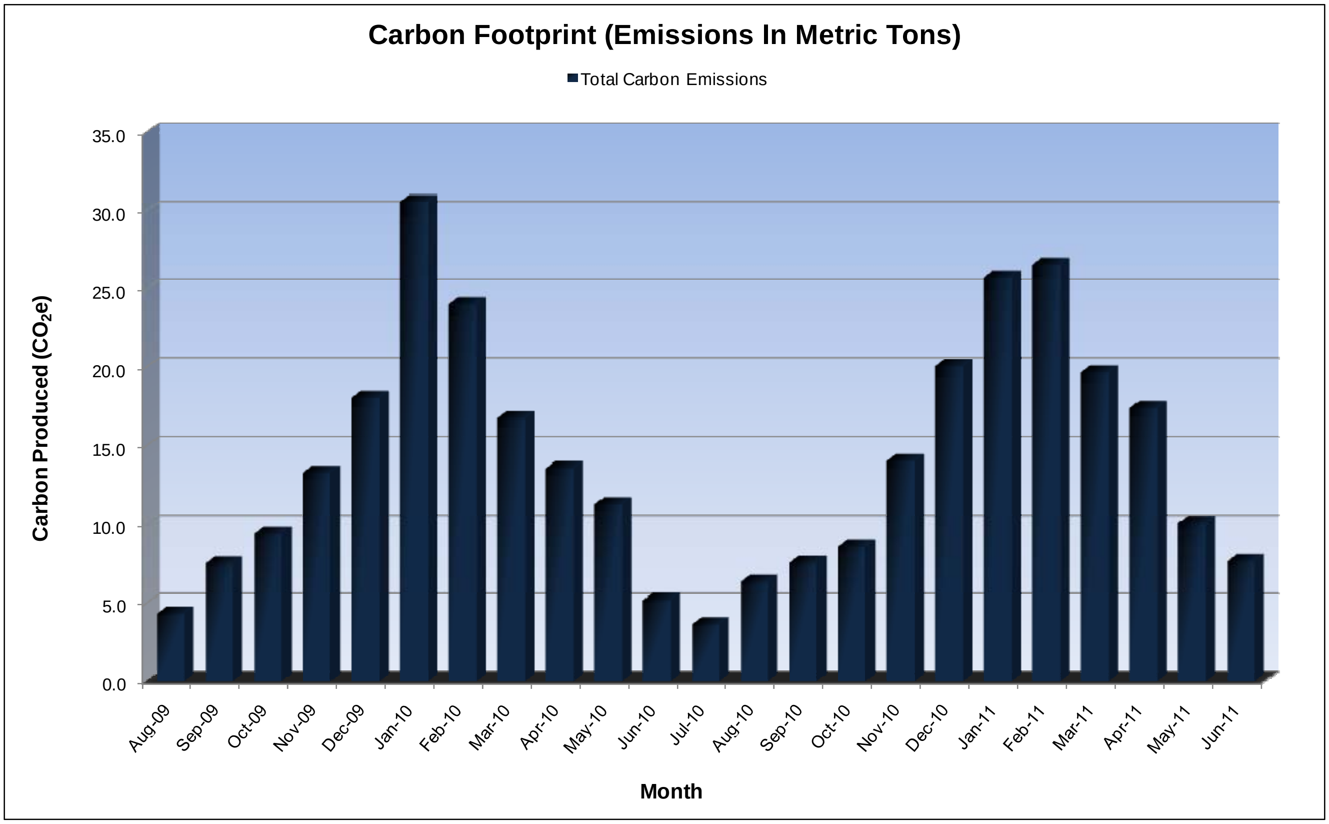


Figure 3. Monthly Greenhouse Gas Emissions for McClelland Elementary School



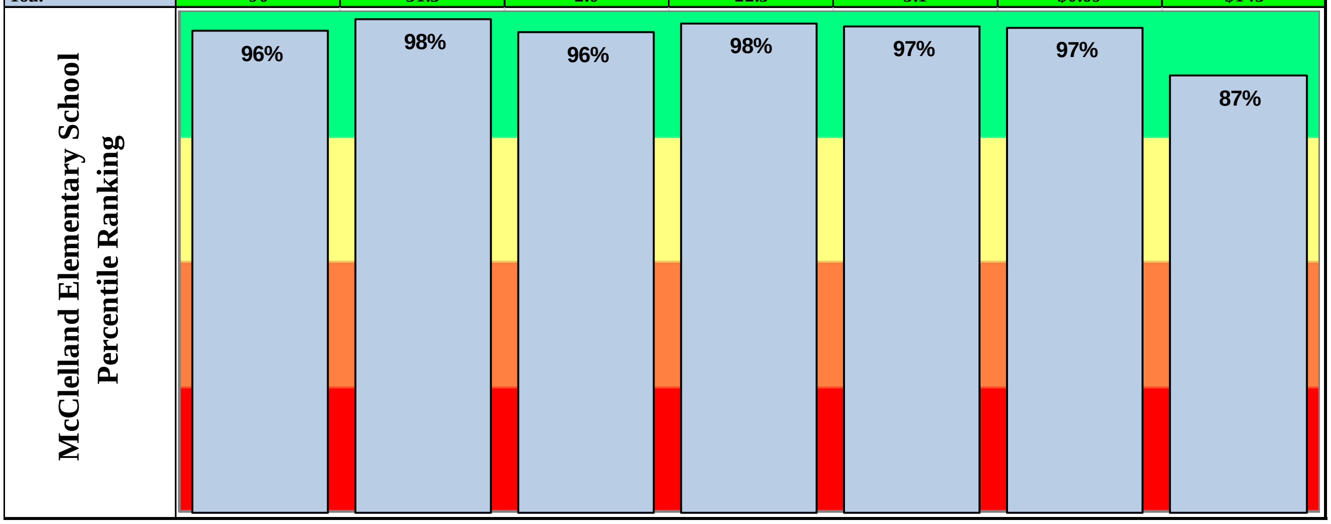
Benchmarking Data

To evaluate the energy and environmental performance of your school, the building data collected above has been compared against two different sets of school energy data: the U.S. Environmental Protection Agency's national data and New Hampshire specific state data. The results are illustrated in Figure 4 on the following page.

This will allow you to assess your building's performance relative to other buildings designed and constructed to the same codes and standards, operating under the same regulations and schedules and similar weather conditions. The indicators are calculated on a *per square foot* or *per student* basis, so you can compare your school to different sized schools.

Figure 4. EnergySmart Schools Benchmarks for McClelland Elementary School

Schools	U.S. EPA Portfolio Manager Score	New Hampshire State Schools (Annual Data)					
		Total Energy Use (kBtu/sq.ft.)	Electric Use (kWh/sq.ft.)	Heating Fuel Use (kBtu/sq.ft.)	Weather Adjusted Heating Fuel Use (Btu/sq.ft./HDD)	Total Energy Cost ($/sq.ft.)	Total Energy Cost ($/student)
NH Average:	50	60.3	5.2	41.7	5.7	$1.42	$256
You:	96	31.3	2.6	22.3	3.1	$0.69	$143



Major Benchmark Indicators

1. Total Energy Use, kBtu/sq.ft.

This indicator shows how much total energy your school consumes each year. It includes the energy used for heating, cooling (if any), lights, cooking, computers, etc.

Your school's total energy use of 31.3 kBtu per square foot per year (kBtu/sq.ft.) is significantly better than the New Hampshire K-12 schools state average of 60.3 kBtu/sq.ft. Your total energy use figure is lower than 98% of New Hampshire K-12 schools. The EnergySmart School Report is weather normalized so fuel consumption for heating takes the difference in climate between northern and southern New Hampshire into account.

This is a good indicator of how well, overall, your school is performing. However, it doesn't help you find ***where*** in your building to look for improvement opportunities. Multiple factors included on the following pages can help with that. Analysis of energy consumption for this program does not control for operational variations. An example is an improperly ventilated school may appear to have lower energy consumption. Ventilation systems that are not operating properly result in lower indoor air quality.

2. Electricity Data

Most electric utilities use the following two factors to estimate your electricity bill – Electric Use and Electric Demand.

a. Electric Use, kWh/sq.ft.

This shows how well the building does with its lights, cooling/air conditioners and cafeteria systems (if any), and what's referred to as "plug load." Plug load is anything that plugs into a socket. The major plug loads are generally computers (including monitors, printers and copiers), refrigerators, coffee machines, fans, shop equipment and projectors. If electric consumption is much higher than average, but heating fuel use (see below) is average or better, then focus your efforts on the electric-powered elements.

New Hampshire schools state average electric use is 5.2 kWh per square foot. Your school's electric consumption of 2.6 kWh per square foot this year is lower than 96% of New Hampshire schools benchmarked through the New Hampshire EnergySmart Schools Program.

b. Electric Demand, Watts/sq.ft.

Demand is a measure of the maximum electric draw in kW that your building places on the grid and is measured by adding up the kW draw for a 15 minute period. To give an analogy, if electricity usage is the amount of water going through a hose in gallons, electric demand would be how fast that water flows expressed in gallons per minute. Whichever 15 minute period during your monthly billing cycle places the highest kW demand on the grid is the demand factor applied to your bill. The best way to improve this demand factor is to stagger the times when your electrical systems draw at their maximum or reduce unnecessary electric load altogether.

The average electric demand for New Hampshire schools is 1.9 watts per square foot. Your school's electric demand is 0.86 watts per square foot and is lower than 98% of New Hampshire Schools benchmarked through the New Hampshire EnergySmart Schools Program.

3. Heating Fuel Use, kBtu/sq.ft.

Reviewing these indicators is relatively straightforward. If your school's heating fuel use is much higher than average, an audit of your heating system along with your building envelope - doors, windows, roof - is recommended. This factor is 'fuel-neutral' as it works for either fuel oil or natural gas heating systems.

New Hampshire K-12 schools state average heating fuel use is 41.7 kBtu/sq.ft. or 5.7 Btu/sq.ft./HDD. Your school's heating fuel use of 22.3 kBtu/sq.ft. per year is lower than 98% of other New Hampshire schools in the database. Your school's weather adjusted heating fuel use of 3.1 Btu/sq.ft./HDD is lower than 97% of other New Hampshire schools benchmarked through the New Hampshire EnergySmart Schools Program.

4. Energy Cost, $/sq.ft. & $/student

Cost is the bottom line. These numbers help you understand, in terms of budget, the gain through energy efficiency improvements. New Hampshire K-12 schools state averages $1.42/sq.ft. and $256/student.

Your school's annual energy cost of $0.69 per square foot is lower than 97% of other New Hampshire benchmarked schools. Your school's cost expressed on a per student basis of $143 is lower than 87% of other New Hampshire schools benchmarked through the New Hampshire EnergySmart Schools Program.

5. U.S. EPA *Portfolio Manager* Score

Portfolio Manager is a benchmarking model based on a national set of data from K-12 schools. It is provided by the U.S. Environmental Protection Agency's ENERGY STAR® Program. The impact of factors outside of your control (such as location, occupancy and operating hours) are removed, providing a 1-100 ranking of a school's energy performance relative to the national school building market. A score of 50 represents the national average and a score of 100 is best. Schools that achieve a score of 75 or higher are eligible for EPA's ENERGY STAR® Building Label, the national symbol for protecting the environment through energy efficiency. Districts can achieve ENERGY STAR® Leader Awards in recognition if their buildings, on average, improve by 10%, 20%, 30%, etc. over their baseline year of reported energy use or if the district's overall weighted average *Portfolio Manager* Score is at least a 75.

Your school's *Portfolio Manager* Score of 96 places it higher than 96% of K-12 schools nationwide. As noted above, this rating potentially qualifies your school for the prestigious ENERGY STAR® Label for Buildings.

III. Potential Energy Saving Opportunities

Based on the preceding analysis of your school's energy performance, implementation of the following recommendations can help you save energy and money. The first step is to look at reducing electrical lighting and HVAC consumption (burners, circulators and fans) which typically account for 67% of a building's electric consumption.

- **Perform an Energy Audit on the Building**

An energy audit involves a comprehensive analysis of the building's general characteristics, its energy use and allocation of that use amongst the facility's energy end uses. The goal is to identify sources of potential energy savings. Your auditor should develop a list of recommendations that will result in substantial energy and operational cost savings. These may include, building envelope improvement and mechanical systems, lighting upgrades, equipment replacement and installation of lighting and HVAC control mechanisms, among others.

A good audit should include information specific to each recommendation which *at least* includes approximate annual energy unit and cost savings, demand reduction, installation cost, lifetime cost savings and information related to cost-effectiveness. This will help to prioritize the recommendations based on their energy efficiency and shortest payback.

The recommendations provided in an energy audit report may reduce facility energy bills by 20% or more in addition to improving occupant health and comfort. Following this report, an energy audit is the next step in realizing the full potential of energy savings opportunities.

- **Request Retro-Commissioning**

Retro-commissioning is a detailed process applied to existing facilities aimed at correcting many of the degradations and inefficiencies that are indicative of older and/or poorly performing buildings. Many older buildings tend to be less comfortable and operate less efficiently when not properly commissioned. Retro-commissioning includes a detailed energy audit and focuses on not only potential energy savings but also the interaction of the building's equipments and mechanical systems with an eye toward restoring it to optimal performance.

In contrast to an energy audit, this optimization focuses on operational improvements to existing equipment, rather than replacement. Apart from energy savings, other improvements and benefits include substantial operation and maintenance (O&M) cost savings, improved air quality, occupant comfort, health and safety, equipment controls, and improved system interactivity.

In addition to providing recommendations, retro-commissioning includes implementation of the recommended improvements and hence the cost for retro-commissioning is higher than an audit. However, when the costs of improvements are added to the energy audit cost, prices may be comparable. If high O&M costs or occupant health, comfort and safety are concerns in addition to reduction in energy use, retro-commissioning may be a suitable strategy.

- **Upgrade Lighting Systems**

Lighting typically accounts for 30-60% of all energy consumed in school buildings. Additionally, the electrical energy consumed by lights during the summer creates heat and increases cooling costs.

McClelland Elementary School's electricity significantly low (better) compared to other schools in the State. Even so, upgraded lighting systems in high consumption areas like classrooms, gymnasiums, libraries, offices, etc. can reduce costs, improve the lighting quality and increase occupant comfort and productivity.

Over-lit Spaces: Light levels should be recorded in classrooms and hallways to ensure they are not over-lit, 40-50 foot candles are adequate light levels for an instructional space. If classroom light levels are much higher than 50 foot candles, McClelland Elementary School should consider de-lamping classrooms or installing dimming ballasts, which dim the lights when outdoor light levels are adequate. In over-lit hallway spaces photo sensors can be installed to turn lights off completely when light levels exceed a pre-set threshold.

In over-lit spaces a T8 to Super T8 lighting retro-fit can reduce the number of light fixtures needed. Super T8 lamps use between 4 and 7 Watts less electricity than standard T8 lamps, but they produce more light per Watt. In some cases this increase in light per Watt can allow for the removal of an entire lamp, saving 32 Watts. The room characteristics must be factored in before this type of retro-fit. The shape of the space, ceiling height, color of the walls, etc. all need to be taken into account when exploring a de-lamping project. We recommend that before retro-fitting the entire facility, begin by changing one classroom and monitor the comfort level of the occupants at McClelland Elementary School.

Another proven energy reduction measure with a short payback period is to identify any areas where your school may still be using metal halide lighting. Typically metal halide lights are found in gymnasiums or cafeteria areas, many districts have been very satisfied by replacing these lights with high bay T5 lighting fixtures. In addition to the reduced operational wattage, high bay T5 lights turn on instantly, as opposed to metal halide fixtures which have an extended warm up period. The long warm up period associated with metal halides typically leads to the lights being left on all day, at 250 to 400 watts a fixture; the costs begin to add up. Adding occupancy sensors to high bay T5 fixtures further reduces the payback period.

Occupancy Sensors: We recommend that you explore the use of occupancy sensors to ensure that lights are turned off in unoccupied spaces. Lights controlled by occupancy sensors typically run a third of the time when compared with manually controlled lighting. Reduced runtime leads to decreases in both energy usage and operation and maintenance costs. Additionally, a study conducted in Massachusetts found that controlling the security lighting with occupancy sensors reduced vandalism; neighbors and police recognized something wrong when the lights were on in a building that was typically dark and investigated.

To summarize and add a few ways in which McClelland Elementary School may be able to conserve energy and cost through lighting upgrades is to:

- Design light quantity and quality for the task and occupants' needs in that area.
- Maximize lamp and ballast efficiency.
- Activate the power saving features on office equipment such as copiers, printers and fax machines and ensure that they are turned off at the end of the day.
- Use automatic controls to turn lights off or dim lights in unoccupied spaces.
- Establish a maintenance schedule for group re-lamping and fixture cleaning.
- Replace T12 fixtures with the most efficient fixtures which may include T8/super T8/T5 fixtures.
- Replace incandescent lighting with compact fluorescent technology.

- Replace incandescent exit lighting which consumes 30 Watts with LED type exit lights with 1.5 Watts consumption. LED units last up to 10 years, which is a maintenance advantage.

- Install daylight sensors in areas with significant natural light.

- Install occupancy sensors in areas that are often unoccupied.

- Lighting retrofits reduce maintenance costs associated with lighting that is close to end of life.

- Establish a regular cleaning schedule particularly for areas where student safety of low light levels may be a concern, such as shop classes.

- Look to make lamp and fixture selection as uniform as possible to reduce maintenance and inventory overhead.

- Educate students and staff to turn off lights when rooms are unoccupied.

Lighting upgrades seek to reduce the connected electrical load (kW) and energy consumption (kWh) of lighting equipment. Lighting controls can also significantly reduce operating hours and costs by turning off lighting when spaces are unoccupied or sufficiently lit by natural light.

- **Install NEMA Premium Motors and VFDs**

Commercial and industrial electric motor-driven systems consume approximately 23% of all electricity in the U.S., making it the single largest category contributor to electric use in the country. With very high operating hours, the annual energy cost to run a system is more than its installation cost. Even a small increase in the efficiency of an electric motor can result in substantial energy cost savings. Typical opportunities for motor upgrades in schools include: ventilation fans, and heating and cooling system pumps and fans.

Motors with efficiency up to 90% are available to replace the older ones with efficiency less than 75%. Although standards for efficiency of new equipment are set by the Energy Policy Act, motor efficiency can be further increased by selecting Premium Efficiency motors as specified by the National Electrical Manufacturers Association (NEMA). This can cut the electric motor system demand by as much as 18%.

Savings can be increased further by optimizing system performance through the use of variable frequency drives (VFDs). When system load is known to vary substantially, these flow control systems can be utilized to match system output to system demand, significantly reducing energy usage during partial load hours. By employing high-efficiency motors and VFDs, facility owners can improve environmental conditions, utilize better control of motor-driven processes, and reduce waste output.

- **Install Demand Control Ventilation**

Demand control ventilation (DCV) monitors indoor air CO_2 content as a result of occupancy production levels and uses this data to regulate the amount of outdoor air that is permitted for ventilation. In order to ensure adequate air quality, standard ventilation systems permit outside air based on estimated occupancy levels in CFM, cubic feet per minute/occupant. However, during low occupancy hours, the space may become over ventilated due to decreased CO_2 levels and unnecessary ventilation results in wasted energy. DCV reduces unnecessary outdoor air intake by regulating ventilation based on actual CO_2 levels, saving energy. DCV is most suited for areas where occupancy levels are known to fluctuate considerably such as auditoriums, cafeterias, and gymnasiums.

Install Energy Recovery Ventilators. According to energy recovery equipment manufacturer's typical paybacks are less than 5 years for schools without cooling. The keys to success with ventilation retrofits are going with fewer larger units with long run hours as opposed to several small units with limited run time. Equipment with moisture recovery capabilities would cut humidity up to 50% during the cooling season.

- **Improve/Replace Inefficient Heating Systems**

Replacing an old boiler that is < 70% efficient with a modern 85-90% efficient natural gas-fired furnace alone will reduce heating costs by 15-20%. This combined with additional system improvements and installation of advanced HVAC control mechanisms can result in up to 20%+ heating load reduction.

Because of the high capital cost of new heating systems, some financial analysis should be performed to assess the cost-effectiveness of immediate replacement. If the current system is fairly new, replacement may not be immediately justifiable from a financial standpoint. However, as is the case with cooling systems, early replacement may prove to be a more cost-effective solution than waiting until existing systems fail or reach the end of their estimated useful life.

- **Improve/Replace Inefficient Air Conditioning Systems**

The useful life of a rooftop A/C unit is generally 12-18 years. However, depending on the efficiency, early replacement of outdated, inefficient, split, or packaged rooftop air conditioning units with new A/C systems that are 15% more efficient than 10-15 year old equipments can considerably reduce annual energy consumption. The energy cost savings and maintenance savings offset the high installation cost of a more efficient system. Installing thermostats and/or economizers on new or existing A/C systems will further reduce the cooling demand.

Economizers provide "free" cooling by using controllable dampers that bring in outside air to cool the space when the outdoor temperature or enthalpy is below the building's return air conditions. Although they require operation by a well calibrated and maintained control system, economizers have impressive energy-saving capabilities.

Install Occupancy Controlled/Programmable Thermostats

Combining efficient HVAC equipment with occupancy controlled and programmable thermostats can save a facility up to 10% of its annual heating and cooling costs:

- Areas with unpredictable occupancy on a daily/weekly basis - gym, bathrooms, outdoors: Use an *occupancy controlled thermostat* - a thermostat paired with a sensor and/or door detector to identify movement/occupancy. If occupancy is sensed by the sensor, the thermostat goes into an occupied mode (i.e. programmed set point). If a pre-programmed time frame elapses (i.e. 30 minutes) and no occupancy is sensed during that time, the thermostat goes into an unoccupied mode (e.g., setback set point or off) until occupancy is sensed again. This reduces the overall time the heating or cooling system is running, saving energy.

- Areas with predictable occupancy: e.g.: classrooms, cafeteria, offices: A *programmable thermostat* is recommended. This device is programmed on a schedule to reduce the heating or cooling output of the facility's HVAC systems in relation to its predetermined occupancy schedule. In this way, the thermostat acts to set-back or set-up the facility temperature during unoccupied hours, and re-establish a comfortable facility temperature during business hours. By employing programmable thermostat technology, the heating and cooling system demand coincides with occupancy level, reducing energy usage.

- **Install Vending Misers on Vending Machines**

Vending misers for refrigerated and non-refrigerated vending machines is an often overlooked source of potential savings. Uncontrolled, vending machine lights remain on 24/7, consuming a constant amount of energy year round. By controlling these lights with an occupancy sensor, energy consumption attributed to vending machines can be reduced considerably, in many cases, by as much as 50% and can save up to $150 per machine per year.

In the case of refrigerated vending machines, electric demand can be further reduced by controlling the machines' refrigeration systems. In a manner similar to programmable thermostats, vending misers for refrigerated machines act on a pre-set occupancy schedule to allow a marginal increase in operating temperature during non-business hours. Although products in the machine are delivered to the customer at the same temperature as in an uncontrolled vending machine, products are not being cooled unnecessarily when the machine is not in use, significantly reducing the machine's energy consumption. Because of the relatively low vending miser installation cost and high operating hours of vending machines, this improvement is typically cost-effective with a very short payback period.

- **Install ENERGY STAR® Rated Equipment / Plug Load Control**

Plug loads (computers, televisions, coffee makers, etc.) account for, on average, about 10% of total energy consumption. One of the easiest and most cost-effective energy saving strategies is the reduction of electric usage through installation of efficient appliances and the control of plug loads. In addition to utilizing ENERGY STAR® qualified appliances, greater savings can be realized through the various devices available that control every day plug loads.

By connecting non-critical loads (coffee makers, fans, microwave ovens, etc.) to an occupancy or timer controlled power strip, significant energy savings can be achieved. These savings result not only from the neglect of the user to turn the device off manually, but also from reduction of "phantom load". Phantom load is the small but constant energy draw from many plug-in devices when not in use. By connecting certain appliances to an occupancy controlled power strip, phantom load can be eliminated by cutting power supply to those devices. When replacing or ordering new equipment, emphasize ENERGY STAR® devices when they are available. Also, purchase controlled power strips and connect appropriate devices to those strips to reduce unnecessary consumption due to phantom load and appliances left on. The EPA offers free computer power management software which has saved some districts as much as $75 per computer per year, the software can be found at http://www.energystar.gov/index.cfm?c=power_mgt.pr_power_mgt_low_carbon_join.

IV. Resources:

The State of New Hampshire along with the utility companies offer multiple programs designed to improve the energy efficiency of schools through financial incentives and technical support, including:

Northeast Energy Efficiency Partnerships:

- **Northeast Collaborative for High Performance Schools (NE-CHPS)**
  NE-CHPS is a set of building and design standards for all schools from pre-K through community colleges tailored specifically for NH state code requirements, the New England climate, and the environmental priorities of the region. NH Department of Education offers up to a 3% re-imbursement for New Construction School projects. To learn more about NE-CHPS and incentive programs please visit: http://neep.org/public-policy/hpse/hpse-nechps.

New Hampshire Public Utilities Commission:

- **New Hampshire Pay for Performance**
  This program addresses the energy efficiency improvement needs of the commercial and industrial sector. The Program is implemented through a network of qualified Program Partners. Incentives will be paid out on the following three payment schedule: Incentive #1: Is based on the area of conditioned space in square feet. Incentive #2: Per/kWh saved and Per/MMBTU saved based on projected savings and paid at construction completion. Incentive #3: Per/kWh saved and Per/MMBTU saved based on actual energy savings performance one year post construction. Total performance incentives (#2 and #3) will be capped at $200,000 or 50% of project cost on a per project basis. For more information visit http://nhp4p.com.

- **New Hampshire Public Utilities Commission's Renewable Energy Rebates**
  The Sustainable Energy Division provides an incentive program for solar electric (photovoltaic or PV) arrays and solar thermal systems for domestic hot water, space and process heat, with a capacity of 100 kW or equivalent thermal output or less. The rebate for PV systems as follows: $1.00 per Watt, capped at 25% of the costs of the system or $50,000, whichever is less. For solar hot water (SHW) systems, the base rebate is $0.07 per rated or modeled kBtu/year, capped at 25% of the cost of the facility or $50,000, whichever is less, as a one-time incentive payment. http://www.puc.state.nh.us/Sustainable%20Energy/RenewableEnergyRebates-CI.html.

New Hampshire Community Development Finance Authority:

- **New Hampshire Community Development Finance Authority Revolving Loan Fund**
  The Enterprise Energy Fund is a low-interest loan and grant program available to businesses and nonprofit organizations to help finance energy improvements and renewable energy projects in their buildings. The loans will range from $10,000 to $500,000. Larger amounts will be considered on a case by case basis. The program is available to finance improvements to the overall energy-efficiency performance of buildings owned by businesses and nonprofits, thereby lowering their overall energy costs and the associated carbon emissions. More information about the program can be found on their website www.nhcdfa.org. These activities may include:

  - Improvements to the building's envelope, including air sealing and insulation in the walls, attics and foundations;
  - Improvements to HVAC equipment and air exchange;
  - Installation of renewable energy systems;
  - Improvements to lighting, equipment, and other electrical systems; and
  - Conduction of comprehensive, fuel-blind energy audits.

Public Service of New Hampshire (PSNH):

- **Commercial (Electric) Energy Efficiency Incentive Programs**
  This program targets any commercial/industrial member building a new facility, undergoing a major renovation, or replacing failed (end-of-life) equipment. The program offers prescriptive and custom rebates for lighting and lighting controls, motors, VFDs, HVAC systems, chillers and custom projects. http://www.psnh.com/SaveEnergyMoney/For-Business/Energy-Saving-Programs-and-Incentives.aspx

- **SmartSTART**
  The SmartSTART (Savings Through Affordable Retrofit Technologies) advantage is simple - pay nothing out of pocket to have energy efficiency products and services installed in your building. The Smart Start program is limited to PSNH's municipal customers only and includes schools. The program is available on a first-come, first served basis to projects which have been pre-qualified by PSNH. The cost of the improvements is fronted by PSNH which is then repaid over time by the municipality or school using the savings generated by the products themselves! This program is for lighting and lighting controls, air sealing, insulation and other verifiable energy savings measures which have sufficient kilowatt-hour savings. For more information on this program visit:
  http://www.psnh.com/SaveEnergyMoney/For-Business/Municipal-Smart-Start-Program.aspx

- **Schools Program**
  For major renovation or equipment replacement projects, this program offers prescriptive and custom rebates for energy efficient lighting, motors, HVAC, chillers, and variable frequency drives to towns or cities that install energy efficient equipment at their schools. Financial incentives are available for qualifying energy efficient equipment. Technical assistance is also offered through the Schools Program. http://www.psnh.com/SaveEnergyMoney/Large-Power/Schools-Program.aspx

Unitil:

- **Commercial and Industrial Energy Efficiency Programs**
  Subject to program qualifications and availability of funding - Unitil offers different programs for its commercial, industrial, and institutional customers in New Hampshire: the Small Business Energy Efficiency Program, the Small Commercial and Industrial Program, the Large Commercial and Industrial Program, the Large Commercial and Industrial (C&I) Retrofit Program, and the Large C&I New Construction Program. Rebates are available for various technologies including water heaters, lighting, lighting controls/sensors, chillers, furnaces, boilers, central air conditioners, compressed air, programmable thermostats, energy management systems/building controls, motors, motor VFDs, processing and manufacturing equipment, LED exit signs, commercial cooking and refrigeration equipment. http://www.unitil.com/.

Clean Air – Cool Planet:

- **Community Energy Efficiency**
  CA-CP works with communities throughout the Northeast to find solutions to climate change and build constituencies for effective climate policies and actions. Much of their work focuses on successful models for energy efficiency and renewable energy planning. They advise and partner with citizens, educators, faith groups, small businesses, municipal governments, and other local leaders. They explore cost-effective opportunities that exist for communities to reduce their emissions as well as their vulnerability to climate impacts. One such example is CA-CP's partnership with the University of NH, NH Sustainable Energy Association and UNH Cooperative Extension to create www.myenergyplan.net, a groundbreaking suite of web and outreach tools for individual action used by households, schools and community groups around the northeast. http://www.cleanair-coolplanet.org/for_communities/index.php.

Environmental Protection Agency (EPA):

- **ENERGY STAR Challenge for Schools**
  EPA is challenging school administrators and building managers to improve energy efficiency throughout their facilities. More than 500 school districts across the country are helping to fight climate change by committing to reducing their energy use with help from ENERGY STAR. Schools that take the ENERGY STAR Challenge can use energy tracking tools, technical guidance, case studies and other ENERGY STAR tools and resources to help them improve their energy efficiency. More information can be found at:
  http://yosemite.epa.gov/opa/admpress.nsf/d985312f6895893b852574ac005f1e40/d74f768ecfa9e11f8525762500522260!OpenDocument

For additional assistance in helping you save money and improve school conditions, please call TRC at (603) 766-1913 or (877) 442-9181.

NEW HAMPSHIRE
ENERGYSMART SCHOOLS PROGRAM

Energy Benchmarking Report for:

Maple Street Elementary School
Rochester, NH

Period: ***July 1, 2010*** through ***June 30, 2011***

PREPARED BY:

155 Fleet Street, Suite #305

Portsmouth, NH 03801

(603) 766-1913

www.trcsolutions.com

Table of Contents

I. Introduction

The Sustainable Energy Division of the New Hampshire Public Utilities Commission, with support from the New Hampshire Department of Education has sponsored TRC to develop the New Hampshire ***EnergySmart Schools Program*** to support New Hampshire K-12 public and private schools in the pursuit of energy efficiency and sustainability initiatives.

Energy efficiency has become an increasingly important issue for schools due to tightening budgets and rising energy costs. Since 2003, the prices of natural gas, fuel oil and electricity have increased by 123%, 107% and 32% respectively. Schools that have participated in energy benchmarking programs have shown a decrease in overall energy use by approximately 22% through the adoption of energy efficiency measures.

Tracking and documenting the energy use and associated carbon emissions in the state's K-12 schools will allow New Hampshire to account for the impact of its energy efficiency and renewable energy programs and determine which have the greatest effect. The analysis in this report, provided by the ***EnergySmart Schools Program*** is designed to help you:

- Understand the energy consumption and cost trends at each of your school buildings.
- Learn how your buildings are performing compared to other schools locally and nationally.
- Identify opportunities for improving operations and reducing costs.
- Take advantage of resources to implement efficiency improvements and save money.

The analysis was based on the information provided on the *Building Data Request Form* submitted, which included building descriptions, energy suppliers and other information. The building's utility bills were also used to assess its electricity and heating fuel consumption for the year(s) provided.

The energy performance for your school has been compared to national data for similar school facilities through EPA's ENERGY STAR® Portfolio Manager. Also shown are the five major benchmarks used to analyze building performance, which include: electricity use; heating fuel use; weather-normalized heating fuel use; total cost; and total cost per student, all of which have been normalized for comparison by square footage and weather. As part of the program's focus on sustainability, your school's carbon footprint is also presented.

II. Benchmarking Analysis and Review Results

Building and energy usage of your school was analyzed to assess the basic nature of your energy consumption and utility costs. The Building Data Summary table shown below summarizes this information.

Table 1: Building Data Summary for Maple Street Elementary School

Building Data			
District	SAU 54 Rochester School Department	**School Name**	Maple Street Elementary School
City	Rochester	**Zip Code**	03867
Year Built	1928	**Floor Area (sq.ft.)**	16,000
Number of Students	68	**Number of PCs**	29
Weekly Operating Hours	60	**Months School Used**	12
Cooking?	YES	**% AC**	0
Pool Size?	N/A	**Months Pool Used**	0

Utility Data			
Data End Point	6/30/2011	**Total Cost ($)**	21,697
Electric Provider	PSNH	**Natural Gas Provider**	N/A
Electricity Usage (kWh)	73,920	**Electricity Cost ($)**	9,315
Natural Gas Usage (therms)	0	**Natural Gas Cost ($)**	0
Fuel Oil Usage (gal)	6,006	**Fuel Oil Cost ($)**	12,382
Other Fuel Usage (gal)	0	**Other Fuel Cost ($)**	0

Energy Indicators			
EPA Score	74	**Electric Usage (kWh/sq.ft.)**	4.6
Heating Fuel Usage (kBtu/sq.ft.)	52	**Weather Adjusted Heating Usage Btu/sq.ft./HDD)**	7.2
Site Energy (kBtu/sq.ft.)	68	**Source Energy (kBtu/sq.ft.)**	105

Environmental Impact Indicators			
Greenhouse Gas Emissions			
Last Year Heating Fuel CO_2e (Mt)	61.3	**Last Year Total CO_2e (Mt)**	84.2
Last Year Electricity CO_2e (Mt)	22.9	**CO_2e Efficiency Savings Over Previous Year (Mt)**	-19.2
EPA Target Score			
Target Score	75	**Site Energy Reduction Needed (kBtu/sq.ft.)**	0.5

Figures 1a, 1b, 2a and 2b display the energy use, demand and cost data tracked on a monthly basis. This demonstrates the energy consumption of your building over the course of the year. As a part of the program's focus on sustainability, your school's carbon footprint was also measured and is presented in Figure 3.

Figure 1a. Monthly Electric Use & Max Demand for Maple Street Elementary

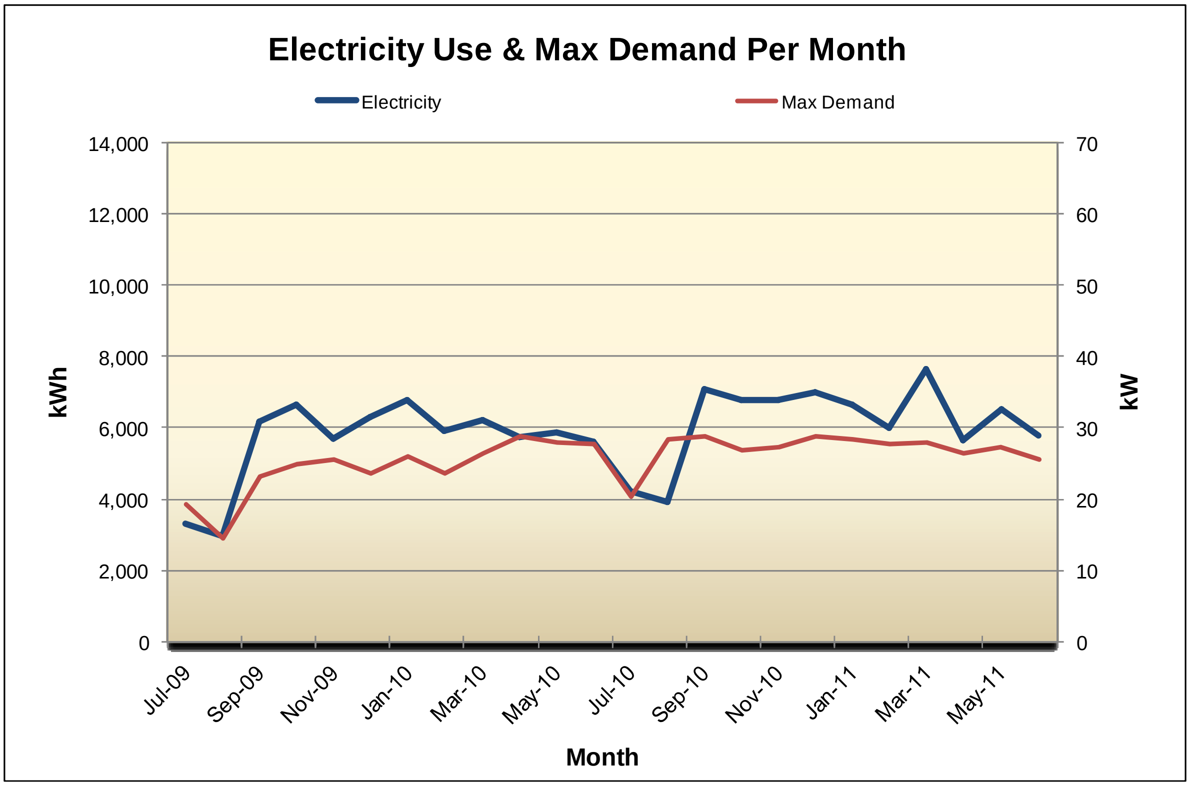
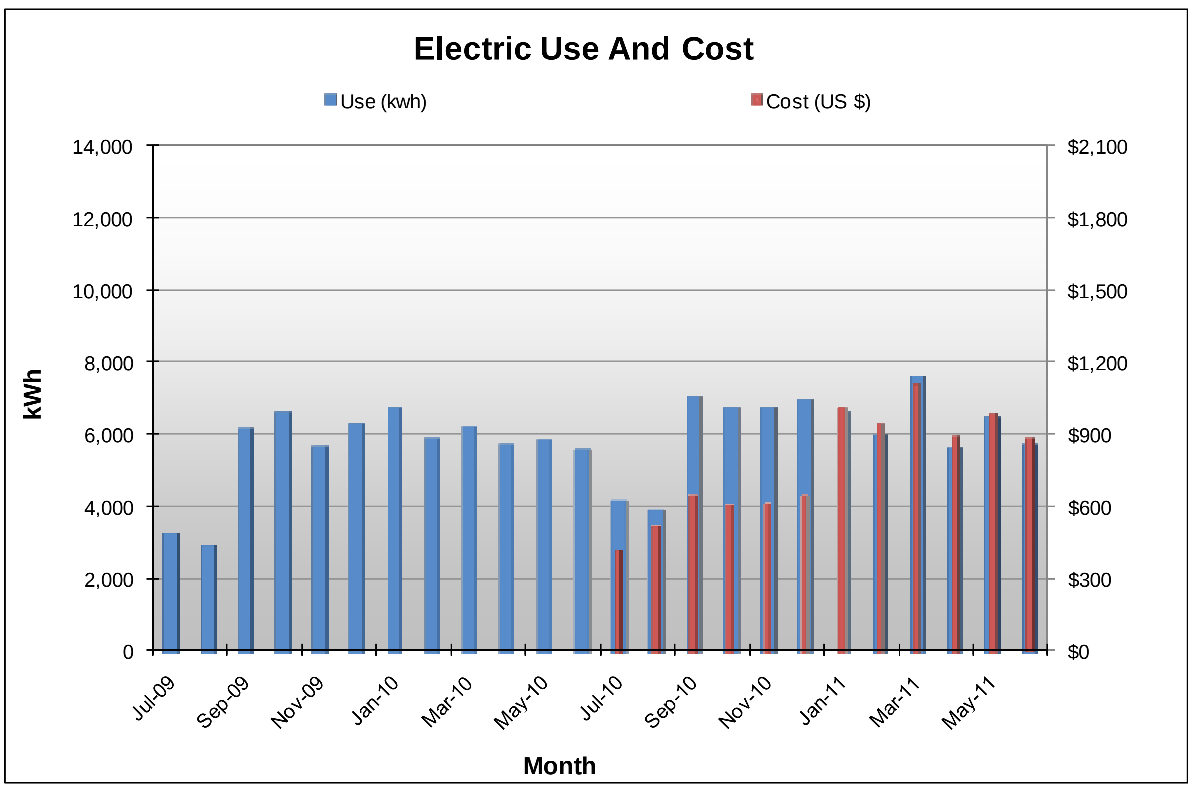


Figure 1b. Monthly Electric Use vs. Cost for Maple Street Elementary



Note: Electric Cost was only available for the most recent twelve month period.

Figure 2a. Monthly Heating Fuel Use for Maple Street Elementary

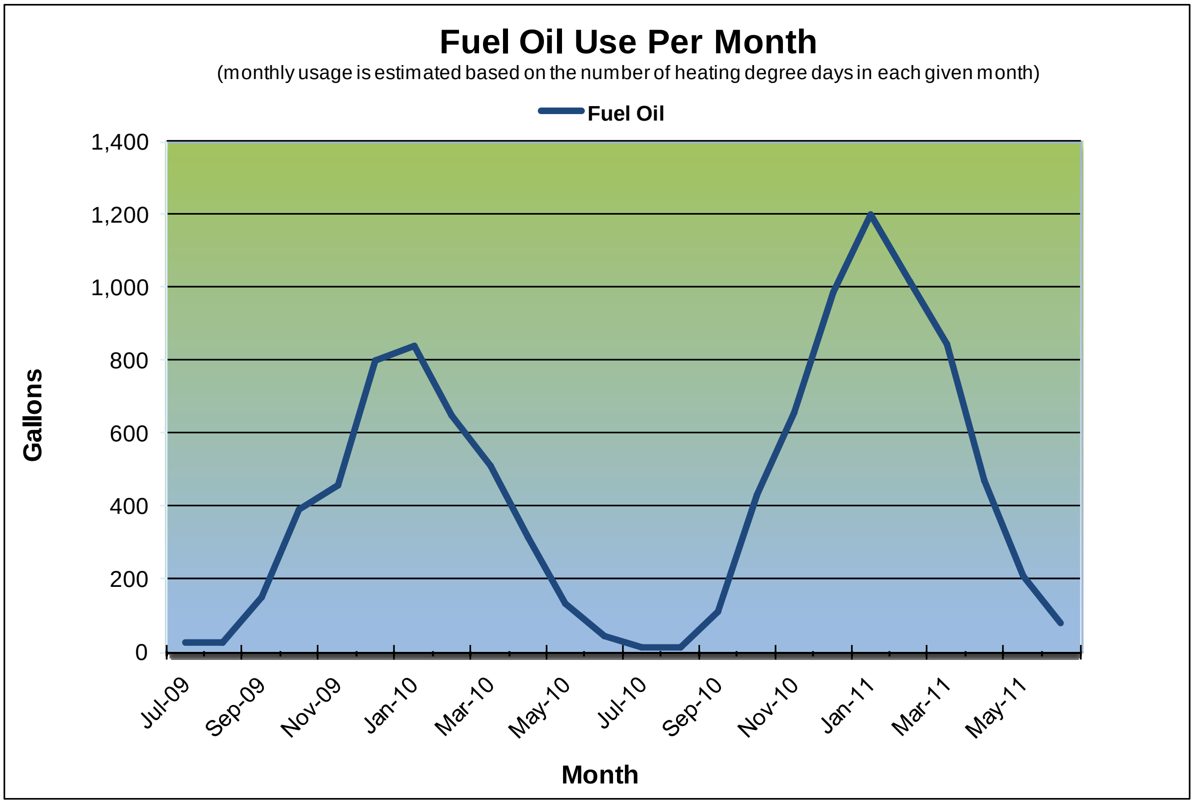


Figure 2b. Monthly Heating Fuel Use vs Cost for Maple Street Elementary

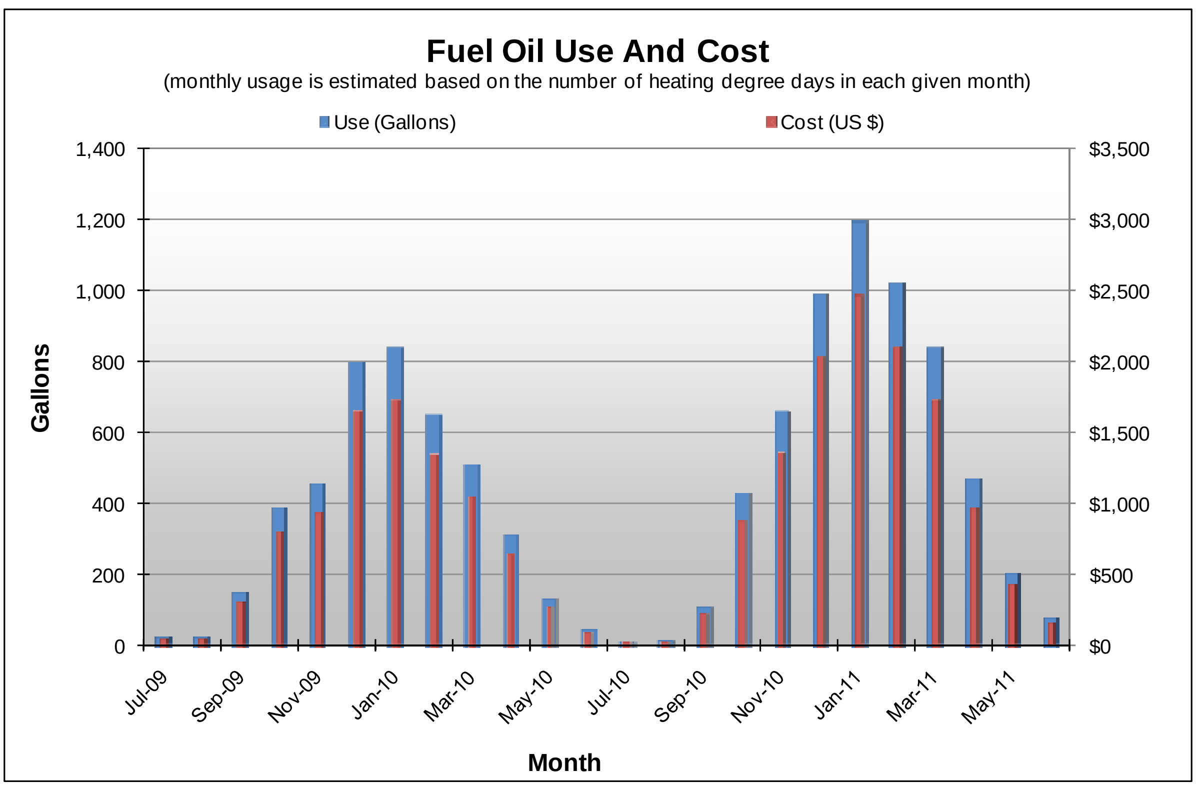
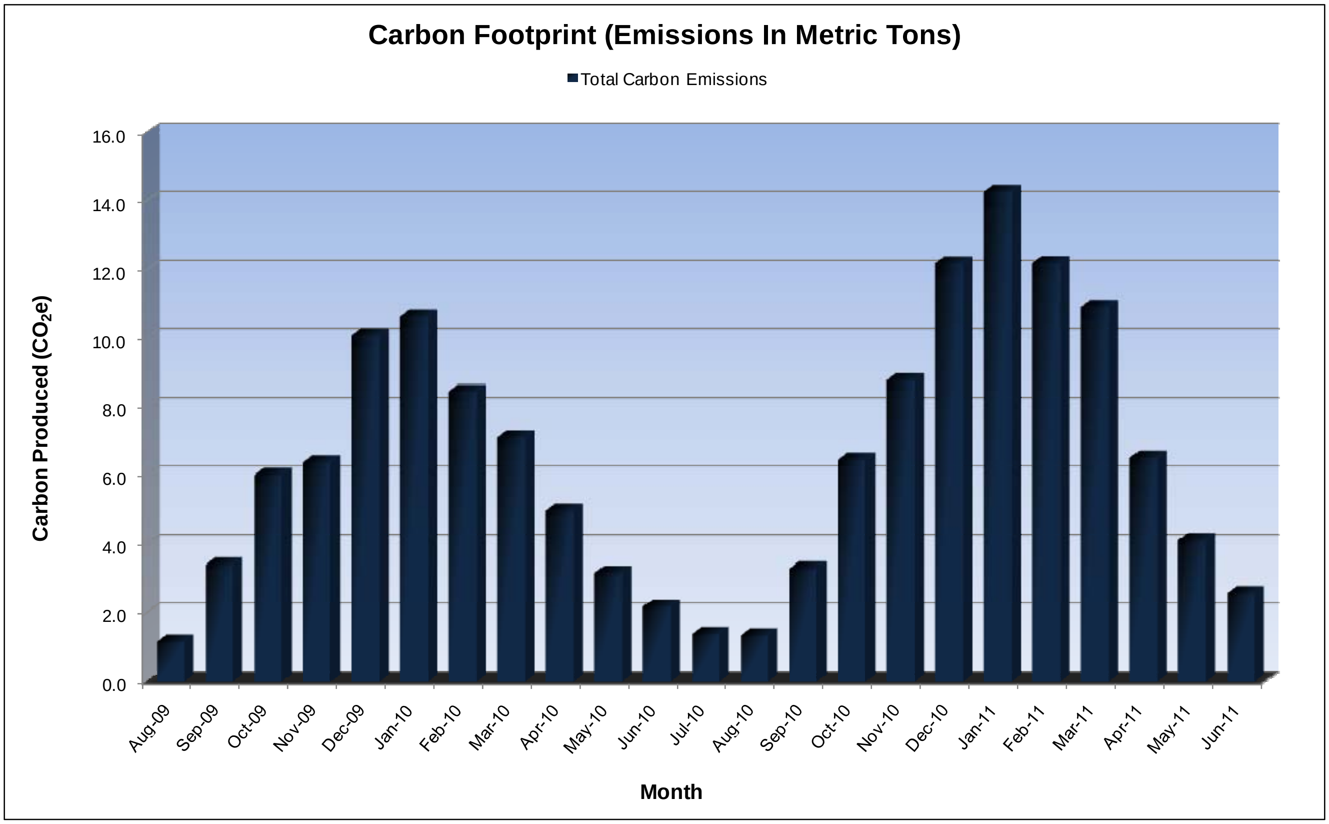


Figure 3. Monthly Greenhouse Gas Emissions for Maple Street Elementary



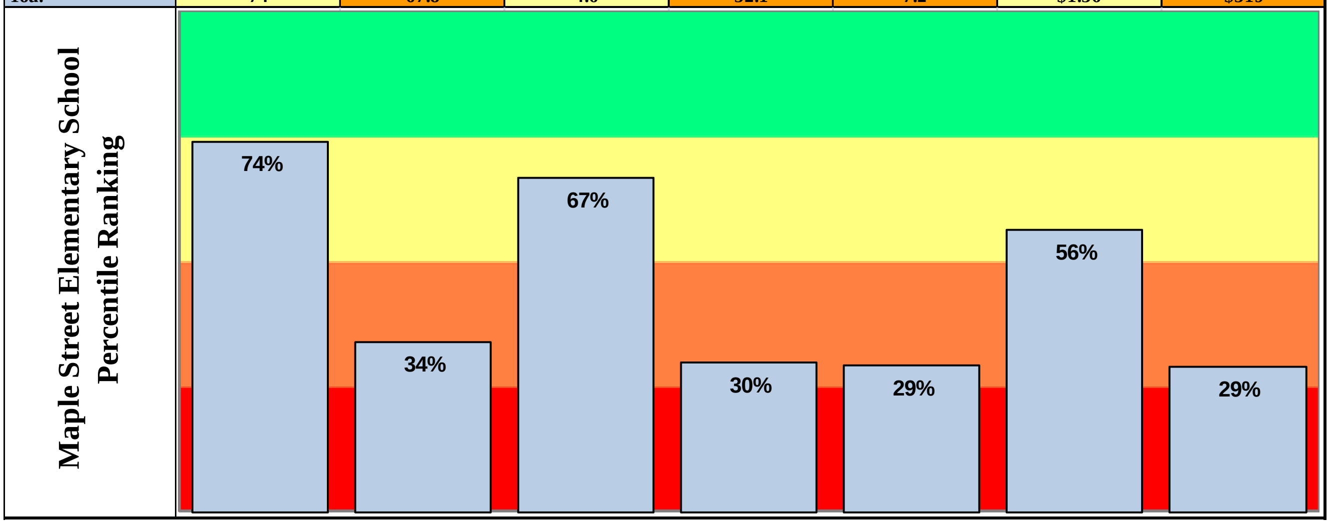
Benchmarking Data

To evaluate the energy and environmental performance of your school, the building data collected above has been compared against two different sets of school energy data: the U.S. Environmental Protection Agency's national data and New Hampshire specific state data. The results are illustrated in Figure 4 on the following page.

This will allow you to assess your building's performance relative to other buildings designed and constructed to the same codes and standards, operating under the same regulations and schedules and similar weather conditions. The indicators are calculated on a *per square foot* or *per student* basis, so you can compare your school to different sized schools.

Figure 4. EnergySmart Schools Benchmarks for Maple Street Elementary School

Schools	U.S. EPA Portfolio Manager Score	New Hampshire State Schools (Annual Data)					
		Total Energy Use (kBtu/sq.ft.)	Electric Use (kWh/sq.ft.)	Heating Fuel Use (kBtu/sq.ft.)	Weather Adjusted Heating Fuel Use (Btu/sq.ft./HDD)	Total Energy Cost ($/sq.ft.)	Total Energy Cost ($/student)
NH Average:	50	60.3	5.2	41.7	5.7	$1.42	$256
You:	74	67.8	4.6	52.1	7.2	$1.36	$319



Major Benchmark Indicators

1. Total Energy Use, kBtu/sq.ft.

This indicator shows how much total energy your school consumes each year. It includes the energy used for heating, cooling (if any), lights, cooking, computers, etc.

Your school's total energy use of 67.8 kBtu per square foot per year (kBtu/sq.ft.) is higher than the New Hampshire K-12 schools state average of 60.3 kBtu/sq.ft. Your total energy use figure is higher than 66% of New Hampshire K-12 schools. The EnergySmart School Report is weather normalized so fuel consumption for heating takes the difference in climate between northern and southern New Hampshire into account.

This is a good indicator of how well, overall, your school is performing. However, it doesn't help you find ***where*** in your building to look for improvement opportunities. Multiple factors included on the following pages can help with that. Analysis of energy consumption for this program does not control for operational variations. An example is an improperly ventilated school may appear to have lower energy consumption. Ventilation systems that are not operating properly result in lower indoor air quality.

2. Electricity Data

Most electric utilities use the following two factors to estimate your electricity bill – Electric Use and Electric Demand.

a. Electric Use, kWh/sq.ft.

This shows how well the building does with its lights, cooling/air conditioners and cafeteria systems (if any), and what's referred to as "plug load." Plug load is anything that plugs into a socket. The major plug loads are generally computers (including monitors, printers and copiers), refrigerators, coffee machines, fans, shop equipment and projectors. If electric consumption is much higher than average, but heating fuel use (see below) is average or better, then focus your efforts on the electric-powered elements.

New Hampshire schools state average electric use is 5.2 kWh per square foot. Your school's electric consumption of 4.6 kWh per square foot this year is lower than 67% of New Hampshire schools benchmarked through the New Hampshire EnergySmart Schools Program.

b. Electric Demand, Watts/sq.ft.

Demand is a measure of the maximum electric draw in kW that your building places on the grid and is measured by adding up the kW draw for a 15 minute period. To give an analogy, if electricity usage is the amount of water going through a hose in gallons, electric demand would be how fast that water flows expressed in gallons per minute. Whichever 15 minute period during your monthly billing cycle places the highest kW demand on the grid is the demand factor applied to your bill. The best way to improve this demand factor is to stagger the times when your electrical systems draw at their maximum or reduce unnecessary electric load altogether.

The average electric demand for New Hampshire schools is 1.9 watts per square foot. Your school's electric demand is 1.8 watts per square foot and is lower than 58% of New Hampshire Schools benchmarked through the New Hampshire EnergySmart Schools Program.

3. Heating Fuel Use, kBtu/sq.ft.

Reviewing these indicators is relatively straightforward. If your school's heating fuel use is much higher than average, an audit of your heating system along with your building envelope - doors, windows, roof - is recommended. This factor is 'fuel-neutral' as it works for either fuel oil or natural gas heating systems.

New Hampshire K-12 schools state average heating fuel use is 41.7 kBtu/sq.ft. or 5.7 Btu/sq.ft./HDD. Your school's heating fuel use of 52.1 kBtu/sq.ft. per year is higher than 70% of other New Hampshire schools in the database. Your school's weather adjusted heating fuel use of 7.2 Btu/sq.ft./HDD is higher than 71% of other New Hampshire schools benchmarked through the New Hampshire EnergySmart Schools Program.

4. Energy Cost, $/sq.ft. & $/student

Cost is the bottom line. These numbers help you understand, in terms of budget, the gain through energy efficiency improvements. New Hampshire K-12 schools state averages $1.42/sq.ft. and $256/student.

Your school's annual energy cost of $1.36 per square foot is lower than 56% of other New Hampshire benchmarked schools. Your school's cost expressed on a per student basis of $319 is higher than 71% of other New Hampshire schools benchmarked through the New Hampshire EnergySmart Schools Program.

5. U.S. EPA *Portfolio Manager* Score

Portfolio Manager is a benchmarking model based on a national set of data from K-12 schools. It is provided by the U.S. Environmental Protection Agency's ENERGY STAR® Program. The impact of factors outside of your control (such as location, occupancy and operating hours) are removed, providing a 1-100 ranking of a school's energy performance relative to the national school building market. A score of 50 represents the national average and a score of 100 is best. Schools that achieve a score of 75 or higher are eligible for EPA's ENERGY STAR® Building Label, the national symbol for protecting the environment through energy efficiency. Districts can achieve ENERGY STAR® Leader Awards in recognition if their buildings, on average, improve by 10%, 20%, 30%, etc. over their baseline year of reported energy use or if the district's overall weighted average *Portfolio Manager* Score is at least a 75.

Your school's *Portfolio Manager* Score of 74 places it higher than 74% of K-12 schools nationwide.

III. Potential Energy Saving Opportunities

Based on the preceding analysis of your school's energy performance, implementation of the following recommendations can help you save energy and money. The first step is to look at reducing electrical lighting and HVAC consumption (burners, circulators and fans) which typically account for 67% of a building's electric consumption.

- **Perform an Energy Audit on the Building**

An energy audit involves a comprehensive analysis of the building's general characteristics, its energy use and allocation of that use amongst the facility's energy end uses. The goal is to identify sources of potential energy savings. Your auditor should develop a list of recommendations that will result in substantial energy and operational cost savings. These may include, building envelope improvement and mechanical systems, lighting upgrades, equipment replacement and installation of lighting and HVAC control mechanisms, among others.

A good audit should include information specific to each recommendation which *at least* includes approximate annual energy unit and cost savings, demand reduction, installation cost, lifetime cost savings and information related to cost-effectiveness. This will help to prioritize the recommendations based on their energy efficiency and shortest payback.

The recommendations provided in an energy audit report may reduce facility energy bills by 20% or more in addition to improving occupant health and comfort. Following this report, an energy audit is the next step in realizing the full potential of energy savings opportunities.

- **Request Retro-Commissioning**

Retro-commissioning is a detailed process applied to existing facilities aimed at correcting many of the degradations and inefficiencies that are indicative of older and/or poorly performing buildings. Many older buildings tend to be less comfortable and operate less efficiently when not properly commissioned. Retro-commissioning includes a detailed energy audit and focuses on not only potential energy savings but also the interaction of the building's equipments and mechanical systems with an eye toward restoring it to optimal performance.

In contrast to an energy audit, this optimization focuses on operational improvements to existing equipment, rather than replacement. Apart from energy savings, other improvements and benefits include substantial operation and maintenance (O&M) cost savings, improved air quality, occupant comfort, health and safety, equipment controls, and improved system interactivity.

In addition to providing recommendations, retro-commissioning includes implementation of the recommended improvements and hence the cost for retro-commissioning is higher than an audit. However, when the costs of improvements are added to the energy audit cost, prices may be comparable. If high O&M costs or occupant health, comfort and safety are concerns in addition to reduction in energy use, retro-commissioning may be a suitable strategy.

- **Upgrade Lighting Systems**

Lighting typically accounts for 30-60% of all energy consumed in school buildings. Additionally, the electrical energy consumed by lights during the summer creates heat and increases cooling costs.

Maple Street Elementary School's electricity consumption is slightly lower than average compared to other schools in the State. Even so, upgraded lighting systems in high consumption areas like classrooms, gymnasiums, libraries, offices, etc. can reduce utility costs, improve the lighting quality and increase occupant comfort and productivity.

Over-lit Spaces: Light levels should be recorded in classrooms and hallways to ensure they are not over-lit, 40-50 foot candles are adequate light levels for an instructional space. If classroom light levels are much higher than 50 foot candles, Maple Street Elementary School should consider de-lamping classrooms or installing dimming ballasts, which dim the lights when outdoor light levels are adequate. In over-lit hallway spaces photo sensors can be installed to turn lights off completely when light levels exceed a pre-set threshold.

In over-lit spaces a T8 to Super T8 lighting retro-fit can reduce the number of light fixtures needed. Super T8 lamps use between 4 and 7 Watts less electricity than standard T8 lamps, but they produce more light per Watt. In some cases this increase in light per Watt can allow for the removal of an entire lamp, saving 32 Watts. The room characteristics must be factored in before this type of retro-fit. The shape of the space, ceiling height, color of the walls, etc. all need to be taken into account when exploring a de-lamping project. We recommend that before retro-fitting the entire facility, begin by changing one classroom and monitor the comfort level of the occupants at Maple Street Elementary School.

Another proven energy reduction measure with a short payback period is to identify any areas where your school may still be using metal halide lighting. Typically metal halide lights are found in gymnasiums or cafeteria areas, many districts have been very satisfied by replacing these lights with high bay T5 lighting fixtures. In addition to the reduced operational wattage, high bay T5 lights turn on instantly, as opposed to metal halide fixtures which have an extended warm up period. The long warm up period associated with metal halides typically leads to the lights being left on all day, at 250 to 400 watts a fixture; the costs begin to add up. Adding occupancy sensors to high bay T5 fixtures further reduces the payback period.

Occupancy Sensors: We recommend that you explore the use of occupancy sensors to ensure that lights are turned off in unoccupied spaces. Lights controlled by occupancy sensors typically run a third of the time when compared with manually controlled lighting. Reduced runtime leads to decreases in both energy usage and operation and maintenance costs. Additionally, a study conducted in Massachusetts found that controlling the security lighting with occupancy sensors reduced vandalism; neighbors and police recognized something wrong when the lights were on in a building that was typically dark and investigated.

To summarize and add a few ways in which Maple Street Elementary School may be able to conserve energy and cost through lighting upgrades is to:

- Design light quantity and quality for the task and occupants' needs in that area.
- Maximize lamp and ballast efficiency.
- Activate the power saving features on office equipment such as copiers, printers and fax machines and ensure that they are turned off at the end of the day.
- Use automatic controls to turn lights off or dim lights in unoccupied spaces.
- Establish a maintenance schedule for group re-lamping and fixture cleaning.
- Replace T12 fixtures with the most efficient fixtures which may include T8/super T8/T5 fixtures.
- Replace incandescent lighting with compact fluorescent technology.

- Replace incandescent exit lighting which consumes 30 Watts with LED type exit lights with 1.5 Watts consumption. LED units last up to 10 years, which is a maintenance advantage.
- Install daylight sensors in areas with significant natural light.
- Install occupancy sensors in areas that are often unoccupied.
- Lighting retrofits reduce maintenance costs associated with lighting that is close to end of life.
- Establish a regular cleaning schedule particularly for areas where student safety of low light levels may be a concern, such as shop classes.
- Look to make lamp and fixture selection as uniform as possible to reduce maintenance and inventory overhead.
- Educate students and staff to turn off lights when rooms are unoccupied.

Lighting upgrades seek to reduce the connected electrical load (kW) and energy consumption (kWh) of lighting equipment. Lighting controls can also significantly reduce operating hours and costs by turning off lighting when spaces are unoccupied or sufficiently lit by natural light.

- **Install NEMA Premium Motors and VFDs**

Commercial and industrial electric motor-driven systems consume approximately 23% of all electricity in the U.S., making it the single largest category contributor to electric use in the country. With very high operating hours, the annual energy cost to run a system is more than its installation cost. Even a small increase in the efficiency of an electric motor can result in substantial energy cost savings. Typical opportunities for motor upgrades in schools include: ventilation fans, and heating and cooling system pumps and fans.

Motors with efficiency up to 90% are available to replace the older ones with efficiency less than 75%. Although standards for efficiency of new equipment are set by the Energy Policy Act, motor efficiency can be further increased by selecting Premium Efficiency motors as specified by the National Electrical Manufacturers Association (NEMA). This can cut the electric motor system demand by as much as 18%.

Savings can be increased further by optimizing system performance through the use of variable frequency drives (VFDs). When system load is known to vary substantially, these flow control systems can be utilized to match system output to system demand, significantly reducing energy usage during partial load hours. By employing high-efficiency motors and VFDs, facility owners can improve environmental conditions, utilize better control of motor-driven processes, and reduce waste output.

- **Install Demand Control Ventilation**

Demand control ventilation (DCV) monitors indoor air CO_2 content as a result of occupancy production levels and uses this data to regulate the amount of outdoor air that is permitted for ventilation. In order to ensure adequate air quality, standard ventilation systems permit outside air based on estimated occupancy levels in CFM, cubic feet per minute/occupant. However, during low occupancy hours, the space may become over ventilated due to decreased CO_2 levels and unnecessary ventilation results in wasted energy. DCV reduces unnecessary outdoor air intake by regulating ventilation based on actual CO_2 levels, saving energy. DCV is most suited for areas where occupancy levels are known to fluctuate considerably such as auditoriums, cafeterias, and gymnasiums.

Install Energy Recovery Ventilators. According to energy recovery equipment manufacturer's typical paybacks are less than 5 years for schools without cooling. The keys to success with ventilation retrofits are going with fewer larger units with long run hours as opposed to several small units with limited run time. Equipment with moisture recovery capabilities would cut humidity up to 50% during the cooling season.

- **Improve/Replace Inefficient Heating Systems**

Replacing an old boiler that is < 70% efficient with a modern 85-90% efficient natural gas-fired furnace alone will reduce heating costs by 15-20%. This combined with additional system improvements and installation of advanced HVAC control mechanisms can result in up to 20%+ heating load reduction.

Because of the high capital cost of new heating systems, some financial analysis should be performed to assess the cost-effectiveness of immediate replacement. If the current system is fairly new, replacement may not be immediately justifiable from a financial standpoint. However, as is the case with cooling systems, early replacement may prove to be a more cost-effective solution than waiting until existing systems fail or reach the end of their estimated useful life.

- **Improve/Replace Inefficient Air Conditioning Systems**

The useful life of a rooftop A/C unit is generally 12-18 years. However, depending on the efficiency, early replacement of outdated, inefficient, split, or packaged rooftop air conditioning units with new A/C systems that are 15% more efficient than 10-15 year old equipments can considerably reduce annual energy consumption. The energy cost savings and maintenance savings offset the high installation cost of a more efficient system. Installing thermostats and/or economizers on new or existing A/C systems will further reduce the cooling demand.

Economizers provide "free" cooling by using controllable dampers that bring in outside air to cool the space when the outdoor temperature or enthalpy is below the building's return air conditions. Although they require operation by a well calibrated and maintained control system, economizers have impressive energy-saving capabilities.

Install Occupancy Controlled/Programmable Thermostats

Combining efficient HVAC equipment with occupancy controlled and programmable thermostats can save a facility up to 10% of its annual heating and cooling costs:

- Areas with unpredictable occupancy on a daily/weekly basis - gym, bathrooms, outdoors: Use an *occupancy controlled thermostat* - a thermostat paired with a sensor and/or door detector to identify movement/occupancy. If occupancy is sensed by the sensor, the thermostat goes into an occupied mode (i.e. programmed set point). If a pre-programmed time frame elapses (i.e. 30 minutes) and no occupancy is sensed during that time, the thermostat goes into an unoccupied mode (e.g., setback set point or off) until occupancy is sensed again. This reduces the overall time the heating or cooling system is running, saving energy.

- Areas with predictable occupancy: e.g.: classrooms, cafeteria, offices: A *programmable thermostat* is recommended. This device is programmed on a schedule to reduce the heating or cooling output of the facility's HVAC systems in relation to its predetermined occupancy schedule. In this way, the thermostat acts to set-back or set-up the facility temperature during unoccupied hours, and re-establish a comfortable facility temperature during business hours. By employing programmable thermostat technology, the heating and cooling system demand coincides with occupancy level, reducing energy usage.

- **Install Vending Misers on Vending Machines**

Vending misers for refrigerated and non-refrigerated vending machines is an often overlooked source of potential savings. Uncontrolled, vending machine lights remain on 24/7, consuming a constant amount of energy year round. By controlling these lights with an occupancy sensor, energy consumption attributed to vending machines can be reduced considerably, in many cases, by as much as 50% and can save up to $150 per machine per year.

In the case of refrigerated vending machines, electric demand can be further reduced by controlling the machines' refrigeration systems. In a manner similar to programmable thermostats, vending misers for refrigerated machines act on a pre-set occupancy schedule to allow a marginal increase in operating temperature during non-business hours. Although products in the machine are delivered to the customer at the same temperature as in an uncontrolled vending machine, products are not being cooled unnecessarily when the machine is not in use, significantly reducing the machine's energy consumption. Because of the relatively low vending miser installation cost and high operating hours of vending machines, this improvement is typically cost-effective with a very short payback period.

- **Install ENERGY STAR® Rated Equipment / Plug Load Control**

Plug loads (computers, televisions, coffee makers, etc.) account for, on average, about 10% of total energy consumption. One of the easiest and most cost-effective energy saving strategies is the reduction of electric usage through installation of efficient appliances and the control of plug loads. In addition to utilizing ENERGY STAR® qualified appliances, greater savings can be realized through the various devices available that control every day plug loads.

By connecting non-critical loads (coffee makers, fans, microwave ovens, etc.) to an occupancy or timer controlled power strip, significant energy savings can be achieved. These savings result not only from the neglect of the user to turn the device off manually, but also from reduction of "phantom load". Phantom load is the small but constant energy draw from many plug-in devices when not in use. By connecting certain appliances to an occupancy controlled power strip, phantom load can be eliminated by cutting power supply to those devices. When replacing or ordering new equipment, emphasize ENERGY STAR® devices when they are available. Also, purchase controlled power strips and connect appropriate devices to those strips to reduce unnecessary consumption due to phantom load and appliances left on. The EPA offers free computer power management software which has saved some districts as much as $75 per computer per year, the software can be found at http://www.energystar.gov/index.cfm?c=power_mgt.pr_power_mgt_low_carbon_join.

IV. Resources:

The State of New Hampshire along with the utility companies offer multiple programs designed to improve the energy efficiency of schools through financial incentives and technical support, including:

Northeast Energy Efficiency Partnerships:

- **Northeast Collaborative for High Performance Schools (NE-CHPS)**
  NE-CHPS is a set of building and design standards for all schools from pre-K through community colleges tailored specifically for NH state code requirements, the New England climate, and the environmental priorities of the region. NH Department of Education offers up to a 3% re-imbursement for New Construction School projects. To learn more about NE-CHPS and incentive programs please visit: http://neep.org/public-policy/hpse/hpse-nechps.

New Hampshire Public Utilities Commission:

- **New Hampshire Pay for Performance**
  This program addresses the energy efficiency improvement needs of the commercial and industrial sector. The Program is implemented through a network of qualified Program Partners. Incentives will be paid out on the following three payment schedule: Incentive #1: Is based on the area of conditioned space in square feet. Incentive #2: Per/kWh saved and per/MMBTU saved based on projected savings and paid at construction completion. Incentive #3: Per/kWh saved and per/MMBTU saved based on actual energy savings performance one year post construction. Total performance incentives (#2 and #3) will be capped at $200,000 or 50% of project cost on a per project basis. For more information visit http://nhp4p.com.

- **New Hampshire Public Utilities Commission's Renewable Energy Rebates**
  The Sustainable Energy Division provides an incentive program for solar electric (photovoltaic or PV) arrays and solar thermal systems for domestic hot water, space and process heat, with a capacity of 100 kW or equivalent thermal output or less. The rebate for PV systems as follows: $1.00 per Watt, capped at 25% of the costs of the system or $50,000, whichever is less. For solar hot water (SHW) systems, the base rebate is $0.07 per rated or modeled kBtu/year, capped at 25% of the cost of the facility or $50,000, whichever is less, as a one-time incentive payment. http://www.puc.state.nh.us/Sustainable%20Energy/RenewableEnergyRebates-CI.html.

New Hampshire Community Development Finance Authority:

- **New Hampshire Community Development Finance Authority Revolving Loan Fund**
The Enterprise Energy Fund is a low-interest loan and grant program available to businesses and nonprofit organizations to help finance energy improvements and renewable energy projects in their buildings. The loans will range from $10,000 to $500,000. Larger amounts will be considered on a case by case basis. The program is available to finance improvements to the overall energy-efficiency performance of buildings owned by businesses and nonprofits, thereby lowering their overall energy costs and the associated carbon emissions. More information about the program can be found on their website www.nhcdfa.org. These activities may include:
    - Improvements to the building's envelope, including air sealing and insulation in the walls, attics and foundations;
    - Improvements to HVAC equipment and air exchange;
    - Installation of renewable energy systems;
    - Improvements to lighting, equipment, and other electrical systems; and
    - Conduction of comprehensive, fuel-blind energy audits.

Public Service of New Hampshire (PSNH):

- **Commercial (Electric) Energy Efficiency Incentive Programs**
This program targets any commercial/industrial member building a new facility, undergoing a major renovation, or replacing failed (end-of-life) equipment. The program offers prescriptive and custom rebates for lighting and lighting controls, motors, VFDs, HVAC systems, chillers and custom projects. http://www.psnh.com/SaveEnergyMoney/For-Business/Energy-Saving-Programs-and-Incentives.aspx

- **SmartSTART**
The SmartSTART (Savings Through Affordable Retrofit Technologies) advantage is simple - pay nothing out of pocket to have energy efficiency products and services installed in your building. The Smart Start program is limited to PSNH's municipal customers only and includes schools. The program is available on a first-come, first served basis to projects which have been pre-qualified by PSNH. The cost of the improvements is fronted by PSNH which is then repaid over time by the municipality or school using the savings generated by the products themselves! This program is for lighting and lighting controls, air sealing, insulation and other verifiable energy savings measures which have sufficient kilowatt-hour savings. For more information on this program visit:
http://www.psnh.com/SaveEnergyMoney/For-Business/Municipal-Smart-Start-Program.aspx

- **Schools Program**
For major renovation or equipment replacement projects, this program offers prescriptive and custom rebates for energy efficient lighting, motors, HVAC, chillers, and variable frequency drives to towns or cities that install energy efficient equipment at their schools. Financial incentives are available for qualifying energy efficient equipment. Technical assistance is also offered through the Schools Program. http://www.psnh.com/SaveEnergyMoney/Large-Power/Schools-Program.aspx

Unitil:

- **Commercial and Industrial Energy Efficiency Programs**
  Subject to program qualifications and availability of funding - Unitil offers different programs for its commercial, industrial, and institutional customers in New Hampshire: the Small Business Energy Efficiency Program, the Small Commercial and Industrial Program, the Large Commercial and Industrial Program, the Large Commercial and Industrial (C&I) Retrofit Program, and the Large C&I New Construction Program. Rebates are available for various technologies including water heaters, lighting, lighting controls/sensors, chillers, furnaces, boilers, central air conditioners, compressed air, programmable thermostats, energy management systems/building controls, motors, motor VFDs, processing and manufacturing equipment, LED exit signs, commercial cooking and refrigeration equipment. http://www.unitil.com/.

Clean Air – Cool Planet:

- **Community Energy Efficiency**
  CA-CP works with communities throughout the Northeast to find solutions to climate change and build constituencies for effective climate policies and actions. Much of their work focuses on successful models for energy efficiency and renewable energy planning. They advise and partner with citizens, educators, faith groups, small businesses, municipal governments, and other local leaders. They explore cost-effective opportunities that exist for communities to reduce their emissions as well as their vulnerability to climate impacts. One such example is CA-CP's partnership with the University of NH, NH Sustainable Energy Association and UNH Cooperative Extension to create myenergyplan.net, a groundbreaking suite of web and outreach tools for individual action used by households, schools and community groups around the northeast. http://www.cleanair-coolplanet.org/for_communities/index.php.

Environmental Protection Agency (EPA):

- **ENERGY STAR Challenge for Schools**
  EPA is challenging school administrators and building managers to improve energy efficiency throughout their facilities. More than 500 school districts across the country are helping to fight climate change by committing to reducing their energy use with help from ENERGY STAR. Schools that take the ENERGY STAR Challenge can use energy tracking tools, technical guidance, case studies and other ENERGY STAR tools and resources to help them improve their energy efficiency. More information can be found at:
  http://yosemite.epa.gov/opa/admpress.nsf/d985312f6895893b852574ac005f1e40/d74f768ecfa9e11f8525762500522260!OpenDocument

For additional assistance in helping you save money and improve school conditions, please call TRC at (603) 766-1913 or (877) 442-9181.

NEW HAMPSHIRE ENERGYSMART SCHOOLS PROGRAM

Energy Benchmarking Report for:

Gonic Elementary School

Gonic, NH

Period: ***July 1, 2010*** through ***June 30, 2011***

PREPARED BY:

TRC

155 Fleet Street, Suite #305

Portsmouth, NH 03801

(603) 766-1913

www.trcsolutions.com

Table of Contents

I. Introduction

The Sustainable Energy Division of the New Hampshire Public Utilities Commission, with support from the New Hampshire Department of Education has sponsored TRC to develop the New Hampshire ***EnergySmart Schools Program*** to support New Hampshire K-12 public and private schools in the pursuit of energy efficiency and sustainability initiatives.

Energy efficiency has become an increasingly important issue for schools due to tightening budgets and rising energy costs. Since 2003, the prices of natural gas, fuel oil and electricity have increased by 123%, 107% and 32% respectively. Schools that have participated in energy benchmarking programs have shown a decrease in overall energy use by approximately 22% through the adoption of energy efficiency measures.

Tracking and documenting the energy use and associated carbon emissions in the state's K-12 schools will allow New Hampshire to account for the impact of its energy efficiency and renewable energy programs and determine which have the greatest effect. The analysis in this report, provided by the ***EnergySmart Schools Program*** is designed to help you:

- Understand the energy consumption and cost trends at each of your school buildings.
- Learn how your buildings are performing compared to other schools locally and nationally.
- Identify opportunities for improving operations and reducing costs.
- Take advantage of resources to implement efficiency improvements and save money.

The analysis was based on the information provided on the *Building Data Request Form* submitted, which included building descriptions, energy suppliers and other information. The building's utility bills were also used to assess its electricity and heating fuel consumption for the year(s) provided.

The energy performance for your school has been compared to national data for similar school facilities through EPA's ENERGY STAR® Portfolio Manager. Also shown are the five major benchmarks used to analyze building performance, which include: electricity use; heating fuel use; weather-normalized heating fuel use; total cost; and total cost per student, all of which have been normalized for comparison by square footage and weather. As part of the program's focus on sustainability, your school's carbon footprint is also presented.

II. Benchmarking Analysis and Review Results

Building and energy usage of your school was analyzed to assess the basic nature of your energy consumption and utility costs. The Building Data Summary table shown below summarizes this information.

Table 1: Building Data Summary for Gonic Elementary School

Building Data			
District	SAU 54 Rochester School Department	**School Name**	Gonic Elementary School
City	Gonic	**Zip Code**	03839
Year Built	1897	**Floor Area (sq.ft.)**	42,400
Number of Students	260	**Number of PCs**	56
Weekly Operating Hours	60	**Months School Used**	12
Cooking?	YES	**% AC**	10
Pool Size?	N/A	**Months Pool Used**	0

Utility Data			
Data End Point	6/30/2011	**Total Cost ($)**	47,767
Electric Provider	PSNH	**Natural Gas Provider**	Unitil
Electricity Usage (kWh)	167,280	**Electricity Cost ($)**	25,280
Natural Gas Usage (therms)	16,641	**Natural Gas Cost ($)**	22,488
Fuel Oil Usage (gal)	0	**Fuel Oil Cost ($)**	0
Other Fuel Usage (gal)	0	**Other Fuel Cost ($)**	0

Energy Indicators			
EPA Score	90	**Electric Usage (kWh/sq.ft.)**	3.9
Heating Fuel Usage (kBtu/sq.ft.)	39.2	**Weather Adjusted Heating Usage Btu/sq.ft./HDD)**	5.4
Site Energy (kBtu/sq.ft.)	52.7	**Source Energy (kBtu/sq.ft.)**	86

Environmental Impact Indicators			
Greenhouse Gas Emissions			
Last Year Heating Fuel CO_2e (Mt)	88.6	**Last Year Total CO_2e (Mt)**	140.5
Last Year Electricity CO_2e (Mt)	51.9	**CO_2e Efficiency Savings Over Previous Year**	-9.5
EPA Target Score			
Target Score	Reached	**Site Energy Reduction Needed (kBtu/sq.ft.)**	N/A - Reached

Figures 1a, 1b, 2a and 2b display the energy use, demand and cost data tracked on a monthly basis. This demonstrates the energy consumption of your building over the course of the year. As a part of the program's focus on sustainability, your school's carbon footprint was also measured and is presented in Figure 3.

Figure 1a. Monthly Electric Use & Max Demand for Gonic Elementary School

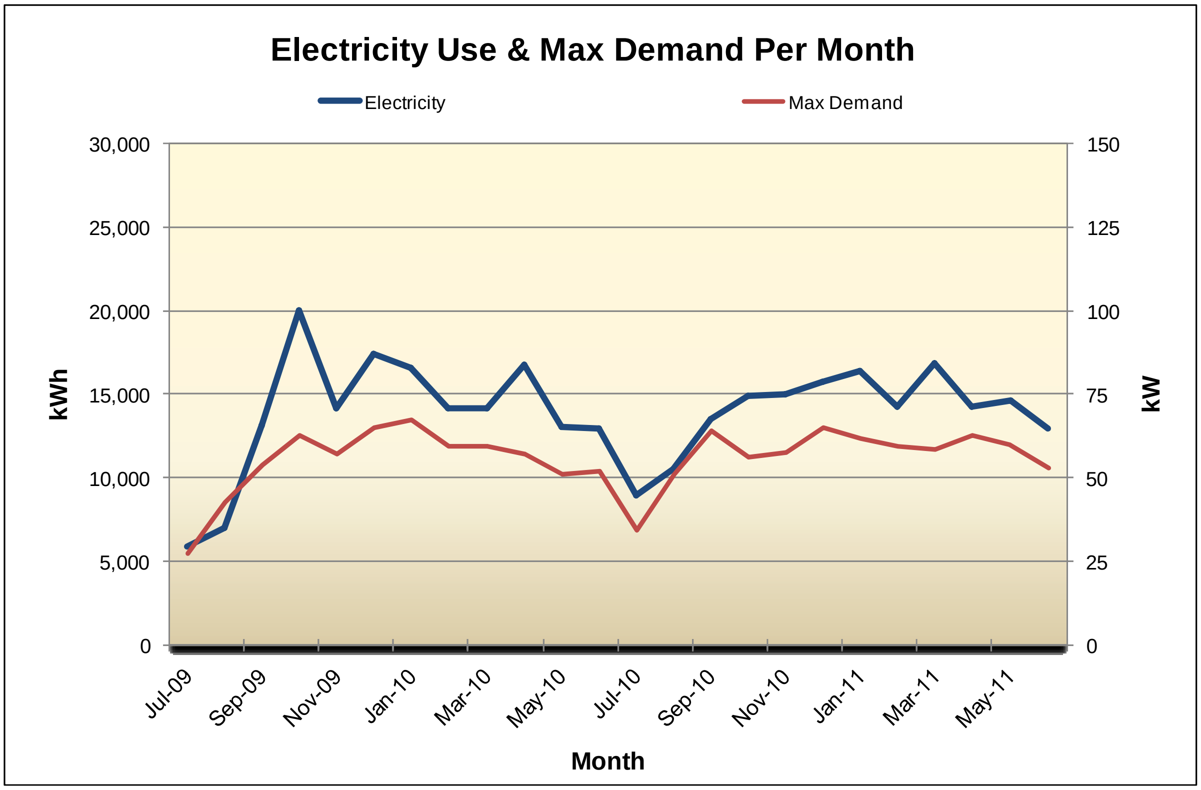


Figure 1b. Monthly Electric Use vs. Cost for Gonic Elementary School

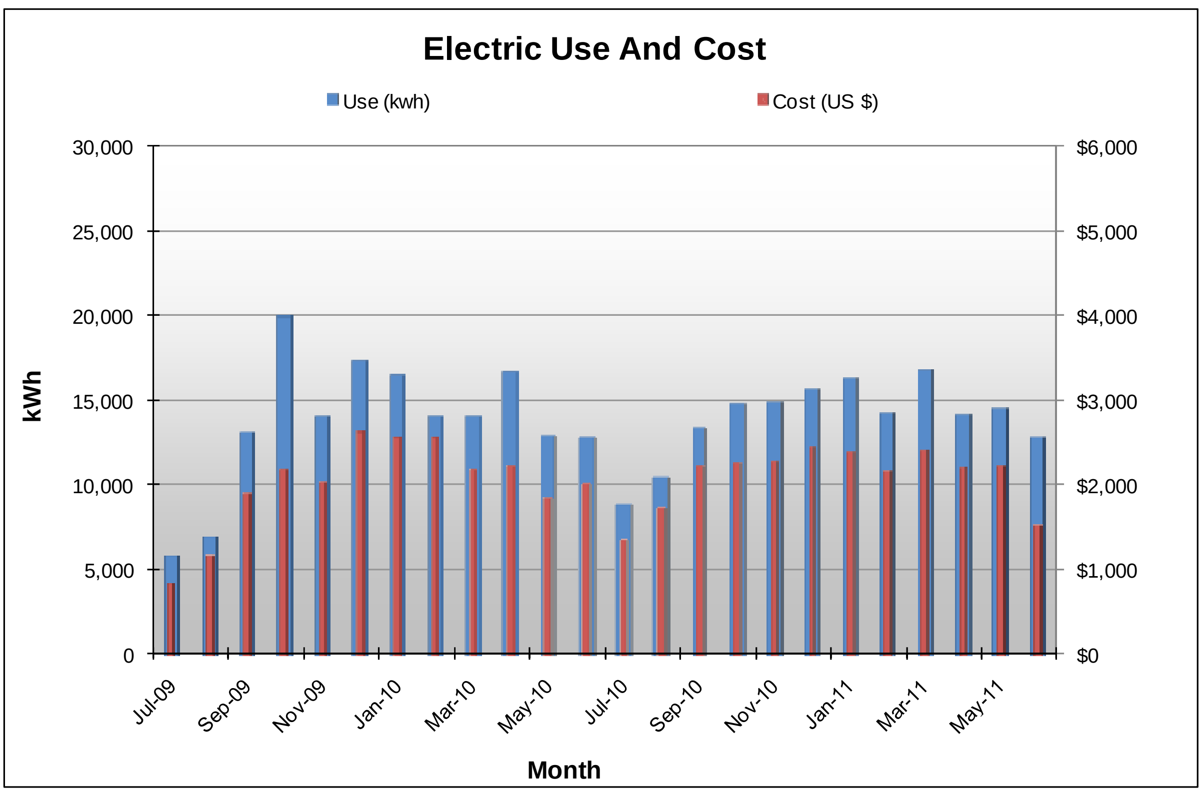


Figure 2a. Monthly Natural Gas Use for Gonic Elementary School

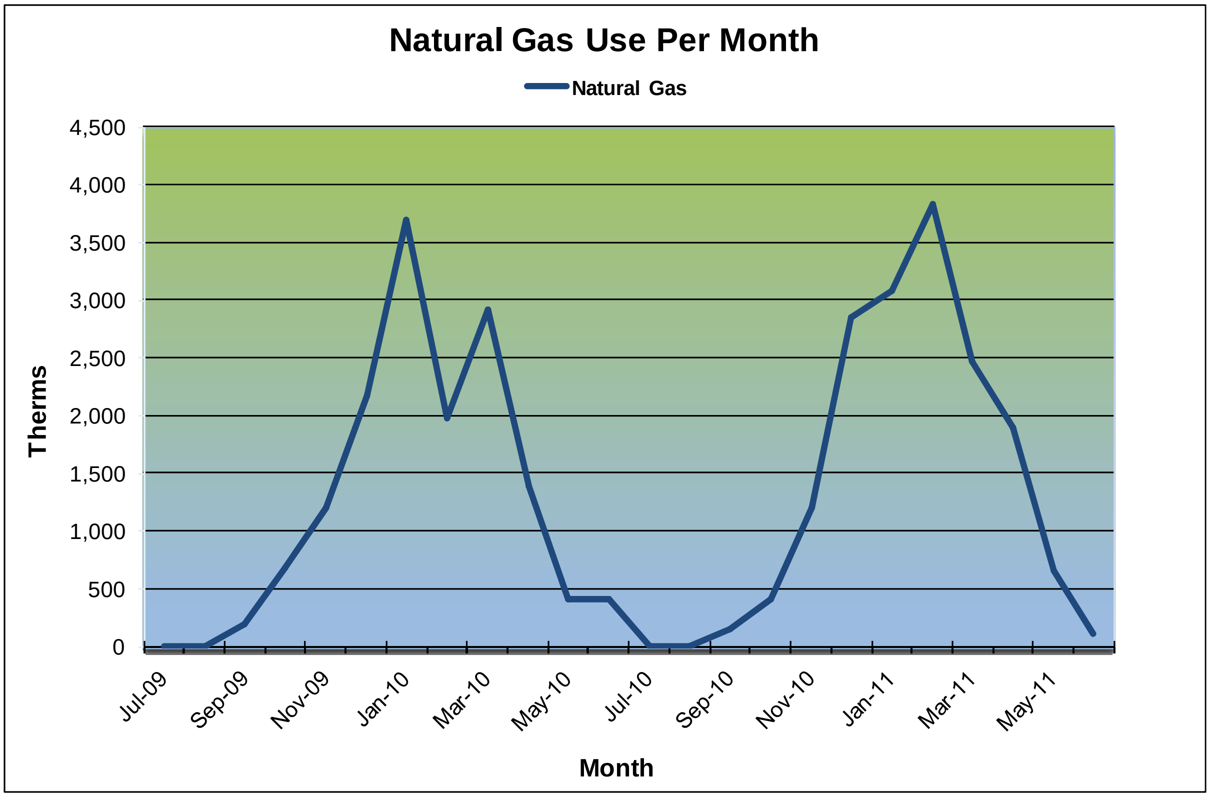


Figure 2b. Monthly Natural Gas Use vs Cost for Gonic Elementary School

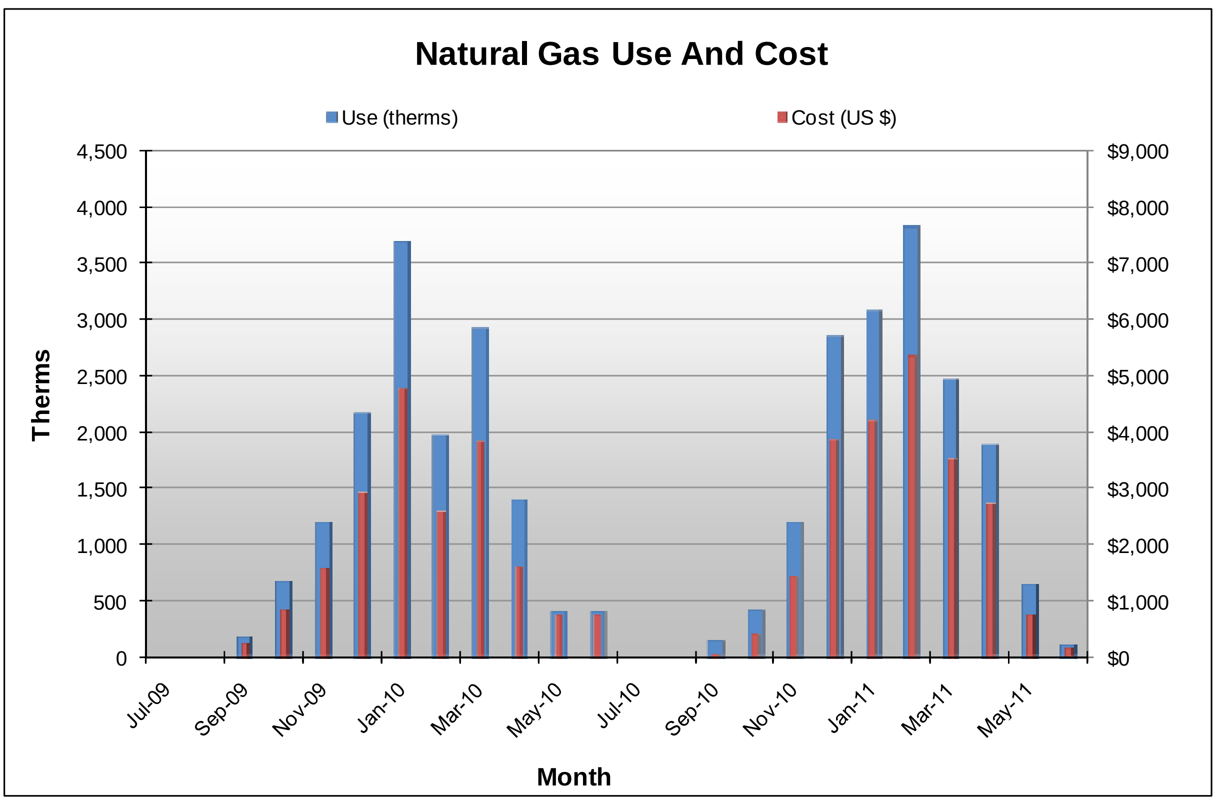
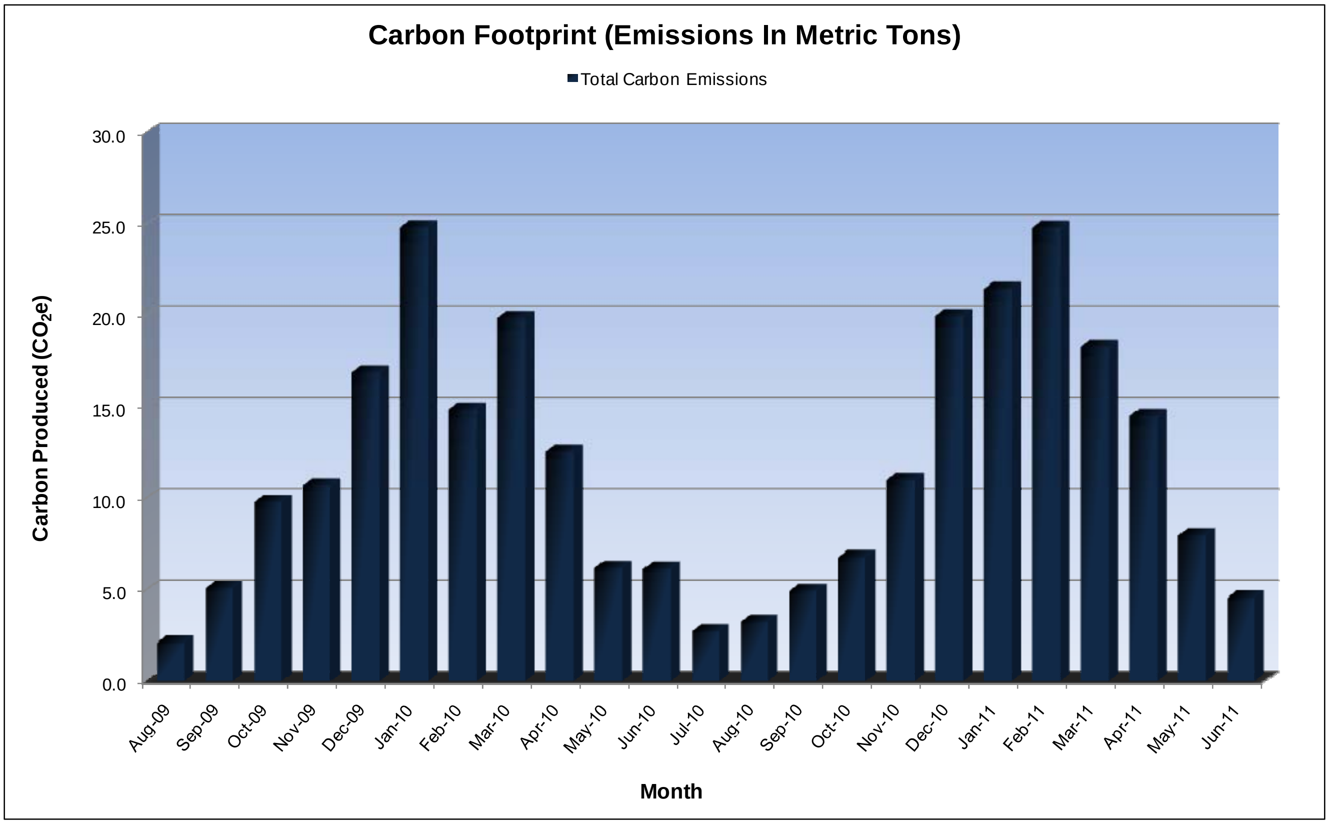


Figure 3. Monthly Greenhouse Gas Emissions for Gonic Elementary School



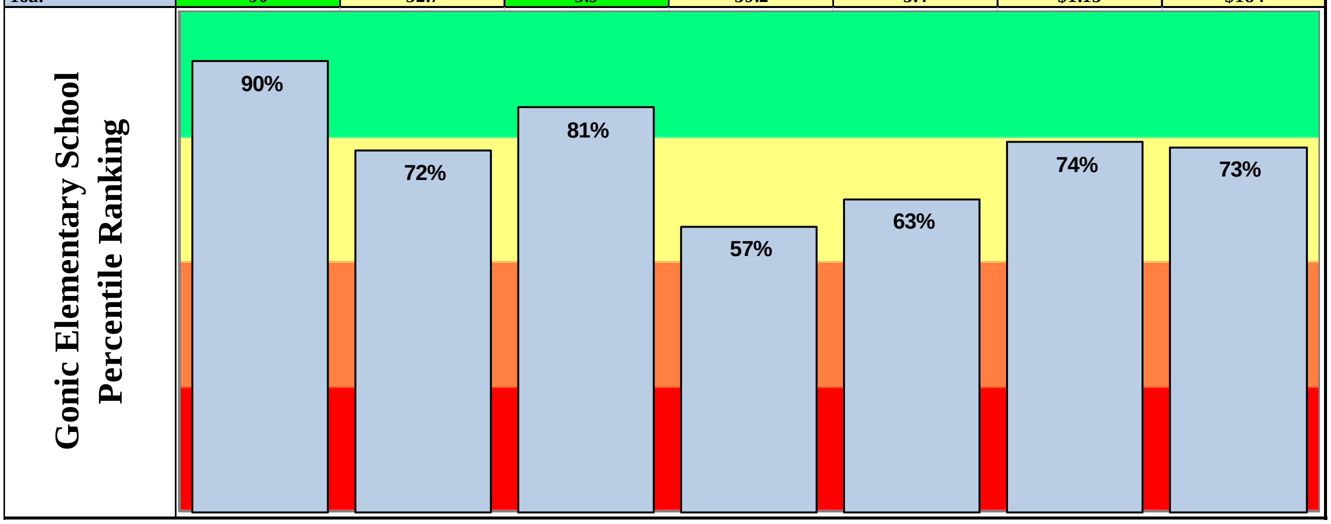
Benchmarking Data

To evaluate the energy and environmental performance of your school, the building data collected above has been compared against two different sets of school energy data: the U.S. Environmental Protection Agency's national data and New Hampshire specific state data. The results are illustrated in Figure 4 on the following page.

This will allow you to assess your building's performance relative to other buildings designed and constructed to the same codes and standards, operating under the same regulations and schedules and similar weather conditions. The indicators are calculated on a *per square foot* or *per student* basis, so you can compare your school to different sized schools.

Figure 4. EnergySmart Schools Benchmarks for Gonic Elementary School

Schools	U.S. EPA Portfolio Manager Score	New Hampshire State Schools (Annual Data)					
		Total Energy Use (kBtu/sq.ft.)	Electric Use (kWh/sq.ft.)	Heating Fuel Use (kBtu/sq.ft.)	Weather Adjusted Heating Fuel Use (Btu/sq.ft./HDD)	Total Energy Cost ($/sq.ft.)	Total Energy Cost ($/student)
NH Average:	50	60.3	5.2	41.7	5.7	$1.42	$256
You:	90	52.7	3.9	39.2	5.4	$1.13	$184



Major Benchmark Indicators

1. Total Energy Use, kBtu/sq.ft.

This indicator shows how much total energy your school consumes each year. It includes the energy used for heating, cooling (if any), lights, cooking, computers, etc.

Your school's total energy use of 52.7 kBtu per square foot per year (kBtu/sq.ft.) is better than the New Hampshire K-12 schools state average of 60.3 kBtu/sq.ft. Your total energy use figure is lower than 72% of New Hampshire K-12 schools. The EnergySmart School Report is weather normalized so fuel consumption for heating takes the difference in climate between northern and southern New Hampshire into account.

This is a good indicator of how well, overall, your school is performing. However, it doesn't help you find ***where*** in your building to look for improvement opportunities. Multiple factors included on the following pages can help with that. Analysis of energy consumption for this program does not control for operational variations. An example is an improperly ventilated school may appear to have lower energy consumption. Ventilation systems that are not operating properly result in lower indoor air quality.

2. Electricity Data

Most electric utilities use the following two factors to estimate your electricity bill – Electric Use and Electric Demand.

a. Electric Use, kWh/sq.ft.

This shows how well the building does with its lights, cooling/air conditioners and cafeteria systems (if any), and what's referred to as "plug load." Plug load is anything that plugs into a socket. The major plug loads are generally computers (including monitors, printers and copiers), refrigerators, coffee machines, fans, shop equipment and projectors. If electric consumption is much higher than average, but heating fuel use (see below) is average or better, then focus your efforts on the electric-powered elements.

New Hampshire schools state average electric use is 5.2 kWh per square foot. Your school's electric consumption of 3.9 kWh per square foot this year is lower than 81% of New Hampshire schools benchmarked through the New Hampshire EnergySmart Schools Program.

b. Electric Demand, Watts/sq.ft.

Demand is a measure of the maximum electric draw in kW that your building places on the grid and is measured by adding up the kW draw for a 15 minute period. To give an analogy, if electricity usage is the amount of water going through a hose in gallons, electric demand would be how fast that water flows expressed in gallons per minute. Whichever 15 minute period during your monthly billing cycle places the highest kW demand on the grid is the demand factor applied to your bill. The best way to improve this demand factor is to stagger the times when your electrical systems draw at their maximum or reduce unnecessary electric load altogether.

The average electric demand for New Hampshire schools is 1.9 watts per square foot. Your school's electric demand is 1.5 watts per square foot and is lower than 80% of New Hampshire Schools benchmarked through the New Hampshire EnergySmart Schools Program.

3. Heating Fuel Use, kBtu/sq.ft.

Reviewing these indicators is relatively straightforward. If your school's heating fuel use is much higher than average, an audit of your heating system along with your building envelope - doors, windows, roof - is recommended. This factor is 'fuel-neutral' as it works for either fuel oil or natural gas heating systems.

New Hampshire K-12 schools state average heating fuel use is 41.7 kBtu/sq.ft. or 5.7 Btu/sq.ft./HDD. Your school's heating fuel use of 39.2 kBtu/sq.ft. per year is lower than 57% of other New Hampshire schools in the database. Your school's weather adjusted heating fuel use of 5.4 Btu/sq.ft./HDD is lower than 63% of other New Hampshire schools benchmarked through the New Hampshire EnergySmart Schools Program.

4. Energy Cost, $/sq.ft. & $/student

Cost is the bottom line. These numbers help you understand, in terms of budget, the gain through energy efficiency improvements. New Hampshire K-12 schools state averages $1.42/sq.ft. and $256/student.

Your school's annual energy cost of $1.13 per square foot is lower than 74% of other New Hampshire benchmarked schools. Your school's cost expressed on a per student basis of $184 is lower than 73% of other New Hampshire schools benchmarked through the New Hampshire EnergySmart Schools Program.

5. U.S. EPA *Portfolio Manager* Score

Portfolio Manager is a benchmarking model based on a national set of data from K-12 schools. It is provided by the U.S. Environmental Protection Agency's ENERGY STAR® Program. The impact of factors outside of your control (such as location, occupancy and operating hours) are removed, providing a 1-100 ranking of a school's energy performance relative to the national school building market. A score of 50 represents the national average and a score of 100 is best. Schools that achieve a score of 75 or higher are eligible for EPA's ENERGY STAR® Building Label, the national symbol for protecting the environment through energy efficiency. Districts can achieve ENERGY STAR® Leader Awards in recognition if their buildings, on average, improve by 10%, 20%, 30%, etc. over their baseline year of reported energy use or if the district's overall weighted average *Portfolio Manager* Score is at least a 75.

Your school's *Portfolio Manager* Score of 90 places it higher than 90% of K-12 schools nationwide. As noted above, this rating potentially qualifies your school for the prestigious ENERGY STAR® Label for Buildings.

III. Potential Energy Saving Opportunities

Based on the preceding analysis of your school's energy performance, implementation of the following recommendations can help you save energy and money. The first step is to look at reducing electrical lighting and HVAC consumption (burners, circulators and fans) which typically account for 67% of a building's electric consumption.

- **Perform an Energy Audit on the Building**

An energy audit involves a comprehensive analysis of the building's general characteristics, its energy use and allocation of that use amongst the facility's energy end uses. The goal is to identify sources of potential energy savings. Your auditor should develop a list of recommendations that will result in substantial energy and operational cost savings. These may include, building envelope improvement and mechanical systems, lighting upgrades, equipment replacement and installation of lighting and HVAC control mechanisms, among others.

A good audit should include information specific to each recommendation which *at least* includes approximate annual energy unit and cost savings, demand reduction, installation cost, lifetime cost savings and information related to cost-effectiveness. This will help to prioritize the recommendations based on their energy efficiency and shortest payback.

The recommendations provided in an energy audit report may reduce facility energy bills by 20% or more in addition to improving occupant health and comfort. Following this report, an energy audit is the next step in realizing the full potential of energy savings opportunities.

- **Request Retro-Commissioning**

Retro-commissioning is a detailed process applied to existing facilities aimed at correcting many of the degradations and inefficiencies that are indicative of older and/or poorly performing buildings. Many older buildings tend to be less comfortable and operate less efficiently when not properly commissioned. Retro-commissioning includes a detailed energy audit and focuses on not only potential energy savings but also the interaction of the building's equipments and mechanical systems with an eye toward restoring it to optimal performance.

In contrast to an energy audit, this optimization focuses on operational improvements to existing equipment, rather than replacement. Apart from energy savings, other improvements and benefits include substantial operation and maintenance (O&M) cost savings, improved air quality, occupant comfort, health and safety, equipment controls, and improved system interactivity.

In addition to providing recommendations, retro-commissioning includes implementation of the recommended improvements and hence the cost for retro-commissioning is higher than an audit. However, when the costs of improvements are added to the energy audit cost, prices may be comparable. If high O&M costs or occupant health, comfort and safety are concerns in addition to reduction in energy use, retro-commissioning may be a suitable strategy.

- **Upgrade Lighting Systems**

Lighting typically accounts for 30-60% of all energy consumed in school buildings. Additionally, the electrical energy consumed by lights during the summer creates heat and increases cooling costs.

Gonic Elementary School's electricity consumption is low (better) compared to other schools in the State. Even so, upgraded lighting systems in high consumption areas like classrooms, gymnasiums, libraries, offices, etc. can reduce costs, improve the lighting quality and increase occupant comfort and productivity.

Over-lit Spaces: Light levels should be recorded in classrooms and hallways to ensure they are not over-lit, 40-50 foot candles are adequate light levels for an instructional space. If classroom light levels are much higher than 50 foot candles, Gonic Elementary School should consider de-lamping classrooms or installing dimming ballasts, which dim the lights when outdoor light levels are adequate. In over-lit hallway spaces photo sensors can be installed to turn lights off completely when light levels exceed a pre-set threshold.

In over-lit spaces a T8 to Super T8 lighting retro-fit can reduce the number of light fixtures needed. Super T8 lamps use between 4 and 7 Watts less electricity than standard T8 lamps, but they produce more light per Watt. In some cases this increase in light per Watt can allow for the removal of an entire lamp, saving 32 Watts. The room characteristics must be factored in before this type of retro-fit. The shape of the space, ceiling height, color of the walls, etc. all need to be taken into account when exploring a de-lamping project. We recommend that before retro-fitting the entire facility, begin by changing one classroom and monitor the comfort level of the occupants at Gonic Elementary School.

Another proven energy reduction measure with a short payback period is to identify any areas where your school may still be using metal halide lighting. Typically metal halide lights are found in gymnasiums or cafeteria areas, many districts have been very satisfied by replacing these lights with high bay T5 lighting fixtures. In addition to the reduced operational wattage, high bay T5 lights turn on instantly, as opposed to metal halide fixtures which have an extended warm up period. The long warm up period associated with metal halides typically leads to the lights being left on all day, at 250 to 400 watts a fixture; the costs begin to add up. Adding occupancy sensors to high bay T5 fixtures further reduces the payback period.

Occupancy Sensors: We recommend that you explore the use of occupancy sensors to ensure that lights are turned off in unoccupied spaces. Lights controlled by occupancy sensors typically run a third of the time when compared with manually controlled lighting. Reduced runtime leads to decreases in both energy usage and operation and maintenance costs. Additionally, a study conducted in Massachusetts found that controlling the security lighting with occupancy sensors reduced vandalism; neighbors and police recognized something wrong when the lights were on in a building that was typically dark and investigated.

To summarize and add a few ways in which Gonic Elementary School may be able to conserve energy and cost through lighting upgrades is to:

- Design light quantity and quality for the task and occupants' needs in that area.
- Maximize lamp and ballast efficiency.
- Activate the power saving features on office equipment such as copiers, printers and fax machines and ensure that they are turned off at the end of the day.
- Use automatic controls to turn lights off or dim lights in unoccupied spaces.
- Establish a maintenance schedule for group re-lamping and fixture cleaning.
- Replace T12 fixtures with the most efficient fixtures which may include T8/super T8/T5 fixtures.
- Replace incandescent lighting with compact fluorescent technology.

- Replace incandescent exit lighting which consumes 30 Watts with LED type exit lights with 1.5 Watts consumption. LED units last up to 10 years, which is a maintenance advantage.

- Install daylight sensors in areas with significant natural light.

- Install occupancy sensors in areas that are often unoccupied.

- Lighting retrofits reduce maintenance costs associated with lighting that is close to end of life.

- Establish a regular cleaning schedule particularly for areas where student safety of low light levels may be a concern, such as shop classes.

- Look to make lamp and fixture selection as uniform as possible to reduce maintenance and inventory overhead.

- Educate students and staff to turn off lights when rooms are unoccupied.

Lighting upgrades seek to reduce the connected electrical load (kW) and energy consumption (kWh) of lighting equipment. Lighting controls can also significantly reduce operating hours and costs by turning off lighting when spaces are unoccupied or sufficiently lit by natural light.

- **Install NEMA Premium Motors and VFDs**

Commercial and industrial electric motor-driven systems consume approximately 23% of all electricity in the U.S., making it the single largest category contributor to electric use in the country. With very high operating hours, the annual energy cost to run a system is more than its installation cost. Even a small increase in the efficiency of an electric motor can result in substantial energy cost savings. Typical opportunities for motor upgrades in schools include: ventilation fans, and heating and cooling system pumps and fans.

Motors with efficiency up to 90% are available to replace the older ones with efficiency less than 75%. Although standards for efficiency of new equipment are set by the Energy Policy Act, motor efficiency can be further increased by selecting Premium Efficiency motors as specified by the National Electrical Manufacturers Association (NEMA). This can cut the electric motor system demand by as much as 18%.

Savings can be increased further by optimizing system performance through the use of variable frequency drives (VFDs). When system load is known to vary substantially, these flow control systems can be utilized to match system output to system demand, significantly reducing energy usage during partial load hours. By employing high-efficiency motors and VFDs, facility owners can improve environmental conditions, utilize better control of motor-driven processes, and reduce waste output.

- **Install Demand Control Ventilation**

Demand control ventilation (DCV) monitors indoor air CO_2 content as a result of occupancy production levels and uses this data to regulate the amount of outdoor air that is permitted for ventilation. In order to ensure adequate air quality, standard ventilation systems permit outside air based on estimated occupancy levels in CFM, cubic feet per minute/occupant. However, during low occupancy hours, the space may become over ventilated due to decreased CO_2 levels and unnecessary ventilation results in wasted energy. DCV reduces unnecessary outdoor air intake by regulating ventilation based on actual CO_2 levels, saving energy. DCV is most suited for areas where occupancy levels are known to fluctuate considerably such as auditoriums, cafeterias, and gymnasiums.

Install Energy Recovery Ventilators. According to energy recovery equipment manufacturer's typical paybacks are less than 5 years for schools without cooling. The keys to success with ventilation retrofits are going with fewer larger units with long run hours as opposed to several small units with limited run time. Equipment with moisture recovery capabilities would cut humidity up to 50% during the cooling season.

- **Improve/Replace Inefficient Heating Systems**

Replacing an old boiler that is < 70% efficient with a modern 85-90% efficient natural gas-fired furnace alone will reduce heating costs by 15-20%. This combined with additional system improvements and installation of advanced HVAC control mechanisms can result in up to 20%+ heating load reduction.

Because of the high capital cost of new heating systems, some financial analysis should be performed to assess the cost-effectiveness of immediate replacement. If the current system is fairly new, replacement may not be immediately justifiable from a financial standpoint. However, as is the case with cooling systems, early replacement may prove to be a more cost-effective solution than waiting until existing systems fail or reach the end of their estimated useful life.

- **Improve/Replace Inefficient Air Conditioning Systems**

The useful life of a rooftop A/C unit is generally 12-18 years. However, depending on the efficiency, early replacement of outdated, inefficient, split, or packaged rooftop air conditioning units with new A/C systems that are 15% more efficient than 10-15 year old equipments can considerably reduce annual energy consumption. The energy cost savings and maintenance savings offset the high installation cost of a more efficient system. Installing thermostats and/or economizers on new or existing A/C systems will further reduce the cooling demand.

Economizers provide "free" cooling by using controllable dampers that bring in outside air to cool the space when the outdoor temperature or enthalpy is below the building's return air conditions. Although they require operation by a well calibrated and maintained control system, economizers have impressive energy-saving capabilities.

Install Occupancy Controlled/Programmable Thermostats

Combining efficient HVAC equipment with occupancy controlled and programmable thermostats can save a facility up to 10% of its annual heating and cooling costs:

- Areas with unpredictable occupancy on a daily/weekly basis - gym, bathrooms, outdoors: Use an *occupancy controlled thermostat* - a thermostat paired with a sensor and/or door detector to identify movement/occupancy. If occupancy is sensed by the sensor, the thermostat goes into an occupied mode (i.e. programmed set point). If a pre-programmed time frame elapses (i.e. 30 minutes) and no occupancy is sensed during that time, the thermostat goes into an unoccupied mode (e.g., setback set point or off) until occupancy is sensed again. This reduces the overall time the heating or cooling system is running, saving energy.

- Areas with predictable occupancy: e.g.: classrooms, cafeteria, offices: A *programmable thermostat* is recommended. This device is programmed on a schedule to reduce the heating or cooling output of the facility's HVAC systems in relation to its predetermined occupancy schedule. In this way, the thermostat acts to set-back or set-up the facility temperature during unoccupied hours, and re-establish a comfortable facility temperature during business hours. By employing programmable thermostat technology, the heating and cooling system demand coincides with occupancy level, reducing energy usage.

- **Install Vending Misers on Vending Machines**

Vending misers for refrigerated and non-refrigerated vending machines is an often overlooked source of potential savings. Uncontrolled, vending machine lights remain on 24/7, consuming a constant amount of energy year round. By controlling these lights with an occupancy sensor, energy consumption attributed to vending machines can be reduced considerably, in many cases, by as much as 50% and can save up to $150 per machine per year.

In the case of refrigerated vending machines, electric demand can be further reduced by controlling the machines' refrigeration systems. In a manner similar to programmable thermostats, vending misers for refrigerated machines act on a pre-set occupancy schedule to allow a marginal increase in operating temperature during non-business hours. Although products in the machine are delivered to the customer at the same temperature as in an uncontrolled vending machine, products are not being cooled unnecessarily when the machine is not in use, significantly reducing the machine's energy consumption. Because of the relatively low vending miser installation cost and high operating hours of vending machines, this improvement is typically cost-effective with a very short payback period.

- **Install ENERGY STAR® Rated Equipment / Plug Load Control**

Plug loads (computers, televisions, coffee makers, etc.) account for, on average, about 10% of total energy consumption. One of the easiest and most cost-effective energy saving strategies is the reduction of electric usage through installation of efficient appliances and the control of plug loads. In addition to utilizing ENERGY STAR® qualified appliances, greater savings can be realized through the various devices available that control every day plug loads.

By connecting non-critical loads (coffee makers, fans, microwave ovens, etc.) to an occupancy or timer controlled power strip, significant energy savings can be achieved. These savings result not only from the neglect of the user to turn the device off manually, but also from reduction of "phantom load". Phantom load is the small but constant energy draw from many plug-in devices when not in use. By connecting certain appliances to an occupancy controlled power strip, phantom load can be eliminated by cutting power supply to those devices. When replacing or ordering new equipment, emphasize ENERGY STAR® devices when they are available. Also, purchase controlled power strips and connect appropriate devices to those strips to reduce unnecessary consumption due to phantom load and appliances left on. The EPA offers free computer power management software which has saved some districts as much as $75 per computer per year, the software can be found at http://www.energystar.gov/index.cfm?c=power_mgt.pr_power_mgt_low_carbon_join.

IV. Resources:

The State of New Hampshire along with the utility companies offer multiple programs designed to improve the energy efficiency of schools through financial incentives and technical support, including:

Northeast Energy Efficiency Partnerships:

- **Northeast Collaborative for High Performance Schools (NE-CHPS)**
  NE-CHPS is a set of building and design standards for all schools from pre-K through community colleges tailored specifically for NH state code requirements, the New England climate, and the environmental priorities of the region. NH Department of Education offers up to a 3% re-imbursement for New Construction School projects. To learn more about NE-CHPS and incentive programs please visit: http://neep.org/public-policy/hpse/hpse-nechps.

New Hampshire Public Utilities Commission:

- **New Hampshire Pay for Performance**
  This program addresses the energy efficiency improvement needs of the commercial and industrial sector. The Program is implemented through a network of qualified Program Partners. Incentives will be paid out on the following three payment schedule: Incentive #1: Is based on the area of conditioned space in square feet. Incentive #2: Per/kWh saved and Per/MMBTU saved based on projected savings and paid at construction completion. Incentive #3: Per/kWh saved and Per/MMBTU saved based on actual energy savings performance one year post construction. Total performance incentives (#2 and #3) will be capped at $200,000 or 50% of project cost on a per project basis. For more information visit http://nhp4p.com.

- **New Hampshire Public Utilities Commission's Renewable Energy Rebates**
  The Sustainable Energy Division provides an incentive program for solar electric (photovoltaic or PV) arrays and solar thermal systems for domestic hot water, space and process heat, with a capacity of 100 kW or equivalent thermal output or less. The rebate for PV systems as follows: $1.00 per Watt, capped at 25% of the costs of the system or $50,000, whichever is less. For solar hot water (SHW) systems, the base rebate is $0.07 per rated or modeled kBtu/year, capped at 25% of the cost of the facility or $50,000, whichever is less, as a one-time incentive payment. http://www.puc.state.nh.us/Sustainable%20Energy/RenewableEnergyRebates-CI.html.

New Hampshire Community Development Finance Authority:

- **New Hampshire Community Development Finance Authority Revolving Loan Fund**
  The Enterprise Energy Fund is a low-interest loan and grant program available to businesses and nonprofit organizations to help finance energy improvements and renewable energy projects in their buildings. The loans will range from $10,000 to $500,000. Larger amounts will be considered on a case by case basis. The program is available to finance improvements to the overall energy-efficiency performance of buildings owned by businesses and nonprofits, thereby lowering their overall energy costs and the associated carbon emissions. More information about the program can be found on their website www.nhcdfa.org. These activities may include:

  - Improvements to the building's envelope, including air sealing and insulation in the walls, attics and foundations;
  - Improvements to HVAC equipment and air exchange;
  - Installation of renewable energy systems;
  - Improvements to lighting, equipment, and other electrical systems; and
  - Conduction of comprehensive, fuel-blind energy audits.

Public Service of New Hampshire (PSNH):

- **Commercial (Electric) Energy Efficiency Incentive Programs**
  This program targets any commercial/industrial member building a new facility, undergoing a major renovation, or replacing failed (end-of-life) equipment. The program offers prescriptive and custom rebates for lighting and lighting controls, motors, VFDs, HVAC systems, chillers and custom projects. http://www.psnh.com/SaveEnergyMoney/For-Business/Energy-Saving-Programs-and-Incentives.aspx

- **SmartSTART**
  The SmartSTART (Savings Through Affordable Retrofit Technologies) advantage is simple - pay nothing out of pocket to have energy efficiency products and services installed in your building. The Smart Start program is limited to PSNH's municipal customers only and includes schools. The program is available on a first-come, first served basis to projects which have been pre-qualified by PSNH. The cost of the improvements is fronted by PSNH which is then repaid over time by the municipality or school using the savings generated by the products themselves! This program is for lighting and lighting controls, air sealing, insulation and other verifiable energy savings measures which have sufficient kilowatt-hour savings. For more information on this program visit:
  http://www.psnh.com/SaveEnergyMoney/For-Business/Municipal-Smart-Start-Program.aspx

- **Schools Program**
  For major renovation or equipment replacement projects, this program offers prescriptive and custom rebates for energy efficient lighting, motors, HVAC, chillers, and variable frequency drives to towns or cities that install energy efficient equipment at their schools. Financial incentives are available for qualifying energy efficient equipment. Technical assistance is also offered through the Schools Program. http://www.psnh.com/SaveEnergyMoney/Large-Power/Schools-Program.aspx

Unitil:

- **Commercial and Industrial Energy Efficiency Programs**
  Subject to program qualifications and availability of funding - Unitil offers different programs for its commercial, industrial, and institutional customers in New Hampshire: the Small Business Energy Efficiency Program, the Small Commercial and Industrial Program, the Large Commercial and Industrial Program, the Large Commercial and Industrial (C&I) Retrofit Program, and the Large C&I New Construction Program. Rebates are available for various technologies including water heaters, lighting, lighting controls/sensors, chillers, furnaces, boilers, central air conditioners, compressed air, programmable thermostats, energy management systems/building controls, motors, motor VFDs, processing and manufacturing equipment, LED exit signs, commercial cooking and refrigeration equipment. http://www.unitil.com/.

Clean Air – Cool Planet:

- **Community Energy Efficiency**
  CA-CP works with communities throughout the Northeast to find solutions to climate change and build constituencies for effective climate policies and actions. Much of their work focuses on successful models for energy efficiency and renewable energy planning. They advise and partner with citizens, educators, faith groups, small businesses, municipal governments, and other local leaders. They explore cost-effective opportunities that exist for communities to reduce their emissions as well as their vulnerability to climate impacts. One such example is CA-CP's partnership with the University of NH, NH Sustainable Energy Association and UNH Cooperative Extension to create www.myenergyplan.net, a groundbreaking suite of web and outreach tools for individual action used by households, schools and community groups around the northeast. http://www.cleanair-coolplanet.org/for_communities/index.php.

Environmental Protection Agency (EPA):

- **ENERGY STAR Challenge for Schools**
  EPA is challenging school administrators and building managers to improve energy efficiency throughout their facilities. More than 500 school districts across the country are helping to fight climate change by committing to reducing their energy use with help from ENERGY STAR. Schools that take the ENERGY STAR Challenge can use energy tracking tools, technical guidance, case studies and other ENERGY STAR tools and resources to help them improve their energy efficiency. More information can be found at:
  http://yosemite.epa.gov/opa/admpress.nsf/d985312f6895893b852574ac005f1e40/d74f768ecfa9e11f8525762500522260!OpenDocument

For additional assistance in helping you save money and improve school conditions, please call TRC at (603) 766-1913 or (877) 442-9181.

NEW HAMPSHIRE ENERGYSMART SCHOOLS PROGRAM

Energy Benchmarking Report for:

East Rochester Elementary School

East Rochester, NH

Period: ***July 1, 2010*** through ***June 30, 2011***

PREPARED BY:

TRC

155 Fleet Street, Suite #305

Portsmouth, NH 03801

(603) 766-1913

www.trcsolutions.com

Table of Contents

I. Introduction

The Sustainable Energy Division of the New Hampshire Public Utilities Commission, with support from the New Hampshire Department of Education has sponsored TRC to develop the New Hampshire ***EnergySmart Schools Program*** to support New Hampshire K-12 public and private schools in the pursuit of energy efficiency and sustainability initiatives.

Energy efficiency has become an increasingly important issue for schools due to tightening budgets and rising energy costs. Since 2003, the prices of natural gas, fuel oil and electricity have increased by 123%, 107% and 32% respectively. Schools that have participated in energy benchmarking programs have shown a decrease in overall energy use by approximately 22% through the adoption of energy efficiency measures.

Tracking and documenting the energy use and associated carbon emissions in the state's K-12 schools will allow New Hampshire to account for the impact of its energy efficiency and renewable energy programs and determine which have the greatest effect. The analysis in this report, provided by the ***EnergySmart Schools Program*** is designed to help you:

- Understand the energy consumption and cost trends at each of your school buildings.
- Learn how your buildings are performing compared to other schools locally and nationally.
- Identify opportunities for improving operations and reducing costs.
- Take advantage of resources to implement efficiency improvements and save money.

The analysis was based on the information provided on the *Building Data Request Form* submitted, which included building descriptions, energy suppliers and other information. The building's utility bills were also used to assess its electricity and heating fuel consumption for the year(s) provided.

The energy performance for your school has been compared to national data for similar school facilities through EPA's ENERGY STAR® Portfolio Manager. Also shown are the five major benchmarks used to analyze building performance, which include: electricity use; heating fuel use; weather-normalized heating fuel use; total cost; and total cost per student, all of which have been normalized for comparison by square footage and weather. As part of the program's focus on sustainability, your school's carbon footprint is also presented.

II. Benchmarking Analysis and Review Results

Building and energy usage of your school was analyzed to assess the basic nature of your energy consumption and utility costs. The Building Data Summary table shown below summarizes this information.

Table 1: Building Data Summary for East Rochester Elementary School

Building Data			
District	SAU 54 Rochester School Department	**School Name**	East Rochester Elementary School
City	East Rochester	**Zip Code**	03868
Year Built	1968	**Floor Area (sq.ft.)**	51,400
Number of Students	362	**Number of PCs**	69
Weekly Operating Hours	60	**Months School Used**	12
Cooking?	YES	**% AC**	0
Pool Size?	N/A	**Months Pool Used**	0

Utility Data			
Data End Point	6/30/2011	**Total Cost ($)**	47,694
Electric Provider	PSNH	**Natural Gas Provider**	Unitil
Electricity Usage (kWh)	211,304	**Electricity Cost ($)**	32,874
Natural Gas Usage (therms)	10,701	**Natural Gas Cost ($)**	14,819
Fuel Oil Usage (gal)	0	**Fuel Oil Cost ($)**	0
Other Fuel Usage (gal)	0	**Other Fuel Cost ($)**	0

Energy Indicators			
EPA Score	95	**Electric Usage (kWh/sq.ft.)**	4.1
Heating Fuel Usage (kBtu/sq.ft.)	20.8	**Weather Adjusted Heating Usage Btu/sq.ft./HDD)**	2.9
Site Energy (kBtu/sq.ft.)	34.8	**Source Energy (kBtu/sq.ft.)**	69

Environmental Impact Indicators			
Greenhouse Gas Emissions			
Last Year Heating Fuel CO_2e (Mt)	57.1	**Last Year Total CO_2e (Mt)**	122.7
Last Year Electricity CO_2e (Mt)	65.6	**CO_2e Efficiency Savings Over Previous Year**	35.9
EPA Target Score			
Target Score	N/A - Reached	**Site Energy Reduction Needed (kBtu/sq.ft.)**	N/A - Reached

Figures 1a, 1b, 2a and 2b display the energy use, demand and cost data tracked on a monthly basis. This demonstrates the energy consumption of your building over the course of the year. As a part of the program's focus on sustainability, your school's carbon footprint was also measured and is presented in Figure 3.

Figure 1a. Monthly Electric Use & Max Demand for East Rochester Elementary

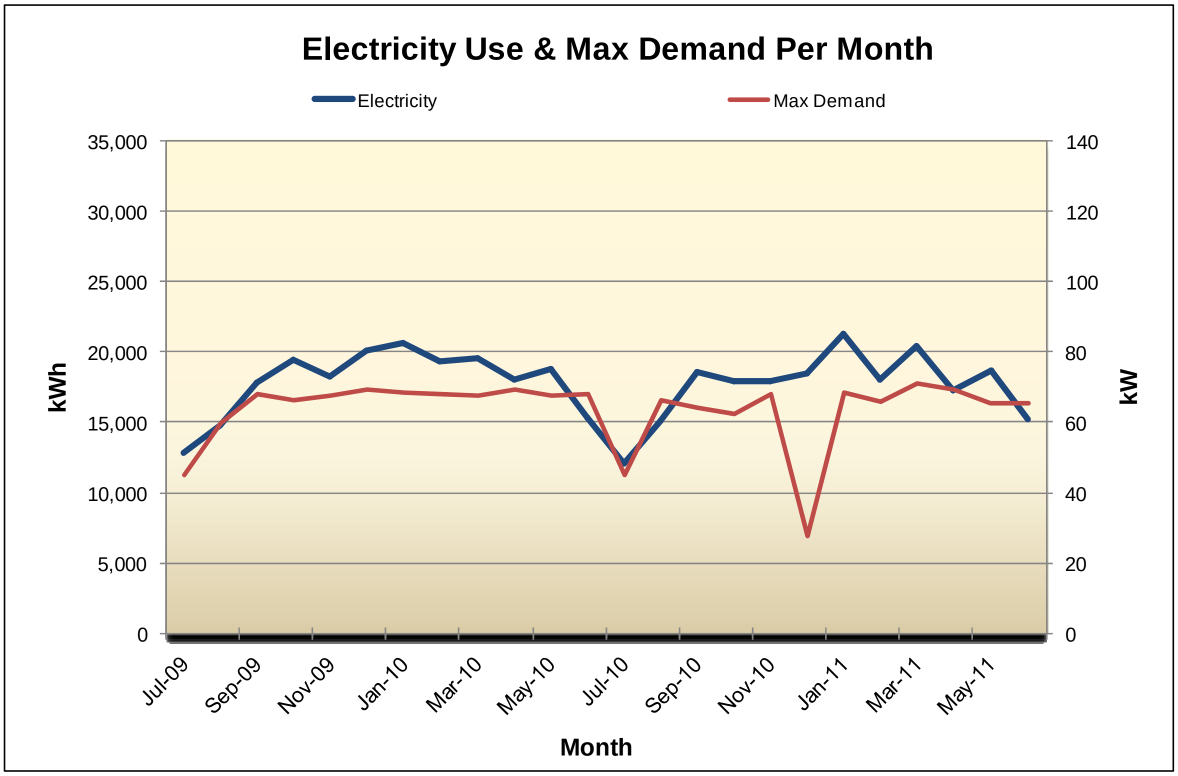
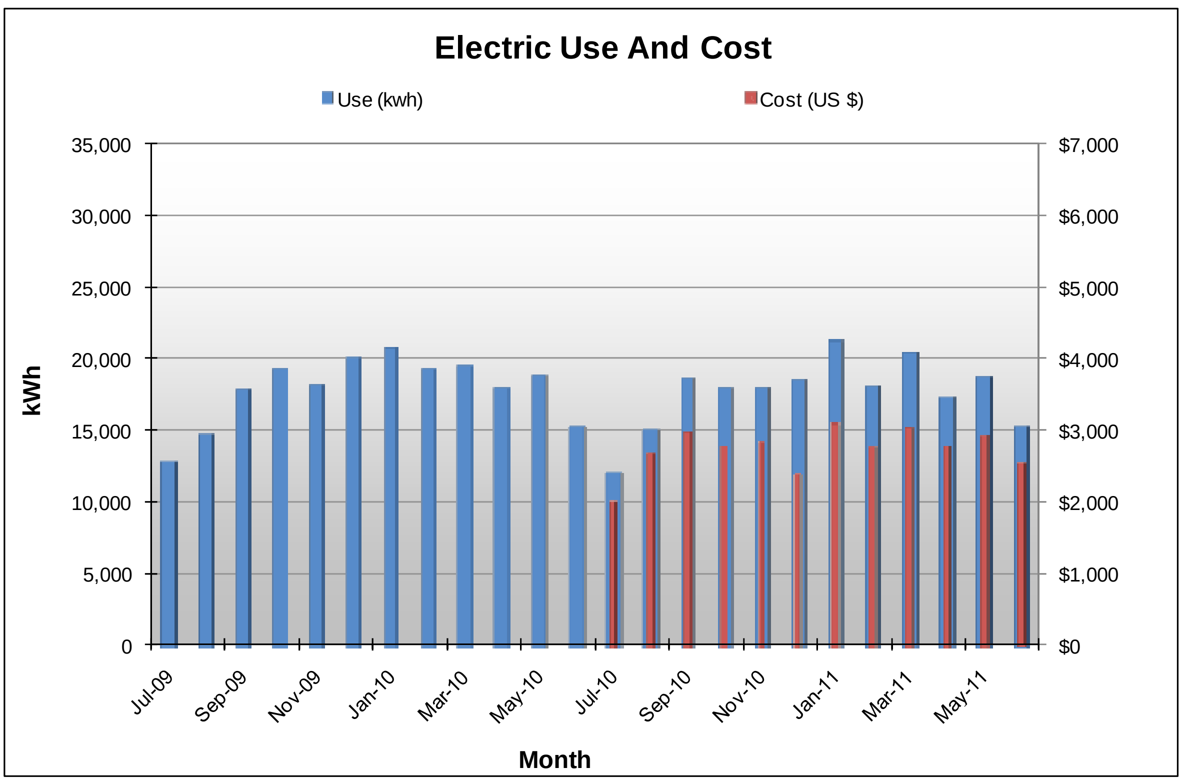


Figure 1b. Monthly Electric Use vs. Cost for East Rochester Elementary



Note: Electric Cost was only available for the most recent 12 month period.

Figure 2a. Monthly Heating Fuel Use for East Rochester Elementary

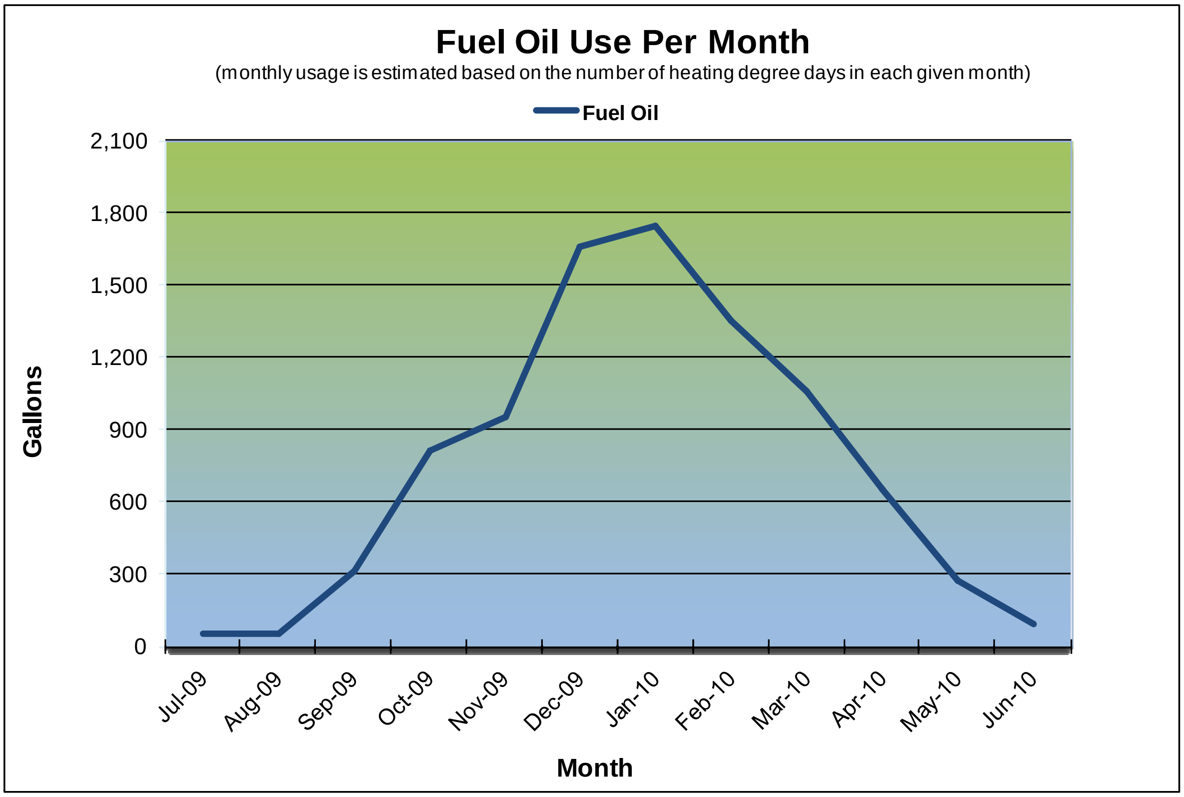


Figure 2b. Monthly Heating Fuel Use vs Cost for East Rochester Elementary

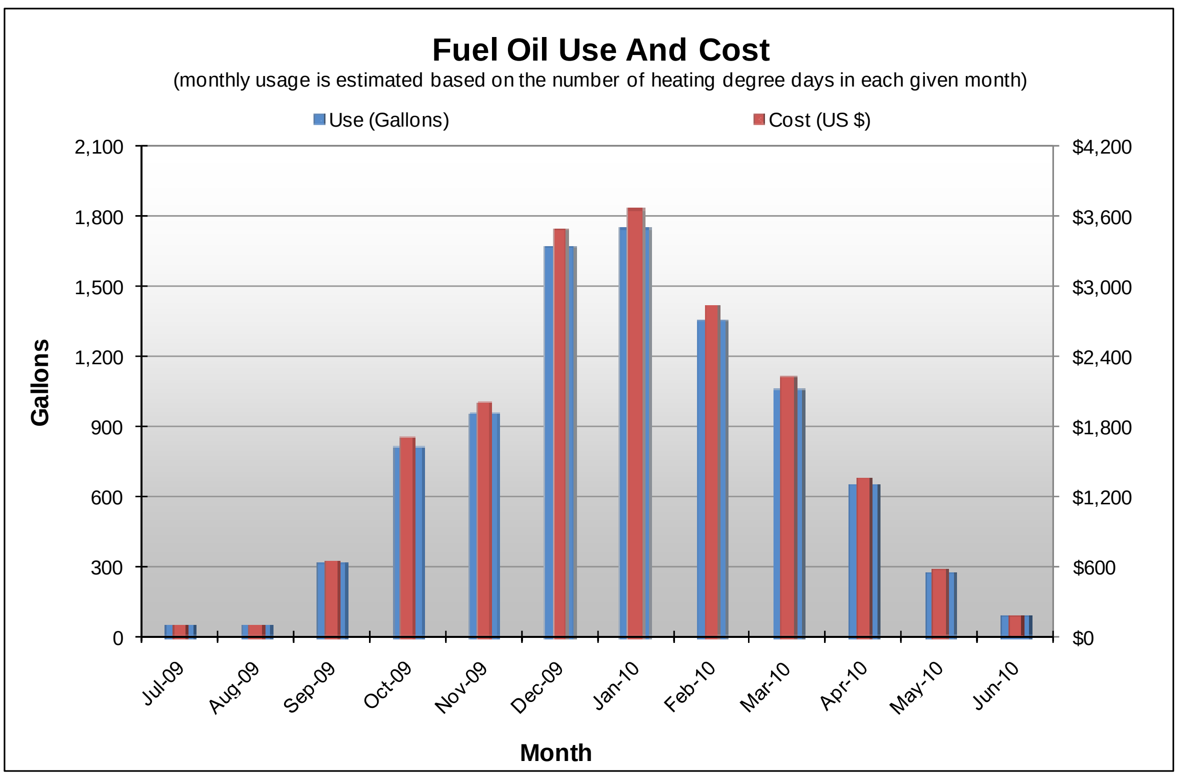


Figure 2a. Monthly Heating Fuel Use for East Rochester Elementary

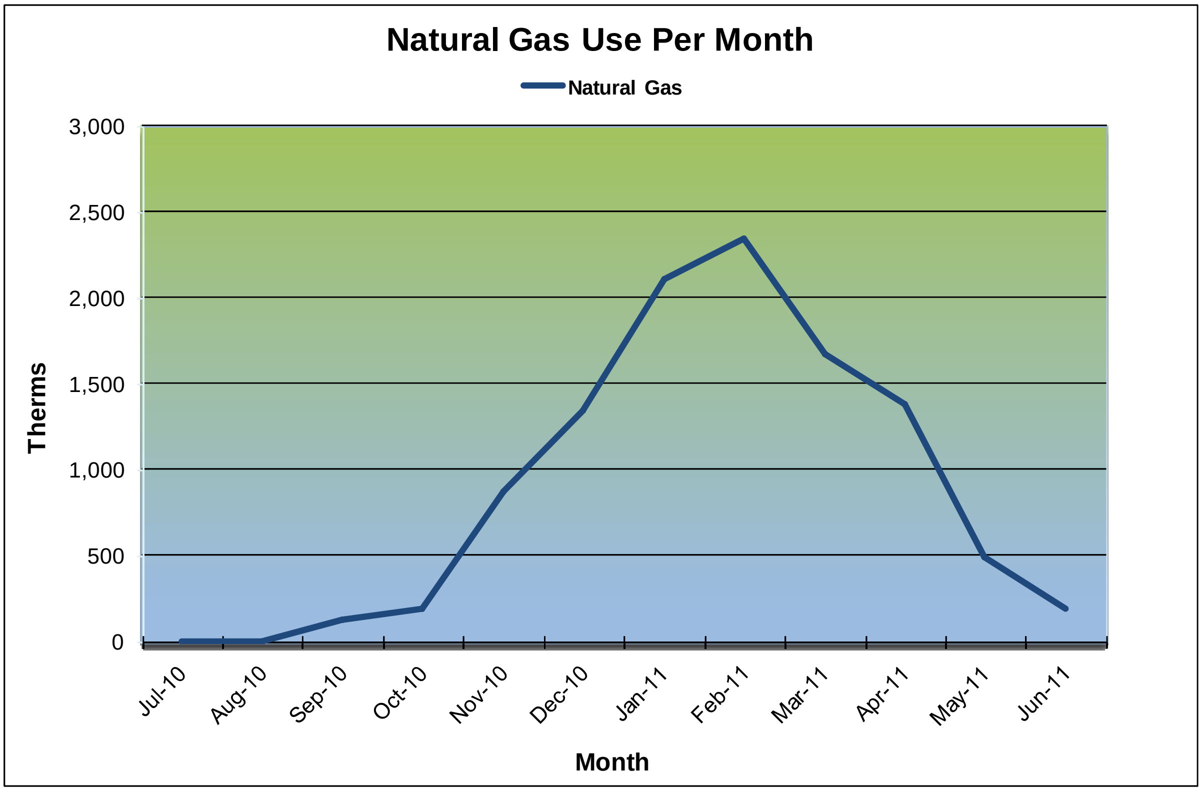


Figure 2b. Monthly Heating Fuel Use vs Cost for East Rochester Elementary

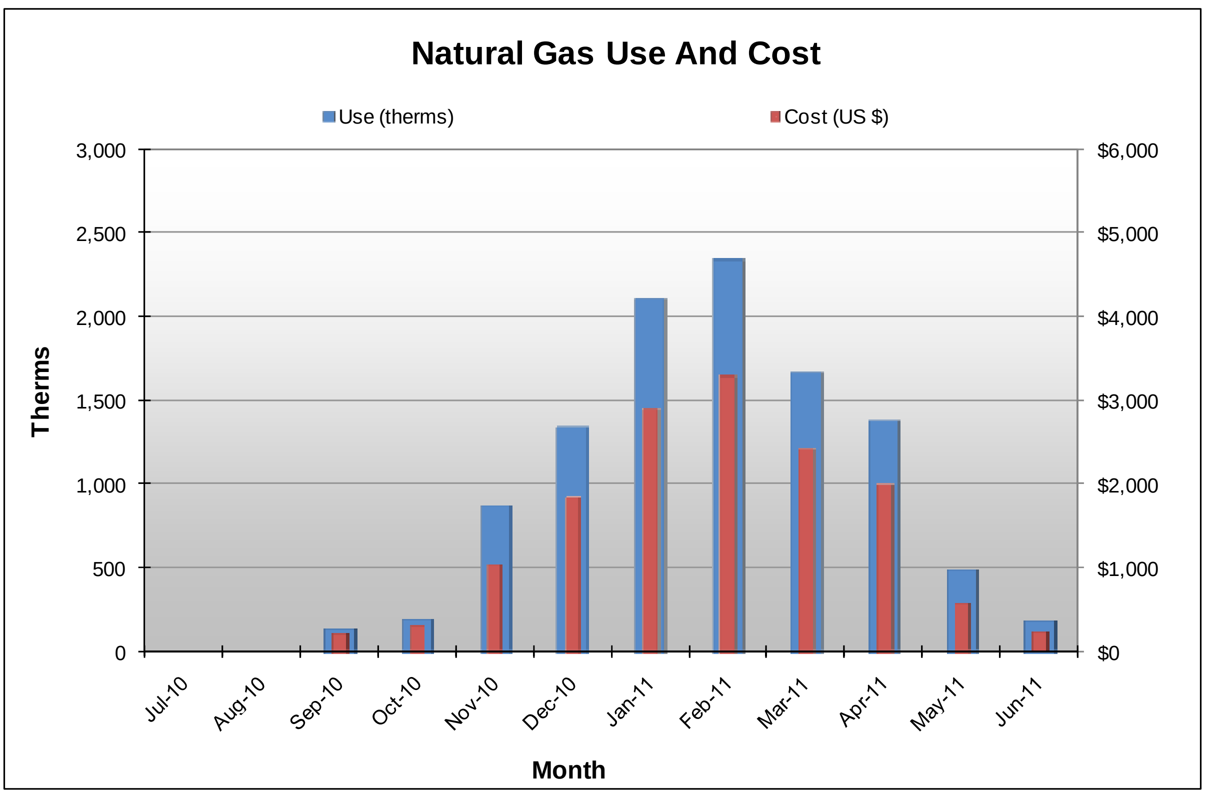
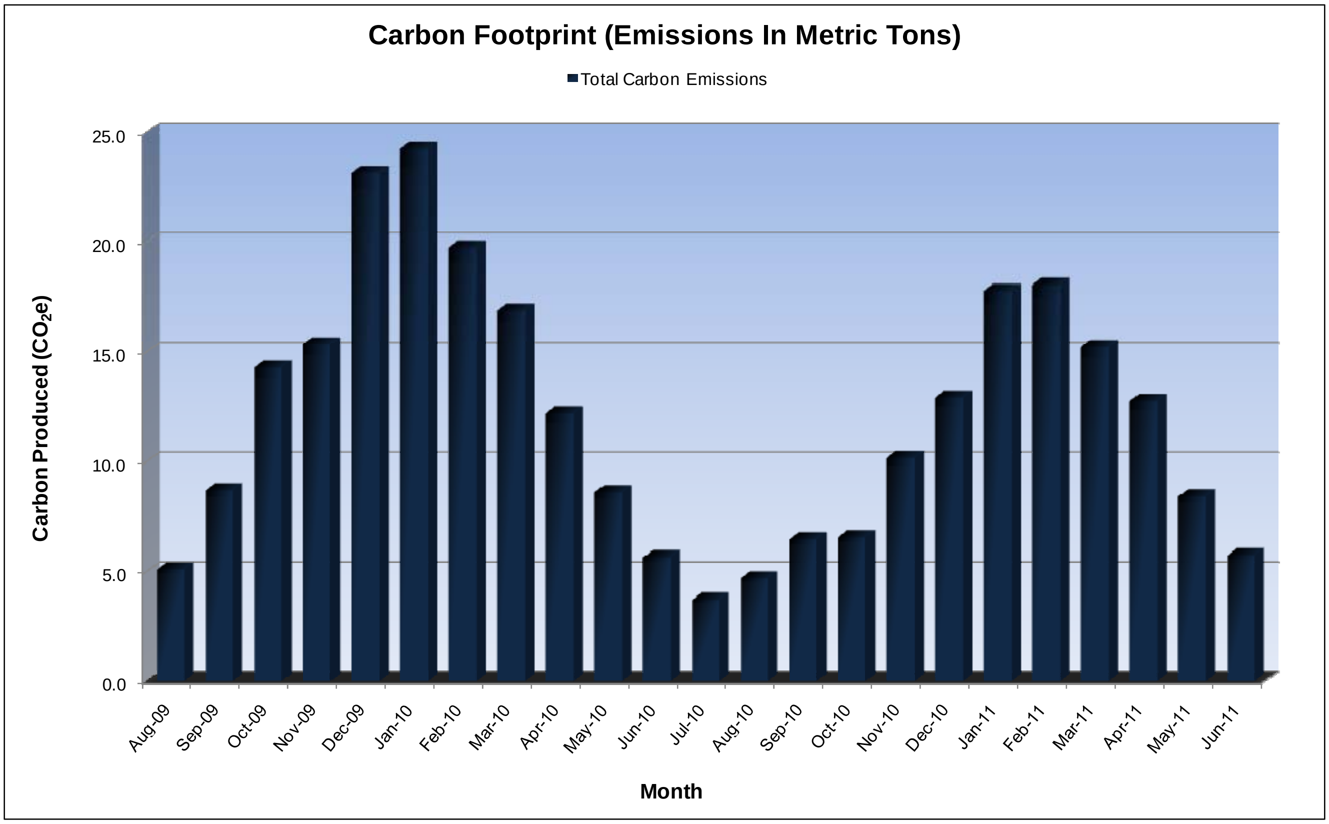


Figure 3. Monthly Greenhouse Gas Emissions for East Rochester Elementary



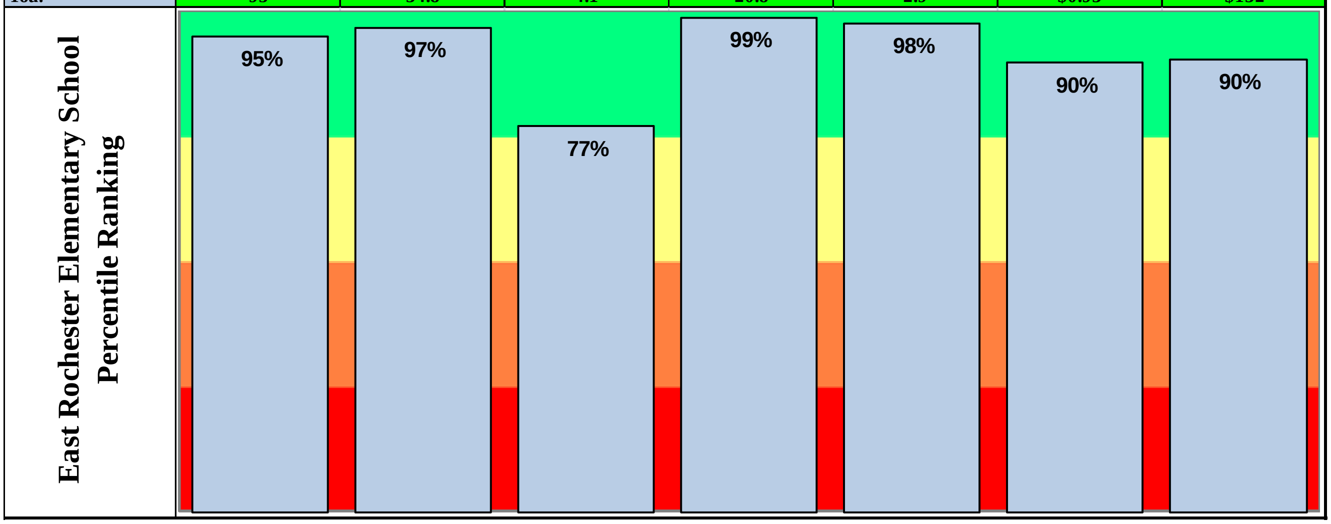
Benchmarking Data

To evaluate the energy and environmental performance of your school, the building data collected above has been compared against two different sets of school energy data: the U.S. Environmental Protection Agency's national data and New Hampshire specific state data. The results are illustrated in Figure 4 on the following page.

This will allow you to assess your building's performance relative to other buildings designed and constructed to the same codes and standards, operating under the same regulations and schedules and similar weather conditions. The indicators are calculated on a *per square foot* or *per student* basis, so you can compare your school to different sized schools.

Figure 4. EnergySmart Schools Benchmarks for East Rochester Elementary

Schools	U.S. EPA Portfolio Manager Score	New Hampshire State Schools (Annual Data)					
		Total Energy Use (kBtu/sq.ft.)	Electric Use (kWh/sq.ft.)	Heating Fuel Use (kBtu/sq.ft.)	Weather Adjusted Heating Fuel Use (Btu/sq.ft./HDD)	Total Energy Cost ($/sq.ft.)	Total Energy Cost ($/student)
NH Average:	50	60.3	5.2	41.7	5.7	$1.42	$256
You:	95	34.8	4.1	20.8	2.9	$0.93	$132



Major Benchmark Indicators

1. Total Energy Use, kBtu/sq.ft.

This indicator shows how much total energy your school consumes each year. It includes the energy used for heating, cooling (if any), lights, cooking, computers, etc.

Your school's total energy use of 34.8 kBtu per square foot per year (kBtu/sq.ft.) is significantly better than the New Hampshire K-12 schools state average of 60.3 kBtu/sq.ft. Your total energy use figure is lower than 97% of New Hampshire K-12 schools. The EnergySmart School Report is weather normalized so fuel consumption for heating takes the difference in climate between northern and southern New Hampshire into account.

This is a good indicator of how well, overall, your school is performing. However, it doesn't help you find ***where*** in your building to look for improvement opportunities. Multiple factors included on the following pages can help with that. Analysis of energy consumption for this program does not control for operational variations. An example is an improperly ventilated school may appear to have lower energy consumption. Ventilation systems that are not operating properly result in lower indoor air quality.

2. Electricity Data

Most electric utilities use the following two factors to estimate your electricity bill – Electric Use and Electric Demand.

a. Electric Use, kWh/sq.ft.

This shows how well the building does with its lights, cooling/air conditioners and cafeteria systems (if any), and what's referred to as "plug load." Plug load is anything that plugs into a socket. The major plug loads are generally computers (including monitors, printers and copiers), refrigerators, coffee machines, fans, shop equipment and projectors. If electric consumption is much higher than average, but heating fuel use (see below) is average or better, then focus your efforts on the electric-powered elements.

New Hampshire schools state average electric use is 5.2 kWh per square foot. Your school's electric consumption of 4.1 kWh per square foot this year is lower than 77% of New Hampshire schools benchmarked through the New Hampshire EnergySmart Schools Program.

b. Electric Demand, Watts/sq.ft.

Demand is a measure of the maximum electric draw in kW that your building places on the grid and is measured by adding up the kW draw for a 15 minute period. To give an analogy, if electricity usage is the amount of water going through a hose in gallons, electric demand would be how fast that water flows expressed in gallons per minute. Whichever 15 minute period during your monthly billing cycle places the highest kW demand on the grid is the demand factor applied to your bill. The best way to improve this demand factor is to stagger the times when your electrical systems draw at their maximum or reduce unnecessary electric load altogether.

The average electric demand for New Hampshire schools is 1.9 watts per square foot. Your school's electric demand is 1.4 watts per square foot and is lower than 87% of New Hampshire Schools benchmarked through the New Hampshire EnergySmart Schools Program.

3. Heating Fuel Use, kBtu/sq.ft.

Reviewing these indicators is relatively straightforward. If your school's heating fuel use is much higher than average, an audit of your heating system along with your building envelope - doors, windows, roof - is recommended. This factor is 'fuel-neutral' as it works for either fuel oil or natural gas heating systems.

New Hampshire K-12 schools state average heating fuel use is 41.7 kBtu/sq.ft. or 5.7 Btu/sq.ft./HDD. Your school's heating fuel use of 20.8 kBtu/sq.ft. per year is lower than 99% of other New Hampshire schools in the database. Your school's weather adjusted heating fuel use of 2.9 Btu/sq.ft./HDD is lower than 98% of other New Hampshire schools benchmarked through the New Hampshire EnergySmart Schools Program.

4. Energy Cost, $/sq.ft. & $/student

Cost is the bottom line. These numbers help you understand, in terms of budget, the gain through energy efficiency improvements. New Hampshire K-12 schools state averages $1.42/sq.ft. and $256/student.

Your school's annual energy cost of $0.93 per square foot is lower than 90% of other New Hampshire benchmarked schools. Your school's cost expressed on a per student basis of $132 is also lower than 90% of other New Hampshire schools benchmarked through the New Hampshire EnergySmart Schools Program.

5. U.S. EPA *Portfolio Manager* Score

Portfolio Manager is a benchmarking model based on a national set of data from K-12 schools. It is provided by the U.S. Environmental Protection Agency's ENERGY STAR® Program. The impact of factors outside of your control (such as location, occupancy and operating hours) are removed, providing a 1-100 ranking of a school's energy performance relative to the national school building market. A score of 50 represents the national average and a score of 100 is best. Schools that achieve a score of 75 or higher are eligible for EPA's ENERGY STAR® Building Label, the national symbol for protecting the environment through energy efficiency. Districts can achieve ENERGY STAR® Leader Awards in recognition if their buildings, on average, improve by 10%, 20%, 30%, etc. over their baseline year of reported energy use or if the district's overall weighted average *Portfolio Manager* Score is at least a 75.

Your school's *Portfolio Manager* Score of 95 places it higher than 95% of K-12 schools nationwide. As noted above, this rating potentially qualifies your school for the prestigious ENERGY STAR® Label for Buildings.

III. Potential Energy Saving Opportunities

Based on the preceding analysis of your school's energy performance, implementation of the following recommendations can help you save energy and money. The first step is to look at reducing electrical lighting and HVAC consumption (burners, circulators and fans) which typically account for 67% of a building's electric consumption.

- **Perform an Energy Audit on the Building**

An energy audit involves a comprehensive analysis of the building's general characteristics, its energy use and allocation of that use amongst the facility's energy end uses. The goal is to identify sources of potential energy savings. Your auditor should develop a list of recommendations that will result in substantial energy and operational cost savings. These may include, building envelope improvement and mechanical systems, lighting upgrades, equipment replacement and installation of lighting and HVAC control mechanisms, among others.

A good audit should include information specific to each recommendation which *at least* includes approximate annual energy unit and cost savings, demand reduction, installation cost, lifetime cost savings and information related to cost-effectiveness. This will help to prioritize the recommendations based on their energy efficiency and shortest payback.

The recommendations provided in an energy audit report may reduce facility energy bills by 20% or more in addition to improving occupant health and comfort. Following this report, an energy audit is the next step in realizing the full potential of energy savings opportunities.

- **Request Retro-Commissioning**

Retro-commissioning is a detailed process applied to existing facilities aimed at correcting many of the degradations and inefficiencies that are indicative of older and/or poorly performing buildings. Many older buildings tend to be less comfortable and operate less efficiently when not properly commissioned. Retro-commissioning includes a detailed energy audit and focuses on not only potential energy savings but also the interaction of the building's equipments and mechanical systems with an eye toward restoring it to optimal performance.

In contrast to an energy audit, this optimization focuses on operational improvements to existing equipment, rather than replacement. Apart from energy savings, other improvements and benefits include substantial operation and maintenance (O&M) cost savings, improved air quality, occupant comfort, health and safety, equipment controls, and improved system interactivity.

In addition to providing recommendations, retro-commissioning includes implementation of the recommended improvements and hence the cost for retro-commissioning is higher than an audit. However, when the costs of improvements are added to the energy audit cost, prices may be comparable. If high O&M costs or occupant health, comfort and safety are concerns in addition to reduction in energy use, retro-commissioning may be a suitable strategy.

- **Upgrade Lighting Systems**

Lighting typically accounts for 30-60% of all energy consumed in school buildings. Additionally, the electrical energy consumed by lights during the summer creates heat and increases cooling costs.

East Rochester Elementary School's electricity consumption is low (better) compared to other schools in the State. Even so, upgraded lighting systems in high consumption areas like classrooms, gymnasiums, libraries, offices, etc. can reduce these costs even further, improve the lighting quality and increase occupant comfort and productivity.

Over-lit Spaces: Light levels should be recorded in classrooms and hallways to ensure they are not over-lit, 40-50 foot candles are adequate light levels for an instructional space. If classroom light levels are much higher than 50 foot candles, East Rochester Elementary School should consider de-lamping classrooms or installing dimming ballasts, which dim the lights when outdoor light levels are adequate. In over-lit hallway spaces photo sensors can be installed to turn lights off completely when light levels exceed a pre-set threshold.

In over-lit spaces a T8 to Super T8 lighting retro-fit can reduce the number of light fixtures needed. Super T8 lamps use between 4 and 7 Watts less electricity than standard T8 lamps, but they produce more light per Watt. In some cases this increase in light per Watt can allow for the removal of an entire lamp, saving 32 Watts. The room characteristics must be factored in before this type of retro-fit. The shape of the space, ceiling height, color of the walls, etc. all need to be taken into account when exploring a de-lamping project. We recommend that before retro-fitting the entire facility, begin by changing one classroom and monitor the comfort level of the occupants at East Rochester Elementary School.

Another proven energy reduction measure with a short payback period is to identify any areas where your school may still be using metal halide lighting. Typically metal halide lights are found in gymnasiums or cafeteria areas, many districts have been very satisfied by replacing these lights with high bay T5 lighting fixtures. In addition to the reduced operational wattage, high bay T5 lights turn on instantly, as opposed to metal halide fixtures which have an extended warm up period. The long warm up period associated with metal halides typically leads to the lights being left on all day, at 250 to 400 watts a fixture; the costs begin to add up. Adding occupancy sensors to high bay T5 fixtures further reduces the payback period.

Occupancy Sensors: We recommend that you explore the use of occupancy sensors to ensure that lights are turned off in unoccupied spaces. Lights controlled by occupancy sensors typically run a third of the time when compared with manually controlled lighting. Reduced runtime leads to decreases in both energy usage and operation and maintenance costs. Additionally, a study conducted in Massachusetts found that controlling the security lighting with occupancy sensors reduced vandalism; neighbors and police recognized something wrong when the lights were on in a building that was typically dark and investigated.

To summarize and add a few ways in which East Rochester Elementary School may be able to conserve energy and cost through lighting upgrades is to:

- Design light quantity and quality for the task and occupants' needs in that area.
- Maximize lamp and ballast efficiency.
- Activate the power saving features on office equipment such as copiers, printers and fax machines and ensure that they are turned off at the end of the day.
- Use automatic controls to turn lights off or dim lights in unoccupied spaces.
- Establish a maintenance schedule for group re-lamping and fixture cleaning.
- Replace T12 fixtures with the most efficient fixtures which may include T8/super T8/T5 fixtures.
- Replace incandescent lighting with compact fluorescent technology.

- Replace incandescent exit lighting which consumes 30 Watts with LED type exit lights with 1.5 Watts consumption. LED units last up to 10 years, which is a maintenance advantage.

- Install daylight sensors in areas with significant natural light.

- Install occupancy sensors in areas that are often unoccupied.

- Lighting retrofits reduce maintenance costs associated with lighting that is close to end of life.

- Establish a regular cleaning schedule particularly for areas where student safety of low light levels may be a concern, such as shop classes.

- Look to make lamp and fixture selection as uniform as possible to reduce maintenance and inventory overhead.

- Educate students and staff to turn off lights when rooms are unoccupied.

Lighting upgrades seek to reduce the connected electrical load (kW) and energy consumption (kWh) of lighting equipment. Lighting controls can also significantly reduce operating hours and costs by turning off lighting when spaces are unoccupied or sufficiently lit by natural light.

- **Install NEMA Premium Motors and VFDs**

Commercial and industrial electric motor-driven systems consume approximately 23% of all electricity in the U.S., making it the single largest category contributor to electric use in the country. With very high operating hours, the annual energy cost to run a system is more than its installation cost. Even a small increase in the efficiency of an electric motor can result in substantial energy cost savings. Typical opportunities for motor upgrades in schools include: ventilation fans, and heating and cooling system pumps and fans.

Motors with efficiency up to 90% are available to replace the older ones with efficiency less than 75%. Although standards for efficiency of new equipment are set by the Energy Policy Act, motor efficiency can be further increased by selecting Premium Efficiency motors as specified by the National Electrical Manufacturers Association (NEMA). This can cut the electric motor system demand by as much as 18%.

Savings can be increased further by optimizing system performance through the use of variable frequency drives (VFDs). When system load is known to vary substantially, these flow control systems can be utilized to match system output to system demand, significantly reducing energy usage during partial load hours. By employing high-efficiency motors and VFDs, facility owners can improve environmental conditions, utilize better control of motor-driven processes, and reduce waste output.

- **Install Demand Control Ventilation**

Demand control ventilation (DCV) monitors indoor air CO_2 content as a result of occupancy production levels and uses this data to regulate the amount of outdoor air that is permitted for ventilation. In order to ensure adequate air quality, standard ventilation systems permit outside air based on estimated occupancy levels in CFM, cubic feet per minute/occupant. However, during low occupancy hours, the space may become over ventilated due to decreased CO_2 levels and unnecessary ventilation results in wasted energy. DCV reduces unnecessary outdoor air intake by regulating ventilation based on actual CO_2 levels, saving energy. DCV is most suited for areas where occupancy levels are known to fluctuate considerably such as auditoriums, cafeterias, and gymnasiums.

Install Energy Recovery Ventilators. According to energy recovery equipment manufacturer's typical paybacks are less than 5 years for schools without cooling. The keys to success with ventilation retrofits are going with fewer larger units with long run hours as opposed to several small units with limited run time. Equipment with moisture recovery capabilities would cut humidity up to 50% during the cooling season.

- **Improve/Replace Inefficient Heating Systems**

Replacing an old boiler that is < 70% efficient with a modern 85-90% efficient natural gas-fired furnace alone will reduce heating costs by 15-20%. This combined with additional system improvements and installation of advanced HVAC control mechanisms can result in up to 20%+ heating load reduction.

Because of the high capital cost of new heating systems, some financial analysis should be performed to assess the cost-effectiveness of immediate replacement. If the current system is fairly new, replacement may not be immediately justifiable from a financial standpoint. However, as is the case with cooling systems, early replacement may prove to be a more cost-effective solution than waiting until existing systems fail or reach the end of their estimated useful life.

- **Improve/Replace Inefficient Air Conditioning Systems**

The useful life of a rooftop A/C unit is generally 12-18 years. However, depending on the efficiency, early replacement of outdated, inefficient, split, or packaged rooftop air conditioning units with new A/C systems that are 15% more efficient than 10-15 year old equipments can considerably reduce annual energy consumption. The energy cost savings and maintenance savings offset the high installation cost of a more efficient system. Installing thermostats and/or economizers on new or existing A/C systems will further reduce the cooling demand.

Economizers provide "free" cooling by using controllable dampers that bring in outside air to cool the space when the outdoor temperature or enthalpy is below the building's return air conditions. Although they require operation by a well calibrated and maintained control system, economizers have impressive energy-saving capabilities.

Install Occupancy Controlled/Programmable Thermostats

Combining efficient HVAC equipment with occupancy controlled and programmable thermostats can save a facility up to 10% of its annual heating and cooling costs:

- Areas with unpredictable occupancy on a daily/weekly basis - gym, bathrooms, outdoors: Use an *occupancy controlled thermostat* - a thermostat paired with a sensor and/or door detector to identify movement/occupancy. If occupancy is sensed by the sensor, the thermostat goes into an occupied mode (i.e. programmed set point). If a pre-programmed time frame elapses (i.e. 30 minutes) and no occupancy is sensed during that time, the thermostat goes into an unoccupied mode (e.g., setback set point or off) until occupancy is sensed again. This reduces the overall time the heating or cooling system is running, saving energy.

- Areas with predictable occupancy: e.g.: classrooms, cafeteria, offices: A *programmable thermostat* is recommended. This device is programmed on a schedule to reduce the heating or cooling output of the facility's HVAC systems in relation to its predetermined occupancy schedule. In this way, the thermostat acts to set-back or set-up the facility temperature during unoccupied hours, and re-establish a comfortable facility temperature during business hours. By employing programmable thermostat technology, the heating and cooling system demand coincides with occupancy level, reducing energy usage.

- **Install Vending Misers on Vending Machines**

Vending misers for refrigerated and non-refrigerated vending machines is an often overlooked source of potential savings. Uncontrolled, vending machine lights remain on 24/7, consuming a constant amount of energy year round. By controlling these lights with an occupancy sensor, energy consumption attributed to vending machines can be reduced considerably, in many cases, by as much as 50% and can save up to $150 per machine per year.

In the case of refrigerated vending machines, electric demand can be further reduced by controlling the machines' refrigeration systems. In a manner similar to programmable thermostats, vending misers for refrigerated machines act on a pre-set occupancy schedule to allow a marginal increase in operating temperature during non-business hours. Although products in the machine are delivered to the customer at the same temperature as in an uncontrolled vending machine, products are not being cooled unnecessarily when the machine is not in use, significantly reducing the machine's energy consumption. Because of the relatively low vending miser installation cost and high operating hours of vending machines, this improvement is typically cost-effective with a very short payback period.

- **Install ENERGY STAR® Rated Equipment / Plug Load Control**

Plug loads (computers, televisions, coffee makers, etc.) account for, on average, about 10% of total energy consumption. One of the easiest and most cost-effective energy saving strategies is the reduction of electric usage through installation of efficient appliances and the control of plug loads. In addition to utilizing ENERGY STAR® qualified appliances, greater savings can be realized through the various devices available that control every day plug loads.

By connecting non-critical loads (coffee makers, fans, microwave ovens, etc.) to an occupancy or timer controlled power strip, significant energy savings can be achieved. These savings result not only from the neglect of the user to turn the device off manually, but also from reduction of "phantom load". Phantom load is the small but constant energy draw from many plug-in devices when not in use. By connecting certain appliances to an occupancy controlled power strip, phantom load can be eliminated by cutting power supply to those devices. When replacing or ordering new equipment, emphasize ENERGY STAR® devices when they are available. Also, purchase controlled power strips and connect appropriate devices to those strips to reduce unnecessary consumption due to phantom load and appliances left on. The EPA offers free computer power management software which has saved some districts as much as $75 per computer per year, the software can be found at http://www.energystar.gov/index.cfm?c=power_mgt.pr_power_mgt_low_carbon_join.

IV. Resources:

The State of New Hampshire along with the utility companies offer multiple programs designed to improve the energy efficiency of schools through financial incentives and technical support, including:

Northeast Energy Efficiency Partnerships:

- **Northeast Collaborative for High Performance Schools (NE-CHPS)**
  NE-CHPS is a set of building and design standards for all schools from pre-K through community colleges tailored specifically for NH state code requirements, the New England climate, and the environmental priorities of the region. NH Department of Education offers up to a 3% re-imbursement for New Construction School projects. To learn more about NE-CHPS and incentive programs please visit: http://neep.org/public-policy/hpse/hpse-nechps.

New Hampshire Public Utilities Commission:

- **New Hampshire Pay for Performance**
  This program addresses the energy efficiency improvement needs of the commercial and industrial sector. The Program is implemented through a network of qualified Program Partners. Incentives will be paid out on the following three payment schedule: Incentive #1: Is based on the area of conditioned space in square feet. Incentive #2: Per/kWh saved and Per/MMBTU saved based on projected savings and paid at construction completion. Incentive #3: Per/kWh saved and Per/MMBTU saved based on actual energy savings performance one year post construction. Total performance incentives (#2 and #3) will be capped at $200,000 or 50% of project cost on a per project basis. For more information visit http://nhp4p.com.

- **New Hampshire Public Utilities Commission's Renewable Energy Rebates**
  The Sustainable Energy Division provides an incentive program for solar electric (photovoltaic or PV) arrays and solar thermal systems for domestic hot water, space and process heat, with a capacity of 100 kW or equivalent thermal output or less. The rebate for PV systems as follows: $1.00 per Watt, capped at 25% of the costs of the system or $50,000, whichever is less. For solar hot water (SHW) systems, the base rebate is $0.07 per rated or modeled kBtu/year, capped at 25% of the cost of the facility or $50,000, whichever is less, as a one-time incentive payment. http://www.puc.state.nh.us/Sustainable%20Energy/RenewableEnergyRebates-CI.html.

New Hampshire Community Development Finance Authority:

- **New Hampshire Community Development Finance Authority Revolving Loan Fund**
  The Enterprise Energy Fund is a low-interest loan and grant program available to businesses and nonprofit organizations to help finance energy improvements and renewable energy projects in their buildings. The loans will range from $10,000 to $500,000. Larger amounts will be considered on a case by case basis. The program is available to finance improvements to the overall energy-efficiency performance of buildings owned by businesses and nonprofits, thereby lowering their overall energy costs and the associated carbon emissions. More information about the program can be found on their website www.nhcdfa.org. These activities may include:

  - Improvements to the building's envelope, including air sealing and insulation in the walls, attics and foundations;
  - Improvements to HVAC equipment and air exchange;
  - Installation of renewable energy systems;
  - Improvements to lighting, equipment, and other electrical systems; and
  - Conduction of comprehensive, fuel-blind energy audits.

Public Service of New Hampshire (PSNH):

- **Commercial (Electric) Energy Efficiency Incentive Programs**
  This program targets any commercial/industrial member building a new facility, undergoing a major renovation, or replacing failed (end-of-life) equipment. The program offers prescriptive and custom rebates for lighting and lighting controls, motors, VFDs, HVAC systems, chillers and custom projects. http://www.psnh.com/SaveEnergyMoney/For-Business/Energy-Saving-Programs-and-Incentives.aspx

- **SmartSTART**
  The SmartSTART (Savings Through Affordable Retrofit Technologies) advantage is simple - pay nothing out of pocket to have energy efficiency products and services installed in your building. The Smart Start program is limited to PSNH's municipal customers only and includes schools. The program is available on a first-come, first served basis to projects which have been pre-qualified by PSNH. The cost of the improvements is fronted by PSNH which is then repaid over time by the municipality or school using the savings generated by the products themselves! This program is for lighting and lighting controls, air sealing, insulation and other verifiable energy savings measures which have sufficient kilowatt-hour savings. For more information on this program visit:
  http://www.psnh.com/SaveEnergyMoney/For-Business/Municipal-Smart-Start-Program.aspx

- **Schools Program**
  For major renovation or equipment replacement projects, this program offers prescriptive and custom rebates for energy efficient lighting, motors, HVAC, chillers, and variable frequency drives to towns or cities that install energy efficient equipment at their schools. Financial incentives are available for qualifying energy efficient equipment. Technical assistance is also offered through the Schools Program. http://www.psnh.com/SaveEnergyMoney/Large-Power/Schools-Program.aspx

Unitil:

- **Commercial and Industrial Energy Efficiency Programs**
  Subject to program qualifications and availability of funding - Unitil offers different programs for its commercial, industrial, and institutional customers in New Hampshire: the Small Business Energy Efficiency Program, the Small Commercial and Industrial Program, the Large Commercial and Industrial Program, the Large Commercial and Industrial (C&I) Retrofit Program, and the Large C&I New Construction Program. Rebates are available for various technologies including water heaters, lighting, lighting controls/sensors, chillers, furnaces, boilers, central air conditioners, compressed air, programmable thermostats, energy management systems/building controls, motors, VFDs, processing and manufacturing equipment, LED exit signs, commercial cooking and refrigeration equipment. http://www.unitil.com/.

Clean Air – Cool Planet:

- **Community Energy Efficiency**
  CA-CP works with communities throughout the Northeast to find solutions to climate change and build constituencies for effective climate policies and actions. Much of their work focuses on successful models for energy efficiency and renewable energy planning. They advise and partner with citizens, educators, faith groups, small businesses, municipal governments, and other local leaders. They explore cost-effective opportunities that exist for communities to reduce their emissions as well as their vulnerability to climate impacts. One such example is CA-CP's partnership with the University of NH, NH Sustainable Energy Association and UNH Cooperative Extension to create myenergyplan.net, a groundbreaking suite of web and outreach tools for individual action used by households, schools and community groups around the northeast. http://www.cleanair-coolplanet.org/for_communities/index.php.

Environmental Protection Agency (EPA):

- **ENERGY STAR Challenge for Schools**
  EPA is challenging school administrators and building managers to improve energy efficiency throughout their facilities. More than 500 school districts across the country are helping to fight climate change by committing to reducing their energy use with help from ENERGY STAR. Schools that take the ENERGY STAR Challenge can use energy tracking tools, technical guidance, case studies and other ENERGY STAR tools and resources to help them improve their energy efficiency. More information can be found at:
  http://yosemite.epa.gov/opa/admpress.nsf/d985312f6895893b852574ac005f1e40/d74f768ecfa9e11f8525762500522260!OpenDocument

For additional assistance in helping you save money and improve school conditions, please call TRC at (603) 766-1913 or (877) 442-9181.

NEW HAMPSHIRE ENERGYSMART SCHOOLS PROGRAM

Energy Benchmarking Report for:

Chamberlain Street Elementary

Rochester, NH

Period: ***July 1, 2010*** through ***June 30, 2011***

PREPARED BY:

TRC

155 Fleet Street, Suite #305

Portsmouth, NH 03801

(603) 766-1913

www.trcsolutions.com

Table of Contents

I. Introduction

The Sustainable Energy Division of the New Hampshire Public Utilities Commission, with support from the New Hampshire Department of Education has sponsored TRC to develop the New Hampshire ***EnergySmart Schools Program*** to support New Hampshire K-12 public and private schools in the pursuit of energy efficiency and sustainability initiatives.

Energy efficiency has become an increasingly important issue for schools due to tightening budgets and rising energy costs. Since 2003, the prices of natural gas, fuel oil and electricity have increased by 123%, 107% and 32% respectively. Schools that have participated in energy benchmarking programs have shown a decrease in overall energy use by approximately 22% through the adoption of energy efficiency measures.

Tracking and documenting the energy use and associated carbon emissions in the state's K-12 schools will allow New Hampshire to account for the impact of its energy efficiency and renewable energy programs and determine which have the greatest effect. The analysis in this report, provided by the ***EnergySmart Schools Program*** is designed to help you:

- Understand the energy consumption and cost trends at each of your school buildings.
- Learn how your buildings are performing compared to other schools locally and nationally.
- Identify opportunities for improving operations and reducing costs.
- Take advantage of resources to implement efficiency improvements and save money.

The analysis was based on the information provided on the *Building Data Request Form* submitted, which included building descriptions, energy suppliers and other information. The building's utility bills were also used to assess its electricity and heating fuel consumption for the year(s) provided.

The energy performance for your school has been compared to national data for similar school facilities through EPA's ENERGY STAR® Portfolio Manager. Also shown are the five major benchmarks used to analyze building performance, which include: electricity use; heating fuel use; weather-normalized heating fuel use; total cost; and total cost per student, all of which have been normalized for comparison by square footage and weather. As part of the program's focus on sustainability, your school's carbon footprint is also presented.

II. Benchmarking Analysis and Review Results

Building and energy usage of your school was analyzed to assess the basic nature of your energy consumption and utility costs. The Building Data Summary table shown below summarizes this information.

Table 1: Building Data Summary for Chamberlain Street Elementary School

Building Data			
District	SAU 54 Rochester School Department	**School Name**	Chamberlain Street Elementary School
City	Rochester	**Zip Code**	03867
Year Built	1961	**Floor Area (sq.ft.)**	48,800
Number of Students	358	**Number of PCs**	79
Weekly Operating Hours	60	**Months School Used**	12
Cooking?	YES	**% AC**	0
Pool Size?	N/A	**Months Pool Used**	0

Utility Data			
Data End Point	6/30/2011	**Total Cost ($)**	52,821
Electric Provider	PSNH	**Natural Gas Provider**	Unitil Corporation
Electricity Usage (kWh)	215,140	**Electricity Cost ($)**	33,893
Natural Gas Usage (therms)	15,806	**Natural Gas Cost ($)**	18,929
Fuel Oil Usage (gal)	0	**Fuel Oil Cost ($)**	0
Other Fuel Usage (gal)	0	**Other Fuel Cost ($)**	0

Energy Indicators			
EPA Score	89	**Electric Usage (kWh/sq.ft.)**	4.4
Heating Fuel Usage (kBtu/sq.ft.)	32.4	**Weather Adjusted Heating Usage Btu/sq.ft./HDD)**	4.5
Site Energy (kBtu/sq.ft.)	47.4	**Source Energy (kBtu/sq.ft.)**	84

Environmental Impact Indicators			
Greenhouse Gas Emissions			
Last Year Heating Fuel CO_2e (Mt)	83.9	**Last Year Total CO_2e (Mt)**	150.6
Last Year Electricity CO_2e (Mt)	66.7	**CO_2e Efficiency Savings Over Previous Year**	23.9
EPA Target Score			
Target Score	N/A - Reached	**Site Energy Reduction Needed (kBtu/sq.ft.)**	N/A - Reached

Figures 1a, 1b, 2a and 2b display the energy use, demand and cost data tracked on a monthly basis. This demonstrates the energy consumption of your building over the course of the year. As a part of the program's focus on sustainability, your school's carbon footprint was also measured and is presented in Figure 3.

Figure 1a. Monthly Electric Use & Max Demand for Chamberlain Elementary

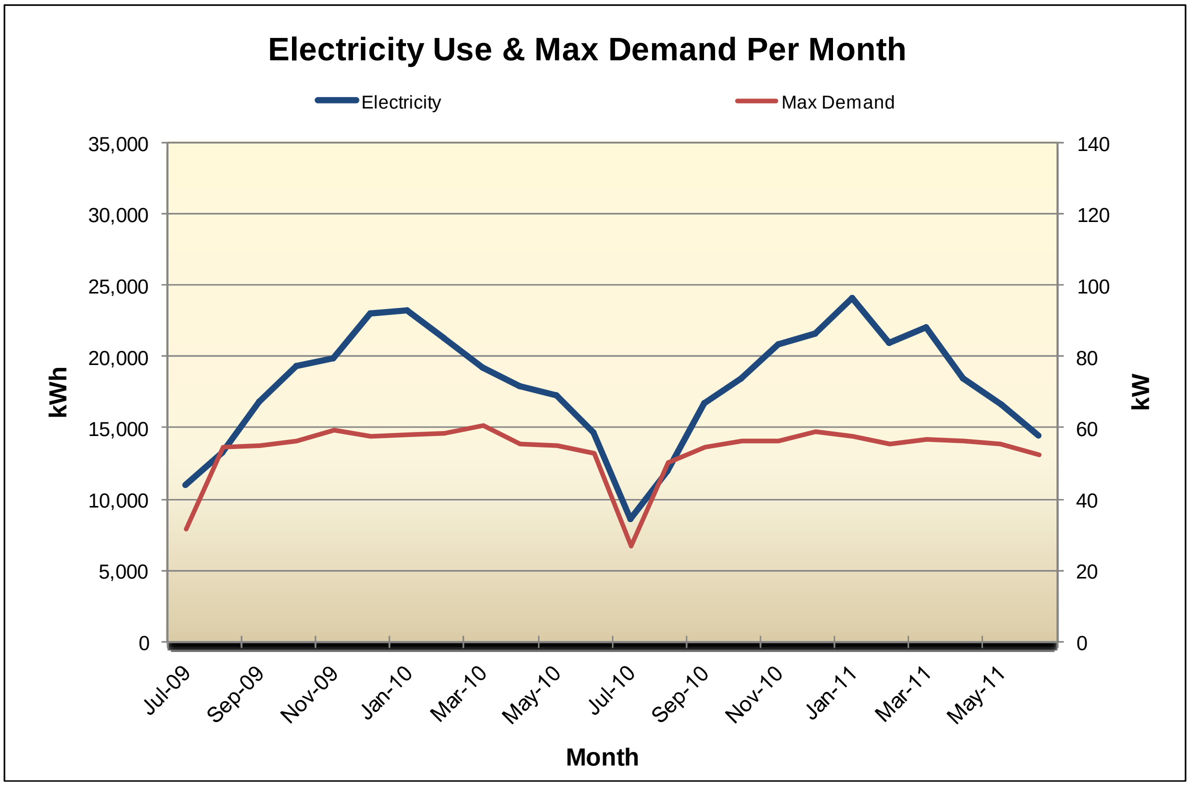
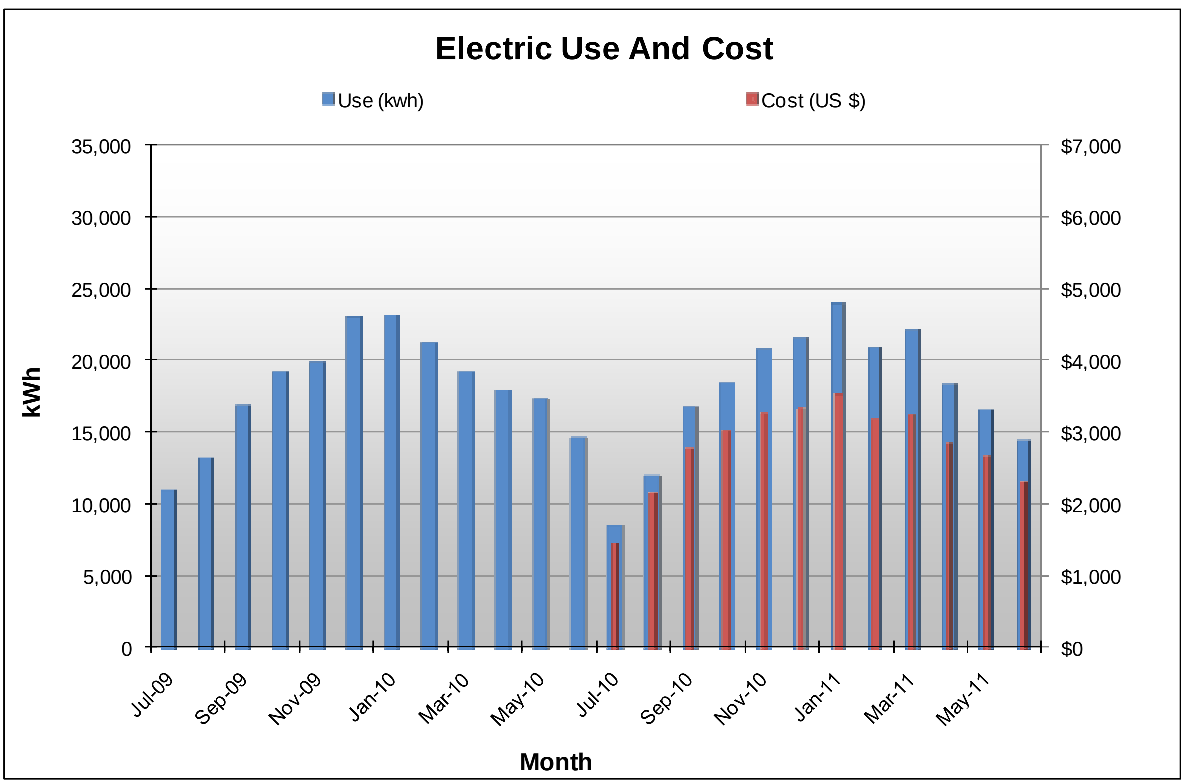


Figure 1b. Monthly Electric Use vs. Cost for Chamberlain Elementary



Note: Electric Cost was only available for the most recent 12 month period.

Figure 2a. Monthly Heating Fuel Use for Chamberlain Elementary

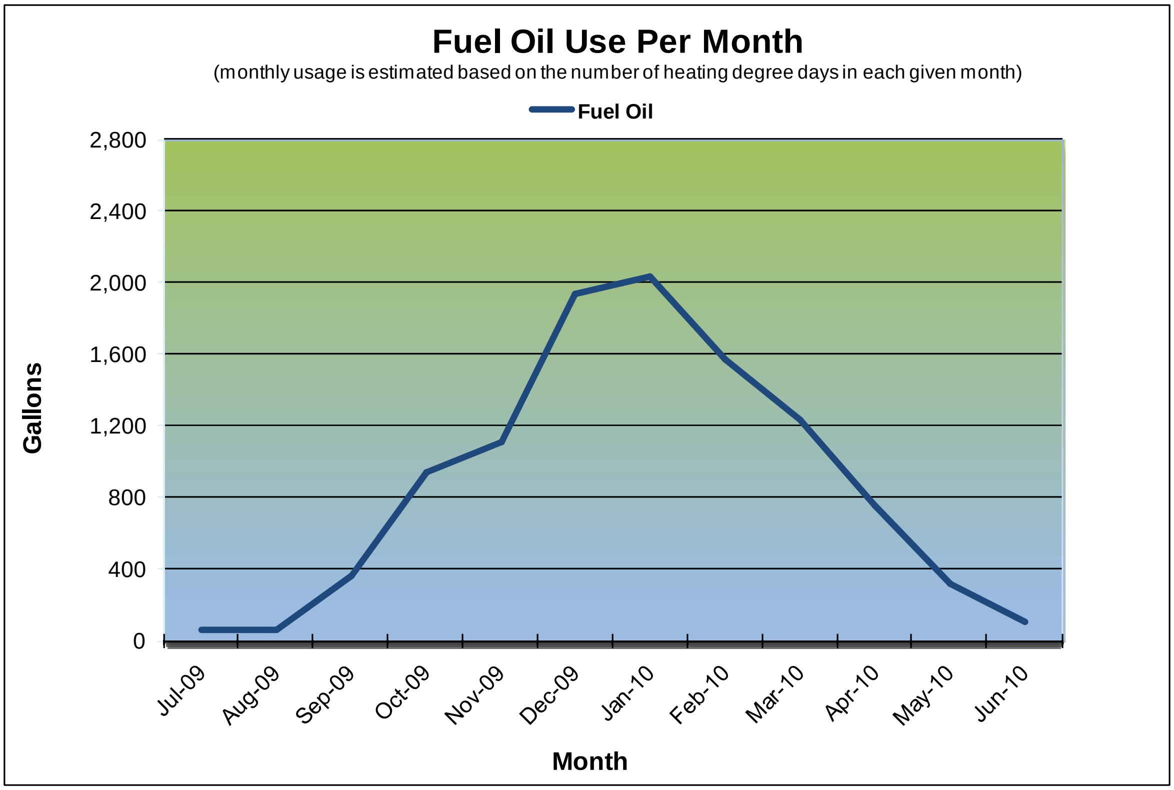


Figure 2b. Monthly Heating Fuel Use vs Cost for Chamberlain Elementary

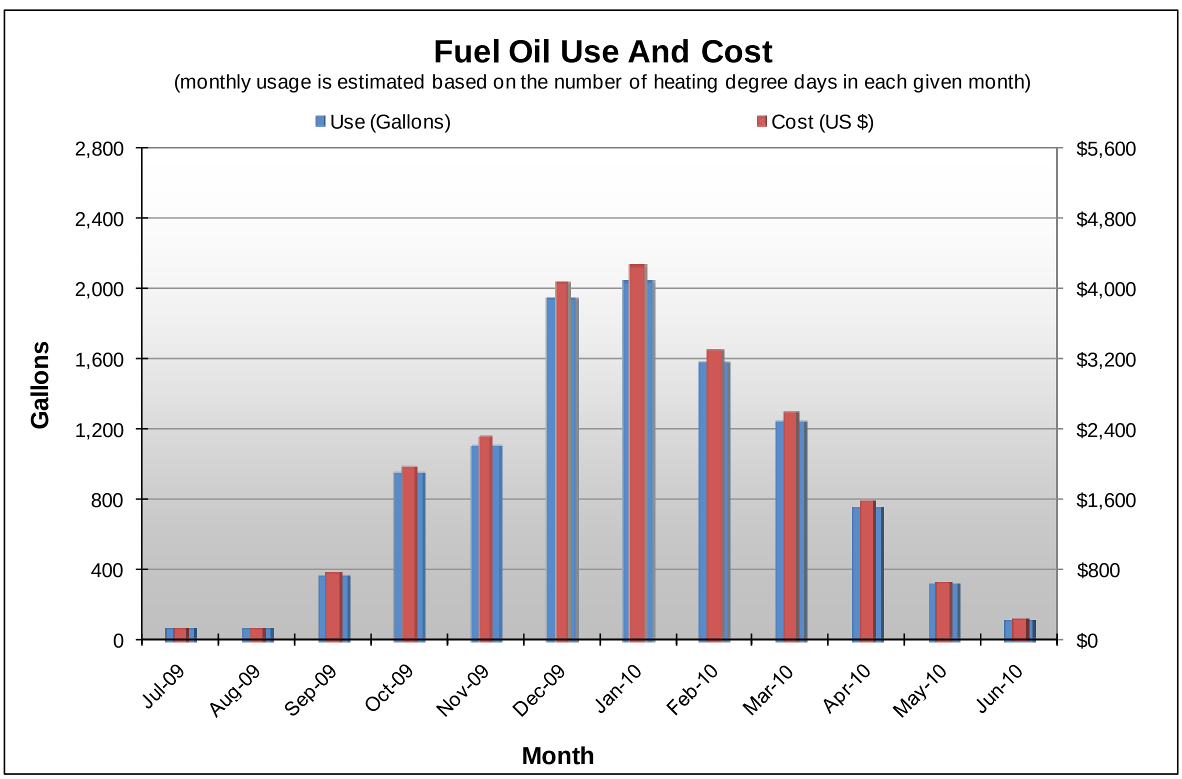


Figure 2a. Monthly Heating Fuel Use for Chamberlain Elementary

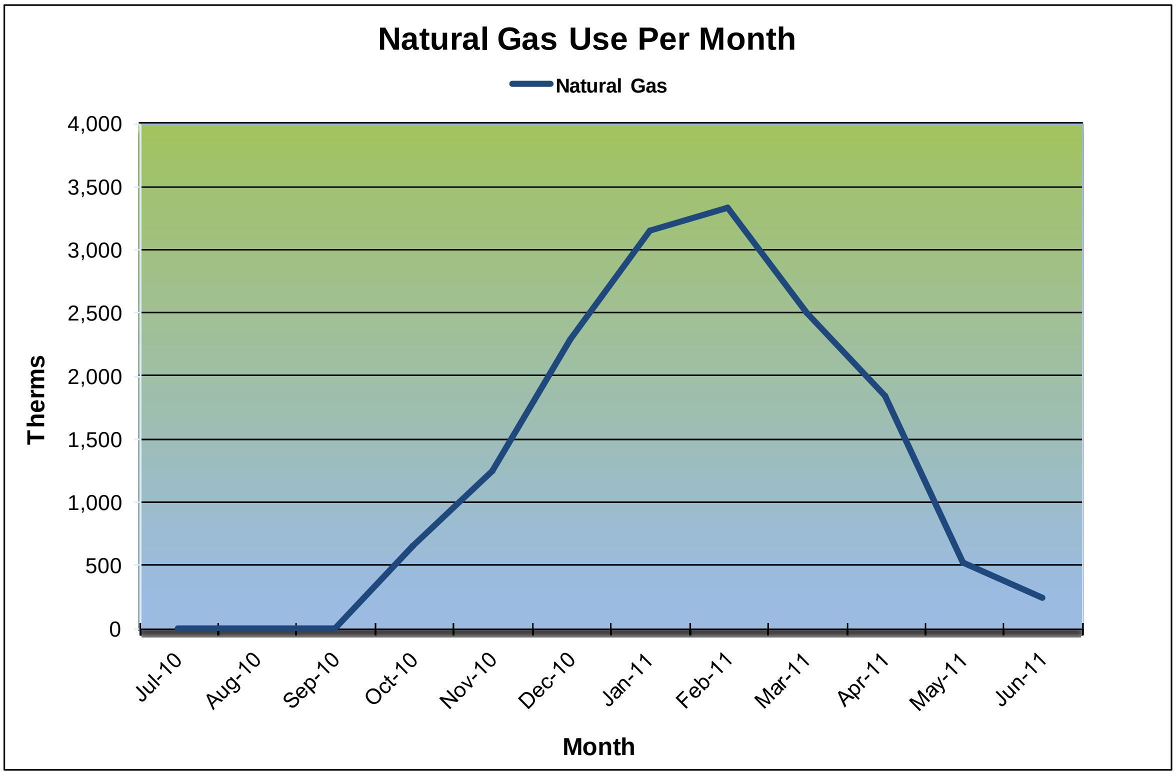


Figure 2b. Monthly Heating Fuel Use vs Cost for Chamberlain Elementary

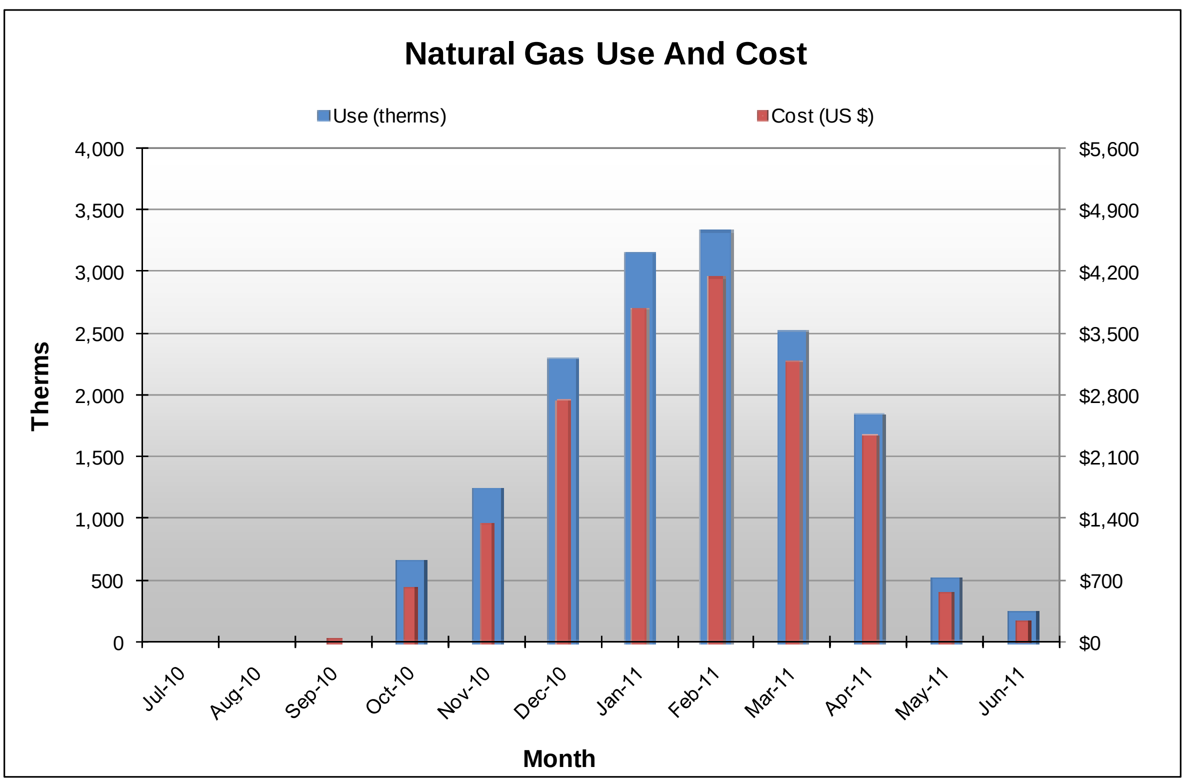
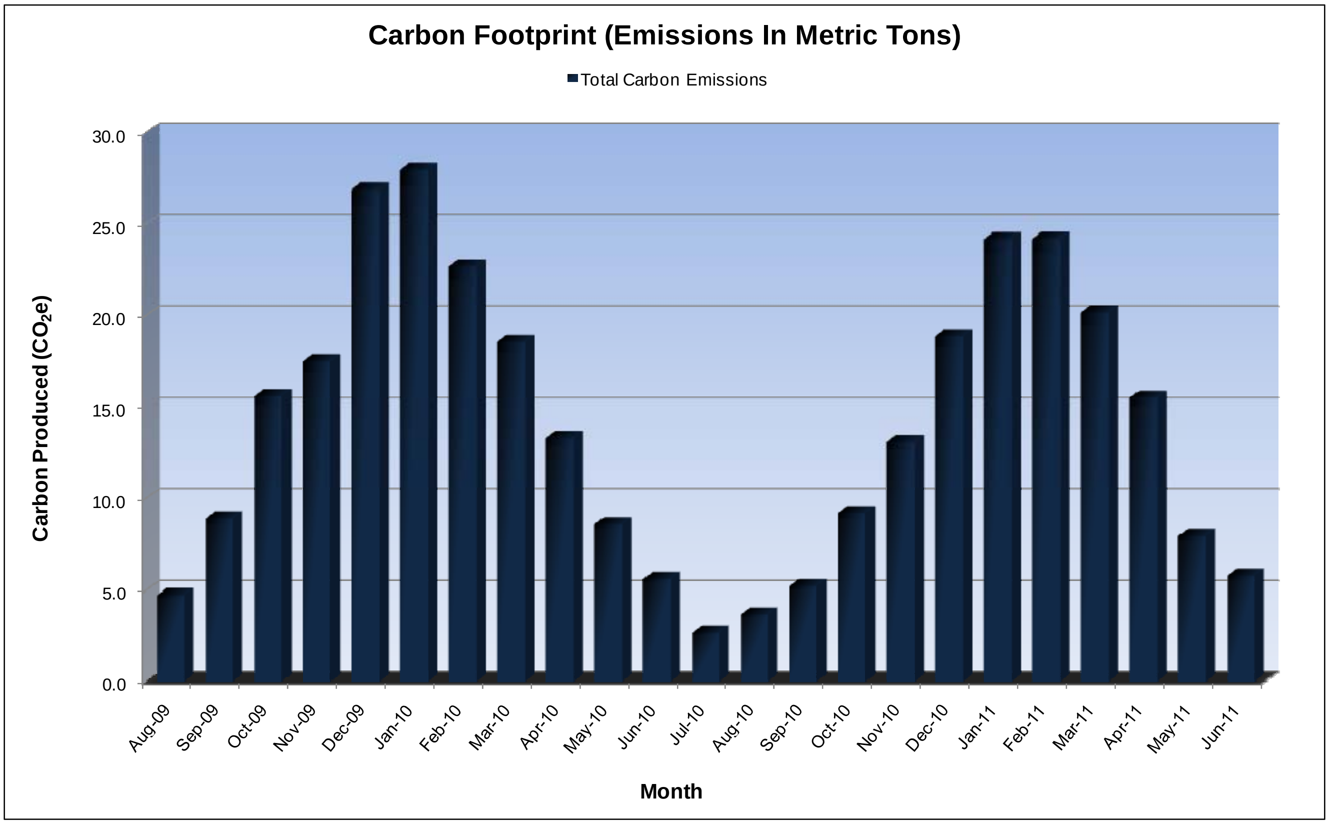


Figure 3. Monthly Greenhouse Gas Emissions for Chamberlain Street Elementary



Benchmarking Data

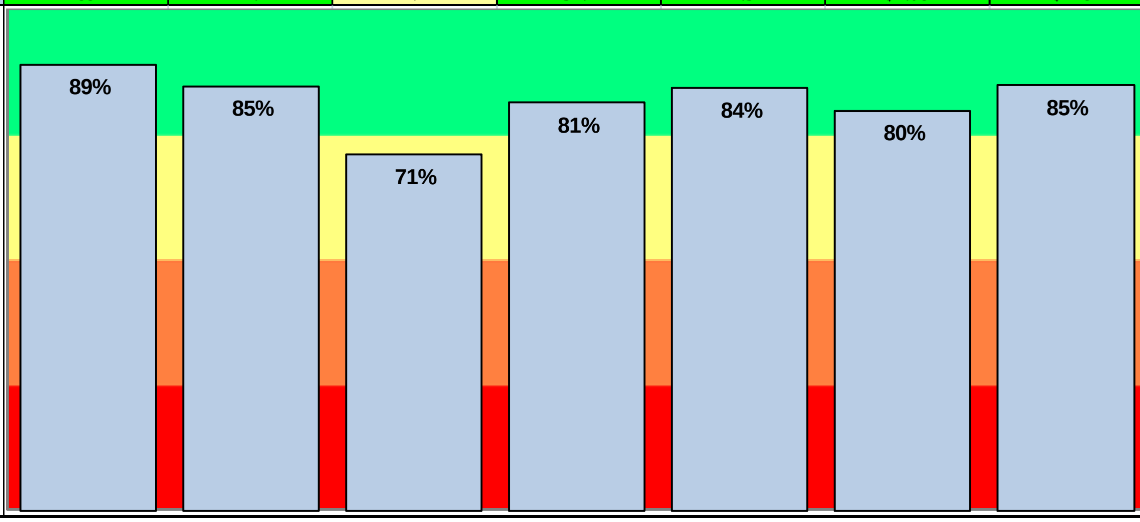
To evaluate the energy and environmental performance of your school, the building data collected above has been compared against two different sets of school energy data: the U.S. Environmental Protection Agency's national data and New Hampshire specific state data. The results are illustrated in Figure 4 on the following page.

This will allow you to assess your building's performance relative to other buildings designed and constructed to the same codes and standards, operating under the same regulations and schedules and similar weather conditions. The indicators are calculated on a *per square foot* or *per student* basis, so you can compare your school to different sized schools.

Figure 4. EnergySmart Schools Benchmarks for Chamberlain Street Elementary

Schools	U.S. EPA Portfolio Manager Score	New Hampshire State Schools (Annual Data)					
		Total Energy Use (kBtu/sq.ft.)	Electric Use (kWh/sq.ft.)	Heating Fuel Use (kBtu/sq.ft.)	Weather Adjusted Heating Fuel Use (Btu/sq.ft./HDD)	Total Energy Cost ($/sq.ft.)	Total Energy Cost ($/student)
NH Average:	50	60.3	5.2	41.7	5.7	$1.42	$256
You:	89	47.4	4.4	32.4	4.5	$1.08	$148

Chamberlain Elementary School Percentile Ranking



Major Benchmark Indicators

1. Total Energy Use, kBtu/sq.ft.

This indicator shows how much total energy your school consumes each year. It includes the energy used for heating, cooling (if any), lights, cooking, computers, etc.

Your school's total energy use of 47.4 kBtu per square foot per year (kBtu/sq.ft.) is better than the New Hampshire K-12 schools state average of 60.3 kBtu/sq.ft. Your total energy use figure is lower than 85% of New Hampshire K-12 schools. The EnergySmart School Report is weather normalized so fuel consumption for heating takes the difference in climate between northern and southern New Hampshire into account.

This is a good indicator of how well, overall, your school is performing. However, it doesn't help you find ***where*** in your building to look for improvement opportunities. Multiple factors included on the following pages can help with that. Analysis of energy consumption for this program does not control for operational variations. An example is an improperly ventilated school may appear to have lower energy consumption. Ventilation systems that are not operating properly result in lower indoor air quality.

2. Electricity Data

Most electric utilities use the following two factors to estimate your electricity bill – Electric Use and Electric Demand.

a. Electric Use, kWh/sq.ft.

This shows how well the building does with its lights, cooling/air conditioners and cafeteria systems (if any), and what's referred to as "plug load." Plug load is anything that plugs into a socket. The major plug loads are generally computers (including monitors, printers and copiers), refrigerators, coffee machines, fans, shop equipment and projectors. If electric consumption is much higher than average, but heating fuel use (see below) is average or better, then focus your efforts on the electric-powered elements.

New Hampshire schools state average electric use is 5.2 kWh per square foot. Your school's electric consumption of 4.4 kWh per square foot this year is lower than 71% of New Hampshire schools benchmarked through the New Hampshire EnergySmart Schools Program.

b. Electric Demand, Watts/sq.ft.

Demand is a measure of the maximum electric draw in kW that your building places on the grid and is measured by adding up the kW draw for a 15 minute period. To give an analogy, if electricity usage is the amount of water going through a hose in gallons, electric demand would be how fast that water flows expressed in gallons per minute. Whichever 15 minute period during your monthly billing cycle places the highest kW demand on the grid is the demand factor applied to your bill. The best way to improve this demand factor is to stagger the times when your electrical systems draw at their maximum or reduce unnecessary electric load altogether.

The average electric demand for New Hampshire schools is 1.9 watts per square foot. Your school's electric demand is 1.2 watts per square foot and is lower than 93% of New Hampshire Schools benchmarked through the New Hampshire EnergySmart Schools Program.

3. Heating Fuel Use, kBtu/sq.ft.

Reviewing these indicators is relatively straightforward. If your school's heating fuel use is much higher than average, an audit of your heating system along with your building envelope - doors, windows, roof - is recommended. This factor is 'fuel-neutral' as it works for either fuel oil or natural gas heating systems.

New Hampshire K-12 schools state average heating fuel use is 41.7 kBtu/sq.ft. or 5.7 Btu/sq.ft./HDD. Your school's heating fuel use of 32.4 kBtu/sq.ft. per year is lower than 81% of other New Hampshire schools in the database. Your school's weather adjusted heating fuel use of 4.5 Btu/sq.ft./HDD is lower than 84% of other New Hampshire schools benchmarked through the New Hampshire EnergySmart Schools Program.

4. Energy Cost, $/sq.ft. & $/student

Cost is the bottom line. These numbers help you understand, in terms of budget, the gain through energy efficiency improvements. New Hampshire K-12 schools state averages $1.42/sq.ft. and $256/student.

Your school's annual energy cost of $1.08 per square foot is lower than 80% of other New Hampshire benchmarked schools. Your school's cost expressed on a per student basis of $148 is lower than 85% of other New Hampshire schools benchmarked through the New Hampshire EnergySmart Schools Program.

5. U.S. EPA *Portfolio Manager* Score

Portfolio Manager is a benchmarking model based on a national set of data from K-12 schools. It is provided by the U.S. Environmental Protection Agency's ENERGY STAR® Program. The impact of factors outside of your control (such as location, occupancy and operating hours) are removed, providing a 1-100 ranking of a school's energy performance relative to the national school building market. A score of 50 represents the national average and a score of 100 is best. Schools that achieve a score of 75 or higher are eligible for EPA's ENERGY STAR® Building Label, the national symbol for protecting the environment through energy efficiency. Districts can achieve ENERGY STAR® Leader Awards in recognition if their buildings, on average, improve by 10%, 20%, 30%, etc. over their baseline year of reported energy use or if the district's overall weighted average *Portfolio Manager* Score is at least a 75.

Your school's *Portfolio Manager* Score of 89 places it higher than 89% of K-12 schools nationwide. As noted above, this rating potentially qualifies your school for the prestigious ENERGY STAR® Label for Buildings.

III. Potential Energy Saving Opportunities

Based on the preceding analysis of your school's energy performance, implementation of the following recommendations can help you save energy and money. The first step is to look at reducing electrical lighting and HVAC consumption (burners, circulators and fans) which typically account for 67% of a building's electric consumption.

- **Perform an Energy Audit on the Building**

An energy audit involves a comprehensive analysis of the building's general characteristics, its energy use and allocation of that use amongst the facility's energy end uses. The goal is to identify sources of potential energy savings. Your auditor should develop a list of recommendations that will result in substantial energy and operational cost savings. These may include, building envelope improvement and mechanical systems, lighting upgrades, equipment replacement and installation of lighting and HVAC control mechanisms, among others.

A good audit should include information specific to each recommendation which *at least* includes approximate annual energy unit and cost savings, demand reduction, installation cost, lifetime cost savings and information related to cost-effectiveness. This will help to prioritize the recommendations based on their energy efficiency and shortest payback.

The recommendations provided in an energy audit report may reduce facility energy bills by 20% or more in addition to improving occupant health and comfort. Following this report, an energy audit is the next step in realizing the full potential of energy savings opportunities.

- **Request Retro-Commissioning**

Retro-commissioning is a detailed process applied to existing facilities aimed at correcting many of the degradations and inefficiencies that are indicative of older and/or poorly performing buildings. Many older buildings tend to be less comfortable and operate less efficiently when not properly commissioned. Retro-commissioning includes a detailed energy audit and focuses on not only potential energy savings but also the interaction of the building's equipments and mechanical systems with an eye toward restoring it to optimal performance.

In contrast to an energy audit, this optimization focuses on operational improvements to existing equipment, rather than replacement. Apart from energy savings, other improvements and benefits include substantial operation and maintenance (O&M) cost savings, improved air quality, occupant comfort, health and safety, equipment controls, and improved system interactivity.

In addition to providing recommendations, retro-commissioning includes implementation of the recommended improvements and hence the cost for retro-commissioning is higher than an audit. However, when the costs of improvements are added to the energy audit cost, prices may be comparable. If high O&M costs or occupant health, comfort and safety are concerns in addition to reduction in energy use, retro-commissioning may be a suitable strategy.

- **Upgrade Lighting Systems**

Lighting typically accounts for 30-60% of all energy consumed in school buildings. Additionally, the electrical energy consumed by lights during the summer creates heat and increases cooling costs.

Chamberlain Street Elementary School's electricity consumption is low (better) compared to other schools in the State. Even so, upgraded lighting systems in high consumption areas like classrooms, gymnasiums, libraries, offices, etc. can reduce these costs even further and improve the lighting quality and increase occupant comfort and productivity.

Over-lit Spaces: Light levels should be recorded in classrooms and hallways to ensure they are not over-lit, 40-50 foot candles are adequate light levels for an instructional space. If classroom light levels are much higher than 50 foot candles, Chamberlain Street Elementary School should consider de-lamping classrooms or installing dimming ballasts, which dim the lights when outdoor light levels are adequate. In over-lit hallway spaces photo sensors can be installed to turn lights off completely when light levels exceed a pre-set threshold.

In over-lit spaces a T8 to Super T8 lighting retro-fit can reduce the number of light fixtures needed. Super T8 lamps use between 4 and 7 Watts less electricity than standard T8 lamps, but they produce more light per Watt. In some cases this increase in light per Watt can allow for the removal of an entire lamp, saving 32 Watts. The room characteristics must be factored in before this type of retro-fit. The shape of the space, ceiling height, color of the walls, etc. all need to be taken into account when exploring a de-lamping project. We recommend that before retro-fitting the entire facility, begin by changing one classroom and monitor the comfort level of the occupants at Chamberlain Street Elementary School.

Another proven energy reduction measure with a short payback period is to identify any areas where your school may still be using metal halide lighting. Typically metal halide lights are found in gymnasiums or cafeteria areas, many districts have been very satisfied by replacing these lights with high bay T5 lighting fixtures. In addition to the reduced operational wattage, high bay T5 lights turn on instantly, as opposed to metal halide fixtures which have an extended warm up period. The long warm up period associated with metal halides typically leads to the lights being left on all day, at 250 to 400 watts a fixture; the costs begin to add up. Adding occupancy sensors to high bay T5 fixtures further reduces the payback period.

Occupancy Sensors: We recommend that you explore the use of occupancy sensors to ensure that lights are turned off in unoccupied spaces. Lights controlled by occupancy sensors typically run a third of the time when compared with manually controlled lighting. Reduced runtime leads to decreases in both energy usage and operation and maintenance costs. Additionally, a study conducted in Massachusetts found that controlling the security lighting with occupancy sensors reduced vandalism; neighbors and police recognized something wrong when the lights were on in a building that was typically dark and investigated.

To summarize and add a few ways in which Chamberlain Street Elementary School may be able to conserve energy and cost through lighting upgrades is to:

- Design light quantity and quality for the task and occupants' needs in that area.
- Maximize lamp and ballast efficiency.
- Activate the power saving features on office equipment such as copiers, printers and fax machines and ensure that they are turned off at the end of the day.
- Use automatic controls to turn lights off or dim lights in unoccupied spaces.
- Establish a maintenance schedule for group re-lamping and fixture cleaning.
- Replace T12 fixtures with the most efficient fixtures which may include T8/super T8/T5 fixtures.
- Replace incandescent lighting with compact fluorescent technology.

- Replace incandescent exit lighting which consumes 30 Watts with LED type exit lights with 1.5 Watts consumption. LED units last up to 10 years, which is a maintenance advantage.

- Install daylight sensors in areas with significant natural light.

- Install occupancy sensors in areas that are often unoccupied.

- Lighting retrofits reduce maintenance costs associated with lighting that is close to end of life.

- Establish a regular cleaning schedule particularly for areas where student safety of low light levels may be a concern, such as shop classes.

- Look to make lamp and fixture selection as uniform as possible to reduce maintenance and inventory overhead.

- Educate students and staff to turn off lights when rooms are unoccupied.

Lighting upgrades seek to reduce the connected electrical load (kW) and energy consumption (kWh) of lighting equipment. Lighting controls can also significantly reduce operating hours and costs by turning off lighting when spaces are unoccupied or sufficiently lit by natural light.

- **Install NEMA Premium Motors and VFDs**

Commercial and industrial electric motor-driven systems consume approximately 23% of all electricity in the U.S., making it the single largest category contributor to electric use in the country. With very high operating hours, the annual energy cost to run a system is more than its installation cost. Even a small increase in the efficiency of an electric motor can result in substantial energy cost savings. Typical opportunities for motor upgrades in schools include: ventilation fans, and heating and cooling system pumps and fans.

Motors with efficiency up to 90% are available to replace the older ones with efficiency less than 75%. Although standards for efficiency of new equipment are set by the Energy Policy Act, motor efficiency can be further increased by selecting Premium Efficiency motors as specified by the National Electrical Manufacturers Association (NEMA). This can cut the electric motor system demand by as much as 18%.

Savings can be increased further by optimizing system performance through the use of variable frequency drives (VFDs). When system load is known to vary substantially, these flow control systems can be utilized to match system output to system demand, significantly reducing energy usage during partial load hours. By employing high-efficiency motors and VFDs, facility owners can improve environmental conditions, utilize better control of motor-driven processes, and reduce waste output.

- **Install Demand Control Ventilation**

Demand control ventilation (DCV) monitors indoor air CO_2 content as a result of occupancy production levels and uses this data to regulate the amount of outdoor air that is permitted for ventilation. In order to ensure adequate air quality, standard ventilation systems permit outside air based on estimated occupancy levels in CFM, cubic feet per minute/occupant. However, during low occupancy hours, the space may become over ventilated due to decreased CO_2 levels and unnecessary ventilation results in wasted energy. DCV reduces unnecessary outdoor air intake by regulating ventilation based on actual CO_2 levels, saving energy. DCV is most suited for areas where occupancy levels are known to fluctuate considerably such as auditoriums, cafeterias, and gymnasiums.

Install Energy Recovery Ventilators. According to energy recovery equipment manufacturer's typical paybacks are less than 5 years for schools without cooling. The keys to success with ventilation retrofits are going with fewer larger units with long run hours as opposed to several small units with limited run time. Equipment with moisture recovery capabilities would cut humidity up to 50% during the cooling season.

- **Improve/Replace Inefficient Heating Systems**

Replacing an old boiler that is < 70% efficient with a modern 85-90% efficient natural gas-fired furnace alone will reduce heating costs by 15-20%. This combined with additional system improvements and installation of advanced HVAC control mechanisms can result in up to 20%+ heating load reduction.

Because of the high capital cost of new heating systems, some financial analysis should be performed to assess the cost-effectiveness of immediate replacement. If the current system is fairly new, replacement may not be immediately justifiable from a financial standpoint. However, as is the case with cooling systems, early replacement may prove to be a more cost-effective solution than waiting until existing systems fail or reach the end of their estimated useful life.

- **Improve/Replace Inefficient Air Conditioning Systems**

The useful life of a rooftop A/C unit is generally 12-18 years. However, depending on the efficiency, early replacement of outdated, inefficient, split, or packaged rooftop air conditioning units with new A/C systems that are 15% more efficient than 10-15 year old equipments can considerably reduce annual energy consumption. The energy cost savings and maintenance savings offset the high installation cost of a more efficient system. Installing thermostats and/or economizers on new or existing A/C systems will further reduce the cooling demand.

Economizers provide "free" cooling by using controllable dampers that bring in outside air to cool the space when the outdoor temperature or enthalpy is below the building's return air conditions. Although they require operation by a well calibrated and maintained control system, economizers have impressive energy-saving capabilities.

Install Occupancy Controlled/Programmable Thermostats

Combining efficient HVAC equipment with occupancy controlled and programmable thermostats can save a facility up to 10% of its annual heating and cooling costs:

- Areas with unpredictable occupancy on a daily/weekly basis - gym, bathrooms, outdoors: Use an *occupancy controlled thermostat* - a thermostat paired with a sensor and/or door detector to identify movement/occupancy. If occupancy is sensed by the sensor, the thermostat goes into an occupied mode (i.e. programmed set point). If a pre-programmed time frame elapses (i.e. 30 minutes) and no occupancy is sensed during that time, the thermostat goes into an unoccupied mode (e.g., setback set point or off) until occupancy is sensed again. This reduces the overall time the heating or cooling system is running, saving energy.

- Areas with predictable occupancy: e.g.: classrooms, cafeteria, offices: A *programmable thermostat* is recommended. This device is programmed on a schedule to reduce the heating or cooling output of the facility's HVAC systems in relation to its predetermined occupancy schedule. In this way, the thermostat acts to set-back or set-up the facility temperature during unoccupied hours, and re-establish a comfortable facility temperature during business hours. By employing programmable thermostat technology, the heating and cooling system demand coincides with occupancy level, reducing energy usage.

- **Install Vending Misers on Vending Machines**

Vending misers for refrigerated and non-refrigerated vending machines is an often overlooked source of potential savings. Uncontrolled, vending machine lights remain on 24/7, consuming a constant amount of energy year round. By controlling these lights with an occupancy sensor, energy consumption attributed to vending machines can be reduced considerably, in many cases, by as much as 50% and can save up to $150 per machine per year.

In the case of refrigerated vending machines, electric demand can be further reduced by controlling the machines' refrigeration systems. In a manner similar to programmable thermostats, vending misers for refrigerated machines act on a pre-set occupancy schedule to allow a marginal increase in operating temperature during non-business hours. Although products in the machine are delivered to the customer at the same temperature as in an uncontrolled vending machine, products are not being cooled unnecessarily when the machine is not in use, significantly reducing the machine's energy consumption. Because of the relatively low vending miser installation cost and high operating hours of vending machines, this improvement is typically cost-effective with a very short payback period.

- **Install ENERGY STAR® Rated Equipment / Plug Load Control**

Plug loads (computers, televisions, coffee makers, etc.) account for, on average, about 10% of total energy consumption. One of the easiest and most cost-effective energy saving strategies is the reduction of electric usage through installation of efficient appliances and the control of plug loads. In addition to utilizing ENERGY STAR® qualified appliances, greater savings can be realized through the various devices available that control every day plug loads.

By connecting non-critical loads (coffee makers, fans, microwave ovens, etc.) to an occupancy or timer controlled power strip, significant energy savings can be achieved. These savings result not only from the neglect of the user to turn the device off manually, but also from reduction of "phantom load". Phantom load is the small but constant energy draw from many plug-in devices when not in use. By connecting certain appliances to an occupancy controlled power strip, phantom load can be eliminated by cutting power supply to those devices. When replacing or ordering new equipment, emphasize ENERGY STAR® devices when they are available. Also, purchase controlled power strips and connect appropriate devices to those strips to reduce unnecessary consumption due to phantom load and appliances left on. The EPA offers free computer power management software which has saved some districts as much as $75 per computer per year, the software can be found at http://www.energystar.gov/index.cfm?c=power_mgt.pr_power_mgt_low_carbon_join.

IV. Resources:

The State of New Hampshire along with the utility companies offer multiple programs designed to improve the energy efficiency of schools through financial incentives and technical support, including:

Northeast Energy Efficiency Partnerships:

- **Northeast Collaborative for High Performance Schools (NE-CHPS)**
  NE-CHPS is a set of building and design standards for all schools from pre-K through community colleges tailored specifically for NH state code requirements, the New England climate, and the environmental priorities of the region. NH Department of Education offers up to a 3% re-imbursement for New Construction School projects. To learn more about NE-CHPS and incentive programs please visit: http://neep.org/public-policy/hpse/hpse-nechps.

New Hampshire Public Utilities Commission:

- **New Hampshire Pay for Performance**
  This program addresses the energy efficiency improvement needs of the commercial and industrial sector. The Program is implemented through a network of qualified Program Partners. Incentives will be paid out on the following three payment schedule: Incentive #1: Is based on the area of conditioned space in square feet. Incentive #2: Per/kWh saved and Per/MMBTU saved based on projected savings and paid at construction completion. Incentive #3: Per/kWh saved and Per/MMBTU saved based on actual energy savings performance one year post construction. Total performance incentives (#2 and #3) will be capped at $200,000 or 50% of project cost on a per project basis. For more information visit http://nhp4p.com.

- **New Hampshire Public Utilities Commission's Renewable Energy Rebates**
  The Sustainable Energy Division provides an incentive program for solar electric (photovoltaic or PV) arrays and solar thermal systems for domestic hot water, space and process heat, with a capacity of 100 kW or equivalent thermal output or less. The rebate for PV systems as follows: $1.00 per Watt, capped at 25% of the costs of the system or $50,000, whichever is less. For solar hot water (SHW) systems, the base rebate is $0.07 per rated or modeled kBtu/year, capped at 25% of the cost of the facility or $50,000, whichever is less, as a one-time incentive payment. http://www.puc.state.nh.us/Sustainable%20Energy/RenewableEnergyRebates-CI.html.

New Hampshire Community Development Finance Authority:

- **New Hampshire Community Development Finance Authority Revolving Loan Fund**
  The Enterprise Energy Fund is a low-interest loan and grant program available to businesses and nonprofit organizations to help finance energy improvements and renewable energy projects in their buildings. The loans will range from $10,000 to $500,000. Larger amounts will be considered on a case by case basis. The program is available to finance improvements to the overall energy-efficiency performance of buildings owned by businesses and nonprofits, thereby lowering their overall energy costs and the associated carbon emissions. More information about the program can be found on their website www.nhcdfa.org. These activities may include:
  - Improvements to the building's envelope, including air sealing and insulation in the walls, attics and foundations;
  - Improvements to HVAC equipment and air exchange;
  - Installation of renewable energy systems;
  - Improvements to lighting, equipment, and other electrical systems; and
  - Conduction of comprehensive, fuel-blind energy audits.

Public Service of New Hampshire (PSNH):

- **Commercial (Electric) Energy Efficiency Incentive Programs**
  This program targets any commercial/industrial member building a new facility, undergoing a major renovation, or replacing failed (end-of-life) equipment. The program offers prescriptive and custom rebates for lighting and lighting controls, motors, VFDs, HVAC systems, chillers and custom projects. http://www.psnh.com/SaveEnergyMoney/For-Business/Energy-Saving-Programs-and-Incentives.aspx

- **SmartSTART**
  The SmartSTART (Savings Through Affordable Retrofit Technologies) advantage is simple - pay nothing out of pocket to have energy efficiency products and services installed in your building. The Smart Start program is limited to PSNH's municipal customers only and includes schools. The program is available on a first-come, first served basis to projects which have been pre-qualified by PSNH. The cost of the improvements is fronted by PSNH which is then repaid over time by the municipality or school using the savings generated by the products themselves! This program is for lighting and lighting controls, air sealing, insulation and other verifiable energy savings measures which have sufficient kilowatt-hour savings. For more information on this program visit:
  http://www.psnh.com/SaveEnergyMoney/For-Business/Municipal-Smart-Start-Program.aspx

- **Schools Program**
  For major renovation or equipment replacement projects, this program offers prescriptive and custom rebates for energy efficient lighting, motors, HVAC, chillers, and variable frequency drives to towns or cities that install energy efficient equipment at their schools. Financial incentives are available for qualifying energy efficient equipment. Technical assistance is also offered through the Schools Program. http://www.psnh.com/SaveEnergyMoney/Large-Power/Schools-Program.aspx

Unitil:

- **Commercial and Industrial Energy Efficiency Programs**
  Subject to program qualifications and availability of funding - Unitil offers different programs for its commercial, industrial, and institutional customers in New Hampshire: the Small Business Energy Efficiency Program, the Small Commercial and Industrial Program, the Large Commercial and Industrial Program, the Large Commercial and Industrial (C&I) Retrofit Program, and the Large C&I New Construction Program. Rebates are available for various technologies including water heaters, lighting, lighting controls/sensors, chillers, furnaces, boilers, central air conditioners, compressed air, programmable thermostats, energy management systems/building controls, motors, VFDs, processing and manufacturing equipment, LED exit signs, commercial cooking and refrigeration equipment. http://www.unitil.com/.

Clean Air – Cool Planet:

- **Community Energy Efficiency**
  CA-CP works with communities throughout the Northeast to find solutions to climate change and build constituencies for effective climate policies and actions. Much of their work focuses on successful models for energy efficiency and renewable energy planning. They advise and partner with citizens, educators, faith groups, small businesses, municipal governments, and other local leaders. They explore cost-effective opportunities that exist for communities to reduce their emissions as well as their vulnerability to climate impacts. One such example is CA-CP's partnership with the University of NH, NH Sustainable Energy Association and UNH Cooperative Extension to create myenergyplan.net, a groundbreaking suite of web and outreach tools for individual action used by households, schools and community groups around the northeast. http://www.cleanair-coolplanet.org/for_communities/index.php.

Environmental Protection Agency (EPA):

- **ENERGY STAR Challenge for Schools**
  EPA is challenging school administrators and building managers to improve energy efficiency throughout their facilities. More than 500 school districts across the country are helping to fight climate change by committing to reducing their energy use with help from ENERGY STAR. Schools that take the ENERGY STAR Challenge can use energy tracking tools, technical guidance, case studies and other ENERGY STAR tools and resources to help them improve their energy efficiency. More information can be found at:
  http://yosemite.epa.gov/opa/admpress.nsf/d985312f6895893b852574ac005f1e40/d74f768ecfa9e11f8525762500522260!OpenDocument.

For additional assistance in helping you save money and improve school conditions, please call TRC at (603) 766-1913 or (877) 442-9181.

Rochester School District
Primary Schools Space Study

January 2012
Comprehensive Report

LAVALLEE I BRENSINGER ARCHITECTS