nationalgrid

Melrose Public Library

Prepared for

NATIONAL GRID

Prepared by

B2Q Associates, Inc.

Beverly, MA

Revision Date

September 10, 2008

Whole Building Program

5 Arrowhead Lane
Beverly, MA 01915

Opportunities Screening Final Report
Melrose Public Library
NGRID Whole Building Program

Walk Through Date: 6/9/08
Address: 69 W Emerson Street, Melrose, MA

Facility Description

Building Description

Melrose Public Library is a three story town library estimated at approximately 28,000 ft2. The original section was built in 1903 with an addition in 1963. Most equipment is newer, except the boiler which is approximately 20 years old.

The library has approximately 300 patrons per day, which is being estimated at an average of 50 people in the building at any one time.

This building has very knowledgeable facility staff who operate the building well, which would in part explain the low energy use of the building.

Utilities

Electric supplied by Trans Canada
Electric delivery company is National Grid
Gas supply and delivery company is National Grid (Keyspan)

HVAC

Dual temperature piping supplies ceiling and floor mounted fan coils throughout the building. Fin tube radiation on the perimeter of the basement and main floor.

(4) Unit ventilators in small offices.

There are radiators in the Board Room and in a few select locations.

Heating

(1) Weil McLein natural gas boiler rated at 1,974 kBTU/h, 78.5% efficiency as rated by service contractor documentation, and is approximately 20 years old. This boiler is controlled by a Heat Timer controller which appears to have hot water reset.

(2) fractional horsepower (1/6, ¼) hot water supply pumps.
(1) fractional horsepower pump circulates domestic hot water.
(1) 50 gallon electric domestic hot water heater with 4500W upper and lower elements.

Cooling
(1) Air cooled Carrier chiller model 30GT-040---510 with (2) reciprocating compressors, and (4) 1hp condenser fans.

2hp pump for chilled water supply

Lighting
This report does not focus on lighting, however we suggest the following lighting upgrades for this building:

- Occupancy sensors in hallways and in the book stacks
- Daylight dimming in corridors, stairwells, and some of the rooms of the third floor
- Screw-in compact fluorescent bulbs to replace any incandescent bulbs

Building Automation System (BAS or EMS)
Heat Timer controls on the boiler equipment. Separate pneumatic wall mounted thermostats control the perimeter radiation and the fan coils in each space.

Other Equipment
(1) air compressor at 15psi
(1) Aprilaire humidifier
Approximately 50 computers

Schedules
Equipment schedules are as follows:

7am to 9pm Monday through Thursday
7am to 5pm Friday and Saturday
2pm to 5pm Sunday

Open hours:

10am to 9pm Monday through Thursday
10am to 5pm Friday and Saturday
2pm to 5pm Sunday

Notes:

- Closed weekends in summer
- High occupancy times 2:30pm to 5:30pm during school year
- No after hours use

Contacts

Customer's Contacts

Dennis Kelley	Library Director	781-665-2313	kelley@noblenet.org
Mike Lindstrom	Project Administrator	781-979-4440	mlindstrom@cityofmelrose.org

National Grid

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Utility Data and Benchmarking

The table below compares this building to two typical benchmarks – CBECS and EPA Portfolio Manager. CBECS is a database of buildings and their characteristics, and is commonly used to compare energy use in buildings and establish benchmarks. Portfolio Manager is a Web-based tool supported by the EPA which rates your building against similar buildings.

$/kWh	$/therm
$0.15	$1.71

Building Information			Performance Ratings					Operating Costs / SqFt		
Building Type	EPA Bldg Type	Area sqft	Occ W/ft2	UnOcc W/ft2	EPA Rank (1-100)	CBECS 2003 Avg Site kBtu /sqft	2007 % Above CBECS Avg	2007 Electric $/sqft	2007 Fuel $/sqft	Total $/sqft
Library	K-12	28,000	1.59	*N/A*	73	104	-58%	$0.78	$0.46	$1.23

Weather Information			Electric and Fuel Use			Energy Use Indices			
Year	Heating Degree Days	Cooling Degree Days	Actual Electric kWh	Actual Fuel kBtu	Norm. Fuel kBtu	kWh/sqft	Norm. Fuel kBtu /sqft	Norm. Site Total kBtu /sqft	Norm. Source Total kBtu /sqft
2006	5,007	806	134,862	598,500	674,284	5	24	41	74
2007	5,662	907	144,758	745,600	742,835	5	27	44	80
30 yr avg	5,641	678							

Norm = Normalized values. Normalized based on 30 year average weather data. Degree days are base 65.

Note: The EPA building type that was chosen by National Grid is a school because no library data is available in the EPA Portfolio Manager tool. Therefore, we believe the EPA rank presented above may be skewed due to the difference in building types. Once EPA includes Libraries as a building type within Portfolio Manager, we recommend modifying to the appropriate building type for a more accurate score.

The terms in the table above are described on the next page.

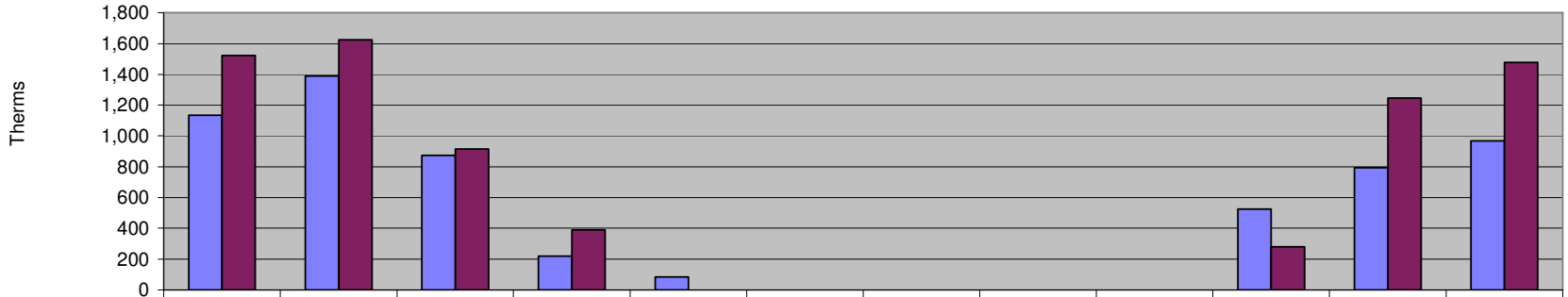
The following terms are used in the table above:

- ***Building type:*** The type of building being examined.
- ***EPA Building Type:*** EPA Portfolio Manager has a limited number of building types used for benchmarking one building against another. The EPA building type indicates what type of building was chosen to compare this building against.
- ***Occ W/ft2:*** This is the occupied Watts per square foot (W/ft2), which is an indication of how much energy is being used while the building is occupied on a typical day.
- ***Unocc W/ft2:*** This is the unoccupied Watts per square foot, which is an indication of how much energy is being used while the building is unoccupied on a typical day. High levels of unoccupied W/ft2 indicate that equipment is running when there are few people in the building, and may indicate the opportunity to shutoff equipment.
- ***EPA Rank:*** This is the rank of the building in EPA's Portfolio Manager benchmarking tool. The scale is 1 to 100, with an average building ranking a 50. Buildings can apply for an Energy Star Award when they receive a rank of 75 or above.
- ***Site and Source:*** Shown in the table above are the total annual electric and fuel use, and approximate costs per square foot based on average electric and fuel rates. *Site* and *Source* benchmark indices are also shown. Site means how much energy is consumed at the site, while Source means how much energy is consumed back at the power plants used to generate the energy, which is then transmitted to the Site. The difference is in the conversion of kWh – for Site the conversion is 3.413 kBtu/kWh, while for Source it is 10.3 kBtu/kWh.
- ***Heating Degree Days:*** An indication of how cold the year was, with higher Heating Degree Days indicating a colder year.
- ***Cooling Degree Days:*** An indication of how warm the year was, with higher Cooling Degree Days indicating a warmer year.
- ***Actual Fuel kBtu:*** How much heating energy was used during the year, including gas, oil, propane, and other heating fuels. Measured in kBtu, which is 1000 Btu's, or 1/100 of a therm of natural gas.
- ***Norm. Fuel kBtu:*** The heating energy used during the year, normalized to 30 yr averages based on Heating Degree Days.
- ***kWh/sqft:*** The total electric energy use per year in kilowatt-hours divided by the gross square footage of the building.
- ***Norm Site Total kBtu/sqft:*** The total Site-based energy use of the building, including electricity use and normalized fuel use, divided by the gross square footage of the building.
- ***Norm Source Total kBtu/sqft:*** The total Source-based energy use of the building, including electricity use and normalized fuel use, divided by the gross square footage of the building.

Electric and gas utility data for this facility are shown below:

Total electricity use from January 2007 to December 2007	144,758	kWh
Total electricity cost 2007	$21,687	$
Average electricity supply and delivery cost	$0.15	$/kWh
Total gas use from January 2007 to December 2007	7,456	Therms
Total gas cost 2007	$12,715	$
Average gas supply and delivery cost	$1.71	$/Therm
Total energy cost 2007	$34,402	$

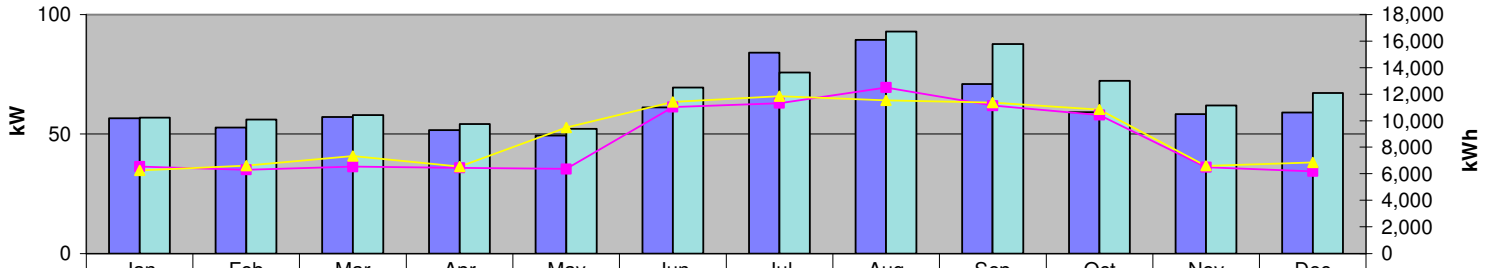
Gas Use
Previous and Current Year-to-Date



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Gas Use 2006 (therms)	1,133	1,390	873	219	83	0	0	0	0	526	793	968
Gas Use 2007 (therms)	1,523	1,625	915	390	0	0	0	0	0	279	1,247	1,477

Month

Electric Use and Demand
Previous Year and Current Year-to-Date



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Electricity Use 2006 (kWh)	10,188	9,503	10,284	9,283	8,874	11,001	15,117	16,092	12,756	10,641	10,511	10,612
Electricity Use 2007 (kWh)	10,236	10,095	10,433	9,748	9,388	12,494	13,638	16,719	15,777	13,012	11,134	12,084
Electric Demand 2006 (kW)	36	35	36	36	35	61	63	70	62	58	36	34
Electric Demand 2007 (kW)	35	37	41	36	53	63	66	64	63	60	37	38

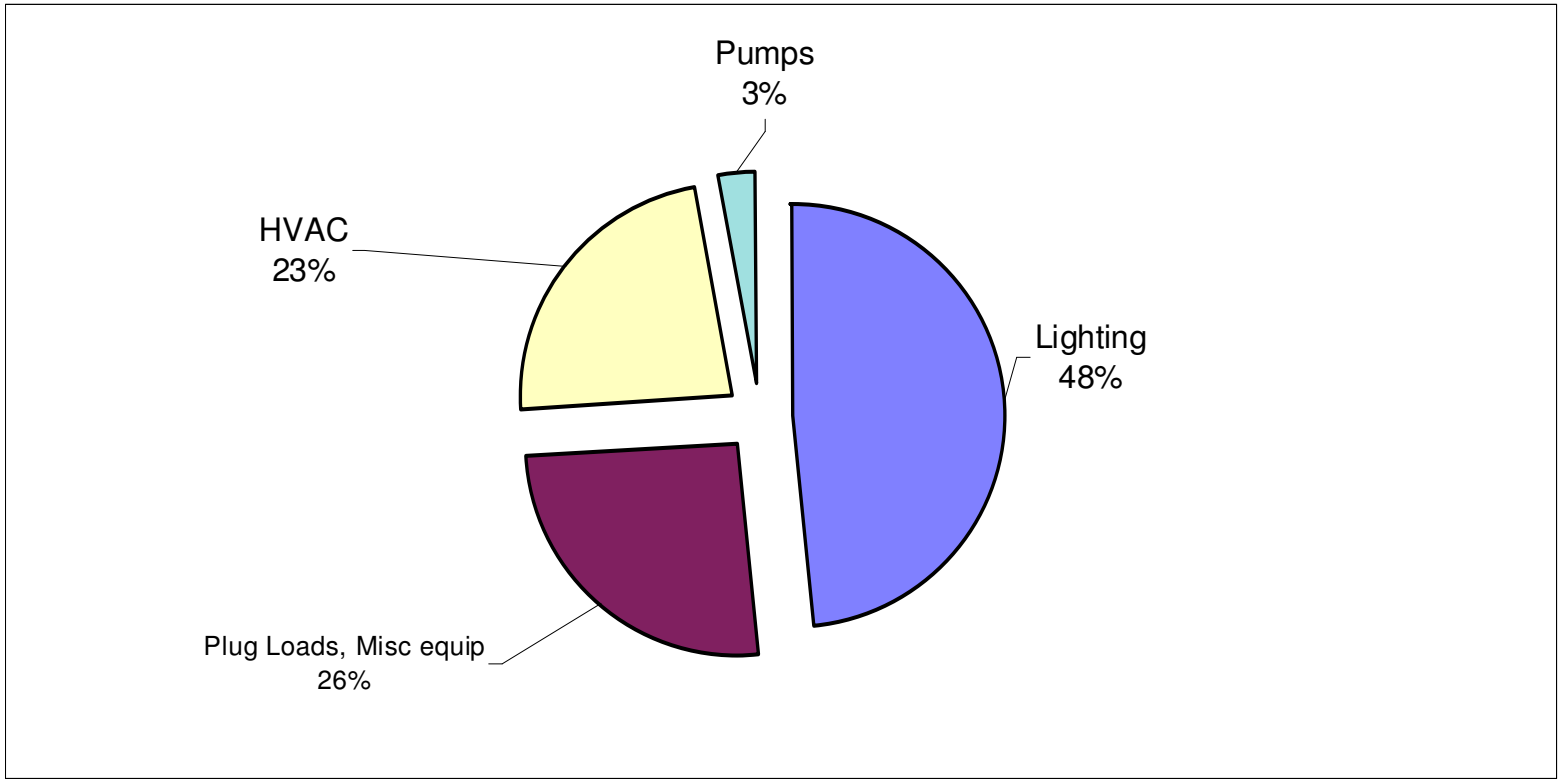
Benchmarking Notes:

- Gas use was significantly higher in 2007. Older boilers may experience significant decreases in efficiency towards the end of their life. This increase may be due to greater heating requirements in 2007, a decrease in boiler efficiency, or a combination of both.

- Electricity use and demand generally track well from 2006 to 2007, although there were some increases in electricity use during September and October in 2007. This may be due to a longer cooling season, however it may also indicate that some equipment is running unnecessarily.

Electricity End-Use Reconciliation Estimate

The chart below estimates the percentage of annual electricity use by each of the resources listed.



Energy Efficiency Measures for Further Study

The energy efficiency measures (EEMs) recommended for further study are summarized on the next page. This is based on initial discussions and observations, and each will require further detailed study of the systems to ensure that they are compatible with the technologies suggested. Costs and savings estimates for each measure are shown as initial estimates, with further refinement needed through detailed study of the facility. As the opportunities listed here are studied in more detail, additional opportunities may emerge.

These initial cost and savings estimates are expected to be within 15% of the final numbers, which will be determined after a detailed study of the facility.

Important Note(s):

1. These amounts do ***not*** include gas company rebates, which could impact both economics and design recommendations.
2. Since a "menu" of choices is supplied for this report, there is deliberately overlap in costs and savings estimates. This means that there is overlap in the savings estimates if all measures were to be done together. It also means that there are likely economies of scale to be realized by doing multiple projects, and that cost estimates could be lowered.
3. Additional recommendations and explanations are included in the text following the EEM table. Not all recommendations are included in the EEM table because some measures may need more detailed study or are otherwise outside the scope of this preliminary study.

Energy Efficiency Measure Table

Utility Rates		
Elec Rate	$0.15	*$/kWh*
Gas Rate	$1.71	*$/therm*

Results		
Total Cost	*$24,498*	
Total Savings	*$3,851*	
Simple Payback	*6.4*	*yrs*

Climate Impact Table	*lbs of Pollutants Reduced*	*Equiv trees planted*	*Equiv gallons of gasoline*
CO2 Reduction	*27,470*	*14*	*1,374*
SO2 Reduction	*20*		
NOx Reduction	*33*		

EEM	Savings Estimate (kWh)	Savings Estimate (therms)	Savings Estimate ($)	Cost Estimate ($)	Potential Incentive ($)	Net Cost ($)	Simple Payback (yrs)	Action Items
1. No/Low Cost Measures								
Computer Power Management	2,500	0	$375	$250	$0	$250	0.7	Utilize internal IT staff
Schedules, Setpoints, O&M	368	75	$183	$250	$0	$250	1.4	Utilize facilities staff
2. Programmable Thermostats	2,171	596	$1,346	$4,500	$450	$4,050	3.0	Contact HVAC service tech
3. Boiler Replacement	0	1,094	$1,871	$24,000	$4,500	$19,500	10.4	Gas Rebate estimated; replace as part of capital plan
4. Refrigerator Replacement	511	0	$77	$448	$0	$448	5.8	
Total	5,550	1,765	$3,851	$29,448	$4,950	$24,498	6.4	
% of Total Existing Amount	4%	24%	11%					

Additional Information on Energy Efficiency Measures

1. *No/low cost measures*: National Grid is providing guidance on a number of no and low cost measures which can be implemented. Please review the Notebook provided by National Grid. Reviewing these measures and educating personnel can provide immediate energy savings and improve comfort throughout the buildings. In addition, the following no/low cost measures are recommended:

    a. Computer Power Management: Power Management features are standard in Windows and Macintosh operating systems, and can place monitors and computers into a low-power "sleep mode" after a period of inactivity. Touching the mouse or keyboard "wakes" the computer and monitor almost instantly. There are many ways to activate sleep features across entire networks of computers, including free solutions that utilize open source software and/or tools that you may already have at your disposal. Alternatively, a number of commercial software packages offer more feature-rich solutions for a fee, and may deliver more energy savings.

    To maximize power savings, set computers to enter system standby or hibernate after 30 minutes or less of inactivity, and set monitors to enter sleep mode after 15 minutes or less of inactivity. The lower the time settings, the more energy you save. On laptops, be sure to activate these settings in the AC as well as DC (battery) power profiles. See the Energy Star website for more information at: http://www.energystar.gov/index.cfm?c=power_mgt.pr_power_management

    b. Schedule, Setpoints and O&M Measures: All spaces should have their schedules and temperature setpoints for occupied and unoccupied periods reviewed and tightened in the BAS. See Appendix A for more detailed information about energy use patterns and electric loads.

    Check all copiers, personal appliances, printers, etc. and ensure they are set to power down to their standby or energy saving modes when not in use. There appears to be a large number of personal appliances in the building which should be shut off when not in use, and/or consolidated with central cafeteria equipment.

    Create a preventative maintenance (PM) program, to systematically check and manage the following items:

    Adjust Belts
    Clean Condenser Coils
    Clean Evaporator Coils
    Clean Filters
    Check Refrigerant Charges
    Maintain Condenser Fans and Motors
    Fix Refrigerant Leaks
    Maintain Cabinet Integrity
    Maintain Outside Air Dampers
    Check Airflow
    Maintain Fans
    Seal Ducts

Incorporating a quality PM vendor will keep equipment running smoothly and efficiently, and identify potential problems early on.

2. *Install Programmable Thermostats:* A programmable thermostat can be pre-set by the user to turn the heating and air-conditioning on and off based on the occupancy schedule of the building. The effect of this is that the equipment is not operating when the building is not in use or only partly in use, saving energy wasted on climate control when it is not needed. Programmable thermostats can save daily and weekly schedules that can be manually overridden without affecting the next day's or week's schedule.
3. *Replace boiler with high efficiency units*: The existing boiler can be replaced with a high efficiency unit at the end of its service period, which is typically around 20 years of service. New high efficiency boilers can operate at efficiencies of up to 97%, whereas the existing boiler operates at 78.5%. High efficiency boilers can significantly decrease heating energy use, often up to 20%.
4. *Replace Refrigerator:* Significant advancements in refrigeration technology over the last 10 to 15 years have led to the availability of higher efficiency refrigerator models. Older, less efficient refrigerator models can be replaced with high efficiency Energy Star models that use less electrical power to do the same job. The refrigerator in the staff kitchenette is a good candidate for replacement.

Recommendations not included in summary table:

1. Replace Air Compressor: The existing air compressor can be replaced with a new, high efficiency compressor to reduce power consumption.
2. Lighting Sensors: Occupancy sensors can reduce unnecessary energy use by performing the duties of turning lights in an area on and off when they sense someone entering or leaving an area. Areas that are good candidates for occupancy sensors are those that are used infrequently or unpredictably, such as classrooms, private offices, conference rooms, storage rooms, and bathrooms. The Library has several of these types of areas, most notably the book stacks.

   Daylight dimming sensors measure the amount of natural light reaching a space, and using dimming ballasts to reduce or increase the amount of light accordingly. By reducing the light levels when there is adequate natural light in some areas, electrical and cooling energy can be reduced.
3. Install Small Building Automation System (BAS): A BAS can control the heating, cooling. and ventilation systems of the entire building according to schedules and setpoints. The BAS only runs the equipment as necessary to meet the heating and cooling needs of the building. These systems allow an operator to override and modify the schedule or equipment function as needed via a graphical user interface. The result of this is a more efficient, streamlined HVAC operation that can significantly reduce energy use and associated costs.

   Additionally, the BAS has the capacity to log system data points over time (trending) to view how equipment behaves over several weeks. Often examining a point (temperature, humidity, etc) requires seeing how that information behaves over a period of time. By setting up trends on all the equipment in the building, at any point in time facility staff can review how that equipment has been behaving over the past several weeks, and determine if there is a problem.

   Although energy savings alone would not justify the installation of a BAS, it would provide invaluable information to building operators for operating and maintaining building equipment.

Next Steps

- Immediately implement no/low cost measures
- Determine objectives and level of interest to proceed with detailed study
- Contact NGRID and local gas utility to review opportunities and begin detailed audit of opportunities
- Detailed report reviewed
- Implementation of recommended measures

Please feel free to contact me if you have any questions.

Sincerely,

Richard Andelman, PE, CEM, CBCP

Joshua Doolittle

Appendix A – Statement of Energy Performance

Statement of Energy Performance
FACILITY SUMMARY REPORT
Melrose Public Library

For 12-month Period Ending: December 31, 2007
Date Generated: September 08, 2008

This document was generated using EPA's Portfolio Manager system. All information shown is based on data provided by the Portfolio Manager account holder. Depending on the use of the SEP Facility Summary, building owners or managers may want to have a professional engineer (PE) verify that the underlying data is accurate. Blank space has been left intentionally on the SEP Facility Summary for a PE stamp.

69 W Emerson Street
Melrose, MA 02176

Year Built: 1903
Gross Floor Area (ft²) 28,000

Facility Space Use Summary

K-12 School

Space Name	Gross Floor Area (ft2)	Number of Students	Number of PCs	Weekly operating hours	Cooking Facility	% Cooled	% Heated	Months	Ventilated
Melrose Public Library	28,000	50	50	60	N	90	100	12	Y

Energy Performance Comparison

Results	Current (12/31/2007)	Baseline (12/31/2007)	Delta	Target	Industry Average	ENERGY STAR
Energy Performance Rating	**73**	**73**	**-2**		**50**	**75**
Energy Intensity (kBtu/ft2)						
Site	43	43	0		53	43
Source	85	85	0		105	86
Energy Cost						
$/year	21804	21804	0		26832	21921
$/ft2/year	0.78	0.78	0.00		0.96	0.78
CO_2 Emissions (tons/year)	115	115	0		142	116

More than 50% of your building is defined as K-12 School. Please note that your rating accounts for all of the spaces listed. If you cannot see a rating, you will be compared to the national average of K-12 School.

EPA
United States
Environmental Protection
Agency

Appendix B– Images

Boiler control, air compressor for controls, thermostats, fan coil unit, perimeter fin tube heating