Gill Montague Regional School District

Preliminary
Energy Conservation Report

Prepared by:

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Performance Contracting Approach to Achieving Self Funded Energy Conservation Measures and Facility Improvements:

Siemens' Energy Performance Solutions Program is a customized program designed to reduce energy and operating costs through the implementation of infrastructure and management improvements. The program is typically financed through a third party lender, within existing utility budgets and typically requires no capital monies or additional ongoing expense.

Some benefits of the program include:

- Improved facility infrastructure
- Lowered operating costs
- Self-funded modernization of infrastructure
- Guaranteed cost reductions
- Reduced financial risk
- Improved operating efficiencies
- Improved occupant satisfaction and comfort

What is Performance Contracting?

Performance contracting is a legislated procurement process that enables municipalities and schools to use energy and operational savings within their existing buildings to fund necessary building upgrades, retrofits and other improvements (i.e. fire and security, infrastructure improvements, etc.) typically without requiring an increase to the budget. (capital dollars).

Siemens installs energy efficient equipment (lighting, controls, boilers, chillers, etc.), which reduces your existing energy budget and pays for the new equipment over time.

There are no required upfront costs and annual savings are guaranteed over the term of the agreement.

EXECUTIVE SUMMARY

Siemens provides a comprehensive solution to your building upgrades and cost-containment needs while maintaining a flexible approach. The Siemens Performance Contracting Team consists of highly qualified individuals with years of experience in servicing the energy and building needs of municipal and K-12 facilities nationwide. Our definition of success is improving the learning environment for your students, teachers and staff, reducing your costs, and building a long-term business partnership by investing in your community. We'd like to make our contribution and look forward to earning your business.

For the purposes of this report, Siemens has conducted a preliminary evaluation of the Gill Montague Regional School District to identify potential facility improvement opportunities.

Details about the buildings audited are listed in the table below:

	Building Information
Building Name	**Sqft.**
Turners Falls HS/ Great Falls MS	189,894
Sheffield ES	110,163
Hillcrest ES	34,438
Gill ES	18,320
	352,815

Based on the preliminary benchmarking analysis and a conservative savings estimate based on our past project experiences with similar space types, there is an opportunity to save approximately $ 158,984 per year from your existing budget. This savings is equivalent to 26.9% of the existing annual utility costs.

Based on the result of the benchmark analysis, there is a potential to fund approximately $ 3,052,492 in facility upgrades which could be paid for out of guaranteed savings in a 20 year contract term. Estimated savings do not include renewable technologies, utility rebates and operational and maintenance savings, which could also be used to fund the program. Operational and maintenance savings will be further investigated during the Detailed Energy Analysis (DEA). However, it should be noted that the final selection of measures depends on several components such as payback, financing terms and cost.

It is important to note that these cost/savings dollar values are based upon GMRSD's historical costs for utilities. Today's costs and future costs are proving to be higher which would increase the overall value of the savings and therefore fund more work. Reasonably, based upon today's costs, the savings would be 10-25% more in real dollar value.

UTILITY DATA

The benchmark analysis was performed using the historical average consumption of each facility. The current unit cost was applied to this number.

	# 2 Oil			Natural Gas			Electricity		
Building Name	Gals	Cost	Mbtu/ Sqft	CCF	Cost**	Mbtu/ Sqft	kWh	*Cost	kWh/ Sqft
Turners Falls HS/ Great Falls MS	17,645	$36,822	12.9	69,765	$102,764	37.8	1,369,800	$191,772	7.2
Sheffield ES	40,365	$94,235	50.8	22,392	$32,983	20.9	276,933	$38,771	2.5
Hillcrest ES	18,235	$42,785	73.4				107,099	$14,994	3.1
Gill ES	11,060	$28,386	83.7				82,606	$11,565	4.51

** Based on 2007 fixed price of $1.473

** Based on average cost of $.14/ kWh

ENERGY STAR BENCHMARKING

Siemens used the Energy Star Benchmarking Tool to compare each of the buildings to buildings of similar usage. As a result we were able to conservatively identify the savings potential for each of the buildings.

Gill Montague Regional School District
Benchmark Results

Building Name	Pre	Post	Reduction
Turners Falls HS/ Great Falls MS	$325,514	$239,434	$86,080
Sheffield ES	$166,172	$131,825	$34,347
Hillcrest ES	$57,846	$31,802	$26,044
Gill ES	$39,989	$27,476	$12,513
	$589,521		**$158,984**
			26.97%

Turners Falls High School / Middle School

Target Energy Performance Results (estimated)			
Energy	**Design**	**Target**	**Top 10%**
Energy Performance Rating (1-100)	36	70	90
Energy Reduction (%)	N/A	18	41
Source Energy Use Intensity (kBtu/Sq. Ft./yr)	134.0	98.9	71.6
Site Energy Use Intensity (kBtu/Sq. Ft./yr)	74.5	54.8	39.7
Total Annual Source Energy (kBtu)	25,440,545.6	18,778,620.4	13,591,488.0
Total Annual Site Energy (kBtu)	14,147,941.4	10,406,607.3	7,532,037.8
Total Annual Energy Cost ($)	$ 325,514	$ 239,434	$ 173,296
Pollution Emissions			
CO2-eq Emissions (metric tons/year)	1,023.8	753.0	545.0
CO2-eq Emissions Reduction (%)	-12%	18%	41%

Facility Information Edit

Turners Falls High School/ Middle School
Turners Falls, MA 01376
United States

Facility Characteristics Edit

Space Type	Gross Floor Area (Sq. Ft.)
K-12 School	189,894
Total Gross Floor Area	189,894

Estimated Design Energy Edit

Energy Source	Units	Estimated Total Annual Energy Use	Energy Rate ($/Unit)
Electricity	kWh	1,369,800	$ 0.140/kWh
Natural Gas	ccf	93,526	$ 1.430/ccf

Source: Data adapted from DOE-EIA. See EPA Technical Description.

Note that the current # 2 oil consumption was converted to natural gas.

Hillcrest Elementary School

Target Energy Performance Results (estimated)			
Energy	**Design**	**Target**	**Top 10%**
Energy Performance Rating (1-100)	10	70	90
Energy Reduction (%)	N/A	16	36
Source Energy Use Intensity (kBtu/Sq. Ft./yr)	109.3	60.1	45.4
Site Energy Use Intensity (kBtu/Sq. Ft./yr)	83.7	46.0	34.8
Total Annual Source Energy (kBtu)	3,764,097.7	2,069,358.4	1,562,885.3
Total Annual Site Energy (kBtu)	2,883,826.6	1,585,418.7	1,197,389.3
Total Annual Energy Cost ($)	$ 57,846	$ 31,802	$ 24,018
Pollution Emissions			
CO2-eq Emissions (metric tons/year)	225.9	124.2	93.8
CO2-eq Emissions Reduction (%)	-53%	16%	36%

Facility Information Edit

Hillcrest Elementary School
Turners Falls, MA 01376
United States

Facility Characteristics	Edit
Space Type	**Gross Floor Area (Sq. Ft.)**
K-12 School	34,438
Total Gross Floor Area	34,438

Estimated Design Energy			Edit
Energy Source	**Units**	**Estimated Total Annual Energy Use**	**Energy Rate ($/Unit)**
Electricity	kWh	107,099	$ 0.140/kWh
Diesel (No. 2)	Gallons	18,235	$ 2.350/Gallons

Source: Data adapted from DOE-EIA. See EPA Technical Description.

Sheffield Elementary School

Target Energy Performance Results (estimated)			
Energy	**Design**	**Target**	**Top 10%**
Energy Performance Rating (1-100)	45	70	90
Energy Reduction (%)	N/A	17	39
Source Energy Use Intensity (kBtu/Sq. Ft./yr)	101.9	81.3	59.7
Site Energy Use Intensity (kBtu/Sq. Ft./yr)	79.1	62.8	46.1
Total Annual Source Energy (kBtu)	11,222,563.0	8,961,107.6	6,579,104.8
Total Annual Site Energy (kBtu)	8,719,366.5	6,917,175.4	5,078,481.8
Total Annual Energy Cost ($)	$ 166,171	$ 131,825	$ 96,784
Pollution Emissions			
CO2-eq Emissions (metric tons/year)	518.7	411.5	302.1
CO2-eq Emissions Reduction (%)	-4%	17%	39%

Facility Information Edit

Sheffield Elementary School
Turners Falls, MA 01376
United States

Facility Characteristics	Edit
Space Type	**Gross Floor Area (Sq. Ft.)**
K-12 School	110,163
Total Gross Floor Area	110,163

Estimated Design Energy			Edit
Energy Source	**Units**	**Estimated Total Annual Energy Use**	**Energy Rate ($/Unit)**
Electricity	kWh	276,933	$ 0.140/kWh
Natural Gas	ccf	76,747	$ 1.660/ccf

Source: Data adapted from DOE-EIA. See EPA Technical Description.

Gill Elementary School

Target Energy Performance Results (estimated)			
Energy	**Design**	**Target**	**Top 10%**
Energy Performance Rating (1-100)	20	70	90
Energy Reduction (%)	N/A	16	36
Source Energy Use Intensity (kBtu/Sq. Ft./yr)	136.8	94.0	71.2
Site Energy Use Intensity (kBtu/Sq. Ft./yr)	99.9	68.6	52.0
Total Annual Source Energy (kBtu)	2,505,266.4	1,721,326.3	1,304,662.6
Total Annual Site Energy (kBtu)	1,830,249.5	1,257,533.6	953,135.4
Total Annual Energy Cost ($)	$ 39,989	$ 27,476	$ 20,825
Pollution Emissions			
CO2-eq Emissions (metric tons/year)	145.3	99.8	75.6
CO2-eq Emissions Reduction (%)	-23%	16%	36%

Facility Information Edit

Gill Elementary School
Gill, MA 01376
United States

Facility Characteristics	Edit
Space Type	**Gross Floor Area (Sq. Ft.)**
K-12 School	18,320
Total Gross Floor Area	18,320

Estimated Design Energy			Edit
Energy Source	**Units**	**Estimated Total Annual Energy Use**	**Energy Rate ($/Unit)**
Electricity	kWh	82,606	$ 0.140/kWh
Fuel Oil (No. 2)	Gallons	11,060	$ 2.570/Gallons

Source: Data adapted from DOE-EIA. See EPA Technical Description.

FACILITY DESCRIPTIONS

Turners Falls HS/ Great Falls MS

BUILDING DESCRIPTION

The Turners Fall High School/ Great Falls Middle School comprises of a 3-story, brick faced building with aluminum frame, double pane windows and flat membrane roof. Originally built in 1925 with additions and renovations in 1988, the school was completely overhauled and rededicated in 2004. Current occupancy for the school is 637 students and 130 teachers/ staff members. Operating schedules are 6:00 AM to 10:00 PM, Mon.-Sat. with some Sundays.

SYSTEM DESCRIPTIONS

Lighting

Majority of the lighting system consists of T-8 fluorescent fixtures. Metal halide fixtures were observed in the gymnasium.

Mechanical Systems

Heating hot water for space conditioning is provided by (3) Bryan, flex tube hot water boilers. Each boiler is equipped with an Iron Fireman Burner rated with an energy input of 2,500 MBH and an output of 2,000 MBH. The boilers have a turn down ration of 50%. (4) 7 ½ HP and (2) 5 HP hot water pumps distribute the heating hot water to the end devices. These pumps operate in a lead/ lag set up and have variable frequency drives installed. Although these

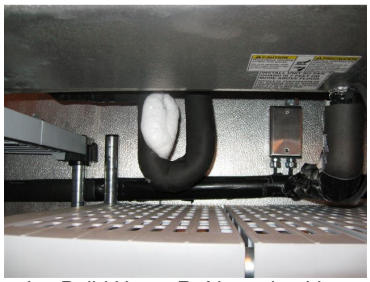
burners have dual-fuel capability, natural gas was their primary fuel source for the last three years. Perimeter is heated via fin tube radiation. Classroom conditioning is provided by unit ventilators. In addition,(2) dedicated rooftop units handle the gymnasium while (5) Heat Recovery Units provide the Classroom Wing North, West, the Library, the Cafeteria and the Music Room.
Only 15% of the school is cooled.

A Dectron unit supplies the pool with the heat needed to maintain the space temperature currently set at 80°F. This Dectron unit is gas-fired and outfitted with a VFD. This VFD however is only used for soft start.
(2) Turbo Power, gas-fired domestic hot water heaters satisfy the buildings domestic hot water needs. Each has a storage capacity of 400 gals and is rated with an energy input of 800 MBH. It was stated by facility personnel that there is an existing problem with domestic hot water for the showers in the pool area.

Energy Management System

Building control is achieved via the use of an Invensys Energy Management System. The system provides basic control strategies like night setback, hot water reset. Space heating temperatures are set at 72°F during occupied and 65°F during unoccupied periods. A project is currently underway to tie the existing security system into the EMS.

Miscellaneous


Ice Build Up on Refrigeration Line

The school is home to a fully operating cafeteria. All cooking equipment is gas fired. However, the dishwasher still utilizes an electric booster heater. Approximately 400 meals are served daily. We observed two walk-in coolers/ freezer and noted ice build up on the refrigeration lines. This can reduce the efficiency of the existing refrigeration system as the heat transfer rate of refrigeration coils could be effected.
In addition 1 snack and 3 cold drink machines were found present in the cafeteria as well.

In an effort to be energy efficient the school installed solar panels on the roof. The solar panels have a capacity of 75 kW. However, the system has been disconnected and abandoned in place.

Hillcrest Elementary School

BUILDING DESCRIPTION

Originally built in 1958, the single story, brick faced Hillcrest Elementary School underwent some building renovations in 2004. As part of this project vinyl windows and new exterior doors were installed. However, the interior walls show clear signs of moisture problems which could be identified as it was obvious that paint was peeling of the walls as a direct result. Although the total square footage for the building is 34,438 square feet, only have of the school is utilized for education while the other half serves as storage space. The facility is occupied Mon.-Fri. from 7:45 am to 4:30 PM by 106 students and 26 staff members.

Moisture Damage on Interior Wall

SYSTEM DESCRIPTIONS

Lighting

Besides the majority of T-8 fluorescent fixtures, (15) 300 W incandescent fixtures were observed in the cafeteria. The gymnasium is illuminated with 8 foot fluorescent 5000 k fixtures. No occupancy sensors were noted during our initial site visit.

Mechanical Systems

The buildings heating system comprises of a single H.B. Smith, cast iron section boiler. This boiler has a capacity of 1,526 MBH and provides low pressure steam to classroom unit ventilators (CUVs). The CUVs are original and have reached the end of their useful life. A visual inspection of the boiler revealed visible corrosion in the boiler water which is an indication for the lack of boiler water treatment. In addition we observed

signs of physical deterioration on the condensate receiver.

A single 32 gallon Bock domestic hot water heater provides the school with all of its domestic hot water. The heater is oil fired and has a capacity of 104 MBH or .75 GPH.

Energy Management System

An original Johnston Control Energy Management System provides the only means of building controls. The system is pneumatic and actual operation is questionable. Only two of the ten pressure gauges were actually reading pressure. It appears that a single time clock is used to turn equipment on and off. The current schedule is 5:00 AM to 5:30 PM Mon.-Fri. However, there does not seem to be a boiler controller connected to this system. Control air is produced by a single air compressor located in the boiler room. Sign of oil leakage are apparent. We also noted that the refrigeration coil of the associated air dryer was completely plugged thus not allowing satisfactory dried air. As a result water may build up in the system which in exchange can make the pneumatic end devices inoperable.

Plugged Air Dryer

Miscellaneous Equipment

All of the kitchen equipment is electric including dishwasher, booster heater, range oven and steam kettle. A propane conversion would certainly provide sufficient energy savings but would require the installation of a code compliant fire suppression system.

Sheffield Elementary School

BUILDING DESCRIPTION

Founded in 1904, the Sheffield Elementary School is the oldest school within the district. The facility consists of a 3-story, brick faced building with original wooden sash windows and a flat, membrane type roof. One of the largest areas for occupant complaints are the windows. 274 students are currently enrolled in the school supported by a total of 57 teachers/ staff members. School hours are from 7:45 AM to 4:30 PM, Mon.-Fri.

SYSTEM DESCRIPTIONS

Lighting

The majority of lighting fixtures comprise of T-8 fluorescent fixtures. Fixtures installed in the gymnasium appear to be new T-5 HID technology. However, various incandescent fixtures as well as older technology Exit signs were observed during our site visit. Lighting control could not be found.

Mechanical Systems

The current heating system encompasses two mechanical rooms. Majority of the heating is supplied by a single, Smith cast iron sectional boiler. This boiler produces low pressure steam that is send to cast iron radiators and original classroom unit ventilators. It is equipped with a Power Flame burner rated with a fuel input of 19.6 GPH of # 2 fuel oil. The burner has a turn down ratio of 28%. It was stated

that the unit ventilators handling the gymnasium are currently not operating and that the only heat source for this area are the existing wall mounted cast iron radiators.

While 75% of the school is handled by a steam system, the remaining 25% utilize (2) Weil McLain cast iron sectional hot water boilers. Heating hot water is pumped via (2) standard efficient 5 HP hot water pumps that operate in a lead/ lag configuration. Outfitted with a dual-fuel Power Flame burner, the primary fuel used in the last 3 years was natural gas. The burner has an input rating of 3,090 MBH on NG or 22 GPH # 2 fuel oil. A combustion efficiency test performed at start up for this boiler stated the combustion efficiency to be 79%. Actual fire damage was observed on the exterior shell of this boiler. It is not clear what the cause for this damage was.

Visible Fire Damage

Domestic hot water for the "New Section" is provided by (2) A.O. Smith, direct fired domestic hot water heaters. Each has a capacity of 89 gallons and operates on natural gas. The "Old Section" uses a single 80 gallon electric domestic hot water heater.

In addition to the described heating equipment (3) direct fired Raznor rooftop units were also observed. These units are gas-fired.

Energy Management System

Current building control is achieved with a single wall mounted thermostat located in the administration office. Accuracy of this thermostat is questionable. The actual site visit was on Monday, 10-20-2008 at 10:35 AM. However, the time displayed on the thermostat was 5:57 PM on Thursday. All of the original pneumatic end devices are supplied by a single air compressor located in the new mechanical room. It appears that they are operated by a time clock. Current schedule is set for 5:30 AM to 5:30 PM, Mon.-Fri.

Miscellaneous

The cafeteria at the Sheffield Elementary School serves approximately 225 meals per day. All of the kitchen equipment is currently electric.

Gill Elementary School

BUILDING DESCRIPTION

With a total of 18,320 square feet the Gill Elementary is the smallest school within the Gill – Montague Regional School District. The school consists of a single story, brick faced building with aluminum frame, double pane windows and a sloped asphalt shingled roof. Occupied by 133 students and 21 teachers/ staff members building operating hours are 7:45 AM to 4:30 PM, Mon.-Fri.

SYSTEM DESCRIPTIONS

Lighting

Lighting fixtures of the school are predominately T-8 fluorescent. T-5 HID fixtures were found in the multi purpose room.

Mechanical Systems

The buildings heating load requirements are met by a single Peerless steam boiler that appears to be original. It shows clear signs of age and physical deterioration and should be replaced. # 2 oil is the primary fuel source and the burner has an input rating of 18.8 GPH. Based on the name plate data this boiler does not seem to provide burner modulating capabilities. Heating hot water is produced through the utilization of a steam to hot water heat exchanger. Two in-line circulator pumps distribute the heating hot water to original classroom unit ventilators, fin tube perimeter heating and single heating and ventilation unit that handles the multi purpose room..

Domestic hot water is supplied by a 80 gal, oil fired domestic hot water heater.

The general observation was made that much of the pipe located in the boiler room was uninuslated.

Energy Management System

Space temperature control is achieved via an original, pneumatic control system. Maintenance personnel stated that this system is no longer operating in a reliable fashion and needs to be recommissioned or replaced.

Miscellaneous

The facility has a fully operating all-electric cafeteria.

Energy Conservation Measure Summary

The following Energy Conservation Measures were identified during our walk thru:

ECM #	Measure Description	Turners Falls HS/ Great Falls MS	Hillcrest Elementary School	Sheffield Elementary School	Gill Elementary School
1	Lighting & Lighting Controls	X	X	X	X
2	EMS Installation/ Optimization	X	X	X	X
3	Boiler Replacement		X	X	X
4	Motors & Drives	X			
5	Steam Trap Replacement		X	X	
6	Kitchen Equipment Conversion		X	X	X
7	Domestic Hot Water Heater Replacement			x	X
8	Booster Heater Replacement	X			
9	Dishwasher Replacement		X	X	X
10	Building Envelope			X	X
11	Window Replacement			X	
12	Pipe Insulation				X
13	Network Controller	X	X	X	X
14	Plugload Controller	X	X	X	X
15	Cooltrol Refrigeration Controls	X			
16	Solar Photo Voltaic	X			
17	Solar Domestic Hot Water	X	X	X	X

THE LIST ABOVE INCLUDES ALL IDEINTIFED MEASURES.
HOWEVER,FINAL MEASURE SELECTION DEPENDS ON PAYBACK CRITERIA SET BY GMRSD.
SOME MEASURES MAY REQUIRE ADDITONAL FUNDS TO BE COST EFFECTIVE.

POTENTIAL ENERGY CONSERVATION MEASURES (ECMS)

Based on preliminary site investigation, Siemens has identified the following potential Energy Conservation Measures (ECMs):

Lighting and Lighting Controls

Lighting*:*
Siemens proposes to replace any existing T-8 fluorescent lamp fixtures with efficient Super T-8 high lumen output fluorescent lamp fixtures and high efficiency electronic ballasts.

Sensors

Occupancy and daylight sensors will be installed in any applicable areas.
Dataloggers will be installed throughout a sampling of areas during the detailed audit to clearly quantify the potential for savings.

EMS Installation/ Optimization

In order to reduce energy consumption and improve occupancy comfort at the Elementary School, Siemens proposes to install new Direct Digital Controls.

The new systems shall be supplied with all the necessary software to perform the specified functions. Details and characteristics of system software shall be included as part of the technical proposal and shop drawing submittals. In addition, sequences and control strategies at the The following system software shall be supplied as a minimum:

- 365 day Zone Scheduling
- Optimum Start
- Historical Tracking Database
- Full Color Graphics
- Logical programming functions

Proposed Sequences of Operations

The following are some of the proposed control sequences which will be used to save energy and reduce operating costs.

Night Setback:

By implementing this EMS strategy, the energy required for heating or cooling during unoccupied hours is reduced by lowering the heating space temperature set point or raising the cooling space temperature set point. For example, the space temperature can be reduced from the normal winter inside design temperature (70°F -72°F) to a lower space temperature (55°F - 60°F) during the unoccupied periods.

Scheduled Start/Stop:

The scheduled start/stop program consists of starting and stopping equipment based on the time of day and day of week. Scheduled start/stop is the simplest of all EMS functions to implement. This program provides the best potential for energy conservation by turning off equipment or systems during unoccupied hours. The new system will also allow systems to be turned off during holidays.

Optimum Start/Stop control of HVAC System Equipment:

The scheduled start/stop program previously described is refined by automatically adjusting the equipment operating schedule in accordance with space temperatures and outside air temperature. In the scheduled start/stop program, HVAC systems are started prior to occupancy to cool down or heat up the space on a fixed schedule independent of outside air temperature and space conditions.

The optimum start/stop program automatically starts and stops the system on a sliding schedule. The program will adjust start/stop time by taking into account the thermal inertia of the structure, the capacity of the HVAC system to either increase or reduce space temperatures, outside air temperature conditions, and current space temperatures, using prediction techniques.

These techniques determine the latest time for starting HVAC equipment to satisfy the space environmental requirements at the beginning of the occupied cycle, and determine the earliest time for stopping equipment at the day's end.

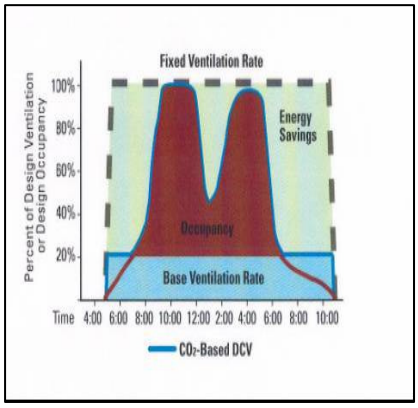
Hot Water Temperature Reset (Gill ES):

The EMS will reset the heating hot water and water supply temperatures based on the outside air temperature. Reset schedules will be determined from the system's heating/cooling needs. The EMS will have the ability to raise the hot water temperature to its maximum in the morning to minimize the morning warm-up period, and then return to the normal outside air temperature reset schedule set point. Thermal energy will be saved by only using as much heat as is required based on outdoor air conditions.

Summer-Winter Operation Monitoring:

A summer-winter operation monitoring program will provide the means to change the operating parameters, alarm limits, and start-stop schedules for HVAC systems interfaced with the EMS from summer to winter operation and vice versa. The summer-winter switchover conditions for each HVAC system may be different; i.e., temperature set points or calendar schedule.

Demand Ventilation Control (TFHS, Gill ES)



Heating and cooling energy will be saved if ventilation air (i.e. outside air) is reduced during the occupied period. The quantity of ventilation shall be based on maintaining a tracer gas, carbon dioxide (CO2) as an indicator of indoor air quality. A limit of 1000 PPM of CO2 is recommended in ASHRAE Standard 62-1982, Ventilation for Acceptable Indoor Air Quality. Sensors shall be installed to measure the building air CO2 concentration. The sensors shall be inputs to a EMCS controller, whose output to the outside air damper will maintain the CO2 setpoint. During unoccupied periods the outside air dampers shall be closed.

The new EMS will allow the facility to monitor the energy consuming equipment in the building remotely in real-time, track the facility energy performance, and remotely adjust setpoints and schedules to optimize the facility operation.

Boiler Replacement (Hillcrest ES/Sheffield ES/Gill ES)

The existing boilers at Hillcrest, Sheffield and Gill Elementary Schools are inefficient and old, outliving its useful life. Replacement of the boilers with high efficiency units will result in considerable energy savings.

At the Hillcrest Elementary School there are two (2) boiler plants, (1) steam boiler plant which consists of a single steam boiler serving approximately 1/3 of the building and (1) hot water boiler plant which consists of (2) hot water boiler which serves approximately 2/3 of the building. Siemens proposes to replace the (2) hot water boilers with a hybrid boiler plant consisting of (1) condensing boiler and (1) non-condensing boiler. The new boiler plant will be gas-fired and sized to handle the entire building with substantial improved efficiency. An interconnection to the steam boiler loop will be installed, thus eliminating the steam boiler plant.

At the Sheffield Elementary School, Siemens proposes to replace the old inefficient steam boiler with a new high efficiency oil-fired steam boiler properly sized to condition the building. The new boiler has a substantially improved efficiency.

At the Gill Elementary School there is a single steam boiler that is converted to hot water utilizing a heat exchanger in the boiler plant. Siemens proposes to replace the old inefficient steam boiler with a new high efficiency oil-fired hot water boiler properly sized to condition the building. The new boiler has a substantially improved efficiency.

Motors and Drives (Turners Falls HS/ Great Falls)

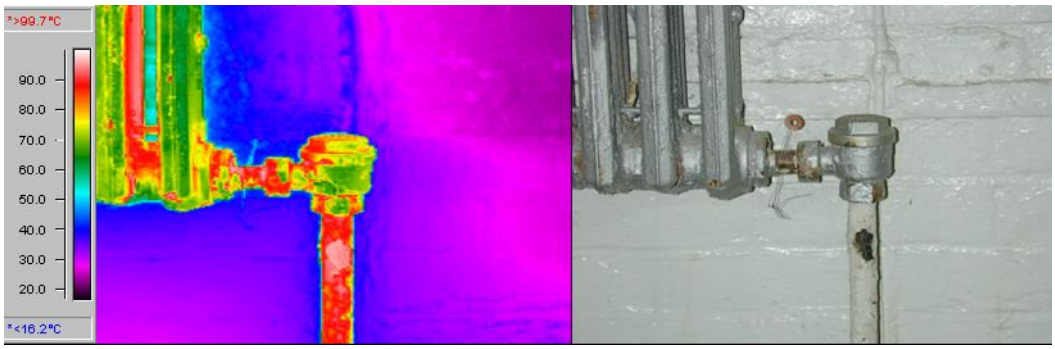
Substantial energy savings will be obtained by replacing the standard efficiency motors with energy efficient motors on heating hot water pumps with premium efficiency motors. Energy-efficient electric motors reduce energy losses through improved design, better materials, and improved manufacturing techniques. With proper installation, energy-efficient motors run cooler and consequently have higher service factors, longer bearing and insulation life, and less vibration.

In addition Siemens will install Variable Frequency Drives (VFD's) on pumping systems that are not required to be at 100% load most of the time. A VFD will reduce the operating speed of the motor to effectively match the output of the fan or pump to the systems requirements. The flow rate of the fan or pumping system is also reduced with the reduction in motor speed. The VFD will either be individually programmed to maintain system operating parameters with feedback from system monitoring sensors or can be modified via an energy management system

(EMS) that will provide the necessary feedback to the VFD through monitoring sensors.

Steam Trap Replacement (Hillcrest & Sheffield ES)

The steam system consists of steam and condensate main piping, steam and condensate distribution piping, strainers, steam control valves, terminal equipment (steam coils, heaters, etc.), condensate pumps, and steam traps. The function of the steam trap is to vent air and drain condensate that is formed in the steam distribution system to prevent live steam from



exiting when condensate in the lines is vented. Condensate is trapped and removed via various styles of steam traps (float and bucket, thermodynamic, thermostatic, and impulse types), each having a specific function and range of applications. These traps require constant maintenance to assure proper operation.

Mechanical steam traps can lose steam in two different ways. The first unavoidable loss occurs during the normal cycling of steam traps. This loss typically amounts to 1% of the trap capacity. The second loss is from failed and malfunctioning traps. Since traditional steam traps are mechanical, they are susceptible to failures resulting in the trap “blowing” steam. The traps are also susceptible to a variety of malfunctions that lead to the traps “leaking.”

Siemens proposes to replace/ rebuilt the existing traps with a new mechanical equivalent. The existing float and thermostatic traps (F&Ts) will be rebuilt with components from their original manufacturers. Typically, the float ball, the thermostatic air vent and all seats will be rebuilt. Cover gaskets will be replaced. This action will restore the traps to their original operating condition, without the expense of replacing the entire trap body. Although there are other type of traps available (I.e. Orifice Type Traps), given the age of the existing system, proper operation could not be guaranteed.

Kitchen Equipment Conversion

All electric kitchen equipment used for cooking is a very expensive means of food preperation.

Existing kitchen equipment at the Hillcrest, Gill and Sheffield Elementary School is electric and appears to be of older technology. Siemens is recommending replacing

existing electric kitchen equipments in the building with propane or natural gas fired equipment. Significant amount of savings can be achieved by implementing this measure given the fact that cooking with natural or propane gas is more efficient that using electricity.

Domestic Hot Water Heater Replacement

The existing direct fired domestic hot water heaters are old and inefficient. As a result energy is wasted due to the standby losses of the storage tank as well as the inefficient burner.

Siemens proposes to replace the existing system with a bank of modular storage tanks that are fed by a new, state of the art condensing boiler. Actual size of the storage tanks shall have to be determined during the detailed energy audit.

Booster Heater Replacement

The cafeteria at the Turners Falls HS/ Great Falls MS utilizes an all electric booster heater to raise the water temperature from 120°F to more than 140°F for dish washing. Considering that the rest of the kitchen equipment is gas fired Siemens proposes to install a new gas fired booster heater. Using gas to heat water is less expensive than using electricity and therefore saves booster related energy cost.

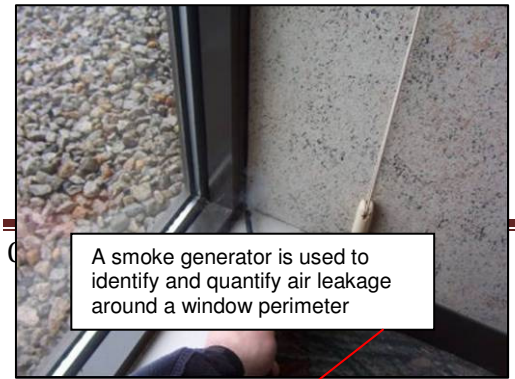
Dishwasher Replacement

The dishwashers at all but the Turners Falls HS appear to be original. Heating water for an automatic dishwasher represents about eighty percent of the energy required. Newer efficient dishwashers use eight to fourteen gallons of water for a complete wash cycle and require a water temperature of 140 °F for optimum cleaning. An added feature in the newer models is the availability of cycle selections and in-built booster heaters that will either automatically raise the water temperature or can be manually switched on before the wash cycle begins. The most efficient dishwasher currently on the market costs about half as much to operate as the most inefficient model.

Siemens proposes to replace the existing dishwashers with a new, high efficient equivalent.

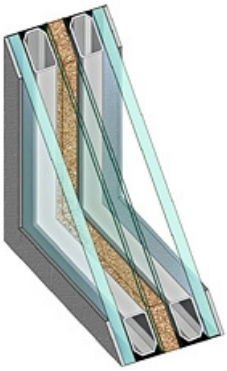
Building Envelope Improvements (Sheffield and Gill Elementary School)

Air leakage is defined as the "uncontrolled migration of conditioned air through the building envelope" caused by pressure differences due to wind, chimney (or stack) effect, and mechanical systems. Air leakage has been shown to represent the single largest source of heat loss or gain through the building envelopes of nearly all



types of buildings. Beyond representing potential for energy savings, uncontrolled air leakage can affect the thermal comfort of occupants, air quality through ingress of contaminants from outside and the imbalance of mechanical systems. The structural integrity of the building envelope can also be compromised through moisture migration. Control of air leakage involves the sealing of gaps, cracks and holes, using appropriate materials and systems, to create, if possible, a continuous plane of "air-tightness" to completely encompass the building envelope. Part of this process also incorporates the need to "decouple" floor - to - floor, and to "compartmentalize" components of the building in order to equalize pressure differences.

Window Replacement



The windows at the Sheffield Elementary School are original and show clear signs of physical wear and tear. These windows have become a large contributor to infiltration and exfiltration problems.
Siemens proposes to replace the existing single-pane window system with a new energy efficient system. The new window system will be comprised of new double-pane, low emissivity ("low-e"), high-performance glass with aluminum trim, which has a U-Value of 0.45 and a shading coefficient (SC) of 0.55. Implementation of this measure will reduce heat losses in the winter and heat gains in the summer, as well as reducing infiltration losses, thereby producing energy savings all year long. Occupants will benefit from improved comfort, especially when seated near windows. In addition, the new window system will greatly improve the aesthetic appearance of the building. The new windows will also close more completely, adding to the safety and security of the building.

It should be noted that windows usually have a higher payback and additional funds will be needed for the implementation of this measure

Pipe Insulation

During our initial visit at the Gill Elementary School we observed a large amount of pipes that were left uninsulated in the boiler room. We recommend to insulate these pipe with 1" thick fiberglass insulation. This will reduce the amount of heat rejected into the space and thus save energy.

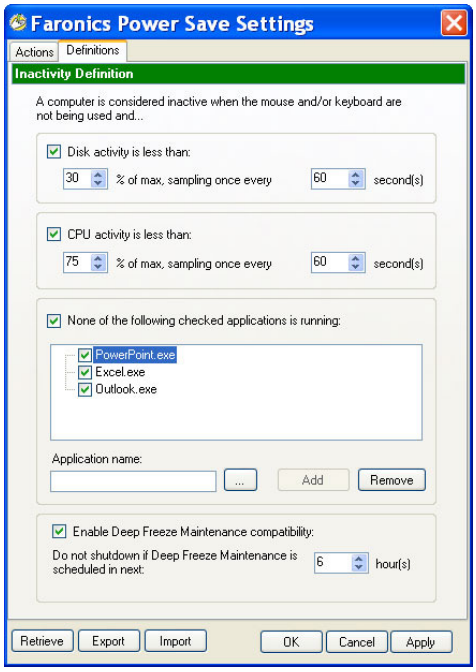
Network Controller

PCs are voracious consumers of electricity, and their energy use is increasing as faster processors, more memory, and more power-hungry peripherals become commonplace. A combination of the Central Processing Unit (CPU) and the monitor consumes around 120 watts (70 watts for the CPU and 50 watts for the monitor) while in operation, 12

watts (10 watts for the CPU and 2 watts for the monitor) while in standby/sleep mode and 2 watts (2 watts for the CPU and 0 watts for the monitor) in hibernation/off mode. According to the Department of Energy and Lawrence Berkeley National Laboratories, the average PC can waste up to 400 kilowatt-hours of electricity a year simply by running at full power when no user is present.

Siemens proposes the installation of the Faronics Power Save Software to reduce the computers energy consumption.

Faronics Power Save changes all this by providing system administrators with enterprise-wide control over advanced computer power configurations. With Power Save, computers can now be configured to shutdown, stand-by and hibernate based upon CPU usage, disk activity and application activity. The application activity feature is particularly useful if you would like a system to remain powered on whenever a certain application is running. Power Save even has the ability to generate detailed reports outlining enterprise-wide energy consumption levels and associated costs savings.



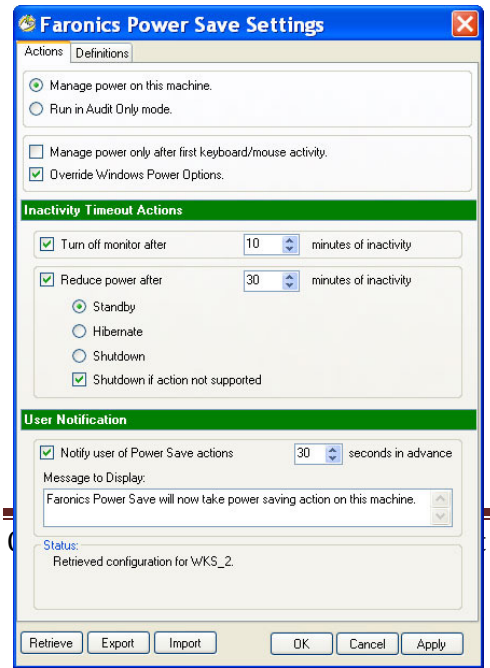
Using the Power Save Console, system administrators also have the ability to deploy a pre-configured installation package containing customized actions, inactivity settings, and more.

Intelligent Configuration Settings

- Definitions can be based on CPU, disk, keyboard, mouse and active applications
- Shutdown without the loss of user productivity

Flexible Scheduling

- Options to turn off the monitor, and standby, hibernate or shutdown the computer
- Schedule Wake-on-LAN, shutdown, or restart events
- Promotes user productivity in tandem with energy conservation



Compatibility Options

- Customize the deployment as well as update and control the client workstations
- Support for MMC – recognized as a standard tool among system administrators

- Localized in five languages: English, French, German, Spanish and Japanese

Enterprise Reporting

- Power Save features a built-in power consumption reporting tool
- Detailed workstation utilization reporting allows you to see how much power you are saving based upon your regional electricity cost.

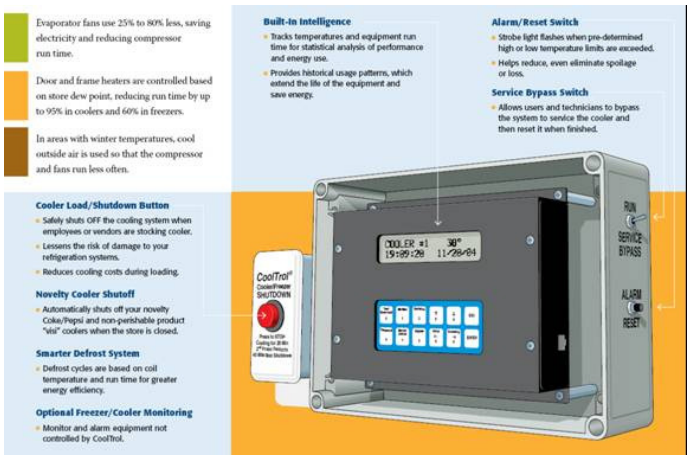
Plugload Controller

For the control of the vending machines Siemens proposes to install vending machine occupancy controllers to manage the power consumption of the vending machines. Utilizing a Passive Infrared (PIR) sensor, the controller completely powers down a vending machine when the area surrounding it is unoccupied. Once powered down, the controller will monitor the room's temperature and use this information to automatically re-power the vending machine at one to three hour intervals, independent of occupancy, to ensure that th e vended product stays cold.

The controller also monitors electrical current used by the vending machine. This ensures that the unit will never power down a vending machine while the compressor is running, so a high head pressure start never occurs. In addition, the current sensor ensures that every time the vending machine is powered up, the cooling cycle is run to completion before again powering down the vending machine. The proposed controller is approved by the Coca Cola Company and the Pepsi Corporation for use on their machines.

Cooltrol Walk-In Controls (Turners Falls HS/ Great Falls MS)

Siemens proposes to install a CoolTrol® Cooler Control System for the walk-in cooler located in the kitchen of the Elementary School. The CoolTrol is an energy efficient, cost-saving solution for your walk-in coolers and freezers. With skyrocketing fuel and energy costs, many owners and managers are turning to a smart and innovative system to help them reduce operational costs and improve their bottom line.



- Evaporator fans run 25% to 80% less, saving electricity and reducing compressor run time.
- Door and frame heaters are controlled based on store dew point, reducing run time by up to 95% in coolers and 60% in freezers.
- Evaporator fan motors are replaced with hi-efficient fan motors saving 40% to 70% in energy.

The proposed system comprises of a door controller, evaporator fan motor replacement and CoolTrol Cooler Control System.

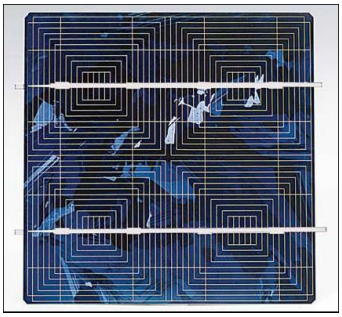
Solar Photo Voltaic

The Turners Falls HS has an abandoned 75kW solar photovoltaic system installed on the roof. Siemens proposes to replace this system with new grid connected, solar photovoltaic

panels. The photovoltaic panels would provide approximately 125,000 kWh of environmentally friendly power for the building. Rather than installing the system like the current which were installed lying down flat, the new panels would be installed in a tilted angle with a solar tracker.

A solar tracker is a device for orienting a solar photovoltaic panel or concentrating solar reflector or lens toward the sun. The sun's position in the sky varies both with the seasons (elevation) and time of day as the sun moves across the sky. Solar powered equipment works best when pointed at or near the sun, so a solar tracker can increase the effectiveness of such equipment over any fixed position, at the cost of additional system complexity. There are many types of solar trackers, of varying costs, sophistication, and performance.

Photovoltaics is the process of converting sunlight into electricity by means of a photovoltaic cell. The photovoltaic cell is a solid-state device composed of thin layers of semiconductor materials which produce an electric current when exposed to light. Single cells are connected in groups to form a module, and modules are grouped to form an array. The voltage and the current output from the array depend upon how the system is configured. Photovoltaic cells produce direct current (DC) electricity, the type of electricity contained in batteries. Most appliances, however, are designed to use alternating current (AC) electricity, the type available from a standard wall socket.

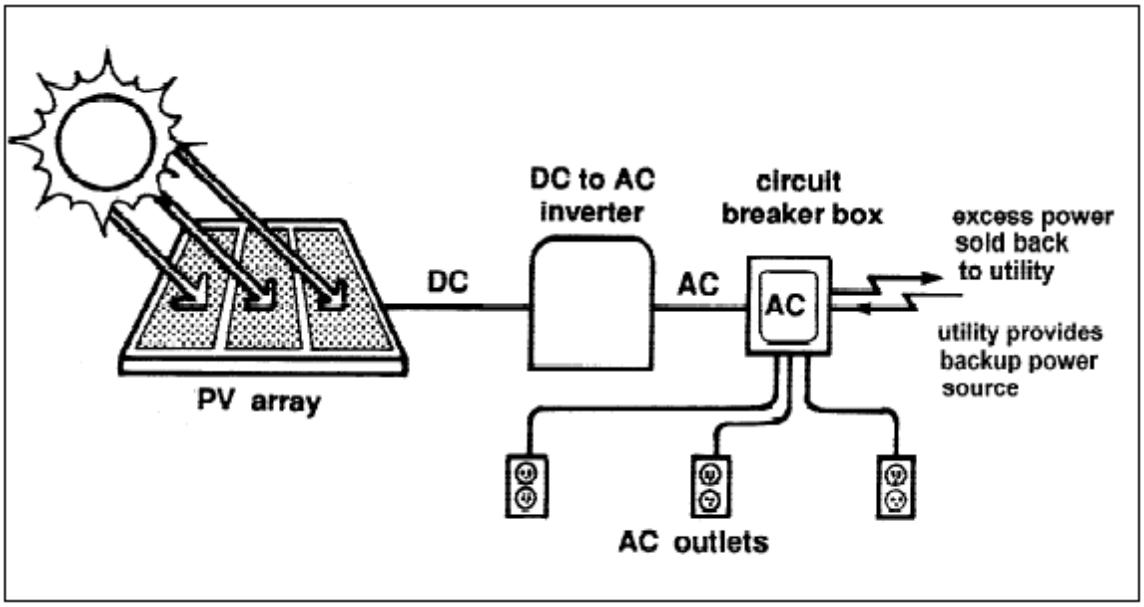


When AC current is required, an inverter is added to the photovoltaic system to change the current from DC to AC, but this will incur a 10-15 percent loss of power output. Photovoltaic-generated electricity has many applications.

The amount of area covered by photovoltaic panels will generate approximately 75,000 watts of electric power at full output. Several factors tend to limit the generation, however, these including the slope of the surface with respect to horizontal, occasional snow cover, and bird excrement. These factors are not expected to decrease the system performance to any great extent, however.

The new panels will be installed directly on the existing roof. Siemens assumes that their weight is not so great as to warrant greater structural support than currently exists, and will be confirmed during the detailed audit.

The energy generated by the photovoltaic modules will be tied directly into the college's power grid. This "Clean Green Energy" output is at its highest level when the sun's intensity is peaking. This new energy will coincide with the facility's need for space cooling and expensive summer electricity demand.

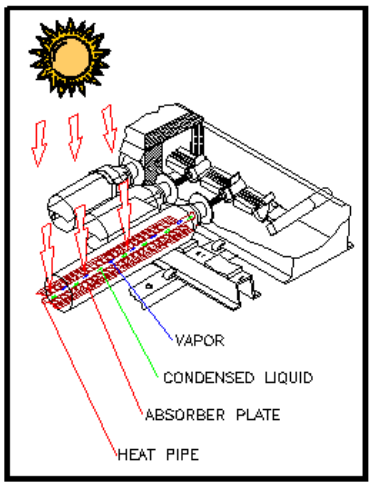


The system is environmentally attractive. Although this measure usually has a high pay back, further financial incentives are anticipated to be available to help defray the initial cost.

Solar Domestic Hot Water

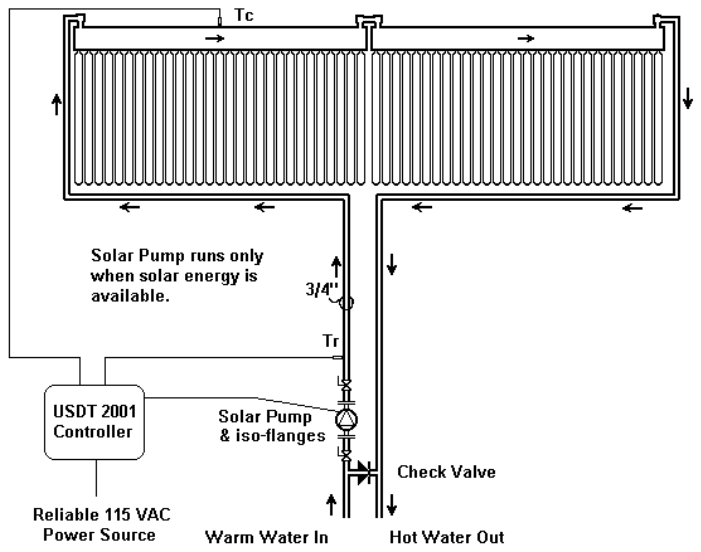
SIEMENS proposes to install a bank of tubed solar collectors on top of the roof. The system shall be installed as a closed loop system and tied directly to the existing domestic hot water tank. This will enable the facility to benefit from the solar energy while still having their existing system available. Instead of using a common solar collector panel, SIEMENS proposes the use of an Evacuated Heat Pipe Solar Collector or similar.

Evacuated Heat Pipe Solar Collectors (tubes) operate in a different way than other collectors available on the market. These solar collectors consist of a heat pipe inside a vacuum-sealed tube, as shown on the picture to your right. It should be noted that the collector tube has no water in it. The manifold across the top serves as a heat exchanger holding about one pint of heat-transfer liquid. Because of the "Thermal Diode" one-way heat transfer mechanism of the



heat pipe, heat in the manifold cannot leak out through the collector tubes.

Since water circulates only through the well-insulated collector manifold (equivalent to ¾ copper pipe with R-10.8), there are no significant heat losses in the manifold and collector system. The system configuration is extremely simple in principal and thus low in cost to execute.



Each tube contains a sealed copper pipe (heat pipe). The pipe is then attached to a black copper fin that fills the tube (absorber plate). Protruding from the top of each tube is a metal tip attached to the sealed pipe (condenser). These tubes are mounted, the metal tips up, into a heat exchanger (manifold). As the sun shines on the black surface of the fin, the alcohol is heated and hot vapor rises to the top of the pipe. Water, or glycol, flows through the manifold and picks up the heat from the tubes. The heated liquid circulates through another heat exchanger and gives off its heat to water that is stored in the existing tank. Please refer to the sketch on the left for hook-up detail.