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**Gallatin Gateway Elementary School– ENERGY AUDIT – September 2009**



**INTRODUCTION**

A preliminary or basic energy audit was performed on the Gallatin Gateway Elementary School. A basic energy audit as defined by the Montana Department of Commerce is as follows: “The preliminary audit is the simplest and quickest type of audit. It may consist of interviews with site-operating personnel, reviews of utility bills or other operating data, and a walk-through of the facility. In a basic audit, the auditor will identify major areas of energy waste or inefficiency, briefly describe available corrective measures, and provide basic estimates of cost of recommended improvements, the potential operating cost savings, and the estimated payback periods”.

**BUILDING SUMMARY**

The Gallatin Gateway Elementary School is roughly a 18,500 square foot facility serving elementary age children in Gallatin Gateway, MT. Construction of the original Gallatin Gateway Elementary building was completed in the 1914. The building houses general functions associated with elementary schools.

The building has undergone many renovations over the years. The gymnasium and cafeteria were constructed in the 1970’s. The original 2 story structure consists of brick walls, asphalt shingled roof, and double hung single pane windows. The Gymnasium consists of masonry wall, membrane roof, and metal frame dual pane windows. It is our understanding; the original brick building is used in a limited fashion. The first floor is partially utilized and the second floor is primarily used for storage.

**ENERGY CONSERVATION MEASURE SUMMARY**

Energy Conservation Measure	First Cost	Annual Energy Saved	Annual Cost Savings	Simple Payback (in years)
1. Boiler Upgrade	\$ 35,565	4749 therm	\$ 3,941.00	7.3

**\*First Costs do not reflect engineering design fees and construction administration services. See Cost Estimates\***

**MECHANICAL SYSTEM SUMMARY**

The primary source of heating for this facility is derived from two gas-fired hot water boilers located in the basement mechanical room. The boilers are assumed to be 15-20 years old. Each boiler has a rated input of 319,000 btu/hr and is listed as 80% efficient when new. It is assumed, based on condition of units, the efficiency is roughly

72%. One boiler is currently operational, however, is temperamental at times. The other boiler is off-line due to a failed heat exchanger.

The combustion air is not sized per current International Mechanical Code requirements.

The overall low system efficiencies and equipment age justify a boiler upgrade.

The boiler supplies heating water to (3) three separate zones. The zones use a combination of cabinet unit heaters, with outside air supplied by ventilating units, and heating and ventilating units for heating purposes.

This facility is controlled by a Direct Digital Control (DDC) system. The current temperature control provider is Johnson Controls.

The Gymnasium is provided with gas-fired heating and ventilating units. The units are currently operational, however, should be scheduled for replacement as funds come available.

The kitchen/cafeteria system includes a Type I hood. No make-up air unit is utilized. The heating for the space is via 2) gas fired duct furnaces, again with no outside air.

#### **PLUMBING SYSTEM SUMMARY**

The domestic hot water is generated for the facility by (1) one A.O. Smith model #BT 80 202 gas-fired water heater. The unit has a capacity of 75 gallons and 75, 000 bth/hr input rating. The system appears fully operational. Plumbing fixtures appeared to be low flow with the exception of 1) water closet in the Boy's room.

#### **ELECTRICAL SYSTEM SUMMARY**

The electrical system for the facility is a 208V, 600Amp, three phase service.

#### **ENERGY AUDIT ASSUMPTION SUMMARY**

The Gallatin Gateway Elementary School is on a single meter for natural gas and electricity. Certain assumptions had to be made to perform this energy audit. The boiler upgrade energy savings were modeled using Carrier's Hourly Analysis Program. The simple payback analysis was calculated using Carrier's Engineering Economic Analysis program. Building occupant densities were estimated using ASHRAE 90.1-2004.

#### **BUILDING ENVELOPE**

The building envelope should be upgraded if a major renovation was to take place. Envelope enhancements were not analyzed under this audit. Experience has shown that envelope upgrade do save energy, however, they are initially costly to perform and are unable to show any realistic payback.

#### **WATER**

Water savings were not estimated in this audit. Fairly efficient fixtures and trim are currently installed.

#### **ENERGY**

To truly see the effects of energy conservation measures, the Gallatin Gateway School facilities department will need to be involved in logging monthly energy use. The school currently uses Direct Digital Controls.

Energy rates for this audit were acquired from the Northwestern Energy website. The average cost for electricity used in this audit was \$0.050/kWh. The average cost for natural gas was \$0.83/Therm.

## LIGHTING

The Gallatin Gateway Elementary School should consider replacement of fluorescent lighting as funds become available. The recommended replacement would be T-8 lamps with electronic ballasts. Due to changes in technology and contracting costs, the estimated cost savings and replacement cost should be evaluated at time of proposed replacement.

## HVAC Energy Conservation Measures

### HOT WATER BOILER PLANT

The existing hot water boiler plant consists of a two 319,000 BTU copper boilers which are in fair and poor condition. One boiler is operational and the other is off-line due to a failed heat exchanger. We have modeled this boiler versus (2) new 374,000 BTU boilers. The proposed boilers would be rated at 83% efficient. The estimated annual cost savings associated with energy use is \$3,941. Estimated cost to upgrade the boiler plant is \$35,565. A simple payback analysis was conducted over a 20 year period. The estimated payback is 7.3 years. See Appendix A for energy analysis and detailed cost breakdown. See Appendix B for simple payback analysis.

### Gymnasium Units

The existing gymnasium units should be replaced as funds become available. Currently the gym is served by two indoor gas-fired units. One of the units is non functional and the other is extremely noisy when operating. Neither unit has cooling capabilities. A few different options exist: 1) replace units with new indoor units, 2) replace with packaged rooftop HVAC. Both options seem to meet the application and should be investigated deeper if money is available. The district should also consider controlling the outside air off occupant load versus minimum damper setpoint. Demand control ventilation and upgrading units would, by experience, save energy.

### *Simple Conservation measures*

1. On hot days, use blinds or shades on the sunny side of the room to help keep solar gain down.
2. On cold days, keep desks and workstation away from outside walls if possible.
3. Close blinds or shades at the end of the day to reduce heat loss in winter and solar gain in evening.
4. Turn off lighting when you leave the room.
5. Use daylighting when available
6. Keep thermostat set to a reasonable level: 68-70 winter and 75-80 summer.
7. Set back thermostats during unoccupied times.
8. Turn off all plug-in equipment (computers, printers, copiers, coffee pots, etc) when not in use.

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Table A1 – Gallatin Gateway Annual HVAC Energy Use – Boiler Upgrade (From HAP 4.4)

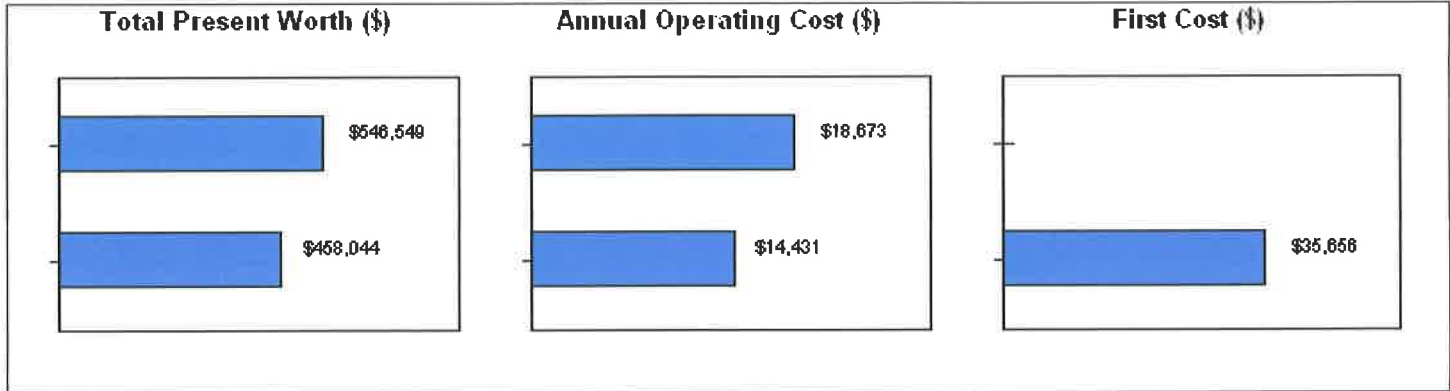
HVAC Energy Use	Exist. Boilers	New Boilers
HW Boiler Plant (Therm)	20,051	10,122
<b>TOTAL HVAC ENERGY USE SAVINGS (Therm)</b>		<b>9,929</b>

Table A2 – Boiler Upgrade Cost Estimate

Item	Unit Measure	Quantity	Material Cost	Labor Cost (\$85/hr)	O & P	Total Installed Cost
Demo	LS	1	\$ -	\$ 1,000.00	\$ 200.00	\$ 1,200.00
Boilers	EA	2	\$ 4,319.00	\$ 3,750.00	\$ 3,227.60	\$ 19,365.60
Piping	LS	1	\$ 2,000.00	\$ 2,000.00	\$ 800.00	\$ 4,800.00
Venting	LS	2	\$ 500.00	\$ 1,000.00	\$ 600.00	\$ 3,600.00
Controls	LS	1	\$ 1,000.00	\$ 1,000.00	\$ 400.00	\$ 2,400.00
TAB	LS	1	\$ 1,000.00	\$ 1,000.00	\$ 400.00	\$ 2,400.00
Electrical	LS	1	\$ 750.00	\$ 750.00	\$ 300.00	\$ 1,800.00
<b>BOILER UPGRADE COST</b>						<b>\$ 35,565.60</b>

**-APPENDIX B-**

**Gallatin Gateway School**



**Table 1. Executive Summary**

<b>Economic Criteria</b>	<b>Best Design Case for Each Criteria</b>	<b>Value (\$)</b>
Incremental SIR Analysis	Upgrade Boilers	-
Lowest Total Present Worth	Upgrade Boilers	\$458,044
Lowest Annual Operating Cost	Upgrade Boilers	\$14,431
Lowest First Cost	Existing Boilers	\$0

**Table 2. Design Cases Ranked by First Cost**

<b>Design Case Name</b>	<b>Design Case Short Name</b>	<b>Total Present Worth (\$)</b>	<b>Annual Operating Cost (\$/yr)</b>	<b>First Cost (\$)</b>
Existing Boilers		\$546,549	\$18,673	\$0
Upgrade Boilers		\$458,044	\$14,431	\$35,656

**Table 3. Incremental Analysis Data**

<b>Challenger</b>	<b>Base Case</b>	<b>Additional First Cost (\$)</b>	<b>NPW Savings (\$)</b>	<b>SIR</b>	<b>Payback Period (yrs)</b>
[Winner]		\$35,656	\$88,505	3.482	7.3