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The following pages will outline a case study, which shows the benefits in energy and cost savings of properly installed mechanical insulation.

Insulation is a proven means for conserving energy, reducing greenhouse gas emissions, increasing process productivity, providing a safer and more productive work environment, controlling condensation (which can lead to mold growth), supporting sustainable design technology and a host of other benefits.

Mechanical insulation does all of this, while providing a return on investment (ROI) rate, which is seldom rivaled. Despite the proven ROI, insulation is often overlooked and its benefits undervalued. Insulation is truly the lost or forgotten technology. Can you think of a more important time than now to think about how insulation can help you?

An insulation system is a technology, which needs to be engineered and maintained throughout the entire process. Several studies have estimated roughly 10 to 30 percent of all installed insulation is now missing or damaged.

The practice of not replacing or maintaining an insulation system in a timely and correct manner reduces the full benefits of insulation, and in return, decreases the ROI. In many cases, significant other issues - such as excessive energy loss, corrosion under insulation (CUI), mold development, increased cost of operations and reduced process productivity or efficiency - develop.

You can learn more on www.MechanicalInsulatorsLMCT.com, where additional case studies can be viewed.

Please do not hesitate to contact me should you have any additional questions. Thank you,

Peter Ielimi

Executive Director Mechanical Insulators Labor Management Cooperative Trust

Insulation Energy Survey Report

South Suburban College

Date: <u>11-30-2018</u> <u>Heating & Domestic</u> <u>Hot Water Systems</u>

Survey Objectives

- Identify energy loss with thermal image camera
- Supply college with calculations & possible energy savings
- Save college operating costs & meet sustainability goals

Daniel Haguewood

Level 3 Thermographer (702) 466-0110

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Savings Quick Look Numbers

Using the National Institute of Building Sciences energy calculator, the mechanical room's missing insulation is costing the college \$7,582 annually in fuel costs.

South Suburban College can reduce their fuel costs by \$6,740 annually with just 1 inch of insulation.

A comprehensive, scientific approach to insulation can mean significant savings in terms of energy consumption. And in this day and age, every BTU counts – which makes insulation integral to any energy efficiency plan.

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INTRODUCTION

This report is what we call in the industry an "Energy audit". We gather information from the facility's heating and cooling process. We then perform calculations to determine how much, if any, energy can be converted to work making the process more efficient. Energy cannot be created nor destroyed, so we can't save energy, but we can save energy costs. The energy we have in these processes usually comes from natural gas or a powerplant of some kind. This fuel is being paid for by the facility. We use Btu as a measurement for this amount of energy converted from fuel to heat. A BTU is the amount of work converted to make 1 pound of water raise 1 degree. By calculating how much BTU's it takes to reach an operating temperature we then can see how efficient the process is by knowing the amount of fuel it took to reach that temperature. Insulation is a very important if not crucial part of making these processes retain these temperatures over distance. Many times, we see that facilities tend to ignore missing or damaged insulation. Missing or damaged insulation is leaving the tempered water lines and equipment exposed to ambient temperature. Ambient temperature will constantly be fighting too either cool or heat the pipes and equipment. This will cost the process to require more fuel to maintain the desired operating temperature making the energy conversion less efficient.

The technology we use today to see potential fuel savings is with a thermal infrared camera. This camera detects energy objects emit. This technology allows us to measure with great accuracy how much energy is being emitted, then converts this to temperature. It also allows us to visually see heat. We can capture these images just like a camera takes a photo. We then present our findings to the facility. Only a certified thermographer should use these cameras for quantitative purposes.

When performing our calculations, we use many different values. Some are input into the camera parameters for accurate temperature readings and some are needed for the mathematical equations that produce the production cost savings. These values are specific to your facility. Some of the more important parameters are, ambient temperature, cost of fuel for the facility, hours of operation, and operating temperature. The higher the temperature, the more BTU's required. All calculations for cost savings are performed by a calculator from the Mechanical Insulation Design Guide that's backed by the Department of Energy (DOE).

NOTE: This audit was performed only on the Heating and Domestic Hot Water systems, the chilled water system was not in operation at time of audit.

FACILITY INFORMATION

IR CAMERA PARAMETERS THAT WERE USED

Camera Model: E60

Camera Lens: 24°

Ambient Temperature: Average 75°F

Humidity: 22%

Object Distance: 6' – 15'

Emissivity: 0.96

Thermographer: Daniel Haguewood, Certified Level III

FACILITY OPERATING INFORMATION THAT WAS USED FOR COST CALCULATIONS

Facility: South Suburban College

Address: 15800 S. State St. South Holland, IL 60473

Contact: Justin Papp

Operating Hours Boiler 1 & 3: 4011 Hours

Operating Hours Domestic Hot Water: 8000 Hours

Cost of Natural Gas for the year 2018:(\$83,658 for 182,916 Therms used) = 4.74 \$/Mcf

Inside Ambient Temperature: Average 75°F

Humidity: 22%

FINANCIAL SUMMARY DISCLAIMER

The Investment numbers used for this report were based off a nationwide average generated by the DOE's calculator. The investment costs for South Suburban College may be higher, contact your local Insulation Contractors for pricing.

BOILER #1



BOILER #1 LEFT SIDE



BOILER #1 RIGHT SIDE

Item Description: Boiler #1 (Boiler Walls) Total ft²: 182 Average Temperature: 172°F Fuel Costs: The uninsulated Boiler walls are costing the college \$1,071.79 annually. Recommendation: Insulate Boiler wall with 2-inch Fiberglass Board

INSULATION THICKNESS	HEAT LOSS	FUEL COST \$/Yr	1 st yr. SAVINGS.	5yr. SAVINGS	CO2 EMMISSIONS
0	34,738 Btu/h	\$1,071.79	NA	NA	12.36 MT/yr
1"	3,967 Btu/h	\$122.38	\$949.41	\$4,747.05	1.41 MT/yr
1.5"	2,835 Btu/h	\$87.46	\$984.33	\$4,921.65	1.01 MT/yr
2"	2,208 Btu/h	\$68.14	\$1,003.65	\$5,018.25	0.79 MT/yr

BOILER #3



BOILER #3 LEFT SIDE

Item Description: Boiler #3 Boiler Walls (NOT IN OPERATION DURING SURVEY) Notes: Heated water does seem to be circulating through the unused boiler, recommend shutting down the flow to this boiler if possible while in standby. Total ft²: 182 Average Temperature: 87.2°F

Fuel Costs: 🗪

The uninsulated boiler #3 is costing the college \$95.53 annually. **Recommendation:**

Insulate boiler #3 walls with 2-inch fiberglass board

INSULATION THICKNESS	HEAT LOSS	FUEL COST \$/Yr	1 st yr. SAVINGS.	5yr. SAVINGS	CO2 EMMISSIONS
0	3.096 Btu/h	\$95.53	NA	NA	1.1 MT/yr
1"	422 Btu/h	\$13.01	\$82.52	\$412.60	0.15 MT/yr
1.5"	307 Btu/h	\$9.46	\$86.07	\$430.35	0.11 MT/yr
2"	241 Btu/h	\$7.44	\$88.09	\$440.45	0.09 MT/yr

(5) 8-INCH HEATING SUPPLY & RETURN GATE VALVES



(5) 8-INCH HEATING SUPPLY & RETURN GATE VALVES CONTINUED ON NEXT PAGE

*Estimated Calculations supplied by National Institute of Building Sciences Mechanical Insulation Energy Calculator *

(5) 8-INCH HEATING SUPPLY & RETURN GATE VALVES





Item Description: (5) 8-inch gate valves Total ft²: 40 Average Temperature: 161° Fuel Costs: The uninsulated gate valves are costing the college \$202.69 annually. Recommendation: Insulate gate valves with 1-inch removable pad

INSULATION THICKNESS	HEAT LOSS	FUEL COST \$/Yr	1 st yr. SAVINGS.	5yr. SAVINGS	CO2 EMMISSIONS
0	6,569 Btu/h	\$202.69	NA	NA	2.34 MT/yr
1"	759 Btu/h	\$23.42	\$179.27	\$896.35	0.27 MT/yr
1.5"	543 Btu/h	\$16.76	\$185.93	\$929.65	0.19 MT/yr
2″	423 Btu/h	\$13.06	\$189.63	\$948.15	0.15 MT/yr

(2) 6-INCH HEATING SUPPLY & RETURN GATE VALVES





Item Description: (2) 6-inch gate valves
Total ft²: 13
Average Temperature: 155°F
Fuel Costs:
The uninsulated gate valves are costing the college \$60.23 annually.
Recommendation:
Insulate gate valves with 1-inch removable pad

INSULATION THICKNESS	HEAT LOSS	FUEL COST \$/Yr	1 st yr. SAVINGS.	5yr. SAVINGS	CO2 EMMISSIONS
0	1,952 Btu/h	\$60.23	NA	NA	0.69 MT/yr
1"	227 Btu/h	\$7.01	\$53.22	\$266.10	0.08 MT/yr
1.5"	163 Btu/h	\$5.02	\$55.21	\$276.05	0.06 MT/yr
2″	127 Btu/h	\$3.91	\$56.32	\$281.60	0.05 MT/yr

(4) 6-INCH HEATING SUPPLY & RETURN GATE VALVE BONNETS



(2) OF THE (4) 6-INCH BONNETS WERE IN STANDBY





INSULATION THICKNESS	HEAT LOSS	FUEL COST \$/Yr	1 st yr. SAVINGS.	5yr. SAVINGS	CO2 EMMISSIONS
0	960 Btu/h	\$27.35	NA	NA	0.32 MT/yr
1"	117 Btu/h	\$3.34	\$24.01	\$120.05	0.04 MT/yr
1.5"	85 Btu/h	\$2.41	\$24.94	\$124.70	0.03 MT/yr
2″	66 Btu/h	\$1.88	\$25.47	\$127.35	0.02 MT/yr

CONTINUED ON NEXT PAGE SEE NOTES

(4) 8-INCH HEATING SUPPLY & RETURN GATE VALVE BONNETS



Item Description on previous page: (2) 6-inch gate valve bonnets
Item Description:(4) 8-inch gate valve bonnets
Total ft²: 24
Average Temperature: 162°F
Fuel Costs:
The uninsulated gate valves are costing the college \$75.33 annually.
Recommendation: 🖚
Insulate gate valves with 1-inch removable pad

Results

	INSULATION THICKNESS	HEAT LOSS	FUEL COST \$/Yr	1 st yr. SAVINGS.	5yr. SAVINGS	CO2 EMMISSIONS
➡	0	2,645 Btu/h	\$75.33	NA	NA	0.32 MT/yr
	1"	306 Btu/h	\$8.70	\$66.63	\$333.15	0.04 MT/yr
	1.5"	219 Btu/h	\$6.23	\$69.10	\$345.50	0.03 MT/yr
	2"	171 Btu/h	\$4.86	\$70.47	\$352.35	0.02 MT/yr

(2) 8-INCH FLANGE COUPLINGS



Item Description: (2) 8-inch flange couplings Total ft²: 6.5 Average Temperature: 149°F Fuel Costs: The uninsulated couplings are costing the college \$25.04 annually. Recommendation: Insulate couplings with 1-inch removable pad

	INSULATION THICKNESS	HEAT LOSS	FUEL COST \$/Yr	1 st yr. SAVINGS.	5yr. SAVINGS	CO2 EMMISSIONS
⇒	0	1,241 Btu/h	\$38.28	NA	NA	0.44 MT/yr
⇒	1"	142 Btu/h	\$4.37	\$33.91	\$169.55	0.05 MT/yr
	1.5"	101 Btu/h	\$3.12	\$35.16	\$175.80	0.04 MT/yr
	2"	79 Btu/h	\$2.43	\$35.85	\$179.25	0.03 MT/yr

(3) HEATING PUMPS

1 HEATING PUMP IN OPERATION AT TIME OF AUDIT



2 HEATING PUMPS ON STANDBY AT TIME OF AUDIT

CALCULATIONS ON NEXT PAGE

HEATING PUMP CALCULATION



Item Description: 1 Heating pump during operation was used for calculation. The other 2 pumps would result the same amount of energy loss while in operation. Total ft²: 17 Average Temperature: 171°F Fuel Costs: The uninsulated pumps are costing the college \$91.22 annually. Recommendation: Insulate pumps with 1-inch removable pad

Results

	INSULATION THICKNESS	HEAT LOSS	FUEL COST \$/Yr	1 st yr. SAVINGS.	5yr. SAVINGS	CO2 EMMISSIONS
►	0	3,245 Btu/h	\$100.11	NA	NA	1.15 MT/yr
≻	1"	371 Btu/h	\$11.43	\$88.68	\$443.40	0.13 MT/yr
	1.5"	265 Btu/h	\$8.17	\$91.94	\$459.70	0.09 MT/yr
	2"	206 Btu/h	\$6.36	\$93.75	\$468.75	0.07 MT/yr

(3) EXPOSED STRAINERS AND VALVES CONNECTED TO HEATING PUMPS



(1) EXPOSED STRAINER IN OPERATION DURING AUDIT



(2) EXPOSED STRAINERS IN STANDBY DURING AUDIT

CONTINUED ON NEXT PAGE

3 EXPOSED STRAINERS AND 3 VALVES CONNECTED TO HEATING PUMPS



INSULATION REPAIR NEEDED (RECOMMEND REMOVAL PAD FOR CONTINUED ACCESS)



THE TWO VALVES ABOVE WERE IN STANDBY, SO WERE NOT USED IN ENERGY CALCULATION

CONTINUE TO NEXT PAGE FOR CALCULATIONS

CALCULATIONS FOR 1 STRINAER AND 1 VALVE BELOW





<i>Item Description:</i> 1 Strainer Bonnet & 1 Valve was used for this calculation. The other 2
valves and 2 strainers would render the same loss while in operation.
Total ft.: 4 feet of 14-inch O.D.
Average Temperature: 166°F
Fuel Costs:
The uninsulated strainer and valve are costing the college \$96.20 annually.
Recommendation:
Insulate strainer with 2-inch fiberglass pipe cover with removable endcap

Insulate valve with 1-inch removable pad

	INSULATION THICKNESS	HEAT LOSS	FUEL COST \$/Yr	1 st yr. SAVINGS.	5yr. SAVINGS	CO2 EMMISSIONS
>	0	3,118 Btu/h	\$96.20	NA	NA	1.11 MT/yr
>	1"	N/A Btu/h	N/A	N/A	N/A	N/A MT/yr
	1.5"	246 Btu/h	\$7.58	\$84.72	\$423.60	0.09 MT/yr
>	2"	195 Btu/h	\$6.00	\$85.54	\$427.70	0.07 MT/yr

DOMESTIC HOT WATER TANK

















*Estimated Calculations supplied by National Institute of Building Sciences Mechanical Insulation Energy Calculator *

DOMESTIC HOT WATER TANK CALCULATIONS



Item Description: Hot water storage tank with damaged and degraded insulation Total ft²: 166

Operating Temperature: 120° **Average Temperature:** 105°

Fuel Costs: 🗪

The degraded insulation on the hot water tank is costing the college \$384.44 annually. Normal surface temperature should be about 81° with 2-inch insulation.

Recommendation:

Remove all insulation on tank and heads (caution heads may contain asbestos) Insulate tank and heads with 2-inch fiberglass tank wrap.

	INSULATION THICKNESS	HEAT LOSS	FUEL COST \$/Yr	1 st yr. SAVINGS.	5yr. SAVINGS	CO2 EMMISSIONS
 	0	12,460 Btu/h	\$384.44	NA	NA	4.43 MT/yr
	1"	1,530 Btu/h	\$47.22	\$337.22	\$1,686.10	0.54 MT/yr
	1.5"	1,102 Btu/h	\$33.99	\$350.45	\$1,752.25	0.39 MT/yr
⇒	2″	862 Btu/h	\$26.58	\$57.86	\$289.30	0.31 MT/yr

HEATING PIPING FOR POT FEEDERS

















HEATING PIPING FOR POT FEEDERS CONTINUED ON NEXT PAGE

HEATING PIPING FOR POT FEEDERS CALCULATIONS 25 feet of ¾-inch iron pipping

	INSULATION THICKNESS	HEAT LOSS	FUEL COST \$/Yr	1 st yr. SAVINGS.	5yr. SAVINGS	CO2 EMMISSIONS
	0	2,980 Btu/h	\$92.13	NA	NA	1.06 MT/yr
	1"	311 Btu/h	\$9.62	\$82.51	\$412.55	0.11 MT/yr
\rightarrow	1.5"	240 Btu/h	\$7.43	\$84.70	\$423.50	0.09 MT/yr
	2″	208 Btu/h	\$6.42	\$85.71	\$328.55	0.07 MT/yr

POT FEEDERS CALCULATIONS



Item Descrip	ition:
Total ft ² :	Total length:
Average Ter	nperature:
Fuel Costs:	\rightarrow
The uninsula	ted gate valves are costing the college \$2,000 annually.
Recommend	lation:
Insulate gate	e valves with 2-inch removable pad

INSULATION THICKNESS	HEAT LOSS	FUEL COST \$/Yr	1 st yr. SAVINGS.	5yr. SAVINGS	CO2 EMMISSIONS
0	9,768 Btu/h	\$301.81	NA	NA	3.47 MT/yr
1"	984 Btu/h	\$30.40	\$271.41	\$1,357.05	0.35 MT/yr
1.5"	760 Btu/h	\$23.47	\$278.34	\$1,391.70	0.27 MT/yr
2″	632 Btu/h	\$19.51	\$282.30	\$1,411.50	0.23 MT/yr

BOILER ROOM MEZ L-255

HEATING WATER EXPANSION TANK PIPING



Item Description: Total ft²: Average Temperature: Fuel Costs: The uninsulated gate valves are costing the college \$2,000 annually. Recommendation: Insulate gate valves with 2-inch removable pad

INSULATION THICKNESS	HEAT LOSS	FUEL COST \$/Yr	1 st yr. SAVINGS.	5yr. SAVINGS	CO2 EMMISSIONS
0	4,277 Btu/h	\$132.25	NA	NA	1.52 MT/yr
1"	419 Btu/h	\$12.96	\$119.29	\$596.45	0.15 MT/yr
1.5"	314 Btu/h	\$9.71	\$122.54	\$612.70	0.11 MT/yr
2"	261 Btu/h	\$8.08	\$124.17	\$620.85	0.09 MT/yr

BOILER ROOM MEZ L-255

HEATING WATER EXPANSION VALVES







3" HEATING WATER EXPANSION GATE VALVE







182

90.8



HEATING WATER EXPANSION VALVE BONNETS







HEATING WATER EXPANSION 3-INCH PNEUMATIC VALVE CALCULATION ON NEXT PAGE

BOILER ROOM MEZ L-255

HEATING WATER EXPANSION VALVES CALCULATION









Item Description: Total ft²: Average Temperature: Fuel Costs: The uninsulated gate valves are costing the college \$2,000 annually. Recommendation: Insulate gate valves with 2-inch removable pad

	INSULATION THICKNESS	HEAT LOSS	FUEL COST \$/Yr	1 st yr. SAVINGS.	5yr. SAVINGS	CO2 EMMISSIONS
	0	3,054 Btu/h	\$94.22	NA	NA	1.09 MT/yr
	1"	349 Btu/h	\$10.76	\$83.46	\$417.30	0.12 MT/yr
	1.5"	249 Btu/h	\$7.69	\$86.53	\$432.65	0.09 MT/yr
	2"	194 Btu/h	\$5.99	\$88.23	\$441.15	0.07 MT/yr

BOILER ROOM & MEZ L-255 FINANCIAL SUMMARY

BOILER ROOM CALCULATION TOTALS

INSULATION THICKNESS	HEAT LOSS	FUEL COST \$/Yr	1 st yr. SAVINGS.	5yr. SAVINGS	CO2 EMMISSIONS
0	90,103 Btu/h	\$2,772.36	NA	NA	31.40 MT/yr
1"	9,904 Btu/h	\$304.62	\$2,467.74	\$12,338.70	3.44 MT/yr
1.5"	7,429 Btu/h	\$228.50	\$2,543.86	\$12,719.30	3.41 MT/yr
2"	5,873 Btu/h	\$180.66	\$2,591.70	\$12,958.50	2.06 MT/yr

BOILER ROOM FINANCIAL SUMMARY

- 1. Investment (Initial Installed Cost), \$
- 2. First Year Energy Cost Savings, \$/yrs
- 3. Energy Cost Escalation Rate, %/yrs.
- 4. Estimated Economic Life, yrs.
- 5. Discount Rate, %

20

\$0

\$4,326

Γ	16,964.87	
	2,467.44	
	3.0	
	20	
	5.0	

Results	
Simple Payback Period, yrs.	6.9
Internal Rate of Return (IRR or ROI)	16.3%
Net Present Value,	\$22,421

Calculations							
Investment	Annual Savings	Annual Cash Flow	Cumulative Cash Flow				
\$-16,964	\$0	\$-16,964	\$-16,964				
\$0	\$2,467	\$2,467	\$-14,497				
\$0	\$2,541	\$2,541	\$-11,956				
\$0	\$2,617	\$2,617	\$-9,339				
\$0	\$2,696	\$2,696	\$-6,643				
\$0	\$2,777	\$2,777	\$-3,866				
\$0	\$2,860	\$2,860	\$-1,006				
\$0	\$2,946	\$2,946	\$1,939				
\$0	\$3,034	\$3,034	\$4,973				
\$0	\$3,125	\$3,125	\$8,099				
\$0	\$3,219	\$3,219	\$11,317				
\$0	\$3,315	\$3,315	\$14,633				
\$0	\$3,415	\$3,415	\$18,048				
\$0	\$3,517	\$3,517	\$21,565				
\$0	\$3,623	\$3,623	\$25,188				
\$0	\$3,732	\$3,732	\$28,920				
\$0	\$3,844	\$3,844	\$32,763				
\$0	\$3,959	\$3,959	\$36,722				
\$0	\$4,078	\$4,078	\$40,799				
\$0	\$4,200	\$4,200	\$44,999				
	Investment \$-16,964 \$0 \$0 \$0 \$0 \$0 \$0 \$0 \$0 \$0 \$0 \$0 \$0 \$0	Investment Annual Savings \$-16,964 \$0 \$-16,964 \$0 \$0 \$2,467 \$0 \$2,541 \$0 \$2,617 \$0 \$2,696 \$0 \$2,696 \$0 \$2,696 \$0 \$2,696 \$0 \$2,696 \$0 \$2,860 \$0 \$2,860 \$0 \$2,3034 \$0 \$2,3034 \$0 \$3,034 \$0 \$3,034 \$0 \$3,034 \$0 \$3,125 \$0 \$3,315 \$0 \$3,315 \$0 \$3,315 \$0 \$3,623 \$0 \$3,623 \$0 \$3,732 \$0 \$3,844 \$0 \$3,959 \$0 \$4,078 \$0 \$4,078	Carbone Annual Savings Annual Cash Flow \$-16,964 \$0 \$-16,964 \$0 \$2,467 \$2,467 \$0 \$2,541 \$2,541 \$0 \$2,617 \$2,607 \$0 \$2,617 \$2,696 \$0 \$2,696 \$2,696 \$0 \$2,777 \$2,777 \$0 \$2,860 \$2,946 \$0 \$2,946 \$2,946 \$0 \$2,777 \$2,777 \$0 \$2,860 \$2,946 \$0 \$2,7946 \$2,946 \$0 \$2,3034 \$3,034 \$0 \$2,304 \$3,034 \$0 \$3,125 \$3,125 \$0 \$3,315 \$3,315 \$0 \$3,315 \$3,315 \$0 \$3,623 \$3,623 \$0 \$3,623 \$3,623 \$0 \$3,732 \$3,732 \$0 \$3,844 \$3,844 \$0 \$4,078 \$4,078				

\$49,325

\$4,326

RADIATION & REHEAT SYSTEM PUMPS







Item Description: Radiation & Reheat System Pumps (2) Total ft²: 14 Average Temperature: 138 °F Fuel Costs: The uninsulated gate valves are costing the college \$58.84 annually. Recommendation: Insulate pumps with 1-inch removable pad

	INSULATION THICKNESS	HEAT LOSS	FUEL COST \$/Yr	1 st yr. SAVINGS.	5yr. SAVINGS	CO2 EMMISSIONS
→	0	1907 Btu/h	\$58.84	NA	NA	0.68 MT/yr
	1"	227 Btu/h	\$7.01	\$51.83	\$259.15	0.08 MT/yr
	1.5"	163 Btu/h	\$5.03	\$53.81	\$269.05	0.06 MT/yr
⇒	2"	127 Btu/h	\$3.92	\$54.92	\$274.60	0.05 MT/yr

RADIATION & REHEAT SYSTEM 6" PIPING 12 FEET



Item Description: 6-inch Iron piping Total Length of Piping Run, ft.: 12 feet Pipe Size: 6 Average Temperature: 137° Fuel Costs: The uninsulated piping is costing the college \$159.42 annually. Recommendation: Insulate piping with 2-inch fiberglass insulation

Results

INSULATION THICKNESS	HEAT LOSS	FUEL COST \$/Yr	1 st yr. SAVINGS.	5yr. SAVINGS	CO2 EMMISSIONS
0	5,156 Btu/h	\$159.42	NA	NA	1.83 MT/yr
1"	544 Btu/h	\$16.83	\$142.59	\$712.95	0.19 MT/yr
1.5"	399 Btu/h	\$12.32	\$147.10	\$735.50	0.14 MT/yr
2"	313 Btu/h	\$9.69	\$149.73	\$748.65	0.11 MT/yr

RADIATION & REHEAT SYSTEM GATE VALVES (2) 4-INCH (2) 6-INCH



71.3

\$FLIR

RADIATION & REHEAT SYSTEM PNUEMATIC VALVES (2)



Item Description: Flange valves, gate valves and bonnets, and pneumatic valves **Total ft²:** 70

Average Temperature: 148°F

Fuel Costs: ----->

The uninsulated valves in this area are costing the college \$310.56 annually. **Recommendation:**

Insulate all valves with 1-inch removable pad

INSULATION THICKNESS	HEAT LOSS	FUEL COST \$/Yr	1 st yr. SAVINGS.	5yr. SAVINGS	CO2 EMMISSIONS
0	10,065 Btu/h	\$310.56	NA	NA	3.58 MT/yr
1"	1,175 Btu/h	\$36.25	\$274.31	\$1,371.55	0.42 MT/yr
1.5"	841 Btu/h	\$25.94	\$284.62	\$1,423.10	0.30 MT/yr
2″	656 Btu/h	\$20.23	\$290.33	\$1,451.65	0.23 MT/yr

RADIATION & REHEAT SYSTEM VALVE BONNETS (7)



Item Description: Radiation & Reheat System Valve Bonnets (7) Total ft²: 21 Average Temperature: 126°F Fuel Costs: The uninsulated gate valves are costing the college \$56.41 annually. Recommendation: Insulate gate valves with 1-inch removable pad

INSULATION THICKNESS	HEAT LOSS	FUEL COST \$/Yr	1 st yr. SAVINGS.	5yr. SAVINGS	CO2 EMMISSIONS
0	1,828 Btu/h	\$56.41	NA	NA	0.65 MT/yr
1"	222 Btu/h	\$6.85	\$49.56	\$247.80	0.08 MT/yr
1.5"	160 Btu/h	\$4.92	\$51.49	\$257.45	0.06 MT/yr
2"	125 Btu/h	\$3.85	\$52.56	\$262.80	0.04 MT/yr

RADIATION & REHEAT SYSTEM PNUEMATIC VALVES (2)



Item Description: Total Length of Piping Run, ft.: 9 Average Temperature: 138°F Fuel Costs: The uninsulated gate valves are costing the college \$91.68 annually. Recommendation: Insulate gate valves with 2-inch removable pad

INSULATION THICKNESS	HEAT LOSS	FUEL COST \$/Yr	1 st yr. SAVINGS.	5yr. SAVINGS	CO2 EMMISSIONS
0	2,971 Btu/h	\$91.68	NA	NA	1.06 MT/yr
1"	308 Btu/h	\$9.51	\$82.17	\$410.85	0.11 MT/yr
1.5"	227 Btu/h	\$7.03	\$84.65	\$423.25	0.08 MT/yr
2″	184 Btu/h	\$5.67	\$86.01	\$430.05	0.07 MT/yr

RADIATION & REHEAT STANDBY SYSTEM



Item Description: Standby system was not in operation and was not used for any calculations or investment numbers. Recommendation: Insulate system to reduce fuel costs while in operation. Note: In this area there was missing insulation on the chilled water system. Insulate to prevent condensation.

PENTHOUSE 4 FINANCIAL SUMMARY

PENTHOUSE 4 CALCULATION TOTALS

INSULATION THICKNESS	HEAT LOSS	FUEL COST \$/Yr	1 st yr. SAVINGS.	5yr. SAVINGS	CO2 EMMISSIONS
0	21,927 Btu/h	\$676.91	NA	NA	7.80 MT/yr
1"	2,476 Btu/h	\$76.45	\$600.46	\$3,002.30	0.88 MT/yr
1.5"	1,790 Btu/h	\$55.24	\$621.67	\$3,108.35	0.64 MT/yr
2″	1,405 Btu/h	\$43.36	\$633.55	\$3,167.75	0.50 MT/yr

PENTHOUSE 4 FINANCIAL SUMMARY

1. Investment (Initial Installed Cost), \$

2. First Year Energy Cost Savings, \$/yrs.

3. Energy Cost Escalation Rate, %/yrs.

4. Estimated Economic Life, yrs.

5. Discount Rate, %

3,411.45		
600.46	Results	
3.0	Simple Payback Period, yrs.	5.7
20	Internal Rate of Return (IRR or ROI)	19.7%
5.0	Net Present Value,	\$6,168

		20 Y	ear Calculations	
Year	Investment	Annual Savings	Annual Cash Flow	Cumulative Cash Flow
0	\$-3,411	\$0	\$-3,411	\$-3,411
1	\$0	\$600	\$600	\$-2,811
2	\$0	\$618	\$618	\$-2,193
3	\$0	\$637	\$637	\$-1,556
4	\$0	\$656	\$656	\$-901
5	\$0	\$675	\$675	\$-226
6	\$0	\$696	\$696	\$470
7	\$0	\$716	\$716	\$1,186
8	\$0	\$738	\$738	\$1,924
9	\$0	\$760	\$760	\$2,684
10	\$0	\$783	\$783	\$3,467
11	\$0	\$806	\$806	\$4,274
12	\$0	\$831	\$831	\$5,104
13	\$0	\$855	\$855	\$5,960
14	\$0	\$881	\$881	\$6,841
15	\$0	\$908	\$908	\$7,748
16	\$0	\$935	\$935	\$8,683
17	\$0	\$963	\$963	\$9,646
18	\$0	\$992	\$992	\$10,638
19	\$0	\$1,021	\$1,021	\$11,659
20	\$0	\$1,052	\$1,052	\$12,711

PENTHOUSE 3 DOMESTIC HOT WATER SYSTEM EQUIPMENT



Item Description: Domestic Hot water Tank, 3-inch Gate Valve Total ft²: 32 Average Temperature: 175°F Fuel Costs: The uninsulated gate valves and tank are costing the college \$205.80 annually. Recommendation: Insulate gate valves with 1-inch removable pad, insulate hot water tank with 2" fiberglass tank wrap

INSULATION THICKNESS	HEAT LOSS	FUEL COST \$/Yr	1 st yr. SAVINGS.	5yr. SAVINGS	CO2 EMMISSIONS
0	6,670 Btu/h	\$410.47	NA	NA	4.73 MT/yr
1"	756 Btu/h	\$46.53	\$363.94	\$1,819.70	0.54 MT/yr
1.5"	540 Btu/h	\$33.21	\$377.26	\$1,886.30	0.38 MT/yr
2"	420 Btu/h	\$25.86	\$384.61	\$1,923.05	0.30 MT/yr

PENTHOUSE 3 DOMESTIC HOT WATER SYSTEM PIPING





PENTHOUSE 3 DOMESTIC HOT WATER SYSTEM PIPING CALCULATIONS

Item Description: (Size of Pipe: 7/8" Length: 30') (Size of Pipe: 1" Length: 4') (Size of Pipe: 2" Length: 4') (Size of Pipe: 3" Length: 5') (Size of Pipe: 8" Length: 3') (Size of Pipe: 12" Length: 1') Average Temperature: 143.5°F Fuel Costs: The uninsulated piping is costing the college \$552.96 annually. Recommendation:

Insulate piping with 2inch fiberglass insulation.

	INSULATION THICKNESS	HEAT LOSS	FUEL COST \$/Yr	1 st yr. SAVINGS.	5yr. SAVINGS	CO2 EMMISSIONS
➡	0	8,985 Btu/h	\$552.96	NA	NA	6.37 MT/yr
	1"	832 Btu/h	\$51.14	\$501.82	\$2,509.10	0.60 MT/yr
	1.5"	691 Btu/h	\$42.51	\$510.45	\$2,552.25	0.48 MT/yr
⇒	2"	581 Btu/h	\$35.79	\$517.17	\$2 <i>,</i> 585.85	0.42 MT/yr

PENTHOUSE 3 HEATING SUPPLY & RETURN PIPING & EQUIPMENT





Item Description: (Size of Pipe: 2.5" Length: 3') (Size of Pipe: 4" Length: 20') (Size of Pipe: 8" Length: 4') Average Temperature: 150°F Fuel Costs: The uninsulated piping is costing the college 372.98 annually. Recommendation: Insulate piping with 2-inchfiberglass insulation

Results

INSULATION THICKNESS	HEAT LOSS	FUEL COST \$/Yr	1 st yr. SAVINGS.	5yr. SAVINGS	CO2 EMMISSIONS
0	6,061 Btu/h	\$194.43	NA	NA	2.25 MT/yr
1"	599 Btu/h	\$19.21	\$175.22	\$876.10	0.22 MT/yr
1.5"	373 Btu/h	\$14.32	\$180.11	\$900.55	0.16 MT/yr
2"	368 Btu/h	\$11.78	\$182.65	\$913.25	0.13 MT/yr

36

PENTHOUSE 3 HEATING SUPPLY & RETURN EQUIPMENT

























PENTHOUSE 3 HEATING SUPPLY & RETURN EQUIPMENT CONTINUED ON NEXT PAGE

PENTHOUSE 3 HEATING SUPPLY & RETURN EQUIPMENT









Item Description: 2 Heating pumps, (12) 4-inch gate valves and (4) 4-inch valve bonnets Total ft²:138 Average Temperature: 153.5°F Fuel Costs: The uninsulated pumps and gate valves are costing the college \$619.78 annually. Recommendation: Insulate pumps and gate valves with 1-inch removable pad

	INSULATION THICKNESS	HEAT LOSS	FUEL COST \$/Yr	1 st yr. SAVINGS.	5yr. SAVINGS	CO2 EMMISSIONS
	0	20,087 Btu/h	\$619.78	NA	NA	7.15 MT/yr
⇒	1"	2,343 Btu/h	\$72.30	\$547.48	\$2,737.40	0.83 MT/yr
	1.5"	1,678 Btu/h	\$51.77	\$568.01	\$2 <i>,</i> 840.05	0.60 MT/yr
	2"	1,309 Btu/h	\$40.38	\$579.40	\$2,897.00	0.47 MT/yr

PENTHOUSE 3 HEATING SUPPLY & RETURN EQUIPMENT





A PREVIOUS FIRE HAS CAUSED MAJOR DAMAGED TO THE INSULATION AND PVC FITTINGS ON THE RADIATION AND REHEAT SYSTEM. RECOMMEND ALL DAMAGED INSULATION BE REMOVED AND REPLACED.

PENTHOUSE 3 FINANCIAL SUMMARY

PENTHOUSE 3 CALCULATIONS TOTAL

INSULATION THICKNESS	HEAT LOSS	FUEL COST \$/Yr	1 st yr. SAVINGS.	5yr. SAVINGS	CO2 EMMISSIONS
0	41,803 Btu/h	\$1,777.64	NA	NA	20.50 MT/yr
1"	4,530 Btu/h	\$189.18	\$1,588.46	\$7,942.30	2.19 MT/yr
1.5"	3,282 Btu/h	\$141.81	\$1,635.83	\$8,179.15	1.62 MT/yr
2″	2,678 Btu/h	\$113.81	\$1,663.83	\$8,319.15	1.32 MT/yr

PENTHOUSE 3 FINANCIAL SUMMARY

- 1. Investment (Initial Installed Cost), \$
- 2. First Year Energy Cost Savings, \$/yrs.
- 3. Energy Cost Escalation Rate, %/yrs.
- 4. Estimated Economic Life, yrs.
- 5. Discount Rate, %

5,416.73	
1,588.46	
3.0	
20	
5.0	

Results				
Simple Payback Period, yrs.	3.4			
Internal Rate of Return (IRR or ROI)	32.1%			
Net Present Value,	\$19,936			

		Calc	ulations	
Year	Investment	Annual Savings	Annual Cash Flow	Cumulative Cash Flow
0	\$-5,416	\$0	\$-5,416	\$-5,416
1	\$0	\$1,588	\$1,588	\$-3,828
2	\$0	\$1,636	\$1,636	\$-2,192
3	\$0	\$1,685	\$1,685	\$-508
4	\$0	\$1,735	\$1,735	\$1,228
5	\$0	\$1,787	\$1,787	\$3,015
6	\$0	\$1,841	\$1,841	\$4,856
7	\$0	\$1,896	\$1,896	\$6,752
8	\$0	\$1,953	\$1,953	\$8,705
9	\$0	\$2,012	\$2,012	\$10,717
10	\$0	\$2,072	\$2,072	\$12,789
11	\$0	\$2,134	\$2,134	\$14,923
12	\$0	\$2,198	\$2,198	\$17,121
13	\$0	\$2,264	\$2,264	\$19,385
14	\$0	\$2,332	\$2,332	\$21,717
15	\$0	\$2,402	\$2,402	\$24,119
16	\$0	\$2,474	\$2,474	\$26,593
17	\$0	\$2,548	\$2,548	\$29,141
18	\$0	\$2,625	\$2,625	\$31,766
19	\$0	\$2,703	\$2,703	\$34,470
20	\$0	\$2,785	\$2,785	\$37,254

90 FEET OF 3" X 1" FIBERGLASS PIPE COVER MISSING, COSTING 395.40 ANNUALLY





21 FEET OF 2-1/2" IRON MISSING FIBERGLASS PIPE COVER AND 13 90'S, COSTING 175.72 ANNUALLY

























ADDITIONAL FITTINGS MISSING INSULATION



TOTAL CALCULATION FOR THIS AREA ARE BELOW

Item Description: 92 feet of 3" iron piping with (16) 90's, 21 feet of 2.5" iron piping with (15) 90's, 8 feet of 6" iron piping and 5 feet of 4" iron piping **Average Temperature:** 140°F Fuel Costs:

The uninsulated piping is costing the college \$928.57 annually. **Recommendation:** Insulate piping with 2-inch fiberglass insulation

INSULATION THICKNESS	HEAT LOSS	FUEL COST \$/Yr	1 st yr. SAVINGS.	5yr. SAVINGS	CO2 EMMISSIONS
0	30,097 Btu/h	\$928.57	NA	NA	10.71 MT/yr
1"	2,916 Btu/h	\$89.94	\$838.63	\$4,193.15	1.05 MT/yr
1.5"	2,192 Btu/h	\$67.62	\$860.95	\$4,304.75	0.78 MT/yr
2"	1,820 Btu/h	\$56.21	\$872.36	\$4,361.80	0.64 MT/yr

MISC. DAMAGED OR MISSING INSULATION





SMALL PATCH AND REPAIR NEEDED





INSULATION HAS BEEN SMASHED FROM FOOT TRAFFIC. RECOMMEND: REPLACING INSULATION WITH A DENSER TYPE OF INSULATION WITH PROTECTIVE METAL JACKETING. RECOMMEND ANYWHERE HEAVY FOOT TRAFIC IS PRESENT

PENTHOUSE 3-4 FRONT & BACK CORRIDOR FINANCIAL SUMMARY

PENTHOUSE 3-4 FRONT & BACK CORRIDOR CALCULATION TOTALS

INSULATION THICKNESS	HEAT LOSS	FUEL COST \$/Yr	1 st yr. SAVINGS.	5yr. SAVINGS	CO2 EMMISSIONS
0	30,097 Btu/h	\$928.57	NA	NA	10.71 MT/yr
1"	2,916 Btu/h	\$89.94	\$838.63	\$4,193.15	1.05 MT/yr
1.5"	2,192 Btu/h	\$67.62	\$860.95	\$4,304.75	0.78 MT/yr
2″	1,820 Btu/h	\$56.21	\$872.36	\$4,361.80	0.64 MT/yr

PENTHOUSE 3-4 FRONT & BACK CORRIDOR FINANCIAL SUMMARY

- 1. Investment (Initial Installed Cost), \$
- 2. First Year Energy Cost Savings, \$/yrs.
- 3. Energy Cost Escalation Rate, %/yrs.

8	38.63	
3	5.0	
2	20	
5	5.0	

4,616.47

Results	
Simple Payback Period, yrs.	5.5
Internal Rate of Return (IRR or ROI)	20.4%
Net Present Value,	\$8,762

4. Estimated Economic Life, yrs.

5. Discount Rate, %

			Calculations	
Year	Investment	Annual Savings	Annual Cash Flow	Cumulative Cash Flow
0	\$-4,616	\$0	\$-4,616	\$-4,616
1	\$0	\$838	\$838	\$-3,778
2	\$0	\$863	\$863	\$-2,915
3	\$0	\$889	\$889	\$-2,026
4	\$0	\$916	\$916	\$-1,110
5	\$0	\$943	\$943	\$-167
6	\$0	\$971	\$971	\$805
7	\$0	\$1,001	\$1,001	\$1,805
8	\$0	\$1,031	\$1,031	\$2,836
9	\$0	\$1,062	\$1,062	\$3,897
10	\$0	\$1,093	\$1,093	\$4,991
11	\$0	\$1,126	\$1,126	\$6,117
12	\$0	\$1,160	\$1,160	\$7,277
13	\$0	\$1,195	\$1,195	\$8,472
14	\$0	\$1,231	\$1,231	\$9,702
15	\$0	\$1,268	\$1,268	\$10,970
16	\$0	\$1,306	\$1,306	\$12,275
17	\$0	\$1,345	\$1,345	\$13,620
18	\$0	\$1,385	\$1,385	\$15,005
19	\$0	\$1,427	\$1,427	\$16,432
20	\$0	\$1,469	\$1,469	\$17,901

PENTHOUSE 1 HEATING SUPPLY & RETURN PUMPS (3)



ONE OUT OF THREE PUMPS WAS ON STANDBY AT TIME OF AUDIT

Item Description: Heating & Supply Pumps (2)
Total ft²: 21
Average Temperature: 123°F
Fuel Costs:
The uninsulated pumps are costing the college \$58.30 annually.
Recommendation: 🖚
Insulate pumps with 1-inch removable pad

INSULATION THICKNESS	HEAT LOSS	FUEL COST \$/Yr	1 st yr. SAVINGS.	5yr. SAVINGS	CO2 EMMISSIONS
0	1,890 Btu/h	\$58.30	NA	NA	0.67 MT/yr
1"	229 Btu/h	\$7.06	\$51.24	\$256.20	0.08 MT/yr
1.5"	164 Btu/h	\$5.07	\$53.23	\$266.15	0.06 MT/yr
2″	128 Btu/h	\$3.96	\$54.34	\$271.70	0.04 MT/yr

PENTHOUSE 1 HEATING SUPPLY & RETURN GATE VALVES











PENTHOUSE 1 HEATING SUPPLY & RETURN PUMPS



Item Description: Gate Valve Bonnets (7)
Total ft²: 21
Average Temperature: 152°F
Fuel Costs:
The uninsulated gate valves in this area are costing the college \$99.10 annually.
Recommendation: 💴
Insulate gate valves with 1-inch removable pad
Results

INSULATION THICKNESS	HEAT LOSS	FUEL COST \$/Yr	1 st yr. SAVINGS.	5yr. SAVINGS	CO2 EMMISSIONS
0	3,212 Btu/h	\$99.10	NA	NA	1.14 MT/yr
1"	373 Btu/h	\$11.51	\$87.59	\$437.95	0.13 MT/yr
1.5"	267 Btu/h	\$8.23	\$90.87	\$454.35	0.09 MT/yr
2"	208 Btu/h	\$6.42	\$92.68	\$463.40	0.07 MT/yr

PENTHOUSE 1 HEATING SUPPLY & RETURN PNEUMATIC VALVES & PIPING



Item Description: Pneumatic Valves and Piping (Size of Piping: 8" Length: 15'), (Size of Piping: 6" Length: 6') Average Temperature: 160°F Fuel Costs:

The uninsulated valves and piping are costing the college \$237.63 annually. **Recommendation:**

Insulate valves with 1-inch removable pad, insulate piping with 1-1/2 thick fiberglass insulation

INSULATION THICKNESS	HEAT LOSS	FUEL COST \$/Yr	1 st yr. SAVINGS.	5yr. SAVINGS	CO2 EMMISSIONS
0	7,689 Btu/h	\$237.63	NA	NA	2.73 MT/yr
1"	883 Btu/h	\$27.28	\$210.35	\$1,051.75	0.28 MT/yr
1.5"	630 Btu/h	\$19.46	\$218.17	\$1,090.85	0.17 MT/yr
2″	496 Btu/h	\$15.31	\$222.32	\$1,111.60	0.17 MT/yr

PENTHOUSE 1 FINANCIAL SUMMARY

PENTHOUSE 1 AREA CALCULATION TOTALS

INSULATION THICKNESS	INSULATION HEAT LOSS THICKNESS		FUEL COST 1 st yr. SAVINGS. \$/Yr		CO2 EMMISSIONS	
0	12,791 Btu/h	\$395.03	NA	NA	4.54 MT/yr	
1"	1,485 Btu/h	\$45.85	\$349.18	\$1,745.90	0.49 MT/yr	
1.5"	1,061 Btu/h	\$32.76	\$362.27	\$1,811.35	0.32 MT/yr	
2″	832 Btu/h	\$25.69	\$369.34	\$1,846.70	0.28 MT/yr	

PENTHOUSE 1 FINANCLE SUMMARY

1. Investment (Initial Installed Cost), \$

2. First Year Energy Cost Savings, \$/yr

3. Energy Cost Escalation Rate, %/yr

4. Estimated Economic Life, yrs

5. Discount Rate , %

20

\$0

1914.45
349.18
3.0
20
5.0

Results	
Simple Payback Period, yrs	5.5
Internal Rate of Return (IRR or ROI)	20.4%
Net Present Value,	\$3,658

	Calculations								
Year	Investment	Annual Savings	Annual Cash Flow	Cumulative Cash Flow					
0	\$-1,914	\$0	\$-1,914	\$-1,914					
1	\$0	\$349	\$349	\$-1,565					
2	\$0	\$359	\$359	\$-1,206					
3	\$0	\$370	\$370	\$-835					
4	\$0	\$381	\$381	\$-454					
5	\$0	\$393	\$393	\$-61					
6	\$0	\$405	\$405	\$343					
7	\$0	\$417	\$417	\$760					
8	\$0	\$429	\$429	\$1,189					
9	\$0	\$442	\$442	\$1,632					
10	\$0	\$455	\$455	\$2,087					
11	\$0	\$469	\$469	\$2,556					
12	\$0	\$483	\$483	\$3,039					
13	\$0	\$498	\$498	\$3,537					
14	\$0	\$513	\$513	\$4,049					
15	\$0	\$528	\$528	\$4,577					
16	\$0	\$544	\$544	\$5,121					
17	\$0	\$560	\$560	\$5,681					
18	\$0	\$577	\$577	\$6,258					
19	\$0	\$594	\$594	\$6.852					

\$612

\$612

\$7,464

PENTHOUSE 1 & 2 CORRIDOR

PENTHOUSE 1 & 2 CORRIDOR HEATING SUPPLY & RETURN VALVES & PIPING





Item Description: 4-inch Gate Valves (2) & 3-inch Iron Piping Total ft²: 12 (Size of Piping: 3" Length: 3') Average Temperature: 116°F ⇒

Fuel Costs:

The uninsulated gate valves are costing the college \$41.66 annually.

Recommendation:

Insulate gate valves with 1-inch thick removable pad, insulate piping with a minimum 1-1/2 thick fiberglass insulation

Results

	INSULATION THICKNESS	HEAT LOSS	FUEL COST \$/Yr	1 st yr. SAVINGS.	5yr. SAVINGS	CO2 EMMISSIONS
→	0	1,350 Btu/h	\$41.66	NA	NA	1.14 MT/yr
⇒	1"	157 Btu/h	\$4.86	\$36.80	\$184.00	0.13 MT/yr
⇒	1.5"	114 Btu/h	\$3.52	\$38.14	\$190.70	0.09 MT/yr
	2"	90 Btu/h	\$2.79	\$38.87	\$194.35	0.07 MT/yr

*Estimated Calculations supplied by National Institute of Building Sciences Mechanical Insulation Energy Calculator *

PENTHOUSE 1 & 2 CORRIDOR FINANCIAL SUMMARY

PENTHOUSE 1 &2 CORRIDOR AREA CALCULATION TOTALS

INSULATION THICKNESS	HEAT LOSS	FUEL COST \$/Yr	1 st yr. SAVINGS.	5yr. SAVINGS	CO2 EMMISSIONS
0	1,350 Btu/h	\$41.66	NA	NA	1.14 MT/yr
1"	157 Btu/h	\$4.86	\$36.80	\$184.00	0.13 MT/yr
1.5"	114 Btu/h	\$3.52	\$38.14	\$190.70	0.09 MT/yr
2″	90 Btu/h	\$2.79	\$38.87	\$194.35	0.07 MT/yr

PENTHOUSE 1 & 2 CORRIDOR FINANCLE SUMMARY

292.68

36.80

3.0

20

5.0

1. Investment (Initial Installed Cost), \$

2. First Year Energy Cost Savings,

\$/yrs.

3. Energy Cost Escalation Rate, %/yrs.

4. Estimated Economic Life, yrs.

5. Discount Rate, %

Results	
Simple Payback Period, yrs.	8.1
Internal Rate of Return (IRR or ROI)	13.6%
Net Present Value,	\$283

			Calculations	
Year	Investment	Annual Savings	Annual Cash Flow	Cumulative Cash Flow
0	\$-292	\$0	\$-292	\$-292
1	\$0	\$36	\$36	\$-256
2	\$0	\$37	\$37	\$-219
3	\$0	\$38	\$38	\$-181
4	\$0	\$39	\$39	\$-141
5	\$0	\$41	\$41	\$-101
6	\$0	\$42	\$42	\$-59
7	\$0	\$43	\$43	\$-16
8	\$0	\$44	\$44	\$28
9	\$0	\$46	\$46	\$74
10	\$0	\$47	\$47	\$121
11	\$0	\$48	\$48	\$169
12	\$0	\$50	\$50	\$219
13	\$0	\$51	\$51	\$270
14	\$0	\$53	\$53	\$323
15	\$0	\$54	\$54	\$378
16	\$0	\$56	\$56	\$434
17	\$0	\$58	\$58	\$491
18	\$0	\$60	\$60	\$551
19	\$0	\$61	\$61	\$612
20	\$0	\$63	\$63	\$675

Coloulations

PENTHOUSE 2 HEATING SUPPLY & RETURN PUMPS



Item Description: Heating Supply & Return Pumps (3)
Total ft ² : 35
Average Temperature: 125°F
Fuel Costs:
The uninsulated pumps are costing the college \$101.57 annually.
Recommendation:
Insulate pumps with 1-inch removable pad

INSULATION THICKNESS	HEAT LOSS	FUEL COST \$/Yr	1 st yr. SAVINGS.	5yr. SAVINGS	CO2 EMMISSIONS
0	3,292 Btu/h	\$101.57	NA	NA	1.17 MT/yr
1"	397 Btu/h	\$12.25	\$89.32	\$446.60	0.14 MT/yr
1.5"	285 Btu/h	\$8.80	\$92.77	\$463.85	0.10 MT/yr
2″	223 Btu/h	\$6.87	\$94.70	\$473.50	0.08 MT/yr

PENTHOUSE 2 HEATING SUPPLY & RETURN GATE VALVES





















*Estimated Calculations supplied by National Institute of Building Sciences Mechanical Insulation Energy Calculator *

PENTHOUSE 2 HEATING SUPPLY & RETURN GATE VALVES CALCULATION

Item Description: (6) Valve Bonnets & (2) Pneumatic Valves Total ft²: 44 Average Temperature: 147°F Fuel Costs: The uninsulated gate valves are costing the college \$192.13 annually. Recommendation: Insulate gate valves with 1-inch removable pad

	INSULATION THICKNESS	HEAT LOSS	FUEL COST \$/Yr	1 st yr. SAVINGS.	5yr. SAVINGS	CO2 EMMISSIONS
>	0	6,227 Btu/h	\$192.13	NA	NA	2.22 MT/yr
>	1"	728 Btu/h	\$22.45	\$169.68	\$848.40	0.26 MT/yr
	1.5"	521 Btu/h	\$16.07	\$176.06	\$880.30	0.19 MT/yr
	2"	406 Btu/h	\$12.53	\$179.60	\$898.00	0.14 MT/yr

PENTHOUSE 2 HEATING SUPPLY & RETURN FLANGE VALVES

















PENTHOUSE 2 HEATING SUPPLY & RETURN FLANGE VALVES CALCULATIONS

Item Description: Heating Supply and Return Valves and Oversize Flanges Size of Piping: 10" Length of Piping: 15' Average Temperature: 130°F Fuel Costs: The uninsulated gate valves are costing the college \$2,000 annually. Recommendation: Insulate gate valves with 2-inch removable pad

Results

	INSULATION THICKNESS	HEAT LOSS	FUEL COST \$/Yr	1 st yr. SAVINGS.	5yr. SAVINGS	CO2 EMMISSIONS
►	0	5,524 Btu/h	\$170.43	NA	NA	1.97 MT/yr
	1"	612 Btu/h	\$18.87	\$151.56	\$757.80	0.22 MT/yr
≻	1.5"	416 Btu/h	\$12.83	\$57.60	\$288.00	0.15 MT/yr
	2"	336 Btu/h	\$10.38	\$160.05	\$800.25	0.12 MT/yr

MISSING INSULATION ON CHILLED WATER LINES, THIS WILL ALLOW CONDENSATION.





PENTHOUSE 2 FINANCIAL SUMMARY

PENTHOUSE 2 AREA CALCULATION TOTALS

INSULATION THICKNESS	HEAT LOSS	FUEL COST \$/Yr	1 st yr. SAVINGS.	5yr. SAVINGS	CO2 EMMISSIONS
0	15,043 Btu/h	\$460.13	NA	NA	5.36 MT/yr
1"	1,737 Btu/h	\$53.57	\$406.56	\$2,032.80	0.62 MT/yr
1.5"	1,222 Btu/h	\$37.70	\$422.43	\$2,112.15	0.44 MT/yr
2"	965 Btu/h	\$29.78	\$430.35	\$2,151.75	0.34 MT/yr

PENTHOUSE 2 FINANCIAL SUMMARY

1. Investment (Initial Installed Cost), \$ 2. First Year Energy Cost Savings, \$/yr

3. Energy Cost Escalation Rate, %/yr

4. Estimated Economic Life, yrs

5. Discount Rate , %

2,714.11		
406.56	Results	
3.0	Simple Payback Period, yrs	6.7
20	Internal Rate of Return (IRR or ROI)	16.7%
5.0	Net Present Value,	\$3,768

Year	Investment	Annual Savings	Annual Cash Flow	Cumulative Cash Flow
0	\$-2,714	\$0	\$-2,714	\$-2,714
1	\$0	\$406	\$406	\$-2,308
2	\$0	\$418	\$418	\$-1,890
3	\$0	\$431	\$431	\$-1,459
4	\$0	\$444	\$444	\$-1,015
5	\$0	\$457	\$457	\$-558
6	\$0	\$471	\$471	\$-88
7	\$0	\$485	\$485	\$397
8	\$0	\$499	\$499	\$896
9	\$0	\$514	\$514	\$1,411
10	\$0	\$530	\$530	\$1,940
11	\$0	\$546	\$546	\$2,486
12	\$0	\$562	\$562	\$3,048
13	\$0	\$579	\$579	\$3,627
14	\$0	\$596	\$596	\$4,223
15	\$0	\$614	\$614	\$4,837
16	\$0	\$633	\$633	\$5,470
17	\$0	\$652	\$652	\$6,121
18	\$0	\$671	\$671	\$6,792
19	\$0	\$691	\$691	\$7,483
20	\$0	\$712	\$712	\$8,195

PENTHOUSE 6 HEATING INLINE PUMP



Item Description: Inline Heating Pump Total ft²: 6 Average Temperature: 95°F Fuel Costs: The uninsulated gate valves are costing the college \$9.81 annually. Recommendation: Insulate inline pump with 1-inch removable pad

INSULATION THICKNESS	HEAT LOSS	FUEL COST \$/Yr	1 st yr. SAVINGS.	5yr. SAVINGS	CO2 EMMISSIONS
0	3,212 Btu/h	\$9.81	NA	NA	0.11 MT/yr
1"	373 Btu/h	\$1.27	\$8.54	\$42.70	0.01 MT/yr
1.5"	267 Btu/h	\$0.92	\$8.89	\$44.45	0.01 MT/yr
2"	208 Btu/h	\$0.72	\$9.09	\$45.45	0.01 MT/yr

PENTHOUSE 6 HEATING SUPPLY VALVES



Item Description: Flanged Valve, Strainer and metering valve
Total length of piping: 5 feet, O.D. of Piping: 6"
Average Temperature: 178°F
Fuel Costs:
The uninsulated piping is costing the college \$75.05 annually.
Recommendation: 🖚
Insulate piping with 1-1/2-inch fiberglass insulation

INSULATION THICKNESS	HEAT LOSS	FUEL COST \$/Yr	1 st yr. SAVINGS.	5yr. SAVINGS	CO2 EMMISSIONS
0	2,432 Btu/h	\$75.05	NA	NA	0.87 MT/yr
1"	256 Btu/h	\$7.90	\$67.15	\$335.75	0.09 MT/yr
1.5"	187 Btu/h	\$5.78	\$69.27	\$346.35	0.07 MT/yr
2"	147 Btu/h	\$4.55	\$70.50	\$352.50	0.05 MT/yr

PENTHOUSE 6 FINANCIAL SUMMARY

PENTHOUSE 6 CALCULATION TOTALS

INSULATION THICKNESS	HEAT LOSS	FUEL COST \$/Yr	1 st yr. SAVINGS.	5yr. SAVINGS	CO2 EMMISSIONS
0	5,644 Btu/h	\$84.81	NA	NA	0.98 MT/yr
1"	629 Btu/h	\$9.17	\$75.64	\$378.20	0.10 MT/yr
1.5"	454 Btu/h	\$6.70	\$78.11	\$390.55	0.08 MT/yr
2″	355 Btu/h	\$5.27	\$79.54	\$397.70	0.06 MT/yr

PENTHOUSE 6 FINANCIAL SUMMARY

337.14

75.64

3.0

20

5.0

\$120

\$124

\$128

\$132

1. Investment (Initial Installed Cost), \$

2. First Year Energy Cost Savings, \$/yr

3. Energy Cost Escalation Rate, %/yr

4. Estimated Economic Life, yrs

5. Discount Rate , %

17

18

19

20

\$0

\$0

\$0

\$0

Results	
Simple Payback Period, yrs	4.5
Internal Rate of Return (IRR or ROI)	24.8%
Net Present Value,	\$860

Year	Investment	Annual Savings	Annual Cash Flow	Cumulative Cash Flow
0	\$-337	\$0	\$-337	\$-337
1	\$0	\$75	\$75	\$-262
2	\$0	\$77	\$77	\$-185
3	\$0	\$80	\$80	\$-105
4	\$0	\$82	\$82	\$-23
5	\$0	\$84	\$84	\$61
6	\$0	\$87	\$87	\$148
7	\$0	\$90	\$90	\$238
8	\$0	\$92	\$92	\$330
9	\$0	\$95	\$95	\$425
10	\$0	\$98	\$98	\$523
11	\$0	\$101	\$101	\$624
12	\$0	\$104	\$104	\$727
13	\$0	\$107	\$107	\$834
14	\$0	\$110	\$110	\$944
15	\$0	\$113	\$113	\$1,058
16	\$0	\$117	\$117	\$1,175

Calculations

\$120

\$124

\$128

\$132

\$1,295

\$1,419

\$1,547

\$1,678

PENTHOUSE 5 HEATING SUPPLY & RETURN PIPING



Item Description: Heating Supply & Return Piping (Pipe Size: 3" Length: 30') (Pipe Size:6" Length:16') (Pipe Size:2" Length:9') (Pipe Size: 4" Length: 3') Average Temperature: 132°F

Average remperature: 1.

Fuel Costs: 🗪

The uninsulated piping is costing the college \$353.58 annually.

Recommendation: 🖚

Insulate with minimum 1" fiberglass insulation for 2-inch piping and use a minimum 1-1/2 fiberglass insulation for all other size piping.

INSULATION THICKNESS	HEAT LOSS	FUEL COST \$/Yr	1 st yr. SAVINGS.	5yr. SAVINGS	CO2 EMMISSIONS
0	11,460 Btu/h	\$353.58	NA	NA	408 MT/yr
1"	1,162 Btu/h	\$35.82	\$317.76	\$1,588.80	0.41 MT/yr
1.5"	865 Btu/h	\$26.67	\$326.91	\$1,634.55	0.31 MT/yr
2″	703 Btu/h	\$21.70	\$331.88	\$1,659.40	0.25 MT/yr

PENTHOUSE 5 GATE VALVE BONNETS (8)



Item Description: (8) Valve Bonnets Total ft²: 16 Average Temperature: 129°F Fuel Costs: The uninsulated gate valves are costing the college \$50.52 annually. Recommendation: Insulate gate valves with 1-inch removable pad

INSULATION THICKNESS	HEAT LOSS	FUEL COST \$/Yr	1 st yr. SAVINGS.	5yr. SAVINGS	CO2 EMMISSIONS
0	1,637 Btu/h	\$50.52	NA	NA	0.58 MT/yr
1"	196 Btu/h	\$6.06	\$44.46	\$222.30	0.07 MT/yr
1.5"	141 Btu/h	\$4.35	\$46.17	\$230.85	0.05 MT/yr
2"	110 Btu/h	\$3.39	\$47.13	\$235.65	0.04 MT/yr

PENTHOUSE 5 HEATING SUPPLY & RETURN PUMPS



Item Description: Heating Supply & Return Pumps (2) Total ft²: 14 Average Temperature: 126°F Fuel Costs: The uninsulated pumps are costing the college \$41.52 annually. Recommendation:

Insulate each pump with 1-inch removable pad

INSULATION THICKNESS	HEAT LOSS	FUEL COST \$/Yr	1 st yr. SAVINGS.	5yr. SAVINGS	CO2 EMMISSIONS
0	1,346 Btu/h	\$41.52	NA	NA	0.48 MT/yr
1"	162 Btu/h	\$5.00	\$36.52	\$182.60	0.06 MT/yr
1.5"	116 Btu/h	\$3.59	\$37.93	\$189.65	0.04 MT/yr
2″	91 Btu/h	\$2.80	\$38.72	\$193.60	0.03 MT/yr

PENTHOUSE 5 FINANCIAL SUMMARY

PENTHOUSE 5 CALCULATION TOATLS

INSULATION THICKNESS	HEAT LOSS	FUEL COST \$/Yr	1 st yr. SAVINGS.	5yr. SAVINGS	CO2 EMMISSIONS
0	14,443 Btu/h	\$445.62	NA	NA	5.14 MT/yr
1"	1,520 Btu/h	\$46.88	\$376.51	\$1,882.55	0.54 MT/yr
1.5"	1,122 Btu/h	\$34.61	\$387.93	\$1,939.65	0.40 MT/yr
2″	904 Btu/h	\$27.89	\$394.16	\$1,970.80	0.32 MT/yr

PENTHOUSE 5 FINANCIAL SUMMARY

2537.46

376.51

3.0

20

5.0

1. Investment (Initial Installed Cost), \$

2. First Year Energy Cost Savings, \$/yr

3. Energy Cost Escalation Rate, %/yr

4. Estimated Economic Life, yrs

5. Discount Rate , %

	Results	
_	Simple Payback Period, yrs	6.7
_	Internal Rate of Return (IRR or ROI)	16.6%
_	Net Present Value,	\$3,466

Calculations					
Year	Investment	Annual Savings	Annual Cash Flow	Cumulative Cash Flow	
0	\$-2,537	\$0	\$-2,537	\$-2,537	
1	\$0	\$376	\$376	\$-2,161	
2	\$0	\$387	\$387	\$-1,774	
3	\$0	\$399	\$399	\$-1,375	
4	\$0	\$411	\$411	\$-964	
5	\$0	\$423	\$423	\$-541	
6	\$0	\$436	\$436	\$-105	
7	\$0	\$449	\$449	\$344	
8	\$0	\$462	\$462	\$807	
9	\$0	\$476	\$476	\$1,283	
10	\$0	\$491	\$491	\$1,773	
11	\$0	\$505	\$505	\$2,279	
12	\$0	\$520	\$520	\$2,799	
13	\$0	\$536	\$536	\$3,335	
14	\$0	\$552	\$552	\$3,887	
15	\$0	\$569	\$569	\$4,456	
16	\$0	\$586	\$586	\$5,042	
17	\$0	\$603	\$603	\$5,645	
18	\$0	\$621	\$621	\$6,267	
19	\$0	\$640	\$640	\$6,907	
20	\$0	\$659	\$659	\$7.566	

Energy Savings Summary

COSTS AND	INVESTMENT	TABLE BY AREA
000101110		

9 AREAS	HEAT LOSS	FUEL COST	CO2 EMISSIONS	COST OF
	Dtu /U	¢VD	MT /VD	INCLUATION
	Dtu/H	ΦΙ Π.	MI/IK	INSULATION
BOILER ROOM	90,103 Btu/h	\$2,772.36	31.40 MT/yr	\$17,000
			-	r.
PENTHOUSE 4	21.927 Btu/h	\$676.91	7.80 MT/vr	\$3,500
	· · · · · · · · · · · · · · · · · · ·			1 - 9
		+ · · · ·		
PENTHOUSE 3	41,803 Btu/h	\$1,777.64	20.50 MT/yr	\$5,500
	30.007 Btu/b	\$928.57	10.71 MT/yr	\$4 700
FILS & 4 CORRIDORS	50,077 Dtu/II	φ720.57	10./1 W11/y1	φ - ,700
PENTHOUSE 1	12,791 Btu/h	\$395.03	4.54 MT/yr	\$2,000
			-	
	1.250 Dtr./b	\$41.00	1 14 MT /	\$200
PH I & 2 CORRIDOR	1,550 Btu/n	\$41.00	1.14 M11/yr	\$200
PENTHOUSE 2	15,043 Btu/h	\$460.13	5.36 MT/yr	\$2,800
PENTHOUSE 6	5 644 Btu/h	\$84.81	98 MT/vr	\$400
I LIVIIIOUSL U	5,011 Dtu/II	φ01.01		<i>Q</i> 100
	14 442 Dr. 4	¢ 4 4 5 < 0		#3 <00
PENTHOUSE 5	14,443 Btu/h	\$445.62	5.14 M1/yr	\$2,600
CURRENT TOTALS	233.201 Btu/h	\$7.582.73	87.57 MT/vr	\$38,800
		+·;- 5		+,000
	05.054 D/ //	0.40 55		N T/ A
AFTER TINCH	25,354 Btu/h	\$842.75	9.44 MT/yr	N/A
INSULATION				
1 YEAR SAVINGS TOTAL	207,847 Btu/h	\$6,739.98	78.13 MT/yr	N/A

The Investment numbers (cost of Insulation) used for this report are only an estimate. These numbers were based off a nationwide average generated by the DOE's calculator. The investment costs for South Suburban College might be higher, contact your local Insulation Contractors for pricing.

Total Energy Cost Savings Summary

1. In

*Estimated Calculations supplied by National Institute of Building Sciences Mechanical Insulation Energy Calculator *

- 2. First Year Energy Cost Savings, \$/yrs.
- 3. Energy Cost Escalation Rate, %/yrs.
- 4. Estimated Economic Life, yrs.
- 5. Discount Rate, %

0		
6,739.98	Results	
3.0	Simple Payback Period, yrs.	5.6
20	Internal Rate of Return (IRR or ROI)	19.9%
5.0	Net Present Value,	\$69,587

Calculations					
Year	Investment	Annual Savings	Annual Cash Flow	Cumulative Cash Flow	
0	\$-38,000	\$0	\$-38,000	\$-38,000	
1	\$0	\$6,739	\$6,739	\$-31,261	
2	\$0	\$6,941	\$6,941	\$-24,320	
3	\$0	\$7,149	\$7,149	\$-17,170	
4	\$0	\$7,364	\$7,364	\$-9,807	
5	\$0	\$7,585	\$7,585	\$-2,222	
6	\$0	\$7,812	\$7,812	\$5,591	
7	\$0	\$8,047	\$8,047	\$13,637	
8	\$0	\$8,288	\$8,288	\$21,925	
9	\$0	\$8,537	\$8,537	\$30,462	
10	\$0	\$8,793	\$8,793	\$39,255	
11	\$0	\$9,057	\$9,057	\$48,312	
12	\$0	\$9,328	\$9,328	\$57,640	
13	\$0	\$9,608	\$9,608	\$67,248	
14	\$0	\$9,896	\$9,896	\$77,145	
15	\$0	\$10,193	\$10,193	\$87,338	
16	\$0	\$10,499	\$10,499	\$97,837	
17	\$0	\$10,814	\$10,814	\$108,651	
18	\$0	\$11,139	\$11,139	\$119,790	
19	\$0	\$11,473	\$11,473	\$131,263	
20	\$0	\$11,817	\$11,817	\$143,079	

Glossary of Terms

*Estimated Calculations supplied by National Institute of Building Sciences Mechanical Insulation Energy Calculator *

<u>Ambient Temperature</u> The average temperature of the medium, usually air, surrounding an object under consideration.

British thermal unit (Btu) The quantity of heat required to raise on pound of water (about one pint) one degree Fahrenheit at or near its point of maximum density. A common unit of measurement for gas prices. 1034 Btus = 1 cubic foot an MMBtu (-mil Btus) is roughly equivalent to an Mcf (a thousand cubic feet)

<u>*CE*</u> Carbon Equivalents. Estimates of green house gas emissions are presented in units of millions of metric tons of carbon equivalents (MMTCE), which weighs each gas by its GWP value, or Global Warming Potential.

<u>CO</u>₂ Carbon Dioxide is the key greenhouse gas responsible for global warming concerns. The overwhelming share of the U.S. and world CO_2 emissions comes from burning fossil fuels, such as oil, coal and gas – our main source of energy.

<u>Emissivity</u> The ability of a surface to radiate energy as compared to that emitted by an ideal black body at the same temperature. Significant when the surface temperature of the insulation must be regulated as with the moisture condensation or personal protection.

<u>**GHG**</u> Greenhouse gases. The six GHGs recognized and regulated by the Kyoto Protocol are: carbon dioxide (CO_2), methane (CH4), nitrous oxide (N2O), hydrofluorocarbons (HFCs) and perfluoro-carbons (PFCs) and sulphurhexaflouride (SF6)

<u>Heat flow/Heat transfer</u> In order to understand how insulation works, it is important to understand the concept of heat flow or heat transfer. Heat always flows from warmer to cooler surfaces. This flow does not stop until the temperature in the two surfaces is equal. Heat is 'transferred' by three different means: conduction, convection, and radiation. Insulation reduces the transference of heat/energy. Hot insulation systems will suffer heat loss and cold insulation systems will suffer heat gain

<u>*Kilowatt-hour*</u> The basic unit for pricing electric energy, equal to one kilowatt of power supplied continuously for one hour (or the amount of electricity needed to light ten 100-watt light bulbs for one hour). One kWh equals 1,000 watt-hours. One kWh = 3.306 cu ft of natural gas. An average household will use between 800-1300 kWh/month.

Mcf One thousand cubic feet of natural gas

NOAA Acronym for the National Oceanographic and Atmospheric Administration. Their website at homepage <u>www.noaa.org</u> contains the Ambient Temperature Tables and Average Wind Speed information needed to determine outside temperature and wind speed when performing appraisals on outside piping.

<u>ROI</u> Return on Investment. The time that it takes for a facility to save enough money from insulation to pay for the actual cost of the insulation...often as a short as 6 months. Usually the rate at which the money used could have earned interest if not spent on insulation with the minimum being the annual cost of money rate.

<u>Surface temperature</u> (Ta) The surface temperature of finished insulation.