Gordon Library Energy Efficiency

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Abstract

We preformed cost calculations on different methods to make Gordon Library at WPI more energy efficient. We focused mainly on the insulation of windows and walls, the analysis of different methods to decrease the amount of energy used by computers and televisions, and the feasibility of installing a photovoltaic system on the roof. The windows and walls both proved to have viable payback options while the photovoltaic system proved to have long run cost benefits. The Technology in the Library, if switched from logged-out mode to standby mode can save the Library money in the short run if awareness is raised.

Background

Gordon Library located on WPI's campus was built in 1967. Since the library is 42 years old and the only renovation done was for more offices the original structure has remained unchanged. The original windows and the walls are poor insulators and a consistent draft of wind can be felt from the panes and the walls which are made of cement. Therefore this creates a good amount of heat and energy loss. The library provides many computers for use by WPI students. Having such a large amount of computers can cause a major draw of energy from the library. Cutting down on the energy draw from the computers will offset the libraries electricity usage. Installing Photovoltaics (PV) also known as solar energy may help to offset the overall electricity draw as well as save the library money. With the help of insulation, photovoltaics, window treatments, and cost analysis's, the library can potentially reduce heat, electricity and energy loss.

Methodology

Photovoltaic

- Calculate the size of photovoltaic system
- Calculate the yearly kWh and electricity savings
- Calculate price of photovoltaic system
- Calculate payback period

Windows

- Calculate Heat loss in dollars (Q)
- Determine a U-value for the Library windows U= 1.01
- Calculate the total number of windows and square inches
- Determine average heating and cooling degree days for Massachusetts

-Heating- 7909 days $Q = (\text{Degree Days})\frac{\text{hours}}{\text{day}}(\text{U}-\text{value})(\text{area of windows})\frac{\text{cubic ft.}}{\text{BTU}}\frac{\$\ \text{Natural Gas}}{\text{cubic ft}}$

- Cooling- 750 days $Q = (\text{Degree Days})\frac{\text{hours}}{\text{day}}(\text{U}-\text{value})(\text{area of windows})\frac{\text{cubic ft.}}{\text{BTU}}\frac{\$\ \text{Natural Gas}}{\text{cubic ft}}$

- Calculate the Payback: $\frac{\text{Cost of Curtians}}{\text{Initial heat loss} - \text{Heat loss with Curtains}}$

Walls

- Determine possible R-values
- Calculate wall square footage
- Determine amount of heating days vs. amount of cooling days in MA
- Calculate heat lost (Q) and Calculate money lost
- Calculate Payback

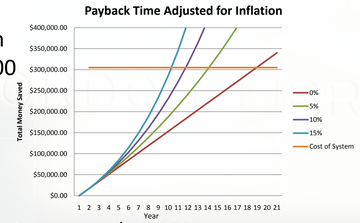
Technology

- Survey usage conditions of computers and televisions in the library, including the bills from National Grid
- Create a rough estimate of how many computers and televisions are in the library
- Determine the amount of watts the television and computers use while on, in standby, and while off
- Calculate the consumption of running the televisions computers
- Figure out the best way to set computers and televisions

Results

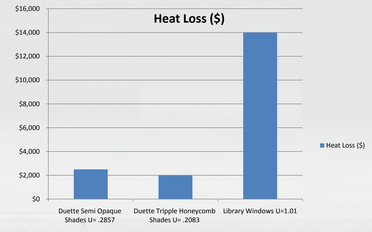
Photovoltaic

- 62.4kW photovoltaic system
- Total cost of system $305,000
- 90000kWh produced yearly
- Savings of $17,000 yearly



Windows

- Library (without window shades) Q = $13,850
- Library with Duette semi- opaque shades (U- value = .2857) Q= $2500;
  Shade and Installation cost= $35,500
- Library with Duette Triple Honeycomb shades (U- value = .2083)
  Q= $2000; Shade and Installation cost= $45,000



Payback

- Library with Duette semi- opaque shades (U-value = .2857)
  Payback= 3 years
- Library with Duette Triple Honeycomb shades (U- value = .2083)
  Payback= 4 years

Walls

- Current walls (approx. 18" concrete R=1.92) $34,148 lost
- With Tuff-R insulation (installed with 5/8" drywall) $4,692.95 lost
- Total new R= 13.84
- Approximate insulation cost $32,000
- Approximate materials cost $20,248.05
- Total costs $52,248.05
- Approximate payback period 2.7 years

Technology

The table shows the average cost for each type of television and computers per year. (Note: the bracketed number is the amount of that brand in the Library)

Consumption Types	Normal (logged out)	Maximum (operation)	Standby	Turn-off
50"NEC #P50XP10(4)	$1283	N/A	$1.37	N/A
50"Panasonic #TH-50PH11UK (3)	$1183	N/A	$0.1	N/A
Dell OptiPlex GX620 & Dell 1905FP (96)	$7812	$12751	$105	$100
Dell OptiPlex 755 & Dell 1907 FPv (7)	$710	$847	$11	$4

Recommendations

Photovoltaic

We recommend adding a photovoltaic system for the long term benefits that include less CO_2 emissions and a reduction in the electricity bill

Windows

The Payback period for the thermal windows shades of three and four years is a viable short and long run investment. Not only will either of the investments pay for the initial costs in less than five years, but the investment will continue to save WPI money in heating and cooling costs long after the project is complete.

Walls

Insulating the walls would be a very obtrusive project, however if done over the summer, it could be a viable option for reducing energy loss from the library. Using the Tuff-R insulation would instantly add an additional R-value of 12. The payback period would be just under 3 years.

Technology

We recommend to reduce the timing of standby mode of the computers in the library. In addition, light work such as word processing and checking E-mails will also help to save energy in the short and long run..

Acknowledgement

Professor Savilonis
Mr. Grudzinski, William G.
Tracy Ledger-Hornby