The Canadian Coalition for Green Health Care
Coalition canadienne pour un système de santé écologique

Assessment of Window Replacement Project

Weeneebayko General Hospital

Background

As part of a multi-year energy management and training initiative between the Canadian Coalition for Green Health Care (the Coalition) and James Bay's Weeneebayko Area Health Authority (WAHA), the Coalition's HealthCare Energy Leaders Ontario (HELO) team was contracted to perform a building audit of the Weeneebayko General Hospital (WGH) in Moose Factory. Of primary importance was developing viable facility upgrade initiatives that would bring energy savings and an improved patient care environment through building envelope improvements.

This Case Study outlines the annual savings potential of the window project and shares simple payback, and return on investment (ROI) calculations which do not take into account maintenance savings achieved through the window systems replacement.

Project Outline

The project objective was to replace WGH's aged and drafty single-glazed aluminum- and vinyl-framed windows with modern energy-efficient units. Existing windows were not equipped with a thermal break so their construction and installation characteristics meant that excessive air infiltration around the sash and frame, and the single-glazed nature of the glass, were contributing to heat loss during the winter months and heat gains during summer thereby drastically increasing the heating and cooling costs.

New replacement windows utilize fibreglass sills, sash and frames providing superior thermal break qualities and are equipped with thermal pane glazing rendering them equal to, or above, the minimum ENERGY STAR® rating requirements for James Bay's climate zone.

To ensure the installation was being completed in strict accordance with project specifications and manufacturer's recommendations, project architects, engineers and WAHA's facility management team constantly monitored the project's progress.

Skids of new windows await installation at WAHA's Weeneebayko General Hospital site in Moose Factory.

The Fine Print

To ensure the success of the project, the HELO team paid close attention to the fine print including simple payback and overall return on investment (ROI), ensuring to WAHA's leadership that the project had credible financial savings before moving the project forward.

Savings and payback calculations

Historical data for the James Bay area was used to establish average Heating Degree Day (HDD) and Cooling Degree Day (CDD) values for the region. These were then used to determine heat gain and heat loss numbers through established engineering and architectural practices, as well as to calculate cubic feet per minute air infiltration.

Using the HDD and CDD data, the average difference in radiant heat loss for single glazed windows versus double glazed, for windows of various exposures, were then calculated on an annualized basis.

Based on measurements taken on site, the average glazed window area was 17.5 ft^2. The number of windows replaced was 398 with total area of new glazing calculated at 6,965 ft^2, plus seven doors of 147 ft^2 to bring the total to 7,112 ft^2.

Using the calculated Btu/ft2/year for heat loss over the 7,112 ft^2 a savings of 405,234,648 Btu/year in avoided heat loss was calculated. By using the established Btus of energy in one imperial gallon of #2 fuel oil, savings become 2412.11 imperial gallons per year or 10,964.14 litres. Heat loss differences due to variations in air infiltration between the old and new window construction and installation details were also considered.

Assuming 50% of windows face the prevailing wind direction at any given point in time, and applying the difference in coefficients for infiltration for old weatherstrip details versus new weatherstripping, calculations were made for ft3/minute of air infiltration for old versus new windows.

Further, assuming hospital HVAC equipment operated 8,760 hours per year, average winter wind velocity at 15 mph, and boiler efficiency at .65, established charts pinpoint Btu losses per thousand cfm per year. In this case, the loss stands at 919,138,462 Btu. This can be converted to 5,471.06 Imperial gallons of #2 fuel oil, or 24,868.46 litres.

Applying similar calculations to the 65 in-filled window areas, results were obtained for both heat loss and infiltration losses avoided by the hospital. Heat loss avoided by in-filling the window areas totals an equivalent of 3,727.07 litres of #2 fuel oil, while infiltration savings totals 35,998 litres of fuel. Therefore, total #2 fuel oil savings becomes 75, 557.67 litres.

Similar calculations were performed to determine Btu heat gain for new windows versus old, and for the avoided heat gain associated with in-filling of windows with values of 59,065,160 and 81,055,975 Btu/yr respectively. Converting the Btu results to kWh shows savings of 17,305.94 kWh and 23,749 kWh respectively, or $2,942.00 and $3,562.38 in annual dollar savings.

Replacement windows being installed at Weeneebayko General Hospital with some windows locations eliminated - awaiting filler panel installation, insulation, flashing, trim, and caulking.

Total savings for fuel oil, based on the estimated 75,557.67 litres of reduced consumption and the current winter pricing of $1.23/litre, is $92,935.93 annually. Adding an estimated 10% additional fuel savings for fixed window replacement of operable windows and total annual fuel savings reaches $119,683.34. Cumulative ($2,942 + $3,562.38 + $119,683.34) yearly savings total $126,187.38. Based on a construction cost of $1.4 million, simple payback is 11.09 years and ROI at 9.01%

Summary

Replacement window and door project cost: $1,400,000

Average life expectancy of new windows and doors: 25 years

Total projected annual savings: $126,187.38

Projected annual savings: $126,187.38

Total 25 Year Lifetime Savings: $3,154,684.50

Return on Investment (ROI): 9.01% without incentives

Projected fuel oil savings: 75,557.67 litres

Avoided CO_2 emissions: 206,650.23 kg

Credits

We would like to thank the senior leadership team and the facility management staff at the Weeneebayko Area Health Authority for assisting us in the development of this Case Study.

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