Thompson Rivers University
ASHRAE Level 1 Energy Study

Energy Study for:

House 1 - Faculty Association

Attention:
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1. Background Description of Facility, Hardware and Systems

1.1 Overview and Facility Use

House 1, housing the Faculty Association, was constructed in 1945 with 2 floors and a gross floor area of 127 m^2 (1,367 ft^2). It contains a board room, offices, and a small kitchen.

1.1.1 Physical condition and window type

The original building appears to be well maintained. The windows are double paned. The building insulation contains asbestos so there are no plans to upgrade the insulation in this building. The building will likely be torn down in the near future. Because of this, no insulation upgrades for considered for this facility.

1.2 Mechanical Systems

1.2.1 Ventilation

Ventilation is supplied by a single furnace, located in the basement, through vents located in the 1st and 2nd floor.

1.2.2 Cooling

Cooling is provided by a direct expansion (DX) coil, located in the building's furnace, with an external condensing unit.

1.2.3 Heating

A single natural gas furnace provides heating to the building's occupied spaces on the 1st and 2nd floor.

1.2.4 Domestic Hot Water

Domestic hot water (DHW) is provided by an electric tank-type heater, located in the basement. While this DHW tank is nearing the end of its recommended service life, we do not recommend replacing it as this time since the building is likely to be torn down in the near future. If the building plans change, this DHW could be replaced with a heat pump version.

1.3 Lighting System

The majority of the building, 85% of the occupied spaces, are illuminated by TLEDs. The remaining ~15% of building spaces, mainly corridors and basement mechanical spaces, are illuminated by CFL bulbs. TRU is in the process of replacing all lighting on campus with LEDs.

1.4 Control Equipment

The furnace is controlled by a single programmable Trane thermostat in the 1st floor board room.

1.5 Energy Analysis

1.5.1 Energy Use Profile

Energy metering is not available for the houses. Figure 1 presents the building's simulated electrical consumption based on equipment capacity and usage estimates. Our simulation follows a typical cooling profile.

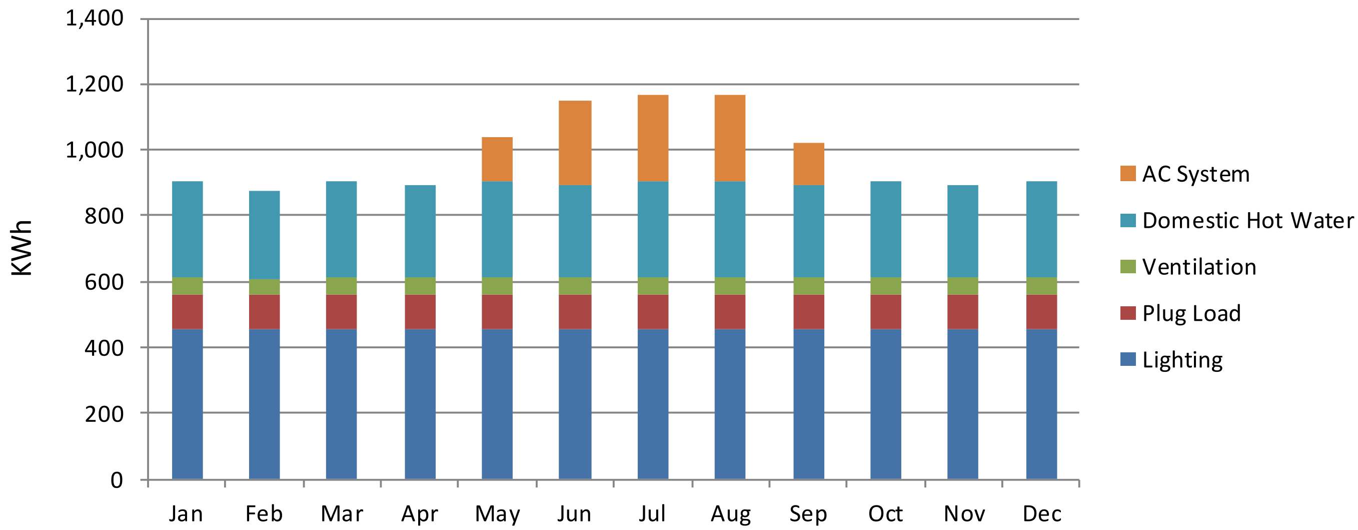

Figure 1: Monthly Electricity Consumption

Figure 2 presents the building's simulated gas consumption. Our simulation follows a typical heating profile.

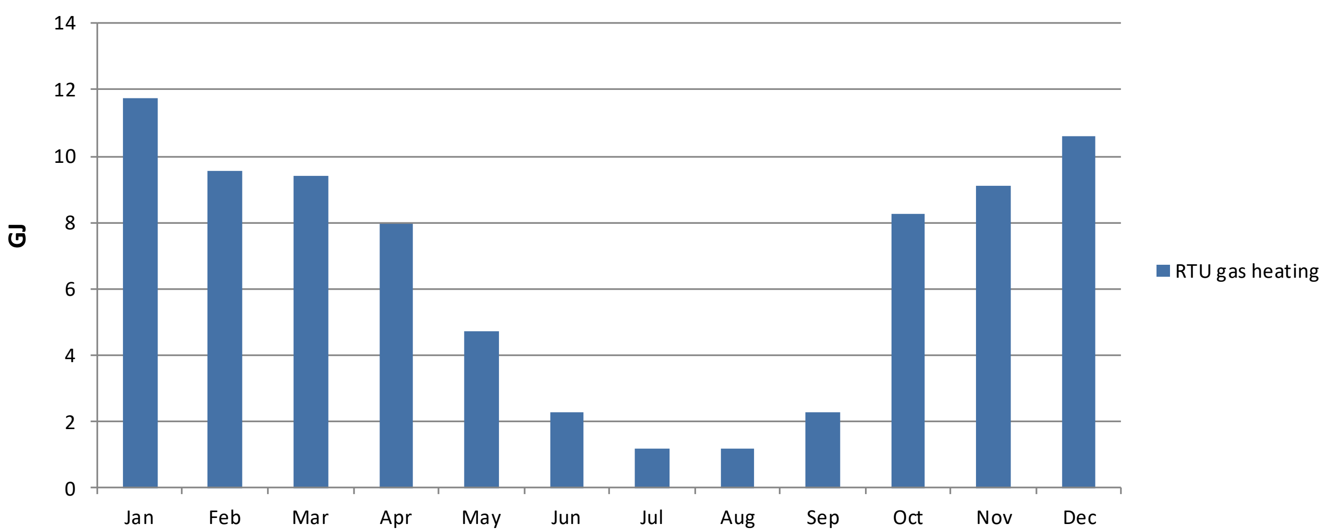

Figure 2: Monthly Gas Consumption

1.5.2 Energy Intensity Analysis

A summary of Baseline Energy consumption and the corresponding costs and energy intensity for the facility is presented in Table 1. House 1 – Faculty Association has an Energy Use Intensity (EUI) of 940 MJ/m^2.

Table 1: Summary of Baseline Energy Data

Utility	Energy Use (GJ)	EUI (MJ/m2)	Cost ($)	Cost ($/ft2)
Gas	80	630	$1,000	$0.73
Electricity	40	310	$1,000	$0.73
Total	**120**	**940**	**$2,000**	**$1.46**

1.5.3 Energy End Use Breakdown

The energy use is based on estimated equipment operation profiles. The estimated breakdown of electricity consumption by building system is presented in Figure 3. Gas is only used for space heating.

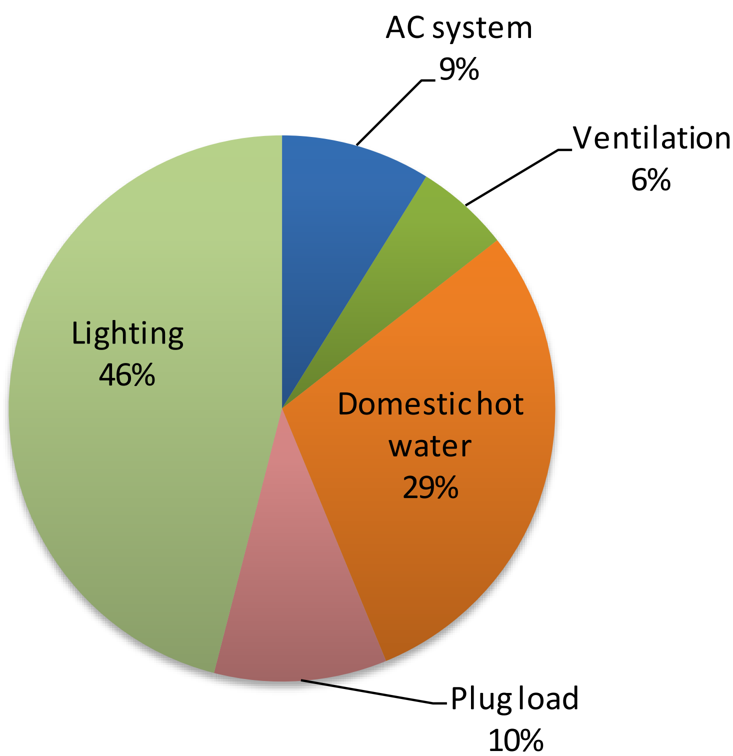

Figure 3: Electricity Consumption

The estimated percentage of total energy consumption by building system is presented in Figure 4.

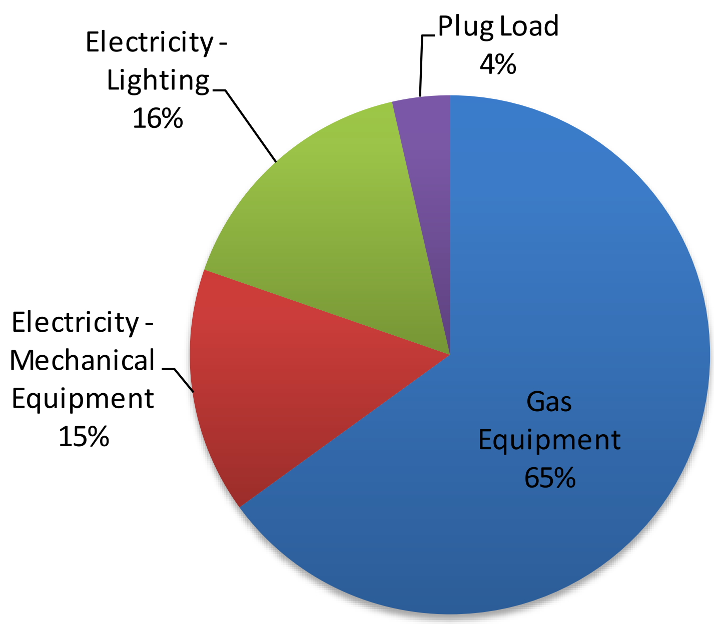

Figure 4: Total Energy Breakdown

2. Conservation Opportunities

The primary objective of this study was to identify and analyse energy conservation opportunities at House1. The rate schedules used in this analysis for financial savings estimates are presented in Table 2. The financial savings estimates include goods and services tax (GST) and provincial sales tax (PST). For Greenhouse Gas estimates, we have used emissions factors of 0.010 kg CO_2e / kWh of electricity in BC, and 49.87 kg CO_2e / GJ for gas.

It should be noted that the paybacks for the measures consider the carbon tax escalation provided by the federal government.

Table 2: Rate Schedules

Utility	Rate
Electricity	
Marginal Demand Charge	$12.26 / kW (inc taxes)
Marginal Consumption	$0.063 / kWh (inc taxes)
Gas	
Recent Gas Consumption	$15.00 / GJ (inc taxes)

A number of potential conservation opportunities have been analyzed. A detailed explanation as well as an estimated cost and energy saving potential are summarized for these projects. If all of the recommended measures are implemented, we estimate the following savings outcomes.

Table 3: Estimated Savings

Energy footprint	Electricity	Natural Gas	Greenhouse gases	Cost per ft^2
40%	-50%	89%	85%	$ 0.44

2.1 Energy Conservation Measures

A summary of the analysis for the recommended measures is presented in Table 4. Detailed descriptions for each project are presented below. The analysis for the measures does not include any incentives provided by either BC Hydro or FortisBC. It should be noted that, based on conversations with operators, this building is likely to be torn down in the near future. As such, it may not make sense to implement any energy conservation measures on this building.

Table 4: Measure Summary

Item	Description	Base Case Cost	Incremental Cost	Total Cost	Effective Payback	NPV	Annual Savings			
							$	GJ	kWh	GHG
1.1	Heat Pump for Furnace	$5,000	$6,500	$11,500	6.0	2,900.0	$690	70	(5,900)	3.4
1.2	Renewable Natural Gas				≥ 40		($90)			0.4

2.1.1 Heat Pump for Furnace

Ventilation is supplied by a single gas furnace that has a direct expansion (DX) cooling coil and external condensing unit. Given the minimal gas usage in the building, it is unlikely it will be connected to the central plant. As such, we recommend replacing the existing condensing unit with a heat pump. This will allow for efficient heating and cooling of the building. The gas heating can still be used as a backup in the colder winter months. Please note the analysis of this measure using incremental costing as it assumes the heat pump is not installed until the condensing unit is due to be replaced. It does not include the incentives available for heat pumps which will further reduce the payback. It should be noted that the gas furnace itself has also reached the end of its recommended service life, however, given the plans for the building and the minimal gas savings achieved from upgrading the furnace itself, we do not recommend upgrading the furnace unless necessary. If it is upgraded, we recommend installing a high efficiency condensing model.

The furnace is controlled by single programmable Trane thermostat in the 1st floor board room. It was noted that there is often a temperature differential between the first and second floor. We recommend installing a second thermostat on the second floor to vary the supply temperature based on the average space temperature conditions. Though this is not an energy savings measure, it may be completed at the same time as the upgrade to improve occupant comfort.

2.1.2 Renewable Natural Gas

FortisBC offers Renewable Natural Gas (RNG), or biomethane, as an alternative to non-renewable natural gas. This presents an easy path to reducing GHG emissions. The cost of RNG is approximately 1.5 times the cost of non-renewable natural gas, however, there is no additional cost for implementing this measure, given that RNG is delivered using existing FortisBC infrastructure. The analysis of this measure assumes all the remaining natural gas in the building is converted to RNG however, there are options for converting any portion (5%, 10%, 25%, 50%, 100%) of the total gas consumption to RNG. The cost per tonne would be the same regardless of the portion converted. Given the plans for this building, renewable natural gas may be the best option to offset emissions in this facility in the short term.

3. Disclaimer

This document was prepared by SES Consulting Inc. for Thompson Rivers University. The scope was to perform a Level 1 Energy Study at this site. An initial investigation has been performed to estimate the probable costs and savings associated with each project. Further detailed design work will be required for project implementation. Any estimates of probable cost are made on the basis of SES's judgment and experience. SES makes no warranty, express or implied, that cost of the work will not vary from the SES's estimate of probable cost. SES accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.