



Thompson Rivers University ASHRAE Level 1 Energy Study

Energy Study for:

House 4 – Sustainability

Attention:

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1. Background Description of Facility, Hardware and Systems

1.1 Overview and Facility Use

House 4, Sustainability Offices, was originally constructed in 1945. The gross conditioned square footage of the building is 134 m² (1,442 ft²). There are offices on the first and second levels of the building. The basement is used for storage and contains the mechanical systems.

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 are considered for this facility.

1.2 Mechanical Systems

1.2.1 Ventilation

A gas fired furnace takes in outdoor air, and supplies conditioned air to the entire house.

1.2.2 Cooling

One direct expansion cooling unit located outside the building provides cooling to a coil in the furnace.

1.2.3 Heating

The gas fired furnace provides heating to the house. There are some electric baseboard heaters on the second level.

1.2.4 Domestic Hot Water

There is one small electric domestic hot water tank in the basement.

1.3 Lighting System

Linear LEDs provides most of the lighting. CFLs provide lighting to the bathroom and hallways. TRU is in the process of replacing all lighting on campus with LEDs.

1.4 Control Equipment

One programmable thermostat controls heating and cooling for the building. Where baseboard heaters are present, standalone thermostats are used.

1.5 Energy Analysis

1.5.1 Energy Use Profile

Energy metering is not available for this facility. Figure 1 presents the building's simulated electrical consumption based on equipment capacity. Electricity usage is assumed higher in the summer during cooling season.

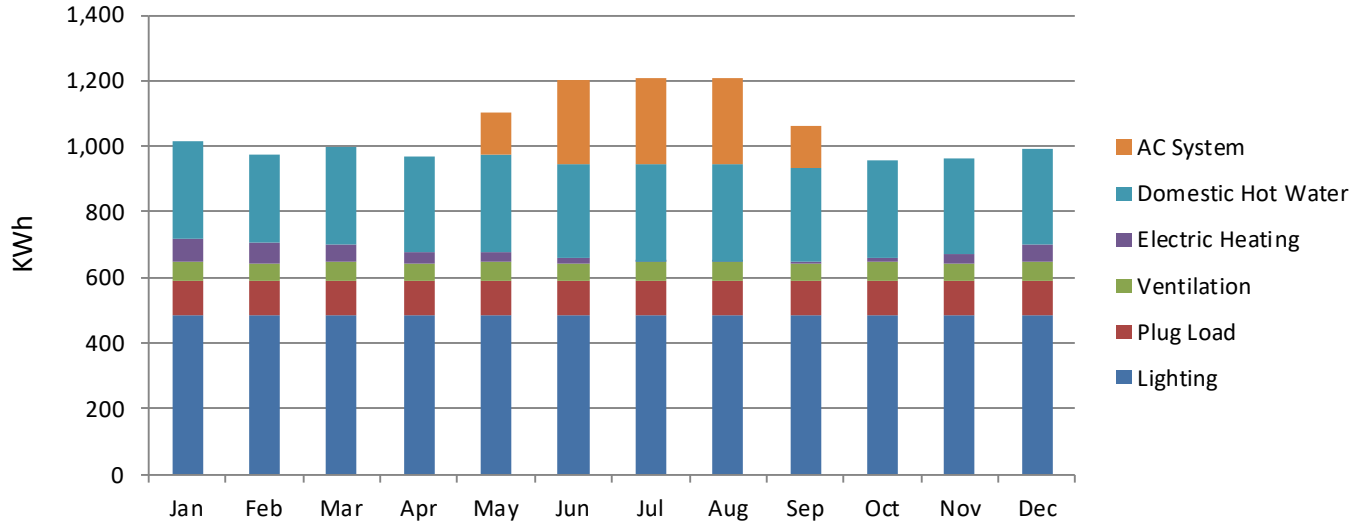


Figure 1: Simulated Monthly Electricity Consumption

Figure 2 presents the building's simulated gas consumption based on estimated equipment use. Gas usage is higher during heating season.

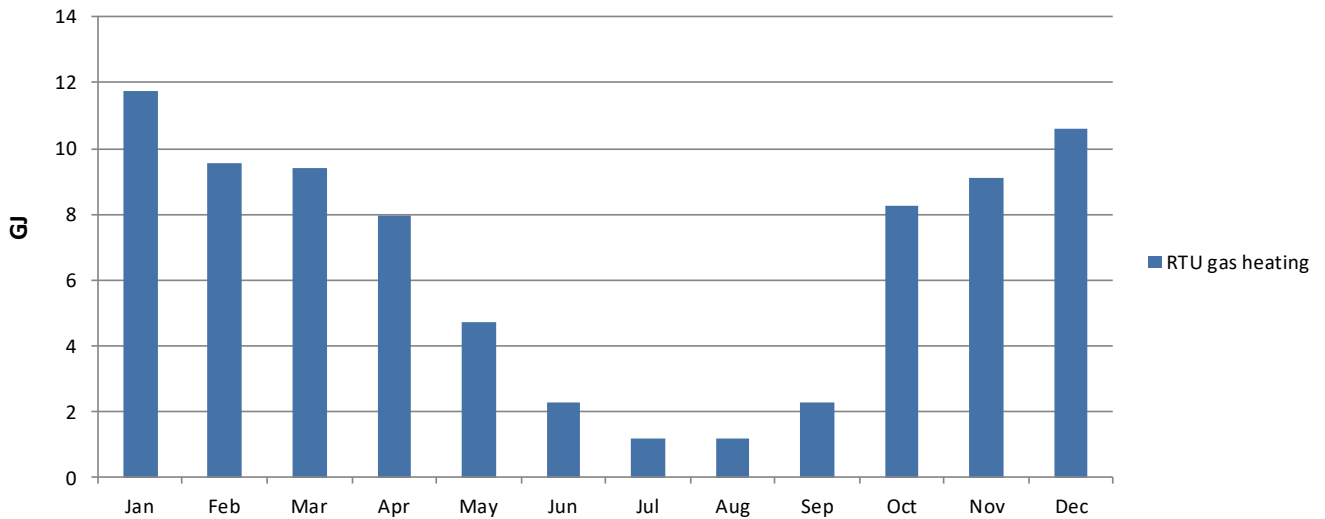


Figure 2: Simulated Monthly Gas Consumption

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 and is based on a simulated building consumption profile. House 4 has an energy use intensity (EUI) of 1,000 MJ/m².

Table 1: Summary of Baseline Energy Data

Utility	Energy Use (GJ)	EUI (MJ/m ²)	Cost (\$)	Cost (\$/ft ²)
Gas	80	600	\$1,000	\$0.69
Electricity	50	400	\$1,000	\$0.69
Total	130	1,000	\$2,000	\$1.39

1.5.3 Energy End Use Breakdown

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

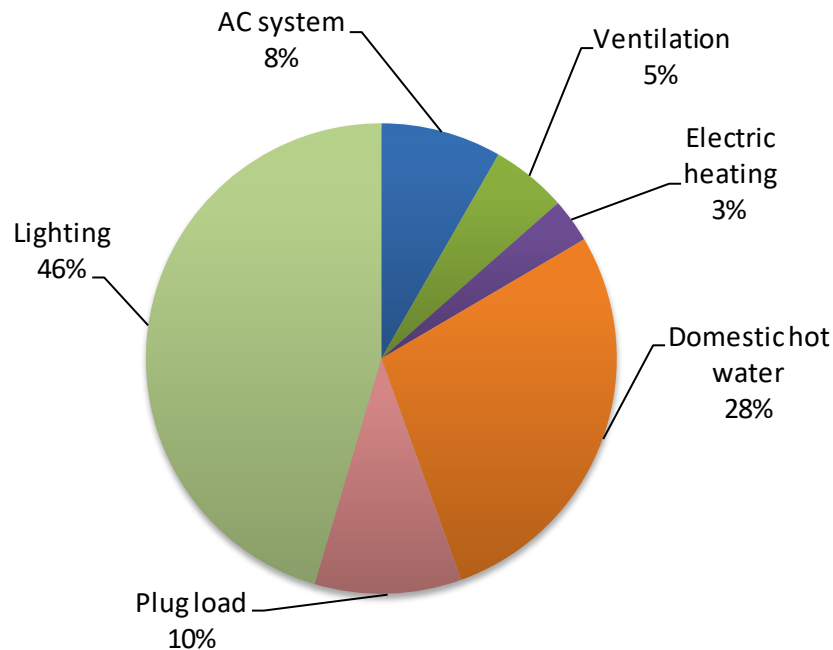


Figure 3: Electricity Consumption

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

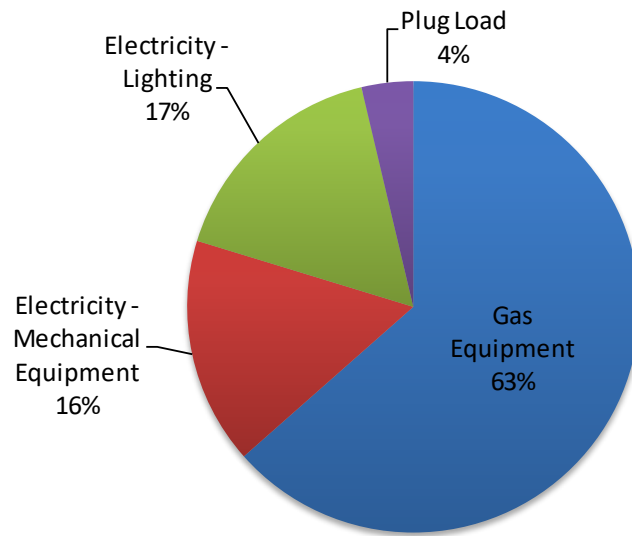


Figure 4: Total Energy Breakdown

2. Conservation Opportunities

The primary objective of this study was to identify and analyse energy conservation opportunities. 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 CO₂e / kWh of electricity in BC, and 49.87 kg CO₂e / 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%	-46%	89%	85%	\$ 0.42

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 these measures does not include incentives from either BC Hydro or Fortis BC. Based on conversations with operators, this building is likely to be torn down in the near future so 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	3,000	\$690	70	(5,800)	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 uses 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 the building, this measure may be the best option to offset emissions at the 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.