Thompson Rivers University
ASHRAE Level 1 Energy Study

Energy Study for:

Human Resources

Attention:
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Prepared by:

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Human Resources
- ASHRAE Level 1 Study -

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1. Background Description of Facility, Hardware and Systems

1.1 Overview and Facility Use

The Human Resources building was constructed in 1972. It is a single-story facility with a gross floor area of 528 m^2. It contains the Human Resources offices, as well as Safety Management offices, Media Services, REACH offices as well as an open workspace, washrooms, and a small staff kitchen.

1.1.1 Physical condition and window type

The original building appears to be well maintained. The windows are double paned. It was noted that many of the older TRU buildings contain asbestos. As such, no envelope upgrades are planned.

1.2 Mechanical Systems

1.2.1 Ventilation

Ventilation is supplied by five roof top units (RTUs) serving the following areas. The RTUs are due for renewal in 2022. Stantec is currently doing a study to investigate replacing all existing RTUs with RTU heat pumps.

- RTU-1 serves the Human Resources (HR) workstations
- RTU-2 serves the HR meeting room and director's office
- RTU-3 serves the HR individual offices
- RTU-4 serves the REACH offices and Media Services
- RTU-5 serves the Safety Management offices

1.2.2 Cooling

Cooling is provided by five direct expansion (DX) coils, each located in one of the RTUs.

1.2.3 Heating

Heating is provided by five gas burners, each located in one of the five RTUs.

A condensing natural gas boiler, located in the mechanical room, supplies heating water to baseboards in the handicap bathroom and neighboring chemical shed. It was noted that some of the piping was un-insulated. This is being fixed as part of the Fortis Bundle A Cycle 2 implementation work. The exact age of this unit is not known. This boiler is significantly oversized for the heating water demand in the building.

There is also the following supplemental electric heating:

- An electric force flow unit provides heating to the Human Resources vestibule
- Electric baseboards are located in offices 152 and 146

1.2.4 Domestic Hot Water

Domestic hot water (DHW) is provided by a single natural gas tank-type heater, located in the mechanical room. The exact age of this unit is not known.

1.3 Lighting System

The building was converted to LED in 2016.

1.4 Control Equipment

Human Resources has an Automated Logic Building Automation System (BAS) that controls the equipment listed below:

- RTUs 1, 2, & 3
- Damper from RTU-2 to offices 112/114
- Condensing gas boiler
- Chemical shed radiation units and exhaust fans

The zones served by RTUs 1, 2, & 3 all have adjustable digital thermostats with occupancy sensors.

RTUs 4 & -5 are not controlled by the BAS system, each having their own independent programmable thermostat, located in Media Services, and the Safety Management offices, respectively.

Perimeter radiation units in Human Resources are controlled by analogue thermostats in the spaces they serve.

1.5 Energy Analysis

1.5.1 Energy Use Profile

Figure 1 presents the building's electrical consumption since 2014. Baseline electricity consumption was calculated based on consumption between January 2014 and September 2017. No more recent data was available for the Human Resources building. There is some data in the new energy monitoring system, IoTORQ, however, there are currently multiple unconsolidated meters for Human Resources so the data was not used. It appears the setup is not yet complete. As there have been minimal changes to the building since 2017, the existing consumption data was deemed sufficient. There is a significant variation in seasonal load, which is atypical for this type of building. This is likely a result of the personal electric resistance heaters that staff bring into the building as well as the seasonal occupancy.

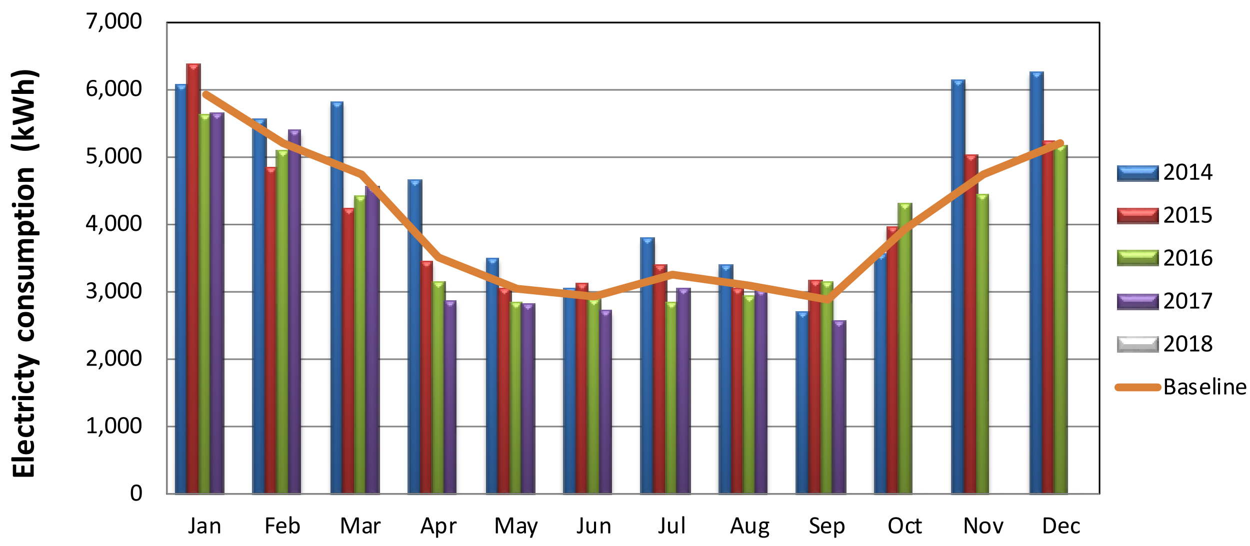

Figure 1: Monthly Electricity Consumption

Gas metering was not available for Human Resources. Figure 2 presents the building's simulated gas consumption based on expected equipment profiles and benchmarking data. Consumption follows a typical heating profile. It should be noted that the boiler is significantly oversized for this building.

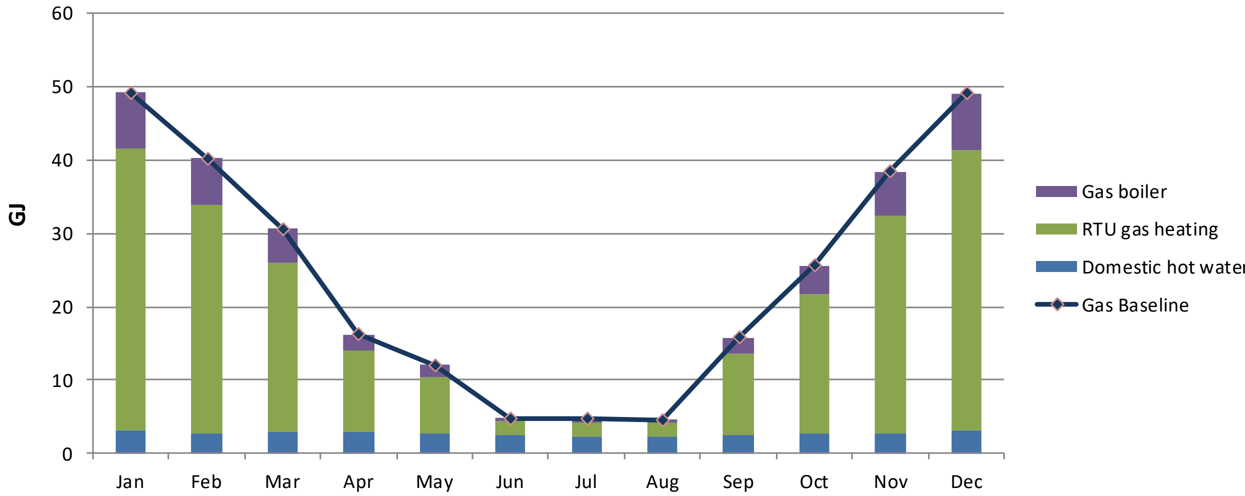

Figure 2: Monthly Gas Consumption

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. Human Resources has an Energy Use Intensity (EUI) of 880 MJ/m^2.

Table 1: Summary of Baseline Energy Data

Utility	Energy Use (GJ)	EUI (MJ/m2)	Cost ($)	Cost ($/ft2)
Gas	290	550	$4,350	$0.77
Electricity	174	330	$7,418	$0.54
Total	**464**	**880**	**$11,768**	**$1.31**

1.5.3 Energy End Use Breakdown

The estimated breakdown of electricity consumption by building system is presented in Figure 3.

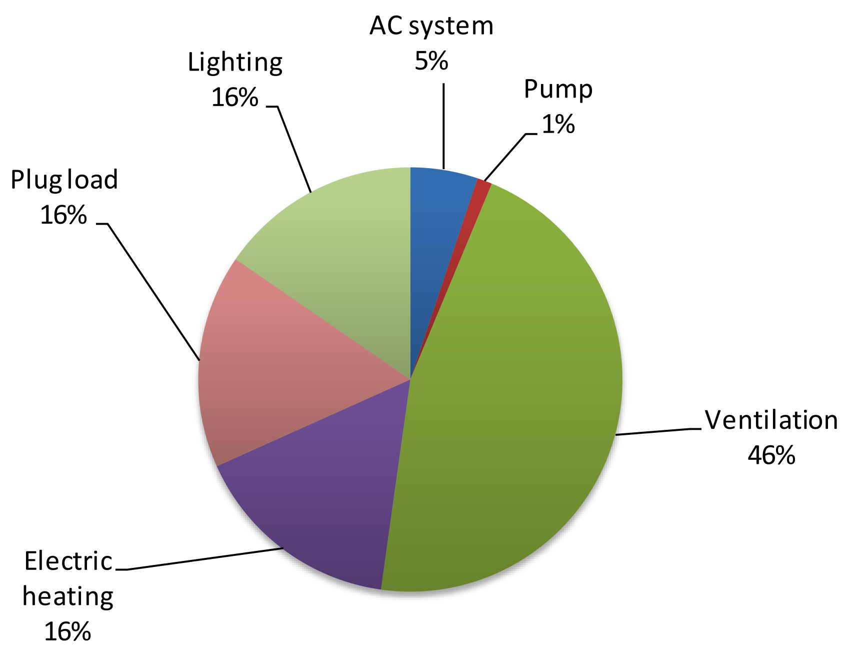

Figure 3: Electricity Consumption

The estimated breakdown of gas consumption by building system is presented in Figure 4.

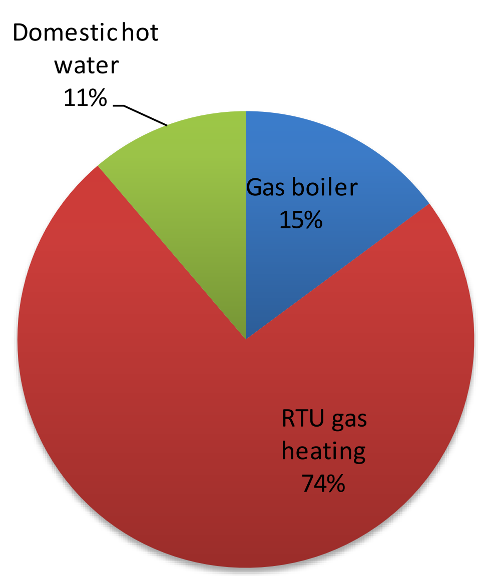

Figure 4: Gas Consumption

The estimated percentage of total energy consumption by building system is presented in Figure 5.

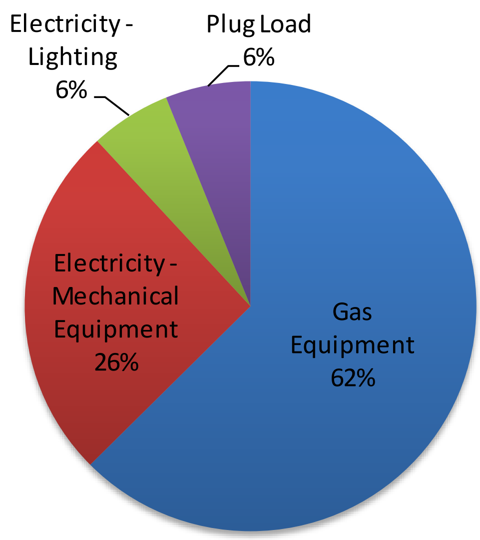

Figure 5: Total Energy Breakdown

2. Conservation Opportunities

The primary objective of this study was to identify and analyse energy conservation opportunities at Human Resources. 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
18%	9%	24%	24%	0.66

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 any incentives from BC Hydro or Fortis BC. It should be noted that based on conversations with Stantec, it is unlikely this building will be connected to the district energy system.

Table 4: Measure Summary

Item	Description	Base Case Cost	Incremental Cost	Total Cost	Effective Payback	NPV	Annual Savings			
							$	GJ	kWh	GHG
1.1	Occupancy & Scheduling		3,300	3,300	3.0	3,700	840	20	8,200	1.1
1.2	DHW Upgrade	2,000	2,300	4,300	10.0	(400)	100	10		0.5
1.3	Boiler Removal		1,400	1,400	3.0	3,700	410	40	(3,800)	2.0
1.4	Renewable Natural Gas				≥ 40					10.9

2.1.1 Occupancy & Scheduling

The schedules in this building were updated prior to the completion of the 2020 Fortis study, however, additional opportunities have since been identified.

- RTU-2, which serves the boardroom, was operating 24/7. As part of the Cycle 2 implementation on this building, an occupancy sensor will be installed in this area. However, we also recommend updating the schedule to reflect normal operating hours.
- RTU-1 was noted be coming on at 5:25 am, but the heating does not come on until 6:15 am. The schedule for this unit is currently 5:30 am – 7:00 pm, which is likely longer than necessary. We recommend recommissioning the schedule and the optimal start programming on this RTU to ensure the unit only comes on early in order to get the space up to temperature.
- RTU-3 and RTU-4 were noted to come on as early as 2:30 am despite the schedule being 5:30 am – 7:00 pm. We recommend recommissioning the schedule and the optimal start programming on these RTUs.

2.1.2 DHW Upgrade

Domestic hot water (DHW) for the building is currently provided by a standard efficiency gas DHW heater. Given the limited DHW usage in the building, we recommend replacing this with an on-demand condensing model. Incremental costing was used in the analysis for this measure as it assumes this upgrade is only done when the unit is due to be replaced.

2.1.3 RTU Replacement

This measure was not analyzed as a separate study is being done by Stantec, however, it is noted here because replacing the existing RTUs with heat pumps is the best option to offset gas usage in this building.

2.1.4 Boiler Removal

The existing boiler is significantly oversized for the building heating water demand. We recommend removing this boiler and replacing the four hot water radiant heaters with electric baseboard heaters with programmable thermostat control. Given the limited boiler usage in the building, the payback for this measure is poor, however it would make financial sense if it was done when the boiler reaches end of life.

2.1.5 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 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.