Thompson Rivers University
ASHRAE Level 1 Energy Study

Energy Study for:

Animal Health Technology

Attention:

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Animal Health Technology
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1. Background Description of Facility, Hardware and Systems

1.1 Overview and Facility Use

The Animal Health building was originally built in 2002 and is comprised of a single storey structure with a gross floor area of 1,180m2. The building gets its name from the animal health technical program which is delivered from this building. The building is comprised of classrooms, kennels, lab facilities and faculty offices.

1.1.1 Physical condition and window type

The original building appears to well maintained. The windows are double glazed. Window and door systems are typically constructed in aluminum frame and some windows are operable.

1.2 Mechanical Systems

1.2.1 Ventilation

Ventilation is supplied by 8 roof top units (RTUs) via constant volume diffusers:

- RTU-1 is a mixed air unit with constant volume fans, gas heating and a water to air heat pump. It also has an electric pre-heating element. It serves the east perimeter offices and was replaced in 2020.
- RTU-2 is a mixed air unit with constant volume fans, gas heating and a water to air heat pump. It also has an electric pre-heating element. It serves the north interior zone and was replaced in 2020.
- RTU-3 is a 100% outdoor air (OA) unit with gas heating and direct expansion (DX) cooling. It serves room 119 and is equipped with occupancy sensors (OS). It is from 2002.
- RTU-4 is a mixed air unit with constant volume fans, gas heating and a water to air heat pump. It also has an electric pre-heating element. It serves multi-use room #1 and was replaced in 2020.
- RTU-5 is a mixed air unit with constant volume fans, gas heating and a water to air heat pump. It also has an electric pre-heating element. It serves multi-use room #2 and was replaced in 2020.
- RTU-6 is a mixed air unit with constant volume fans, gas heating and a water to air heat pump. It also has an electric pre-heating element. It serves the south interior zone (labs, rats) and was replaced in 2020.
- RTU-7 is a mixed air unit with constant volume fans, gas heating and a water to air heat pump. It also has an electric pre-heating element. It serves the south perimeter zone (cat kennels) and was replaced in 2020.
- RTU-8 is a 100% outdoor air (OA) unit with gas heating. It serves the dog kennels and was replaced in 2020.

1.2.2 Cooling

RTU-1,2,4,5,6,7 have water sourced heat pumps that provide both heating and cooling for the spaces. In heating mode, heat for heat pump loop is drawn from the boiler and in cooling mode, heat from heat pump loop is rejected by cooling tower.

RTU-3 has DX cooling coil.

1.2.3 Heating

Heating is provided by a condensing natural gas boiler, which provides heating water for the following. The boiler was installed in 2017.

- In floor slab heating (in kennels)

- duct heating water coils (in CV diffuser ducts)
- Radiant panels
- RTU heat pumps

RTU-3 and RTU-8 have indirect natural gas fired heating sections.

1.2.4 Domestic Hot Water

Domestic hot water (DHW) at the facility is generated by a separate condensing natural gas fired domestic hot water heater.

1.3 Lighting System

The building is 100% LED.

1.4 Control Equipment

An Automated Logic BAS controls all major equipment in the building. This system was switched from Siemens to Automated Logic during the Fortis Implementation completed by Stantec in 2021.

2. Energy Analysis

2.1.1 Energy Use Profile

Figure 1 presents the building's electrical consumption since 2018. The Fortis energy conservation measures were implemented in 2020, which caused a decrease in electricity consumption in the building. However, there was also a drastic reduction in energy use as a result of decreased space usage due to COVID. As a result, the data is unrealistically low. All data from 2018 onwards was then used in the baseline calculation to offset the variations due to COVID. The new RTUs that were installed in 2020 would have increased electricity usage in the building as they replaced the existing gas fired heating sections with electric heat pumps.

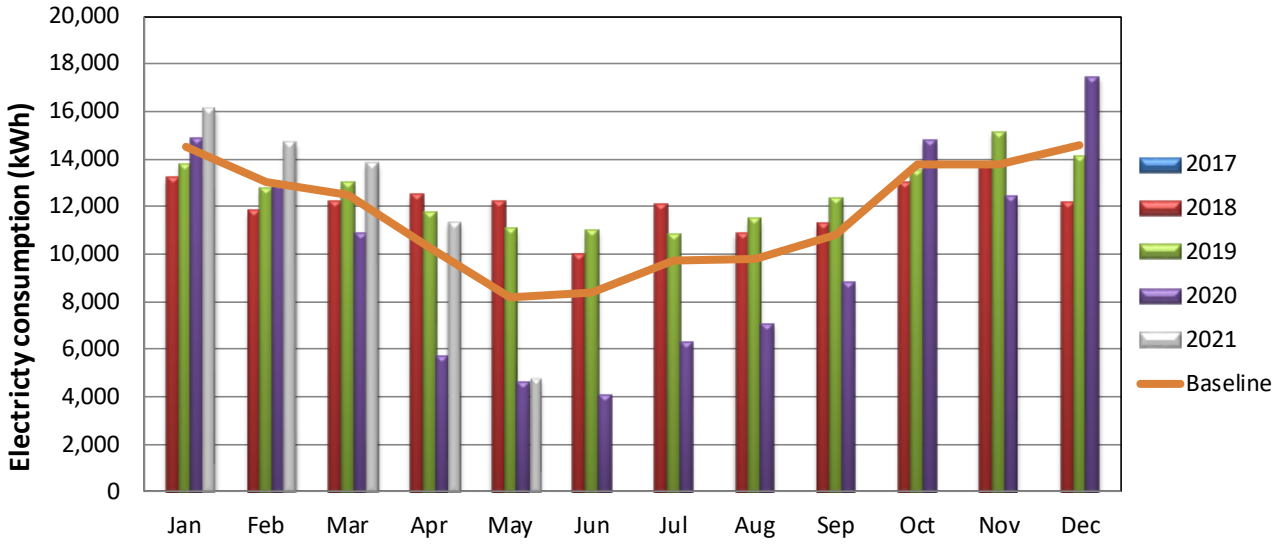

Figure 1: Monthly Electricity Consumption

Figure 2 presents the building's gas consumption from 2018 onwards. The Fortis energy conservation measures and RTU upgrade were implemented in 2020, which caused a significant decrease in gas consumption in the building. However, there was also a drastic reduction in energy use as a result of decreased space usage due to COVID. Since the installed heat pumps are water source and are still fed from the boilers, it is thought that using only 2020 onwards creates an unrealistically low baseline. Therefore, all data from 2018 onwards was used in the baseline calculation to offset the variations due to COVID.

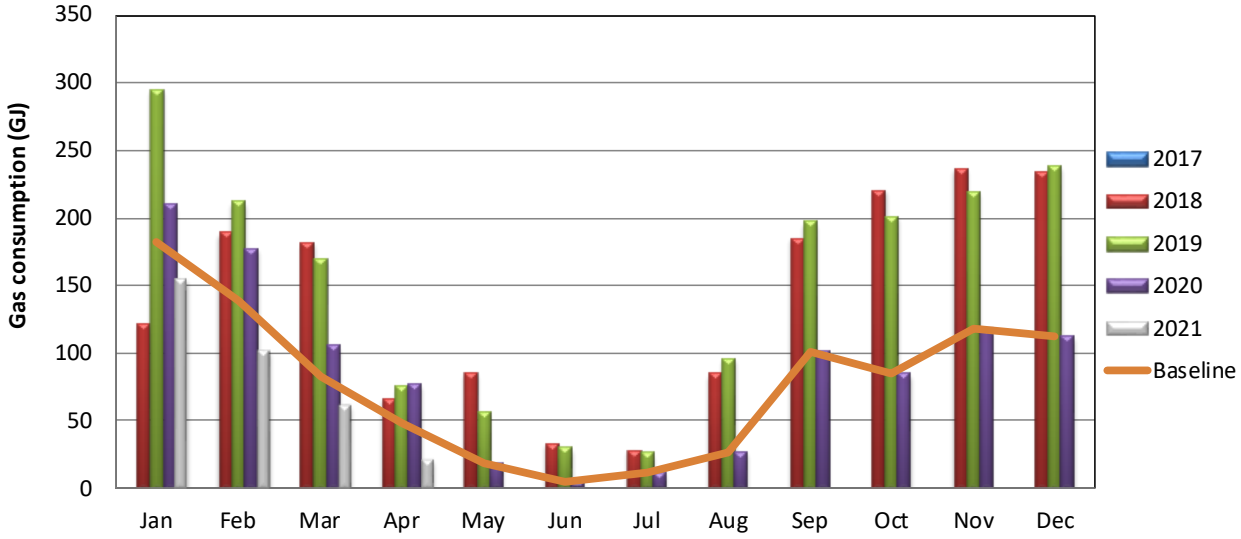

Figure 2: Monthly Gas Consumption

2.1.1 Energy Intensity Analysis

A summary of Baseline Energy consumption and the corresponding costs and energy intensity for the facility is presented in Table 1. Animal Health has an Energy Use Intensity (EUI) of 1,639 MJ/m^2. It should be noted this has decreased significantly from the pre-Fortis study value of 2,313 MJ/m^2. This decrease is a result of both the implemented energy conservation measure completed during the Fortis Implementation as well as the installation of RTUs with water source heat pumps.

Table 1: Summary of Baseline Energy Data

Utility	Energy Use (GJ)	EUI (MJ/m2)	Cost ($)	Cost ($/ft2)
Gas	1,435	1,215	$21,524	$1.69
Electricity	501	424	$8,816	$0.69
Total	**1,936**	**1,639**	**$30,340**	**$2.39**

2.1.2 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. This breakdown uses the new RTU specifications.

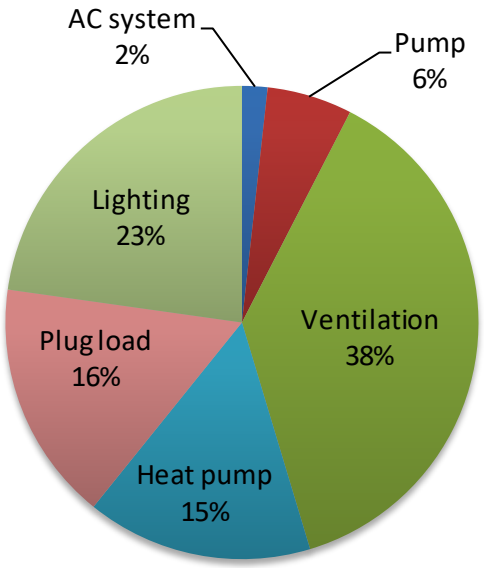

Figure 3: Electricity Consumption

The energy use is based on estimated equipment operation profiles. The estimated breakdown of gas consumption by building system is presented in Figure 4. This breakdown uses the new RTU specifications.

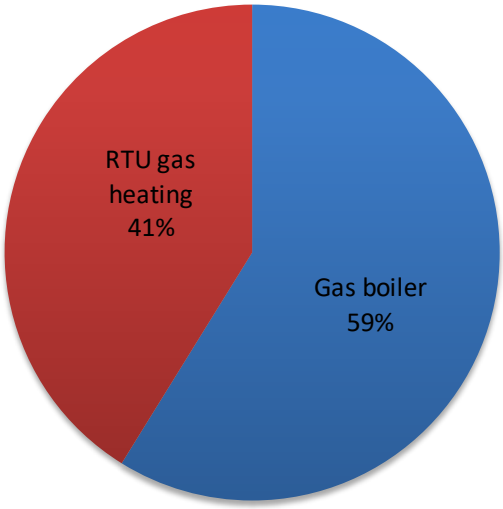

Figure 4: Gas Consumption

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

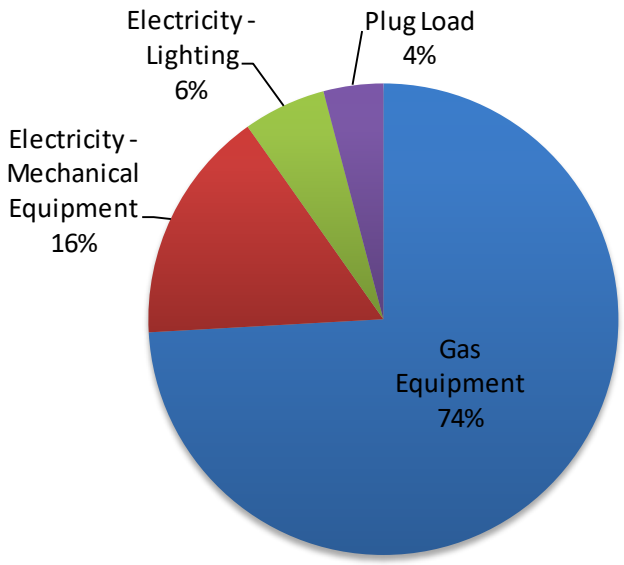

Figure 5: Total Energy Breakdown

3. Conservation Opportunities

The primary objective of this study was to identify and analyse energy conservation opportunities at the Animal Health Authority building. 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. Since some of these measures are mutually exclusive, it does not make sense to present total savings for all measures. The individual measure savings summaries are found in Table 3.

3.1 Energy Conservation Measures

A summary of the analysis for the recommended measures is presented in Table 3. Detailed descriptions for each project are presented below. The analysis for these measures does not include any incentives from BC Hydro or Fortis BC. Based on conversations with Stantec, this building is unlikely to be connected to the district energy plant.

Table 3: Measure Summary

Item	Description	Base Case Cost	Incremental Cost	Total Cost	Effective Payback	NPV	Annual Savings			
							$	GJ	kWh	GHG
1.1	BAS Commissioning		$9,000	$9,000	12.0	(2,800)	$470	30	500	1.5
1.2	RTU-3 Heat Pump	$13,000	$8,500	$21,500	10.0	(800)	$590	40	(100)	2.0
1.3	Renewable Natural Gas				≥ 40		($5,010)			22.7

3.1.1 BAS Commissioning

The Animal Health BAS was switched from Siemens to Automated Logic during the Fortis Implementation completed by Stantec in 2021. Based on discussions with Automated Logic and TRU operations, a full commissioning of this system has not yet been done. A preliminary review of the new system has noted some remaining deficiencies and additional opportunities for optimization. New RTUs are still showing DX cooling coils when they have now been switched to heat pumps

- Certain trends required for system monitoring have not yet been set up. For example, the heat pump usage is not trended. This will be required to ensure the heat pumps are being used as the first source of heating.
- The new heat pump water loop and cooling tower are not on BAS. As such, it is likely that this system not optimized. This has been the case for many other buildings on campus with similar configurations. We recommend bringing this system onto the BAS and doing full commissioning of this system.
- The boiler return water temperature was noted to be consistently above 60°C despite them being condensing boilers. We recommend a heating water supply temperature reset be done in parallel to the heat pump loop recommissioning.
- The Coppertree report that was run in May of 2021 noted that the RTU free cooling did not appear to be optimized and that the discharge air temperature was cycling. This should be investigated to determine if it is still an issue.

While this measure will yield energy savings, the main purpose of it is to ensure the building is operating optimally after the BAS switchover. Given the complexity of the TRU buildings, we recommend budgeting for commissioning of all future building switchovers.

3.1.2 RTU-3 Heat Pump

RTU-3 has gas heating and DX cooling. It was last replaced in 2002 and was the only RTU that was not replaced as part of the 2020 RTU upgrade project completed by Stantec. This RTU is nearing the end of its recommended service life. When it is replaced, we recommend it be replaced with a variable air volume heat pump unit. The analysis for this measure uses incremental costing and assumes that a unit with gas backup was selected.

3.1.1 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 boiler 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.

3.1.1 Gas Absorption Heat Pumps

This measure was not analyzed as the existing boilers were replaced in 2017 and are not due to replacement in the near future. However, when the boilers are due for replacement, this building would be an excellent candidate for a gas absorption heat pump. This heat pump would replace the existing condensing boilers and would provide heating water for the heat pump loop. Gas absorption heat pumps use natural gas as their primary fuel source and provide efficiencies of greater than 100% making them an excellent substitute for condensing boilers. Fortis is currently offering significant incentives for the studies and installation of these units.

4. 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.