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UBC Okanagan Campus
Energy Team
Quarterly Report
July 2020 – September 2020

Report Date: 2020-11-30

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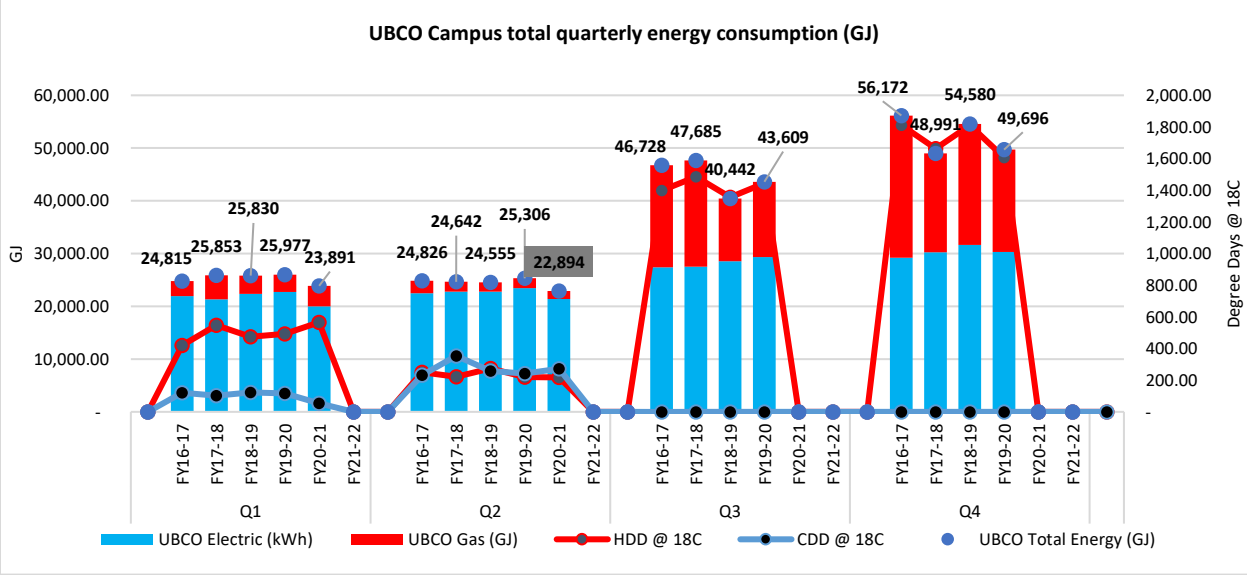
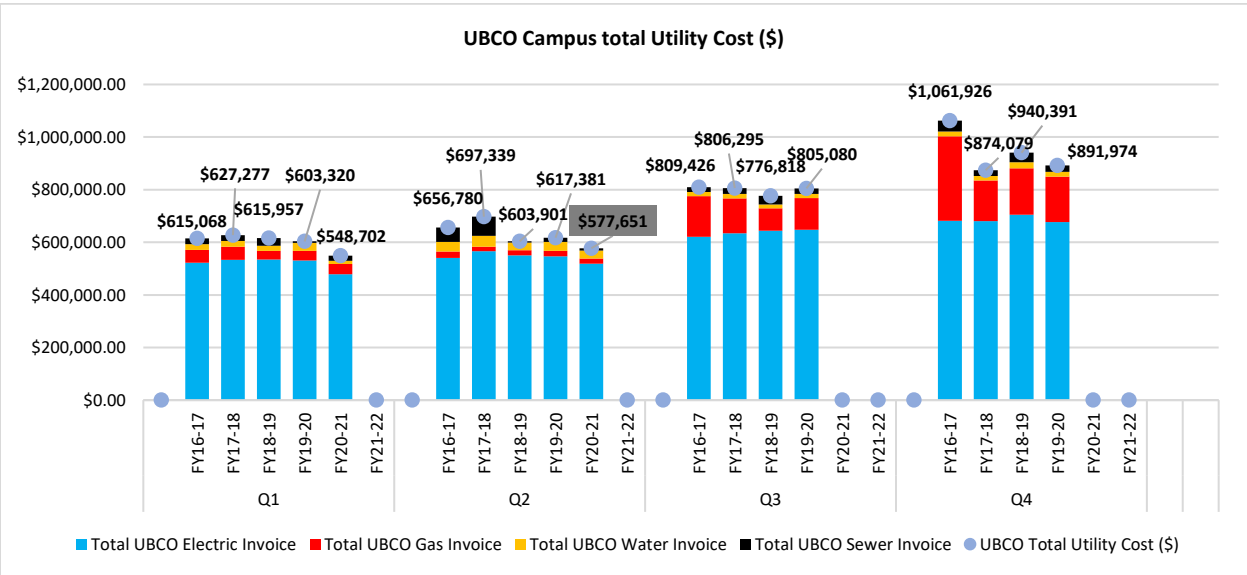
1. Overview of the Second Quarter of FY2020-2021

UBCO Campus total energy consumption over the past quarter (Q2 2020) was 22,894 GJ compared to 25,305 GJ for Q2 last year (Q2 2019), a 9.53% year over year quarterly reduction (in line with a 9.62% reduction in energy consumption in Q1) leading to a 6.4% reduction in total campus energy utility cost. This total energy consumption includes an 8.70% reduction in campus Electricity consumption i.e. from 6,516 MWh in Q2 2019 to 5,949 MWh in Q2 2020 and a 20% reduction in campus Natural Gas consumption i.e. from 1,848 GJ in Q2 2019 to 1,479 GJ in Q2 2020.

In Q2 2020, CDD increased by 30 degree-days from 242 in Q2 2019 to 272 in Q2 2020 whereas HDD remained flat i.e. 218 degree-days in 2020 vs 220 degree-days in 2019. Hence, this reduction in campus energy consumption can be primarily attributed to SARS-CoV-2 (Covid-19) and a few energy conservation measures implemented in Q2 to Q4 of FY 19-20.





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2. Policy Development

Appropriate policies and guidelines assist in meeting campus energy goals and as such are championed by the Energy Team. Significant developments in energy-related campus guidelines and policies that occurred in the past quarter are described below.

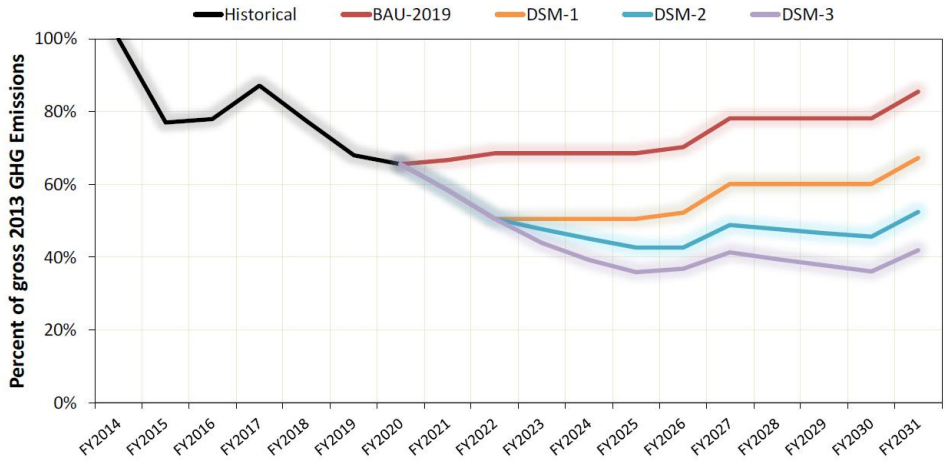
2.1. Strategic Energy Management Plan (SEMP) 2020

A list of demand-side management (DSM) projects were analyzed and grouped into five bundles to represent annual implementation plans starting with the present fiscal period of FY2021, and proceeding through FY2025, as presented in Table below.

Bundle	Budget	Annual Savings	NPV	IRR
FY2021	$ 110,000	$ 80,000	$ 667,900	86%
FY2022	$ 100,000	$ 100,000	$ 860,600	114%
FY2023	$ 520,000	$ 50,000	($30,700)	12%
FY2024	$ 500,000	$ 40,000	($137,000)	8%
FY2025	$ 580,000	$ 30,000	($301,500)	4%
Future	$ 590,000	$ 10,000	($497,300)	-6%
Residences	$ 173,500	$ 25,900	$ 64,500	18%

SES Consulting projected three DSM scenarios based on different implementation plans for the identified project bundles, as presented in Figure below:

- DSM-1: Is based on the implementation of project bundles FY2021 and FY2022, with no additional energy conservation efforts beyond that.
- DSM-2: Is based on the full implementation of project bundles FY2021 and FY2022, with savings from the remaining bundles (FY2023 – FY2025) linearly scaled to match an annual budget of $200k.
- DSM-3: Is based on the implementation of all project bundles (FY2021 – FY2025) as planned over the next five years, with the GHG emissions reduction over the remaining five years (up to FY2031) extrapolated.



DSM-2 has been the chosen strategy to set and meet the goals with respect to carbon emissions reduction. The same has been used in the CAP emissions scenario modelling as discussed further in this report.

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2.2. High-Level Net-Zero Carbon District Energy (DE) Strategy

The main campus is expected to grow with the addition of Innovation Precinct. This has motivated further analysis and consideration of district energy strategy with a view of modernization, renewal, and growth to serve both existing and new load.

A decision was made by the UBC steering committee to proceed with district energy utility services where district scaled water source heat pumps provide hot and cold water to the buildings. With the distribution and energy transfer station strategy set, the focus turns to definition and decarbonization, as well as strategy for service to the new ICI building on the main campus.

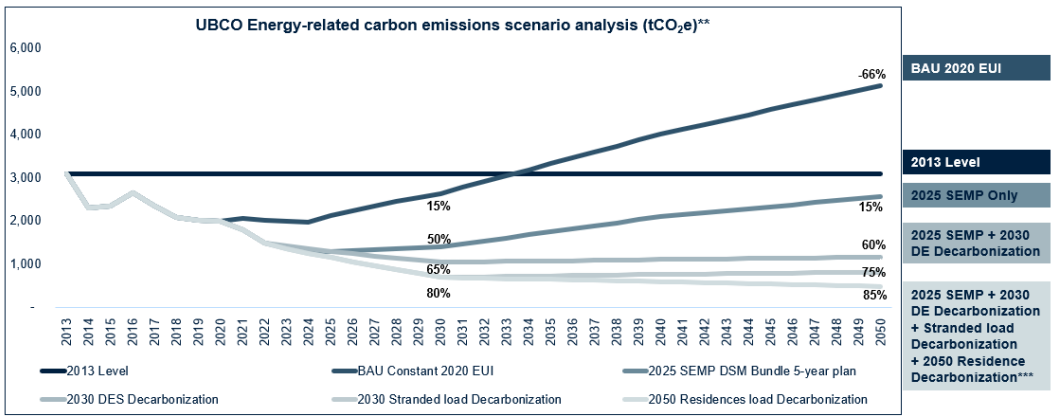
Energy Team has been working with dJoule LLC to advance the DE Strategy as it relates to the ICI building Energy transfer station. The work being done includes discussion and brainstorming sessions around cluster plant temperature strategy and building-side design conditions such that the building heating, cooling and domestic water demands are being met in the most cost-effective manner.

In order to zero in on the design temperature for the LDES system which will supply heating and cooling need to the ICI cluster plant (Energy transfer station), Energy Team in collaboration with the Facilities Management conducted a heat loss test from LDES piping system where supply temperature was increased from the existing 9°C to 15°C. Falcon Engineering was contacted to support the estimation of the heat loss from the pipeline. As per Falcon's findings, under assumed conditions for Scenario 1 (15 °C supply), energy loss for a supply/return pair increases on average by approximately 7% compared to the calculated single pipe loss.

The next phase of the DE strategy would include pathways as it relates to the decarbonization of the District Energy System i.e. LDES and MDES.

2.3. Climate Action Plan Scope 1 and 2 GHG Emissions Scenario Analysis

Energy Team has been working with the UBCO's sustainability group to prepare annual GHG emissions inventories for energy-related activities occurring within its organizational and operational boundaries. This activity involves modelling various scenarios to understand and establish UBCO's climate goals with input from 2020 SEMP, DES Decarbonization strategy.



* Scope 1 & 2 in this graph only includes energy-related emissions.
** Electricity carbon emissions intensity for the FortisBC grid are expected to increase from 2021, however due to lack of clarity, it has been assumed constant here.
*** Electrification is the decarbonization option chosen here.

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2.4. Energy Monitoring and Data Management Platform

Energy data for the campus is obtained from a number of sources including utility bills, manual meter readings and building digital control systems. UBCO Energy Team has engaged with the UBCO School of Engineering to develop a custom data management system for the campus. This project aims to develop an intelligent data driven energy monitoring and management system for micro communities using statistical and advanced data analysis methods.

In the meantime, Energy Team has developed a utility tracking tool using advanced programming language knowledge python and excel to track overall campus utility consumption (Electricity, Natural Gas, Water, Sewer) as well as building level consumption at the monthly, quarterly and annual interval. The tracking is being done for three different parameters i.e. utility consumption, utility cost and carbon emissions associated.

2.5. UBCO HVAC Infrastructure Asset Management Database

Energy Team has been working with the Facilities Management to advance and update the Infrastructure HVAC Asset Management database and potentially linking this up with the major capital retrofit projects on campus in the near future. This also includes consolidating campus-wide DDC points, physical meters and manual metering points in one location and further developing a meter tree. This will further be input to the Data Analytics platform which Energy Team has been working on with UBCO School of Engineering.

2.6. Future Campus Construction

In order to ensure that future campus energy goals and targets are met, it is important that new buildings constructed on campus are designed and built to be consistent with the Whole Systems Infrastructure plan as well as other campus plans and goals. As such, the Energy Team has been involved in providing technical reviews and setting goals, targets and strategies as early as possible for future campus expansions.

2.7. Technical Guidelines

Technical Guidelines are intended to provide minimum standards for campus projects. There are a large number of guidelines that cover both UBC as a whole and some that are specific to the Okanagan campus. The Energy Team has been working to update several that are specific to energy performance and monitoring.

UBC's Climate Action Plan (CAP) has set a target of 100% reduction in GHG emissions below 2007 levels by 2050. In support of this plan, natural gas shall not be used as the primary heating source in domestic water heating and in new and replacement air handling and space heating equipment, including but not limited to rooftop units, unit heaters, space heaters, etc. Natural gas may be used as a backup heating source at the unit where required to ensure heating requirements can be met. Refer to "Section 22 30 00 Plumbing Equipment" for Domestic water heating and "Section 23 05 00 HVAC – General Requirements" for Heating, Ventilating, and Air Conditioning (HVAC).

3. Energy Conservation Projects

Energy Team has been working on an ECM template to track potential Energy Conservation Measures identified on campus from various sources such as SEMP, RCx studies, staff inputs etc. This will act as a one-stop source for any potential energy conservation implementation project and enable the team to

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select & bundle future retrofit/ modernization projects. In terms of actual studies/ projects, following projects have been completed/ in progress over the last quarter.

3.1. UBCO Science Laboratory Rooms Demand Controlled Ventilation (DCV)

SES Consulting identified this measure in their 2020 SEMP report for the FY20-21 implementation. The ventilation rate of non-critical laboratory spaces is not strictly controlled, causing significantly higher air changes per hour than required for occupant health and comfort. The use of upgraded controls equipment and strategies will be considered for reduction and standardization of air changes during both occupied and unoccupied hours. This project is expected to save 317,100 kWh Electricity and 4,950 GJ Natural Gas per year equivalent to 250 tonnes CO_2e.

UBCO Energy Team has put forward an incentive application to perform an engineering study for this project to better determine the cost and benefits of this project. However, due to delay in the application processing from FortisBC, the project might move forward without the support from FortisBC.

3.2. Recommissioning study for the Arts building

UBCO Energy Team has put forward an incentive application to perform a Recommissioning (RCx) study for the Arts building. This study is expected to identify deficiencies in the operation of the buildings that were wasting energy, increasing equipment wear and tear or decreasing occupant comfort. This is study and further measure implementation is expected to save 58,900 kWh Electricity and 130 GJ Natural Gas per year equivalent to 7 tonnes CO_2e.

3.3. Recommissioning study for the RHS building

FortisBC funded recommissioning (RCx) study for Reichwald Health Sciences Centre (RHS) Building was completed by Prism Engineering in March 2019. This study identified deficiencies in the operation of the buildings that were wasting energy, increasing equipment wear and tear or decreasing occupant comfort. Johnson Controls has been contracted to implement the RCx recommendations as per the study which included the reprogramming and onsite testing. The RCx measures implementation is currently underway and will be reviewed once completed.

3.4. Recommissioning study for the UCH building

Kimco Controls Ltd. was contracted to implement the RCx recommendations as per the study which included the reprogramming and onsite testing. The RCx measures implemented will be reviewed and monitored in the heating season of this year.

3.5. Monitoring improvements

A few monitoring improvements were implemented by UBCO Energy Team which included resolving WIFI occupancy reporting issue, working with Siemens to fix Desigo deficiencies list and add missing trends on the key hydronic graphics.

4. New Construction Projects

The Energy Team is involved in the design and construction process for new construction on campus. The Energy Team's goal is to ensure that the design and construction of new buildings on campus are consistent with the campus Whole Systems Plan in terms of energy targets and sources. The Energy Team also co-ordinates the pursuit of energy efficiency incentives from FortisBC. The two new major buildings

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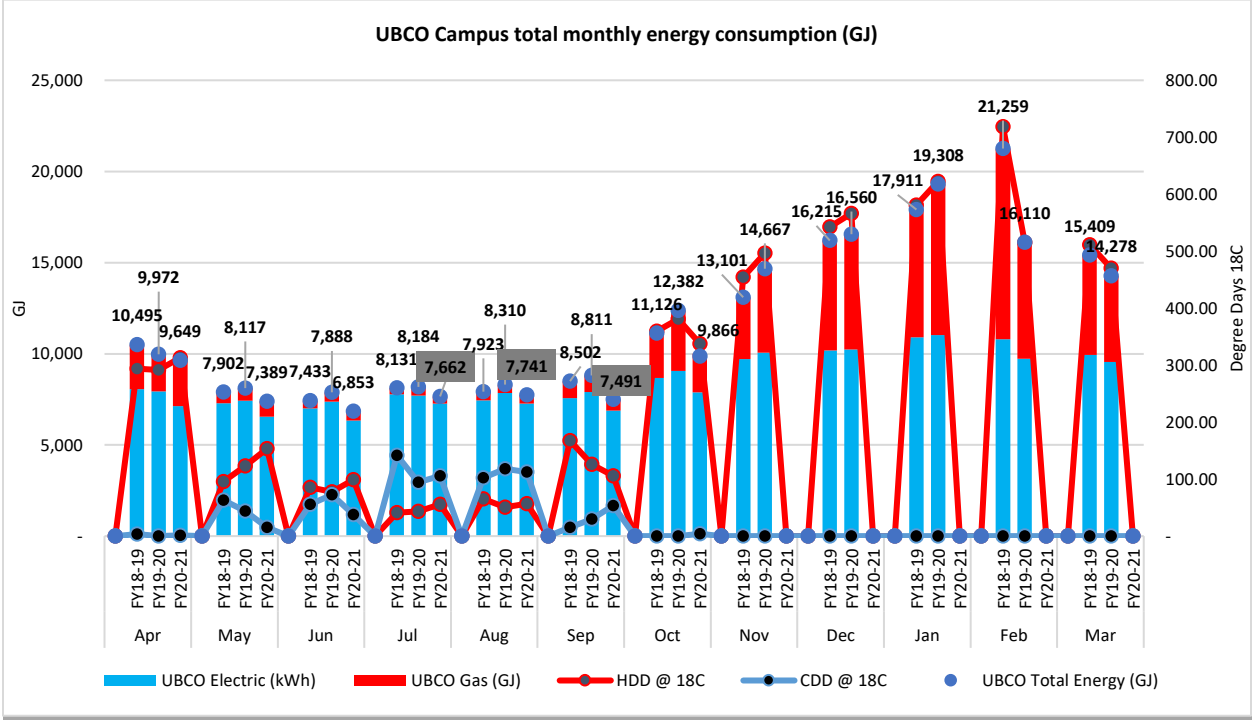
Skeena and Nechako residence buildings have already been discussed in Annual FY 19-20 report. A total of $324K have been approved by FortisBC towards the construction of these two residence buildings.

4.1. Interdisciplinary Collaboration and Innovation (ICI)

The UBC Okanagan Campus (UBCO) is proposing a new building to facilitate world-leading, interdisciplinary/ transdisciplinary research and academic programming, and to advance its mandate as a partner in regional development. Tentatively titled the Interdisciplinary Collaboration and Innovation (ICI) building and is expected to be up to 13,364 gross square meters. Energy Team has been involved in advocating the Owner's Project Requirements (OPR) for the ICI building and provide inputs on the energy related standards/ benchmarks.

5. Monthly Energy Performance Graphs

This section presents various figures which shows and compares the month over month energy consumption from FY 17-18 to FY 20-21[1].



[1] For section 6, any year listed in the graph is start of the fiscal year.

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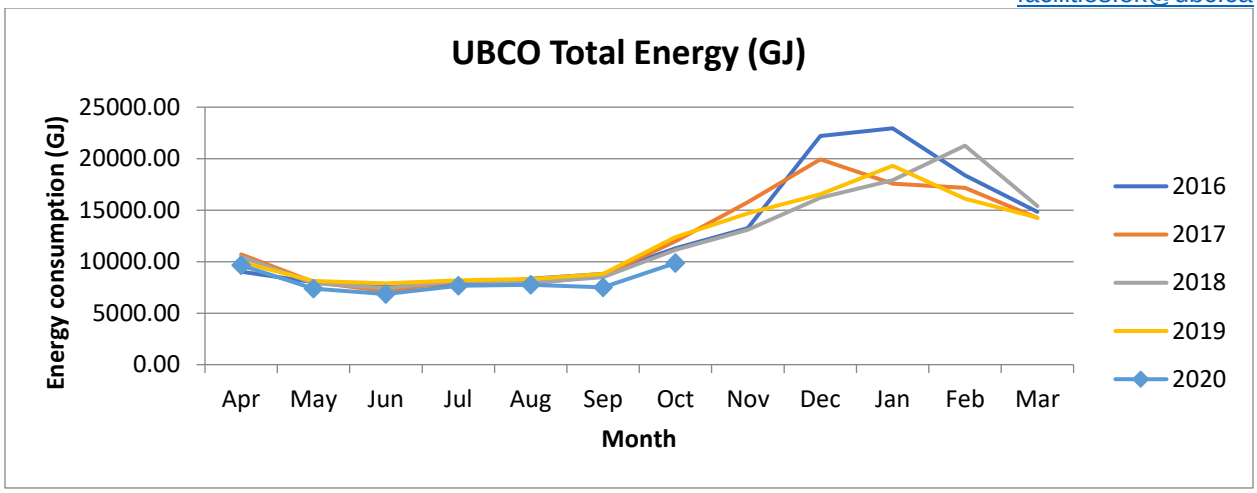

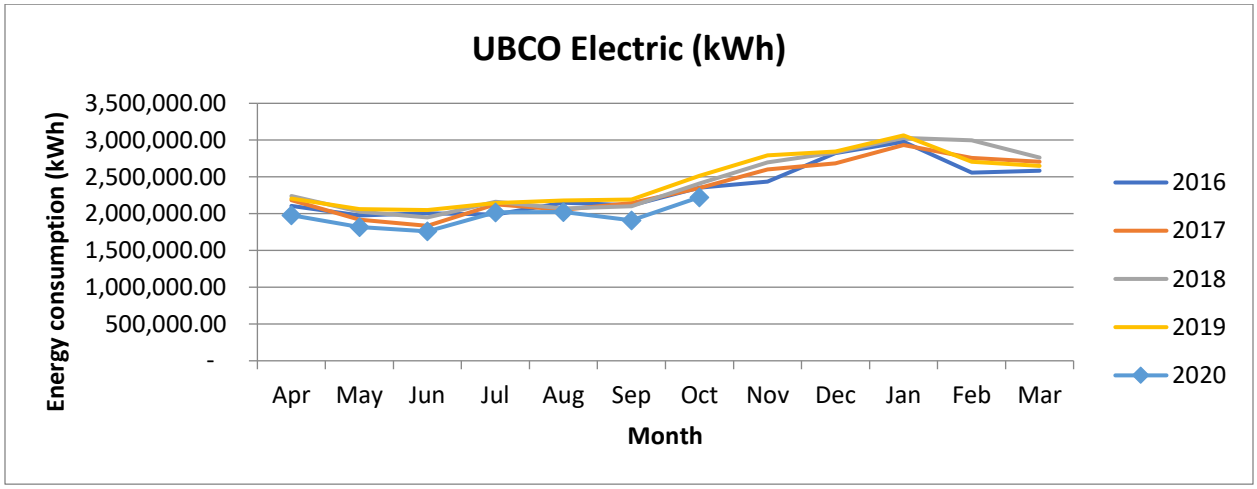

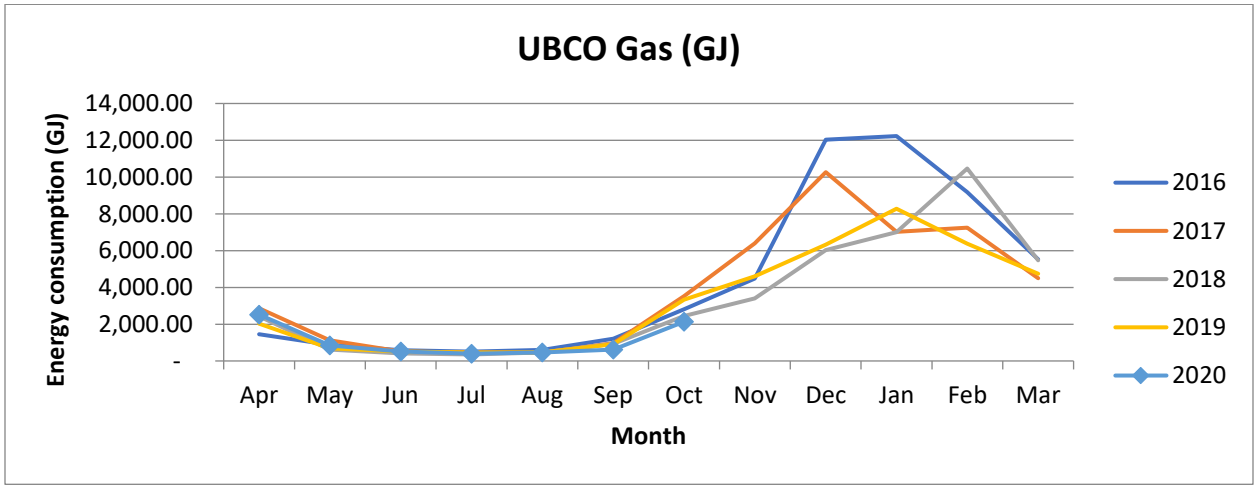

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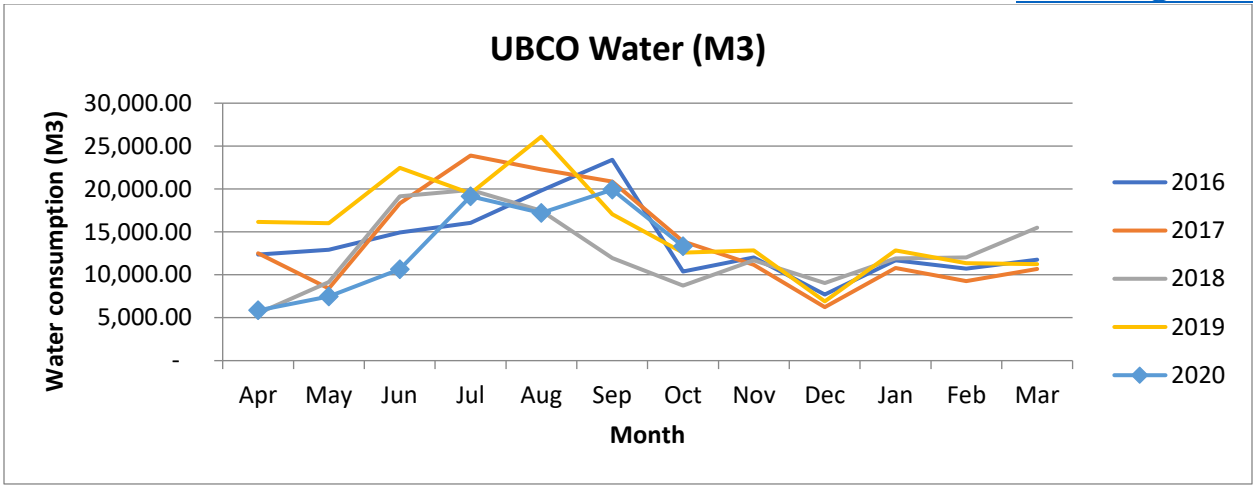

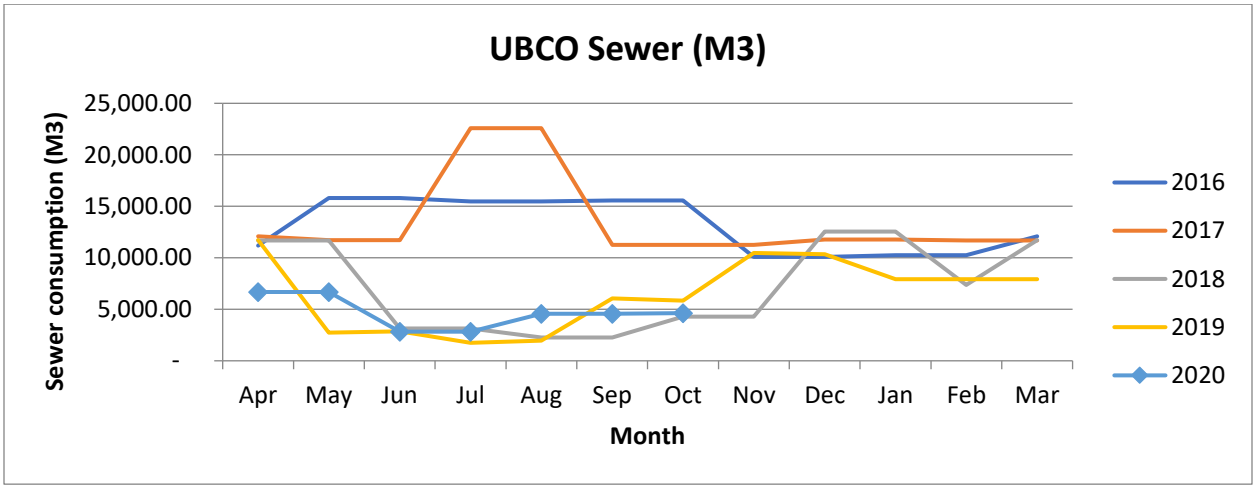

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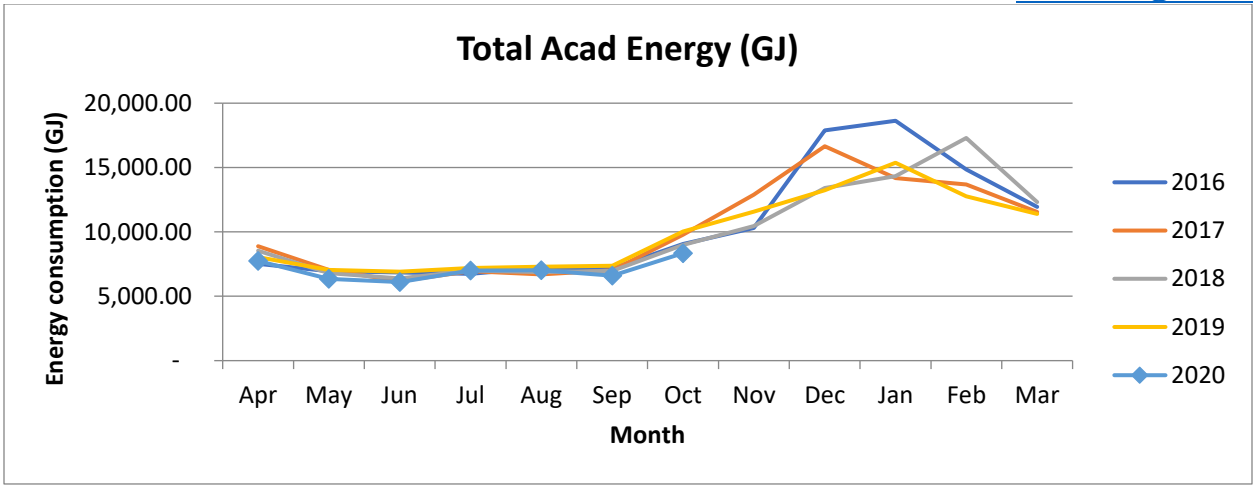

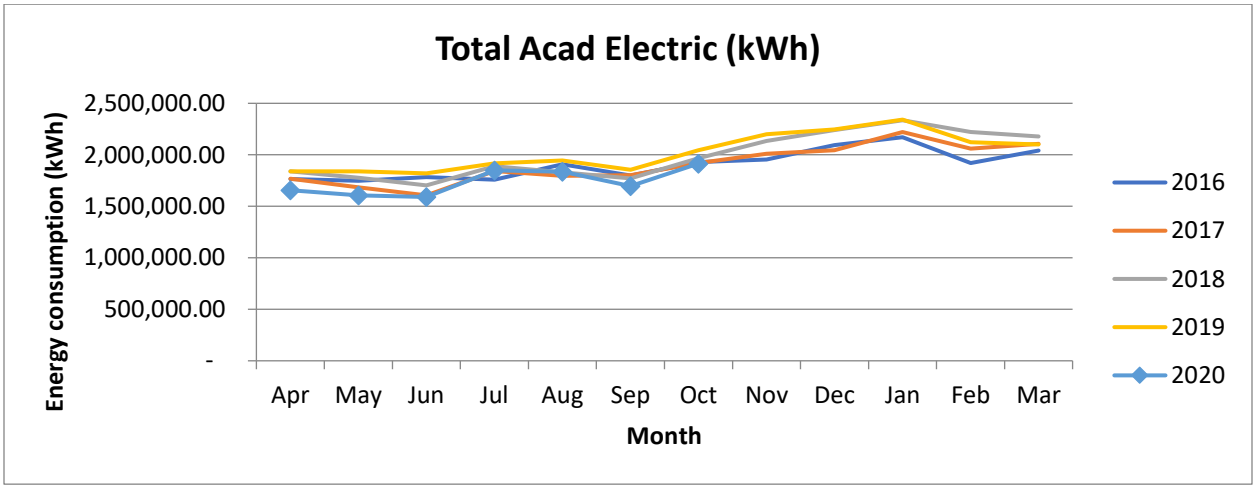

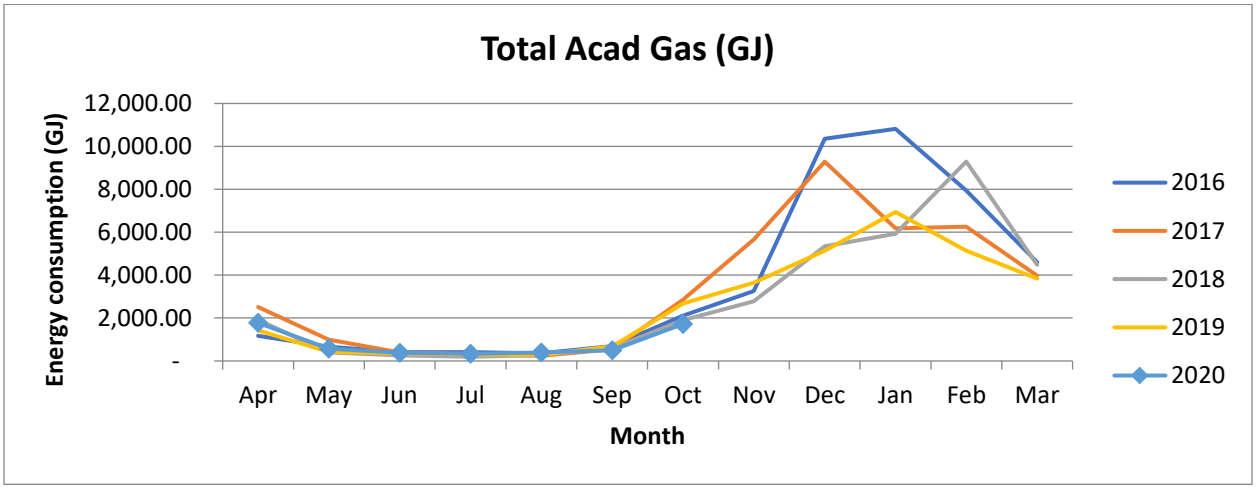

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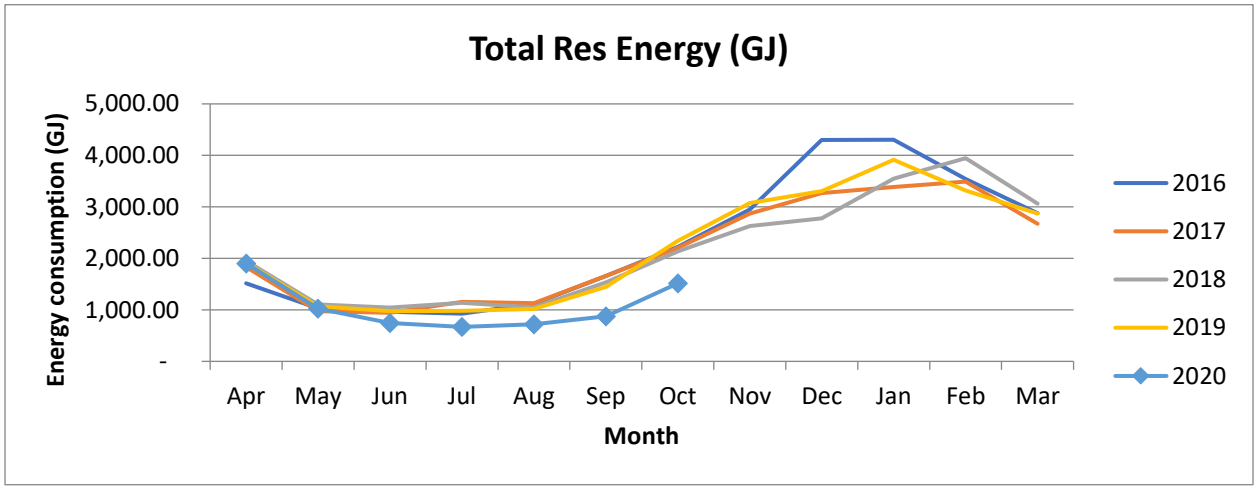

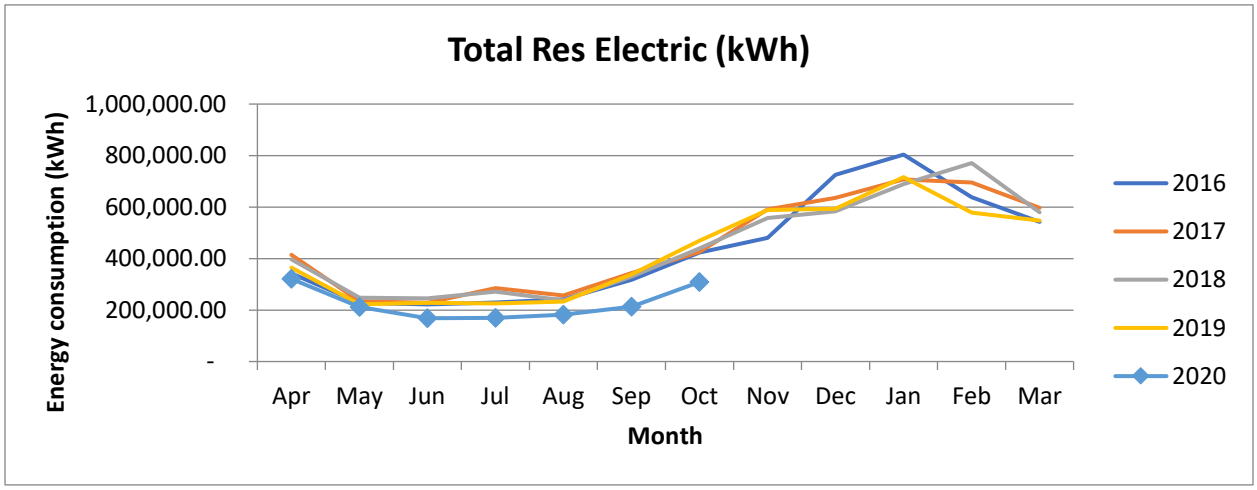

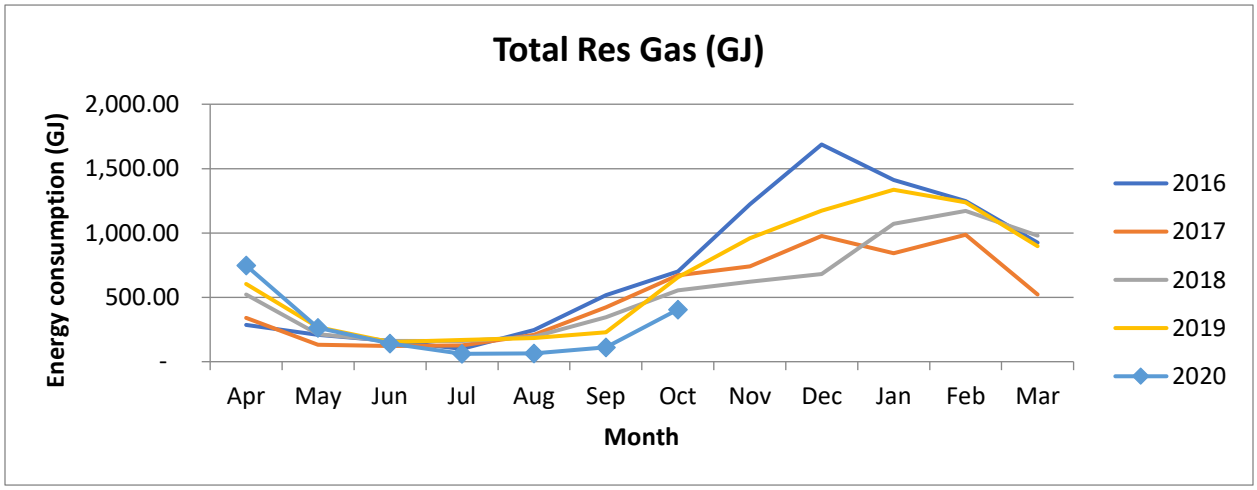

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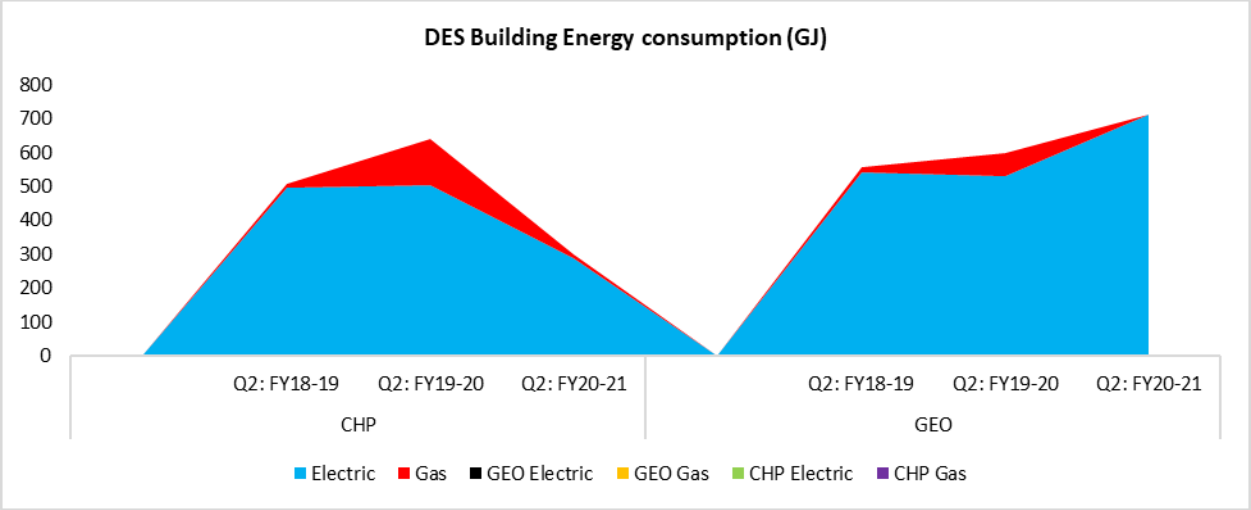

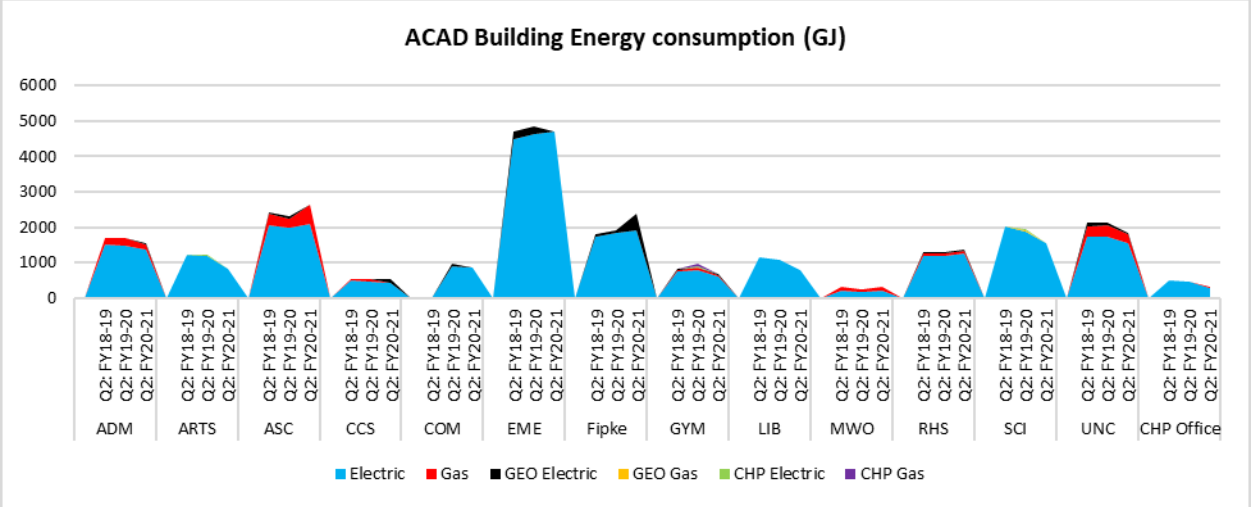

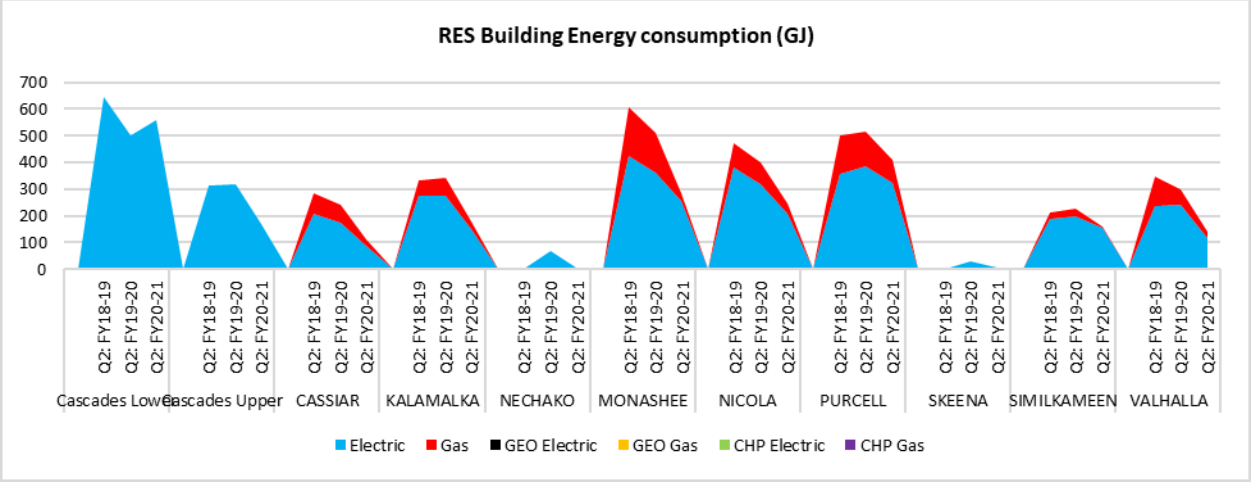

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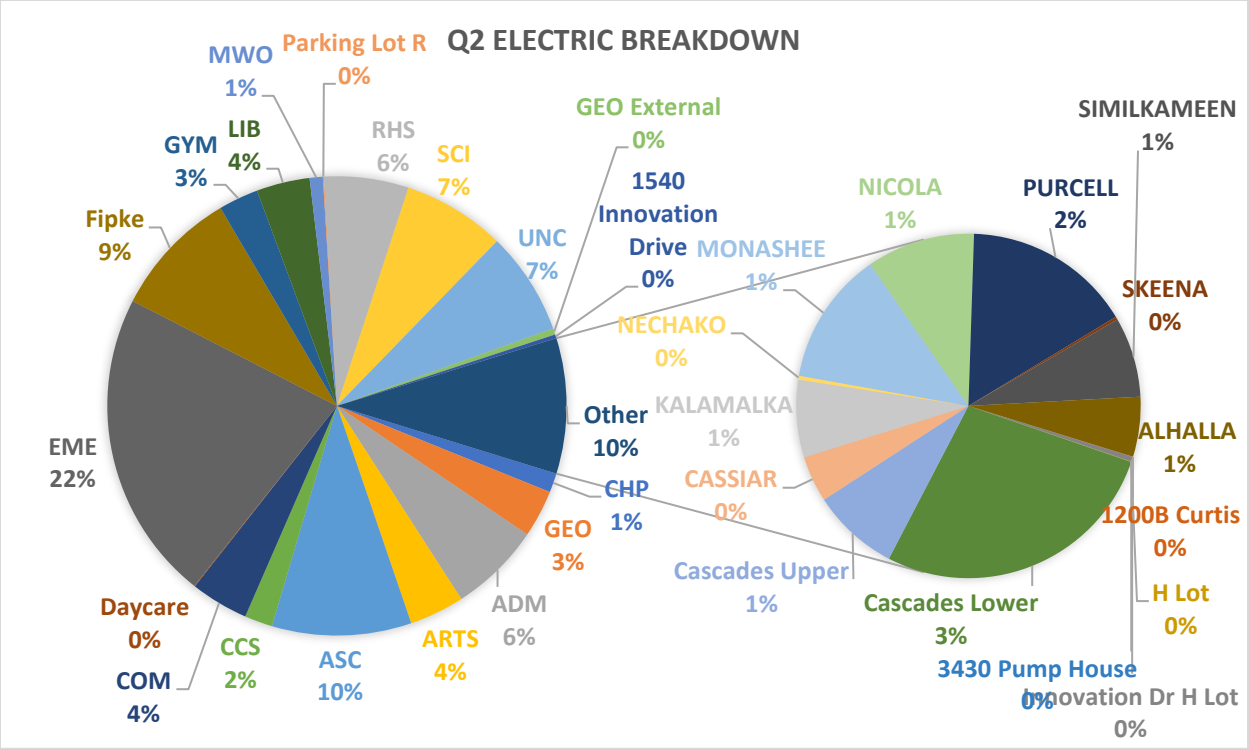

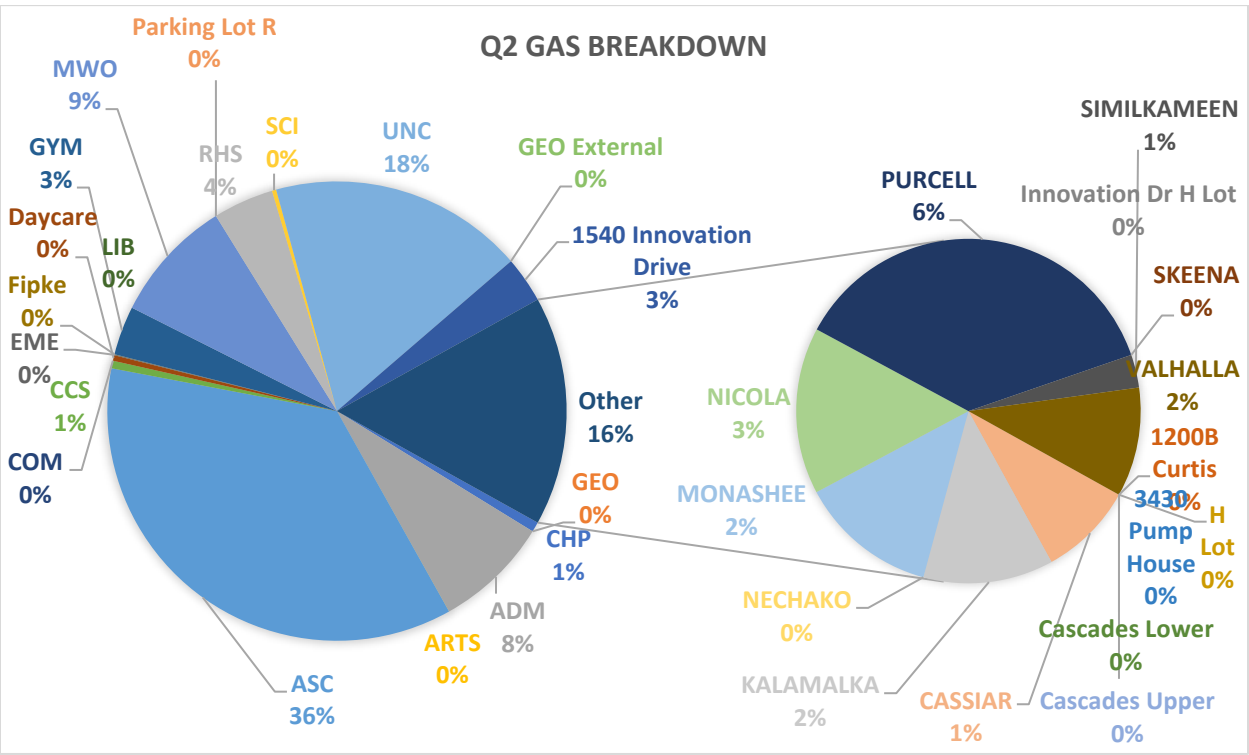

Note: Building electricity and gas consumption values shown are for consumption within the building. Indirect gas consumption via MDES & LDES is not included.

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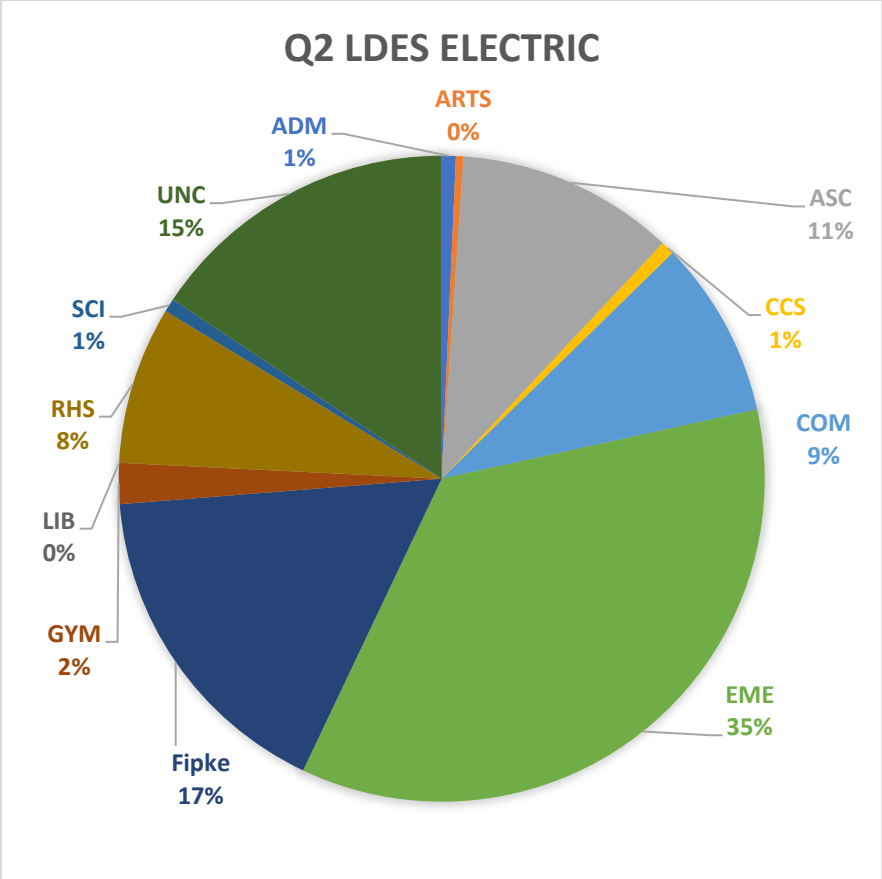

Note: LDES gas consumption and MDES consumption data not shown for Q2 due to minimal use during this season.

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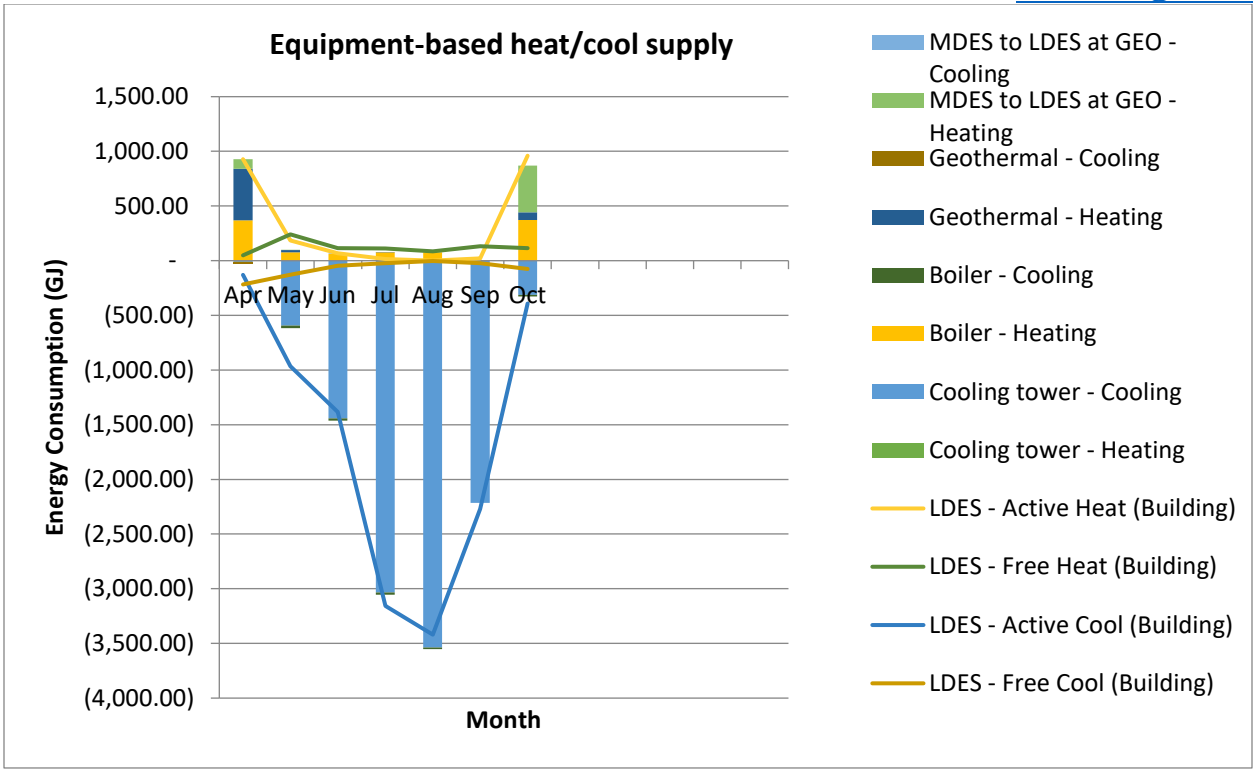

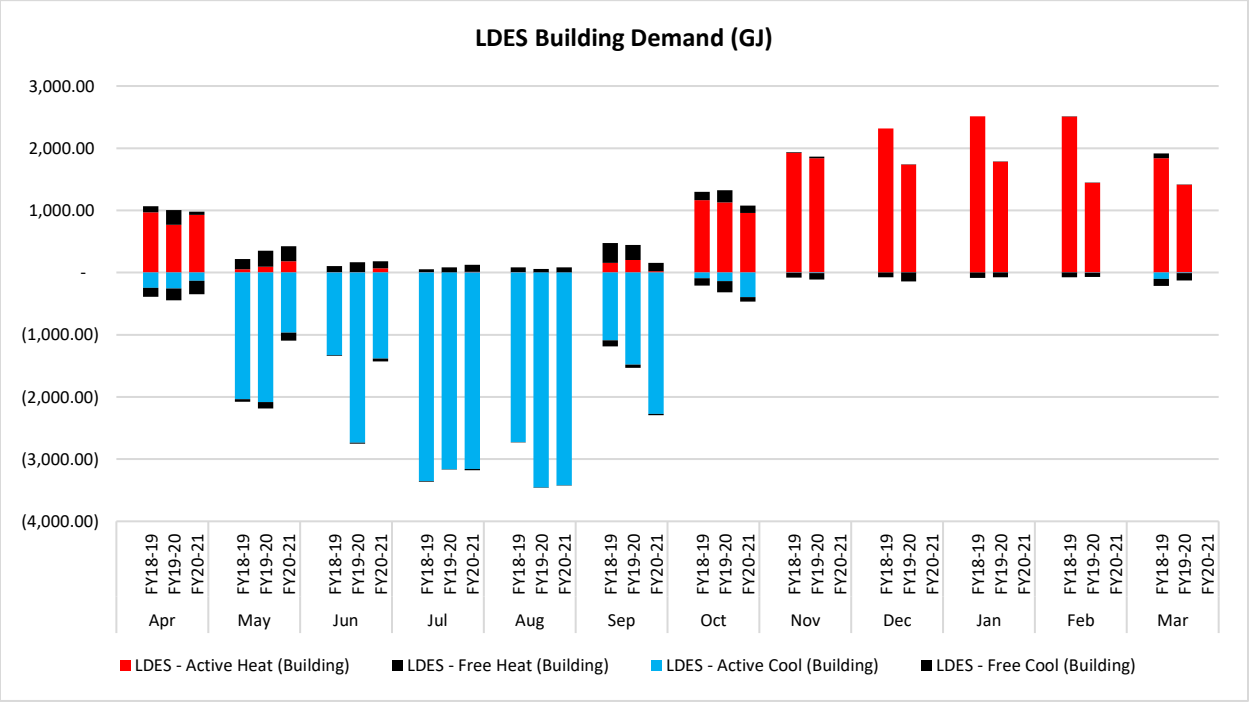

Note: MDES data not shown for Q2 due to minimal use during this season.