



**a place of mind**  
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UBC Okanagan Campus  
Energy Team  
Quarterly Report  
October 2020 – December 2020

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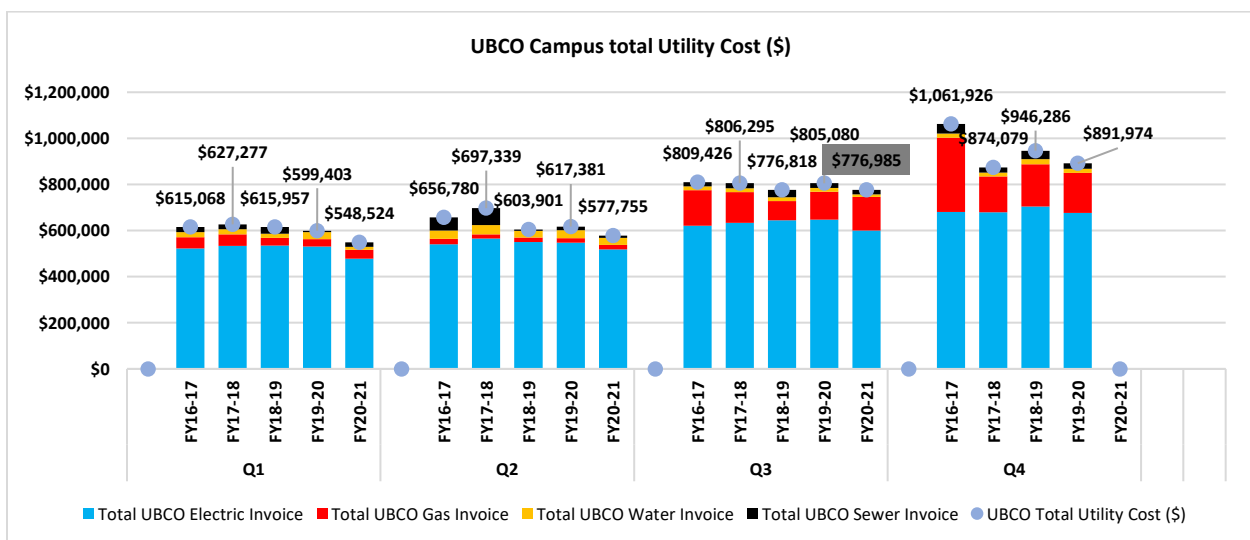
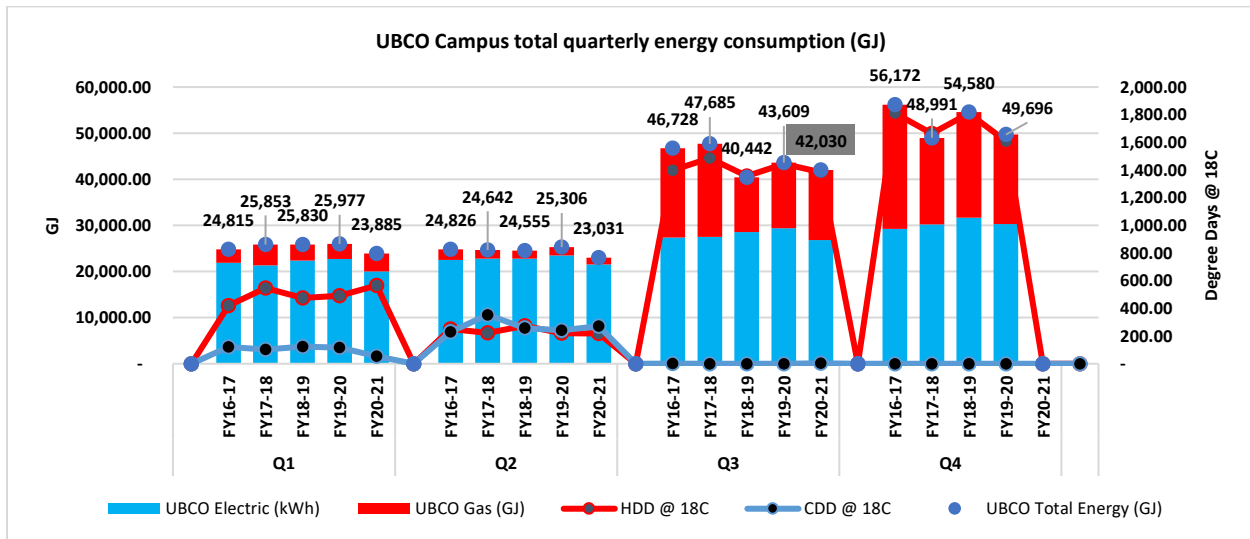


## 1. Overview of the Third Quarter of FY2020-2021

UBCO Campus total energy consumption over the past quarter (Q3 2020) was 42,030 GJ compared to 43,609 GJ for Q3 last fiscal year (Q3 2019), a 3.62% year over year quarterly reduction leading to a 3.5% reduction in total campus energy utility cost. This total energy consumption includes an 8.58% reduction in campus Electricity consumption i.e. from 8,154 MWh in Q3 2019 to 7,454 MWh in Q3 2020 and an increment of 6.5% in campus Gas consumption i.e. from 14,254 GJ in Q3 2019 to 15,193 GJ in Q3 2020.

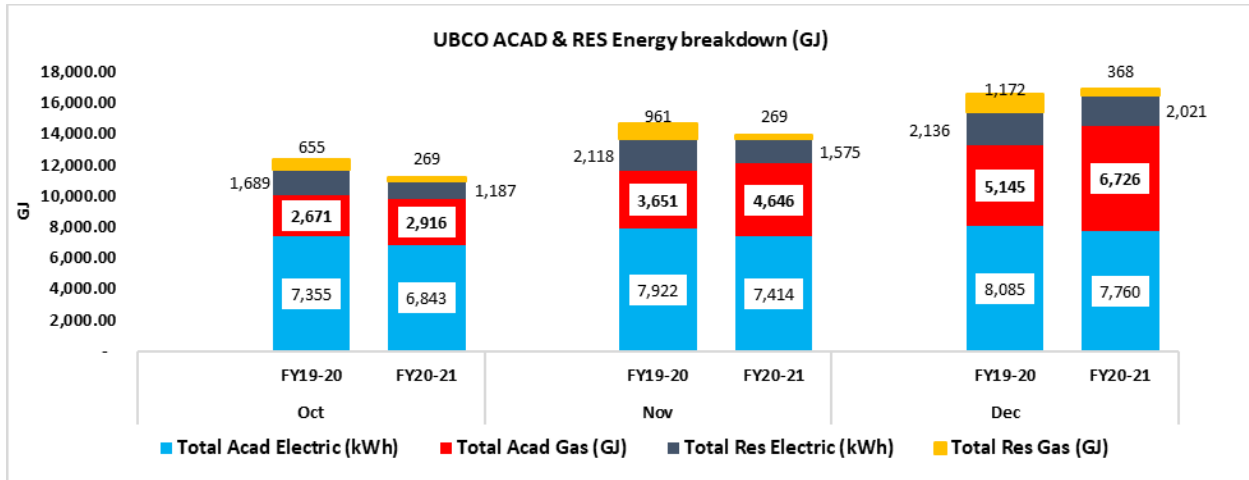
In Q3 2020, a 4% reduction in Heating Degree-Days (HDD) was observed i.e. from 1,444 degree-days in Q3 2019 to 1384 degree-days in Q3 2020. A further investigation was conducted in this quarter's energy consumption because of two primary reasons:

1. Natural Gas consumption which is primarily used to service heating demand on campus increased in the quarter even though there was a reduction in HDD.
2. The year over year quarterly reduction fell short of the 10% reduction that was observed in Q1 and Q2 of the current fiscal year.





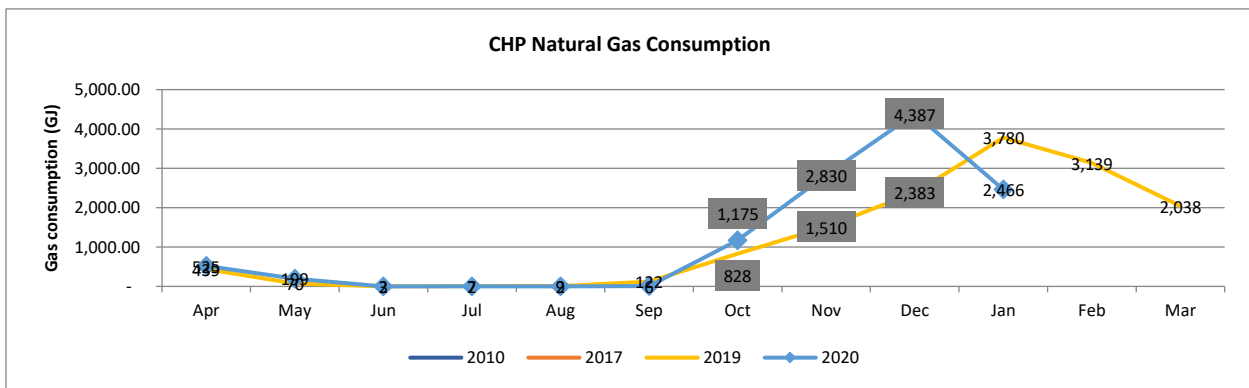
The figure below shows that Residences Electricity and Natural Gas consumption reduced as a result of SARS-CoV-2 (Covid-19) and a few energy conservation measures implemented in FY 19-20 Q4 to FY 20-21 Q2. However, Natural Gas consumption for the Academic buildings was consistently higher every month of Q3 2020 compared to 2019.

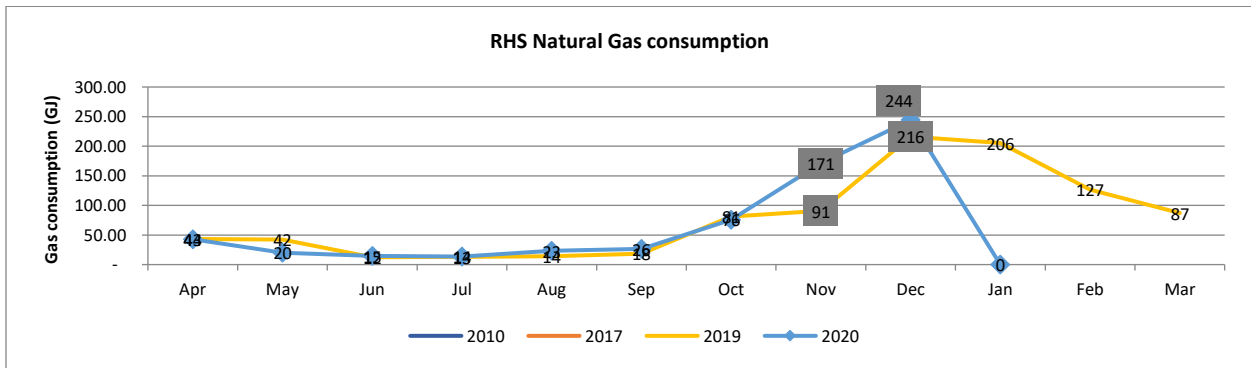
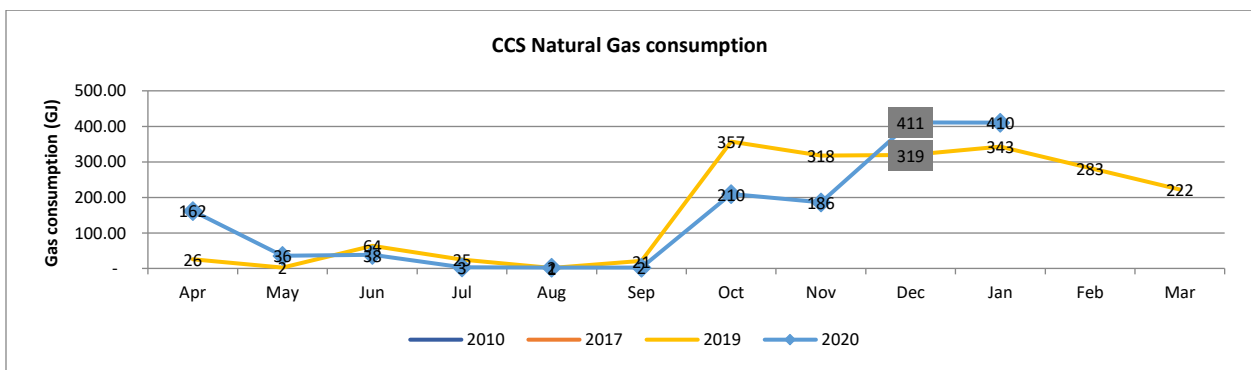
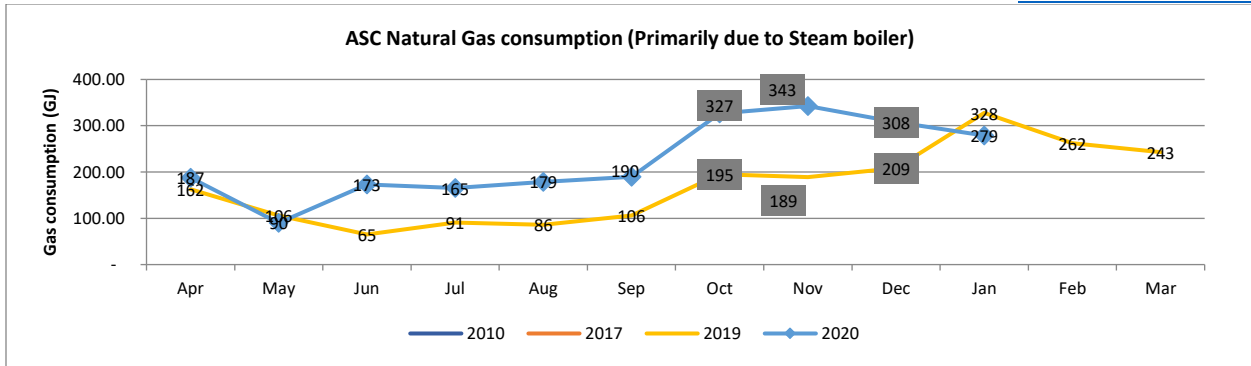


One of the main reasons for this increment was in Q3 2019, LDES ambient loop used the Geothermal system to extract a total of 3000 GJ of heat from the ground. This system was not operational in Q3 2020, therefore to make up for this lost heat, the LDES system used higher Natural Gas through the MDES system. LDES and MDES systems are connected via heat exchanger where MDES supplies heating demand to LDES system in winter months. In Q3 2020, the MDES system supplied approx. 5200 GJ (5812 GJ – 608 GJ) more gas to LDES system compared to Q3 2019 resulting in LDES system boiler gas consumption reduction from 1682 GJ in Q3 2019 to 910 GJ in Q3 2020.

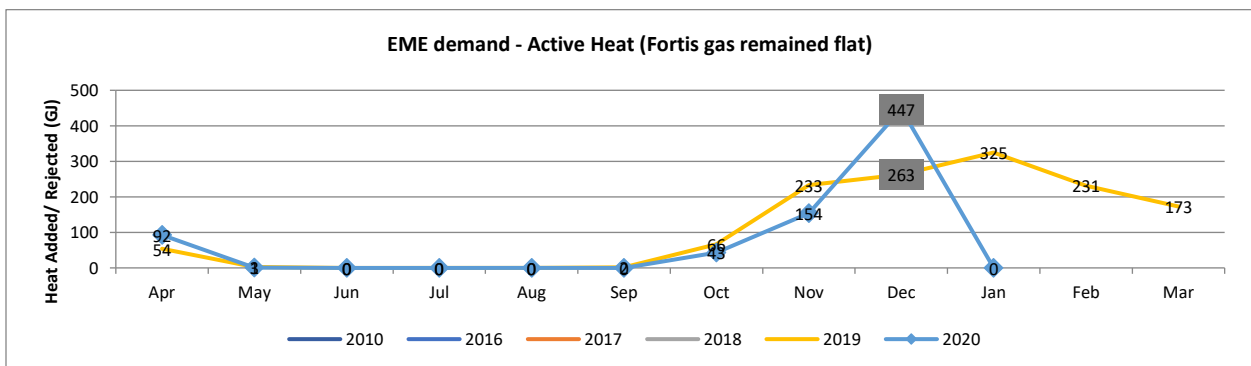
A deeper analysis into the heating Academic building heating revealed that the Natural Gas consumption for the following buildings CHP, ASC, CCS, and RHS have gone up compared to 2019.

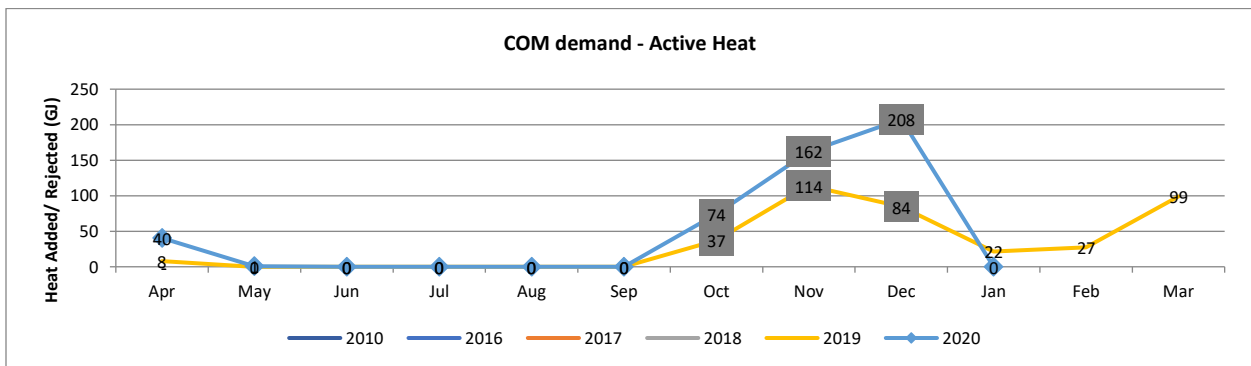
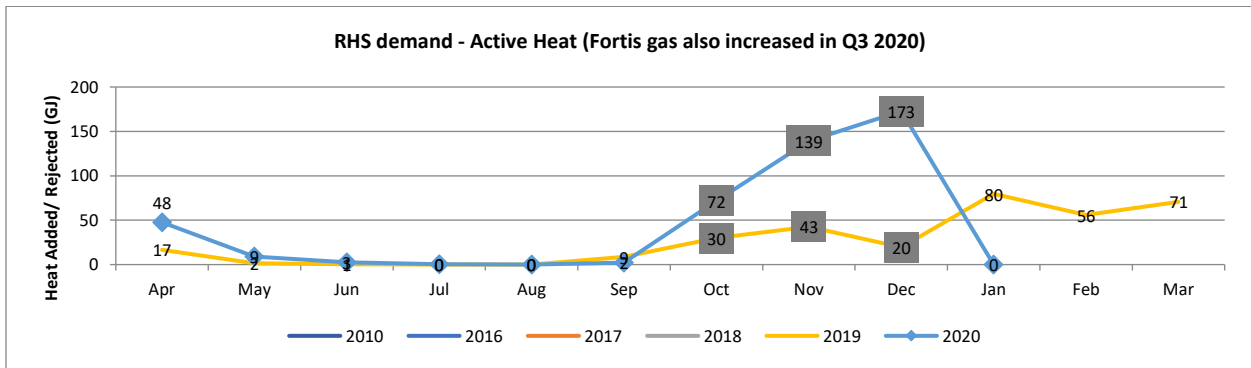
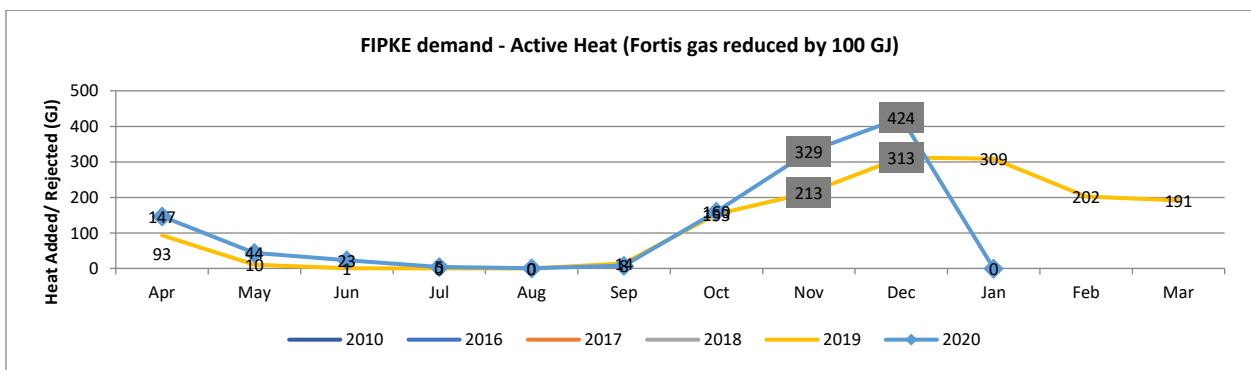
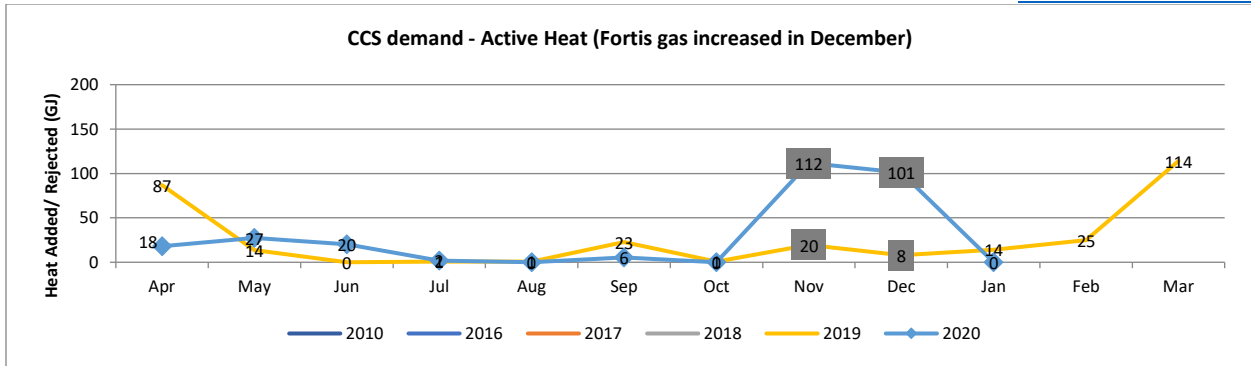
Energy Team will work with Facilities to identify the root cause of these increased Natural Gas consumption or heating demand in the buildings.





Following buildings EME, CCS, FIPKE, RHS, and COM show an increased heating demand from the LDES system.







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

The main campus is expected to grow with the addition of the 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 a 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 most cost-effectively.

Phase 3 of the DE strategy was completed in this quarter which highlighted UBCO district energy decarbonization strategy in a transition to a future state that is affordable, sustainable, and resilient in service to connected customers. Important new elements include high lift heat pumps and thermal storage adjacent to the GEO building to displace natural gas use. Plus, service to a first cluster plant in the ICI building from which surrounding buildings are served.

The key strategy for decarbonization features the integration of air source heat pumps (ASHP) and hot water thermal energy storage (TES). This approach is designed for baseload down to outside air temperatures as low as -5C (23 deg F) before gas boiler heat is required. These hours represent less than 10% of the annual operating hours in a year.

Future options considered include closed-loop geo, solar thermal, dispatchable combined heat and emergency power, and electric boilers. All strategies would be opportunistically deployed based on the weather and grid conditions.

The next phase of the DE strategy is proposed to include the following:

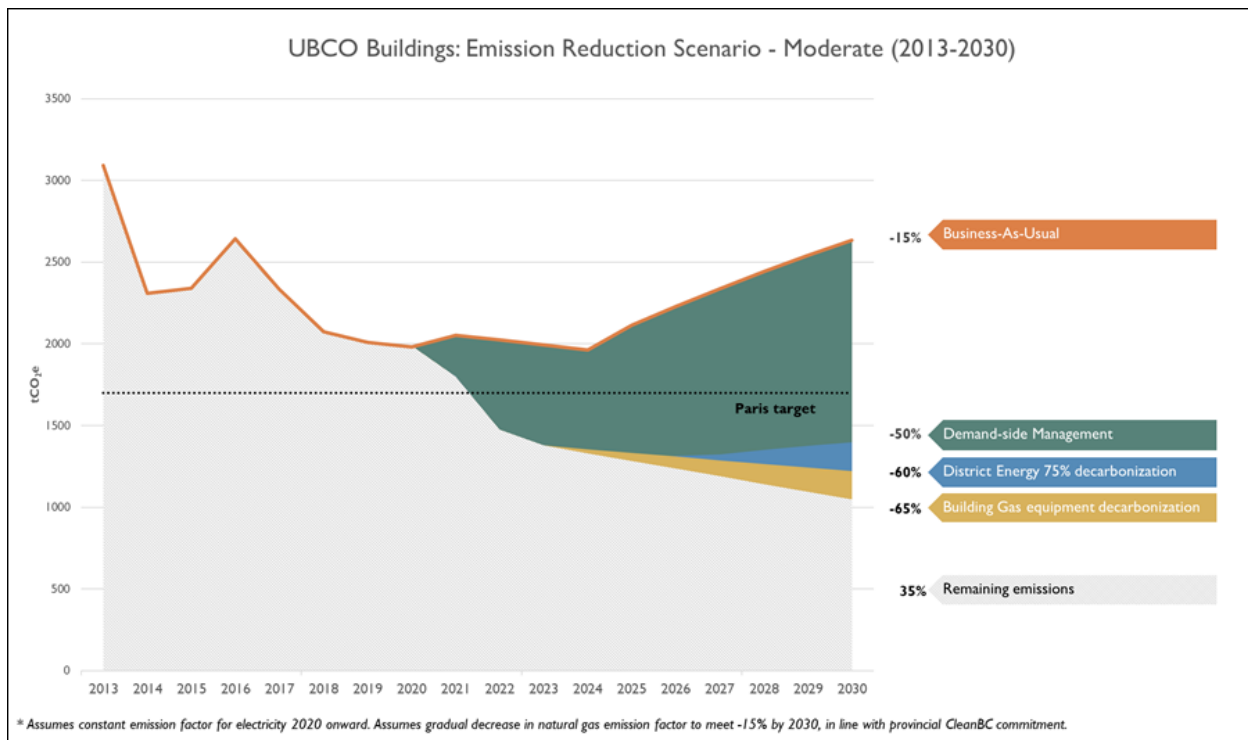
- Schematic design of an air source heat pump and thermal storage plant at or near the GeoExchange building.
- Concept Design of Combined Heat and Emergency Power (CHeP) at GeoExchange or Central Heating Plant Building Location
- Establish 4-pipe direct bury piping alternatives for service downstream of cluster plants located in the ICI Building and near the Geoexchange building
- Sharpen assessment of peak load thermal energy supply for the Innovation Precinct and expansion areas using the existing model and new space or type of use data provided by UBCO.

Phase 4 is expected to be completed by May 1, 2021.



## 2.2. Low Carbon Energy Strategy

Energy Team was tasked by the Whole Systems Steering Committee with developing a High-Level Campus Carbon Energy Strategy that would help inform realistic carbon emission reduction targets. The strategy included the completion of pro forma for various alternate energy supply options, as well as a sensitivity analysis and rough “order of magnitude” costs for each option. The result was the selection of an option that was deemed to be the lowest cost for the campus, as well as the best option to achieve UBC carbon reduction goals, simplify building operations, maximize resilience, and provide a foundation for the integration of waste heat, renewable energy, and other low carbon energy sources in the future.



Based on the strategy, a moderate (realistic) target of 65% emission reduction from 2013 levels by 2030 is recommended. This can be achieved by partial decarbonization of the central plant, implementing projects that will reduce energy demand, and connecting select existing buildings to central energy supply systems (district energy).

## 2.3. UBCO Net Positive Modelling Study – Archetype update and Analysis

Energy team will be working with RDH Building Science Inc. to update the five archetype models from the previous UBC Net Positive Modelling Study using Okanagan climate files and building archetypes that are representative of UBCO new construction with TEUI, TEDI, GHGI results for each archetype.

This work will include updating the ECM bundles to be specific to UBCO, as well as updating the costing and financial analysis for the new construction archetypes, and will also determine the applicability of each bundle to existing building retrofits.





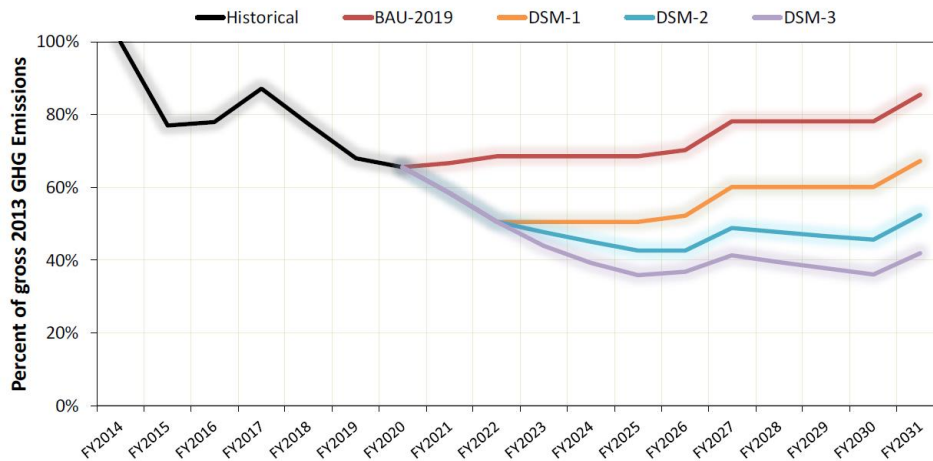
#### 2.4. Strategic Energy Management Plan (SEMP) 2020

A list of demand-side management (DSM) projects was 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 Residences	\$ 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: This is based on the implementation of project bundles FY2021 and FY2022, with no additional energy conservation efforts beyond that.
- DSM-2: This 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: This 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 modeling as discussed further in this report.

Energy Team is working on implementing the Energy Conservation Measures (ECMs) identified as per the SEMP 2020.



## 2.5. 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.

## 2.6. 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.

## 2.7. 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.

## 2.8. 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 wherever 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



select & bundle future retrofit/ modernization projects. In terms of actual studies/ projects, the 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<sub>2e</sub>.

UBCO Energy Team had 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 a delay in the application processing from FortisBC, the project went forward without support from FortisBC.

Siemens Controls is the prime contractor working on this project which is being managed by UBCO's Project Services along with the help of the Energy Team. Following labs have been identified for this first phase of the project:

- Priority 1 Labs: 121, 142, 143, 145, 358, 374
- Priority 2 Labs: 119, 127, 141
- Priority 3 Labs: 336, 338, 345, 347, 355, 363 (second phase of the project)

The construction start date is the first week of February 2021 and is expected to be completed by end of March 2021.

### 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 the 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<sub>2e</sub>.

### 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 the UBCO Energy Team which included resolving the WIFI occupancy reporting issue, working with Siemens to fix the 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 Skeena and Nechako residence buildings have already been discussed in Annual FY 19-20 report. A total of \$324K have been approved by FortisBC for 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 provides inputs on the energy-related standards/ benchmarks.

### 4.2. Innovation Precinct 1 (1540 Innovation Drive) Renovations

In 2017, UBC purchased 1540 Innovation Drive – a 1.36-acre land parcel with 24,400 sq. ft. warehouse/office building – at the north end of the university's future Innovation Precinct. This property is of strategic importance as it will be the first example that pairs commercial activity with UBC Okanagan research and learning. It will facilitate innovation and co-location partnerships with local technology companies, support graduate student needs, and help address the shortage of academic space at UBC Okanagan.

The building is being renovated to accommodate research laboratory facilities for Engineering faculty, studio space for Faculty of Creative and Critical Studies Master of Fine Arts students, an industry-UBC partnership research centre, and shared collaborative space.

Energy Team has been working with the Project Manager UBC Properties Trust and contractors Falcon Engineering to apply for an eligible incentive for the renovations through FortisBC.

### 4.3. University House Renovations

UBCO is currently working on renovating its existing U-House building. The intent is to co-locate CORM departments as much as possible and maximize opportunities for collaboration and productive collisions. The scope of work is currently being developed and Energy Team will be working to apply for an eligible incentive for the renovations through FortisBC.

### 4.4. UBC Okanagan's Downtown site

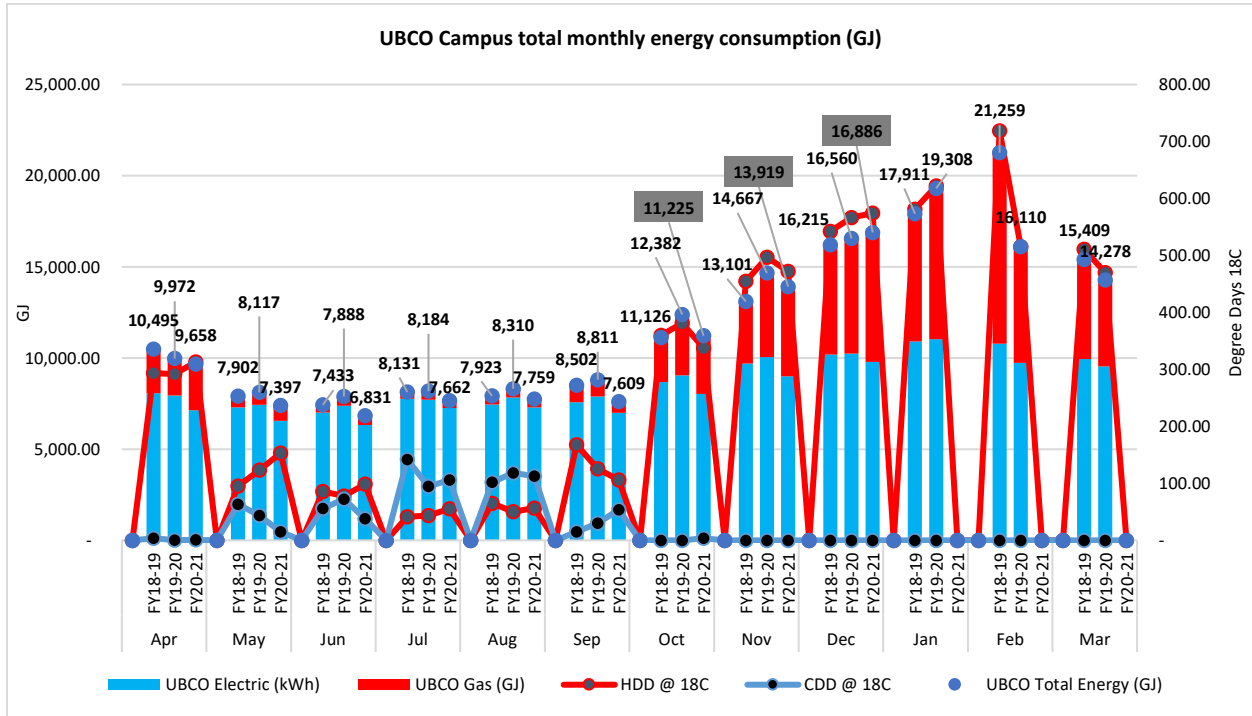
Planning is underway for UBC Okanagan's downtown Kelowna site with a number of community-accessible facilities being considered, including a new public gallery, creative innovation spaces, and a public engagement and learning suite.



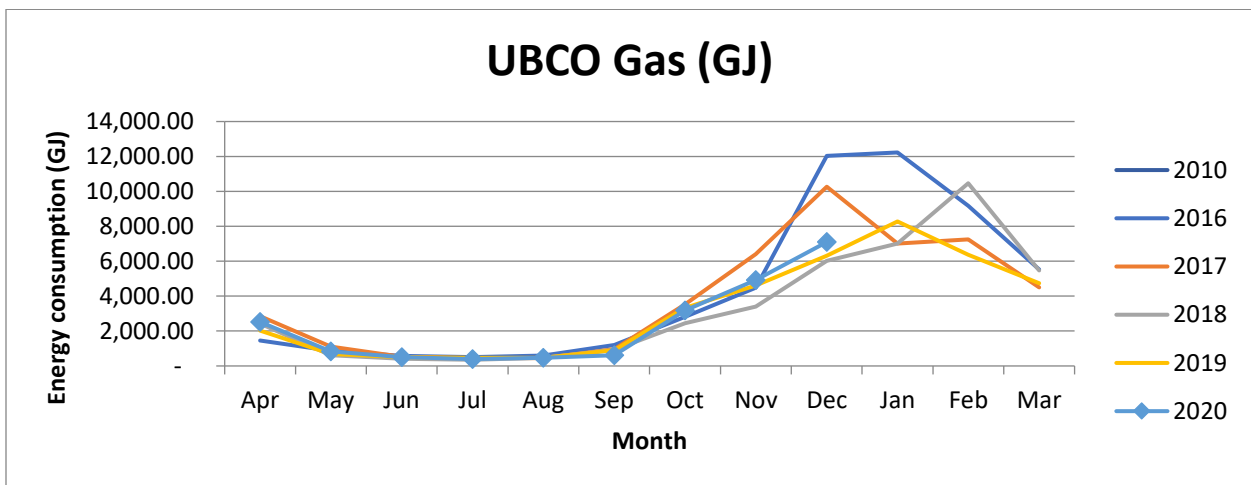
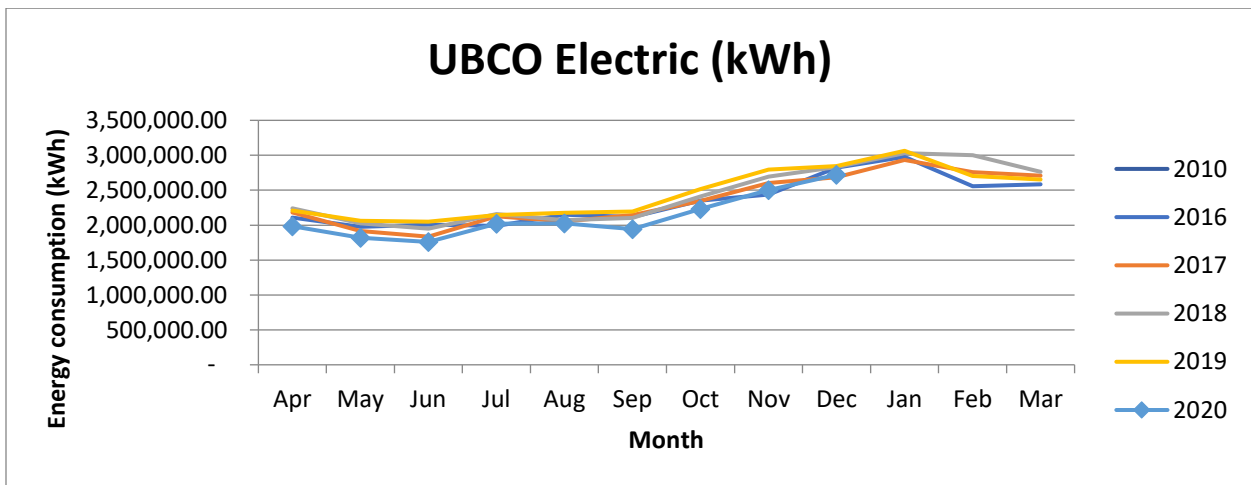
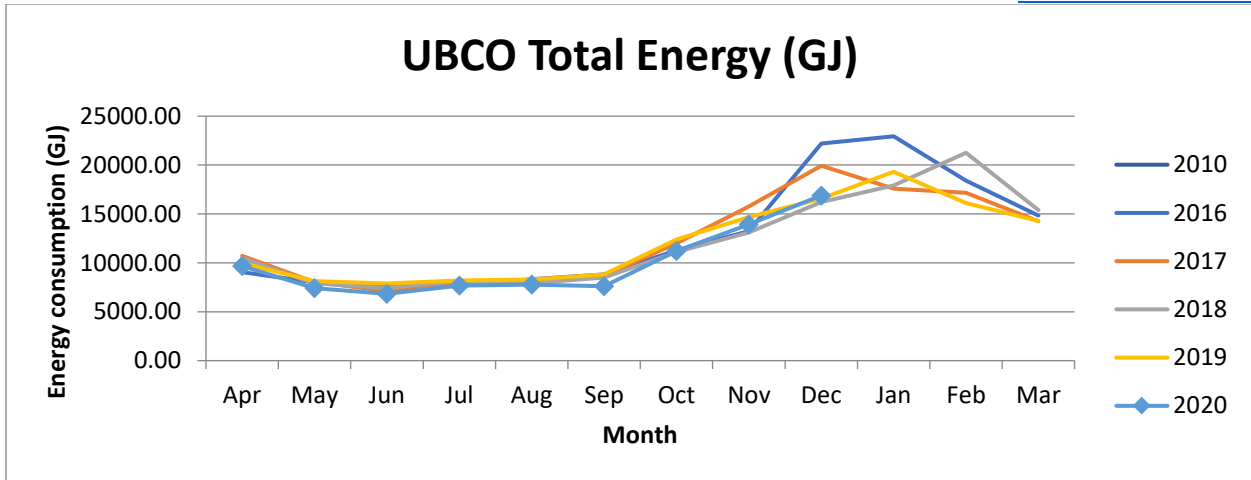
In partnership with UBC Properties Trust, UBC is planning a new building at 550 Doyle Avenue. Once design and approvals are in place, construction is expected to begin in mid-2022.

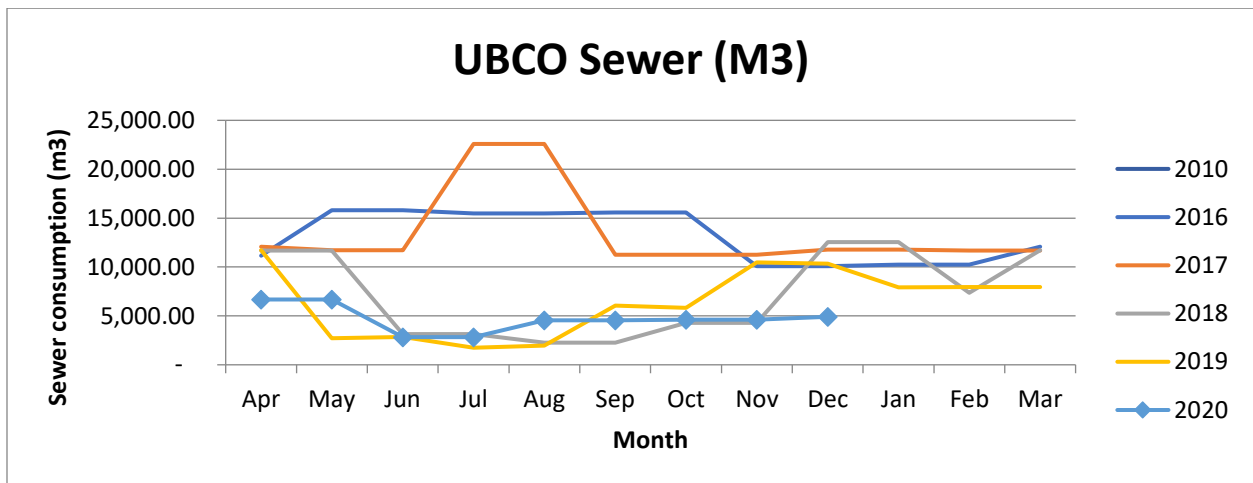
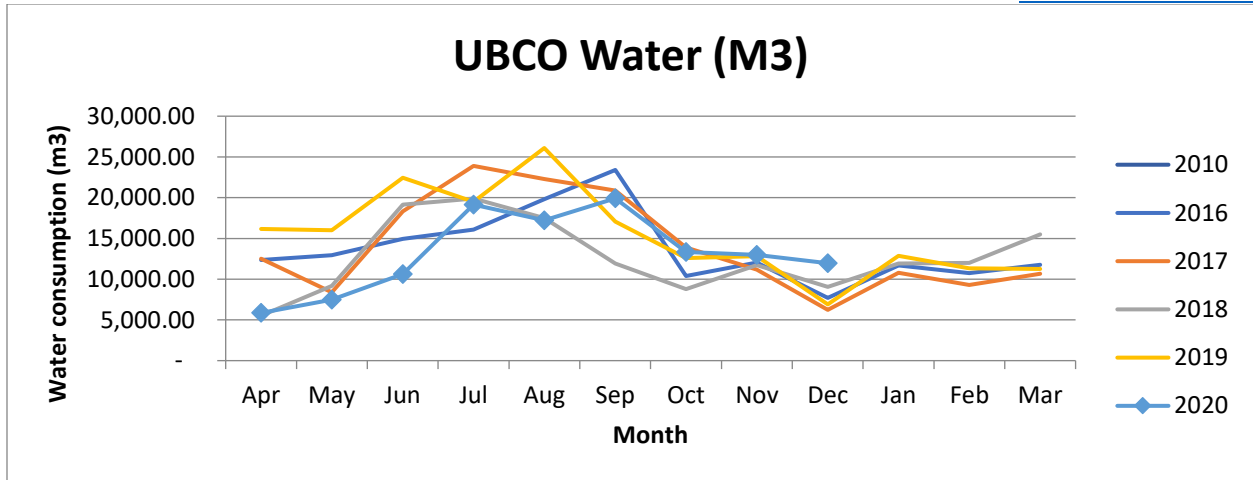
## 5. Monthly Energy Performance Graphs

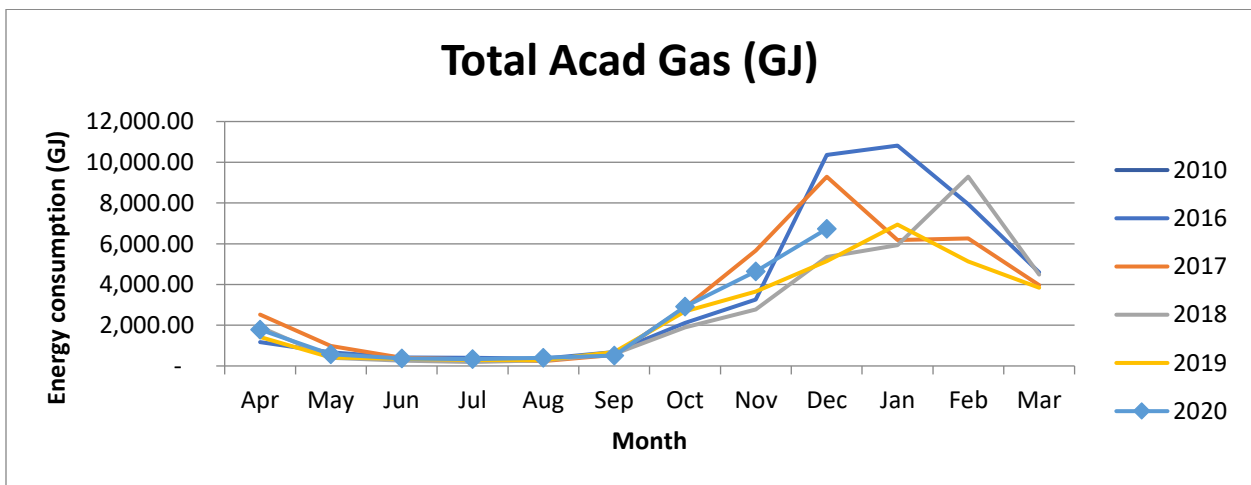
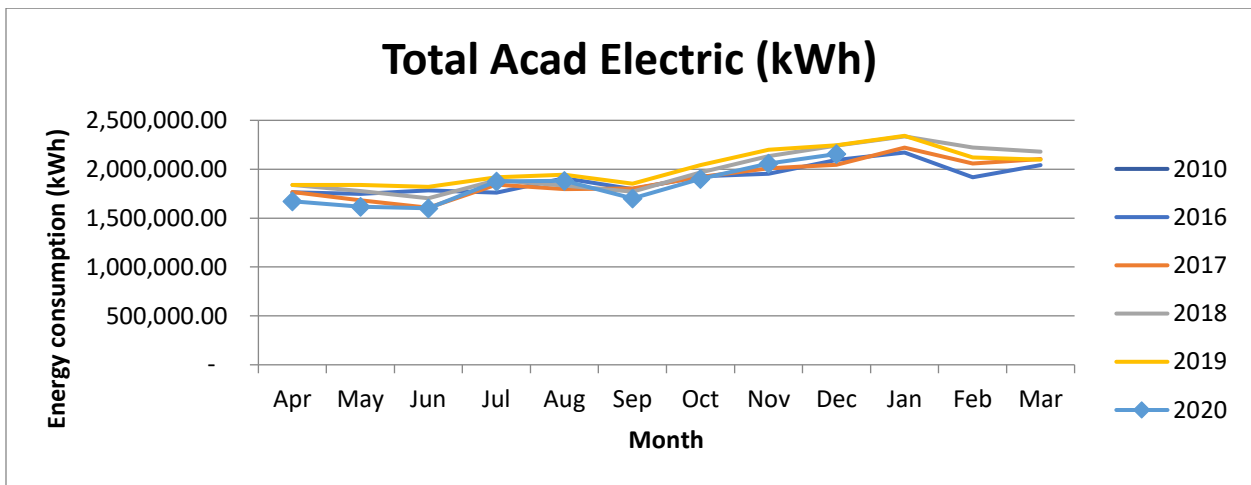
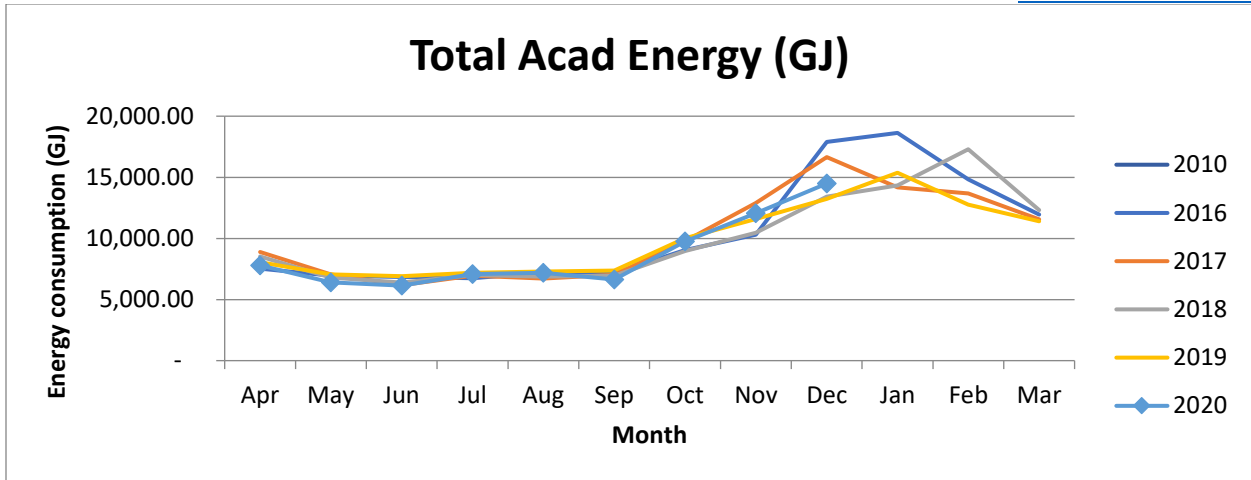
This section presents various figures which show and compares the month over month energy consumption from FY 18-19 to FY 20-21<sup>1</sup>.



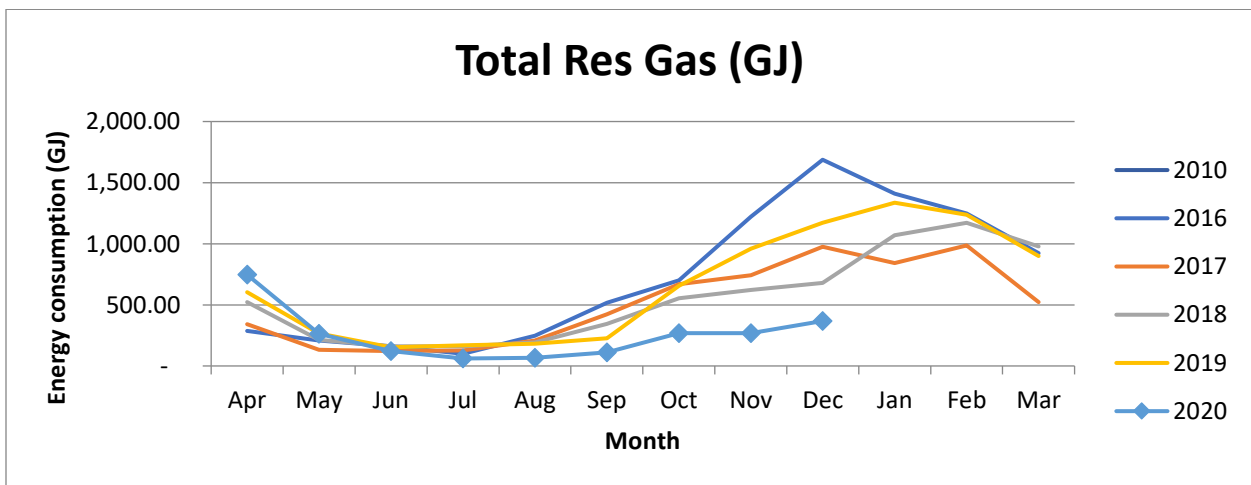
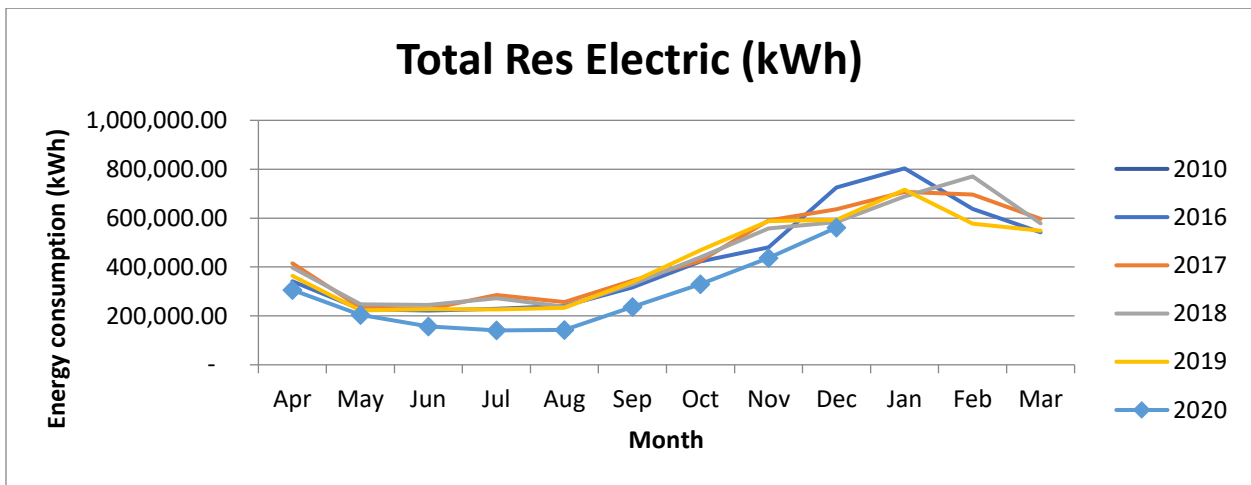
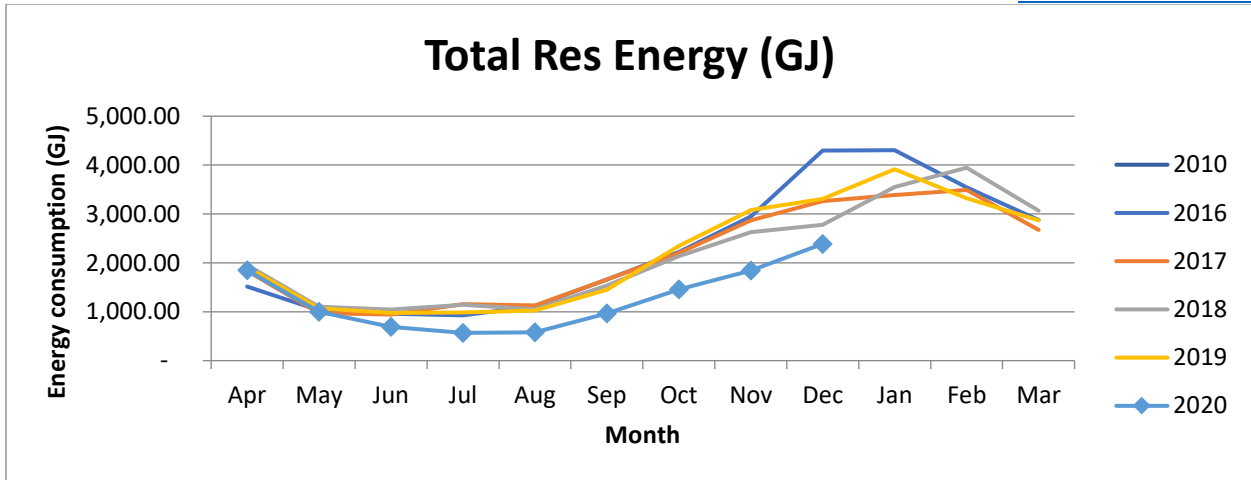
<sup>1</sup> For section 6, any year listed in the graph is start of the fiscal year.

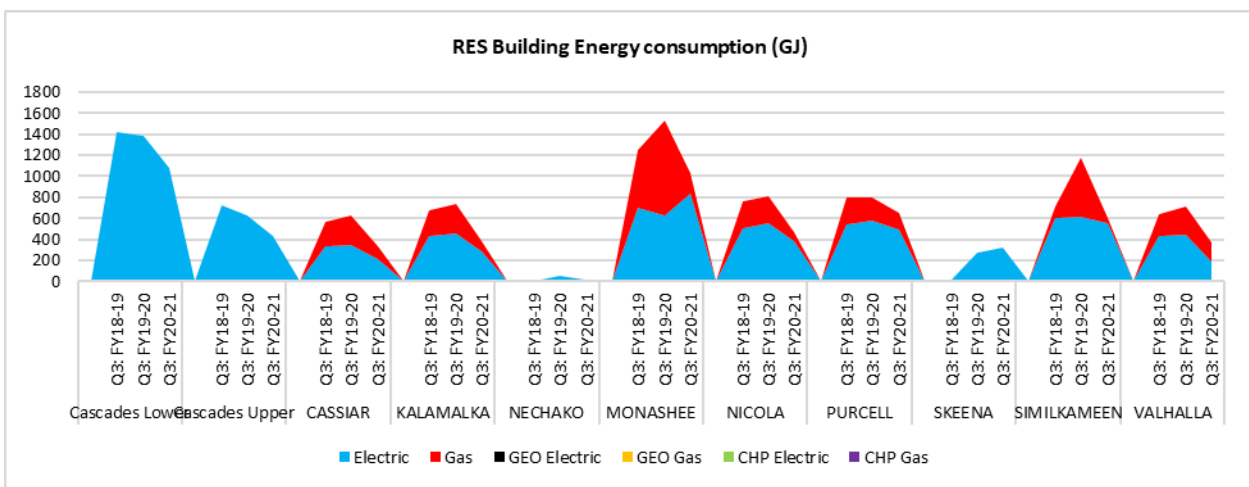
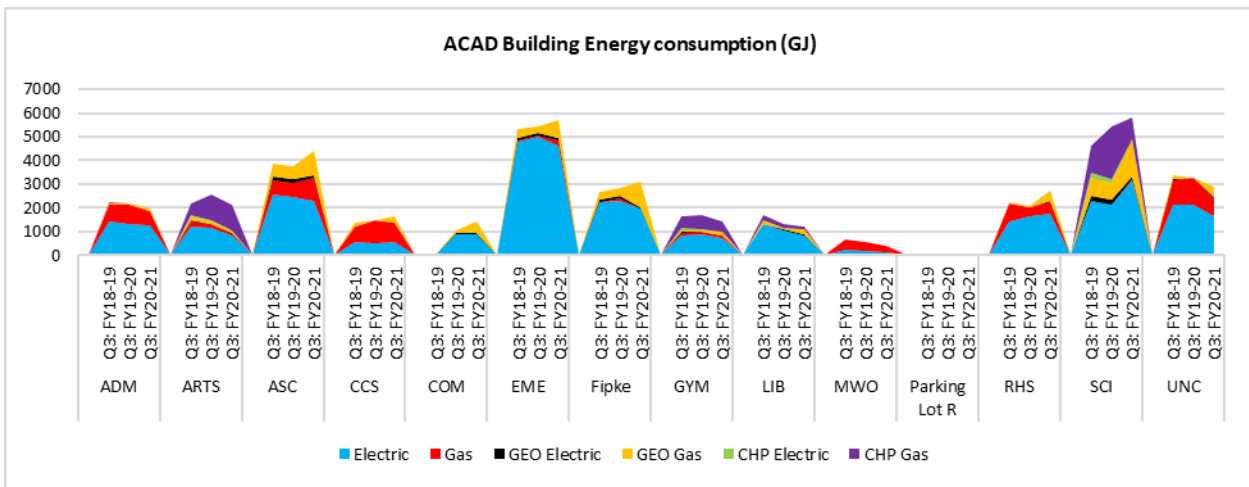
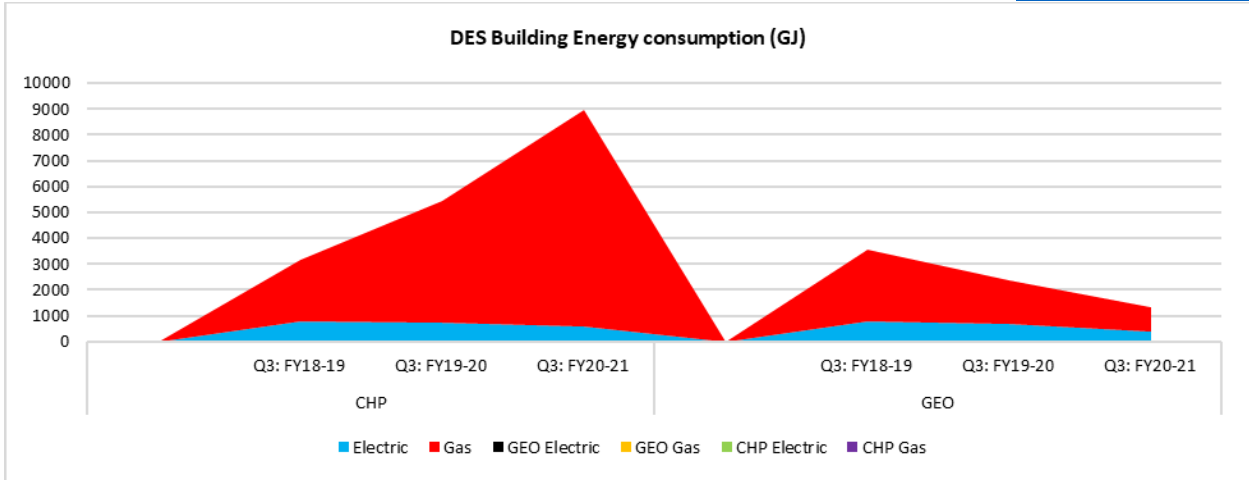






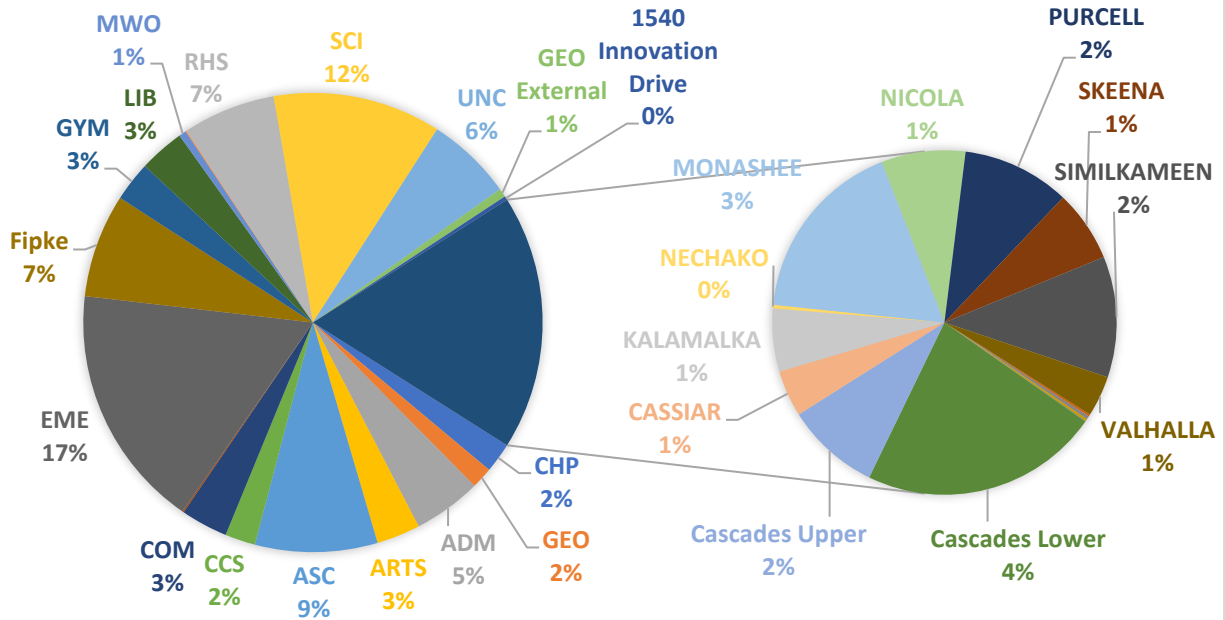




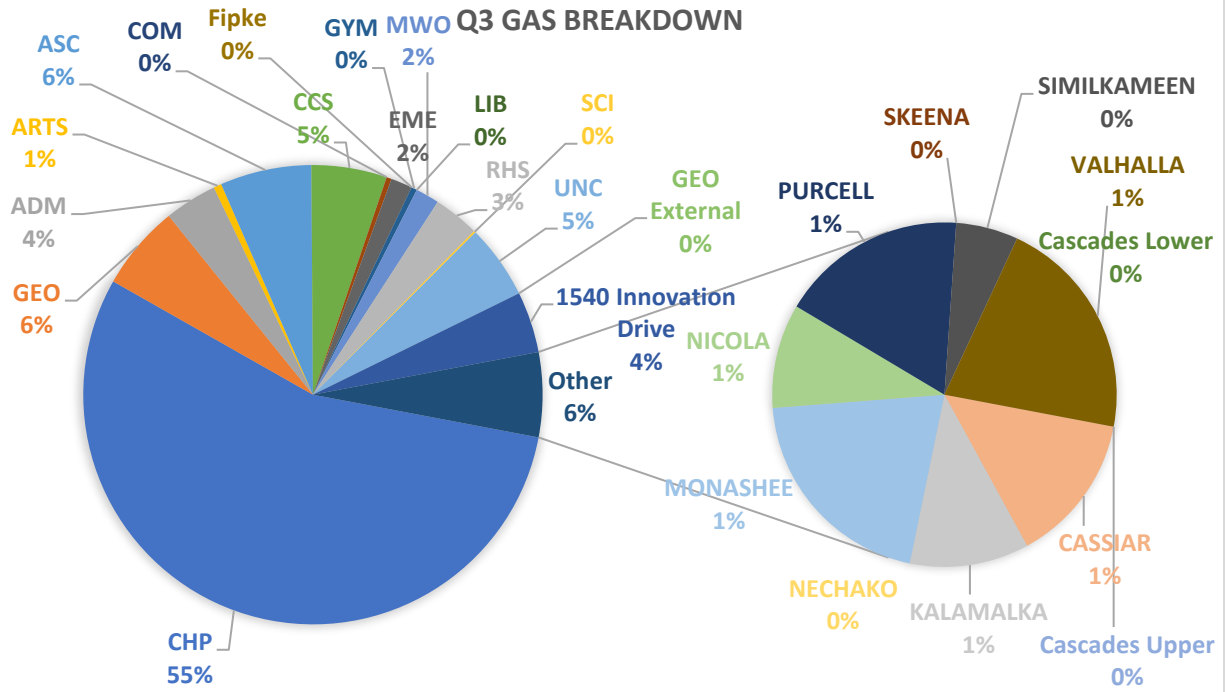




**Q3 ELECTRIC BREAKDOWN**



**Q3 GAS BREAKDOWN**





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

