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UBC Okanagan Campus
Energy Team
Quarterly Report
October 2018 – December 2018

Report Date: 2019-02-04

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1. Overview of the Third Quarter of FY2018-2019

Campus natural gas consumption over the past quarter was 37 000 GJ compared to over 65 000 for Q3 last year. This is a significant reduction compared to all prior Q3 consumption levels. This reduction is attributed to increased heating load shifts from campus boilers (within buildings and in the CHP) to the campus low-temperature district energy system (LDES) and increased usage of groundwater heating by the LDES.

The increase in groundwater heating was allowed for by the addition of glycol to the EME and RHS buildings. These upgrades allowed for lowered LDES temperatures which allowed for heat extraction from groundwater. While usage of groundwater heat significantly reduced consumption of natural gas, it was found that the current groundwater injection system could not continuously handle the water flow rates (60 L/s) for extended periods of time. As such, utilization of the groundwater system has been reduced by reducing the groundwater flow rates. While optimization of the system is being undertaken to determine how to maximize heat extraction from limited quantities of groundwater, it is expected that the savings accorded to groundwater use this past quarter will only be partially realized in future quarters. Additionally, weather over the past quarter was mild compared to prior years and this resulted in further savings outside the control of the energy team.

In contrast to the reduction in natural gas usage, electricity usage on campus for Q3 was 7910 MWhr compared to 7620 in FY17-18, a 4% increase year over year. This increase is related to the natural gas reductions as the load shift from boilers/MDES to the LDES reduces gas consumption at the expense of increasing electricity consumption. Were it not for other electricity reduction measures implemented by the energy team, such as lighting retrofits, it is believed that the increase in electricity use would be higher.

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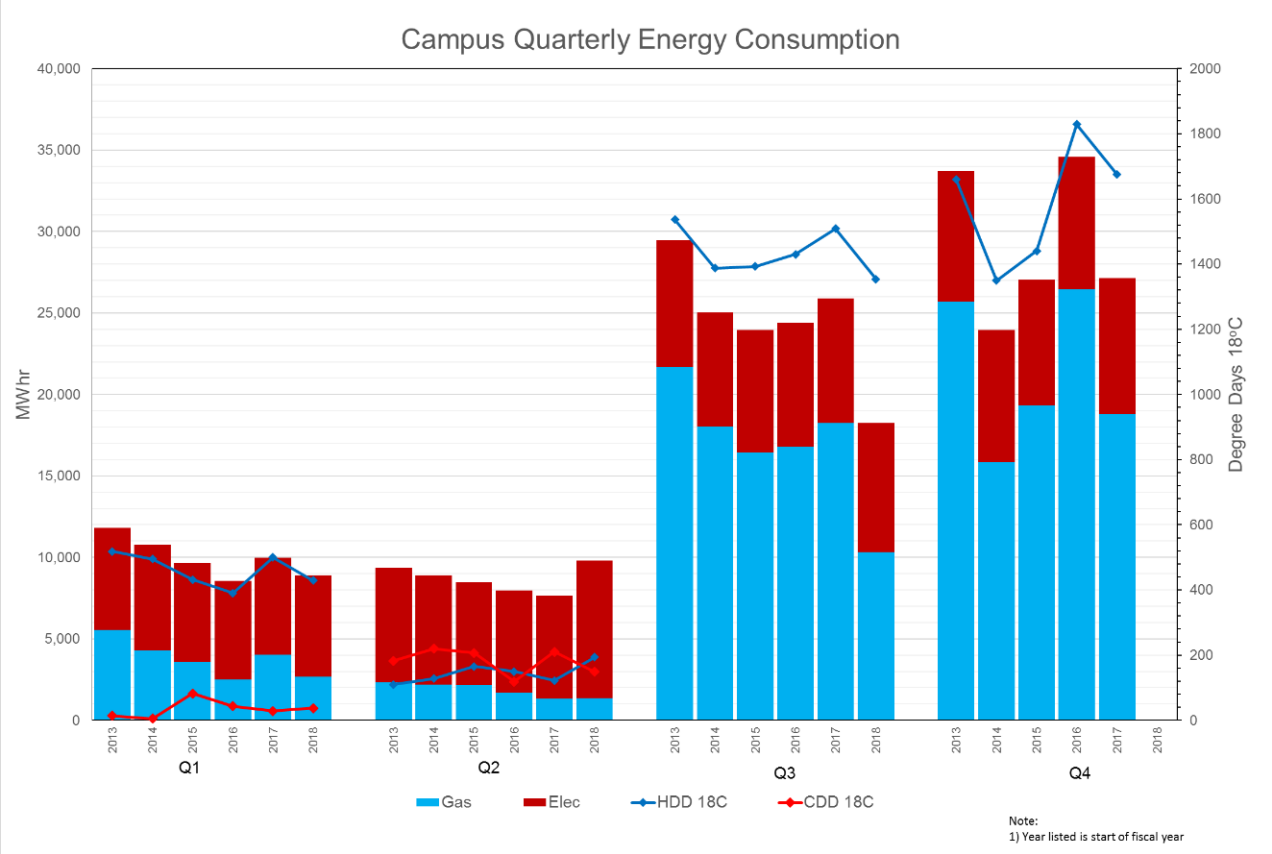

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2. Policy Development

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. Campus District Energy Strategy

A strategy to guide possible further development of the District Energy Systems on the Okanagan campus is under development. To date, a scope of work for developing this strategy has been developed. Further work on development of the campus District Energy Strategy is pending confirmation of funding for the work. The strategy is intended to guide how district energy systems on campus evolve to meet the requirements of an expanding campus.

2.2. 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. Ensuring timely development, review and acceptance of rigorous Owner's Project Requirements documents will be an important part of this work.

2.3. 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 specific to the Okanagan campus. The energy team is working to update several that are specific to energy performance and monitoring.

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3. Completed Projects

The following projects have been completed over the last quarter:

3.1. ASC Exhaust Heat Recovery

While a glycol run around system was installed during construction of this building to recover heat from laboratory exhaust air, it was not operational for some time due to deficiencies in the original construction. Deficiencies of this system have now been addressed and the system is operational. Based on a review of the initial performance of the system, energy savings of over 800GJ per year of heat are expected.

3.2. Science Ventilation Upgrade

Various building changes that have accrued over time have reduced the efficiency of the ventilation in this building which includes a large number of laboratories. Optimization of the Science building's ventilation is currently estimated to save $52,000 in energy costs per year (2,600 GJ of gas and 415,000 kWhr of electricity). The project has been approved for $25,815 in FortisBC electrical incentives and $55,681 in FortisBC gas incentives. Rebalancing of laboratory airflows has been completed as well as installation of variable-frequency drives on the building's main exhaust fan motors. Additionally, several laboratories have been connected to a system that monitors laboratory exhaust chemical content in order to allow for ventilation rate optimization and key fumehoods have been upgraded to variable air volume flow.

4. Projects in Progress

The following are energy conservation projects that are currently in progress.

4.1. LDES Optimization

The addition of glycol to the EME and RHS buildings has allowed for lowered LDES temperatures which consequently allows for heat extraction from groundwater. As such, utilization of groundwater heat extraction was significantly increased during this past quarter. For most of November the groundwater system was providing about 500kW of heat. Unfortunately the water flow rates being used (60L/s) exceeded the capacity of the system's infiltration basins to return the water to the aquifer. As such, the groundwater flow rate was halved in early December and the heat extraction since then has been reduced to less than 300kW. Further optimization of the LDES system is planned in order to maximize the amount of heat extracted from the limited groundwater flow rate available.

4.2. Library Data Center Heat Recovery

Data centers on campus produce a significant amount of heat year-round. In order to utilize this heat during cold weather, a hydronic connection is being made between the library data centre and the new adjacent Commons (TLC) building's central heating/cooling plant. With this connection, cooling for the data centre will be provided by the Commons' central plant with the heat being available for use in the

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Commons building. This system is expected to save 480 GJ of natural gas and 53 MWhr of electricity consumption annually.

4.3. Lighting Upgrades

Upgrades of existing campus lighting to LED lights is ongoing. Over the past quarter UBCO electricians have been replacing fluorescent tubes in the Arts building as well as outdoor street lights with LED replacements. The purchase of an indoor man-lift has reduced the labour required for indoor lighting upgrades.

4.4. HVAC System Efficiency Maintenance

The energy team has employed an HVAC Efficiency Technician since the spring of 2017. This technician has been cleaning heat exchangers and other campus HVAC equipment. Improved operational efficiencies are expected as the technician has found and cleaned significantly fouled equipment. Trends in the fouling of equipment are being noted. As systems with faster/slower fouling rates are identified, cleaning schedules can be optimized.

Significant fouling of terminal equipment was found in terminal devices in the Science building. Cleaning of this equipment will result in improved occupant comfort and more efficient usage of the building's heatpumps.

Additionally, the LDES/Science building heat exchanger was found to have significant particulate buildup that was impairing flow. Cleaning of the heat exchanger increased flow to the building's heatpumps increasing their capacity by a factor of 4/3.

Material buildup was found to be less significant in the Arts building than in Science. However AHU-3 in Arts was found to have a plugged heating coil. Cleaning of this coil is expected to improve system efficiencies and increase occupant comfort.

An additional finding was insufficient water flow due to particulate fouling in the LDES/Fipke heat exchanger. Correction of this issue is planned for the fourth quarter and should positively impact required HVAC system capacity upgrades in the building.

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5. 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.

5.1. The Commons

The new Commons building (formerly referred to as the Teaching and Learning Centre) was under construction during Q3 with building occupancy beginning in January 2019. The final amount of the Fortis incentives available for this project is still being determined. Current estimates are that the Commons building will consume less than half the energy compared to a minimally code compliant reference building. Final commissioning of this building is still ongoing.

5.2. Nechako Residence Commons

The Nechako building is a new residence building with a large cafeteria and other campus amenities included. While the energy team has provided detailed feedback on the design of this building, as a residence building, decisions for this building are the responsibility of UBC Student Housing and Hospitality Services. Completion of this building is expected for summer 2021. The energy performance and potential FortisBC incentives for this building are still being evaluated.

5.3. Skeena Residence

The Skeena Residence is a new residence building that is planned to be the first Passive House Certified building on campus. The energy team has provided detailed feedback on the design of this building. Completion of this building is expected for summer of 2020. The energy performance and potential FortisBC incentives for this building are still being evaluated.

5.4. Greenhouse

A research greenhouse is planned for construction near Mountain Weather Office. It is expected that due to cost constraints, this building will be built in phases with the final indoor growing area being 1000 m^2 total. The energy team has provided evaluations of energy conservation measures that may minimize the energy costs and greenhouse gas emissions of this facility.

5.5. Engineering Portable

In order alleviate current building space issues, a portable containing engineering student laboratories is planned to be installed adjacent to the new Commons (TLC) building. In order to minimize energy consumption this portable is being constructed with its envelope meeting NECB 2011 standards. The building will not use any natural gas. Electric heat will be by air-source heatpumps. Demand controlled ventilation combined with heat recovery ventilators are planned to reduce electricity consumption.

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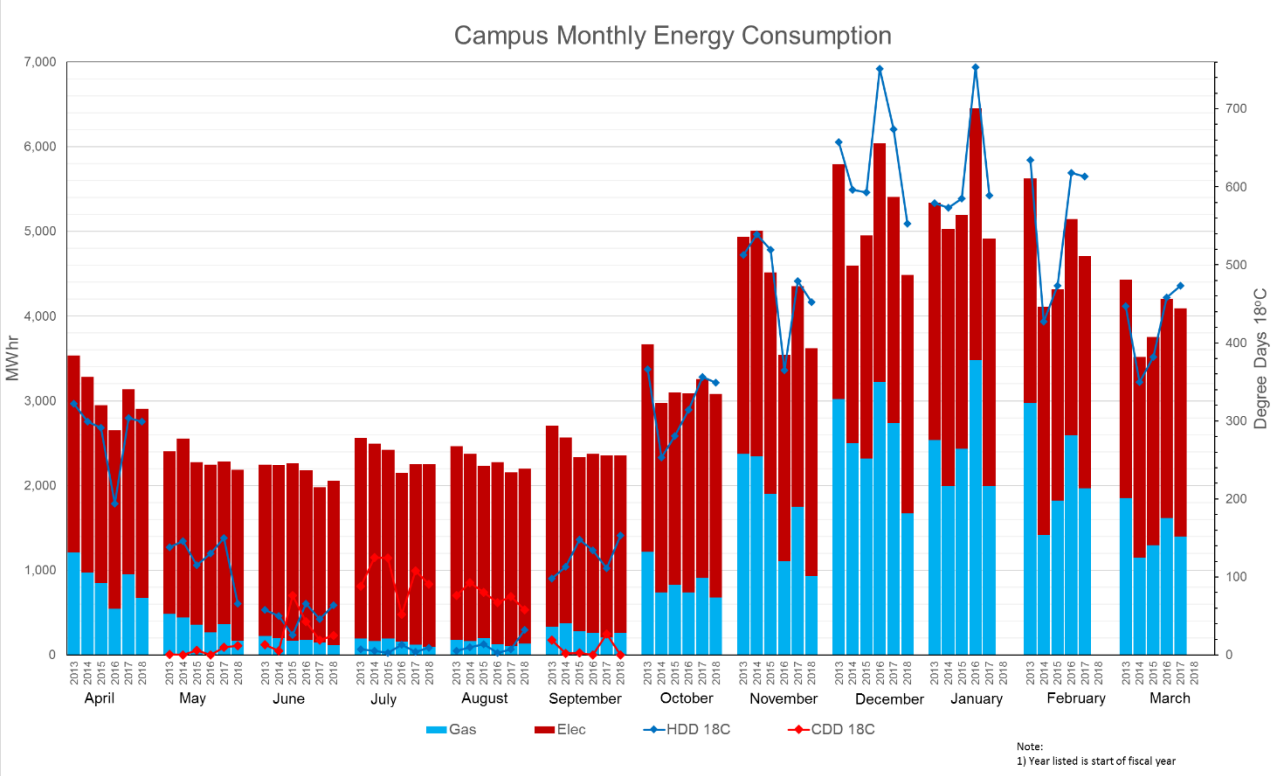
5.6. Energy Performance Graphs



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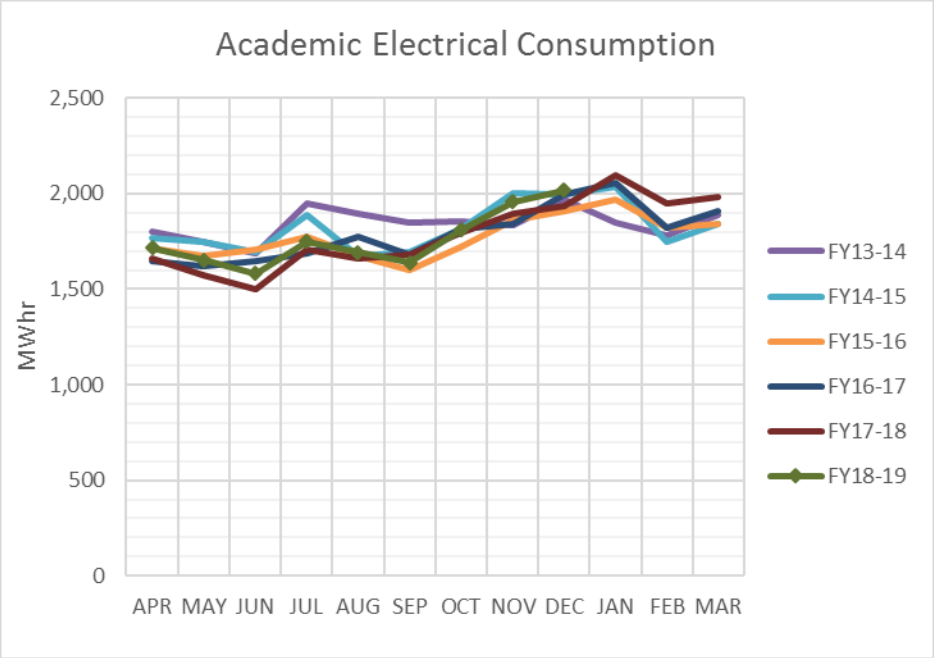

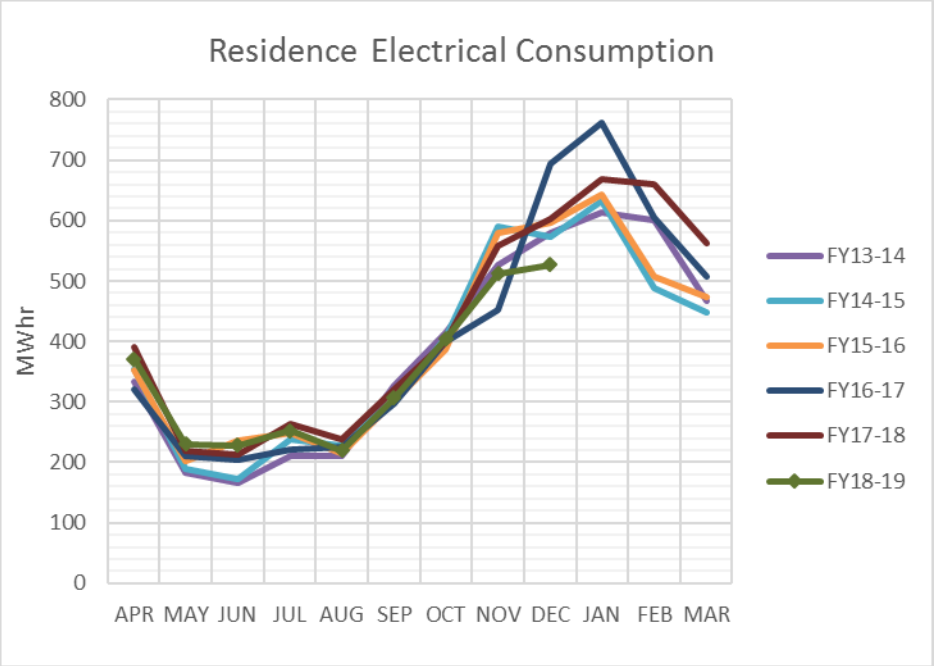

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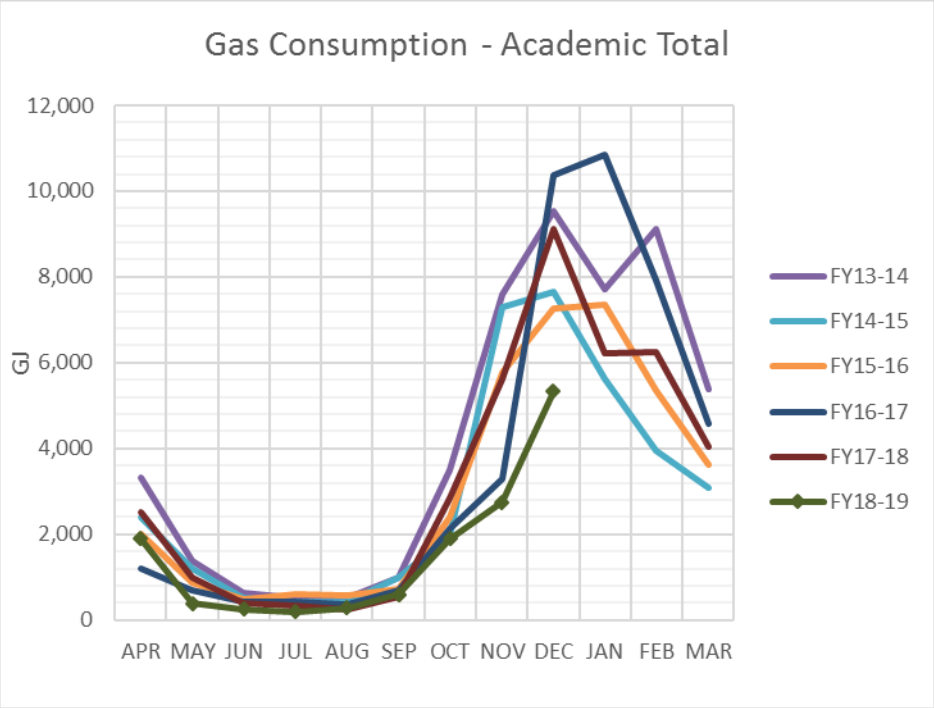

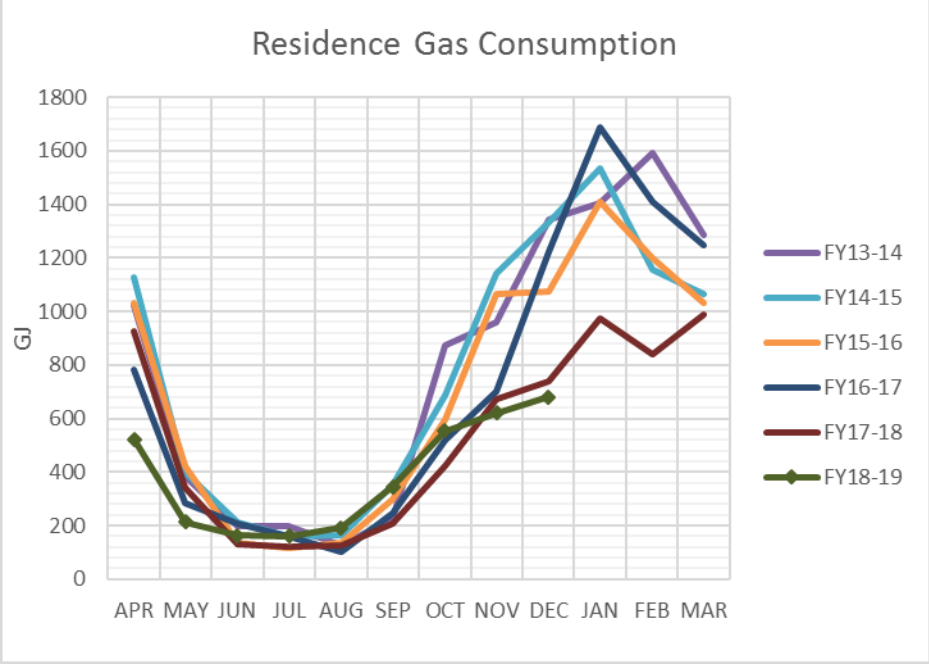

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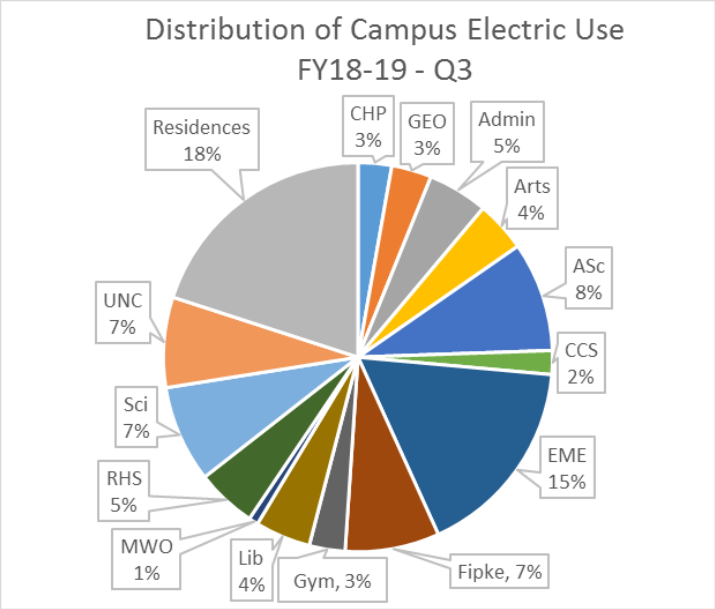

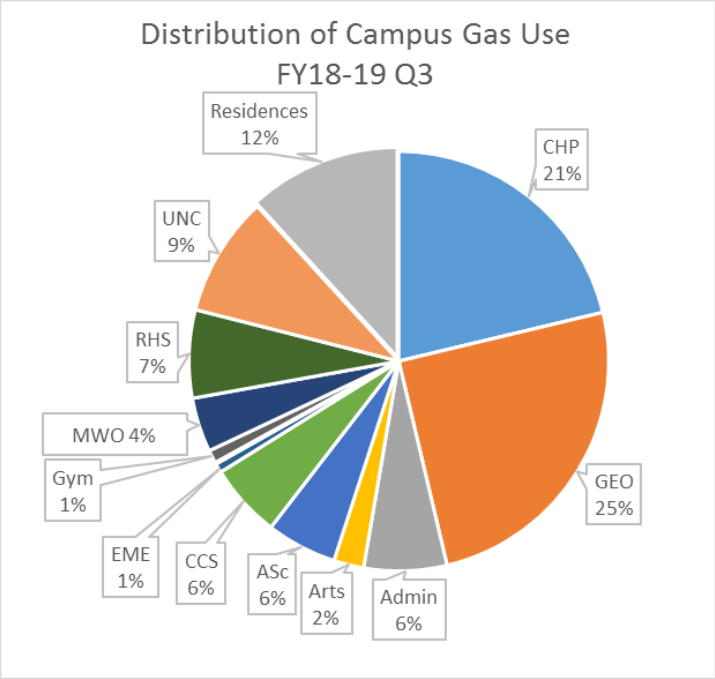

Note: Building electricity and gas consumption values shown are for consumption within the building. Indirect gas consumption via MDES & LDES is not included.

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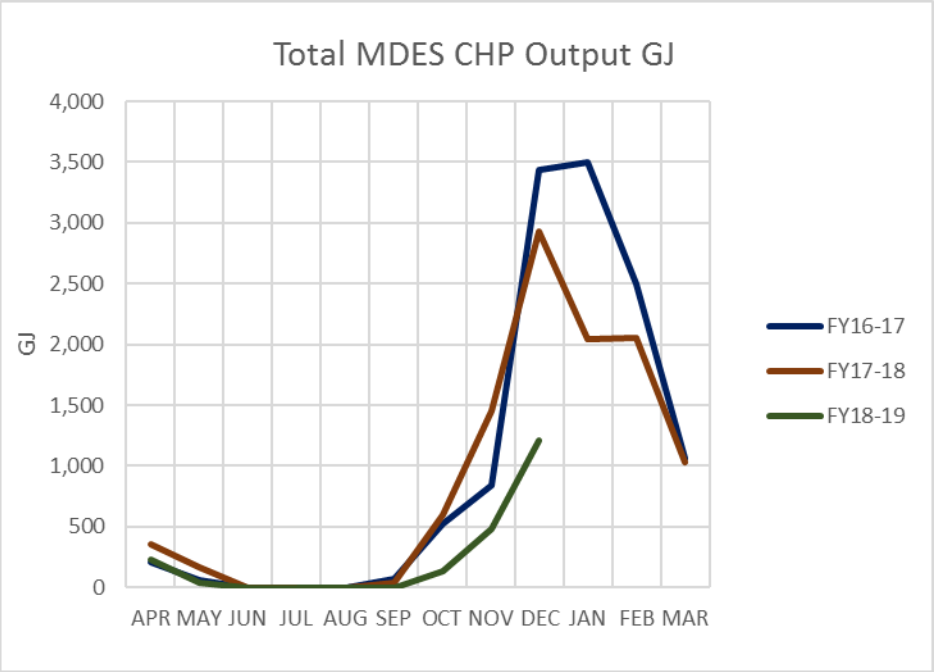

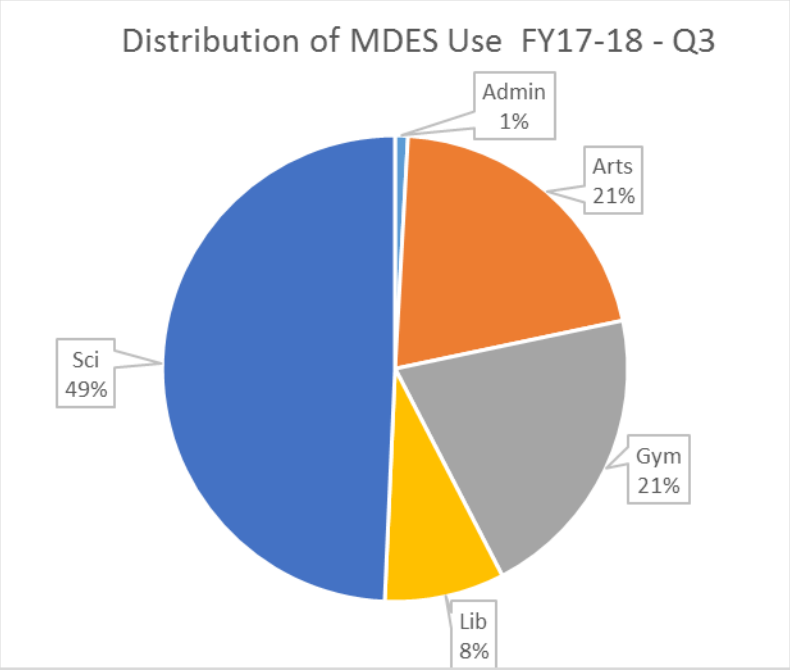

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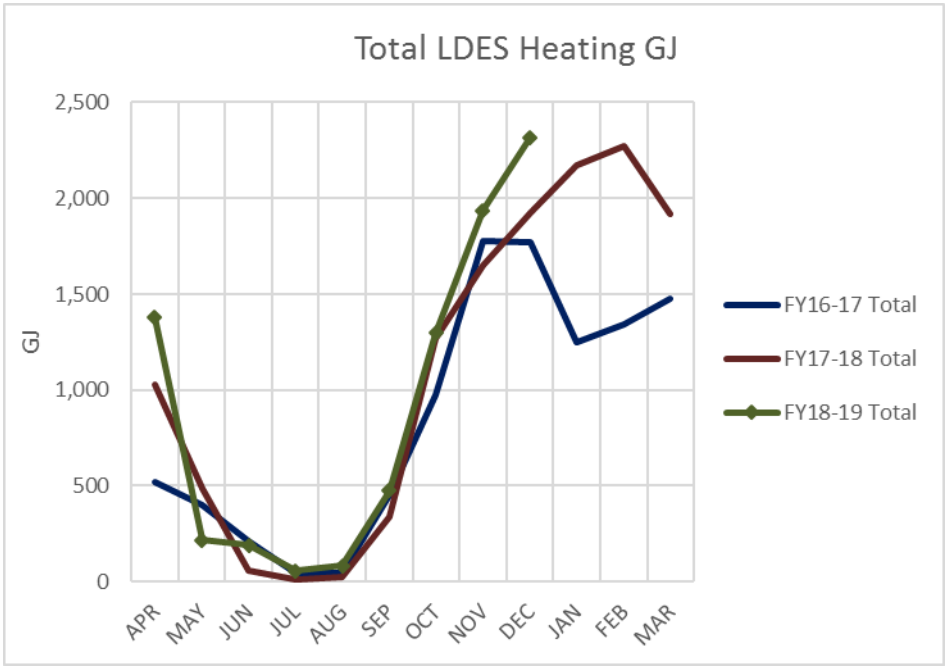
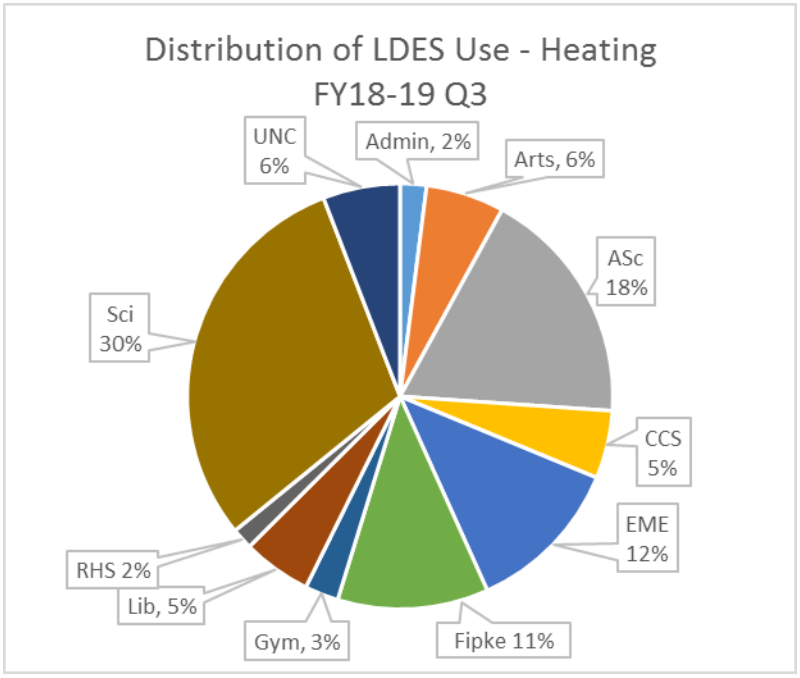


Note: 'Total' value indicates thermal GJ of heating delivered to all buildings.



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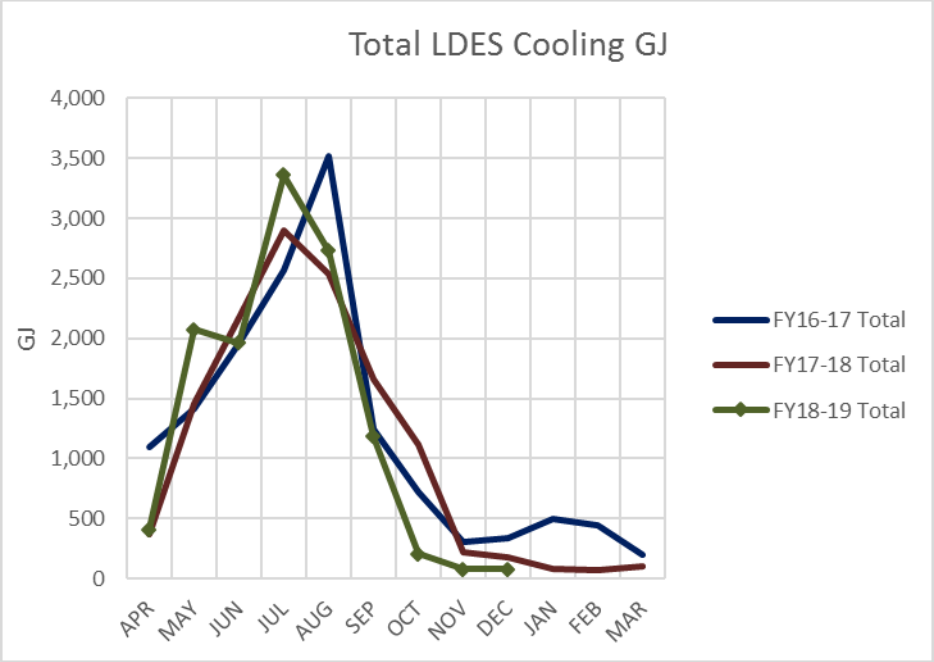

Note: 'Total' value indicates thermal GJ of cooling delivered to all buildings.