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THE UNIVERSITY OF BRITISH COLUMBIA

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UBC Okanagan Campus
Energy Team
Quarterly Report
October 2017 – December 2017

Report Date: 2019-02-01

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1. Introduction

The goal of the campus energy team is to reduce energy use and associated GHGs and costs for the Okanagan campus. Over the past quarter, the energy team has implemented a number of energy conservation projects and has identified future projects based on potential return on investment and consistency with the campus Whole Systems Implementation Plan.
In addition, in order to evaluate the results of previous projects and use experience to guide future ones, the team has been improving campus energy tracking to provide quantitative information for decision making.

2. Policy Development

The presence of appropriate policies and guidelines assist in meeting campus energy goals and as such are championed by the energy team. Key developments in energy-related campus guidelines and policies are decribed below.

2.1. Five Year Energy Plan

SES Consulting has been contracted to develop a five year Strategic Energy Plan. This plan will provide guidance for campus energy strategies and priorities for upcoming energy projects. The consultant's final report on this plan is expected by March 2018.

2.2. Campus District Energy Strategy

UBCO Campus Planning and Development is leading the development of a Campus District Energy Strategy. The energy team has been providing input into the development of this plan.

2.3. 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 consistant 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.

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3. Completed Projects

The following projects have been completed over the last quarter:

3.1. Cooling Plant Expansion

Funding from the federal government ($1,030,000) was received for installation of an additional cooling tower for the LDES system. This tower will increase the air-cooled capacity of the LDES system. Construction was mostly completed in the fall of 2017 with final commissioning expected in spring 2018 when weather allows.

3.2. Science Building Third Floor Heating Upgrade

Previously, heat was provided to the third floor of the science building from the central heating plant alone. By connecting the 3rd floor heating systems to the campus LDES, the central heating plant will be able to remain off for longer during shoulder seasons. This measure has been completed and is estimated to save $6000 per year in energy costs and 45 tons of GHG emissions.

3.3. MWO Boiler Replacement

The low-efficiency 190kW boiler in the MWO building was replaced with two 117kW high-efficiency condensing boilers. FortisBC gas incentives of about $7000 were received for this project.

3.4. Building/LDES Optimization

Currently the effectiveness of the LDES is compromised due to Phase I buildings not being able to operate with supply water temperatures appropriate for the LDES. In order to effectively utilize both the heating and cooling capacity of the geothermal system and the cooling capacity of the cooling towers, upgrades to Phase I buildings on campus need to take place. SIF funding ($1,200,000) has been utilized to complete the upgrades on three buildings: Fipke, UNC and ASC. For these buildings, an upgrade of the central plant to a 4-pipe glycol system with hot and cold tanks has been completed. A reduction in the winter operating temperatures of the LDES has already been observed as result of the completion of these upgrades.

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4. Projects in Progress

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

4.1. 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. In order to improve the ventilation to this building the following work has been proposed:

1. Analyze current airflows including identification of interior penetrations that require remediation.
2. Add occupancy controls to laboratories to allow for reduced ventilation rates where and when possible.
3. Add variable-frequency drives to the building's Strobic exhaust fans.

This project 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. The first stage of this project, completing an air balancing audit of this building, has been completed. Installation of the variable frequency drives has also now been completed. Rebalancing of airflows and addition of occupancy controls is expected to be completed by the end of March 2018. Provincial funding has been approved for this project and as a result the project scope may change as the project progresses.

4.2. Science Exhaust Air Heat Recovery

Currently a portion of, but not all of the exhaust air connected to the Science building's Strobic fans have heat recovery systems installed. Provincial funding to install heat recovery for the remaining portion of the exhaust air has been received. A glycol run around heat recovery system has been designed and is expected to be tendered by the end of January 2018 with project completion planned for March 2018.

4.3. EME LDES Optimization

Currently the effectiveness of the LDES is compromised due to limitations on LDES supply and return water temperatures required by campus buildings. In order to effectively utilize both the heating and cooling capacity of the geothermal system and cooling capacity of cooling towers, upgrades to the RHS and EME buildings on campus need to take place in addition to the now complete upgrades to ASC, Fipke and UNC.

EME has had its hydronic controls adjusted to allow for reduced LDES supply/return water temperatures and reduced flows. In order to further reduce LDES temperatures, the addition of glycol between the heatpumps and LDES heat exchanger in EME is planned. This work is expected to be completed by March 2018.

Further optimization of EME along with similar upgrades to RHS will be completed as resources allow. Completion of all of these projects will allow for a lower water return temperature for the LDES which is expected to allow for ground water heating.

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4.4. ASC Exhaust Heat Recovery

While a glycol run around system was installed in order to recover heat from laboratory exhaust air, it has not been operational for some time due to deficiencies in the original contruction.

A mechanical consultant was contracted to evaluate the sytem and has provided recommended remedial actions required in order to activate and operate the system. The required actions are planned for completion by the spring of 2018.

4.5. MDES Building Heat Exchanger

The efficiency of the boilers in the central heating plant would increase if the return water temperature of the MDES loop was reduced. One way to decrease the MDES return water temperature is to increase the size of the MDES/building heat exchangers. An application for FortisBC incentives for upgrading the heat exchangers in the Science, Arts and Gym buildings has been prepared and it is estimated that upgrading these heat exchangers could result in 400 GJ of gas savings per year. The schedule of these heat exchanger upgrades is dependent on available funding.

4.6. MDES/LDES Heat Exchanger

Completion of a MDES pipeline between the Central Heating Plant (CHP) and the Geothermal building is planned for spring 2018. One benefit of this pipeline is that the MDES system could be used to provide heat to the LDES system. This mode of operation provides two main benefits:

- Boiler B-2 in the Geothermal plant is a low-efficiency boiler and is in poor condition. A LDES/MDES connection would replace it.
- Boilers in the CHP can be made to operate more efficiently with a source of colder return water which can be provided using the MDES/LDES heat exchanger.

An energy study of this system was completed for a Fortis incentive application and indicated expected savings of over 500GJ of gas consumption. The design of this system is expected to be completed in January 2018. Construction of this project will be based on available funding.

4.7. Teaching and Learning Centre

The energy team has been involved as a part of the design process for the proposed new Teaching and Learning Centre. The energy team's goal is to ensure that the design and construction of the facility is consistent with the campus Whole Systems Plan in terms of energy targets and sources. The energy team has also been pursuing energy efficiency incentives from FortisBC. At the present time it is unclear what incentives will be available.

4.8. Peak Load Management

Electricity costs for the campus are a mixture of charges for energy consumption (kWhr) and peak demand (kW). As such, reducing electrical demand at peak times can have significant impacts on campus energy costs. This project is currently being

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pursued as a partnership between SES consultants and Siemens to develop and implement peak load management algorithms. The project is currently underway, with initial control sequences in place. These sequences will be modified as experience indicates is appropriate. Further peak load management strategies are planned as further resources are available and will be adjusted based on experience gained from implementation of the initial measures.

4.9. Recommissioning HVAC Systems

The energy team's BMS Technician has been systematically recommissioning campus HVAC systems. Active and passive methods were used during recommissioning of systems in the UNC, CCS and EME buildings to ensure uninterrupted user comfort. Lists of failed equipment and recommended adjustments to setpoints and schedules have been generated and remedial actions have either been completed or logged for action. Some specific examples of significant gains are:

- EME HRV-4 is now scheduled to run during normal building operating hours; estimated annual savings of 260,000kWh and 212GJ of Gas.
- UNC AHU-4 rescheduled to run only during utilized hours; estimated annual savings of 29,700 kWh and 27GJ of Gas.

4.9.1. Carbon Dioxide Sensor Calibration

Carbon dioxide sensors are used in various locations across campus to ensure occupants receive good indoor air quality (IAQ) by increasing ventilation rates on demand. Numerous carbon dioxide sensors across campus are slated for recalibration or replacement. Recalibration of sensors that have drifted high and are bringing in more outdoor air than necessary will result in substantial energy savings.

4.9.2. Cold Weather Operation

During this past quarter, periods of weather that were significantly colder than recent experience occurred. During these periods, significant increases in gas consumption were noted. Upon further investigation, it was found that during cold weather, buildings were being put into occupied mode overnight in order to avoid the need for a morning warmup period during which the heating load might be greater than the available heating capacity. This procedure resulted in increased outdoor air rates during cold weather and correspondingly increased energy consumption. Control sequence upgrades are being investigated to avoid this issue and will be completed as time and funding allow.

4.9.3. Heating Water Temperature Optimization

The heating supply water setpoints in the Science, Library, Admin and Arts buildings have been programmed to be variable in order to increase the operating efficiency of the buidings' heatpumps.

4.10. HVAC System Efficiency Maintenance

A HVAC efficiency technician has been added to the energy team. Over the last several month's, the technician has been cleaning heat exhangers and

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other campus HVAC equipment. Improved operational efficiencies are expected as the technician has found and cleaned significantly fouled equipment.

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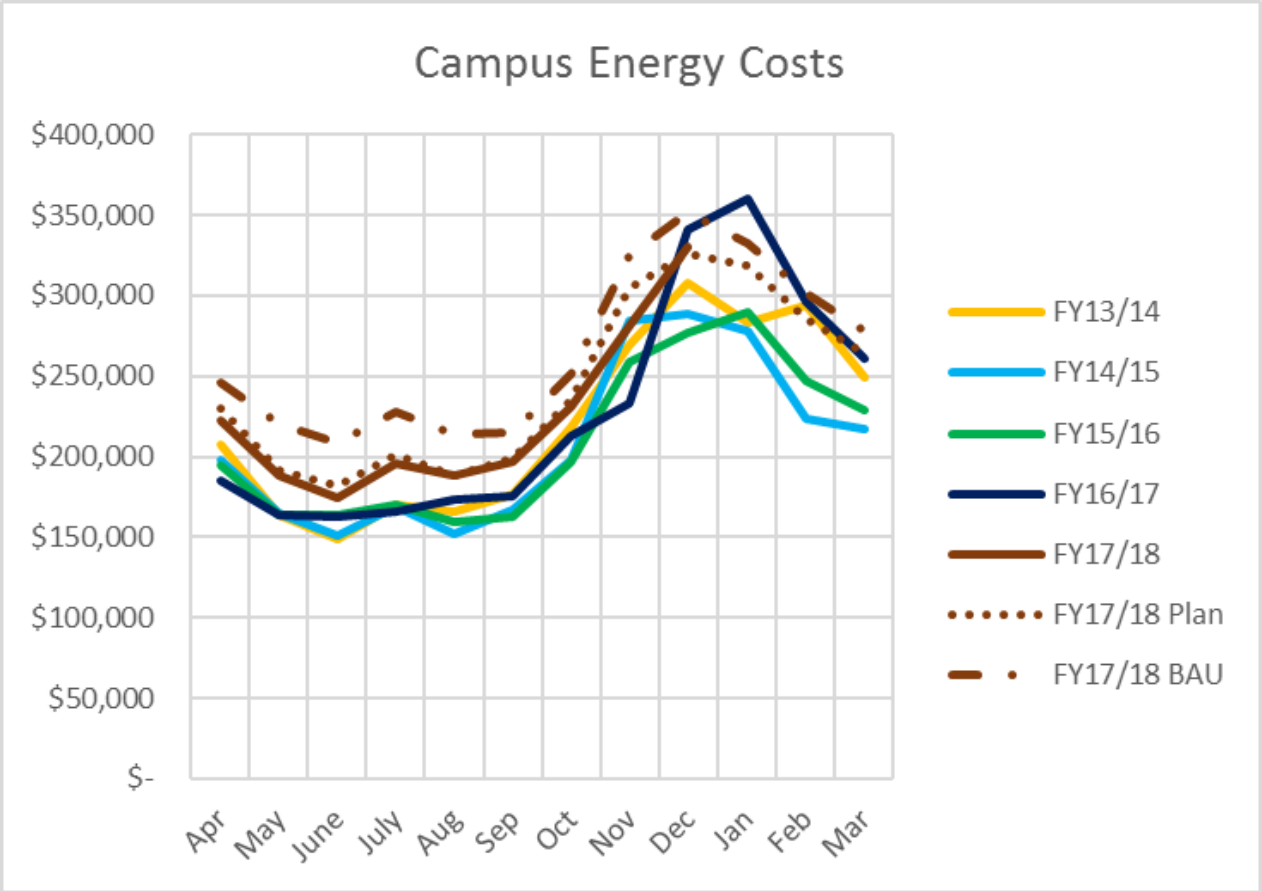
5. Energy Performance Graphs



Note: The FY17/18 BAU data represents what FY17-18 energy costs would be if campus gas and electrical EUIs remained at FY13-14 levels.

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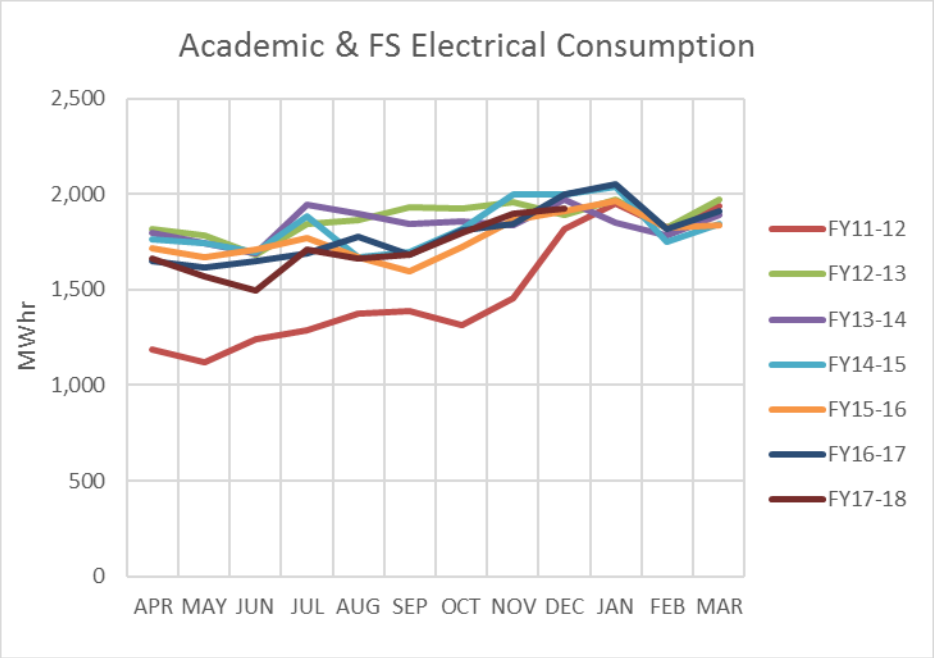

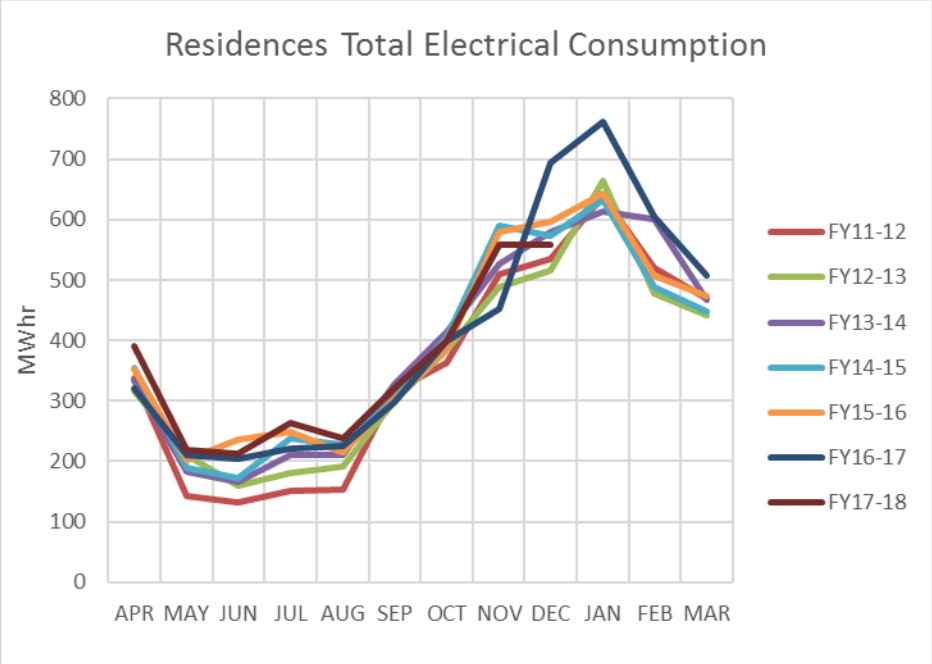

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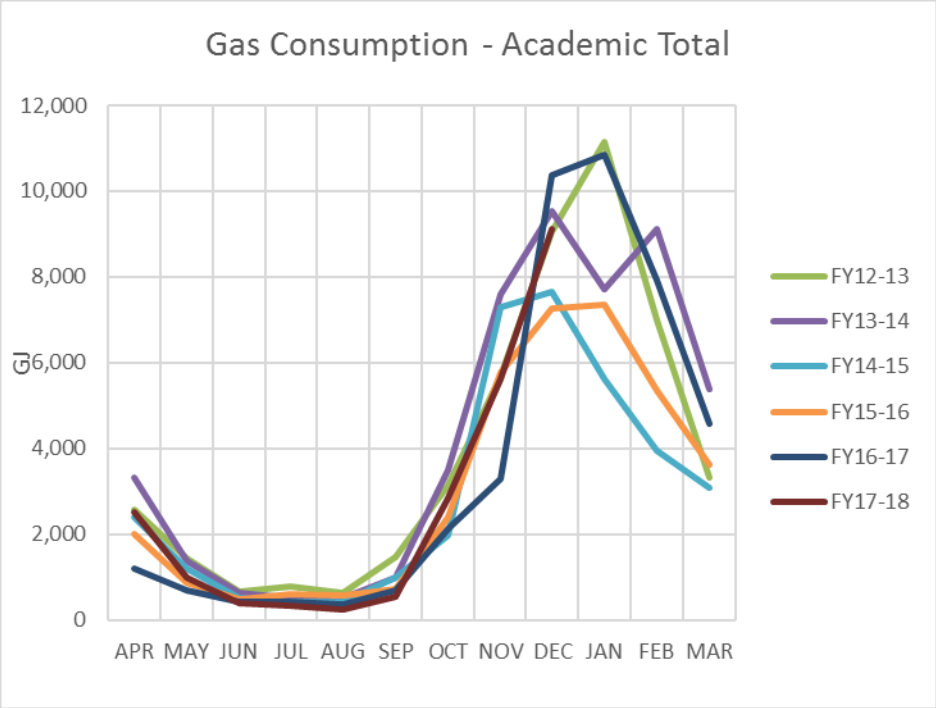

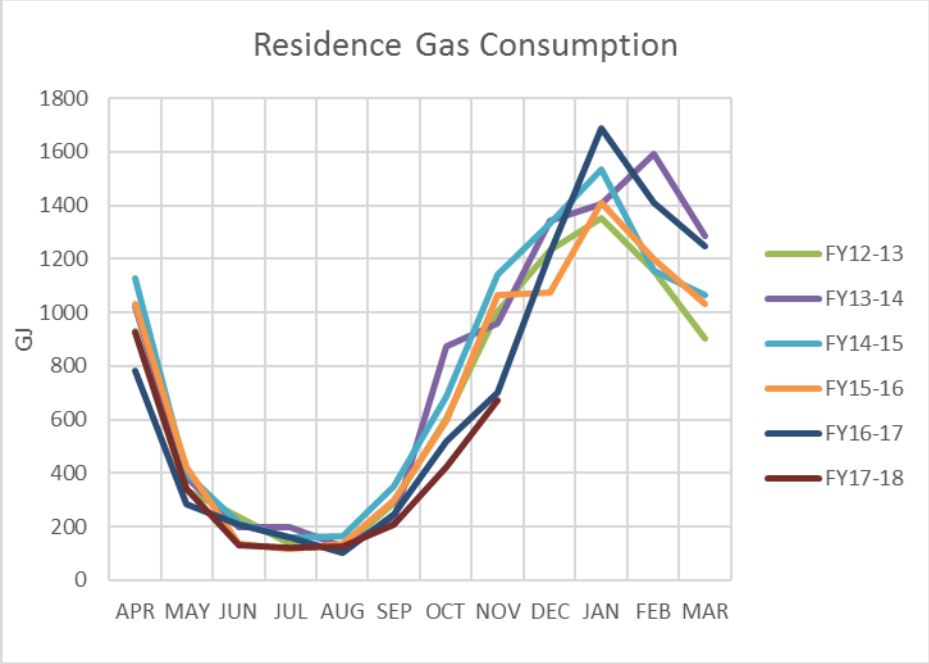

Note: Gas consumption values shown are for gas consumed within the building. Indirect gas consumption via MDES & LDES is not included in the gas plots.

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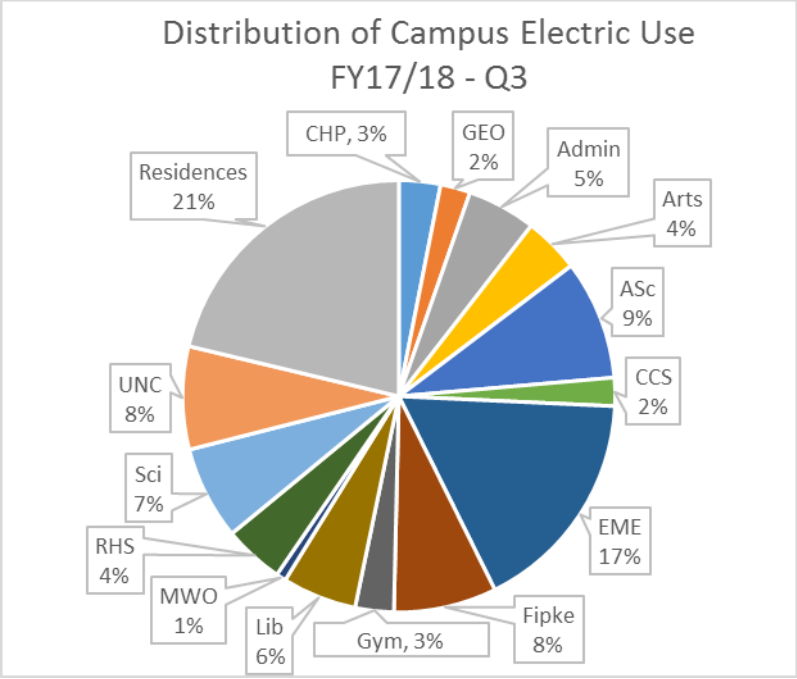

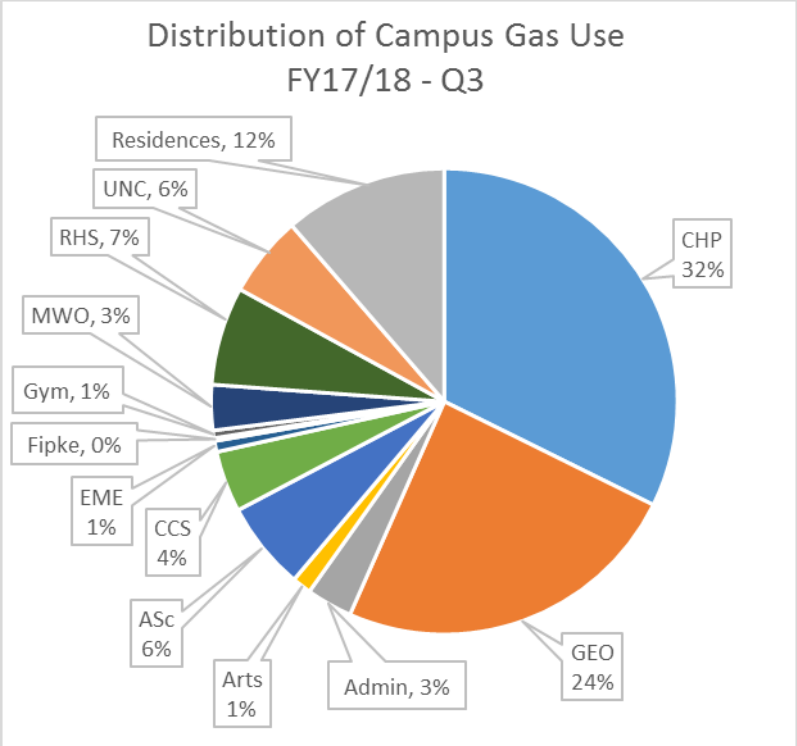

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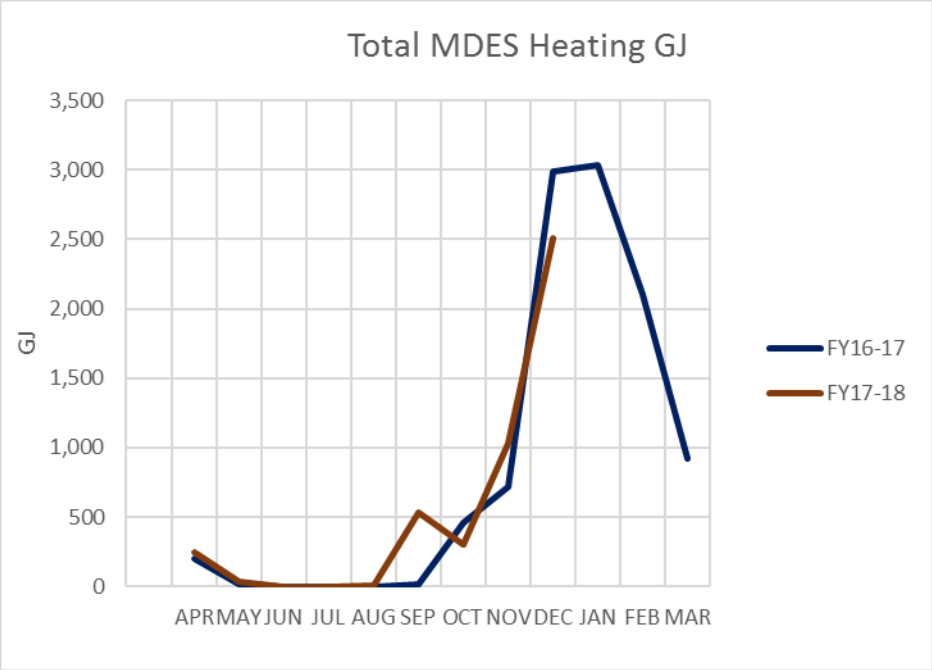
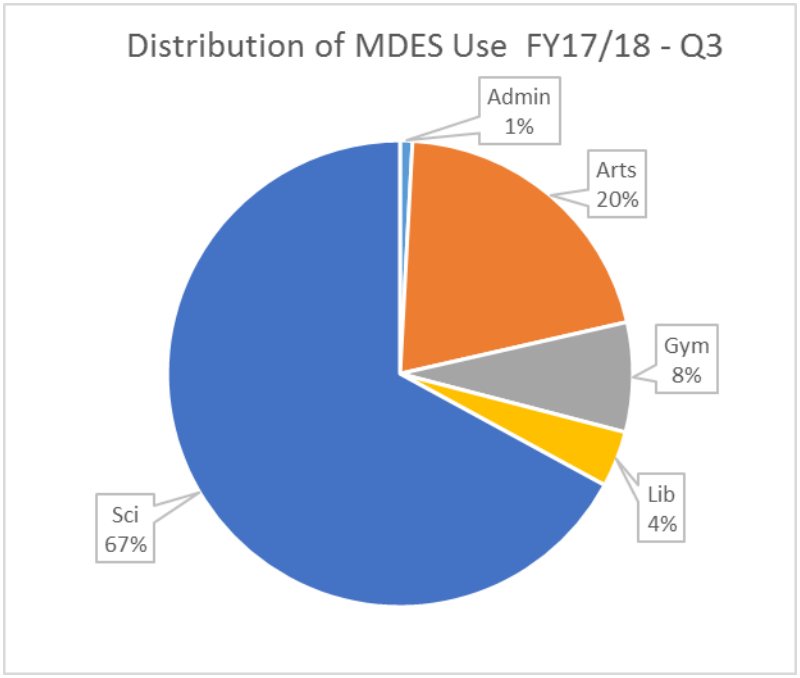


Values shown are for thermal GJ delivered to the building by the MDES.



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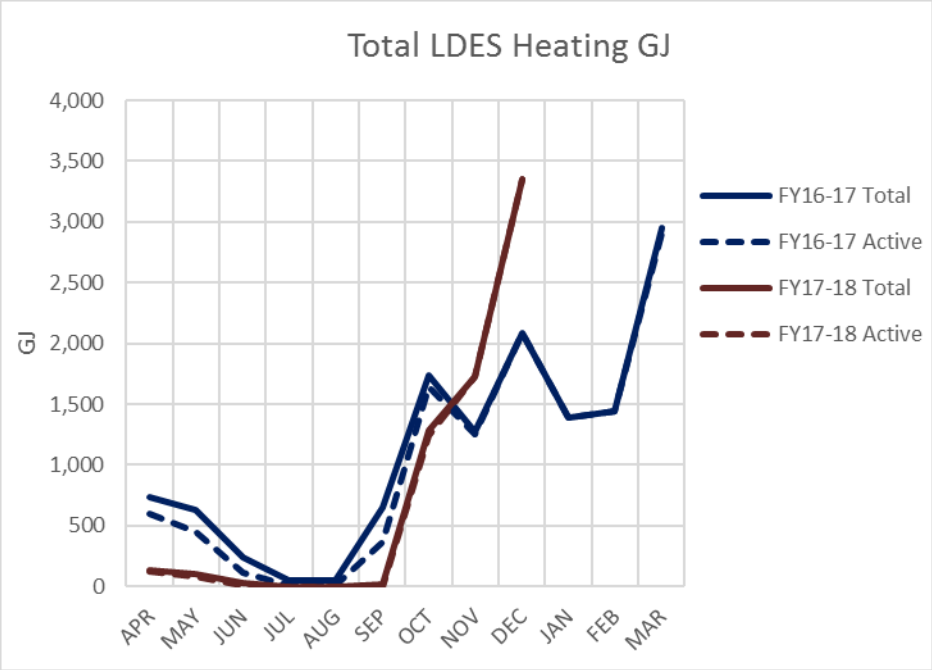

Note: 'Total' value indicates thermal GJ delivered to building by the LDES, 'Active' value indicates thermal GJ delivered to building by the LDES when the loop is in a net heating mode.