2017 – 2018

Campus Annual Energy Use Report

Contents

Year at a Glance

Utility Costs:

	FY 2015-2016	FY 2016-2017	FY 2017-2018
Total Utility Costs	**$1,747,496**	**$1,798,437**	**$1,852,145**
Electricity Costs	$1,106,076	$1,122,669	$1,101,852
Fuel Costs	$383,770	$411,953	$475,121
Water & Sewer Costs	$257,650	$263,815	$275,172

Weather Normalized Energy Consumption:

	FY 2015-2016	FY 2016-2017	FY 2017-2018
Total Energy KBTUs	**141,943,232**	**141,305,489**	**133,922,563**
Fuel KBTUs	100,624,460	101,217,429	95,624,036
Electricity KBTUs	41,318,772	40,088,061	38,298,527

Water Consumption:

	FY 2015-2016	FY 2016-2017	FY 2017-2018
Total Water CCF	40,046	39,947	38,522

Performance vs. 3% Annual Energy Reduction Goal:

	FY 2014-2015	FY 2016-2017	FY 2017-2018
Energy Utilization Index (KBTUs/GSF/Year)	101.2 Base Year	99.8 (1.7% Cum. Reduction)	94.6 (6.8% Cum. Reduction)

Executive Summary

This report summarizes the energy and water consumed on Macalester College's campus during FY 2017 – 2018. The College utilizes electricity, natural gas, and #2 fuel oil as its primary sources of energy, with each energy source providing different amounts of energy per unit but at significantly different costs. For example, the electricity consumed in FY 2017-2018 comprised only 28% of the total energy consumed across the campus but accounted for 59% of the College's total expenditures for energy.

Starting with FY 2015-2016, Macalester College set a goal of 3% per year reduction in its total energy consumption for the following five-year period. FY 2014-2015 was selected as the baseline period for measuring progress toward the consumption targets. In order to achieve these goals, Macalester has increased its ongoing energy conservation efforts via participation in Xcel Energy's Commercial Energy Efficiency Program, implementation of lighting efficiency and control projects, and the deployment of other new technologies. An energy manager position was also created within the Facilities Services department to assist with the implementation of energy conservation projects and to track the College's progress toward achieving the campus' energy reduction targets.

Progress towards achieving the energy reduction targets is monitored by tracking all of the energy sources used on campus each year and calculating the College's energy utilization index (EUI) value. The EUI value is presented in KBTUs/GSF/Year and is a commonly used value for energy use evaluations because it accommodates the use of weather normalization and also compensates for changes in the area of the campus over time.

Since the 2014-2015 base year Macalester College has reduced the EUI value for its campus from 101.2 KBTU/GSF/Year to 94.6 KBTU/GSF/Year, which equates to a cumulative reduction of 6.8% vs. the desired 9% cumulative reduction target for that period. Although the reduction in electrical consumption in FY 2017-2018 was 11.2% less than the consumption

in the base year, the reduction in the weather-normalized amount of fuel consumed during the year was just 5%, resulting in a combined EUI value that did not meet the three-year goal.

Macalester College's total expenditures for electricity and fuel in FY 2017-2018 were $1,576,973, which was approximately 3% higher than the previous fiscal year's total energy costs. Compared to FY 2016-2017, the cost paid per Kilowatt hour (kWH) for electricity rose by 2% and the cost per million BTU (MMBtu) of fuel rose by 5%.
In addition to the expense for fuel & electricity, in FY 2017-2018 Macalester consumed 38,522 CCF of water, at a cost of approximately $275,172. (1 CCF = 100 Cubic Feet = 748 Gallons.)

Fuel Consumption & Cost

Campus Fuel Consumption

Approximately 98,000,000 KBTUs of natural gas and #2 fuel oil were consumed on campus during FY 2017-2018. 83% of the fuel energy was used by the central heating plant and the balance was used in buildings and houses on campus for space heating, domestic water heating, and cooking applications. The Art building's kilns and forges are also a significant consumer of natural gas on campus. In addition to natural gas, approximately 19,000 gallons of #2 fuel oil were used by the central heating plant during FY 2017-2018 due to curtailments of natural gas that were requested by Xcel Energy. (Macalester benefits from a lower price for natural gas year-round due to an agreement with Xcel Energy that, at their request, the College will use fuel oil in the boiler plant instead of natural gas during periods of extremely cold weather.)

The actual amount of fuel consumed in any given year can be adjusted via weather normalization calculations to allow comparison with the fuel consumption in other years. After weather normalization of the fuel consumed by the College's central boiler plant, the total fuel consumption for the campus in FY 2017-2018 was approximately 96,000,000 KBTUs, which was 5% less than the weather normalized fuel use in the FY 2014-2015 base year. The quantity of natural gas used for heating the houses on campus has not been weather normalized because it accounts for a relatively small percentage of the campus' overall fuel consumption.

Campus Fuel Cost

The total cost for the natural gas and #2 fuel oil consumed on Macalester College's campus in FY 2017-2018 was $475,121. This expenditure was 15% higher than the $411,953 spent on natural gas in FY 2016-2017, when no fuel oil was used. The increase in cost compared to the previous year is disproportionally higher than the increase in the amount of fuel consumed due to the higher cost per MMBtu for fuel oil compared to natural gas.

Electricity Consumption & Cost

Campus Electrical Consumption and Demand

Macalester College's actual electrical consumption in FY 2017-2018 was approximately 11,320,000 KWH. 87% of Macalester's total electric energy was used for the electrical loads that are served by the campus main electric meter, such as building lighting, distributed mechanical equipment, and plug loads. The College's chiller plant used about 8% of the campus' total electric energy, and the remaining 5% was used in the various campus buildings and houses that have individual electric meters.

Like the boiler plant, the amount of electricity used in Macalester College's central cooling plant is highly affected by seasonal weather variations and is presented in a weather normalized basis to provide a standardized method of measuring year-to-year progress toward the College's energy reduction goals.

Several components of the campus' electrical energy use have not been weather normalized for this report. The amount of electricity used for lighting, distributed mechanical equipment, and building plug loads has not been normalized because it varies more with changes in the number of people on campus over the academic year than due to seasonal weather variations.

After adjusting the amount of electricity consumed by the chiller plant for seasonal weather variations, the total amount of electricity consumed on campus during FY 2017-2018 was approximately 11,225,000 KWH. The weather normalized total for FY 2017-2018 was 11% less than the 2014-2015 baseline period, out-performing the 9% cumulative energy reduction goal for the year.

In addition to the amount of electricity consumed on campus (measured in kilowatt-hours or KWH), the College is also charged for the rate at which it uses electricity (demand, which is measured in kilowatts or KW). Macalester was billed for 27,334 KW in FY 2017-2018, which was 5% less than the amount used in the 2014-2015 base year.

Campus Electrical Cost

Although the amount of electricity consumed on campus over the past three years has decreased each year, the amount spent has remained nearly constant due to increases in electric utility rates. Electrical demand charges for FY 2017-2018 comprised 28% ($310,000) of the campus' total electrical costs of $1,102,000.

Electrical consumption and demand charges for Macalester College's chiller plant in FY 2017-2018 were $155,000. Although the chiller plant's electrical consumption in FY 2017-2018 amounted to only 8% of the electricity consumed on campus it accounted for more than 20% of the campus' total electrical demand charges.

Water Consumption & Cost

During FY 2017-2018 Macalester College consumed approximately 36,500 CCF of water, or approximately 27,300,000 gallons (1 CCF = 100 Cubic Feet = 748 gallons). This quantity of water would fill 27 swimming pools that are each 267 feet long by 50 feet wide to a depth of 10 feet.

Depending on the amount of rain received during the growing season, approximately 20-25% of the water consumed on campus is used for irrigation of the campus vegetation and in the central chiller plant's cooling towers. After deducting the non-potable consumption, the amount of water consumed for drinking, cooking, and bathing has remained fairly constant at about 30,000,000 CCF for the past three years.

Macalester College's total water & sewer charges in FY 2017-2018 were approximately $275,000, which represents 15% of the College's total expenditures for electricity, fuel, and water/sewer charges. The rate at which the College is charged for water & sewer costs has increased by 20% since the 2014-2015 base year.

Energy Conservation Projects & Reporting Initiatives

2017-2018 Energy Conservation Projects & Initiatives:

Lighting Upgrade Projects: The original fluorescent & incandescent lighting fixtures in the buildings listed below were retrofitted to LED lighting technology:

- Campus Center – Building-wide retrofit
- Olin-Rice – Building-wide retrofit
- Wallace Library – Building-wide retrofit
- Ordway Research Station – Building-wide retrofit
- Doty Hall – Installation of bi-level LED fixtures with integrated occupancy sensors in residence hall corridors
- Residence Hall Restrooms & Corridors – Began campus-wide installation of LED retrofit kits in compact fluorescent recessed fixtures

Building Automation System Upgrades: The legacy building automation systems that control the HVAC equipment in the buildings listed below were upgraded to newer direct digital control equipment, which will provide the ability to implement energy conservation strategies that were not possible with the original equipment.

- Olin-Rice – The controls for all of the building's major HVAC equipment (air handling units, heating & cooling pumps, etc.) were upgraded. In addition, a multi-year project to replace the obsolete laboratory ventilation controls was started.
- George Draper Dayton Hall – Building wide controls retrofit
- Neill Hall – Retrofit of the controls for all of the building's major HVAC equipment

Electrical/Mechanical Projects: Upgrades were made to electrical and mechanical systems:

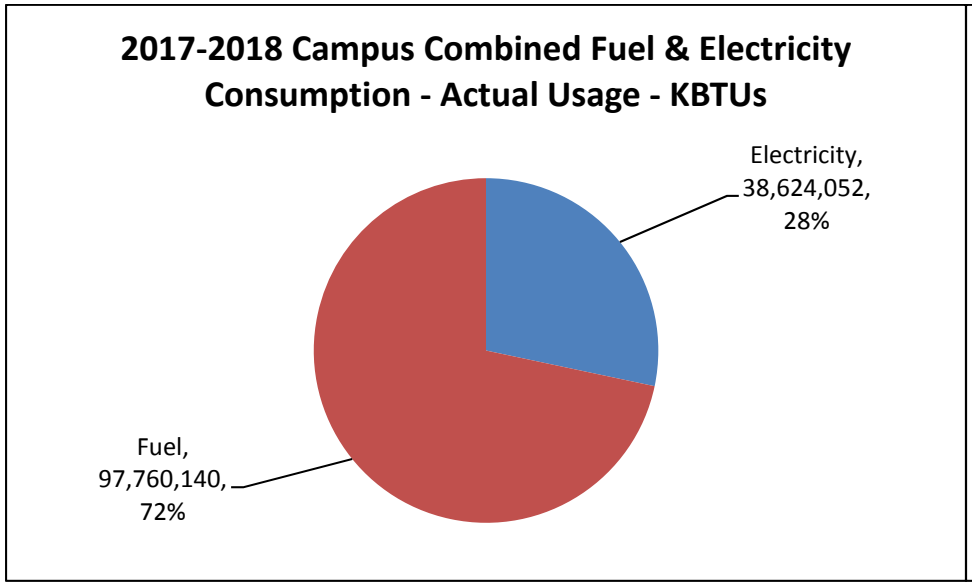
- George Draper Dayton Hall – Installation of equipment and controls that will allow improved control of the heat trace tapes used to clear ice and snow from the building roof and gutters

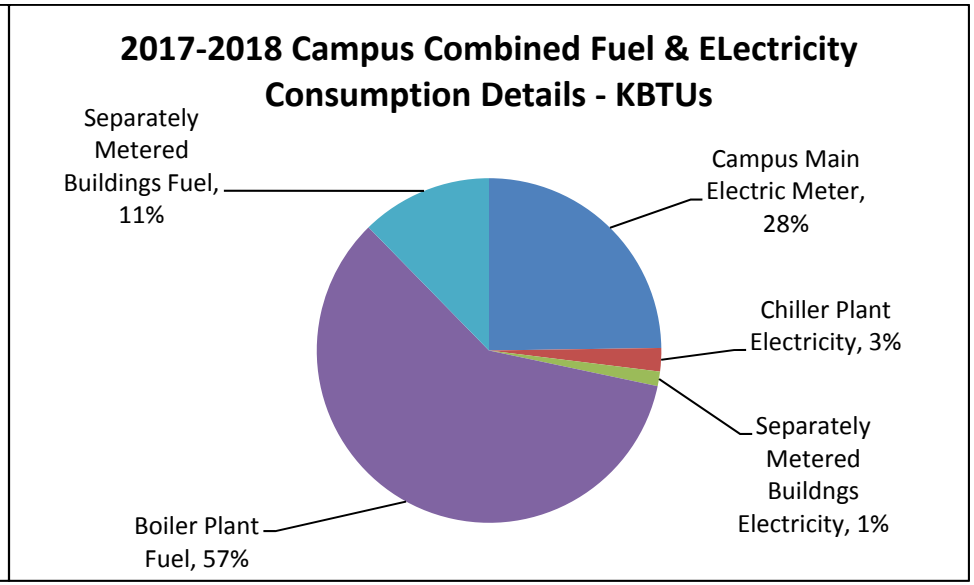
Sub-metering and Energy Reporting Initiatives:

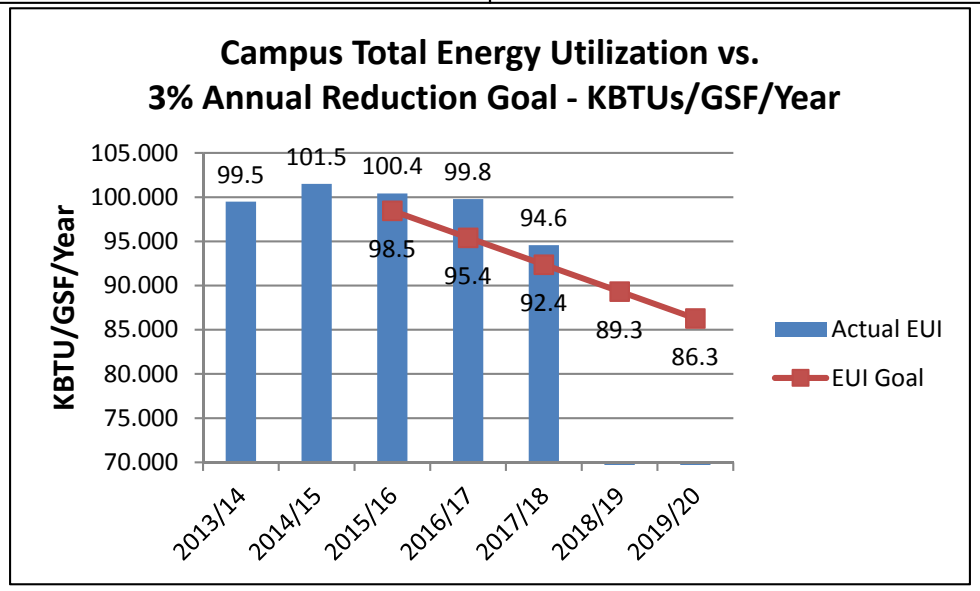
- Submeters – Continued installation of additional submeters for monitoring electricity and steam condensate
- kWh360 – Continued Implementation of cloud-based utility bill tracking software application
- GRITS – Continued Implementation of cloud-based energy conservation project tracking software application
- Sustainability Dashboard – Partnered with staff & students from Macalester's Sustainability office to develop an energy reporting dashboard that displays the consumption data reported by the electric and condensate submeters installed in campus buildings.
- Energy Star Portfolio Manager – Continued use of the Energy Star Portfolio Manager energy tracking software for verification of the energy usage and savings calculations performed by Macalester staff.

Charts & Graphs

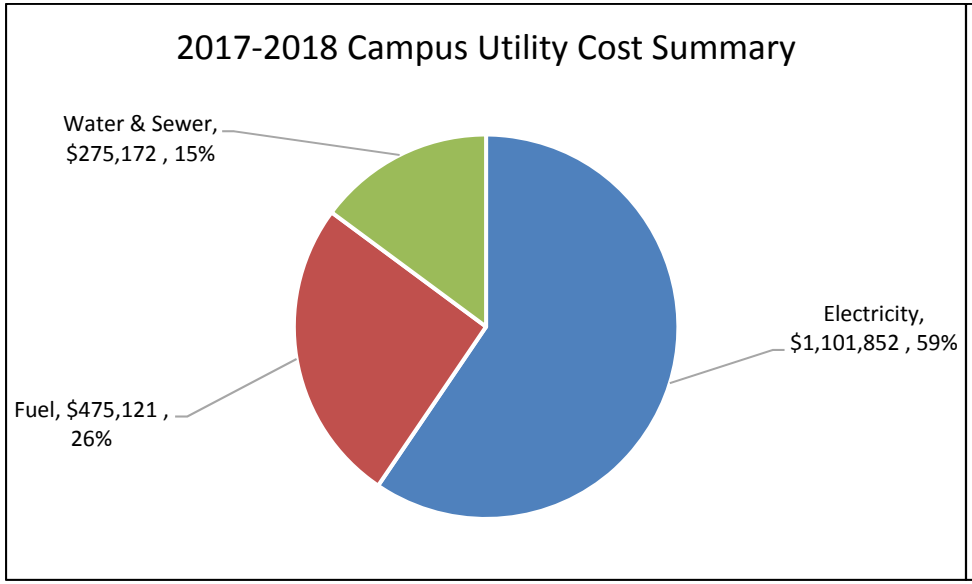
Campus Total Energy Consumption

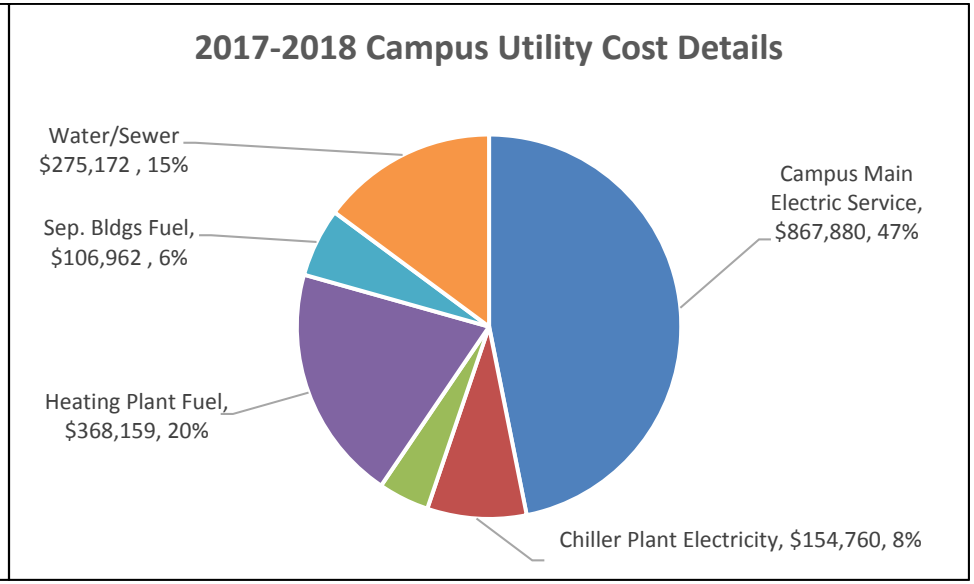


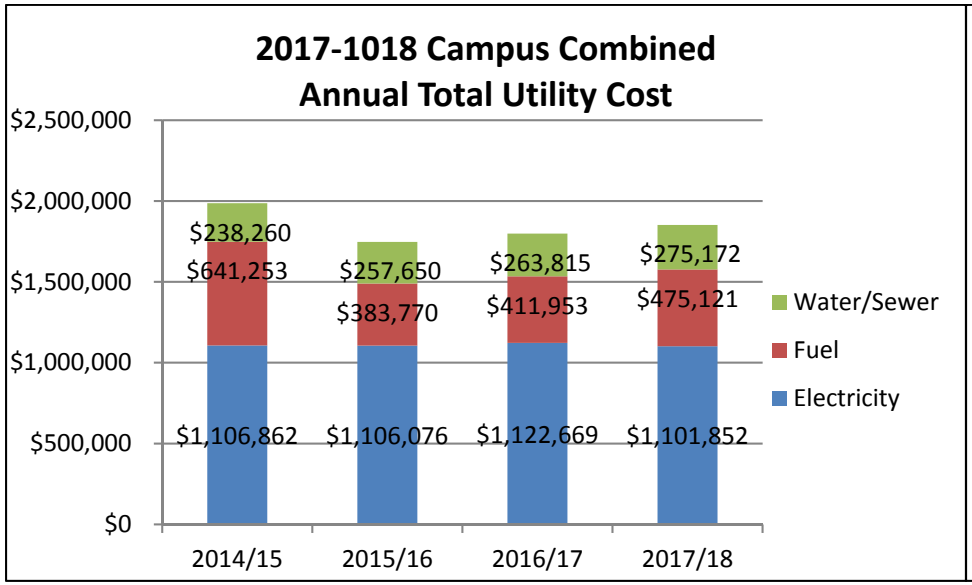


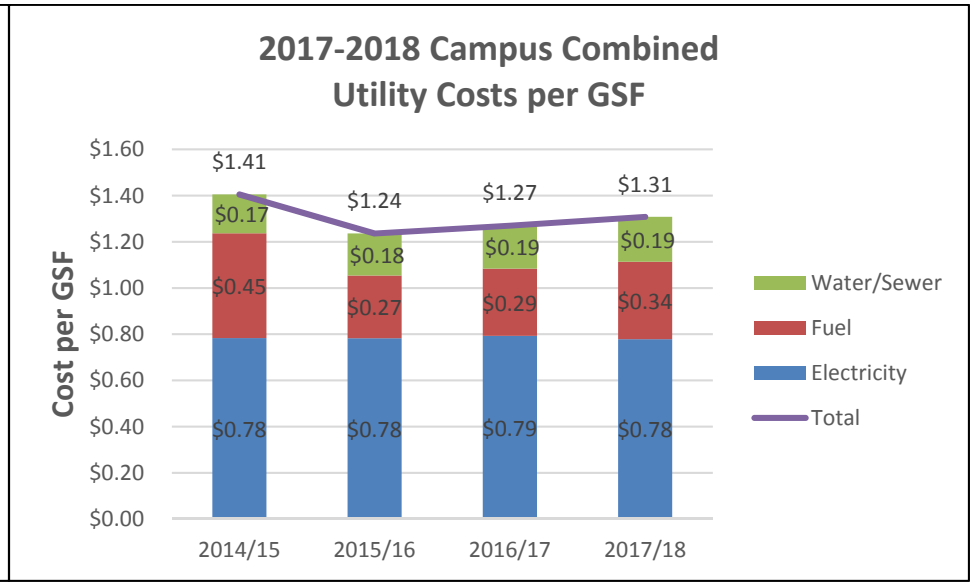


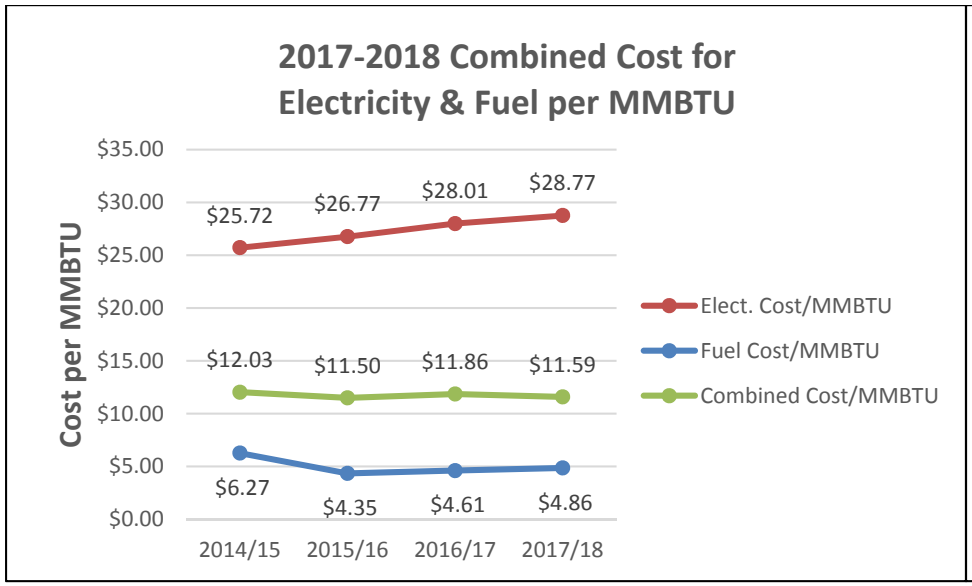
Campus Total Utility Costs

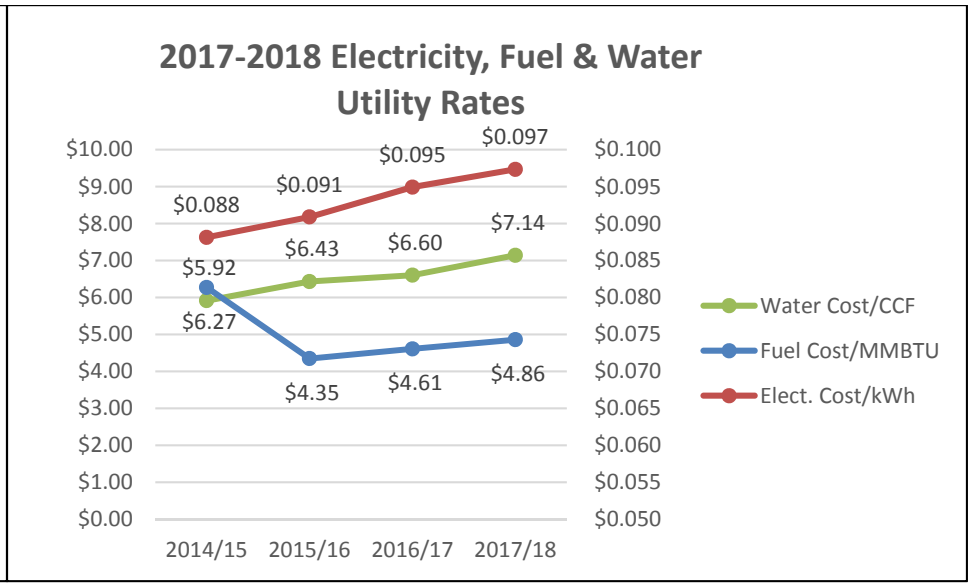




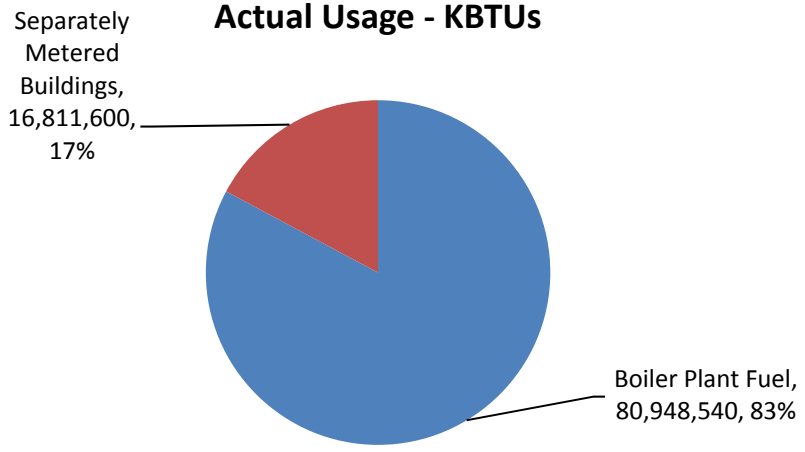


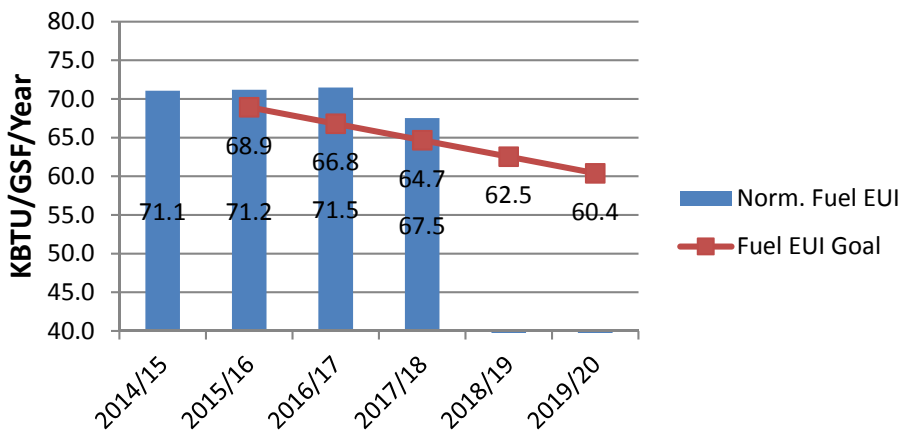


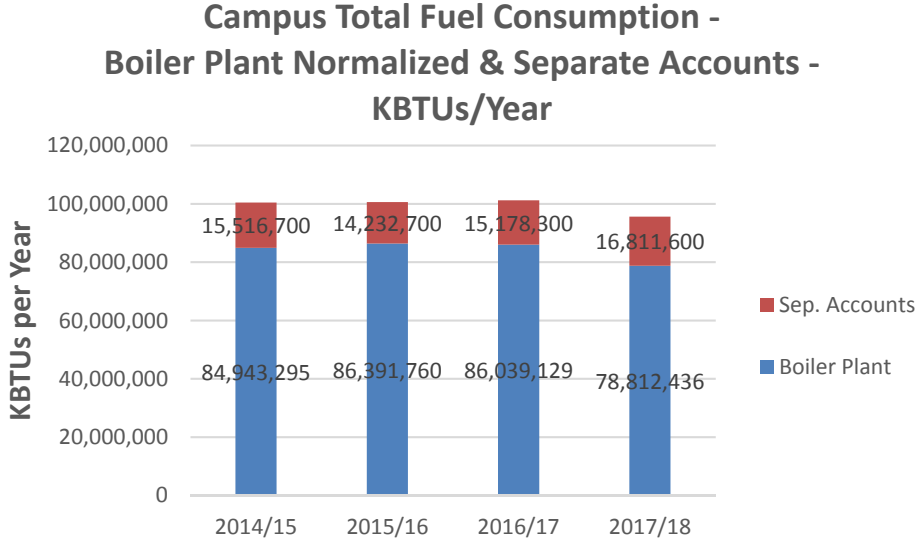

2017-2018 Combined Cost for Electricity & Fuel per MMBTU
Cost per MMBTU
$35.00
$30.00
$25.00
$20.00
$15.00
$10.00
$5.00
$0.00
$25.72
$26.77
$28.01
$28.77
$12.03
$11.50
$11.86
$11.59
$6.27
$4.35
$4.61
$4.86
2014/15
2015/16
2016/17
2017/18
Elect. Cost/MMBTU
Fuel Cost/MMBTU
Combined Cost/MMBTU

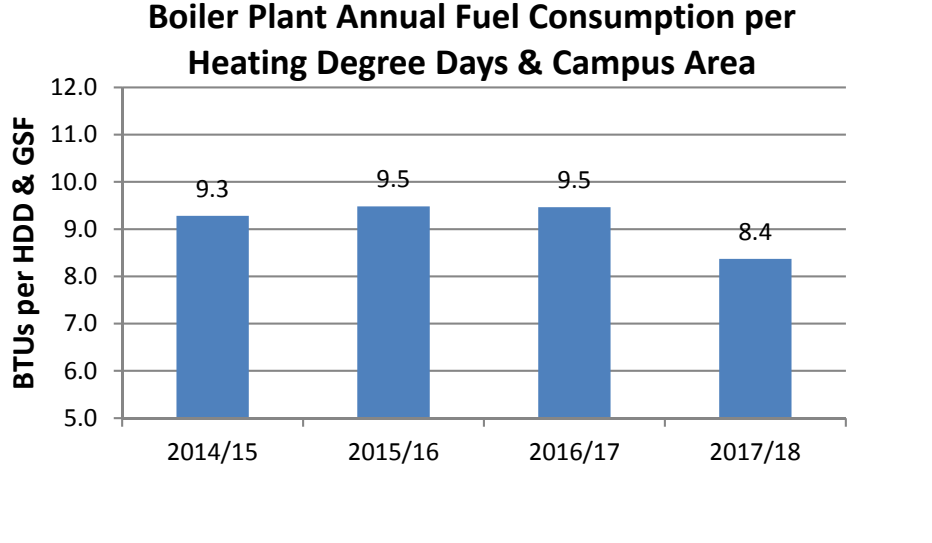

2017-2018 Electricity, Fuel & Water Utility Rates
$10.00
$9.00
$8.00
$7.00
$6.00
$5.00
$4.00
$3.00
$2.00
$1.00
$0.00
$0.100
$0.095
$0.090
$0.085
$0.080
$0.075
$0.070
$0.065
$0.060
$0.055
$0.050
$0.088
$0.091
$0.095
$0.097
$5.92
$6.43
$6.60
$7.14
$6.27
$4.35
$4.61
$4.86
2014/15
2015/16
2016/17
2017/18
Water Cost/CCF
Fuel Cost/MMBTU
Elect. Cost/kWh

Campus Fuel Consumption

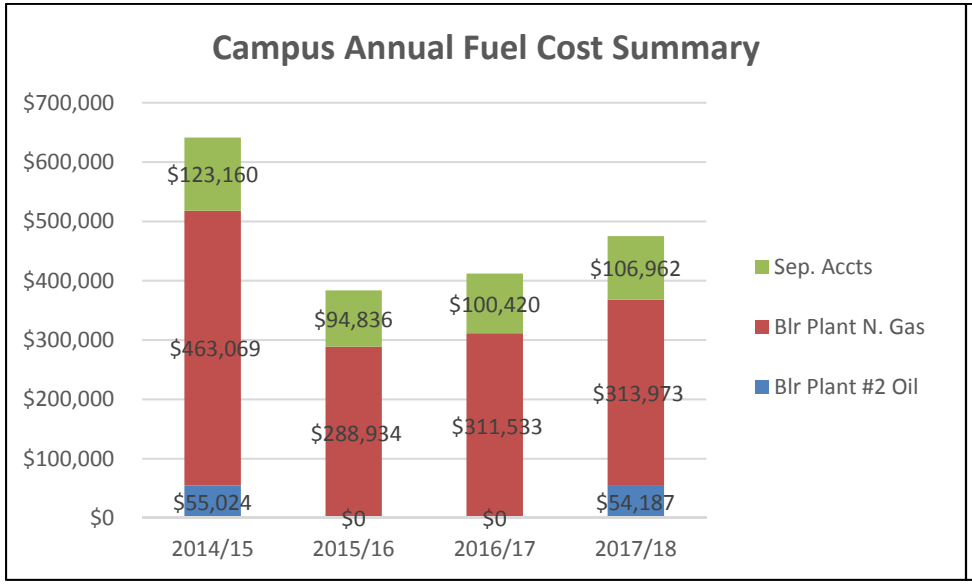


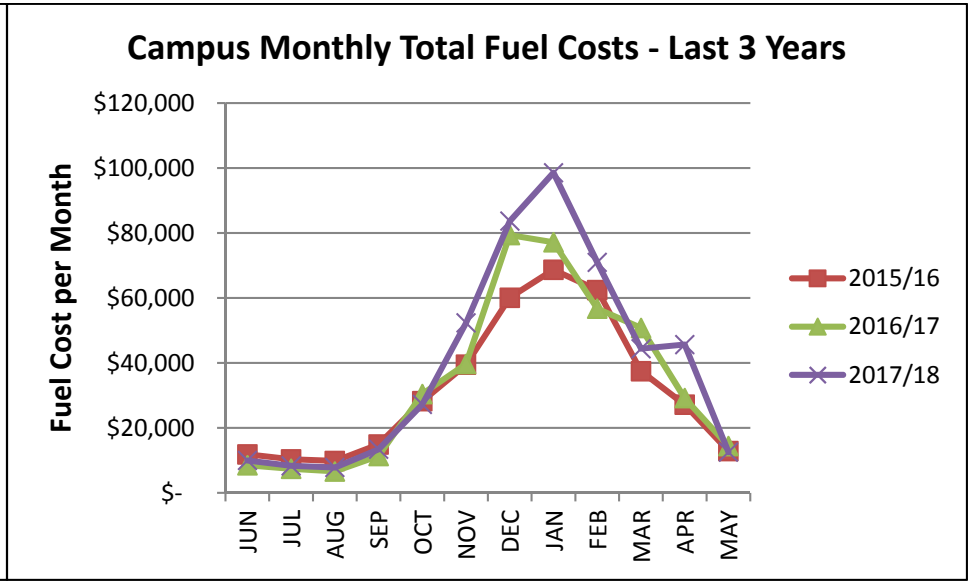


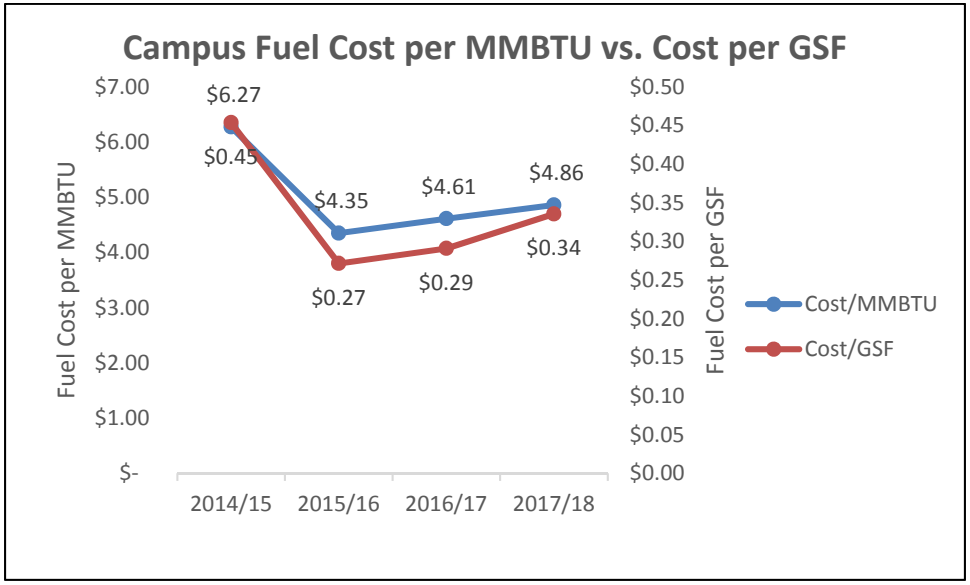




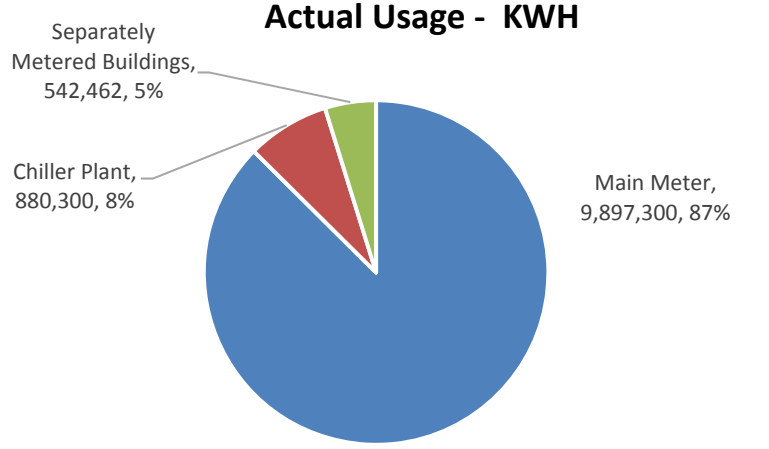
Campus Fuel Cost

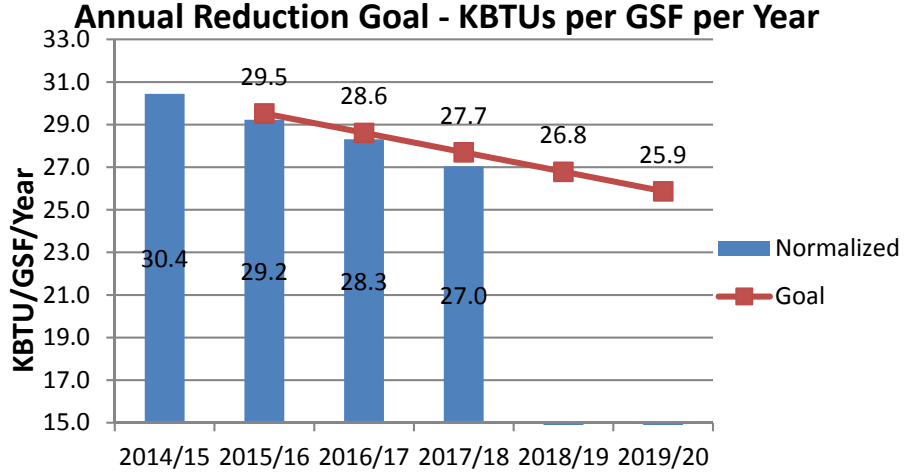


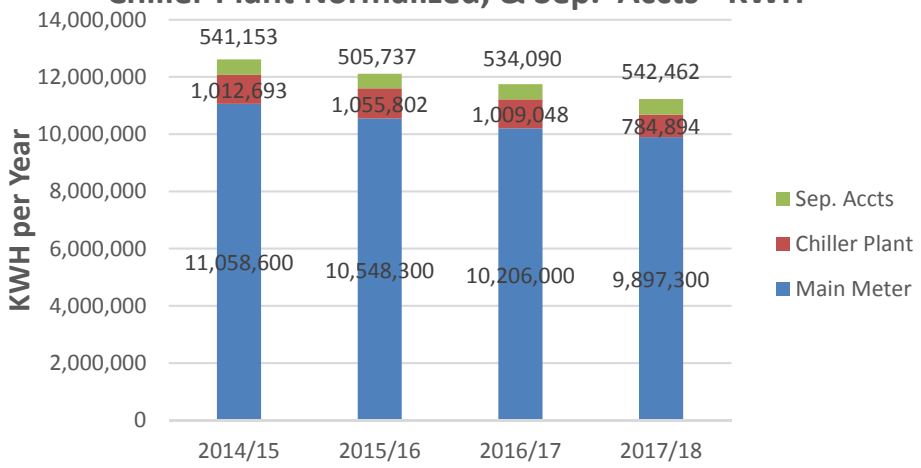


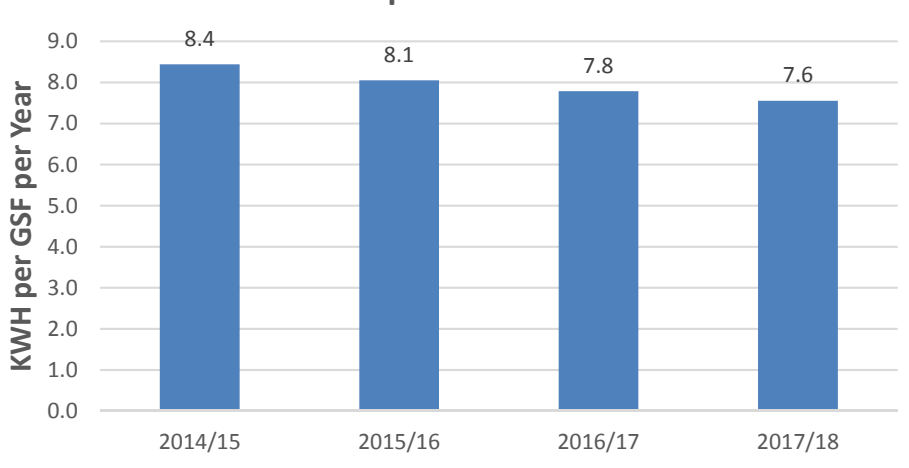


Campus Electrical Consumption

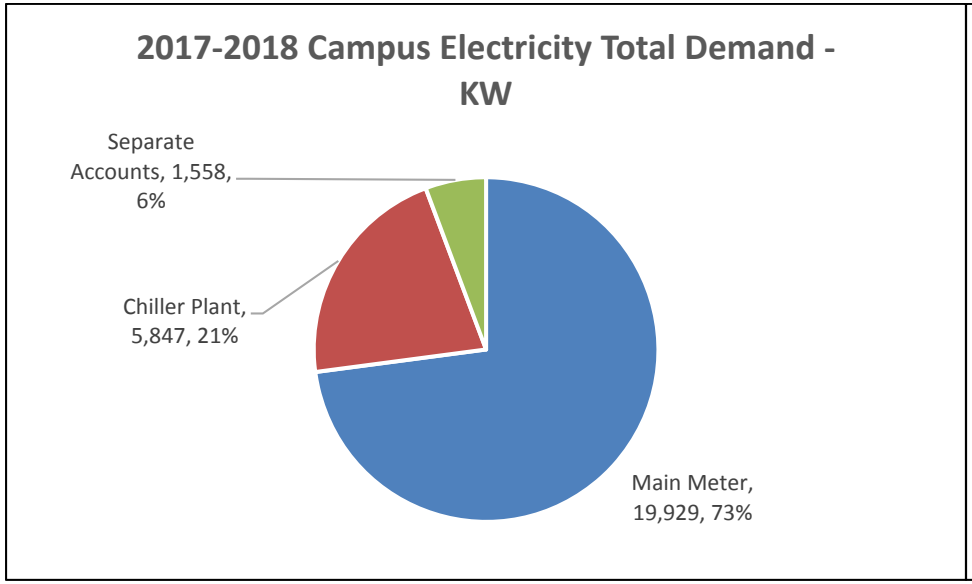


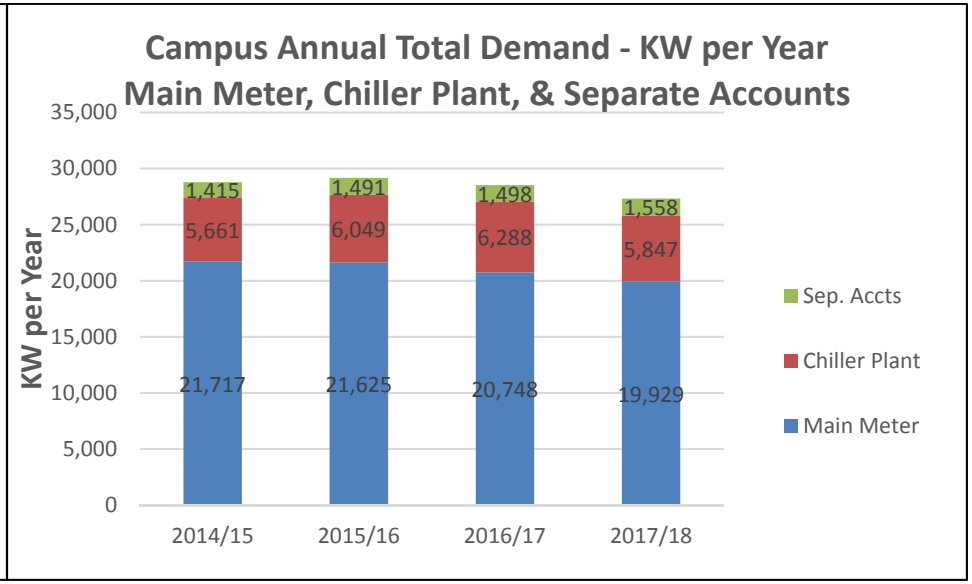


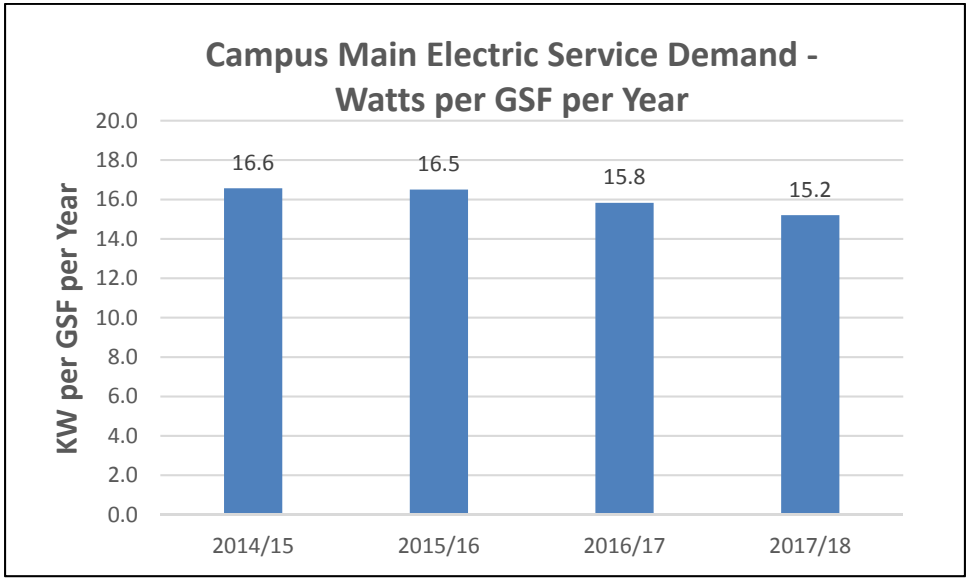




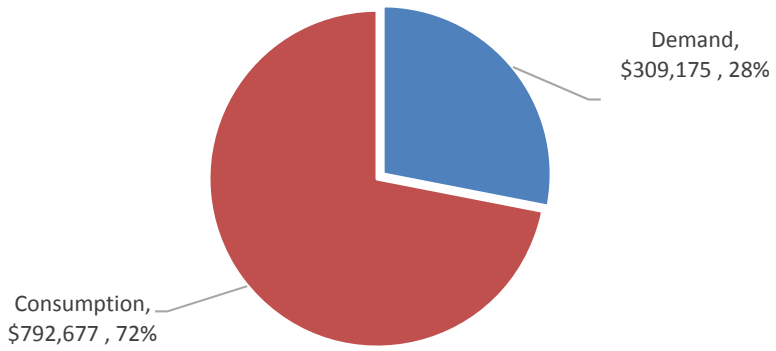
Campus Electrical Demand

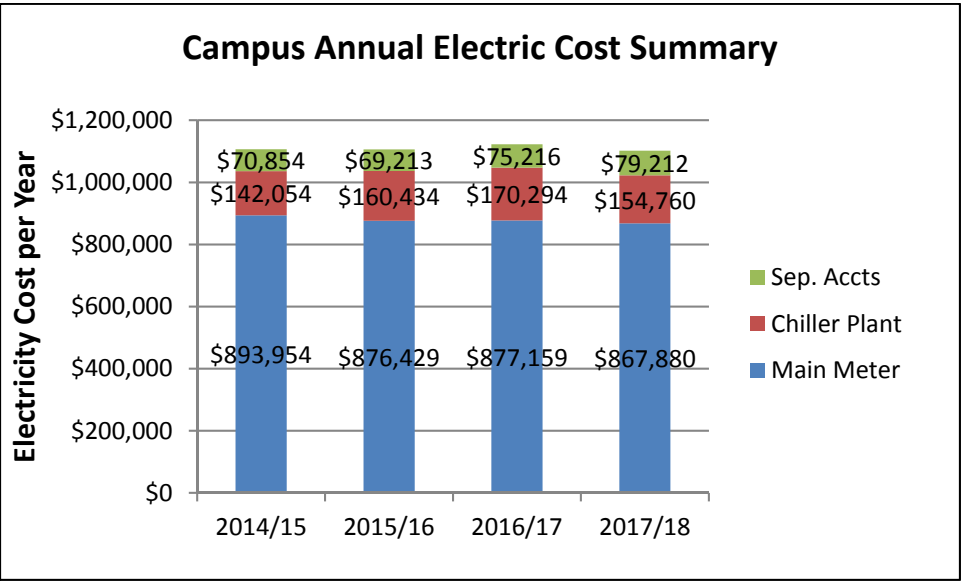


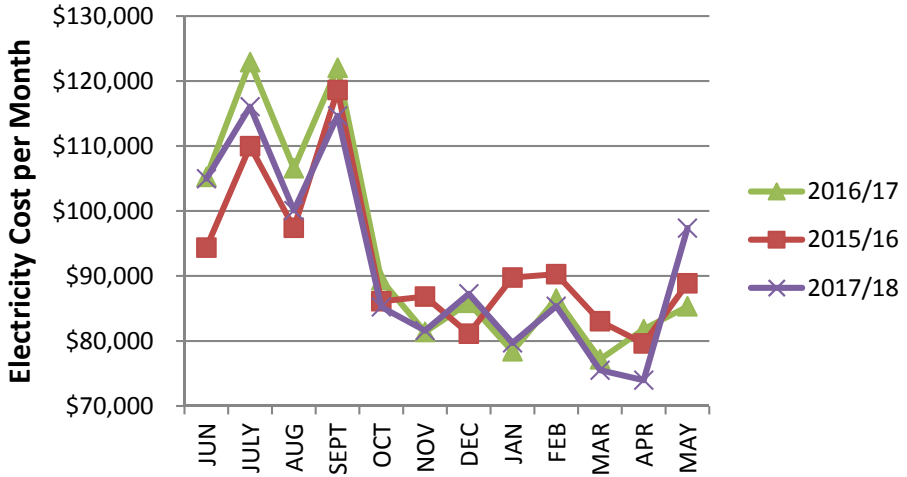


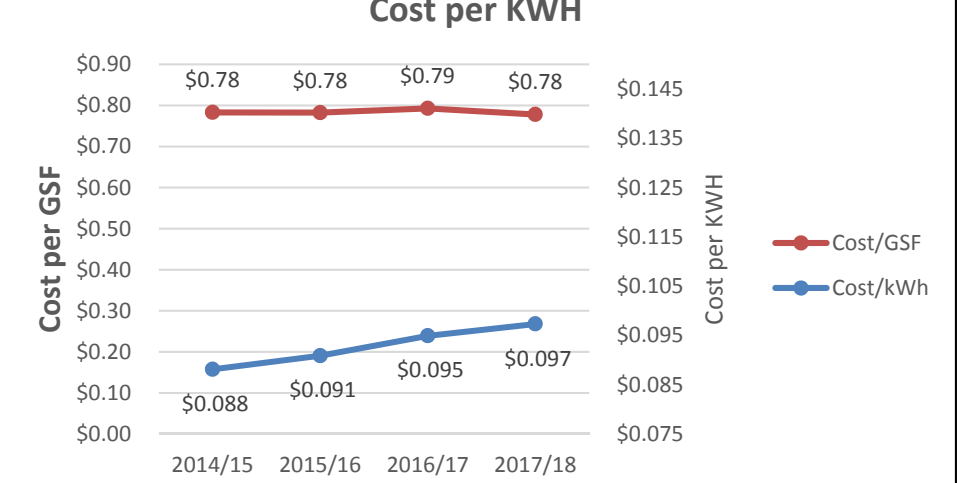


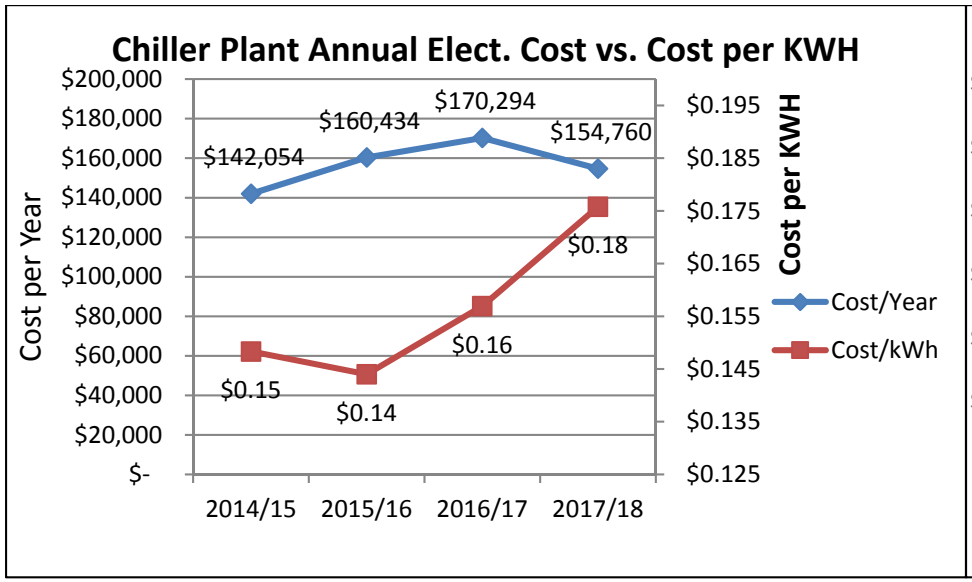
Campus Electrical Costs

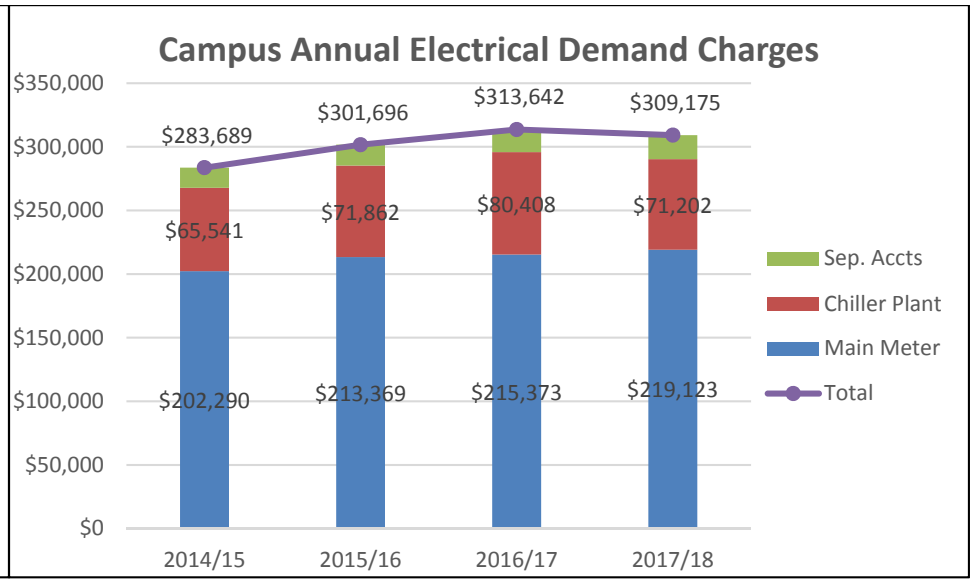




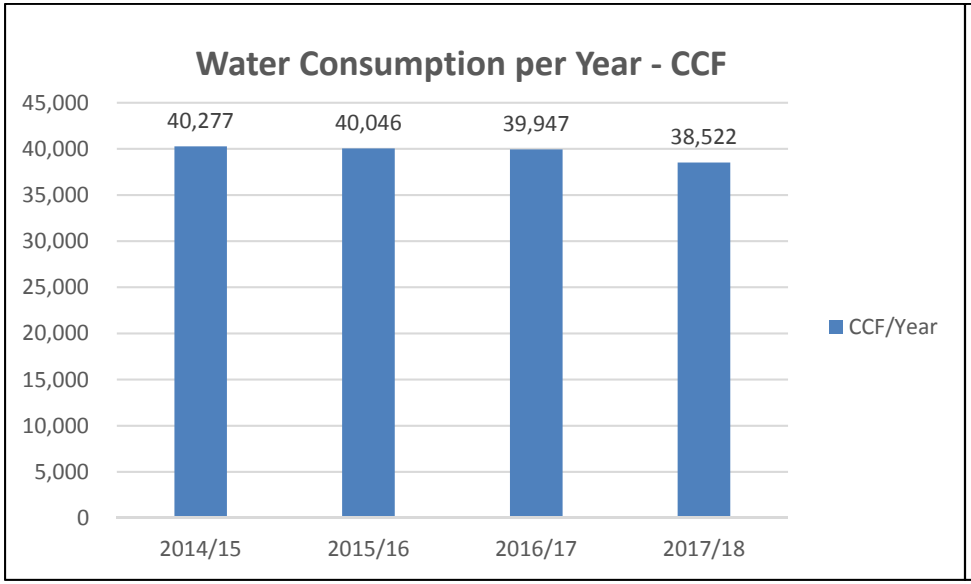


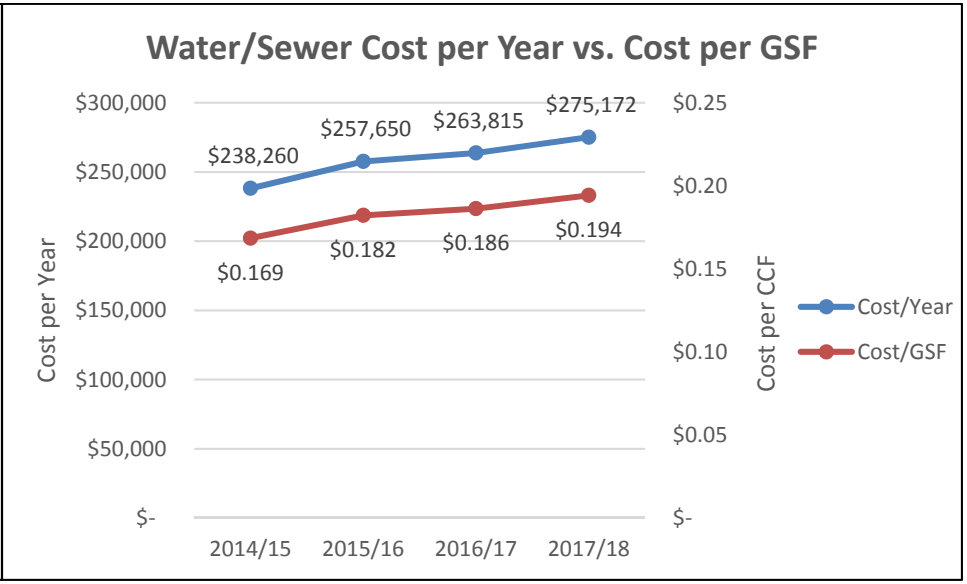



Chiller Plant Annual Elect. Cost vs. Cost per KWH
Cost per Year
Cost per KWH
$200,000
$180,000
$160,000
$140,000
$120,000
$100,000
$80,000
$60,000
$40,000
$20,000
$-
$0.195
$0.185
$0.175
$0.165
$0.155
$0.145
$0.135
$0.125
$142,054
$160,434
$170,294
$154,760
$0.15
$0.14
$0.16
$0.18
2014/15
2015/16
2016/17
2017/18
Cost/Year
Cost/kWh

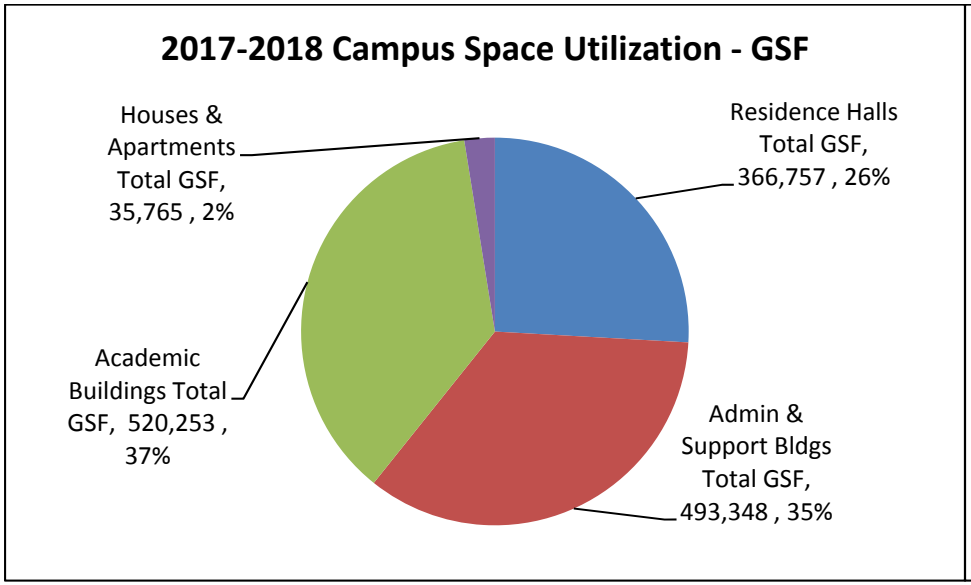

Campus Annual Electrical Demand Charges
$350,000
$300,000
$250,000
$200,000
$150,000
$100,000
$50,000
$0
$283,689
$301,696
$313,642
$309,175
$65,541
$71,862
$80,408
$71,202
$202,290
$213,369
$215,373
$219,123
2014/15
2015/16
2016/17
2017/18
Sep. Accts
Chiller Plant
Main Meter
Total

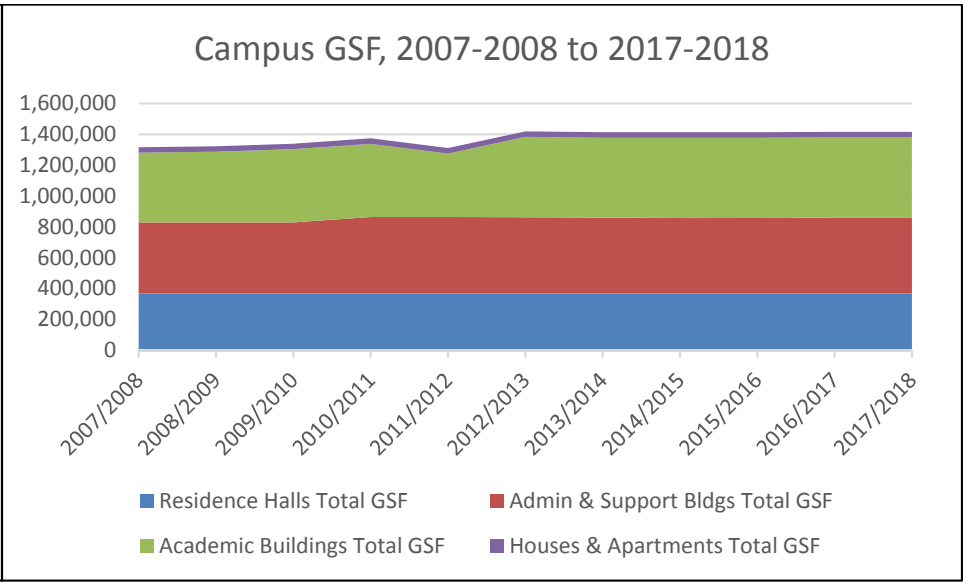
Water Consumption & Cost Data





Campus Square Footage Information





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