COLORADO COLLEGE

2016 ENERGY REPORT

Mark J. Ferguson, P.E.
Campus Operations & Plant Manager

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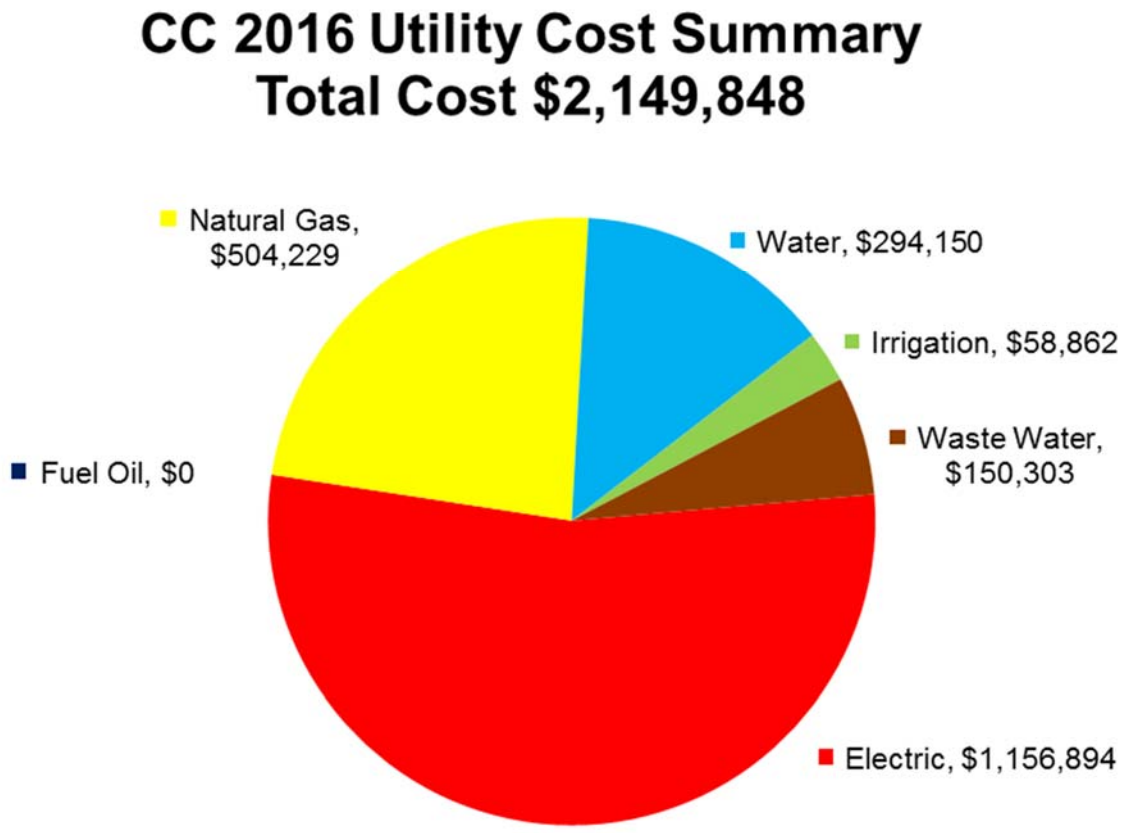
Executive Summary

The Facilities Services Department at Colorado College (CC) is committed to taking action to meet the College's carbon goals. The stewardship of resources and utilities management is one of the primary strategic initiatives of the Technical Services Department. In FY 16, CC experienced a 3.1% decrease in energy consumption. Since 2008 campus energy intensity per square foot has decreased 25.8%. Cumulative avoided costs for utilities are estimated to be nearly $4.0M since the 2008 baseline year. Notable accomplishments for 2016 are:

- Cost – The College experience cost reductions in each utility area. A significant portion of the annual utilities budget was returned to support other mission essential services and functions.
- Renewable Energy Production - This year 7.5% of the electricity used on campus was produced from solar. 3.9% of the electricity consumed was produced from on campus renewable energy platforms.
- Recognitions – In 2015, Colorado College achieved a gold rating from the Association for the Advancement of Sustainability in Higher Education (ASHEE) Sustainability Tracking, Assessment, and Ratings System (STARS).

- 2016 Sustainability Projects – This year CC completed a large quantity of projects with the purpose of supporting campus energy efficiency goals. Completed projects include the conversion to LED lighting in many facilities on campus, student installation of PV solar at the Baca Campus, and sustainable design for the Tutt Library Project. Repairs were made to the pool and central cooling plant reducing water consumption by approximately 4.1M gallons for 2016. More detail on this year's completed projects begins on page 13 of this report.
- 2017 Sustainability Projects – We have an exciting list of projects on the horizon for fiscal year 17. Projects include sustainable design for the East Campus Housing Project, continued LED lighting retrofits, and continued energy efficiency improvements at the Central Plant. More detail on these projects begins on page 16 of this report.

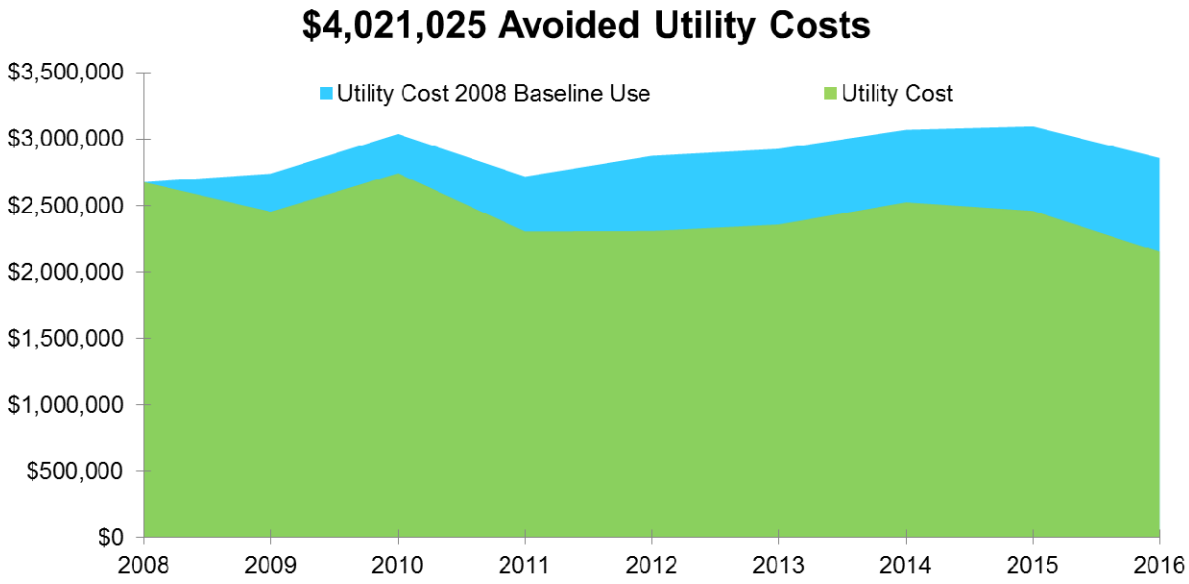
Utilities Overview



- **For the 2016 academic year, Colorado College's main campus energy related characteristics were:**
  - Approximately 2,034,520 square feet (SF) of space
  - Approximately 95 acres of land
  - 162 Buildings
- **For the 2016 academic year, Colorado College's main campus energy performance statistics were:**
  - Energy use averaged **78.1 kBtu per square foot** (SF)
    - 3.1% decrease over previous year
    - 7.5% of electricity from renewable sources
  - Energy costs averaged **$0.82 per SF**
    - 11.9% decrease over previous year
    - $4.0M in avoided costs since 2008
  - $MTCO_2$ emissions from energy use averaged **0.0090 $MTCO_2e$ per SF**
    - 3.6% increase over previous year
    - 25.8% decrease since 2008

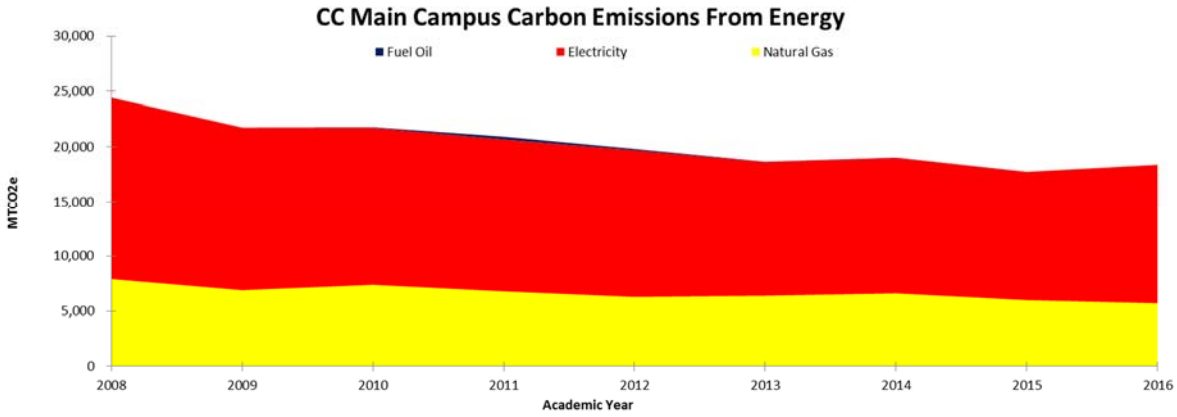
Avoided Cost

The cumulative campus utility cost avoidance compared to the campus baseline of 2008 is estimated at $4.0M. The avoided cost for the 2016 academic year is estimated at $706K. These numbers reflect combined utility savings, which include avoided electricity, natural gas, water, and waste water costs. Below is a graphical representation of overall avoided utility costs (area in blue).



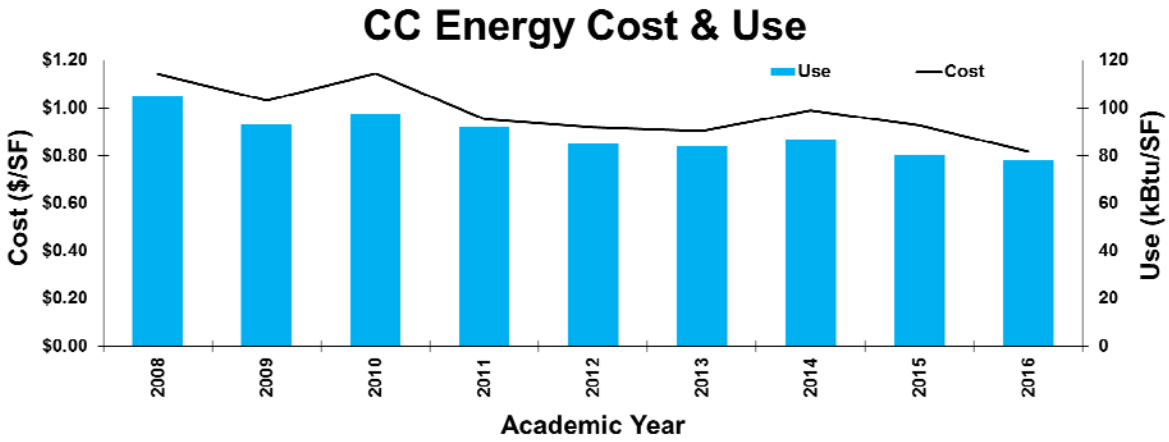
Carbon Footprint

Colorado College's commitment to become carbon neutral stems from the College's signing of the Presidents' Climate Commitment in early 2009. The College's carbon footprint, in 2008, from energy use is estimated at 24,437 metric tons of CO_2 ($MTCO_2$). Since 2008, Colorado College has made steady progress toward its carbon neutrality goal. For 2016, the College's carbon emissions from energy use are estimated at 18,382 $MTCO_2$ for a reduction of 24.8% compared to the 2008 baseline. This year carbon emissions increased due to the expiration of the College's wind purchasing agreement. These measurements assume a consistent Colorado Springs Utilities (CSU) fuel mix and include emissions as charted below:



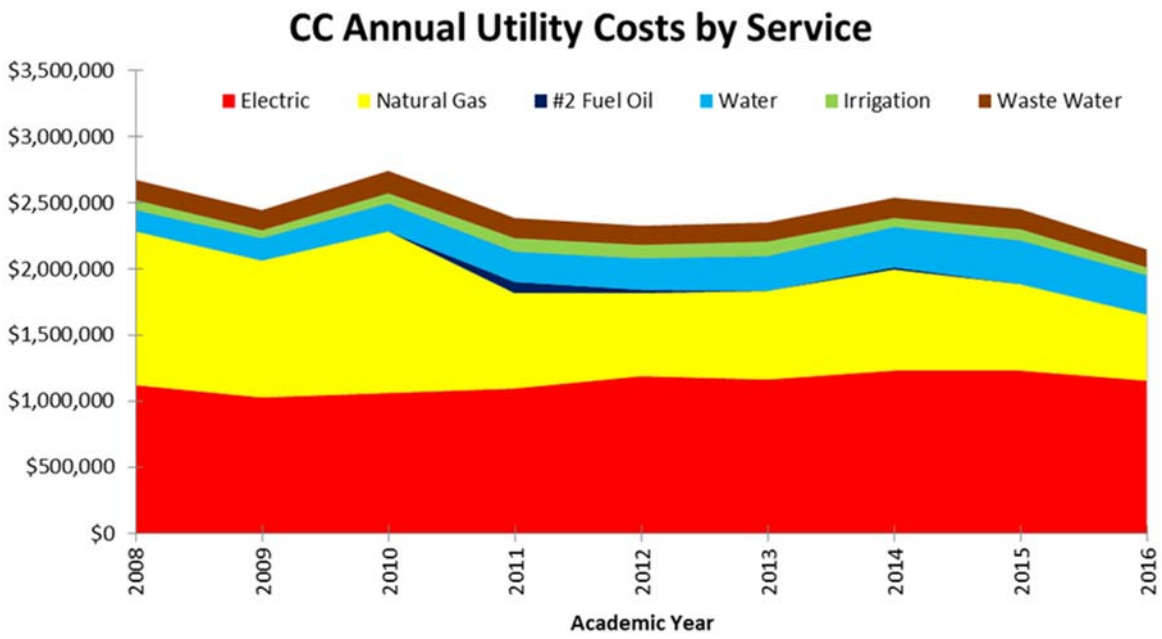
Benchmarking Colorado College

Colorado College has closely monitored and documented overall campus energy and cost intensity since 2008. For reference, the Association of Physical Plant Administrators (APPA), who represents the largest international association of educational institutions and their facilities departments, list the 2014 average energy intensity for higher education facilities at 130 kBtu/SF/Yr. APPA lists the average utilities cost per square foot at $2.46 / SF. The chart illustrates that CC's performance far exceeds both figures with an average energy intensity of 78 kBtu/SF/Yr and energy cost of $0.82/SF. The chart confirms CC's sustained decline in both energy cost and consumption (use).

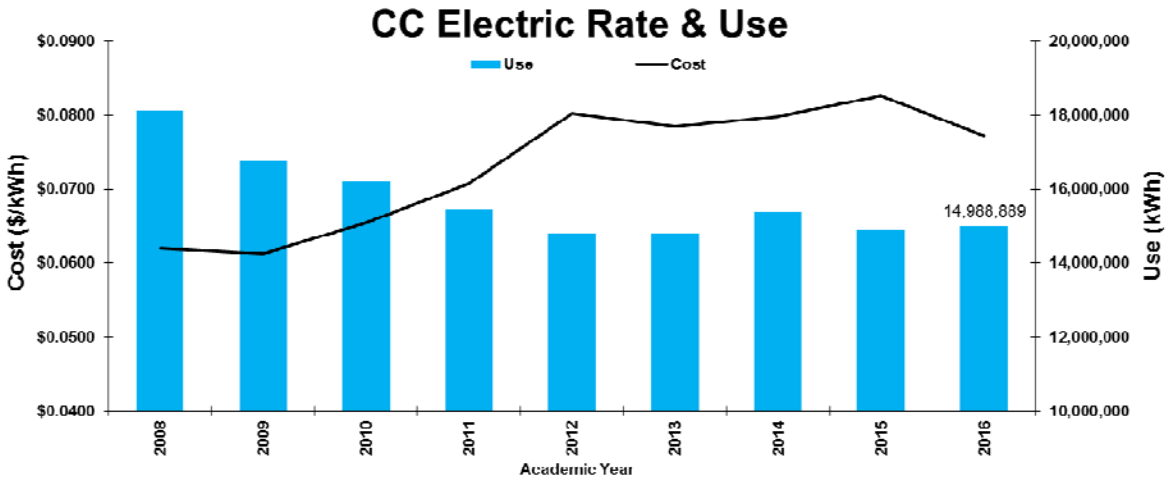


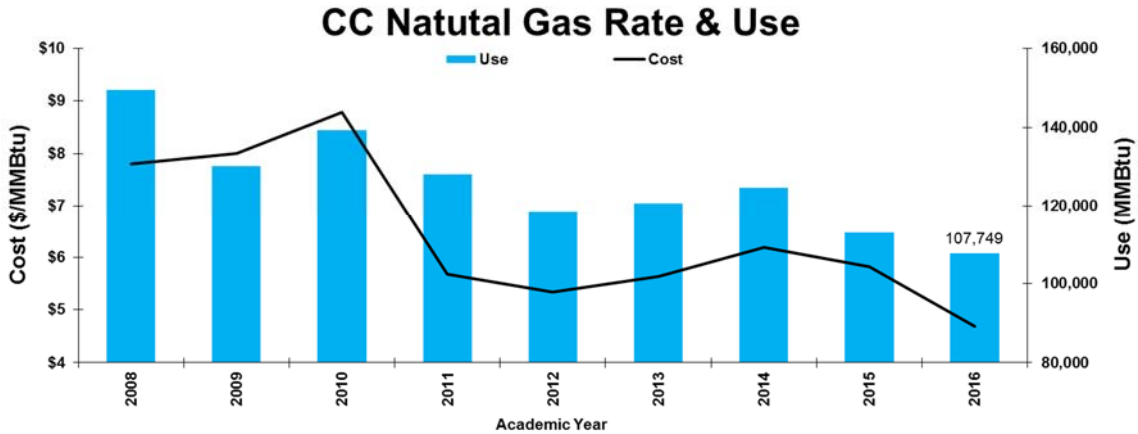
One factor that is unclear is what effect CC's block plan has on our overall energy use intensity. The block is thought to require more educational space because all spaces are used simultaneously. For comparison, the following annual kBtu/SF/Yr numbers were calculated using the most recent ASHEE STARS data at comparable institutions:

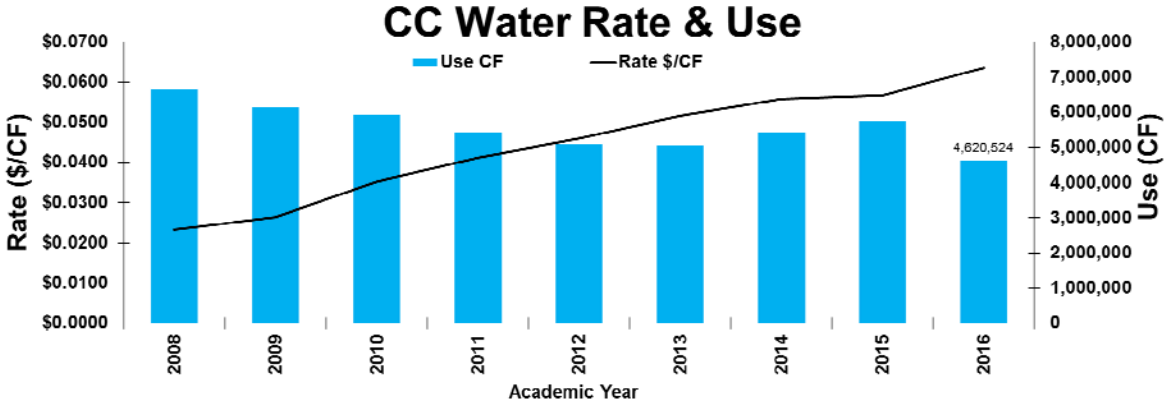
• Colby College	144 kBtu / SF	12/2014 data
• Colgate University	161 kBtu / SF	07/2013 data
• Middlebury College	137 kBtu / SF	05/2014 data
• Pomona College	114 kBtu / SF	10/2015 data
• University of Denver	104 kBtu / SF	02/2016 data
• University of Colorado Boulder	144 kBtu / SF	09/2014 data
• Williams College	148 kBtu / SF	02/2016 data

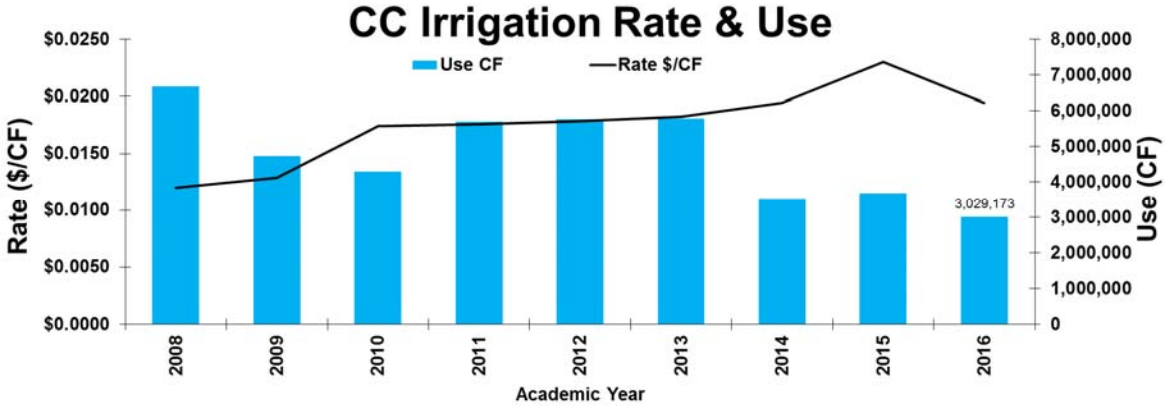


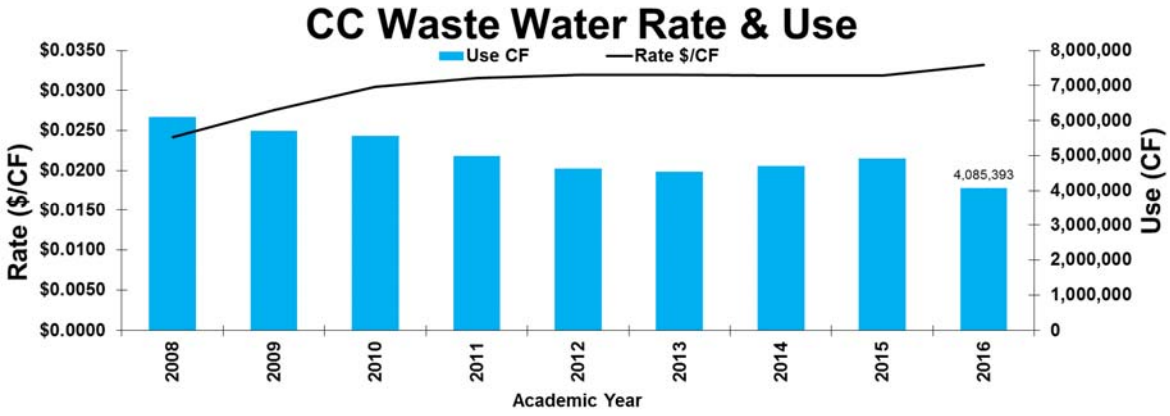
The chart above breaks down expenses by utility commodity. The most notable information is the continued pressure on water rates and the sustained trend of reduction in consumption in each utility. The charts below give more detail on these relationships.





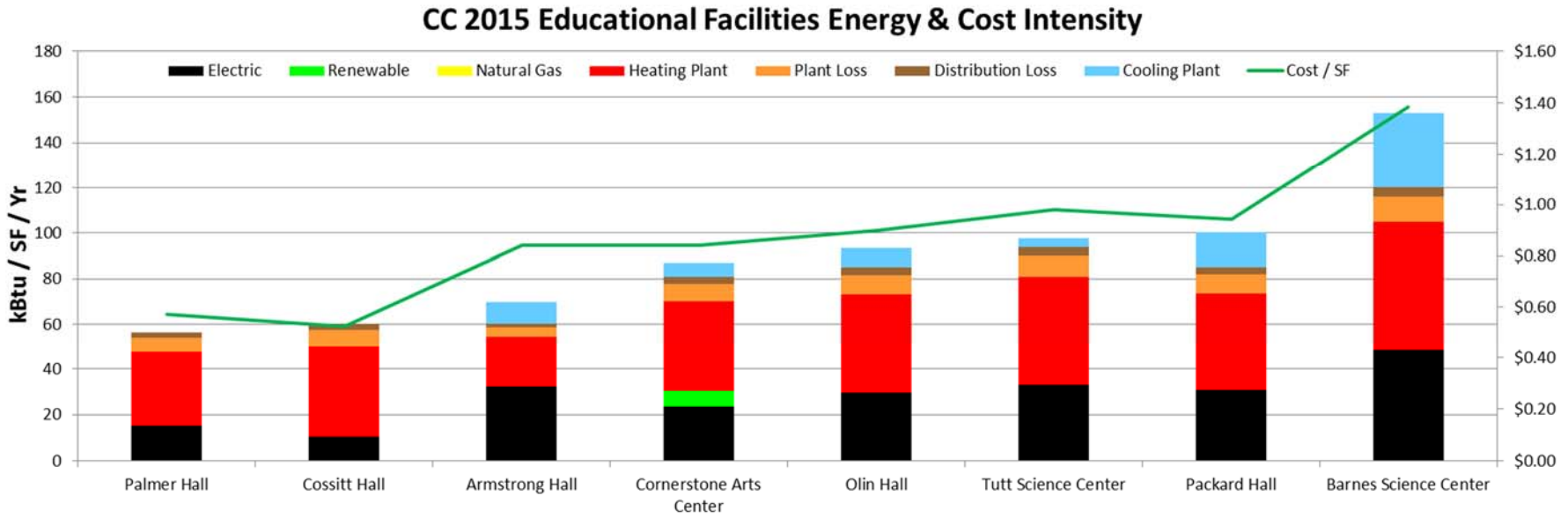


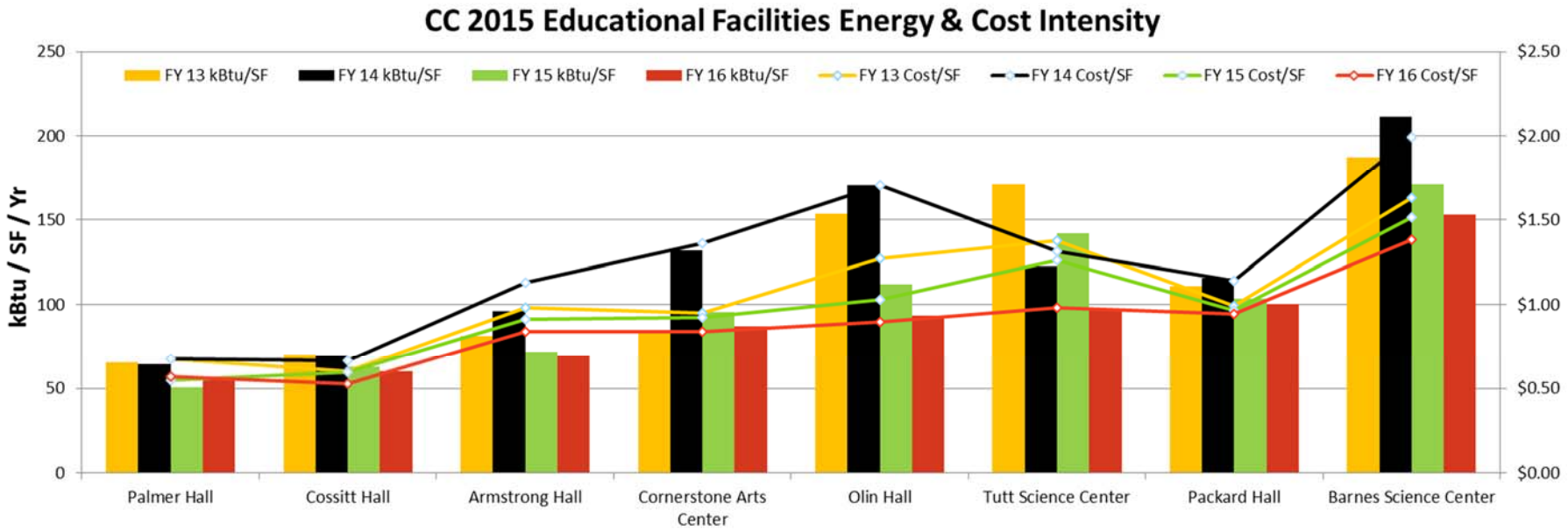




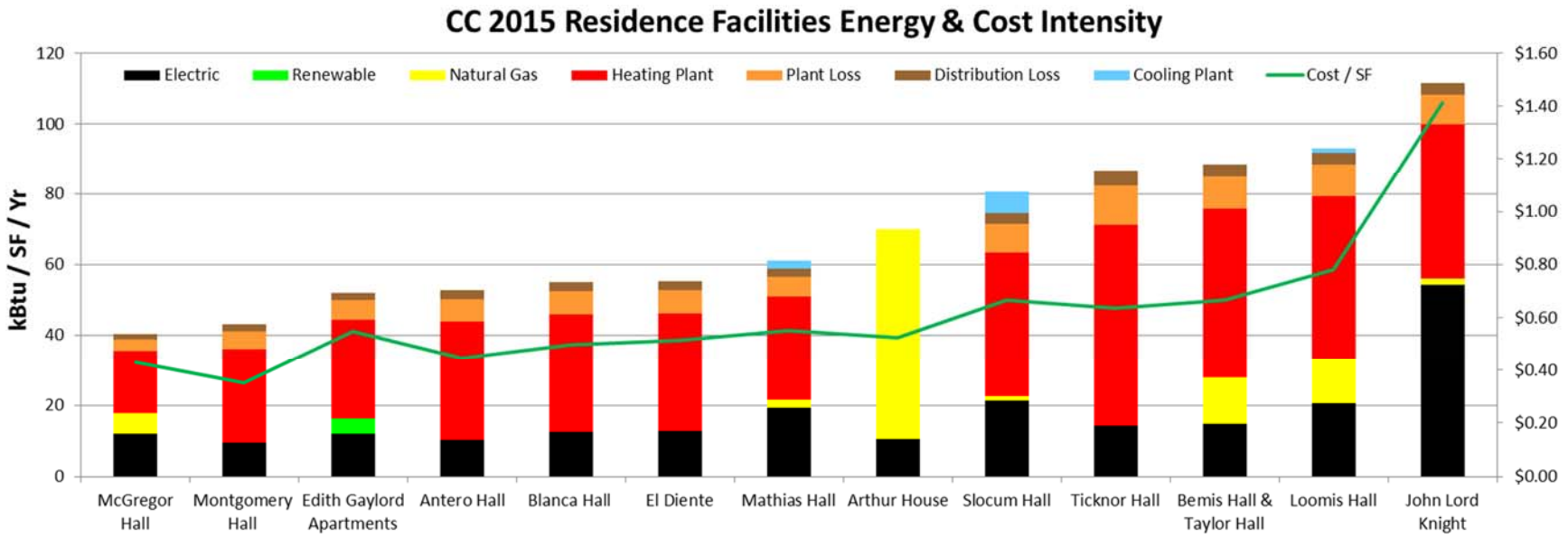
This is the fourth year for energy benchmarking at the building level. In 2011, thermal metering was installed. Thermal metering has enabled CC to measure the amount of heating and cooling energy flowing from the central plant to respective buildings. The following charts are the result of building level thermal and electrical metering.

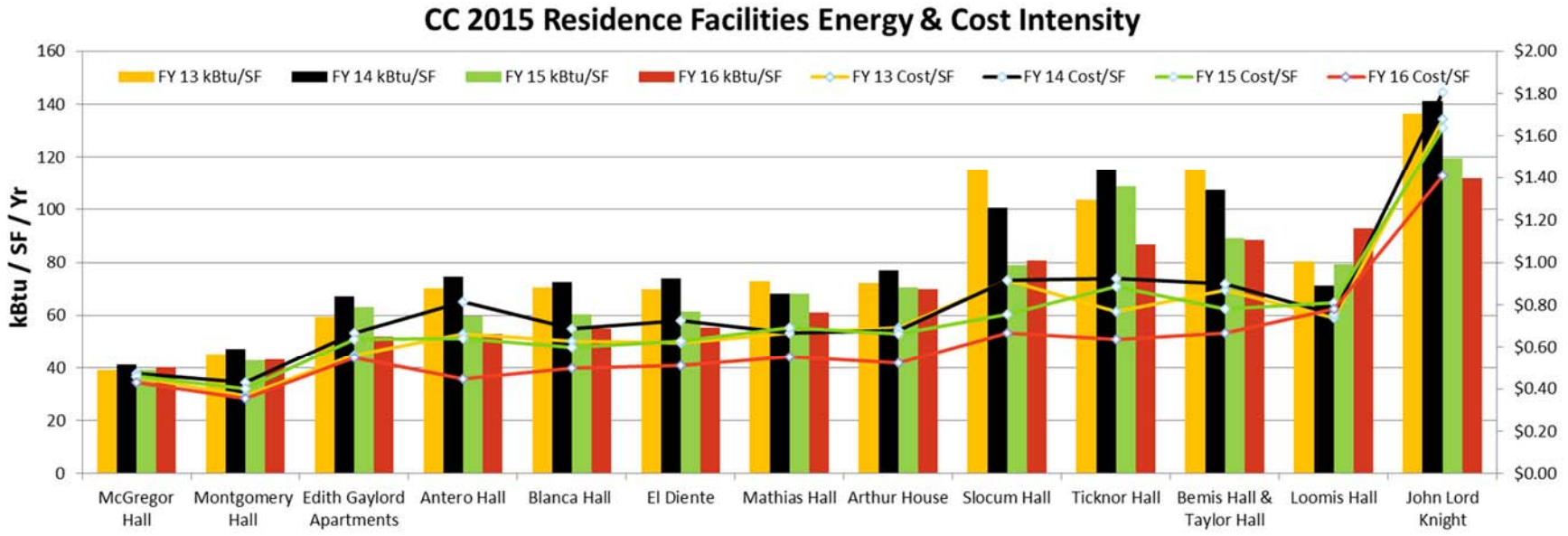
Benchmarking Educational Facilities



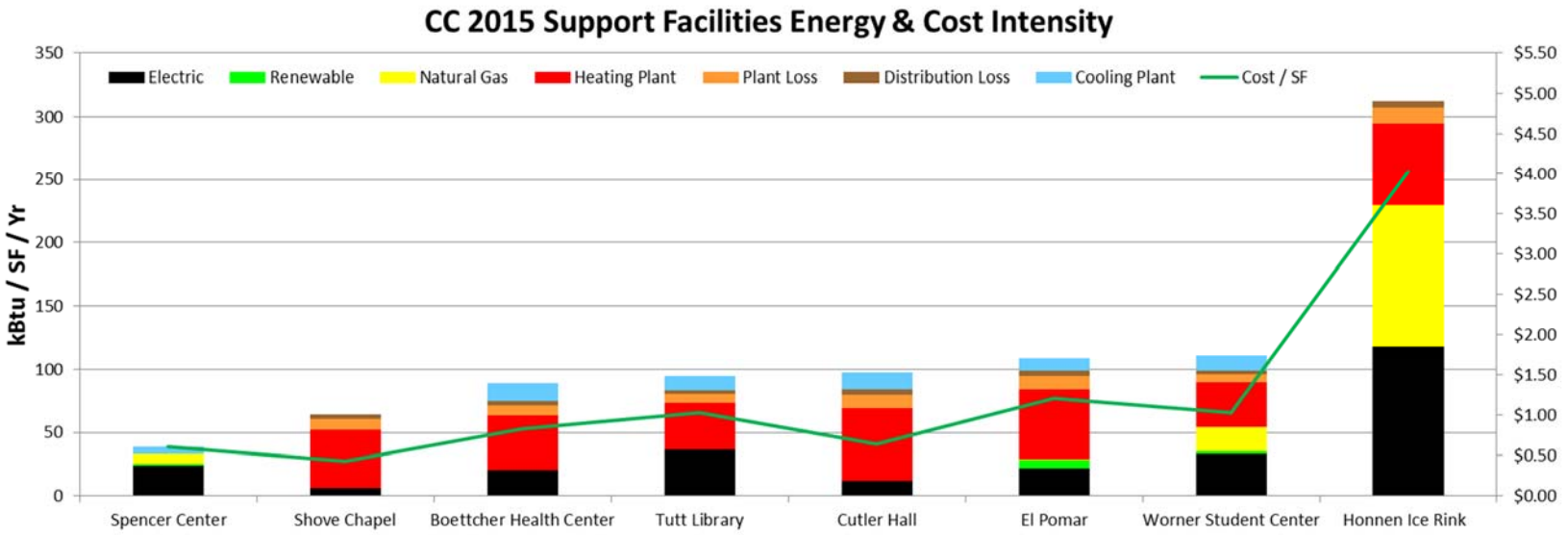


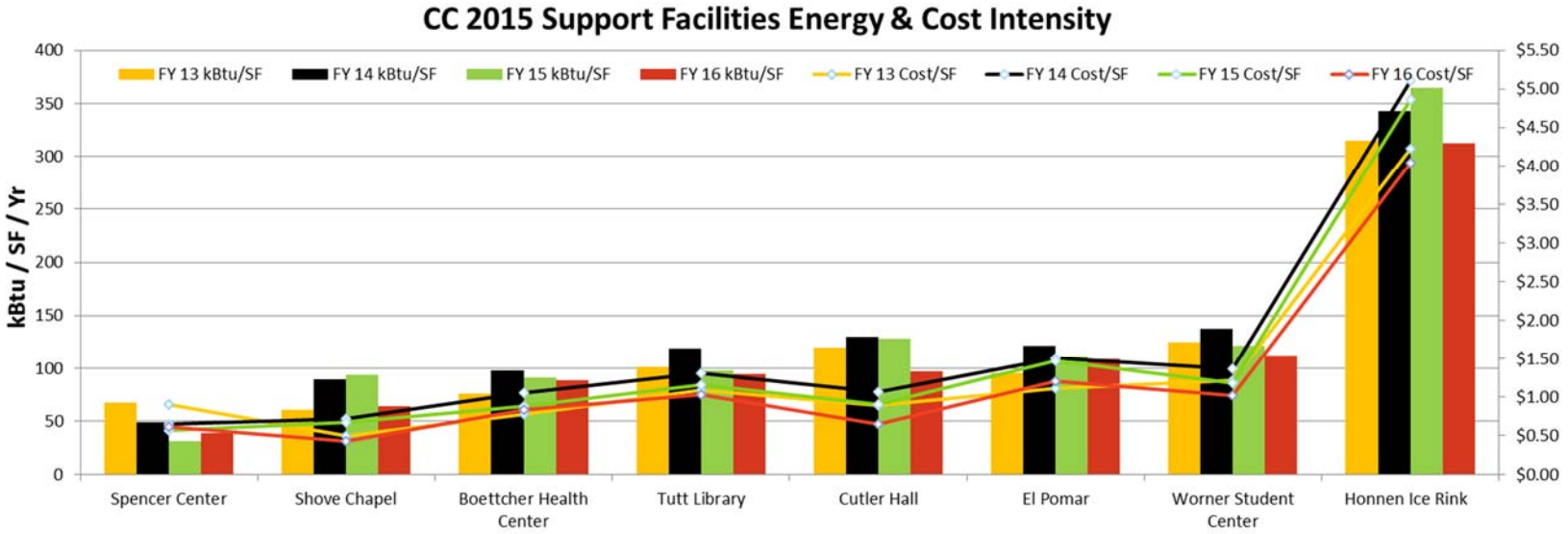
Benchmarking Residential Facilities





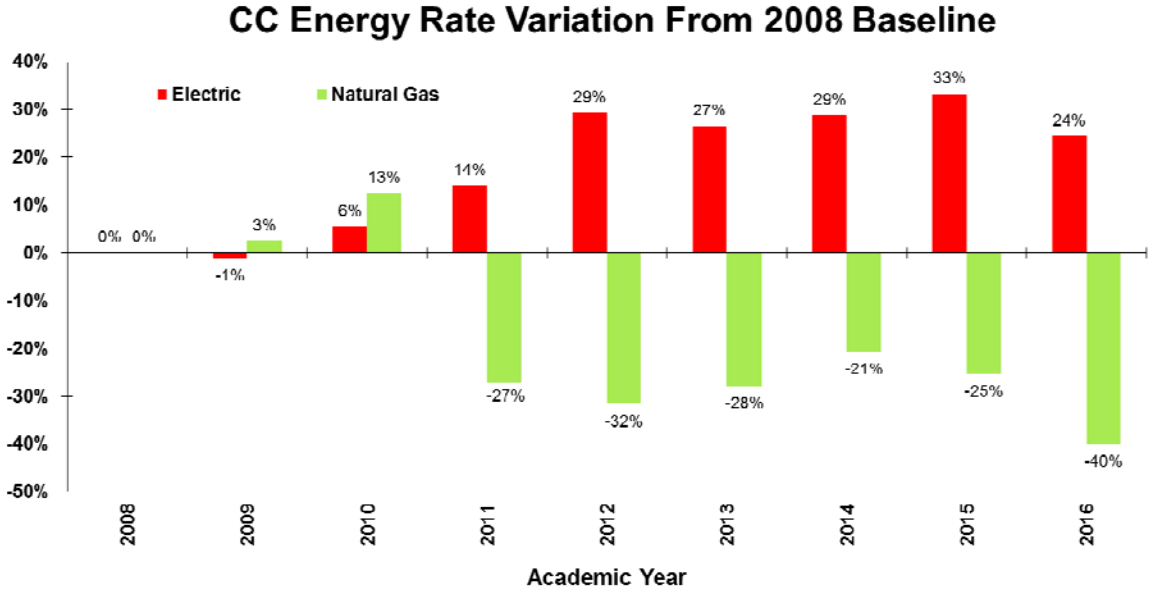
Benchmarking Support Facilities

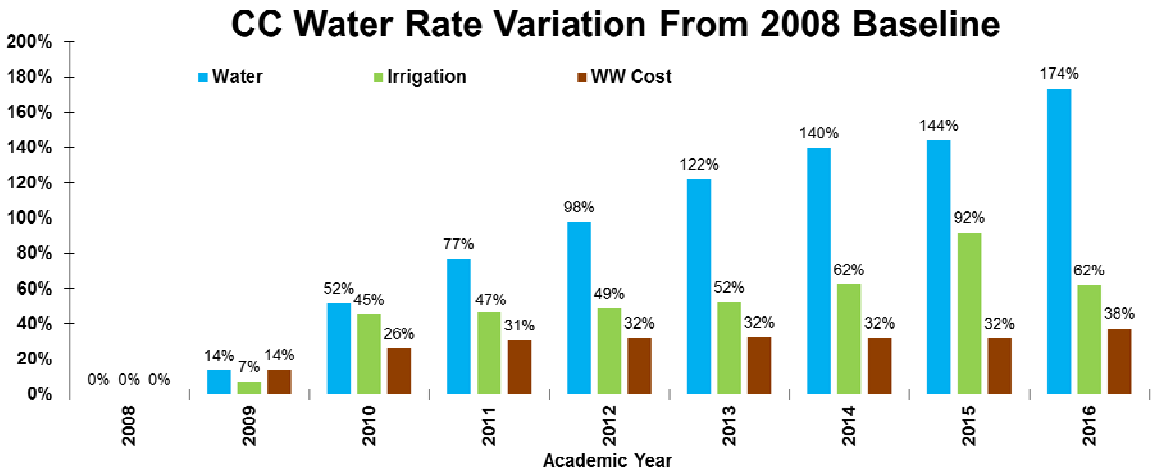




Utility Rates

CC has made significant improvements in reducing utility consumption since 2008. Because of these improvements, total costs are relatively unchanged even with increases in most utility rates. The charts below show the variation in commodity rates per unit experienced by CC since 2008. Electricity and water rate increases have seen larger than expected upward pressure. Natural gas costs have declined due to market conditions.





In July of 2016 the ETL electric rate which accounts for most of the buildings square footage at CC increased 12%. On January 1st, 2017 we are expecting Colorado Springs Utilities to change rates as follows:

- Electric 12% increase (ETL rate)
- Water 6% increase
- Waste water 4% increase

2016 Sustainability Projects

Baca PV Solar

Project Status: Complete

Project Description: The Baca PV solar project is nearly complete. This project is designed to provide more power than is consumed at the Baca Campus. The project is a hands on opportunity for students to learn about renewable energy. The picture below is of students who participated in the second day of installation as part of early new student orientation August 2016.

Project Highlights:

- Student installed
- 2 – 15.5 kW PV arrays

Schlessman Pool Water Conservation

Project Status: Complete

Project Description: The Schlessman pool water conservation project reduced water consumption at the pool. Our benchmarking efforts have revealed that the pool consumed more than 760,000 cubic feet (CF) of water during the 2015 academic year. Evaporation calculations estimated the annual consumption from evaporation for the pool to be ~57,000 CF. Facilities Services performed extensive testing and made repairs to the pool piping to correct the problem. For the 2016 academic year water consumption on the meter that serves the pool and central cooling plant water consumption has been reduced by approximately 4.1M gallons.

Tutt Library Design Review

Project Status: Complete

Project Description: The Tutt Library design review project was a continuous effort to ensure the owners project requirements are accurately captured in the building's design documents. The new Tutt Library is to be a building whose design teaches critical lessons about how to create and sustain healthy, productive, and flexible student, staff, and faculty spaces. The purpose of this project is to make sure that the design meets Colorado College's innovative high performance standards. High performance at Colorado College means achieving the optimal balance between maximizing building performance and occupant comfort while minimizing operational life cycle cost, energy consumption and carbon emissions. Achieving high performance design requires collaboration and integrated solutions from each discipline of the design team and owner collaboration throughout the design process.

Project Highlights: The Tutt Library Project high performance design goal is to achieve the following levels of sustainable building performance in the new library.

- Net Building Energy Use = 0 kBtu/SF/Yr or less
- Net Carbon Emission = 0 $MTCO_2e$/Yr or less
- Annual Energy Cost = $0.50/SF/Yr or less
- Total Building Envelope Performance (U) = .05 or less
- Indoor Air Quality = 700 PPM CO_2 or less during occupied times
- Occupant Comfort = ±2°F or less from set point
- Artificial Lighting = .3W/SF or less
- Building Power Factor = not less than 0.95 lagging at the utility meter
- A building that educates occupants about its sustainable features and how to properly use them.
- A building that supports campus recycling practices.

East Campus Housing Design

Project Status: Complete

Project Description: The east campus housing design project is the production of mechanical and plumbing design documents for east campus housing project consisting of 5 separate structures. The designs are being completed in-house by the Facilities Technical

Services Department and include a premium efficiency geo-exchange heat pump system for building heating.

Honnen Firm Natural Gas Transportation

Project Status: Complete
Project Description: The Honnen firm natural gas transportation project is a change in the way we buy natural gas for our Honnen Ice Arena. Previously we purchased natural gas at Honnen Ice Arena on an interruptible rate meaning Colorado Springs Utilities can stop natural gas delivery to us at any time. When this happens, Honnen Ice Arena is without heat. This project moves us from interruptible service to firm service meaning our service cannot be interrupted. For this project the College utilized its existing contract to purchase natural gas from Center Pointe Energy.
Project Highlights:

- Firm natural gas supply
- Utilizes existing capacity

Monthly Building Automation Review

Project Status: Ongoing
Project Description: The monthly building automation review project is a periodic review with stakeholders to review building performance through the building automation system and make adjustments as needed. This periodic review is used to commission new projects, troubleshoot controls issues, and retro-commission buildings that are not operating at their peak efficiency.

El Pomar Efficiency Upgrades

Project Status: Ongoing
Project Description: The El Pomar energy efficiency upgrades project includes lighting and controls retrofits to improve building energy efficiency. El Pomar is one of the most expensive facilities on campus for electricity averaging over $0.15/kWh making it a great opportunity for efficiency upgrades. So far we have completed LED lighting retrofits in the auxiliary gym, squash, and racket ball courts. These retrofits reduced lighting energy consumption by more than 70% in these areas. This year we have completed the addition of occupancy sensors that control the HVAC system operation in large spaces.

Campus LED Lighting Upgrades

Project Status: Ongoing
Project Description: The campus LED lighting upgrade project is an ongoing project to replace lighting on campus with more efficient LED lighting. This project leverages utility rebates to assist with the restoration and replacement of campus lighting.
Project Highlights:

- Takes advantage of utility rebates
- Improves lighting levels
- Reduces energy consumption

2017 Sustainability Projects

El Pomar Electrical Service Upgrades

Project Status: Complete
Project Description: The El Pomar electrical service upgrades project will split the buildings electrical service. Due to demand at El Pomar the building experiences rates as high as $0.18/kWh which is more than double the campus average of $0.085/kWh. The buildings use profile is unique because its peak demand occurs between 4 pm and 10 pm during the winter which is an on-peak period. During this time student are utilizing the fitness center and the field lights. Adding meters and move the facility from the ETL rate to the E2C rate which does not charge for demand. The project will yield approximately a 3 to 5 year payback.
Project Highlights:

- Reduces energy costs

Campus Controls Upgrades Phase 2

Project Status: Construction
Project Description: This project is phase 2 of a 3 phase project to replace obsolete controls on campus with the latest platform of direct digital controls. The updated controls allow the College to apply more sophisticated logic and manage energy consumption more closely. In addition to updating controls, the project allows more space for archiving data and alarms. This data is essential for benchmarking continuous operational improvements.

Central Plant Controls Upgrade Phase 2

Project Status: Construction
Project Description: The central plant controls upgrade phase 2 project will improve the automation of the central plant heating operation. The controls work includes adding controls and system logic to enable remote starting and automate temperature modulation of the high temperature hot water generators and distribution system pumps. These controls optimize central heating plant reliability and efficiency. The project will expand alarms for safety allowing the plant to be controlled remotely and left unmanned for extended periods beyond just the summer. The extended periods of time will allow central plant operators time to perform maintenance activities on the distribution system and respond to after-hours emergencies on campus.
Project Highlights:

- Improves central plant efficiency
- Improves system reliability
- Improves after hours response to campus emergencies

Cutler HVAC System Replacement

Project Status: Design

Project Description: This project will replace the existing heating, ventilation and air conditioning (HVAC) systems at Cutler Hall. Currently Cutler utilizes steam for heating provided from Bemis Hall. The system does not have good zone control, so as a result occupants are often too hot or too cold. The new system will utilize a new variable refrigerant flow heat pump system to maximize occupant comfort and efficiency while maintaining the historic characteristics of the building. The system will also help support renovation to repurpose the second floor of the facility.

Project Highlights:

- Improved system reliability & efficiency
- Improved occupant comfort

Barnes Repair 1st & 3rd Floor Heating Piping

Project Status: Planning

Project Description: Barnes repair 1st & 3rd floor piping is the third phase of piping repairs in Barnes Science Center. The project includes work to weld leaky Victaulic fittings and replace pneumatic controls on the 1st & 3rd floor. The project saves energy because the old piping must be maintained at higher operating temperatures through the summer to prevent leaking. Welding the piping will allow heating system temperatures to be setback in the summer.

Project Highlights:

- Summer energy savings
- Improved system reliability
- Improved occupant comfort

Central Plant Water Conservation & Heat Recovery

Project Status: Planning

Project Description: The central plant water conservations & heat recovery project will work to optimize water use and heat recovery at the central plant. Currently we utilize domestic water to cool the bearings on our central high temperature hot water pumps. This project would automate the flow of water to these pumps and look at recovering heat from this water. The recovered heat could be sent to either the low temperature heating loop or the chilled water loop during the heating season. The project will also look at recovering heat from the ice rink cooling tower.

Project Highlights:

- Improves central plant efficiency
- Reduces water use and cost

Cornerstone Retro-Commissioning

Project Status: Planning

Project Description: The Cornerstone retro-commissioning project will reduce the overall energy intensity at Cornerstone Arts Center. The project is to evaluate the operation of building systems and return them to the intended design parameters. From there additional savings opportunities will be identified and pursued to maximize the buildings energy performance. Currently the building utilizes large quantities of outside air. As part of this project we will attempt to minimize the amount of conditioned air that leaves the building when indoor air quality is at acceptable levels. In many cases commissioning work also improves occupant comfort.

Fine Arts Center Energy Audit and Commissioning

Project Status: Planning

Project Description: The Fine Arts Center energy audit and commissioning project will evaluate and propose projects for reducing the overall energy intensity, associated carbon emissions, and cost at the Colorado Springs Fine Arts Center at Colorado College. The evaluation will study both utility supply and demand opportunities. The project will evaluate the operation of building systems and complete make minor system adjustments as needed.