

Future HVAC Sustainability

By: Blake Bengtson, Clayton Bryant, and Kyle Hrenyo

Introduction

Sustainable Energy on Campus is about trying to reduce energy consumption campus-wide to a more sustainable level. Our group is specifically focusing on the consumption of energy by HVAC systems in buildings all around campus. The project will investigate building(s) around campus to evaluate the current state of energy consumption, then we will research into technologies that exist to help mitigate energy consumption, with a focus on how they can be applied to future or current buildings to reduce energy costs. The issue of energy consumption on a campus-wide level will have a significant impact on the energy consumption of the community as a whole; the hope is that other large institutions can see Riddle's lead and also reduce energy use. In such a case, the level of energy savings is sure to have an impact on pollution due to electricity generation, which will lead to a healthier environment.

Problem

Inefficient energy usage

- Rooms are temperature controlled, even when no one is in there or using the room for hours
- Rooms that need temperature control don't get as much heating/cooling as needed

Wasted money

- Money spent temperature controlling empty rooms is money out of the university's pocket and ultimately extra money included in tuition
- Reducing electricity consumption during the day reduces the peak consumption, which reduces electricity cost per kW-hr

Negative Environmental Impact

- Electricity consumed through the burning of fossil fuels such as natural gas and coal contributes to pollution
- Fossil fuel use is also linked to climate change

Estimated Cost and Benefit

Thermostat Installation Cost

There are approximately 80 thermostat-ready rooms in the COAS:
80 rooms * \$150 / Thermostat = **\$12,000 to install**

Energy Cost and Projected Savings

Based on a preliminary reading of the COAS utility meter, the COAS uses approximately 100 kWh of energy per day on the weekend.

- 100 kWh / day * \$0.20 / kWh
 - = \$20 / day
- \$20 / day * 365 days / year
 - = **\$7,300 / year**

Smart HVAC systems can reduce power consumption by 30% - 50%.

- 30% - 50% * \$3,650 / year
 - = **\$1,100 - \$1,800 / year**

According to research from the Washington D.C. Department of Energy & Environment,

- 50% of commercial energy is used in HVAC.
- 50% * \$7,300 / year
 - = **\$3,650 / year for HVAC**

Dividing cost by benefit gives time to return on investment.

- \$12,000 / \$1,100 - \$1,800 / year
 - = **7 - 11 years**

This calculation was done using the weekend power consumption of the COAS. Since the majority of the savings of a smart HVAC system would be seen during the week, 7 - 11 years is a very conservative estimate. In reality, the system would likely pay for itself in less time.

Technology

Motion Sensors

Motion sensors are used to detect the presence of people in a room. By installing motion sensors in the principally occupied rooms of the College of Arts and Sciences, we will be able to collect continuous and accurate data about building occupancy.

Smart Thermostats

Smart thermostats are similar to regular thermostats in that they allow fine control of the temperature of a space. However, smart thermostats are able to communicate with each other and other computers over a network. They can follow complex programs and receive commands remotely.

Smart HVAC Control

By installing motion sensors and smart thermostats in the principally occupied rooms throughout the COAS, we will be able to build a central controller that monitors building occupancy and adjusts room temperatures accordingly. When rooms are unoccupied during long stretches during the day or overnight, the thermostats will automatically raise or lower the temperature (depending on the season) to reduce load on the HVAC system. This system will reduce power consumption by the building.

Resources

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Electricity Consumption by end use in the southern U.S., 2012

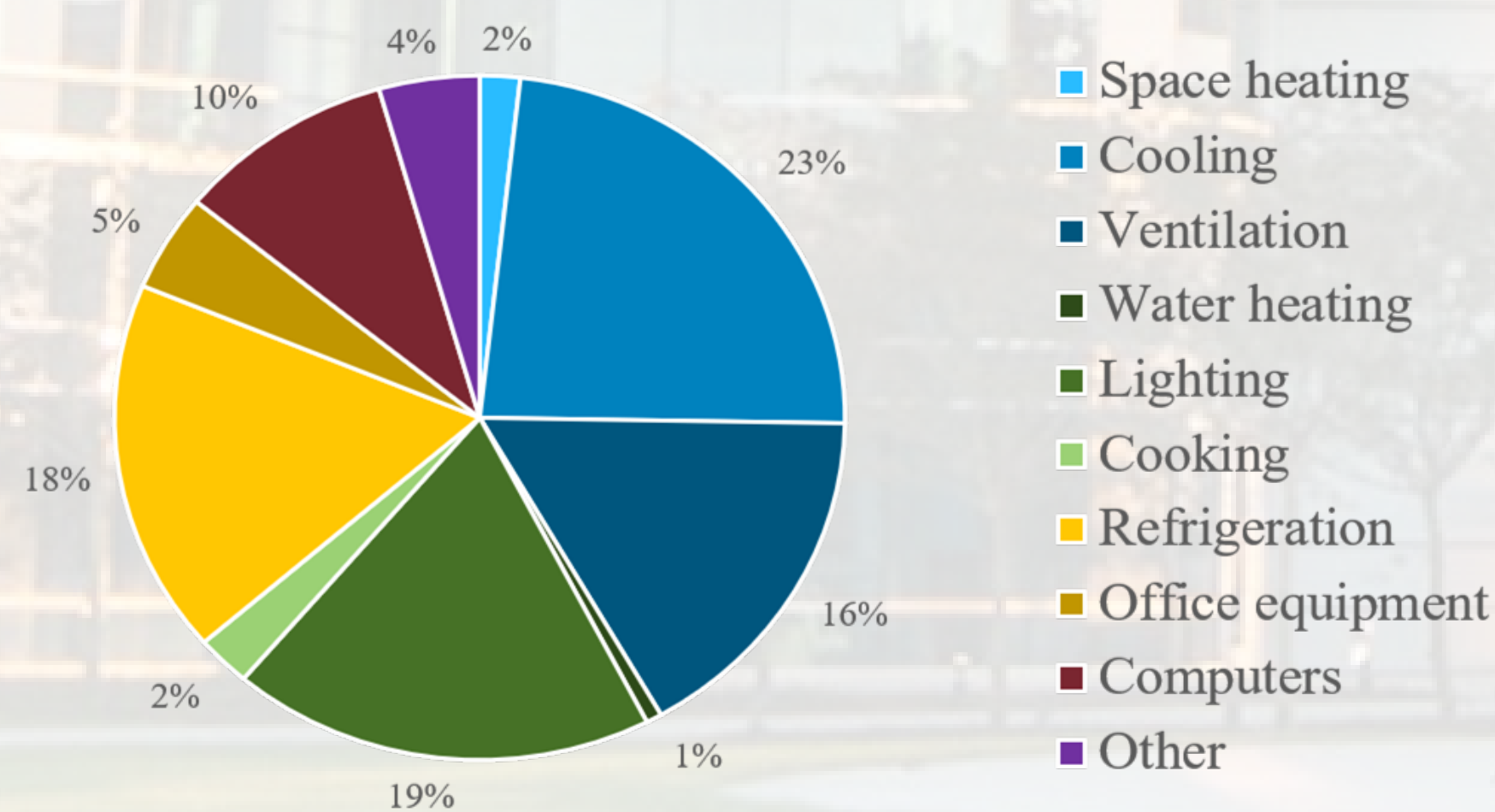


Figure 1: Electricity Consumption in Commercial Buildings. Data from Table 6: Electricity consumption by end use, U.S. Energy Information Administration - EIA - Independent Statistics and Analysis. (2016, March 28). Retrieved October 19, 2018, from <https://www.eia.gov/consumption/commercial/reports/2012/energyusage/>