Spring 5-11-2016

Chapman University 2016 Environmental Audit: Residence Life Dining Services Equipment

Alexandra FW Sidun
Chapman University, sidun100@mail.chapman.edu

Devon T. Bloss
Chapman University, bloss101@mail.chapman.edu

Chapman University 2016 Environmental Audit: Residence Life Dining Services Equipment

Bloss, D., Sidun, A.
ENV 498, Senior Capstone
School of Earth & Environmental Sciences, Chapman University, Orange, CA

Introduction

Chapman University's student population is consistently growing with larger incoming freshman classes every year. Students typically live in Residence Life freshman and sophomore years, with some students living on campus all four years of their undergraduate careers. Students that live in the on-campus residences are required to have a dining plan and receive almost all of their meals through the on campus dining services provided by Sodexo Restaurant Services.

To accommodate thousands of students, the commercial-grade kitchens at Chapman are constantly in use to prepare food for the highly concentrated student population living in the residence halls; three meals a day, seven days a week. The main dining hall for Residence Life, Randall Dining Commons (RDC), has staff working virtually around the clock and appliances constantly running to meet the high demand. The frequent use of commercial kitchen appliances results in enormous consumption of energy and water resources, making it a crucial component for this audit and for future audits. This chapter of the Chapman University 2016 Waste Management and Dining Services Audit will seek to quantify the energy and water use and mitigate any waste from the RDC commercial kitchen through specific recommendations.

The main goals of this chapter are as follows:

- Collect numerical data from large kitchen appliances in RDC
- Collect survey data from staff on behavioral practices
- Evaluate appliance efficiency and distinguish areas of improvement
- Provide insight on ways for University utility cost savings
- Provide suggestions on how to upgrade/retrofit kitchen equipment to be more efficient
- Provide the necessary education on resource use for specific appliances to kitchen staff
- Encourage operational improvements for kitchen staff
- Encourage sustainable use of finite resources

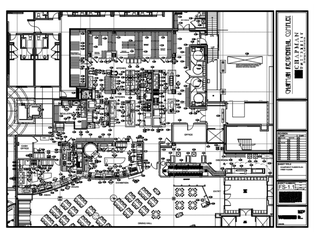


Figure 1. RDC kitchen as-built, 2009

History at Chapman

Randall Dining Commons (RDC)

•Sandhu constructed in 2009 (re-facing dining area summer of 2016)
•Serve approx. 2,000 customers/day
•Upwards of 100+ appliances and fixtures for dining services
•Audit history: topic has not been analyzed

Equipment Breakdown

Stations = 8
Refrigeration = 24 Appliances
Freezing = 4 Appliances
Heating = 23 Appliances
Water Use* = 2 Appliances

Audit total = 53 Kitchen Appliances
*not including faucets and end-pipes, only cooking appliances

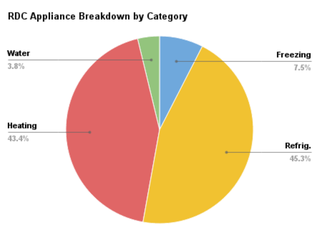


Figure 2. Equipment breakdown by appliance category

Recommendations

Low cost/effort:

- Call Sempra Energy service technician for FREE equipment calibration and repairs once per semester (utilize manufacture-specific/certified technicians only)
- Staff sustainability and orientation/training on efficient equipment operations
- Place all electric heating equipment on power strips and turn them off each night to eliminate phantom loads
- Add appliance timers for improved efficiency
- Consolidate refrigerator items to not waste space
- Turn off faucets when not in use; do not fill and drain sinks frequently
- Reduce standby/idle preheat times by better time management
- Close ice-machine door when making ice
- Replace ripped curtains and damaged spray heads on dishwasher and pre-wash station

Moderate cost/effort:

- Replace gaskets and hinges on all refrigerators and ovens
- Commission Doyon rack oven
- Use *fishnick* web calculator for EnergyStar CBA
- Install individual sub-meter for RDC electrical consumption
- Install occupancy sensors and LED bulbs
- Replace sink faucets with low-flow water heads and aerators
- Install, rotate, and log data from end-pipe water meters
- Create a list of "pre-approved" appliances for purchasing dept.

Figure 8. Office Solutions green catalog.

High cost/effort:

- Upgrade equipment to Energy Star certified (energy reduction by 30%)
- Initiate "Green Captain" position for increased sustainability awareness/management
- Create a sustainability handbook for all kitchen staff
- Upgrade cookware to newer, energy efficient materials for heat transfer/insulation
- Require annual sustainability reports for kitchen facilities to track sustainability progress and achieve annual goals (e.g. 20% energy reduction by Summer of 2017)
- Install back-kitchen cameras for operational accountability
- Install circuit timer-relays for hardwired appliances to maximize TOU energy rates

Figure 9. Furniture in the storage facility.

Figure 10. Three full wash basins of 165L each in the RDC back kitchen with faucet still running, no dishes being washed, and no staff attendants; approx. 500L of wasted water from this single occurrence.

Current Status

RDC Kitchen Energy Consumption

Figure 3 represents the estimated energy consumption of the RDC kitchen facility, determined by normalizing Sandhu's energy consumption by the average residence hall energy consumption. Total energy consumption from January - December of 2015 in RDC alone reached approximately 2 GWh of energy usage. This value equates to the amount of energy required to power 130 U.S homes for an entire year, or can be represented as 1400 metric tons of atmospheric carbon dioxide emissions!

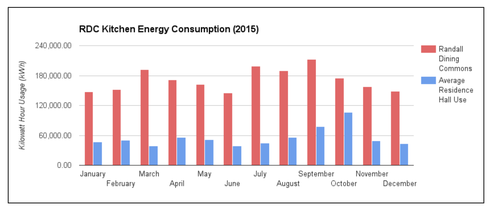


Figure 3. January-December 2015 estimated energy consumption for RDC

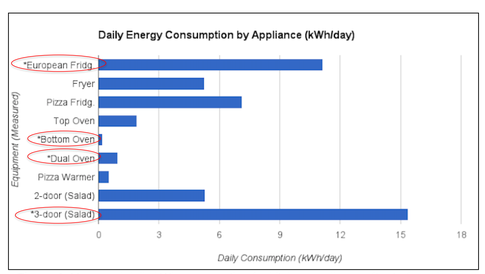
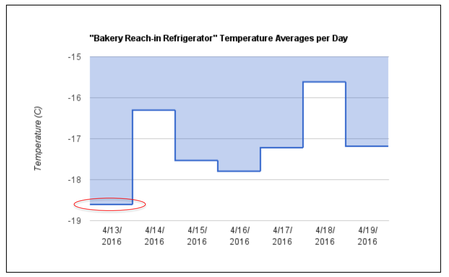


Figure 4. Measured daily kWh consumption for kitchen appliances (*out-of-service or malfunctioning) using Kill-A-Watt meters (**Figure 6**)

Out-of-service appliances are pulling phantom loads equivalent to 58% of the energy consumed in this one-week period of nine observed appliances. The 3-door salad refrigerator should not be using double the amount of daily energy as a large, reach-in Pizza Refrigerator and is clearly wasting both energy and financial resources.

The *Track It* logger data for the Bakery Reach-in Refrigerator on April 13th, 2016, averages at nearly -18.5 degrees Celsius, while the handwritten log of the ambient temperature reading recorded a temperature of 40 degrees Fahrenheit at the beginning and end of the day (see **Figure 5**). -18.5 degrees Celsius is equivalent to -1.3 degrees Fahrenheit, which means there is an observed 40.9 degrees Fahrenheit error in temperature recording by the staff or refrigerator display log.

Figure 5. Percentage of faculty and staff aware of sustainable items in the Office Solutions Catalog.



The 2013 Audit, focusing on residential buildings, found an increase in water consumption by 78% from 2009-2012. This increased consumption includes Sandhu's and RDC's water usage. The notable increase in overall water costs for Sandhu can be attributed to slight increases in water usage and to tiered prices of water. The tiered prices of water are based on consumption rates due to the extreme drought conditions California is currently facing (Municipal Water District of Orange County)

Figure 6. *Kill-A-Watt meter*

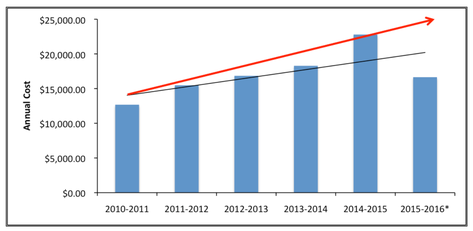


Figure 7. Annual cost of water consumption in Sandhu (*billing periods Feb.-May 2016 are missing). Trend line (black) is calculated assuming 2015-2016 data is complete; projected line (red) is an estimate of the actual cost for 2015-2016's water usage based on previous usage data.

Concluding Assessment

Areas of progress

- The EnviroPure food digester that was installed in the dishwashing area can be run from grey water and eliminates food waste to landfills and subsequent CO2 emissions through the anaerobic breakdown of organic matter.
- Sustainability investigation of energy efficiency measures to be implemented during the RDC "facelift" by Chapman Facilities is taking place Summer '16.
- Communication and outreach with SoCal Gas Co. resulted in their first energy efficiency audit of a commercial kitchen account.

Areas in which to improve

- Add electric utility sub-meter in RDC
- New equipment ROI & Simple Payback
- End-pipe water meter installation
- Staff observational survey
- Staff sustainability education programs
- Periodic maintenance by professionals
- Consistent thermal calibration and logging
- Regular appliance cleaning
- Negligent water and energy waste reduction

Figure 10. *Doyon bread proofer w/ electrical control panel re-wired to to oven dial controls after maintenance repair.*

Future Research

- Grey water recycling of prewash station output into EnviroPure food digester to eliminate excess water waste
- Installation of water meter for monitoring RDC consumption
- Optimal refrigeration/freezing temperatures for food inventory and health codes
- Building management software for gas, electricity, water, and HVAC system real-time data
- Return on Investment for Green Captain position
- Battery storage for peak shaving and TOU load shifting
- On-site solar generation to reduce utility dependency

Contacts

1. Mackenzie Crigger, Sustainability Manager, Chapman University Facilities Management (crigger@chapman.edu, 714-997-7370)
2. Dustin Fitch, Sodexo Operations Manager, Chapman University
3. Andrew Gibson, Food Service Equipment Technical Specialist, Sempra Utilities-Energy Resource Center Food Services
4. Melanie Winscher, Commercial Service Technician, Sempra Utilities
5. Blaine Waymire, Account Executive, Southern California Gas

Acknowledgements

This audit was made possible by Dr. Christopher Kim and Mackenzie Crigger. It was also made possible by the Sempra Utility-SoCal Gas team and the cooperation of Sodexo Staff. Thanks also to every person listed in the contacts section for their valuable contributions to this project.

References

Anthony, Tyler, Chloe McConnell, Jennifer Feinstein, and Sophie Gantz. "Chapter 2: Residential Buildings." *Chapman University*. N.p., 2013. Web.
"Chapman Residential Complex: Randall Dining Commons." *Webb Foodservice Design*. N.p.: n.p., 2009. 1.0-8.8. Web.
City of Orange Water Utility Bill. Oct. 2015. Raw data. Chapman University, Orange, CA.
De La Torre, Harvey, and Keith Lyon. "Water Rates and Charges." *Water Rates and Charges*. Municipal Water District of Orange County, 21 May 2014. Web. 20 Mar. 2016.
"Greenhouse Gas Equivalencies Calculator." *EPA*. Environmental Protection Agency, Apr. 2014. Web. 08 May 2016. <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>.
"SCE Energy Conservation Series-On The Menu: Major Energy Savings." *Southern California Edison*. Edison International Co., 2015. Web.
Southern California Edison Utility Bill. Dec. 2015. Raw data. Chapman University, Orange, CA.
Southern California Gas Company Utility Bill. Oct. 2015. Raw data. Chapman University, Orange, CA.
US EPA. "ENERGY STAR® Guide for Restaurants Putting Energy into Profit." *ENERGY STAR Guide for Restaurants: Putting Energy into Profits* (n.d.): n. pag. *ENERGY Star*. US EPA, Nov. 2010. Web.