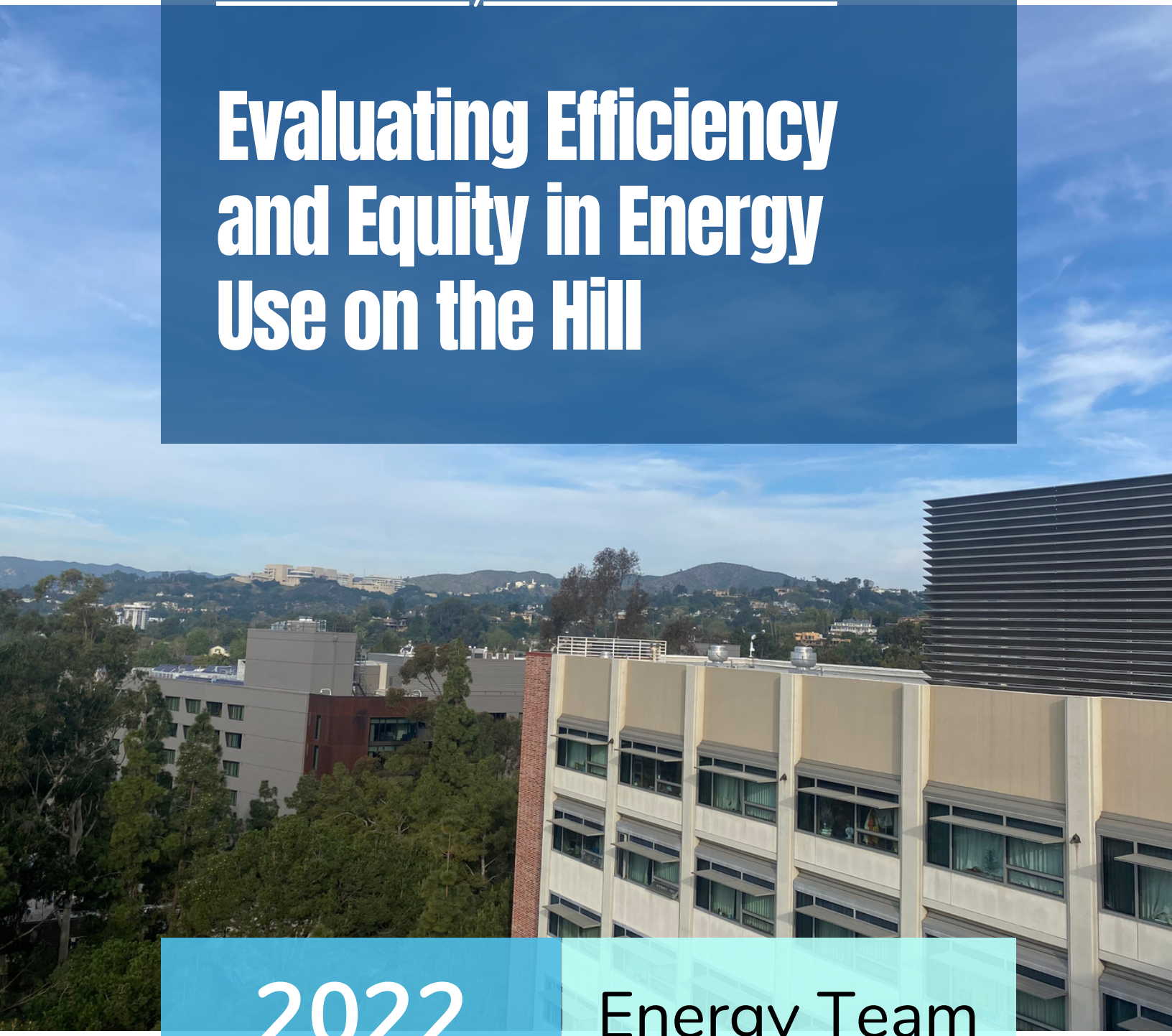
Sustainability Action Research

Evaluating Efficiency and Equity in Energy Use on the Hill



2022

Energy Team

Prepared for UCLA Housing and Hospitality Services

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Meet the Team

Anna Novoselov
She/Her
Team Co-Lead

Anna is a second-year Environmental Science major and Biomedical Research minor with a broad range of interests including sustainability, Integrative biology, biomedical innovations and environmental journalism. She joined the Energy Team with the hopes of making a tangible impact in helping UCLA reduce its greenhouse gas emissions. Outside of school, she enjoys hiking, swimming, and painting!

Qin He
She/Her
Team Co-Lead

Qin is a fourth-year Environmental Science major with an Environmental Systems and Society minor with interests in affordable housing and sustainability. She joined the SAR Energy Team in 2022 in hopes to make energy accessible for all students on campus! In her free time, she enjoys dancing competitively, painting, knitting, and watching movies with friends.

Mason Lehman
He/They
Team Member

Mason is a second-year studying Environmental Science and has a passion for climate justice and green building. They participated in SAR's Equity, Diversity, and Inclusion Team in 2021 and returned to the program's 2022 Energy Team to understand infrastructure procedures and student behaviors around energy use. Mason will study abroad this summer in France to learn about global sustainability. Beyond SAR, he mountain bikes, bakes, and spends time exploring Los Angeles.

Meet the Team

Nicholas Leong
He/Him
Team Member

Nick is a second-year Environmental Science major with an interest in oceanography and sustainable living practices. This led him to join the Energy Team, where he helps push for greater sustainability on campus with the hope to see the subject be a more significant part of people's everyday lives. In his free time, you will likely find Nick on the tennis courts or in the kitchen cooking up meals for friends.

Karlie Hayes
She/Her
Team Member

Karlie is a third-year Cognitive Science major with minors in English and Environmental Systems and Society. She is passionate about the impact of behavioral choices on sustainability, communicating environmental information, and the intersection of data and the environment. She joined the Energy Team to learn more about data analysis and how energy is used at UCLA. When she's not in class, Karlie is usually on a run or drinking coffee.

Reily Fairchild
She/Her
Team Member

Reily is a first-year Applied Mathematics major and Environmental Systems and Society minor. She joined the Energy Team to explore her growing passion for the creative, technological solutions required to ensure environmental resiliency. In the future, she hopes to be involved in data science and dynamic systems modeling to improve food systems or the energy grid. Some of her favorite activities include climbing, vegan cooking, painting, and music.

Meet the Stakeholder

Spencer Middleton
He/Him
Stakeholder
Energy Analyst at UCLA Facilities Management

Spencer Middleton holds the position of Energy Analyst within the Energy Services and Building Controls division of UCLA's Facilities Management department, where he manages data relating to utility consumption, costs, and greenhouse gas emissions for UCLA's real estate portfolio. He works to achieve the University's carbon and energy goals as a member of the Smart Buildings and Labs program, which focuses on whole-building energy efficiency upgrades, as well as the Smart Lighting program, which focuses on LED lighting retrofits across campus. Spencer earned a Master's degree in Environmental Science & Management from the Bren School at the University of California, Santa Barbara, where he specialized in Corporate Environmental Management.

The SAR Energy Team during our walkthrough of Centennial Hall

ABSTRACT

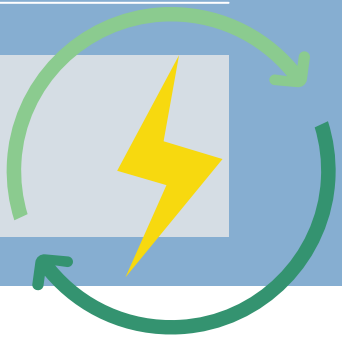
The 2022 Sustainability Action Research (SAR) Energy Team investigated energy use by UCLA's on-campus student dormitories (The Hill) with the goal of promoting energy conservation and increasing equity, diversity, and inclusion (EDI) in energy allocation. The three-part project consisted of:

1. A quantitative analysis of heating, ventilation, and air conditioning (HVAC) energy use depending on the different temperature set points in the lounges of Rieber Vista and Centennial Hall.
2. A qualitative analysis of equity in energy use on the hill, which included three community-based focus groups.
3. A petition supporting increased transparency and sustainability in building remodels.

While past SAR projects have specialized in influencing student behavior, our research utilizes data from a quantitative experiment to recommend both structural and usage changes in HVAC systems. Early on, feasibility challenges shifted our goal from performing a comparative audit of different buildings to identifying the influence of set base temperature and heating/cooling degree days on HVAC system energy use in lounges. Our data collection process included building walkthroughs, interviews with UCLA Facilities and Housing Management, HVAC audits using data loggers, and focus groups conducted with Living Learning Communities.

Our final deliverables include suggestions for UCLA Housing and Facilities to reduce HVAC energy consumption and increase equity in energy distribution. We hope that this report promotes a greater focus on sustainability in on-campus housing by facilitating discussions on maximizing energy conservation in a way that is efficient, equitable, and environmentally-just.

Introduction



In the 2022 Sustainability Plan, UCLA's Office of Sustainability has outlined two critical goals to reduce its carbon footprint: (1) to reduce energy use by 2% each year and (2) to reduce Greenhouse Gas emissions to 1990 levels by 2020 and reach carbon neutrality by 2025 (Climate & Energy, n.d.). To support these goals, UCLA Facilities Management (FM) has implemented the Smart Building/Lab Program. In this program, FM conducted energy audits of labs and suggested retrofits, such as the installation of LED lights and occupancy sensors (Smart Buildings & Labs Program, 2021). Past SAR teams have suggested similar infrastructural changes: the 2012 SAR team measured the illuminance of each light in the Engineering IV hallways and then suggested low-wattage bulb replacements (Smithers, 2012). Additional teams have initiated behavioral research to try and reduce individual students' energy use such as advertising energy-saving strategies in common areas (Fong, 2013).

1. To support UCLA's sustainability goals, the 2022 Sustainability Action Research Energy Team built on the work of past SAR projects by examining energy use in dorm buildings to suggest efficiency improvements through infrastructural and behavioral change. We designed a quantitative experiment to gather data to support limiting temperature ranges in dorm lounges across the hill based on seasonal temperature variability. The goal of this research is to gather evidence that guides a reduction in the amount of energy required to maintain certain base temperatures in floor lounges and other common spaces in residential buildings on The Hill.
2. In order to understand equity in energy use on The Hill, our team conducted focus group interviews with three Living Learning Communities: Philipinx, Chicanx/Latinx, and Afrikan Diaspora. All these communities are located in the older student dorms without air conditioning units in individual rooms. We developed questions centered around identity-related energy experiences and requested input from participants on how to increase EDI. We synthesized the key themes discussed and developed recommendations for how to make energy on the Hill more equitable.

Introduction

UCLA Facilities updates building infrastructure every 10 years and does a full building remodel every 20 years. These updates are done preventatively to avoid large-scale system failures and to ensure equipment is maintained at a high standard. HVAC systems are often replaced with identical models or slightly updated versions. When choosing systems, sustainability is often not as thoroughly considered as cost-efficiency. The UCLA Housing Sustainability Manager left at the beginning of 2022, so there are no sustainability-oriented staff members advocating for energy-efficient systems during remodels.* Thus, our team created a petition to advocate that this vacancy be filled by a representative to advocate for sustainability in system replacements and work with students to understand their needs in energy use.*

*Note: At the end of our project, we were informed that UCLA is actively trying to fill the sustainability position; however, we hope our petition still shows student support for this action.

SAR Energy Team touring on the rooftop of Reiber Vista

BUILDING WALKTHROUGHS

Our team's walkthroughs of Rieber Vista and Olympic Hall immensely contributed to the development of our guiding questions and the finalization of our research project. The first walkthrough at Rieber Hall, led by HHS Maintenance Specialist Bill Gonzalez, gave us the opportunity to examine the HVAC systems stationed in the lounges. We interviewed Bill Gonzalez and two building engineers to better understand the extent of influence we could have on manipulating the HVAC system and monitoring energy expenditure. From our first walkthrough we gathered the following crucial information:

- Data loggers can be installed to monitor the energy use of individual HVAC systems
- HHS has the ability to set the HVAC at certain temperature set points
- Upper floors have their AC run more as a result of rising heat
- Newer buildings, such as Centennial Hall, have more efficient HVAC systems than older buildings, such as Rieber Vista
- AC temperature set points are limited to 68°F-74°F due to California State regulations for air conditioning in public buildings

This information led us to develop a quantitative experiment to analyze the effect of setting different base temperatures on energy consumption by an HVAC system. Rieber Vista was chosen as the focus building for this experiment.

Rieber Vista's HVAC Infrastructure

BUILDING WALKTHROUGHS

The next walkthrough was through Olympic Hall (which is similar to Centennial Hall), where we viewed the centralized HVAC system. This tour equipped us with a stronger understanding of the differences between Olympic VIllage's newer, more efficient HVAC infrastructure in comparison to the infrastructure of Rieber Vista's older, less centralized system. The significance of a centralized system is that a building can be retrofitted faster and at a lower expense, making it more adaptable to changing technologies and thus more efficient. On the other hand, several barriers prevent energy infrastructure from being upgraded in older buildings. For example, while glycerol is much more efficient than water in heating infrastructure due to its higher heat capacity, HHS Maintenance would have to entirely replace all pipes in order to upgrade older buildings to utilize the more effective liquid.

Additionally, the housing team discussed how the majority of their building infrastructure plans are focused on the most efficient and cost-effective options rather than sustainability and environmental impact. The Energy Team wanted to raise sustainability to the forefront of building innovations. Thus, we brainstormed ways in which current and future students might use their voices to advocate for more adaptable, centralized, and sustainability-focused building renovations. From this our petition was born, campaigning for increased transparency and sustainable advocacy in building renovations (see appendix for petition methodology and results). We also wanted to see how energy equity can be improved on the hill during building renovations (see the EDI Focus Groups portion of our project).

Centennial Hall's HVAC Infrastructure

Methodology

Aim #1: Analyzing HVAC energy use in lounges in Rieber Vista and Centennial depending on different set temperatures.

The SAR Energy Team collaborated with UCLA Housing Maintenance to collect energy use, temperature, and humidity data

METHODOLOGY: OVERVIEW

We designed a quantitative experiment that manipulated the AC set temperature in the lounges of Rieber Vista and Centennial Hall to examine the effect of different set temperatures on the lounges' HVAC system energy use. We chose Rieber Vista as our focus building because it has air conditioning (a large source of energy use) and has a remodel scheduled for 2025. Additionally, we wanted to compare energy use in Rieber Vista to energy use in Centennial Hall (a building that opened in 2021 and includes an HVAC system that was subject to more recent, and thus more strict, energy efficiency standards) to compare the energy use of an older, less efficient HVAC system to a more efficient, newer system. We also utilized the energy expenditure data we collected to calculate a carbon cost and conduct a cost-benefit analysis.

First, we collaborated with UCLA Housing and Hospitality Services (HHS) Maintenance to develop a schedule for varying the temperature set points of the lounges on the 8th and 9th floors of Rieber Vista and on the 8th floor of Centennial. HHS Maintenance connected data loggers to Rieber Vista and Centennial lounges' HVAC monitors which recorded the HVAC system's energy use. Specifically, each data logger collected information about the kilowatt-hours of the HVAC system every 15 minutes. Because we had only one quarter to collect data, we set up one data logger on the 8th floor and one on the 9th floor in order to assess the full range of possible set temperature values (68°F - 74°F).

Separate data loggers collected the indoor and outdoor air temperature and relative humidity. We collected this data to control for confounding variables, as both temperature and humidity can influence HVAC system energy use. Furthermore, to take into account the influence of floor height, we recorded the energy use of both the 8th and the 9th-floor of Rieber Vista at the same base temperature (72°F) during the same week (Week 7). To compare the energy expenditure difference between Rieber Vista and Centennial Hall, we collected both temperature and energy expenditure data of the 8th and 9th-floor lounges of Rieber Vista and the 8th-floor lounge of Centennial Hall during the same week (Week 7) with the same base temperature set points (72°F). To control for the influence of different lounge sizes, we divided energy consumption by the square footage and compared those values.*

Note: we experienced several difficulties related to this methodology, which are discussed in the Challenges section.

METHODOLOGY

Experimental Setup

We developed a schedule to collect data from Wednesdays to Tuesdays (7 full days of data for each different temperature set point), with the data loggers moved and/or the temperature set point changed each Wednesday. We received the following data at 5-minute intervals for indoor temperature, 5-minute intervals for outdoor temperature, and 15-minute intervals for energy usage.

- Kilowatt-hours (KWh) of energy used by the HVAC system in the Rieber Vista 8th floor, Rieber Vista 9th floor, and Centennial Hall 9th floor lounges were measured by an energy data logger
- Indoor air temperature and relative humidity in each of the lounges, measured by a data logger
- Outdoor air temperature and relative humidity outside Rieber Vista and Centennial, measured by a data logger

HVAC system in the Rieber Vista 9th floor lounge

Energy use data logger

Data Analysis Methods

Data analysis was conducted using Google Sheets. Each week, HHS Maintenance Managers sent us spreadsheets that included energy use, indoor air temperature, outdoor air temperature, indoor relative humidity, and outdoor relative humidity. We joined information from the spreadsheets into one master spreadsheet to create rows that contained data collected every 15 minutes. We also filtered the data such that the sheet excluded days when the set temperature was changed. Furthermore, we calculated the cooling and heating degree days for each time of day using the integration method, which includes taking the difference between the outdoor temperature and indoor set temperature and dividing this value by the number of 15-minute intervals in a day.

We calculated cooling and heating degree days (a measure of the difference between indoor and outdoor air temperature) to take into account the effect of this value on energy use. Finally, after cleaning and formatting the data, we analyzed the data by creating pivot tables and graphs. Each pivot table and graph was used to isolate and clarify the relationship between specific factors such as cooling degree days and set the temperature on energy use.

Note: see appendix for full schedule of the data we received.

Results

Aim #1: Analyzing HVAC energy use in lounges in Rieber Vista and Centennial depending on different set temperatures.

The SAR Energy Team utilized Google Sheets to create visualizations to elucidate trends

RESULTS

Does changing the temperature of the HVAC units in the Rieber Vista lounges significantly change energy use?

The effect of thermostat set point on HVAC energy use

Our first research question asked: Does changing the temperature of the HVAC units in the Rieber Vista lounges significantly change energy use? Our study found that controlling temperature indoors does not significantly affect the amount of energy used by the HVAC system (see Figure 1). There did not appear to be a relationship between thermostat set point and average HVAC system energy usage; while the HVAC system used a large amount of energy at the 68-degree set point, there did not appear to be a pattern for the rest of the thermostat set points. This lack of correlation could be due to the influences of confounding variables such as outdoor temperature and humidity, floors of the lounges, lounge capacity on different days, or other variables that were unaccounted for. We also suspect that the outlier at 68° F during the first week may have been due to an issue with the setup of the data logger.

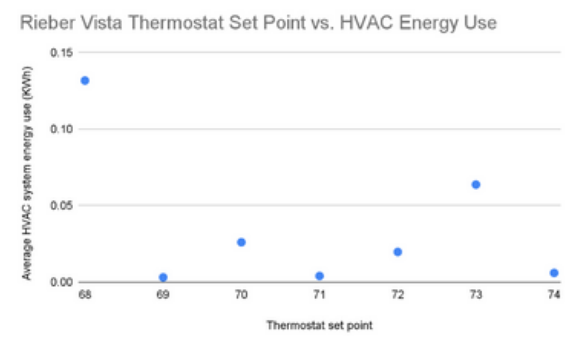


Figure 1

The correlation between cooling degree days and HVAC energy use

One potential explanation for this variation in energy usage is the fact that outdoor air temperature changed over the weeks that the data was collected. To keep in mind the effect of this variable, we compared cooling degree days to HVAC system energy use; similarly, we compared heating degree days to HVAC system energy use. Specifically, we calculated heating degree days when the outdoor temperature was lower than indoor temperature, and cooling degree days when the outdoor temperature was higher than the indoor temperature. As demonstrated in Figure 2, we found a moderate positive correlation between cooling degree days and standardized HVAC system energy usage (r = 0.509). Thus, when an HVAC system cools a room to an increasingly colder temperature relative to the outdoor temperature, the HVAC system tends to use more energy per square foot. This suggests that to save energy, building managers should set the HVAC system base temperature as close to the outdoor air temperature as possible while staying within the mandated 68°F-74°F range.

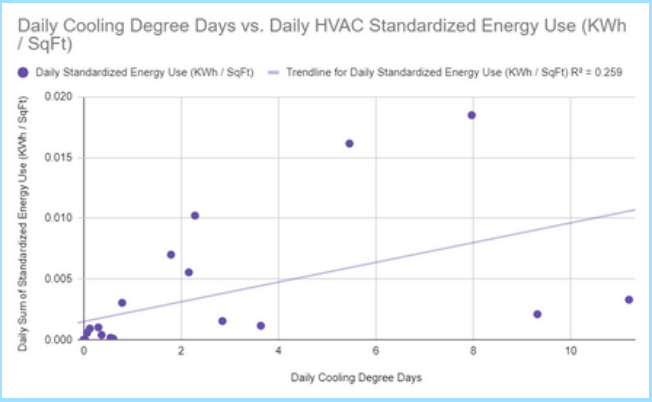


Figure 2

RESULTS

The correlation between heating degree days and HVAC energy use

We conducted a similar analysis of heating degree days. Figure 3 plots the daily sum of heating degree days against the standardized HVAC energy use (measured in kilowatt-hours / square feet of the lounge). As this graph demonstrates, there is a moderate positive correlation between cooling degree days and standardized energy use (r = 0.495). This suggests that when an HVAC system heats a room to a progressively warmer temperature relative to the outdoor temperature, the HVAC system will use more energy. Thus, to save energy, building managers should set the HVAC system base temperature as close to the outdoor air temperature as possible while staying within the mandated 68°F-74°F range.

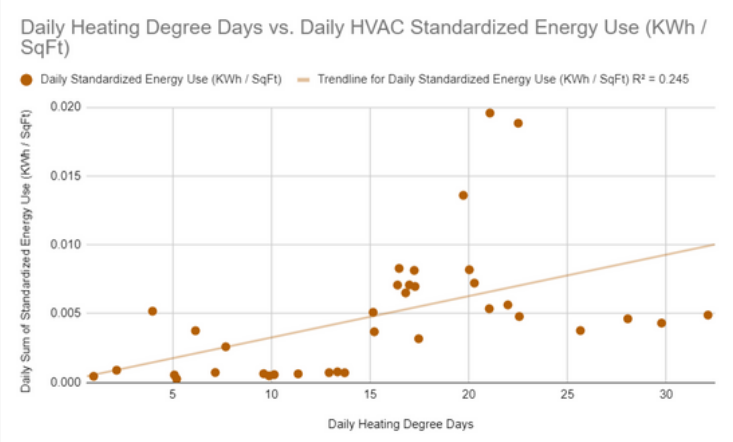


Figure 3

Differences in HVAC energy usage due to floor elevation

Using data loggers on the 8th and 9th floor of Rieber Vista introduced a new variable to our data set: floor elevation. We could not fully control for this variable. To check for the influence of elevation, we set the AC temperature at 72°F in the 8th and 9th floor lounges during week 7. We found that on average and in total, the HVAC system on the 9th floor of Rieber Vista used more energy than the HVAC system on the 8th floor, which may be explained by the fact that heat rises. This pattern persisted even when we controlled for different lounge sizes by calculating the standardized energy use (KWh / SqFt). Thus, the HVAC system on the 9th floor may have experienced a greater cooling demand.

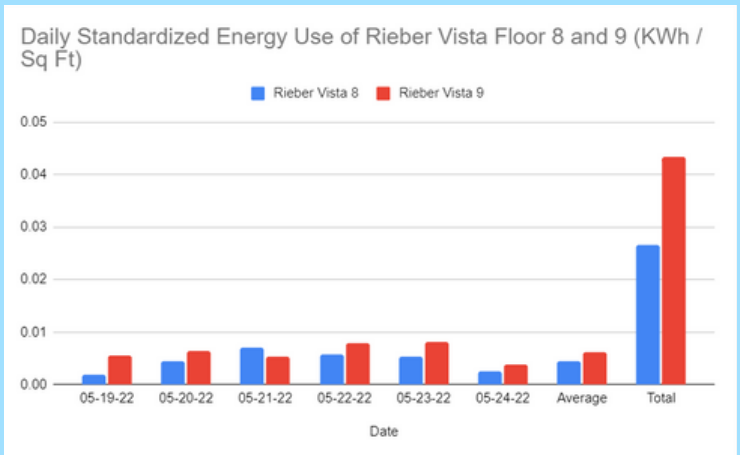


Figure 4

RESULTS

What difference does a more efficient HVAC system, such as the one in Centennial, make in terms of energy consumption?

A second part of our quantitative experiment included comparing the energy consumption of Centennial and Rieber Vista. To make this comparison, we recorded the energy use of lounges in both buildings while controlling several variables: both lounges' thermostats were set at 72 degrees Fahrenheit, the data was collected during the same time period (5/19 - 6/1), and the data was collected from the same floor level in both buildings (Floor 8). Furthermore, we standardized the data by dividing the energy use of each lounge by the lounge's area. As demonstrated in Figure 5, on average, the Centennial 8th floor lounge used 40% less energy per square foot than the Rieber Vista 8th floor lounge. This indicates that a more efficient HVAC system, such as that found in Centennial, uses significantly less energy per square foot than an older HVAC system, such as that found in Rieber Vista.

However, we also warn that these are preliminary findings and should be analyzed with more rigor. Due to time constraints and data logger limitations, energy use was only recorded for two weeks (5/19 - 6/1). Thus, we encourage future researchers to collect data for longer periods of time before making a definitive claim about the difference between the two buildings.

Rieber Vista HVAC system

Centennial Hall HVAC system

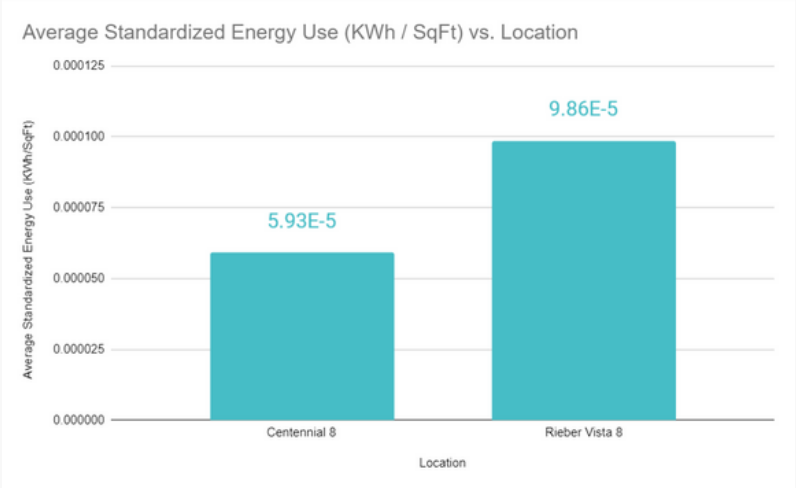


Figure 5

Summary and Limitations

Quantitative Results: Summary

- Thermostat set temperature does not have a significant effect on HVAC system energy use
- Cooling degree days are positively correlated with HVAC system energy use
- Heating degree days are positively correlated with HVAC system energy use
- The Rieber Vista 9th floor lounge used more energy than the Rieber Vista 8th floor lounge
- The Centennial 8th floor lounge used significantly less energy per square foot than the Rieber Vista 8th floor lounge

Limitations

Listed below are the limitations of our data analysis:

- Due to the short length of the program, energy use data was only collected for one quarter (3/29 - 6/1). To examine the entire range of temperatures (68 - 72 degrees Fahrenheit) within this time constraint, we collected energy use data from the lounges of two Rieber Vista floors (floors 8 and 9). In other words, the full range of temperatures was not tested on both floors
- We were only able to collect data during the springtime when temperatures are fairly moderate. Energy use findings could have been different in other seasons
- Due to the crossing of the CT wires in the Centennial Hall data logger, we were only able to collect data from Centennial for 2 weeks. Thus, we had fewer data points than we had originally planned
- We only had access to 3 data loggers, which prevented us from collecting data on both Centennial 8th and 9th floor, which would have allowed for a stronger comparison between the two buildings
- Centennial and Rieber Vista are in two separate locations. These separate locations could introduce fundamental differences between the two buildings, thus limiting our ability to compare them

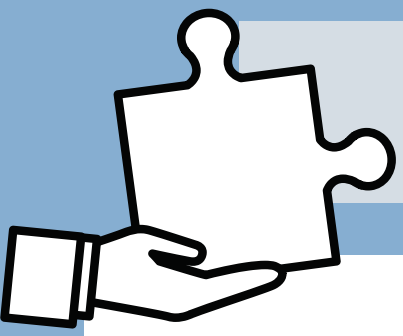
Cost Benefit Analysis

Methodology:
As previously discussed, we used degree days to standardize the amount of energy that was used in each lounge so that variable outside temperatures would not significantly affect our cost-benefit analysis. We separate each 15-minute interval into a heating degree day (when heating was used in the lounge) or a cooling degree day (when air conditioning was used in the lounge). In our calculations, we subtracted the daily outdoor temperature from the "set" base temperature for the week. For lounges on Reiber 8th floor, Reiber 9th floor, and Centennial 8th floor, we obtained the energy cost per degree day, carbon cost per degree day, and total cost per degree day.

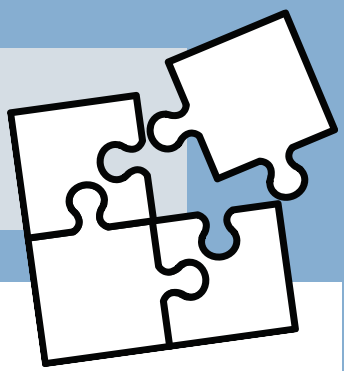
To get the energy cost per cooling degree day of Reiber 8th floor, for example, we obtained the sum of kilowatt-hours (kWh) for the period observed. Time periods that were filtered as "cooling" were added together to get the number of "cooling" degree days (CDD). We then divided the kWh sum by the number of CDD to get kWh used per CDD. Lastly, to calculate the energy cost per CDD, we multiplied the previous variable by $0.198, which is the amount UCLA pays per kWh (UCLA Energy Services).

Calculating the carbon cost per CDD requires converting kWh/CDD to greenhouse gas emissions in MTCO2E using the conversion factor of 632 pounds of CO2E in one megawatt-hour (MWh). Given that the social cost of one metric tonne of equivalent carbon dioxide is $246 (Vaughan, E., 2022), we get the carbon cost per CDD by multiplying the GHG emissions by $246. The total cost is found by adding the energy cost per CDD and carbon cost per CDD. Getting the heating degree and combined (cooling and heating) degree-day calculations, involves taking the same measures but with the data filtered for those categories. We did this for each lounge we had a data logger installed on.

Results and Conclusions of CBA:
After calculating the cooling and heating degrees for Reiber 8th lounge and Centennial 8th lounge, we found that cooling is 2.5x more expensive in Reiber as opposed to Centennial. On the other hand, heating was about 1.3x more expensive in Reiber. Overall, cooling was about 4.5x more expensive in both lounges, meaning that higher temperature degree days should be preferred over cooling degree days when setting the automatic temperature ranges in residential buildings.



Challenges



Throughout the course of our project, our team ran into a multitude of problems related to our methods and the data that we collected. To start, a majority of the preliminary data from our stakeholders and the UCLA campus housing staff was found to have a significant lack of standardization between parties. It was difficult to compare and combine values from our multiple sources as each individual spreadsheet utilized different units of energy and different abbreviations for buildings. There was also a major issue with the energy data provided for parts of the 2020 and 2021 years due to the COVID-19 pandemic that showed no quantifiable changes or trends. While some buildings' energy usage was lower during this time, others had higher energy usage which could not be explained by building occupancy.

Furthermore, there was no clear distinction between buildings in some of the energy data sets, such as Sproul Cove and Sproul Landing. Data for both of the buildings were combined and the scope of our audit was limited as there was no way to separate the two. The same issue occurred when trying to distinguish all of the De Neve buildings. For dorm buildings that contained dining halls like Rieber Terrace, De Neve, and Sproul, we faced similar issues when distinguishing dining hall energy usage from residential usage, which proved to be another limiting factor in the buildings we were trying to select for comparative analysis. Also, we were not able to record some of the data (e.g energy use per room or lounge) that we initially wanted to gather, as the existing sensors inside of these buildings were not designed to take these types of data measurements.

When older buildings on the hill were constructed, regulations for meter placement and energy usage were not as important, and as a result, submeters were placed in areas that did not track energy usage. Thus, when we examined energy meter data, we were unsure of what values the submeters were reading and where the data was coming from. Data from these submeters was also difficult to obtain as some meters recorded data automatically while others required manual readings. A combination of these issues and concerns about the feasibility of our project, given the time constraints, led our team to shift from performing a comparative analysis to examining current HVAC system energy use.

Challenges

When extracting energy readings from dorm buildings, a big challenge was communicating with housing service employees due to their busy schedules. This led to some inconsistent data sets as housing was not able to consistently extract and reprogram data loggers at the exact same time every week. As a result, some sets were longer or shorter than others, so we needed to take this into account in our final analysis. In addition, miscommunication between our team and UCLA staff members led our team to create a petition for an already solved issue. Initially, we were informed that the sustainability advocate position on the Housing Renovations Board was recently vacated. However, after we created a petition and spread the word, members of the Office of Sustainability revealed to us that a plan to fill the position had already been set in motion.

The team faced other challenges that complicated our quantitative experiment to analyze the effect of setting different AC base temperatures. For instance, several issues compromised the data we received, so we had to adjust accordingly:

- We initially planned to set the AC on Centennial's 9th floor at 70˚F, but the lounge of the 9th floor of Centennial was under service, so the data logger was moved to the 8th floor. This prevented us from using that week's data to compare the same floor of Rieber Vista and Centennial when the temperatures were at the same set point. However, we adjusted this by adding instructions to collect data from both Centennial and Rieber's 8th-floor lounges during week 5.
- A data logger disappeared during week 3, so we added an extra week of data collection for a total of 6 weeks (the original plan was to collect data for 5 weeks).
- The current transformer (CT) lead wires for the data logger gathering KWh data in Centennial Hall were crossed. Therefore, we received negative values for the energy usage in Centennial Hall for floor 8 at 70°F during week 2, Centennial Hall floor 8 at 70°F during week 5, and Centennial Hall floor 8 at 72°F during week 6. To correct for this, we added an additional week of data collection (for a total of 7 weeks) with the same conditions as were originally planned for week 6. But, due to the limited time frame of our project, we were not able to redo the data collection planned for Centennial during week 2 and week 5.

These challenges combined produced several gaps in our data sets and also led us to disregard a significant amount of data due to inaccuracies in data collection. Despite the issues that we ran into, we are truly appreciative of all the staff that continuously worked with our team and for helping us navigate our way through a tough year. We are grateful for the experience to learn and all of the valuable knowledge that everyone was able to provide.

EQUITY IN ENERGY USE

SAR ENERGY TEAM 2022

INSIGHTS FROM FOCUS GROUP CONVERSATIONS WITH LIVING LEARNING COMMUNITIES

Methodology

Aim #2: Talking about energy equity, diversion, and inclusion with Living Learning Communities on The Hill.

Interviews with 3 Living Learning Communities:
African Diaspora, Chicanx/Latinx, and Philipinx

METHODOLOGY

After creating the EDI podcast in Winter Quarter where we interviewed students about their experiences with energy use on the Hill, we wanted to continue student engagement in our research to gather wider feedback about energy use on The Hill. We applied for The Green Initiative Fund (TGIF) Funding in Winter Quarter to compensate students for their participation and prepared for three focus groups with Living Learning Communities (LLCs). The full list of focus group questions can be found in the Appendix.

Between the three focus groups, we had 12 participants discuss the following key themes:

1. **Access to Energy**
    a. Access to air conditioning is only available in more expensive dorms
    b. Nine out of 13 LLCs are located in residential halls without air conditioning
    c. Older buildings do not have a consistent energy supply (e.g. lighting, water heaters)
2. **Building Insulation**
    a. Older buildings absorb heat on sunny days and reach dangerous temperatures inside dorm rooms, even with low outside temperatures. Students in rooms without AC cannot cool down the inside temperature
    b. These buildings also do not retain heat as efficiently in the winter which increases the use of heaters in dorm rooms

FOCUS GROUP BIASES

We recognize the following sampling biases in our focus groups: The three ethnic LLCs do not represent the full set of LLCs at UCLA. The sample size consisted of 12 students. Their feedback does not represent all student opinions on energy use. Participants were invited from three LLCs based on a list of interested participants provided by each community's Residential Assistant. Our focus groups were a voluntary, financially incentivized commitment.

Results

Aim #2: Talking about energy equity, diversion, and inclusion with Living Learning Communities on the Hill.

RECOMMENDATIONS

- Dim hall lights at night
- Add motion sensors to all room lights
- Preventatively update fixtures to create long-term solutions
- Increase outlets in dorm rooms or provide free extension cords and power strips for students to rent

Note: The full methodology and list of recommendations can be found in the appendix graphic.

QUOTES FROM LLC STUDENTS

"Coming from Nigeria, we don't really get electricity...[a luxury to] be used appropriately and not waste it."

"A lot of people really aren't aware of... how much of a difference it makes to not have AC... it is hard to go out and buy your own heaters."

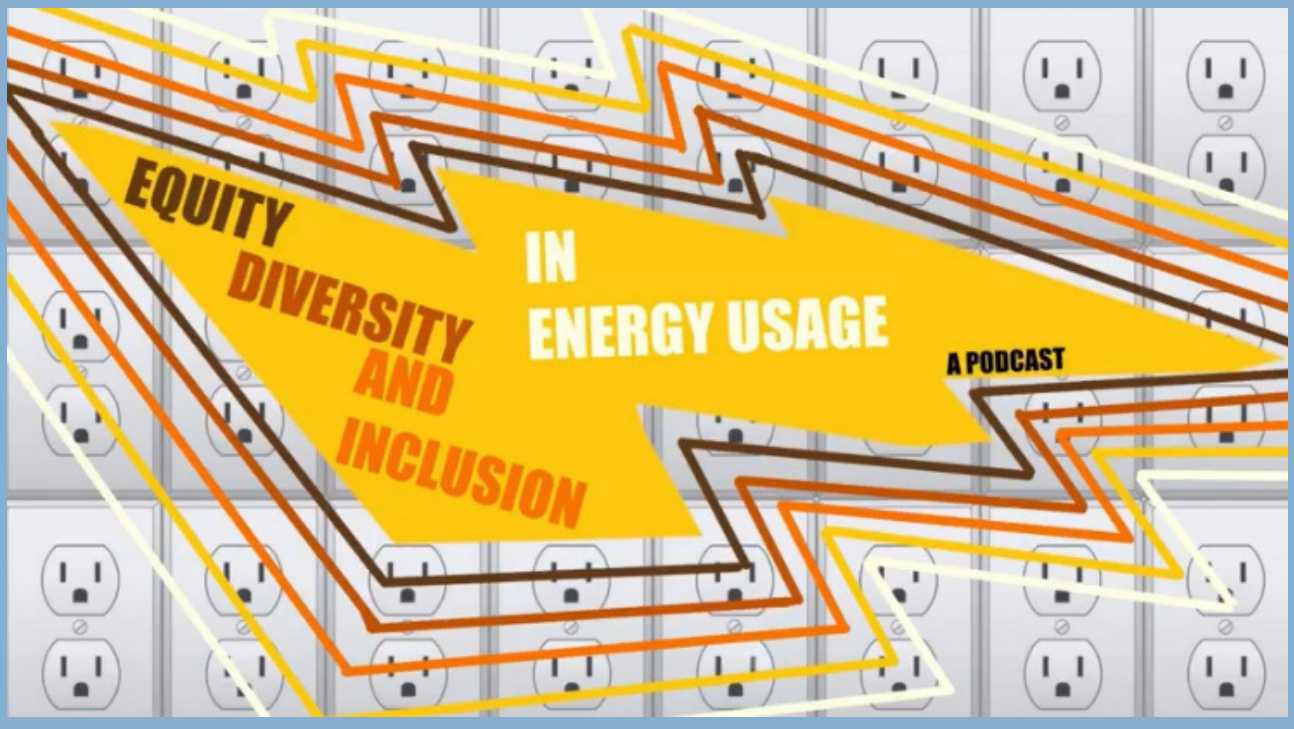
"They should also have more transparency in where the [housing fees are] going... it builds more trust."

"Make The Hill more uniform in terms of energy use and provide especially minority LLCs better facilities."

Incorporating EDI

When we began our project, we wanted to ensure that our research was serving students and incorporating components of energy justice. Communities of color and low-income areas have historically had less, inconsistent access to energy. "Energy justice refers to the goal of achieving equity in both the social and economic participation in the energy system, while also remediating social, economic, and health burdens on those disproportionately harmed by the energy system." (Initiative). Even with a limited timeframe to conduct our research, making access to energy on The Hill consistent and equitable, especially for traditionally underserved populations, was extremely important.

We were able to kickstart our project by creating a podcast about equity in energy use, for which we interviewed students about their experiences with energy. This helped inform the topic of our focus groups which were centered around identity-informed interactions with energy. We learned that for many students interviewed, access to energy is often taken for granted. Students discussing their experiences in older buildings were vocal about the inequities across infrastructure and inconsistent supply of energy. Our team encourages HHS to examine the principles of energy justice and energy inequities on The Hill to make a more equitable campus.



DISCUSSION

To conclude, our research provides UCLA with several research-based suggestions to improve sustainability and equity in The Hill's energy consumption.

First, we outline ways to reduce HVAC energy usage by optimizing the AC temperature range. Our data analysis shows a moderate positive correlation between heating degree days and cooling degree days when compared to energy usage. The closer the HVAC set point matches the outdoor air temperature, the less significant the heating or cooling degree days will be, and thus, HVAC system energy usage will be minimized. Our team has two recommendations for achieving a shift to greater energy conservation.:

1. **UCLA Housing establishes an acceptable range of HVAC setpoints for common spaces within buildings depending on the outside temperature each day.** For example, set room temperatures within 2°F of the average outside temperature within the constraints of the possible AC set temperatures: 68°F-74°F. External temperatures below this range would be set at 68°F-69°F and above this range would be set at 73°F-74°F. A further step could be limiting students' use of the HVAC system with similar constraints. Assessing students' responsiveness to these outlined HVAC restrictions could be a valuable future SAR project.
2. **UCLA Housing takes active steps toward fostering a more informed, energy-conscious student body by educating students about the actual energy used for heating and cooling dorms.** For instance, future SAR teams could collaborate with UCLA HHS to produce a student deliverable detailing energy-conservative behaviors. These steps would save money while also lowering UCLA's environmental footprint. Another SAR project could work on improving the standardization between different energy usage data sets to allow for more direct and accurate comparisons.

Second, we examined energy equity on The Hill. Our focus groups yielded unanimous agreement among all participants that they experienced energy inequities on the Hill. Upon further investigation, we discovered that 9/13 LLCs (and all of the racial/ethnic communities) reside in residence halls with the oldest infrastructure. In light of this information, we urge UCLA to take accountability for this inequity and place LLCs at the forefront of energy resources. Our team has three recommendations to address energy inequities on The Hill.

DISCUSSION

1. Housing supplies residence halls (especially older builders) with complementary extension cords, fans, and other amenities to mitigate the difficulties caused by the old infrastructure of their building.
2. Maintenance prioritizes students' requests to fix issues consistently between buildings
3. Placing LLCs in newer buildings and working to make all students' access to energy consistent by reducing the high correlation between family income and quality of housing.

The final section of our research recommendations concerns the building renovation board's sustainable advisor position. By promoting our petition, we increased student involvement and awareness of building renovations on the Hill. We hope for there to be a consistent member on the building renovations board discussing the upcoming Rieber Vista building remodel in 2025 as well as future building renovations.

Having more transparent building renovations that are accessible to the student body could have substantial impacts. If students were allowed to provide input on building plans, renovations on the Hill would reflect a community that fosters cooperative development where all voices are heard. This goal could help inform a future SAR team. We recommend that as a future project a SAR team may work alongside the sustainable renovation advocate as a stakeholder to research various approaches to improve the building's sustainability or to increase student involvement in reducing the environmental impact of their residence.

To summarize, we utilized the information we gathered through conducting HVAC energy audits, assessing energy inequities on the hill through LLC interviews, and creating a petition to call for increased student involvement and transparency in building renovation to develop a set of guidelines to help UCLA improve its sustainability and equity in terms of energy usage. Learning to navigate the bureaucracy of UCLA was an eye-opening experience for our team and left us with a newfound understanding of the challenges associated with implementing large-scale change. Despite the many obstacles we faced, our team was humbled by seeing how our work and collaboration could inspire meaningful change in our campus infrastructure and community. We hope to see UCLA Housing leverage the information we provided to ignite conversations that could lead to a more equitable energy allocation and greater energy conservation.

Appendix

Petition Methodology and Results
Schedule of Data Received
LLC Focus Group Results Infographic
LLC Focus Group Questions
Acknowledgements
References

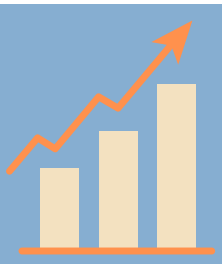
PETITION METHODOLOGY & RESULTS

Our team made a petition advocating for increased transparency in building renovations and for a sustainable advocate to be placed on the building renovations board. We came to this decision after our walkthrough with UCLA HHS Maintenance who communicated they sometimes did not prioritize sustainable infrastructure over cost-efficient infrastructure and that there is currently no official role within the building planning to uphold environmental building activism.

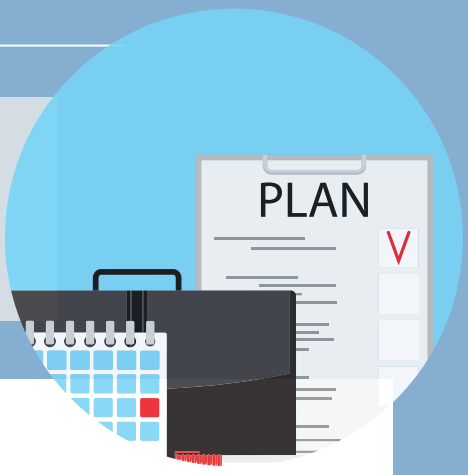
Building remodels are conducted every 10 years and we hoped that our petition would encourage greater emphasis on sustainability when designing these remodels as well as greater transparency. After writing a brief explanation of our goals and placing it in a petition on change.org, we created a QR code and infographic to gain student support. All team members conducted outreach through social media, printed flyers, and presentations in class, reaching 83 supporters.

However, our team ended the petition once we were informed by a third source that the Housing Sustainability position did exist but was vacant for the duration of our research period. We were also informed that UCLA is actively recruiting to fill this role.

Despite this misunderstanding, we hope the petition will still show the student support of a consistent member urging sustainability on the board overseeing the Hill's buildings' renovations. We also hope the petition demonstrates the need for increased student involvement and transparency in the Hill's future infrastructural changes.



SCHEDULE



Week 1: 3/28-4/6

Outside temperature

Rieber Vista Floor 8 energy use and inside temperature at set point 68F

Rieber Vista Floor 9 energy use and inside temperature at set point 69F

Week 2: 4/6 - 4/12

Outside temperature

Rieber Vista Floor 9 energy use and inside temperature at set point 70F

Centennial Hall Floor 8 energy use at set point 70F (inaccurate)

Week 3: 4/13 - 4/20

Outside temperature

Rieber Vista Floor 9 energy use and inside temperature at set point 71F

Week 4: 4/21 - 4/26

Outside temperature

Rieber Vista Floor 8 energy use and inside temperature at set point 73F

Rieber Vista Floor 9 energy use and inside temperature at set point 74F

Week 5: 4/27 - 5/3

Outside temperature

Rieber Vista Floor 8 energy use and inside temperature at set point 70F

Rieber Vista Floor 9 energy use and inside temperature at set point 71F

Centennial Hall Floor 8 energy use at set point 70F (inaccurate)

Week 6: 5/4 - 5/10

Outside temperature

Rieber Vista Floor 8 energy use and inside temperature at set point 72F

Rieber Vista Floor 9 energy use and inside temperature at set point 72F

Centennial Hall Floor 8 energy use at set point 72F

Week 7: 5/18-5/24

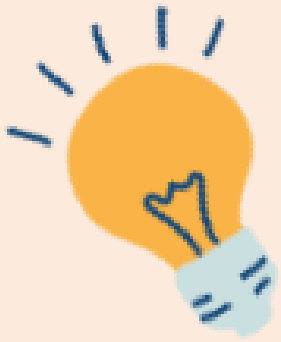
Outside temperature

Rieber Vista Floor 8 energy use and inside temperature at set point 72F

Rieber Vista Floor 9 energy use and inside temperature at set point 72F

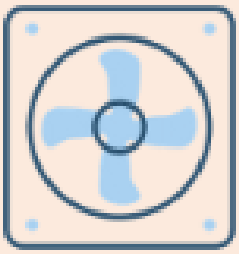
Centennial Hall Floor 8 energy use at set point 72F

*Note: some data received is not mentioned due to inaccuracies in the data or project relevancy.



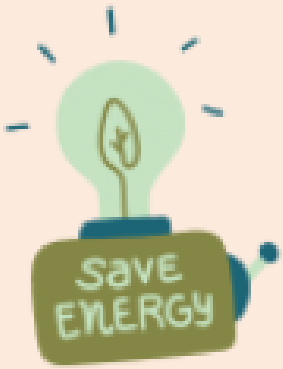
Equal access to Energy

- Access to air conditioning (AC) is directly based on income
- Older buildings to not have consistent energy supply



Building Insulation

- Older buildings absorb heat reflected from pavements and warm more than the ambient air temperature
- Poor insulation does not preserve heat in rooms in the winter



Energy Saving

- Dim hall lights at night
- Add motion sensors to all rooms
- Fix issues for long-term solutions

Recommendations

- Access to AC for all students on the Hill
- Preventative updates to fixtures
- Increase outlets in dorm rooms
  - Provide free extension cords and power strips for students to rent

Focus Group funding provided by

the green initiative fund

Focus Group Questions

1. What are your experiences with energy?
2. What are your experiences with energy on The Hill?
3. Has your identity shaped your experience? If yes, how? please be specific and if not, why do you think that?
4. Do you feel like energy on The Hill is inclusive of people from all backgrounds?
5. How would you describe the degree to which energy use on The Hill is inclusive of or accessible to people from all racial/ethnic backgrounds?
6. What do you value most about energy use?
7. Do you think your identity is important to represent in conversations about energy and building remodels? Why/why not?
8. What can housing do to make energy use on the hill more inclusive?

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- **Bill Gonzalez**
- **William Herrera**
- **Ronnie Flores**
- **Scott Bowling**

UCLA Living Learning Communities:

- **Afrikan Diaspora**
- **Chicanax/Latinax**
- **Philipinax**

The SAR Project Directors and Communication Team

- **Phoebe Chiu** (Project Director)
- **Maddie Wilson** (Project Director)
- **Eric Ha** (Communications Director)
- **Ruhena Randhawa** (Communications Director)

References

Climate & Energy. (n.d.). UCLA Sustainability. Retrieved March 11, 2022, from https://www.sustain.ucla.edu/climate-and-energy

Fong, D., Savarani, S., Lau, T., Lee, C., & Nguyen, R. (2013). ESLP Energy Efficiency Action Research Team 2013. Retrieved January 25, 2022, from https://www.ioes.ucla.edu/wp-content/uploads/ARTEnergyFinalReport.pdf

Initiative for Energy Justice. (2022, June 7). Retrieved June 9, 2022 from https://iejusa.org/

Smart Buildings & Labs Program. Facilities. (2021, June 30). Retrieved March 11, 2022, from https://ww.facilities.ucla.edu/smart-buildings -and-labs-program

Smithers, J., Cun, S., Geene, W., Graycar, K., Amirapu, A., Woods-Robinson, R., & Clark, A. (2012). Campus Energy Action Research Team 202. Retrieved March 11, 2022 from https://www.ioes.ucla.edu/wp-content/uploads/Energy_Final_Report-e4-c1j.pdf

UCLA Energy Services. Facilities. (2022, March 21). Retrieved June 9, 2022, from https://facilities.ucla.edu/energy-management-building-controls

UCLA Sustainability. (2022, April 22). UCLA Sustainability Plan. Los Angeles.

Vaughan, E. (2022). (rep.). *University of California Implementation of a Social Cost of Carbon 2022*. Retrieved June 9, 2022, from https://docs.google.com/document/d/19Cz04iBqAAzGeL4uKTvMO84uoo7Bwwr4fCD_xymgjyE/edit.