2025 SAR Tracking Energy at the UCLA Apartments Team Final Report:

Establishing a Baseline Energy Audit for UCLA's Boulevard Apartments.

UCLA
Institute of the Environment and Sustainability

Team Co-Leaders: Selena Yu and V Malian

Team Members: Diya Gopinath, Liam Jenny, Clairese Wright, Leah Acosta, Kayla Yeung

Stakeholder: Brianna Moncada, Sustainability Manager, UCLA Housing and Hospitality

Abstract

Managing and tracking energy use is a vital aspect of UCLA Housing and Hospitality's sustainability plan. Improving energy efficiency can help UCLA reach the goals listed in its Climate Action Plan and Energy Conservation Program, as well as provide both long-term economic and sustainable benefits. UCLA Housing has noticed that the Boulevard Apartments at 1500 Granville Avenue and 1515 Granville Avenue have displayed unusually high energy consumption for the size and occupancy of the buildings. Our project aims to establish a baseline energy audit based on the hours of operation for all appliances throughout the building and the known energy efficiency of different appliance models used in the building. We hope to accomplish this through our compilation of audit data, housing data, and information obtained from building managers. Our research answers: *How can we establish a baseline for energy usage at UCLA's Boulevard apartments?* and: *How do residents and housing staff at the Boulevard think energy usage can be managed?* We used a focus group with Housing departmental heads, a resident survey, several informational interviews, and an energy audit of 1500 Granville to answer these questions. Our methods reveal energy usage habits of some residents and issues that maintenance has experienced when managing the building. Our findings include potential improvements to the Boulevard, such as more efficient lighting, thermostats, and other appliances, which have the potential to curb energy usage.

Table of Contents

Introduction

UCLA's commitment to sustainable efforts on campus expands to its housing department's energy-efficient initiatives for its off-campus apartments. For these apartments, the department's initiatives include incorporating ENERGY STAR appliances, LEED certifications for new constructions, switching to LED lightbulbs, as well as collaborations with the Los Angeles Department of Water and Power (LADWP) (University Apartments, n.d.). These sustainable energy efforts have significantly affected the development and maintenance of the Boulevard Apartments; which are UCLA's graduate student housing located a couple of miles southwest of the main campus. Our research question is: *How can we establish a baseline for energy usage at UCLA's Boulevard Apartments?* UCLA's Boulevard apartments include 1500 Granville Avenue and 1515 Granville Avenue in Sawtelle; however, 1500 Granville is the building that we will be primarily focusing on for its larger inconsistencies and energy usage. We believe that this energy variability is due in part to inefficient appliances, lighting, thermostats, and other high-energy contributors found throughout the building in its residential units and in communal spaces.

Previous research conducted by SAR groups has focused on energy efficiency on the Hill, and at Perloff Hall, we plan on building upon this work by applying similar methods to our research (Energy Conservation Behavior, 2022; Energy Reduction, 2023). To understand the energy usage at the Boulevard, we planned on employing several of the data calculation and collection strategies previously used by past SAR teams. The primary variables of our study include kilowatt hours (kWh), time, and the opinions and knowledge of residents and building managers. We have compiled qualitative data from observations, interviews, and survey responses to gain a deeper understanding of the potential experiences of residents. Furthermore, it was essential to hear from a diverse group of individuals, including housing and energy experts, as well as those who reside in the building and will be directly affected by potential changes. Quantitative data includes the wattage, estimated kWh of appliances and units in the building, and the count of types of appliances throughout the building. The goal of this project was to calculate with as much accuracy as possible a theoretical baseline for yearly energy usage at The Boulevard based on the electricity use observed. Establishing this baseline has the potential to identify further areas for improvement or investigation by UCLA Housing & Hospitality. By identifying these areas that need further investigation, our project will allow for more energy-efficient practices and management in not only The Boulevard but also other off-campus UCLA-managed buildings.

Methods

Throughout this project, a combination of energy audits, data analyses, resident surveys, and expert focus groups was conducted. These were specifically chosen so as to provide us with a multidimensional understanding of the energy usage anomaly of the Boulevard Apartments. Both data collection and data analysis are crucial for the goals of this project, and the mixture of methodologies utilized proved effective in allowing the team to draw informed conclusions and recommendations.

Residential Survey

A survey of the Boulevard apartment residents was performed during the Spring Quarter. The goal of this survey was to gain a deeper understanding of residents' day-to-day usage of energy. This information was intended for the use of a baseline energy consumption calculation, as well as for determining whether unit-by-unit energy usage was influencing the anomalous energy intake of the Boulevard Apartments. To implement into our report the concerns that residents have, we also included a Qualitative Questions section (see Appendix C) to inform our final recommendations. An Equity, Diversity, and Inclusion (EDI) component was integrated into the survey component of our methodology through the opportunity it posed for all residents to be involved in research and in future building-wide changes.

The residents were informed of the survey starting in late April, and it remained open for about 30 days. Communication of this survey consisted of a flyer posted on every resident's door, as well as a mass email to all residents. Though the survey was voluntary-response, it was incentivized through three fifty-dollar rewards funded by The Green Initiative Fund (TGIF). The flyer included a Quick Response (QR) code, which led respondents to a Google Form questionnaire with four sections: Personal Information, Background Information, Energy Usage Habits, and Qualitative Questions (see Appendix C). These sections aimed to establish an understanding of the respondents' interest in sustainability, external appliance use, personal habits, and concerns, respectively.

Energy Audit

We conducted an energy audit to get an understanding of the Boulevard’s energy usage, problem areas, and energy inefficiencies. We first started by doing an initial walkthrough of the Boulevard in mid-February, to understand the kinds of equipment, get a feel for the space, and collect some initial model numbers. This also provided insight into the areas of the Boulevard that would require special attention, such as the roof area with solar panels and the parking garage attached to retail spaces. Next, we conducted a focus group with the heads of various departments at UCLA Housing, as well as other available staff members. The goal of this focus group was to understand what kinds of equipment UCLA Housing currently uses, as well as the methods used for energy saving. We especially wanted to draw on the expertise of specific departments, including HVAC (heating, ventilation, and air conditioning), lighting, and plumbing. See Appendix A for the questions participants were asked. This focus group helped us determine what we should focus on and what kinds of data we should gather during the energy audit.

After preparing spreadsheets with what data we would like to gather at each building, we conducted two full energy audits in April, one at 1500 Granville and one at 1515 Granville. To conduct the audit, our team split into three groups: parking garage/roof, in-unit, and hallway. We initially encountered some challenges with getting access to different parts of the building at the same time, but later, for the second audit, we worked with maintenance staff to more effectively split up and work in parallel on different sections. All teams took photos of each type of light, noted the location, and how many of each type. Each team also noted different electricity-using equipment present in their sections. The parking garage/roof team surveyed solar panels, electric vehicle charging stations, fans, and other equipment. The in-unit team focused on refrigerators, laundry machines, dishwashers, and similar appliances. Lastly, the hallway team noted gym equipment, pool pumps, and community lounge appliances.

After collecting these data, the next step was to cross-reference against floor plans and consult with our stakeholder, Brianna Moncada, to identify the model numbers of lights and appliances from their respective photos and locations.

Data Analysis

With access to LADWP billing sheets and UCLA metering data, members of our team were able to better visualize the problem at hand. These sheets contained a plethora of data, including metric variables such as kilowatt hours distributed and the associated price for said power, as well as variables that express energy efficiency, such as the power factor. The billing sheets from LADWP are non-standardized compared to other data sheets we have access to through UCLA metering systems. In order to come up with a comparison metric that would create a baseline standard across all of the data we had access to, we sought insight from an Energy Analyst from UCLA Facilities Management, who advised us to focus on specific independent variables, such as occupancy and square footage, to create these standards. To this extent, we visualized the data at hand in three categories – total energy consumed (kilowatt hours), energy consumed by building square footage, and energy consumed by building capacity. In this manner, we were able to analyze energy consumption at 1500 Granville Avenue (one of the complexes within the Boulevard Apartments) and compare this to consumption at two other off-campus UCLA Housing residences – Gayley Heights and the Southwest Apartments. These residences were chosen as a comparison point due to their relatively new construction and commendation for sustainability efforts.

Challenges

Establishing a comprehensive energy baseline and conducting detailed audits for the Boulevard apartments presented a range of challenges, both technical and logistical. Throughout the two quarters of working on this project, we encountered evolving obstacles that not only shaped the trajectory of our research but also deepened our understanding of the complexities involved in real-world energy assessments. Addressing these challenges was crucial to refining our methodology, understanding energy data, and laying the groundwork for actionable sustainability recommendations.

During the winter quarter, one of our biggest obstacles was accessing resources as students, particularly, securing facility access and the building's energy data/information. Without having any connections to the building due to being undergrads, we had to rely heavily on our stakeholders to acquire this information. Additionally, our team faced challenges related to conflicting busy schedules and a lack of prior knowledge on topics such as HVAC systems and energy tracking. This made it difficult to interpret the data provided and also to find a suitable program that aligned with our skill level for establishing a baseline for the building's energy usage. On top of this, working with the data presented its own hurdles, as we encountered missing or inconsistent data points, which required extra effort to interpret.

Moving into our spring quarter, our challenges shifted towards refining our project scope, organizing our audit data, and gathering information about all energy contributors in the building. After spending winter quarter laying the groundwork and developing a feasible plan, we realized our project had become too broad and needed a clearer direction. We decided to narrow our focus to just 1500 Boulevard due to the given data we received and also the higher likelihood of coming up with a solid deliverable within our timeframe. Organizing our audit data proved to be another major challenge this quarter. We had gained information and data from our various sources - survey, audit, focus groups- but we discovered compiling all this information into tables was more complex than anticipated. While doing this, we needed to standardize the information, ensure accuracy among results, and resolve any inconsistencies so it could effectively inform our analysis.

Additionally, identifying all the energy contributors in the building was a more detailed task than we initially expected. Beyond just major appliances or lighting, we had to consider hidden or indirect energy uses such as water heating, phantom loads from electronics, and HVAC systems operating at inefficient settings. This process involved not only technical research but also communicating with building management and residents to fully understand usage patterns. These spring quarter challenges pushed us to think critically, collaborate more effectively, and build a more complete picture of the building's energy landscape. We also found that gathering information about all energy contributors in the building was a more detailed task. Beyond just basic lighting and appliances found in the Boulevard, we had to take into consideration solar, HVAC, and water heaters operating at inefficient settings. This process involved not only a lot of technical research but also communication with building management to take into account all energy contributors.

From these challenges, we gained important knowledge that enhanced both our technical and collaborative skills. We learned the value of early stakeholder engagement to secure critical access, the importance of maintaining clear internal communication, and the need to be adaptable when faced with incomplete or inconsistent data. Through navigating real-world complications like scheduling constraints, missing information, and a steep learning curve in energy systems, we developed greater resilience and problem-solving capabilities.

Ultimately, overcoming these obstacles helped us grow as researchers and collaborators. Each difficulty required us to think creatively, seek external guidance, and work together to adapt our strategy. These lessons not only strengthened the outcome of our project but also prepared us to approach future sustainability challenges with confidence and flexibility.

Results

Residential Survey

After having our Survey open for about 30 days, we received responses from 27 residents of the Boulevard apartments. There was a generally even response rate between 1500 Granville and 1515 Granville. However, due to the low response rate between the buildings, the results discussed in the present section cannot be generalized to all residents of the Boulevard apartments. The average interest in sustainability across respondents was 3.5 on a scale from 1 to 5, where 1 was not interested and 5 was most interested. In light of the general interest in sustainability, it is important to note that because the survey was voluntary, response bias must be taken into account. Issues in interpreting the submissions of open-ended questions also posed another challenge for data representation.

To integrate the concerns of residents into our final suggestions, the team filtered through the residents' Qualitative responses so as to inform our recommendations outlined later in the report. In this way, the team ensured that future actions taken to mitigate the energy consumption anomaly of the Boulevard Apartments had the opportunity to be informed by the residents who live there, and in turn, implement a level of EDI into the project.

The average reported energy usage by respondents for the top three most-used appliances was 6.8 hours for lights, 6 hours for air conditioning, and 5.5 hours for fans. The use of dishwashers, washers and dryers, and stoves was all less than two hours daily. Among the reported external appliances used by the residents, lamps were the most prevalent response, with multiple residents listing the use of 5-6 lamps. Across all respondents, the average was about two lamps per person (see Appendix D). Reported thermostat settings averaged at 71.9 degrees Fahrenheit during the summer and 71.4 degrees Fahrenheit during the winter.

Though lighting seems to be a major energy consumer at the Boulevard apartments, when comparing light usage to the United States averages, in which lights are used for about 6.4 hours daily, there does not seem to be anything anomalous (Gifford et al., U.S. Department of Energy, 2012). Overall light usage tended towards the later afternoon and night hours, though they generally were used for all 24 hours of the day, which may be informed by the lifestyles of the residents, as more than 70% of them are either medical residents or graduate students.

Qualitative survey questions gave further insight into the energy use habits of the respondents. For one, when asked about their use of the appliances in communal spaces, all but two respondents answered that they do not use them. The fridge and TV were the only appliances reported for use. When asked about any outstanding issues they residents have experienced that may contribute to excessive energy consumption, the majority of concerns were related to water temperature issues, poor lighting and the need for lamps, and issues with the air conditioning. Energy conservation practices reported by the respondents were primarily those of turning off the lights when not being used, and overall limiting appliance use. All but a single respondent reported performing at least one energy conservation practice.

Energy Audit

After compiling model numbers, we calculated overall energy usage in a couple of different areas. First, for in-unit usage, we used the average daily reported usage for lights and appliances to calculate the total watt-hours of the major electricity-using equipment for each unit type: Studio, One Bedroom, Two Bedroom, and Three Bedroom. (Below is an example calculation for the studio apartment type.)

Figure F1

	Unit Type:	Studio			
	Appliance:	Wattage	Count/Unit	Avg Daily Usage (Hours)	total (Wh)
lights	HR-LED90	5W	4	7	140
	NLCBC-45	13W-16W	1	7	101.5
	VL10323	16W	1	7	112
	KITCHEN HANG	9W	2	7	126
closet light	SLD606-9-30 WI	9.75W	1	1	9.75
kitchen light	"16' LED Linear LS-LM22190-12	50W	~10 ft	7	350
kitchen light	EL-5061 ENERG STAR Interior Ceiling Pendant Lighting Fixture	6W	2	7	84
Balcony Light	WS-W61806AL	9W	1	1	9
oven	Whirlpool Electri	3000W	1	0.744	2232
microwave	Whirlpool 1.7 Cu	1920W	1	0.1	192
refridgerator	Whirlpool 19.2 c	747.5W	1	8	5980
laundry machine	Whirlpool 3.5 cu	7200W	1	0.24	1728
dishwasher	Whirlpool Dishw	1200W	1	1.26	1512
thermostat	Honeywell TH83	0.17W	1	24	4.08
				Per unit (kWh/da	12.58033
		Total Studio Count:	30		

For the two-bedroom and three-bedroom apartments, we multiplied the applicable appliance usage by two and three, respectively. For the appliances where we did not have data from residents, such as for the microwave, we made assumptions based on the nationwide reported daily average usage. After accounting for all units, we found that if 1500 Granville were to operate at full capacity, **the 150 units would use an expected 793,304 kWh/year**. It is important to note that the Boulevard Apartments averaged 85.41% occupancy in 2024.

We based our HVAC calculations on the reported HVAC size used for different unit types. After adding up total horsepower and converting into watts, we found that with our survey results of using AC for 6 hours a day, this means **1500 Granville uses approximately 880,000 kWh/ year for HVAC purposes**.

Finally, the remaining large category of energy usage is lighting. For hallway calculations, we made general estimates for lengths from the floor plan to find the usage for the LED light strips that line the hallways. We assumed hallway lights were on 24/7, as well as most main building lights. We also took into account the motion sensors attached to some of the lights, such as those in the garage and those in the stairwells. We assumed all outdoor lights were on 24/7 because when we conducted our audit around midday, all exterior lighting was on. Overall, we found that the **main building lights consume approximately 45,900 kWh/year,** and the **outdoor lights consume approximately 49,200 kWh/year.**

Please refer to Appendix F for details on our calculation spreadsheets.

<u>Energy Audit Limitations</u>

I. Assumptions on daily average usage

For in-unit appliances, microwave usage and laundry machine usage were estimated based on an informal survey of community members, which limits our accuracy. There are also limitations in generalizing our survey averages to the entire Boulevard population, especially with a small sample size.

II. Missing or inaccurate appliance/lighting information

Despite looking at floor plans and extensively gathering model numbers and photos for the appliances/lights at the Boulevard, we still had some missing information, including some exterior lights, balcony lights, and elevator lights. We based our calculations for missing items on the wattage of similarly sized/shaped lights/appliances for which we had information. We heavily relied on floor plans to obtain model numbers based on location and photo comparison, but with some of the appliances we took photos of the model numbers for, there were discrepancies between the reported model on the floor plan versus the actual appliance in the building. This led to some limitations from using our original method of relying on the floor plans due to the newness of the building and assumptions about the accuracy of the floor plan. Some lights had several different potential wattages depending on the specific type or installation of that particular model. Since we did not have access to the exact wattage information or specific version of the models, we relied on ranges or estimates based on the potential wattages in the lighting proposal document.

Additionally, we had to make assumptions for lights we were unable to measure by counting, since we were unable to physically measure all of the LED lights with customizable lengths for strips. This was based on the floor plans and the estimated lengths of the hallways where we observed these types of lights. This goes for the LSG40 hallway lights, which were placed almost entirely across both sides of the hallways, with some separation that made them difficult to measure. Because of this obstacle, our estimation for the length of these lights and total energy use may be inaccurate or range somewhere around our calculations.

III. Lack of access to specific areas

Because we lacked access to roof areas, we based our HVAC calculations on floor plan information, which, as mentioned above, is not necessarily accurate regarding the equipment in place. Rooftop solar could also be evaluated further if given more roof access. We also were not able to enter every unit type. In 1500 Granville, we were not able to view a 3-bedroom apartment.

Recommendations

Upon evaluation of our quantitative audit results, in conjunction with the insight gained through our qualitative survey and focus group interviews, we prepared multiple recommendations that could employ instant or near-future reductions in energy consumption and an increase in overall sustainability. These recommendations offer a baseline of improvement strategies targeted at the areas we deemed most needing attention in the Boulevard apartments, as deduced from our audit and research.

Behavioral Recommendations

Through our surveys, we gained a strong insight into the residents' behaviors, their energy consumption practices, and their opinions of the Boulevard apartments. Analyzing these results informed our behavioral recommendations, which were geared towards both the residents and the Boulevard staff on how to be more sustainable. We focused these behavioral recommendations primarily on built-in appliances, such as the lighting and HVAC systems that come with each apartment unit. Our survey did not gather enough external appliance information for us to make any holistic recommendations for these individual items, so they are omitted from these recommendations considerations.

On average, HVAC systems consume the most energy out of the standard appliances one would find in a Boulevard apartment. Although systems themselves may be energy efficient, long-term use of heating and cooling to control the temperature of an apartment will have large energy demands, which, when considered on a building-wide scale, will be responsible for a majority of energy costs. In our survey, residents reported that the average temperature of their apartment in winter and summer differed by only half a degree, ranging from 72.5 to 72 °F, respectively. Currently, residents can set their thermostats to a wide range of temperatures, allowing some to unnecessarily heat or cool their apartments. HVAC systems have exponentially increasing energy needs the more the system must combat the ambient temperature, especially when it comes to heating. Controlling the bounds of residents' temperature settings, even by a single further degree, will save thousands of dollars per individual apartment. In consultation with an energy engineer, we calculated rough estimates of saving potentials and discovered that increasing the minimum cooling temperature by one degree could save as much as $12,233.00, and decreasing the maximum heating temperature by one degree could save $6,116.50 per year. More information on acceptable minimum and maximum ranges would be necessary, in order to keep in mind the residents' temperature needs and comfort in tandem with sustainable efforts.

Through our focus group and talks with other energy consultants who aided in our research, we were able to learn more about the Nest thermostat, which is effective in curbing energy consumption through HVAC uses and bringing down costs. These Nest thermostats can save an average of 10%-12% on heating bills and 15% on cooling bills. Other benefits of this system include its ability to provide residents with insights on heating and cooling habits to optimize home energy usage, and geofencing, which allows for temperature adjustments when no one is present in the unit. While the Boulevard Apartments are currently equipped with the Honeywell thermostats, the ES-labelled Nest thermostats are an important consideration to take into account when discussions arise on appliance upgrades or replacements in these residences.

While individual changes to lighting usage have a small impact on energy savings, long-term commitment to best practices can reduce energy consumption dramatically, both in the amount of Watts used and in extending the lifespan of bulbs and diodes. Upon conducting our audit, members of our team found many lights left on throughout the building in areas with no to little active occupancy. In communal recreation areas, decorative lighting fixtures were found despite the complete lack of residents using these spaces. Our garage team found many storage closets and maintenance rooms, ranging in purpose, which maintenance staff reported using some of these rooms rarely, if at all. Despite this, many of them were found to have lights left on at all times. Another area where we noticed high unnecessary energy usage was for outdoor lighting, where facade lighting and planter lights were on during the day when we visited the site. This led us to believe that these lights operated 24/7 and were not on any timer. The effect of these lights was negligible during the daytime, and could be made more efficient by being put on a photosensitive timer or manually turned on and off depending on need. Many lights left on throughout the building will steadily accumulate massive energy waste and spending on unnecessarily high electricity bills. Enhanced sustainability communication, in the form of emails, flyers, or digital posters, could help keep residents' lighting usage in mind, especially if posted near or around these communal spaces. Additionally, further emphasizing lighting awareness with maintenance staff can ensure any rooms not in use are not inadvertently being kept illuminated. Building staff may be able to make inexpensive changes to the current lighting systems, simply by adjusting hours of operation for certain types of unnecessary light usage.

When conducting our audit, we were informed that practically all of the units had individual meters to track the energy consumption on a unit-by-unit basis. Despite this, residents themselves do not presently have access to any of their itemized consumption information. Increased transparency and access would allow residents to better understand their energy practices and make more informed decisions about how they use and think about energy. We think these behavioral recommendations would make a fair difference, as many residents expressed interest in learning about and being better practitioners of sustainability. Respondents to the survey averaged 3.5/5 on the sustainability interest scale, with many indicating a 5.

Recommendations for Future Areas of Study

I. LADWP AC Optimization Program

Based on our survey and audit results, participation in the LADWP AC Optimization Program would greatly benefit the Boulevard, so we recommend looking into the energy savings that the Boulevard would gain from this program. The AC Optimization Program has been used previously by UCLA Housing at other off-campus apartments and is planned to be implemented in 2026. This program includes services like cleaning outdoor coils, replacing air filters, and installing smart thermostats, such as Nest thermostats, at no cost. With the recommended programmable thermostat setting to be 78°F in the summer and 68°F in the winter, this would create up to 6°F of temperature control saved in the summer and about 4°F of temperature control saved in the winter, based on resident survey responses. This could lead to savings up to $73,398/year by increasing the minimum cooling temperature, and $24,466/year by decreasing the maximum heating temperature.

II. Insulation Study

During our audit, we noticed that the layout of the Boulevard was quite different from other UCLA off-campus apartments, specifically with the open floor plan where there is no roof covering the entire building, so units on the top floor are exposed to the outdoors on the interior walls too. This likely causes more heat exchange between these units than other apartment units would have, as well as decreasing the buildings' overall insulation abilities. When looking through floor plans, we also found that the insulation material used at the Boulevard does not have especially high R-values, so coupled with the AC habits of residents, this could be a major driver of where the Boulevard's excess energy use is coming from: temperature regulation. Thus, we recommend further research into the thermal performance of the building, including heat loss through exposed surfaces and the effectiveness of existing insulation.

III. Automatic Sensors

As identified above, our group members noticed a large amount of energy consumption being wasted on lighting spaces with no occupants. While we recommend enhancing sustainability communication to correct the behavioral portion of this issue, equipment can also be installed where presently lacking to save energy. Many lights in the garages of the Boulevard apartments had motion sensors equipped, which, when triggered, brightened the output from a standard dimmed setting to full illumination. While a good start, many of the peripheral rooms and lighting systems lacked any form of automation, wasting energy unnecessarily. Although upfront costs for automation installation are high, preliminary research found that effective auto-dimmers' individual first-time costs can range from $2.89 - $42.39. These upfront costs, although economically inefficient upon first-time installation, will gradually accrue savings over their lifetime usage, reducing the number of hours on and the amount of power needed to illuminate the space at a lower luminosity setting. Further research into the most effective models, the number of needed dimmers, and a time series cost-benefit analysis of installation savings could prove an incredibly rich and sustainability-oriented project. Energy savings would begin accumulating instantly upon installation, and as such, we think future research into sensor-based dimmers should be made a priority.

Discussion

Significance

The significance of the project, Establishing a Baseline Energy Audit for UCLA's Boulevard Apartments, lies in its essential role in advancing UCLA Housing and Hospitality's sustainability goals by specifically addressing the unusually high energy usage observed at the Boulevard Apartments. By creating a detailed and precise baseline of current energy consumption, this research provides UCLA Housing with the critical data needed to identify and target areas of inefficiency within apartment units and communal spaces. The comprehensive approach—encompassing rigorous energy audits, in-depth resident surveys, expert consultations, and comparative data analyses—allowed for a thorough understanding of existing energy usage behaviors and structural inefficiencies. Specifically, our audit illuminated energy-intensive practices and appliances such as inefficient lighting, thermostat management, and HVAC usage. Furthermore, engaging residents directly through surveys not only enriched our data with valuable qualitative insights but also fostered greater community awareness and involvement. Residents' expressed interest in sustainability highlighted a clear opportunity for impactful behavioral interventions. Overall, this project equips UCLA with actionable insights and practical recommendations, such as implementing smart thermostat technology, adopting enhanced lighting practices, and improving insulation. These recommendations provide a clear pathway toward reduced energy consumption, substantial cost savings, and a more environmentally responsible housing community, thereby reinforcing UCLA's broader commitment to sustainability and environmental stewardship.

References

Australian Government. "Conduct an Energy Audit," Department of Climate Change, Energy, the Environment and Water, www.energy.gov.au/business/energy-management-business/1-understand-your-energy-use/conduct-energy-audit.

Advanced Metering Infrastructure. Los Angeles Department of Water and Power. (2021). https://www.ladwp.com/who-we-are/power-system/advanced-metering-infrastructure

Advancing a green new deal for Los Angeles renters. Energy Efficiency for All. (n.d.). https://chpc.net/wp-content/uploads/2019/05/EEFA-LA-REPORT-Exec_Summary.pdf

Amiri, A., Ottelin, J., & Sorvari, J. (2019). Are LEED-Certified Buildings Energy-Efficient in Practice? Sustainability, 11(6), 1672. https://doi.org/10.3390/su11061672

Building green residences | UCLA sustainability. UCLA Sustainability. (n.d.-a). https://www.sustain.ucla.edu/housing/living-green/building-green/

Clay, K., National Bureau of Economic Research., Severnini, E. R., & Sun, X. (2021). Does LEED Certification Save Energy? Evidence from Federal Buildings / Karen Clay, Edson R. Severnini, Xiaochen Sun. National Bureau of Economic Research.

CoolCalifornia. (n.d.). *Efficient Home*. Efficient Home | Cool California. https://coolcalifornia.arb.ca.gov/efficient-home

Energy audit. Green Building Alliance. (n.d.). https://gba.org/resources/green-building-methods/processes/energy-audits/#:~:text=Energy%20Audit%20Process&text=The%20auditor%20will%20perform%20multiple,to%20four%20hours%20to%20complete.

Energy conservation behavior — Institute of the Environment and Sustainability at UCLA. UCLA IOES. (2022). https://www.ioes.ucla.edu/project/energy-team-energy-conservation-behavior/

Energy team: Energy reduction in UCLA facilities — Institute of the Environment and Sustainability at UCLA. UCLA IOES. (2023). https://www.ioes.ucla.edu/project/energy2023/

Gifford, W. R., Goldberg, M. L., Tanimoto, P. M., Celnicker, D. R., & Poplawski, M. E. (2012). Residential Lighting End-Use Consumption Study: Estimation Framework and Initial Estimates. https://doi.org/10.2172/1162372

Methods. UCLA Energy Atlas. (n.d.). https://www.energyatlas.ucla.edu/methods

Regents of the University of California. (n.d.). *Green Building*. University of California Office of the President. https://www.ucop.edu/sustainability/policy-areas/green-building/index.html

UCLA. (2022, April 4). *UCLA Sustainability Plan Summary*. Box. https://ucla.app.box.com/s/k8hohp8yxn0q9va0pv1n9b1d03cdewe6

University Apartments | UCLA Sustainability. UCLA Sustainability. (n.d.-b). https://www.sustain.ucla.edu/housing/university-apartments/

Appendix A

Focus Group Questions

1: General Questions (15 mins)

- How would you describe the state of the current equipment used by UCLA Housing in your departments? Is it out of date/ up to date / etc.?
- What is the process of adding in new equipment? Approval, requesting, installation, etc.?
- Is there anything about the Boulevard Apartments that we should take special note of? Any features that might add excessively to the energy usage, problems that have arisen with maintenance, etc?

2: HVAC (10 mins)

- On the UCLA Sustainability website, it states that there is a current initiative to implement ENERGY STAR appliances. Is that the case for the Boulevard Apartments?
- Are there any current challenges to the current HVAC system that may be of special interest to us?
- Generally, how big of a role does HVAC play in the total energy consumption of an apartment building? Is that also the case in the Boulevard Apartments (is it greater/lesser for these apartments?)

3: Lighting (10 mins)

- Are there automatic sensors (motion or daylight) that are installed to monitor times when lighting is not needed or not currently in use? (Are you guys planning on implementing these automatic sensors or at least dimming sensors at any point?)
- How often do you replace or upgrade light bulbs in the building? Do you opt for energy-efficient ones?
- Are there any guidelines or educational resources residents of the Boulevard have access to regarding energy-efficient lighting practices?

4: Plumbing (10 mins)

- Are low-flow or water-efficient fixtures (e.g., faucets, showerheads, toilets) installed in the Boulevard Apartments? If not, are there plans to implement them?
- Does UCLA Housing track water usage in real-time for maintenance purposes? If so, is there a system in place to detect leaks or inefficiencies automatically?
- What are the most common plumbing-related issues in the Boulevard Apartments, and how do they impact water and energy consumption?
- What are the current maintenance procedures for water heating systems? How often are they inspected or replaced?

Appendix B

Data and Figures

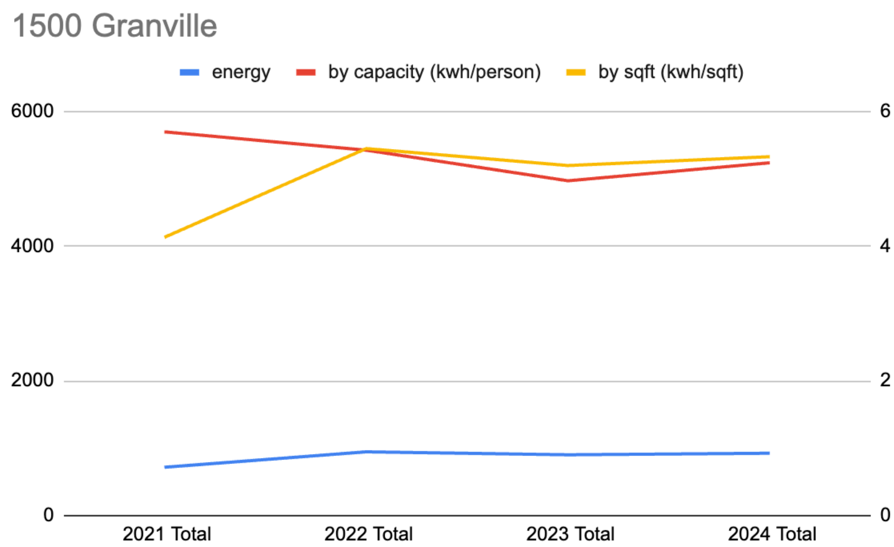


Figure B1: Energy consumption at 1500 Granville between 2021 and 2024

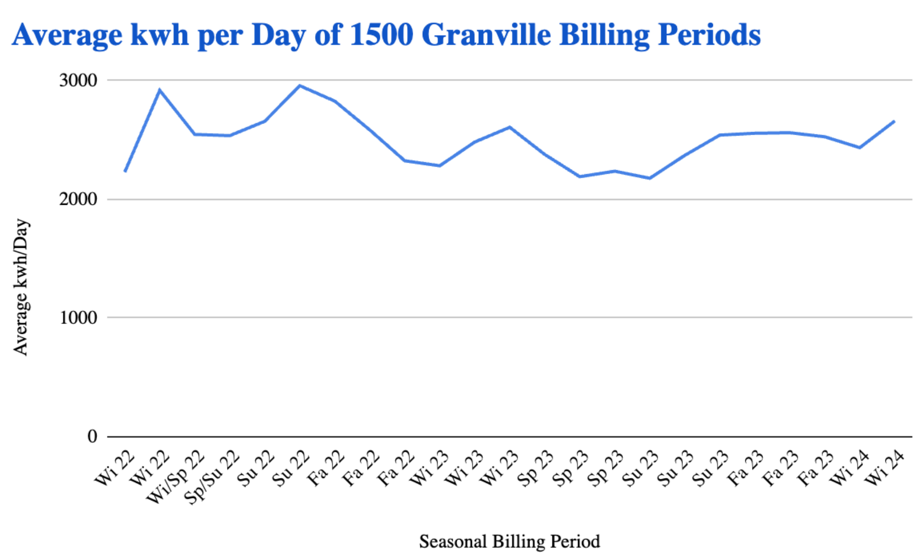


Figure B2: Average kWh/day for the entire billing period time series we have access to

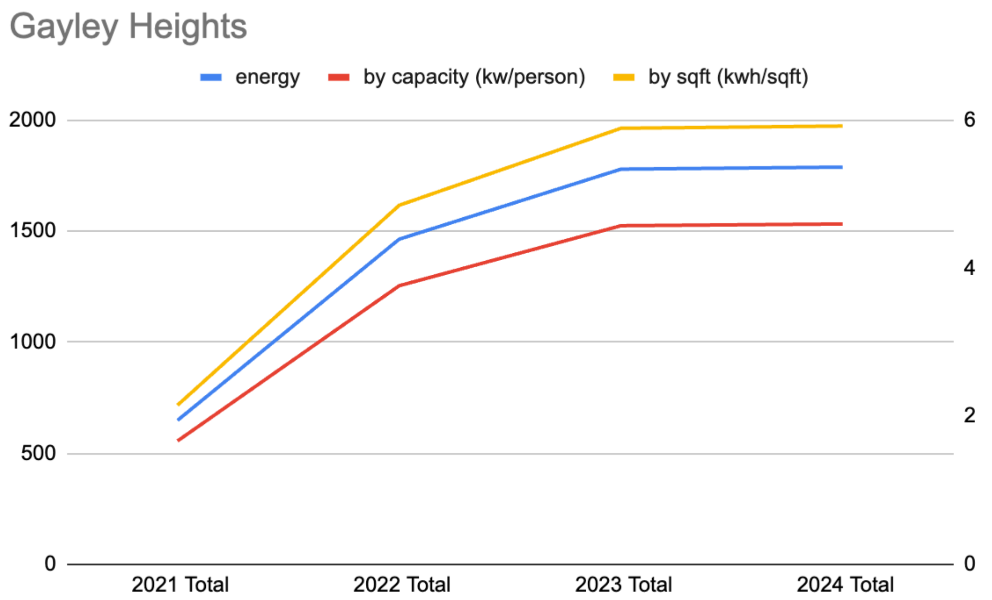


Figure B3: Energy consumption at Gayley Heights between 2021 and 2024

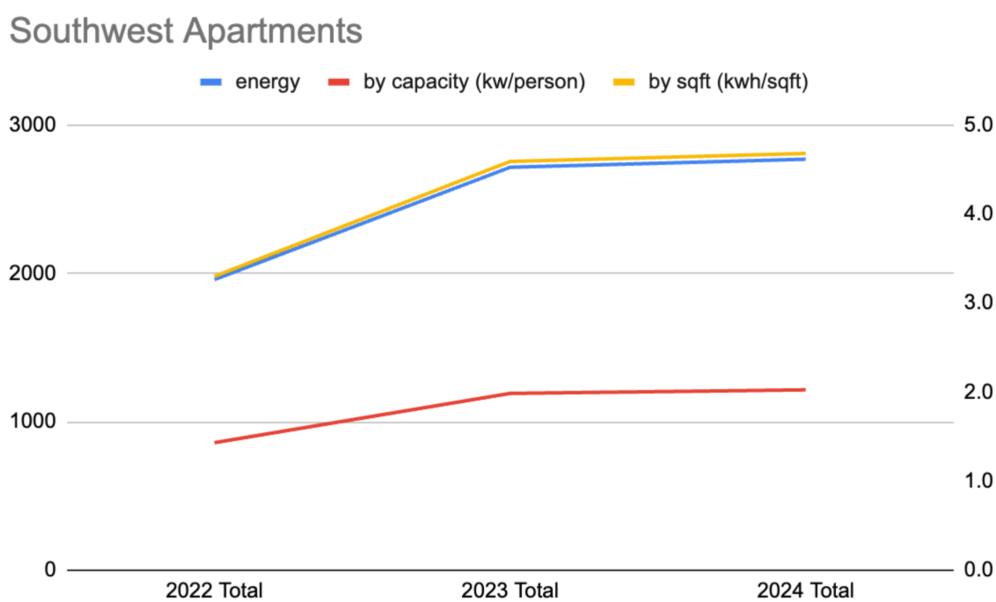


Figure B4: Energy consumption at Southwest Apartments between 2021 and 2024

Appendix C

Resident Opinion Survey

Background Information:

What is your current affiliation with UCLA? (Med student, staff, faculty, graduate student, etc.)

Rate your interest in sustainability

- Least interest (1) to most interest (5)

What building do you reside in?

- ☐ 1515 Granville
- ☐ 1500 Granville

What kind of unit do you live in?

- ☐ Studio
- ☐ One Bedroom
- ☐ Two Bedroom
- ☐ Three Bedroom

How many people reside in your unit?

How long have you resided in this building?

List the external appliances your household has added to your unit that is used regularly?

E.g.: Toaster (1), Fan (2), Rice Cooker (1), Blender (1), Lamps (4)

Energy Usage Habits:

On average, estimate how many hours a day you run appliances such as air conditioning units, ovens, washer/dryer, etc?
E.g.: Air conditioning (12 hours), Dishwasher (2 hours), Oven (3 hours), Washer/dryer (2 hours)

Estimate your unit's average temperature (in Fahrenheit) for summer conditions (the temperature that you set).

Estimate your unit's average temperature (in Fahrenheit) for winter conditions (the temperature that you set).

On average, between what hours of the day do you turn on the lights in your unit?

How frequently/which communal spaces do you use (e.g., the pool, clubhouse, study spaces, gym)?

- ☐ Less than 2 times a week
- ☐ 1-2 times a week
- ☐ 3-4 times a week
- ☐ 5+ times a week

When you use communal spaces besides the gym and pool, which of the provided electrical appliances (TVs, microwaves, ovens, etc) do you use?

Qualitative Questions:

Do you see any outstanding issues with your unit that might contribute to excessive energy consumption? If so, what are they (e.g., faulty lighting, lack of insulation, etc.)?

Do you see any outstanding issues with the overall building/communal spaces that might contribute to excessive energy consumption? If so, what are they (e.g., faulty lighting, lack of insulation, etc.)?

Have there been any electrical/energy issues with your unit that you have brought up with the maintenance teams? If so, list these issues?

What energy conservation practices do you employ in your living spaces?

What kind(s) of energy usage communication do you think would be conducive to lowering your energy consumption?

Is there anything else you would like to share?

Appendix D

Resident Opinion Survey Responses

Figure D1

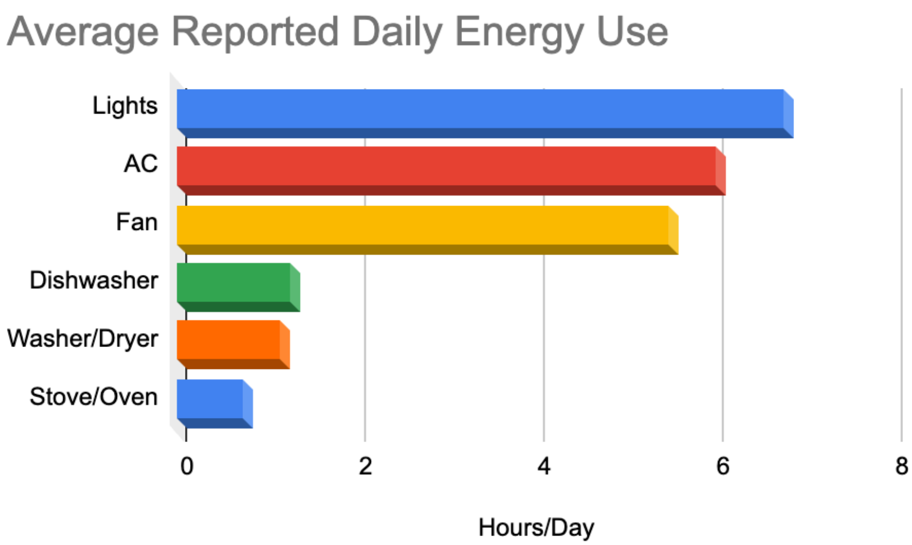


Figure D2

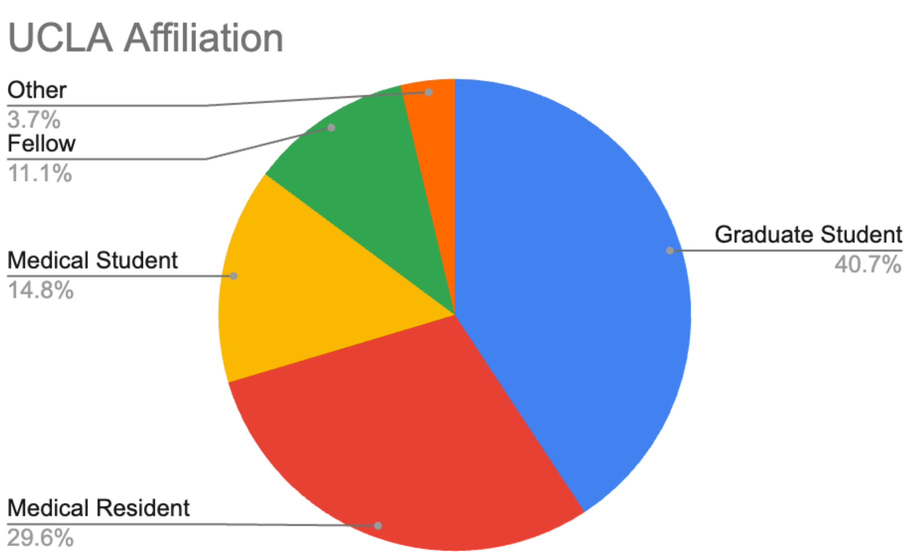


Figure D3

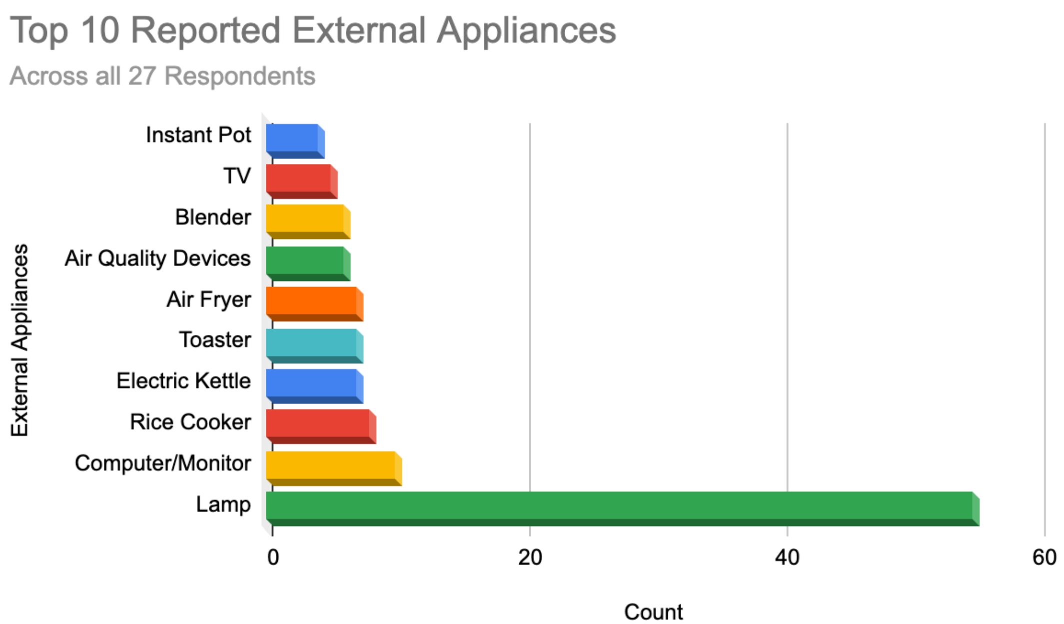


Figure D4

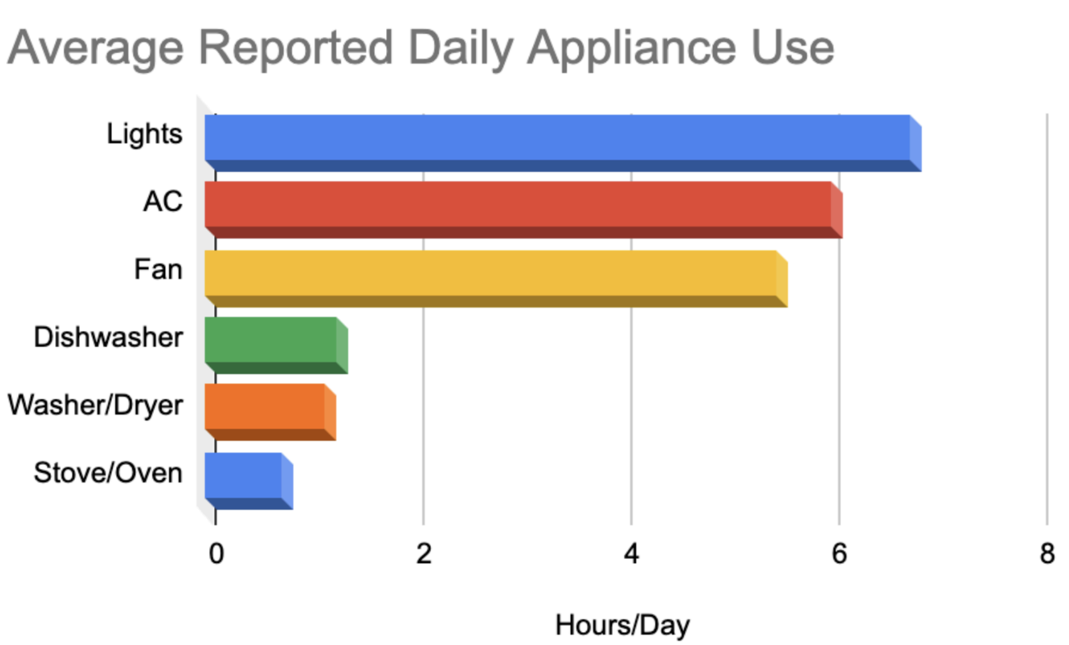
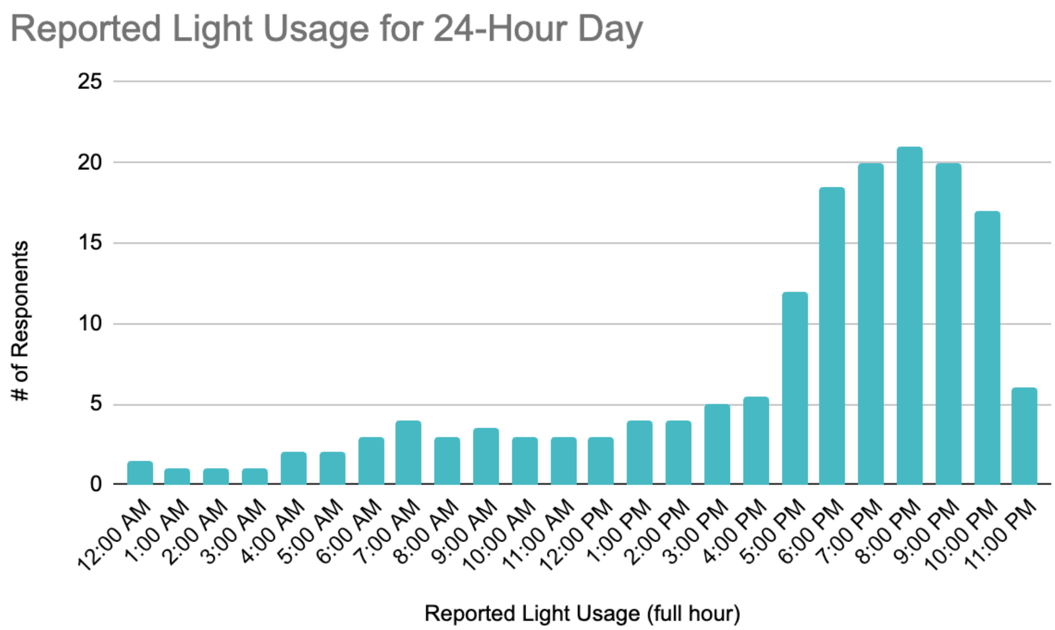


Figure D5


Reported Light Usage for 24-Hour Day
25
20
15
10
5
0
# of Responents
12:00 AM
1:00 AM
2:00 AM
3:00 AM
4:00 AM
5:00 AM
6:00 AM
7:00 AM
8:00 AM
9:00 AM
10:00 AM
11:00 AM
12:00 PM
1:00 PM
2:00 PM
3:00 PM
4:00 PM
5:00 PM
6:00 PM
7:00 PM
8:00 PM
9:00 PM
10:00 PM
11:00 PM
Reported Light Usage (full hour)

Appendix E

Informational Interview Questions

Interview Questions for Spencer Middleton, Energy Analyst

- Would you mind telling us a bit about your work specifically? What does your day-to-day look like? How is sustainability a part of your work?
- What kind of energy usage do you expect at UCLA Apartments, based on size and occupancy? For a set of buildings like the Boulevard with occupancy of around 450, what kind of energy usage would you expect?
- When comparing various energy consumptions, what do you recommend as the best standardization approach?
- What can you tell us about how the data is gathered? What metering systems, if any, does UCLA or LADWP use that you could tell us about?
- Do you understand the ‘power factor,’ and could you tell us why it fluctuates slightly, and how to best optimize it?
- We’ve been given a lot of information, with a ton of variables. Do you have any recommendations on where to start looking in conducting data analysis?
- We were interested to know how the solar panels on top of the buildings are factored into these data sheets. Do you know anything about that?
- Is there any way to have a breakdown of unit-by-unit charges, or is everything billed/tracked cumulatively? (We noticed that some of the Granville buildings have this unit-by-unit breakdown, while others do not.)
- Have you ever personally been to 1500 Granville? Do you know anything about the building or the ways in which power is dispersed?
- Do you have any initial thoughts as to why a residential building might have a greater-than-average amount of energy consumption?

Interview Questions for Anthony Ortega, Assistant Director of Housing Maintenance

- How do you usually make estimates based on light/unit appliance counts?
- How do you account for errors?
- How do you count external appliances?
- What are the biggest sources of error in these audits?
- Is there anything we should take into account for the Boulevard specifically?
- What categories do you calculate? Different numbers for lighting, HVAC, etc.?

- As you can see from our sheet, we are missing some information on the model numbers. What is your advice for approaching calculations for these?
- If there are areas we may have missed, how do you recommend we best make estimates?
- How do you usually utilize the results of an energy audit? How would you recommend we use our results to provide energy-saving recommendations for the Boulevard?
- When you are missing a variable of an equation (calculating energy consumption), like time "on", wattage, etc, what do you do? Make the best guess? Estimate?
- In what areas do you think anyone conducting an audit "messes up" the most? // What do you think is the most challenging part about conducting an energy audit?
- In what areas of accounting do you see differences between a building's perceived energy consumption and what is calculated through the audit – lightning, HVAC, miscellaneous appliances?
- How accurate do you find these audits compare to actual reported energy consumption/billing?
- How do you account for potential differences in energy usage across units?

Appendix F

Energy Audit Calculation Spreadsheets

Figure F1 - Studio Apartment

Unit Type:	Studio			
Appliance:	Wattage	Count/Unit	Avg Daily Usage (Hours)	total (Wh)
HR-LED90	5W	4	7	140
NLCBC-45	13W-16W	1	7	101.5
VL10323	16W	1	7	112
KITCHEN HANGING LIGHTS	9W	2	7	126
SLD606-9-30 WH	9.75W	1	1	9.75
"16' LED Linear Surface Mount LS-LM22190-1261-1270-1280-OUT	50W	~10 ft	7	350
EL-5061 ENERGY STAR Interior Ceiling Pendant Lighting Fixture	6W	2	7	84
WS-W61806AL	9W	1	1	9
Whirlpool Electric Front Control Range	3000W	1	0.744	2232
Whirlpool 1.7 Cu. Ft Over the Range Microwave	1920W	1	0.1	192
Whirlpool 19.2 cu. ft. Top Freezer Refrigerator	747.5W	1	8	5980
Whirlpool 3.5 cu.ft Long Vent Electric Stacked Laundry Center	7200W	1	0.24	1728
Whirlpool Dishwasher	1200W	1	1.26	1512
Honeywell TH8321WF1001 WiFi VisionPRO 8000 Programmable Thermostat	0.17W	1	24	4.08
			Per unit (kWh/day)	12.58033
	Total Studio Count:	30	Total Studio Wattage:	377.4099 kWh/Day

Figure F2 - One Bedroom

Unit Type:	One Bedroom			
Appliance:	Wattage	Count/Unit	Avg Daily Usage (Hours)	total (Wh)
HR-LED90	5W	6	7	210
NLCBC-45	13W-16W	1	7	101.5
VL10323	16W	1	7	112
KITCHEN HANGING LIGHTS	9W	2	7	126
SLD606-9-30 WH	9.75W	1	1	9.75
16’ LED Linear Surface Mount LS-LM22190-1261-1270-1280-OUT	50W	~10 ft	7	350
"EL-5061 ENERGY STAR Interior Ceiling Pendant Lighting Fixture"	6W	2	7	84
WS-W61806AL	9W	1	1	9
Whirlpool Electric Front Control Range	3000W	1	0.744	2232
Whirlpool 1.7 Cu. Ft Over the Range Microwave	1920W	1	0.1	192
Whirlpool 19.2 cu. ft. Top Freezer Refrigerator	747.5W	1	8	5980
Whirlpool 3.5 cu.ft Long Vent Electric Stacked Laundry Center	7200W	1	0.24	1728
Whirlpool Dishwasher	1200W	1	1.26	1512
Honeywell TH8321WF1001 WiFi VisionPRO 8000 Programmable Thermostat	0.17W	1	24	4.08
			kWh/day	12.65033
	Total 1bd Count:	59	TOTAL 1BD Wattage	746.36947 kWh/Day

Figure F3 - Two Bedroom

Unit Type:	Two Bedroom			
Appliance:	Wattage	Count/Unit	Avg Daily Usage (Hours)	
HR-LED90	5W	10	7	350
NLCBC-45	13W-16W	2	7	203

VL10323	16W	2	7	224
KITCHEN HANGING LIGHTS	9W	2	7	126
SLD606-9-30 WH	9.75W	2	1	19.5
16’ LED Linear Surface Mount LS-LM22190-1261-1270-1280-OUT	50W	~10 ft	7	350
EL-5061 ENERGY STAR Interior Ceiling Pendant Lighting Fixture	6W	2	7	84
WS-W61806AL	9W	1	2	18
Whirlpool Electric Front Control Range	3000W	1	1.488	4464
Whirlpool 1.7 Cu. Ft Over the Range Microwave	1920W	1	0.2	384
Whirlpool 19.2 cu. ft. Top Freezer Refrigerator	747.5W	1	8	5980
Whirlpool 3.5 cu.ft Long Vent Electric Stacked Laundry Center	7200W	1	0.48	3456
Whirlpool Dishwasher	1200W	1	1.26	1512
Honeywell TH8321WF1001 WiFi VisionPRO 8000 Programmable Thermostat	0.17W	1	4.08	4.08
			kWh/day	17.17458
	Total 2bd Count:	60	Total 2BD Wattage:	1030.4748 kWh/Day

Figure F4 - Three Bedroom

Unit Type:	Three Bedroom			
Appliance:	Wattage	Count/Unit	Avg Daily Usage (Hours)	total (wh)
HR-LED90	5W	12	7	420
NLCBC-45	13W-16W	2	7	203
VL10323	16W	2	7	224
KITCHEN HANGING LIGHTS	9W	2	7	126
SLD606-9-30 WH	9.75W	3	1	29.25
16’ LED Linear Surface Mount LS-LM22190-1261-1270-1280-OUT	50W	~10 ft	7	350

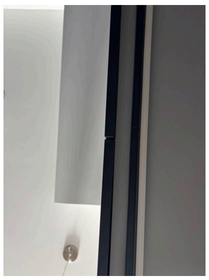
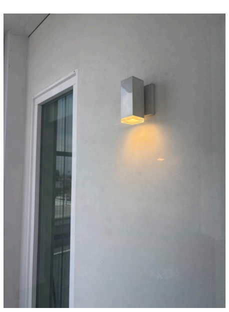
EL-5061 ENERGY STAR Interior Ceiling Pendant Lighting Fixture	6W	2	7	84
WS-W61806AL	9W	1	3	27
Whirlpool Electric Front Control Range	3000W	1	2.232	4464
Whirlpool 1.7 Cu. Ft Over the Range Microwave	1920W	1	0.3	576
Whirlpool 19.2 cu. ft. Top Freezer Refrigerator	747.5W	1	8	5980
Whirlpool 3.5 cu.ft Long Vent Electric Stacked Laundry Center	7200W	1	0.72	5184
Whirlpool Dishwasher	1200W	1	1.26	1512
Honeywell TH8321WF1001 WiFi VisionPRO 8000 Programmable Thermostat	0.17W	1	4.08	4.08
			Per unit (kWh/day)	19.18333
	Total 3bd Count:	1	Total 3BD Wattage	19.18333 kWh/year

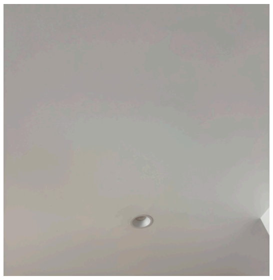
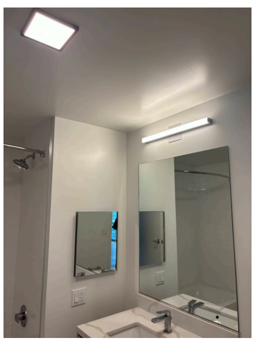
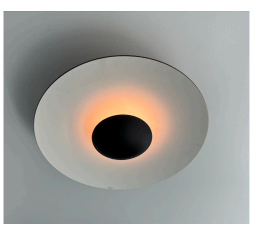
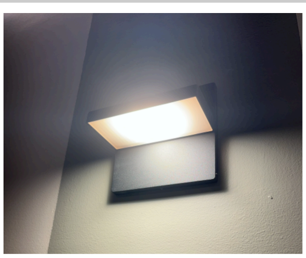
Figure F5 - Outdoor Lighting Calculation

Outdoor				
Lighting	**Wattage**	**Count**	**Avg Daily Use**	**Total (Wh)**
LSG40	4W/Ft	620	24	59520
33058-K3-SLV	12.3 W	41	24	12103
LUMINTURS AMD14019G	6W	13	24	1872
RICH BRILLIANT WILLING Ledge Stonewall Sconce	8.7W	150	24	31320
20V GU10 Uplight	20W	46	24	22080
Lumiere EON 303 B1-KEDB2	8.5W	14	24	2856
DRDH-N-JD-DRD2M	11.8W	18	24	5097
			kwH/day	134.848
			kwH/year	49219.52

Appendix F

Lighting Specs Sample - 1500 & 1515 Granville

In unit	Quantity	Model number	Notes	Others
	1/unit	16’ LED Linear Surface Mount LS-LM22190-1261-1270-1280-OUT/ TFT-DIM-PS-100|130VAC-CV-24V-50W-ELV-EN-DRB	50W kitchen counter light facing down	
	1/unit	SLD606-9-30 WH 1/unit	9.75 W	
	2/unit	EL-5061 ENERGY STAR Interior Ceiling Pendant Lighting Fixture	6W kitchen lights, dimmable	
	1/unit	WS-W61806AL	balcony light	

	6/1b1b unit, 10/2b2b unit	HR-LED90	ceiling light	
	1/unit	NLCBC-45	bathroom light 13W - 16 W	
	1/unit	VL10323	bathroom light 13W	Color: WS-10323 -BN
Hallways / common spaces				
	13	AURA - JOAN GASPAR	21W	
	150	RICH BRILLIANT WILLING Ledge Stonewall Sconce	8.7 W	

Acknowledgements

We would like to thank the following people for their support and contributions to our project. This project would not have been possible without their assistance.

Our stakeholder, Brianna Moncada, the Sustainability Manager for UCLA Housing & Hospitality, for her guidance and assistance in gathering data for our project.

We have interviewed and collaborated with several additional stakeholders and professionals from UCLA and UCLA Housing & Hospitality. These individuals include:

- Anthony Ortega, Assistant Director of Housing Maintenance
- Spencer Middleton, Energy Analyst
- Walter Vasquez
- Jeff Prondzinski
- Bill Gonzalez
- Joel Lozano

The SAR Project Directors, Faculty Advisors, and Communication Team:

- Audrey Jason, Program Director
- Gabrielle Biederman, Program Director
- Carl Maida, Faculty Advisor
- Cully Nordby, Faculty Advisor
- Pam Nelson, Communications Director
- Joy Huang, Communications Director