UCLA Sustainability Action Research

AUDIOVISUAL (AV) EQUIPMENT SUSTAINABILITY

FINAL REPORT

STAKEHOLDER: Joe Way, Executive Director of Digital Spaces Department

TEAM LEADS: Chloe Ng-Lee, Tina Su

TEAM MEMBERS: Grace Morris, Danielle Soykin, Zsaby Diana, Isabella De La Rosa, Kim Vu

Abstract

In response to the growing concerns over energy consumption and electronic waste at UCLA, our team investigated how sustainable audiovisual (AV) practices could support UCLA's campus-wide environmental goals. Through the past two quarters, we worked closely with UCLA's Digital Spaces Department and our stakeholder, Joe Way, to target the replacement process of 11 classrooms' AV equipment. Our research included facility tours, rapid surveys, assessments of potential sustainable AV companies, and expert interviews. Findings revealed teaching faculty's dissatisfaction with UCLA's current projectors, microphones, and speakers. To procure the most efficient and sustainable AV equipment for our campus, we also used a sustainability scoring system to evaluate and interview top performing AV companies like Crestron and PlaceOS, concluding that their technologies and supply chain transparency best aligns with UCLA's sustainability goals. Furthermore, Equity, Diversity, and Inclusion (EDI) were central to our research because we did not want to offshore e-waste to third world countries. The rapid surveys also confirmed the challenges that faculty and students encounter with UCLA's current AV equipment.

Based on our findings, we have provided recommendations for UCLA's planned summer overhaul. Therefore, our project lays the foundation for future AV improvements both at UCLA and across other institutions seeking to meet similar goals.

Table of Contents

Introduction

Goal 4-1 of UCLA's Strategic Plan, updated in 2022, is to reduce campus-wide energy use by 2% annually, and upgrading the school's audiovisual (AV) equipment provides an auspicious avenue to do so (UCLA Sustainability). Replacing the outdated, inefficient hardware—including old projectors, display screens, speakers, microphones, and cameras—in 11 of UCLA's classrooms with newer, more sustainable equipment reduces both energy consumption and carbon emissions. The AV Equipment Sustainability Team has supported UCLA's Digital Spaces Department in their equipment overhaul planned for this summer in several ways. We have researched current innovations in AV sustainability, such as equipment made out of eco-friendly materials that supports replacement parts to maximize their lifespan, which has informed recommendations for specific product requirements to look for. We have also performed company sustainability assessments and interviews to optimize the AV sustainability program at UCLA and advised proper disposal of the current equipment in order to ensure that none of this e-waste is discarded in underprivileged communities.

Past literature on AV sustainability is sparse because it's a relatively new priority to the industry. The only comparable project to ours was our stakeholder, Joe Way's, project at USC. During his previous tenure as the Director of Learning Environments at USC's IT Department, he upgraded similar dated equipment, resulting in less physical space being used in classrooms and lowered energy consumption. To achieve similar outcomes at UCLA, we first surveyed teaching staff to understand their habits and opinions regarding AV equipment in classrooms. This ensures that replacements can satisfy end-user needs while also elevating schoolwide sustainability. Additionally, to ensure we've selected the most sustainable products from the list of companies the Department plans to buy from, we evaluated each company by grading each of

their commitment to sustainability based on a response that was sent to the Digital Spaces Department.

The Digital Space Department set the scope of our project early in winter quarter, including which rooms will be upgraded this summer and which AV companies to research. Equity, diversity, and inclusion (EDI) has been at the forefront of our project. We worked with UCLA's recycler, Human-I-T, to prevent the practice of obsolete AV equipment being shipped to the Global South. We also stressed the importance of selecting locally-made equipment when possible, which avoids emissions that come from shipping equipment across great distances, ensuring sustainability in the entire supply chain. Finally, our suggestions for upgraded AV equipment in the most in-demand classrooms will help enhance an equitable, accessible education for all students.

Methods

I. Facility Tours

During week five of winter quarter, our team conducted a facility tour of the 11 classrooms within our scope with John Lisiewicz, the facility coordinator for the AV department at UCLA. The 11 classrooms are housed in the Physics and Astronomy Building (PAB), Kaplan, Franz, Boelter, and the AV department in Campbell Hall (See Table 1 in Appendix for full equipment list). This in-person tour allowed us to see the layout of the classrooms, identify the exact equipment in use, and take reference photos to inform our research. In addition, we received insight from Lisiewicz regarding the function and reasoning behind the placement of various equipment. With Lisiewicz's expertise, our team identified issues with current equipment related to accessibility and general usage as detailed in the results section.

The team documented most of the equipment in the classrooms through photos and asked questions about the equipment. While our main focus was on equipment such as the projectors and speakers, we ensured that other equipment, such as touchscreens, LED proximity sensors, and lighting fixtures, wouldn't be overlooked through repetitive questioning and note-taking. We asked questions whenever possible regarding unfamiliar hardware, types of lightbulbs, and the functionality of different equipment we couldn't identify on our own. Additionally, multiple team members took notes and photos to create a comprehensive overview of the tour from different perspectives. Furthermore, as part of our assessment and alignment of our project with EDI, we evaluated the accessibility of the AV equipment, particularly for individuals with disabilities. We noted whether classrooms were equipped with assistive devices such as the infrared emitters for hearing aids, and identified potential barriers to access, such as the strewn about wiring in PAB 1749 and 2434 (See Figure 1 and Figure 2 in Appendix). These wires risk tripping and pulling by the general public, and pose an additional risk to users of assistive devices such as wheelchairs. By broadening our focus beyond the common AV equipment, like projectors, we were able to create a more inclusive and thorough evaluation of the AV equipment in the classrooms.

II. Sustainability Ratings

A total of ten companies submitted proposals to UCLA's Digital Spaces Department to be considered for a possible partner position. The Digital Spaces Department drafted a question within the application: how does your system align with UCLA's sustainability goals, including energy efficiency and eco-friendly materials? As a team, we gave each company a score from 1-5 based on their response to the above question, no outside sources were considered per Joe Way's request. The rubric we had utilized was created after a thorough review of what the Digital

Spaces Department should look for when evaluating sustainability statements such as sustainability initiatives that had been implemented throughout the company and how they planned to leverage their services to help UCLA reduce their carbon footprint. In the future, this rubric can be employed in order to assess future partners within the AV industry.

Score	**Rating Reasoning**	**Count of Companies that Received the Following Scores**
0	● No sustainability statement given	0
1	● Vague statement given, very little information regarding the company is given.	2
2	● Short statement is given. ● Little information surrounding the company's sustainability goals and technology is given, but it is specific.	2
3	● Outlined sustainability initiatives and goals that have been implemented throughout the company. ● Addresses sustainable material usage, packaging, products and/or sustainability goals. ● Descriptions for the above are not very fleshed out and remain slightly vague.	2
4	● Addresses the company's sustainability goals. ● Lists out and describes their sustainability initiatives around procurement, packaging, and/or product lifespan. ● List is short, but detailed.	2
5	● Addresses the company's sustainability goals. ● Goes above and beyond with their descriptions and has a substantial amount of sustainability initiatives. ● Extensively lists out and describes their sustainability initiatives around procurement, packaging, and product lifespan. ● Specifically aligned their goals with UCLA sustainability goals	2

III. Expert Interviews

Our team decided to move forward with expert interviews to inform us on AV technology, sustainability integration, and the overall life cycle of these products. Many of our interviews set the tone for the next as we transitioned from informative sessions to consultations. The interviews not only bridged the gap in our knowledge of AV systems but also provided a direction for the topics we should inquire to our companies of interest, both in manufacturing and disposal.

Our interview with Joe Way was completed on March 9, 2025. We asked him various questions regarding the methods and results of USC's AV equipment sustainability program he spearheaded, paving the way for USC to become the first SAVe-certified university. We discussed the challenges that came with implementing sustainability within the AV department, the procedural difference for a public institution like UCLA, and any anticipated obstacles he expected we'd have to overcome. As our stakeholder, Joe Way prepared us for future interviews with methods and implications to pursue a technology replacement program at an institutional level.

To devise a plan that actively incorporates sustainability, we interviewed Christina De Bono on May 2, 2025. Christina De Bono is the founder and president of SAV——Sustainability in AV—and pioneers sustainability within the AV industry through the SAVe certification program. This program distinguishes organizations in AV that are equipped with an action plan that is in alignment with the 2030 UN Sustainable Development Goals. With Christina, we aimed to examine the methodology behind SAVe's sustainability assessments, determine how UCLA can become SAVe certified, and discuss the benefits of acquiring this certification. Additionally,

we were introduced to SAVe's guide on Sustainable AV Design and Installation. This resource was beneficial to our team as it provided a direction and clear guideline on what to ask about when conducting interviews with AV companies in order to ensure that sustainability was considered and will continue to be considered in key aspects of their company.

Based on the sustainability ratings, our team proceeded with interviewing Crestron and PlaceOS. Interviews were held on May 18th with Crestron and May 21st with PlaceOS. The purpose of these interviews were to discuss and further understand each company's sustainability initiatives and goals directly from their representatives. We delved into topics such as energy consumption, sustainability within the supply chain, and pollution and waste management to determine how these are in alignment with UCLA's Sustainability Plan. Additionally, we inquired about how they ensured ethical procurement throughout their supply chain. As a means to conserve energy usage, our team questioned the use of automated shut-off systems equipped with sensors to detect occupancy, otherwise translated to when classrooms are in use. However, we came across concerns over privacy as many professors are opposed to being recorded while teaching. Our team internalized these concerns and planned to request an accommodation as a compromise between privacy and occupancy censoring. Lastly, we questioned how greenhouse gas emissions are accounted for and mitigated to identify hotspots across the supply chain with respect to Scope 1, 2, and 3 emissions.

Our final interview was with Human-I-T, UCLA's contracted recycler for e-waste, on June 5, 2025. Human-I-T holds the role of collecting corporate technology or e-waste to refurbish and redirect the technology to local communities in need. Our team spoke with Senior Business Development Executive, India Tucker, and Head of Technology Donations, Tori Lowe, from Human-I-T. We asked about the disposal process, potential challenges with UCLA's

outdated equipment, and details on the receipts they send to donating companies. Our interview with Human-I-T served as an understanding of how e-waste is mitigated to prevent irresponsible disposal, especially with respect to the industry challenge of other recycling companies shipping e-waste overseas as a means of shifting the burden to those without proper resources and protection.

IV. Digital Spaces Survey Data

To gauge faculty's opinions on classroom's audiovisual equipment, Joe Way's team sent out a survey for school-wide teaching staff to rate individual classrooms' facilities over last summer. Our team received the survey results last quarter. The data contains 180 observations from individual teaching faculty and 54 variables that are different survey questions. These questions are mainly short answer questions asking the faculty members if they had a favorite or a least favorite room on campus that they have used in the past. These questions also go into details in asking about levels of satisfaction for specific types of equipment (e.g. projectors, microphones). By analyzing this data, our team is able to have a baseline understanding of the current opinion surrounding equipment before we start interviewing individual faculty at the classrooms in our scope.

V. Rapid Surveys

Rapid surveys were carried out to understand how teaching staff at UCLA engage with the AV equipment and their opinions on the current functionality of this technology. Unlike the Digital Spaces campus wide surveys, we focused on the 11 classrooms within our scope. This was done to inform our recommendations on how the future overhaul could improve on current conditions in these specific classrooms that will be targeted in this summer's overhaul. The team

surveyed undergraduate and graduate classes, including lectures, discussions, seminars, and labs across various disciplines. To conduct these surveys, our team utilized the UCLA Classroom Grid Search to identify and choose various class sessions held in the classrooms within our scope. A group member assigned to a specific class approached the instructor or teaching assistant once class was dismissed and, if permitted, they asked multiple questions regarding the faculty's experiences with the classroom's AV equipment. To respect the instructor's time, most of the questions were a mixture of short answers, yes or no, and number scale ranking responses.

VI. EDI

EDI was critical to every stage of our project—Goal 4 of UCLA's Strategic Plan is to create an inclusive, accessible learning environment where every student can reach their full potential. Upgrading AV equipment in frequently used classrooms is a crucial way to accomplish this goal. In developing our recommendations to the Digital Spaces Department, we made sure to select the companies that demonstrated the strongest dedication to not only sustainability principles, but also emphasized ethical best practices. In advising for sustainable disposal, we also aimed to prevent UCLA from contributing to the e-waste that often disproportionately impacts impoverished communities of color in places like Ghana, home to the world's largest e-waste landfill. During our SAVe certification, we learned the best ways for the AV industry to advance EDI goals in tandem with sustainability initiatives.

Later, during our facility tour, we evaluated the accessibility of the AV equipment, particularly for individuals with disabilities, in each classroom we visited. We noted whether classrooms were equipped with assistive devices such as infrared emitters for hearing aids, and identified potential barriers to access such as the fixed seating and exposed wiring in PAB 1434. By broadening our scope beyond projectors and speakers, we were able to create a more

inclusive and thorough evaluation of the AV equipment in the classrooms. Upgrading AV equipment, by creating a smoother, more accessible educational environment, will ensure that all students are engaged, faculty are satisfied, and UCLA advances its EDI goals.

Challenges

At the start of winter quarter, the main challenge we faced was trying to solidify the scope of our project. Originally, our project was proposed as an overarching research project that would help inform UCLA's Digital Spaces Department of the most sustainable method to upgrade the university's AV technology. However, during fall quarter, UCLA realized that the equipment in certain older classrooms needed to be replaced as soon as possible. The current audiovisual equipment is not only outdated and inefficient, but also becoming increasingly difficult to source replacement parts for. Upon this realization, the Digital Spaces Department reconfigured their plans as they planned for an equipment overhaul this upcoming summer. Despite this initial confusion, we were able to understand the goal of our project after consistent communication with our stakeholder, Joe Way, once he solidified all of the initial details with his team.

We also overcame a very large learning curve regarding AV equipment and its industry. Very little pre-existing research exists around sustainability in AV and there are even less related programs for our team to reference. Additionally, none of our team had a background in AV or related technology. The logistics of different products' functions, components, and sustainability was a very wide scope when we did not know what equipment was present in certain classrooms. However, a facility tour led by John Liescwicz, the Digital Spaces Facilities Coordinator, allowed us to gain insight into what and how audiovisual equipment serves our school and why our project was so necessary. Furthermore, our sustainable AV equipment

certification training with the non-profit organization SAVe, known as Sustainability in AV, was also indispensable in understanding how sustainability relates to AV and how it can be feasibly enforced.

When conducting rapid surveys during spring quarter, we encountered several unexpected challenges. Some instructors were unavailable or declined to participate due to time constraints or personal reasoning. In other cases, classes were canceled or ended early without our knowledge, making it difficult to carry out the planned rapid surveys within our original two week timeframe. Another challenge we faced was coordinating our team's schedules to conduct these rapid surveys. Since rapid surveys have to be done in person at the end of each class and be completed within the 10 to 15 minute passing time, they often conflicted with our academic schedules and other commitments. Challenges in conducting the rapid surveys led to delays and limited opportunities for data collection. As a result, we expanded our list of target classes and often adjusted our own availability to conduct additional surveys on short notice.

Over the course of our project, we found that flexibility was the most essential skill in managing a long term project regarding UCLA's AV equipment overhaul. As the AV industry continues to evolve and the Digital Spaces Department refines their own part of the project, we had to adapt to the department's changing needs and project planning. It was essential to work with the department to ensure that our research aligned with their sustainable AV goals. Despite these challenges, we gained a significant amount of knowledge on sustainability in AV and explored how these best practices could benefit UCLA by better meeting our campus's sustainability goals.

Results

I. Facility Tours

During our facility tours, we noted the presence of overhead projectors sitting in the corner of several classrooms, such as PAB 1749, PAB 2434, and Boelter 2760 (See Figure 3 in the Appendix). These older projectors sit on carts and appear to be unused, with a noticeable layer of dust. According to John Lisiewicz, the facility coordinator, these overhead projectors are not only rarely used, but may no longer be functional. We learned that faculty opinions are heavily valued when deciding what to add and remove in classrooms. Since these overhead projectors were usually used to project lecture notes onto the screen, several professors continued to prefer this learning style and advocate for this equipment. However, it is believed that these professors have retired, and as such, these projectors no longer serve a purpose. If this equipment remains unused, removing them would be beneficial given that they take up a considerable amount of space, and allowing these projectors to be refurbished or recycled by Human I-T would give them a further purpose. In order to figure out if the overhead projectors were still used by teaching faculty, we had integrated a question regarding their usage in our rapid surveys.

Furthermore, our team examined the projectors and associated screens in each of the classrooms. The projectors were given the most attention as they are used in the majority of lectures, in addition to general use by many people who enter these classrooms. In PAB 2434, we noted the presence of a smaller screen overlapping the main bigger screen, making its simultaneous use impractical (See Figure 4 and 5). The smaller screen was originally intended for the overhead projector, but given the projector's disuse, the screen no longer serves a purpose. Additionally, we learned that the light bulbs used by many of these bulb projectors have been discontinued by their manufacturers, and that the stock owned by UCLA is running low

(See Figure 6). This means that in the procurement process, it is important to ensure that the AV equipment can be readily repaired or recycled at the end of its lifetime.

During the early years of the COVID-19 pandemic, the cameras in many of the lecture halls were replaced to accommodate virtual learning. Therefore, much of the camera equipment is at most five years old, removing the need to consider its replacement anytime soon. Similarly, other AV equipment, such as speakers and microphones, did not have an immediate need to be considered for replacement. As part of UCLA's classroom philosophy to provide all necessary equipment onsite, UCLA implemented touchscreen devices that people can connect their devices to (See Figure 7). However, these devices take up a considerable amount of space, given that they have their own CPU, and the computer cores need to be placed alongside these screens. Furthermore, the space influences the placement of the other AV and non-AV equipment, limiting how layouts can be structured. Although the Digital Spaces Department anticipates that these screens will be removed in favor of a bring your own device system, currently, they will still be utilized in order to abide by UCLA's policies.

Finally, we noted the presence of a mix of incandescent, fluorescent, and LED lighting in the classrooms. The incandescent and fluorescent lights were noticeably dimmer compared to the LED lights, which can be attributed to both age and as a former way to reduce energy consumption. Much of the energy used by incandescent and fluorescent lighting is lost to heat, so less lights technically lead to less energy consumption. However, the dim classroom lighting can make it harder for students to learn, and for instructors to effectively teach. Given the lack of efficiency of the incandescent and fluorescent lighting systems, the Digital Spaces team, in collaboration with UCLA Sustainability, is looking to replace all lighting with LED lighting, which will reduce overall energy consumption. LED lights are more energy efficient, and LED

lighting systems offer more flexibility when it comes to dimming, so the lights can be adjusted as needed. The Digital Spaces team will be working with PlaceOS to introduce software for efficient lighting control systems and AV-systems to reduce energy use, such as turning off lights when classrooms are not being actively used.

II. Digital Spaces Survey Results

After cleaning and parsing through the survey data, we found that most of the faculty is somewhat dissatisfied or extremely dissatisfied with the classroom space that they teach in. Specifically, 51% of teaching faculty is generally dissatisfied with projectors and screens, 40% is dissatisfied with microphones and speakers, and 48.88% is dissatisfied with the lighting system in classrooms and lecture halls (see Graphs 1-3 in Appendix). These numbers reveal that roughly half of the active teaching faculty believe that classroom conditions should be improved.

A deeper dive into the dissatisfied responses reveal that the majority of these faculty teach most often in Kaplan Hall, Broad Art Center, Boelter Hall, and La Kretz. There are multiple mentions of different rooms on the A level of Kaplan Hall, whose rooms are included in our research scope (see Graph 4 in Appendix). According to teaching faculty, these rooms lacked adequate projectors, speakers, microphones and lighting systems. These results further confirm that an AV equipment upgrade is needed in UCLA classrooms as better equipment will provide a more engaging environment for both students and faculty.

III. Rapid Survey Results

We conducted rapid surveys in 37 classrooms in our study scope. By including classes from different disciplines (See Graph 5 in Appendix), we are able to receive data that is representative of the general usage of the classroom equipment. After cleaning the data by

removing the classrooms that did not respond, we performed analysis on the data of 28 classrooms. A preliminary analysis reveals that the median score of AV equipment reliance is 9 out of 10. In addition, we found that over 50% of the teaching faculty have technical difficulties with the classroom AV equipment very often, often, or sometimes. The high reliance rate combined with the high frequency of having problems reveal the necessity of procuring new equipment. More specifically, the survey results reveal that 48.7% of the teaching faculty are having difficulty with projectors and display screens while 34.8% are having difficulty with speakers and microphones (See Graph 6 in Appendix). In addition to these results, a few faculty mentioned the connection times to equipment are too long (>5 min) and many requested adapters for connecting their devices to the projector. Our team will focus on remediating these problems within our implementation section.

Some additional findings that we found was the divide in AV equipment usage between STEM classes and non-STEM classes. STEM classes in general have a mean AV reliance score of 4.44 whereas the non-STEM classes have a mean AV reliance score of 6.74[1]. Out of the 18 STEM classes in our data, only 9 of the classrooms report usage and they are less frequent than non-STEM classes. Most of these classes are housed in the classrooms in PAB whereas most of the non-STEM classes are housed in classrooms at Kaplan Hall (See Graph 7 in Appendix). All classes in PAB that we surveyed are STEM classes (e.g. physics, statistics). Therefore, the results in these classrooms may be biased since these classes do not frequently use the AV equipment and therefore, cannot form any insightful opinions regarding it. This divide also shows that there may be a discretion of AV usage in classrooms based on class types. Therefore, in our

[1] Mean values are used instead of median values like before due to NA values in the data. Treated NA's as 0 in this case.

implementation we will attempt to cater classroom equipment solutions based on class types as well.

Our rapid survey also sought to understand teaching faculty's habits regarding equipment usage that can shed light on what could be remediated in the summer. Previously on our facility tours, we discovered that a few classrooms housed unused overhead projectors. During our rapid surveys, we paid attention to the usage of these projectors specifically. None of the surveyed faculty reported using the overhead projectors. Furthermore, one of the classrooms in PAB already removed the projector that was previously present due to disuse. Therefore, we are able to conclude that the Digital Spaces team does not need to purchase replacement overhead projectors in the future. In addition, our survey revealed that over 50% of the teaching faculty turns on the classroom built-in projector when they enter the classroom while only about 35% of them turn off the projector when they leave the classroom (See Graph 8 in Appendix). For many faculty, the projector is already on by the time they start class, usually due to the short switchover times between lectures. However, some faculty did mention that they didn't know how to turn off the projectors, which may affect long-term energy consumption. We will take the faculty's habits into consideration as well while generating recommendations.

IV. Company Sustainability Scores

It is required by University of California's Sustainable Practices Policy that a minimum of 15% of the points used to assess solicitation evaluations must be allocated to sustainable purchasing goals unless an exception should be made for the benefit of teaching, research, and public service (St. Clair 2024). Throughout the Digital Spaces Department's evaluation process, each company was rated based on the accessibility and quality of their products, with an

emphasis on how they could align themselves with UCLA's sustainability goals while also developing and upholding theirs.

The two companies that UCLA had chosen to partner with in this summer's overhaul were Crestron, an electronics company with experience in providing AV equipment optimized for educational settings, and PlaceOS, a software company specializing in smart building management. Crestron and PlaceOS had received scores of 5 and 4 respectively in the sustainability evaluations we had conducted. Crestron had stood out due to their commitment to sustainability, energy efficiency, and environmentally responsible manufacturing. Their company is SAVe certified, ensuring that waste, energy, and emissions are reduced throughout the supply chain, which will allow UCLA to not only source their hardware sustainably, but increase energy efficiency while investing in durable products. PlaceOS had also promised energy efficiency, but through system integration to minimize energy consumption. Additionally, their real-time sustainability monitoring that would allow UCLA to visualize their energy consumption and any potential areas for energy saving would provide a necessary resource to understand how energy usage changes as systems and equipment are updated. Overall, both companies had promising answers that ensured sustainable solutions for UCLA to manage e-waste, energy consumption, and emissions.

V. Interview Responses

Our interview with Joe Way offered us a unique perspective as to why a sustainable audiovisual equipment overhaul was necessary and how he wanted to use his past experience in developing this program for USC to build a better one for UCLA. He shared with us how UCLA faculty's low satisfaction with AV equipment was due to a lack of technology, care, efficiency, sourcing, and a nonexistent strategic vision on sustainability. USC faced a few implementation

challenges as the forerunning program, especially as sustainable AV items are 3-5% more costly than typical AV products, but was still able to see an 80% classroom energy decrease. UCLA has the advantage of a smoother transition due to the UC system's support and enacted sustainability goals. Joe believes UCLA's eagerness to shed light on this project, especially as the Olympics approach, will allow for other schools to follow suit in the sustainable AV movement. This interview proved useful when trying to understand the process of implementing a sustainable AV equipment program that could be tailored to UCLA and detailing any future expectations that we could have.

Founder of Sustainability in AV (SAVe), Christina de Bono, sought to make meaningful change against the socio-environmental harms caused by AV equipment. In past years, 23 metric tons of e-waste were generated), with only 19.4% officially recycled due to the persistence of very few e-waste regulations. As an internationally recognized sustainability leader, Christina's mission with SAVe is to certify companies and institutions, allowing them to create long-term strategies, find certified recyclers, and instructional guides. Following the consultation with Christina De Bono from SAVe, we were recommended to follow up on their publication "Guide to Sustainable AV Design and Installation." Our team utilized this guide as a basis for the types of questions to later ask Crestron and PlaceOS.

Crestron's Mike Rogers had detailed how the company actively focuses on integrating sustainable practices in the supply chain, product design, and other operational areas. Supplier scorecards are used to assess the ethical and environmental practices of suppliers. They then utilize third-party ESG certifications and monitor geopolitical issues to ensure that these scores are verifiable. Upon receiving these answers, Crestron is able to question their suppliers on whether or not they can redesign their products or recycle an additional amount of waste in order

to support decreasing both their suppliers' environmental impact along with their own. Crestron also works with their engineering teams to devise different sustainable and long-lasting packaging and product designs to ensure that they minimize waste and the usage of unsustainable materials while also creating efficient, durable hardware. Although it is tough to eliminate plastic packaging when dealing with fragile products such as AV equipment, they hope that all single-use plastic can be eliminated in the future. Aligning with UCLA's sustainability goals, Crestron aims to package everything economically, fit as much as possible in one pallet, and prioritize ground transportation in order to decrease their emitted emissions on all fronts. Additionally, Rogers had ensured us that Crestron does not design their products for planned obsolescence like the majority of consumer electronics. Their products are built to last and be upgraded, not to be replaced in the near future.

An interview with PlaceOS' Jonathan McFarlane revealed that the company will be able to help UCLA lower their emissions and energy consumption from automated building operations by automatically controlling and tracking lighting, heating, and air conditioning systems (HVAC) through software integration with preexisting equipment. A previous study done by their company at Canada's McMaster University revealed that HVAC operations ran on average three hours longer than they needed to, which had greatly increased the amount of energy consumed and energy inefficiency. Utilizing their software, PlaceOS had listed a set of recommendations to inform the university on how they could curb their energy usage, which included: integrating their software into preexisting security and network systems to track classroom occupancy to inform their programs on when lighting and HVAC could be turned off, adjusting stop and go times, and calculating how long classrooms needed their HVAC to run to reach a standard temperature. Although wifi networks and cameras are utilized to control lighting

and HVAC systems based on whether there are people in a given area, identities of individual persons and their personal data will not be tracked, because this technology relies on device and motion sensors. PlaceOS' software has the potential to aid UCLA in decreasing overall energy consumption and improving energy efficiency throughout the campus without having to invest in new equipment.

In addition to the AV companies, we also interviewed India Tucker and Tori Lowe, the Senior Business Development Executive and the Manager of Business Development from Human-I-T, UCLA's certified recycler. Human-I-T guarantees the proper disposal of e-waste by detailing intake, reviewing for reusability, and sending the items that cannot be repurposed to an R2-certified vendor for safe disposal. Notably, Human-I-T ensures the waste is dealt with in the US and not sent overseas in the Global South for unsafe, improper handling. To eliminate gas-powered truck emissions and its negative impact on the environment, equipment pickup at UCLA is conducted once a week. Human-I-T also locates their closest facility to UCLA so that they can further reduce gas emissions from driving long distances. Finally, we learned that reports of e-waste statistics are given back to the school, presenting the amount of emissions lowered, e-waste redirected, and toxic metals mitigated. Our team acquired a copy of the 2024 impact report at UCLA specifically. In the report, we learned that 193,628 lbs of electronic waste was diverted from landfills and 60% of the donated equipment was repurposed to aid individuals who are in need (See Figure 8 in the appendix). These statistics showed us how Human-I-T contributes to a more sustainable and circular economy and how UCLA has assisted them in doing so.

Many of the responses directed our team on the topics to cover for the later interviews we had scheduled, allowing us to generate a general structure of how each entity was connected.

Based on the series of interviews we have conducted over the course of this project, we plan to forward this information to the Digital Spaces Department in order to advise them on the implementation process over the Summer of 2025.

Implementation

I. Procurement

When Joe Way previously implemented an AV sustainability program at USC, he worked with Crestron to decrease the amount of packaging waste by requesting that equipment should not be packaged individually, but in conjunction with other products. This decreased the amount of individual boxes and other packaging materials such as cushioning agents (e.g. bubble wrap, styrofoam) and tape. Similar shipping requests should also be made for this summer's overhaul in order to diminish accumulated packaging waste, especially when it comes to plastic products. In the interview with Crestron's Mike Rogers, he had also specified that in order to mitigate transportation emissions, Crestron would ship all feasible products from the warehouse that is closest to Los Angeles and focus on delivering this equipment with ground transport. A proper request for these preferences should be submitted to Crestron in order to ensure that UCLA can limit the amount of greenhouse gas emissions emitted throughout the supply chain.

Additionally, UCLA also has the purchasing power to request adjustments to what packaging materials are used in the shipping of all equipment. A request to eliminate styrofoam when possible, due to its inability to biodegrade properly into the environment, can be made, especially when shipping more resilient equipment such as cables.

Although it is a given that equipment such as projectors and displays will be replaced in this summer's overhaul, multiple professors and teaching assistants in the rapid surveys

requested that UCLA's Digital Spaces Department provide adapters (e.g. HDMI, USB, VGA) in their classrooms. Teaching staff had disclosed that displaying the screens of their personal devices was vital for their teaching, especially for classes that depended on slides or included programming within their curriculums. It was a struggle for some faculty to remember to bring their own adapters to every class, and when they forgot, they were forced to scramble for another one, eating into their lecture times. Additionally, some staff also had problems with their own adapters not being able to play audio or randomly disconnecting their device from the projector screen. Being able to possibly provide adapters within classrooms could be a vital possibility to increase the quality of student learning experiences and efficiency across campus.

Regarding equipment that does not have to be replaced in the next coming months, and could possibly be phased out entirely, are the overhead projectors in all 11 classrooms. Not a single faculty member had reported utilizing the overhead projectors in their classrooms and in fact, some had expressed that it had to be moved a couple of times due to it blocking walkways or seats. It is possible that these assumptions can be extended to other classrooms on campus and can inform future AV equipment overhauls on what they can exclude from their buying list.

II. Software Integration and Energy Efficiency

Decreasing energy consumption provides a feasible solution to mitigate emissions for campuses such as UCLA, where AV equipment, lighting, and HVAC systems are both integral to operations and overall environmental impact. In 2022, UCLA outlined Goal 4-1 in their Strategic Plan to reduce energy usage by 2% annually. With PlaceOS' software, UCLA may be able to increase energy efficiency utilizing occupancy tracking systems to shut down unused appliances after a certain time frame. Based on PlaceOS' McMaster University case study in Ontario, Canada, by tracking the amount of time HVAC systems were being run versus the amount of

time classes actually occurred, the HVAC operated three hours longer than classes were scheduled. This had revealed a possibility for energy savings, in which if McMaster University ran their systems for three hours less daily in each of their classrooms and implemented new stop and go time frames (e.g. if a classroom only needed 30 minutes to get to a standard temperature, HVAC systems should run for 30 minutes and promptly stop), they could save around 4,000 MWh of electricity and 18,800 MWh of natural gas a year. This in turn decreases 4,927 tonnes of CO2/year. In addition to energy and emission reduction, McMaster University was projected to save around $838,100 a year[2]. Not only could implementing a similar case study at UCLA advance initiatives surrounding sustainability such as Goal 4-1, but annual financial savings would also have a projected increase in the future.

There are three main areas that we need to address when deliberating potential energy saving possibilities: HVAC systems, lighting, and AV equipment. In PlaceOS' case study at McMaster University in Canada, much of the energy use was attributed to running AC and heating systems, which may also indicate an area that needs to be addressed at UCLA. Los Angeles is known for its mediterranean climate, with hot dry summers and cooler wet winters, and HVAC systems run to accommodate these temperature fluctuations. However, not all classrooms will require the same amount of heat and air conditioning due to differing conditions such as size, presence of windows, and building insulation. Each type of classroom within the Digital Spaces Department's scope, from "lecture hall" to "seminar room", should be evaluated with PlaceOS in order to calculate the average time it takes to heat or cool a classroom to a comfortable, predetermined temperature. Although it would be optimal for each individual

[2] These calculations were based on ROI forecasting based on Canadian energy costs, but a similar or even larger savings amount could be possible for UCLA.

classroom to have their own stop and go time, these times can be extrapolated to other rooms of similar size and circumstances.

Occupancy sensors could also prove vital to understanding when HVAC, lighting, and AV equipment systems could be shut off. McFarlane delineated two main ways in which PlaceOS could implement this technology: counting people or counting active devices. By utilizing equipment that is already in place, PlaceOS could integrate this occupancy tracking alongside the schedule of classes to create a system where UCLA can efficiently shut off systems when they're no longer being used by teaching faculty, student organizations, or maintenance staff. In addition to merging the schedule of classes with occupancy sensors to ensure greater energy efficiency, SOLE, or the Office of Student Organizations, Leadership, and Engagement, should also be contacted. Many student organizations book classrooms and lecture halls for their general meetings and this is not represented in the classroom schedule. By collaborating with Mike Cohn, the director of SOLE, or Kris Kaupalolo, SOLE's associate director, the Digital Spaces Department will have a more encompassing look at when and where other students will be on campus so that HVAC, lighting, and AV equipment can run accordingly.

III. Data Analysis and Tracking

Throughout the summer, and other future AV equipment overhauls, UCLA's Digital Spaces Department should draft a comprehensive list detailing what equipment will be disposed of and what it will be replaced with in order to understand any possible decreases or increases in physical equipment needed for each room. This calculated difference can be referenced for future overhauls to visualize the change in the amount of physical product and waste. Additionally, packaging waste accumulated from new hardware shipments can be categorized into three main

categories: recyclable material (e.g. cardboard, paper), plastic (e.g. bubble wrap, plastic containers), and other (e.g. styrofoam). By tracking what materials are used and disposed of throughout the replacement process, the Digital Spaces Department can monitor how much additional waste was accumulated and compare these measurements to future overhauls, where materials and waste may change as Crestron evolves their packaging systems.

UCLA's contracted e-waste disposer, Human-I-T, ensures that all of the e-waste that UCLA disposes of will be properly sorted through and categorized as equipment that could either be refurbished or recycled. The Digital Spaces Department will have to fill out a web form to delineate their point of contact, pickup, and a list of everything they are handing over, which can include the make models of the equipment. Human-I-T requests that all tech be unplugged and uninstalled. The company currently picks up e-waste from UCLA every Tuesday, and the Digital Spaces Department should plan to accommodate this in order to decrease the amount of transportation emissions released from Human-I-T's vehicles. Once the entire shipment has been processed, the department can request a report that details the social impact from any refurbished equipment, amount of e-waste diverted, toxic metal count, and greenhouse gas emission calculations to visualize their environmental and social impact (see Figure 8 in the appendix).

In the long term, the Digital Spaces Department can track energy savings with PlaceOS' interfaces. As outlined by McFarlane, these interfaces can be customized to the department's needs and typically show energy consumption broken down by building or classroom. This data could prove vital in future projects to see how the new equipment obtained from Crestron has decreased energy consumption in the 11 classrooms within this overhaul's scope. Additionally, the ability to identify any additional opportunities for energy savings by adjusting AV system automatic shut off times is also entirely possible.

Mike Rogers of Crestron had also expressed interest in having assistance in tracking and calculating the company's Scope 3 emissions regarding product longevity and emissions after they're sold. Although Crestron does have an ISO9001 certification, a certification that ensures their business delivers high-quality products, they are lacking data regarding product lifespans (ISO). In order to assist Crestron with this goal, UCLA's Digital Spaces Department can keep inventory on when certain equipment was purchased, installed, upgraded or repaired, and eventually replaced to measure how long these products have served UCLA and could possibly be utilized by others.

Discussion

Our research implies that, on the end-user side, dated and inefficient hardware leads to dissatisfaction with UCLA's teaching infrastructure and delays in the educational experience. We thus expect increased satisfaction and engagement from both students and teaching staff when new equipment is installed. Energy and waste savings, from having to replace only parts instead of full pieces of equipment, will benefit teaching faculty, create a less disruptive teaching environment for students, and enhance UCLA's sustainability goals regarding waste and energy. Given that only one comparable project—led by our stakeholder Joe Way at USC—has been conducted to date, further research is needed to continue advancing the efficiency, durability, and sustainability of AV equipment. UCLA is uniquely positioned to lead by example, promoting a comprehensive approach to sustainability that addresses the full lifecycle of AV products, from procurement and maintenance to eventual disposal.

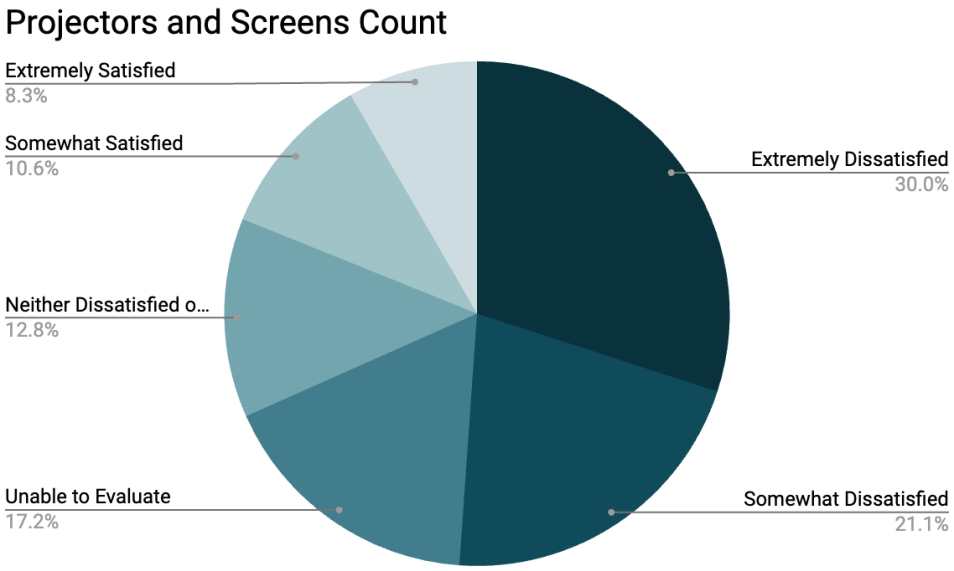
Our team's work plays a valuable role in advancing campus sustainability by focusing on a frequently overlooked area of resource consumption: AV equipment. Our findings demonstrate that implementing sustainable AV practices can significantly support UCLA in achieving its

campus-wide sustainability goals by reducing energy use and carbon emissions. Since AV equipment is one of the cruxes of modern learning, our project supports multiple objectives: creating a learning experience that maximizes student potential, optimizing classroom functioning and space, and ensuring teaching faculty satisfaction. Through our analysis of data gathered from surveys, facility tours, and interviews with sustainable AV companies and industry experts, we identified key opportunities for UCLA to improve energy efficiency, reduce electronic waste, and address teaching faculty's needs to better uphold the long-term sustainability and accessibility of our campus infrastructure. Our work can support not only immediate improvements to the classrooms within our scope, but also lay a foundation for future AV equipment replacements across campus at UCLA and beyond.

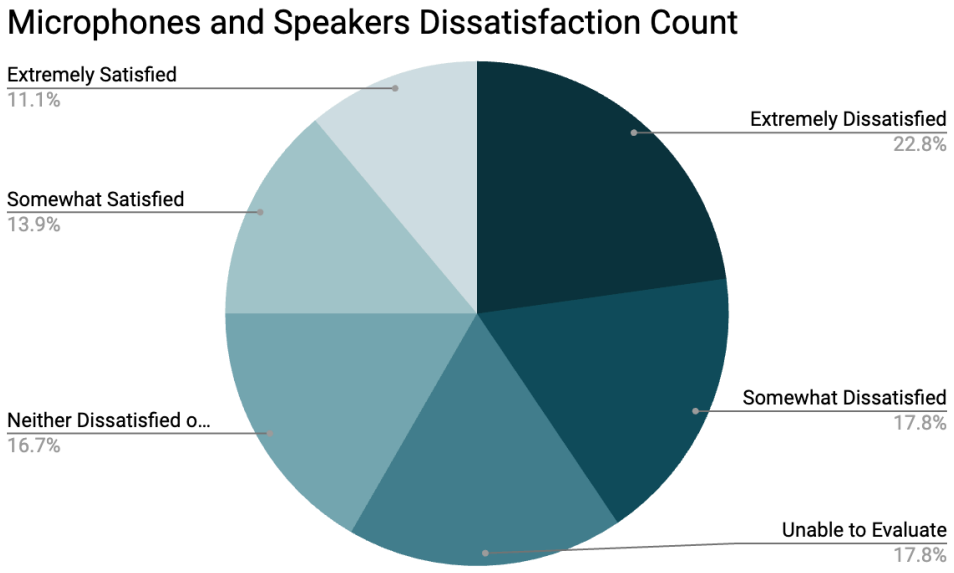
Moving forward, there is great potential to expand our project to more classrooms, which the Digital Spaces Department expects to do, causing campuswide savings on energy. First, though, long-term monitoring needs to occur in order to see if this newly-procured equipment is meeting faculty standards in addition to saving energy. The more sustainable hardware and software that will be installed could also be used in conference rooms in UCLA's dormitories and university apartments, including projectors, display screens, and software. The positive effects of our 11-classroom upgrade could ripple out into the broader UCLA property, and from there, more schools can follow in UCLA's footsteps. We encourage future SAR Directors to continue and expand on AV sustainability projects, looking at other types of classrooms, student housing, and monitoring and performing energy audits of the new equipment after this summer's installation. This data can help us to further explore areas of improvement regarding energy and waste reduction in the future, allowing both UCLA to further their sustainability goals in a way that was previously not considered.

Appendix

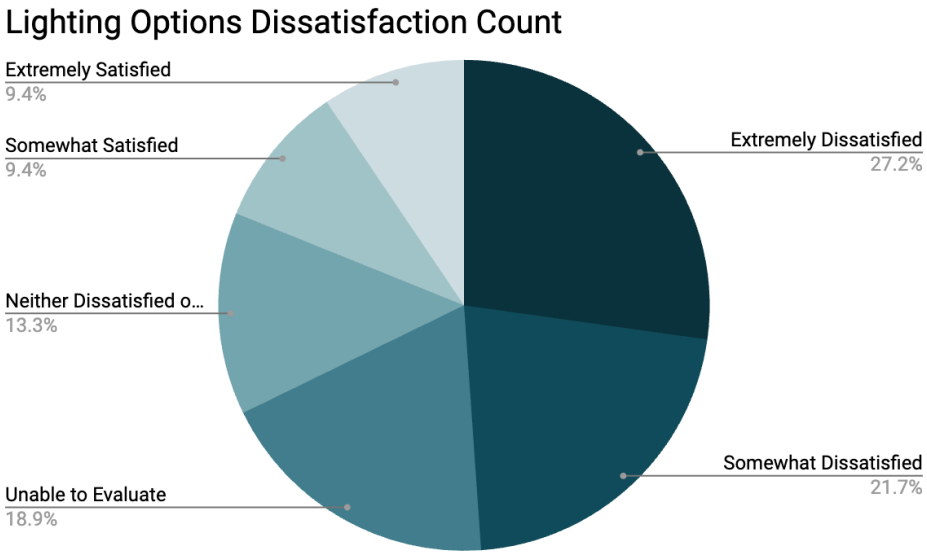
I. Graphs



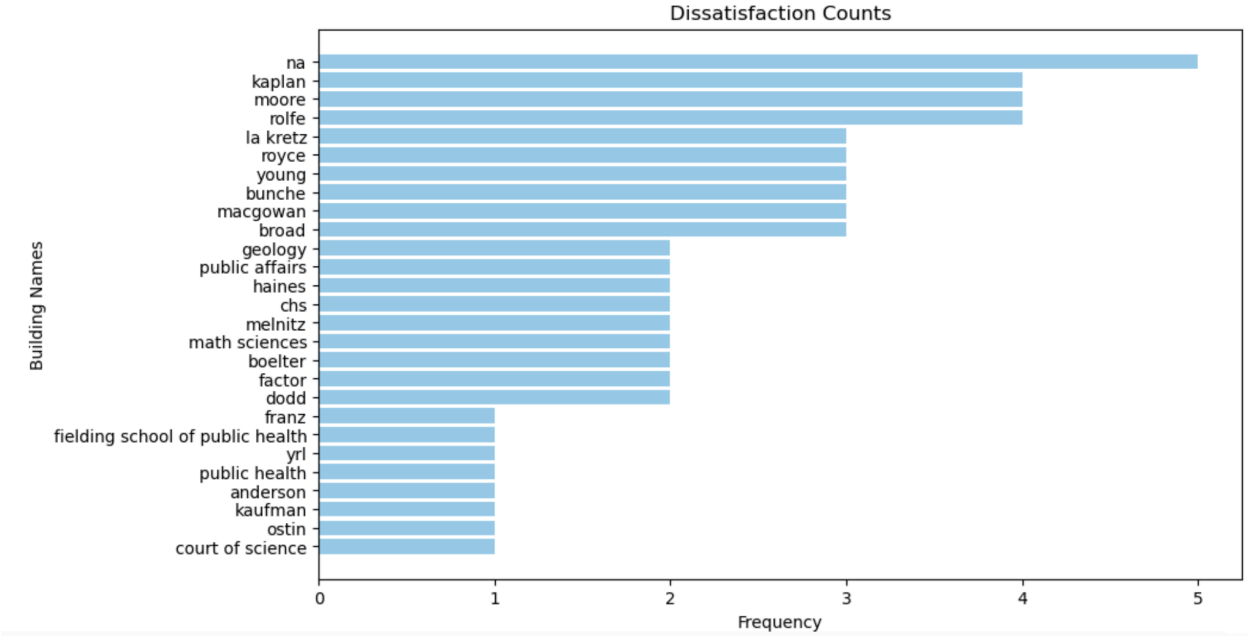
Graph 1. Pie chart of teaching faculty's satisfaction degree on projectors and screens



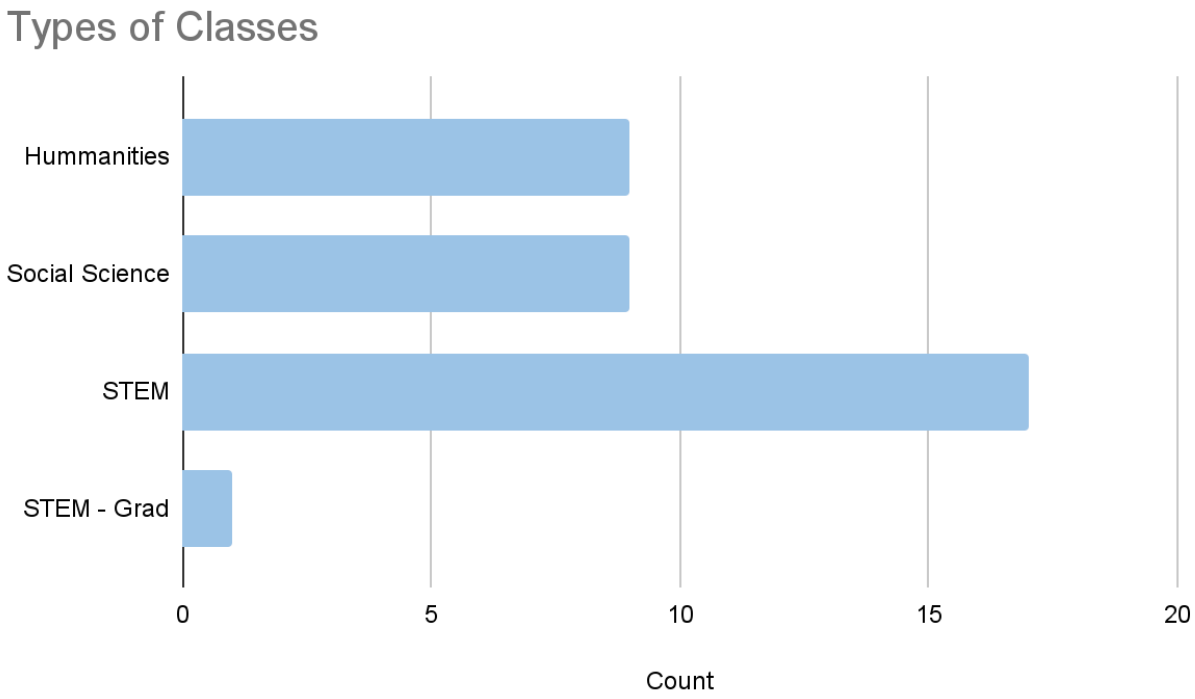
Graph 2. Pie chart of teaching faculty's satisfaction degree on microphones and speakers



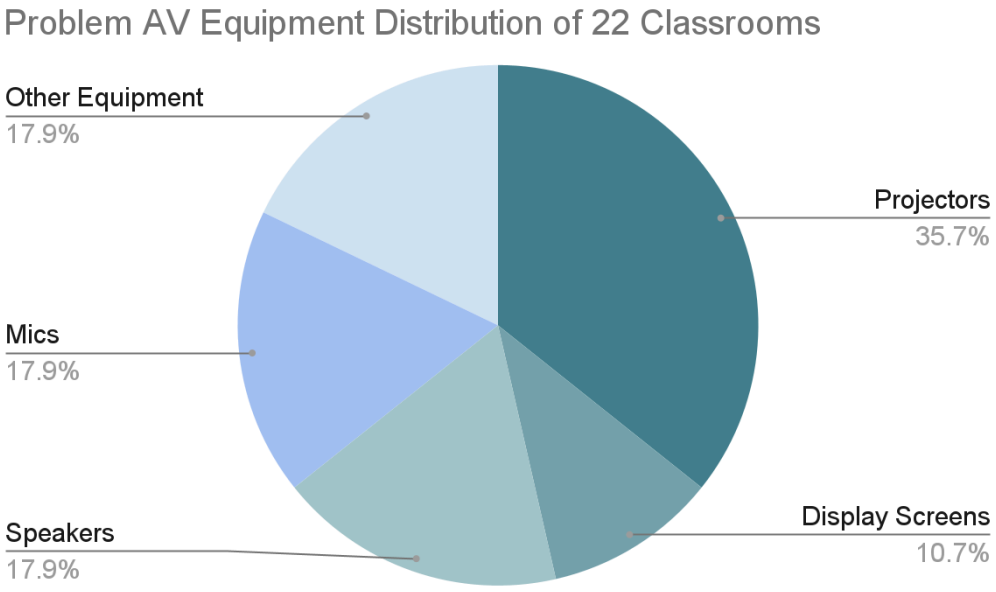
Graph 3. Pie chart of teaching faculty's satisfaction degree on lighting



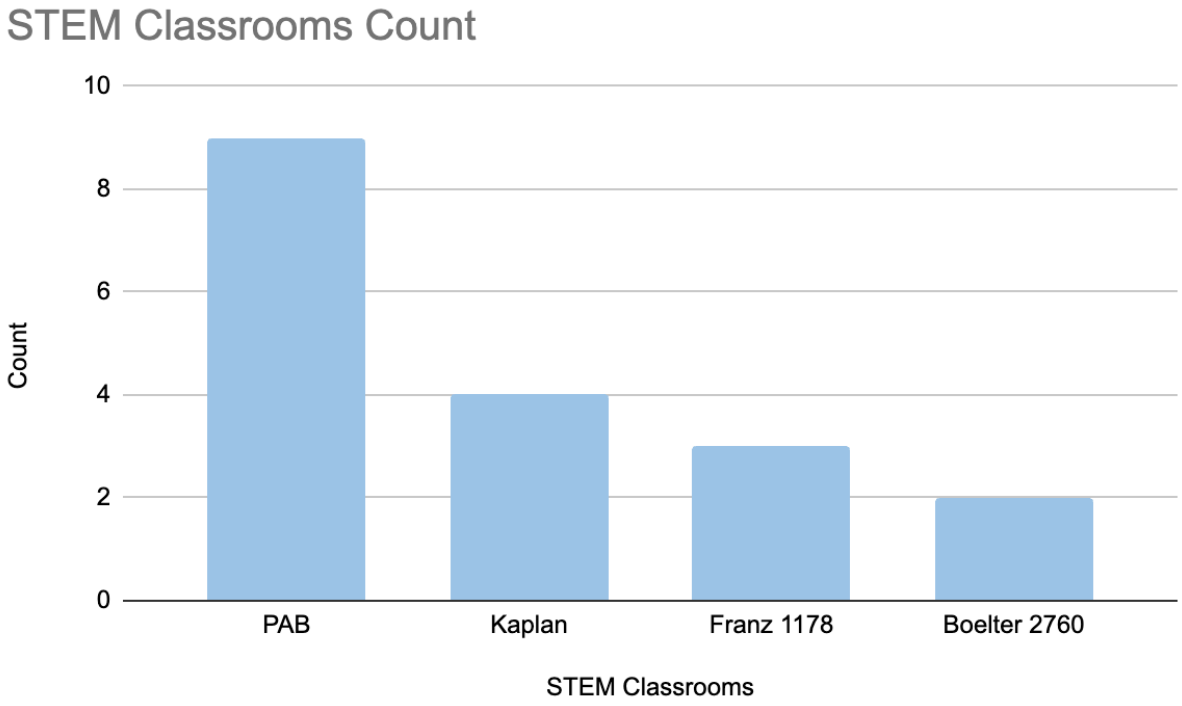
Graph 4. Bar chart of classroom locations of dissatisfied equipment

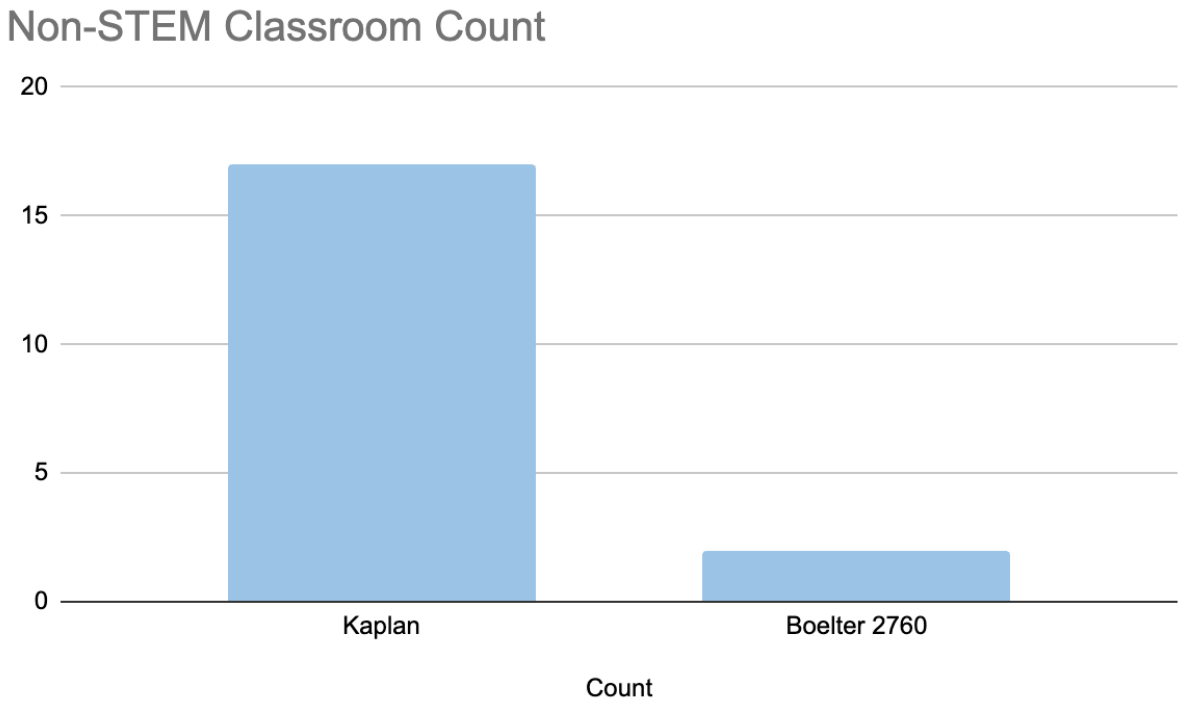


Graph 5. Number of Classes Surveyed

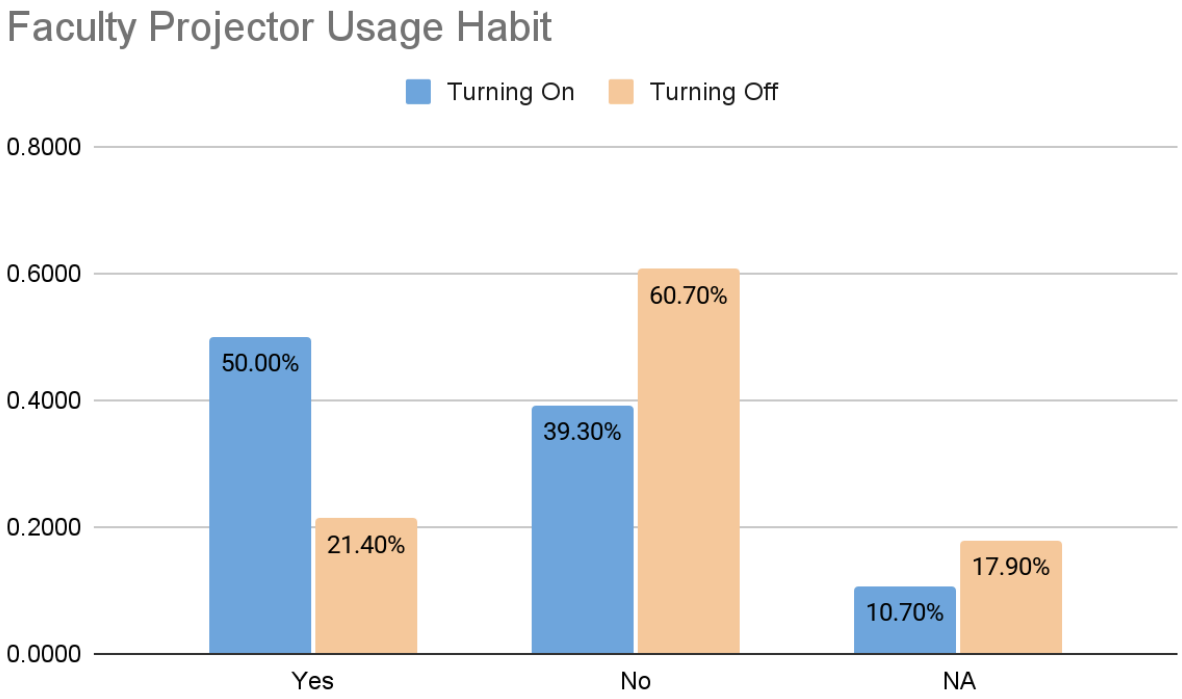


Graph 6. AV Equipment Dissatisfaction Distribution





Graph 7. STEM Classes Count vs. Non-STEM Classes Count



Graph 8. Faculty Projector Usage

II. Tables

Building	Room	Lights/Type	Video Projector	Media Player	PA/Wireless Mic	Installed PC	Bruincast Camera	Flatscreen Monitor
Kaplan	A26	Lutron/Fluorescent	Panasonic PT-FW-300NTU	Magnavox DV225MG9 DVD/VHS	N/A	N/A	N/A	N/A
Kaplan	A40	Lutron/Fluorescent	Panasonic PT-FW-300NTU	Magnavox DV225MG9 DVD/VHS	N/A	N/A	N/A	N/A
Kaplan	A48	Lutron/Fluorescent	Panasonic PT-FW-300NTU	Magnavox DV225MG9 DVD/VHS	N/A	N/A	N/A	N/A
Kaplan	A51	?/LED	Christie D16WU-HS	N/A	Yes	MacMini	Logitech	ELO
Kaplan	A65	?/LED	Panasonic PT-VMZ51	N/A	Yes	MacMini	Logitech	ELO
PAB	1434A	Furman/Fluorescent	Panasonic PT-VMZ50	N/A	Yes	MacMini	Logitech	ELO
PAB	1749	Furman/Fluorescent	Panasonic PT-VMZ50	N/A	Yes	MacMini	N/A	ELO
PAB	2434	Furman/Fluorescent	Panasonic PT-VMZ50	N/A	Yes	?	Logitech	N/A
Boelter	2760	Mid-Atlantic/Fluorescent	Panasonic PT-EW550	N/A	Yes	MacMini	Logitech	ELO
Franz	1178	Mid-Atlantic/Fluorescent	Panasonic PT-DZ680/InFocus IN5108	N/A	Yes	MacMini	Logitech	ELO
Campbell	B125							

Table 1. Equipment List for Classrooms in Scope

III. Photos

Figure 1. AV Cart in PAB 1749

Figure 2. Wifi Router and Embedded AV Machine with Exposed Wiring in PAB 2434

Figure 3. Overhead Projector in Boelter 2760

Figure 4. Overlapping Projector Screens in PAB 2434

Figure 5. Ceiling Openings for Overlapping Projector Screens in PAB 2434

Figure 6. Bulb Projector in Kaplan A65

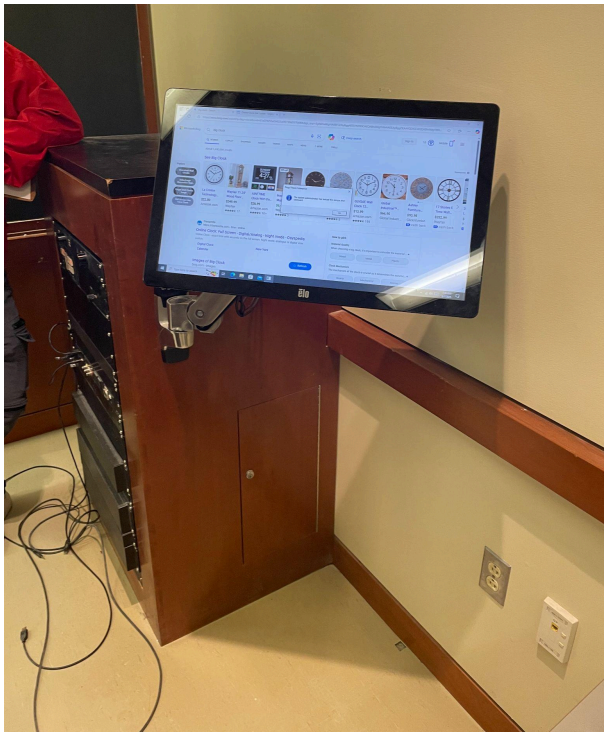


Figure 7. Touchscreen and CPU Box in PAB 1749

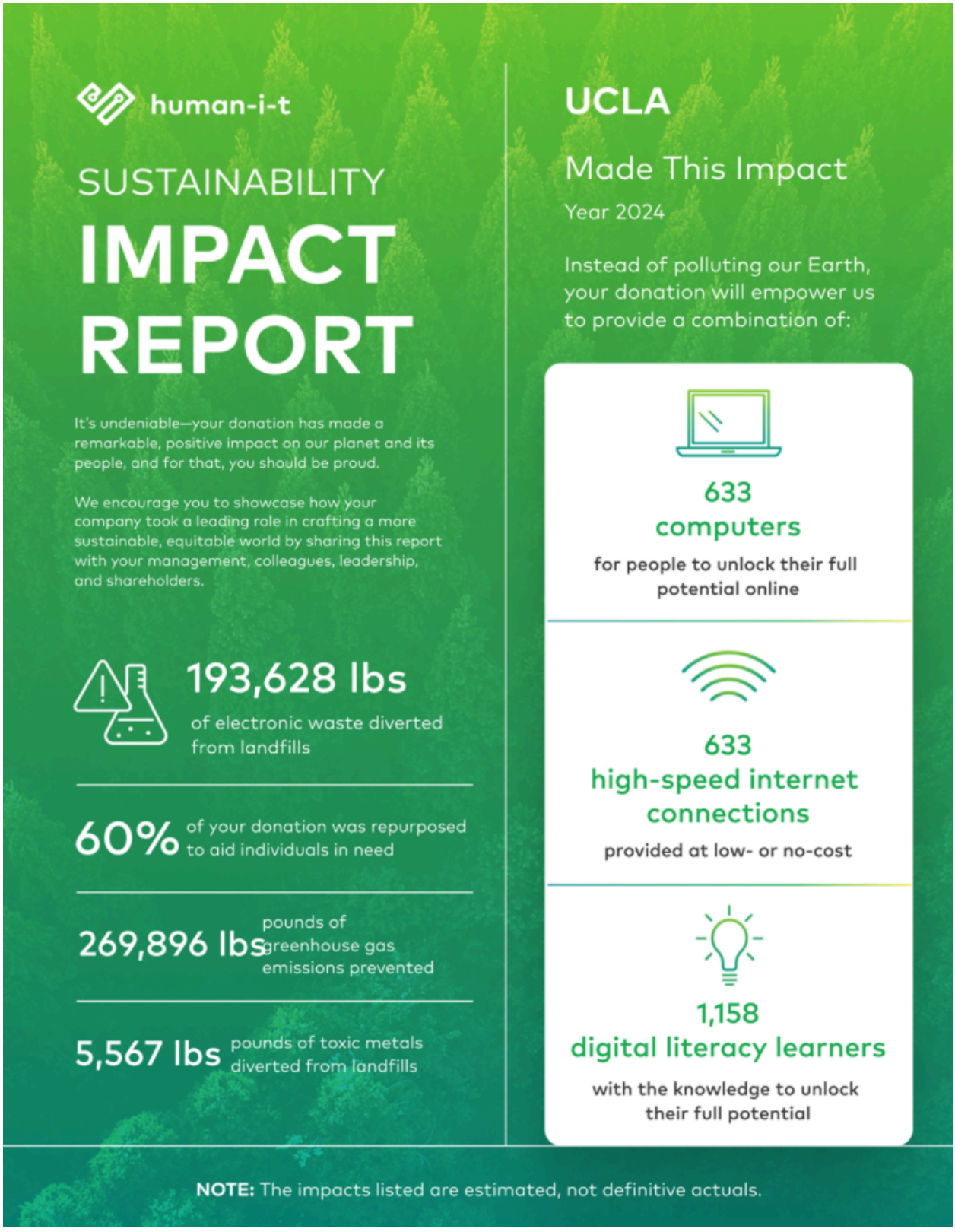


Figure 8. UCLA Environmental and Social Impact Report from Human-I-T

Works Cited

"ISO 9001 Standard - Quality Management Systems." *ISO9001*, https://iso9001.com/. Accessed 11 June 2025.

St. Clair, Matthew. "University of California - Policy on Sustainable Practices." *University of California*, 10 April 2024. https://policy.ucop.edu/doc/3100155/SustainablePractices.

UCLA Sustainability. (2022, April). *UCLA_SP_FULL_v2022.06.13.PDF*. UCLA Sustainability. Full Plan. https://ucla.app.box.com/s/j2zya9hb0c6w6vy5ic877dlnghs69tyy