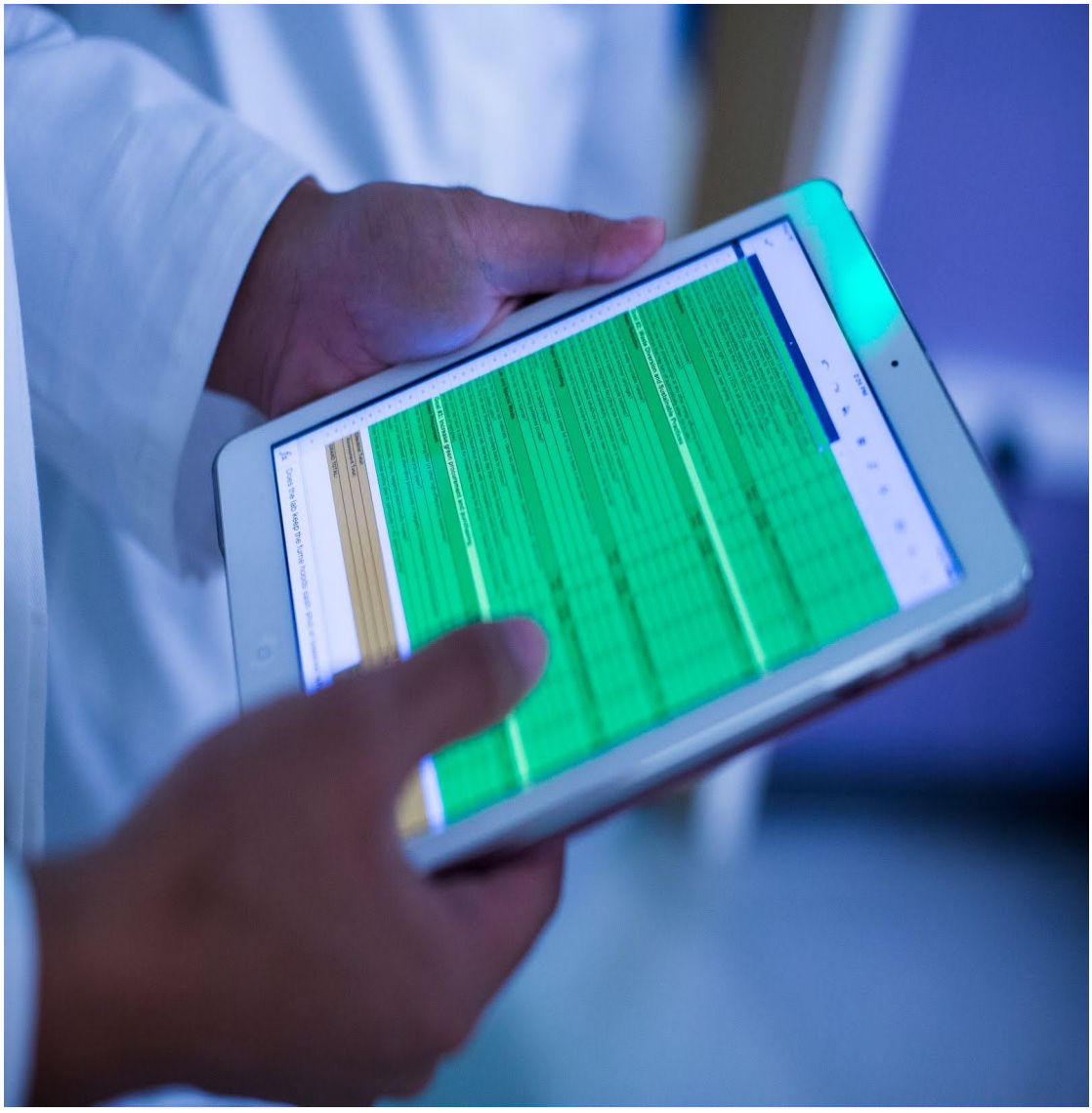

UC Santa Cruz Green Laboratories Action Plan

Spring 2019

Executive Summary

UC Santa Cruz's six primary lab buildings on its main campus account for 35% of the electricity consumption while consisting of only 22% of the square footage. They produce significant waste and have been the single largest purchaser from UC Santa Cruz's procurement platform, CruzBuy. The UC Santa Cruz Green Labs Program was formed under the campus Sustainability Office with three main goals: 1) promote energy efficiency, 2) promote waste and water reduction, and 3) implement green procurement practices.

With the UC systemwide goals of carbon neutrality by 2025 and zero waste by 2020, the UC Santa Cruz Green Labs Program is committed to being significant contributors towards reaching these goals. The Green Labs Program also supports Goal 3, "Improve the energy efficiency of campus buildings by 10% below a 2010-2012 baseline," within the Climate and Energy section of UCSC's 2017-2022 Campus Sustainability Plan.

With this *UC Green Laboratories Action Plan,* we hope to provide a framework that gives students, researchers, and the entire UC community insight into the programs that are currently in place and the long-term strategic objectives the Green Labs Team will work to implement in the coming years.

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History

Started in the 2012-13 academic year, the Green Labs Program was created to improve energy efficiency, increase green purchasing, and reduce waste in research laboratories on the UC Santa Cruz campus through behavior change, physical improvements, and education. In 2013, the program was formalized by the Climate Action Team in the Sustainability Office. The program consists of a staff manager, a student program coordinator, and a student outreach coordinator. The program is heavily dependent on the student worker team to be the main representatives of the program and successfully engage with labs across campus.

The program is housed in the UC Santa Cruz Sustainability Office and has secured funding through student-fee Measures 44 and 45 which support sustainable initiatives on campus. Since the initiation of the Green Labs Program, it has been awarded multiple grants totaling over $100,000 from the UC Santa Cruz Carbon Fund. The Carbon Fund is an on-campus granting body supported by student Measure 44 that allocates funds for projects that reduce greenhouse gas emissions, conduct relevant research, or carry out education and behavioral change programs. Grants from the Carbon Fund have historically been dedicated to create an "Equipment Retrofit Fund" which supports certified labs in upgrading their old equipment with new efficient models.

Table 1. 2019 UC Santa Cruz Green Labs Committee & Key Stakeholders

Name	Title	Department
Ellen Vaughan	Water & Climate Action Manager	Sustainability Office
Sarina Sylavong	Student Program Coordinator	Sustainability Office - Green Labs Program
Carolyn Burch	Student Outreach Coordinator	Sustainability Office - Green Labs Program
Elida Erickson	Sustainability Director	Sustainability Office
Kristen Lee	Sustainability Programs Manager	Sustainability Office - Zero Waste Team
Neema Mahini	Environmental Programs Specialist	Environmental Health & Safety
Justin Delemus	Environmental Programs Manager	Environmental Health & Safety
Sarah Gilchrist	Assistant Energy Manager	Physical Planning, Development and Operations
John Steward	Associate Director	Physical Planning, Development and Operations
Patrick Testoni	Campus Energy Manager	Physical Planning, Development and Operations
Kathleen Rogers	Strategic Sourcing Manager	Procurement Services
Allison Paradise	Executive Director	My Green Lab Nonprofit

Current Programs

Green Lab Assessment Program

Over the years, the Green Labs Program has grown to encompass multiple facets of sustainability into laboratories through its assessment program. The assessment is based off of a survey provided by the national My Green Lab nonprofit organization. My Green Lab maintains the self assessment tool and provides multiple resources to utilize during lab certifications and recertifications. The hour long self-assessment is completed by a lab's principal investigator (PI) or a representative, and is an in-depth questionnaire, inquiring about the sustainable characteristics of the lab's waste management practices, equipment, lighting, and much more.

Once the self-assessment has been completed, the Green Labs Team conducts a walk-through of the lab in which the team observes the current waste, water, and energy practices of the lab. This is based on a comprehensive scoring system using the Walkthrough Assessment Scorecard. The scorecard contains weighted questions divided into the three program goals (Energy Efficiency, Waste Diversion & Sustainable Practices, and Green Procurement). Each question has a score range between 0 to 9 points. The highest point on the scorecard indicates the lab's commitment to that specific sustainable practice; this practice may be keeping a fume hood sash shut when not in use or recycling lab materials into their proper bins. After results from both the self-assessments and walk-through assessment are compiled, a final score determines the lab certification level achieved.

Upon completion of the walk-through, the lab will be awarded one of the following certification levels: Platinum, Gold, Silver, or Copper. The level of certification is determined by the percentage of the total points earned out of total points available (excluding any non applicable points).

Levels of Certification:

Platinum (Pt) certification is achieved by labs with exceptional continuous sustainable practices and labs who maintain their level of certification by showing their overall commitment to reducing their carbon footprint. Labs must achieve 90% of total points to receive a Platinum certification.

Gold (Au) certification is granted to labs who incorporate an excellent amount of sustainable practices and labs devoted to goals of improvement. Labs must achieve 75% - 89% of total points to receive a Gold certification.

Silver (Ag) certification is awarded to labs who have incorporated a great amount of sustainable practices. Labs must achieve between 61% - 74% of total points to receive Silver certification.

Copper (Cu) certification is given to labs who have incorporated a substantial amount of sustainable practices. Labs must be between 50% - 60% of total points to receive a Copper certification.

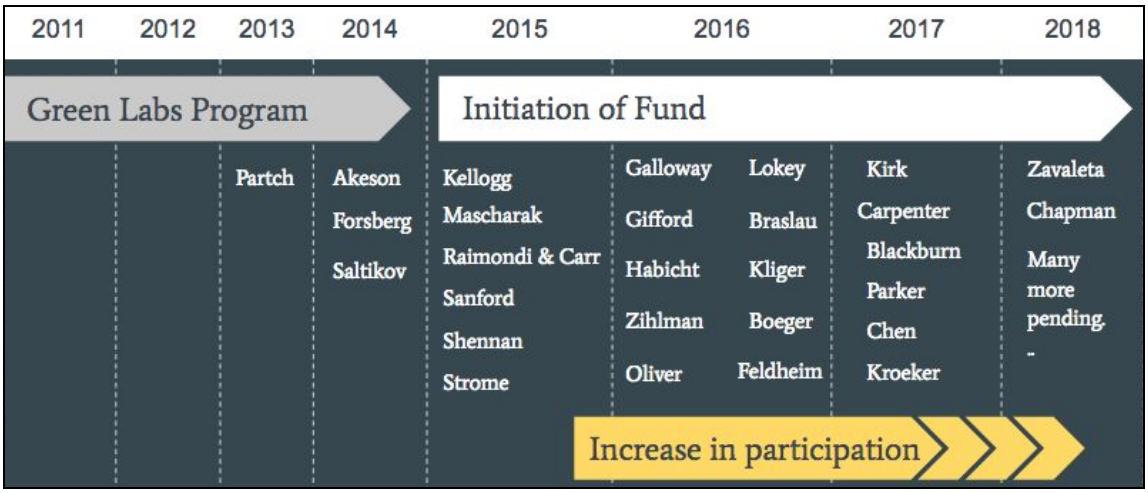
Labs will also receive feedback and recommendations about which areas of the assessment they excelled on and which they can improve on. These recommendations include posting signage such as exit procedure reminders to promote energy savings or utilizing Smart Strips to reduce power consumption from task lighting, computer accessories, and other plug loads in the lab. Additionally, certified labs are awarded with biodegradable stickers, lab hand towels, a certificate, patches, and a freezer scraper.

Promotion of this program is heavily dependent on email outreach, quarterly newsletters, and quarterly presentations at Lab Safety Representative (LSR) meetings.

Equipment Retrofit Fund

Becoming Green Labs certified is an advantage to labs. With the completion of the certification process, labs become eligible to apply for funding through the program's Equipment Retrofit Fund. Once a lab has become certified, they can put in a request to the Green Labs Team to have an older, less energy efficient piece of equipment in their lab be replaced with a newer, more energy efficient model. The amount of funding granted to the project depends on the amount of energy, water, or waste that will be saved. In order to measure these savings, the Green Labs Team conducts a preliminary assessment of the amount of resources actively used and compares it to the cost of the new equipment and the projected monetary savings associated with the reduced resource use. The request may only be partially funded in some instances, but provides an incentive that encourages labs to sign up for the program and overcome the potential cost barriers associated with purchasing new efficient equipment in laboratories.

Figure 1. The increase in lab participation with the initiation of the Green Labs Equipment Retrofit Fund.



Moving forward, the Green Labs Team is looking to replace the Equipment Retrofit Fund program with an inventory assessment of existing equipment across campus to identify the most energy intensive equipment for replacement.

Sustainable Vendor Fair

Each year the Green Labs Team hosts a Sustainable Vendor Fair to educate labs on available sustainable equipment from trusted vendors. Past vendors include MyGreenLabs, Thermo Fisher, Fisher Scientific, Labcon, VWR, and Excelitas. Vendors are encouraged to bring their most sustainable equipment and showcase a variety of options. In the 2017-2018 academic year, the fair included a keynote speaker who presented on climate change to provide greater context on the importance of reducing emissions. This was followed by a presentation from the program to highlight resources available to labs, such as the Equipment Retrofit Fund. The inclusion of presentations drew the program's largest crowd as well as attracted a higher diversity of people including graduate students and undergraduate students. The 2018-2019 fair

will include a presentation on UC Santa Cruz's current efforts to reach its Zero Waste by 2020 goal.

Freezer Retrofit Program

In the 2017-2018 academic year, the Green Labs Program began working in conjunction with UC Santa Cruz's Energy Services and Procurement departments to create a Freezer Retrofit Program. The program has received funding from the Equipment Retrofit Fund, previous Carbon Fund grants, Energy Services, and a PG&E rebate program. This project is working in three phases with Phase 1 focusing on retrofitting old ultra low -80℃ freezers on campus, Phase 2 focusing on retrofitting ultra low -20℃ freezers, and Phase 3 for other cold storage. The program to date has replaced six -80℃ freezers, seventeen -20℃ freezers, and seven fridges. Freezers are extremely energy intensive and many labs are using out of date freezers because they cannot overcome the cost barrier of purchasing a new one. By covering the total cost of the new freezer and requiring labs to trade in their older less efficient models for a new model, freezer energy reduction on campus has been significant. The accompanied metrics and data can be found in the Best Practices section.

Waterless Condenser Program

During the 2016-2017 academic year, the Green Labs Team began investigating ways to reduce single pass cooling systems on campus. Single pass cooling systems remove heat by transferring the heat to a supply of clean water from the faucet and dumping it down the drain. This process of recirculation is an extremely inefficient use of water that results in significant water waste and costs.

To target the issue, the program focused on the Chemistry Department and reflux reactions. In order to conduct reflux reactions, many chemistry labs were using single pass cooling systems, where water is continuously pumped through equipment and discarded. To eliminate the water use in these systems, the program invested in CondenSyn waterless condensers in order to reduce the large burden of wasted water being used for reflux reactions. So far, five labs have received multiple waterless condensers. The accompanied metrics and data can be found in the Best Practices section.

Styrofoam Collections

The Green Labs Program, in conjunction with the Environmental Health and Safety department (EH&S) and the Zero Waste Team, have established a Styrofoam Collection program to ensure that Styrofoam that can be recycled is diverted from the landfill. The program occurs once every quarter, at which point labs are able to deliver their #6 Styrofoam to the Physical Sciences Building loading dock. Once delivered, the Green Labs Team and the Zero Waste Team will sort the Styrofoam to ensure there is no contamination from stickers or labels. The shipment is then taken to a local Styrofoam recycling organization called Grey Bears. More information can be found in the Best Practices section.

Freezer Challenge

During the last two academic years, UC Santa Cruz participated in the national Freezer Challenge. The Freezer Challenge is a competition run by the International Institute for Sustainable Laboratories and My Green Lab that promotes simple steps to reduce the energy use by freezers in labs and increase the longevity of equipment. The Green Labs Team has worked in conjunction with faculty members and EH&S to increase the visibility and accessibility of this program to campus labs.Through the program, labs will make major energy reduction strides while gaining the knowledge of better storage sample management.

Site Overview

UC Santa Cruz has made significant contributions to the body of research that has made the University of California the foremost public university system in the world. In an analysis of the world's top universities published by *Times Higher Education* in 2017, the Santa Cruz campus ranked third in research influence as measured by the average number of times its faculty's published work is cited by scholars around the world.

The quality and quantity of research activities at UC Santa Cruz has received steadily increasing public and private support. In the past five years alone, the campus has received $680 million in research grants and contracts.

UC Santa Cruz's researchers are so highly regarded because they work across disciplines to address the most pressing scientific, social, and political issues of the day. In pursuit of that knowledge, they are blazing a trail of bold, progressive, and fearless inquiry.

UCSC Research Statistics for calendar year 2018	
# of Faculty Principal Investigators	**200**
# of Undergraduate Students Enrolled at UCSC	**16,952**
# of Graduate Students Enrolled at UCSC	**1,813**
Square footage of research laboratories.	**1,237,297**
# of Research Laboratories	**200**

Current Benchmarks

Benchmarks for calendar year 2018	
# of Laboratories that have been assessed to date	**31**
# of researchers directly engaged in the past reporting period	**62**

The Green Labs Team has certified 31 labs since our creation in 2012. From those labs, 62 researchers have been directly engaged with the Green Labs Program as they are principal investigators or act as the sustainability manager for the lab. Hundreds of researchers participate in some capacity with these certified labs. Researchers consist of professionals, undergraduates, or graduate students.

Best Practices

Plug Load

ULT Freezer Replacements

The project's goal is to replace ultra-low temperature (ULT) lab freezers with more energy efficient models. The replacements occured in three phases: Phase 1 being the -80°C ULT freezers, Phase 2 for the -20°C freezers, and Phase 3 for other cold storage such as under counter units.

The ULT Freezer Replacement project scope includes a total of 30 units. Of these, six are -80°C freezers, seventeen are -20°C freezers, and seven are fridges. Because of the large procurement contract that the UC system has with Thermo-Fisher, their price offered the most cost-effective lifecycle cost for the -80°C Freezers. All of the -80°C units have been replaced with Thermo's TSX60086D model. The -20°C freezers were replaced with Thermo's -20°C Freezer Upright (UEN2320A).

The Green Labs Team engaged the Energy Services department to calculate the total energy savings from the ULT freezer replacements as 92,019 kWh savings per year with a total cost savings of $12,422.00 per year. Eleven labs are partnering with the Green Labs Team around this initiative and the Energy Services and Procurement departments are collaborating to purchase the ultra-low freezers. These labs include: the Biology Thimann Labs, Kellogg Lab, Costa Lab, Kay Lab, Arribere Lab, Carpenter Lab, Lyon Lab, Parker Lab, Pogson Lab, Sanford Lab, Sinervo Lab, and the Zavaleta Lab.

Coastal Biology Building Design

In 2015, a study was conducted by the Integral Group, a Green Lab consultant group, in UC Santa Cruz's new Coastal Biology Building to calculate the percentage of the building's energy usage that could be attributed from plug loads. "Plug loads" refer to the amount of energy being used by a building through its electrical outlets by appliances or electronic devices such as freezers or computers. The study calculated that plug loads will be responsible for approximately 58% of total building energy use intensity (EUI) or 47 kBTU/sf/yr (energy per square foot per year) out of 81 kBTU/sf/yr.

The study included recommendations for strategies to reduce plug load energy use, and estimated that if all the strategies were implemented the building would be able to see a reduction in plug load EUI to 30 kBTU/sf/yr. Three top strategies were identified to reduce the

plug load energy use: replacement of existing ultra-low freezers with more energy efficient freezers, replacement of end-of-life equipment with new Energy Star certified equipment, and efficient scheduling of autoclave steam sterilizers. The UC Santa Cruz Green Labs Team has already begun moving forward with the ultra-low freezer retrofit recommendation from this study. This study included an in-depth monitoring program of all equipment at the Coastal Science Campus. By prioritizing energy efficiency in the construction process, UC Santa Cruz is able to keep energy usage low and move toward the UC's goal of carbon neutrality while avoiding the costly process of retrofits down the line.

Signage

To ensure laboratory safety and energy efficiency, signage is provided to and used in labs. signage serves as instructional reminders indicating proper procedures such as unplugging equipment from outlets and turning off power strips when not in use.

Lighting

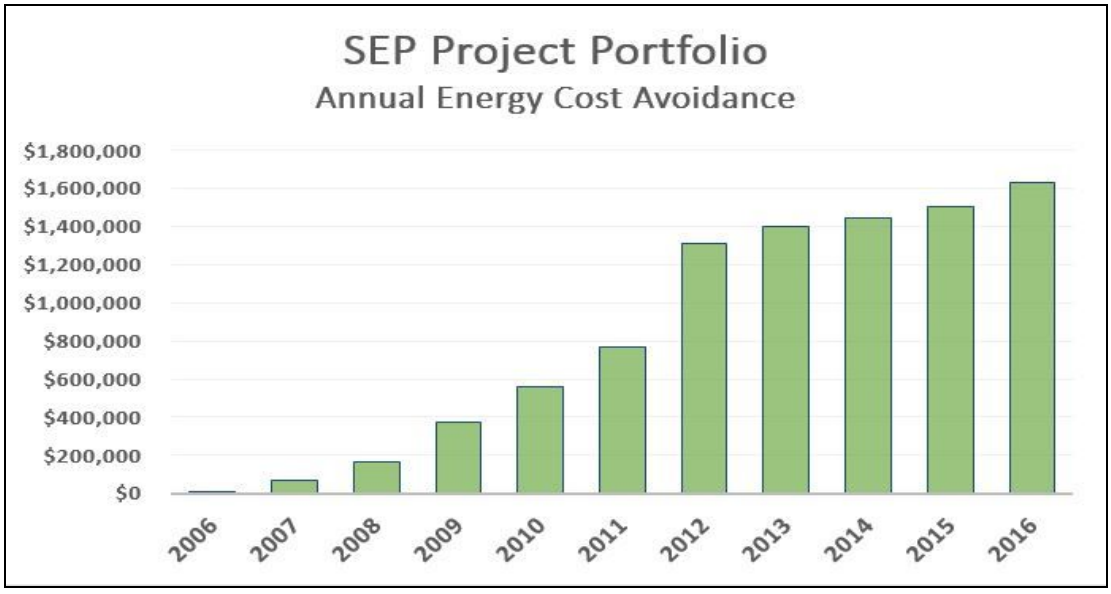
SEP Projects

The Strategic Energy Partnership (SEP) engages with Work Management project managers and trades within the Physical Plant department to implement projects that increase energy efficiency within existing buildings. The types of projects comprise of lighting retrofits, boiler replacements, controls upgrades, commissioning projects, and motor replacements.

Several SEP lighting projects and their approximate energy savings for lab buildings include:

- Physical Sciences Building lighting retrofit (200,676.70 kWh reduction)
- Engineering 2 Building lighting retrofit (108,914 kWh reduction)
- Earth & Marine Science Building lighting retrofit (650,382 kWh reduction)

Projects like these help to reduce the total cost of campus utilities every year and further guide UC Santa Cruz towards their goal of carbon neutrality. Overall, SEP projects has allowed UC Santa Cruz to avoid over $9 million in energy costs since 2006.



HVAC

Phoenix Proximity Sensor

The fume hoods in the Physical Sciences Building and the Coastal Biology Building include additional energy savings through Phoenix Proximity Sensors that throttle back their speed of air intake to 60 feet per minute (fpm) from a typical hood flow rate of 100 fpm. This conservation technique saves thousands of dollars a year and drastically reduces CO_2 emissions. To ensure that the fume hood is in full operation whenever it is in use, the proximity sensor will detect the personnel's presence and will immediately ramp the hood flow rate back up to 100 fpm.

Fume Hood Sash Stickers

UC Santa Cruz has over two hundred fume hoods in research facilities across campus. Although they are critical for fresh air ventilation, they require large amounts of energy since they operate continuously. One of the simplest ways to reduce this energy footprint is to shut the sash when it is not in use or lower the sash of the fume hood to its lowest operational setting. The sash is the movable pane in front of the fume hood which controls the exhaust flow from an experiment.

In 2013, the Green Labs Program placed reminders, also known as "Shut the Sash" stickers, on all campus fume hoods. Environmental Health and Safety requires that each fume hood should have a current calibration sticker and marker indicating the highest sash height to be used when working. The sash stickers help to prompt researchers to keep the hood sash closed as much as possible.

Storage and Sample Management

Freezer Challenge

To promote sample accessibility, sample integrity, reduced costs, and energy efficiency we encourage labs to participate in the Laboratory Freezer Challenge hosted by My Green Lab and the International Institute for Sustainable Laboratories (I2SL).

The objective of this challenge is to utilize friendly competition between labs all around the world over a five month period where individual labs work at their own pace to implement optimal cold storage management practices. Labs earn points for defrosting freezers, cleaning out their freezers and refrigerators, inventorying their samples, storing their samples at high density, storing samples at appropriate temperatures, sharing refrigeration space with colleagues, barcoding samples, and adopting room-temperature sample storage.

By participating in this challenge, labs are able to recognize the benefits of good cold storage management such as the removal of unnecessary samples and the reduced costs associated with maintaining refrigeration units. In 2017, the Freezer Challenge estimated that UC Santa Cruz was able to save approximately 5,400 kWh/year as a result of our efforts.

Sample Inventory

All certified labs maintain and update checklists for the inventory and disposal of their samples, and electronically track their chemicals, oligos, and reagents. This is evaluated through the Green Labs Certification Process during the in-lab walkthroughs as well as the self assessments.

Waste Management

Waste Reduction

One of the Green Lab Program's main goals is waste reduction. The Green Lab Team has been working towards this goal through promoting reduced consumption, product reuse, and improved recycling. After a 2011 waste assessment, it was shown that labs produced 12% of landfill-bound campus waste. Since then, the program has identified many of these items as recyclable and created programs which labs can utilize to reduce their waste.

Kimberly-Clark Nitrile Gloves

A waste assessment found that nitrile gloves made up a large component of laboratory waste destined for the landfill. To reduce this waste stream, the Green Labs Team and EH&S collaborated with the Kimberly-Clark RightCycle nitrile glove recycling program to promote laboratory sustainability and expand a national effort that has so far diverted 70,000 pounds of waste from landfills.

The Green Labs Program officially began its Kimberly-Clark RightCycle program February of 2014. Many labs throughout campus are participating in recycling their current stock of Kimberly Clark gloves.

In 2017 and 2018, UC Santa Cruz received a Kimberly-Clark Environmental Impact Achievement Award for reducing our impact on the environment by diverting a total of 4,615 lbs of nitrile glove waste.

Styrofoam Collection Program

The Green Labs Team, EH&S, and the Zero Waste team have quarterly Styrofoam Collections in place for labs and all other departments who may have high influxes of Styrofoam. Every year, the program diverts approximately 1,500 pounds Styrofoam that would otherwise be discarded into the landfill.

Styrofoam is collected each quarter and transported to Grey Bears, a nonprofit corporation focused on reusing, repairing, and repurposing donated items. There, Grey Bears operates a machine that will densify the Styrofoam before it is sent to a recycler.

Pipette Tip Box & Plastic Pail Recycling

With the help of Physical Plant and EH&S, the program has been able to set up various recycling bins for rigid plastics such as pipette tip boxes and plastic pails throughout science

buildings. Since the start of this program, we have diverted 10,000-15,000 lbs of plastic. Recycling signage is provided to labs to improve contamination rates.

Clean Lab Plastics & Conical Tube Recycling and Metal Container Recycling

Conjoined recycling bins are located at the Physical Science Building loading dock for labs to recycle clean lab plastic containers and conical tubes. Recycling bins for alcohol cans and metal shipping containers have also been set up throughout science buildings. Recycling bin signage from Physical Plant Recycling is provided to labs and can be found on the Green Labs Program website.

Post-Certification Follow Up

After a lab certification, labs receive follow up emails with several recommendations relating to waste practices and are provided a document of our best waste practices.

Hazardous Waste and Green Chemistry

Training

EH&S requires that all persons generating or handling hazardous waste receive training by taking the eCourse - Hazardous Waste Training or must be under direct supervision of a properly trained person.

Inspections

All waste storage areas are required to have monthly documented inspections, certifying there are no leaks or spills and that labeling and storage requirements have been met.

Other

All persons generating or handling hazardous waste are not allowed to evaporate solvent wastes in fume hoods or open laboratory, dispose of hazardous wastes in the sewer or ordinary trash, and are discouraged from using fume hoods as designated waste storage areas.

Waste Minimization

The Green Labs Program works to reduce UC Santa Cruz's quantity of hazardous waste through a conscientious implementation of best practices and innovative initiatives.

It is often difficult to recognize waste reductions due to changing growth patterns within the campus community. However, there are federal (Hazardous Material Business Plan) and state (SB-14 Waste State Policy) requirements that UCSC follows. Also, EH&S has recommended campus hazardous waste procedures that labs can follow to begin their waste minimization process. These include:

- Keeping an up-to-date chemical inventory in the Chemical Inventory System (CIS)
- Reviewing inventory periodically to remove unwanted or unusable chemical stocks
- Managing peroxide formers and disposing of them by their expiration dates
- Only purchasing gas cylinders from manufactures that will accept the return of partially used or empty cylinders

- Ensuring proper identification is on all chemical containers
- Attaching properly completed hazardous waste tags to each chemical waste container
- Submitting container pickups through the Waste, Accumulation, Storage, and Tracking electronic Program (WASTe)

Other waste minimization Green Lab certification suggestions include:

- Substitute less hazardous chemicals or ingredients for ones that labs are currently using now. A MIT-developed tool made possibly by an EPA People, Planet, and Prosperity grant called Green Alternatives Wizard, provides information on alternatives to hazardous chemicals or processes such as SYBR Safe, GelRed, GelGreen in substitution for Ethidium Bromide (a known mutagen)
- Substitute mercury thermometers for harmless alcohol based thermometers or spirit thermometers. EH&S has more information on a no-cost exchange program
- Borrow a chemical from a colleague to conduct an investigate research trial. EH&S has further information on which labs on campus might have similar chemicals
- Avoid mixing hazardous and non-hazardous wastes and avoid cross contamination as much as possible
- Rotate chemical stock to keep chemicals from becoming outdated
- Order the smallest container of material necessary for use
- Review experimental protocol to assure that chemical usage is minimized

Travel and Field Work

Through the Green Labs online certification process, labs are give sustainable suggestions for travel and field work that includes but are not limited to:

- Carpooling, riding bikes, or taking public transportation
- Taking public transportation or shuttle services to the airport for business travel
- Purchasing carbon offsets when feasible for business air travel
- Using teleconferencing or video conferencing (e.g. Zoom) instead of flying to meet with other researchers
- Using alternative transportation around campus
- Posting information about alternative transportation

Other field work suggestions (if applicable) include:

- Using reusable or recyclable staking or flagging material
- Accounting for and recovering all staking and flagging materials, as well as batteries and electronics deployed in the field
- Using reusable small containers
- Using only sterile sample containers and only autoclaving when necessary
- Using electronic data collection instead of paper
- Reducing water by using water conserving technology (e.g. drip hoses) and watering at appropriate times during the day
- Reducing travel footprint by eliminating unnecessary travel
- Having a protocol in place to ensure there is no trace left behind after lab research activities

Communication and Engagement

Education and Outreach

The goal of the education and outreach element is to expand beyond the certification program so that awareness of sustainable lab practices can spread more rapidly across campus and as a result, have a greater impact. Part of this is outreaching to specific buildings as well as campus faculty, staff, and students to participate in the program and to become aware of the difference they can make. Another part of the outreach plan is creating broad programs inclusive of all campus labs that support the three main Green Lab goals (energy efficiency, waste and water reduction, and increasing green procurement). Communication focused on behavior changes that everyone can participate in can deliver great results through reaching many more people.

Student Outreach Coordinator

The role of the student outreach coordinator is to identify, contact, and meet with labs interested in the program, as well as reaching out to more stakeholders to gain broader, campus-wide support for the program. As the program continues to grow and encompass more participating labs, the coordinator will expand outreach to more diverse stakeholders to promote the program's successes.

Throughout the certification process, the outreach coordinator maintains regular communication with participants through updates on next steps and scheduling the in-lab walkthroughs, the post-certification recommendations meeting, and lab recertifications dates. The outreach coordinator will also attend quarterly Lab Safety Representative expos and Environmental Health & Safety conferences.

Water

Waterless Condensers

During the 2016-2017 school year, the Green Labs Team began a program to implement waterless condensers in all chemistry labs on campus. To date, the program has successfully distributed 10 waterless condensers to five chemistry labs on campus.

Waterless condensers are a tool used in chemistry labs for condensation reactions. Normally, labs would use water intensive methods for condensation reactions such as single pass cooling, constantly flowing water overnight, or using fish pumps to pump ice cold water continuously through the system. By replacing these methods with waterless condensers, all water and energy use from this reaction will be eliminated. Waterless condensers can save up to 761 gallons of water per one day of implementing a condensation reaction. Anecdotally, labs that have participated in the Green Labs Program have condensation reactions that average two days and they run approximately three condensation reactions per month. Extrapolating on the aforementioned savings and anecdote, the Green Labs Program assumes that an average lab can expect to save approximately 54,794 gallons of water and $620 a year.

Autoclaves

In 2013, a proposal from the Strategic Energy Partnership was put forth to increase water savings from autoclaves on campus. At the time there were 17 autoclaves being utilized on campus. A subset of those were capable of being retrofitted using WaterEco Gravity and WaterEco Gravity Plus technology to reduce the amount of water being used. The WaterEco series has proven to reduce a conventional sterilizer with constant bleed, which has a daily water use of approximately 1,500 gallons per day, down to approximately 20 gallons per day with the Eco Gravity model and less than one gallon per day for the WaterEco Gravity Plus model. In 2014, the campus allocated $374,000 in funding to water saving projects, one of which included the autoclave retrofit program.

With this funding, UC Santa Cruz began a pilot program in which two autoclaves in the BioMed building were monitored. One of the autoclaves had been retrofitted with the WaterEco Gravity kit, and the other autoclave was used as the baseline. The autoclaves were assumed to have approximately the same usage and were monitored for one month. At the end of the trial period, it was found that the autoclave with the WaterEco Gravity kit used approximately 75% less water than the baseline autoclave. Based on these results, it was decided to retrofit the remainder of the units in the building, which totalled six autoclaves.

Through the UC Santa Cruz Water Action Plan, four funding sources have been identified as potential resources to retrofit autoclaves on campus including Campus Sustainability Plan Grants, Carbon Fund Grants, Green Labs Certification Funding and UCOP Be Smart about Safety funding source. Outside of the University's funding framework, PG&E also offers a custom incentive program which can be used on autoclaves or other technologies that can prove to significantly reduced energy use. This incentive allows you to receive $0.24 per kWh of annual savings. This program has a minimum incentive amount of $5,000.

Next Steps - Actions & Timeline Overview

Action	Responsibility	Target completion date
Vendor Fair and Styrofoam Collection Event	Green Labs Program	Annually
Lab Recertification	Green Labs Program	Spring-Summer 2019
Efficient Product Distribution	Green Labs Program	Spring-Summer 2019
New Labs Handbook	Green Labs Program Environmental Health & Safety	Spring-Summer 2019
Revise Green Labs Checklist	Green Labs Program Green Labs Committee Green Office Certification Program	Fall-Winter 2019

Green Labs Networking Event	Green Labs Program	Winter 2019
UCSC Equipment Inventory	Green Labs Program Green Labs Committee	Fall 2019-Spring 2020
Green Chemistry	Green Labs Program Chemistry Department Environmental Health & Safety	TBD in 2020
Motion Sensor Lighting	Green Labs Program Physical Plant Environmental Health & Safety	TBD in 2020
Drying Ovens Retrofit	Green Labs Program Procurement Physical Plant	TBD in 2020
Reestablishment of UCSC Spring Cleaning Program	Green Labs Program Environmental Health & Safety	TBD in 2020

Next Steps - Detailed Actions

Plug Load

Efficient Product Distribution

In the 2018-2019 academic year, the Green Labs Team will distribute a gift bag for all newly certified labs. Each gift bag will include one smart power strip to help reduce plug load energy use. Smart power strips work to reduce power usage by shutting off power to devices that go into standby mode. It has two components: an electrical outlet and circuit which detects any change in power consumption and controls the outlets. By providing labs with the smart power strips, this will enable them to reduce their plug load by simply turning off all equipment that is not in use, while also allowing labs to maintain power to equipment that should not be turned off.

Currently, information about smart power strips is given to labs upon completion of certification, but by directly supplying labs with a power strip, chances of using this energy savings device are significantly increased.

Additional items available for labs include outlet timers, recycling bins, lab towels, and signage.

Drying Ovens

Within four years (2022-2023 academic year), the Green Labs Team will work on a plan to reduce the energy use of drying ovens on campus.

Based on anecdotal evidence, drying ovens are often kept on 24 hours a day in order to overcome heat up times for the ovens. This significantly contributes to plug load energy consumption, and has resulted in multiple fires on the UC Santa Cruz campus.

Campus stakeholders, such as Lab Department Managers, Environmental Health and Safety, and Physical Plant, will be identified to aid in the process of metering the energy use of drying ovens and will work with the Green Labs Team to create a plan to retrofit inefficient models.

Lighting

Motion Sensor Lighting

The Green Labs Team plans to implement motion sensor lights in existing buildings on the UC Santa Cruz campus. The main focus will be in older existing buildings, such as Sinsheimer, which often has hallway and central area lights kept on around the clock. Other areas include cold rooms in laboratory buildings where lights are often always on. Keeping lights on in cold rooms have the additional energy drain of having to increase cooling to offset the heat created from the lights.

The Green Labs Team will partner with the Energy Services department to create a motion sensor lighting plan during the 2019-2020 academic year.

HVAC

Fume Hoods

As mentioned in the Best Practices section, Phoenix Sensors are located in the Physical Sciences Building and the Coastal Biology Building. These sensors allow fume hoods to enter a "sleep" mode in order to reduce the amount of energy being used by the fume hoods at any given time.

The program will reach out to Physical Plant and EH&S to develop a plan to incorporate more Phoenix Sensors into the fume hoods of additional lab buildings. The upfront cost required to execute this plan may be a barrier to the overall goal, but with additional data, the establishment of more Phoenix Sensors can be partially covered by Strategic Energy Planning.

Storage and Sample Management

UC Santa Cruz Spring Cleaning Program

An internal Spring Cleaning Program will be implemented across all laboratories on campus. The cleaning program will focus primarily on laboratory freezer storage and sample management by getting labs to go through their freezers once a year. The process will include discarding old samples that are no longer useful, labeling all remaining samples with a label maker or utilizing bar codes (so that the labels will not degrade over time in the freezer), and inputting all remaining samples into an electronic database. To facilitate this, team members and recruited student volunteers from the Sustainability Office, will assist researchers with the process.

This program will be integrated into the existing national Freezer Challenge as best as possible. Stakeholders include the Sustainability Office, laboratory PI's and research assistants, department chairs, and EH&S.

Waste Management

Vendor Fair and Styrofoam Collection Event

The Green Labs Team will continue the annual Vendor Fair and in early 2019 they took over the Styrofoam Collection service from EH&S. They will continue to have quarterly Styrofoam collection events.

Recycling Bins

Included in the certified Green Labs' gift basket, outlined in the Plug Load section, is a recycling container, also known as a "Slim Jim." The need to install more recycling bins was recently brought to our attention by a laboratory asking if the program could provide them. Upon further discussion with the UC Santa Cruz Campus Resource Recovery Center, it was found that the Center is currently at capacity for how many locations they can service.

As a result of this limitation, there are laboratories on campus that do not currently have any recycling bins. Although laboratory volunteers will need to take their own recycling to outside containers themselves, providing labs with recycling bins will be able to reduce the amount of recyclable material that labs are otherwise throwing into the trash.

The Green Labs Program has coordinated with Ground Services to acquire bins and will be distributing them to Labs as they become certified and recertified.

Hazardous Waste and Green Chemistry

Green Chemistry

UC Santa Cruz has no formal Green Chemistry program. Green Chemistry is the utilization of a set of principles that reduces or eliminates the generation of hazardous substances. Many labs seek to reduce the toxicity of their chemicals and thus choose to incorporate green chemistry into their research, however, there is no sanctioned program or policy that requires UC Santa Cruz's labs for incorporating safer chemicals and materials into their research.

In the next two years, the team will identify the correct stakeholders, create a feasible Green Chemistry Program plan, and create an implementation strategy for this program. Berkeley Center for Green Chemistry, provides examples of best practices for the development of a green chemistry program.

Although some chemicals relating to research practices cannot be completely eliminated, other schools have demonstrated that creation of a Green Chemistry Program can encourage labs to use less harmful chemicals through finding equivalent sustainable alternatives.

Communications and Engagement

Lab Recertification Process

In the 2018-2019 academic year, the team plans to recertify all labs currently in the certification program. Since the program began in 2012, there has been no large scale recertification process. Instead, UC Santa Cruz has focused on spreading the word about the program and signing up new labs to participate. By recertifying labs, this will enable the team to evaluate the program and see if the certification process has truly inspired and changed labs to become more sustainable. Collecting lessons learned and best practices from existing certified labs will help the team to identify how to better engage and recruit future labs.

New Lab Handbook

To increase communication and engagement with labs, the Green Labs Program will be featured in the new UC Santa Cruz lab handbook. Lab handbooks are distributed to new lab members by the EH&S department and must be reviewed before EH&S will allow researchers to begin conducting research.

Through incorporating the Green Labs Program into the handbook, we hope to get more researchers participating in the program sooner than later as well as getting more researchers aware of energy and water efficiency funds available through the program. Information that will be added to the lab handbook includes program details, the certification process, and a list of best practices. Some of the best practices featured will be the promotion of carpooling or taking public transportation to campus and to practice "take only data, leave only footprints" field work,

which entails collecting data in natural environments in the least disruptive way possible in order to maintain ecosystem health and promote UC Santa Cruz's sustainable initiatives while conducting meaningful research.

Revise Green Labs Checklist

The Green Labs Team will revise the green labs checklist to correspond and complement the existing Green Office Certification checklist. The Green Office Certification Program works to empower campus offices to implement sustainable practices in their everyday operations. They perform water audits and energy and waste assessments in campus offices and work with participating staff to identify actions they can take to decrease waste, conserve resources, and improve their overall environmental performance. The two teams will work together to ensure that both of their online checklists are operating on the same platform, have a similar user experience, and have actionable items that are not redundant but complementary to each other.

Green Labs Networking Event

In an effort to increase laboratory staff engagement around greening their laboratories, the Green Labs Team will sponsor "Coffee with Green Labs" events where researchers can share best practices and give the program feedback on existing initiatives and brainstorm new projects to prioritize.

Water

Single Pass Cooling

Single pass cooling is against UCSC policy. As outlined in the December 2017 UC Santa Cruz Water Action Plan, the Sustainability Office will be working with stakeholders on campus during the 2019 Spring and Summer quarters to identify any remaining single pass cooling systems on campus. From this inventory, the Green Labs Team will assess which systems are eligible for retrofit or replacement cost sharing opportunities. There are four funding sources available to retrofit or replace single pass cooling systems, three of which are on campus. These on campus funding sources include Campus Sustainability Plan Grant Funding, Carbon Fund Grants, and the Green Labs Equipment Retrofit Fund. At the UC wide level, there is the UCOP Be Smart about Safety funding which may also be utilized for this retrofit or replacement. The removal of single pass cooling is particularly important as UC Santa Cruz has already had one flood related to a single pass cooling system, so removal of this practice is not only a policy but a large conservation and safety concern.

ALL

UCSC Equipment Inventory

The Green Labs Team will assess UCSC's current inventory of equipment over $5,000 and identify future equipment retrofit projects. The Green Labs Team will create a plan for equipment retrofitting, based on criteria such as resource savings, return on investment, quantity of equipment needing replacement, and available incentives. They will use the plan to submit a Carbon Fund application to retrofit the identified out of date equipment.

Summary

Through collaborative discussions during the creation of this Action Plan, the UC Santa Cruz Green Labs Team has identified three key areas for program improvement: engagement with labs, energy efficiency improvements, and water reduction.

The team hopes to increase visibility of the program with the implementation of a Green Labs Program section in the new lab handbook that EH&S distributes every academic year. To better understand labs' needs and improve researchers' engagement, the Green Labs Team will increase the frequency of lab visits. A gift bag for certified labs will including recycling bins and smart strips which will act as an additional program incentive.

The top 2019 priority of the Green Labs Program will be the completion of the Freezer Retrofit Program, which has been calculated to have significant energy savings. Other priorities include vendor fair, styrofoam collection, and Green Labs networking events, finishing existing lab recertification, getting into the EH&S new labs handbook, revising the Green Labs checklist, and assessing the campus equipment inventory.

Overall, the program hopes to continue to move towards the UC wide goal of carbon neutrality and upholding the values of sustainability and environmentalism that UC Santa Cruz holds dear.

Reporting and Review

Formulation of this plan was created in conjunction with the Physical Plant department, Environmental Health and Safety, the Sustainability Office, and champion researchers leading in Green Lab practices.

This plan will be reviewed yearly by the incoming Green Labs student team, and act as a framework to create yearly timelines and work plans to ensure that all programs are completed in a timely manner. The majority of the responsibility for implementing this plan will be on the Green Labs student team, with the condition that necessary stakeholders such as Environmental Health and Safety and the Physical Plant departments, among others, will be consulted for relevant programs. The Green Labs Team is supervised by the Water & Climate Action Manager, who is a staff member of the Sustainability Office. The Water & Climate Action Manager will conduct weekly or bi-weekly meetings with student staff to ensure that all programs are going smoothly and completed in a timely manner.

The Green Labs Team will strive to collect energy, water, and waste data before any projects from this plan are implemented in order to properly assess project results. Pre- and post-project data will be analyzed and made publicly accessible in order to promote program accountability and contribute to the greater UC Green Labs initiative.

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The 2017 UC Santa Cruz Water Action Plan also served as a valuable resource for information regarding on campus water programs and data.