Berkeley
UNIVERSITY OF CALIFORNIA

Green Labs Action Plan

May 2020

Executive Summary

The Green Labs Program was created to improve sustainable practices within research and teaching labs on campus with the goal to incorporate the use of water reduction, waste elimination and energy saving technology, along with actions and procurement strategies for researchers, instructors, and lab spaces.

The Green Labs (GLs) program was started by the Chancellor's Advisory Committee on Sustainability (CACS) in 2012 to promote environmental management and sustainable operations in laboratories at UC Berkeley. Green Labs certified the first labs in 2015 after creating an initial checklist program and marketing campaign. Currently, the program's focus is on a green labs certification process coordinated by the Environment, Health & Safety Office (EH&S). The program includes a checklist, information on green lab actions and product incentive promotions, and engagement with interested labs in an information and best practice exchange. To date it has been a grassroots effort overall with little funding except for small grants covering student interns.

A workshop with key staff stakeholders including EH&S, Cal Zero Waste office, the Campus Energy Office, Supply Chain Management office, lab and building managers from the College of Natural Resources, and the Office of Sustainability was held Feb. 7, 2020 to discuss how to broaden engagement in Green Labs and enhance current programs. This subsequent Action Plan outlines the results of that workshop and the core initiatives that the workshop attendees agreed to work on collectively. These core initiatives are scoped to meet current workshop staff capacity and generally include programs that are already planned and have identified funding. The workshop also covered longer-term initiatives, that require deeper commitments and new funding sources.

The core initiatives that are part of this Action Plan fall into these categories with these lead departments:

- Environment, Health & Safety Office: Engagement, Green Labs Certification, Chemical and Regulated Waste Reduction
- Supply Chain Management Office: Procurement, Consumables, Packaging and Equipment
- Campus Energy Office: Energy and Water Efficiency
- Cal Zero Waste Office: Municipal solid waste reduction

The initiatives and progress of Green Labs will be guided by the newly formed Green Labs Steering Group with representatives from each of these offices, plus the Office of Sustainability and at-large stakeholders. While the Green Labs program represents a cross department, collective effort, EH&S will continue to serve as the overall lead of the program.

The following Action Plan details identifies near-term initiatives and responsibilities as well as longer-range ideas for Green Labs.

Table of Contents

Executive Summary 1

Table of Contents 2

Background 3

2020-2022 Program Goals and Actions 4

Key Actions & Targets 4

1. Engagement and Green Lab Certification 6
2. Procurement, Consumables, & Equipment 6
3. Water and Energy Efficiency 7
4. Waste Management 8

2022 and Beyond 10

Implementation, Reporting and Review 11

Acknowledgements 12

Appendix A: Summary of Green Labs Activities Since 2015 13

Appendix B: Green Labs Steering Group Charter 17

Appendix C: Related Documents 19

Background

The Green Labs Program was created to improve sustainable practices within research labs on campus. Started by the Chancellor's Advisory Committee on Sustainability (CACS) in 2012, Green Labs officially certified its first sustainable labs in 2015 after creating an initial checklist program and marketing campaign. Today the program continues creating promotions and garnering interest, but has been a grassroots effort overall.

Since its inception the focus of Green Labs' has been the Green Lab Certification program, which recognizes laboratories for their implementation of environmentally sustainable and efficient practices. Labs are able to achieve credits in the areas of energy and water efficiency, waste reduction, chemical management, purchasing, and education as well as by evaluating potential areas of improvement. It is designed to certify both traditional and non-traditional chemical or engineering labs, as well as design studios, architecture programs, electronics, robotics, prototyping, 3D printing and fabrication shops. See the green labs checklists here.

Green Labs has certified 16 labs on the UC Berkeley campus since 2015 with most growth in membership occurring in 2016 - 2017. Generally, the program has focused on labs that have shown interest in pursuing certification and can be accommodated by resources and staffing of the GL program. Current certifications include: Almeida Lab, Berkeley Institute of Design (BiD), BEST Lab, Blackman Lab, Chen Lab, Cohen Lab, College of Chemistry, Conboy Lab, Healy Lab, Kumar Lab, Lemaux Lab, Pallud Lab, Niyogi Lab, Sarpong Lab, Specht Lab, Wildermuth Lab.

UC Berkeley is a large research intensive public university with 14 colleges and schools. The campus area is 1,232 acres (499 ha), and the "central campus" occupies only the low-lying western 178 acres (72 ha) of this area. About 25% of the campus space is dedicated to resource intensive research. The following provides the overall institutional size and populations characteristics:

Gross Square Feet floor area of building space: 16,284,867

Gross Square Feet Floor area of laboratory space: 4,020,413

Number of academic departments (or the equivalent): 123

Full-time equivalent student enrollment in fall 2018 (30,574 undergraduate and 11,336 graduate): 41,910

Full-time equivalent of employees (staff + faculty): 15,475

The Green Labs program also partners with labs that are not officially certified, but are collaborators and provide the program useful feedback, information, and technology sharing. The Toste and Long labs, General Chemistry and GPB teaching labs have been important in practice and technological understanding in making labs more sustainable. Additional outreach activities have included lunch-hour green lab interest meetings with lab members, partner departments, and product vendors. Improvement projects in labs have included pilot autoclave and printer upgrades and dishwasher reprogramming to save energy and water. See more detail on certified labs and past projects in Appendix A.

A Green Labs workshop was held in February 2020 with representatives from EH&S, Office of Sustainability, Energy Office, Supply Chain Management, Capital Strategies, College of Natural Resources, and Cal Zero Waste. The workshop focused on priority actions for the program for the next three years as well as organization of a Steering Group to oversee the program. The results of this workshop form the basis of this plan.

2020-2022 Program Goals and Actions

UC Berkeley Green Labs will engage with multiple partners of the University to conduct greener research and promote environmental stewardship within as many labs as possible at UC Berkeley.

The program will promote improvements in each of the key areas listed below:

1. Environment, Health & Safety Office: Engagement and Green Labs Certification
2. Supply Chain Management Office: Procurement, Consumables and Equipment
3. Campus Energy Office: Energy and Water Efficiency
4. Cal Zero Waste Office: Waste Reduction

Every year Green Labs will focus on manageable projects within key areas identified by the program to aid the larger theme of sustainability that accomplishes water, energy or waste reduction in campus labs.

Key Actions & Targets

Top near-term actions agreed to include:

Core Area	Action	Responsibility	Target Due Date
1. Engagement + GL Certification	a. Certify five new labs annually	EH&S	Ongoing
1. Engagement + GL Certification	b. Increase community involvement (lab managers, researchers, teachers)	EH&S, Cal Zero Waste, Energy Office, Supply Chain Management, Office of Sustainability	On-going
1. Engagement + GL Certification	c. Track and report on Green Labs progress annually	EH&S, Office of Sustainability	Annually in June
2. Procurement + Equipment	a. Conduct outreach to encourage the removal of obsolete equipment and facilitate the replacement with more efficient equipment	EH&S, Cal Zero Waste, Energy Office, Supply Chain Management	Ongoing
2. Procurement + Equipment	b. Establish a database/software to track chemical and equipment inventories	Supply Chain Management, EH&S, Energy Office	2022
2. Procurement + Equipment	c. Meet with lab stakeholders to identify top 10-20 consumable products and greener options, including packaging, that could be included in upcoming RFPs	Supply Chain Management, EH&S, Cal Zero Waste	2021

2. Procurement + Equipment	d. Work with BearBuy to sort "greener" options for top consumables and packaging. Develop "Green Lab" label to identify preferred products in BearBuy	Supply Chain Management	2022
3. Energy + Water Efficiency	a. The Energy Office will complete an assessment of existing ULTs by the end of 2021 to identify opportunities for energy savings. Pilot ULT freezer replacement program	Energy Office, Supply Chain Management	2021, Ongoing
3. Energy + Water Efficiency	b. Update and distribute behavior change information for labs (equipment stickers, brochure)	Energy Office	2021
3. Energy + Water Efficiency	c. Develop autoclave retrofit pilot for newer systems	Energy Office	2021
3. Energy + Water Efficiency	d. Add reference to UC Lab Safety Design Guide into Campus Design Standards	Energy Office, Capital Strategies	2020
3. Energy + Water Efficiency	e. Hold an initial workshop to develop strategy to create EUI and WUI benchmarks and targets	Capital Strategies EH&S, Cal Zero Waste, Energy Office, Office of Sustainability, Supply Chain Management	2021
3. Energy + Water Efficiency	f. Continue dishwasher and other equipment reprogramming efficiency efforts	EH&S, Energy Office	Ongoing
4. Waste Management	a. Standardize bin municipal solid waste infrastructure and signage, including hazardous waste in labs and add to Campus Design Standards	Cal Zero Waste, EH&S	2021
4. Waste Management	b. Create a UC Berkeley Specific Lab Waste disposal guide, to include chemical and hazardous waste. Make it well communicated and accessible to all labs	Cal Zero Waste, EH&S	2022
4. Waste Management	c. Continue chemical reuse system	EH&S, Supply Chain Management, Cal Zero Waste	Ongoing

4. Waste Management	d. Develop initial lab specific strategies to phase-out non-essential single use plastics	EH&S, Supply Chain Management, Cal Zero Waste	2022

1. Engagement and Green Lab Certification

The Green Labs Workshop identified the following priorities for Engagement and Green Lab Certification:

a. Certify five new labs annually
b. Increase community involvement including lab managers, researchers, and teachers/faculty
c. Track and report on Green Labs progress annually

Project accomplishments will be summarized and distributed annually on campus, UOCP, and with other interested partners. Metrics will illustrate how Green Lab programs are impacting waste, energy, water and financial savings and show trends over-time.

c. Increase Community Support

Ideas about how to increase engagement that came out of the Green Lab Workshop include, and may be considered for implementation:

- Use existing lab networks and others such as Chancellor's Advisory Committee on Sustainability,, Planning processes like the current Long Range Development Plan, Campus Design Standards and Policies, and ASUC/GA
- Expand Green Labs in student focused programs
- Increase annual GL certificationst Have more tabling events and consider developing seminars to introduce GL concepts
- Focus on CNR and potentially hold a friendly competition with Chemistry or within departments
- Leverage vendor events (such as ULT vendor visits) to also promote Green Labs
- Map GL networks and existing engagement
- Provide discounts and/or incentives paired with a GL certification

2. Procurement, Consumables, & Equipment

The Green Labs Workshop identified the following priorities for Procurement, Consumables, & Equipment for the next three years:

a. Conduct outreach to encourage the removal of obsolete equipment and facilitate the replacement with more efficient equipment
b. Establish a database/software to track chemical and equipment inventories
c. Meet with lab stakeholders to identify top 10-20 consumable products and greener options including packaging that could be included in upcoming RFPs
d. Work with BearBuy to sort "greener" options for top consumables. Develop "Green Lab" label to identify preferred products in BearBuy

Green Labs will partner with Supply Chain Management and equipment vendors to review applicable policy details, lab needs and bulk pricing of new lab equipment. Green Labs may also attempt to garner free trials of equipment or create discounts with vendors for bulk pricing or in order to create lab incentives for joining the certification program or for other reasons to help labs make improvements.

Green Labs will promote products that are ACT-labeled and third-party validated (https://act.mygreenlab.org/using-act.html) by partnering with vendors who carry these rated products and directing researchers to various green purchasing options through our own purchasing list or as promoted through MyGreenLab.org.

Procurement practices will be a special focus of the next three years. The GL program, led by Supply Chain Management and in consultation with lab managers, will improve content management of BearBuy to identify top green products, create a Green Labs Certified label in BearBuy, and leverage upcoming contract renewals to increase the sustainable offerings for consumables and equipment.

The Green Labs Steering Committee will also focus on outreach to encourage the removal of obsolete equipment and facilitate the replacement with more efficient equipment.

3. Water and Energy Efficiency

The Green Labs Workshop identified the following priorities for Water and Energy Efficiency for the next three years:

a. The Energy Office will complete an assessment of existing ULTs by the end of 2021 to identify opportunities for energy savings. Pilot ULT freezer replacement program
b. Update and distribute behavior change information for labs (equipment stickers, brochure)
c. Develop autoclave retrofit pilot for newer systems
d. Add reference to UC Lab Safety Design Manual into Campus Design Standards
e. Hold an initial workshop to identify options for EUI and WUI benchmarks and targets
f. Continue dishwasher and other equipment reprogramming efficiency efforts

Currently Green Labs works with the Energy Office and other divisions within Facilities Services to conduct building assessments to investigate potential water and energy saving opportunities within buildings on campus. Potential water and energy savings results are shared with partners within Facilities Services and Sustainability as each location is completed.

During the Green Labs Workshop, a number of future actions were identified as well that will be important to create a more systematic and prioritized approach to achieving energy and water savings in labs:

- Gather stakeholders to further clarify roles of different departments in supporting water and energy savings.
- Conduct additional data assessments of water and energy use in labs and develop Energy Use Intensity (EUI) and Water Use Intensity (WUI) metrics to baseline and assess equipment upgrades with an eventual goal of incorporating EUI and WUI reduction targets into future green lab plans.
- Highlight and communicate the work that is already happening to reduce energy and water use in labs.

Autoclave Retrofits

Current information from the campus Energy Office confirms that each autoclave can use approximately 400,000 gallons of water per year (gpy), including while in use and idling. This volume of water can be drastically reduced to approximately 12,000 gpy by adding quench tanks to existing units or by replacing them with new water efficient units.

Based on the surveys completed by Green Labs through 2019, Facilities Services selected 4 autoclaves to replace with new water efficient units. These units are expected to be installed by July 2020. The Energy Office will gather and analyze water data from the existing and new units to confirm the expected water savings. This pilot will inform further autoclave replacements around campus by Facilities Services.

The Energy Office is also coordinating a pilot retrofit project of 3 autoclaves. Quench tanks will be installed on three existing units, and the Energy Office will confirm the expected water savings. This pilot is planned to lead into further retrofits around campus wherever it is possible and practical to retrofit existing autoclaves.

Dishwasher reprogramming

Green labs will continue to review dishwasher program settings with Facilities Services and equipment vendors to create water saving options that are programmed into equipment and are promoted to researchers as sustainable alternatives.

It's estimated that some dishwasher cycles can save up to 70 Liters per wash by reducing certain rinse cycles that may not impact research quality needs.

Green Labs initial feedback from researchers is positive and are happy with glassware cleaning under these new cycles. Green Labs will begin promoting these dishwasher settings with the help from researchers who provided feedback, building managers and through Facilities Services (who actually pay the utilities).

Ultra-Low Temperature Freezer Replacement

In recognition that ultra-low temperature (ULT) freezers are usually the most energy intensive piece of equipment in a laboratory, a working group including Green Labs, the Energy Office, Supply Chain Management, and the Office of Sustainability have been working to create a rebate program to incentivize replacement of old ULT freezers with new efficient models. The working group also sees this program as an opportunity to modernize the campus's freezer stock with units that include monitoring capabilities and are configured for gas backup. The Berkeley Equipment Tracking System (BETS) was used to create an inventory of ULT freezers on campus. The working group has been creating a strategy for bulk pricing and a rebate program that will cover freezer retirement, replacement, new freezer purchases, and commitments to set freezers at -70C. The program will prioritize the oldest freezers on campus. The group hopes to roll out this program as soon as possible. The Energy Office will complete an assessment of existing ULTs by the end of 2021 to identify opportunities for energy savings.

4. Waste Management

The Green Labs Workshop identified the following priorities for Waste Management for the next three years:

a. Standardize bin municipal solid waste infrastructure and signage, including hazardous waste in labs. Add to Campus Design Standards
b. Collectively create a UC Berkeley Specific Lab Waste disposal guide, to include chemical and hazardous waste. Make it well communicated and accessible to all labs
c. Continue chemical reuse system
d. Develop initial lab specific strategies to phase-out of non-essential single use plastics to be included in the update to the campus zero waste plan

Green Labs has multiple avenues to work within regarding waste topics and laboratories. Partners include Cal Zero Waste, EH&S, lab supply vendors and outside vendors who collect refuse and recycling. Green Labs relies on EH&S to review hazardous materials and biological waste disposal data, including chemical waste and general lab dry waste. Green Labs and EH&S review waste streams annually to audit and find opportunities to possibly alter a portion of our waste requirements based on a form of alternative treatment or disposal, depending on technology and regulations of that time.

Cal Zero Waste is the main coordinator for all other waste services and recycling so will be a key partner to work with regularly on these topics. Engagement with Cal Zero Waste and EH&S, will be regular and ongoing in order to share common efforts that may be occurring in lab buildings.

Waste management in labs requires a tandem effort with each lab personnel and the custodial staff that collects waste. The Cal Zero Waste team plans to team with the EH&S department to collectively create a UC Berkeley Specific Lab Waste disposal guide, to include chemical and hazardous waste. The guide should be well communicated and accessible to all labs.

In addition to the disposal guide, the Cal Zero Waste team aims to standardize bin infrastructure and signage in labs. These standards should be established in partnership with the custodial staff and communicated in mandatory lab safety training. GLs and Cal Zero Waste will coordinate with custodial staff and the GL Steering Committee will help support when there is resistance from labs and/or other staff.

Increasing Recycling

GLs will review the Glass solvent bottle recycling program established by the College of Chemistry and promote similar efforts across campus by partnering with Cal Zero Waste and recycling vendors. To reduce or eliminate glass bottles and metal can waste, GLs will be responsible for researching applicable solutions and provide more specific guidelines for glass recycling on campus. GLs will work to bridge the gap between existing guidelines and insufficient efforts by extending outreach and potentially increasing the accessibility of recycling bins with Cal Zero Waste.

GLs will collaborate to decrease polystyrene in shipments through discussions with Purchasing and Cal Zero Waste along with distributors and vendors of lab supplies. GLs also encourages labs to have this conversation or dialogue with vendors directly through our certification checklist.

Evaluate campus recycling options by working with Cal Zero Waste. The campus may need to add more recycling containers in buildings across campus, reuse on campus, find new markets for waste products to possibly sell or trade with partners like the UC Berkeley Department of Engineering.

Chemical Inventory

UC Berkeley's College of Chemistry has successfully managed a Chemical reuse system on campus for at least 10 years, saving unused chemicals from being disposed of. EH&S with it's upgraded chemical inventory system will have similar options for researchers to post a notice when they have chemicals to share that could be discovered by other users. Currently the program is being tested by selected labs. In the future, we look forward to working with multiple stakeholders and labs on campus to improve the sharing system when the program is spread across campus.

Increase research of chemical alternatives such as some solvents and replacement of halogenated reagents. Green Labs will research and determine which alternatives are valid and should be promoted by highlighting these options within the Green Labs Purchasing Guide. Green Labs will create case studies with researchers within the program which have successfully adopted greener alternatives to encourage other scientists to make these changes.

Reducing/eliminating single-use plastic

The campus has adopted a policy to eliminate non-essential single-use plastic by 2030. The laboratory research environment, in particular, includes a high proportion of single-use plastics for which alternatives do not currently exist. New solutions will require special attention to ensure safety, hygiene and sanitation. It will be important that the impacts of alternatives to single-use plastics are evaluated to ensure the replacement of non-essential single-use plastics is a net-positive for the environment. Exemptions from this policy target will include products that cannot be reduced because of accessibility, safety, sanitation, decontamination/sterilization, health codes, or other major concerns. The campus will be producing an updated campus zero waste plan by 2023 that will include initial lab specific strategies to phase-out non-essential single use plastics in these spaces.

2022 and Beyond

During the Green Labs Workshop, a number of future potential priorities were identified:

Core Area	Action	Responsibility	Target Due Date
Engagement + GL Certification	Engage with P3 lab projects	Capital Strategies EH&S, Cal Zero Waste, Energy Office, Office of Sustainability	TBD
Engagement + GL Certification	Increase leadership guidance and engagement	Capital Strategies EH&S, Cal Zero Waste, Energy Office, Office of Sustainability, Supply Chain Management	TBD
Engagement + GL Certification	Leverage vendor events to promote Green Lab programs	EH&S, Energy Office, Supply Chain Management	TBD
Engagement + GL Certification	Provide discounts and/or incentives paired with a GL certification	EH&S, Supply Chain Management	TBD
Procurement + Equipment	Develop a fund to support Green Labs through contributions from vendor contract negotiations	EH&S, Supply Chain Management	TBD
Procurement + Equipment	Review and daylight hidden cost of energy, water and waste in purchasing decisions	Supply Chain Management, EH&S, Energy Office	TBD
Energy + Water Efficiency	Develop data collection strategy to create EUI and WUI benchmarks and targets for equipment	Capital Strategies EH&S, Cal Zero Waste, Energy Office, Office of Sustainability, Supply Chain Management	TBD

Energy + Water Efficiency	Perform lab evaluations across campus for energy/water saving infrastructure opportunities	EH&S, Energy Office	TBD
Energy + Water Efficiency	Develop other equipment replacement programs similar to ULT like growth chambers	Energy Office	TBD
Energy + Water Efficiency	Evaluate and implement UC lab safety design standards as appropriate for UC Berkeley projects	Capital Strategies, Energy Office	TBD
Waste	Further develop waste education in lab trainings	EH&S, Cal Zero Waste	TBD
Waste	Connect Cal Zero Waste guidelines to Capital Strategies to help guide projects to proper waste infrastructure	Supply Chain, Cal Zero Waste, EH&S	TBD
Waste	e. Continue to develop and plan for lab specific strategies to phase-out non-essential single use plastics	EH&S, Supply Chain Management, Cal Zero Waste	Ongoing

Implementation, Reporting and Review

A Green Labs Steering Group Charter (see Appendix B) was developed during the Feb. 7, 2020 workshop to provide guidance and structure for the successful implementation of Green Labs programs at UC Berkeley. The Green Labs Steering Group will be chaired initially by the Office of Sustainability's CSCS Officer. Each of the following will elect one or two representatives:

- Environment, Health & Safety Office: Engagement, Green Labs Certification, Chemical and Regulated Waste Reduction
- Supply Chain Management Office: Procurement, Consumables, Packaging, and Equipment
- Campus Energy Office: Energy and Water Efficiency
- Cal Zero Waste Office: Municipal Solid Waste, Education
- Office of Sustainability: Planning and Facilitation
- At-Large Representatives, including lab operators and campus research enterprise

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Diane Mayo, Project Manager, Capital Strategies

Michelle La, Specialist, Cal Zero Waste

Izzy Parnell-Wolfe, Specialist, Cal Zero Waste

Jonathan Rennella, Facilities Manager, R-CNR

Bruce Chamberlain, Campus Energy Manager, Energy Office

Catherine Patton, Energy Office Analyst

Lin King, Manager, Cal Zero Waste

Russell K Chung, Chief Procurement Officer

Irania Alarcon, Plant and Microbial Biology, R-CNR

Student Green Lab Fellows:

Edward Yang

Kendall Stuscavage

Jenna Koopman

Rachelle Rosano

Lillian Carille

Kelia Liang

Ruyin Lily Li

Kelly Chou

Avani Vaid

Appendix A: Summary of Green Labs Activities Since 2015

Green Labs has certified 16 labs on the UC Berkeley campus since 2015 with most growth in membership occurring in 2016 - 2017.

Current participating labs and departments includes the following:

LAB	LAB TYPE
• Almeida Lab • Berkeley Institute of Design (BiD) • BEST Lab • Blackman Lab • Brem Lab • Chen Lab • Cohen Lab • Conboy Lab • Healy Lab • Kumar Lab • Lemaux Lab • Pallud Lab • Niyogi Lab • Sarpong Lab • Specht Lab • Wildermuth Lab	• Environmental Science, Policy & Management • Multi-disciplinary • Robotics - Space rovers • Plant & Microbial Biology • Plant & Microbial Biology • Nutritional Sciences & Toxicology • Computational/Atmospheric sciences • Biosciences/QB3 • Bioengineering • Biosciences/QB3 • Plant & Microbial Biology • Plant & Microbial Biology • Plant & Microbial Biology • Organic Chemistry • Plant & Microbial Biology • Plant & Microbial Biology

Summary of Progress to Date

1. Engagement and Green Lab Certification

In 2017, Green Labs focused on outreach with labs and studios on the UC Berkeley campus to promote sharing sustainable practices and new ideas. Through meeting with lab leads, the program was able to evaluate the practical needs, existing challenges and potential improvements from certified labs. Other partners invited to outreach events included vendors, Office of Sustainability, Central Purchasing and Facilities Services.

In 2018 - 2020, UC Berkeley Green Labs focused on pursuing water saving efforts with autoclaves and dishwashers within the bioscience buildings and single-pass cooling within the College of Chemistry, while beginning to further evaluate waste streams from labs across campus.

2. Water and Energy Efficiency

GLs has identified a few primary areas of research that hold significant water saving potential. Working with the College of Chemistry and Facilities Services, Green Labs identified the highest water consuming lab practices and equipment to include condensation reactions/reflux columns, autoclaves, and dishwasher operations.

Condensation Reactions and Reflux Columns

Condensation/reflux reactions within laboratories require cooling a glass column with tap water that is wasted to the drain within many fumehoods on campus. Green Labs will work towards the elimination of single pass cooling in chemistry labs by utilizing the following equipment and any new technology discovered later:

a.) Fish pumps can be connected to glassware and placed within a plastic water reservoir inside the fumehood or adjacent to on a bench, and used to recirculate water. This is the cheapest and easiest solution to implement, costing less than $20 per station.

b.) Findenser columns are air-cooled columns with metal fins that do not require water to accomplish the same condensation/reflux reactions as traditional glassware that utilize water for cooling. These units may cost $200-$300 and may require slightly different glassware mounting/arrangements for the researcher.

c.) The Ecodenser is a small pump that is installed inside a fumehood wall and is connected to the building chilled water supply. The Ecodenser chills the cooling water from the chemistry reaction in a closed loop or recirculation system, utilizing the chilled water loop. This allows water cooling the chemistry reaction to be recirculated, eliminating the use of single-pass cooling.

d.) The CondenSyn is an air-cooled column that relies on it's glassware design to eliminate the need for water cooling. It also solves the issue of single-pass cooling for traditional chemistry condensation reflux reactions.

Green Labs will continue working to install each of these solutions as sample equipment within College of Chemistry labs to run trials and garner feedback from researchers on these alternatives. Assuming the research is not impacted by these equipment changes, Green Labs will promote their use in additional laboratories or find sponsorship to purchase additional units.

Examples of sustainability projects include:

Equipment	Existing Energy/Water Use	Energy/Water Use After Replacement	Energy/Water Savings	Replacement Cost	Annual Cost Savings	CO2e Reduction (kg CO2e)
Replace old printer with new (Cohen)	Standby: 116 W / Operating: 637 W *(old 6700 printer)*	Standby: 43 W / Operating: 230 W *(New 8560 printer)*	**1060.8 kWh** *908.96 kWh (operating) + 151.84 kWh (standby)*	**≅$500**	**$117**	**220**
Replace old freezer (Wildermuth)	**21.1 kWh/day**	**8.7 kWh/day** (standard), 10.2kWH/day (high-performance) *ThermoFisher TSX400A*	**4526 kWh/yr** *(21.1 kWh/day x 365) - (8.7 kw/day x 365)*	**≅$10,000**	**$498**	**937**
Replace old -80 freezer (Chen)	**28 kWh/day** *Isotemp basic U86-21A34*	**17 kW/day** (energy saving), 19 kW/day (high	**4015 kWh/yr** *(28 kWh/day x 365) - (17 kWh/day x 365)*	**$9,250**	**$442**	**831**

	(Revco Technologies)	performance) *TSU500-Ult Freezer*				
Replace old -80 freezer (Blackman)	29 kWh/day *Revco Legaci from about 2003*	**11.1 kWh/day** *ThermoFisher TSX600*	**6533.5 kWh/yr** (29 kWh/day x 365) - (11.1 kWh/day x 365)	**$11,500**	**$719**	**1352**
Findenser **replacement** (Sarpong)			**100,000 gallons/yr** 150 L/hr * 2500 hrs/yr = 375,000 L/yr[1]	**$500**	**$469**	**N/A**
Water Bath Replacement (Healy)	**175.2 kWh/yr** 0.04 x 12 hrs/day = 0.48kWh/day * 365 **260 L** 5 L * 52 (once a week) *Old 6 L Water Bath*	**125.04 kWh/yr[2] 90 L** 5 L * 18 (once every 2-4 weeks) *Lab Armour Bead Bath, 6 L Bath w/ 5 L beads[3]*	**50.16 kWh/yr 170 L/yr**	**$600**	**$6**	**10.6**
Fish Pump[4] (Alivasatos)			65,000 gal/yr based on lab's usage		**$305.01**	
Fish Pump[4] (Arnold)			85,000 gal/yr based on lab's usage		**$398.86**	
Fish Pump[4] (Francis)			80,000 gal/yr based on lab's usage		**$375.40**	
Fish Pump[4] (Katz)			80,000 gal/yr		**$375.40**	
Fish Pump[4] (Toste)			665,000 gal/yr		**$3,120.52**	
Fish Pump[4] (Tilley)			257,000 gal/yr		**$1,205.98**	
Retrofit shaker Table (Pallud)				Barker Lab support personnel repaired unit for		

[1] In one year, a conservative estimate would be: 2 people x 3 hours (average hours of running water) x 350 working days (approx 2 weeks Christmas holiday where most people will not work) = 2100 hours PLUS 1 person x 1 (average once per week) x 8 hours (average hours of running water overnight) x 50 working weeks = 400 hours

[2] .01 x 24 hrs/day = .25 * 365 = 87.6 kWh/year + .04 x 12 hrs/day = .48kWh/day * 78 ("once or twice a week ~ 1.5 * 52 wks) = 37.44 kWh/year

[3] Considerations: Brian from Healy Lab said the bead bath is able to serve a purpose in warming media, and water bath is still being used but is reserved for frozen samples. Chances of contamination are heavily decreased and samples are organized better with two baths serving two different functions rather than one doing everything.

[4] College of Chemistry - Fish pumps recirculation project. Approximately 65/70 fish pumps ordered were distributed to the labs below in various quantities each. Impacts are large due to the extremely long reaction times conducted by these researchers.

				$1,100 instead of buying new at cost of $5-7k. Lab bought motor for $300.		
Autoclave replacement	LSA: 11 autoclaves x 400,000 gal/yr Koshland: 21 autoclaves x 400,000 gal/yr based on actual metering Barker: 5 x 100,000 gal/yr based on estimated age		4.8 Million gal/yr 8.4 Million gal/yr 500,000 gal/yr			

Appendix B: Green Labs Steering Group Charter

UC Berkeley
Green Labs Steering Group Charter
February 7, 2020

Purpose:
Provide guidance and structure for the successful implementation of Green Labs programs at UC Berkeley.

Outcomes:
In the next three years, implement the following core initiatives (note: core initiatives are those that the group has prioritized together for Green Labs and have stakeholder agreement to move forward):

- Engagement
- Equip/Consumables/purchasing
- Water/Energy
- Waste

Will review the group goals and action plan by the end of this term.

Process:

- The Green Labs Steering Group will be chaired initially by Kira Stoll. The group will determine Chairship terms and process during the initial year of the group. The Steering group will meet quarterly for one to two hours with follow up meetings as needed in between. The Chair will be responsible for organising the meeting, sending the invitations, and coordinating the agendas and next steps. Rotating note taker.
- Each of the following departments will elect one representative. If that representative can not make a meeting, they are requested to send a substitute.
- Each representative will actively lead/perform/implement at least one core program. All documents will be housed in google drive.
- Meetings will be focused on working meetings. Sub-groups identified as needed to support programs.
- Decisions will be made by gradients of agreement*
- This Charter will be reviewed and updated annually
- Additional members will be added as needed.

*Gradients of Agreement: Decisions shall be made using the following gradients of agreement:

1 - Move forward with the given proposition
2 - Move forward with the following considerations
3 - Research the following issues and report back before moving forward
4 - Do not move forward with the given proposition

Initial Green Labs Steering Group Members and Responsibilities:

DEPARTMENT	REPRESENTATIVE	PROGRAM LEAD	PROGRAM SUPPORT
Office of Sustainability	Kira Stoll, Chief Sustainability & Carbon Solutions Officer	Chair/Leadership Communication	
Supply Chain Management	Alex Butler, Strategic Sourcing Commodity Manager	Supplier Engagement	
Cal Zero Waste	Lin King, Cal Zero Waste Manager	Zero Waste	
EH&S (2 positions)	David Scrimger, EH&S Specialist Greg Haet, Associate Director, Environmental Protection, EH&S	Assessment/Checklist	Zero Waste / liaison to VCR
Energy Office	Catherine Patton, Energy Analyst	Energy / Water	
At large: R-CNR	Irania Alarcon, Plant and Microbial Biology	Teaching Labs	
At large - Facilities Services Operations-Custodial	Teresa Ochoa, Custodial Supervisor	Zero Waste	

Liaisons:

- Diane Mayo, Capital Projects
- Jonathan Rennella, Facilities Manager, R-CNR
- Russell Chung, Chief Procurement Officer
- Pat Goff, Executive Director, EHS

Appendix C: Related Documents

University of California, Berkeley Green Labs & Green Labs Certification:
https://sustainability.berkeley.edu/engage/green-certifications

University of California Sustainable Practices Policy:
http://policy.ucop.edu/doc/3100155/SustainablePractices

University of California Policy on Management of Health, Safety, and the Environment:
http://policy.ucop.edu/doc/3500506/MgmtHealthSafetyandEnvironment

University of California, Berkeley Statement of our Commitment to the Environment
https://sustainability.berkeley.edu/sites/default/files/commitment-to-environment.pdf

University of California, Berkeley Hazardous Waste Minimization Policy:
https://ehs.berkeley.edu/hazardous-waste-minimization-policy

University of California, Berkeley Drain Disposal Restrictions for Chemicals:
https://ehs.berkeley.edu/sites/default/files/lines-of-services/environmental-protection/2014draindisposal.pdf

University of California, Berkeley Water Protection Policy:
https://campuspol.berkeley.edu/policies/waterprotection.pdf?Refresh=0.0214160312125

University of California, Berkeley Environment, Health & Safety:
https://ehs.berkeley.edu/

University of California, Berkeley Office of Sustainability & Carbon Solutions:
https://sustainability.berkeley.edu

University of California, Berkeley Energy Office:
https://facilities.berkeley.edu/departments/engineering-and-technical-services/energy-office

University of California, Berkeley Supply Chain Management:
https://supplychain.berkeley.edu/

University of California Cal Zero Waste:
https://facilities.berkeley.edu/operating-units/campus-operations/cal-zero-waste