The Carbon Action Plan: UCSB Decarbonization Through Electrification

A Bren Group Project | Winter 2022 – Spring 2023

UC SANTA BARBARA
Bren School of Environmental Science & Management

UC SANTA BARBARA
Sustainability

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OBJECTIVES

UCSB Sustainability is a collaboration of staff, students, administrators, and faculty from across campus that work to implement substantial changes and improvements to reduce our impact on the environment. They are committed to fostering a culture of sustainability through campus-wide sustainability efforts, program development, and promulgating the sustainability work of staff, faculty, and students – our greatest renewable resource (1). Decarbonizing the campus by 2025 is a challenge that UCSB Sustainability is currently focusing on. The objective of this project is to analyze the fossil fuel burning infrastructure on the campus to identify where changes can be implemented to reduce carbon emissions. This project will:

1. Perform an audit to determine actual carbon dioxide emissions of fossil fuel infrastructure serving UCSB campus buildings.
2. Using the data provided, identify the equipment approaching end of life for possible electric model replacement or retrofit.
3. Complete site surveys of equipment locations to determine replacement viability, including accessing the electrical infrastructure capacity and space issues.
4. Research replacement or retrofit options and work with UCSB Gaucho Energy and Electrical Services to develop installation cost and replacement schedules.

SIGNIFICANCE

Climate change is the greatest challenge of our time. Science has proven that releasing carbon dioxide into the atmosphere directly affects the climate and our actions at UCSB should set an example for a cost effective approach to eliminating emissions. The campus needs to shift away from water heating and cooking systems that require burning fossil fuels on site. These systems account for two-thirds of the campus energy portfolio, which total between 10,000 to 13,000 metric tons of carbon release annually (2)**.** The large building boilers account for approximately 83% of these CO2 emissions. They will also be the most challenging to replace since they “represent major investments in long-lived, cost-efficient natural gas-burning infrastructure” (3) and are typically part of the infrastructure of the buildings they serve. Most were installed before the building enclosure walls were built. However, replacing or retrofitting them may be the most economical choice in the long run.

Scope 1 emissions are due to onsite fossil fuel combustion, whereas scope 2 emissions are from offsite energy production (4). In 2020, the UCSB campus achieved carbon-free scope 2 emissions for our main campus by reducing demand, building onsite solar electricity, and purchasing carbon neutral electricity. However, UCSB still needs to mitigate its scope 1 emissions from onsite fossil fuel combustion. Emergency electricity generators produce a small percentage of onsite emissions while Transportation Services and the Sustainable Transportation Committee are addressing fleet vehicle emissions. Consequently, this project will focus on reducing the scope 1 emissions mainly from heating water for building HVAC, with small amounts coming from cooking facilities and space heating.

Starting in 2025, the UC Office of the President is anticipating that campuses will need to purchase carbon offsets to meet the climate neutrality goals. For UCSB, these costs would be between $8 - 17 per metric ton, which is about $80,000 - $221,000 annually, but prices are expected to increase tenfold by 2030 when the university could be looking at $800,000 to $2,210,000 annually (5). UCSB is choosing not to pursue offsets for the 2025 goal, but to use the avoided costs for offsets and invest those dollars to create a realistic plan and scope of work to achieve climate neutrality by investing in its infrastructure to realize its carbon reductions. This project will set out a plan to replace as many of the water boilers, water heaters, stoves and space heaters by 2030 to eliminate the need for Carbon offsets purchases. UCSB would ultimately reduce the amount of carbon and other noxious gasses entering the atmosphere (6), which is the ultimate goal.

Developing this plan to phase out UCSB's scope 1 emissions spans across campus entities. UCSB Sustainability compiled a campus list of all 1958 pieces of fossil fuel burning equipment with specifications like type, category, fuel, age, energy rating, and location. The project has the support of the three campus divisions that oversee and use this equipment, Facilities Management (FM), Housing, Dining & Auxiliary Services (HDAE), and Student Affairs (SA). Students are behind the Climate Neutrality Initiative and it seems fitting to have them involved in crafting an action plan to drive campus carbon emissions to zero by 2030. Students have an opportunity to drive change on campus and reducing our carbon emissions affect their lives as they will experience the effects of climate change most dramatically.

BACKGROUND

In 2013 the UC President Janet Napolitano announced a Carbon Neutrality Initiative (CNI) that all the UC campuses shall be carbon-free by 2025 for scope 1 and 2 emissions (7) something no other major university system had done at the time. President Napolitano knew that the goal would not be easy and challenged the university's leaders and innovators to show their greatness in achieving it. The UC Santa Barbara campus has made great strides to reach this goal through energy efficiency measures and sourcing green electricity as of 2020. There is a system wide policy that states, "No new building or major renovation that is approved after June 30, 2019, shall use onsite fossil fuel combustion (e.g., natural gas) for space and water heating (except those projects connected to an existing campus central thermal infrastructure)" (8). This policy does not cover small projects or renovations. The Office of Sustainability has met with Associate Chancellor Chuck Haines and Vice Chancellor Mac Pherson to review the offsets that would be required and our preference is to not pursue offsets for the 2025 goal, but create a realistic investment plan to achieve scope 1 reductions by 2030. To date, UCSB is the first of the 10 UC campuses to announce this approach. Current UC System wide conversations are that climate neutrality is going to be assessed as achieving a 95% reduction in scope 1, as there will most likely be some fossil fuels required for research or other specialized needs on the campus. The Office of Sustainability has also met with Julie Hendricks, the Director & Campus Architect from Design and Construction Services, and she is planning to incorporate it into her work.

EQUITY

UCSB is committed to diversity, equity and inclusion (DEI) and works towards a more equitable world. This project does not directly affect the underrepresented campus group but it will have some influence on the amount of carbon entering the atmosphere. Reducing 10,000 to 13,000 metric tons of carbon annually is significant and influences global warming. Making these reductions benefits us all but especially the disenfranchised populations living in proximity to power plants.

AVAILABLE DATA

The Office of Sustainability has compiled an extensive list of equipment that has been vetted by Environmental Health & Safety, Facilities Management, and Housing, Dining & Auxiliary Enterprises and will provide the following data:

- Campus list of all 1958 pieces of fossil fuel burning equipment with specifications including equipment type, manufacturer, manufacture year/age, make, model, serial number, fuel type used, energy rating/rated heat input (MMBtu/hr.), and location. This will be our guide for measurement and verification and to determining a priority for replacing equipment based on type and age.
- Table of carbon offsets and quantity of offsets/yr. that UCSB would need to achieve climate neutrality.
- GHG emissions inventory going back to 2008. Our GHG emissions inventory is third party verified and updated annually.

- FOVEA CAP tool that is updated annually. We can also model various approaches to assess progress and proposed plans.

POSSIBLE APPROACHES

Reducing scope 1 emissions requires obtaining an in-depth understanding of the current equipment, its location and nature of use. A suggested approach:

- Analyze the data provided by UCSB sustainability about the campus equipment to help identify possible initial replacement or conversion kits for items and related savings.
- Research equipment lifespans and compare it to campus equipment to create a shortlist of replacement items and gather available energy data consumption for each piece of equipment. Where data is not available, approximate energy usage for smaller equipment using usage rating and schedule. From there we calculate the actual carbon footprint of each piece of equipment by using the online CO2 calculator (9).
- Perform site-surveys to assess replacement feasibility. This can be scaled to select sample sets of equipment to run a detailed assessment on.
- Conduct research to determine equipment replacement or retrofit options.

DELIVERABLES

In addition to the final written report, executive summary, poster, and oral presentation, deliverables may include:

- Priority replacement list, which includes age metric, amount of carbon reduction, unit cost, and infrastructure, cost.
- Feasibility analysis that includes replacement complexity and associated costs. This includes electrical upgrades and building modifications.
- Schedule that details the project timeline for each piece of equipment.
- Comprehensive cost analysis for each equipment purchase, cost versus the carbon offset cost project. This will include recommended replacements with total replacement costs, operational cost comparison, metric tons of carbon saved, and the associated reduction of carbon offsets purchased.
- Assess the need and make recommendations for developing a campus specific policy for renovations and small projects to require electrification/eliminate natural gas.

This action plan will be instrumental for UCSB to achieve carbon neutrality within eight years instead of the three remaining the UC has left. It will detail the cost of replacing or retrofitting scope 1 emitters versus the carbon credit cost of operating the equipment on campus. Knowing these numbers will help accelerate the replacements and retrofits necessary to achieve carbon neutrality on the UCSB campus.

INTERNSHIPS

The Office of Sustainability has submitted a TGIF proposal to fund two MESM students' interns to work full time with our staff in summer 2022. This work would be 13 weeks of full time employment at $24.16/hr. for two students. This should not be affected by any possible UCSB COVID restrictions as we can follow masking and social distancing guidelines while completing the onsite measurement and verification and we can blend this with additional remote work if needed.

CITATIONS

1. https://sustainability.ucsb.edu/ucsb-sustainability
2. Persad, Jewel. UCSB Campus Strategy Presentation _2022 + Offsets. Winter 2022.
3. Meier, Alan, et al.Strategies for Replacing Natural Gas to Help Decarbonize the University of California. *Findings from the TomKat Natural Gas Exit Strategies Working Group*. NCEAS. 2018. USED https://www.nceas.ucsb.edu/tomkat-natural-gas-replacement-strategies
4. https://sustainability.ucsb.edu/uccni
5. Holder, Michael. Carbon offset prices set to increase tenfold by 2030. *GreenBiz Group.com*. June 14, 2021. https://www.greenbiz.com/article/carbon-offset-prices-set-increase-tenfold-2030
6. Emissions 101, *Cole Industrials*. 2021. https://coleindust.com/resources/boiler-emissions-101/
7. President proposes tuition freeze, new system wide initiatives. UC Office of the President. Press Room, 2013. https://www.universityofcalifornia.edu/press-room/president-napolitano-proposes-tuition-freeze-new-systemwide-initiatives
8. EVP-Chief Operating Officer. UC Energy & Sustainability. *Sustainable Practices*, 07/24/22, p.9. https://policy.ucop.edu/doc/3100155/SustainablePractices
9. Boiler emission calculator. https://www.combustionportal.org/bcalc3.php

BUDGET AND JUSTIFICATIONS

The Office of Sustainability has submitted a TGIF grant with the budget listed below requesting funding for two MESM student intern positions for summer 2022. This work would include onsite measurement, verification, and data analysis. Both the Office of Sustainability and Gaucho Energy and Electrical Services would provide mentorship during this period.

Salaries		Rate/Hr.	Total
1) TBN MESM Intern; 13 weeks @ 40/hrs./wk.	@	$ 24.16	$ 12,563.20
2) TBN MESM Intern; 13 weeks @ 40/hrs./wk.	@	$ 24.16	$ 12,563.20
Benefits			
1) TBN MESM Intern; consolidated benefit rate .049			$ 615.60
2) TBN MESM Intern; consolidated benefit rate .049			$ 615.60
		TOTAL:	$ 26,357.59

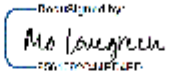
CLIENT LETTER OF SUPPORT

Please see the attached client letters of support from the UC Santa Barbara's Office of Sustainability and Gaucho Energy and Electrical Services.

UC SANTA BARBARA CAMPUS SUSTAINABILTY

January 18, 2022

TO: MESM Group Project Proposal Review Committee

FM: Mo Lovegreen, Director, Campus Sustainability 

RE: Letter of Support for The Carbon Action Plan: UCSB Decarbonization through Electrification

I am writing this letter in support of the MESM group project proposal submitted by Sage Davis to decarbonize the campus through electrification.

With our goal to achieve climate neutrality for Scopes 1 & 2 by 2025, we need to assess the campus infrastructure and make a plan to reduce our carbon emissions by modifying or replacing boilers, water heaters, and other equipment from fossil fuel burning sources to electrified units. This makes an excellent group project as it will provide recommendations to reduce our environment footprint, provide an economic analysis, and policy recommendations for the campus. In our meeting with the Office of Budget & Planning last week, they recommended that rather than invest in offsets, the campus would prefer to invest in further energy efficiency measures onsite. This project will help us set both the timeline and goals for achieving climate neutrality without offsets by a particular date (hopefully by 2030). We suspect this group project will be closely watched by our sister campuses and potentially adopted by many of them.

The Office of Sustainability will provide on-going mentorship from Katie Maynard, Jewel Persad, and myself. We have crafted a TGIF proposal for 2 internships to work on the campus in summer 2022 to complete the onsite measurement and verification needed for the project. We anticipate the response from TGIF in late April 2022.

UC SANTA BARBARA GAUCHO ENERGY

January 18, 2022

TO: MESM Group Project Proposal Review Committee

FM: Jim Morrison, Superintendent, Gaucho Energy and Electrical Services

RE: Letter of Support for The Carbon Action Plan: UCSB Decarbonization through Electrification

I am writing this letter in strong support of the group project proposal submitted by Sage Davis to assess the list of fossil fuel burning equipment on campus and make recommendations for electrification.

My office will provide on-going mentorship for the group as well as assist them with equipment to do onsite measurement and verification and access to the suite of equipment around the campus. We will make ourselves available to guidance, mentorship, and training in the use of this equipment and provide guidance on assessing the data for the project.