UC SANTA BARBARA

CLIMATE ACTION PLAN

2016

UCSB Sustainability
Action today for tomorrow

UCSB
Utility & Energy Services

The campus would like to give special thanks to Henry Bart, Brandon Kaysen, Melissa Maggass, Hye Min Park, and Owen Watson for their contributions to the Climate Action Plan. The findings of their yearlong Master Group Project, *Achieving Carbon Neutrality at UCSB by 2025: A Critical Analysis of Technological and Financial Strategies,* were essential in the development of this plan.

The campus would like to thank and acknowledge the following individuals for their involvement and contributions to the completion of the Climate Action Plan:

OFFICE OF THE CHANCELLOR
Henry T. Yang
Chancellor

ADMINISTRATIVE SERVICES
Marc Fisher
Vice Chancellor

Jewel Snavely
Campus Sustainability Coordinator

OFFICE OF BUDGET & PLANNING
Chuck Haines
Acting Assistant Chancellor

Mark Nocciolo
Acting Director, Capital Development

Terry Macy
Senior Facilities Planner

BREN SCHOOL OF ENVIRONMENTAL SCIENCE & MANAGEMENT
Sangwon Suh
Faculty Advisor to the Masters Student study, Achieving Carbon Neutrality at UCSB by 2025: A Critical Analysis of Technological and Financial Strategies

COLLEGE OF CREATIVE STUDIES
Bruce Tiffney
Co-Chair of Campus Chancellor's Sustainability Committee

DEPARTMENT OF GEOGRAPHY
Mo Lovegreen
Executive Officer, Director, Campus Sustainability

Katie Maynard
Sustainability Coordinator

Amorette Getty
Staff Advisor, LabRATS

INSTITUTE FOR ENERGY EFFICIENCY
David Auston
Director, UC TomKat Carbon Neutrality Project

TRANSPORTATION SERVICES
Nestor Covarrubias
Interim Director

John Behlman
Transportation Services Manager

Arjun Sarkar
Alternative Fuel Coordinator

DIVISION OF STUDENT AFFAIRS
Bill McTague
Executive Director

Andrew Riley
Sustainability Coordinator

ENVIRONMENTAL HEALTH & SAFETY
Jodi Switzer
Environmental Compliance Specialist

HOUSING, DINING, & AUXILIARY ENTERPRISES
Mark Rousseau
Environmental & Energy Manager

FACILITIES MANAGEMENT
Jordan Sager
Campus Energy Manager

REVIEW COMMITTEES
Chancellor's Campus Sustainability Committee

Chancellor's Campus Sustainability Committee
Subcommittee on Alternative Energy

Academic Senate,
Council on Planning and Budget

Table of Contents

1.0 Executive Summary

In March 2007, University of California (UC) then-President Robert C. Dynes signed the American College and University Presidents Climate Commitment (ACUPCC) on behalf of all UC Chancellors. ACUPCC membership requires development of a Climate Action Plan to establish strategic Greenhouse Gas (GHG) reduction measures, as well as to set a target date for carbon neutrality. The UC Policy on Sustainable Practices, which pre-dates the ACUPCC, sets system-wide policy guidelines and implementation procedures for environmental impact minimization and operational sustainability. This policy was originally envisioned and developed by student leaders working closely with staff and faculty. It includes the following provisions regarding Climate Protection Practices:

With an overall goal of reducing GHG emissions while maintaining enrollment accessibility for every eligible student, enhancing research, promoting community service, and operating campus facilities more efficiently, the University will develop a long term strategy for voluntarily meeting the State of California's goal, pursuant to California Assembly Bill 32 (AB32), the California Global Warming Solutions Act of 2006, that is to reduce GHG emissions to 1990 levels by 2020.

The University will pursue the goal of reducing GHG emissions to 2000 levels by 2014.

The University will pursue the goal of reducing GHG emissions to 1990 levels by 2020.

The University will pursue the goal of carbon neutrality by 2050.

In accordance with these initiatives, the University of California, Santa Barbara (UCSB) created a Climate Action Plan (CAP), approved by the Chancellor's Campus Sustainability Committee in August 2009. The 2009 CAP was drafted with the best available data and methodology. It was intended to establish an institutional framework for the inventorying, annual tracking, and strategic reduction of GHG emissions, to be updated on a biennial basis. The 2012 CAP included revised GHG emissions baselines and reduction goals, as well as updated GHG emissions inventory results through calendar year 2010. Additionally, it included GHG emissions from commuting and University-funded air travel.

This 2016 CAP supersedes the 2012 document and includes a new goal for carbon neutrality by 2025. In November 2013, UC President Janet Napolitano announced an initiative to achieve complete carbon neutrality in University of California operations (Scope 1 and 2) by 2025. In 2015, ahead of the United Nations Environment Programme (UNEP) Conference of Parties (COP 21), Chancellor Henry Yang signed a pledge affirming UCSB's commitment to the UC-wide goal.

The 2016 CAP includes GHG emissions inventory results through calendar year 2015 and mitigation strategies as well as revised emissions forecasts. The total 2015 GHG emissions were 79,446 metric tons of carbon dioxide equivalent (MT CO2e). UCSB emissions fell below the 2020 reduction target in both calendar years 2014 and 2015. This was achieved primarily through investment in energy efficiency projects funded through the continuation of the Statewide Energy Partnership. Business as usual (BAU) emissions are projected to remain under 1990 emissions levels through 2020. 2025 BAU projections for Scope 1 and 2 emissions are 42,137 MT CO2e.

The Carbon Neutrality Initiative (CNI) is arguably one of the most ambitious goals the campus has committed to and will require an aggressive approach to investing in energy efficiency, green building, and renewable energy. The following graph provides a summary of the Scope 1 & 2 mitigation strategies discussed in the plan, which account for a potential 16,197 MT CO2e (40%) reduction in emissions.

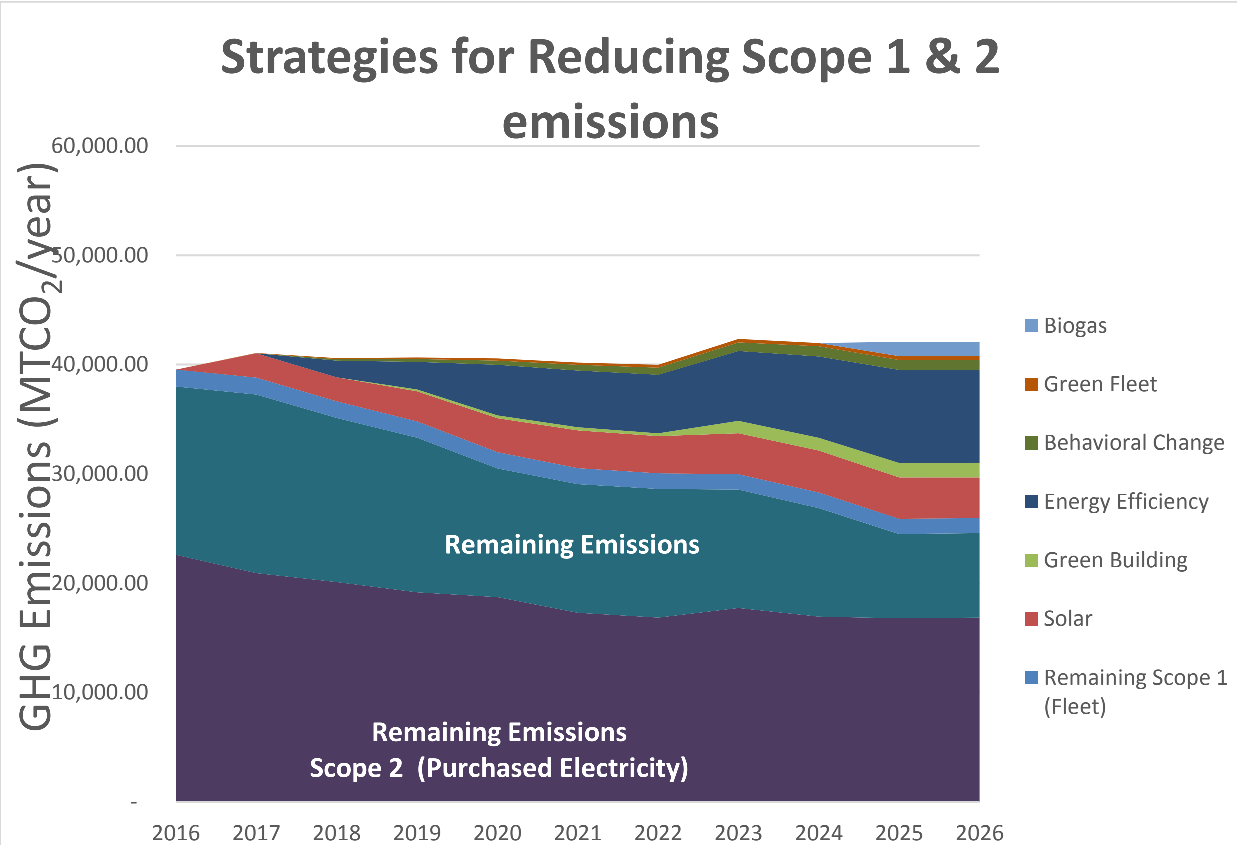

Figure 1: UCSB Scope 1 and 2 Greenhouse Gas Abatement Wedge

Energy efficiency strategies account for a 20% reduction in total emissions and are estimated to cost $13.2 million, which is only about 1% of the campuses annual operating budget. Energy efficiency projects not only cut UCSB's emissions, they result in significant cost savings and help us meet required air pollution reduction targets. Additional cost-effective mitigation strategies include development of onsite and offsite renewable electricity and new construction energy efficiency measures.

Potential strategies for abatement of the remaining emissions (25,940 MT CO2e) explored in the plan include continued investment in energy efficiency, carbon offsets which would cost an estimated $600K annually, procurement of renewable energy, and electrification of heating in existing buildings. Initial analysis indicates that building electrification will be more cost effective than long term reliance on offsets. The next step would be to conduct a study to refine estimates and identify feasible buildings.

While the campus strives to reduce emissions as quickly as possible, UCSB recognizes that the campus may not be able to achieve the carbon neutrality goal given the short duration from now until 2025 and the financial constraints the University faces. On the other hand, UCSB recognizes the severity of the climate crisis faced by humanity, and feels it imperative to protect our students, workforce, the people of California, and the world, in accord with the principles of climate justice.[1]

2.0 Introduction

Background

The University of California, Santa Barbara (UCSB) has long been a leader in the advancement of environmental protection, education, and research. In 1990, then-Chancellor Barbara Uehling was one of the first chancellors in the US to sign the Talloires Declaration. This document, originally signed by 22 university presidents, declares that institutions of higher learning will be world leaders in developing, creating, supporting, and maintaining sustainability on their campuses. In September 2006, Governor Arnold Schwarzenegger signed into law AB 32 – the Global Warming Solutions Act of 2006. In June 2004, University of California then-President, Robert Dynes, approved the Policy on Sustainable Practices guidelines for the UC system to minimize its impact on the environment and decrease its dependence on non-renewable energy. In 2007, a section on Climate Protection Practices was added that mandates each campus develop, by December 2008, a long-term plan for (1) achieving 2000 emissions levels by 2014, (2) achieving 1990 levels by 2020, and (3) eventual carbon neutrality. In 2007, then-President Robert Dynes also signed the American College and University Presidents' Climate Commitment (ACUPCC), and UCSB Chancellor Henry T. Yang was appointed to the ACUPCC advisory board. As part of this commitment and ongoing development of sustainability initiatives, in October 2008, Chancellor Yang appointed a high-level campus-wide sustainability committee consisting of faculty, staff, and students. This committee reviews and prioritizes sustainability projects and initiatives and submits recommendations to the Chancellor for project approval and funding. Student Affairs (SA) at UCSB has been a leading division on climate action and planning. In 2007, student leaders advocated for and successfully passed a student lock-in fee for the Renewable Energy Initiative (REI) a student funded effort to support UCSB's Student Affairs (SA) Department in achieving zero-net energy (ZNE) for all of the facilities they managed.

[1] "Climate justice" refers to a set of insights and practices that center the effects of climate change on the stakeholders and communities who are most affected by it yet least responsible for it and often possessing the fewest resources to adapt to it. These tend to be people who live on the "front-lines" of the climate problem, from low-lying island nations to populations in the Global South, to communities of color and low-income areas in the United States. Due to the broad and growing diversity of California's population, we believe this is an appropriate and exciting lens on climate change to frame our sustainability efforts in the educational field.

Moreover the concept of climate justice is referenced in the recent UN "Paris Agreement," and is consonant with the educational goal of the recently adopted United Nations 2030 Agenda for Sustainable Development as expressed in Sustainable Development Goal 4.7: "To ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development:" see the web platform https://sustainabledevelopment.un.org/, and in particular the document "Transforming Our World: The 2030 Agenda For Sustainable Development: Sustainable Development Knowledge Platform" (2016), https://sustainabledevelopment.un.org/post2015/transformingourworld

In November 2013, UC President Janet Napolitano announced an initiative to achieve complete carbon neutrality in University of California operations (Scope 1 and 2) by 2025. The Carbon initiative proposes four efforts; (1) procuring large quantities of renewable electric power; (2) increasing campus energy efficiency and renewable energy projects; (3) procuring biogas to substitute for natural gas; and (4) managing carbon allowances and offsets. The initiative is designed by the UC Office of the President to enable the University of California to become the first major Research University in the world to achieve carbon neutrality and capitalizes on the UC's historic standing as a sustainability leader.

In 2014, the UC Global Climate Leadership Council (GCLC) was formed by President Napolitano to advise UC leadership on achieving carbon neutrality by 2025 and in 2015, the GCLC approved 15 research and engagement projects to support the carbon neutrality goal. "These projects leverage UC faculty expertise and student creativity to make the University a global leader in climate change research, education, and business practices."[2] Projects include the UC's purchase of 80 megawatts of solar capacity. A special task force was also formed to accelerate reductions system-wide. The taskforce is currently looking at incorporating lifecycle cost assessments for new buildings. Recommendations made by this committee will be incorporated into future revisions of the climate action plan.

In May of 2013 the Academic Senate voted in favor of divesting from the 200 most polluting fossil fuel companies and in August of 2014, the Chancellor's Sustainability Committee called upon Chancellor Yang to endorse the ongoing campaign at the UC to divest its endowment from the 200 most polluting fossil fuel companies. In September 2015 the UC divested from coal and tar sands companies. While the Climate Action Plan doesn't directly focus on the issue of divestment, it is important that UCSB recognize student, faculty, and staff's commitment to fossil fuel divestment and climate justice.

Ahead of the United Nations Environment Programme (UNEP) 2015 Conference of Parties (COP 21), Chancellor Henry Yang signed a pledge affirming UCSB's commitment to the UC-wide goal of becoming carbon neutral by 2025. As UCSB moves forward in planning new efforts to reduce emissions, this ambitious goal of neutrality will guide our strategies for improving energy efficiency and renewable energy supplies.

2016 Update

The 2016 Climate Action Plan quantifies and analyzes UCSB's current, historical, and projected emissions and evaluates the campus' progress toward meeting reduction targets in years 2020 and 2025. Planned and conceptual climate change mitigation strategies outlined in this document demonstrate UCSB's ability to maintain GHG emissions below 1990 levels and move closer to the 2025 goal of Carbon neutrality even as the campus' building stock and population continue to grow.

The 2016 Climate Action Plan includes:

- 2015 GHG emissions inventory methodology and results
- Updated emissions projections

[2] ANNUAL REPORT ON SUSTAINABLE PRACTICES 2015. Rep. University of California. http://ucop.edu/sustainability/_files/annual-sustainability-report2015.pdf

- Mitigation strategies and projected reductions
- Strategies for financing Energy Efficiency projects
- Carbon Management Mechanisms

Continuing engagement and evaluation of this plan by the Chancellor's Campus Sustainability Committee and the Academic Senate Sustainability Workgroup will help in ensuring that UCSB meets its commitments to reducing campus climate impacts. The Climate Action Plan is intended to assist in this process by documenting progress, identifying unknowns, and framing next steps.

Though this plan does not directly address resiliency planning, UCSB does recognize that climate adaptation is an important strategy to alleviate the effects of climate change. A separate working group has formed to develop a resiliency plan.

3.0 Greenhouse Gas Emissions Inventory

Scope of Emissions

UCSB Physical Scope

The UCSB Campus is located in the Santa Barbara County, on the Pacific coast where it is highly susceptible to the effects of sea level rise. UCSB is made up of four principal campuses: the 422 acre Main Campus, acquired in 1948; the 184 acre Storke Campus, purchased in 1962; the 273 acre West Campus, purchased partly in 1967 and partly in 2007; and the 174 acre North Campus, purchased in 1994. The University also owns three apartment buildings in Isla Vista (El Dorado, Westgate, and Tropicana del Norte). Including all of its land holdings, UCSB currently occupies over 8 million California-Adjusted Gross Square Feet (CAGSF) of built-out space. Several for-sale housing projects for faculty and staff are not included in these projections since UCSB does not maintain operational control or ownership of these housing units.

Scope of Emission Sources

The following summarizes UCSB's approach to inventorying emissions. UCSB's GHG emissions inventory includes emissions of the six Kyoto Protocol gases – carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6) – resulting from fossil fuel consumption and refrigerant use at facilities under operational control of the University, including the main campus, off-campus housing, and auxiliary facilities. This inventory also includes emissions associated with commuting patterns and business air travel. Each year, UCSB performs an audit of its emissions sources through the Climate Registry (formerly the California Climate Action Registry). From 2004-2006, it only included CO2 emissions. Starting in calendar year (CY) 2007, it began auditing all six Kyoto Protocol gases. UCSB's annual GHG emissions inventory quantifies emissions in three categories:

Scope 1 – Direct Emissions: on-site natural gas, diesel, and propane combustion; campus fleet emissions; marine vessel emissions; and fugitive emissions.

Scope 2 – Indirect Emissions: purchased electricity.

Scope 3 – Indirect Emissions (Other): University-funded business air travel and student, staff, and faculty commuting.

While UCSB currently does not track scope 3 emissions associated with purchased goods, waste, and investments, the campus recognizes that the associated indirect emissions will have a significant impact on UCSB's carbon footprint. It would be beneficial for the campus to begin the process of quantifying and reporting these emissions for future inclusion into the Climate Action Plan.

Historical and Current Emissions

Historical Emissions

Figure 2 below depicts the trend in CO2e emissions levels between 1990 and 2015. While the majority of Scope 1 and 2 historical electricity and fuel consumption data is available, this analysis relies on extrapolated usage data for the years 1990-1995. Scope 3 commuter emissions are based on historical mode-split survey data and are normalized for population.

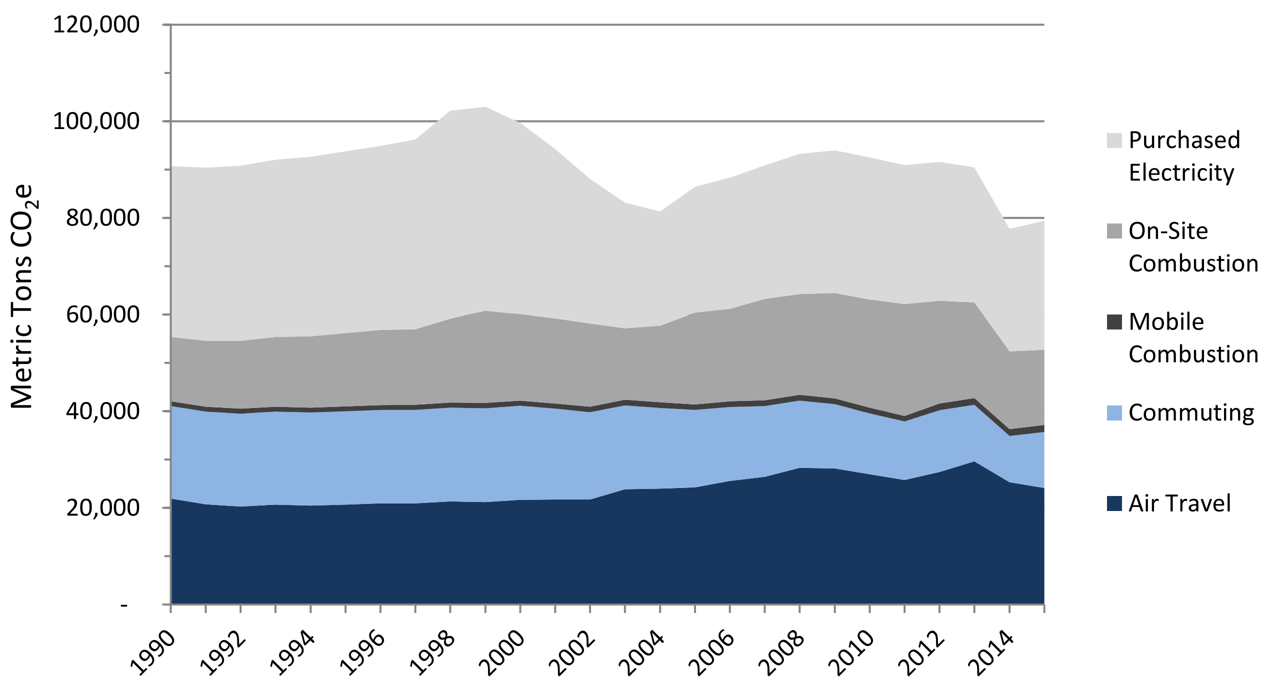

Figure 2: Historical GHG Emissions - 1990 to 2015

Emissions increased relatively steadily from 1990 to 1999, followed by a decline in emissions from 1999 to 2004 and an increase in emissions from 2004 to 2009. The decrease in emissions from 1998 to 2004 was due to the implementation of a number of energy efficiency projects which reduced campus electricity usage intensity considerably, while the increase from 2004 to 2009 was due to the increase in square footage resulting from new building construction, and from an increase in associated natural gas consumption. The decline in emissions from 2009 – 2013 was a result of improvements in energy efficiency. Examination of the GHG intensity factors for electricity and natural gas, based on gross square footage (GSF), show that electricity-related GHG emissions per GSF have decreased from 1998 through 2014 (figure 3). The campus natural gas usage intensity has fluctuated over the years, which is partly due to variations in annual heating degree days.

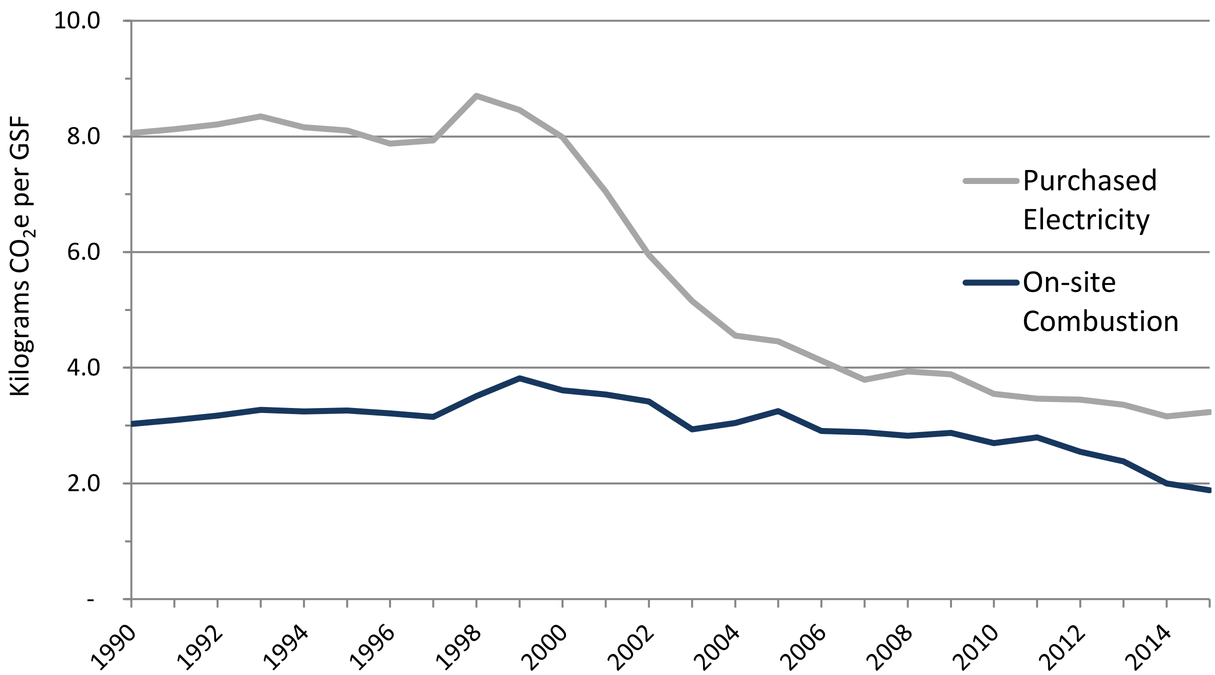

Figure 3: Historical Electricity and Onsite Combustion GHG Intensity - 1990 to 2015

During the period of 1990 to 2014, the total student, faculty, and staff counts increased from 22,261 to 27,381, for an increase of 23%, and building GSF increased from 4,385,989 to 8,028,181, for an increase of 83%. The increase in students, faculty, and staff has been fairly steady through 2009 but dropped slightly in 2010 and 2011. UCSB experienced its most rapid build-out during the time period 2004 through 2008, resulting in a recent increase in GSF per capita.

Commuting and air travel data to 1990 has been normalized for population, based on 2010 calculation methods. Although some data is available on commuting and air travel in the past, it is largely incomplete. This CAP presents the best estimation for consistent back casting, given the limited or absent data. It is worth noting that this method does not capture reduction trends in commuting or air travel and likely under-represents commuting and travel emissions in 1990.

Current Emissions

For 2015, UCSB reported Scope 3, in addition to Scope 1 and 2 GHG emissions, to The Climate Registry (TCR). 2015 GHG emissions and sources as reported to TCR in Metric Tons Carbon Dioxide Equivalent (MTCO2e) are presented in the table and figure below.

Table 1: 2015 Campus Emissions

GHG Emission Scope and Source - 2015	$MTCO_2e$	Percent of Total
Scope 1 - Stationary Combustion (Campus)	13,293	16.74%
Scope 1 - Stationary Combustion (Other)	2,264	2.85%
Scope 1 - Mobile Combustion	1,462	1.84%
Scope 1 - Fugitive Emissions	44	0.01%
Scope 2 - Purchased Electricity (Campus)	26,049	32.80%
Scope 2 - Purchased Electricity (Other)	655	0.83%
Scope 3 - Air Travel	24,139	30.40%
Scope 3 - Commuting	11,540	14.53%
TOTAL	79,446	100.00%

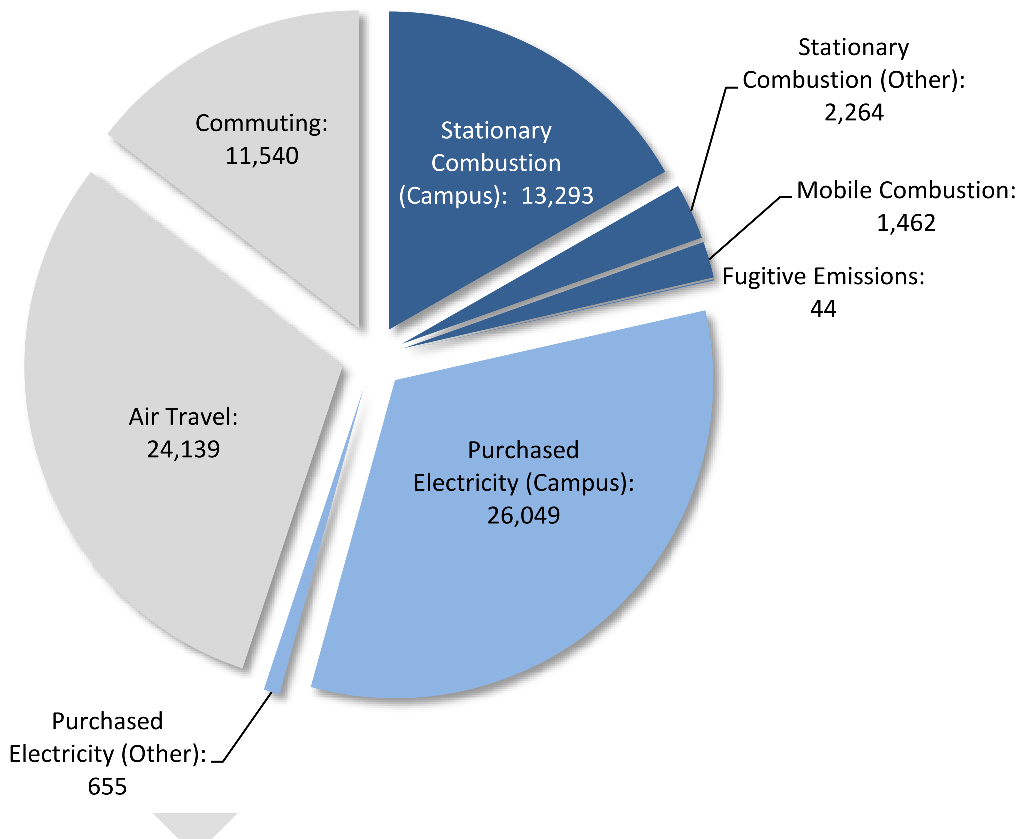

Figure 4: 2015 Emissions by Source

Scope 1 emissions reported to TCR are calculated following a thorough analysis of current fuel and refrigerant consumption data for all UCSB operations and by applying fuel-specific emissions factors as prescribed by the TCR General Reporting Protocol (GRP) version 2.1.

Scope 2 emissions reported to TCR are calculated by applying the TCR Default Emissions Factor. During calendar year 2015, UCSB's electricity generation and transmission provider was Southern California Edison (SCE).

Scope 3 emissions reported to TCR include emissions resulting from University-paid business air travel, and faculty, staff, and student commuting to and from campus. Air travel emission calculations are based on mileage calculations derived from a subset of total amount spent on air travel. The Connexxus travel system tracks air miles, and from this data, a campus-specific cost factor can be applied to derive air miles traveled. Miles are converted to resultant GHG emissions using air travel emissions factors from the Clean Air Cool Planet Calculator version 6.7-2010. The UC Transportation Working Group and Climate Change Working Group expect to refine and standardize this calculation method for inclusion in further iterations of UC Climate Action Plans. Commuter emissions are based on accurate mode-split data derived from comprehensive campus surveys administered annually during spring quarter. Using methodology developed by the UC Transportation Working Group, GHG emissions for the entire population of the campus are calculated and updated annually. GHG-emitting transportation modes include single-occupancy vehicles, carpooling, vanpools, motorcycles, and bus commuting. These figures are adjusted for average ridership.

Projected Emissions

The current UC Santa Barbara Long Range Development Plan (LRDP) was approved by the UC Board of Regents in September 2010, and by the California Coastal Commission in November 2014. This document describes campus growth through 2025. The following LRDP projections informed CAP projections through 2025:

- Increase in undergraduate and graduate student population of 1 - 2% per year, for a total of approximately 25,000 in 2025.
- Increase in faculty and staff population to a total of 6,431 in 2025.
- Addition of sufficient housing to accommodate each new student

Table 2: Campus Growth Projections

Growth Projections	2015	2020	2025
Calif OGSF* *** Outside Gross Square Feet**	8,265,176	8,797,409	9,243,209
Students	22,574	23,726	24,936
Faculty and Staff	5,204	6,039	6,431

The LRDP implements principles of sustainability in urban planning. Specifically, the LRDP adds housing for each new student in a close enough proximity to main campus. Commuting trips that would have otherwise been in a vehicle are likely to be made by alternative means (e.g., cycling, walking, and public transit). UCSB also funded a new bus line from the most recently built housing to campus and additional operating hours and shrunken headways on express busses to and from downtown.

The 2016 CAP projections are based on the 2015-25 Capital Financial Plan (CFP). Based on the most current version of the CFP, the CAP projections assume that approximately 532,233 GSF will be built out by 2020 and an additional 445,800 GSF by 2025 and will be within the scope of UCSB's GHG emissions inventory (Table 2). Several for-sale housing projects for faculty and staff are not included in these projections since UCSB does not maintain operational control or ownership of these housing units. Business As Usual (BAU) emissions for future years, 2016 through 2025, are calculated, based on conditions described in the current CFP, UCSB Building Energy Benchmarks (Table 3), Compliance targets in UC green building policy, and forecasted Renewable Portfolio Standards (RPD).

Table 3: UCSB Building Energy Benchmarks[3]

UCSB Building Energy Benchmarks		
Benchmark Building Energy Use as published in Sahai, et al. 2014		
Building type	Annual Electricity (kWh/gsf/yr)	Annual Natural gas therm/gsf/yr
Academic/ Administrative non complex	11	0.19
Housing non complex	8	0.28
Lab/complex	36	1.81

The Campus procured the generation component of its purchased electricity through Direct Access contracts for years 2010 and 2011. For this reason, campus emissions for 2010 and 2011 are based on the Environmental Protection Agency (EPA) statewide E-GRID emissions factors for the WECC region. However, projected scope 2 emissions from 2016-2025 are based on Renewable Portfolio Standard (RPS)-adjusted Southern California Edison (SCE) utility-specific power generation. The California RPS mandates that SCE must increase procurement from eligible renewable energy resources to 33% of total procurement by 2020 and 50% by 2030.

The BAU emissions for UCSB's fleet of mobile sources (i.e. on-road and marine fleets) is calculated by taking the previous three year average mobile source emissions and scaling it by the increase in faculty and staff. Backup generator, gas cylinder, and refrigerant emissions are each scaled by the increase in square footage of the main campus buildings. Similarly, scope 3 emissions from commuting and air travel have been scaled for population increases.

[3] Sahai, Rashmi, and Karl Brown. Benchmark-based, Whole-Building Energy Performance Targets for UC Buildings. Rep. University of California. Print.

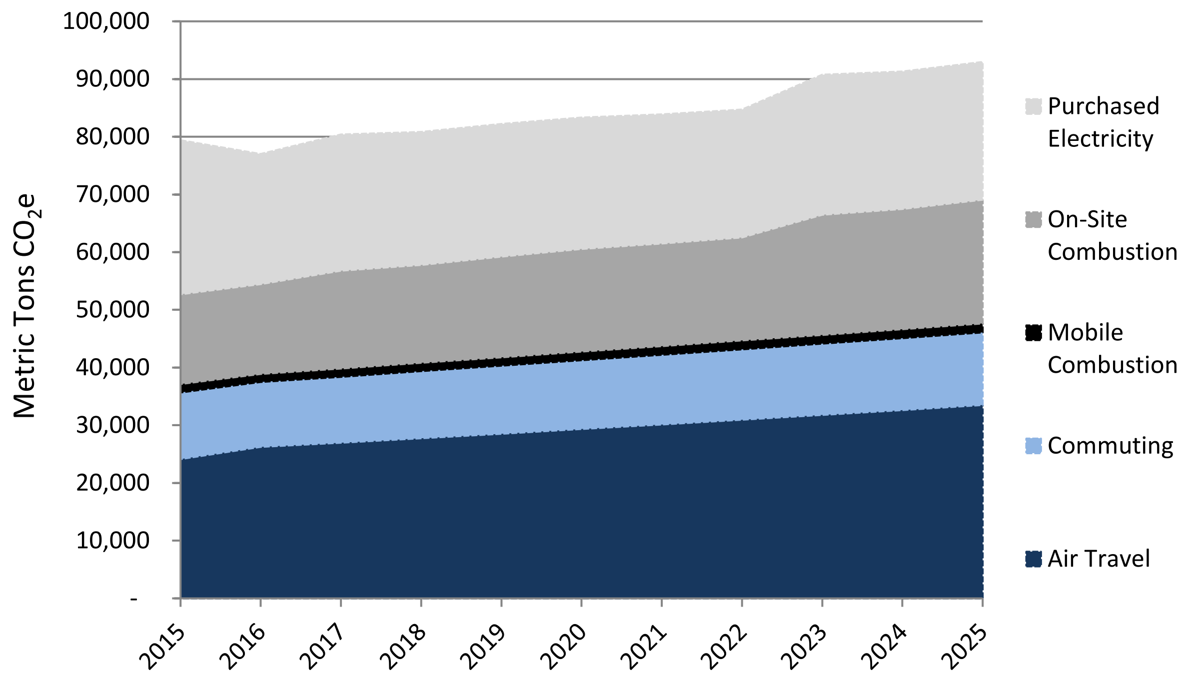

Figure 5: Projected Business as Usual Emissions 2016-2025

Emissions Reduction Targets

The interim emissions reduction goal to attain CY 1990 emissions levels by 2020 was achieved in 2014 and business as usual projects for 2020 are well under 1990 levels (Table 4). The Presidential Carbon Neutrality Initiative commits each campus to carbon neutral in Scopes 1 and 2 emissions by 2025. UCSB is also committed to achieving full carbon neutrality in Scope 1, 2, and 3 by 2050. For comparison, projected BAU emissions for each of the target years are presented in Table 4.

Table 4: Emissions Reduction Targets

	Metric Tons Mitigated Annually (CO_2e)		
	2020	**2025**	**2050**
Emission Reduction Targets	90,736 (1990 level)	0 (Scope 1 & 2)	0 (Scope 1, 2, 3)
Projected BAU emissions	81,882	88,243(42,137 scope 1 & 2)	Not projected

The first step in achieving the 2025 goal is avoiding and reducing emissions as much as possible by using mitigation strategies outlined below (Table 5) and described in Section 4. Once financially feasible mitigation strategies for the campus are exhausted, the second step will be to provide offsets for any remaining emissions, also covered in Section 4.

Table 5: Mitigation Measure and Associated Potential Reductions

Metric Tons Mitigated Annually (CO_2e)	
Energy Efficiency	8,487
On-site Solar	3,787
Green Building	1,328
Green Fleet	366
Biogas	1313
Behavioral Change	915
Commuter	3,241
Air Travel	3,350
Total Reduction	22,788

4.0 Mitigation Strategies

Comparing BAU projections for 2025 with UCSB's target, the campus must reduce scope 1 and 2 GHG emissions by 41,137 MT CO2e. Mitigation strategies discussed in this section include emissions avoidance through improved planning and the reduction of the carbon intensity of development; emissions reductions through improved efficiency in campus operations; and replacement of high-carbon energy sources with 'de-carbonized' sources of electricity and natural gas. These strategies will be implemented through changes to building design and construction, retrofitting of existing buildings, changes in policy and practices, and education and outreach to promote behavioral change.

Energy Efficiency

In the late 1990s, UCSB Utility & Energy Services began implementing aggressive energy efficiency measures such as HVAC upgrades, lighting retrofits, de-lamping, advanced controls installations, building commissioning, and development of district energy systems. Since 2006, the campus has made tremendous efforts to reduce GHG emissions. Projects with high returns on investment were targeted early by the campus and have played a major role in emissions reductions and utility cost avoidance. From 2001 - 2003, the campus upgraded 50+ buildings with T8 lamps and program start electronic ballasts. High Pressure Sodium (HPS) lights on building exteriors were also replaced with compact fluorescent and metal halide lights, reducing GHG emissions 1,110 MT CO_2e annually and saving almost $400,000 annually in electricity costs. Since the last Climate Action Plan Update in 2014, UCSB Utility & Energy Services has completed more than 20 energy efficiency projects, saving the campus $550,000 annually in electricity and natural gas costs and reducing GHG emissions by over 2,000 metric tons. Energy efficiency projects present the greatest opportunity for the campus to reduce emissions as well as campus operating costs.

This CAP forecasts **8,487** MT CO_2e in annual emissions reductions, resulting from planned and projected efficiency projects. The campus plans to complete several energy efficiency projects over the next five years resulting in a 5,448 MT CO2e reduction annually (Table 6). This will cost just over $8 Million dollars but will result in a net annual savings of over $1 Million.

Table 6: Planned Energy Efficiency Projects (2017 – 2021)

Project	Project Cost	Total Incentive	Electricity Savings (kWh)	Natural Gas Savings (therms)	Total Savings ($2016)	Payback (yrs)	GHG savings
PSB North/Chemistry Commissioning and Heat Pump Plant	$1,262,427	$262,664	144,343	231,242	$177,747	5.62	1,261
CNSI Commissioning	$200,000	$50,580	167,000	10,500	$ 25,720	5.81	98
ESB Commissioning	$250,000	$73,354	273,560	7,700	$ 35,482	4.98	111
Campbell Hall Lighting Retrofit	$40,000	$ 9,792	40,800	-	$4,488	6.73	10
Ellison Hall Lighting Retrofit	$175,000	$ 48,000	200,000	-	$ 22,000	5.77	51
Embarcadero Hall Lighting Retrofit	$25,000	$ 7,200	30,000	-	$3,300	5.39	8
Energy Storage/Demand Management	$300,000	$ -	-	-	$139,300	2.15	-
Lab Equipment Upgrade Incentive Program	$40,000	$ -	74,000	-	$8,140	4.91	19
Harder Stadium Lighting Retrofit	$45,000	$14,400	60,000	-	$6,600	4.64	15
Broida Hall Lab Ventilation Optimization	$694,000	$243,971	319,835	167,211	$152,230	2.96	967
Music (Lotte Lehmen Theater) Lighting Retrofit	$71,500	$14,400	60,000	-	$6,600	8.65	15
12-Bldg Heating Electrification	$1,200,000	$ -	(1,872,450)	421,731	$ 89,242	13.45	1,752
Davidson Library 4-Story Lighting Retrofit	$297,040	$72,000	300,000	-	$33,000	6.82	77
Davidson Library Tower Lighting Retrofit	$141,680	$33,600	140,000	-	$15,400	7.02	36
Engineering II Commissioning	$250,000	$78,984	220,000	26,184	$42,529	4.02	195
Lab Exhaust Stack Study	$1,750,000	$600,000	2,500,000	-	$275,000	4.18	641
Campuswide Exterior Lighting Retrofit	$1,500,000	$180,000	750,000	-	$82,500	16.00	192
Total	$8,241,647	$1,688,945	3,407,088	864,568	$1,119,277	6.42	5,448

Efficiency measures are currently the most cost effective methods for reducing GHG emissions and are driven primarily by strong returns on investment.

This CAP also forecasts a 3,039 MT CO2e reduction from 2022, 2023, and 2024 through additional investments in energy efficiency. Since the campus has not yet planned energy efficiency projects past 2021, estimates are based on the average annual investment planned for 2017 through 2021. These estimates a fairly conservative, if the campus had access to additional funding, much more ambitious emissions reductions could be made through energy efficiency. In 2016, 5 graduate students at UCSB's

Donald Bren School of Environmental Science & Management (Carbnewt) completed a group project, *University of California, Santa Barbara - Optimal strategies for achieving Carbon Neutrality at UCSB by 2025.* They estimated that our campus could reduce emissions over 19,000 MT CO2e through five energy demand reduction technologies: LED & Controls Retrofits, HVAX retrofits, Monitoring-Based Commissioning, Lab Retrofits, and a Hot Water Loop.[4] While these estimates are ambitious, they show that our campus could further decrease emissions, given additional financial support.

Energy efficiency measures have been the primary mitigation strategy to reduce campus GHG emissions and their contribution will continue to grow as more projects are implemented each year. These projects are essential to the University meeting the 2025 target. Major energy efficiency projects implemented at UCSB are primarily run through the Statewide Energy Partnership (SEP), an incentive-based partnership with the State's Investor Owned Utilities. The SEP incentives are approved through 2025, allowing UCSB to continue utilizing advantageous utility incentives to reduce GHG emissions.

Future Recommendations:

- Building upon the initial work done to identify energy demand reduction technologies, the campus would benefit from conducting a comprehensive technology feasibility study. This would allow the campus to identify and prioritize the existing cost-effective strategies for energy efficiency implementation, Cap and Trade compliance, and progress toward Carbon Neutrality. Below are brief descriptions of each section of the proposed study:
    - Energy Efficiency: Develop and implement a comprehensive energy efficiency audit and identify specific carbon reduction measures, with a focus on natural gas savings, deep energy efficiency opportunities, and carbon emission reduction;
    - Electrification: Conduct a feasibility study focused on eliminating the use of natural gas for heating and cooling campus buildings.

  The study should also account for potential future costs that result from the recommendations, as well as future savings. Based on similar study done at UCSC, we estimate that this study would cost anywhere from $400,000 - $500,000. To narrow down the cost estimate, the campus could go through the Request for Information (RFI) process.

- Establishing a campus-wide policy broadening temperature set points for buildings. Additional energy savings and reductions in GHG emissions can be achieved by setting standard temperatures and operating parameters for campus buildings. Every degree reduction in winter and increase in summer temperature set point yields 1-2% reduction in annual heating/cooling costs.

[4] Bart, Kaysen, Maggass, Park, Watson, 2016. Achieving Carbon Neutrality at UCSB by 2025: A Critical Analysis of Technological and Financial Strategies. Page 41. University of California, Santa Barbara Bren School of Environmental Science and Management. http://www.sustainability.ucsb.edu/wp-content/uploads/UCSBCarbonNeutralityFinalReport6-6-16signaturesredacted-1.pdf

- Establish a flexible equipment replacement incentive program that would allow for laboratories to submit a request for support to replace lab equipment with an energy efficient alternative.

New Construction Through 2025

UCSB has historically been a leader in green building. In 2002, Bren Hall was the first laboratory building in the US to achieve Platinum-level certification in Leadership in Energy and Environmental Design (LEED) for New Construction (NC), a rating system developed by the US Green Building Council. Subsequently in 2009, Bren Hall was awarded a second LEED Platinum certification for its ongoing maintenance and operational practices, making it the first facility in the world to have achieved such a distinction. The University has maintained this leadership position in green building design and construction with the first Platinum LEED for Homes certification in the UC system completed in 2015 for the North Campus Faculty Housing. UCSB achieved yet another LEED Platinum certification for Sierra Madre Villages, an undergraduate apartment complex.

This CAP forecasts 1,328 MT CO_2e in annual emissions reductions by designing for energy efficiency using benchmark-based, whole-building energy performance compliance stretch targets outlined in the UCOP Green Building Policy (Table 7) and by electrifying heating in new buildings.

Table 7: Estimated Energy Savings and GHG Reductions Through Achieving Whole-Building Energy Stretch Targets

Energy Benchmark	Total GSF	Projected Electricity (kWh/year)	Projected Natural Gas (therms/year)	Energy Cost Savings ($/year)	GHG Savings (MT CO_2e/Year)
Compliance Targets (BAU)	978,033	12,977,274	605,374		
Stretch Targets	978,033	10,403,484	467,375	$504,446	1,182
Electrification	978,033	15,377,235	0	$341,653	1,328

Benchmark-based, whole building energy performance targets are becoming the best practice method for designing energy efficient buildings. “There are several advantages to energy performance targets, including a static baseline (to allow for comparison of buildings over time), the ability to capture energy use and efficiency for all building energy loads (not just the loads regulated by code), and the ability to carry design targets through to operations.”[5] Meeting stretch targets set by UCOP for all new buildings will reduce emissions from new growth by an estimated 1,182 MT CO_2e annually (Table 7).

Electrification of new buildings would reduce emissions 1,328 MT CO_2e (Table 7). Electrification is seen as an important step towards creating a carbon neutral and Zero Net Energy (ZNE) Building, because renewable electricity can replace natural gas use in buildings. Heat pumps are the key technology for delivering electrification of heating. A ZNE building is a building with zero net energy consumption. This means that the total amount of energy used by the building on an annual basis is roughly equal to the amount of renewable energy created on the site. “As California’s building code continues to move

[5] Sahai, Rashmi, and Karl Brown. Benchmark-based, Whole-Building Energy Performance Targets for UC Buildings. Rep. University of California. Print.

toward increased stringency, developing a ZNE building approach will greatly benefit UCSB in the future."[6] UCSB has not invested in a cogeneration facility, which makes it easier for the campus to replace natural gas with renewable electricity, moving us closer to achieving ZNE.

Electrification of new buildings will also help the campus meet strict New Source Review (NSR) standards. NSR is a permitting program through the Santa Barbara County Air Pollution Control District (APCD) that evaluates potential air quality impacts from regulated stationary sources of air pollution. The purpose of this program is to ensure that Santa Barbara County meets the Clean Air Plan goals of attaining State and Federal ambient air quality standards. While the previous version of this NSR program had been in place for nearly 20 years, it has recently undergone significant revisions, which will impact the types of emissions which UCSB will be required to eliminate, reduce, or mitigate.

Under the recently amended NSR program, a facility's Potential to Emit (PTE) is compared against a significance threshold for each criteria pollutant. Exceeding a significance threshold is not a violation of an air quality standard, rather, it simply means that a facility may be subject to offset requirements for new or replacement emission sources. Of the criteria pollutants regulated by APCD, the only significance threshold exceeded by UCSB is for permitted nitrogen oxide (NOx) emissions. What this means for UCSB is that the campus will now be required to offset NOx emissions for all non-exempt new or replacement sources of combustion emissions. The amended NSR program includes exemptions for emergency units and replacement units that implement Best Available Control Technology (BACT). Therefore, this will primarily affect new natural gas boiler installations or replacement units that do not meet the BACT standard.

NOx offsets are traded in the form of Emission Reduction Credits (ERCs) which are produced when a facility has demonstrated a real, quantifiable reduction in emissions. In order to achieve a net air quality benefit, APCD required that ERCs be traded at a ratio of 1.3 to 1 when the ERCs are produced elsewhere within Santa Barbara County and 1.1 to 1 when ERCs are created within the same facility (UCSB). The estimated offset costs range from $25,000 for class room buildings to $100,000 for lab buildings. This estimate is based on the assumption that offsets were created elsewhere within Santa Barbara County and is based on the current market value. Electrification of new buildings would allow UCSB to avoid buying offsets. There are also some concerns about the availability of ERCs in the future, which provide further motivation for UCSB to proactively reduce emissions.

The campus can also reduce energy use and GHG emissions associated with new building construction by reducing the amount of new space required on campus through better space utilization. Effective space management is an important tool for reducing emissions. Increased space utilization also reduces indirect emissions associated with construction. The energy involved in constructing a building and its

[6] Bart, Kaysen, Maggass, Park, Watson, 2016. Achieving Carbon Neutrality at UCSB by 2025: A Critical Analysis of Technological and Financial Strategies. Page 45. University of California, Santa Barbara Bren School of Environmental Science and Management. http://www.sustainability.ucsb.edu/wp-content/uploads/UCSBCarbonNeutralityFinalReport6-6-16signaturesredacted-1.pdf

construction is often equivalent to operating that building for anywhere between 3 and 20 years, depending on construction efficiency, material sourcing, and sustainable design.[7]

Renewable Energy

Onsite Renewable Energy

The on-site renewable energy emission reduction estimate is 3,787 MT CO_2e, resulting from the build-out of renewable energy generation capacity on campus. Renewable energy generation capacity will contribute increasingly to GHG emission mitigation efforts on the main campus, as well as at auxiliary facilities and campus adjacent housing development. UCSB owns nine installed on-site solar PV systems, ranging in size from 2kW to 424 kW; the aggregate capacity of these systems is 673 kW DC (table 8).

Table 8: On-Campus Solar PV

	Total Onsite Capacity (MW) Cumulative	**Total Estimated Annual Energy Production** (KWh/year) Cumulative	**Cost**	**Annual Saving Cumulative** ($/year)	**GHG Savings** (MT CO_2e/Year)
To Date	0.673	992,122			
Planned	5.99	9,546,186	N/A	240,000	1,819
2025	10.99	17,679,960	250,000	400,000 to 500,000	3,787

In addition, the university entered into a multi-site solar photovoltaic (PV) third party Power Purchase agreement (PPA) with SunPower, to expand solar generated electricity another 5.32 MW DC (9,546,186 kWh annually). The system will come online at the end of 2016 or early 2017. SunPower will install and operate solar PV at six sites on campus and UCSB will pay a fixed and agreed upon rate for the energy that it produces. Together, the current on-campus solar, and the planned SunPower PPA comprise 11% of the total electricity demand.

In order to move our campus closer to achieving carbon neutrality, generation of solar energy directly on campus is necessary. The campus would benefit from building another 5 MW of onsite renewable electricity by 2025, as it would reduce our reliance on offsets to achieve and maintain carbon neutrality. There are still several potential sites on campus where solar arrays could be installed, and PPAs could increase onsite renewable energy without augmenting the campus's debt. A UCSB Geography graduate student funded by The Green Initiative Fund (TGIF) is currently in the process of completing an assessment study of potential solar on campus, which will give us greater information regarding potential on-campus capacity. Once the study has been completed, estimates for planned build out should be reassessed. Several factors that affect our solar capacity include roof type and design (including load capacity), future development plans, and shading.

Considerations should be made in future building design to ensure that roofing materials and roof layouts maximize the solar potential of the campus. Solar readiness (installing electrical systems to

[7] Biswas, Wahidul K. "Carbon Footprint and Embodied Energy Consumption Assessment of Building Construction Works in Western Australia." Carbon Footprint and Embodied Energy Consumption Assessment of Building Construction Works in Western Australia. Sustainable Engineering Group, Curtin University, Perth, Australia, 20 Mar. 2014. Web. 02 Nov. 2016.

support potential future solar installations) should also be designed into buildings in cases where funding/resources are not available to install solar at the time of construction.

Additionally, the campus would benefit from exploring other non-roof locations for onsite solar energy and other forms of alternative energy such as geothermal and bio-methane. For example, the campus is currently looking into the feasibility of using thermal exchange with the ocean for heating and cooling buildings on the UCSB campus.

Offsite Renewable Energy

There are a few limitations to onsite solar including site suitability and scalability. One option to overcome these limitations is to source renewable electricity from an offsite renewable energy project that is relatively close to campus. Offsite systems might not have the same size limitations, allowing UCSB to build bigger systems that meet campus demand and take advantage of economies of scale. In the last few years several campuses have entered into PPA's for large off campus PV plants. In April 2015, Stanford entered into an agreement with SunPower to build a 73 MW solar PV plant that will supply 50% of Stanford's electricity for at least the next 25 years. UC Davis also entered into a PPA with SunPower for a 16-megawatt, ground-mounted solar power plant, located just south of Interstate. It is recommended that UCSB explore a large offsite solar PV PPA. However given limited open space and dwindling agricultural lands in California, especially in Santa Barbara County, careful consideration of the costs and benefits to the local community for offsite development should be weighed.

Renewable Energy Procurement

UCSB may have the opportunity to acquire renewable electricity through one of the following options:

1. **Direct Access (DA)** - Direct Access Service would allow UCSB to purchase electricity and other services from an Electric Service Provider (ESP), instead of Southern California Edison (SCE). Investor Owned Utilities hold an "annual DA lottery" to establish wait lists for customers who wish to transfer to DA service. Once UCSB is eligible for DA, the University could purchase renewable energy from an ESP.
2. **Community Solar** - Community solar allows several energy customers to share the benefits of one local renewable energy power plant. The shared renewables project pools investments from multiple members of a community and provides power and/or financial benefits in return.
3. **Community Choice Energy** – Community Choice Energy (CCE), enables local governments to leverage the purchasing power of their residents, businesses, and public entities to purchase or generate power for their communities, and allows the community to determine what type of energy mix serves its needs. Central Coast Power is a consortium of local governments that has formed to explore the feasibility of a CCE program that could serve San Luis Obispo, Santa Barbara, and Ventura counties. If a CCE is formed in Santa Barbara, UCSB could potentially source a greater percentage of its electricity from renewable energy. According to Central Coast Power, several CCE programs across the state offer energy with a higher renewable energy content at rates that are competitive with the existing utility's rates.
4. **Southern California Edison (SCE) Green Power -** SCE recently announced the opportunity for commercial customers to purchase 100% renewable energy (Table 9).

Table 9: SCE Green Power Rates

	SCE Green Power
Cost premium **($/kWh)**	0.0411 – 0.0637

* Current average price of electricity is 10.5 cents per kWh

5. **Biogas Procurement –** Biogas Procurement –the University of California has secured biogas to cover about 10% of the UC-Systems and hopes to increase the volume up to 50%. In 2025, the biogas attributes will be distributed to campuses on a pro-rata basis to each campus. The cost premium is expected to be around $2.50-$3.00/MMBtu in 2025.[8]

Table 10: Biogas Cost Estimates

Biogas (therms/Year)	**Cost ($/therm)**	**Estimated cost Premium ($/Year)**	**GHG Savings (MT CO2e/Year)**
248,226 (10% of current consumption)	2.75	43,971	1,313

UCSB is also exploring a partnership with Goleta Sanitary District (GSD) to utilize food waste from our dining commons to create biogas.

Fleet

This CAP forecasts a 366 MT CO_2e reduction (25% reduction) in fleet emissions by 2025 through procurement of alternative fuel and/or ultra-efficient vehicles as sufficient funding becomes available.

Table 11: Fleet Projections

	Total Number of vehicles	Total Number of Alt. Fuel or ultra-efficient Vehicles	Total Number of Electric Vehicles	Total Number of EV Charging Stations	CNG Stations	E-85 Stations
To Date	371 (194 Light Duty, 177 Med-Duty)	151	43	50 fleet (level 1), 20 public (level 2)	2	0
Projected	423	317	78	75 (level 1), 40 (level 2)	3	1

UCSB has a well-established alternative fuel program operating within the Parking and Transportation Services Department. As a result, UCSB's fleet of alternative fuel vehicles has more than doubled over the last 10 years (figure 6), however despite progress, fleet emissions have increased slightly. To meet

[8] https://sites.google.com/site/uccapresources/biogas

the emissions reduction goals, BAU will have to be replaced with an aggressive strategy to transform campus fleet.

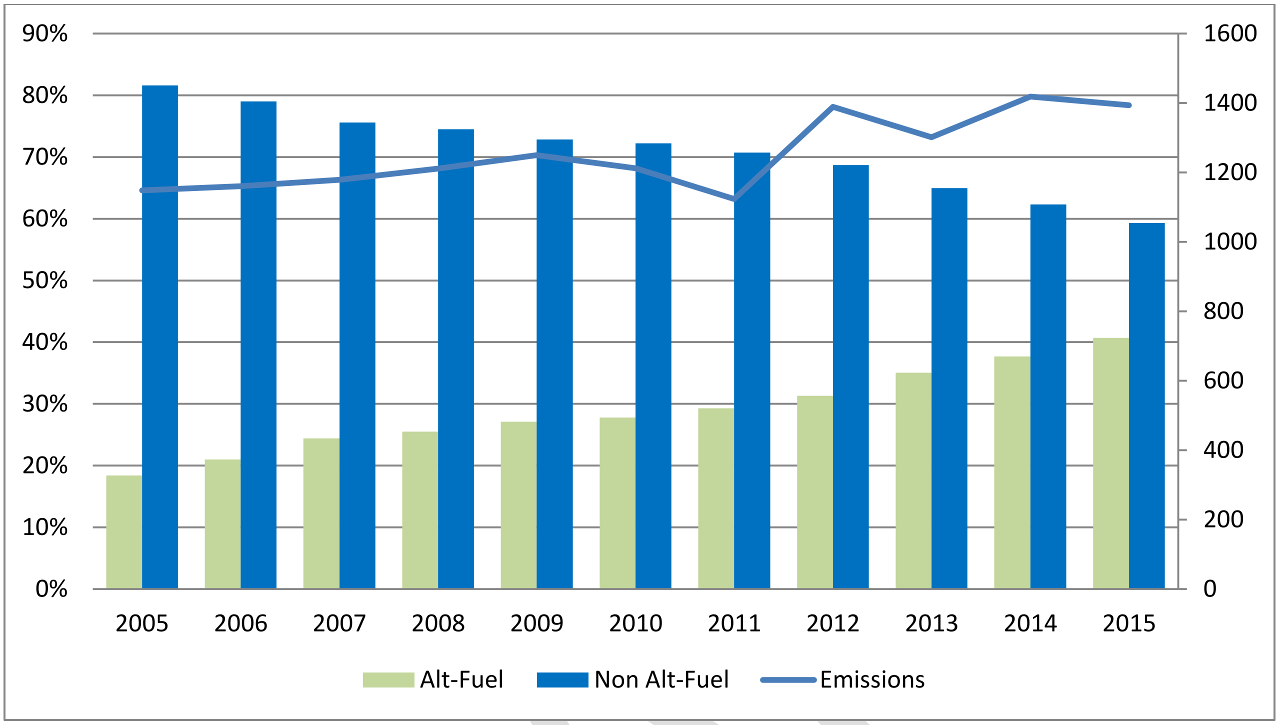

Figure 6: Campus Vehicles and Emissions

The following recommendations will help the campus meet the goal of reducing fleet emissions by 25%:

- Use flex-fuel in current fleet of vehicles. Flexible fuel vehicles (FFVs) are designed to run on gasoline or gasoline-ethanol blends of up to 85% ethanol (E85). UCSB owns 72 flex-fuel vehicles that are currently being operated using conventional gasoline because we do not have a campus ethanol fueling station. Developing and implementing a method to have sustainable ethanol blends available at UCSB will be an important part of our fleet emissions reduction efforts.
- Update Campus Sustainable Procurement and Use Practices policy to include medium-duty vehicles. Currently Campus Sustainable Procurement and Use Practices policy calls for 75% of the light-duty university purchases to be alternative fuel and/or ultra-efficient vehicles. Current policy needs to be expanded to include medium-duty vehicles, which account for almost half of the campus fleet. Compressed Natural Gas (CNG) or flex-fuel vehicles offer a feasible alternative to conventional, medium-duty trucks (Table 12).
- Update Campus Sustainable Procurement and Use Practices policy to include minimum MPG standards for departments purchasing or leasing vehicles. The vehicle selected for purchase or lease should have the lowest CO_2 impact possible while meeting performance and budgetary constraints.

Table 12: Cost and Simple Payback Estimates for Alternatively Fueled Med-Duty Trucks

Vehicle	Average cost premium	Average annual fuel cost savings	Simple payback	GHG Savings (MT CO_2e/on campus vehicle/year)
CNG medium-duty truck	$12,000 (per vehicle)	$695	17	2.02
Medium-duty plug-in hybrid vehicles	$40,000 (per vehicle)	$1,170	34	4.34
Flex-Fuel	$150,000 (for a split tank replacement of our current tank)	-$149 (savings)	~	1.34

Medium-duty plug-in hybrid vehicles may be the best option in terms of emissions reductions, particularly for vehicles used primarily on the campus. However, these vehicles are over twice as expensive as a gasoline vehicle and currently have a payback period that would exceed the life of the vehicle. It wouldn't be feasible for UCSB to purchase medium-duty plug-in hybrid vehicles unless gas prices increased significantly and/or the campus pursued available state incentives. For example, the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP) offers point-of-sale incentives for clean trucks and buses in California. A public or private fleet, large or small, operating vehicles in the state of California is eligible to receive a voucher incentive through HVIP. "HVIP provides vouchers of up to $95,000 for California purchasers and lessees of zero-emission trucks and buses, and up to $30,000 for eligible hybrid trucks and buses on a first-come, first-served basis."[9] Funding is appropriated for HVIP each year in the State Budget. For FY 2016-17, funding has not yet been appropriated for this project.

Switching to low carbon flex-fuel would have the lowest upfront costs, as UCSB currently has 72 E85 vehicles in UCSBs fleet and most vehicle types, light-duty to heavy-duty, are available in flex-fuel. However, this makes the assumption that the fuel will be readily available in the next few years, and that it is officially approved as a low GHG fuel. Using flex-fuels can help us reach a 25% reduction by 2025, but won't be enough to put us on a path towards carbon neutrality.

To meet the carbon neutrality goal, BAU will have to be replaced with an aggressive campus-wide strategy supported by the most senior management group on campus. UCSB has a clear opportunity to grow the Alt Fuel Program and show significant progress in the short term. However, the program will need new sources of funding, the highest level of support, and dedicated staff time to work on strategic planning, vehicle programs, fueling infrastructure, and fuel procurement. Given that the fleet accounts for a very small percentage of the campus Scope 1 emissions, it will be a challenge to maintain its relevance in the dialogue.

[9] http://www.californiahvip.org/docs/HVIP_Y4_Implementation%20Manual_2014-08-01.pdf

Commute

This CAP forecasts 3,241 MT CO_2e in annual emissions reductions from BAU projects resulting from decreases in commuter emissions due to new campus population growth, which will largely be housed in close proximity to main campus, coupled with the expansion of alternative transportation. Commuter emissions account for 14.5% of UCSB's total emissions, making targeted mitigation efforts essential in staying below the campus's 2020 emissions target (Figure 7).

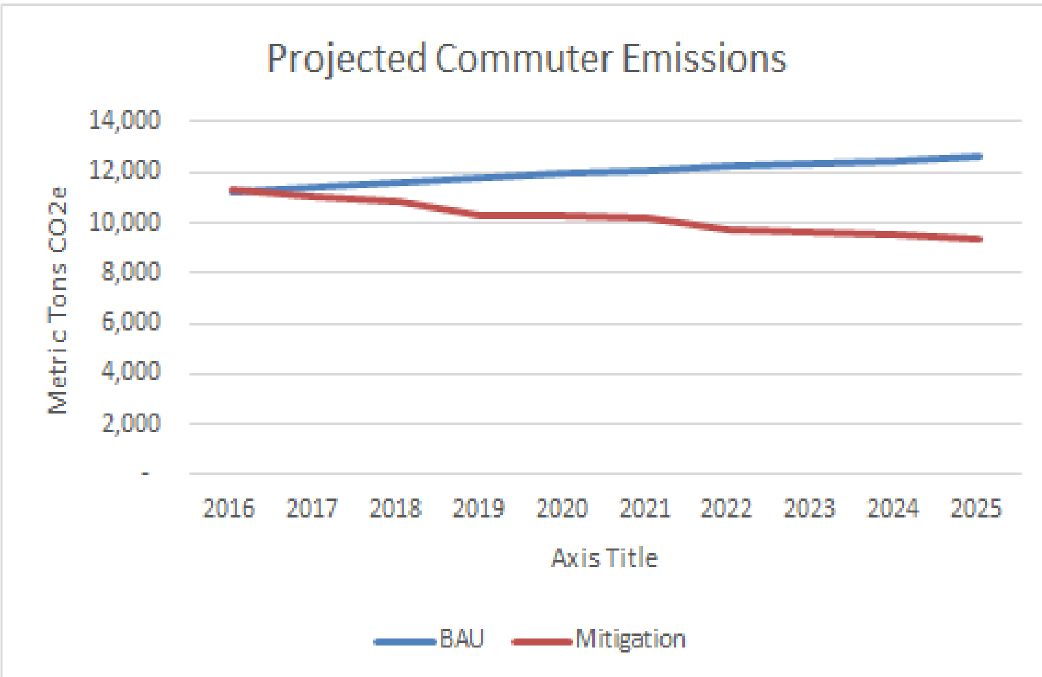

Figure 7: Projected Commuter Emissions

Smart Growth - As outlined in the LRDP, transportation emissions will be substantially reduced in the future by housing all new student growth adjacent to campus, and adding additional housing for faculty and staff nearby, thus reducing the demand for parking and motorized transportation.

Expansion of Alternative Transportation Options – UCSB will continue to work closely with other agencies to expand alternative transportation options for local and long distance commuters. In 2015, 61% of faculty and staff (17% of all commuters) commuting to campus used single occupant vehicles (SOV). UCSB provides a commuter benefit program in the amount of $21/month for transit users and offers a pre-tax deduction program for employees that offers additional savings.

Recent accomplishments towards this goal:

- Partnership with MTD - In an effort to reduce carbon emissions and demand from student riders, UC Santa Barbara partnered with the Santa Barbara Metropolitan Transit District (MTD) to create a brand-new bus line linking the campus to the most proximal large shopping district, allowing university students, faculty, and staff to ride this line for free. Line 28, paid for by UCSB, began service in August 2016 and is helping to reduce single occupant vehicle (SOV) traffic and associated emissions, as well as the need for on-site parking in new campus housing developments.

The following recommendations will help decrease SOV trips even further:

- Commuter rail - A large number of campus employees live in Ventura County, which is about 30-40 miles away, and commute on HWY 101. Over the last year, the Santa Barbara County Association of Governments (SBCAG) has been working to retime one of the northbound and the southbound Amtrak Surfliner trains to provide service during rush hours. The proposed service would arrive at Goleta at 7:45 am and leave at around 5:00 pm. It would stop in Santa Barbara, Carpinteria, Ventura, and Oxnard. If successful, this project could provide a lower carbon option for campus employees living south of Santa Barbara. The campus is exploring two potential options for the last mile of commute between UCSB and the train stations.
    - Bus line service from the Goleta Train station to UCSB provided by MTD
    - Bike share service from Goleta Train Station to UCSB. UCSB has partnered to explore the feasibility of implementing a financially and administratively sustainable bike-share system on Santa Barbara's south coast.
- Expanding vanpool service – UCSB's existing vanpool program provides an inexpensive alternative transportation option for UCSB long-distance employee and student commuters. The Vanpool currently serves commuters from Santa Maria, Buellton, Santa Ynez, Solvang, Lompoc, Ventura, and Thousand Oaks. Expanding the vanpool program to serve the city of Carpinteria could further reduce commuter emissions. This past academic year, UCSB sold over 100 parking permits to staff, faculty, and students from Carpinteria. Expanding the vanpool program could potentially reduce this number.
- The campus recommends that the Transportation subcommittee explore restructuring the existing parking fee rates. The current low monthly cost of parking provides a direct financial incentive to encourage employees to park more frequently. Establishing a new rate structure that builds in subsidies for alternative transportation while accounting for issues of equity in the circumstances of university employees could reduce single occupancy trips.

The Alternative Transportation Subcommittee is working to improve bicycle circulation in order to accommodate additional population growth. Improved circulation for bicycles, particularly between those parts of Goleta north of campus and HWY 101, could greatly increase the number of potential bicycle commuters living within three miles north of campus. A suite of bike improvements currently planned by the City of Goleta will greatly benefit university employees and students.

Air Travel

Emissions from business air travel account for 30% of UCSB's total emissions, making it the second largest source of emissions for the University. The campus will need to continue to reduce business air travel in order for the University to stay below the 2020 campus emissions targets and work towards the 2050 carbon neutrality goal for Scope 3 emissions. Reducing air travel by 10% from BAU by 2025 will reduce emissions by 3,350 MT CO_2e annually and save the campus $371,600 annually in avoided travel costs (Table 13).

Table 13: Estimated Reduction in Business Air Travel

	Emissions Reductions (MT CO_2e/ yr)	Air Travel Cost Savings ($/yr)	Costs ($/yr)	Payback Period (years)
10% reduction in air travel (1% annual reduction)	3,350	371,598	$ 743,197	>2

Teleconferencing is being promoted both system-wide and at UCSB. UCOP just signed an agreement with Zoom for Video, Web, and Audio Conferencing, and UCSB has a videoconferencing center available within Instructional Development. There are also several other videoconferencing rooms throughout campus.

There is also an initiative under way focused on virtual conferences. In May 2016, UCSB Professor Ken Hiltner, Director of the Environmental Humanities Initiative, held UCSB's first nearly carbon-free conference with 50 speakers from eight different countries. This conference saved 100,000 pounds of carbon dioxide (CO_2) from avoided speaker travel alone. "Because it took place online (the talks were prerecorded; the Q&A sessions interactive), conference travel was unnecessary. Consequently, conference CO_2 emissions were approximately 1% of what they would have been as a traditional, fly-in event (http://ehc.english.ucsb.edu/?page_id=14080)." Professor Hiltner has developed a Practical Guide for hosting a nearly carbon neutral conference that can used by others interested in hosting a virtual conference. In addition to reducing emissions, virtual conferences offer several other benefits such as increased accessibility for both presenters and attendees alike (cost and location limitations), improved discussion, greater dissemination of ideas (all talks can be streamed at any time), and cost savings. UCSB faculty and students can also pre-record their own talks when invited to present their research at a conference, thus saving travel costs and reducing Scope 3 emissions. This makes it possible for UCSB researchers with limited resources to "attend" more conferences than normally would be the case. Both Professor Hiltner, and his partner on this initiative, UCSB Professor of Sociology Dr. John Foran believes that the virtual conference and presentation will eventually be widely adopted, and are committed to disseminating this model at UCSB, other universities, and professional academic meetings. In this way, UCSB can be a pioneer in significantly reducing Scope 3 emissions, and do so well before the 2050 target. Dr. Hiltner and Dr. Foran are hosted their second of such conferences in October 2016.

The following recommendations will add to efforts already underway in helping the campus meet the goal of reducing business air travel by 10% by 2025:

- Create and implement an outreach program aimed at educating faculty and staff on the importance of reducing air travel. Most faculty and staff are unaware that business air travel accounts for almost 30% of UCSBs total emissions. Information should be disseminated throughout the campus departments regarding the impacts of air travel, alternative options available, and the time and cost savings associated with teleconferencing and telecommuting.
- Institute a financial system that tracks a mileage component of all air travel and incentivizes air travel reductions. A policy should be adopted on the UC level requiring that all grant supported

travel include (as part of the grant) the purchase of carbon offsets. Partnerships should be developed with major funding agencies to address whether grants can be used for this purpose.
- In 2015, 40% of travel booked through our campus travel system (Connexxus) was for domestic flights. A significant amount of this travel occurred between UC campuses and UCOP. UCOP could help campuses reduce air travel emissions by adopting new practices and guidelines for travel that are consistent with the Carbon Neutrality initiative. For example, guidelines that restrict the number of annual in person meetings statewide committees host and the required duration could reduce air travel emissions. Furthermore, the coordinated development of system-wide guidelines would quickly provide a monetary return on investment while substantially reducing Scope 3 emissions.

Behavior Change

This CAP forecasts 915 MT CO_2e (roughly a 4% reduction in scope 1 and 2 emissions) in annual emission reductions resulting from energy conservation through behavioral changes in both academic buildings and residence halls. Energy conservation through behavioral change is an important component in any plan to reduce GHG emissions from building energy use. Energy conservation can be accomplished through programs that inform energy consumers of current and historical consumption levels, provide them with examples of energy-saving measures and activities, and give frequent, even real-time, feedback on how their energy use compares to social norms. In addition, a successful program builds on making users "energy aware" by motivating individuals to get involved, identifying and supporting committed individuals, and rewarding users for reducing energy waste. A number of programs on campus induce behavioral change and reduce energy waste, such as LabRATS, PACES, and the residence hall energy efficiency competitions.

More aggressive efforts will need to be taken in order to meet the emission reduction goals the campus has set. The following recommendations will help the campus meet these goals:

Table 14: Energy Incentive Program (EIP) 2025 Savings Estimates

	Emission reductions (MT CO_2e/ yr)	**Utility Cost savings ($/yr)**	**Costs ($/yr)**	**Payback Period (years)**
4% reduction in Scope 1 and 2 emissions	915	355,000	$111,750*	0.3

***1 FTE employees at 75,000 plus 49% benefits = $111,750**

1. Implementing an Energy Incentive Program (EIP)

Providing monetary incentives for individual buildings and departments to save energy through behavioral alterations can result in significant energy savings. This would require the campus utility budget to decentralize, shifting responsibility of utility costs "down" the organization. This shift down can create greater awareness of the cost of energy, provide individuals with an opportunity to benefit directly from reducing electricity use, and will thus stimulate conservation. Positive results from EIPs can be witnessed at Stanford University and UC Berkeley. Both Universities have programs in place that establish a baseline based on past energy consumption, and provide monetary incentives for participants to reduce energy consumption below their baseline. Successful energy conservation results were realized at both Universities through the utilization of behavioral changes, such as turning off lights and shutting down computers. These EIPs had great success in saving the universities money and by reducing participants' GHG emissions. A group of master's students at the Bren School of Environmental Science ran a pilot program (UCSB Operational Effectiveness - Energy Management Initiative) to investigate the feasibility of an EIP at UCSB. The group conducted the pilot EIP using strategic messaging and financial incentives in three buildings on campus, and observed more than 4% average energy reduction over a five-month time frame.[10] Studies at other universities show that a 4% reduction in total building energy use is well within reach and may indeed fall short of what is possible. As part of the University of Cambridge's Energy and Carbon Reduction Project, a laboratory pilot program at the University's Gurdon Institute utilized strategies focusing on influencing behavior that successfully changed the way people used energy throughout a department.[11] The pilot program had a 76% participation rate across the department and achieved an overall reduction of 19% in energy usage over a 5-month period. UCSB's LabRATS program already provides most of the educational resources and documentation offered in the Gurdon Institute model. Gurdon Institute was able to achieve higher participation rates due to the use of awards and prizes.

2. Implementing a Residence Hall Energy Conservation Program

Currently, Housing, Dining, & Auxiliary Enterprises holds an annual energy conservation competition that incentivizes students to reduce their energy use in residence halls and encourages behavioral change. In February of 2012, during the competition, an estimated 15,059 kWh were reduced at a total savings of approximately $1,506. Reward systems are effective at encouraging behavior as long as the reward system is ongoing. When a reward is offered then taken away, individuals most often revert to their behavior prior to being given the incentive and in some cases even go back to using more energy than they originally used. This concept similarly applies to the preceding section when considering awards and prizes. In order to maintain reductions throughout the year, the campus recommends developing a Residence Hall Energy Conservation Program, which would include a reward system that incentivizes students to conserve energy year-round, as well as an energy awareness and education campaign focused on students living in residence halls that is part of a larger campus Energy Awareness and Education campaign.

3. Creating an Energy Awareness and Education Campaign

Incentive programs in both academic and residence halls will need to include an Energy Awareness and Education campaign. As previously mentioned, in order to achieve energy savings through behavioral changes, it is essential that consumers: 1) are informed of their present and historical energy use, 2) are given context for how their impact affects others, 3) are reassured that they can create a real impact and provided the knowledge needed to reduce use, such as examples of energy-saving measures and

---

[10] Campbell et al., UCSB Operational Effectiveness - Energy Management Initiative. (2015). University of California, Santa Barbara Bren School of Environmental Science and Management. http://www.esm.ucsb.edu/research/2015Group_Projects/documents/UCSBOperationalEffectiveness-EnergyManagementInitiative.pdf

[11] University of Cambridge Energy and Carbon Reduction Project. (2012). Introducing Behavioral Change Towards Energy Use.
Retrieved from http://www.gurdon.cam.ac.uk/downloads_public/green/Gurdon-behavioural-change.pdf

activities, and 4) are given frequent, and when possible, real-time feedback on how their energy use compares to social norms. It is especially helpful if individuals can be given feedback at key moments when they will be making a decision. Some examples of this would be Energy Report Cards given to building users or a text messaging system that would remind employs to shut off the equipment in their offices before going home. Educating the campus community on the importance of energy conservation is the first step in encouraging thoughtful use of energy on-campus.

Peer-to-peer education campaigns have also been successful at many campuses. These programs engage employees across the campus to learn about sustainability and to educate their colleagues about what they have learned. Programs such as this build on existing social networks, encourage employees to share their innovative ideas, and are effective at empowering large groups of people to feel invested in the campus carbon neutrality effort.

4. Create and fill a 'Climate Manager' position within Facilities Management. The CNI is arguably one of the most ambitious goals the campus has committed to and will demand additional staff support. In addition to assisting in the development and implementation of the recommendations outlined in this CAP, the Climate Manager would work to ensure that the campus fulfills or exceeds relevant policies, commitments, and regulations related to GHG emissions (Scope 1, 2, 3), and engages with leaders to foster sustainability and greenhouse gas reduction broadly across campus units.

5. Integrate climate change and sustainability into the curriculum.

The CNI Faculty Education and Engagement and Student Education and Engagement Committees have set the goal across the UC system of ensuring that every UC graduate is literate in sustainability by 2025. The Talloires Declaration, previously referenced in this document and signed by the UCSB Chancellor in the 1990s, also commits UCSB to "ensure that all university graduates are environmentally literate and have the awareness and understanding to be ecologically responsible citizens." This past year, a series of efforts were funded to support this goal through the UC CNI including workshops for faculty on infusing sustainability into curriculum, funding to support faculty to become "Climate Action Champions", a database of syllabi and course materials related to climate change and sustainability, fellowship and internship funding for UC students, and more. Currently 61% of UCSB Departments offer at least one course related to sustainability. UCSBs goal is to increase this to 75% by 2025 through voluntary measures and incentives.

6. UCSB version of Cool Campus Challenge

In the fall of 2015, the Cool Campus Challenge (CCC) engaged nearly 20,000 staff, students, and faculty at the University of California (UC) in an online pledge campaign aimed at reducing the UC's carbon footprint and creating a culture of sustainability across campuses. Over 1,400 faculty, staff, and students from UCSB participated in the challenge. While there are no plans for another system-wide competition, the Campus may benefit from running its own version of the challenge to keep the campus community engaged in the CNI.

7. Scale up existing programs that have proven to be successful

LabRATS recently reviewed their assessment system to evaluate energy savings. The average energy savings across nine recent laboratory assessments was 9,921 kwH/year/per lab or an $892 cost savings/lab/year. Assuming a student intern with LabRATS assesses at least five labs a year, which is consistent with recent successes, each intern would save enough energy to balance out the cost of their salary. LabRATS has also had success with equipment replacement programs and efforts to advise laboratories on new purchases. The replacement of a fly incubator saved $2,623/year from direct energy use and helped to reduce the heat load on the building. Replacement of inefficient ULT freezers with more efficient models can save $803/unit/year. PACES could similarly be scaled up to impact more departments on campus.

Landscape and Vegetation

UCSB owns and maintains nearly 300 acres of open space on campus, including 90 acres of turf, 86 acres of irrigated vegetation, and 122 acres of un-irrigated vegetation. Landscape and vegetation can be important sinks for carbon dioxide through carbon sequestration. Trees, in particular, sequester large amounts of carbon in their wood. In addition, vegetation counteracts the urban heat island effect by reducing heat-absorbing impermeable materials like concrete and asphalt and by providing cooling shade. Subsequently, energy use of buildings near trees and vegetation is reduced because less energy is needed for cooling. In fact, strategic placement of trees can reduce a building's energy needs for cooling by providing shade and for heating by blocking winter winds and insulating buildings. The vast majority of trees on the core campus lie within 60 feet of buildings and provide cooling and heating energy reduction benefits. The campus should insure that future plantings continue this tradition.

Use of landscapes for mitigation is complicated by the fact that vegetated landscapes both absorb carbon through photosynthesis and emit CO_2 through respiration and decomposition. Consequently, the sequestration potential of landscapes differs, depending on the vegetation or ecosystems present and the energy used to maintain them. Landscapes, particularly lawns and turf, can be significant sources of GHG emissions, depending on the energy and practices used to maintain them. GHG emissions related to landscape have a number of sources:

- Use of lawn and garden equipment
- Water-related electricity use (pumps, etc.)
- Decomposition of plant material
- Fertilizer and irrigation practices
- Disturbance and erosion of soils
- Transportation emissions related to vehicular travel of maintenance crews

Recommendations for reducing GHG emissions in relation to landscape

- Afforestation - UCSB can increase carbon sequestration by planting additional trees in its campus urban forest. For example, if the University set a goal of strategically planting an additional 500 medium broadleaf evergreens on campus, it could reduce emissions from energy consumption by 25,000 kWh per year, resulting in a 7 MT CO2e reduction in emissions annually once the trees reach 10 inches in diameter. Strategically placed trees can increase building energy efficiency. In summer, trees shading east and west walls cool buildings. In winter, allowing the sun to strike the southern side of a building can warm interior spaces, whereas if southern walls are shaded by dense evergreen trees, winter heating costs could rise. A tool like MyTreeKeeper helps managers strategically plant trees for the greatest energy savings.

- Fertilizer and pesticide electronic record-keeping - Fertilizer and pesticide application should be electronically recorded to enable better management and to build sufficient data for emission reduction calculations. Performance of soil tests can be used to assess the nutrient use efficiency of fertilizers applied to plants.
- Explore the use of biochar as a soil amendment - If applied to campus landscapes and restoration projects, biochar can sequester carbon and increase plant productivity. Biochar production involves heating biomass in a low oxygen environment. This process limits combustion of biomass into CO_2, and instead converts 25 - 30% of the feedstock into a stable form of carbon that will decay to GHGs over a time frame on the order of hundreds of years. By preventing the decomposition of biomass through its natural cycle, this form of biochar production enables carbon sequestration. The current methodology for carbon accounting with biochar is detailed in the California Air Pollution Control Officers Association (CAPCOA) 2015 protocol[12] titled Biochar Production Project Reporting Protocol, GHG Emission Reduction. Biochar can also decrease the amount of fertilizer needed and increase the removal of carbon dioxide from the atmosphere by increasing plant productivity.

Carbon Offsets

After implementing projects to mitigate emissions from the UCSB campus, the purchase of renewable energy certificates and/or carbon offsets will be necessary to achieve carbon neutrality. Based on mitigation projections, the campus would need to purchase an estimated 25,940 $MTCO_2e$ of offsets in 2025 to reach the carbon neutrality goal.

Table 15: Projected Costs of Offsets[13]

	Voluntary offsets	UC developed offsets	Golden offsets	Average
2016	2.0	20.0	11.7	12.3
2017	2.0	20.4	12.5	12.8
2018	2.1	20.8	13.4	13.4
2019	2.1	21.2	14.3	14.0
2020	2.2	21.6	15.3	14.6
2021	2.2	22.1	16.4	15.3
2022	2.3	22.5	16.7	15.6
2023	2.3	23.0	17.1	15.9
2024	2.3	23.4	17.4	16.2
2025	2.4	23.9	17.8	16.5

[12] "Biochar Production Project Reporting Protocol GHG Emission Reduction Accounting." https://www.placer.ca.gov/~/media/apc/documents/apcd%20biomass/biocharproductionforprojectreportingprotocol.pdf?la=en

[13] https://sites.google.com/site/uccapresources/offsets-and-recs

2026	2.4	24.4	18.1	16.9

Carbon offsets can be purchased in compliance and voluntary markets. UCSB is currently participating in the California cap-and-trade compliance market. However, there are voluntary markets for carbon offsets throughout the world. Currently, the price to offset a metric ton of CO_2 tends to be more expensive in a compliance market than in a voluntary market. However, "the voluntary offset market has been criticized in the past for having less stringent standards to ensure the "additionality" of offsets."[14] Due to this skepticism, several organizations have been formed to certify offsets, three of which are accepted by TCR and the CA Air Resources Board. The campus recommends purchasing offsets from one of the following three accepted organizations accepted by TCR and CA Air Resources Board: The Verified Carbon Standard, American Carbon Registry (ACR), and the Climate Action Reserve (CAR), the TCR parent organization.

TCR has developed a clear set of criteria to insure the "additionality" of offsets. TCR-recognized offsets must demonstrate that their associated GHG reductions meet six key accounting criteria:[15]

- Real: GHG reductions must represent actual emission reductions quantified using comprehensive accounting methods.
- Additional: GHG reductions or removals must be surplus to regulation and beyond what would have happened in the absence of the incentive provided by the offset credit. Offsets quantified using a project vs. performance standard methodology may establish slightly different requirements for demonstrating additionally.
- Permanent: The GHG reductions must be permanent or have guarantees to ensure that any losses are replaced in the future.
- Transparent: Offsets must be publicly and transparently registered to clearly document offset generation, transfers and ownership.
- Verified: The GHG reductions must result from projects whose performance has been appropriately validated and verified to a standard that ensures reproducible results by an independent third-party that is subject to a viable and trustworthy accreditation system.
- Owned Unambiguously: No parties other than the project developer must be able to reasonably claim ownership of the GHG reductions.

In addition to meeting the criteria set forth by TCR, it is recommended that the campus explore carbon offset projects that have benefits for the local community in which the offset is created. Some offset programs can exacerbate existing inequalities. For instance, many carbon offset programs lead to displacing indigenous peoples from their lands. Offsets the campus pursues need to be evaluated carefully through a social justice lens.

[14] Bart, Kaysen, Maggass, Park, Watson, 2016. Achieving Carbon Neutrality at UCSB by 2025: A Critical Analysis of Technological and Financial Strategies. Page 34. University of California, Santa Barbara Bren School of Environmental Science and Management. http://www.sustainability.ucsb.edu/wp-content/uploads/UCSBCarbonNeutralityFinalReport6-6-16signaturesredacted-1.pdf

[15] General Reporting Protocol for the Voluntary Reporting Program. Version 2.1. The Climate Registry, Jan. 2016. Web. Oct. 2016. https://www.theclimateregistry.org/wp-content/uploads/2014/11/General-Reporting-

Another strategy that could be beneficial as an alternative to purchasing offsets is the establishment of a reinvestment fund. Instead of spending money each year to purchase offsets, UCSB would make a commitment to annually invest an equal or greater value into additional on campus energy conservation and renewable energy projects. This would ensure additionality while retaining value on campus.

5.0 Financing

The effort to reach carbon neutrality will require large capital investments and considerable ongoing efforts. Considering the short duration from now until 2025, it may be challenging for the campus to achieve this goal. In addition, due to the capital-intensive expansion of campus infrastructure, UCSB does not have capacity for debt financing. In light of UC President Napolitano's Carbon Neutrality Initiative, the need for financing options for energy efficiency projects is clearer than ever. One solution would be to establish a Utility Conservation Revolving Fund (UCRF) to capture avoided utility costs and reinvest savings into future investments in energy efficiency.

In the early 2000's the campus utility budget was in the red due to multiple factors, including the Enron Energy crisis and investments in Goleta Sanitary district. Through over a decade of investments in energy efficiency projects, the campus has driven down annual utility costs and the utility budget is now in the black. The establishment of a UCRF would involve transferring this surplus into a separate account that would be used to support energy projects that generate cost savings. Utility cost savings would then be used to replenish the fund for the next round of investments. The following table attempts to illustrate how a UCRF can be used to fund planned energy projects over the next five years.

Table 16: 5-Year UCRF Projections

	2016-17	**2017-18**	**2018-19**	**2019-20**	**2020-21**	**2021-22**
Utility Budget (fixed)	$10,308,137	$10,308,137	$10,308,137	$10,308,137	$10,308,137	$10,308,137
Total Utility Cost (BAU)	$8,487,737	$9,041,319	$9,041,319	$9,198,129	$9,217,871	$9,217,871
Total Project Savings	-	-	$416,177	$944,606	$1,124,777	$1,482,277
Utility Incentives	-	-	$64,992	$452,771	$784,584	-
Total Utility Cost (w/ Project savings)	$8,487,737	$9,041,319	$8,560,150	$7,800,751	$7,308,509	$7,818,093
Utility Conservation Revolving Fund (UCRF)						
Annual UCRF Project Savings	$-	$-	$416,177	$944,606	$1,124,777	$1,399,777
Total UCRF Project Savings	$-	$-	$416,177	$1,360,783	$2,485,560	$3,885,338
Annual UCRF Project Investment	$2,292,427	$1,060,500	$1,888,720	$1,750,000	$1,500,000	-
Total UCRF Project Investment	$2,292,427	$3,352,927	$5,241,647	$6,991,647	$8,491,647	$8,491,647
Available Project Balance (Beginning of Year)	$2,322,440	$1,296,831	$1,984,319	$2,602,985	$3,852,612	$4,842,656

Available Project Balance (End of Year)	$30,013	$236,331	$95,599	$852,985	$2,352,612	$4,842,656

Note for more detail see Appendix 7.3

Several other universities have successfully set up similar accounts including UCLA, they established an Energy and Sustainability Revolving Fund in 2014. A UCRF is particularly useful for energy efficiency projects with quick returns on investments (ROI) that can be used to replenish the fund.

Potential funding sources for small projects and projects with significant emissions reductions but less attractive ROIs include:

- Sale of AB32 Emission Allowances - Each UC campus is permitted to sell unused AB32 emission allowances. The revenue generated for this process is a potential small source of seed money for the GRF.
- Donor funding - The Campus would benefit from working with development to reach out to potential donors that may be drawn to helping UCSB achieve carbon neutrality. Donors may be attracted to the fact that UCSB is one of 3 UCs that could potentially achieve this, this would be a tremendous asset to campus stature, placing it as a leader.
- Strategic Energy Partnership - This is a UCOP partnership that teams UCSB up with the local investor-owned utilities, Southern California Edison (SCE) and Sempra Energy. UCOP provides funding for this program along with rebate funding. SEP will continue to be a key funding source for energy efficiency projects, as it extends through 2025, although its extension beyond that date is uncertain.
- The Green Initiative Fund (TGIF) - TGIF is a grant program funded by student fees for the purpose of financing green projects on campus. A locked-in fee of $3.47 per student per quarter generates approximately $170,000 annually to be redistributed toward green projects. TGIF was the first of its kind in the UC system when it was created in 2006. Since its inception, TGIF has awarded over $1 million in grants, funding over 100 projects. Examples of projects funded to date include solar power projects, wind turbines, natural gas meters, an on-campus hourly rental Zipcar, electric vehicle charging stations, an educational energy efficiency video for the Residence Halls, electric hand dryers in library bathrooms, energy and comfort re-commissioning, student internship funding to assist with campus energy intensity data collection, and real-time energy consumption displays in office spaces. While an extraordinarily valuable resource, the TGIF fund cannot and should not be used to support major infrastructural innovations.
- Student Services Renewable Energy Initiative - The Renewable Energy Initiative (REI) is based in Student Affairs. REI is a fund built from a mandatory fee of $6.00 per undergraduate and graduate student per quarter, used toward renewable energy installations, such as large-scale photovoltaic arrays, across campus. The REI fee began in fall 2010 and will be collected for a period of ten years (terminating at the end of spring 2020), without reaffirmation. REI has already provided funding for a system on top of Parking Structure 22.
- State Programs - Through the Energy Conservation Assistance Act (ECAA), the state offers loans at a 1% interest rate for Energy Efficiency & Energy Generation Projects. The interest rate is fixed at 1% for the term of the loan. The maximum loan amount is $3 million per applicant. Loans must be repaid from energy cost savings or other legally available funds within a maximum term of 20 years (including principal and interest).

- Federal Programs - Federal government programs that can be used to provide funding for projects include:
    - Federal Tax Credits - The federal government provides tax credits for solar energy systems, wind energy systems, fuel cells, and energy-efficient commercial buildings. These credits cannot be received by the University but can be received by a private sector third party owner.
- UCSB Programs:
    - Department budgets – Occasionally departments use their own funding and/or donors to fund projects within the department. This funding source is limited though as most departmental budgets experienced significant cuts in recent years and have very little discretionary funding remaining.
    - UCSB research projects – U.S. Department of Energy and other research grants may be sought to advance the technology for measures involving research, such as methane capture from coastal seeps.

Additionally, the UC Carbon Neutrality Financial and Management Task Force is currently developing strategies to generate the necessary funding for the Carbon neutrality initiative at each campus.

6.0 Scenario Analysis & Conclusion

This CAP forecasts an annual emissions reduction of 22,788 MT CO_2, resulting from mitigation outlined in Section 4. Scope 1 and 2 emissions account for 16,197 MT CO_2e of the forecasted reductions. Each of the energy conservation measures suggested in this plan is represented by its own wedge, equivalent to the greenhouse gas abatement potential in metric tons of carbon dioxide equivalent. While there are additional measures that UCSB may employ for further GHG abatement, the measures represented in the wedge graph below are the most promising and financially feasible measures identified within the timeframe of this plan. These measures would require a capital investment estimated at 13.4 million, plus an additional 44k each year for the procurement of biogas. In proportion to UCSBs total annual operating budget, total investments are minimum (1%).

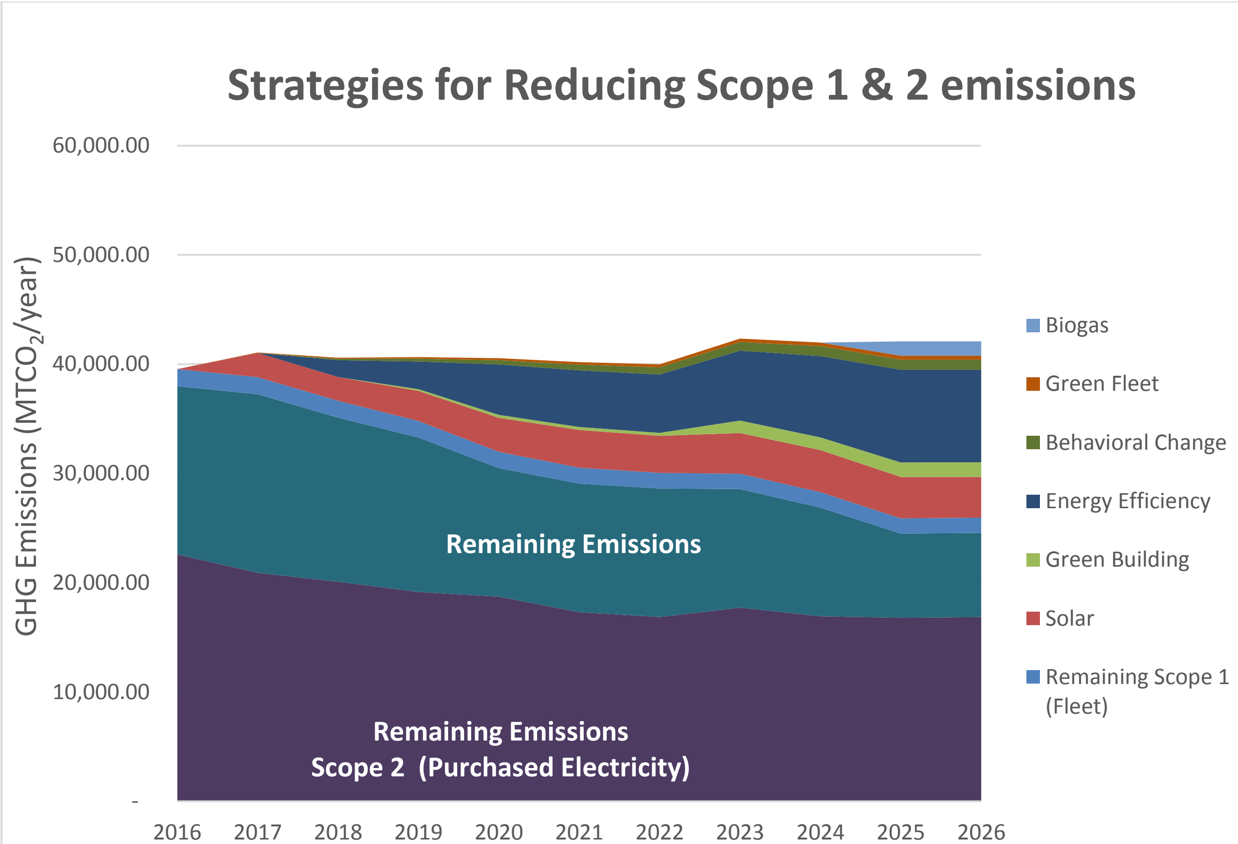

Figure 8: UCSB Scope 1 and 2 Greenhouse Gas Abatement Wedge

To reach carbon neutrality by 2025 the campus will need to reduce emissions a remaining 25,940 MT CO_2e.

Potential strategies for abatement of the remaining emissions include offsets, procurement of renewable electricity, and electrification. Costs will depend on market conditions and the level of investment in each option. Options aren't mutually exclusive. Table 17 shows the monetary implications of the following three scenarios:

Scenario I: Purchase carbon offsets for all remaining emissions.

Scenario II: Purchase renewable electricity and offsets for Scope 1 emissions.

Scenario II (Electrification): Replace 50% of boiler systems that use natural gas with systems that use renewable electricity in existing buildings and purchase offsets for the remaining emissions.

Table 17: Cost Estimates for Reaching Carbon Neutrality

	Scenario I	**Scenario II**	**Scenario III**

Annual increase in operational costs	$619,898	$3,516,388	$92,813
Annual Cost Savings	-	-	$801,323
Capital Costs	-	-	$10,107,756
Total Costs Over 20 years	$12,397,959	$70,327,758	$(4,062,454) (Savings)

Initial analysis indicates that a combination of electrification of feasible existing buildings and offsets would be the least costly option (Scenario III) for achieving the carbon neutrality goal. For the purpose of these calculations, the campus assumed it would be feasible to replace 50% of existing boilers.[16] However, to further refine these estimates and identify feasible buildings, the campus would need to conduct a feasibility study focused on eliminating the use of natural gas for heating and cooling campus buildings. The scenarios explored may not be mutually exclusive nor exhaustive, and a hybrid might be sought through campus discussion. Furthermore, any potential strategy to reduce remaining emissions should be accompanied by additional energy efficiency projects.

Considering the short duration from now until 2025 and the lack of upfront capital financing provided for this initiative, it may not be feasible for the campus to achieve this goal. UCSB will need to rapidly pursue demand-reduction strategies, plan new buildings to meet aggressive efficiency standards, and build out on-campus renewable energy.

Feasible mitigation strategies identified by UCSB can reduce Scope 1 & 2 emissions by roughly 40% and will cut our current annual energy budget by roughly $2 Million. These savings can then be reinvested into energy efficiency strategies.

Additionally, offsets will play a key role in achieving carbon neutrality on such a short time frame. However, over the long term the campus would benefit from exploring a suite of solutions including, electrification, additional energy efficiency and renewable energy projects, and offsets.

Economic conditions will continue to fluctuate, and new solutions will continue to emerge. It is essential that the University maintain a consistent effort with the flexibility to adjust to changing conditions in order to achieve the ultimate target of Carbon neutrality.

7.0 Appendix

7.1 Campus Growth Projections

Year	Calif OGSF	Students	Faculty & Staff

[16] Note: The campus could potentially electrify close to 100% of buildings however we did not have enough information about the potential costs to include this in our scenarios above.

2016	8,265,176	22,800	5,217
2017	8,713,109	23,028	5,422
2018	8,713,109	23,258	5,628
2019	8,763,109	23,491	5,833
2020	8,797,409	23,726	6,039
2021	8,797,409	23,963	6,117
2022	8,874,409	24,202	6,196
2023	9,183,209	24,444	6,274
2024	9,183,209	24,689	6,353
2025	9,243,209	24,936	6,431

7.2 Campus Business as Usual Emissions Projections

Year	Scope 1 On-Site Combustion (MT CO_2e)	Scope 1 - Mobile Combustion (MT CO_2e)	Scope 1 - Fugitive Emissions (MT CO_2e)	Scope 2 Purchased Electricity (MT CO_2e)	Scope 3 - Air Travel (MT CO_2e)	Scope 3 – Commuting (MT CO_2e)	TOTAL (MT CO_2e)
2016	15,552	1,398	44	22,596	26,227	11,256	**77,073**
2017	16,962	1,419	44	23,598	26,984	11,430	**80,438**
2018	16,977	1,440	44	23,079	27,753	11,605	**80,898**
2019	17,448	1,461	44	22,994	28,535	11,781	**82,264**
2020	17,783	1,482	44	22,772	29,330	11,958	**83,370**
2021	17,784	1,497	44	22,385	30,138	12,085	**83,933**
2022	17,862	1,513	44	22,194	30,959	12,213	**84,784**
2023	20,838	1,528	44	24,243	31,794	12,342	**90,788**
2024	20,838	1,544	44	23,831	32,642	12,471	**91,369**

2025	21,416	1,559	44	23,881	33,504	12,602	**93,006**

7.3 Cost Estimates for Reaching Net Neutrality

A 20% contingency was added to electrification costs.
Electrification calculation assumptions:

- Existing boiler replacement cost: $60,000/MMBtuHr based on Goss Engineering APCD Rule 361 Boiler Study, February 1, 2016
    - 50% of campus boilers could be replaced at this cost
- Annual natural gas consumption to nameplate capacity ratio: 8% based on aggregate usage data and UCSB natural gas equipment inventory
- Average marginal additional electricity consumption with heat pump vs boiler: 1.15 kWh per consumed baseline therm
- Annual natural gas consumed by campus boilers: 1.97 million therms (77.2 % of total campus through-put)

Carbon offset assumptions:

	UC developed offsets ($/MT CO_2e
2016	20.0
2017	20.4
2018	20.8
2019	21.2
2020	21.6
2021	22.1
2022	22.5
2023	23.0
2024	23.4
2025	23.9
2026	24.4

Procurement of Renewable Energy:

- Campus could procure renewable energy through SCE for a premium of 4.11 Cents per kWh.

7.3 5 – year UCRF projections

		Savings ($): Projects by Implementation Year					
		2016-17	**2017-18**	**2018-19**	**2019-20**	**2020-21**	**2021-22**
Implementation Year	**Project ID**	**-**	***1***	***2***	***3***	***4***	***5***
2017	**PSB North/Chemistry Commissioning**	-	-	177,747	177,747	177,747	177,747

	and Heat Pump Plant[1]						
2017	**CNSI Commissioning**	-	-	25,720	25,720	25,720	25,720
2017	**ESB Commissioning**	-	-	35,482	35,482	35,482	35,482
2017	**Campbell Hall Lighting[2]**	-	-	4,488	4,488	4,488	4,488
2017	**Ellison Hall Lighting**	-	-	22,000	22,000	22,000	22,000
2017	**Embarcadero Hall Lighting**	-	-	3,300	3,300	3,300	3,300
2017	**Energy Storage/Demand Management[3]**	-	-	139,300	139,300	139,300	139,300
2017	**Lab Equipment Upgrade Incentive Program**	-	-	8,140	8,140	8,140	8,140
2019	**12-Bldg Heating Electrification[4]**	-	-	-	-	89,242	89,242
2019	**Davidson Library 4-Story Lighting**	-	-	-	-	33,000	33,000
2019	**Davidson Library Tower Lighting**	-	-	-	-	15,400	15,400
2018	**Harder Stadium Lighting**	-	-	-	6,600	6,600	6,600
2018	**Broida Hall Lab Ventilation Optimization**	-	-	-	152,230	152,230	152,230
2019	**Engineering II Commissioning**	-	-	-	-	42,529	42,529
2020	**Lab Exhaust Stack Study[5]**	-	-	-	-	-	275,000
2021	**Campuswide Exterior Lighting**	-	-	-	-	-	-
2018	**Music (Lotte Lehmen Theater)**	-	-	-	6,600	6,600	6,600
2018	**Solar PV Phase II Rooftop PPA[6]**	-	-	-	363,000	363,000	363,000
	Total Savings (Scheduled, Escalated)	-	-	416,177	944,606	1,124,777	1,399,777
	Utility Incentives	-	-	64,992	452,771	784,584	-

	Available Balance 644011-19903 (Year Start)	2,322,440	1,296,831	1,984,319	2,602,985	3,852,612	4,842,656
	Available Balance 644011-19903 (Year End)	30,013	236,331	95,599	852,985	2,352,612	4,842,656
	Perm UTIL Funding	**10,308,137**	**10,308,137**	**10,308,137**	**10,308,137**	**10,308,137**	**10,308,137**
	Electric Expense	6,293,820	6,728,336	6,728,336	6,847,136	6,864,923	6,864,923
	Water/Sewer Expense	1,352,963	1,352,963	1,352,963	1,352,963	1,352,963	1,352,963
	Natural Gas Expense	820,452	939,518	939,518	977,528	979,483	979,483
	Propane Expense	20,502	20,502	20,502	20,502	20,502	20,502
	Total Utility Expense (BAU)	8,487,737	9,041,319	9,041,319	9,198,129	9,217,871	9,217,871
	Total Utility Expense (w/ Project Imp.)	**8,487,737**	**9,041,319**	**8,560,150**	**7,800,751**	**7,308,509**	**7,818,093**
	Escalation Rate	-	-	-	-	-	-
	Reserve	**1,000,000**	**1,000,000**	**1,000,000**	**1,000,000**	**1,000,000**	**1,000,000**
	Annual UCRF Project Savings	**-**	**-**	**416,177**	**944,606**	**1,124,777**	**1,399,777**
	Total UCRF Project Savings	*-*	*-*	*416,177*	*1,360,783*	*2,485,560*	*3,885,338*
	Annual UCRF Project Investment	**2,292,427**	**1,060,500**	**1,888,720**	**1,750,000**	**1,500,000**	**-**
	Total UCRF Project Investment	*2,292,427*	*3,352,927*	*5,241,647*	*6,991,647*	*8,491,647*	*8,491,647*
	Available Project Balance (Beginning of Year)	**2,322,440**	**1,296,831**	**1,984,319**	**2,602,985**	**3,852,612**	**4,842,656**
	Available Project Balance (End of Year)	*30,013*	*236,331*	*95,599*	*852,985*	*2,352,612*	*4,842,656*