CHANGING THE CAMPUS CLIMATE:
Strategies to Reduce Greenhouse Gas Emissions at The University of California, Santa Barbara

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The mission of the Donald Bren School of Environmental Science & Management is to produce professionals with unrivaled training in environmental science and management who will devote their unique skills to the diagnosis, assessment, mitigation, prevention, and remedy of the environmental problems of today and the future. A guiding principle of the school is that the analysis of environmental problems requires quantitative training in more than one discipline and an awareness of the physical, biological, social, political, and economic consequences that arrive from scientific or technological decisions.

The Group Project is required of all students in the Master's of Environmental Science and Management (MESM) program. It is a three-quarter activity in which small groups of student conduct focused, interdisciplinary research on the scientific, management, and policy dimensions of a specific environmental issue. The final Group Project report is authored by MESM students and has been reviewed and approved by:

Faculty Advisor Oran Young, Ph.D

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EXECUTIVE SUMMARY

Background & Significance

Anthropogenic climate change is arguably the most significant problem of our generation. Unfortunately, its drivers – greenhouse gas (GHG) emissions from energy use and land use changes – are among the most integral inputs to the current economic system. Furthermore, the range of possible effects of climate change – from rising sea levels to increases in extreme weather events – makes addressing the consequences of climate change especially challenging and important.

Recognizing this, much of the world (and almost all "developed" countries) is starting to act to reduce GHG emissions, with both the Kyoto Protocol coming into force and the European Union (EU) implementing its Emissions Trading Scheme recently. Unfortunately, the United States has no equivalent national GHG emissions reduction regulation. Given this lack of leadership at the federal level, action at the state and local level is all the more important, and a number of initiatives are underway (e.g., Northeastern State's Regional Greenhouse Gas Initiative, U.S. Mayors Climate Protection Agreement) that will help reduce GHG emissions and demonstrate that doing so need not be detrimental to local and state economies.

Indeed, California is already leading the way with a number of policies enacted (e.g., Assembly Bill 1493 (Pavley), Renewable Portfolio Standard) or in the development stages that directly or indirectly address global warming. With the Governor's new executive order (S-3-05) committing California to eighty percent reductions below 1990 levels by 2050, California is likely to continue to be a leader into the future.

Set against this background is the University of California (UC), an institution that educates tomorrow's business, political, and intellectual leaders. As the main higher education institution within California, the UC system is well positioned to play a pivotal role in California's climate strategy. UCSB, with its history of environmental stewardship, can serve as a model to public universities and other UC schools to show that greenhouse gas emissions mitigation is the right thing to do. Furthermore, universities can reap the following benefits from prioritizing the reduction of greenhouse gas emissions:

- Reduce campus energy costs;
- Hedge against future climate regulations and energy price volatility;
- Transform markets for low-cost climate mitigation technologies through their large purchasing power; and,
- Improve the reputation of the University.

Ultimately, UCSB, and the wider UC system, has the responsibility of producing tomorrow's leaders and citizens who will significantly influence California's and the U.S.'s response to global warming. Therefore, commitments to reduce greenhouse gas emissions from campuses are of great importance.

Approach

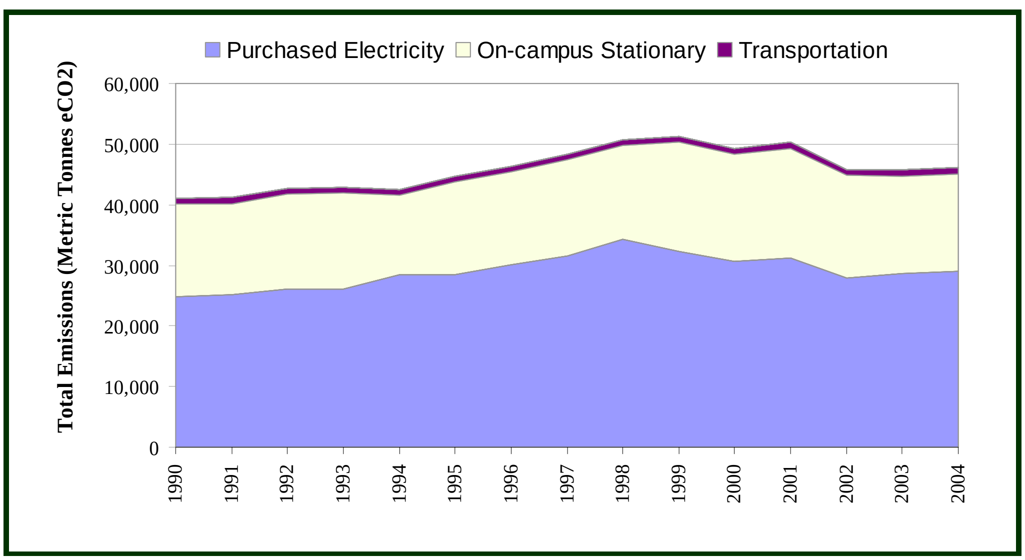
This Group Project encourages UCSB to be a leader, and to provide lessons learned to other universities with a similar vision. Our efforts can be divided into two inter-related tracks – analysis and implementation. In the analysis phase, we characterize the main sources of GHG emissions on campus and how they are likely to change in the future, identify mitigation strategies, develop criteria for selecting mitigation strategies, and analyze the feasibility of several prominent emissions reductions targets. In the implementation phase, we seek to understand UCSB as a complex organization and to both identify institutional obstacles that constrain the implementation of the previously described mitigation strategies and opportunities to maneuver around the obstacles. These two parallel and complementary tracks are aimed at inducing UCSB to actually reduce its net GHG emissions over time and to receive the associated benefits previously discussed.

UCSB GHG Emissions Inventory

We use the Greenhouse Gas Inventory Calculator (volume 4.0), developed by Clean Air – Cool Planet specifically for universities, to create a GHG inventory for UCSB. The inventory includes emissions from electricity consumption, natural gas consumption, the UCSB fleet, student, faculty and staff commuting, faculty and staff air travel, fugitive emissions of coolants, and solid waste. However, for the purposes of our primary analysis, we only consider the first *three* emissions sources on the list; this is because these are the emissions sources for which the University is committed to measuring and certifying with the California Climate Action Registry (CCAR), and the other emissions are highly uncertain because of poor data quality.

Figure 1 displays UCSB's GHG emissions by source over the past 15 years. Electricity is the single largest source of GHG emission at UCSB, representing roughly two thirds of total emissions, followed by natural gas, representing roughly one third of total emissions, and the campus fleet, which is almost negligible.

Figure 1: UCSB GHG Emissions by Source



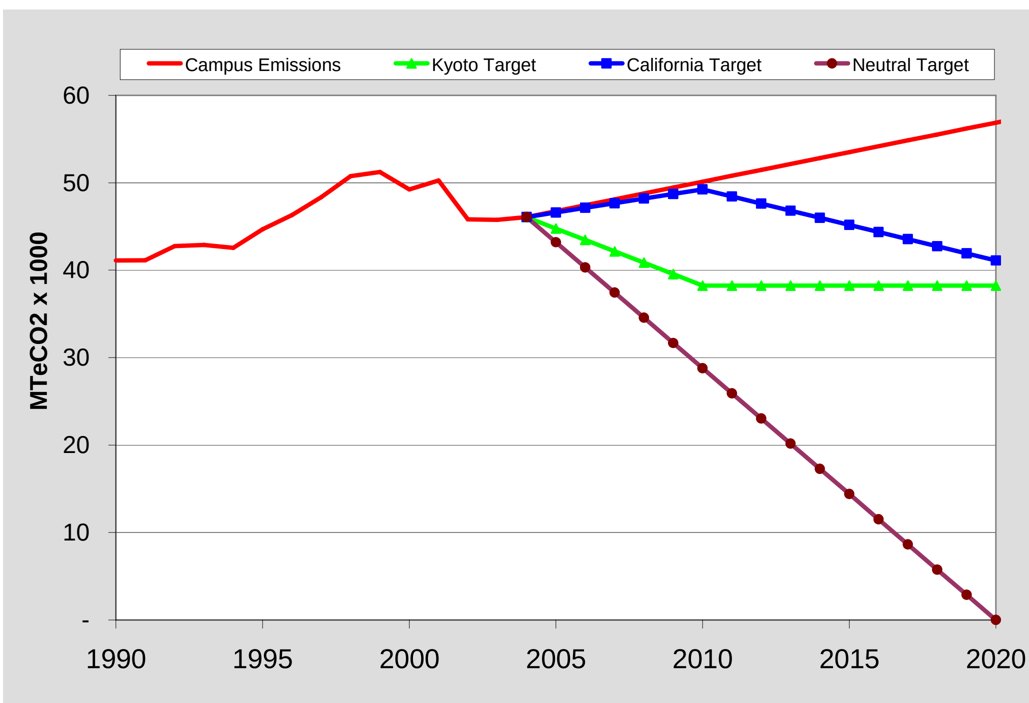
In 2004, the most recent year for which we have complete data, total GHG emissions were approximately 46,000 metric tons of carbon dioxide equivalent ($MTCO_2e$). Interestingly, total emissions peak in 1999 and shrink by approximately two percent per year through 2004. This emissions reduction was not caused by a reduction in enrollment or building square footage; rather it was largely due to significant new investments in energy efficiency on campus precipitated by the California energy crisis. This is a promising finding and suggests that UCSB has the potential to reduce its climate footprint without reducing enrollment or campus size.

Emissions Targets Applied to UCSB

Determining an appropriate reduction target for GHG emissions is a critical first step towards long term emissions reductions. We analyze what three separate emissions targets would look like as applied to UCSB through 2020 – the U.S. targets from the first commitment period of the Kyoto Protocol (7% below 1990 levels by 2010), the first two California state targets (2000 levels by 2010, 1990 levels by 2020), and Climate Neutrality (net zero GHG emissions by 2020).

First, we project UCSB's GHG emissions through 2020 given current emissions levels and assumptions about campus growth. Given historical emissions levels of roughly 2.25 $MTCO_2e$ per student and anticipated growth of approximately 300 students per year through 2020, we project total emissions through 2020 (see solid red line in Figure 2). Second, we apply the three potential targets to UCSB in order to understand the scale of emissions reductions that would be required to meet the specific targets (displayed in Figure 2 as the vertical distance between the projected emissions line and any particular target line).

Figure 2: Projected Emissions and Potential Targets



Mitigation Strategies

We profile a range of mitigation strategies available to UCSB, including energy efficiency and conservation projects, on campus renewable energy projects, alternative fuel vehicles, and external mitigation options (e.g., carbon offsets, renewable energy credits).[1] For each mitigation mechanism we provide the capital cost, associated savings (e.g., energy), annual GHG reduction potential, net cost per unit of GHG reduced[2], and payback period.

Feasibility Analysis of Meeting Specific Targets

We identify the specific combination of mitigation mechanisms that would enable UCSB to meet the previously discussed emissions targets. We assume a consistent mechanism choice logic that reflects UCSB priorities – we first select projects with no capital costs that yield savings, then we select projects that yield the highest savings over time (best in terms of $/ $MTCO_2e$), and finally, once all mechanisms with costs below the price of external offsets (an estimated average of $11/$MTCO_2e$) have been exhausted, the University meets all additional emissions reductions through the purchase of carbon offsets (see Figure 3).

Figure 3: Mitigation Mechanism Schedule for CA Targets

Year Stage	Mechanisms	Potential MT/year	Capital Cost	NPV/MT	Annual Saving
ASAP	**Energy star computer settings**	**310**	$0	**196**	**$94,000**
Stage A	**Fleet smaller vehicles**	**33**	$0	**215**	**$9,545**
	Fleet ethanol	**1**	$0		**$0**
2011	**HVAC Upgrade – Air Handlers 1**	**573**	$200,000	**245**	**$112,000**
Stage B	**HVAC Commissioning**	**340**	$120,000	**241**	**$71,159**
	HVAC Upgrade – Filters	**607**	$372,323	**196**	**$184,053**
	EE – Fume Hoods	**55**	$80,000	**156**	**$14,298**
	Building baseline awards	**14**	$15,000	**127**	**$4385**
2012	**HVAC Upgrade – Fans**	**914**	$1,574,464	**125**	**$277,048**
Stage C	**Lighting Upgrades**	**835**	$1,797,762	**97**	**$252,919**
2013	**HVAC Upgrade – Air Handlers 2**	**174**	$550,000	**42**	**$45,328**
Stage D	**Reduce fleet driving – bikes**	**1**	$2500	**11**	**$27**
	Begin purchasing offsets	**763**	$8,091	**-11**	**$0**

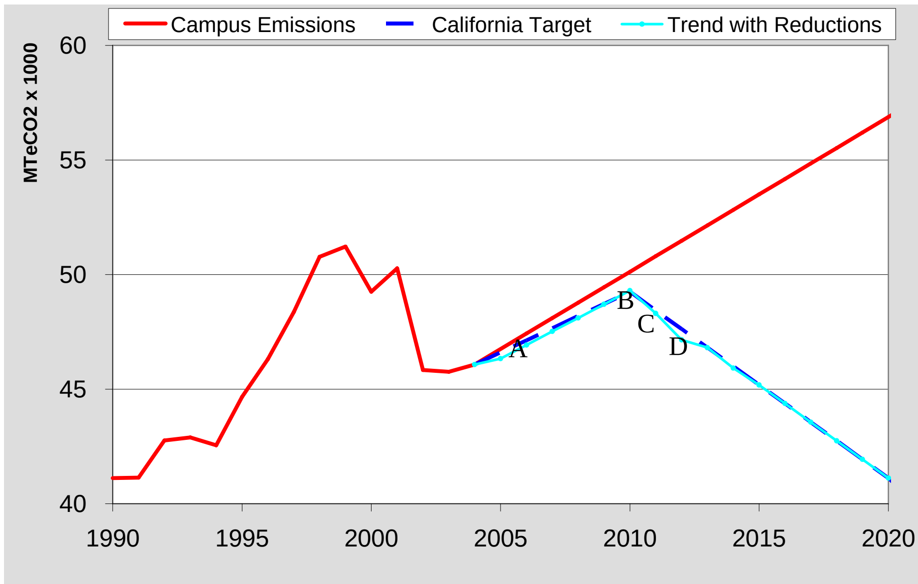
Figure 4 illustrates the specific four stage emissions reduction path that UCSB could take to meet the first two California targets – the 2010 and 2020 standards (see dashed line in Figure 4). The solid trend line shows how UCSB can reduce its GHG emissions through time with the implementation of on-campus projects with costs lower than the external offset price; these on campus emissions reduction opportunities keep UCSB on track with the California goals through 2012. After that point, the most inexpensive mitigation mechanisms have been exhausted, and

[1] The mitigation mechanisms profiled in this section represent examples of the types of projects UCSB could implement to reduce its emissions, rather than an exhaustive or fully comprehensive survey of the University's mitigation options.

[2] This includes the upfront capital cost and the discounted savings over the lifetime of the project.

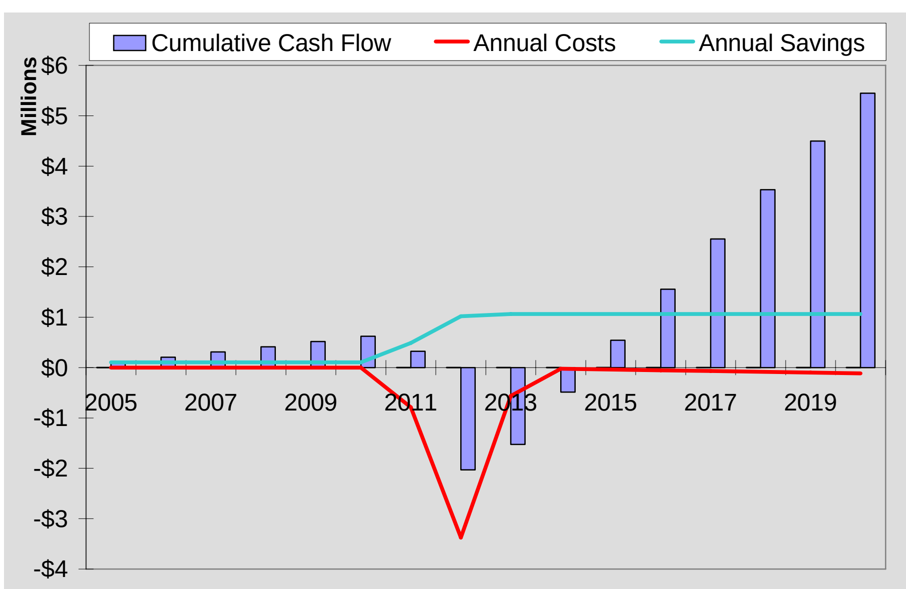
purchasing offsets becomes the next cheapest alternative. Therefore, we assume that UCSB purchases external offsets to make up the difference in subsequent years.

Figure 4: Four Stage Emissions Reduction Path



This combination of mechanisms has a net present value (NPV) of $2.6 million, including the cost of offsets through 2020, suggesting that the University could meet the California targets through 2020 according to the previously described emissions path and save a significant amount of money in the process. This emissions trajectory does require some significant capital investments after 2010 (when the emissions target increases in stringency); but, as the cash flow analysis below illustrates, these capital investments are recouped quickly through energy savings (see Figure 5).

Figure 5: Cash Flow for CA Targets



According to our analysis, meeting the California targets not only appears feasible through 2020 despite significant campus growth, it also appears to be justified solely on the economics. We performed similar analyses for two additional targets – the Kyoto Protocol and Climate Neutrality – and observe similar findings. These targets imply more aggressive emissions reductions, both in timing and the absolute level of emissions reductions. In terms of NPV, this turns out to increase the savings associated with the mitigation strategies – because they are implemented earlier, which captures more years of energy savings – and to increase the number of offsets purchased. We find the NPV of the savings to be $5.8 million for the Kyoto targets and $4.3 million for Climate Neutrality. Finally, as a sensitivity analysis, we perform the same calculations using an offset price of $30/MTCO$_2$e, which is similar to the current price of carbon in the EU market; we find a NPV of savings equaling $4.3 million, $2.1 million, and -$0.2 million for the Kyoto, California, and Climate Neutrality targets, respectively.

Implementation

Given the previous analysis, it would seem that UCSB should already be implementing GHG mitigation strategies. To some extent it is – through the energy efficiency projects implemented by the Facilities Management team, the efforts to green UCSB buildings by a virtual Office of Sustainability, and efforts to reduce the use of single occupancy vehicles through the Transportation Alternative Program, among others – and the results of these efforts can be seen in the declining aggregate GHG emission trend over the past 5 years (see Figure 1). Although, UCSB has typically done so with energy savings or reduced traffic congestion in mind, not GHG emissions. We argue that reduction in GHG emissions is another important reason for UCSB to consider – one that points towards increasing the overall scale and the immediacy of their current efforts.

Notwithstanding their significant previous efforts, there are a number of institutional obstacles that constrain UCSB from implementing more GHG mitigation projects, and from doing so more immediately. These include:

- The state funding allocation system, which allots separate funds for capital projects and for operations and prevents borrowing from the operations budget to fund capital projects;
- Lack of funding in general and restrictions on UCSB's access to capital;
- Lack of an information management system for GHG emissions, which hinders efforts to understand emissions sources and trends; and,
- Institutional inertia and risk averseness.

Addressing these barriers is integral to the implementation of any significant GHG reduction policy.

Our Group's Direct Contribution to GHG mitigation:

- Facilitation of UCSB membership with California Climate Action Registry.
- Design of The Green Initiative Fund (a student fee based revolving fund for environmental projects on campus), which passed on April 24, 2006.
- Participation in the development of the Campus Sustainability Plan

Final Recommendations and Conclusion

Based on our mitigation and institutional analyses, and from our experience engaging with the relevant decision makers at UCSB over the past year, we identify a main recommendation and five supporting recommendations that would put UCSB on track to be a leader in responding to climate change.

Key Recommendation

With consideration to the financial findings of our research and evaluation of institutional barriers, **UCSB should make a firm commitment to meet the California GHG reduction targets**.

In order to accomplish this, UCSB should:

1. Use aggregate GHG emissions targets as a metric in long-term campus planning documents.
2. Turn the "Sustainability Working Team" of the Campus Planning Committee's Sub-Committee on Sustainability into a real Office of Sustainability.
3. Implement zero cost emissions reduction projects first, followed by the most cost effective (i.e., highest \$/ $MTCO_2e$) projects.
4. Focus on identifying additional cost-effective GHG mitigation opportunities on campus, such as energy efficiency.
5. Work with administrators at other UC schools to press UCOP and the state legislature for capital budget funding reform as one of the top priorities.

These recommendations should allow UCSB to reap the multiple benefits previously discussed, including significant dollar savings, improved environmental performance, and positive public relations opportunities. Furthermore, UCSB's leadership on addressing climate change has the potential to have significant impacts beyond the UCSB campus, including:

- Mobilizing other public universities, in the UC system and beyond, to address climate change;
- Demonstrating the feasibility – indeed benefits – of meeting the first two commitments of the California targets; and,
- Educating the students of UCSB, as future consumers, investors, professionals, and leaders.

Ultimately, it is these longer term and broader scale implications of UCSB's actions today that make climate mitigation so important. As David Orr (2000), a professor of Environmental Studies at Oberlin College puts it: "*Education is done in many ways, the most powerful of which is by example.*" It is time for UCSB to educate – its students, other universities, and California businesses – by example.

NAELS National Association of Environmental Law Societies

Using this Group Project as a model, NAELS is working to implement a nationwide campaign to develop bottom-up climate leadership through its Campus Climate Neutral (CCN) program – an ambitious and unprecedented grassroots effort to mobilize graduate students around the United States to lead the way to aggressive, long-term climate solutions.

CHAPTER 1: BACKGROUND & SIGNIFICANCE

1.1 Introduction

Avoiding serious climate change will require deep cuts in greenhouse gas (GHG) emissions from all sources. Given the lack of federal leadership on the climate change issue in the United States and the urgency of the problem, bottom-up efforts to address climate change – from states, cities, businesses, and universities – are important. Universities can provide both practical and moral leadership with regards to our society's efforts to address climate change by taking steps to reduce their own emissions. The goal of the Bren School's Campus Climate Neutral (CCN) project is to facilitate UCSB's leadership with regard to climate change; we do so by identifying projects and policies that will help reduce net GHG emissions related to campus activities and developing the business case for incorporating GHG mitigation plans within UCSB's institutional framework. The results of this study will assist other universities within the UC system and nation-wide in the assessment and development of decisive action to enable campuses to reduce their GHG emissions within the broader sustainability movement. This project is part of a larger effort spearheaded by the CCN client – the National Associations of Environmental Law Societies - to avoid dangerous anthropogenic interference in the Earth's climate system.

1.2 Climate Change Science & Impacts

Over the course of human history, people have dramatically altered the natural landscape for agriculture, housing, industry and a myriad of other activities. Although our footprint already includes deforestation, altered waterways, and industrial pollutants, a powerful new force – global climate change – will impact natural systems, and the services we derive from them, in new and profound ways. The scientific consensus, reflected by recent reports of the Intergovernmental Panel on Climate Change (IPCC) and confirmed by the U.S. National Academy of Sciences, is that the Earth's climate is warming and that human activities are largely responsible (IPCC, 2001a; Joint science academies statement, 2005). Specifically, the IPCC notes in its most recent comprehensive report, the Third Assessment Report (TAR), that:

- The present atmospheric CO_2 concentration of 378 parts per million (ppm) is almost 1/3 higher than pre-industrial levels (280 ppm) and is the highest concentration in the last 420,000 years[3] (IPCC, 2001b);
- Global average surface temperature has increased by 0.6 C during the 20^{th} century, likely the largest warming in any century during the last millennium. (IPCC, 2001b);
- It is very likely that the 1990s were the warmest decade since the instrumental record began in 1861 (IPCC, 2001b).

The TAR concludes that "There is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities," predominantly the burning of fossil fuels and land use changes (IPCC, 2001b, p. 10).

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[3] A new ice core taken from the EPICA Dome C site in Antarctica extends the CO_2 concentration record back to 650,000 before the present (BP). The new data show CO_2 concentrations between 430,000 and 650,000 BP ranging from 260-180 parts per million, suggesting that the current CO_2 concentration is the highest concentration in the last 650,000 years (Siegenthaler, 2005).

Already, the impacts of the currently modest increase in global average surface temperature are beginning to be seen: decreases in snow cover, retreat of non-polar mountain glaciers, sea level rise of 0.1 to 0.2 meters, and more frequent and more intense El Nino/Southern Oscillation (ENSO) events (IPCC, 2001b). However, global warming and its impacts are likely to be of increasing concern in the future. IPCC climate scenarios project CO_2 concentrations by 2100 of 540 ppm to 970 ppm primarily due to fossil fuel burning, with global average surface temperature rising by 1.4 to 5.8º C over the 1990 to 2100 period (IPCC, 2001b). They emphasize that this increase in temperature is much larger than 20th century warming (with its already observable effects) and is very likely unprecedented in the last 10,000 years (IPCC, 2001b). The projected impacts of such a warmer climate by 2100 include:

- Increases in overall precipitation and in the intensity and variability of precipitation;
- Sea level rise of 0.09 to 0.88 meters due to thermal expansion and melting of glaciers; and,
- Increases in extreme weather events (IPCC, 2001b).

Such unprecedented climate change has wide ramifications for human and natural systems world-wide, likely including increased flooding, reduced farm output, animal and plant extinctions, and droughts. Additionally, as GHGs have atmospheric lives ranging from decades to centuries, GHG emissions will affect atmospheric composition and climate for many generations (IPCC, 2001b).

Although climate change is a global issue, its impacts are decidedly local. Due to regional variations in projected climate change and vulnerability, it is important to comprehend how climate change may impact California residents in the coming years. According to the California Climate Action Registry (based on Union of Concerned Scientists & Ecological Society of America, 1999):

- "The sea level has already risen along the California coastline, perhaps by as much as 7 inches in the last 150 years. Another 8 - 12 inch rise could have severe impacts on the San Francisco Bay-Delta which provides water to more than 20 million Californians. Furthermore, salt-water intrusion into the Delta would degrade the quality of water that currently supplies the southern part of the state.
- With more than 1,600 miles of coastline, many coastal cities will be vulnerable to a rise in sea level that could cause beach erosion and saltwater intrusion into estuaries and rivers used for agriculture. Coastal cities will also be at greater risk to extreme weather events associated with global warming.
- The California mountain snow pack is shrinking. Warmer and shorter winters have reduced the annual snow pack, and the snow is melting earlier. Over the past 100 years, spring runoff has decreased by about 10 percent. At the same time, longer and hotter summers are increasing demand for water. New research by scientists at the Scripps Institution of Oceanography predicts that critical water sources will be cut by 15-30 percent in the 21st century."

Climate change also has potentially significant and negative implications for California's public health (e.g., air pollution, heat waves), agriculture, forestry, and natural systems (California Climate Action Team, 2006; Union of Concerned Scientists & Ecological Society of America, 1999).

Taking into account the state of the science and the large future risks of unabated growth in greenhouse gas emissions, the large majority of the world's scientists agree that the debate over the existence of anthropogenic climate change is over and that the time for significant action to reduce emissions is now (Joint science academies statement, 2005).

1.3 Climate Change Policy

1.3.1 International Efforts

International efforts to address climate change began in 1992 with the United Nations Framework Convention on Climate Change (UNFCCC). While not laying out specific targets or timetables, the UNFCCC established the objective of stabilizing GHG concentrations "…at a level that would prevent dangerous anthropogenic interference with the climate system" and affirmed several important principles of environmental law, including common but differentiated responsibility, sustainable development, and the precautionary principle (UNFCCC, 1992). These principles highlight the responsibility and ethical obligation of developed countries, such as the United States, to provide leadership on addressing climate change, as the largest historical emitters of GHG emissions and the most financially and technically capable of reducing GHG emissions.

The international response to climate change transitioned from broad rhetoric to specific targets and timetables with the Kyoto Protocol. Adopted in 1997, the Kyoto Protocol set binding targets for developed countries to reduce GHG emissions (7% for the U.S., 8% for Europe) by the 2008-12 commitment period and, consistent with the principle of common but differentiated responsibility, leaves the issue of developing country commitments to the post-2012 commitment period (UNFCCC, 1997). The Kyoto Protocol also introduced several flexibility mechanisms intended to decrease the costs of mitigation and promote technology transfer to developing countries, including emissions trading, joint implementation, and the clean development mechanism. With Russian ratification the Kyoto protocol entered into force on February 16, 2005 without the participation of the United States.

In order to meet its Kyoto targets the European Union (EU) established a cap-and-trade program – the EU Emissions Trading Scheme (ETS) – through which EU countries cap national emissions (currently only CO_2) and allocate the right to emit CO_2 to regulated installations (mainly facilities in the energy, metals, minerals, and pulp and paper sectors) representing forty five percent of the EU's total carbon dioxide emissions (European Commission, 2004). Once issued, installations within the EU can trade emissions allowances to other operators, or to individuals, NGOs, or institutions, helping to ensure that mitigation occurs at least cost. In early 2006, the price of a metric ton of carbon on the European market was approximately $30, which suggests that if the U.S. chose to implement a similar cap-and-trade program, unused allowances would be a valuable asset (Point Carbon, 2006).

1.3.2. U.S. Federal Efforts

In 2005, with both the Kyoto Protocol coming into force and the European Union implementing its Emissions Trading Scheme, much of the world (and almost all OECD countries) is acting now to reduce GHG emissions. Unfortunately, the United States has no equivalent national GHG emissions reduction regulation. The U.S. is party to the UNFCCC, but not its implementing treaty, the Kyoto Protocol. The U.S. is technically a signatory to Kyoto; however, after the Senate issued the Byrd-Hagel Resolution expressing its concern over the potential negative economic impacts of emissions restrictions and its refusal to participate in a treaty that did not also cover developing countries, the treaty was not sent to the Senate for ratification by the Clinton administration. Shortly thereafter, the Bush II administration renounced the Kyoto protocol. At the international level, the Bush II administration has been a vocal opponent of the Kyoto Protocol despite efforts by Tony Blair and other international leaders to coax the U.S. into a more responsible GHG policy, preferring voluntary programs that focus on the transfer of clean technologies (e.g., Asia-Pacific Partnership on Clean Development and Climate).

At the federal level, the Bush II administration has been opposed to quantitative restrictions on aggregate GHG emissions, preferring GHG emissions intensity targets (i.e., $MTCO_2e/GDP$) and voluntary programs (e.g., EPA's Climate Leaders, Methane to Markets, and Energy Star). Unfortunately, the Administration's goal of cutting greenhouse gas intensity by 18 percent by 2012 is underwhelming, as business as usual over the past 10 years has already yielded an 18 percent overall decrease in greenhouse gas intensity (World Resources Institute, 2002). Furthermore, due to projected increases in GDP, a GHG intensity decline of this magnitude actually implies a 14 percent *increase* in the total amount of greenhouse gas emissions by 2012 (World Resources Institute, 2002). Voluntary programs and goals, while a step in the right direction, will be insufficient to motivate public and private organizations to reduce greenhouse gas emissions on the scale necessary to curb global warming.

Fortunately, with increasing media attention to climate change and broader demand for a federal response, the Bush II administration policies are becoming increasingly isolated, even among Republicans. The U.S. Senate acknowledged in June 2005 that anthropogenic GHG emissions are a substantial driver of climate change and that mandatory GHG emissions restrictions will be necessary and should be adopted (Sense of the Senate on Climate Change, 2005). Additionally, there are several bills in the U.S. Congress that propose regulating GHG emissions, including the Climate Stewardship Act which would cap the aggregate emissions of the electricity, transportation, commercial, and industrial sectors at the 2000 level. While the U.S. is currently not regulating GHG emissions at the federal level, there are signs that regulation is coming, and organizations that act early to reduce GHG emissions may stand to benefit.

1.3.3 California Efforts

Given this lack of leadership at the federal level, action at the state and local level is all the more important, and a number of initiatives are underway (e.g., New England's Regional Greenhouse Gas Initiative) that will help reduce GHG emissions and demonstrate that doing so need not be detrimental to state economies. Indeed, California is proving to be a leader, with a number of policies in effect or in the development stages that directly or indirectly address global warming. In 2002, the California legislature enacted the California Assembly Bill (A.B.) 1493-Pavley, which directs the Air Resources Board to adopt standards that will achieve "the maximum feasible and cost-effective reduction of greenhouse gas emissions from motor vehicles," taking into account environmental, social, technological, and economic factors. California also currently has a Renewable Portfolio Standard that requires its regulated utilities (e.g., PG&E, SCE) to source 20% of retail electricity from renewable energy sources by 2010. California is also a member of the West Coast Governor's Global Warming Initiative, which works to enhance regional collaboration on energy efficiency, renewable energy, and potentially, a regional cap and trade program for GHG emissions involving California, Oregon, and Washington.

More comprehensively, California Governor Arnold Schwarzenegger recently signed Executive Order S-3-05, committing California to specific emissions reduction targets and creating a Climate Action Team to help implement the directives. While the targets – 2000 levels by 2010, 1990 levels by 2020, and eighty percent below 1990 levels by 2050 – are not ambitious in the short term, they are in the long term, which demonstrates that California is likely to continue to be a leader into the future with regard to climate change; this should not come as a surprise as a vast majority Californians believe that global warming will affect current and future generations and support initiatives by the California legislature to address GHG emissions (Public Policy Institute of California, 2005). Furthermore, because of California's large size (it is the 12th largest emitter of GHGs in the world) and reputation for innovation in addressing environmental issues, actions taken by California matter (California Climate Action Team, 2006b). Given the opportunity for GHG emissions reductions and leadership, and the interest in climate change in both California's statehouses and with the people, leadership from California's universities would seem to be both popular and important.

1.3.4 Santa Barbara Efforts

Even at the local level, municipalities are committing to take action to reduce their GHG emissions and to put pressure on state and federal governments to enact mandatory GHG regulation. The City of Santa Barbara is a signatory to the U.S. Mayor's Climate Protection Agreement, through which they will strive to meet or exceed Kyoto targets in the local community, create a GHG emissions inventory, and develop a climate action plan (U.S. Mayor's Climate Protection Agreement, 2005). Under the agreement, the cities have also agreed to urge federal and state governments to enact programs to meet or beat Kyoto targets and to urge Congress to pass Climate Stewardship Act. With the City of Santa Barbara interested in climate change mitigation, UCSB is in a unique position to collaborate with the city on its climate protection efforts.

1.4 Why Universities Should Take Action

Set against the scientific and policy background are universities – institutions that educate tomorrow's business, political, and intellectual leaders. Universities have long played a leadership role in addressing important societal issues, such as civil rights, free speech, and U.S. foreign policy. For example, universities figured prominently in the Civil Rights, Free Speech, and anti-Vietnam War movements. This type of campus activism is appropriate for institutions of higher learning as centers for intellectual inquiry, critical thinking, and innovation. Since universities are not bound by the same constraints as other public and private organizations, they are freer to play a leadership role with regard to issues that question the status quo. Within this context, campus leadership on climate change is both appropriate and expected.

Not only can universities play an important role in shaping future policy concerning climate change, but campus activities today have a direct impact on greenhouse gas emissions. Fortunately, universities can benefit in many ways from prioritizing the reduction of GHG emissions. In addition to contributing to the broader climate change movement, universities can realize several private benefits from campus GHG reductions:

- **Reduce campus energy costs:** Many of the strategies for reducing greenhouse gas emissions involve energy efficiency/conservation projects, which result in energy cost savings over time. Often, such projects recoup the capital investment quickly and can be justified solely on the economics (i.e., without consideration of the GHG emissions reduction benefits).

- **Hedge against energy price volatility:** Strategies for reducing GHG emissions (e.g. energy efficiency and renewable energy investments) help reduce the demand for purchased electricity and natural gas, which can make universities less vulnerable to fluctuations in fossil fuel prices. By diversifying energy portfolios, campuses may ensure a higher degree of cost stability and certainty in the face increasing fuel prices.

- **Hedge against future regulations:** Early action will also put universities in a strong position when inevitable GHG restrictions (either regional or national) are put in place, including the possibility of banking emissions reduction credits for the future given participation with the GHG registries (e.g., California Climate Action Registry).

- **Improve the reputation of the University and appeal to student, alumni, staff and faculty values:** Taking action to address global warming will provide universities with good public relations opportunities, both among other universities and alumni. Staff and faculty may also respond positively to GHG mitigation – demonstrating that the University shares in the concern for environmental and social values may help to recruit and retain high-quality staff and faculty.

Recognizing these opportunities, an increasing number of campuses have "greening" programs, and some universities have taken the lead on dealing directly with their impact on climate change. For instance, Yale, Tufts, Cornell, UC Berkeley and all 56 New Jersey colleges and universities have made public commitments to reduce greenhouse gas emissions related to campus operations (see Appendix A for details).

Beyond the direct benefits to the universities themselves of reducing GHG emissions, it is the external dividends (i.e., positive externalities) associated with such actions that make university efforts toward climate change potentially so important. Universities in general emit a significant amount of GHGs and influence the economies of the states in which they are located through construction, purchasing and endowment investments. Universities have the potential, through their purchasing power, to transform markets and encourage the dissemination of technology, which they often play significant roles in developing, that can help individuals and organizations reduce their emissions. Furthermore, universities, as large complex organizations, can demonstrate to other large, complex organizations (e.g., corporations, municipalities) the methods of effective GHG reduction and the associated benefits. Most importantly, if universities are to produce the leaders and citizens we so greatly need to respond to climate change, they will need to go beyond teaching about climate change and start mitigating their climate impact, or in the words of David Orr (2000), "educating by example." Emissions reduction programs at universities can help influence the behavior of its graduates, as future consumers, investors, and professionals, and, by incorporating students in the emissions reduction process, universities can help train the next generation of leaders that will be needed to adequately address global warming.

In recognition of the important role that universities have to play to prevent climate change, the National Association of Environmental Law Societies (NAELS) has launched a campaign to foster bottom-up climate leadership through its Campus Climate Neutral (CCN) program. Similar to the way that the anti-Apartheid movement grew out of an urgent moral imperative to address systemic discrimination, the CCN campaign is envisioned as a call to action for aggressive measures to respond to the current generation's great crisis – climate change. CCN's goals are to train the next generation of climate leaders while immediately engaging the faculty and administration to develop aggressive plans to move campuses towards climate neutrality. NAELS has chosen to sponsor a CCN project at UCSB, in order for it to serve as a model to other campuses in the UC system and nationwide.

1.5 Why UCSB Should Take Action

> "California is the 12th largest source of climate change emissions in the world, exceeding most nations. Actions taken in this State make a difference; not only because we are a major contributor to the problem but also because California is known throughout the world as a leader in addressing public health and environmental issues" (California Climate Action Team, 2006b, p. i).

Clearly there is a need for a bottom up approach to addressing climate change in the U.S. due to the lack of action and leadership at the federal level. Fortunately, the benefits of reducing GHG emissions – in the form of energy savings, reduced risk, and increased employee morale, among others – appear to be in place to motivate broad participation for a bottom-up approach. UCSB is well positioned to help provide such leadership in California, and by extension, nationally. As the above quote from the Climate Action Report indicates, what happens in California matters. As the main higher education institution within California, the UC system is can play an important role in California's climate strategy, and by extension, the U.S.'s response to climate change.

In addition to the broader implications, a public commitment by UCSB to reduce greenhouse gas emissions could yield multiple benefits, including the previously discussed benefits that would apply to most universities (see Section 1.3), and others specific to UCSB, including:

- **Appeal to student, alumni, staff and faculty values:** The campus community has a strong culture of environmentalism and prides itself on its beautiful natural setting – on the Santa Barbara coastline set against the Santa Ynez mountain range. Environmental Studies is one of the larger undergraduate departments, while the Bren School for Environmental Science & Management is one of the most well-respected interdisciplinary environmental graduate programs in the country. Taking action to address global warming will also provide the UC system with good public relations opportunities, both among other universities and alumni.

Many alumni, such as Jack Johnson and Michael Douglas, have demonstrated their dedication to environmental protection. Staff and faculty may also respond positively to the social values that UCSB demonstrates as an employer.

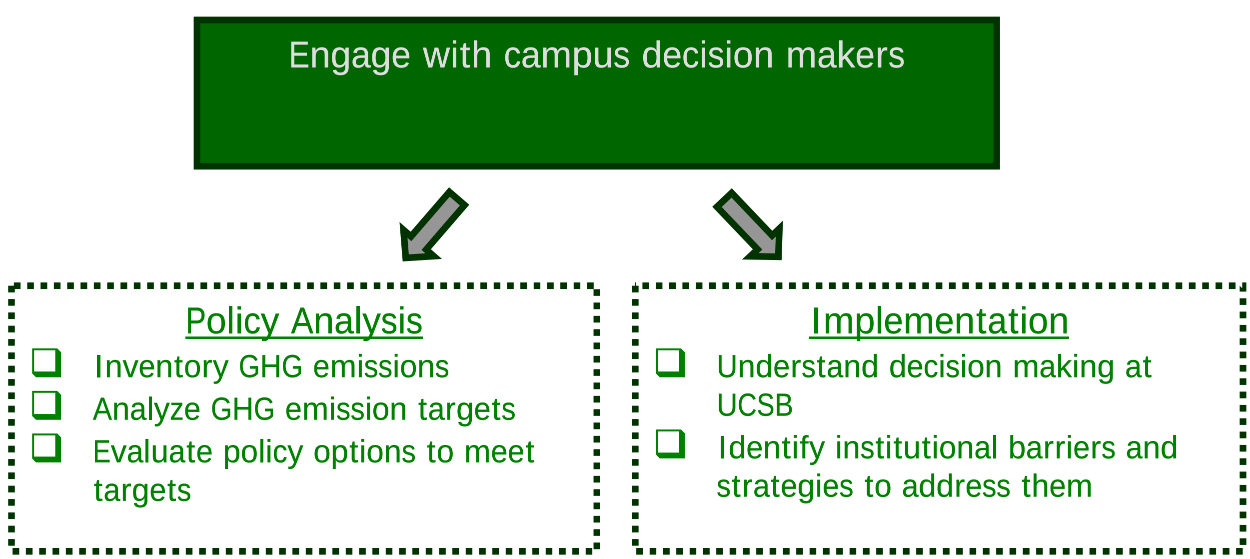
- **Strengthen relations with local communities:** A university commitment to greenhouse gas reductions can improve relations with the local community by establishing the campus as a good neighbor and fortifying its "license to operate." Reducing transportation-related emissions may be a particularly positive strategy to engender community good-will.

More broadly, universities in California have long played a leadership role in addressing important societal issues. The time is right for campuses to once again provide moral leadership. Not only students, but campus administrators should also press for change in the educational institutions that produce tomorrow's leaders and citizens who will need to address global warming. The 120,800 students currently enrolled in the UC system will eventually be living in a carbon-constrained world. Taking this opportunity to encourage students to be conscious of their carbon footprints is both needed and long overdue.

1.6 Turning Ideas into Action – Our Project Approach

This Group Project seeks to enable UCSB to capture the social, environmental and economic benefits of reducing its campus GHG emissions and become a state and national university leader with regards to climate change. Our efforts can be divided into two inter-related tracks – analysis and implementation (see Figure 1.1). In the analysis phase, we characterize the main sources of GHG emissions on campus and how they are likely to change in the future, identify mitigation strategies, develop criteria for selecting mitigation strategies, and analyze the feasibility of several prominent emissions reductions targets. In the implementation phase, we examine UCSB as a complex organization to both identify institutional obstacles that constrain the implementation of the previously described mitigation strategies and potential strategies to maneuver around the obstacles. By combining research with action, we assist UCSB in reducing its net GHG emissions over time and in receiving the associated benefits previously discussed.

Figure 1.1: Project Approach



CHAPTER 2: GHG EMISSIONS INVENTORY AT UCSB

One of the first steps in addressing climate change at an organization is to understand the organization's climate footprint – both its size and what influences the size. A greenhouse gas (GHG) emissions inventory facilitates this understanding – it helps identify, quantify, and categorize major sources of GHG emissions. Furthermore, organizations measure what matters to them, so performing a GHG inventory is integral to a legitimate GHG reduction strategy as it is a signal of organizational commitment to addressing climate change. Recognizing this, UCSB became a member of the California Climate Action Registry (CCAR) [4] in June 2005 and voluntarily committed to performing an inventory of its GHG emissions annually starting in 2004. This inventory is audited annually by a third party verifier and made publicly available. The CCAR inventory is primarily designed to allow companies and institutions "to establish GHG emissions baselines against which any future GHG emissions reductions requirements may be applied" (California Climate Action Registry, 2006). The CCAR inventory reflects this regulatory-based approach, focusing only on Scope I & II emissions (see Box 2.1) as defined by the World Resources Institute (2004), measuring only carbon dioxide for the first three reporting years, and demanding rigorous data.

Our inventory effort took place in parallel with a University-led effort to inventory UCSB's GHG emissions for certification with CCAR. While we recognize the importance of the University's CCAR inventory, we wanted to take a more comprehensive approach in order to more completely describe the University's climate footprint, identify the relative significance of all emissions sources (including those that are not being captured in the CCAR inventory), and allow for a wider array of GHG reducing policies. We were also interested in the emissions trends over time and wanted to be able to convey what potential emissions targets (i.e., Governor's targets, Kyoto and neutrality by 2020) would look like for UCSB; this was the other main motivation for the separate inventory effort, as the CCAR inventory was just for the 2004 reporting year. Thus, our inventory considers all six Kyoto gases and is much broader, covering several significant Scope III emissions (i.e., commuting, air travel, refrigerants and solid waste); this more comprehensive approach, although at times less rigorous because of data quality issues, adds value by more broadly representing the GHG emissions over which the University has some control. Also, it has helped us to identify areas where data management can be improved (see Section 5.4.2), which could be important if CCAR expands the scope of its reporting requirements.

In this chapter, we discuss the emissions sources included in the CCAR inventory first, and then present the other emissions sources as additional opportunities for GHG reductions. Finally, it should be noted that there are small differences in the emissions totals for our inventory and the CCAR inventory due to the use of slightly different emissions factors and the fact that the CCAR inventory only considers CO_2. We will largely rely on the emissions totals from our inventory for the rest of the report.

[4] The California Climate Action Registry was established by the California legislature as a voluntary registry for GHG emissions.

Box 2.1 The Concept of Emissions "Scope"

According to the World Resources Institute (2004), three scopes (Scope I, Scope II, and Scope III) are defined for greenhouse gas (GHG) accounting and reporting purposes. Scopes I and II are carefully defined by WRI and WBCSD's Greenhouse Gas Protocol to ensure that two or more organizations will not account for emissions in the same scope.

The Greenhouse Gas Protocol requires organizations to separately account for and report on Scopes I and II at a minimum. The scopes are defined as follows:

- **Scope I**: Direct GHG emissions
  Direct GHG emissions occur from sources that are owned or controlled by the organization. For example, emissions from combustion in owned or controlled boilers, furnaces, vehicles, etc.
- **Scope II**: Electricity indirect GHG emissions
  This encompasses GHG emissions from the generation of purchased electricity consumed by the organization. Scope II emissions physically occur at the facility where electricity is generated, not at the end user site.
- **Scope III**: Other indirect GHG emissions
  This is an optional reporting category under the Greenhouse Gas Protocol that allows for the inclusion of all other indirect emissions. Scope III emissions are a consequence of the activities of the organization, but occur from sources not owned or controlled by the organization. Some examples include extraction and production of purchased materials, and use of sold products and services.

2.1 Scope & Emissions Sources

The first step in developing an inventory is defining the organizational and operational boundaries (WRI, 2002). For the purposes of our inventory, UCSB as an organization includes teaching and research buildings funded by the state, campus housing, and the student-fee-funded buildings (e.g., Recreational Center, University Center). The organizational boundary does not include the University Club, located in downtown Santa Barbara, or other UCSB owned or managed off-campus locations, largely due to lack of available data. The operational boundaries – the activities that we will call UCSB GHG emissions – include all activities represented in the CCAR inventory (Scope I emissions from natural gas-fired boilers and the University fleet, and Scope II emissions from purchased electricity), plus fugitive emissions of HCFCs from cooling units (Scope I), faculty, student, and staff commuting in individual-owned vehicles (Scope III), air travel for University-related business (Scope III), and landfill emissions caused by University-generated waste (Scope III). The *operational boundary* does not include business travel in non-university owned cars or upstream production of materials (e.g., paper), equipment (e.g., computers), or infrastructure (e.g., building materials) used on campus. In setting the operational boundary, we tried to follow the principles outlined by the GHG Protocol (2004) – relevance, completeness, consistency, transparency, and accuracy – but were ultimately largely influenced by the availability of data of reasonable quality (i.e., what UCSB was already measuring, or what could be estimated from something that UCSB was measuring). Finally, our inventory considers the six Kyoto gases[5] and R-22[6], an HCFC used in some on-campus HVAC systems. Figure 2.1 summarizes this information, identifying GHG emissions sources by scope, by whether it is included in the CCAR inventory, and by type of GHG emission.

Figure 2.1: Emissions Sources Considered in the CCN Inventory

Emission Source	Scope	Included in CCAR	Type of GHGs
Natural Gas Use	I	Yes (only CO_2)	CO_2, CH4, N20
University Fleet	I	Yes (only CO_2)	CO_2, CH4, N20
Coolant	I	No	HCFC (R-22)
Purchased Electricity	II	Yes (only CO_2)	CO_2, CH4, N20
Commuting in Individual Owned Vehicles	III	No	CO_2, CH4, N20
Air Travel	III	No	CO_2, CH4, N20
Solid Waste	III	No	CH4

2.2 Methodology & Data Sources

We used the Greenhouse Gas Inventory Calculator (volume 4.0), developed by Clean Air – Cool Planet[7] (CA-CP) specifically for universities, to create a GHG inventory for UCSB. Using the CA-CP Calculator, activity data (e.g., therms of natural gas, kilowatt hours of electricity, number of commuters, miles of air travel) are multiplied by an emissions factor (e.g., kg CO_2/kWh, kg CH_4/kWh) to yield emissions for each activity by specific type of greenhouse gas. However, each GHG has a different heat trapping potential and a different atmospheric lifetime, which results in a different global warming potential (GWP) for each GHG (see Figure 2.2 below).

Figure 2.2: Global Warming Potential

Figure 2.2: Global Warming Potentials and Atmospheric Lifetime of several greenhouse gases[1]		
Gas	**Atmospheric Lifetime (Years)**	**Global Warming Potential (100 Year)**
Carbon Dioxide (CO_2)	50-200	1
Methane (CH_4)	9-15	21
Nitrous Oxide (N_2O)	120	310
HFC – 134A	15	1,300
HFC – 404A[1]	>48	3,260
Sulfur Hexafluoride (SF_6)	3,200	23,900

(Source: CA-CP, 2005)

[5] Carbon dioxide (CO_2), Methane (CH_4), Nitrous oxide (N_2O), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs), Sulphur hexafluoride (SF_6)

[6] R22, also known as Chlorodifluoromethane (CHClF2), is a HCFC with a 100 year global warming potential of 1700 (IPCC, 2001c).

[7] A non-profit based in Portsmouth, NH dedicated to finding and promoting solutions to global warming. http://www.cleanair-coolplanet.org/

The CA-CP Calculator solves this problem by converting the GHG emissions to a common unit of measurement, metric tons of carbon dioxide equivalent ($MTCO_2e$), that can be used to compare all emission sources. What follows is a brief description of the major sources of GHG emissions from UCSB operations.

2.2.1 GHG Emissions Sources Included in CCAR Inventory

Electricity

UCSB does not generate electricity on campus (except in emergency situations), but is responsible for the GHG emissions associated with the generation of the electricity it purchases from its electricity provider. The results of the inventory show that purchased electricity is the single largest source of GHG emission at UCSB and through the previous 15 year time period has been responsible for roughly two thirds of UCSB's total GHG emissions.

For academic years 1996-2003, total electricity demand was determined from an energy use spreadsheet produced by UCSB's energy manager (Sustainability Indicators for UCSB, 2005, p. 2), so we assume the data to be high quality and reliable. For 2004, total electricity demand was calculated based on monthly electricity bills, and so the data is also highly accurate. Prior to 1996, there was limited data available on electricity consumption. For the 1991-1995 period, we utilize data presented in a UCSB Facilities Management presentation (Sustainability Indicators for UCSB, 2005, p. 2), which displays total electricity consumption over the period but does not disaggregate the data. For this reason, we are unsure whether the total numbers over this period include all of the same users of electricity as the more recent periods. Finally, we wanted to obtain data back to 1990 so that we could show what the adoption of a Kyoto target would like for UCSB. We calculated the 1990 electricity consumption by assuming that it was approximately 1% less than energy consumption in 1991.[8]

Once annual kWh data is entered, the CA-CP Calculator converts annual electricity consumption data into GHG emissions through a region specific emissions factors for CO_2, CH_4, and N_20 and then converts these numbers into $MTCO_2e$[9]. In 2004, electricity consumption at UCSB was responsible for emitting **28,941 $MTCO_2e$**, roughly 63% of total emissions. This number is very close to the amount of emissions related to electricity consumption as reported in the University's CCAR inventory, 29,100; the small difference is a result of our inclusion of CH_4 and N_2O emissions from electricity generation and the slightly higher emission factor used in the CCAR inventory.[10]

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[8] The 1% estimation is based on the average growth rate in electricity consumption over the 14 years for which we do have data (see Appendix B).

[9] We chose WECC California, for an emissions factor of 0.362C kg CO_2/kWh, 3.05E-6 kg CH_4/kWh, and 1.68E-6 kg N_2O/kWh (CA-CP, 2005). The CA-CP Calculator took the factors from the US EPA's Emissions and Generated Resource Integrated Database (eGRID) based on data from 2000.

[10] The CCAR used 0.81 lb/kWh (0.367 kg/kWh), which is slightly higher than the emissions factor used in the CA-CP Calculator.

Natural Gas

UCSB utilizes natural gas on campus for building heating and cooling requirements, laboratory research and some fleet vehicles. Natural gas use has historically been the second largest single emission category at UCSB, representing roughly one third of UCSB's total GHG emissions.

For academic years 1996-2003, total natural gas usage was also determined from an energy use spreadsheet produced by UCSB's energy manager (Sustainability Indicators for UCSB, 2005, Page 2); the data is assumed to be of high quality and reliable. For 2004, total natural gas demand was calculated based on monthly bills, also considered to be accurate. Prior to 1996, there was limited data available on total natural gas consumption. We were able to find data for 1992, 1994, and 1995, but had to estimate consumption in 1900, 1991, and 1993 based on average campus growth over time of approximately 1% per year.

The CA-CP Calculator converts annual MMBtu natural gas use into GHG emissions through emissions factors for CO_2, CH_4, and N_20 and then converts these numbers into $MTCO_2e$.[11] In 2004, natural gas consumption at UCSB was responsible for emitting **16,112 $MTCO_2e$**, roughly 35% of total emissions. This number is again very close to the natural gas related emissions reported in UCSB's CCAR inventory (16,067 $MTCO_2$), with differences stemming from the same two reasons provided before for electricity.[12]

Campus Vehicle Fleet

The University fleet includes all University-owned cars and trucks, including carpool and vanpool vehicles. The campus fleet is the smallest of the three categories considered in the CCAR inventory and emissions from these sources are almost negligible in comparison to electricity and natural gas related emissions.

The University fleet includes both gasoline and diesel vehicles, which are entered into the inventory separately because of their differing emissions factors. Gasoline fleet usage is provided by the Campus Fleet Technician over the 1996-2004 time period, and is based on credit card receipts and fuel dispensed on campus. For the 1990-95 period, for which there is no direct data, we assume an annual usage that approximates the average over the time period for which we do have data (see Appendix B for calculation). The diesel consumption data comes from an estimation by the Campus Fleet Technician, as there is no direct measurement available.[13] The CA-CP Calculator converts the annual fuel use into GHG emissions through emissions factors for CO_2, CH_4, and N_2O and then converts these numbers into $MTCO_2e$. In 2004, UCSB fleet fuel consumption was responsible for emitting **1022 $MTCO_2e$**, roughly 2% of total emissions.

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[11] The CACP Calculator uses emission factors of 52.8 kg CO_2/MMBtu, 5.3E-03 kg CH_4/MMBtu, and 1.05E-04 kg N_2O/MMBtu.

[12] The CCAR used 5.28 kg/therm for the Natural Gas calculations.

[13] A lower figure of 2000 gallons per year was provided by the Transportation Department's Computer Systems Coordinator (John Behlman) based on diesel sales for the fleet ambulance and several department-owned vehicles. For consistency, however, we used the Campus Fleet Technician's data since he also provided information on annual gasoline consumption

2.2.2 Other GHG Emissions Sources (not covered by CCAR)

We also provide estimations of GHG emissions from several sources not currently covered by UCSB's CCAR inventory. This broader initial scope allows us to identify potentially significant emissions sources and provide the University with a more accurate reflection of its actual climate footprint and a wider range of mitigation strategies. While some of the "other sources" have relatively small impacts, others (e.g., commuting, air travel) are potentially large GHG emissions sources; and while these emissions are might not be considered "UCSB" emissions in a legal sense, the actions of the University certainly influence these emissions, and so they are relevant when considering mitigation strategies. Furthermore, including these emissions sources improves the comparability of UCSB's inventory with other organizations, since many of these emissions categories are being reported by universities and corporations nationwide.

Refrigeration

UCSB currently uses multiple refrigerants to meet cooling demands, but only R-22 is considered a GHG. UCSB does not currently keep track of summary information on refrigerant usage on campus or fugitive emissions of refrigerants. Therefore, we estimated fugitive emissions of R-22 based on a collection of work orders for the 2004-05 fiscal year, which is labeled 2004 in our inventory. These work orders describe how much R-22 is added and how much was reclaimed or recycled. We assume the difference between what is added and what is taken out is the fugitive emissions. In 2004, based on available work orders, the net R-22 added to the system was 523 pounds, which we take to be the amount of fugitive emissions. Since there was only one year of available data, it was not possible to develop a trend; so, we assumed that 523 pounds were emitted every year from 1990 through 2004. Emissions of R-22 is converted to $MTCO_2e$ in the CA-CP Calculator using an emissions factor, yielding an estimate of **1956 $MTCO_2e$** for refrigerants. If included in the CCAR inventory, emissions of R-22 would represent roughly 4% of UCSB's total GHG emissions.

Solid Waste

Waste disposal produces methane gas emissions in the decomposition of organic matter, and is a common GHG emissions category included in campus inventories. Data on UCSB's solid waste disposal was provided courtesy of UCSB Recycling, Refuse & Integrated Pest Management Manager, Mary Ann Hopkins. The University has a contract with Marborg Industries for waste disposal, which began measuring trash weights in 1993. Therefore, waste disposal data prior to 1993 was estimated at 1993 levels[14]. UCSB waste is disposed of in Tajiguas Landfill, which currently captures landfill gas[15] for electricity generation. Since methane is captured and removed from the atmosphere at the landfill, the CA-CP calculator credits the University with emissions reductions[16]. Therefore, solid waste disposal from UCSB results in negative GHG emissions (net removal of emissions from atmosphere). In 2004, GHG reductions from University waste was **631 $MTCO_2e$**, mitigating roughly 1% of total emissions.

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[14] Note that data from 1994 was not available, so UCSB uses trash weights from 1993 data.

[15] Landfill gas is approximately 50% methane and 50% carbon dioxide (EPA Landfill Methane Outreach Program, 2006).

[16] It is somewhat debatable, however, whether these emissions reductions should be credited to UCSB (or to the landfill), as these projects may or may not be within UCSB's operational control.

Transportation (non-fleet): students, faculty and staff commuting

Non-fleet transportation emissions are a result of students, staff, and faculty commuting to UCSB. Although these emissions belong to the individual commuters, the University has the potential to encourage alternative modes of transportation through its policy decisions and development pattern; as a result, these sources are relevant to an analysis of how UCSB can reduce GHG emissions. In order to calculate the GHG emissions from commuters we estimated the total number of gallons of gasoline consumed. Since there is no easy way of having an accurate quantification (as is available with utility bills), the number of gallons consumed is estimated using a stream of assumptions (listed below). The CA-CP spreadsheet is setup to accept the following inputs to estimate total annual gasoline usage.

1. Number of people
2. Fuel efficiency
3. Percentage who drive alone (Single Occupancy Vehicles or SOV)
4. Percentage who carpool
5. Number of daily trips
6. Number of days completing the trip per year
7. Trip distance

This is broken up into 4 sections in the inventory: Students, Summer School Students, Faculty & Staff. For the students section, the primary data source was the UCSB Office of Budget and Planning (BAP). At BAP, the Institutional Research and Planning group publishes a campus profile each year which documents total enrollment beginning in 1995. To fill in years prior to 1995, the department was contacted directly. The national averages included in the CA-CP spreadsheet were utilized to estimate fuel efficiency.

In 2002 a transportation mode survey was conducted by BAP to determine the number of single occupancy vehicle (SOV) drivers, carpoolers and bus riders. Unfortunately these data were only available for a single year, so extrapolating a trend is not possible. It was therefore assumed that each year had the same mode split percentage. Parking permit sales data was provided by Transportation and Parking Services (TPS) for 2004. This data set included the zip code for the permit purchase. From the zip code distances were estimated from the center of the zip code to the east gate entrance of UCSB for each permit sold. From this an average commute distance was determined to be 10.4 miles each way. It was then assumed that a total of 2 trips were taken daily. The typical academic year is 150 days, so we assumed that was the number of days an individual would travel to campus.[17] From this, the amount of fuel consumed was estimated.[18]

Finally, the CA-CP calculator converts fuel consumption to GHG emissions just as it did for UCSB fleet. In 2004, student commuting was responsible for approximately **8200 MT CO_2e**, representing **12%** of total GHG emissions in the broader CCN inventory. Faculty/Staff commuting was estimated using the same methods, and in 2004, resulted in the emission of **4500 MT CO_2e**, or **7%** of total emissions.

[17] An identical procedure was used to determine the faculty and staff, however the number of people was provided by Carol Houchens at UCSB Human Resources.

[18] Fuel Consumption = MPG / [(Total Students x % Drive Alone) + (Total Students x % Carpool)/2] x Trips/Day x Days/Year x Miles/Trip

Air Travel

Air Travel emissions are associated with the flights of UCSB faculty and staff while on University-related business. In the CA-CP Calculator, the input is air miles for faculty and staff. However, UCSB does not have thorough documentation of all air travel from UCSB faculty and administration. The UCSB Accounting Services and Controls Department only tracks total travel costs, which can also include car rental and hotel costs. Furthermore, since travel planning is extremely decentralized, there are many ways in which people on campus can purchase and get reimbursed for travel expenses.

As air mile data is not tracked on campus, determining GHG emissions from air travel relies on a stream of assumptions, similar to the methods used in calculating emissions from commuters. Since the only documentation of air travel was total travel cost, we decided to estimate mileage from total money spent, using a range of $0.15 - $0.25 per mile traveled (Huang, 2000). Using a rough estimate[19] of 50% of total travel expenses being attributable to airline tickets, we assume a range of $6,000,000 to $10,000,000 for air travel costs in 2004. Using these combinations of ranges, the total air mileage in 2004 was determined to be between 24,000,000 miles and 67,000,000 miles. Since there is very little certainty in this calculation, we elected to use to lower estimate to be conservative. In 2004, we estimate air travel related emissions of **6700 MT CO_2e**, which represent 10% of UCSB's total emissions[20].

2.3 Current GHG Emissions and Historical Trends

2.3.1 Assessment of Current UCSB Emissions Sources

Figure 2.3 displays the total CCAR-included GHG emissions for the most current period (2004) by emissions source. In 2004, total emissions were approximately 46,000 MTCO_2e, the majority of which came from electricity and natural gas consumption. To give some perspective, this is approximately the amount of GHG emitted by 8,000 cars per year.[21]

Figure 2.3: UCSB CCAR-included GHG Emissions for 2004

2004	2004	Energy Consumption	CO_2	CH_4	N_2O	MTCO_2	Percent of Total
		MMBtu	Kg	kg	kg	Metric Tons	%
Purchased Electricity		494,729	28,895,569	242	134	**28,941**	**62.81%**
Stationary Sources	Natural Gas	304,315	16,065,201	1,604	32	**16,112**	**34.97%**
Transport Total	University Fleet	14,184	997,696	191	66	**1,022**	**2.22%**
Total		**813,228**	**45,958,466**	**2,036**	**232**	**46,074**	**100%**

[19] Based on a meeting with Asger Pedersen, Manager of Accounts Payable in the Accounting Department.
[20] If the higher estimate were used, air travel would account for over 40% of UCSB emissions.
[21] For one car = 15,000 miles/year * 0.045 gallons/mile * 0.00871 MTCO_2e/gallon = 5.88 MTCO_2e/year → 46,074 MTCO_2e / 5.88 MTCO_2e = 7835 cars

Figure 2.4 includes the total GHG emissions (from both CCAR and non-CCAR sources) for the most current period. The inclusion of these additional sources (commuting, air travel, coolants) results in an increase of 20,000 $MTCO_2e$, almost 50% of total CCAR-included emissions.

Figure 2.4: UCSB Total GHG Emissions for 2004

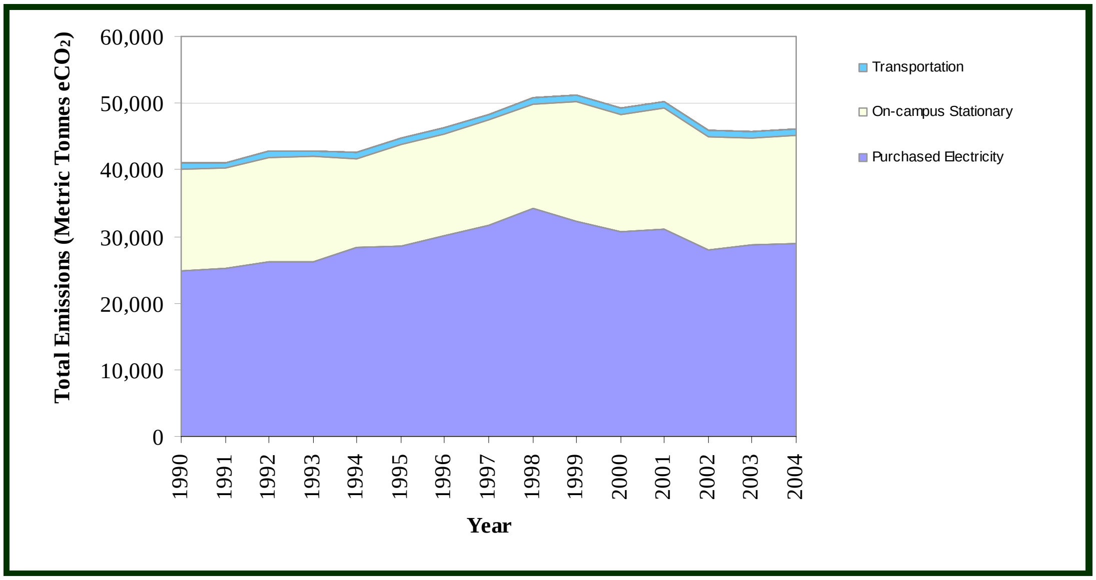
2004		Energy Consumption	CO_2	CH_4	N_2O	Other Chemicals	$MTCO_{2e}$	Percent of Total
		MMBtu	kg	kg	kg	kg	Metric Tons	%
Purchased Electricity		494,729	28,895,569	242	134		**28,941**	**43.32%**
Stationary Sources	Natural Gas	304,315	16,065,201	1,604	32		**16,112**	**24.11%**
Transport Total		285,420	20,036,153	2,855	1,130		**20,436**	**30.59%**
	University Fleet	14,184	997,696	191	66		**1,022**	**1.53%**
	Student Commuters	114,104	8,010,565	1,603	552		**8,211**	**12.29%**
	Faculty/Staff Commuters	62,572	4,392,815	879	302		**4,503**	**6.74%**
	Faculty/Staff Air Travel	94,560	6,635,077	183	210		**6,701**	**10.03%**
Solid Waste		-	-	(27,439)	-		**(631)**	**-0.94%**
Refrigeration						1,151	**1,956**	**2.93%**
Total		**1,084,464**	**64,996,922**	**(22,738)**	**1,296**	**1,151**	**66,814**	

The results of the inventory suggest that the largest opportunities for GHG emissions reductions are likely to be related to electricity and natural gas consumption. However, the relatively large size of these "other" emissions – commuting and air travel, in particular – suggests that the UCSB does have the potential to reduce GHG emissions significantly through strategies that address these categories of emissions as well.

2.3.2 Historical Trends in GHG Emissions

Although non-CCAR emissions sources are acknowledged to be potentially important, the rest of the analysis in this chapter will focus on CCAR sources only, since these are the categories for which the university has committed to measuring and reporting annually. Additionally, the data underlying these categories are believed to be fairly accurate and certain. This section assesses the historic CCAR-included emissions inventory for the past fifteen years. Figure 2.5 shows that emissions have grown by roughly 5000 $MTCO_2e$ over this time period, roughly one percent per year, largely due to a small increase in electricity consumption.

Figure 2.5: Total CCAR GHG Emissions Trend by Source



Interestingly, total emissions peak in 1999 and shrink by two percent per year, on average, through 2004. This emissions reduction was not caused by a reduction in students or square footage; rather it was largely due to significant new investments in energy efficiency on campus precipitated by the California energy crisis. In fact, this trend occurs *despite* increases in enrollment and building footage (see Appendix B). The noteworthy results of this investment in energy efficiency in the late 90s can also be seen in the declining trends of emissions per student and emissions per building square footage (see Figures 2.6 and 2.7).

Figure 2.6: MTCO$_2$e per student from 1990 – 2004

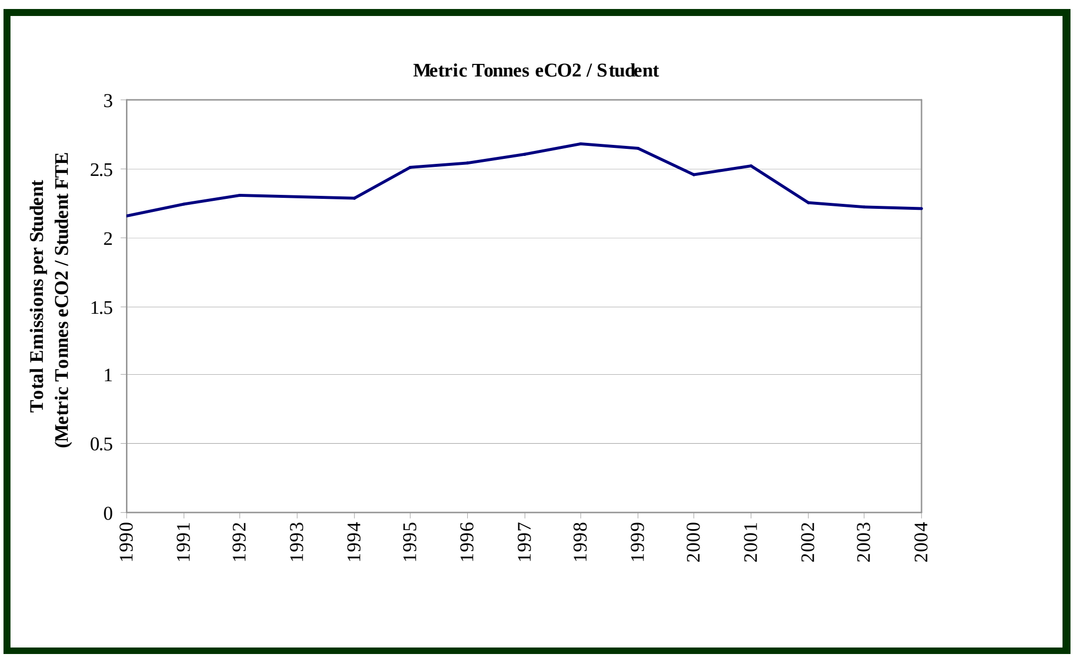
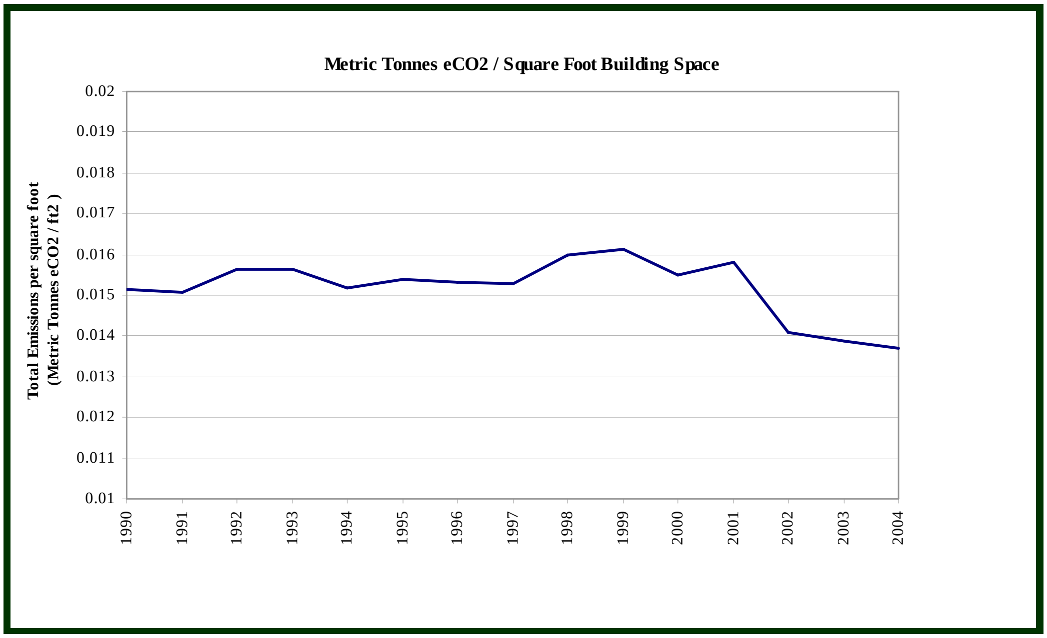


Figure 2.7: $MTCO_2e$ per square foot building space from 1990 – 2004



These emissions intensity trends show a similar peak in 1999 and reductions through 2004. Emissions per student in 2004 is roughly equivalent to 1990 levels and emissions per square foot is actually less than 1990 levels. This is a promising finding and suggests that UCSB has the potential to reduce emissions without reducing campus despite projected growth.

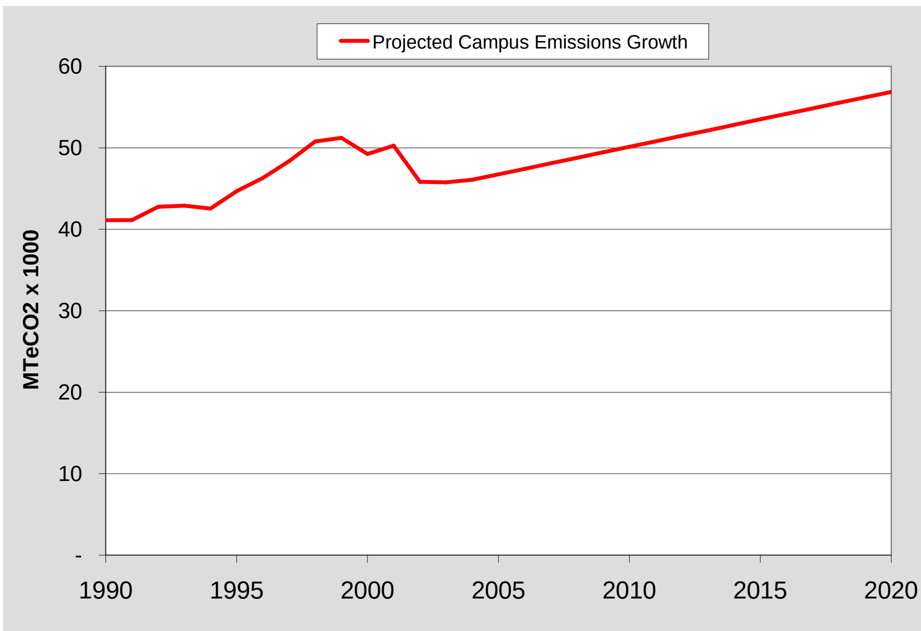
After completing the initial inventory, it is possible to consider targets for GHG emissions reductions in the future. The following sections build upon the inventory, first by estimating future emissions growth in a business as usual scenario. Then, from this baseline, we quantify the emissions reductions that would be required to meet particular reduction targets – California State, Kyoto, and Climate Neutrality – through 2020.

2.4 Campus Growth Projections

According to the Office of Campus Planning and Design, UCSB is anticipating growth of approximately 300 students per year through 2020 (UCSB, 2005). Using this information we can project campus emissions as well. Figure 2.6, which shows total emissions divided by total students for each year, illustrates that this intensity index has remained relatively level at about 2.25 – 2.5 $MTCO_2e$/student for the past 15 years. Although the GHG emissions/student intensity has shown a decreasing trend in recent years, interviews with Facilities staff indicate that several energy intensive laboratory buildings are being constructed, and that this will increase energy consumption on campus significantly. UCSB's projected growth, however, is not likely to differ significantly from its current academic profile (it is likely to continue to grow in both the sciences and the humanities).[22] As a result of these two facts – the stability of the intensity metric over the last 15 years and the knowledge about the balanced nature of projected campus growth – the intensity metric (total GHG emissions/ total students) can reasonably be utilized to project a business as usual scenario for UCSB's GHG emissions into the future.

Utilizing the most current intensity index, we assume that each of the 300 new students per year will increase UCSB's GHG emissions by 2.25 $MTCO_2e$ annually, totaling 675 $MTCO_2e$ per year. We utilize this projection (Figure 2.8) as a baseline from which we can quantify the emissions reductions that would be required to meet particular reductions targets through 2020 (displayed in Figure 2.9 as the vertical distance between any target line and the projected campus emissions line for any particular year). We chose a fifteen year time horizon for our analysis because it conforms well to the University's planning horizon and the physical lifetimes of many of our mitigation strategies.

Figure 2.8: Projected Campus Emissions Growth



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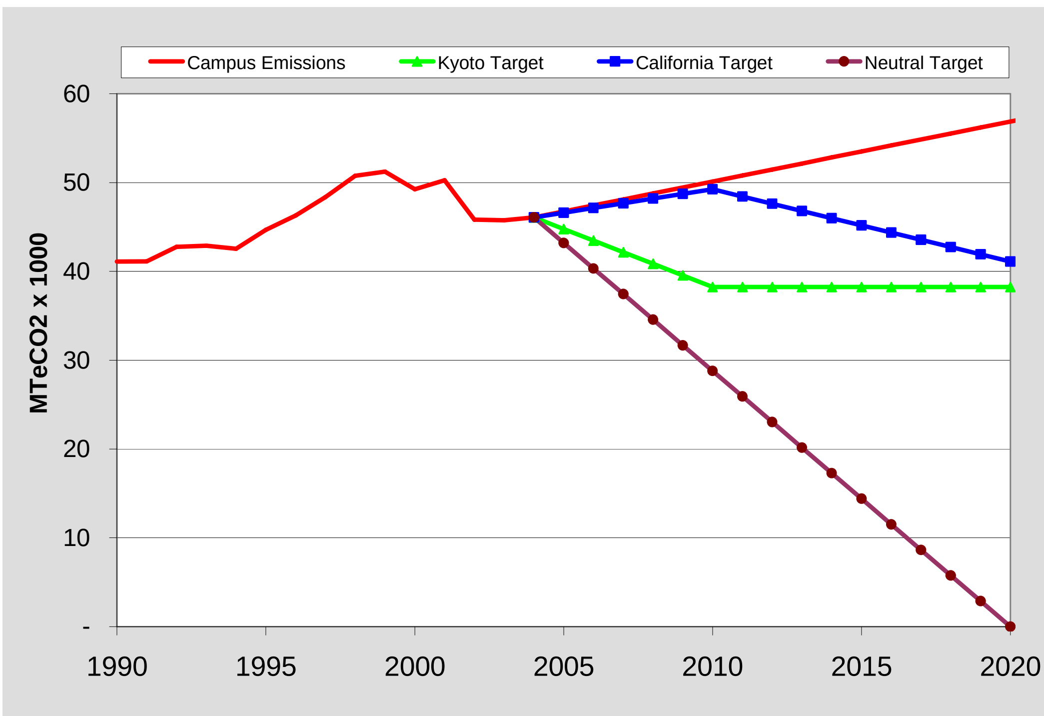
[22] Science buildings tend to be much more energy intensive than Humanities buildings, so if UCSB's projected growth was likely going to be targeted towards the sciences, this would have implications for the growth in GHG emissions through time and would make our use of the current intensity index (GHG emissions/student) less reliable.

2.5 Application of Emissions Reduction Targets to UCSB

With climate change policies being proposed at the international, federal and state level, it is worth analyzing what these proposed reduction targets would look like if implemented at UCSB. With improved climate change science and increasing awareness of the necessity of action, climate regulation is likely to be passed at the California, if not at the federal, level in the near future. Rather than make up arbitrary emissions reduction targets for UCSB, we examine three possible emissions cap regimes that have been proposed by policymakers and non-profit organizations – the California Targets proposed by Governor Schwarzenegger, the Kyoto Target, in effect for most developed countries, and Climate Neutrality (by 2020), proposed by environmentalists (see Figure 2.9).

Figure 2.9 – Projected Campus Growth with Target Comparison



2.5.1 California State Targets for UCSB

At the United Nations World Environment Day on June 1st, 2005 Governor Schwarzenegger announced "clear and ambitious" GHG emissions reduction targets for California (Schwarzenegger, 2005). These targets were formalized in Executive Order S-3-05, which called for 3 different phases of GHG reduction:

- 2000 levels by 2010;
- 1990 levels by 2020; and
- 80% below 1990 levels by 2050.

We consider the first two of the California targets in our analysis for UCSB as our planning horizon is through 2020. The targets as applied to UCSB and the resulting emission reductions required are shown in Figure 2.10. The energy crisis in 2000-2001 and resulting energy conservation already undertaken by UCSB helps to make the California targets very achievable in the near-term; specifically, UCSB's current emissions are already below 2000 levels. Given projected campus growth, UCSB is expected to be at 50,124 $MTCO_2e$ by 2010. In order to achieve the first target, emissions would have to be reduced by 145 $MTCO_2e$ on average per year until 2010 below the business as usual scenario. Achieving the more aggressive 2020 target would require more aggressive cuts on the order of 1500 $MTCO_2e$ per year beginning in 2010.

Figure 2.10: California Target Reduction Requirement

Year	Projected UCSB Growth ($MTCO_2e$)	CA Targets	UCSB Target Level ($MTCO_2e$)	Average annual change below projection ($MTCO_2e$)
2010	50,124	2000 emissions level	49,249	-145 beginning in 2004
2020	56,874	1990 emissions level	41,119	-1575 beginning in 2010

2.5.2 Kyoto Protocol Targets for UCSB

The Kyoto Protocol went into effect on February 16, 2005. Developed countries which have ratified the protocol will have to reduce their collective emissions to 5.2% below 1990 levels, calculated as an average from 2008 – 2012[23]. The specific emission targets for the signing countries varied depending on their emission profiles. If the U.S. had ratified, it would have been responsible for reducing by 7% below 1990 levels.

Given estimated campus emissions in 1990 of 41,119 $MTCO_2e$, a 7% reduction in emissions below 1990 levels implies that UCSB's total emissions would have to be 38,240 $MTCO_2e$. Since emissions have grown since 1990, this target will be more challenging than simply meeting the Governor's targets for California (see Figures 2.10 and 2.11). Furthermore, projected campus growth would result in emission levels of approximately 50,124 $MTCO_2e$ by 2010 under a business as usual scenario, which corresponds to a 22% increase in 1990 emissions by 2008-2012.

On average, to meet the Kyoto Target, approximately 1,980 $MTCO_2e$ would have to be reduced each year beginning at 2004 numbers and ending in 2010, the midway point of the commitment period. We then hold this emissions level constant through 2020 because the targets and timetables beyond the 2008-2012 commitment period have yet to be agreed upon.

Figure 2.11: Kyoto Target Reduction Requirement

Year	Projected Growth ($MTCO_2e$)	Kyoto Target	UCSB Target Level ($MTCO_2e$)	Average Annual Change below projection ($MTCO_2e$)
2010	50,124	7% below 1990	38,240	-1980

[23] For ease of calculation, we replace the 5 year commitment period (2008-2012) with a 2010 target. Furthermore, because there are currently no commitments beyond the 2012 period, we hold the established commitments constant through 2020.

2.5.3 Climate Neutral by 2020 Target for UCSB

We also consider a more ambitious goal – Climate Neutrality, or net zero GHG emissions. Recognizing that the current emissions reduction targets being proposed (e.g., California State Targets and Kyoto Protocol) will likely be insufficient to prevent dangerous levels of climate change, the European Union has set a 2ºC climate target that implies that GHG emissions must be reduced by 15-30% below 1990 levels by 2020 (Elzen, M.G.J & Meinshausen, M., 2005). Additionally, since financial, technical, and political challenges exist in ensuring comprehensive participation in GHG reductions across all countries and sectors, some have recognized that it will be necessary for others to more aggressively reduce emissions to make up for those who are currently unable or unwilling (Worth , 2005; Friedman, 2006; Climate Neutral Network, 2006). Although this certainly raises issues of equity and burden sharing, the importance of maintaining a stable climate for present and future generations can not be overemphasized. Meeting this target will require aggressive reductions on campus and the purchase of external offsets to cover the remainder of emissions. Figure 2.12 shows a summary of the requirements to reach Climate Neutrality by 2020.

Figure 2.12: Neutral by 2020 Reduction Requirement

Year	Projected Growth ($MTCO_2e$)	Climate Neutral Target	UCSB Target Level ($MTCO_2e$)	Average Annual Change below projection ($MTCO_2e$)
2020	56,874	0 by 2020	0	-2880

2.6 Summary

Undertaking GHG emissions reduction requires staff time, creation of new programs, buying new equipment, and ultimately, encouraging people to change their consumption patterns. Establishing an overarching target from the top can help to encourage these types of changes. Determining an appropriate reduction target for greenhouse gas emissions is a critical first step towards lasting change. The Kyoto Protocol, the California targets, and Climate Neutrality are examples of the type of goals that could be set for UCSB. Being that UCSB is a State-funded institution, there could be a natural synergy in encouraging the use of the California targets as a default target. The next chapter will consider specific policy mechanisms which UCSB could pursue to reduce emissions to levels prescribed by the targets.

CHAPTER 3: GHG MITIGATION STRATEGIES AT UCSB

There are a wide variety of mitigation options available for organizations attempting to reduce their net GHG emissions, from investments in energy efficiency to the purchase of carbon offsets, from procurement of renewable energy to funding alternative transportation programs. This multitude of different options can make deciding on the best path overwhelming, especially since the options appear difficult to compare – how does one compare a forestry sequestration project to an energy conservation program? We address the apples and oranges problem by describing all mitigation mechanisms according to some common metrics. One useful metric, $/ $MTCO_2e$, reflects the net present value of the mechanism (including upfront costs and energy savings over time) and the quantity of GHG emissions reduced by the mechanism. We also recognize that UCSB, as a public university, does not make decisions solely on the basis of net present value. For this reason, we include other evaluation criteria that are also relevant to decision makers on campus, including sheer capital cost and payback. Finally, we organize the discussion of mitigation strategies in a similar way to how we analyze the emissions inventory, choosing to differentiate between the mechanisms that reduce emissions from CCAR-covered sources and those that reduce emissions from other sources.

3.1 Mitigation Mechanism Evaluation Criteria

One important characteristic of any GHG reduction mechanism is its net present value (cost) per unit of GHG reduced ($MTCO_2e$), which we call $/$MTCO_2e$ (Hummel, n.d., p.8). The $ term is a net present value (NPV) calculation, and includes the upfront costs and the discounted stream of future savings (e.g., energy savings, avoided air travel) associated with the mechanism. The NPV calculation is then divided by the GHG savings over the lifetime of the project to yield the $/$MTCO_2e$ figure, which represents the net savings (or costs) to UCSB by reducing one metric ton of carbon dioxide equivalent using the particular mechanism (see Figure 3.1 for an example calculation). In performing this calculation we make a number of assumptions, including values for the cost of energy, the discount rate, the lifetime of a mechanism, that significantly influence the results. We maintain the same assumptions across the various mechanisms, where appropriate, and display these assumptions as clearly as possible so that they could be changed as new information develops.

Figure 3.1: An Example Calculation – Bren Hall Fume Hood Proximity Sensors

This project would install proximity sensors on 16 fume hoods in Bren Hall that would reduce the fume hood airflow by 40% during nonuse periods. UCSB Facilities Management (FM) estimate the project will cost $80,000 up front (without considering grants) and will result in annual energy savings of 96,580 kWh and 4,082 therms of natural gas. Furthermore, we assume a project lifetime of 15 years, energy costs of $0.11/kWh and $0.90/therm, and a discount rate of 6 percent.

<u>$ Calculation</u>
NPV = Upfront cost + energy savings over lifetime of project
NPV = -80,000 + [(96,580 kWh* $.11/kWh)* NPV factor + (4082 therms * $0.90/therm)* NPV factor]

Where NPV factor = $\frac{(1+0.06)^{15}-1}{0.06*(1+0.06)^{15}}$ = 9.71

NPV = $-80,000 + [(10,624*9.71) + (3674*9.71)] = -80,000 + (103,159 + 35,673) = $58,832
This project will produce net savings over the lifetime of the project.

<u>$MTCO_2e$ Calculation</u>
We assume emissions factors of 2755 kWh/$MTCO_2e$ and 200 therms/$MTCO_2e$ based on our inventory results.
$MTCO_2e$ = (energy savings/year / emissions factor) * project lifetime in years
$MTCO_2e$ = (96,580 kWh/ 2755 kWh/ $MTCO_2e$ + 4082 therms / 200 therms/MT) * 15 years
$MTCO_2e$ = (35 $MTCO_2e$ + 20.4 $MTCO_2e$) * 15 = 832 $MTCO_2e$

<u>$/$MTCO_2e$ Calculation</u> = $58,832 / 832 $MTCO_2e$ = $70.71/$MTCO_2e$
This number indicates that UCSB should recoup a net present value of savings of $70.7 per $MTCO_2e$ reduced using this mechanism over the lifetime of the project.

Another important characteristic of a GHG reduction mechanism from the University's point of view is the sheer size of the capital cost. Capital cost refers to upfront investment needed for the specific policy mechanism to be implemented on campus (e.g., the cost of solar panels, the cost of carbon offsets). UCSB faces a number of constraints in obtaining the necessary funding for projects which limit their ability to make investments in projects that otherwise make sense – those with high internal rates of return and quick paybacks (see Chapter 5 for a more detailed discussion of funding constraints). Therefore, the capital requirement of a project in itself (as opposed to the NPV) is a very important characteristic of a mechanism. Also relevant is the number of years required to recover the upfront investment – the payback period[24]. While not without its drawbacks (i.e., ignoring the time value of money, ignoring savings after the breakeven time period), this is a metric commonly used to evaluate on campus projects and can be a more accessible number than NPV.

[24] Payback period (in years) = Capital cost of project /Cost savings per year.

We also include several other pieces of information for each mitigation mechanism that are not meant to be criteria in themselves, but that provide important information that decision makers would want to see when comparing the various mechanisms across the previously described criteria. The first, GHG reduction potential, refers to the amount of GHG reduction UCSB could achieve through a specific policy mechanism in a given year (not the lifetime emissions reduction). This metric gives decision makers important information about how far a particular mechanism can get them in terms of GHG reductions in any particular year and is integral to determining the number of projects needed to meet a specific emissions target. Finally, we include a label to indicate whether or not a particular mechanism responds to emissions sources covered by the CCAR inventory or whether they correspond to emissions from other sources. The University is likely to be interested in opportunities for reductions in emissions that are being measured first, so this label allows for an easy separation of the mechanisms into the ones that respond to CCAR-covered emissions and those that do not.

3.2 GHG Emissions Reduction Strategies

We profile a range of GHG reduction strategies with the twin purposes of providing the University with a menu of options that would reduce emissions and demonstrating the method of analysis. Within each GHG reduction strategy (e.g., energy efficiency, on-site renewable energy), several specific mitigation mechanisms are explored as concrete steps the University may take towards emissions reductions. The mitigation mechanisms profiled in this section represent examples of the kinds of things UCSB could do to reduce its emissions rather than an exhaustive or fully comprehensive survey of the University's on-campus mitigation options; furthermore, the inclusion of a specific mechanism in our analysis does not reflect the CCN team's support for the implementation of the mechanism (we provide recommendations in Chapter 6). This section provides a synthesis of the mitigation options we considered, with some discussion of their relative attractiveness. Detailed information for any specific mitigation mechanism, including descriptions, calculations, and underlying assumptions can be found in Appendix C.

3.2.1 Mechanisms to Reduce CCAR Emissions Sources

Energy Efficiency Improvements

Improvements in energy efficiency have been the primary driver of UCSB's reduced energy consumption in the recent past; these investments have saved the University millions of dollars while, at the same time, reducing the University's GHG emissions (Dewey, 2004, p. 32). While an engineering style energy audit of the University would have been ideal for identifying UCSB-specific energy efficiency projects in a comprehensive manner, this was not within the means of the CCN project; instead, we do provide several potential energy efficiency projects developed by UCSB engineers as examples of the kinds of savings that are available to UCSB through energy efficiency, recognizing that there are a multitude of additional efficiency opportunities not considered in our analysis.[25] As Figure 3.2 demonstrates, energy efficiency mechanisms are very attractive GHG reducing mechanisms – they all generate net savings per $MTCO_2e$ and almost all projects have paybacks of less than five years. As such, these projects make sense even without an explicit goal of

[25] All energy efficiency mechanisms come from a UCSB Energy Team analysis with the exception of Energy Star Computer Settings.

reducing GHG emissions; however, as GHG reduction projects they also make sense, yielding a total annual emissions reduction of 3800 tons, or 8% of UCSB's 2004 CCAR emissions.

Figure 3.2: Energy Efficiency Mechanisms[26]

Mechanism	CCAR?	Capital Cost ($)	Payback (Years)	$/$MTCO_2e$	Annual GHG Reduction Potential ($MTCO_2e$)	Project Lifetime (Years)
Energy Star Computer Settings	Yes	$0	0.0	$196	310	15
Lighting Upgrades	Yes	$1,797,762	4.9	$97	835	15
HVAC Upgrade - Fans	Yes	$1,574,464	3.5	$125	914	15
HVAC Upgrade - Filters	Yes	$372,323	0.0	$196	607	15
HVAC Upgrade- Air Handlers	Yes	$550,000	10.2	$42	174	15
Fume Hood Proximity Sensors	Yes	$80,000	3.7	$156	55	15
Air Handlers - Optimize Hot/Cold Deck Temperature	Yes	$200,000	0.4	$245	573	15
HVAC Commissioning	Yes	$120,000	0.2	$241	340	15

On-Site Renewable Energy

On-site renewable energy plays a small but critical role in reducing the University's GHG emissions. The current presence of photovoltaic and solar hot water heating systems on campus is a noticeable mark in the University's Sustainability mission and commitment to reduce GHG emissions. Energy provided by on-site renewable energy is not connected to the fossil-fuel based energy grid and therefore emits no greenhouse gas emissions and is also price static (not subject to energy price spikes and blackouts) for the life of system. Furthermore, government subsidies (California Public Utilities Commission renewable energy rebates, Federal Tax Credits) can help to significantly reduce the cost of expensive on-site renewable energy projects.

Figure 3.3 below demonstrates two on-site renewable energy mechanisms that are based on past UCSB accomplishments – the seven UCSB Housing buildings that contain solar heating systems and the photovoltaic array on the Bren School roof. The solar heating project was purchased by a third party Energy Services Company (ESCO), which agreed to cover the capital and continual maintenance costs of the project. The ESCO was able to qualify for the CPUC energy rebate as well as the Federal Energy tax credit greatly reducing their costs for the project. In addition, the monthly amount paid by the University for a solar therm providing hot water is 75% of the monthly cost of a therm provided by natural gas. This current system captures annual emissions reduction of 312 $MTCO_2e$, or 0.68% of UCSB's CCAR emissions, and yields net savings of $23/$MTCO_2e$. With

[26] See Appendix C (Policy mechanisms 5, 6.1 – 6.7) for assumptions and calculations.

current government subsidies for solar water heating, a similar project could be completed for the West Campus Family Housing expansion.

Bren Hall currently has a 42 kW photovoltaic array on its roof. If a similar project were to be completed on a similar existing building, such as the neighboring Marine Science Institute, UCSB can directly qualify for the current CPUC rebate of $2.80/W (DSIRE, 2006) but will *not* qualify for the Federal Energy tax credit because of its tax exempt status. If UCSB decided to employ a third party contractor to purchase the panels it would qualify for the Federal Energy tax credit of up to 30% (this calculation has been excluded from this mechanism). This project will provide an annual reduction of 24 $MTCO_2e$, or 0.05% of UCSB's CCAR emissions and yield net cost of $139/$MTCO_2e$.

Figure 3.3: On-site Renewable Energy Mechanisms[27]

Mechanism	In CCAR?	Capital Cost ($)	Payback (Years)	$/$MTCO_2e$	Annual GHG Reduction Potential ($MTCO_2e$)	Project Lifetime (Years)
On-site 42KW PV System	Yes	$323,400	53.0	-$492	20	25
Solar Water Heating Project for UCSB Housing	Yes	$0	0.0	$23	312	25

Energy Conservation through Occupation Awareness

While UCSB has made tremendous strides in energy efficiency in the past years, less attention has been devoted to raising the consciousness of energy end users on campus. Since students, staff and faculty do not directly pay the utility bills, the campus building occupants have little incentive to conserve energy; anecdotal evidence suggests that a significant opportunity exists to reduce energy load through modifying occupant behavior. Two mechanisms are suggested to help raise awareness of campus building occupants: publicize department energy usage and reward departments for energy conservation.

Both mechanisms would require the installation of additional building level meters for electricity and natural gas, which are approximately $1000 per meter. The mechanism to publicize department energy usage was inspired by the successful EPA Toxic Release Inventory that resulted in significant reductions in reported emissions[28]. Presumably, energy data could be both published monthly in the school paper, The Daily Nexus, as well as posted prominently on the UCSB Facilities homepage. Publicly available data on energy consumption would encourage individuals to be mindful of their energy consumption by making it obvious who the large energy users are on campus, and by reminding the community that energy conservation is important every time the data is published.

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[27] See Appendix C (Policy mechanisms 3.1 - 3.2) for assumptions and calculations.
[28] Between 1998 and 1999, TRI reported emissions fell by approximately 40% (Bui & Mayer, 2003).

Rewarding departments for energy conservation may help to encourage additional efforts to reduce energy usage at the individual level. Giving departments a prize, or other financial reward, for reducing energy load below some baseline or relative to other departments may help to motivate departments and individuals to more actively reduce their energy usage. Although both mechanisms examined here require the same capital cost for installing building-level meters, developing a program of rewards for departments may need additional staff time. Yet department rewards for energy conservation are likely to result in more greenhouse gas emissions reductions.

Figure 3.4: Occupant Awareness Mechanisms[29]

Mechanism	CCAR?	Capital Cost ($)	Payback (Years)	$/MTCO$_2$e	Annual GHG Reduction Potential (MTCO$_2$e)	Project Lifetime (Years)
Building Public Data	Yes	$15,000	14.5	-$149	3	15
Building Baseline Awards	Yes	$15,000	2.9	$127	14	15

Fleet Related Emissions Reduction

Although the campus fleet contributes a relatively small amount of greenhouse gas emissions compared to other campus sources, many fleet-related emissions reduction mechanisms can be implemented with minimal time and money. Two types of alternative fuel mechanisms are examined, since both can be utilized by campus fleet vehicles with no retrofits or other capital costs. While biodiesel is expected to have an operating cost premium, personal interviews with the campus fleet technician indicate that ethanol may not have such a premium if a fueling station could be set up within the community. Since most vehicles on campus run on gasoline, significant emissions savings could be found if all fleet trucks were flex-fuel vehicles running on E85[30].

Besides alternative fuels, the UCSB may also invest in vehicles that have superior fuel efficiency, and hence fewer emissions. Hybrids and smaller vehicles are two such mechanisms. While more expensive, hybrids typically have almost twice the gas efficiency of non-hybrids by running on both gasoline and electricity generated from waste energy related to braking. The University may also improve fuel efficiency simply by purchasing smaller vehicles. For this example, an improvement of fuel efficiency from 16 mpg to 20 mpg yielded significant emissions reductions at a cost savings. Furthermore, a smaller vehicle will often cost less which means that the University reaps savings from both avoided gasoline purchases and in the capital cost of the car.

Lastly, the University may also reduce emissions related to its campus fleet simply by encouraging staff members to drive less. Some facilities personnel indicated that they would be happy to use bicycles to travel across campus for meetings and other calls when larger equipment and supplies are not needed.

[29] See Appendix C (Policy mechanisms 2.1 - 2.2) for assumptions and calculations.

[30] Nearly 5 million flex-fuel vehicles are already commonly found on the road today. For example, most GMC trucks sold on the market today are flex-fuel vehicles and UCSB already owns two flex-fuel vehicles.

Figure 3.5: Fleet-related Emissions Reduction Mechanisms[31]

Mechanism	CCAR?	Capital Cost ($)	Payback (Years)	$/MTCO₂e	Annual GHG Reduction Potential (MTCO₂e)	Project Lifetime (Years)
Fleet Ethanol	Yes	$0	0.0	$0	796	15
Fleet Biodiesel	Yes	$0	never	-$65	30	15
Fleet Biking	Yes	$2,500	9.0	$11	1	15
Fleet Smaller Vehicles	Yes	$0	0.0	$215	33	10
Fleet Hybrids	Yes	$155,000	12.9	-$162	41	10

External Mitigation Options – Off-site Renewable Energy & Offsets

In addition to the multitude of mitigation options available to UCSB on campus, there are also an increasing number of external sources of emissions reduction credits. Specific external mitigation mechanisms include purchases of renewable energy (e.g., green power from electric utilities, renewable energy credits (RECs)), where purchasers pay a premium (e.g., 1 cent/kWh) to receive electricity generated from renewable sources; external mitigation mechanisms also include the various forms of carbon offsets, including market based credits (e.g., carbon dioxide on the EU market) and project based credits (e.g., carbon sequestration, renewable energy), where purchasers pay a price per ton of CO2. External mitigation options, to the extent that they represent real emissions reductions, are just as effective from the perspective of climate impact as on-campus mitigation strategies. These external sources can provide opportunities for further emissions reductions once all feasible on-campus mechanisms are implemented; additionally, should the University commit to specific targets, they represent a place where the University could find emissions credits should it find itself short of its target.

Figure 3.6: External Mitigation Options

Mechanism	CCAR?	Capital Cost ($)	Payback (Years)	$/MTCO₂e	Annual GHG Reduction Potential (MTCO₂e)	Project Lifetime (Years)
15% Offset Purchase	Yes	$73,309	never	-$11	6911	1
100% Offset Purchase	Yes	$488,725	never	-$11	46074	1
15% RECs	Yes	$119,600	never	-$28	4341	1

We specifically profile two types of external mitigation options – carbon offsets and RECs.[32] They are generally not attractive according to the $/ $MTCO_2e$ and payback criteria because there are not savings associated with these strategies (see Figure 3.6). Despite this, there are several useful features of these mitigation strategies that justify their consideration. First of all, from a strict cost point of view, the price of external offsets should represent the price cap for all on-campus

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[31] See Appendix C (Policy mechanisms 7.1 – 7.5) for assumptions and calculations.
[32] See Appendix C (Policy mechanisms 1) for assumptions and calculations.

mitigation projects – any project that costs (\$/MTCO_2e) more than the price of a high-quality emissions offset should not be undertaken solely for its carbon reduction purposes (other considerations might also be important, which would alter the decision making criteria). Additionally, external offsets, because of their large GHG reduction potential, facilitate the calculation of relevant metrics; for instance, it would cost UCSB approximately $500,000 (Figure 3.6) to be Climate Neutral[33] this year. Similar calculations can be made for any potential emissions target and can provide important information to decision makers when deciding upon the feasibility of an emissions target.

3.2.2 Mechanisms to Reduce Non-CCAR Emissions Sources

We also provide a few example mechanisms that address GHG emissions from sources not included in the California Climate Action Registry (CCAR) inventory. While UCSB would probably not legally own any emission reduction credits created by these mechanisms, these projects still have the potential to reduce emissions; being that UCSB is currently under no regulatory requirements to its emissions, the legal ownership of emissions credits is less important. Furthermore, many of these mitigation mechanisms have benefits beyond GHG emissions reductions (e.g., dollar savings, traffic reduction) that also justify their consideration.

Video Conferencing

UCSB Faculty and Staff air travel is a potentially major, yet difficult to quantify, GHG source. The Department of Accounting Services and Controls currently lacks participation from its travelers to submit records through its electronic travel voucher system (Web TV). Once full participation occurs, all travel can be conveniently retrieved and exact emissions can be calculated. Even without knowing exact emissions from travel, a videoconferencing program could mandate staff and encourage faculty to use on-campus videoconferencing technology instead of traveling off-site. Such trips include: UCOP, UC Regents and other university related meetings and staff-related trainings that are held in the central office in Oakland or at the other UC campuses. This would avoid the current high cost and emissions generated from traveling to these remote locations. It is also important to note, but difficult to quantify, the significant opportunity costs of employee travel – an employee may not be able to perform his or her job effectively while traveling on flights and switching from different modes of transportation (e.g., plane to taxi/train/rental car) as opposed to working in the office.

The financial and GHG related information for three scenarios considering this option are given in Figure 3.7. These scenarios aimed to substitute the annual flights (30) taken by the Department of Accounting Services and Controls at UCSB with videoconferencing (Corkill, personal interview, 2/24/06). For the first mechanism we assume that the existing videoconference facilities, both Studio B and Studio C, of capacity 5 people and 25 people respectively, at Kerr Hall could immediately satisfy this department's travel needs. For the second mechanism we assume that constructing an additional small videoconference room (similar to the size of Studio C with a capital cost of $30,000) could then satisfy another similar department's travel needs (totaling 60 annual flights). For the third mechanism we assume constructing an additional large video conference room (similar to the size of Studio B with a capital cost of $80,000) could satisfy two other similar department's needs, totaling 90 annual flights (Tracey, personal interview, 2/8/2005). Due to the

[33] Offset its CCAR emissions.

high cost of air travel, video conferencing projects can be justified solely on their cash savings and quick payback in addition to their emissions reductions.

Figure 3.7: Videoconferencing

Mechanism	CCAR?	Capital Cost ($)	Payback (Years)	$/MTCO$_2$e	Annual GHG Reduction Potential (MTCO$_2$e)	Project Lifetime (Years)
Use current videoconference rooms	No	$0	0.0	$1,506	4	15
Construct small videoconference room	No	$30,000	1.5	$1,279	9	15
Construct large videoconference room	No	$80,000	2.6	$1,102	13	15

Commuting Mechanism

Commuting to campus is one of the most politically challenging GHG sources to mitigate – however when included in the total emissions, commuters account for a non-negligible part of the overall profile. At the same time building parking structures is very costly – about $25,000 per parking space – and space intensive (UCSB BAP Website, 2006). There are many reasons to reduce parking demand, one of which is climate change. Both of the policies listed below assume that parking is a normal economic good (i.e., that if price increases, demand will decrease). The assumptions for parking rate increase model rely upon a study by Washbrook (1992), which assumes that a doubling in rates will result in a 10% reduction in parking demand. Using the assumption of doubled parking rates, UCSB has the potential to eliminate 600 single occupancy vehicle (SOV) drivers, saving 966 MTCO$_2$e annually and increasing revenue by $2.1 million as a result of the higher rates. This level of rate increase would probably be considered impossible because of the campus attitude; however, it would be possible to extrapolate results using less aggressive assumptions.

Another option for reducing parking demand is by providing additional payment options for parking on campus. Currently individuals can choose to pay for hourly spaces (approximately $8.00 per day) or purchase quarterly parking permits ($40 per month). This policy mechanism assumes that some people may be purchasing parking permits, encouraging unlimited usage of parking on campus, when they may actually be able to avoid driving to campus on certain days. A third option could be allowing people to pay for their actual usage, like hourly parking, but at a more competitive price, thus discouraging unnecessary trips to campus. While this policy is theoretically technology neutral, we assume the use of In-Vehicle Parking Meters (IVPMs), something that is already used on campus in the TAP program. Assuming 100 people participate in the program per year, and choose to drive to school one less day per week, approximately 26 MTCO$_2$e could be conserved annually.

Figure 3.8: Commuting Mechanisms

Mechanism	CCAR?	Capital Cost ($)	Payback (Years)	$/MTCO$_2$e	Annual GHG Reduction Potential (MTCO$_2$e)	Project Lifetime (Years)
Increase Parking Rates	No	$0	0.0	$1,407	2	15
Parking Rate Incrementilization	No	$6,000	never	$15	26	15

Solid Waste

Since solid waste generated by UCSB campus creates methane when it decomposes, UCSB should consider mechanisms to reduce the amount of solid waste that is disposed of in the local landfill. Although the Clean Air – Cool Planet calculator gives UCSB emissions "credit" for the methane capture and combustion at its local landfill, it may be debatable whether these credits truly belong to UCSB or to the landfill. Since UCSB is already composting much of its green waste, and some of the dorm kitchen waste[34], one of the last opportunities to reduce organic solid waste would be at the University Center (UCen). Unfortunately, preliminary cost estimations indicate that composting food waste from the UCen would come at a cost premium.

Figure 3.9: Solid Waste Mechanism – Composting

Mechanism	CCAR?	Capital Cost ($)	Payback (Years)	$/MTCO$_2$e	Annual GHG Reduction Potential (MTCO$_2$e)	Project Lifetime (Years)
Composting program	No	$1,500	never	-$22	36	15

[34] Grounds keeping green waste is composted by Marborg Industries. Dorm kitchen waste is composted behind the UCSB Santa Ynez Apartments.

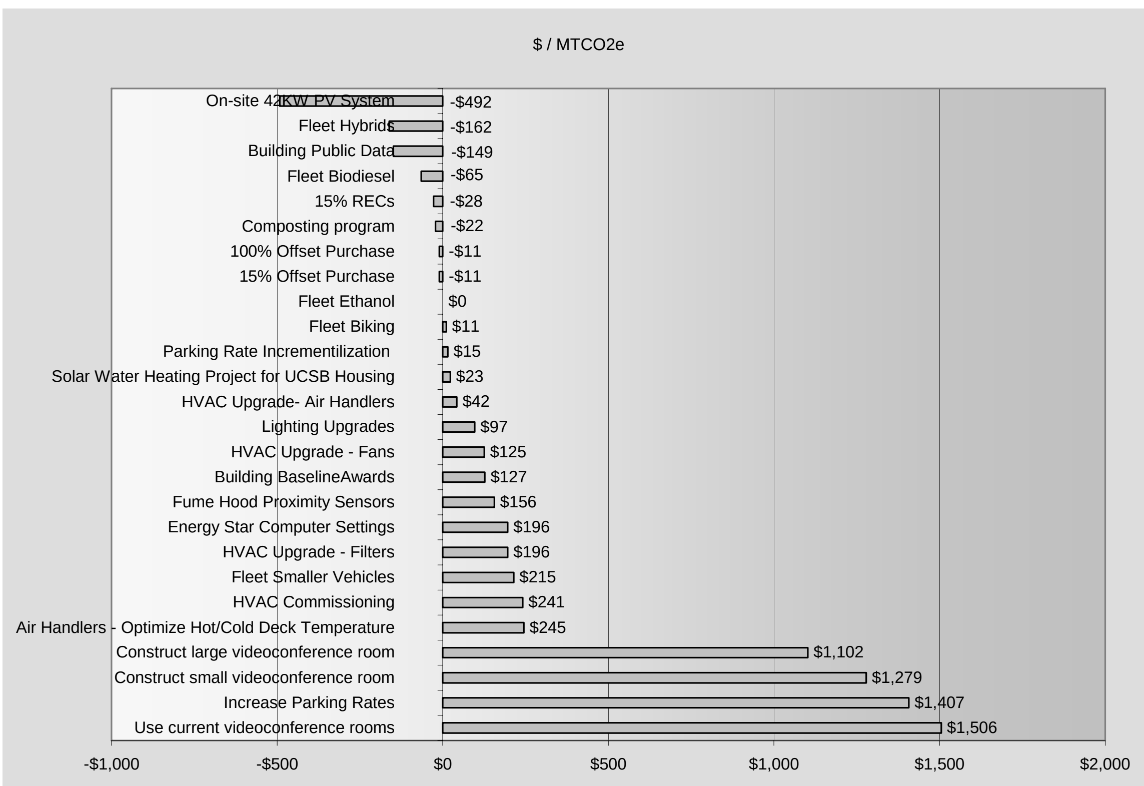
3.3 Results

As was alluded to earlier, there are a number of criteria with which UCSB decision makers evaluate campus projects. Accordingly, we provide a synthesis of the results of our mitigation mechanism evaluations according the three key criteria: \$/MTCO_2e, capital cost, and payback.

3.3.1 \$/ MTCO_2e

According to the \$/MTCO_2e criteria alone, the energy efficiency mechanisms, a smaller vehicle fleet, and incentives for energy conservation in on-campus buildings all have net savings per ton mitigated (see Figure 3.10) – these mechanisms save UCSB money over the life of the project in addition to reducing GHG emissions. If UCSB were to only choose projects with zero or positive \$/MTCO_2e, it could reduce emissions by almost 5000 MTCO_2e, or 11% of its total 2004 CCAR-covered GHG emissions.

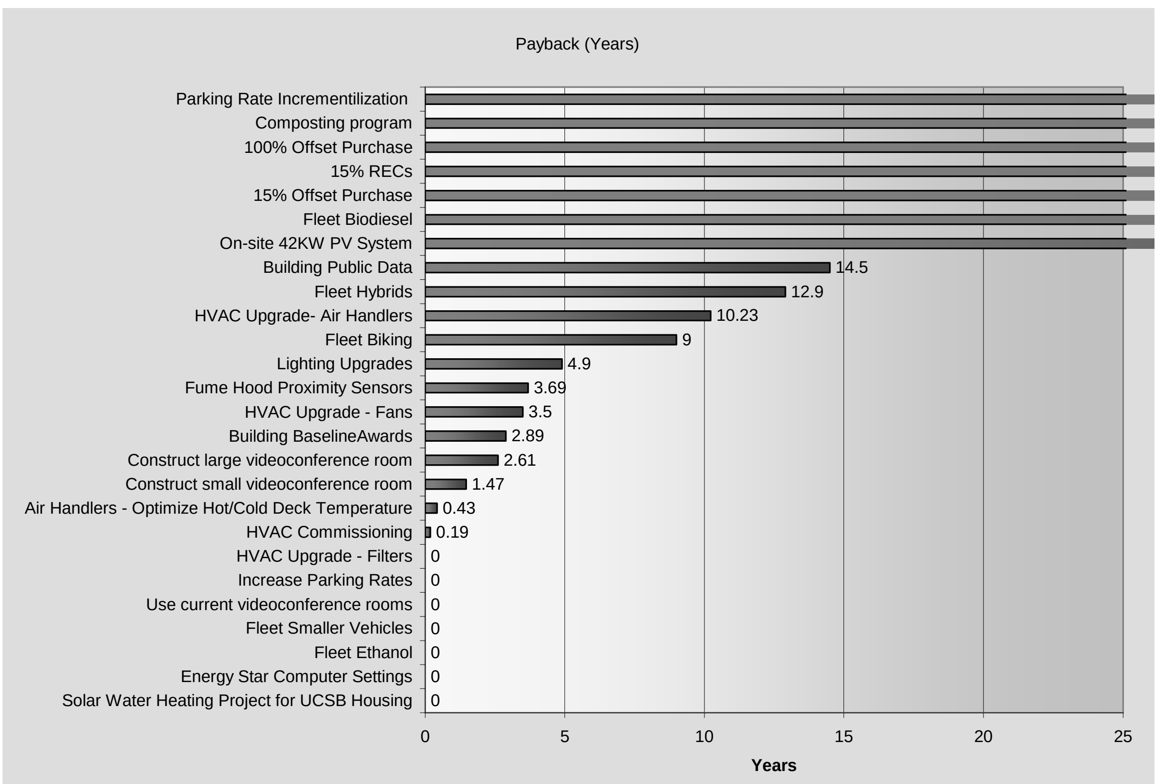
Figure 3.10: Policy Mechanisms (CCAR) Sorted by \$/MTCO_2e



3.3.2 Payback Period

According to the payback criterion, mechanisms with low to no capital costs and mechanisms with large energy savings are attractive. These include energy efficiency mechanisms that receive external funding (i.e., through grants, rebates, or performance contracting), low cost energy conservation incentives, and fleet improvements (see Figure 3.11). If UCSB implemented only those mechanisms that pay back immediately (an overly restrictive standard), it could reduce GHG emissions by over 2000 $MTCO_2e$ (almost 5% of total emissions). UCSB decision makers typically look for projects with payback periods of less than five years, which in itself is a fairly stringent standard (implying a 20% simple internal rate of return); if all such projects were implemented, UCSB could reduce its emissions by almost 5000 $MTCO_2e$, which represents more than 10% of UCSB's total CCAR-included emissions.

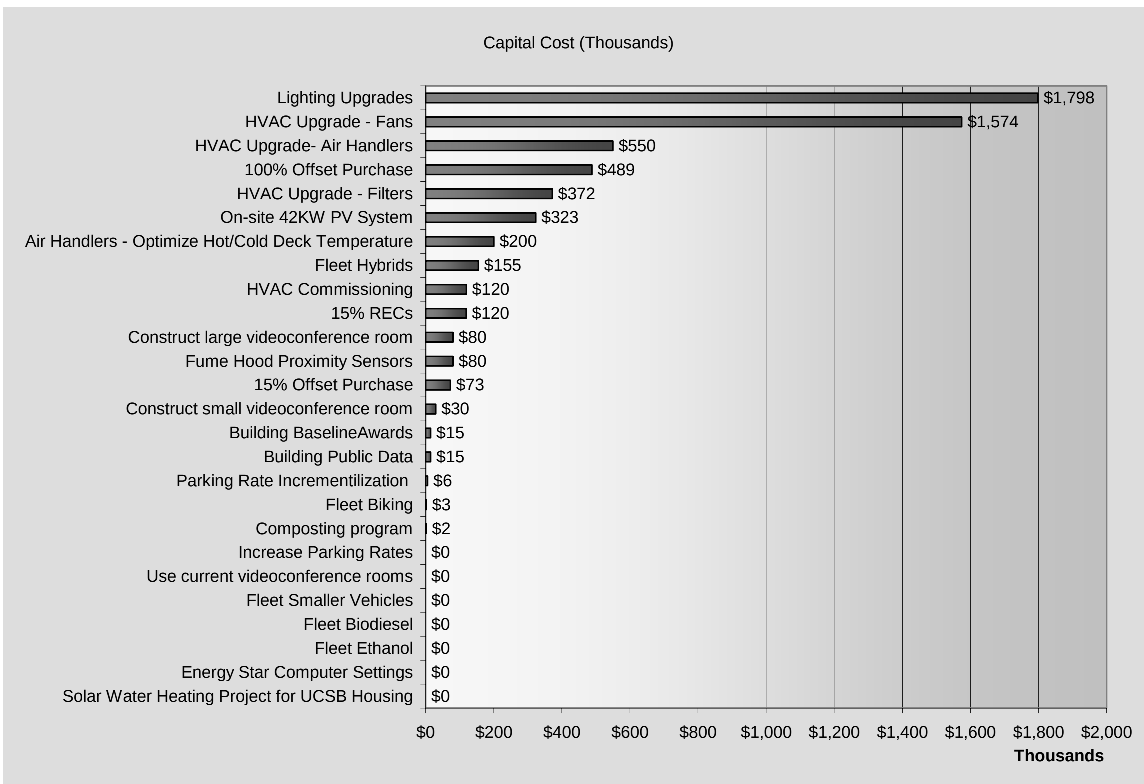
Figure 3.11: Policy Mechanisms (CCAR) Sorted by Payback Period



3.3.3 Capital Cost

According the capital cost criteria alone (see Figure 3.12), attractive mitigation mechanisms include those that address the UCSB fleet, energy conservation through behavior change, and energy service companies (e.g., solar hot water heaters). Alternatively, the energy efficiency mechanisms are problematic under this single criterion because the energy savings produced by them are not reflected in this criterion. The renewable energy projects, both on-campus and external, also entail significant capital costs (>$75k) and so do not do well according to this criteria. If UCSB were to implement only the mechanisms with zero capital cost, they could reduce GHG emissions by almost 1500 $MTCO_2e$ (3% of total emissions).

Figure 3.12: Policy Mechanisms (CCAR) Sorted by Capital Cost



The next chapter integrates the previous two chapters – the GHG emissions inventory reduction targets and the mitigation mechanisms – and analyzes the overall financial feasibility of meeting particular GHG emissions reduction targets given projected campus growth and the mitigation options outlined above.

CHAPTER 4: ANALYSIS OF UCSB MEETING EMISSIONS TARGETS

In the previous two chapters we described potential emissions targets that UCSB may adopt and a range of mitigation strategies that could reduce emissions. This chapter combines the findings of these two previous chapters and identifies combinations of mitigation mechanisms that would enable UCSB to meet the proposed emissions target timelines. In addition to GHG impact, the financial terms of these packaged mitigation strategies are also assessed in terms of net present value and cash flow.

4.1 Approach for Selecting Mitigation Mechanisms

We employ a common logic for choosing the appropriate mitigation mechanisms to meet the desired targets (see Box below). This logic reflects the University's initial preference for implementing zero or low capital cost projects first. However, the emissions reduction targets cannot be met solely with mechanisms with zero capital cost given projected campus growth; once these projects have been exhausted, we turn to projects yielding the highest energy savings relative to their project lifetime cost, reflecting the University's preference for mechanisms that payback quickly. Finally, the price of external carbon offsets represents the price ceiling for mitigation strategies – once projects with a $/$MTCO_2e$ below the price of external offsets ($11/ton) are used up, we assume the University would chose to purchase the external offsets rather than invest in the more expensive on-campus projects.

Mechanism Choice Logic

1) Implement all feasible mechanisms with no capital costs that yield dollar savings as soon as possible.
    a. Energy Star.
    b. Fleet – Purchase small vehicles.
    c. Fleet – Purchase ethanol.
2) Implement mechanisms that yield the highest savings over time (highest $/$MTCO_2e$).
    a. Energy efficiency and conservation projects.
3) Once all mechanisms with costs below the price of external offsets have been exhausted, the University meets all additional emissions reductions through the purchase of carbon offsets.

There are two important caveats to this decision logic. The first, and most important, is that while the energy efficiency mechanisms are by far the best mechanisms on the policy matrix, we only consider a small sample of the potential cost-effective mitigation mechanisms. As mentioned earlier, we did not perform building energy audits and believe that UCSB could identify additional cost-effective mitigation mechanisms that would delay the need for purchasing carbon offsets. The second is that we assume the purchase of offsets to demonstrate a least cost approach for UCSB to meet specific emissions targets and not necessarily as a recommendation that UCSB should offset its emissions.

In terms of the time frame of analysis, we assume that 2005 is the present and extend our analysis for fifteen years (to 2020). We chose the former because 2004 is the last year for which we have complete inventory data and the latter because fifteen years corresponds to the lifetime length of the majority of the mitigation mechanisms and the time frame also includes the key commitment periods for the potential emissions reductions targets (i.e. California State Targets and Kyoto Target). Additionally, beyond 2020, our assumptions (i.e. energy costs and available technology) become more tenuous and, by then, new developments in mitigation technology would likely make this analysis obsolete. Finally, only CCAR-covered emissions sources and mitigation strategies are considered in this analysis.[35]

4.2 California State Targets at UCSB[36]

Following the decision logic described above, Figure 4.1 outlines the proposed project implementation timeline for meeting the first two California State Targets. Figure 4.2 illustrates graphically how these projects enable UCSB to follow the necessary emissions reduction path (CA State Targets shown with dashed line). The solid trend line shows UCSB reducing its GHG emissions through time with the implementation of on-campus projects with costs lower than the external offset price; these *on campus* emissions reduction opportunities keep UCSB on track to with the California Targets through 2012. After that point, the most inexpensive mitigation mechanisms have been exhausted, and purchasing offsets becomes the next cheapest alternative. Therefore, we assume that UCSB purchases external offsets to make up the difference in the following years. See Figure 4.1 for a specific project implementation schedule and corresponding chart in Figure 4.2.

Figure 4.1: Proposed Implementation of Mechanisms to Achieve California Targets

Year	Mechanism	Annual GHG reduction ($MTCO_2e$)	Capital cost	Annual savings
2005	Energy star computer settings	310	$0	$94,000
	Fleet smaller vehicles	33	$0	$9,545
	Fleet ethanol	1	$0	$0
2011	HVAC Upgrade – Air Handlers (1)	573	$200,000	$112,000
	HVAC Commissioning	340	$120,000	$71,159
	HVAC Upgrade – Filters	607	$372,323	$184,053
	EE – Fume Hoods	55	$80,000	$14,298
	Building baseline awards	14	$15,000	$4385
2012	HVAC Upgrade – Fans	914	$1,574,464	$277,048
	Lighting Upgrades	835	$1,797,762	$252,919
2013	HVAC Upgrade – Air Handlers (2)	174	$550,000	$45,328
	Reduce fleet driving – bikes	1	$2500	$27
	Begin purchasing offsets	763	$8,091	$0

35 We assume that UCSB is likely to be primarily interested in reducing emissions from sources that they are measuring and publicly reporting through the CCAR. Additionally, we assume that only projects that reduce CCAR-covered emissions are relevant emissions reduction strategies.

36 For a description of the California State targets and the emissions reductions necessary to meet them given projected campus growth, see Section 2.5.

Figure 4.2: Emissions Trends and Path to California Targets

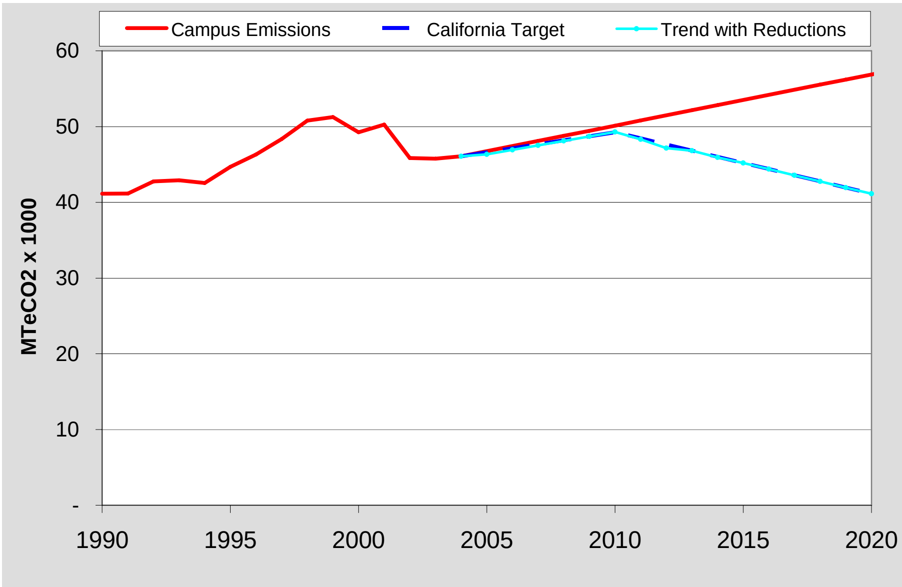
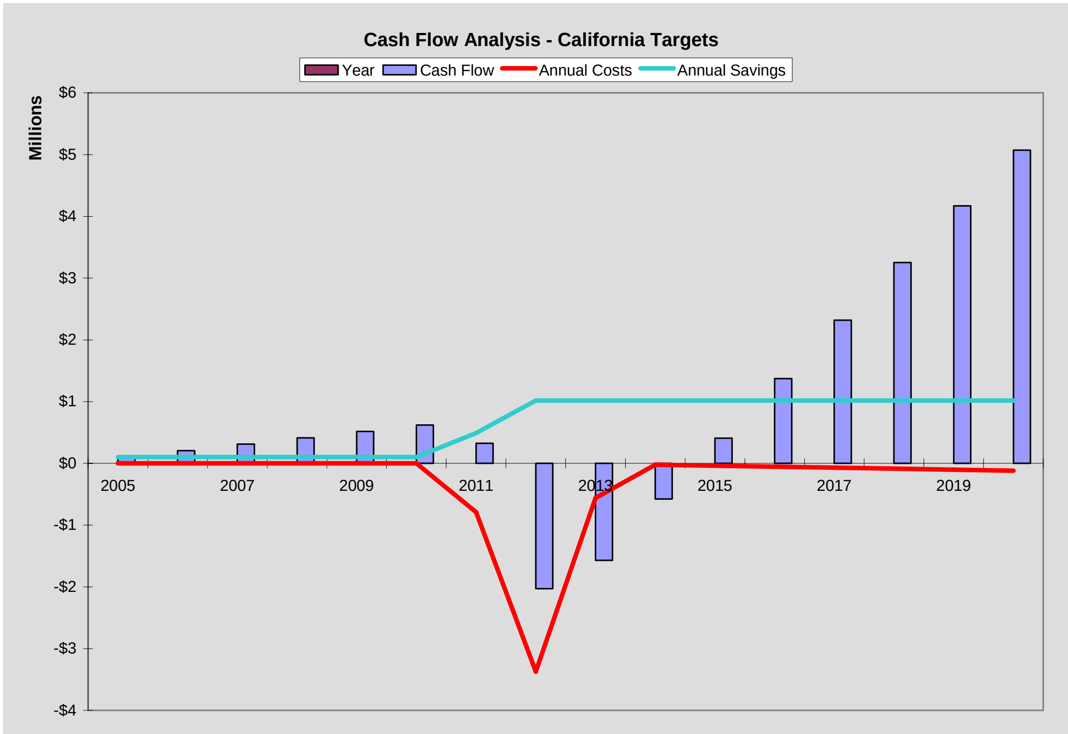


Figure 4.3 shows the cash flow analysis for this implementation schedule. This combination of mechanisms has a net savings of **$5 million**. Using a 6% discount rate, the net present value is **$2.4 million**, including the cost of offsets, suggesting that the University could meet the Governor's targets through 2020 according to the emissions path described and save a significant amount of money in the process. This emissions trajectory does require some significant capital investments after 2010 (when the target increases in stringency); but, as the cash flow analysis illustrates, these capital investments are recouped quickly through energy savings.

Figure 4.3: Cash Flow Analysis for Meeting the California Targets



According to the previous analysis meeting the Governor's targets not only appears feasible through 2020 despite significant campus growth, it is also justified solely on the basis of economics.

4.3 Kyoto Protocol Target at UCSB

The charts below tell a similar story for the Kyoto Target. Figure 4.4 shows a more aggressive implementation schedule in the short-term – implementation of mitigation mechanisms would be required sooner than for the California Targets. However, it uses the same logic and implements the projects in the same order, only faster. Figure 4.5 illustrate the specific reduction path that UCSB could take to meet the Kyoto Protocol for a commitment period of 2008 – 2012.

Figure 4.4: Proposed Implementation of Mechanisms to Achieve Kyoto Target

Year	Mechanism	Annual GHG reduction MTCE	Capital cost	Annual savings
2006	Energy star computer settings	310	$0	$94,000
	Fleet smaller vehicles	33	$0	$9,545
	Fleet ethanol	1	$0	$0
	HVAC Upgrade – Air Handlers (1)	573	$200,000	$112,000
	HVAC Commissioning	340	$120,000	$71,159
	HVAC Upgrade – Filters	607	$372,323	$184,053
	EE – Fume Hoods	55	$80,000	$14,298
	Building baseline awards	14	$15,000	$4,385
	HVA Upgrade – Fans	914	$1,574,464	$277,048
	Lighting Upgrades	835	$1,797,762	$252,919
2007	HVAC Upgrade – Air Handlers (2)	174	$550,000	$45,328
	Reduce fleet driving – bikes	1	$2500	$27
	Begin purchasing offsets			

Figure 4.5: Emissions Path to Kyoto Target

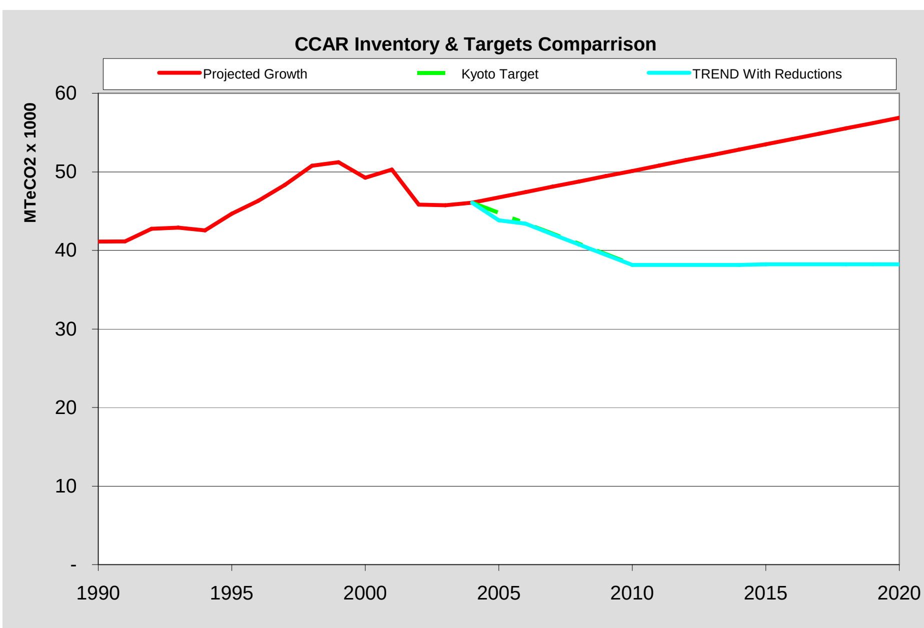


Figure 4.6: Cash Flow Analysis for Meeting the Kyoto Target

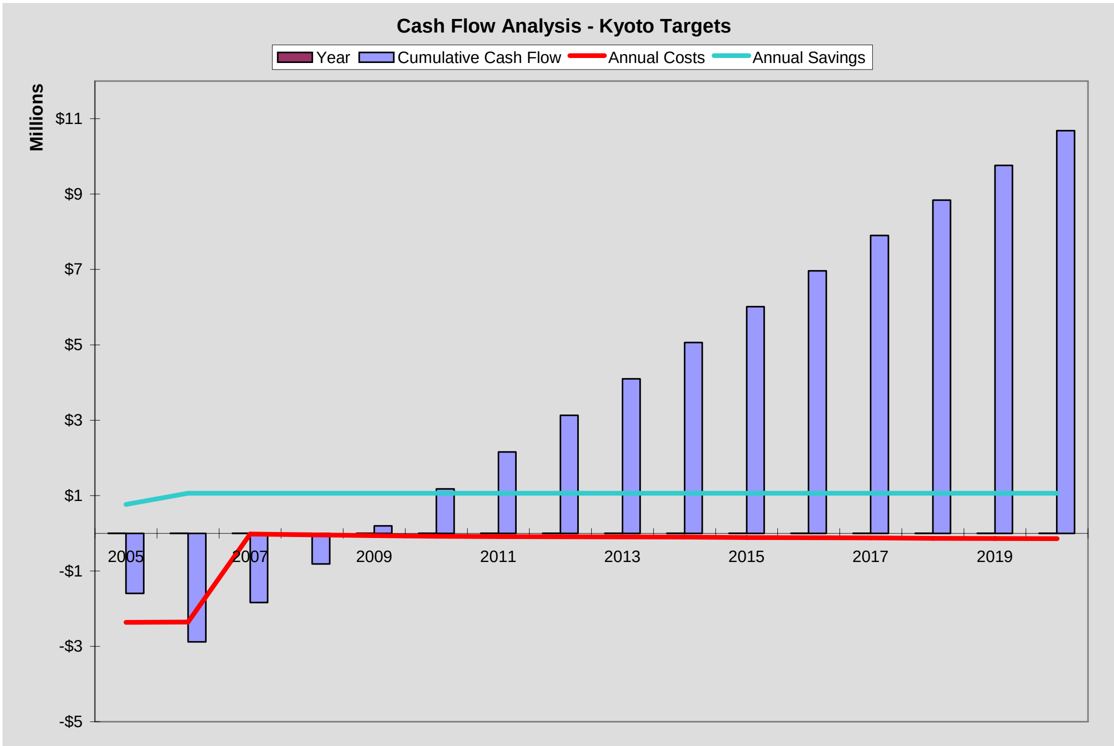


Figure 4.6 shows the cash flow analysis for the Kyoto Target. Total costs for implementing all the projects is the same for the previous scenario, however the $1 million dollars in annual savings – which is expected once all the mechanisms have been implemented – will begin accruing much earlier, yielding a higher overall savings. The net savings would be approximately **$11 million** by 2020. Using a 6% discount rate the NPV of this scenario is approximately **$5.7 million**.

4.4 Climate Neutral Target for UCSB

Like the California Targets and the Kyoto Target, achieving neutrality is both profitable and achievable. Following the implementation methodology described above, we show that all identified projects would have to be implemented immediately and offsets would have to be purchased every year from 2006 onwards to achieve the level of reduction necessary to be on schedule to achieve Climate Neutrality by 2020. See Figures 4.7 and 4.8 for a description and diagram of the implementation schedule. Figure 4.9 shows the cash flow analysis for the Climate Neutral Target. It is notable that significant purchases of offsets are required to achieve neutrality and reduces the net savings below the level of the Kyoto targets, to approximately **$8 million** by 2020, or **$4.3 Million** using a 6% discount rate.

Figure 4.7: Proposed Implementation of Mechanisms to Achieve Neutral Target by 2020

Year	Mechanism	Annual GHG reduction MTCE	Capital cost	Annual savings
2006	Energy star computer settings	310	$0	$94,000
	Fleet smaller vehicles	33	$0	$9,545
	Fleet ethanol	1	$0	$0
	HVAC Upgrade – Air Handlers (1)	573	$200,000	$112,000
	HVAC Commissioning	340	$120,000	$71,159
	HVAC Upgrade – Filters	607	$372,323	$184,053
	EE – Fume Hoods	55	$80,000	$14,298
	Building baseline awards	14	$15,000	$4,385
	HVA Upgrade – Fans	914	$1,574,464	$277,048
	Lighting Upgrades	835	$1,797,762	$252,919
	HVAC Upgrade – Air Handlers (2)	174	$550,000	$45,328
	Reduce fleet driving – bikes	1	$2,500	$27
	Begin purchasing offsets			

Figure 4.8: Emission Path to Climate Neutrality by 2020

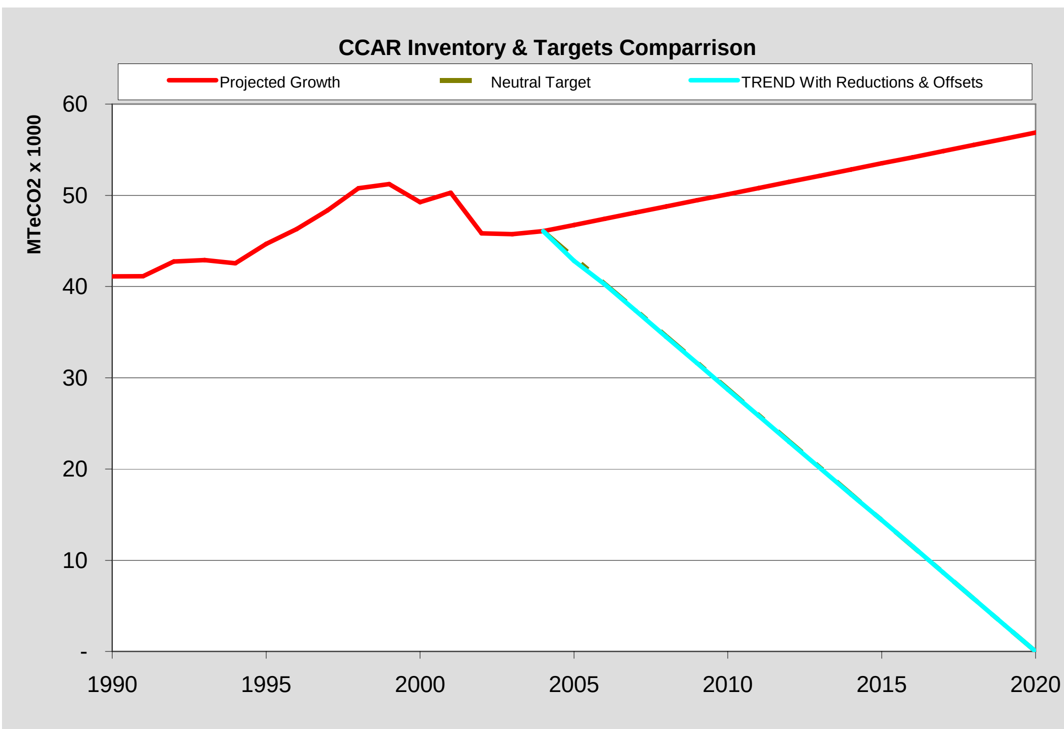
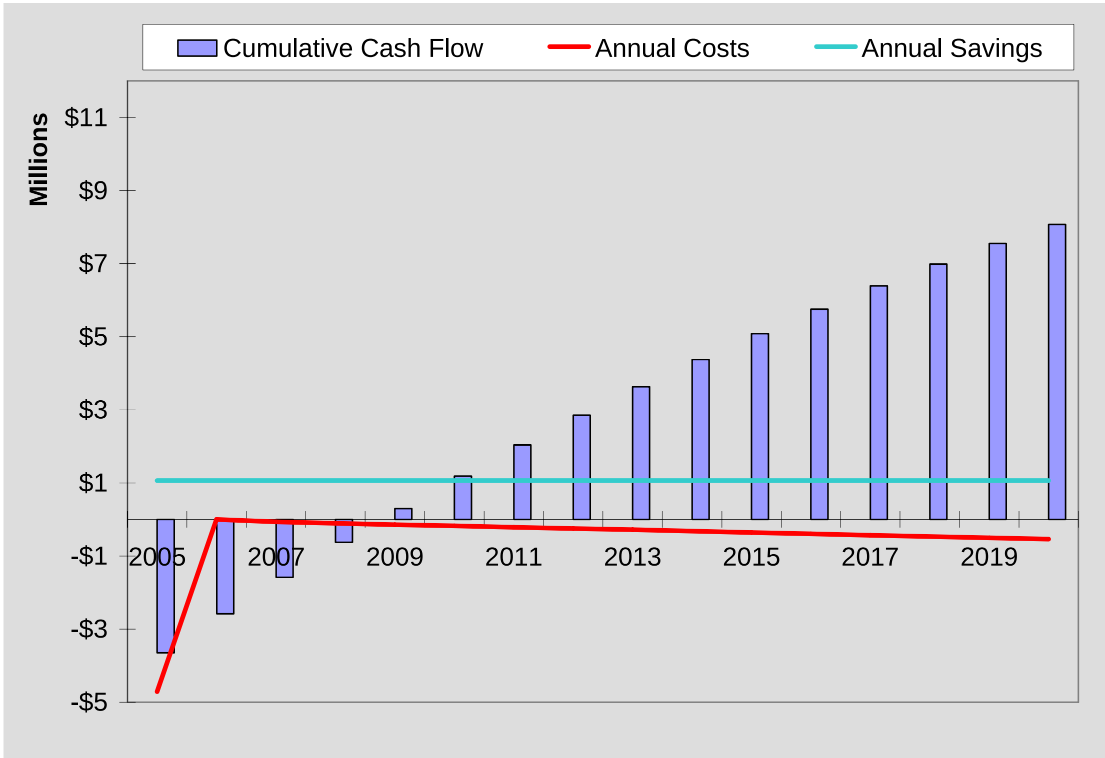


Figure 4.9 Cash Flow Analysis for Climate Neutral by 2020



4.5 Sensitivity analysis

Finally, as a sensitivity analysis, we perform the same calculations using a higher offset price of \$30/MTCO_2e (instead of \$11/MTCO_2e), which is closer to the price of EU ETS carbon offsets in early 2006 (Point Carbon, 2006); we find a NPV of savings of \$2.1 million, \$4.3 million and -\$0.2 million for the California, Kyoto, and Climate Neutrality targets, respectively. This implies that there is very little financial risk associated with the modest emissions reduction targets (i.e., California and Kyoto Targets). Furthermore, fuel prices were assumed to stay constant at 2006 levels (\$2.54/gallon gasoline, \$0.11/kWh, \$0.90/therm natural gas), which suggests a conservative cost estimate.

In conclusion, given the high energy savings associated with on campus mitigation mechanisms and the price of external offsets, all three emissions targets we profile are financially attractive through 2020. The California and Kyoto Target are the most feasible, given current offset and fuel prices. The Climate Neutrality target by 2020 is also feasible given U.S. offset prices today, but is more sensitive to variations in the price of carbon offsets in the future. Additionally, the Kyoto and Climate Neutral targets require large capital investments in the very near term, which present potential problems (see Chapter 5). The California targets do not require large (i.e., greater than \$1 million) capital investments until 2012, and also result in significant savings by 2020. Given these results, it appears that UCSB can realize significant economic benefits in addition to providing leadership on university climate mitigation by, at the very least, adopting the California State Targets.

CHAPTER 5: IMPLEMENTATION OF GHG EMISSIONS REDUCTION

Given the compelling financial gains from investing in emissions reduction projects, it would seem that UCSB should already be implementing these types of GHG mitigation projects. To some extent it is – through the energy efficiency projects implemented by the Facilities Management team, the efforts to green UCSB buildings by the virtual Office of Sustainability, and efforts to reduce the use of single occupancy vehicles through the Transportation Alternative Program, to name a few – and the results of these efforts can be seen in the declining aggregate GHG emission trend over the past 5 years (Figure 2.9, Chapter 2). Although, UCSB has typically done so with energy savings or reduced traffic congestion in mind, reduction in GHG emissions is another important reason for UCSB to consider – one that points towards increasing the overall scale and the immediacy of their current efforts. In this chapter, we identify how UCSB can increase their efforts toward GHG emissions reduction by addressing the institutional constraints that hinder the University's ability to implement cost-effective mitigation mechanisms in the near-term.

5.1 State of UCSB and its Institutional Goals

Like many other universities, UCSB is a large and dynamic academic institution consisting of a complex governance system, a large population and numerous organizations. UCSB's governance system consists of the UC Regents, UC Office of the President, UCSB Faculty and UCSB Office of the Chancellor. The population includes roughly 25,000 people, including 20,847 undergraduate and graduate students, 1,095 faculty and 3,547 staff (UCSB, 2005). Hundreds of organizations make up the Academic, Research, Administrative and Student systems on campus. The interplay between the complex governance system, the sub-populations (e.g., students, faculty, staff), and the various on-campus organizations (e.g., Facilities Management, Office of the Chancellor, Campus Planning Committee) contributes to a distributed decision-making authority. This type of institutional complexity makes implementation of new policies challenging. Furthermore, although environmental awareness on campus is strong, climate change has yet to emerge as a priority for campus leaders. As a result, just having a compelling analysis with economic gains from GHG emissions reduction does not ensure implementation of GHG reduction policies.

5.1.1 State of UCSB

The UC Office of the President has recently acknowledged the importance of GHG emissions reductions at the campus level. For instance, in January 2006, the UC Regents approved policies to meet the California targets (see Appendix F). Furthermore, in February 2006, UCOP's Sustainability Steering Committee approved the formation of a Climate Change Working Group to pursue implementation of GHG emissions measurement. UCSB has a great opportunity to provide leadership in the state and within the UC system by adopting and meeting the California GHG reduction targets (at a minimum) at UCSB.

Our assessment of UCSB suggests that the campus community has a high commitment to environment and sustainability. The University has a strong Facilities Management team with energy experts that are dedicated to reducing the University's energy use while maintaining the services required of a top-notch research university. The emission reductions from 1999 to 2004 of 2% on average per year were largely due to specific energy efficiency projects installed on campus, which speaks to the University's ability to reduce its climate footprint. In addition to staff, UCSB students indicate that they are concerned about climate change. In an Associated Students survey administered by the Environmental Affairs Board at UCSB of over 3,000 students, 82% of respondents felt that it was UCSB's responsibility to reduce its green house gas emissions (UCSB 2006 Voters guide and Sample Ballot, 2006).

Furthermore, the University is already committed to sustainability efforts on campus. In 2004 Chancellor Yang established that the UCSB campus shall implement the Regents Green Building Policy and strive to achieve the LEED™ Silver certification for new buildings approved after July 1, 2004 (Overview of UCSB's Sustainability Efforts, 2005). The Campus Planning Committee Subcommittee on Sustainability is committed to developing a comprehensive Campus Sustainability Plan by summer 2006 (Pellegrin, personal interview, 2006). To meet this goal, seventy five staff members involved in various sustainability activities on campus are developing actionable goals for nine key sustainability areas[37]. Climate change mitigation is a natural part of already existing University-wide efforts to promote campus sustainability.

5.1.2 Institutional Goals

An important institutional goal for UCSB is managed growth – a commitment to steadily increase the University's academic presence without placing strain on environmental and financial resources. The quality of programs has been steadily increasing across education, engineering, fine arts, humanities, science, social science and environmental studies departments. The campus is now home to five Nobel Laureates, 24 members of the National Academy of Engineering, 23 members of the National Academy of Sciences, 22 members of the American Academy of Arts and Science, and 81 recipients of Guggenheim Fellowships. Student enrollment is projected to increase at an average rate of 1% through 2025, and "the growth is driven by a number of factors, predominantly by the desire of the faculty to growth in size to achieve its academic goals" (Draft Academic Plan, 2006). To support campus growth, inevitably, additional buildings are necessary. In many ways, UCSB's growth is desirable to the local economy, as UCSB is a great source of income for the city of Goleta and Santa Barbara. UCSB currently spends nearly $400 million, students spend almost $570 million, and visitors attracted by the university spend another $23 million, annually in the Santa Barbara region (Draft academic Plan, 2006). Yet increased enrollment may also have negative effects by increasing local congestion and air pollution. Addressing these negative impacts is important in ensuring that the growth is socially desirable and politically feasible.

[37] The specific areas are Academic and Research, Built Environment, Energy, Water, Procurement, Transportation, Waste, Communications, Land use/Landscape and Food.

Another important institutional goal for UCSB is an emphasis on interdisciplinary studies. The UCSB academic plan (Draft Academic Plan, 2006) describes shown that there are four campus wide themes that would need continued monetary and infrastructure investment. They are:

- Environment, with further development in the study of environmental issues;
- Global and International Issues, with emphasis in social change on a global scale;
- Digital Studies, with higher digital processing and mapping; and
- Academy and Society, at the intersection point between the University and public sphere.

Other than Digital Studies, the focus areas present the opportunity to integrate climate change, GHG mitigation, and sustainable living into academic curriculum and research.

Essentially, many initiatives currently underway at UCSB have a direct connection to, or implications for, GHG emissions. Additional construction and investment decisions will continue to elevate the campus debates around fund allocation as the campus continues to grow. Therefore, the implementation of any GHG emissions reduction plan requires an understanding of how the current state of the campus system presents both opportunities and challenges to more aggressive action on climate change.

5.2 Implementation Scheme

Successful implementation of GHG mitigation policies depends on their smooth integration into existing efforts towards campus sustainability. The Campus Sustainability Plan is one initiative that already broadly encompasses campus environmental and energy efficiency efforts. This was a logical intervention point for promoting a campus-wide GHG reduction approach, without having to reinvent the (sustainability) wheel. In addition, we found important leverage points within certain campus-related organizations that can significantly integrate GHG emissions reduction into their mission and operations and move UCSB forward on a path to more aggressive emissions reductions. We list these organizations below, along with reasons why they are appropriate and necessary partners to a successful implementation of GHG reduction policies on campus.

- The UC Office of the President (UCOP) is the administrative headquarters that oversees all the UC-wide policies. The GHG emissions reduction policy at this level can give support and motivation to UCSB and other UC schools to prioritize emissions reduction initiatives.
- The UCSB Chancellor has the ability to allocate financial and personnel resources for new initiatives. Substantial GHG emission reduction planning and implementation requires his commitment to providing such resources.
- The Campus Planning Committee Subcommittee for Sustainability, consisting of a core group of Facilities Management staff and appointed sustainability coordinators, has created sustainability goals for campus. Other players on campus (such as the Chancellor) recognize them as an official channel for sustainability initiatives.
- The Transportation and Parking Services Department is very committed to the Transportation Alternatives Program (TAP), which is designed to reduce commuter traffic on campus. Their goal is in alignment with GHG emissions reduction because transportation is a significant source of GHG emissions for UCSB.
- The Office of Budget and Planning makes budget allocation decisions for new constructions. Since some emissions reduction projects require significant upfront capital, it is important to work closely with this Office in order ensure that long-term cost savings enter their cost-benefit calculations.

5.3 Barriers to Implementation

The primary goal of our project is to recommend a path for UCSB to achieve significant GHG emissions reductions. However, some significant institutional barriers exist that currently constrain the University from realizing the environmental and financial benefits associated with the GHG mitigation mechanisms we profile. These obstacles are also opportunities for identifying new methods of implementation, and if necessary, creating new values, laws and procedures to accommodate a new policy direction. After all, "institutionalization requires taking the time to build systems – committees, policies, and training – that will support far reaching and long lasting change" (Creighton, 1998, p. 285).

It is important that we understand if the identified barriers are transient or stable so that we can identify the level or duration of effort needed to overcome them (Blumstein, 1979, page 354). *Transient* barriers are typically caused by societal inertia, but when they are removed, implementation of the new idea happens smoothly. Some examples of transient barriers are "...obsolete information, regulations that are no longer appropriate and old-fashioned habits" (Blumstein, 1979, page 354). *Stable* barriers, on the other hand, are embedded in the institutional fabric and likely to resurface after overcoming them unless a culture shift happens or new regulation appears. As the description would suggest, stable barriers would require the most effort and carefully planned strategies to overcome them.

In the next sections we describe and characterize key institutional barriers and outline potential strategies to overcome them. Note that one of the most important barriers to consider is the fact that a stable climate is a public good – it is subject to under-provision and free-riding. This type of market failure can make it difficult to justify expenditures on climate mitigation efforts against other University priorities. For our report, we will discuss barriers that are specific to UCSB, and that can be overcome by actions taken by UCSB.

5.4 Institutional Barriers and Strategies to Address Them

5.4.1 Fund Allocation System

Funding issues pose the most significant constraint to implementation of mitigation mechanisms. First, the state budget allocation system hinders the University's efforts to invest in energy efficiency projects. The budget of UCSB is broken into two principal components: a capital budget and operating budget. While the capital budget is earmarked exclusively for new constructions, the operating budget is allocated to fund all of the Campus' operations (e.g., salaries, utility bills). Typically, for new construction, energy efficiency projects get cut to keep capital costs down. Under a well-designed system, these projects could be funded by borrowing from the operating budget, which would make sense because efficiency projects would reduce future operating costs. However, this cannot happen because borrowing between capital and operating budgets is prohibited by Section 28 of the California Administrative Code. A report based on a presentation by Michael Bade, director of capital programs at UC San Francisco, explained the situation eloquently:

> As if the challenges of developing a system-wide policy on energy efficiency and sustainability were not enough, an ironic and unfortunate clash between legal technicalities and external circumstances left the UC system essentially in a catch-22 bind with respect to financing energy efficiency improvements. Specifically, Section 28 of the California administrative code prohibits use of operating cost savings to fund capital improvements. Institutions can apply for a waiver of the requirements, but only if their overall energy budgets are in the black. In the wake of the California energy crisis and the large increase in energy costs, state appropriations to cover UC's energy requirements fall far short, leaving the University unable to apply for the waiver (Bade, 2004).

Second, new construction projects are approved by the State with a set budget limit. During the planning phase, many equipment and design aspects that are justified by lifecycle cost assessments[38] must be removed due to high upfront costs to meet the allocated budget for a new construction. When these projects go out to general bid, sometimes the low bid comes in below the budget limit set by the State. Currently, the monetary difference between the bid and the budget limit must be returned back to the State, as called the "bid reversion" (Williams, personal interview, April 4, 2006). The University accepts the lowest bid for construction, but unfortunately, the University does not get to keep the difference between the lowest bid and the allocated budget. If the University could keep that difference (the amount from bid reversion), it could put energy efficiency components back into new construction to reduce energy consumption and GHG emissions in the long run.

The state funding allocation system is a *stable barrier* restricting the implementation of energy efficiency projects and other projects that require high upfront investments for long-term cost savings. It forces the efficiency projects to compete with capital projects for funding, and as a result, efficiency projects rarely get priority due to their high cost (Harris et al., 2001). Even if the

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[38] Life-cycle cost assessments include both the upfront capital and projected operating costs in the longer term (including utility bills).

University's planning and design processes include explicit consideration of lifecycle costs, the state funding process prevents UCSB from acting on these considerations.

Strategies to overcome funding obstacles:

1. Lobby to the State – Ultimately, the University and UCOP can only overcome this stable barrier by approaching the State legislature. Although it may be a slow process, proponents for environmental and financial sustainability need to find a different way for the California to fund public education infrastructure. UCSB administration could raise this issue with other UC schools to push it as a priority at the UCOP level, which could more effectively address the state legislature. The capital and operating budgets need to be more interoperable and flexible to permit the financing of projects that save money over time. Furthermore, this would seem to be an issue with considerable political traction; their funding practices are constraining public institutions from investing in projects that reduce GHG emissions, and being that they are interested in reducing the State's GHG emissions, this should be something they are willing to re-consider.

2. *Pursue External Sources* - Energy efficiency projects result in monetary savings and provide environmental benefits over time. However, even financially attractive projects with large upfront costs will remain unfunded unless additional sources of capital can be identified. The following are some alternative funding strategies that rely on capital external to UCSB:

- Energy Services Companies (ESCO) – ESCOs are companies that provide the up-front capital for projects and are paid out of the energy savings associated with the project; the specifics of the energy savings sharing between the ESCO and the client are specified through an energy savings performance contract (ESPC) or a shared-savings agreement (Energy/Utility Glossary, 2006). UCSB already engages with ESCOs and we believe they should expand this practice if they are unable to find the capital internally.

- External Funders – UCSB could be eligible for funding in the form of low-interest loans from external sources like the California Energy Commission. The California Energy Commission's Energy Efficiency Financing Program funds many types of projects (e.g., audits, lighting, pumps, insulation, HVAC) up to $3 million per application for projects with payback of 9.8 years or less (Energy Efficiency Financing, 2006). Many of UCSB's potential projects fall into this category, with an average payback of 3.5 years (see Chapter 4).

- Alumni – Alumni are very resourceful members of the University community that can be approached for both expertise about GHG reductions and funding. UC alumni may be willing to donate their time and resources if approached with well designed projects that appeal to the alumni community's sense of legacy. Public universities tend to have smaller endowments than private universities, and UCSB should continue to identify issues that alumni care about to encourage private donations.

3. Student Fees – Setting up a student fee based revolving fund is proving to be a very poplar financial resource on university campuses[39]. The principle is that a fixed fee charged to each student would be used to set up a fund for mitigation projects on campus. Revenue or savings generated by the projects would be put back into the fund and reinvested into additional projects. When students vote to "tax" themselves to support GHG reduction initiatives, the campus administration should seriously consider providing support by matching the student efforts. This can include money from the Chancellor's discretionary funds, and providing staff hours, office space, and other financial resources to support the operation of the fund.

CCN Success Story at UCSB

Students Approved The Green Initiative Fund (TGIF)

The Green Initiative Fund (TGIF) at UCSB passed on April 28, 2006 for both graduate and undergraduate students:

74.64% of undergraduate students who voted, voted YES;
82% Graduate Students who voted, voted YES.

TGIF is UCSB students' contribution to the growing need for funding – through a mandatory student fee of $2.60/quarter, TGIF will raise $186,000 annually. TGIF will provide interest free loans and matching funds to projects that increase the amount of renewable energy used on campus, increase energy efficiency, and reduce the amount of waste created by the University. Portions of the fund will support education initiatives, student aid, and internships. TGIF will be administered through a student majority governance board.

The Bren Campus Climate Neutral team designed and campaigned for this fund along with the Environmental Affairs Board and Education for Sustainable Living Program. This is the first fee based fund set up to support green projects at UCSB. The fee begins in Fall 2006 and is subject to reaffirmation in Spring 2010.

See Appendix G for more information about TGIF.

[39] The Harvard Environmental Loan Fund has been a prime example in the revolving fund concept. The University conducted a study of the efficiency of using an interest-free revolving loan fund as an incentive for environmentally preferred buildings. This study found that the $2.6 million total loaned yielded a 34% return on investment and five-year savings amounting to $4.5 million. Of this savings, 55% was a result of decreased electricity use. The school also reduced its CO_2 emissions by 8.8 million pounds over this time period (Harvard Green Campus Initiative, 2006).

5.4.2 GHG Information Management Constraint

The University does not currently have an integrated system to manage information relevant to GHG emissions generated by Campus activities. Data collection from some potentially important sources (e.g., campus fleet, commute, air travel) is manual and disorganized. This is particularly true for air travel, where there is no system that tracks air travel trips or mileage. Second, information on different GHG emissions sources is not integrated. It was not until we performed the inventory that we realized the relative size of the different sources of emissions on campus. This is typical of most institutions given that climate change mitigation is a fairly recent interest.

Since access to campus GHG emissions data is laborious and disorganized, it increases the transaction costs of including GHG considerations in policy making criteria. Furthermore, lack of access to this data prevents the disparate campus decision-makers from knowing if they are enacting emission reduction policies in a cost-effective manner for the University. These decision-makers may be discouraged from including GHG considerations into their energy or transportation projects if the data is difficult to find. The lack of an integrated energy information system is a *transient* barrier because creating such a system requires a short term commitment.

Strategies to overcome information obstacles:

Information about campus GHG emissions sources needs to be better managed, analyzed and communicated within and outside Facilities Management. The University commitment towards a Campus Sustainability Plan is a good start towards creating a centralized approach to sustainability, but it has not necessarily committed to an integrated approach to greenhouse gas data management. The following strategies help address the information obstacles to implement GHG emission reduction policy.

1. Establish a formal Office of Sustainability - In 2001, the Bren Project on Greening UCSB stated that there was a "lack of a clear commitment to sustainability" (Harris, 2001, page xii.). Although UCSB has made tremendous strides in the past several years to establish a culture of sustainability, the institution still lacks an official department or office to coordinate sustainability efforts on campus. Currently a virtual entity known as the "Sustainability Working Team" of the Campus Planning Committee's Subcommittee on Sustainability plays this role; but, it has no budget or physical office space. A formal Office of Sustainability can serve as a central node for management of emissions data and mitigation projects.

To achieve these objectives, Office of Sustainability needs a stable home and reporting structure, and would best function under the Office of the Executive Vice Chancellor (EVC). The importance of having staff dedicated to sustainability from a position that spans both Facilities and Academic branches of the University organization can not be overemphasized. Positioning the Office of Sustainability under the EVC would also demonstrate to the community that that sustainability is a priority for the Administration.

2. Invest in a new or enhanced GHG Management System - An integrated energy information system that manages and analyzes greenhouse gas data along with energy indicators would be invaluable for UCSB to organize its GHG information. This could be a new technological (software) tool that the University invests in. Alternatively, new features could be added to the current Energy Information System (EIS) at UCSB, which is maintained by Facilitates Management and already captures electricity and natural gas data. Perhaps EIS could be enhanced to include fleet fuel consumption, as well as perform the calculations needed to measure and report campus-wide greenhouse gas emissions.

A complete and integrated GHG management system needs to be user friendly and with a web-based computing interface that can be used by staff, students and faculty for transparency and wide accessibility to campus GHG data. This technological tool can help decision makers manage and analyze energy use, and easily compare how disparate energy projects (e.g., fleet versus electricity efficiency) can yield the greatest emissions and cost reductions. Our interview with the Associate VC of Facilities Management (on March 6, 2006) indicated that the following capabilities should be included in such a system:

- Emissions calculator – to instantly calculate cost and GHG emissions comparisons given certain inputs (e.g., electricity use, fuel consumption);
- Implementation schedule – to generate a project implementation schedule, based on different targets and projected campus growth data;
- Financial impacts – to calculate cash flow analysis of project implementation schedule.

The University plans to develop a spatial information system to link the flow of energy and materials through the campus with spatial features that can make individuals more accountable for their campus environmental footprint[40] (Pellegrin, P., Lee, C. & Stratton, L., 2006). Findings from this research should be applied to the creation of a GHG management system.

3. Assign Sustainability Coordinators – In addition to an overarching Office of Sustainability, awareness and coordination on the academic departmental level would be helpful in creating a culture of energy conservation that leads to reduced emissions by students and faculty. Every department should have a sustainability coordinator who is trained in principles of energy savings and can manage and communicate sustainability and GHG reduction data on a departmental level. These coordinators can disseminate information from the formal Office of Sustainability and help implement mandates and policies created by administration and governing student bodies; they can also assess what types of policies are most effective. These coordinators need not be new appointees – we believe that the sixty some members of the Academic Business Officers Group are excellent candidates for this role. These are senior business officers from academic departments and research organizations "who gather information about, provide input to and comment upon policies affecting the operation of their organizations" (ABOG, UCSB, 2006). Helping coordinate information on GHG mitigation policies and practices appear to be a natural fit. Alternatively, the Management Services Officers (MSOs), who are responsible for providing management support to Deans, Directors, Department Chairman and Administrative Officers, could also be excellent candidates to fulfill this role. (MSO, UCSB, 2006).

[40] Bren Group Project 2007: Prototyping a Campus Sustainability Management System

CCN Success Story at UCSB

UCSB Membership to California Climate Action Registry in June 2005

In an effort to address this constraint, we are pleased to have facilitated UCSB's membership with the California Climate Action Registry. Membership with the Registry is a public commitment to emissions reporting and is a first step towards helping Facilities Management to organize information about GHG emissions.

5.4.3 Disincentives for Transportation Alternatives

Transportation and Parking Services (TPS) has the dual charter of providing alternative transportation (through TAP) and ensuring adequate parking for faculty, staff and students. These opposing priorities have become significant and stable barriers to any alternative transportation program. On one hand, TAP aims to reduce parking demand through innovative programs such as free bus passes, car-share, van pool, discounted carpool permits, and extensive bike paths. On the other hand, campus is building new parking structures, priced at $25,000 per parking spot, which can only be financed through future parking permit sales (UCSB, 2006). If too many university commuters decide to switch to alternative means, the parking structure spaces will not be used and the university will remain in debt. Therefore, according to the current institutional set-up, University administrators have conflicting goals – to simultaneously encourage alternative transportation while promoting parking permit sales.

Strategies to overcome disincentives:

Developing new policies to reduce single occupancy vehicle (SOV) commuters, and consequently emissions, is a political debate for this campus. Yet the benefits to discouraging SOVs is significant, ranging from extensive costs savings related to parking infrastructure, to reduced traffic congestion in the local community, to a safer, more pedestrian friendly campus. We believe that the following strategies can make the barriers in alternative transportation planning less constraining and begin to encourage less driving without placing UCSB deeper in debt.

1. Alternate funding sources for UCSB Parking – The University could partly decouple debt-financing on parking structures from permit sales. If alternative funding sources can be made available, or if more uncertainty can be accepted in permit sales, then there will be greatly improved flexibility in the TAP manager's ability to alter the incentive structure for SOV drivers to find alternatives.

2. No New Net Parking Spaces – Successfully implemented on the UCLA campus, capping the total number of parking spaces is a very effective way to ensure less debt requirements. If supply is restricted, emissions will inevitably stabilize as opposed to continually increasing along with campus growth. Instead of investing in new parking structures, the University could put money into improving bicycle infrastructure, bus routes and other transportation alternatives. Additionally, pursuing housing developments for students and faculty in close proximity to campus, as the LRDP currently does, will allow the campus to grow without the need for additional parking spaces.

5.4.4 Institutional Inertia

Perhaps the most obvious institutional constraint is inertia. The UC system is a giant, 130 year old organization. UC governance is shared among the Board of Regents, the system wide Office of the President, and the UC faculty. With fractured and diverse constituents, UCSB inherits the complexity of the UC system's decision making process. This contributes to institutional inertia and a tendency for key players to be risk averse. Institutional inertia could be perceived as a transient barrier because there are initiatives in place that suggest growing commitment towards climate change mitigation. The UCSB Sustainability Committee meetings are a step in the right direction. Leadership from top administrators, such as the Chancellor, could overcome many of the barriers previously discussed in this chapter and move UCSB decisively towards significant GHG reductions that save the University money over time.

Strategies to overcome institutional inertia:

1. Establish Chancellor's Commitment - GHG emissions reduction needs to be accepted and supported by the highest level of the Administration in order to become a part of the UCSB institutional planning and reporting process. A public commitment by the Chancellor to a specific GHG emissions target (e.g., California targets) would be a key first step. Other examples of commitment could come in the form of additional funding for mitigation projects, new GHG management system, and emphasis on climate change related topics in academic curriculum.

2. Incorporate GHG Reduction in the Campus (Growth) Plan: Given that UCSB will continue to grow in terms of student body and building square footage, GHG reduction needs to be included in the long term planning for managed growth. Addressing community concerns about environmental impact should be an important aspect of the Campus Growth Plan, and including GHG mitigation can be one strategy to address community concerns. Furthermore, GHG emissions should serve as an important overall metric of energy consumption and traffic congestion related to campus growth. The campus growth plan should include an explicit commitment to managed growth that minimizes UCSB's greenhouse gas emissions and natural resource consumption.

3. Incorporate GHG Reduction in the Long Range Development Plan (LRDP): The LRDP is a guiding document which provides a conceptual blueprint for the development of the campus' environment over a time period of fifteen to twenty years. Dictated by the Regental policy and guided by the UCOP, the LRDP identifies the physical developments needed to support the campus' academic goals (UCSB LRDP 1990, page 9). The LRDP takes into account a number of associated planning documents, including the Academic Plan, the Campus Growth Plan, the Campus Housing Master Plan, the Campus Infrastructure Assessment, and the Campus Sustainability Plan. Incorporating GHG reduction commitment into LRDP will help the Campus to formalize its commitment to greenhouse gas reductions and ensure continued attention to the issue.

UCSB's LRDP follows a few key planning principles for maintaining quality of life on campus. One of the principles pledge to "...ensure that the growth on campus should not degrade the quality of life for its occupants" (Harris et al, 2001, p. 146). GHG reduction and climate change mitigation appears to be a natural fit into the planning principles. Behavioral changes that would require less energy use and/or green energy use would maintain and enhance quality of life if environmental benefits are taken into consideration. In fact, the opportunity to update the LRDP with GHG reduction language exists this year. The UCSB campus is presently engaged in the planning steps leading to the revised LRDP since the current 1990 LRDP expires at the conclusion of the 2005-06 academic year.

4. Student Education to Increase Awareness – The University's academic curriculum should demonstrate a serious commitment towards addressing climate change. Initiatives taken by the Education for Sustainable Living Program can help jumpstart student-led courses at the grassroots level. However, the University's Academic Senate, the representative body of the University faculty that can exercise direct control over academic matters, should create a core curriculum focused on climate change (About UC Governance, 2006). At the least, it should create a "flexible course module" on climate change that would be offered to all faculty to be integrated into relevant existing course offerings.

CCN Success Story at UCSB - Chancellor Henry Yang's Support

We have gained Chancellor Yang's initial support to develop recommendations for the Campus Planning Committee. We presented our recommendations to the Campus Planning Committee on April 17, 2006. The Committee is in the process of reviewing the recommendations for incorporation in the Campus Sustainability Plan and in its final recommendations to the Chancellor.

CHAPTER 6: RECOMMENDATION & CONCLUSION

Climate change must be addressed by the institutions that shape society's future leaders – universities. As a key part of the most prominent higher-education system in California, UCSB is strategically located to play a leadership role for public universities nationally and globally, along with other schools within the UC system. In addition to opportunities to be on the forefront of one of the most important issues of the twenty-first century, our analysis indicates that significant cost savings can be found in reducing the University's greenhouse gas emissions.

By focusing on emissions sources reported to the California Climate Action Registry (i.e., electricity, natural gas, campus fleet, and refrigerants), the reduction of these emissions to meet the California, Kyoto, and Climate Neutrality targets could yield net present value (NPV) cost savings of $2.6 million, $5.8 million, and $4.3 million respectively. This analysis indicates that UCSB is missing a significant cost savings opportunity due to a myriad of barriers to implementing projects that would be in its best financial and long-term interests.

Although numerous paths to climate neutrality exist, we offer some final recommendations on how UCSB can build its institutional capacity to address climate change, reduce greenhouse gas emissions and reap the cost savings related to climate mitigation projects. The policies outlined below seek to capitalize on existing University initiatives with momentum, as well as address important institutional barriers that presently constrain the University from implementing more GHG emissions reduction projects.

Key Recommendation

Make a firm commitment to meet the California GHG targets through 2020, at a minimum. As our analyses have shown, meeting the California targets is feasible and financially attractive for UCSB. California specific targets are also a natural fit for a state-funded institution. Through a combination of on-campus mitigation and external offsets, UCSB is in a position to meet the two California targets and save net $5 million in the process, despite campus growth of 25% through 2020. As a result of previous energy efficiency investments, UCSB is already on track to meet the first of the California targets without significant new capital investments. Although the majority of the mitigation projects result in net savings over time and so should be implemented as soon as possible, the implementation schedule allows UCSB to put off significant capital investments until 2012, which should allow enough time to obtain the necessary capital. Since the more aggressive targets we profile generate larger savings, due to projects being implemented more immediately; UCSB should strive for the more aggressive emissions reduction targets such as the Kyoto Protocol. However, these more aggressive targets run into the institutional barriers to implementation (e.g., lack of funding, bureaucratic inertia) profiled in the previous chapter, which makes them less feasible in the near term. Therefore, UCSB should adopt the California targets at a minimum, and strive to meet the more aggressive targets in the long term.

In order to ensure the meeting of the target, we recommend that UCSB should:

1. Include aggregate GHG emissions targets in long-term Campus planning documents, such as the Campus Sustainability Plan component of the Long-Range Development Plan.

   UCSB is committed to rigorously inventorying its GHG emissions annually through the California Climate Action Registry. Once adopted, aggregate GHG emission targets should be included in long-term campus planning documents to ensure the commitment of the University to climate mitigation. Additionally, aggregate GHG emissions can also be used as metric for broader environmental performance that would be relevant to University stakeholders in judging the desirability of campus growth.

2. Turn the "Sustainability Working Team" of the Campus Planning Sub-Committee on Sustainability into a real Office of Sustainability, and authorize them to develop an integrated system to manage GHG emissions.

   The UCSB Sustainability subcommittee already encompasses four staff members, who work on a diversity of sustainability issues and are extremely active and visible on campus. With the development of a Campus Sustainability Plan, the time is ripe to turn the Sustainability subcommittee into a real Office of Sustainability, with a budget and direct reporting line to the Executive Vice Chancellor's Office, spanning both the Facilities and Academic branches. The formal incorporation of a UCSB Office of Sustainability would be invaluable for coordinating the day to day activities related to meeting the California State Target.

3. Implement zero cost emissions reductions projects first, followed by projects found to have the best net present value (NPV) for GHG reductions (e.g., energy efficiency projects).

   In choosing greenhouse gas mitigation projects, the University should begin by selecting projects with no upfront cost. There are several project ideas evaluated in this report that can yield emissions savings with no capital or operating cost. These projects are:
   (a) Implement energy star computer settings
   (b) Choose smaller fleet vehicles, and reverse the trend towards purchasing larger trucks
   (c) Work with local fuel providers to source E85 locally and use it in flex-fuel vehicles
   Once zero cost mitigation projects are exhausted, the University should then look towards the projects with highest net present value per $MTCO_2e$. If the University wishes to continue to seek least cost climate mitigation projects, then the price of carbon offsets can serve as a benchmark against which on-campus projects costs can be measured. When all remaining prospective on-campus projects have a $/$MTCO_2e$ value greater than the price of carbon offsets, then the University should purchase carbon offsets with the savings from previously implemented projects.

Figure 6.1: Suggested Order of Projects Before Purchasing Offsets

Recommended mechanism implementation sequence	Annual GHG reduction MTCE	Capital cost	Annual savings
Energy star computer settings	310	$0	$94,000
Fleet smaller vehicles	33	$0	$9,545
Fleet ethanol	1	$0	$0
HVAC Upgrade – Air Handlers (1)	573	$200,000	$112,000
HVAC Commissioning	340	$120,000	$71,159
HVAC Upgrade – Filters	607	$372,323	$184,053
EE – Fume Hoods	55	$80,000	$14,298
Building baseline awards	14	$15,000	$4385
HVAC Upgrade – Fans	914	$1,574,464	$277,048
Lighting Upgrades	835	$1,797,762	$252,919
HVAC Upgrade – Air Handlers (2)	174	$550,000	$45,328
Reduce fleet driving – bikes	1	$2500	$27

4. **Focus on identifying additional cost-effective GHG mitigation opportunities, such as energy conservation, and leverage the energy and creativity of UCSB students, faculty and staff.**

   The mitigation mechanisms evaluated in our research are by no means exhaustive. Many opportunities for energy conservation on campus still exist, and the UCSB Facilities team has already demonstrated expertise in identifying these types of opportunities in both existing and new buildings. The University should continue developing energy efficiency and energy conservation projects, since these types of projects tend to be very cost effective. Since electricity and natural gas comprise the largest portion of UCSB's GHG emissions, these are important areas to focus on.

   Staff members on campus also possess a great deal of innovative thinking and environmental motivation. UCSB should leverage the energy and creativity of all staff members who wish to promote resource conservation, and to evaluate their ideas seriously. Students on campus are also involved intimately as both consumers and drivers of campus culture. Through both formal and informal avenues, UCSB students are initiating projects that conserve campus energy resources. The ESLP, Bren and Environmental Studies programs have formal courses that can help engage faculty as project advisors. UCSB should seek to foster synergies between the different people on campus interested in reducing Campus GHG emissions.

5. **Work with administrators at other UC schools and the UCOP to lobby the state legislature to address capital budget funding reform.**

   With an increasing body of evidence that climate mitigation can encourage resource conservation that protects the environment and institutional pocketbooks, UCSB should take this opportunity to address funding barriers that prevent the implementation of lifecycle cost evaluations. Although this may the most difficult recommendation to implement, it may also be one of the most important as funding is probably the most important institutional barrier restricting emission reduction projects. UCSB needs to work with other UC schools to push funding reform related to capital budget on two issues:

- Allow the capital budget to borrow from the operating budget;
- Ensure that bid reversions stay with the campus to fund energy efficiency components that may have been removed during value-engineering.

These recommendations should allow UCSB to reap the multiple benefits previously discussed, including significant dollar savings, improved environmental performance, and positive public relations opportunities. Furthermore, UCSB's leadership on addressing climate change has the potential have significant impacts beyond the UCSB campus, including:

- Mobilizing other public universities, in the UC system and beyond, to address climate change;
- Demonstrating the feasibility – indeed benefits – of meeting the first two commitments of the California targets; and,
- Educating the students of UCSB, as future consumers, investors, professionals, and leaders.

Ultimately, it is these longer term and broader scale implications of UCSB's actions today that make climate mitigation so important. As David Orr (2000), a professor of Environmental Studies at Oberlin College puts it, "*Education is done in many ways, the most powerful of which is by example*." It is time for UCSB to educate – its students, other universities, and California businesses – by example.

CHANGING THE CAMPUS CLIMATE:

A Guide for University Student Groups Planning to Mitigate Campus Greenhouse Gas Emissions

Fahmida Ahmed | Jeff Brown | David Felix | Todd Haurin | Betty Seto

May 2006

A Bren School of Environmental Science and Management Master's Project

Sponsored by
National Association of Environmental Law Societies

Project Goal

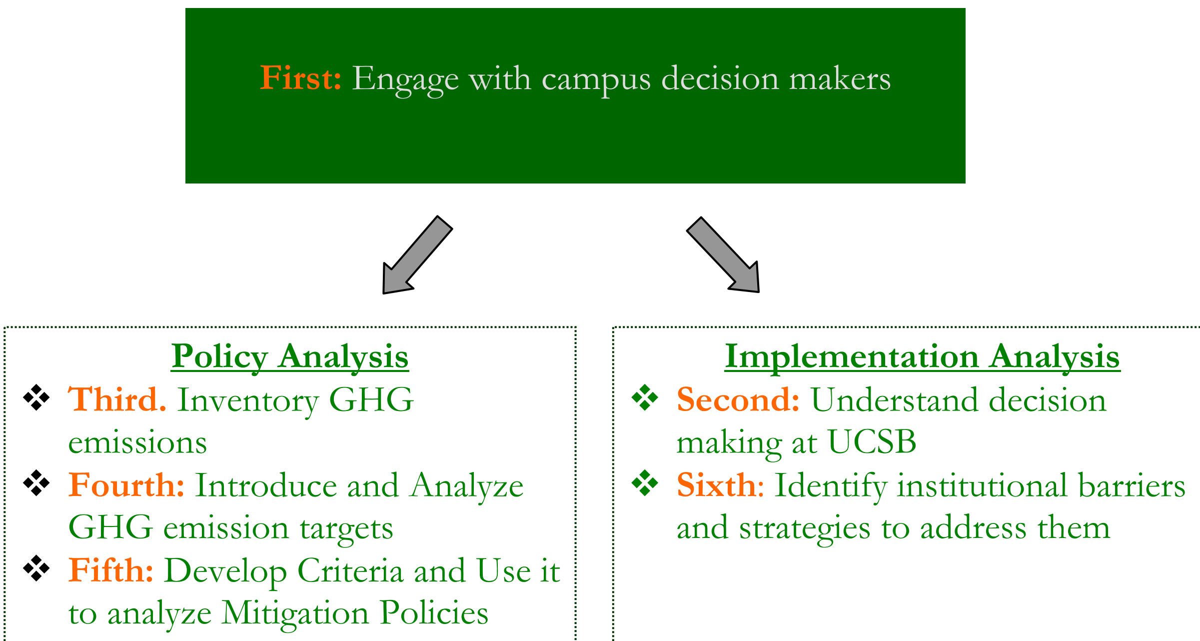
The Campus Climate Neutral campaign is an ambitious and unprecedented grassroots effort to mobilize graduate students to lead the way to aggressive, long-term climate solutions. The premise of our project is that universities, as emitters of greenhouse gases (GHGs), and more importantly as educational institutions, have an important role to play in society's response to climate change. They have the opportunity to transform markets through their purchasing power, to develop new technologies through their research, and, through their education, to produce the citizens and leaders that will be integral to our society's mitigation of and response to climate change.

With this broader perspective in mind, we examine how University of California, Santa Barbara (UCSB) could respond to climate change and undertake emissions reduction measures. The overarching goal was to define a feasible path for UCSB to achieve climate neutrality (i.e., net-zero emissions of GHGs), and we set out with the following specific objectives:

- Obtain support for the adoption of GHG emissions reduction targets and integrate these targets into UCSB institutional planning;
- Develop an appropriate GHG emissions reductions plan for UCSB based on a thorough emissions inventory, a cost analysis of mitigation strategies, and knowledge about current energy and resource reduction initiatives and projected campus growth;
- Identify institutional barriers to the implementation of our final recommendations;
- Collaborate with the UC Office of the President and other UC schools to work towards UC-wide GHG emissions reduction targets;
- Contribute to the literature on campus GHG emissions reduction initiatives; and
- Engage the campus and local community in collaborative efforts to raise awareness to climate change and reduce GHG emissions.

Our Project Approach

To accomplish these objectives, we designed a broad approach that would not only help us understand how UCSB works, but also help us reach those objectives in a systematic fashion. The figure below is a depiction of our approach. From the start, we wanted to engage with the campus decision makers, including the Administration and Facilities Management. We saw their buy-in as a critical step to our mission to ensure our project recommendations will actually be used to implement change. In addition, we formulated a two track approach encompassing both policy analysis and implementation analysis – where policy analysis would help us identify the climate change mitigation options, and implementation analysis would help us identify how the policies would be enacted at UCSB. For the duration of our project, policy and implementation analysis happened in a simultaneous fashion.



Our project sponsor, the National Association of Environmental Law Societies (NAELS), seeks to use our project as a model for other campuses to follow to reduce GHG emissions. Based on our experiences working with UCSB campus officials, we offer our research strategy, findings and best practices in this guide, in an effort to motivate student groups who wish to effect change on their campus.

We present our journey to you organized around the six key steps of our approach depicted above. For each approach, we describe what we did and why, how we did it, and lessons we learned from it so you can follow our journey and relate it to your goals. We conclude this chapter with an estimated timeline for our work and thoughts on the greater CCN network.

First. Engage with Campus Decision Makers

"Any effort to bring about wide-scale participation must be responsive to the existence of three predominant subcultures that exist within universities – faculty, administration and student organizational cultures. Evidence suggests that the greatest leverage in achieving institutional change occurs when all three subcultures or groups have a shared vision and a sense of organizational alignment in their respective actions." (Sharp, 2002)

What We Did and Why

We engaged with decision makers early to introduce our goal of UCSB reducing its GHG emissions. Communicating our goal, technical approach, and analysis plan were important because they helped establish a rapport and credibility with campus decision makers. The early engagement gave these campus decision makers the opportunity to voice their opinions about our approach, and how ready they thought the campus was to receive our recommendations a year down the road. These meetings were also vehicles for data collection on energy consumption and sustainability on campus. Most importantly, an early engagement helped us identify the important stakeholders and campus organizations, as well as management processes. Engaging other campus groups and individuals, in our opinion, would ensure an audience for our finding and increase the probability that our recommendations would be implemented.

How We Engaged with Campus Decision Makers

We interacted with UCSB students, staff, top administrators and faculty – the four most important constituents on campus. Please also refer to Appendix E on "Engaging with UCSB" which detail the specific organizations we interacted with and the strategy we followed to mobilize them.

Working with Students

At the beginning, we leveraged the California Students for Sustainability Coalition (CSSC) at UCSB. This mostly undergraduate organization already worked closely with members of the UCSB administration on various environmental initiatives such as the Green Building Initiative, Green Purchasing and the Long-Range Sustainability Plan. Due to their existing prior work, they were instrumental in the early weeks of our project by bringing us up to speed on existing campus greening initiatives and providing us with key contacts on campus. For instance, they also connected us with the Campus Sustainability Coordinator, who became an invaluable resource for gaining inroads into the campus administration.

Lessons Learned:

- **Outreach to and leverage other people and organizations who share your desire to "green" your campus.** Our team was pleasantly surprised to find how many students have already dedicated their time to these issues. By networking and bringing the relevant minds together, you will not only build consensus, but also create a climate initiative that everyone is enthusiastic about.

- **Give credit to the work that dedicated students have already undertaken.** Other students can provide you with valuable contacts and help you understand the subtleties of working with campus administrators. By working together, different student groups can aggregate their resources, present a united front to the administration and more effectively use limited financial and human resources.

Working with Staff

UCSB staff members, such as the Campus Energy Manager, Fleet Manager, and the Sustainability Coordinator, helped us to collect the data we needed for an emissions inventory and aided our understanding of the constraints they face in further emissions reductions. Since UCSB has already made significant progress in improving energy efficiency and reducing energy demand, staff members offered helpful suggestions for innovative strategies to further emissions reduction.

We initially thought that we may be able to offer appropriate technological recommendations such as lighting retrofits and occupancy sensors to help reduce greenhouse gas emissions. Interviews with campus engineers quickly taught us that they were already familiar with such solutions, and that the constraints they faced required solutions that extended beyond mere technological fixes.

In evaluating the feasibility of various emissions reduction mechanisms, we met with staff members ranging from the solid waste coordinator to the building level engineers to human resources and budget officers who all offered unique insights into campus operations. They were able to tell us which ideas may have traction within the administration (e.g., building more housing), and which ones would be very politically unpopular (e.g., raising parking rates).

Lessons Learned:

- **Interview staff members at all levels to understand where the best intervention point is for you to target your recommendations.** At UCSB, meetings with the Campus Energy Manager and Chancellor of the University pointed to the influential role of the Assistant Vice Chancellor for Facilities and Management in overseeing new campus construction, existing infrastructure and utility budgets.

- **Having a full-time staff member devoted to sustainability (i.e. in the form of a Campus Sustainability Coordinator) is invaluable.** Campus sustainability requires coordination among many different departments and offices. Our sustainability coordinator was able to ensure that all appropriate stakeholders were engaged, and that efforts on campus were properly leveraging the knowledge and resources available.

- **Meet with staff members to explicitly discuss their concerns about GHG emissions reduction efforts.** Most people are under the impression that emissions reductions will be costly and burdensome, and this is your opportunity to collectively brainstorm ideas that address these concerns. Furthermore, staff members can also communicate to you the obstacles they face in reducing emissions on campus. You must evaluate how significant these obstacles are and develop recommendations that are realistic and that Staff can feel comfortable carrying out.

Working with Top Administrators

In addition to gaining the support and commitment from staff members for project-level emissions reductions, we sought to incorporate climate mitigation into the long-term campus strategy. University-wide strategic decisions require leadership from the Chancellor's office, the top position in the University administration.

To accomplish this goal we met with the Chancellor and the Executive Vice Chancellor (EVC) every term. In each meeting, we communicated our vision for UCSB to become a leader in GHG emissions reduction. We also kept them up to date on our analysis and findings so our final recommendations would not come as surprise. This consistent communication helped us establish a rapport and enabled the Chancellor and EVC to advise us on who to work with within the organization for next steps.

We approached with the intent of repeated engagement to make sure they were convinced that climate change mitigation was important for the University. For instance, during our first meeting with the Chancellor and EVC, we introduced our project to both sell it and to hear any initial feedback they might have. By our second meeting with the Chancellor, we already felt a distinct shift in attitude towards a more favorable view of GHG emissions reductions.

Lessons Learned:

- **Approach decision-makers strategically and leverage data that can help to give your message credibility.** Many top campus administrators will be unaware of the relative size and the historical trends of GHG emissions sources on campus. UCSB demonstrated that it could increase enrollment without increasing overall energy consumption; presenting administrators with this information can help convince them that further emissions reductions may be possible and profitable.

- **Seek institutionalization rather than one time events.** A small solar project may be great this year, but a long-term campus commitment to addressing climate change can make a larger impact in the years to come. Focus on systemic change that will endure long after you have graduated.

- **Recognize that gaining buy-in will require time and that Universities change very slowly**. Decisions to acknowledge climate change may require policies and offices that are typically developed over a span of time. Furthermore, people need time to process new ideas and ways of operating.

- **Most often the administration is on your side**: We were pleasantly surprised by how receptive the Administration was to our ideas once we explained how GHG emission reduction was important to the campus community and in alignment with many of UCSB's current goals. We found that they are happy to help if the students acknowledge the constraints and rules the administration faces. If you keep this in mind, your communications will exude a positive attitude which can be contagious!

Working with Faculty

In addition to the Chancellor's office, we quickly learned that the Faculty Academic Senate had a significant amount of influence at UCSB. The Senate is the key organizing body for faculty members to vote on campus-wide issues ranging from general education requirements to allowing on-campus military recruitment to whether the UC system should continue to manage weapons-related research laboratories.

Although we recognized the potential power of faculty to leverage change on campus, we initially experienced some difficulty in identifying faculty outside the Bren School who would be willing to help push UCSB to commit to emissions reductions.

Lesson learned:

- **Engage with faculty any way you can – including independent study**. Faculty can be the hardest campus stakeholder to engage, especially if climate change is not related to their research area. In general, they hold a tremendous amount of governing power on campus, while mostly choosing to remain aloof from day-to-day campus operations. By soliciting faculty to oversee your project, you can ensure that at least one professor is engaged.

- **Cultivate faculty champions** – In most universities, faculty are an important component of its governance system, so it is really important to ensure faculty support for your mission. Try to have a faculty advisor for your initiative. Also make sure this person believes in and will champion your cause and help you strengthen your case, especially when you face bureaucracy or resistance.

Second. Understand Decision Making at UCSB

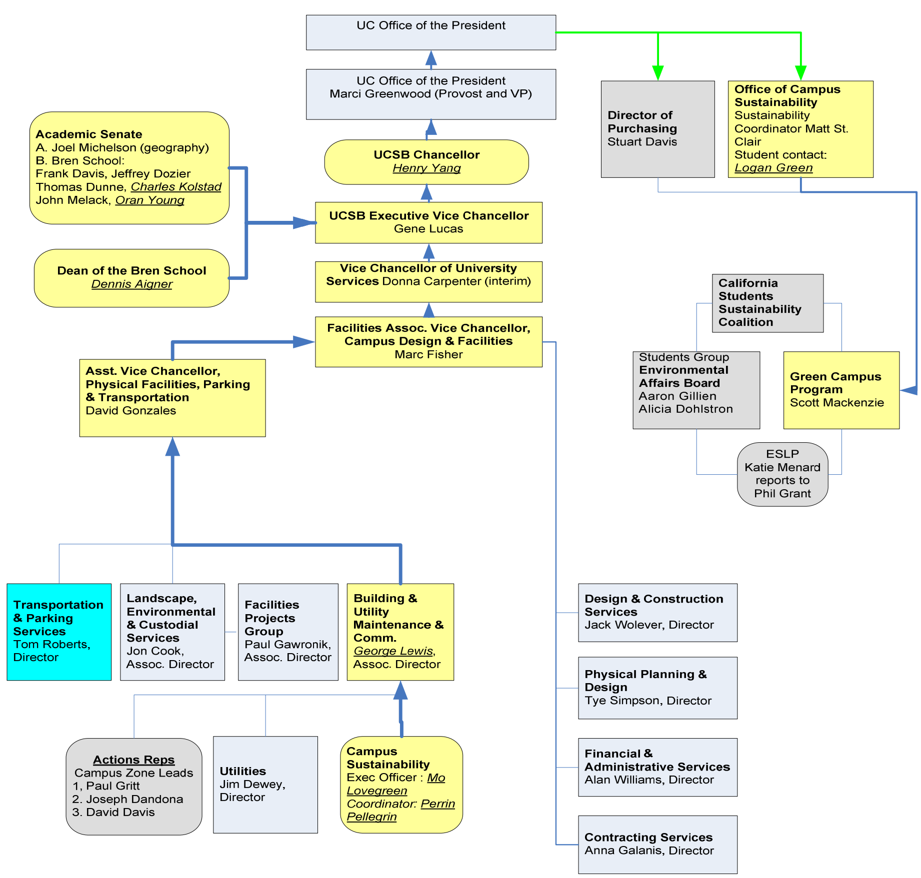
What We Did and Why

As we engaged with campus decision makers, we dedicated a substantial portion of our time researching UCSB's decision making process to focus our efforts on important leverage points within University system.. We compared UCSB's organizational structure as advertised and the actual power and decision making processes, to see how those two differ and who are the key "movers and shakers" within an existing organization.

How We Understood Decision Making at UCSB

We designed a decision tree (example next page), to create a map of how to proceed with our research, who to ask for ideas, and how to reach the high level decision makers. This map helped us apply a "method to the madness" among the myriads of organizations and their processes relevant to our project at the beginning. By following a decision tree, we were able to better scope our investigation and final recommendations.

UCSB Administration Decision Tree for CCN Project



The solid blue arrows represent the path we followed to get an audience with Chancellor Yang. Though the meeting with the Chancellor did not have to be to so formal, we had a strategy of gaining consensus for our ideas before we interacted with him.

Lessons Learned:

- **Watch out for the difference between title and responsibility**: Often, the person who really has the information or the responsibility does not have the title you would necessarily expect. It is important that you find out who has the information and the ideas for sustainability, because they may not always be the managers or the directors of the department who focus on strategic functions as opposed to the daily functions.

- **Work bottom up and top down:** Implementing new ideas requires support from bottom up as well as top down. Without the support and enthusiasm of staff for working on energy efficiency, management may be reluctant to implement new initiatives or projects.. Then again, staff will have difficulty prioritizing work on items that do not have management buy-in. It is important to maintain communication on both ends and convey the ideas and concerns of both parties to bring everyone to the same page. This way, the initiative gains legitimacy and momentum.

Third. Inventory GHG Emissions

What We Did and Why

With contacts and buy-ins in place, we started identifying and documenting GHG emissions at UCSB to have a basis for analyzing data and forming recommendations. The inventory was necessary to develop a baseline against which future emissions reductions can be measured. More importantly, an accurate initial inventory was necessary to identify opportunities for significant emissions reductions.

How We Inventoried GHG Emissions

During this inventory process, we surveyed publications that address GHG inventory methods and reduction strategies developed by other leading universities and organizations. The key players in climate change policy and GHG mitigation that we identified were the World Resources Institute, Pew Center on Global Climate Change, World Business Council on Sustainable Development, Rocky Mountain Institute, Climate Neutral Network, Clean Air Cool Planet, National Association of Environmental Law Societies, the Community Environmental Council and Energy Action. Additionally, several other U.S. universities inventoried their GHG emissions and created plans to reduce these over time, including Oberlin College, Tufts University, Harvard University, and University of California San Diego.

We collected data from various departments in UCSB Facilities Management including facilities management - utilities, housing, transportation, and waste management to capture all the emission sources.

Data collection and inventory continued for several months because, in many cases, the data were not readily available or captured in a usable form (See Chapter 6 on GHG Information Obstacles). However, once we finished the inventory, we did another literature review to ensure that our final results were within a comparable framework with other organizations and universities.

Emissions Inventory as a University Commitment

After a review of different emissions inventory tools, we determined that the California Climate Action Registry (Registry) seemed most logical for UCSB to ensure consistency with other state inventories and to help protect against future state legislation. When we approached UCSB Facilities about membership with the Registry, they were already familiar with the non-profit organization and its legislative mandate to allow institutions and corporations to voluntarily and publicly report annual GHG emissions. When presented with our research and cost estimations, they were very excited to sign on. We acted as a liaison between the Registry and UCSB, to help maintain momentum for UCSB commit to an official GHG inventory.

To most efficiently use our resources (mainly time and personal effort), we focused on catalyzing the relationship between UCSB and the Registry, and then stepping back to allow Facilities staff to work directly with the Registry to complete registration and develop the emissions inventory.

Lessons Learned:

- **Focus on easily achievable initial successes**. Since Facilities Staff were already interested in registering with CCAR, it was relatively easy for us to help them see the process through. By serving to catalyze UCSB's relationship with CCAR, two months into our project, we successfully ensured that an annual emissions inventory would be completed by the University even after we have graduated.

- **Encourage full-time staff to assume responsibility for long-term emissions monitoring and data collection**. It is easy for students to perform an emissions inventory, but University staff need to understand their own emissions sources in order to address them. Furthermore, data collection can be challenging and Universities can take steps to streamline the process if they understand that it will help them in the long-term.

- **Suggest an appropriate forum for your University to collect and report its emissions.** Schools may find their regional GHG registries to be most appropriate for campus inventories, as future state and federal legislation will likely seek to harmonize with these initiatives.

Emissions Inventory - A more Comprehensive Approach

Although CCAR provided a convenient platform for our campus to begin recognizing its greenhouse gas emissions, the required emissions sources mandated by the program is more limited than those typically reported by other universities across the country. Therefore, we decided to use the Clean Air – Cool Planet (CACP) Campus GHG calculator to expand the scope of emissions sources so that the results of our inventory could be more complete. Additionally the CACP calculator generated charts and tables very conveniently.

By performing our own inventory of campus emissions, we were able to compare the relative size of emissions sources excluded from the CCAR inventory. This ensures that our inventory is comparable in scope to other campuses that included sources such as commuting and solid waste. Furthermore, this exercise made sure that the numbers were accurate for both the inventories.

Lessons Learned:

- ➲ **Complete your own campus emissions inventory**. Performing an inventory of campus emissions can help to familiarize your team with the physical sources of emissions. Your emissions inventory can also facilitate relationship building with facilities staff and help support their efforts to complete an accurate inventory. Plus, it is always helpful to compare your own inventory with that of the school's to identify errors, differences in calculation and important gaps in data collection that would not be noticed otherwise.

- ➲ **Expand the scope of emissions sources to include those typically found on other campus inventories**. By looking at additional emissions sources (e.g. commuters, University-related air travel), your inventory may include more sources that the University has the power to influence. This opens up emissions reduction opportunities in more areas of the university, especially where traction may already exist to reduce greenhouse gas emissions for other reasons (i.e. reduced impact from driving).

Inventory Data Management

Below is a list of the specific tasks we performed to collect and organize GHG emissions inventory data.

- Identified our preliminary list of important GHGs. We began by investigating the six Kyoto Protocol gases: carbon dioxide (CO_2), methane (CH_4), hydrofluorocarbons (HFCs), sulphur hexafluoride (SF_6), perfluorocarbons (PFCs) and nitrous oxide (N_2O). We considered all six of these gases in the CA-CP calculator, but then we normalized to CO_2 equivalent ($MTCO_2e$).
- Identified the primary GHG emissions categories for UCSB. They are:
  - **Direct emissions** from campus activities, such as emissions from boilers or furnaces, travel in vehicles owned by UCSB, and other campus related maintenance activities.
  - **Indirect emissions** from purchased electricity, steam, or heat.
  - **Other indirect emissions** from student, staff and faculty commuting, air travel, fugitive emissions of refrigerants, and campus waste.
- Located existing energy and emissions data sources in Facilities Management and determined if any important GHG emissions sources are missing from these datasets. While most divisions and groups within UCSB do not track GHG emissions specifically, many collect the key data (e.g. fuel and electricity use) necessary for a comprehensive campus GHG inventory. Other data sources were more difficult – we found that the university did not thoroughly track commuting and air travel data.
- Established a baseline for UCSB (Year 2004). Appropriate conversion factors were available in the CA-CP Calculator

Fourth. Introduce and Analyze GHG Emissions Targets

What We Did and Why

With the inventory completed, we calculated relevant GHG emissions metrics (e.g., total GHG emissions per student, total GHG emissions per building square footage) and temporal trends in these metrics. By combining these GHG emissions metrics with projected campus growth (specified in number of students) we established a business as usual projection of GHG emissions through 2020. This was important because our University will continue to grow in enrollment, faculty, new building and campus size to meet the growing demand for education in California and our analysis of the feasibility of meeting overall reduction targets needed to take this projected growth into account.

Then, we decided to map possible targets to assess what type of reductions would be feasible for UCSB. Recall that the goal of our project has been to define a feasible path for UCSB to achieve Climate Neutrality, and we felt that assessing the feasibility of other less stringent targets, such as the California or Kyoto targets, were important as stepping stones on the way towards Neutrality. In addition, we suspected that without targets, there was less likelihood that our recommendations would actually be implemented. Many universities with GHG emissions reductions goals (see Appendix A) have chosen to follow Kyoto Protocol targets or their state's goals.

How We Analyzed GHG Emissions Targets

We calculated campus GHG emissions growth based on the emissions per capita for students in 2004 (baseline) multiplied by the projected increase in enrollment. By projecting emissions trends into the future, we pinpointed the gap between business as usual emissions and any established target (California, Kyoto Protocol, or Climate Neutrality, by 2020) to quantify how much emissions reductions would be likely to be necessary to meet a specific target.

The concept of Climate Neutrality, pioneered by the Rocky Mountain Institute and the Climate Neutral Network, combines aggressive GHG cuts with emissions offsets to achieve a zero net impact on the Earth's climate. According to Timothy Wirth, President of the UN Foundation, the world must "stabilize the concentration of carbon at double the historic record. In order to do that, the world needs to cut emissions by at least two-thirds, or about 70% percent, by the year 2050" (Wirth, 2005). This long-term goal - 70% reductions and 30% offsets provided a good model for achieving Climate Neutrality.

Lessons Learned:

- **Enlist the input of staff and administrators in setting a University goal**. Differing perspectives may exist among campus decision-makers about what is considered a realistic emissions reduction goal. Multiple meetings may be necessary to introduce the idea, as University administration may be initially resistant. As you address their concerns and include them in the initiative, they may be more amenable to a goal down the line.

- **Show widespread support for a University goal**. Engage with students, faculty and staff to demonstrate that climate change is an issue that most people at your school care deeply about. Alternatively, engage yourself in existing campus efforts that are addressing greater sustainability issues. In December 2005, we joined with seventy plus Academic Business Officers Group members (known as change agents) to learn more about the Natural Step workshops presented by Brightworks, Inc.

Fifth. Develop Criteria and Use it to Analyze Mitigation Strategies

What We Did and Why

We researched various emissions reduction technologies and projects in order to identify the most cost-effective emissions reduction package for the University. Since Facilities Management and Housing divisions had already made significant strides in the areas of energy efficiency, we worked closely with them to include their energy efficiency projects in our analysis.

How We Developed Criteria and Analyzed Mitigation Strategies

In order to identify emissions mitigations policies, we looked into the following opportunities.

Opportunities for reduction of UCSB's direct GHG emissions. "Direct reductions are the most important, because they are under the control of the institution, and they can be expected to provide additional benefits in the form of cost savings, local pollution reductions, jobs, educational activities, etc." (Rocky Mountain Institute, 2002, p.30) To reduce emissions from fleet vehicles, we investigated options such as use of biodiesel.

Opportunities for energy efficiency improvements. Other institutions that have conducted a detailed inventory of their campus energy use have found that significant and cost-effective opportunities lie in efficiency improvements in the following areas: lighting, HVAC (heating, ventilation and air conditioning), cooling, space heating, water heating, and plug loads such as refrigeration and office equipment. We obtained a list of these projects from Facilities Management for our calculations.

Opportunities for transportation program enhancement. UCSB made significant progress in this area by subsidizing public transportation for students, vanpool, restricting parking permits for students living within 2 miles of campus and by developing bike paths. Because 80% of faculty and staff commutes in single-occupancy vehicles, we looked into additional programs (i.e. rate incrementalization) that could help reduce emissions related to student and employee commuting,

Opportunities for behavioral changes. We explored how to best encourage behavioral changes to reduce energy usage, such as turning off lights, computers and appliances when not in use. Other universities have demonstrated success with simple stickers and education campaigns to raise awareness around campus to energy conservation.

Opportunities to purchase emissions offsets. Direct emissions reduction and efficiency improvements alone may not be enough to achieve any specific target, especially climate neutrality. Even after our best reduction efforts, purchasing CO_2 offsets would be necessary to achieving net zero GHG emissions. Therefore, we paid special attention to including offsets in our analysis of targets. However, your University's values have to be reflected in the choice of offset projects to support. We found that our University staff perceived offsets as "buying your way out of emissions reduction", so we did not actively pursue membership with offset providers such as the Chicago Climate Exchange or AgCert.com.

We also developed criteria to evaluate mitigation projects; these include $/$MTCO_2$e, capital cost, and payback period. These criteria were developed based on interviews with campus decision makers and a literature search. We followed their decision logic, which typically involved implementation of policies with the lowest cost and shortest payback period. We ranked our policies so that the policies with zero capital cost appeared first, followed by the most cost effective reduction policies up to the point of the cost of offsets, at which point the remaining emissions are offset to reach targets.

Finally, once we identified and researched the individual policy options, we analyzed the total cost of the different policy packages to examine the financial feasibility of meeting different targets. We sought to present our findings as policies that can lower energy costs in the short and long run.

During this time, we found that the obstacles related to reducing emissions on campus did not stem from a lack of campus knowledge about technological solutions. What they lacked was a coordinated approach to comparing solutions across emissions sources and for overcoming institutional barriers and funding difficulties. Therefore, we focused our research on a comparative analysis encompassing both cost and environmental considerations across a spectrum of campus emissions sources.

Note: Initially, we included seven criteria including: capital cost, operating cost, payback, $/GHG reduction, risk of ineffectiveness, campus attitude, and external attitude. We quickly realized that there were too many criteria. Follow-up meetings with the Assistant Vice Chancellor for Facilities and Management helped us to narrow it down to the ones he felt were most important.

Lessons Learned:

➲ **Work with those who understand the emission sources best and who will be required to implement emission reduction projects**. They can provide information and advice on what the criteria they would use to evaluate prospective projects.

➲ **Emphasize the compatibility of climate goals with existing campus goals**. Doing so can help sell climate initiatives as another way to justify and raise awareness for the energy efficiency and resource conservation work of the Facilities Management staff.

Sixth. Identify Institutional Barriers and Strategies to Address Them

What We Did and Why

Our analysis revealed reducing GHG emissions could be profitable for the University, but would the university readily take advantage of such a profitable opportunity? We found that even a compelling analysis did not ensure implementation because of various obstacles and exogenous constraints – institutional barriers. Our advisor, Dr. Oran Young, often referred to some of these barriers as "institutional arthritis that rigidifies bureaucracy."

Understanding these implementation obstacles were critical for us throughout the project, not just for formulating policy in the near-term, but also for long-term sustainability. One such example was lack of funding. Therefore, we focused on designing a student-fee based fund and campaigned for it in Spring 2006.

How We Did It

We were able to identify the obstacles by interacting with staff. Our interviews with them revealed why more of the energy efficiency projects cannot happen on campus due to funding, information or management issues. We then did literature review to substantiate our finding and discover strategies to overcome the obstacles.

The University organization is complex and fraught with irrationality (Sharp, 2002) – which we found to be true in some cases for UCSB as well. The current funding systems are set up in a way that discourages many projects that make financial and environmental sense (see Chapter 6). For example, subsidies for public transportation are funded by parking permit sales. Therefore, the success of alternative transportation automatically increases expenditures while decreasing revenue.

We examined these institutional barriers to GHG management explicitly in the effort to effect long-term institutional reform that can support environmental initiatives, rather than detract from these efforts.

For our project, the best recommendations are those which enable significant GHG emissions reductions with minimal implementation problems. In the end, we formulated our recommendations around ideas that will overcome or bypass bureaucracy, which enabled us to present our recommendations to UCSB as a pragmatic and complete solution.

Lessons learned:

- **Address systemic or procedural solutions to GHG management**. University systems are not currently set up to consider GHG emissions, and should be encouraged to include it as a project criterion along with cost considerations. Ultimately, effective environmental solutions must go beyond technical fixes (Hammond, 1998) and address systemic flaws.

- **Identifying institutional barriers is instrumental in supporting the work of facilities staff on campus**. Be sure to interview staff and ask for their feedback on existing organizational structure. Understanding what prevents the implementation of more energy efficiency projects will help you understand the staff constraints, while outlining a more realistic picture of what really needs to happen to improve campus sustainability.

- **Pursue innovative paths and be persistent.** When we first learned about the funding constraints we were somewhat disappointed. After studying literature and talking to other student groups, we soon realized that there were innovative ways to get funding, a student based fee being one of them. Fortuitously, an undergraduate environmental group had decided to propose a new student green fee, and this is where our campus engagement paid off. By involving ourselves in the development of this undergraduate initiative, we were influential in developing a revolving fund for energy efficiency and other sustainability projects on campus. One brainstorming session in September 2005 blossomed into a 6 month campaign for The Green Initiative Fund (TGIF).

In April 27, 2006, 75% of the undergraduate and 82% of the graduate voters voted YES on TGIF, making TGIF the first student fee based fund dedicated for energy efficiency and sustainable projects on campus.

General Best Practices

Get academic credit for your work: Doing so will improve the quality of your work by providing a formal academic advisor to your project, legitimizing the time you spend on the project and helping to keep people committed to project deliverables. Furthermore, it is an invaluable opportunity to involve faculty in campus sustainability issues.

Run with ideas and paths of least resistance: Capitalize on ideas that attract the most support and utilize these as a means of generating the foundation for gradually more challenging ideas (Sharp, 2002). Take action where you can be successful (Hammond, 1998). Focusing on areas where the University can save money will often be the easiest path to environmental stewardship. What campus administrator can be opposed to cost savings?

Be professional and respect staff time: There are likely to be other students on campus also contacting staff with data requests. Coordinate your questions with other students, and seek to identify the most effective communication methods. Some staff members prefer email, and others in the field may respond better to phone calls.

Stay aware of the climate-related initiatives on other campuses: Knowing what other campuses are doing can help you to design and sell your project to your campus administrators. Currently, 59 universities in the United States have pledged to reduce their GHG emissions. The Harvard Green Fund has provided inspiration for other campuses to develop revolving loan funds to support capital-intensive efficiency projects.

Always ask for their opinion: When in doubt, ask the University what it would take for them to reduce their GHG emissions. Try to identify solutions that would meet their criteria. Use their knowledge to propose realistic solutions that may already have momentum, but just need a little extra push.

Make sure key players are aware of opportunities for leadership: It is very important to motivate the people you work with so that they understand there is opportunity for mutual benefit. Asking staff, student or faculty to do something, and even asking very nicely, does not yield support and cooperation. To really gain support, you need to communicate the benefit of their participation to them, to you, and the overarching goal. This approach energizes people and helps them overcome hesitance or reluctance.

Celebrate your successes – Institutional change is a slow process. Take your small victories and give credit to the hard work of those who made it possible.

And ..**Don't give up!**

Project Timeline

We followed this tentative timeline for this year long project. Note that most activities did not have a definite start or end point, but rather they moved in parallel as the project progressed.

Goals	Tasks	Timeline
Diagnose and document GHG emissions at UCSB	Establish campus contacts	March-April 2005
	Basic Emissions Reduction Literature Research	April 2005
	Research UCSB's environmental policy and decision making hierarchy	April 2005
	Create GHG Inventory	May, 2006
Identify and Evaluate Emissions Reduction Policies	Policy Data	July - August 2005
	Identify policy mechanisms and costs calculations	September – October 2005
	Evaluated with decision makers	November-December 2005
Take steps to implement approaches	California Climate Action Registry	June 2005
	Involving stakeholders	Throughout (especially in the beginning and in the end)
	Trends and targets analysis	February 2006
	Final Recommendation to Campus Decision Makers	March 2006
	Establishing the greater CCN network	Throughout
	The Green Initiative Fund	Sept 2005-May 2006

Conclusion

We sought to establish the Bren School initiated campus climate neutral goal as a part of the campus' larger sustainability goals. Our specific recommendations for emissions reductions strategies were channeled through the committee on sustainability because that would ensure implementation and continuity of this important initiative. Our analysis yielded a financially compelling finding (profit in committing to an emissions reduction target), but financial incentives were not enough. To ensure implementation we needed to work hand in hand with campus decision makers and continue to portray the shared vision for why GHG reduction is so important and attainable. To help maintain the momentum out group has built, Campus Climate Neutral 2 (Bren School Class of 2007) will continue our work.

Establishing the Greater CCN Network - a NAELS Directive:

Ultimately, we worked within a broader national movement to encourage behavioral change in society and mobilize communities to be accountable for the climate impact of their actions. We helped pressure and move UCSB to commit to GHG emissions reductions and used analysis to justify our recommendations. In fact, our group became a part of a social movement at UCSB that defines how local actions can be connected and transformed into a broader movement. Here is how we became a part of this broader movement:

Campus level - We participated in several major conferences on climate change policy and student led initiatives to exchange information and ideas on institutional change, energy efficiency, emissions reduction, and emissions offsets. We networked through conferences such as the California Climate Action Registry, student groups such as California Students for Sustainability Coalition. By sharing our lessons and experiences, we joined forces with others who are working with campuses, business and organizations to reduce their emissions of anthropogenic greenhouse gases.

City and State level - The City of Santa Barbara adopted a regional goal of complying with the Kyoto Protocol. By demonstrating the feasibility of reaching the California State targets, we encouraged the City of Santa Barbara and City of Goleta that it is possible to fulfill their organizational missions while preventing dangerous levels of climate change. We also participated with UC system-wide initiatives to endorse sustainable transportation policies and to push for all UC schools to adopt GHG reduction goals.

National level - We stood in solidarity with others in the climate change movement, contributing our voices towards effecting change, and ultimately contributing to the literature of experiences in mobilizing organizations to reduce greenhouse gas emissions.

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CHANGING THE CAMPUS CLIMATE:
Strategies to Reduce Greenhouse Gas Emissions At University of California, Santa Barbara

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APPENDICES

Appendix A – Overview of University Action on Climate Change

The following universities have made public commitments to reduce campus greenhouse gas emissions:

Yale University
Public commitment: "Yale is committed to a level of investment in energy conservation and alternate energy sources that will lead, based on current projections, to a reduction in its greenhouse gas emissions by 10% below 1990 levels by the year 2020." (Levin, R., Hamilton, A., & Pepper, J., 2005)
History: In fall of 2004, a university-wide committee of staff, faculty and students were convened to form the Yale Energy Task Force. They were charged with developing recommendations on Yale's approach to energy production, procurement, demand, greenhouse gas emission reduction and conservation. Following the results of their analysis, the Yale administration adopted the key recommendation from the report presented by the Energy Task Force.

Tufts University
Public commitment: "Tufts, through its agreement to meet the standards of the Kyoto Protocol, has committed to reduce emissions by at least 7% of 1990 levels by 2012. At its current rate of growth, this translates into a 30% reduction in projected emissions." (Tufts Climate Initiative, 2004, p.2) Tufts University is a founding member of the Chicago Climate Exchange, the first market-based effort in the U.S. to initiate multi-sector trading of carbon emissions. This commitment requires Tufts to reduce emissions by at least 1% per year from 2003 to 2006.
History: In the 1990s, Tufts initiated the *Talloires Declaration*, a statement in support of environmental sustainability at the university level that has been signed by more than 300 university presidents to date. In 2003, President Lawrence Bacow renewed the University's dedication to climate protection by adopting the goals of the New England Governors and Eastern Canadian Premiers. The Tufts Climate Initiative (TCI) includes two faculty members, a part-time project manager, a part-time outreach coordinator, and a graduate student intern. With a goal towards leading the university on a path of full sustainability, TCI works on projects with university operations, staff, faculty, and students and focuses on four key areas: CO_2 reductions, research and monitoring, education, and outreach.

Cornell University
Public commitment: "Cornell University has agreed to reduce greenhouse gas emissions to 7% below 1990 levels by 2008." (Wang et al., 2004, p. 4)
History: In 2001, Cornell students comprising the Kyoto Now! movement convinced the university administration of the need to respond to climate change and adopt the goals of the Kyoto Protocol. A Kyoto Task Team was formed by the Utilities Department to oversee the direction of energy conservation efforts, renewable energy sources and the overall goal of reducing greenhouse gas emissions.

All 56 New Jersey Colleges and Universities
Public commitment: The presidents of all 56 New Jersey colleges and universities have pledged to cut their greenhouse gas emissions, in keeping with the state's goal to reduce emissions to 3.5% below 1990 by 2005 (Wang et al., 2004, p. 4).
History: In April 2000, New Jersey adopted a statewide goal to reduce greenhouse gas emissions to 3.5% below 1990 levels by 2005. To accomplish this goal, the New Jersey Department of Environmental Protection established the New Jersey Sustainability Greenhouse Gas Action Plan to identify "no regrets" strategies.

University of California, Berkeley
Public commitment: Chancellor Birgeneau agreed to adopt the California State Targets, consisting of 2000 emissions levels by 2010, 1990 levels by 2020, and 80% below 1990 levels by 2050 (UC Berkeley, 2006).
History: UC Berkeley has launched the Cal Climate Action Partnership (CalCAP) to develop a long-term strategy to reduce campus greenhouse gas emissions. With support from the Chancellor's Advisory Committee on Sustainability (CACS) and the Berkeley Institute of the Environment (BIE), CalCAP expects to complete a feasibility study to outline how the university can commit to more aggressive GHG targets than the existing California targets.

Duke University
Public commitment: "In response to student interest, Duke University administrators committed in 2004 to a greenhouse gas management plan." (Hummel, n.d., p.1) This plan remains under development.
History: The Executive Vice President of Duke University formed a committee of students, faculty and staff to study the feasibility and cost of a wide range of potential emissions reduction measures. The committee found it could not deliver a recommendation for a target emissions level and date with cost and feasibility analysis.

Many additional universities have developed Climate Action plans that demonstrate the feasibility of reduce greenhouse gas emissions from campus activities.

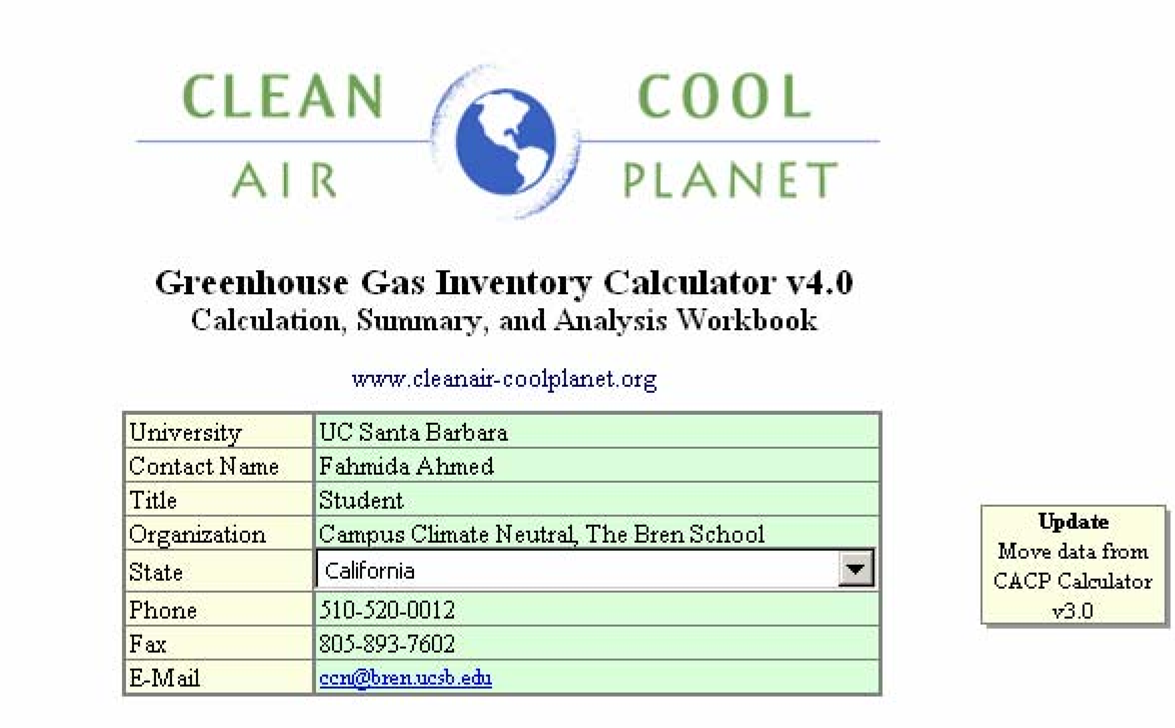
- Middlebury College: In 2003, students from a course ES 010 "The Scientific and Institutional Challenges of Becoming Carbon Neutral" contributed to the university's Carbon Reduction Initiative Working Group of the Community Council of Middlebury College.
- Oberlin College: The *Oberlin College: Climate Neutral by 2020* was initiated by Professor David Orr, Chair of Oberlin's Environmental Studies Department. The project aimed to demonstrate the feasibility of dramatic reductions in greenhouse gas emissions by university campuses.

Meanwhile, many more universities have completed an inventory of campus GHG emissions. These inventories help to highlight areas of opportunity for emissions reductions. Measuring emissions is the first step to managing them.

- Colby College
- Connecticut College
- Harvard University
- Lewis and Clark College
- Rice University
- Rutgers University

- Smith College
- Tulane University
- University of California, San Diego
- University of Colorado, Boulder
- University of New Hampshire
- University of North Carolina
- University of Vermont

Appendix B – Emissions Inventory for UCSB



CLEAN AIR COOL PLANET

Greenhouse Gas Inventory Calculator v4.0
Calculation, Summary, and Analysis Workbook

www.cleanair-coolplanet.org

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Update
Move data from CACP Calculator v3.0

The UCSB Bren School Campus Climate Neutral Group Project used the Clean Air – Cool Planet's Greenhouse Gas Inventory calculator for their campus inventory. This new, improved ***CA-CP Campus GHG Emissions Inventory Calculator*** is an upgrade of a tool that has been used at over 20 schools since 2001, mostly in the Northeast U.S. The tool seeks to facilitate the collection, analysis, and presentation of data, which are necessary for an effective inventory of greenhouse gas emissions related to campus activities.

The Microsoft Excel-based Emissions Inventory Calculator, called the eCalculator is an electronic workbook that has the capacity to include campus data on energy use, agriculture, refrigerant, and solid waste data. It estimates greenhouse gas emissions for our campus based on common energy metrics such as kWh, therms, Btu, and gallons of fuel. It includes the sixes greenhouse gases specified by the Kyoto Protocol (CO_2, CH_4, N_2O, HFC and PFC, and SF_6). The tool enabled us to calculate emissions for the years 1990-2020 and produce charts and graphs illustrating changes and trends in UCSB's emissions over time. In addition to calculating overall emissions, the eCalculator allowed us to examine emissions intensity trends over time as related to student population, building square footage, research dollars, and other metrics specific to university campuses.

The spreadsheets are based on the workbooks provided by the Intergovernmental Panel on Climate Change (IPCC, www.ipcc.ch) for national-level inventories. They have been adapted for use at institutions like university campuses, but follow virtually all the same protocols.

In addition to using the CA-CP eCalculator, we worked closely with UCSB Facilities to ensure that our data and results were consistent with the campus inventory completed in accordance with the California Climate Action Registry.

Greenhouse Gas Inventory Tables

These tables correspond to the INPUT spreadsheet in the "eCalculator.xls" where we entered the information directly and let Excel do the calculations. We also used these tables to facilitate data collection.

Data related to energy consumption and waste generation for years dating back to 1990 can sometimes be incomplete. When data is unavailable, we assumed reasonable values for those years.

red text= Assumption
blue text = Projections

Input Table 1: Institutional Data

UNIVERSITY	UC Santa Barbara									
	Institutional Data									
Fiscal Year	Budget			Population					Physical Size	
	Operating Budget	Research Dollars	Energy Budget	Full Time Students	Time Student	Summer School Students	Faculty	Staff	Total Building Space	Total Research Building Space
	$	$	$	#	#	#	#	#	Square feet	Square feet
1990	$ 292,284,000.00	$ 46,702,000.00	$ 8,080,000.00	19,082		4,961	766	2,802	2,717,700	
1991	$ 302,823,000.00	$ 4,692,000.00	$ 8,644,000.00	18,391		4,961	790	2,844	2,728,300	
1992	$ 309,121,000.00	$ 51,581,000.00	$ 7,526,000.00	18,519		4,961	814	2,886	2,732,900	
1993	$ 312,730,000.00	$ 53,895,000.00	$ 8,750,000.00	18,655		4,961	838	2,928	2,740,500	
1994	$ 309,927,000.00	$ 57,149,000.00	$ 7,243,000.00	18,581		4,961	863	2,970	2,805,900	
1995	$ 337,587,000.00	$ 61,290,000.00	$ 8,936,000.00	17,834		5,123	887	3,012	2,904,100	
1996	$ 349,365,000.00	$ 70,301,000.00	$ 8,933,000.00	18,224		5,275	909	3,013	3,021,400	
1997	$ 363,758,000.00	$ 73,022,000.00	$ 8,620,000.00	18,531		5,159	927	3,191	3,161,300	
1998	$ 376,829,000.00	$ 76,949,000.00	$ 6,822,000.00	18,940		5,128	975	3,119	3,174,200	
1999	$ 406,023,000.00	$ 84,061,000.00	$ 6,472,000.00	19,363		5,375	998	3,179	3,177,700	
2000	$ 437,065,000.00	$ 92,837,000.00	$ 6,534,000.00	20,056		5,695	980	3,197	3,181,700	
2001	$ 472,673,000.00	$ 91,866,000.00	$ 8,465,000.00	19,962		7,985	1,034	3,310	3,181,700	
2002	$ 472,047,000.00	$ 94,623,000.00	$ 10,053,000.00	20,373		8,675	1,054	3,267	3,250,300	
2003	$ 495,270,000.00	$ 102,604,000.00	$ 8,926,000.00	20,559		8,745	1,098	3,177	3,298,900	
2004	$ 505,257,000.00	$ 108,290,000.00	$ 9,612,000.00	20,847		8,422	1,095	3,547	3,360,400	

Input Table 2: Purchased electricity, steam, and chilled water.

Note that we specified the electric grid (WECC) corresponding to our campus location, based on a map within the calculator. No information was entered for steam and chilled water because UCSB does not purchase any produced off-site.

UNIVERSITY			
	Purchased Electricity	Puchased Steam / Chilled Water	
Fiscal Year	Electric produced off-campus	Steam and Chilled water produced off-campus	
	Click here to select your electric region	Purchased Steam	Purchased Chilled Water
	WECC California	Go to EF_Steam to set steam fuel mix	Go to EF_Water to set steam fuel mix
	kWh	MMBtu	MMBtu
1990	68,173,982		
1991	69,565,288		
1992	72,013,528		
1993	72,038,010		
1994	78,278,740		
1995	78,525,470		
1996	83,003,188		
1997	86,966,640		
1998	94,396,107		
1999	88,995,584		
2000	84,357,095		
2001	85,724,842		
2002	76,733,011		
2003	78,930,394		
2004	79,733,909		

Input Table 3: On-campus stationary energy use

UNIVERSITY										
	tationary Sources									
Fiscal Year	This category includes all stationary sources of emissions on campus (heating, cooling, cooking, laboratories, etc)									
	Residual Oil (#5 - #6)	Distillate Oil (#1 - #4)	Natural Gas	Propane	Incinerated Waste	Coal	Other A	Other B	Other C	Solar / Wind / Biomass
	Gallons	Gallons	MMBtu	Gallons	MMBtu	Short Ton	MMBtu	MMBtu	MMBtu	MMBtu
1990			291,069							
1991			281,917							
1992			295,696							
1993			298,009							
1994			248,856							
1995			287,362							
1996			288,679							
1997			299,222							
1998			292,954							
1999			339,537							
2000			333,694							
2001			343,704							
2002			321,440							
2003			304,256							
2004			304,315							

Input Table 4: Transportation: Fleet and air travel

UNIVERSITY									
	Transportation								
Fiscal Year	University Fleet					Air Travel		Commuters	
	Gasoline Fleet	Diesel Fleet	Natural Gas Fleet	Electric Fleet	Other Fleet	Faculty / Staff Business	Student Programs	Faculty / Staff Gasoline	Students Gasoline
	Gallons	Gallons	MMBtu	kWh	MMBtu	Miles	Miles	Gallons	Gallons
1990	100,000	6,000				24,000,000		436,322	783,900
1991	100,000	6,000				24,000,000		426,000	729,819
1992	100,000	6,000				24,000,000		436,804	738,968
1993	100,000	6,000				24,000,000		454,577	759,896
1994	100,000	6,000				24,000,000		457,941	749,940
1995	100,000	6,000				24,000,000		456,813	717,117
1996	93,521	6,000				24,000,000		457,875	731,440
1997	99,948	6,000				24,000,000		474,049	727,096
1998	105,161	6,000				24,000,000		469,104	735,277
1999	99,691	6,000				24,000,000		483,088	762,809
2000	101,128	6,000				24,000,000		472,058	775,916
2001	100,424	6,000				24,000,000		486,489	834,459
2002	100,975	6,000				24,000,000		469,718	922,701
2003	105,242	6,000				24,000,000		464,718	930,833
2004	107,490	6,200				24,000,000		504,613	920,192

Input Table 5: Student commuter habits

MODULE	INPUTS								
WORKSHEET	Commuter Traffic								
UNIVERSITY	UC Santa Barbara								
	Students								
Fiscal Year	Students	Student fuel efficiency	Percent Drive alone	Percent Carpool	Trips / Day	Days / Year	Miles / Trip	Total Distance	Fuel Consumption
	#	mpg	%	%				Miles	Gallons
1990	19,082	20.2	20%	2.7%	2.00	150	10	12,591,830	622,151
1991	18,391	21.1	20%	2.7%	2.00	150	10	12,135,853	574,773
1992	18,519	21.0	20%	2.7%	2.00	150	10	12,220,318	582,834
1993	18,655	20.5	20%	2.7%	2.00	150	10	12,310,061	600,265
1994	18,581	20.7	20%	2.7%	2.00	150	10	12,261,230	591,905
1995	17,834	21.1	20%	2.7%	2.00	150	10	11,768,300	557,087
1996	18,224	21.2	20%	2.7%	2.00	150	10	12,025,653	567,248
1997	18,531	21.5	20%	2.7%	2.00	150	10	12,228,236	568,755
1998	18,940	21.6	20%	2.7%	2.00	150	10	12,498,127	578,617
1999	19,363	21.4	20%	2.7%	2.00	150	10	12,777,256	597,068
2000	20,056	21.9	20%	2.7%	2.00	150	10	13,234,553	604,318
2001	19,962	22.1	20%	2.7%	2.00	150	10	13,172,525	596,042
2002	20,373	22.1	21%	3.0%	2.00	150	10	14,301,846	647,142
2003	20,559	22.1	21%	3.0%	2.00	150	10	14,432,418	653,051
2004	20,547	22.1	21%	3.0%	2.00	150	10	14,423,994	652,669
	Input	3						Total Distance = ((Total Students x % Drive Alone) + (Total Students x % Carpool)/2) x Trips/Day x Days/Year x Miles/Trip	Fuel Consumption = mpg / Total Distance

Input Table 6: Solid Waste

UNIVERSITY					
	Solid Waste				
Fiscal Year	Includes all solid waste produced by campus except waste composted or burned on campus for power				
	Incinerated Waste (waste to energy plant) not used for school power		Landfilled Waste with no CH_4 Recovery	Landfilled Waste with CH_4 Recovery and Flaring	Landfilled Waste with CH_4 Recovery and Electric Generation
	Mass Burn Incinerator	Refuse Derived Fuel (RDF) Incinerator			
	Short Tons	Short Tons	Short Tons	Short Tons	Short Tons
1990					3,073
1991					3,073
1992					3,073
1993					3,073
1994					3,073
1995					3,374
1996					3,381
1997					3,738
1998					3,331
1999					3,299
2000					3,361
2001					3,155
2002					2,880
2003					2,495
2004					2,619

Input Table 7: Refrigeration and other chemicals

In the calculator, you are able to choose from a list of additional gases or enter new gases.

UNIVERSITY							
	Refrigeration and other Chemicals (PFCs, HFCs, SF6)						
Fiscal Year	All other greenhouse gases (click chemical name below to select)						
	R22	HFC-125	HFC-134a	HFC-143a	HFC-143a	HFC-152a	Sum
	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	kg
1990	523						1150.6
1991	523						1150.6
1992	523						1150.6
1993	523						1150.6
1994	523						1150.6
1995	523						1150.6
1996	523						1150.6
1997	523						1150.6
1998	523						1150.6
1999	523						1150.6
2000	523						1150.6
2001	523						1150.6
2002	523						1150.6
2003	523						1150.6
2004	523						1150.6

Appendix C – Policy Mechanism Evaluations

Calculation Methodology for Mechanism Evaluations

Capital cost:
The total investment needed to complete a project, exclusive of staff time, operating, maintenance and operating costs.

Payback:
The length of time before the accumulated cost savings from a project equals the original investment.

$$Payback\,(years) = \frac{Capital\ cost}{Annual\ savings}$$

$/MTCO$_2$e:
Estimated dollar amount saved per MTCO$_2$e avoided

$$\$/MTCO_2e = \frac{(Total\ NPV)}{(Total\ years\ of\ project)} \cdot \frac{1}{Annual\ MTCO_2e\ avoided}$$

$$Total\ NPV = -(Capital\ cost) + (Annual\ savings) \cdot \frac{(1+r)^n - 1}{r(1+r)^n}$$

Where r = discount rate, and n = total years of project:

Annual GHG reduction potential:
This is calculated by multiplying the amount of energy avoided annually (electricity, natural gas or other fossil fuels) by its emissions factor of combustion.

Project lifetime:
This is equal to the total number of years the project or equipment is expected to last.

Commonly Used Assumptions for Mechanism Evaluations

- Total 2004 campus GHG emissions = 46,074 $MTCO_2e$ [1]

UCSB Electricity

- Price of electricity = $0.11/kWh [2]
- Emissions factor for electricity = 2755 kWh/$MTCO_2e$ = 0.000362 $MTCO_2e$/kWh [3]

UCSB Natural Gas

- Price of natural gas = $0.90/therm [4]
- Emissions factor for natural gas = 0.005 $MTCO_2e$/therm [5]

UCSB Transportation Fuel

- Price of gasoline: $2.54 per gallon [6]
- Emissions factor for gasoline: 0.00871 $MTCO_2e$/gallon [7]
- Emissions factor for diesel: 0.00999 $MTCO_2e$/gallon [8]

Capital Cost Discount factor = *r*

- Percent = 6%

Project Lifetimes = *n*

- 25 years for on-site solar projects
- 15 years for most other projects
- 10 years for fleet vehicles

NPV Factor = $\frac{(1+r^n)-1}{r(1+r)^n}$

- 12.78 for 25 year project lifetime
- 9.71 for a 15 year project lifetime

[1] As calculated in the Inventory, for CCAR emissions sources only.
[2] Peppers, M. (2006, March 27). UCSB Proposed Energy Projects, 2006 to 2008. Unpublished calculations and data.
[3] As calculated from the Inventory, where emissions factor = 2755 kWh per $MTCO_2e$.
[4] See Footnote 2
[5] As calculated from the Inventory, based on 200 therms/$MTCO_2e$.
[6] U.S. DOE, Energy Information Agency. (2006). California average fuel price in February 2006. Retrieved February 4, 2006, from http://tonto.eia.doe.gov/oog/info/gdu/gasdiesel.asp
[7] As calculated by Clean Air – Cool Planet. (2005). Greenhouse Gas Inventory Calculator, Version 4.0. Portsmouth, New Hampshire.
[8] See Footnote 7

Overview of Mechanism Evaluations

#	Mechanism	CCAR?	Capital Cost ($)	Payback (Years)	$/MTCO$_2$e	Annual GHG Reduction Potential (MTCO$_2$e)	Project Lifetime (Years)
1.1	15% Offset Purchase	Yes	$73,309	never	-$11	6911	1
1.2	100% Offset Purchase	Yes	$488,725	never	-$11	46074	1
2.1	Building Public Data	Yes	$15,000	14.5	-$149	3	15
2.2	Building Baseline Awards	Yes	$15,000	2.9	$127	14	15
3.1	On-site 42KW PV System	Yes	$323,400	53.0	-$492	20	25
3.2	Solar Water Heating Project for UCSB Housing	Yes	$0	0.0	$23	312	25
4	15% RECs	Yes	$119,600	never	-$28	4341	1
5	Energy Star Computer Settings	Yes	$0	0.0	$196	310	15
6.1	Lighting Upgrades	Yes	$1,797,762	4.9	$97	835	15
6.2	HVAC Upgrade - Fans	Yes	$1,574,464	3.5	$125	914	15
6.3	HVAC Upgrade - Filters	Yes	$372,323	0.0	$196	607	15
6.4	HVAC Upgrade- Air Handlers	Yes	$550,000	10.2	$42	174	15
6.5	Fume Hood Proximity Sensors	Yes	$80,000	3.7	$156	55	15
6.6	Air Handlers - Optimize Hot/Cold Deck Temperature	Yes	$200,000	0.4	$245	573	15
6.7	HVAC Commissioning	Yes	$120,000	0.2	$241	340	15
7.1	Fleet Ethanol	Yes	$0	0.0	$0	796	15
7.2	Fleet Biodiesel	Yes	$0	never	-$65	30	15
7.3	Fleet Biking	Yes	$2,500	9.0	$11	1	15
7.4	Fleet Smaller Vehicles	Yes	$0	0.0	$215	33	10
7.5	Fleet Hybrids	Yes	$155,000	12.9	-$162	41	10
8.1	Use current videoconference rooms	No	$0	0.0	$1,506	4	15
8.2	Construct small videoconference room	No	$30,000	1.5	$1,279	9	15
8.3	Construct large videoconference room	No	$80,000	2.6	$1,102	13	15
9.1	Increase Parking Rates	No	$0	0.0	$1,407	2	15
9.2	Parking Rate Incrementilization	No	$6,000	never	$15	26	15
10	Composting program	No	$1,500	never	-$22	36	15

Campus Climate Neutral (CCN) Policy Mechanism Evaluation # 1

<table>
<tr><td>Category</td><td>Offsets</td></tr>
<tr><td>CCN Strategy</td><td>Purchase carbon offsets.</td></tr>
<tr><td>Mechanism</td><td>Since GHGs are long-lived and well mixed in the atmosphere, reducing emissions in any location reduces overall worldwide levels. This strategy refers to paying to reduce GHG emissions “somewhere else.”
15% offset purchase – If the university were to offset 15% of its emissions.
100% offset purchase – If the university were to offset 100% of its emissions.</td></tr>
<tr><td>Mechanism Description</td><td>There are several options for purchasing offsets. The key sources are:
<u>Emission Offsets/Carbon Market</u> – The Chicago Climate Exchange (CCX) allows electronic trading of greenhouse gas emission allowances and offsets. The offsets come from projects, such as methane collection and carbon sequestration, that are generated by qualifying mitigation projects and registered with CCX by Exchange Participant Members. Price: approximately $2/MTCO$_2$e.
<u>Certified Emission Reductions (CER)</u><ol type="a">
AgCert.com: These are project-based emission reduction activities. “The process requires emission reductions to be certified by an independent third party. Once certified, emission reductions become a legal tender and therefore are transferable as globally tradable assets, a market that is determined by supply and demand.”(AgCert International, 2005). AgCert’s GHG reduction methodology received approval from the CDM Executive Board of the United Nations Framework Convention on Climate Change (UNFCCC.) DrivingGreen (DG) is a division of AgCert that offers consumers the ability to calculate and offset the GHG emissions from their vehicles. DG uses offsets from US GHG emission reduction projects managed by AgCert. DG charges individuals $8/MTCO$_2$e to offset their vehicles.
Climate Care: This organization sells carbon offsets on the one hand while funding and managing projects on the other. The price estimates are shown in the next page.
<u>Land Management Projects</u> - These projects that simultaneously minimize climate change, support sustainable development and combat the loss of biodiversity. The CCBA Project Design Standards (CCB Standards) evaluate land-based carbon mitigation projects in the early stages of development.</td></tr>
</table>

Mechanism as appears in the matrix:

#	Mechanism	CCAR?	Capital Cost ($)	Payback (Years)	$/MTCO$_2$e	Annual GHG Reduction Potential (MTCO$_2$e)	Project Lifetime (Years)
1.1	15% Offset Purchase	Yes	$73,309	never	-$11	6911	1
1.2	100% Offset Purchase	Yes	$488,725	never	-$11	46074	1

Facts and Assumptions for Offsets

- Price of offsets is a function of variables such as quality of the offset, the type of project utilized to generate it, and whether it is third party verified. The estimation of $10.61 is a calculated average of various types of offsets available today. Excluded from the calculation are: the CCX price ($2), because the University is unlikely to commit to a legally binding agreement for GHG reduction as required by CCX, and the Climate Care air travel price ($38) because air travel is not a mandatory UCSB emissions source for the annual CCAR emissions inventory.

Type of Offsets	Price per $MTCO_2e$
CCX	$2
AgCert/Driving Green	$8
Climate Care Driving	$13.03
TerraPass Inc	$11.00
Land Management	$10.40
Climate Care Air Travel	$37.87
Average Price	$10.61

- Excluded from capital cost calculations:
  - Initial membership fees and annual dues, such as CCX requirements of $500 and $500, respectively, to sell offset credits (also called Carbon Financial Instruments under CCX)
  - Upfront investments (up to $10,000) needed for land management projects
- Assume 1 year mechanism lifetime. Purchasing offsets is a one time investment.

Quantitative Evaluation

1. *Capital Cost*
   - 15% offset purchase = ($ 10.6/$MTCO_2e$) * (0.15) * (46074 $MTCO_2e$) = $73,309
   - 100% offset purchase = ($ 10.6/$MTCO_2e$) * (46074 $MTCO_2e$) = $488,725

2. *Payback with rebates/grants*

   Offsets never pay back because they yield no savings. It is also a one time investment.

3. *University $/$MTCO_2e$ with rebates/grants over life of project*

   - $10.61/$MTCO_2e$, based on calculation noted in the box.

4. *Ton GHG Reduction Potential (Annual)*

   15% = 6,911 $MTCO_2e$
   100% = 46,074 $MTCO_2e$

Comments:

- About Purchasing Offsets: Students and sustainability officers at UCSB are supportive of purchasing offsets and consider it a worthwhile investment. However, Facilities Management considers it to be a short term political fix without a long term solution to emission reduction, mostly due to the existing debates about the legitimacy, eligibility and actual GHG reduction potential of the offset projects organizations in the US. We think the cost of offset purchase is financially justified once energy efficiency projects have been implemented because offsets are relatively inexpensive. We also think that purchasing offsets that reduce emissions elsewhere is morally justified.

- About Driving Green: DG's website charges individuals \$8/MTCO_2e to offset their vehicles. Through an affiliate program, DG provides this \$3/MTCO_2e difference as an incentive for the sponsor organization to promote offset purchases from its members. For example, if UCSB commuters purchased offsets for their personal vehicles through an affiliate sponsor such as the Transportation and Parking Services' (TPS) parking permit website they would pay \$8/MTCO_2e. DG would then return \$3/MTCO_2e purchased back to TPS for use in the Transportation Alternatives Program (TAP).

Sources

U.S. DOE, Energy Efficiency and Renewable Energy. (2006). The Green Power Network: Buying green power. Retrieved February 10, 2006, from http://www.eere.energy.gov/greenpower/buying/buying_power.shtml?state=CA ;

Chicago Climate Exchange. (2006). Emission offsets from carbon market. Retrieved February 10, 2006, from http://www.chicagoclimatex.com/about/program.html

AgCert International. (2005). Certified Emission Reductions (CERs). Retrieved February 10, 2006, from http://www.agcert.com/

DrivingGreen. (2005). About us. Retrieved February 10, 2006, from http://www.drivinggreen.com/faq.html

Climate Care. (2006). Our projects. Retrieved February 10, 2006, from http://www.climatecare.org/Projects/index.cfm

The Climate, Community and Biodiversity Alliance. (2005). Confronting climate change. Retrieved February 10, 2006, from http://www.climate-standards.org/index.html

Campus Climate Neutral (CCN) Policy Mechanism Evaluation # 2

Category	Electricity and Natural Gas
CCN Strategy	Modify building occupant behavior
Mechanism	2.1 Publish building level energy consumption. 2.2 Provide reward incentives for individuals to reduce their energy consumption.
Mechanism Description	Technological solutions to reduce energy demand are but one approach. Significant opportunity exists for building occupants to modify their behavior to reduce energy consumption. Currently, staff, students and faculty have little incentive to conserve energy since they do not pay the bills directly. The mechanisms below seek to raise awareness and provide incentives for building users to conserve energy. 2.1 Publish each month a summary of building level energy consumption. (Idea modeled after the Toxic Release Inventory). This information could be posted on the UCSB Sustainability website, or published in the student newspaper, The Daily Nexus. 2.2 Reward buildings that use less energy than an established baseline level. Types of rewards could include pizza parties or financial payouts for the department. Theoretically, the University could also charge departments for excess energy consumption, but this may prove to be too politically unpopular.

Mechanism as appears in the matrix:

#	Mechanism	CCAR?	Capital Cost ($)	Payback (Years)	$/MTCO$_2$e	Annual GHG Reduction Potential (MTCO$_2$e)	Project Lifetime (Years)
2.1	Building Public Data	Yes	$15,000	14.5	-$149	3	15
2.2	Building Baseline Awards	Yes	$15,000	2.9	$127	14	15

Facts and Assumptions

- Assume 15 more building level meters will be needed[1].
- Capital cost of a single meter[2] = $1000
- 2004 total electricity consumption = 79,733,909 kWh
- Assume price of electricity[3] = $0.11/kWh
- Emissions factor for electricity = 0.000363 MTCO$_2$e/kWh
- Assume 15 year project lifetime.

[1] This information is based on meter reading data available through http://energy.ucsb.edu/ASP-HTM.asp
[2] As estimated by Campus Sustainability Coordinator, Perrin Pellegrin
[3] As used by UCSB Design & Construction Services Project Manager, Mark Peppers

Quantitative Evaluation

1. *Capital Cost*

2.1 Capital cost = (15 meters) x ($1000 per meter) = $15,000
2.2 Capital cost = (15 meters) x ($1000 per meter) = $15,000

2. *Payback*

2.1 Assume 0.01% reduction in energy demand
Annual savings = (0.01%) x (79,733,909 kWh) x ($0.11/kWh) = $877
Payback = Capital cost/Annual savings = $15,000/$877 = 17 years

2.2 Assume 0.05% reduction in energy demand
Annual savings = (0.05%) x (79,733,909 kWh) x ($0.11/kWh) = $4385
Payback = Capital cost/Annual savings = $15,000/$4385 = 3.4 years

3. *University $/MTCO$_2$e*

2.1 Annual MTCO$_2$e = (0.01%) x (79,733,909 kWh) x (0.000363 MTCO$_2$e/kWh) = 3
Annual net present value of project = - $6481.65/15 years = - $432.11
University $/MTCO$_2$e = Annual NPV/Annual MTCO$_2$e = - $149.30/MTCO$_2$e

2.2 Annual MTCO$_2$e = (0.05%) x (79,733,909 kWh) x (0.000363 MTCO$_2$e/kWh) = 14
Annual net present value of project = $27,591.76 savings/15 years = $1839.45
University $/MTCO$_2$e = Annual NPV/Annual MTCO$_2$e = $127.11/MTCO$_2$e

4. *Ton GHG Reduction Potential (Annual)*

2.1 Annual MTCO$_2$e = 3

2.2 Annual MTCO$_2$e = 14

Comments:
In general, Facilities staff indicated that rewarding reduced energy consumption is a more politically feasible approach as compared to imposing fines on buildings which consume over their baseline.

Campus Climate Neutral (CCN) Policy Mechanism Evaluation # 3.1

Category	Electricity
CCN Strategy	On-site renewable energy
Mechanism	On-site 42KW PV System
Mechanism Description	This project would install 572 175-watt panels on the roof of a campus building similar to the size of Bren Hall (e.g., Marine Science Institute) equaling a total of 42 kW.

Mechanism as appears in the matrix:

#	Mechanism	CCAR?	Capital Cost ($)	Payback (Years)	$/MTCO$_2$e	Annual GHG Reduction Potential (MTCO$_2$e)	Project Lifetime (Years)
3.1	On-site 42KW PV System	Yes	$323,400	53.0	-$492	20	25

<u>Facts and Assumptions</u>

The upfront capital cost (including installation) will be $323,400 (considering CPUC rebates). We assume a project lifetime of 25 years, a grid-based energy costs of $0.11/kWh and a discount rate of 6 percent. According to Solar Module Price Index posted by Solarbuzz[1] in April 2006, the average price from January 2002 to March 2006 for 1 watt of solar energy was $5.25. The total *installed* cost of a Solar Energy System is $10.50/W.

On Jan. 12, 2006, CPUC approved the California Solar Initiative (CSI), a comprehensive $2.8 billion program that provides incentives toward solar development over 11 years. The Emerging Renewable (Rebate) Program in California provides $2.80 per Watt for PV projects up to 1 MW. NOTE: The Federal Energy Tax Credit provides up to a 30% tax credit for the purchase price of installing qualified solar energy equipment. Since UCSB is a state institution and is therefore tax exempt, it does not qualify for a tax break; however, the benefit of having the installer qualify for the tax credit may be shared by both parties. This could potentially further lower UCSB's installed cost for a solar system. For the purposes of this calculation, the Federal Energy Tax Credit has been omitted.

- Bren Hall's total energy use is between 420 – 600 kW.
- The current 42 kW array on Bren Hall provides between 7% - 10% of the buildings energy needs.
- kWh generation potential for photovoltaics = 42 kW * $\frac{8{,}760hr}{yr}$ * .15 capacity factor = 55,188 kWh/yr
- Assume 25 year project lifetime

[1] http://www.solarbuzz.com/Moduleprices.htm

Quantitative Evaluation

1. *Capital Cost*

- Total Cost of an installed solar watt = $10.50
- State Rebate for a solar watt = - $ 2.80
- Capital Cost for a watt of installed solar = $ 7.70
- Capital Cost of potential project = 42 kW = 42,000 W * $7.70/W = $323,400

2. *Payback*

55,188 kWh/yr * $.11/kWh = $6,070 savings/year

$$\frac{CapitalCost}{Savings/year} = \frac{\$323{,}400}{\$6{,}070} = 53 \text{ years}$$

3. *Ton GHG Reduction Potential (Annual)*

$$\text{Annual } MTCO_2e = \frac{55{,}188 kWh/yr}{2{,}755 kWh/MTCO2e} = 20 \ MTCO_2e/yr$$

4. *University $/$MTCO_2e$*

NPV Factor = 12.78
Net Present Value = $323,400 – (55,188 kWh/yr* $.11/kWh) * 12.78 = $323,400 – ($6,070 savings/yr * 12.783) = $323,400 – $77,601 = $245,799

$$\text{University \$/GHG} = \frac{NPV}{AnnualGHGpotential * projectlifetime} =$$

$$\frac{-\$245{,}799}{20 MTCO2e * 25 yrs} = \frac{-\$491.60}{MTCO2e}$$

Sources

Solarbuzz, LLC. (2006). Solar module price environment. Retrieved May 6, 2006, from http://www.solarbuzz.com/Moduleprices.htm

DSIRE: Database of State Incentives for Renewable Energy. (2006). California incentives for renewable energy: Emerging renewables (rebate) program. Retrieved May 6, 2006, from http://www.dsireusa.org/library/includes/incentive2.cfm?Incentive_Code=CA30F&state=CA&CurrentPageID=1&RE=1&EE=0

U.S. Department of Energy. (2006). The Energy Policy Act of 2005. Retrieved May 6, 2006, from http://www.energy.gov/taxbreaks.htm

Campus Climate Neutral (CCN) Policy Mechanism Evaluation # 3.2

Category	Electricity
CCN Strategy	On-site renewable energy
Mechanism	On-site Solar Water Heating Project for UCSB Housing
Mechanism Description	This mechanism is based on an actual project that was implemented on seven University owned housing units on-campus. There is currently a prime opportunity with the expansion of the West Campus Family Housing project and the availability of government subsidies for solar water heating.

Mechanism as appears in the matrix:

#	Mechanism	CCAR?	Capital Cost ($)	Payback (Years)	$/MTCO$_2$e	Annual GHG Reduction Potential (MTCO$_2$e)	Project Lifetime (Years)
3.2	Solar Water Heating Project for UCSB Housing	Yes	$0	0.0	$23	312	25

<u>Facts and Assumptions</u>

The solar heating project was purchased by a third party known as an Energy Services Company (ESCO), which agreed to cover the capital and continual maintenance costs of the project and thereby owns the system. The ESCO was able to qualify for the CPUC energy rebate as well as the Federal Energy tax credit, greatly reducing their costs for the project. In addition, the monthly amount paid by the University for a solar therm providing hot water is 75% of the monthly cost of a therm provided by natural gas.

- The system is an all-water based (chemical free) solar heating system – no risk of contamination.
- The following Housing units that currently contain this system include:
  - West Campus Family Housing
  - Santa Cruz
  - Anacapa
  - Santa Rosa
  - San Miguel
  - San Nicolas
  - San Rafael
  - Carrillo Dining Commons (solar water heaters on top of Carrillo preheat water for the boiler serving San Rafael and San Miguel).
- Emission factor = 200 therms/ MTCO$_2$e
- Annual solar therms provided by system = 62,400
- Cost of a solar therm = $0.675
- Annual solar heat cost at $0.675/therm = $0.675 * 62,400 = $42,120
- Annual natural gas heat cost at $ 0.90/therm = $.90 * 62,400 = $56,160
- Annual heat savings = $56,160 - $42,120 = $14,040
- Assume 25 year project lifetime.

Quantitative Evaluation

1. *Capital Cost*
   Paid by an ESCO = $0

2. *Payback*
   Since the system does not have a capital cost, there is nothing to payback.

3. *Ton GHG Reduction Potential (Annual)*

   Annual $MTCO_2e = \frac{62{,}400\_therms/yr}{200\_therm/MTCO2e}$ = 312 $MTCO_2e$

4. *University $/MTCO_2e$*
   NPV Factor = 12.78
   Net Present Value = $0 – ($14,040 saving/year * 12.78) = $0 – $179,478 = $179,478 savings

   University $/GHG = $\frac{NPV}{AnnualGHGpotential * projectlifetime}$ =

   $$\frac{\$179{,}478}{312\_MTCO2e * 25yrs} = \frac{\$23}{MTCO2e}$$

Sources

Mark Rousseau, Housing & Residential Services Energy & Environmental Manager. (2006, March 20). Personal interview.

DSIRE: Database of State Incentives for Renewable Energy. (2006). California incentives for renewable energy: Emerging renewables (rebate) program. Retrieved May 6, 2006, from http://www.dsireusa.org/library/includes/incentive2.cfm?Incentive_Code=CA30F&state=CA&CurrentPageID=1&RE=1&EE=0

U.S. Department of Energy. (2006). The Energy Policy Act of 2005. Retrieved May 6, 2006, from http://www.energy.gov/taxbreaks.htm

Campus Climate Neutral (CCN) Policy Mechanism Evaluation # 4

Category	Electricity
CCN Strategy	Off-site renewable electricity
Mechanism	Purchase renewable energy certificates (RECs), also known as green tags.
Mechanism Description	This strategy refers to displacing conventional electricity with renewable energy sources that emit little or no greenhouse gas emissions. Renewable energy certificates represent the environmental benefits related to clean energy generation that occurs off-site.

Mechanism as appears in the matrix:

#	Mechanism	CCAR?	Capital Cost ($)	Payback (Years)	$/MTCO$_2$e	Annual GHG Reduction Potential (MTCO$_2$e)	Project Lifetime (Years)
4	15% RECs	Yes	$119,600	never	-$28	4341	1

<u>Facts and Assumptions</u>

- Assume cost of REC[1] = $0.01/kWh
- UCSB 2004 total electricity consumption = 79,733,909 kWh
- Assume electricity emissions factor = 0.000362 MTCO$_2$e/kWh
- Assume 1 year project life.

Quantitative Evaluation

1. *Capital Cost*

   (79,733,909 kWh) * (15%) * ($0.01/kWh) = $119,600

2. *Payback*

   Since this mechanism does not generate any savings, there is no payback.

3. *University $/MTCO$_2$e*

   (- $0.01/kWh) * (1/0.000362 MTCO$_2$e/kWh) = - $27.55/MTCO$_2$e

4. *Ton GHG Reduction Potential (Annual)*

   (79,733,909 kWh) * (15%) *(0.000362 MTCO$_2$e/kWh) = 4330 MTCO$_2$e

[1] U.S. DOE, U.S. EPA, World Resources Institute & Center for Resource Solutions. (2004, September). Guide to purchasing green power: Renewable electricity, renewable energy certificates and on-site renewable generation. Washington, D.C.

Comments:

The per unit cost of RECs are typically a function of the total amount of RECs purchased – with bulk purchasers receiving a lower per unit cost. Accordingly, UCSB should think about pursuing consolidated purchases of RECs with other UCs.

Additional renewable electricity products may be available from the utility or power marketer and they can be structured with block rates ($x/MWh) or as percentage of use (e.g., 10% of usage). Unfortunately, UCSB's current electricity provider, Southern California Edison, does not offer a renewable energy product, but several in California do and costs are similar to RECs (1-3 cents/kWh).

Campus Climate Neutral (CCN) Policy Mechanism Evaluation # 5

Category	Electricity
CCN Strategy	Reduce computer energy usage
Mechanism	Energy Star Computer Setting Management
Mechanism Description	This policy mechanism takes advantage of free software provided by the EPA. IT managers are able to download the software which overrides the Energy Star Sleep settings on each individual computer. This UCSB to save a potentially significant amount of money on energy costs in addition to GHGs

Mechanism as appears in the matrix:

#	Mechanism	CCAR?	Capital Cost ($)	Payback (Years)	$/MTCO$_2$e	Annual GHG Reduction Potential (MTCO$_2$e)	Project Lifetime (Years)
5	Energy Star Computer Settings	Yes	$0	0.0	$196	310	15

<u>Facts and Assumptions for Energy Star Settings</u>

- Number of computers on campus = 10,000[1]
- Assume 10% will implement the energy star computer setting management – 1000 computers
- Typical computer energy demand = 200 watts[2]
- Half computers use a CRT monitor = 60 watts.
  Half use LCD monitors = 30 watts
  Average monitor energy usage = 45 watts.[2]
- Therefore, average computer power requirements are estimated to be 245 watts
- Computers in sleep mode use 10 watts in sleep mode[2]
- Assume time that each computer will be in standby = 10 hours per day.
- Assume 15 year project life.

[1] Arlene Allen, UCSB Information Systems & Computing Director. (November, 17, 2005). Personal email communication.

[2] Bluejay, M. (2005). Saving electricity. Retrieved March 10, 2006, from http://michaelbluejay.com/electricity/computers.html

Quantitative Evaluation

1. *Capital Cost*

    $0

    The software is available for free download[3] from the EPA website. There will be minimal staff time required by the IT managers for the separate networks around campus; however, this project did not consider staff time towards project costs.

2. *Payback*

    Since capital cost is $0, this mechanism pays back immediately. 0 years.

3. *University $/MTCO$_2$e with rebates/grants over life of project*

    1000 computers * (245 watts – 10 watts) * 10 hours/day * 365 = 857,750 kWh/year avoided
    Annual $MTCO_2e$= (857,750 kWh/year) / (2755 kWh/ $MTCO_2e$) = 310 $MTCO_2e$
    Annual savings = (857,750 kWh) * $0.11/kwh = $94,000

    $$\text{NPV factor} = \frac{(1+0.06)^{15}-1}{0.06*(1+0.06)^{15}} = 9.71$$

    Total NPV = ($94,000) * (9.71) = $912,740 savings over 15 years
    $/ $MTCO_2e$ = ($912,740/15 years)/(310) = $196/$MTCO_2e$

4. *Ton GHG Reduction Potential (Annual)*

    (857,750 kWh/year) / (2755 kWh/ $MTCO_2e$) = 310 $MTCO_2e$ avoided/year

Sources

U.S. EPA, Energy Star. (n.d.). Buy products that make a difference: EZ GPO software. Retrieved March 10, 2006, from http://www.energystar.gov/index.cfm?c=power_mgt.pr_pm_ez_gpo

Terra Novum, LLC. (2004). EZ GPO Tool. Retrieved March 10, 2006, from http://www.terranovum.com/projects/energystar/ez_gpo.html

[3] U.S. EPA, Energy Star. (n.d.). Buy products that make a difference: Save $25 to $75 per desktop PC annually through power management. Retrieved March 10, 2006, from http://www.energystar.gov/index.cfm?c=power_mgt.pr_power_management

Campus Climate Neutral (CCN) Policy Mechanism Evaluation # 6.1

Category	Electricity and natural gas
CCN Strategy	Energy efficiency
Mechanism	Lighting upgrades
Mechanism Description	Upgrade lighting systems on 17 campus buildings totaling 1.0 million gross square feet. Replace "power kut" electromagnetic ballasts with electronic ballasts and T8 lamps. Install daylight dimming controls on 250 perimeter fixtures. Install 250 bi-level stairwell dimming fixtures (Peppers, 2005).

Mechanism as appears in the matrix:

#	Mechanism	CCAR?	Capital Cost ($)	Payback (Years)	$/MTCO$_2$e	Annual GHG Reduction Potential (MTCO$_2$e)	Project Lifetime (Years)
6.1	Lighting Upgrades	Yes	$1,797,762	4.9	$97	835	15

Facts and Assumptions

Replacing lighting systems at UCSB is a logical and economical way to cut greenhouse gas emissions because it saves energy and money. Facilities Management uses a 15 year project lifetime for its energy efficiency upgrades based on new technology and maintenance needs. We use the same 15 year project lifetime in our energy efficiency mechanisms.

- All efficiency projects at UCSB consider CPUC Grants and Southern California Edison Rebates
- Schedule of energy grants: 20% in Year 1, 40% in Year 2 and 40% in Year 3.
- Capital cost recognizes energy grants immediately and NPV recognizes them in Year 0.
- Assume 15 year project lifetime.

Quantitative Evaluation

1. *Capital Cost*

Project Cost = $1,797,762
Energy Grant/Rebate = - $ 551,823
$1,245,939

2. *Payback*

$$\frac{CapitalCost}{Savings/year} = \frac{\$1{,}245{,}939}{\$252{,}919} = 4.93 \text{ years}$$

3. *Ton GHG Reduction Potential (Annual)*

$$\text{Annual } MTCO_2e = \frac{2{,}299{,}263 kWh/yr}{2{,}755 Kwh/MTCO2e} = 835 \text{ MTCO2e}$$

4. *University $/MTCO_2e$*

NPV Factor = 9.71

Net Present Value = - $1,245,939 + ($252,919 * 9.71) = - $1,245,939 + $2,456,412 = $1,210,473

$$\text{University \$/GHG} = \frac{NPV}{AnnualGHGpotential * projectlifetime} =$$

$$\frac{-\$1{,}210{,}473}{835\_MTCO2e * 15 yrs} = \frac{\$97}{MTCO2e}$$

Sources

Peppers, M. (2006, March 27). UCSB Proposed Energy Projects, 2006 to 2008. Unpublished calculations and data.

DSIRE: Database of State Incentives for Renewable Energy. (2006). California incentives for renewable energy: Emerging renewables (rebate) program. Retrieved May 6, 2006, from http://www.dsireusa.org/library/includes/incentive2.cfm?Incentive_Code=CA30F&state=CA&CurrentPageID=1&RE=1&EE=0

U.S. Department of Energy. (2006). The Energy Policy Act of 2005. Retrieved May 6, 2006, from http://www.energy.gov/taxbreaks.htm

Campus Climate Neutral (CCN) Policy Mechanism Evaluation # 6.2

Category	Electricity and natural gas
CCN Strategy	Energy Efficiency
Mechanism	HVAC Upgrade - fans
Mechanism Description	Replacing old V-belt drive fans (efficiency = 50%) with direct drive fans (efficiency = 72%). This will upgrade UCSB's aging fans and save significant energy without changing the fan airflow.

Mechanism as appears in the matrix:

#	Mechanism	CCAR?	Capital Cost ($)	Payback (Years)	$/MTCO$_2$e	Annual GHG Reduction Potential (MTCO$_2$e)	Project Lifetime (Years)
6.2	HVAC Upgrade - Fans	Yes	$1,574,464	3.5	$125	914	15

<u>Facts and Assumptions</u>

Replacing old drive fans with new and more efficient drive fans on HVAC systems at UCSB is a logical and economical way to cut greenhouse gas emissions because it saves energy and money. Facilities Management uses a 15 year project lifetime for its energy efficiency upgrades based on new technology and maintenance needs. We use the same 15 year project lifetime in our energy efficiency mechanisms.

- All efficiency projects at UCSB consider CPUC Grants and Southern California Edison Rebates.
- Schedule of energy grants: 20% in Year 1, 40% in Year 2 and 40% in Year 3.
- Capital cost recognizes energy grants immediately and NPV recognizes them in year 0.
- Assume 15 year project lifetime.

Quantitative Evaluation

1. *Capital Cost*

   Project Cost = $1,574,464
   Energy Grant/Rebate = - $ 604,469
   $ 969,995

2. *Payback*

$$\frac{CapitalCost}{Savings/year} = \frac{\$969,995}{\$277,048} = 3.5 \text{ years}$$

3. *Ton GHG Reduction Potential (Annual)*

$$\text{Annual } MTCO_2e = \frac{2,518,619\_kWh/yr}{2,755Kwh/MTCO2e} = 914 \text{ MTCO2e}$$

4. *University $/$MTCO_2e$*

   NPV Factor = 9.71
   Net Present Value = - $969,995 + ($277,048 savings/year * 9.71) = - $969,995 + $2,290,760 = $1,720,765 savings

$$\text{University \$/GHG} = \frac{NPV}{AnnualGHGpotential * projectlifetime} =$$

$$\frac{\$1,720,765}{914\_MTCO2e*15yrs} = \frac{\$125.48}{MTCO2e}$$

Sources

Peppers, M. (2006, March 27). UCSB Proposed Energy Projects, 2006 to 2008. Unpublished calculations and data.

DSIRE: Database of State Incentives for Renewable Energy. (2006). California incentives for renewable energy: Emerging renewables (rebate) program. Retrieved May 6, 2006, from http://www.dsireusa.org/library/includes/incentive2.cfm?Incentive_Code=CA30F&state=CA&CurrentPageID=1&RE=1&EE=0

U.S. Department of Energy. (2006). The Energy Policy Act of 2005. Retrieved May 6, 2006, from http://www.energy.gov/taxbreaks.htm

Campus Climate Neutral (CCN) Policy Mechanism Evaluation # 6.3

Category	Electricity and natural gas
CCN Strategy	Energy efficiency
Mechanism	HVAC Upgrade - Filters
Mechanism Description	Installing low pressure drop, long life filters will save energy and reduce the change out frequency. The reduced maintenance will allow UCSB's preventative maintenance staff to focus on higher priority work.

Mechanism as appears in the matrix:

#	Mechanism	CCAR?	Capital Cost ($)	Payback (Years)	$/MTCO$_2$e	Annual GHG Reduction Potential (MTCO$_2$e)	Project Lifetime (Years)
6.3	HVAC Upgrade - Filters	Yes	$372,323	0.0	$196	607	15

Facts and Assumptions

Replacing old filters with new low pressure drop, long life filters on HVAC systems at UCSB is a logical and economical way to cut greenhouse gas emissions because it saves energy and money. Facilities Management uses a 15 year project lifetime for its energy efficiency upgrades based on new technology and maintenance needs. We use the same 15 year project lifetime in our energy efficiency mechanisms.

- All efficiency projects at UCSB consider CPUC Grants and Southern California Edison Rebates.
- Schedule of energy grants: 20% in Year 1, 40% in Year 2 and 40% in Year 3.
- Capital cost recognizes energy grants immediately and NPV recognizes them in year 0.
- Assume 15 year project lifetime.

Quantitative Evaluation

1. *Capital Cost*

Project Cost	=	$372,323
Energy Grant/Rebate	= -	$372,323
		$ 0

2. *Payback*

$$\frac{CapitalCost}{Savings/year} = \frac{\$0}{\$184{,}053} = 0 \text{ years}$$

3. *Ton GHG Reduction Potential (Annual)*

$$\text{Annual } MTCO_2e = \frac{1{,}673{,}210\_kWh/yr}{2{,}755Kwh/MTCO2e} = 607 \text{ MTCO2e}$$

4. *University $/MTCO$_2$e*

NPV Factor = 9.71

Net Present Value = $0 + ($184,053 * 9.71) = $0 + $1,787,570 = $1,787,570 savings

$$\text{University \$/GHG} = \frac{NPV}{AnnualGHGpotential * projectlifetime} =$$

$$\frac{\$1{,}787{,}570}{607\_MTCO2e * 15yrs} = \frac{\$196.22}{MTCO2e}$$

Sources

Peppers, M. (2006, March 27). UCSB Proposed Energy Projects, 2006 to 2008. Unpublished calculations and data.

DSIRE: Database of State Incentives for Renewable Energy. (2006). California incentives for renewable energy: Emerging renewables (rebate) program. Retrieved May 6, 2006, from http://www.dsireusa.org/library/includes/incentive2.cfm?Incentive_Code=CA30F&state=CA&CurrentPageID=1&RE=1&EE=0

U.S. Department of Energy. (2006). The Energy Policy Act of 2005. Retrieved May 6, 2006, from http://www.energy.gov/taxbreaks.htm

Campus Climate Neutral (CCN) Policy Mechanism Evaluation # 6.4

Category	Electricity and natural gas
CCN Strategy	Energy efficiency
Mechanism	HVAC upgrade - air handlers
Mechanism Description	At ENG I building, replace the two south air handlers, S1 and S3, and upgrade ventilation systems using dual duct variable air volume (VAV) boxes and new JCI Metasys controls.

Mechanism as appears in the matrix:

#	Mechanism	CCAR?	Capital Cost ($)	Payback (Years)	$/MTCO$_2$e	Annual GHG Reduction Potential (MTCO$_2$e)	Project Lifetime (Years)
6.4	HVAC Upgrade- Air Handlers	Yes	$550,000	10.2	$42	174	15

Facts and Assumptions

Replacing old air handlers and upgrading ventilation with VAV boxes new Metasys controls on HVAC systems in ENG I is a logical and economical way to cut greenhouse gas emissions because it saves energy and money. Facilities Management uses a 15 year project lifetime for its energy efficiency upgrades based on new technology and maintenance needs. We use the same 15 year project lifetime in our energy efficiency mechanisms.

- All efficiency projects at UCSB consider CPUC Grants and Southern California Edison Rebates.
- Schedule of energy grants: 20% in Year 1, 40% in Year 2 and 40% in Year 3.
- Capital cost recognizes energy grants immediately and NPV recognizes them in year 0.
- Assume 15 year project lifetime.

Quantitative Evaluation

1. *Capital Cost*

Project Cost = $550,000
Energy Grant = - $ 83,278
$ 466,722

2. *Payback*

$$\frac{CapitalCost}{Savings/year} = \frac{\$466{,}722}{\$45{,}628} = 10.23 \text{ years}$$

3. *Ton GHG Reduction Potential (Annual)*

$$\text{Annual } MTCO_2e = \frac{289{,}617\_kWh/yr}{2{,}755Kwh/MTCO2e} + \frac{13{,}770\_therms/yr}{200\_therms/MTCO2e} = 174 \text{ MTCO2e}$$

4. *University $/MTCO$_2$e*

NPV Factor = 9.71

Net Present Value = - $466,722 + ($4,5628 * 9.71) = - $466,722 + $443,149 = $23,573 savings

$$\text{University \$/GHG} = \frac{NPV}{AnnualGHGpotential * projectlifetime} =$$

$$\frac{\$23{,}573}{174\_MTCO2e*15yrs} = \frac{\$9.03}{MTCO2e}$$

Sources

Peppers, M. (2006, March 27). UCSB Proposed Energy Projects, 2006 to 2008. Unpublished calculations and data.

DSIRE: Database of State Incentives for Renewable Energy. (2006). California incentives for renewable energy: Emerging renewables (rebate) program. Retrieved May 6, 2006, from http://www.dsireusa.org/library/includes/incentive2.cfm?Incentive_Code=CA30F&state=CA&CurrentPageID=1&RE=1&EE=0

U.S. Department of Energy. (2006). The Energy Policy Act of 2005. Retrieved May 6, 2006, from http://www.energy.gov/taxbreaks.htm

Campus Climate Neutral (CCN) Policy Mechanism Evaluation # 6.5

Category	Electricity and natural gas
CCN Strategy	Energy efficiency
Mechanism	Fume Hood Proximity Sensors
Mechanism Description	Install proximity sensors on 16 fume hoods at Bren Hall. This will reduce the fume hood air flow by 40% during non-use periods.

Mechanism as appears in the matrix:

#	Mechanism	CCAR?	Capital Cost ($)	Payback (Years)	$/$MTCO_2e$	Annual GHG Reduction Potential ($MTCO_2e$)	Project Lifetime (Years)
6.5	Fume Hood Proximity Sensors	Yes	$80,000	3.7	$156	55	15

<u>Facts and Assumptions</u>

Installing proximity sensors in labs at Bren Hall is a logical and economical way to cut greenhouse gas emissions because it saves energy and money. Facilities Management uses a 15 year project lifetime for its energy efficiency upgrades based on new technology and maintenance needs. We use the same 15 year project lifetime in our energy efficiency mechanisms.

- All efficiency projects at UCSB consider CPUC Grants and Southern California Edison Rebates.
- Schedule of energy grants: 20% in Year 1, 40% in Year 2 and 40% in Year 3.
- Capital cost recognizes energy grants immediately and NPV recognizes them in year 0.
- Assume 15 year project life.

Quantitative Evaluation

1. *Capital Cost*

   Project Cost = \$80,000
   Energy Grant = - \$27,261
   \$52,739

2. *Payback*

$$\frac{CapitalCost}{Savings/year} = \frac{\$52,739}{\$14,706} = 3.59 \text{ years}$$

3. *Ton GHG Reduction Potential (Annual)*

$$\text{Annual } MTCO_2e = \frac{96,580\_kWh/yr}{2,755Kwh/MTCO2e} \frac{40,082\_therms/yr}{200\_therms/MTCO2e} = 55 \text{ MTCO2e}$$

4. *University \$/$MTCO_2e$*

NPV Factor = 9.71

Net Present Value = - \$52,739 + (\$14,298 * 9.71) = - \$52,739 + \$138,862 = \$86,123 savings

$$\text{University \$/GHG} = \frac{NPV}{AnnualGHGpotential * projectlifetime} =$$

$$\frac{\$86,123}{55\_MTCO2e * 15yrs} = \frac{\$103.51}{MTCO2e}$$

Sources

Peppers, M. (2006, March 27). UCSB Proposed Energy Projects, 2006 to 2008. Unpublished calculations and data.

DSIRE: Database of State Incentives for Renewable Energy. (2006). California incentives for renewable energy: Emerging renewables (rebate) program. Retrieved May 6, 2006, from http://www.dsireusa.org/library/includes/incentive2.cfm?Incentive_Code=CA30F&state=CA&CurrentPageID=1&RE=1&EE=0

U.S. Department of Energy. (2006). The Energy Policy Act of 2005. Retrieved May 6, 2006, from http://www.energy.gov/taxbreaks.htm

Campus Climate Neutral (CCN) Policy Mechanism Evaluation # 6.6

Category	Electricity and natural gas
CCN Strategy	Energy efficiency
Mechanism	Air Handlers - Optimize Hot/Cold Deck Temperature
Mechanism Description	Optimize the hot and cold deck temperature on supply air handlers at 11 buildings serving 1,373,212 gross square feet. Metering, data gathering and testing control strategies is required. Some retrofit of the building economizer systems is required.

Mechanism as appears in the matrix:

#	Mechanism	CCAR?	Capital Cost ($)	Payback (Years)	$/MTCO$_2$e	Annual GHG Reduction Potential (MTCO$_2$e)	Project Lifetime (Years)
6.6	Air Handlers - Optimize Hot/Cold Deck Temperature	Yes	$200,000	0.4	$245	573	15

<u>Facts and Assumptions</u>

Dual duct ventilation and control optimization to supply air handlers on HVAC systems is a logical and economical way to cut greenhouse gas emissions because it saves energy and money. Facilities Management uses a 15 year project lifetime for its energy efficiency upgrades based on new technology and maintenance needs. We use the same 15 year project lifetime in our energy efficiency mechanisms.

- All efficiency projects at UCSB consider CPUC Grants and Southern California Edison Rebates.
- Schedule of energy grant: 20% in Year 1, 40% in Year 2 and 40% in Year 3.
- Capital cost recognizes energy grants immediately and NPV recognizes them in year 0.
- Assume 15 year project lifetime.

Quantitative Evaluation

1. *Capital Cost*
   Project Cost = $200,000
   Energy Grant = - $148,000
   $ 199,852

2. *Payback*

$$\frac{CapitalCost}{Savings / year} = \frac{\$199{,}852}{\$112{,}000} = 0.46 \text{ years}$$

3. *Ton GHG Reduction Potential (Annual)*

$$\text{Annual } MTCO_2e = \frac{200{,}000\_kWh / yr}{2{,}755 Kwh / MTCO2e} + \frac{100{,}000\_therms / yr}{200\_therms / MTCO2e} = 573 \text{ MTCO2e}$$

4. *University $/MTCO$_2$e*

   NPV Factor = 9.71
   Net Present Value = - $199,852 + ($112,000 * 9.71) = - $199,852 + $1,087,722 = $1,035,772

$$\text{University \$/GHG} = \frac{\$1{,}035{,}772}{573\_MTCO2e * 15 yrs} = \frac{\$120.59}{MTCO2e}$$

Sources:

DSIRE: Database of State Incentives for Renewable Energy. (2006). California incentives for renewable energy: Emerging renewables (rebate) program. Retrieved May 6, 2006, from http://www.dsireusa.org/library/includes/incentive2.cfm?Incentive_Code=CA30F&state=CA&CurrentPageID=1&RE=1&EE=0

Peppers, M. (2006, March 27). UCSB Proposed Energy Projects, 2006 to 2008. Unpublished calculations and data.

U.S. Department of Energy. (2006). The Energy Policy Act of 2005. Retrieved May 6, 2006, from http://www.energy.gov/taxbreaks.htm

Campus Climate Neutral (CCN) Policy Mechanism Evaluation # 6.7

Category	Electricity and natural gas
CCN Strategy	Energy efficiency
Mechanism	HVAC commissioning
Mechanism Description	Review the Engineering II Lab operation & control for seven supply and exhaust systems. UCSB estimates that 5 of the 7 systems can be reduced to 50% speed from midnight to 7am.

Mechanism as appears in the matrix:

#	Mechanism	CCAR?	Capital Cost ($)	Payback (Years)	$/MTCO$_2$e	Annual GHG Reduction Potential (MTCO$_2$e)	Project Lifetime (Years)
6.7	HVAC Commissioning	Yes	$120,000	0.2	$241	340	15

<u>Facts and Assumptions</u>

Monitoring based commissioning to supply and exhaust systems by reducing their speed during nighttime periods is a logical and economical way to cut greenhouse gas emissions because it saves energy and money. Facilities Management uses a 15 year project lifetime for its energy efficiency upgrades based on new technology and maintenance needs. We use the same 15 year project lifetime in our energy efficiency mechanisms.

- All efficiency projects at UCSB consider CPUC Grants and Southern California Edison Rebates
- Schedule of energy grant: 20% in Year 1, 40% in Year 2 & 40% in Year 3.
- Capital cost recognizes energy grants immediately and NPV recognizes them in year 0.
- Assume 15 year project lifetime.

Quantitative Evaluation

1. *Capital Cost*

Project Cost = $120,000
Energy Grant = - $105,128
$ 14,872

2. *Payback*

$$\frac{CapitalCost}{Savings/year} = \frac{\$14,872}{\$71,159} = 0.21 \text{ years}$$

3. *Ton GHG Reduction Potential (Annual)*

$$\text{Annual } MTCO_2e = \frac{221,286\_kWh/yr}{2,755Kwh/MTCO2e} + \frac{52,019\_therms/yr}{200\_therms/MTCO2e} = 340 \text{ MTCO2e}$$

4. *University $/$MTCO_2e$*

NPV Factor = 9.71
Net Present Value = - $14,872 + ($71,159 * 9.71) = - $14,872 + $691,110 = $676,237 savings

$$\text{University \$/GHG} = \frac{NPV}{AnnualGHGpotential * projectlifetime} =$$

$$\frac{\$676,237}{340\_MTCO2e*15yrs} = \frac{\$132.43}{MTCO2e}$$

Sources

Peppers, M. (2006, March 27). UCSB Proposed Energy Projects, 2006 to 2008. Unpublished calculations and data.

DSIRE: Database of State Incentives for Renewable Energy. (2006). California incentives for renewable energy: Emerging renewables (rebate) program. Retrieved May 6, 2006, from http://www.dsireusa.org/library/includes/incentive2.cfm?Incentive_Code=CA30F&state=CA&CurrentPageID=1&RE=1&EE=0

U.S. Department of Energy. (2006). The Energy Policy Act of 2005. Retrieved May 6, 2006, from http://www.energy.gov/taxbreaks.htm

Campus Climate Neutral (CCN) Policy Mechanism Evaluation # 7

Category	Campus fleet
CCN Strategy	Renewable fuels
Mechanisms	7.1 Use ethanol (E85) 7.2 Use biodiesel (B20 or B100) 7.3 Use bikes
Mechanism Descriptions	7.1 Flex-fuel vehicles are currently readily available on today's fleet market. In fact, all General Motors (GM) trucks are sold as flex-fuel vehicles that can run on both unleaded gasoline and ethanol E85 (blend of 85% ethanol and 15% unleaded gasoline). Ethanol may be provided via UCSB's current fuel vendor, McCormix. 7.2 Although diesel vehicles comprise only a small portion of the fleet, UCSB may choose to use biodiesel (either 20% blend, B20, or 100% biodiesel, B100) through its fuel vendor, McCormix. If a contract is set up, perhaps other Facilities teams, such as grounds maintenance, may also choose to use biodiesel in its diesel operated equipment. 7.3 Instead of driving, facilities personnel may choose to bike to parts of campus for service calls and meetings, especially when not hauling equipment and tools.

Mechanism as appears in the matrix:

#	Mechanism	CCAR?	Capital Cost ($)	Payback (Years)	$/MTCO$_2$e	Annual GHG Reduction Potential (MTCO$_2$e)	Project Lifetime (Years)
7.1	Fleet Ethanol	Yes	$0	0.0	$0	796	15
7.2	Fleet Biodiesel	Yes	$0	never	-$65	30	15
7.3	Fleet Biking	Yes	$2,500	9.0	$11	1	15

Facts and Assumptions

- Assume cost of gasoline[1] = $2.54
- 2004 fleet gasoline consumption = 107,490 gallons
- 2004 fleet diesel consumption = 6200 gallons
- Gasoline emissions factor[2] = 0.00871 MTCO$_2$e/gallon
- Diesel emissions factor[2] = 0.00999 MTCO$_2$e/gallon
- Assume biking only displaces gasoline, since majority of fleet vehicles run on unleaded gasoline, while diesel vehicles include the campus ambulance.
- Assume 15 year project lifetime.

[1] U.S. DOE, Energy Information Agency. (2006). California average fuel price in February 2006. Retrieved May 4, 2006, from http://tonto.eia.doe.gov/oog/info/gdu/gasdiesel.asp

[2] Clean Air – Cool Planet. (2005). Greenhouse Gas Inventory Calculator, Version 4.0. Portsmouth, New Hampshire.

Quantitative Evaluation

1. *Capital Cost*

7.1 $0.

Using ethanol does not require any additional capital cost, since flex-fuel vehicles are available without a cost premium.

7.2 $0

Similarly, the use of biodiesel does not require any equipment retrofits. Biodiesel may be used immediately in any diesel engine. No modifications are required to fueling systems to accommodate biodiesel. No additional spill sensors or safety equipment is required[3].

7.3 Assume 10 bikes at cost of $250/bike = $2500

2. *Payback*

7.1 Net annual cost = $0, since fleet manager believes that fuel vendor can procure ethanol at zero premium cost. Therefore, payback of $0 capital cost is zero years.

7.2 Biodiesel cost premium of approximately $0.20 to $1.00 per gallon. Since there are no savings, this mechanism will never payback.

7.3 Assume biking reduces gasoline consumption by (0.1%) x (107,490) = 107 gallons
Annual cost saving = (107 gallons) x ($2.54) = $273
Payback = Capital cost/Annual savings = ($2500/$273) = 9.2 years

3. *University $/MTCO$_2$e*

7.1 Annual MTCO$_2$e = (85%) x (107,490 gallons) x (0.00871 MTCO$_2$e/gallon) = 796 MTCO$_2$e
Ethanol cost per ton avoided = $0, since no capital or operating cost
University $/MTCO$_2$e = ($0/796 MTCO$_2$e) = $0/MTCO$_2$e

7.2 Annual MTCO$_2$e = (6200 gallons) x (20%) x (0.00999 MTCO$_2$e/gallon) = 12.39 MTCO$_2$e
Biodiesel cost premium for B20 = ($0.20/gallon) x (6200 gallons) x (20%) = - $1240
University $/MTCO$_2$e = ($1240/12.39) = - $64.81/MTCO$_2$e

7.3 Annual MTCO$_2$e of biking = (107 gallons) x (0.00871 MTCO$_2$e/gallon) = 0.94 MTCO$_2$e
Net present value = ($2500)*[(1+0.06)^{15} – 1]/[0.06*(1+0.06)^{15}] = $151.68 saved
University $/MTCO$_2$e = ($151.68)/15 years/0.94 MTCO$_2$e per year = $10.80/MTCO$_2$e

4. *Ton GHG Reduction Potential (Annual)*

7.1 Annual MTCO$_2$e = (85%) x (107,490 gallons) x (0.00871 MTCO$_2$e/gallon) = 796 MTCO$_2$e
7.2 Annual MTCO$_2$e = (6200 gallons) x (20%) x (0.00999 MTCO$_2$e/gallon) = 12.39 MTCO$_2$e
7.3 Annual MTCO$_2$e of biking = (107 gallons) x (0.00871 MTCO$_2$e/gallon) = 0.94 MTCO$_2$e

Comments:

Discussions with fleet technicians indicate a high level of knowledge and interest in renewable fuels. The University should leverage such passion to create a culture of innovation, high employee morale and retention. Furthermore, local fuel vendors indicate a willingness to provide biodiesel and ethanol, in addition to regularly supplied petroleum fuels.

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[3] Howard, L. (1994, March 15). Biodiesel versus other alternative fuels. Bi-State Development Agency. Retrieved May 4, 2006, from http://www.biodiesel.org/resources/reportsdatabase/reports/gen/19940315_GEN-002.pdf

Campus Climate Neutral (CCN) Policy Mechanism Evaluation # 7

Category	Campus fleet
CCN Strategy	Fuel efficiency
Mechanism	7.4 Purchase hybrid vehicles instead of traditional sedans 7.5 Purchase smaller vehicles with higher fuel efficiency
Mechanism Description	7.4 UCSB should consider purchasing more hybrid vehicles to replace sedan vehicles. 7.5 This mechanism considers the example of replacing 20% of trucks and vans in the fleet with sedans, for increased fuel efficiency.

Mechanism as appears in the matrix:

#	Mechanism	CCAR?	Capital Cost ($)	Payback (Years)	$/MTCO$_2$e	Annual GHG Reduction Potential (MTCO$_2$e)	Project Lifetime (Years)
7.4	Fleet Hybrids	Yes	$155,000	12.9	-$162	41	10
7.5	Fleet Smaller Vehicles	Yes	$0	0.0	$215	33	10

<u>Facts and Assumptions</u>

- 2004 number of sedans in UCSB fleet = 31
- 2004 number of trucks or vans in UCSB fleet = 215
- 2004 total vehicles in UCSB fleet = 246
- 2004 total gasoline consumption by UCSB fleet = 107,490 gallons

- Price premium for hybrid sedan[60] = $5000
- Fuel efficiency[1]:

	Highway MPG	City MPG	Average MPG
Corolla	34	26	30
Prius	51	60	56
Accord EX	30	21	26
Accord Hybrid	37	30	34

- Using a Prius displaces 1 – (Corolla Average MPG)/(Prius Average MPG) = 1 – (30/56) = 45.9%
- Using an Accord Hybrid displaces 1 – (26/34) = 23.9%
- In general, using a hybrid over a conventional sedan saves (45.9% + 23.9%)/2 = 34.9 % in gas

- Assume 2006 Chevrolet Silverado truck[61] = 16 City MPG
- Assume 2006 Ford Taurus sedan[62] = 20 City MPG
- Purchasing a sedan instead of a truck displaces 1 – (16/20) = 20% in gas
- Assume project lifetime = 10 years, since UCSB replaces fleet vehicles about every six to eight years, but is hoping to extend that by a couple years.

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[60] Based on Consumer Affairs range of $4800 - $6400.

Quantitative Evaluation

1. *Capital Cost*
   7.4 Replace all sedans = (31) x ($5000) = $155,000
   7.5 $0. Assume no cost premium for purchasing a smaller vehicle.

2. *Payback*
   7.4 Amount of fuel normally consumed by sedan fleet[63] = (31/246) x (107,490) = 13,545 gals
   Amount of fuel saved by switching to hybrids = (13,545 gallons) x (34.9%) = 4729 gals
   Annual cost savings = 4729 gallons x $2.54/gallon = $12,012
   Payback = Capital cost/Annual cost savings = $155,000/$12,012 = 12.9 years

   7.5 Since no capital cost, fuel savings pay back the project immediately. 0 years.

3. *University $/MTCO$_2$e*
   7.4 Annual MTCO$_2$e = (4729 gallons saved) x (0.00871 MTCO$_2$e/gallon) = 41.2 MTCO$_2$e
   Annual net present value of project = $66,589.90/10 years = $6658.99
   University $/ MTCO$_2$e = $6658.99/41.2 MTCO$_2$e = $161.62

   7.5 Annual amount fuel consumed by truck/van fleet = (215/246) x (107,490) = 93,945 gals
   Amount of fuel saved by switching to sedans = (93,945 gals) x (20%) = 3758 gallons
   Annual MTCO$_2$e = (3758 gallons saved) x (0.00871 MTCO$_2$e/gallon) = 32.7 MTCO$_2$e
   Annual net present value of project = ($70,250.28 saved)/10 years = $7,025.03
   University $/MTCO$_2$e = ($7025.03 saved)/32.7 MTCO$_2$e = $214.58/MTCO$_2$e

4. *Ton GHG Reduction Potential (Annual)*
   7.4 Annual MTCO$_2$e = (4729 gallons saved) x (0.00871 MTCO$_2$e/gallon) = 41.2 MTCO$_2$e

   7.5 Annual MTCO$_2$e = (3758 gallons saved) x (0.00871 MTCO$_2$e/gallon) = 32.7 MTCO$_2$e

Comments:
Significant greenhouse gas and cost savings may be achieved by simply purchasing vehicles with a 4 MPG improvement in fuel efficiency. This indicates that UCSB should try to source more fuel efficient trucks, if sedans are not an option. For example, instead of expanding purchases of 3/4 ton trucks to replace 1/2 ton trucks, UCSB fleet managers should try to continue buying 1/2 ton trucks or smaller, which should have improved fuel efficiency.

Benton, J. (2005, June 3). Pining for a hybrid? Do the math! Retrieved January 16, 2006, from http://www.consumeraffairs.com/news04/2005/hybrids_math.html.

[61] Yahoo! Inc. (2006). 2006 Chevrolet Silverado 1500 Regular Cab. Retrieved January 16, 2006, from http://autos.yahoo.com/newcars/chevrolettruck_silverado1500regularcab2wd_2006/4493/model_overview.html.

[62] Yahoo! Inc. (2006). 2006 Ford Taurus. Retrieved January 16, 2006, from http://autos.yahoo.com/newcars/ford_taurus_2006/4373/model_overview.html.

[63] Assume that fuel consumption proportional to fleet percentage.

Campus Climate Neutral (CCN) Policy Mechanism Evaluation # 8

Category	Air travel
CCN Strategy	Encourage videoconferencing instead of air travel
Mechanism	8.1 Use existing videoconference room 8.2 Construct a small videoconference room 8.3 Construct a large videoconference room
Mechanism Description	These mechanisms are based on a scenarios aimed to substitute the annual flights (30) taken by the Department of Accounting Services and Controls at UCSB with videoconferencing (Jim Corkill, personal interview, 2/24/06). A videoconferencing program could mandate staff and encourage faculty to use on-campus videoconferencing technology instead of traveling off-site. Such trips include: UCOP, UC Regents and other university related meetings and staff-related trainings that are held in the central office in Oakland or at the other UC campuses. This would avoid the current high cost and emissions generated from traveling to these locations. Several approaches to increasing videoconferencing at UCSB include: 8.1 Kerr Hall Studio A (small) and B (large) are currently available for videoconferencing use. 8.2 The construction of an additional small video conference room (similar to Studio A) can accommodate an additional department the size of Accounting & Controls with the same annual flights, totaling 60 flights. 8.3 The construction of an additional large conference room (Studio B) can accommodate two additional departments the size of Accounting & Controls with the same annual flights, totaling 90 flights.

Mechanism as appears in the matrix:

#	Mechanism	CCAR?	Capital Cost ($)	Payback (Years)	$/MTCO$_2$e	Annual GHG Reduction Potential (MTCO$_2$e)	Project Lifetime (Years)
8.1	Use current videoconference rooms	No	$0	0.0	$1,506	4	15
8.2	Construct small videoconference room	No	$30,000	1.5	$1,279	9	15
8.3	Construct large videoconference room	No	$80,000	2.6	$1,102	13	15

Facts and Assumptions

- Kerr Hall Studio C capacity = 5 people
- Total approximate Capital Cost to construct Studio C = $30,000
- Kerr Hall Studio B capacity = 25 people
- Total approximate Capital Cost to construct Studio B = $80,000
- YCAL fare is a state-wide flat fare offered to UC employees for air travel.
- UCLA Travel is a UC Travel Agency that offers services to UCSB.
- UCLA Travel will give preference to YCAL flights when possible.
- YCAL does not offer direct flights to Oakland only to San Francisco Int. Airport (SFO).
- YCAL Fare = $330.40
- Cost of BART from SFO to UCOP/Regents Office = $ 10.80
- Roundtrip distance from SBA to SFO = 524 miles
- Emission Factor = 0.00028 MTCO2e/passenger mile

For the first mechanism we assumed that the existing videoconference facility at Kerr Hall could satisfy this department's travel needs. For the second mechanism we assumed constructing another small videoconference room could satisfy additional similar department's travel needs(total of 60 flights). For the third mechanism we assumed constructing another large video conference room could satisfy 2 additional similar department's needs (total of 90 flights).

- Assume project lifetime of 15 years.

Quantitative Evaluation

1. *Capital Cost*

   8.1 Capital cost = Using the existing conference room = $0

   8.2 Capital cost = $30,000

   8.3 Capital cost = $80,000

2. *Payback*

   8.1 There is no capital cost therefore there is no payback.

   8.2 $$\frac{CapitalCost}{Savings / year} = \frac{\$30{,}000}{\$30{,}708} = 1.47 \text{ years}$$

   8.3 $$\frac{CapitalCost}{Savings / year} = \frac{\$80{,}000}{\$30{,}708} = 2.61 \text{ years}$$

3. *Ton GHG Reduction Potential (Annual)*

   8.1 $$30 \text{ flights} * 524 \text{ miles} * \frac{0.00028 \text{ MTCO2e}}{\text{passenger mile}} = 4.4 \text{ MTCO}_2\text{e}$$

   8.2 $$60 \text{ flights} * 524 \text{ miles} * \frac{0.00028 \text{ MTCO2e}}{\text{passenger mile}} = 8.8 \text{ Annual MTCO}_2\text{e}$$

8.3 90 flights * 524 miles * $\frac{0.00028\ \text{MTCO2e}}{\text{passenger mile}}$ = 13.2 Annual MTCO2e

5. University $/MTCO$_2$e

NPV Factor = 9.71

8.1 Total savings per year = 30 * ($330.40 + $10.80) = $10,236
NPV = - $0 + ($10,236 * 9.71) = $99, 415

$$\$/MTCO_2e = \frac{\$99{,}415}{4.62 MTCO2e * 15 yrs} = \frac{\$1{,}434}{MTCO2e}$$

8.2 Total savings over lifetime of project = 60 * ($330.40 + $10.80) * 15 = $307,080
NPV = - $30,000 + ($20,472 * 9.71) = $168,829

$$\$/MTCO_2e = \frac{\$168{,}829}{9.24 MTCO2e * 15 yrs} = \frac{\$1{,}218}{MTCO2e}$$

8.3 Total savings over lifetime of project = 90 * ($330.40 + $10.80) * 15 = $460,620
NPV = - $90,000 + $30,708 * 9.71 = $ 218,244

$$\$/MTCO_2e = \frac{\$218{,}244}{13.87 MTCO2e * 15 yrs} = \frac{\$1{,}049}{MTCO2e}$$

Sources

Asger Pederson, Accounting Services & Controls, Disbursements & Accounts Payable Manager. (January 20, 2006). Personal Interview.

Jim Corkill, Accounting Services & Controls Director. (January 22, 2006). Personal Interview.

Campus Climate Neutral (CCN) Policy Mechanism Evaluation # 9.1

Category	Commuting
CCN Strategy	Parking rate increase
Mechanism	Double parking rates
Mechanism Description	Assuming that parking demand is a normal economic good, raising the price will reduce demand. This mechanism would double current parking rates in order to reduce demand for parking and single occupancy vehicle commuting.

Mechanism as appears in the matrix:

#	Mechanism	CCAR?	Capital Cost ($)	Payback (Years)	$/MTCO$_2$e	Annual GHG Reduction Potential (MTCO$_2$e)	Project Lifetime (Years)
9.1	Increase Parking Rates	No	$0	0.0	$1,407	2	15

<u>Facts and Assumptions for Parking Rate Increase</u>

- Assuming doubling parking rates will reduce demand by 10% (Washbrook, 1992)
- Assume that currently 6000 permits sell for $432.00 = $2.6 Million
- After policy: 5400 permits will sell for $864.00 = $4.7 Million
- Each year additional revenue after policy = $4.7 Million - $2.6 Million = $2.1 Million
- Each commuter = (150 days/yr * 2 trips/day * 10.4 Miles/Trip)/ 22.1 MPG
  = 141.2 gallons/year * 0.01138 MTCO2e/Gallon
  = 1.61 MTCO2e/year
- Reducing 600 permits implies 600 less people drive = 1.61*600 = 966 MTeCO2 avoided
- NPV for 15 years = $2.1 * 9.71 = $20.391 Million
- Total GHG savings for 15 years = 966 * 15 = 14490 MTCO2e
- $/MTCO$_2$e= $20.391 Million /14490 MTCO$_2$e = $1407/MTCO2e
- Assume project lifetime of 15 years.

Quantitative Evaluation

1. *Capital Cost* = $0

2. *Payback* = 0 years. Since this mechanism has no capital cost, saving immediately payback.

3. *University $/MTCO$_2$e* = $1407.00/MTCO2$_e$ in savings

4. *Ton GHG Reduction Potential (Annual)* = 1.61 MTCO$_2$e

Comments: This may be a highly unfavorable mechanism to the campus community. As a result of conversations with campus staff and participating with the Transportation Alternatives Board, it is clear that increasing parking rates is one of the most difficult policies to pass on campus.

Campus Climate Neutral (CCN) Policy Mechanism Evaluation # 9.2

Category	Commuting
CCN Strategy	Parking rate - Pay per use
Mechanism	Parking rate pay per use (purchase 100 IVPMs)
Mechanism Description	The current parking system has two options, either pay hourly rates or purchase a monthly parking pass. The current pricing scheme ($8 per day, or $40 per month) means that people who park on campus more than 5 days a month have an incentive to purchase a monthly permit. Once a monthly parking permit is purchased, there is little incentive not to drive on the other days of this month. This mechanism would introduce a third option, whereby drivers would be charged for the amount they actually park. In this case it assumes that 100 people will choose to use In Vehicle Parking Meters (IVPMs) and choose not to drive to school one day per week for the entire school year.

Mechanism as appears in the matrix:

#	Mechanism	CCAR?	Capital Cost ($)	Payback (Years)	$/MTCO$_2$e	Annual GHG Reduction Potential (MTCO$_2$e)	Project Lifetime (Years)
9.2	Parking Rate Incrementilization	No	$6,000	never	$15	26	15

<u>Facts and Assumptions for Parking Rate Increase</u>

- Assume 100 IVPMs are purchased at $60 each
- Assume each IVPM prevents a single person from driving to school one day per week
- Assume there are 30 school weeks in the year, therefore 30 travel days per IVPM conserved
- (10.4 miles/trip) * (2 trips/day) / 22.1 mpg * 20lbs CO_2e/gallon = 18.8 lbs CO_2e conserved per trip that is avoided
- 15 year project lifetime

Quantitative Evaluation

1. *Capital Cost*

$60 * 100 IVPM = $6,000, assume no maintenance or operating costs

2. *Payback*

Assuming the UCSB does not realize any cost savings (i.e. no increase in revenue), this mechanism will never payback.

3. *University $/ MTCO$_2$e*

Annual MTCO$_2$e = 18.8 lbs CO2 per trip * 30 trips per year * 100 people = 56,400 lbs per year /2200 = 25.64 MTCO$_2$e * 15 years = 384.6 MTCO$_2$e

$6000/384.6 MTCO$_2$e = - $15/MTCO$_2$e

4. *Ton GHG Reduction Potential (Annual)*

Annual MTCO$_2$e = 18.8 lbs CO2 per trip * 30 trips per year * 100 people = 56,400 lbs per year /2200 = 25.64 MTCO$_2$e

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Comments:

The policy is considered technology neutral because there are different ways of accomplishing the goal of allowing people to pay for their actual parking usage besides the use of IVPMs. This policy can be considered an example of the type of technology that is available (and already being used by campus).

Sources

Toor, W. (2003). The road less traveled: Sustainable transportation for campuses. *Planning for Higher Education.* Retrieved March 22, 2006, from http://www.secondnature.org/pdf/snwritings/articles/ToorRoad_Less_Traveled.pdf

Campus Climate Neutral (CCN) Policy Mechanism Evaluation # 10

Category	Solid Waste
CCN Strategy	Increase composting of organic waste
Mechanism	Implement composting program at University Center (UCen)
Mechanism Description	By composting food waste from the kitchens of the UCen, a significant amount of organic waste can be diverted from the municipal landfill. Due to sanitation and hygienic concerns, only pre-consumer vegetable waste will be diverted for composting. Composting of green waste already occurs in the grounds keeping operations and in dorm kitchens.

Mechanism as appears in the matrix:

#	Mechanism	CCAR?	Capital Cost ($)	Payback (Years)	$/MTCO$_2$e	Annual GHG Reduction Potential (MTCO$_2$e)	Project Lifetime (Years)
10	Composting program	No	$1,500	never	- $22	36	15

Facts and Assumptions

- Total amount of food scrap generated on campus annually (1) = 2619 short tons x 20% = 524 short tons
- Amount of solid waste displaced by composting from UCen = 10% x 524 = 52.4 short tons
- Difference between landfill disposal and green waste disposal (2) = $53 - $28 = $25 per ton
- Operating cost = $3.25/day/container = $2372.50 per year
- Emissions factor for solid waste disposal in landfill (3) 0.6827 MTCO$_2$e per short ton of waste
- Assume 15 year project life

Quantitative Evaluation

1. *Capital Cost*
   $1500 (for loading dump containers, green waste bins)[ii]

2. *Payback with rebates/grants*
   Annual operating costs= $2372.50 per year
   Annual savings = ($25/short ton) x (524 short tons) x 10% = $1309.57
   Annual net cost = Annual operating costs – Annual savings = - $1062.94 net cost
   Payback = never (since project does not generate savings)

3. *University $/MTCO$_2$e with rebates/grants over life of project*
   Annual MTCO$_2$e = (52.4 short tons) x (0.6827 MTCO$_2$e/short ton) = 35.76 MTCO$_2$e
   Net present value = - 2500 + (- $1063)*$[(1+0.06)^{15}$-1]/[0.06$(1+0.06)^{15}$] = - $11,823
   University $/MTCO$_2$e = ($11,823/15 years/35.76 MTCO$_2$e) = - $22.04 /MTCO$_2$e

4. *Ton GHG Reduction Potential (Annual)*
   35.76 MTCO$_2$e

Comments:
Some previous discussions involved Associate Students possibly picking up pre-consumer food waste. Unfortunately, there is little incentive for outside vendors to participate in the composting program. The UCen may need to work this into the contract language in order for vendors to participate in the program.

Sources

(1) Campus waste data provided by Mary Ann Hopkins, UCSB Integrated Pest Management, Recycling and Refuse Manager. (January 28, 2006). Personal interview.
Percentage of solid waste that is food scrap is based on City of Santa Barbara data provided by Cascadia, Waste Characterization Study County of Santa Barbara. 2003.
(2) Cost data provided by Mary Ann Hopkins, UCSB Integrated Pest Management, Recycling and Refuse Manager. (January 28, 2006). Personal interview.
(3) Clean Air – Cool Planet. (2005). Greenhouse Gas Inventory Calculator, Version 4.0. Portsmouth, New Hampshire.

Appendix D – Original Group Project Proposal

Changing the Campus Climate:
Developing a Plan for a Climate Neutral
UC Santa Barbara
A Proposal for the Bren School of Environmental Science & Management Group Project Cycle 2005-2006

PROJECT SPONSORS

This project is being proposed by: Dan Worth, Executive Director of the National Association of Environmental Law Societies (NAELS), Durwood Zaelke, Board Chair of NAELS and co-Director of the Program on Governance for Sustainable Development at the Bren School, Danielle Grabiel, Campus Climate Neutral volunteer and Bren School alumnus, and Sarah Minczeski, member of the UCSB Environmental Affairs Board. Campus Climate Neutral (CCN) is a project of the National Association of Environmental Law Societies.

PROJECT SPONSORS

Oran Young, Faculty Sponsor – young@bren.ucsb.edu - (805) 893-8747
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PROPOSED PROJECT

Problem Statement

Leadership on climate change is lacking at the federal level in the United States. Progress at the international level is little better. Although the Kyoto Protocol will finally go into effect with Russia's recent ratification, the Protocol only requires 2.5% reductions of greenhouse gases (GHG) by 2012 for developed countries.[64] China, India, and other important developing countries currently are outside the regime.

The GHG reductions of 2.5% by developed countries stands in sharp contrast to the 70-95% immediate reductions in GHG most credible scientists believe is necessary to prevent further irreparable harm.[65] It also contrasts with the growing calls to move beyond carbon cuts to carbon negative strategies in order to return to the 280 parts per million (ppm) carbon concentration of pre-industrial times (from today's

[64] Following the Kyoto Protocol the EU calculated that the effect of the treaty, after considering offsets by CDM, JI, emissions trading, and carbon sinks, would yield only a 2% reduction by the 2008 to 2012 target period from the 1990 base year levels in actual CO_2 emitted by industrialized countries. The Marrakech Accords in 2001 further clarified the rules surrounding the flexibility mechanisms of the agreement with agreements on CDMs (up to 2.5 % of emissions can be banked toward a country's assigned initial carbon allowance), JI, emissions trading (up to 2.5% of emissions can be banked toward a country's assigned initial carbon allowance between JI and emissions trading), and carbon sinks (up to 1% of a country's carbon emissions can be made up for through carbon sinks), which the EU has now calculated will lead to only a 1.5% reduction in overall CO_2 emissions by industrialized countries for the 2008 to 2012 period

[65] Reada, Peter and Lemit, Jonathan. Bio-energy with carbon storage (BECS): *A sequential decision approach to the threat of abrupt climate change*. http://www.accstrategy.org/draftpapers/R&L.pdf. See page 2, lines 68-81.

level of 380 ppm) to mitigate and reverse-- where still possible-- the impacts already set in motion including the now likely loss of the Greenland Ice Sheet.[66]

Background Information

Given the need for accelerated U.S. action on climate change, it is essential that the several thousand colleges and universities in this country become centers for addressing climate change. US universities taken as a whole emit a significant amount of greenhouse gases, play a lead role in training and educating the next generation of leaders, and have a large influence on the US economy through construction, purchasing and endowment investments.[67] Although an increasing number of campuses have "greening" programs, few deal directly with GHG emissions. Many campuses also waste the opportunity to include students in the "greening" process.

The theory behind CCN is that college campuses should provide the moral leadership for this movement and much of the technological leadership, as well. CCN's goals are to train the next generation of climate leaders while immediately engaging the faculty and administration to develop aggressive plans to move campuses towards climate neutrality. An additional goal is to spur technological innovation on climate mitigation and sequestration.

Against this background, NAELS is launching a campaign to develop bottom-up climate leadership through its Campus Climate Neutral (CCN) program. Similar to the way that the anti-Apartheid movement grew out of an urgent moral imperative to address systemic discrimination, the CCN campaign is envisioned as a call to action for aggressive measures to respond to the current generation's great crisis – climate change.

Project Objectives

The goal of this project is to have Bren students design a plan for the UC Santa Barbara (UCSB) campus to reduce or offset its greenhouse gas emissions and achieve climate neutrality - a net zero impact on the Earth's climate. The plan will be designed to serve as a template for other universities in the UC system and the nation to become climate neutral.

The plan will be informed by a multidisciplinary analysis of:
Current GHG emissions and sources;
Opportunities, options and technologies for emission reductions and offsets (and projections for future opportunities, options, and technologies);
The economic opportunities and costs of proposed actions (and how they are expected to change over time); and
Political and administrative processes and/or obstacles to implementation of the plan (and how they are expected to change over time).

Project Significance

[66] Such as the Abrupt Climate Change Strategy Group and its work on bio-energy as means of addressing the potential for abrupt climate change. http://www.accstrategy.org/

[67] In 1999-2000, the expenditures of public degree-granting institutions totaled over $**237 billion**; In 2001, the top 120 colleges and universities with the largest endowments had endowment funds totaling more than **$186 billion**. http://nces.ed.gov/programs/digest/d02/tables/dt343.asp; dt346.asp; dt345.asp

With an enrollment of nearly 20,000 students and 1,000 faculty members, the climate impact at UC Santa Barbara is significant. In 2004 alone, the campus used an estimated 60,000,000 kWh of electricity and 1,900,000 therms of natural gas. [68] While UCSB has made important commitments to purchasing renewable energy and already has in place progressive transportation policies that will have an effect on reducing its indirect GHG emissions, the university has no plan to prepare a comprehensive GHG inventory nor to aggressively reduce its GHG emissions.

The Bren School is widely recognized within California, and increasingly throughout the US and the world, for its environmental leadership and excellence in environmental education and green building design. The Bren School, with its resources and expertise, provides an ideal starting point for CCN's work at UCSB and within the UC system at large.

This project is an important first step that will complement other initiatives CCN is planning for UCSB and for the UC system outside of, but complimentary to, this project. These initiatives include the launch of a student-based CCN campaign and a UC Santa Barbara Climate Neutral Task Force to include faculty, staff and students who will work to implement the plan put forward by the group project and other Campus Climate Neutral initiatives. The project will also serve as an important tool for use by CCN at other UCs, such as UC San Diego, which has already completed a greenhouse gas inventory.

Stakeholders
Stakeholders in this project include the UC community, professional and student groups working on campus greening projects, professional groups working on climate solutions, and groups specifically working on climate neutrality.

Possible Approach and Available Data
The plan will consist of a step-by-step approach to achieving zero net GHG emissions including:
Recommendations for a scientifically appropriate definition of climate neutral;
Establishment of a GHG emissions inventory in accordance with the California Climate Action Registry General Reporting Protocol;
Recommendations of methods for reducing and/or offsetting emissions including setting goals and timeline for reductions;
Recommendations for steps to achieving administrative cooperation and support;
A summary of the costs and benefits (including a UCSB climate change risk assessment) of the recommended plan; and
Mechanisms for continuous reassessment of goals and technologies, and ultimately for improvement in CCN.

Deliverables
The main deliverable will be the "UCSB Climate Neutral Action Plan" described in the previous section. The group project report should include the data, analyses, assumptions and scenarios that were utilized in designing the plan, including mechanisms for continuous reassessment and improvements. The project will also include a template with appropriate commentary that can be used by other universities involved in the CCN campaign to analyze GHG emissions and create an action plan for climate neutrality.

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[68] Dewey, Jim. *UCSB Energy: FY 2004 Annual Report.* http://energy.ucsb.edu/presentations/AnnualReport_2004.pdf

References
The California Climate Action Registry has agreed to provide project participants with access to its General Reporting Protocol and on-line GHG reporting tool (CARROT) and will train and assist students in preparing the inventory.

In addition, there are several models and tools for university GHG reduction that NAELS will provide to Bren students to develop this project, including:
GHG emissions reductions tools and information from Clean Air-Cool Planet
A five-year report of the Tufts Climate Initiative (an effort to reduce GHGs)
A case study of GHG reduction efforts at the University of New Hampshire
Data on Oberlin's efforts to go climate neutral by 2020

There are also several texts that have been recently written on campus greening efforts including:
Sustainability on Campus, Bartlett & Chase
Greening the Ivory Tower, Sarah Hammond Creighton
New Directions for Higher Education: The Campus and Environmental Responsibility, Egan & Orr
Ecodemia: Campus Environmental Stewardship at the Turn of the Century

Finally, students will have access to numerous resources within the UC system and on the UCSB campus, including:
Sarah Minczeski, member of the UCSB Environmental Affairs Board
UC Santa Barbara Campus Planning Office, the Energy and Facilities Offices, and the Environmental Affairs Board.

CLIENT

National Association of Environmental Law Societies (NAELS) will be the client. Durwood Zaelke, one of the project sponsors, serves as the board Chair.

ANTICIPATED FINANCIAL NEEDS AND SUPPORT

NAELS will provide $500 support for anticipated project costs which include: printing costs for the poster, cost of printing for the final report, and miscellaneous administrative and supply costs.

Appendix E - Engaging with UCSB Organizations

To present emissions reduction as a critical and achievable target for UCSB, we wanted to understand how and who to introduce the concept to. We identified organizations with whom our goals were aligned. Then we interacted with the key people and decision makers in those organizations with the intent to utilize current resources, ideas and initiatives already in place so that we are not "reinventing the wheel." This appendix describes how we understood UCSB, the key organizations for our project, and how we decided to engage with them to promote GHG reduction as a priority on campus. **Note that the "How To" guide in this report details our overall project approach step by step for other university students, while this chapter is specifically meant as reference for UCSB students and staff who will continue with our project goals.**

How We Worked in UCSB

We first studied UCSB in how its organizations are run, and then how we could introduce GHG reduction into those organizational systems. To study the system, we met with key contacts within the organizations, interviewed them on their area of expertise, interacted with them on a regular basis over the course of our research, and participated in meetings involving sustainability, when appropriate. More specifically, we:

- *Established formal relationship with UCSB management* - UCSB Chancellor Henry Yang, Executive Vice Chancellor Gene Lucas, Associate Vice Chancellor of Campus Design & Facilities Marc Fisher, and Assistant Chancellor-Budget & Planning Todd Lee.
- *Regularly collaborated with Facilities Management and Building & Utility Maintenance* (contact: George Lewis, Jim Dewey), Housing & Residential Services (contact: Mark Rousseau), Transportation and Parking Services (contact: Tom Roberts, Jamie Wagner and Arjun Sarkar), Campus Planning Committee's Subcommittee on Sustainability (contact: Mo Lovegreen, Perrin Pellegrin, Katie Maynard), and Office of Purchasing (contact: Stuart Davis, Scott MacKenzie).
- *Actively coordinated with student initiative and student lead organizations on campus* (California Student Sustainability Coalition, Environmental Affairs Board and the Green Campus Program) to engage them with Bren CCN progress and to be tapped into their campus sustainability work. Undergraduate students are actively promoting new energy efficiency initiatives, green product procurement policy, and alternative transportation policies. We established ties with these groups to leverage their leadership on campus, to help us research our policy recommendations, especially those that would require student participation.

Who We Worked With in UCSB

The players we describe below are the University of California, and UCSB-specific, organizational entities that have dedicated staff that work on and influence campus sustainability initiatives. Due to the complex nature of university organizations, we have sought to identify leverage points where we can be most effective in moving UCSB to address climate change. By engaging these key stakeholders, we applied pressure on UCSB from above and from below the level of the Chancellor's office.

UC Office of the President (UCOP)

The UCOP is the administrative headquarters of the UC system, overseeing educational policy, finance, buildings and grounds, health services, investment, and oversight of the Department of Energy laboratories. The Office of the President is governed by the Regents, which under Article IX, Section 9 of the California Constitution has "full powers of organization and governance," subject only to very specific areas of legislative control ("About the Regents", 2006). Policies enacted by the UC Regents are managed by the UCOP to be implemented at individual campuses. Overseeing ten campuses, five medical centers and three U.S. Department of Energy laboratories, the operating standards and policies of the UC system have a wide reach across many sectors of the California economy.

"In response to an active push by the student member of the UC Board of Regents, the UCOP agreed to form a committee to develop a more aggressive policy on energy efficiency and environmental sustainability"(Bade, 2004). The UC Regents passed the Policy on Green Building Design and Clean Energy Standards on July 17, 2003.

The UCOP is developing a policy to address sustainable transportation. "The Sustainable Transportation Policy is meant to be part of a series of initiatives which will come to fruition over the next several years" to address sustainability within the UC system (UCOP Policy 102, 2005). Currently only half (Merced, Berkeley, San Diego, Santa Barbara and Santa Cruz) of the ten UC campuses have Sustainability Committees dedicated to the holistic approach of improving the social, environmental and economic aspects of campus activities.

<u>Bren CCN Involvement for UCOP</u>

The student activism aimed at the UCOP level has historically been quite effective. Over the course of our project, we worked closely with students from the California Students for Sustainability Coalition (CSSC) to support their efforts to convince the UC Regents to adopt the Sustainable Transportation Policy. By publicly speaking at UC Regents' meetings and writing letters in favor of this policy, we lend a slightly different voice to show that multitudes of students from different parts of the UC system care about sustainable transportation and greenhouse gas emissions issues. In February 2006, the UC Sustainability Steering Committee approved the formation of a *Climate Change Working Group* to pursue implementation of the two policy items related to greenhouse gas emissions measurement, reporting, and reductions (St Clair, 2005). While the formation of the working group will continue beyond our project, this is a small but significant step forward on this issue for the UC system. The formation of the Climate Change Working group (expected completion June 2006) is a positive sign that UCOP acknowledge student requests.

Office of the Chancellor

Henry T. Yang has been the Chancellor of UCSB since 1994. The Chancellor is the single most important player within UCSB, with oversight responsibility over the entire university and who acts as an ambassador for the university. He has the authority to make an official university-wide commitment to reducing emissions based on recommendations found in this report. In addition, having the Chancellor's support helps set the stage when engaging with all levels of the administration because it essentially symbolizes UCSB's commitment to reducing its emissions.

Chancellor Yang is keen on environmental issues. It is noteworthy that the Chancellor seeks to go beyond the UC-wide policy of LEED equivalent for a more ambitious target of LEED Silver. Recently, Chancellor Yang established that the UCSB campus shall "as a matter of practice take the necessary steps to implement the Regents Green Building Policy and strive to achieve the LEED™ Silver certification for new buildings approved after July 1, 2004."[69] In order to ensure that his mandate is followed, he demonstrated his commitment by catalyzing the creation of a virtual Sustainability Committee (UCSB Campus Sustainability Plan, 2005).

<u>Bren CCN Involvement for the Chancellor's Office</u>

The Bren CCN group met with Chancellor Yang and Executive Vice Chancellor (EVC) Lucas in Spring 2005, Fall 2006 and Spring 2006 to inform and engage them in the process of our group project. Our team played the role of a consultant to the Chancellor and EVC, performing an analysis of UCSB's current and past GHG emissions levels and soliciting high-level feedback on our research plans. By meeting with them personally we understood their priorities related to campus growth and planning. As we sought their feedback, we set a tone of UCSB leadership in GHG reduction to increase the chances of our recommendations being adopted.

Campus Planning Committee Subcommittee of Sustainability

Since 2003, this virtual Office of Sustainability has been officially operating on campus, with a core group of Facilities Management staff, interested students and faculty. The university has focused on sustainability movement, as demonstrated in the successful LEED™ Platinum certification of Donald Bren School of Environmental Science & Management in April 2002 (UCSB Sustainability, 2005). Furthermore, by creating a staff position dedicated to overseeing sustainability, the Chancellor demonstrates his true commitment and respect for the importance of this issue to campus operations. The goals of the Office of Sustainability are to: ensure that sustainable practices and concepts are integrated into every aspect of UCSB operations; catalog

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[69] For more information on the U.S. Green Building Council's Leadership in Energy and Environmental Design New Construction Rating Systems visit: http://www.usgbc.org/DisplayPage.aspx?CMSPageID=220&.

what UCSB has and is already doing in the field of environmental study; and identify the impediments to broader interdisciplinary work, whether structural, administrative, and/or individual ("Overview of UCSB's Sustainability Efforts, 2005).

UCSB Campus Planning Committee is currently working to develop a *Campus Sustainability Plan* (CSP) as a component of its Long Range Development Plan with the assistance of Brightworks Northwest (www.bwnw.com). The Subcommittee on Sustainability is taking the lead in developing the CSP in 2006 and 2007 based on the Natural Step (www.naturalstep.org) framework that has been proven successful for the cities of Santa Monica, CA, Portland, OR, and Whistler, British Columbia. The CSP aims to provide analysis on current campus conditions and sustainability procedures. It is also developing future targets and goals for the operations of campus activities, including measurable sustainability indicators and planning principles for key areas of the campus. These key areas are: physical environment, built environment, purchasing, parking and transportation. The CSP will incorporate both the academic and physical planning goals of the campus over the next 15 years and should provide sustainability principles to help guide decision making related to the update of the UCSB Long Range Development Plan ("UCSB Campus Sustainability plan, 2005).

<u>Bren CCN involvement for the Campus Planning Committee</u>

We engaged most extensively with this organization because the virtual Office of Sustainability is the main platform on which we can incorporate the message and action for GHG reduction. The interdisciplinary nature of this organization enabled us to disperse our policy recommendations. We focused on energy, commuting, campus sustainability and education because these are the areas that have can have the greatest impact on reducing the University's carbon footprint.

We attended the Phase I workshops of the Campus Sustainability Plan in December 2005, which involved training on sustainability. Individual team members are also participating during Phase II of CSP development (spring 2006) to ensure that GHG reduction is an important part of the CSP. Phase II plans to establish an Environmental Management System that will capture campus sustainability activities and CCN will help with the GHG reduction requirements for this system. Phase II has eight Change Agent Groups that formed from Phase I, each focusing on one of the following areas: Academic and Research, Built Environment, Communications, Energy, Landscape/Grounds, Procurement, Transportation, and Waste.

CCN became specifically involved with the *Transportation Group* which consists of the Transportation Alternatives Program Director and the Campus Fleet Technician/Alternative Fuels Specialist. This group has identified a list of short, medium and long-term goals, including a plan to incorporate a per gallon carbon tax to offset the campus fleet. The presence of the CCN team has been key, not only to ensure that the CSP includes GHG emissions management, but also to maintain the general sustainability dialogue on the importance of GHG emissions reduction.

Education for Sustainable Living Program

The Education for Sustainable Living Program (ESLP) is a component of the Office of Sustainability that has an independent presence and impact on campus. They are engaged in three key activities that present great opportunities for CCN. ESLP sponsors quarterly upper division undergraduate courses on a topic related to sustainability. This involves numerous faculty members across departments and attracts students from different majors. At the end of the quarter, the students deliver a final presentation and show how they implemented their ideas throughout the quarter. ESLP also works with other UCSB campus organizations including Environmental Affairs Board (EAB), California Student Sustainability Coalition (CSSC), Surfrider Foundation, Shoreline Preservation Foundation (SPF) and Engineers Without Borders. As a result, this lean organization is able to keep the pulse of the greater student body and understand their needs.

Bren CCN involvement for ESLP

A cornerstone of CCN's strategy is to increase student awareness, leadership and involvement in the topic of climate change so that students carry education beyond the classroom. Therefore, we are working with ESLP to incorporate a GHG reduction component to existing campus programs mentioned above. More specifically, a CCN member regularly attended the ongoing Campus Sustainability Plan Academics and Research Committee activities, which included communications with EVC Gene Lucas on following recommendations from the Environmental Task Force ("Report on the Environmental Issues Task Force, 2005) and determining the committee goals. In the committee goals we have inserted a commitment to a 'flexible course module' on climate change and energy efficiency that could be marketed to faculty so they in turn would adopt this module in their science, humanities and interdisciplinary course offerings. We think that public presentation of this education content, whether delivered by professors or exercised by students, would increase awareness and develop a campus culture that encourages actions that reduce GHG emissions on and off campus.

Facilities Management

Facilities Management's (FM) mission is to design, build, operate, maintain and renew the physical environment required to support the University's instructional, research, and public service mission in order to place UCSB at the forefront of world class universities ("UCSB Facilities Management", 2006). The Chancellor communicates directly with Marc Fisher, Associate Vice Chancellor of Campus Design and Facilities, regarding the campus' role for sustainable development. The Associate Vice Chancellor oversees many of the physical operations on campus, including: Physical Facilities, Transportation and Parking Services, Design and Construction, Landscape, Environmental and Custodial Services, Building and Utility Maintenance and Commissioning.

Facilities Management makes decisions directly affecting almost the entire amount of GHG emission levels of the university. For example, Physical Facilities decides how and from where the University receives its energy (electricity and natural gas to operate all campus buildings and facilities); *Transportation and Parking Services (TPS)* manages student, staff and faculty commuting and parking needs as well as the university fleet. TPS policy decisions have a direct effect on vehicular travel, which is also a significant contributor of greenhouse gas emissions related to campus activities. According to our emissions inventory of UCSB, Facilities Management alone oversees virtually the entire amount the university's total GHG emissions.

The Transportation Alternative Program (TAP) was developed in 1988 to provide alternative commuting options for UCSB faculty, staff, and students and to help reduce campus parking demand, traffic congestion and resulting air pollution. While trying to reduce parking demand through innovative programs such as free bus passes, carshare, van pool, discounted carpool permits, and extensive bike paths, the campus is simultaneously in the process of building two new parking structures. These massive structures are financed through future permit sales, parking fines, etc. As a result, the campus depends on a certain number of commuters to pay the debt off. This fact is at the root of many of the transportation challenges related to on-campus transportation alternatives.

<u>Bren CCN Involvement with Facilities Management (FM):</u>

Working directly with FM was the most critical piece of our project. Working with this organization we found what energy efficiency projects were most feasible for the university. Our group relied on their technical expertise to achieve increased levels of energy efficiency, and in return we have analyzed the data and presented the feasibility of the projects they identified.

We also wanted to ensure that when the long range growth and associated environmental impacts of these policies are considered, GHG reduction is taken seriously into account. Therefore, we regularly attended the Transportation Alternatives Board (TAB) meetings, met with the director of Transportation and Parking Services and Director of the Transportation Alternatives Program to better understand the institutional dynamics and plans for future policy. We incorporated ideas from these sources into our recommendations and compared their cost and GHG-effectiveness to other types of policies. Through participation in the Transportation Change Agent Group in Phase II of the Campus Sustainability Plan, we have directly collaborated with the Transportation Alternatives Program Director and Fleet Technician to support and act on our recommendations.

Office of Budget and Planning

The Office of Budget and Planning makes decisions regarding the budget for capital development as well as institutional planning. These decisions are ultimately approved by the UCOP. The utility budget is in a $4.2 million deficit, which poses a barrier to investing in energy projects. Currently, UCOP is using lease-repayment bonds, which reduces the amount of debt UCSB can get, there is only 40 million in debt available for the nine UC's (Williams et al., 2005). Another problem is the dichotomy of the Operating and Capital Budgets. The Operating Budget is reserved for ongoing activities such as energy bills and the Capital Budget is reserved for campus construction and renovation. These two budgets are exclusive from one another and this poses a problem when an investment decision facing both budgets is to be made. See Chapter 6 to learn more about the barrier this budgetary characteristic poses.

Bren CCN Involvement with Office of Budget and Planning:

During the course of our research, it became clear that a major institutional barrier to sustainability was in the lack of funding and improper incentives to fund projects that save energy and money down the line. In order to develop recommendations to address these obstacles, we interviewed staff and decision makers of this office to understand the institutional structure for funding facilities projects. Understanding the budgetary constraints, we decided that out best approach would be to continue working with the Campus Energy Manager and Zone Leaders to research which projects have the shorter payback period and has the potential to be packed together to request fund from capital budget. Though the energy managers, engineers and budget planners on campus are already advocating increasing energy efficiency because of its attractive financial returns, we stayed engaged with them to emphasize its direct relationship with GHG emissions reduction. In addition, we focused on alternate funding mechanisms, such us raising money through student lock-in fees to support GHG reduction projects on campus.

Appendix F – Action at the University of California, Office of the President

**UNIVERSITY OF CALIFORNIA POLICY GUIDELINES
FOR THE
GREEN BUILDING DESIGN,
CLEAN ENERGY STANDARDS,
AND
SUSTAINABLE TRANSPORTATION PRACTICES**

Resource sustainability is critically important to the University of California, the State of California, and the nation. Efficient energy use is central to this objective, and renewable energy and energy-conservation projects provide a means to stabilize campus budgets, increase environmental awareness, reduce the environmental consequences of University activities, and provide educational leadership for the 21st century.

On July 17, 2003, The Regents of the University expressed their support for a Presidential policy to promote "…the principles of energy efficiency and sustainability in the planning, financing, design, construction, renewal, maintenance, operation, space management, facilities utilization, and decommissioning of facilities and infrastructure to the fullest extent possible, consistent with budgetary constraints and regulatory and programmatic requirements." At their September 2005 meeting, The Regents authorized the President to incorporate sustainable transportation practices into this Policy. Transportation to and from and within the campus grounds has a significant impact on air quality, and affects both the campus landscape and relations with surrounding communities. It is desirable, therefore, to effectively manage transportation demand, provide transportation options and encourage the use of low-impact vehicles, non-fossil fuels, and creative modes of transport, while ensuring maximum campus access and preserving lifestyle features. This approach to transportation services is a necessary component of the University's sustainability efforts.

The University of California is committed to improving the University's effect on the environment and reducing the University's dependence on non-renewable energy. Guidelines for implementing practices in support of Green Building Design, Clean Energy Standards, and Sustainable Transportation Practices are explained in detail in the following plan for achieving these goals.

I. Green Building Design

a. Given the importance of energy efficiency to Green Building design, the University has set a goal for all new building projects, other than acute-care facilities, to outperform the required provisions of the California Energy Code (Title 24) energy-efficiency standards by at least 20 percent. Standards for energy efficiency for acute care facilities will be developed in consultation with campuses and medical centers.

b. The University of California will design and build all new buildings, except for laboratory and acute care facilities, to a minimum standard equivalent to a *LEED*™ 2.1 "Certified" rating.

c. Campuses will strive to achieve a standard equivalent to a *LEED*™ "Silver" rating or higher, whenever possible within the constraints of program needs and standard budget parameters.

d. Given the importance of specifically addressing sustainability in laboratory facilities, the University of California will design and build all new laboratory buildings to a minimum standard equivalent to a *LEED*™ *2.1* "Certified" rating and the *Laboratories for the 21st Century (Labs21) Environmental Performance Criteria* (EPC), as appropriate. The design process will include attention to energy efficiency for systems not addressed by the California Energy Code (Title 24).

e. Any proposed exception from the above standards may be requested administratively during preparation of the PPG. Any exception proposed after approval of the PPG will be treated as a scope change and processed in accordance with standard University procedures.

f. Further study will be conducted before a similar sustainable design policy for new acute-care facilities is adopted.

g. Any significant renovation projects involving existing buildings will also apply sustainability principles to the systems, components and portions of the building being renovated.

h. In consultation with the campuses, the Office of the President will develop an internal evaluation and certification standard based on the *LEED*™ and *Labs21* measures.

i. Campuses may choose to pursue external certification through the *LEED*™ process, augmented with *Labs21* criteria as appropriate for laboratory systems, in lieu of the internal process for a given project.

j. The measures required by this policy will be incorporated into all new building projects, other than acute care facilities, submitted for first formal scope and budget approval as of July 1, 2004

k. To the extent feasible within approved funding, campuses are encouraged to apply sustainability principles to all projects currently in design.

l. The University planning and design process will include explicit consideration of lifecycle cost along with other factors in the project planning and design process, recognizing the importance of long-term operations and maintenance in the performance of University facilities.

m. For existing buildings, the University will explore the development of a standard methodology for sustainable policies and standards for facilities management, including assessing the *LEED*™ Existing Building (*LEED*™ *EB*) evaluation tool being developed for this purpose. These policies and standards will address aspects of building cleaning, maintenance, and operation to include factors such as chemical usage, indoor air quality, utilities, and recycling programs.

n. The University will work closely with the U.S. Green Building Council, Labs21, the Department of Energy, the U.S. Environmental Protection Agency, State government, and other organizations to facilitate the improvement of evaluation methodologies to better address University requirements. Additionally, the University will work with the U.S. Green Building Council to develop a self-certification tool for University use.

o. The University will use its purchasing power to promote the availability of products that are resource-efficient, energy-efficient, water-efficient, and of recycled and rapidly renewable content for building materials, subsystems, components, equipment, and supplies.

p. The University will work with regulatory agencies and other entities to speed the development, approval, and implementation of products and technologies that improve energy efficiency and support sustainable design, construction, and operating practices.

q. The University will develop a program for sharing of best practices.

r. The University will incorporate the Green Building Design policy into existing facilities-related training programs, with the aim of promoting and maintaining the goals of the policy.

II. Clean Energy Standard

a. The University will implement a systemwide portfolio approach to reduce consumption of non-renewable energy. The portfolio will include a combination of energy efficiency projects, the incorporation of local renewable power measures for existing and new facilities, green power purchases from the electrical grid, and other energy measures with equivalent demonstrable effect on the environment and reduction in fossil fuel usage. The appropriate mix of measures to be adopted within the portfolio will be determined by each campus. Since each campus's capacity to adopt these measures is driven by technological and economic factors, the campus will need to reevaluate their energy measures mix on a regular basis. The portfolio approach will provide valuable analytical information for improving energy efficiency, resulting in an overall improvement in the University's impact on the environment and reduced reliance on fossil fuels during the next decade of capital program growth.

b. The University will strive to achieve a level of grid-provided electricity purchases from renewable sources that will be similar to the State's Renewable Portfolio Standard, which sets a goal of procuring 20 percent of its electricity needs from renewable sources by 2017. The University will initiate progress towards this objective in 2004 by purchasing 10 percent of grid-supplied electricity from renewable sources, subject to funding availability, and will track progress annually toward achievement of the year 2017 goal.

c. With a goal of providing up to 10 megawatts of local renewable power by 2014, the University will develop a strategic plan for siting renewable power projects in existing and new facilities. The plan will include demonstration projects for photovoltaic systems and other renewable energy systems, such as landfill gas fueled electricity generation or thermal energy production. The strategic plan will include criteria for evaluating the feasibility of a variety of projects, such as incorporating photovoltaic systems in replacement roofing projects and in new buildings, as well as forecasting the accommodations necessary for eventual installation of photovoltaic systems. The University will assess the progress of renewable energy technology improvements, both in terms of cost and technical efficiency. To achieve the renewable power goal, the University will maximize the use of available subsidies and negotiate pricing reductions in the marketplace, and will develop funding sources for financing the costs of renewable energy measures.

d. With a goal of reducing systemwide non-renewable energy consumption, the University will develop a strategic plan for implementing energy efficiency projects for existing buildings and infrastructure to include operational changes and the integration of best practices. The plan will identify opportunities to incorporate energy retrofit projects into major building renovations as funding is available, and to initiate standalone retrofit projects as justified by future energy savings. The University will monitor industry progress in energy retrofits and implement technical improvements as they become available. As with renewable energy projects, the University will develop funding sources and establish a program for financing retrofit projects. The initial goal for energy efficiency retrofit projects will be to reduce systemwide growth-adjusted energy consumption by 10 percent or more by 2014 from the year 2000 base consumption level. The University will strive to achieve even greater savings as additional potential is identified and funding becomes available.

e. The University will continuously evaluate the feasibility of other energy-saving measures with equivalent demonstrable effect on the environment and reduction in fossil fuel usage. In particular, campuses will strive to implement the Sustainable Transportation Practices described in Section III, below.

f. The University will develop a variety of funding sources and financing alternatives for energy efficiency, renewable energy, and clean energy projects that will enable campuses to be flexible in addressing their energy needs.

g. The University will pursue marketing of emissions credits as a means to bridge the cost-feasibility gap for green power projects.

h. With an overall goal of reducing greenhouse gas (GHG) emissions while maintaining enrollment accessibility for every eligible student, the University will pursue the development of a long term strategy for voluntarily meeting the State of California's goal, pursuant to the Governor's Executive Order S-3-05, that is: by 2010, to reduce GHG emissions to 2000 levels; by 2020, to reduce GHG emissions to 1990 levels; by 2050, to reduce GHG emissions to 80 percent below 1990 levels.

i. The Senior Vice President-Business and Finance, in coordination with campus administration, faculty, students and other stakeholders (the Sustainability Group), will research options for collection, monitoring, and certification of energy use and greenhouse gas (GHG) emissions. The Sustainability Group will develop an in-house methodology by which to collect, monitor, and certify energy use and GHG emission, and will pursue an affiliate membership with the California Climate Action Registry (CCAR). The methodology will include development of a "higher education protocol" to allow for normalization of data and accurate reporting procedures. The Sustainability Group will monitor progress toward reaching the stated goals for GHG reduction, and will evaluate suggestions for programs to reach these goals. The Sustainability Group will also examine the feasibility of developing benchmarking processes to measure overall energy use over time.

III. Sustainable Transportation Practices

a. In implementing a least-cost economic and environmental strategy for campus fleets, campuses shall implement practicable and cost-effective measures, including, but not necessarily limited to, the purchase of the cleanest and most efficient vehicles and replacement tires, the use of alternative fuels, and other conservation measures. With the goal of measuring all campus fleet vehicles fuel consumption reduction, campuses will collect and report to the Office of the President fuel consumption for 2005-06.

b. The campuses will be encouraged to collect data on Average Vehicle Ridership (AVR) of commuters. AVR is defined as the number of trips to campus divided by the number of automobiles used for those trips (AVR = trips/automobiles). Campuses may use this data to set goals for reduction of fuel consumption. AVR data may also be used in conjunction with transportation mode split data to develop maps of distance "zones" surrounding the campus and to model each zone's proportionate share of various commuting modes (e.g., percentage of bicycle or single-occupancy vehicle trips within 0-2 miles from the central campus core).

c. The Senior Vice President, Business & Finance has made a written request to major automobile manufacturers expressing both the University's commitment to work with industry to provide vehicle and fuel choice, and the expectation that industry will provide these choices to the fullest extent possible. The Sustainability Group will continue to work with State agencies to facilitate the purchase and use of LEV, ZEV, and alternative fuel vehicles by the campuses and to find solutions for increasing the availability of an affordable supply.

d. Using the time period 2004-2005 as a baseline, campuses will strive to increase the percentage of low or zero-emission vehicles (LEV, ZEV) by 50% by the year 2009-2010, or to increase the number of LEV and ZEV vehicles by 20% by the year 2009-2010, whichever is more feasible.

e. The University will work with regulatory agencies and other entities (e.g. regional transit agencies, air quality management districts) to speed the development, approval, and implementation of programs and technologies that support the goals of sustainable transportation as related to the increased use of bio-diesel or other alternative fuel sources.

IV. Transportation Demand Management Programs

a. The University will continue to facilitate the sharing of best practices within UC and with other educational institutions. In particular, the University will continue to participate in Transportation Sessions at the annual UC/CSU/CCC Campus Sustainability Conference, building on the success of transportation information shared at the 2005 Conference.

b. The University will develop a mechanism for ongoing involvement of undergraduate and graduate students in efforts toward achieving sustainable campus transportation. The means may include but are not limited to undergraduate and graduate internships and/or scholarships for relevant conference attendance. The Office of the President will begin funding an internship for one to two students beginning in the 2005-06 academic year and continuing until, at least, 2009-10. At that time, the program's results will be reviewed and the Senior Vice President Business and Finance will determine whether or not to extend the program.

c. Within three years of issuance of these guidelines, each campus will implement a pre-tax transit pass purchasing program to facilitate the purchase of transit passes by University employees or will establish an universal access transit pass program for its employees.

d. The University will pursue the introduction of car-share programs at every campus for all eligible car-share program participants, where available.

e. To the extent practical, the campuses will develop a business case analysis for proposed parking structure projects.

V. Authority and Report Schedule

The Regents have delegated authority to the President for promulgating policy promoting sustainable new capital projects, existing University facilities, and campus transportation resources. The President has delegated authority to the Senior Vice President -- Business and Finance for further definition of measures to implement University policy regarding sustainability. Chancellors are responsible for implementation in the context of individual building projects, facilities operations, and transportation projects and programs.

On an annual basis, the President will provide a report to The Regents that details the impact of the University's sustainability efforts on the overall capital program, University operating costs, energy use, and campus transportation resources. The University's sustainability guidelines will be subject to continuous review. The guidelines will be reexamined every three years, with the intent of developing and strengthening implementation provisions and assessing the influence of the guidelines on existing facilities, new capital projects, plant operating costs, fleet and transportation services, and campus accessibility, mobility, and livability. The University will provide means for the ongoing active participation of students, faculty, administrators, and external representatives in further development and implementation of the Policy on Green Buildings, Clean Energy and Sustainable Transportation Resources.

Appendix G – The Green Initiative Fund (TGIF)

Ballot Language – As it appeared in the 2006 Voters Guide for the Online Spring Election 2006 April 24 – 27.

Undergraduate and graduate students vote on this measure:

The Green Initiative Fund (TGIF)

Do you approve of a $2.60 per undergraduate and graduate student per quarter, including summer, mandatory fee in order to support The Green Initiative Fund (TGIF)? TGIF will provide funding for projects intended to reduce the University's impact on the environment. If passed, the fee would begin fall 2006 and be subject to reaffirmation in spring 2010. There will be a return to aid surcharge added to the fee based on the RTA percentage receiving the most votes..

_______ Yes _______ No

Pollution and waste generated by the University contribute to major environmental problems such as global warming, climate change, and the degradation of air and water quality. In 2004, the University released 143,293,685 lbs of CO2 into the atmosphere by using energy created by burning coal, oil, or gas.

In an Associated Students survey of over 3,000 students 82% of respondents felt that it was the responsibility of UCSB to reduce its green house gas emissions. UCSB has for the past few years worked to assess its environmental impact and to bring staff, faculty, and students together to determine what steps need to be taken.

The TGIF will be controlled by a student-majority grant allocation committee. Projects will likely include renewable energy and energy conservation such as installing solar panels on roofs and energy efficient equipment in labs, student housing retrofits, energy efficiency, and waste reduction. As an example, by replacing the sidewalk lamps around campus, UCSB would save $100+/yr per light.

Other projects will likely focus on water conservation through the use of waterless urinals in bathrooms and using reclaimed water on university landscaping. In addition, 20% of the fund will be allocated by the grant committee for student internships and education.

Election Results for TGIF – Posted 4/28/2006

Voter Turnout:
Both undergraduate and graduate bodies surpassed the 20 % required for the election to be valid.
5,003 out of 16,927 undergraduates voted - 29.56 %
836 out of 2,689 graduates voted – 31.08 %

TGIF PASSED!
74.64% of total students voted Yes
74.64% of undergraduate students voted Yes
81.92% of graduate students voted Yes

TGIF GRANT MAKING COMMITTEE

The grant making committee is the unit of authority within TGIF. Apart from his/her normal function as a part of this unit, Committee Members have no individual authority. The basis of authority for the TGIF is the students' approval of The Green Initiative Fund Student Lock-In Fee (student elections, spring, 2006), a $2.60 per student (undergraduate and graduate) per quarter lock-in fee. The Committee Members have the power to appropriate these funds as determined by the initiative itself, bylaws, and mission statement. As individuals, directors may not commit the Fund to any policy, act, or expenditure. Directors do not represent any fractional segment of the student body, but are, rather, a part of the body that represents the student body as a whole.

DUTIES OF GRANT MAKING COMMITTEE

It shall be the duty of the Committee Members to:

1. Perform any and all duties imposed on them collectively or individually by the Mission Statement and/or these Bylaws.
2. To review project applications and to consider funding those which are found consistent with Mission Statement.
3. Appoint, remove, employ and discharge, and, except as otherwise provided in these Bylaws, prescribe the duties if any, of all staff, interns, and employees of The Green Initiative Fund.
4. Supervise staff of The Green Initiative Fund to assure that their duties are performed properly.
5. Meet at such times and places as required by these Bylaws.
6. Represent the Fund on matters pertinent to their jurisdiction and the TGIF Mission Statement, delivering talks before professional, civil, and lay groups and participating in conferences.

The grant-making committee consists of the following representation:

Voting Members:

1) One Graduate Student Association (GSA) representative
2) One Associated Students (AS) Representative
3) One Environmental Affairs Board Representative (Nominated by Organization they represent)
4) One department-wide Graduate Student
5) One department-wide Undergraduate Student
6) One faculty selected by Academic Senate
7) One Staff from Administrative Services (Selected by the Chancellor)

TGIF ADVISORY BOARD

The advisory board is empowered by the student majority grant making committee to support The Green Initiative Fund (TGIF) in outreaching to the local community, develop TGIF financially, and ensure that grant making committee continues to work towards the fulfillment of the mission statement.

DUTIES OF ADVISORY BOARD

It shall be the duty of the Advisory Board to:

1. Increase awareness about TGIF in the local community
2. Develop partnerships with local donors, business, government, and non-profits throughout the local community which will strengthen the TGIF.
3. Fundraise to increase the fund's financial capacity particularly in the area of grants, endowments, and major gifts.

NUMBER & REPRESENTATION

The advisory board is to be made up of nine members:

1) Student Chair of the Grant Making Committee
2) TGIF grants manager
3) UCSB Development Officer
4) Faculty Representative
5) Community Member
6) Community Member
7) Community Member
8) Community Member
9) Community Member

The advisory board will focus on fundraising and development of the TGIF. All decisions/motions of the advisory board need to be approved by the grant-making committee.

Press Coverage

www.dailynexus.com
http://www.dailynexus.com/news/2006/10958.html

TGIF To Bring New Energy To Sustainable Appliances
by Gibran Maciel - *Staff Writer*
Thursday, February 16, 2006

For this spring's campus-wide elections, students must decide whether or not to support The Green Initiative Fund (TGIF), the campaign for which involves neither tasty eateries nor the ABC network's old Friday night lineup. If passed, TGIF will be used to purchase alternative sources of energy, as well as energy and water efficient appliances or systems on campus. The initiative proposes a lock-in fee of $4 per undergraduate and graduate student per quarter, including Summer Sessions. Campus Sustainability Coordinator Katie Maynard said the lock-in, while requesting a small amount right now, will save students more money in the long run. "[TGIF] focuses on environmental sustainability: It will be there to allow us the funding to work on energy and water efficiency on campus," Maynard said. "These steps will help prevent future increases in tuition, and help lessen the environmental impact of the university. Funding is one of the biggest barriers that we are up against right now."

Although UCSB has already committed itself to buying more sustainable appliances for its buildings, such as waterless urinals, the funding available for such projects is inadequate, Maynard said. She said UCSB gave roughly $70,000 to $80,000 to sustainability projects in the fall, which was used to pay for consultant groups Brightworks and Glumac.

"Brightworks and Glumac brought 79 people from all different areas of campus together in a room to come together and get a consistent idea of what we are trying to accomplish, and motivated all of them to start to look at sustainability within their own department," Maynard said.

"The university [gave] some money to it already, but this will require quite a bit of start-up money," Maynard said. "All these changes are happening because we haven't been building in an environmentally friendly way for a long time, so even the amount of money that the university is paying now will only pay for a fraction. We hope that student funding will encourage the university to match it." TGIF supporters collected 15 percent of undergraduates' signatures, as well as 15 percent of graduate students' signatures, to place the proposal on the spring campus-wide ballot, said Logan Green, a fifth-year business economics major and petition-drive coordinator.

"A lot of people worked on this," Green said. "It is a broad-based group of undergrads and graduate students who care about the environment."

If passed, $2.67 of the $4 lock-in would go toward the purchase of energy and water efficient appliances or alternative energy providers like solar panels. Green said a panel of five students, one staff and one faculty member will decide what projects receive funding. Meanwhile, $1.33 of the lock-in would go to "return-to-aid," which subsidizes financial aid students' lock-in fees.

Financial aid students previously received return-to-aid funds for both their UC-wide fees and UCSB campus-based fees from the pooling of funds from all UC campuses, but this year UCSB must pay for its own return-to-aid for lock-in fees, as per a new UC Office of the President policy. All new lock-in fees and lock-in fees being reaffirmed will include a surcharge.
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"When students decide to pay for something, it really means a lot to the university," Maynard said. "We are hoping to get matching funds and use them to leverage funding from private donors and alumni."

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www.dailynexus.com
http://www.dailynexus.com/opinion/2006/11371.html

Vote for Out Campus' Greener Future
by Kelly Burns
Thursday, April 13, 2006

Megan Horejsi / Daily Nexus

Everyone take a moment to reminisce about this weekend's celebration of Earth Day... You know, the warm sun gently warming your pale winter skin, friends sharing picnic blankets, girls twirling in long flowing skirts and guys proud of their long hair and all its whirling capabilities. You remember now, you got to dance like no one is watching, drink like no one is driving and, of course, love our Earth. But let me introduce you to Earth Day's even hotter twin sister, the Green Initiative Fund. She is just as sexy, wears just as many flowers in her hair, but, watch out, this sister is changing history and inviting you to join her. Her friends call her TGIF, they hang out in the Arbor, wear green and yellow T-shirts everyday and talk about her constantly. She's just that good. All right, all right, let me finally satisfy your gnawing, begging curiosity, allow you to stop pacing back and forth as you anxiously grip the Opinion page of the Nexus, and have the honor of telling you why everyone is talking about TGIF.

The Green Initiative Fund is a fund that will provide recourses for green initiatives that will decrease our impact on the environment. For example, imagine solar panels powering Campbell Hall while you listen to lecture. No longer will you be distracted worrying about greenhouse gases being emitted into the atmosphere causing ice caps to melt, extreme temperatures or another rainy Spring Quarter. Don't worry, with solar panels you can relax and concentrate on your professor's words. There is also the extra bonus of knowing that you are making money by investing in energy efficient appliances, heating and electricity that save the university hundreds of thousands of dollars each year once TGIF sets the infrastructure into place.

I will tell you why this is important. Did you know that our campus alone puts 143 million pounds of carbon dioxide into the atmosphere every year? That is about 7,000 pounds per student. This huge contribution proves that every person can, and does, make a difference. Ladies and gentlemen, now you have the opportunity to choose a positive difference, to create an environment of innovation and forward thinking, to decrease our dependence on foreign oil, to protect the environment so that your grandchildren can enjoy the environment too, and to launch a campaign that will lead our country into a necessary and sustainable future. So, come on by Arbor. Make friends with the lovely TGIF. Spread the word about TGIF. Make Earth Day everyday and vote, vote, vote - until you go crazy.

Kelly Burns is a senior global studies major and A.S. external vice president of local affairs.

"Why TGIF? Because Sustainability is a Necessity"
Scott Mac Kenzie (UCSB staff)
Sustainability Coordinator

On your spring ballot, an initiative you will be voting on will position UCSB to become a national and even global leader towards sustainable design and energy efficient programs. Opportunities like this require more than a quick glance and a few fleeting thoughts. Indeed, if the big picture dilemma was whether to take one door towards prosperity, health, and progress, or another to a hazy waiting room, wheezing patients, and uncertain job prospects, which door would you take? Such a decision is before you, and its one I caution you to take extra time to ponder. Sustainability is a necessity; a clear path is before you. The Green Initiative Fund (TGIF) will propel this campus to the forefront of institutions that are proactively confronting the realities of climate change and global warming, and expand the educational opportunities available to students here at this living laboratory we call UCSB.

Human society is at a crucial point; billions of people on the planet are eager to develop to a level at which we won't be able to sustain ourselves if we continue to operate at the status quo. They will demand energy, access to clean water, improved health, and a quality of life that in many ways we have demonstrated to them to be their objective. In order to meet the demands of the future, we must be able to do so in a manner that does not compromise the ability of current and all future generations to fulfill their own needs. Environmentally preferable processes will be a significant step in this direction. We will require cleaner, renewable, and more efficient products and services that create zero waste and have a positive impact on both the health of our bodies and that of all the life which surrounds us.

So what's in it for me, you might ask. What isn't? Green technology and environmentally preferable products and services are the next industrial revolution; they are transforming markets and improving our relationship with the one and only planet that we call home. Creating a student fund on this campus that provides a vehicle for these projects to come to life more effectively will improve everyone's prospects for a better future. And they will help you. Graduating from a University that is a leader in its advancement towards sustainability and having knowledge of the tools and strategies necessary to tackle the challenges of the 21st century will give students an advantage in future job markets. If you take time to examine the current climate, there is no better place to start: our universities are centers for intellectual and technological growth and the manner in which we develop and grow is highly visible to those around us. The purchasing power of the University of California surpasses that of entire nations on the planet, we have the capacity to transform both markets and society, and now an ability to do so in a manner that is more sustainable and enhances a positive evolution of our values.

This couldn't come at a more pressing time. The University of California has already established itself as a leader in the field and this campus in particular is a focal point of that effort. All of our new construction strives to meet LEED (Leadership in Energy and Environmental Design) Silver standards, a level above the UC systemwide goal of LEED certified. UCSB has three full time Sustainability Coordinators, an engaged faculty and staff, and arguably the most active student groups at any campus in the UC system, even the state of California. What we do on this campus resonates across the UC system and throughout the state of California. Leadership is not always requested by those who assume the role, but it is a responsibility that must be answered.

Already, students have largely been driving these projects and with TGIF they would continue to do so, the key difference being their ability to breathe life into the implementation. TGIF would create a precedent for policy makers elsewhere to point to, as can be seen with the overwhelming success of another student initiated fund at UCSB, the Shoreline Preservation Fund (SPF). Most importantly, TGIF would save us in the long run, not just our pocket books, but our health, our environment, and our ability to thrive and innovate. You are not just voting for several dollars a quarter to help fund more sustainable projects on campus, but for a new paradigm that embraces sustainability and confronts the realities of the world we live in without fear or the folly that someone else will solve the problems we have created.

The realities of the 21st century may be lost on some decision makers, but they cannot be lost on us. The decision you make in next week's election will have a ripple affect beyond the boundaries of our campus community. We live in an interconnected world, and it is one in which our local choices can impact the global community. I, for one, still have hope for the days to come.

Initiatives Return Mixed Results

By Kaitlin Pike — Staff Writer
Published Friday April 28, 2006

This year's spring election saw emotional responses from supporters on all sides, as all reaffirmations passed, all Associated Students fee initiatives failed, both campus initiatives passed and both A.S. constitutional changes passed.

For this year's election, 5,003 undergraduates - 29.56 percent - and 836 graduate students came out to vote; both groups surpassed the 20 percent required for the election to be valid. Students will now pay an additional $4.23 in campus-based fees, bringing them up to a total of $1,487.46 over a three-quarter period.

The 15 reaffirmed fees, including the A.S. Isla Vista Tenants' Union lock-in fee and the Intramural Sports Programs lock-in fee, passed by wide margins. The new A.S. constitution and the constitutional amendment to make the Office of the Student Advocate's Advocate General an elected position also passed.

A.S. BALLOT MEASURE RESULTS

A.S. CAB Support Fee	PASSED	71.71%
TGIF	PASSED	74.64%
RTA (25%)	PASSED	30.55%
UCSA	FAILED	59.54%
A.S. Program Board	FAILED	48.90%
MultiCultural Center	FAILED	60.51%
2006 A.S. New Constitution	PASSED	75.97%

As for the A.S. fee initiatives for undergraduates, the University of California Student Association $2 fee increase failed, receiving only 59.54 percent of the 66.7 percent approval rating required. The A.S. Program Board $4.50 increase failed with 48.9 percent in favor. Finally, the MultiCultural Center $3 fee increase failed, having only received 60.51 percent of the vote.

Meanwhile, The Green Initiative Fund - more commonly known as TGIF - passed with a resounding 74.64 percent from undergraduates and 81.92 percent of graduates. Including a Return to Aid surcharge, the new lock-in charges $3.47 per undergraduate and graduate student per quarter.

Elections Committee Chair Justin Pabian said this year's election season contained a few violations as well as vandalism. Amongst a few other problems, several candidates' signs were vandalized. The responsible parties have yet to be found.

"[Open People's Party] had two violations," Pabian said. "One was for improper leafleting. They received a warning because they had some numbers wrong on their leaflets regarding budget issues. The second came last week where they said they had members involved in the A.S. Elections Committee … We fined everyone $20 from OPP."

However, the inaccuracy of budget information on OPP's fliers has yet to be completely confirmed.

- Nick Durnhofer and Megan Snedden contributed to this story.

Appendix H – Outreach and Publicity

Presentations at Major Events

- *NAELS Summit* (February 2005). Bren School. Santa Barbara, California.
- *California Climate Action Registry Conference* (May 2005). Claremont Hotel. Berkeley, California.
- *NAELS Workshop* (October 8, 2005). Bren School. Santa Barbara, California.
- *SBEEC. Community Design and Global Warming Workshop* (November 5, 2005). Santa Barbara City College. Santa Barbara, California.
- *Energy Action California Summit* (November 5, 2005). UC Berkeley campus. Berkeley, California
- UCSB Bren School of Environmental Science and Management. *Final Group Project Presentations (*April 19, 2006). Fess Parker 's Doubletree Resort. Santa Barbara, California.
- *NAELS Summit* (April 28, 2006). Bren School. Santa Barbara, California
- *Air & Waste Management Association* (May 18, 2006). A. J. Spurs Restaurant. Buellton, California.
- *UCSB Campus Planning Committee* (May 31, 2006). Santa Barbara, California

Various Articles

- Welsh, N. (2005, February 10 – 17) The heat is on. *The Santa Barbara Independent (Santa Barbara, CA),* p. 20.
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- Davison, A. (April 22, 2006). "Emissions cuts may pay off for UCSB." *Santa Barbara News-Press (Santa Barbara, CA),* p. 1A.
- Sadler, M., Stewart E., Welsh, N. with Wallace, L. (2006, May 4 – 11). Green money, green power. *The Santa Barbara Independent (Santa Barbara, CA),* p. 19.

Glossary of Terms

CA-CP
"Clean Air-Cool Planet creates partnerships in the Northeast to implement solutions to climate change and build constituencies for effective climate policies and actions" (CA-CP, 2004).

CCAR
"The California Climate Action Registry (the Registry) was established by California statute as a non-profit voluntary registry for greenhouse gas (GHG) emissions. The purpose of the Registry is to help companies and organizations with operations in the state to establish GHG emissions baselines against which any future GHG emission reduction requirements may be applied" (CCAR, 2006).

CCN
Campus Climate Neutral. "A nationwide campaign to mobilize law students in support of campus greenhouse gas emission reductions and global climate change solutions" (NAELS, 2004).

EU ETS
European Union Greenhouse Gas Emission Trading Scheme is "the largest multi-country, multi-sector Greenhouse Gas emission trading scheme world-wide." (EU, 2006)

GHG
Greenhouse Gas. Specifically the 6 gases recognized by the Kyoto Protocol: Carbon dioxide (CO_2), Methane (CH_4), Nitrous oxide (N_2O), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs), Sulphur hexafluoride (SF_6) (IPCC, 2006).

GWP
"Global warming potential is a measure of how much a given mass of greenhouse gas is estimated to contribute to global warming. It is a relative scale which compares the gas in question to that of the same mass of carbon dioxide (whose GWP is by definition 1). A GWP is calculated over a specific time interval and the value of this must be stated whenever a GWP is quoted or else the value is meaningless" (Wikipedia GWP, 2006).

HVAC
Heating Ventilation and Air Conditioning is "A system that provides heating, ventilating, and/or cooling within or associated with a building." (EERE, 2006).

IPCC
The Intergovernmental Panel on Climate Change. "The role of the IPCC is to assess on a comprehensive, objective, open and transparent basis the scientific, technical and socio-economic information relevant to understanding the scientific basis of risk of human-induced climate change, its potential impacts and options for adaptation and mitigation" (IPCC, 2006).

kWh
kilowatt-hour is equivalent to 1000 watt-hours: "One watt-hour is equivalent to one watt of power used for one hour. This is equivalent to 3,600 joules. For example, a sixty watt light bulb uses 60 watt-hours

of energy every hour. Similarly, a 100 watt light bulb uses 50 watt-hours in thirty minutes" (Wikipedia Watt-Hour, 2006).

MTCO$_2$e
Metric Ton Carbon Dioxide Equivalent is equal to 1000 kilograms or 2200 pounds of Carbon Dioxide (IPCC, 2006).

NAELS
The National Association of Environmental Law Societies (NAELS) is "a non-partisan, nationally diverse organization of Environmental Law Societies. NAELS is working to implement a nationwide campaign to develop bottom-up climate leadership through its Campus Climate Neutral (CCN) program – an ambitious and unprecedented grassroots effort to mobilize graduate students around the United States to lead the way to aggressive, long-term climate solutions" (NAELS, 2004).

NPV
Net-Present Value. An economic term that is "the difference between the present value of cash inflows and the present value of cash outflows. NPV is used in capital budgeting to analyze the profitability of an investment or project" (Investopedia, 2006).

UCOP
University of California Office of the President is "the systemwide headquarters of the University of California" (UCOP, 2006).

UNFCCC
"The United Nations Framework Convention on Climate Change (UNFCCC or FCCC) is an international environmental treaty produced at the United Nations Conference on Environment and Development (UNCED), informally known as the Earth Summit, held in Rio de Janeiro in 1992. The treaty aimed at reducing emissions of greenhouse gas in order to combat global warming" (Wikipedia UNFCCC, 2006).

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