



CHANGING THE CAMPUS CLIMATE: STRATEGIES FOR UCSB TO REDUCE GREENHOUSE GAS EMISSIONS

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UCSB can meet CA GHG Emissions Reduction Targets and Save Money!

Background & Significance

Anthropogenic climate change is arguably the most significant problem of our generation. Unfortunately, its drivers – greenhouse gas 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 greenhouse gas (GHG) emissions, with both the Kyoto Protocol coming into force and the European Union (EU) implementing its Emissions Trading System 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 (i.e., 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 (i.e., 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 uniquely positioned to play a pivotal role in California’s climate action

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 important 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 supreme importance.

Problem Statement & Goals

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 potential strategies 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.

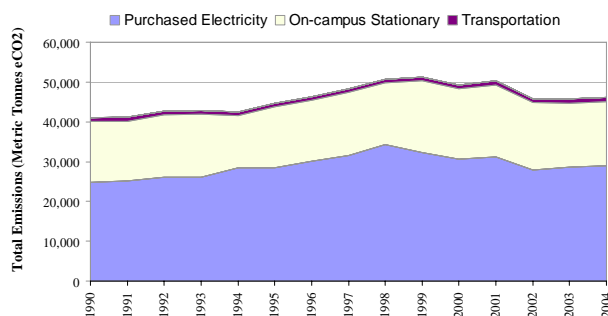


UCSB GHG Emissions Inventory

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 data, total GHG emissions were approximately 46,000 metric tonnes of carbon dioxide equivalent (MT CO2e); this is roughly equivalent to the emissions from 8,000 cars driven throughout the year. Interestingly, total emissions peak in 1999 and shrink by 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.

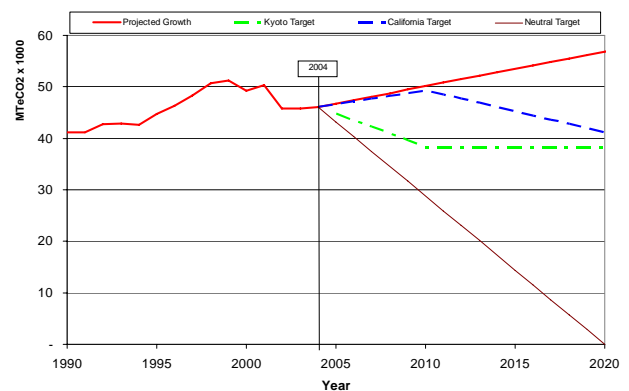
Emissions Targets Applied to UCSB

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 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 MT CO2e/student from the inventory and anticipated growth of approximately 300 students per year through 2020, we project total emissions through 2020 (see 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 opportunities available to UCSB, including energy efficiency and conservation projects, on campus renewable energy projects, alternative fuel vehicles, and external mitigation options (i.e., carbon offsets, renewable energy credits).¹ For each mitigation mechanism we provide the capital cost, associated savings (i.e., energy), annual GHG reduction potential, net cost per unit of GHG reduced², and payback period.

Feasibility Analysis of Meeting Specific Targets

We identify the specific combination of mitigation mechanisms that would enable UCSB to meet the

¹ 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 mitigation options.

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



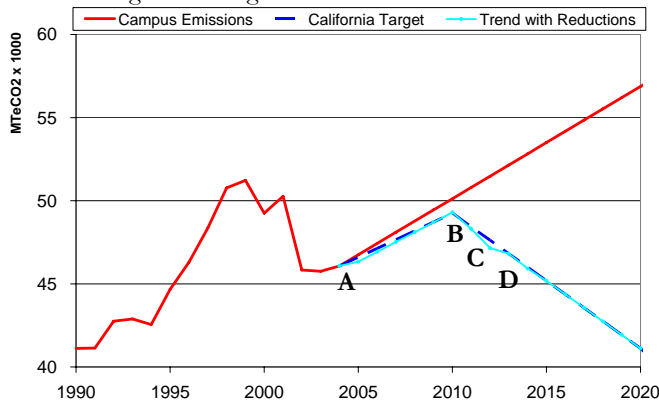
previously discussed emissions targets. We assume a consistent mechanism choice logic that reflects UCSB priorities – we first select projects with no capital costs that yield savings, then we select projects that yield the highest savings over time (best in terms of NPV net cost/GHG), and finally, once all mechanisms with costs below the price of external offsets (\$11/MT CO₂e) 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 Stage A	Energy star computer settings	310	\$0	196	\$94,000
	Fleet smaller vehicles	33	\$0	215	\$9,545
	Fleet ethanol	1	\$0		\$0
2011 Stage B	HVAC Upgrade – Air Handlers 1	573	\$200,000	245	\$112,000
	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 Stage C	HVAC Upgrade – Fans	914	\$1,574,464	125	\$277,048
	Lighting Upgrades	835	\$1,797,762	97	\$252,919
2013 Stage D	HVAC Upgrade – Air Handlers 2	174	\$550,000	42	\$45,328
	Reduce fleet driving – bikes	1	\$2500	11	\$27
	Begin purchasing offsets	763	\$8,091	-11	\$0

Figure 4 illustrates the specific 4 stage emissions reduction path that UCSB could take to meet the first two California targets – the 2010 and 2020 standards (shown in dashed blue below). The aqua blue trend 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 purchasing offsets becomes the next cheapest alternative. Therefore, we assume that UCSB purchases external offsets to make up the difference in subsequent years.

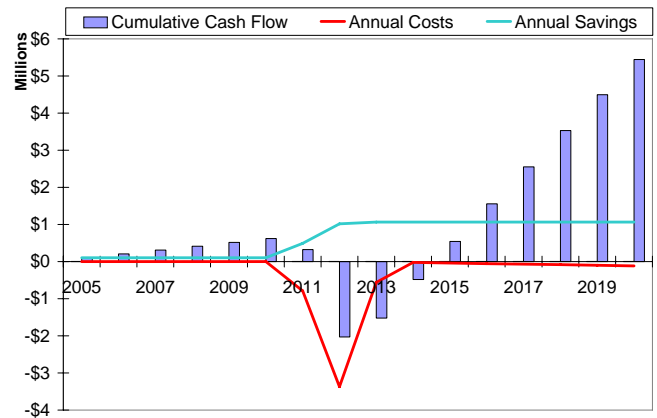
Figure 4: 4 Stage Emissions Reduction Path



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/tonne, which is close to the current price of carbon in the EU market; we find a NPV of savings of \$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 they are – 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, 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.

However, 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 Contribution to GHG mitigation:

- Facilitation of UCSB membership with California Climate Action Registry.
- Formation of The Green Initiative Fund scheduled for vote on April 24, 2006.
- Participation in the development of the Campus Sustainability Plan and membership in Campus Planning Subcommittee on Transportation.

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 have identified six key recommendations that would put UCSB on track to be a leader in responding to climate change. With consideration to the financial findings of our research and evaluation of institutional barriers, UCSB should:

- 1) Make a firm commitment to meet the California GHG reduction targets.

- 2) Use GHG as a metric in long-term campus planning documents.
- 3) Turn the "Sustainability Working Team" of the Campus Planning Sub-Committee on Sustainability into a real Office of Sustainability.
- 4) Implement zero cost emissions reduction projects, followed by lowest cost \$/tonne GHG projects.
- 5) Focus on identifying additional cost-effective GHG mitigation opportunities on campus, such as energy efficiency.
- 6) 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 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, 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.



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.

Acknowledgments

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