

Appendix C



UC Berkeley Climate Action

Feasibility Study 2006 - 2007 Final Report

Executive Summary

**Climate Action
Partnership**

**CalCAP is a collaborative of faculty, administration, staff and students
working to reduce greenhouse gas emissions at UC Berkeley**

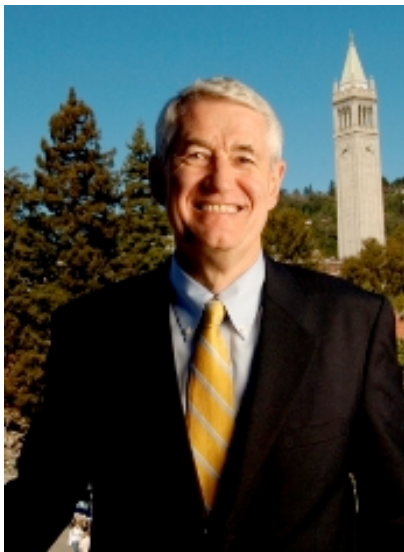
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July 2007

SPOTLIGHT



On April 27, 2007, UC Berkeley Chancellor Robert Birgeneau committed the UC Berkeley campus to reducing its greenhouse gas emissions to 1990 levels by the year 2014. The announcement was made at the 4th Annual Sustainability Summit of the Chancellor's Advisory Committee on Sustainability, and it was based on the final Cal Climate Action Partnership recommendations made to the Chancellor and his cabinet in early April.

"This new emissions target is the next step in the campus's drive to play a pivotal role in California's climate strategy and action. UC Berkeley's new emissions target not only meets [the] ACUPCC criteria, but emphasizes Berkeley's leadership in sound analysis and actionable policy".

- Chancellor Robert Birgeneau, April 27 2007 Keynote address, UC Berkeley Sustainability Summit

In March 2007, UC President Robert Dynes signed the American College and University Presidents Climate Commitment (ACUPCC), which calls for the University of California to reduce its greenhouse gas emissions, with the ultimate goal of making all ten UC campuses carbon-neutral. The CalCAP feasibility study was already underway at the time, so the campus not only supports ACUPCC but also serves as a pioneering program for all.

EXECUTIVE SUMMARY

About the Cal Climate Action Partnership

A group of student leaders conceived of the Cal Climate Action Partnership (CalCAP) in March, 2005. In response to their passion and support from members of faculty and staff, a CalCAP Steering Committee was convened by Vice Provost Catherine Koshland in early 2006. At the Campus Sustainability Summit in April, 2006, Chancellor Birgeneau announced that, at a minimum, UC Berkeley would adopt the State of California's greenhouse gas emissions reduction targets. The Chancellor then approved the request for this feasibility study and inventory certification. The Chancellor's Advisory Committee on Sustainability (CACS) hired Project Manager Fahmida Ahmed in September, 2006 with administrative support from Facilities Services and Environment, Health & Safety.

Feasibility Study Results

Since October 2006, CalCAP has engaged with campus decision makers and stakeholders to complete the following activities:

- ☒ California Climate Action Registry – Joined in October, 2006.
- ☒ Greenhouse Gas (GHG) Inventory – Emissions from the campus have been inventoried, reported to the Registry, and the certification was completed in August, 2007.
- ☒ Project Identification and Evaluation – Over 30 GHG reduction projects were identified in initial scoping, and quantitative analysis was completed for 14 of those projects.
- ☒ Emissions Reduction Target Analysis – Evaluated options to meet state, Kyoto, and more aggressive GHG reduction targets using identified projects.
- ☒ Financial Feasibility Analysis – Estimated the costs and savings associated with implementation of the identified projects, showing that the project portfolio of identified on-campus projects has a 4-year simple payback.

Final Recommendations to the Office of the Chancellor

CalCAP recommends that the university take the following actions:

- **Commit** to reducing greenhouse gas emissions to **1990 levels by 2014**. This is equivalent to meeting California Assembly Bill 32 (passed in September, 2006) six years early. The feasibility study demonstrated that this target can be met or exceeded through execution of identified projects and a greening of the electricity supply.
- **Commit** to long-term climate neutrality, without specifying a target date. In parallel, the university should continue to develop a better understanding of its overall climate footprint.
- **Provide a directive** to the campus to incorporate greenhouse gas reduction criteria and sustainability into the institutional decision-making process. This directive should be targeted at every member of the campus community: administrators, faculty, staff, and students.

- **Support the continuation of CalCAP and sustainability initiatives.** Allocate resources for permanent sustainability staff roles (requests through Facilities Services and Administration), and incorporate GHG reduction criteria and reporting into their mandates.

Why UC Berkeley Should Take Action

Anthropogenic climate change is the most significant problem of our time. Recognizing this, almost all developed countries are taking action to reduce greenhouse gas (GHG) emissions, with both the Kyoto Protocol increasing its influence and the European Union implementing its recent Emissions Trading Scheme. California is already demonstrating national and international leadership in committing to reduce its GHG emissions. AB 32-- *Global Warming Solutions Act of 2006*-- requires that the state's global warming emissions be reduced to 1990 levels by 2020. On March 22, 2007, UC President Robert Dynes signed the systemwide *Policy on Sustainability Practices* that endorses meeting the goals outlined in AB-32. In addition, this policy urged each UC campus to "pursue the goal of reducing GHG emissions to 2000 levels by 2014 and provide an action plan for becoming climate neutral as specified in the Implementation Procedures".

As the nation's leading public educational institution, the University of California, Berkeley is poised to play a pivotal role in California's climate strategy. It is important to demonstrate strategic and financial commitment to reducing climate change and to encourage students to be conscious of their carbon footprints. Furthermore, by taking action, the campus can reap the following benefits:

- Reduce campus energy costs
- Implement GHG reduction technologies developed by campus researchers
- Prepare for future climate regulations and energy price volatility
- Create demand for low-cost renewable energy technologies through its purchasing power
- Appeal to a campus community that has a strong culture of environmental ethics
- Collaborate with local communities and the City of Berkeley in implementing Measure G.

CalCAP Feasibility Study

CalCAP was formed to develop a strategy for significantly reducing UC Berkeley's GHG footprint without compromising its operations. There were three goals for the CalCAP feasibility study:

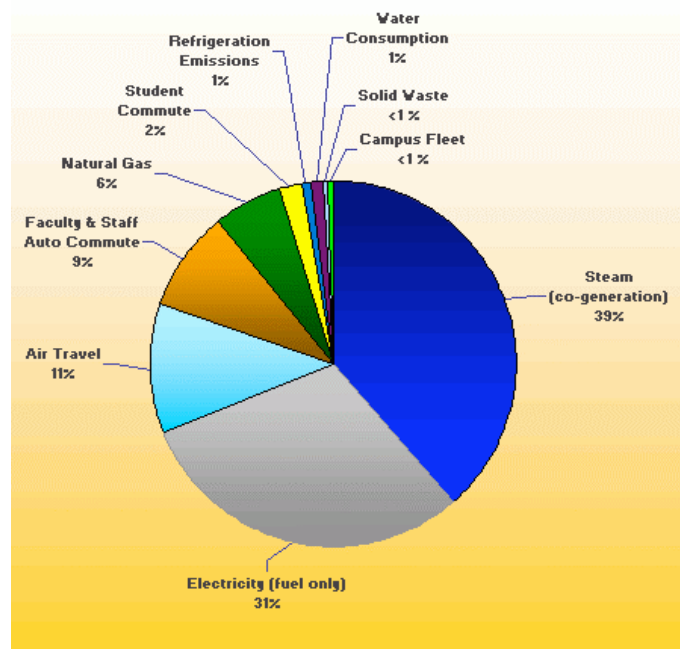
- Create a carbon emissions inventory
- Assess the financial feasibility of emissions reduction through various campus initiatives
- Create an institutional model for emissions reduction.

UC Berkeley GHG Emissions Inventory

The UC Berkeley GHG emissions inventory includes ten emissions sources: electricity consumption; steam use; natural gas consumption; the university fleet; student commuting; faculty and staff commuting; faculty and staff air travel; fugitive emissions from coolants; solid waste; and water use. The geographic boundary for the inventory was defined as campus buildings on the central campus, all student housing on- and off-campus, and the Richmond Field Station.

FIGURE A: UC BERKELEY GHG EMISSIONS BY SOURCE IN CALENDAR YEAR 2006

Emissions Sources (required & optional reporting)	CO ₂ equivalent (metric tons)	Percentage Contribution
Steam (co-generation)	82,000	38.8%
Purchased Electricity	65,000	30.6%
Air Travel	24,000	11.3%
Faculty and Staff Auto Commute	19,000	8.6%
Natural Gas	13,000	6.1%
Student Commute	4,000	1.8%
Fugitive Emissions- Refrigeration	2,000	1.0%
Water Consumption	2,000	0.9%
Solid Waste	1,000	0.4%
Campus Fleet	1,000	0.4%
Total Emissions	209,000	100.0%
Required reporting emissions sources	160,000	76.5%
Optional Reporting emissions sources	50,000	23.5%



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The university joined the California Climate Action Registry (the Registry) in October, 2006 to voluntarily report its emissions. The Registry requires reporting emissions from electricity consumption, steam use, natural gas consumption, university fleet, and fugitive emissions of coolants. The study included the additional emissions because the CalCAP Steering Committee wanted the inventory to reflect the campus's actual greenhouse gas footprint as closely as possible. This has the additional benefit of addressing emissions from additional sources that may eventually be regulated under AB-32.

In 2006, total GHG emissions from the ten sources were approximately 209,000 metric tons of CO₂ equivalent (Figure A). For a campus population of 48,000, this corresponds to 12 kg CO₂/person/day, which is about a third of the total average per capita emissions for Californians (Nazaroff, 2006).

During the course of the inventory process, the CalCAP team recognized that the [emissions inventory](#) does not fully reflect the complete carbon footprint of the campus. The UC Berkeley emissions inventory is only a subset of our campus's total carbon footprint, as it excludes the full lifecycle carbon emissions associated with some of the campus activities. The [Steering Committee decided that](#) UC Berkeley should take a leadership role in documenting and reporting additional optional sources of emissions such as procurement (university purchases including office supplies, furniture, food) and construction. A lifecycle analysis includes greenhouse gas emissions from all stages of a product or service's lifecycle, including mining, manufacturing, transportation, retail, use, and disposal.

The result of adding the lifecycle calculation to the emissions inventory estimates is striking. In 2006, the campus carbon footprint according to lifecycle analysis is at least 482,000 metric tons of CO₂ equivalent. The lifecycle calculation of additional emissions sources for procurement, construction and electricity (not otherwise calculated) adds an additional 273,000 metric tons of CO₂e to our total carbon footprint, which can be expressed as a 130% emissions increase (from 210,000 to 480,000 metric tons). Recognizing and understanding carbon emissions in terms of lifecycle analysis is important to UC Berkeley, and is considered a critical component to achieving the emissions reduction goals.

UC Berkeley GHG Emissions Trend

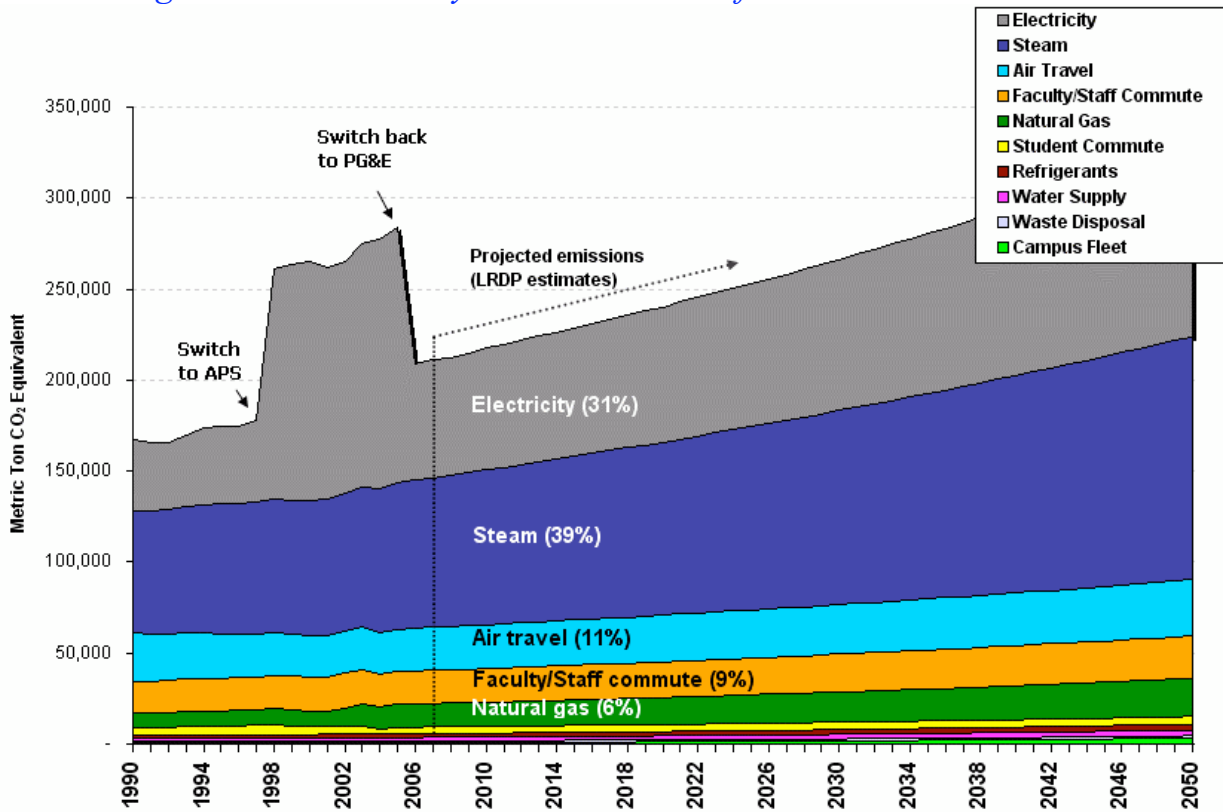
UC Berkeley has data for 1990 through 2006. From 2007 onwards, growth was projected from the *UC Berkeley Long Range Development Plan*, which estimates a 1.14% annual increase in gross square footage and a 0.609% annual increase in population). The annual gross square footage increase estimate was applied to electricity, steam, gas, waste, water supply, and refrigerant, while the annual population increase estimate was applied to commute and air travel calculations. A 2.8% annual growth rate was applied to campus fleet based on calculation performed by campus fleet manager (Robinson, 2006). Figure B displays UC Berkeley's GHG emissions by source over the past 16 years and projected through year 2050.

Two notable items are the largest emissions sources and the importance of choosing a utility provider that uses clean and renewable fuel sources.

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- Steam usage is the single largest source of GHG emissions, representing roughly 40% of total emissions, followed by electricity, air travel and faculty and staff auto commute.
- The increase in electricity emissions between 1998 and 2006 is due primarily to the higher coal content in the power mix for the electricity generated by Arizona Public Services (38% coal for APS vs. 1% coal and a larger percentage of energy from hydroelectricity for PG&E). In 2006, the main campus account (88% of the campus electricity) switched back to PG&E, which uses only 1% coal, 42% natural gas, 12% nuclear, 20% hydro, and 12% renewable--a fuel mix that improves our emissions inventory for calendar year 2006.

Figure B: UC Berkeley Emissions Trend from 1990 to 2050



Emissions Reduction Projects

The CalCAP study identified a range of mitigation strategies available to UC Berkeley that fall into four main categories. At present, CalCAP implementation is focused on projects in the first two categories; we expect these to produce monetary savings that can be recycled to fund more projects. The CalCAP team is also developing strategies for the third and fourth categories, but implementation of these strategies will come later. These project lists are by no means exhaustive and the energy savings calculations are fairly conservative by design. It is essential for this program to identify more intensive and additional reduction opportunities as it evolves.

1. **Infrastructure projects** – These projects are meant to enhance the energy efficiency of campus energy systems. They have a significant upfront cost, but they have a quick payback and generate savings that can be further invested. Projects about which we have gathered information include:
 - Monitoring-based commissioning
 - Co-generation plant steam capture and repair
 - Automated lighting controls
 - Fluorescent lighting retrofits
 - On-site photovoltaic system
 - Retrofitting bathrooms for better water conservation
 - Energy Star (EPA) computer settings

2. **Behavior Projects** – These are campus initiatives that will encourage individuals to conserve more energy. These projects require some capital investment and a significant dedication to coordination and planning. They have a quick payback and also contribute to establishing a culture of environmentally sustainable practices. These projects vary in scope and focus:
 - Introduce fleet biking
 - Expand electric vehicle fleet
 - Implement high priority bicycle plan projects & programs
 - Reward department level energy reduction
 - Increase utilization of videoconference room(s)
 - Increasing occupant awareness and electricity curtailment
 - Introduce Campus Composting program

3. **Renewable Energy Credits (RECs)** – In many jurisdictions, the markets for energy and the environmental attributes of energy production are separate. The campus can green its electricity supply by making an investment in green power credits, also known as Renewable Energy Credits. One REC covers the technological and environmental attributes of one megawatt hour of electricity generated from renewable sources. RECs are third party certified, increase the demand for renewable energy in the utilities market, and are recognized as a sound method for compensating for carbon emissions from essential energy consumption. UC Berkeley will invest in RECs once possible infrastructures improvements have been implemented.

4. **Carbon Offsets** – The purchase of carbon offsets reduces net carbon emissions through arrangements with a carbon-offset provider specializing in projects off-campus that retire or capture carbon from the atmosphere. Examples include investments in renewable energy projects, and carbon capture and sequestration projects. Carbon offsets can be purchased from many organizations, but the lack of formal regulation of this market raises questions about whether the offset credits are only awarded for emissions reductions that would not have otherwise happened, and whether the offsets are permanent. In the coming years, UC Berkeley will investigate local and regional offset opportunities that offer tangible environmental, social and economic benefits to the local community.

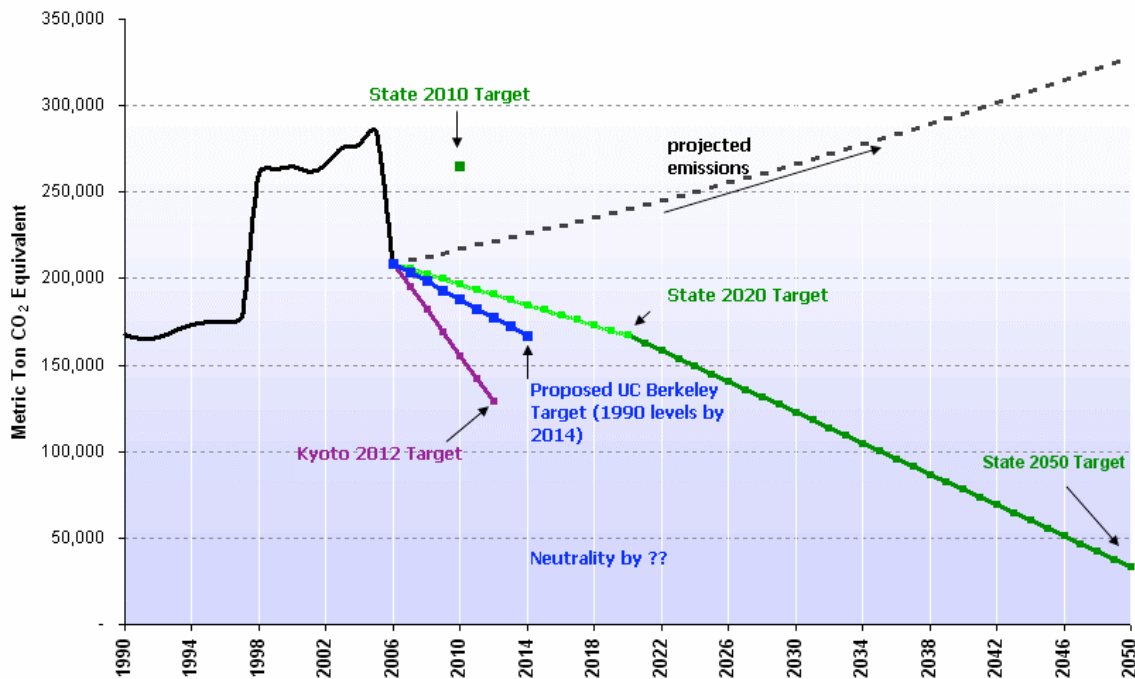
Financial Feasibility Analysis

For each project, we calculated capital cost, associated savings (e.g., energy), annual GHG reduction potential, net cost per unit of GHG reduced,¹³ and payback period. We found that with an initial investment in the infrastructure projects in the first years in the amount of \$14 million (one-time capital) and an additional \$1 million (annual operating), the university can break even approximately around the 4th year, and start generating a **net** savings of approximately \$3 million dollars annually. The upfront capital investment need not be done in the first year--but the sooner the investment happens, the sooner the savings accrue for additional investments.

Emissions Targets for UC Berkeley

We analyzed three separate emissions targets as applied to UC Berkeley through 2050: 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 or AB-32, and 80% below 1990 levels by 2050), and a target appropriate for UC Berkeley based on the identified projects and their financial feasibility (Figure C).

Figure C: Projected Emissions and Potential Targets



With consideration of the GHG inventory and evaluation of various emissions reduction efforts, the CalCAP findings show that UC Berkeley can make a firm commitment to reach **1990 emissions levels by the year 2014**. To accomplish this, UC Berkeley would:

- Use aggregate emissions targets as a metric in campus communication and planning

¹³ This includes the upfront capital cost and the discounted savings over the lifetime of the project.

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- First implement infrastructure-related emissions reduction projects, starting with the most cost-effective (i.e., highest \$/MTCO₂e) projects, and then use the savings from those projects to invest in additional projects or to purchase Renewable Energy Credits (RECs)
- Focus on identifying additional cost-effective GHG mitigation opportunities on campus, such as energy efficiency.

The UC Berkeley target (in blue) is more aggressive than AB-32 and the UCOP Climate Protection mandates. The UC Berkeley target is more aggressive than is required by California state law and the University of California Office of the President for reaching 2000 levels by 2014. This puts the university on a faster trajectory towards neutrality. The next emissions reduction feasibility study and assessment in 2008 will focus on setting a target for neutrality. We know that reaching it will be a challenge, but we believe we have created a process and a team that can get us there.