UCSF Sustainability Baseline Assessment:

Carbon Footprint Analysis

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Background

This chapter of the Sustainability Assessment focuses on UCSF's implementation of practices to support the climate protection policies and goals set by the UC Office of the President (UCOP). The focus of these practices at UCSF has been the development of GHG emission inventories (for calendar years 1990, 2000, and 2008); the development of a Strategic Energy Plan (completed in September, 2008); the development of a Climate Action Plan (CAP) (submitted to the ACUPCC in December, 2009[1]); and the various other activities of the Sustainability Steering Committee (SSC) of the UCSF Chancellors Advisory Committee on Sustainability (CACS).

Consistent with UCOP policies as well as State and Federal regulations, UCSF began reporting greenhouse gas (GHG) emissions in 2007. There are three organizations to which UCSF reports GHG emissions:

- The American Colleges and University Presidents Climate Commitment (ACUPCC)
- The California Air Resources Board (CARB)
- The California Climate Action Registry (CCAR)

As required by UCOP policy, UCSF submitted their first voluntary GHG inventory to the ACUPCC in September, 2007[2]. The UCSF CAP was voluntarily submitted to the ACUPCC in December of 2009. The CAP includes a 2008 inventory which is used as the basis to develop the 1990 and 2000 baselines for use in the CAP reduction targets for 2014 and 2020. Per ACUPCC requirements, a progress report on the implementation of the Climate Action Plan is due two years after submission of the Climate Action Plan. Subsequent progress reports are due every two years thereafter.

Under the mandatory reporting requirements of California Assembly Bill 32 (AB-32), UCSF submitted a 2008 GHG emissions report to the CARB in June, 2009. Mandatory reporting under CARB regulations is only for emissions from the Parnassus Central Utilities Plant (PCUP) cogeneration system[3]. Subsequent emissions data reports are due to CARB no later than April 1 of each calendar year (the next one being due April 1, 2010).

Also per UCSF policy, UCSF has registered with the CCAR for reporting of their 2008 GHG emissions. This inventory, per CCAR guidelines, should be third-party verified. This inventory was due to CCAR in 2009. *However, at the current time, UCSF has not submitted their verified inventory to CCAR.* The third-

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[1] Found at http://acupcc.aashe.org/cap-report.php?id=175

[2] Found at http://acupcc.aashe.org/ghg-report.php?id=84

[3] Found at http://www.arb.ca.gov/cc/reporting/ghg-rep/facility_summary.xls

party verification required by CCAR is an essential component of the University's climate action planning, and the implications of this apparent gap in the compliance process will be discussed further.

UCSF and Regents' Policies on Sustainability

The UCOP climate change policies were created to be applied equally to all ten UC campuses. These policies have created a somewhat unique challenge for UCSF, as it is the only UC campus dedicated exclusively to the health sciences. The anticipated growth in facility square footage between 1990 and 2020[4], as well as the energy intensity of the facilities that are part of UCSF, will require that the institution obtain significant GHG emissions reductions from a portfolio of buildings and properties with an operating environment that requires more effort and investment in financial and human capital than UCSF's sister institutions. To put this into perspective, Table 1 below compares UCSF's goals and reduction targets to three other UC campuses[5]. Of the four UC campuses listed in the table, UCSF has to make the largest reductions on a percentage basis and second largest in metric tons of CO_2 equivalent (MT CO_2e) in order to meet the 2020 goal.

Table 1

Comparison of Campus Targets

Campus	Targets	% Reduction from Business as Usual Case	MT CO2e Reduction from Business as Usual Case
UC Berkeley	1990 levels by 2014	25% below projected 2014 levels	61,000 MT below projected 2014 levels
UC San Diego	2000 levels by 2013, 1990 levels by 2020	50% below projected 2020 levels	176,374 MT below projected 2020 levels
UC Los Angeles	10% below 1990 levels by 2012, Climate neutral by 2025	10% below projected 2012 levels	58,000 MT below projected 2014 levels
UC San Francisco	2000 levels by 2014, 1990 levels by 2020	60% below projected 2020 levels	127,990 MT below projected 2020 levels
Stanford University	20% below 1990 levels by 2020 (Scope 1 and 2 emissions only)	53% below projected 2020 levels	138,000 MT below projected 2020 levels
Johns Hopkins University	51% below 2008 levels by 2025	51% below projected 2025 levels	141,600 MT below projected 2025 levels

[4] From 1990 through 2008, UCSF has grown from 5.12 million square feet to 7.18 million SF, and UCSF expects to add another 2.1 Million square feet of usable space by 2020.

[5] Information has been taken from each University's Climate Action Plan on file with the ACUPCC.

The September 2009 UCOP Policy on Sustainable Practices recognizes the unique considerations of acute care facilities by providing the following exceptions:

- *Acute care facilities are exempted from meeting the requirement to perform a minimum of 20% better than the California Energy Code*. It should be noted that under the California Code of Regulations (CCR), acute care facilities (know as I Occupancies in the CCR) are exempt from the Energy Code. Furthermore, the UCOP Policy states that "standards for energy efficiency for acute care facilities will be developed". To date, this development work has not been completed.

- *Acute care facilities are exempted from meeting the requirement to design and build all new buildings to a minimum standard equivalent to a LEED™-NC "Silver" rating.* Despite this exemption, the new Mission Bay Hospital is being designed to meet the requirements of a LEED™-NC "Silver" rating.

- *"Acute care and patient care facilities" are exempt from the requirements of the Sustainable Operations section of the Policy.*

With respect to climate action planning, the UCSF CAP makes no distinction between the Campus and Medical Center operations and facilities, and the GHG emission reductions currently projected in the CAP come from all portions of the UCSF community. Thus, these exemptions do not appear to be a limitation on the effectiveness of GHG reduction planning.

However, in spite of the fact that UCSF's acute care facilities are not exempted from all UCOP sustainability policy requirements, the exemptions do appear to create an environment in which the Medical Center has been given less direction on maximizing opportunities for sustainable practices. The UCOP Policy states that "Further study will be conducted before a similar sustainable design policy for new acute-care facilities is adopted." Thus, a major sector of the UCSF community is pursuing sustainability practices without a clear mandate or direction from the UCOP. This situation appears to create challenges for the SSC Work Groups as they try to influence the Medical Center's operations. However, there is evidence that these priorities and agendas are merging, primarily through the recent efforts and combined campus and medical center leadership of the SSC Work Groups, and the focus brought about through the development of a CAP.

Regardless of the unique constraints that are faced by UCSF in meeting UCOP Sustainability Policy goals, the Campus and Medical Center have stepped up their efforts over the past few years to develop methods and procedures for meeting those goals. The SSC Work Groups have also begun the internal process of defining – in the absence of a clear definition from the UCOP - sustainability practices for the Medical Center's planning, financing, design, construction, renewal, maintenance, operation, space management, facilities utilization, and decommissioning of facilities and infrastructure.

Comparisons with other UC Campuses and Similar Institutions

Comparisons to other UC campuses are difficult because of the varied educational, research and medical school programs, the differences in climate, the make-up of student, faculty and other populations associated with the facilities, as well as variations in emissions inventory methodologies. While elsewhere in this Baseline Assessment UCSF's accomplishments are compared to other UC campuses, this did not seem to be a fruitful effort when it came to climate action planning and benchmarking UCSF's emissions.

Nevertheless, the following analysis of UCLA in comparison to UCSF is provided in order to better understand the factors that distinguish UCSF from its sister institutions. This comparison reveals that while both UCSF and UCLA have large medical schools and teaching hospitals, UCLA's medical school enrollment in 2002 (approximately 3,800 students) was only 10% of their total campus student population. With the addition of the Ronald Reagan UCLA Medical Center, the campus has roughly 4 million gross square feet of space devoted to the health sciences (17.5% of UCLA total GSF). The UCLA CAP notes that "laboratories only comprise 10% of campus space, but 60% of the campus energy demand." Both UCLA and UCSF have large co-generation plants that generate electricity on-site with district heating and cooling services. Both campuses have experienced similar square footage growth patterns over the 1990 to 2008 period: 34% for UCLA, and 40% for UCSF. Both campuses plan to expand at a comparable rate through 2020.

While these two campuses both added cogeneration facilities in the mid 1990's, UCLA decommissioned a large steam plant in the same period and employed landfill gas as a generation fuel source that significantly improved overall emissions. A large Thermal Energy Storage system on the UCLA campus also allows for increased central plant efficiency. These factors in particular have contributed to UCLA's ability to achieve emissions levels in 2012 that will already be below 1990 levels.

Commuting emission patterns are also divergent between the two campuses. Where UCLA experienced a reported 34% decrease in commute emissions between 1990 and 2007, UCSF increased by 29% for the same period. UCLA has been working on transportation demand management (TDM) since 1984. UCLA introduced the first alternative fueled vehicles using propane in the late 1980's. For UCLA, the growth of on-campus housing, long range development plan (LRDP) caps on overall trips to/from campus, and the mode split shifts seen in both the student and employee populations significantly reduced commuting emissions despite an estimated 20% increase in emissions from airline travel over this period. In 2005, UCSF adopted a Housing Master Plan, and UCSF has a strong TDM program. Nevertheless, more needs to be done towards mobile emissions source reductions. The assumption in the UCSF CAP of a 1.3% per year decrease in emissions from mobile sources may not be an aggressive enough goal to achieve the 2020 target.

Overall, GHG emission patterns for these two campuses diverge significantly. UCSF nearly doubled its emissions between 1990 and 2007, and UCLA reported a less than 0.1% increase for the same period. UCLA total gross Scope 1, 2, and 3 emissions are almost double that of UCSF, but less than UCSF on a

per FTE basis and per 1,000 GSF basis. These numbers are also skewed by the fact that UCLA uses a kilowatt-hour to $MTCO_2e$ conversion factor for electricity that is almost twice that used by UCSF.

Thus, the comparison between UCSF and UCLA suggests that the services delivered by these institutions, the nature of energy use on each campus, and the commute patterns of the students, staff and faculty result in a very different challenge with respect to meeting emissions reduction targets.

Evaluation of the UCSF CAP

The goal of the CAP is to lay out a roadmap for emissions reduction strategies that will allow the University to identify and follow a plan for meeting emission reduction targets. The current UCSF CAP falls short of this goal, as it does not specify the comprehensive set of measures that, if implemented, will meet the GHG emission limits targeted in 2014 and 2020.

The current UCSF CAP published in xx is a significant improvement over the Draft Plan published in August of 2009. The CAP accounting methodologies appear to align with the protocols used for the CCAR and ACUPCC reporting. Approximately 70% of the 1990 and 2000 baseline quantities are based on actual records from those periods. The remaining 30% are extrapolated from 2008 emissions quantities, and are estimates based on the application of algorithms that scale current data to facility size and population in the respective baseline year. CCAR reporting protocols require third-party verification of the 2008 emissions inventory. UCSF has yet to file a verified emissions inventory with CCAR. Lack of third-party verification of 2008 GHG emissions data developed for CCAR reporting means that the 1990 and 2000 baselines are open to question, and may require re-evaluation once verified 2008 data is available.

The UCSF "business as usual" case is outlined in Section 4.3 (numbered incorrectly as 4.1) on page 48 of the CAP. This appears to be a simple extrapolation of 2008 $MTCO_2e$ emissions on a per-square-foot basis, based on anticipated future square footage additions. There is nothing wrong with this methodology. However, it is not clear in the CAP is this is the methodology used, and should be clarified.

Education and Outreach programs are projected to reduce emissions associated with the square footage occupied by the staff receiving the education in any given year by 5%. This reduction is based on the results of previous pilot program efforts. The CAP gives no specific examples of these programs, nor does it outline potential program improvements or enhancements that should be considered. The CAP does establish a clear goal of delivering the educational program to staff occupying at least 8.3% of the University total GSF each year until 2020, but does not outline specific ways to achieve this goal (e.g. identifying groups of buildings or departments that would accomplish this distribution over time). In addition, it is not clear if the educational program will provide one time reductions, or if the savings will be compounded each year.

The UCSF Strategic Energy Plan (SEP) has identified energy use reductions that translate into emission reductions of 2,700 MTCO2e per year between 2009 and 2011. This is based on current projected Tier 1 project energy savings, which are anticipated to occur over this three year period. The CAP assumes that this same annual reduction can be accomplished every year until 2020. It is not at all clear on what basis

this assumption is being made. The SEP outlines Tier 1 projects for the 2012 to 2014 program cycle, as well as Tier 2 (un-funded) projects for the 2009 to 2011 program cycle; if all these projects were performed between 2012 and 2014, the combined savings would result in 86% of the emissions reductions needed to meet the 2014 target. There is no indication of this in the CAP, nor where or how the additional savings are to be obtained.

As stated previously, Transportation Improvements are anticipated to contribute annual emission reductions of 1.3% of the 2008 total transportation emissions (or 492 $MTCO_2e$ per year) until 2020, this assumption may not be aggressive enough to help achieve the 2020 target.

The assumed reductions above account for about 50% of the total reductions needed to meet the 2014 emission reduction target. The CAP goes on to identify "Future Reduction Measures" in Section 5. Upon review, many of the future reduction opportunities are already accounted for in the specific reductions assumed above. The only new sources of reduction appear to be:

- Retrofit of fume hoods from constant volume exhaust operation to variable volume exhaust. However, some of the savings from this strategy are already included in the SEP Tier 1 projects for the 2012 – 2014 program cycle (see SEP Project ID #B1026).
- Water conservation efforts
- Additional PC Power Management projects
- Voluntary airline travel carbon offset purchases

A rough estimate of the savings from these "future reduction" strategies suggests that the following measures would need to be implemented by 2014 in order to meet the target:

- Retrofit of 33% of the 750 existing fume hoods on campus for variable air volume operation. This strategy would make up over 50% of the shortfall in meeting the 2014 target.
- Annual reductions in water consumption of 2 million gallons. The CAP indicates that the Mission Bay campus has already instituted an "aggressive" plan that will save 2 million gallons per year. A similar plan would have to be created and implemented every year for the next 5 years for a total of 10 million gallons. This strategy would make up less than 1% of the shortfall in meeting the 2014 target.
- Annual reductions in PC power use of 4,000 kWh through expansion of the pilot PC Power Management program. The pilot program saved 4,000 kWh per year, and had a roughly 3 year payback. The same number of computers retrofitted in the pilot program would have to be retrofitted every year for the next 5 years. This strategy would make up less than 1% of the shortfall in meeting the 2014 target.

- Assuming a voluntary participation rate of 20%, and assuming that the participants buy 100% offsets, airline travel carbon offset purchases could reduce emissions by over 2,800 MTCO2e by 2014. This strategy would make up over 16% of the shortfall in meeting the 2014 target.

All of the strategies above combine to make up approximately 73% of the shortfall in meeting the 2014 target. Either the strategies above require more aggressive goals, or additional strategies will be needed to meet the 2104 target. These strategies are not offered as recommendations, but are presented as simply an effort to understand the magnitude of the strategies that need to be added to the CAP in order to meet the desired reduction targets.

An alternate path to meeting 2014 targets can be found in the UCSF SEP. The SEP contains a large list of potential projects – including expansion of PV installations up to 2.3 MW of capacity - which could be drawn upon to meet the 2014 target. The SEP indicates that implementation of the entire list of projects identified in Table 11.1, as well as installation of the full 2.3 MW of PV capacity, will reduce GHG emissions by 45,726 MT CO_2e.

Using the CAP year 2000 GHG emissions baseline and projected Business as Usual emissions in 2104, the entire list of SEP projects (including full potential PV use) would result in GHG emissions 4.5% below the year 2000 baseline. Thus, if the CAP incorporated implementation of the entire list of SEP projects (including full potential PV use) the campus would meet its 2014 target. The additional expected savings from Education and Outreach and transportation measures would put UCSF at 12% below 2000 levels in 2014, moving the campus along the path of meeting the more challenging 2020 goal.

It should be noted that the CAP year 2000 Scope 2 GHG emissions baseline (94,419 $MTCO_2e$) and the SEP year 2000 emissions baseline (54,863 $MTCO_2e$) are significantly different. The discrepancies between the SEP and CAP should be resolved.

Finally, the CAP gives a brief discussion of the role of carbon offsets and the ultimate goal of climate neutrality. If the CAP statement in Section 6 is correct ("…the goal of reducing GHG emissions to 1990 levels by 2020 will likely not be met without the use of carbon offsets, based on current projections."), this issue warrants more detailed discussion.

A resolution of the questions regarding the strategies to be used to meet the 2014 goal is a critical element of a complete UCSF CAP. The need to develop a meaningful roadmap for meeting emissions reduction goals should not be confused with the process of committing to specific actions to be taken in order to reach the goals. Simply knowing the destination is not sufficient information for taking the trip, nor is a detailed itinerary a rigid prescription for how the journey is to be made.

<u>Relationship between the SEP and CAP</u>

The energy savings strategies and related emissions reductions contained in the SEP are a critical component of the CAP. Thus, the specific projects, timelines, and energy savings estimates are critical for developing a functional CAP. Initial efforts should be made now to project what measures will be required

to meet the 2020 goals, as the gap between identified reductions and targets is over 80,000 $MTCO_2e$ (compared to an approximately 19,000 $MTCO_2e$ reduction gap needed that needs to be bridged to meet the 2014 goal).

As discussed above, the SEP may need to be better aligned with the CAP, as the emissions targets may require more aggressive pursuit of SEP projects.

For a comparison, the UCLA CAP was evaluated for alignment between that campus's CAP and SEP. The UCLA CAP has incorporated the SEP project timelines and emission reductions, directly showing the correlation between the project completion and the associated reductions. This provides a detailed plan for stationary emission reductions. The UCSF CAP could be improved by taking a similar approach, and outlining the specific projects and timelines needed to meet emissions reduction goals.

Reporting Tools and Emissions Factors

The UCSF CAP and SEP currently appear to use different conversion factors for converting energy use to $MTCO_2e$ emissions. The SEP, in accordance with the California Climate Action Registry (CCAR) General Reporting Protocol, uses EPA's eGRID emissions factor for the CALI – WECC California subregion for 2005 of 0.000366 $MTCO_2e$/kWh for calculating greenhouse gas emissions from purchased electricity. The SEP also uses the emissions factor provided in the CCAR General Reporting Protocol, to calculate the greenhouse gas emissions associated with natural gas purchases. This number is 0.005295 $MTCO_2e$ per therm.

The UCSF CAP is not explicit about the emissions conversion factors used. However, Section 3.3.2 discusses PG&E's energy mix, and a factor of 636 lbs CO2 per MWh is quoted. This translates to approximately 0.000289 MTCO2e per kWh. If this factor was used for conversion of electricity usage, this would result in a 25% greater savings estimate in the SEP versus the CAP for the same kWh savings.

The SEP states that "While the goal of achieving a reduction of greenhouse gas emissions to 1990 levels by 2020 has been set, the lack of data on energy consumption and emission factors in 1990 has made it infeasible to determine an accurate baseline." This fact does not appear to have been noted in development of the 1990 baseline contained in the CAP. More specifically, the CCAR General Reporting Protocol allows for the use of higher emissions factors for historical emissions calculations than for current emissions. Thus, there is the potential for underestimating the 1990 emissions if the 2008 emissions are only adjusted for changes in "facility size and population" as described in the CAP.

The ACUPCC GHG Inventory Brief says the following about the available tracking tools: "The most commonly used are: the Clean Air Cool Planet Campus Carbon Calculator, the Climate Action Registry Reporting Online Tool (CARROT), and the World Resources Institute (WRI) / World Business Council for Sustainable Development (WBCSD) Greenhouse Gas Protocol. Each has its own merits, and signatories are free to choose the tools that work best for their context. The ACUPCC reporting framework will be compatible with multiple calculators, so signatories that are participating in other GHG initiatives will not

have to calculate their emissions multiple times. The ACUPCC recommends using the Clean Air Cool Planet Carbon Calculator."

The default conversion factors contained in the Clean Air Cool Planet calculator – the tool promoted by the ACUPCC and AASHE – appear to be based on national averages. However, most reporting tools allow users to customize their emissions conversion factors. Thus, UCSF may choose to develop utility and year specific emissions factors when filing their greenhouse gas emissions with most of the agencies to which it reports GHG inventories. While we know that UCSF used the Clean Air Cool Planet calculator for their 2007 GHG emission inventory reported to the ACUPCC, we do not know what specific conversion factors were used by UCSF in the calculations.

CARB requires the use of conversion factors for each individual GHG, rather than one factor for arriving at CO_2e. Since CARB only requires reporting of the cogeneration system emissions, this conversion can be accomplished based on the single fuel input – natural gas – and the characteristics of the combustion equipment used.

The methodologies outlined in the CAP are consistent with the relevant reporting agency protocols, even if the CAP calculations do not take advantage of the opportunity to customize their emissions conversion factors.

The UCSF CAP tracks Scope 1, Scope 2, and some Scope 3 emissions which is consistent with the ACUPCC/AASHE protocol. The CAP identifies air travel as the most significant component of the inventory that is poorly tracked. Steps were taken in 2009 to implement a central tracking process for UCSF reimbursed airline travel. In addition, the CAP mentions the need for "improved internal organization and streamlining of record keeping" in order to position UCSF to do a better job of documenting "areas that need improvement in GHG reduction efforts and areas that need further refinement and new solutions." Obtaining more lessons learned from the people who assembled the current CAP would be useful for ensuring that the appropriate tracking mechanisms are put in place immediately, as the ACUPCC will require bi-annual reporting (although annual reporting is encouraged).

Coordination of the CAP and Sustainability Plan

The UCSF CAP makes regular reference to the sustainability efforts reported by the SSC Work groups in their Annual Report to the CACS. However, there is more detail that can be transferred between the Annual Report and the CAP with respect to specific actions that can be taken or policies implemented by UCSF to impact GHG emissions. For instance the Annual Report discusses specific transportation demand management initiatives such as an on-line ride matching system and on-line shuttle trip planner. These are among the specific strategies needed to meet the 1.3% reduction from the 2008 baseline for transportation related emissions that are assumed in the CAP. These should be spelled out more clearly in the CAP, so that the connection between the reductions assumed in the CAP and specific actions that need to be taken by the various UCSF stakeholders and departments can be clearly identified.

Carbon as a Metric

CO_2e is a convenient shorthand for tracking GHG emissions. With respect to prioritizing investments needed to meet the CAP goals, simple payback and life cycle costs analyses are not adequate. The SEPs from UCLA and UCSF use Simple Payback as the primary economic metric. The UCLA CAP uses $/MTCO_2e$ avoided, which provides an excellent metric for prioritizing investments with respect to GHG emission reduction goals. UCSF could find it useful to evaluate SEP projects using both financial metrics.

Sustainable practices extend beyond the climate impacts of UCSF campus operations. Other metrics such as "Carbon footprint" and "Eco footprint" have been used by various institutions to begin to define sustainable performance of an organization more broadly. Carbon is an inadequate metric to reflect the unique environmental and natural resource impacts of the health care sector, such as

- High energy use, estimated at more than twice the energy intensity of commercial office buildings (the healthcare industry has the second highest energy use intensity of any building type in the U.S.)
- High water use (about 70% of hospital's total water use is for process water uses)
- Distinct operations resulting in a unique toxic profile compared to other building types
- Significant volumes of waste generation

When these impacts are measured and tracked consistently, they can be managed well, resulting in more efficient, cost effective healthcare facilities with less impact on the environment.

Clearly, as viewed by an institution whose primary goal is "*advancing health worldwide*", a sustainability metric tied to the unique environmental and natural resource impacts of the health care sector is highly desirable. Thus, UCSF should look beyond emissions measured in CO_2e to establish its overall performance with respect to sustainability. In this way, UCSF's core mission to promote human health and well-being can be expressed through environmental stewardship.

The fact that the SSC has a "Health Care" and "Sustainable Operations" work group should be leveraged to help all the Work Groups align their efforts with the unique requirements to meet the challenge of truly sustainable practices in an institution dedicated exclusively to the health sciences.