UNIVERSITY OF CALIFORNIA, MERCED

CLIMATE ACTION PLAN

MARCH 2009

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CHANCELLOR'S MESSAGE

Dear Friends,

Climate warming is one of the most serious global challenges we face. Greenhouse gas (GHG) emissions from human activities have already led to increased temperatures and earlier springs in California. Continued emission of heat-trapping GHGs threatens even more dramatic climate change in our state, including increased wildfire frequency, adverse impacts on water availability and negative consequences for species and ecosystems we hope to preserve for future generations. Continued emissions and warmer temperatures also degrade air quality in the San Joaquin Valley. Immediate action is required because GHGs remain in the atmosphere for decades.

Universities have a unique responsibility to discover, demonstrate, and share solutions to challenges such as climate warming. UC Merced embraces this responsibility as the first new research university of the 21st Century and as part of the world's foremost public university system. Our campus will serve as a leader in finding and implementing global warming solutions in the San Joaquin Valley through our research, teaching and public service.

An important step in this effort is UC Merced's Climate Action Plan. Our plan maps out an ambitious vision for our campus—emphasizing energy efficiency, renewable energy generation and climate offsets—to become climate neutral by 2020.

Beyond achieving our local campus goals, it is my hope this climate action plan will initiate a dialog on regional solutions to global warming and accelerate the reduction of GHG emissions in the San Joaquin Valley from Stockton to Bakersfield.

Achieving campus climate neutrality in just eleven years will be demanding. Even though we face significant challenges, I must tell you UC Merced's students, faculty and staff are committed to achieving our action plan goals. Indeed, given their commitment, I am unwavering in my confidence that UC Merced will meet this challenge.

Steve Kang

STEVE KANG
Chancellor

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CLIMATE ACTION PLAN, UNIVERSITY OF CALIFORNIA, MERCED

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Portions of this document were reviewed and commented upon by those listed below.

This plan will become a living document that reflects input from the entire UC Merced community. This plan will be updated and made available to the public on an annual basis. Participation and feedback into this ongoing process is invited.

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EXECUTIVE SUMMARY

This climate action plan, provided by the University of California, Merced (UC Merced):

- Builds on a founding commitment to environmental stewardship and articulates a vision of climate sustainability for the campus.
- Presents a climate baseline for the UC Merced campus.
- Provides a summary of goals, progress to date, and planned activities related to saving energy, generating renewable power, and offsetting greenhouse gas emissions.
- Provides a focused presentation of climate-related planning and clarifies policy commitments included in UC Merced's Long Range Development Plan (LRDP) and being planned by individual "sustainability stakeholders" working through the Chancellor's Advisory Committee on Sustainability.
- Satisfies requirements of the Climate Protection Practices section of the University of California (UC) Policy on Sustainable Practices and the American College and University Presidents' Climate Commitment (ACUPCC).
- Begins a dialog with respect to climate planning on the UC Merced campus. This plan will be updated and made available to the public on an annual basis. Participation and feedback into this ongoing process is invited.

The primary commitments driving this plan include goals for:

- A zero net energy campus by 2020, to include campus energy use and exclude off-campus use, commuting, and air travel
- A climate neutral University by 2020, to include campus and off-campus greenhouse gas emissions and exclude commuting and air travel

UC Merced is pursuing these goals with a heavy emphasis on energy efficiency in new building design, implemented through benchmark-based building energy performance targets. Thus, UC Merced's basic approach to mitigating climate effects is to:

1. Save as much energy as is economically feasible
2. Generate from renewable sources as much energy as is consumed annually (zero net energy)
3. Offset remaining greenhouse gas emissions, prioritizing on-site and regional offsets (climate neutrality)

While many of the initiatives included in this plan will save money, the plan does require resources that have not yet been fully identified or sourced. By defining theses goals, UC Merced is taking the first step towards motivating these additional funding sources.

1. INTRODUCTION

This climate action plan, provided by the University of California, Merced (UC Merced), builds on a founding commitment to environmental stewardship and articulates a vision of climate sustainability for the campus. The plan provides an opportunity to present a focused view of climate-related planning and to clarify climate-related commitments included in UC Merced's Long Range Development Plan (LRDP) or being planned by individual "sustainability stakeholders" working through the Chancellor's Advisory Committee on Sustainability[1] This plan also satisfies requirements of the Climate Protection Practices[2] section of the University of California (UC) Policy on Sustainable Practices and the American College and University Presidents' Climate Commitment (ACUPCC). Finally, this plan begins a dialog with respect to climate-related planning on campus. The challenges related to climate change are significant and can only be addressed through continued communication, effort, and action. This plan is an important step towards facilitating that process.

In this plan UC Merced provides:

- Definitions to help clarify further work on climate goals
- A UC Merced climate baseline that is consistent with its reporting to the California Climate Action Registry (CCAR) and the ACUPCC
- A basic approach to meeting the requirements of the policy, which emphasizes saving energy first, generating renewable power second, and offsetting GHG emissions third
- A summary of goals, progress to date, and planned activities related to saving energy, generating renewable power, and offsetting greenhouse gas emissions

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1 The 2009 Draft Long Range Development Plan (LRDP) is currently available in draft form for review and public comment at http://lrdp.ucmerced.edu/2.asp?uc=1&lvl2=40&contentid=40, and is scheduled to be finalized in spring 2009. The Draft UC Merced Sustainability Strategy (Sustainability Strategy), currently available as a working draft to the Chancellor's Advisory Committee on Sustainability, is scheduled for public release in spring 2009. Wherever possible, draft text has been referenced from these documents in order to avoid duplication.

2 The UC Policy on Sustainable Practices is available at http://www.ucop.edu/facil/sustain/documents/policy_sustain_prac.pdf. Generally, this policy requires each UC campus to:

- Join the California Climate Action Registry (CCAR) and report greenhouse gas (GHG) emissions
- Develop an action plan for becoming climate neutral as soon as possible while maintaining the University's overall mission
- By 2014, to reduce GHG emissions to 2000 levels; and by 2020, to reduce GHG emissions to 1990 levels

2. DEFINITIONS

1. **GHG Emissions:** Emissions of the six greenhouse gases covered under the Kyoto Protocol: carbon dioxide (CO2), methane (CH4), nitrous oxide (N20), hydroflurocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF6), expressed as metric tons of CO2 equivalents (Co2e) according to the California Climate Action Registry reporting protocol available at http://www.climateregistry.org/tools/protocols/general-reporting-protocol.html.
2. **Campus:** The main UC Merced campus.
3. **Campus-Related:** Associated with UC Merced but not reflected in campus or off-campus values. As required by UC policy, UC Merced reports campus-related greenhouse gas emissions for commuting (travel to and from campus on a day to day basis by students, the faculty, and staff) and air travel paid for by or through the University as part of its pledge to American College and University Presidents' Climate Commitment (ACUPCC).
4. **Climate Neutral:** According to the UC Policy on Sustainable Practices, climate neutrality means a net zero impact on the earth's climate, achieved by minimizing greenhouse gas emissions as much as possible and using carbon offsets or other measures to mitigate the remaining GHG emissions.
5. **Energy:** Electricity (MWh), natural gas (therms), propane (gallons), gasoline (gallons), or diesel (gallons) consumed. Energy consumption across different units may be expressed collectively in units of one million BTU (MBTU).
6. **Off-Campus:** Facilities owned or operated by UC Merced that are not located on the main campus. This includes leased facilities.
7. **MGSF:** Building maintained gross square feet, synonymous with the Revised California Method (RevOGSF50) method for calculating Outside Gross Square Feet, defined as

   MGSF = BG + CU - NP
   BG = Basic Gross Area
   CU = Covered Unenclosed Area
   NP = Nonassignable Area (i.e., parking, etc.)

   UC Merced uses MGSF when available for climate planning purposes.
8. **Site Energy:** The amount of energy consumed at a site as reflected in utility bills.
9. **Source Energy:** The amount of raw fuel required at a site, including all transmission, distribution, and production losses. Source energy is useful when analyzing alternative approaches to using energy and reducing energy consumption. Source energy is calculated using site energy national average Source-Site Ratios reported in Energy Star Performance Ratings Methodology for Incorporating Source Energy Use dated December 2007 and available at http://www.energystar.gov/ia/business/evaluate_performance/site_source.pdf.
10. **Zero Net Energy:** Generate from renewable sources as much energy as is consumed annually.

3. UC MERCED CLIMATE BASELINE

For the purposes of this plan, UC Merced is defining a climate baseline that reflects current energy usage and GHG emissions, as well as projected building-related campus energy consumption.[3] In order to leverage climate reporting already performed by UC Merced, current usage and emissions are defined using the calendar year 2007 (CY07). UC Merced has reported two years of GHG emissions to the CCAR (CY 06 and CY07) and one year of GHG emissions to support the ACUPCC (CY 07). For UC Merced, 2007 provides a reasonable baseline reference, as this is the first full year in which the main campus was in operation. The specific, current values reported as the baseline include:

- Campus and off-campus energy consumption for CY07
- Campus, off-campus, and campus-related GHG Emissions for CY07

Projected building-related campus energy consumption reflects energy consumption associated with the planned build-out of the campus from its current footprint of 104 acres to an eventual footprint of 815 acres, as expressed in the LRDP and the UC Merced/University Community Environmental Impact Statement/Environmental Impact Report (EIS/EIR).[4] This projection assumes compliance with current Building Energy Performance Targets (see Section 5B).

Energy consumption and emission intensities are also presented per square foot and per student. UC Merced will continue to calculate these consumption and emission intensities for planning purposes. The specific values used to calculate intensities include:

- Average of the total student population for the 2006-2007 and 2007-2008 academic years
- MGSF of buildings, calculated based on a proration of building MGSF occupied through CY 07.

For the climate baseline:

- Table 1 provides details for all campus and off-campus buildings.
- Table 2 provides campus, off-campus, and campus-related energy consumption and emissions for CY07.
- Table 3 provides projection of student population and built square footage over the campus build-out based on the campus EIR/EIS.
- Table 4 provides projected building-related campus energy consumption for build-out of the campus.

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3 Note that this plan explicitly addresses climate impacts from operations and activities only, not those associated with embedded energy – the total energy used to manufacture and supply a product, material, or service at its point of use. Embedded GHG emissions are being reduced through UC Merced's commitment to UC Green Building Council certification (through Materials & Resources credits). The LRDP has moved the campus goal for certification from LEED Silver to LEED Gold for all permanent buildings.

4 The EIS/EIR is available at http://lrdp.ucmerced.edu/2.asp?uc=1&lvl2=35&contentid=41.

Note the following:

- Less than 10% of the eventual 815-acre campus has been built as of CY07.
- For CY07, buildings account for 96% of all energy usage.
- For CY07, there is 848,000 MGSF of built space on campus, and 227,000 MGSF off campus (79% Campus / 21% Off Campus).
- The campus is achieving its current building performance targets (annual electricity use, peak electricity demand, and annual natural gas use - see Section 5B).
- For CY07, Building Site Energy Use Intensity is 0.11 MBTU/yr/MGSF on campus and 0.09 MBTU/yr/MGSF off campus. Building Source Energy Use Intensity is 0.23 MBTU/yr/MGSF on campus and 0.21 MBTU/yr/MGSF off campus.
- For CY07, total GHG Emissions are 7,222 metric tons CO2e on campus, 1,740 metric tons CO2e off campus, and 6,711 metric tons CO2e campus-related (47% campus / 11% off campus / 42% campus-related).
- The UC Merced campus does not have 1990 and 2000 emissions levels as referenced by the UC climate policy. In the spirit of the policy requirement, UC Merced's building energy performance targets imply a consistent reduction in energy use and emissions intensity over the build-out of campus.
- The campus climate baseline includes a projection of building energy use. Other projections of significant non-building energy uses, such as transportation, are not yet prepared.

4. APPROACH

UC Merced's basic approach to mitigating its climate effects is to:

1. Save as much energy as is economically feasible
2. Generate from renewable sources as much energy as is consumed annually (zero net energy)
3. Offset remaining greenhouse gas emissions, prioritizing on-site and regional offsets (climate neutrality)

This approach recognizes that energy efficiency can often be the most cost-effective approach to reducing GHG emissions. For UC Merced, energy efficiency commitments are a key part of making the zero net energy and climate neutrality goals feasible.

5. SAVING ENERGY

As background, energy use at UC Merced is currently dominated by buildings. Building performance is driven by the design of the campus energy infrastructure and building design. Once a building is constructed and commissioned, its performance is influenced by occupant behavior, building maintenance, and building retrofits. Transportation, which will become an increasingly significant portion of campus energy use over time, is driven primarily by the efficiency of fleet purchases and policies that influence parking and commuting.

UC Merced's current activities and commitments in each of these areas (campus energy infrastructure, new building design, occupant behavior, building maintenance, building retrofits, and transportation) are presented below.

A. CAMPUS ENERGY INFRASTRUCTURE

UC Merced has developed an energy infrastructure for campus that includes central cooling for all buildings, thermal energy storage for campus cooling, and central heating for primary academic buildings. This centralized infrastructure and thermal energy storage saves energy, reduces peak period demands, and saves money by:

- Increasing the opportunities to realize savings from system optimization. It is typically easier to produce savings by optimizing a single system, rather than by optimizing several distributed systems.
- Increasing the efficiency of cooling. It is more efficient to operate chillers in the middle of the night when temperatures are lower.
- Reducing the cost of cooling. Electricity is cheaper in the middle of the night than during peak period, summer afternoons.

UC Merced generally intends to continue this basic strategy to future campus infrastructure development, subject to more detailed engineering and cost analysis as the campus is designed. As stated in the LRDP, the campus will:

- Minimize grid-connected peak electricity loads by shifting electricity for cooling away from peak electricity demand periods. (Sustainability Policy SUST-6, excerpt)

B. NEW BUILDING DESIGN

UC Merced has committed to energy-efficient design for all new, permanent buildings. As stated in the campus LRDP:

- Buildings will be designed to consume half of the energy and demand of other University buildings in California, surpass Title 24 [California's Energy Efficiency Standard] minimum efficiency standards by 30%, and achieve all 10 LEED credits for optimizing energy efficiency. (Sustainability Policy TZC-1, excerpt)[5]

In practice, this commitment requires creation of an energy model for each new building in the design phase so that the building can be modeled against the performance requirements and the design can be modified if required.

The requirement to consume half of the energy and demand of other University buildings in California is being implemented through a benchmarking process. Benchmarks were developed to characterize energy use and peak demand intensities by MGSF for three different types of space (laboratory/complex, classroom/office, and housing/service). These benchmarks were developed using regression analysis of 1999 campus-level data from six UC campuses and two CSU campuses, normalized to account for different energy strategies (for example, gas cooling, thermal energy storage, or cogeneration) and climate. This benchmarking effort is reported in University of California, Merced Campus, Energy Planning Module 1, Preliminary Load Calculations by HMH Resources, Inc. dated May 2000. The 1999 UC/CSU benchmarks, which characterize baseline energy use and demand for University buildings in California, are presented in Table 5.

The campus target is set at 50% of the 1999 UC/CSU benchmarks. This target is being phased in such that the first 600,000 gross square feet of buildings were designed to consume no more than 80% of the benchmarks, the next 600,000 gross square feet of buildings are being designed to consume no more than 65% of the benchmarks, and all buildings thereafter will be designed to consume no more than 50% of the benchmarks.

To date, these benchmark-based building energy performance targets have driven efficiency in new building design at UC Merced because they account for the entire building performance, not just selected systems as is the case with the other building code-based targets (30% below Title 24 and achieving 10 LEED Credits). This system is working well for the UC Merced campus and in all cases it is performing better than targets. UC Merced uses data collected through the campus-wide building energy management system to calculate actual building performance in relation to the targets on an annual basis. UC Merced is working towards operationalizing the performance benchmarking process on a real-time basis.

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5 The LRDP energy efficiency goal is complemented by a goal to achieve LEED Gold certification for all new permanent facilities (Sustainability Policy SUST-2).

Over time, the benchmark-based building performance targets will require updating to maintain their relevance and to keep pace with improvements in Title 24. As well, updated targets will be necessary in order to maximize cost-effective investment in energy efficiency given other commitments to zero net energy and carbon neutrality (Section 6 and 7). This cost effectiveness threshold will, at a minimum, be a function of the first cost of the efficiency measure, the purchased utility savings over the lifetime of the measure, the cost of procuring energy over the planning horizon, and the cost of mitigating greenhouse gas emissions over the planning horizon. The campus will need to better define a threshold of economic feasibility for energy efficiency investments in order to capture available savings.

In fact, Title 24 will be updated to align with the California Long-Term Energy Efficiency Strategic Plan, which was adopted in September 2008 by the California Public Utilities Commission (CPUC) with support from the Governor's Office, the California Energy Commission, the California Air Resources Board, the state's utilities and others.[6] This plan calls for "Big, Bold Energy Efficiency Strategies," including that all new commercial construction will be zero net energy by 2030.

In order to capture cost-effective energy savings, UC Merced, as part of its Sustainability Strategy, has committed to:

- Establish an agreement to strengthen building energy performance targets over time by the end of Q4 2009.

While the work to define the improvement in the target will take place in 2009, two concepts for improving the targets are provided here:

- The campus could simply choose a target, such as building performance at 25% of benchmarks, and phase that target in gradually over time. To provide an order-of-magnitude for this measure to save energy, Table 6 shows the energy and demand savings associated with tightening the building performance targets from 50% of the benchmark down to 25% of the benchmark by 2020.
- The campus could raise external funds for a "Strive to 25 Fund" that would help the campus move from a 50% of benchmark performance level down to a 25% of benchmark level. The fund would initially pay for an analysis of each building design that would use the modeling work already required at UC Merced to document the energy performance of each new building design against targets. The analysis would identify design changes required to meet the 25% of benchmark target. It could also provide a high-level assessment of cost effectiveness. As the fund grew, it could fund implementation of efficiency measures. This approach would provide a technical roadmap for "getting to 25" before significant funding is available for implementation.

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6 The California Long-Term Energy Efficiency Strategic Plan is available at http://www.californiaenergyefficiency.com.

C. OCCUPANT BEHAVIOR

Building occupants can significantly affect the energy use intensity of a building, independent of the building design. As part of its Sustainability Strategy currently in draft, UC Merced plans to:

- Establish an Efficient Laboratory Freezer Rebate Program by the end of Q3 2009.
- Establish a student-driven lab hood monitoring and vacation (LHM&V) program by the end of Q3 2009.
- Establish a Building Energy Lobby Label (BELL) program by the end of Q4 2009.

These programs will help sensitize building occupants to energy consumption and address significant future loads on the UC Merced campus - laboratory freezers and hood management in the Science and Engineering building.

D. BUILDING MAINTENANCE

Building maintenance can also significantly affect building performance. To date, UC Merced Facilities Management activities have emphasized routine work order requests, emergency response, and preventative maintenance. Facilities Management also uses extensive monitoring data from its campus-wide building energy management system (part of UC Merced's "Living Laboratory") to troubleshoot systems and verify energy performance. Facilities Management is working to establish means to more explicitly direct building maintenance in a way that will maximize reductions in energy consumption. This work will be integrated with efforts to operationalize the building performance benchmarking system as discussed above in Section 5B. UC Merced is currently collecting extensive data that, given higher staffing levels, could be analyzed and acted upon to save energy.

UC Merced is working to quantify the portion of building performance attributable to maintenance and therefore, to gain the ability to substantiate a return on investment for energy management and building maintenance staff. As part of its Sustainability Strategy, UC Merced has committed to:

- Seek a partner and funding for analysis of maintenance-related building performance, in order to develop a purchased utilities return on investment for building maintenance staff by the end of Q4 2009.

E. BUILDING RETROFITS

UC Merced is pursuing a limited number of building energy efficiency retrofits within its relatively new on-campus building stock and in off-campus buildings. A list of projects has been provided to the UC Office of the President with a total savings of approximately 700,000 kWh/year and 100,000 therms/year. UC Merced will continue to identify and implement cost-effective building efficiency retrofits as staffing allows.

F. TRANSPORTATION

Transportation-related energy use includes fuel consumption by fleet vehicles and a contracted campus and regional transit service, known as CatTracks. Transportation energy use and emissions are reported in the total values of the climate baseline (Table 2), where the total value includes energy or emissions associated with buildings, transportation, and grounds keeping equipment. The transportation values reflect 31 fleet vehicles (of which one is diesel and the rest are gasoline powered), four CatTracks gasoline minibuses or vans, and two CatTracks compressed natural gas (CNG) buses. In early 2008, the campus acquired two additional natural gas fleet vehicles.

In the Sustainability Strategy, UC Merced Transportation, Parking and Fleet Services has set a goal to reduce its carbon footprint. Specifically, the department seeks to:

- Define sustainable best practices and metrics for UC Merced Transportation, Parking and Fleet Services.
- Increase participation in alternative transportation programs.
- Standardize fleet acquisition options optimizing sustainability by Q4 2009.

Energy use and emissions associated with commuting miles is driven to a significant extent by the quantity and location of University housing. According to the LRDP, UC Merced has committed to:

- Ensure a supply of housing adequate to offer housing to 50% of FTE student population and allocate a range of housing types to accommodate both undergraduate students and graduate students. (Communities/Land Use Policies COM-5)

6. GENERATING RENEWABLE ENERGY

The campus LRDP has set the following goal, which it currently plans to apply to campus energy only (not off-campus or campus-related):

- Zero Net Energy: Achieve zero net energy by 2020 through aggressive conservation efforts and development of renewable power. (Sustainability Policy TZC-1, excerpt)

Note that this goal puts UC Merced on the forefront of a statewide effort expressed in the CPUC's "Big, Bold Energy Efficiency Strategy" that all new commercial construction will be zero net energy by 2030. Also note this goal is supported by the Merced Energy Research Institute, a cross-disciplinary research institute emphasizing research in energy efficiency and renewable energy.

The first step in implementing this goal has been the development of a 1 MW solar photovoltaic project on campus. A Request for Proposals was released for the solar project in May of 2008 and a power purchase agreement (PPA) was executed in December 2008. Under a PPA, a third party designs, installs, owns and operates the system and the University purchases the delivered electricity. For this project, UC Merced will retain all Renewable Energy Credits for the project. This project is expected to generate and produce approximately 2,400 MWh annually (approximately 60% of the campus peak load and 20% of its annual electricity in the baseline CY07 year). The system will provide power at a cost well below that provided by the utility.

UC Merced plans to start work on a zero net energy feasibility study in the first quarter of 2009, which will identify an array of technology options for attaining zero net energy by 2020 and develop cost information.

One significant barrier to attaining zero net energy is that the current net metering legislation precludes UC Merced from selling generation in excess of 1 MW. The campus investigated increasing the size of the solar system currently under contract, and found that a system large enough to achieve zero net energy produced more than 1 MW of excess power at times. Since this electricity would be purchased under a PPA but not used or sold, such a system was not economically viable. Accordingly, UC Merced will investigate opportunities in the coming years to change the net metering legislation and to develop a mix of technologies that have a flatter generation profile.

7. OFFSETTING GREENHOUSE GAS EMISSIONS

After efforts to save energy and develop renewable generation renewable power, UC Merced intends to offset its remaining greenhouse gas emissions. As stated in the LRDP, UC Merced will:

- Achieve zero net carbon emissions - carbon neutrality - by 2020. Minimize atmospheric carbon generation by campus operations and employ measures to mitigate carbon emissions such as aggressive tree planting.[7] Onsite and regional measures will be prioritized. (Sustainability Policy TZC-3)

UC Merced plans to apply this goal to campus and off-campus emissions only at this time. UC Merced will continue to support the reporting of campus-related emissions as part of the ACUPCC as well as a process to better define protocols for calculating emissions associated with commuting and airline travel.

Greenhouse gas offsets include activities that reduce GHG emissions such as tree planting, manure biogas control systems for livestock operations, or changes in agricultural tillage practices to increase soil carbon storage. As is clear from these examples, some offset projects are appropriate for on-campus implementation, while others may be more appropriate regionally or elsewhere. As stated in the LRDP goal, UC Merced intends to prioritize onsite and regional offsets.

An important component in considering climate offsets is project "additionality" - whether a project causes a reduction in GHG emissions that otherwise would not have happened. Another important factor is "permanence" - whether avoided or sequestered greenhouse gases remain out of the atmosphere. Markets for climate offsets, as well as the protocols required to calculate emissions reductions, are in the early stage of development. As these institutions develop, better guidance will be available to develop effective climate offset projects.

UC Merced sees development of climate offsets as an excellent teaching opportunity that could be pursued through its Service Learning Program, a program that brings undergraduate students together as multiyear, multidisciplinary teams to solve engineering and technology-based problems for the San Joaquin Valley's leading non-profit organizations. Regional offset projects can be implemented to advance social and economic sustainability of the San Joaquin Valley while UC Merced achieves its environmental climate neutrality goal.

As part of its Sustainability Strategy, UC Merced seeks to:

- Kick-off a Service Learning Class to investigate carbon offset opportunities by end of Q3 2009.

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7 As a back of the envelope calculation, we can assume that the baseline campus GHG emission at full build-out will be 10 times the current level (90,000 metric tons CO2e), that efficiency and renewable generation efforts will reduce emissions to 20% of this total (18,000 metric tons CO2e). The campus landscaping plan includes, conservatively, the planting of 50,000 trees. According to the Climate Action Reserve protocol for Urban Forestry, sequestration for urban tree planting can range from 16 kg/year for small, slow-growing trees to 270 kg/year for larger trees growing at their maximum rate (see http://www.climateregistry.org/resources/docs/protocols/progress/urban-forest/appendices_compiled_final.pdf). Assuming 100 kg/year, 50,000 trees could account for 5,000 metric tons of sequestration, or about 30% of the assumed emissions after accounting for reductions from efficiency and renewable generation efforts (18,000 metric tons CO2e). Questions of additionality, permanence, and the magnitude of GHG emissions caused by tree planting (such as those due to increased water pumping) have not yet been investigated.

8. CONCLUSION

This climate action plan provides a first step towards clarifying UC Merced's commitments and plans to mitigate climate effects. This plan will be updated and made available to the public on an annual basis. Three areas are anticipated to be of critical importance as climate protection activities proceed.

A. EDUCATION AND OUTREACH

Education and outreach forms a foundation for climate-related activities on campus. Through the Chancellor's Advisory Committee on Sustainability, goals and objectives are being defined related to education and outreach, which include development of sustainability content in the campus core curriculum, facilitation of sustainability-related community partnerships, and communications regarding sustainability. Progress in this area will be included in the Sustainability Strategy and updates to this plan.

B. RESOURCES

While many of the initiatives included in this plan will save money, the plan does require resources that have not yet been fully identified or sourced. By defining theses goals, UC Merced is taking the first step towards motivating these additional funding sources. UC Merced anticipates that the Chancellor's Advisory Committee on Sustainability will take the lead in formalizing resource requirements required to achieve UC Merced climate goals.

C. TRACKING PROGRESS

UC Merced currently intends to communicate progress towards achieving climate goals through updates to the Sustainability Strategy and this climate action plan. This regular communication provides a structure for tracking progress and data to evaluate changes against the campus climate baseline (see Table 2). Over time, UC Merced anticipates developing a formalized list of performance indicators to track progress in achieving goals.

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TABLE 1: BUILDING DETAILS

	Key Official Name	Location	Basic Gross	Outside Gross	Related Gross	Maintained Gross Target	Constructed % of Category	Occupied	CY07 MGSF	Applicable Design Benchmark	Applicable Space for Target
9	Science and Engineering Building	On Campus	n/a	n/a	n/a	236,989	1/1/2006	12/1/2006	236,989	80%	Lab/Complex
10	Kolligian Library Building	On Campus	178,468	218,117	198,292	198,292	1/1/2005	11/1/2005	198,292	80%	Class/Office
11	Classroom and Office Building	On Campus	101,644	104,369	103,006	103,006	12/31/2005	12/31/2005	103,006	80%	Class/Office
12	Central Plant	On Campus	19,596	20,837	20,217	20,217	1/1/2005	6/1/2005	20,217	80%	Lab/Complex
13	Telecomm Building	On Campus	3,940	4,910	4,425	4,425	1/1/2005	6/1/2005	4,425	80%	Lab/Complex
17	Calaveras Hall	On Campus	15,122	15,760	15,441	15,441	1/2/2005	9/2/2005	15,441	80%	Housing/Serv
18	Terrace Center	On Campus	14,793	19,463	17,128	17,128	1/6/2005	9/5/2005	17,128	80%	Housing/Serv
19	Tulare Hall	On Campus	15,122	15,760	15,441	15,441	1/2/2005	9/2/2005	15,441	80%	Housing/Serv
20	Madera Hall	On Campus	15,030	15,668	15,349	15,349	1/2/2005	9/2/2005	15,349	80%	Housing/Serv
21	Stanislaus Hall	On Campus	15,122	15,760	15,441	15,441	1/2/2005	9/2/2005	15,441	80%	Housing/Serv
22	Kern Hall	On Campus	14,939	15,577	15,258	15,258	1/2/2005	9/2/2005	15,258	80%	Housing/Serv
23	Kings Hall	On Campus	14,847	15,485	15,166	15,166	1/2/2005	9/2/2005	15,166	80%	Housing/Serv
24	Fresno Hall	On Campus	7,567	7,822	7,695	7,695	1/2/2005	9/2/2005	7,695	80%	Housing/Serv
25	San Joaquin Hall	On Campus	7,567	7,822	7,695	7,695	1/2/2005	9/2/2005	7,695	80%	Housing/Serv
26	Merced Hall	On Campus	15,122	15,760	15,441	15,441	1/2/2005	9/2/2005	15,441	80%	Housing/Serv
27	Pump House	On Campus	1,417	1,417	1,417	1,417	1/1/2004	8/1/2004	1,417	80%	Lab/Complex
28	Valley Terraces Dining	On Campus	12,836	16,225	14,531	14,531	1/2/2005	9/2/2005	14,531	80%	Lab/Complex
16	Facilities / Police Department Trailer	On Campus	4,260	4,260	4,260	4,260	7/2/2005	9/2/2005	4,260	80%	Class/Office
29	Gallo Recreation and Wellness Center	On Campus	34,017	36,610	35,313	35,313	12/31/2005	12/11/2006	35,313	65%	Class/Office
31	Sierra Terraces - Mariposa	On Campus	41,606	46,591	44,098	44,098		9/1/2008	0	65%	Housing/Serv
32	Sierra Terraces - Tuolumne	On Campus	42,793	47,778	45,285	45,285	9/1/2007		15,136	65%	Housing/Serv
	SUBTOTAL ON CAMPUS	On Campus	575,808	645,991	610,899	847,888			773,641		
	SUBTOTAL CAMPUS Square Footage at 80%								723,192		
	SUBTOTAL CAMPUS Square Footage at 65%								50,449		
1	Castle Building 1200	Off Campus	69,169	81,995	75,582	75,582	1/1/1989	3/1/2002	75,582		
2	Castle Building1201	Off Campus	10,272	10,272	10,272	10,272	1/1/1989	6/1/2004	10,272		
3	TC-1 Tri-College Lease	Off Campus	1,481	1,481	1,481	1,481	1/1/1989	2/1/1999	1,481		
4	TC-2 Tri-College Lease	Off Campus	942	942	942	942	1/1/1999	2/1/1999	942		
5	TC-3 Tri-College Lease	Off Campus	587	587	587	587	1/1/1999	2/1/1999	587		
6	550 East Shaw Avenue	Off Campus	63,653	63,653	63,653	63,653	1/1/1997	1/1/1998	63,653		
7	Bakersfield Center Lease	Off Campus	16,305	16,305	16,305	16,305	1/1/2001	9/1/2001	16,305		
8	Mondo Building Lease	Off Campus	10,074	10,074	10,074	10,074	1/1/1930	5/1/2004	10,074		
14	2001 Grogan Avenue	Off Campus	24,416	24,416	24,416	24,416	1/1/1971	7/1/2005	24,416		
15	Chancellor's Residence	Off Campus	4,600	5,144	4,872	4,872	1/1/1997	9/1/1999	4,872		
30	Castle Academic Trailers #2 (Interdisciplinary Re	Off Campus	2,148	2,148	2,148	2,148	1/1/2008	1/1/2008	0		
33	Castle Academic Trailers #1	Off Campus	2,000	2,000	2,000	2,000	1/1/2008	1/1/2008	0		
34	Promenade	Off Campus	6,575	6,575	6,575	6,575		7/1/2008	0		
37	Wawona - Research Station #4000	Off Campus	1,423	1,423	1,423	1,423	9/30/1934	9/30/2006	1,423		
38	Wawona - Learning Center/ Classroom #4050	Off Campus	868	868	868	868	9/30/1934	9/30/2006	868		
39	Wawona - Vincent House	Off Campus	784	784	784	784	9/30/1960	9/30/2006	784		
40	Wawona - Livingston House	Off Campus	2,600	2,600	2,600	2,600	9/30/1960	9/30/2006	2,600		
41	Wawona - Station Managers Residence	Off Campus	2,331	2,331	2,331	2,331	9/30/1964	9/30/2006	2,331		
	SUBTOTAL	Off Campus	220,228	233,598	226,913	226,913			216,190		
	TOTAL		796,036	879,589	837,812	1,074,801			989,831		

NOTES: (a) Gallo Rec and Wellness does not fit well in either of the three space categories, and is assigned Housing/Service category on an interim basis.
(b) The Facilities/Police Department Trailer is temporary, but is included in the calcuation of a campus-wide target. This target was not necessarily used in design.

TABLE 2: CLIMATE BASELINE (CY07)

	Off-Campus	Campus	Campus-Related	Total
Square footage (MGSF)	773,641	216,190	n/a	989,831
Student Population (FTE)	1,595	n/a	n/a	1,595
Building Electricity Use (MWh/yr)	11,749	3,099	n/a	14,848
Building Electricity Use (kWh/yr/MGSF)	15	14	n/a	15
Building Electricity Use (% of target)	82%	n/a	n/a	n/a
Building Electricity Use (% of benchmark)	65%	n/a	n/a	n/a
Building Electricity Peak Period Demand (MW)	1.6 / 2.8	n/a	n/a	n/a
Building Electricity Peak Period Demand (W/MGSF)	2.1 / 3.8	n/a	n/a	n/a
Building Electricity Peak Period Demand (% of target)	89% / 156%	n/a	n/a	n/a
Building Electricity Peak Period Demand (% of benchmark)	37% / 64%	n/a	n/a	n/a
Building Natural Gas Use (therms/yr)	424,778	93,157	n/a	517,935
Building Natural Gas Use (therms/yr/MGSF)	0.55	n/a	n/a	n/a
Building Natural Gas Use (% of target)	87%	n/a	n/a	n/a
Building Natural Gas Use (% of baseline)	69%	n/a	n/a	n/a
Building Propane Use (gallons/yr)	0	1,848	n/a	1,848
Building Backup Diesel Use (gallons/yr)	1,025	41	n/a	1,066
Transportation Natural Gas Use (therms/yr)	7,322	0	n/a	7,322
Transportation and Grounds Gasoline Use (gallons/yr)	17,931	0	n/a	17,931
Transportation and Grounds Diesel Use (gallons/yr)	2,590	0	n/a	2,590
Building Site Energy Use (MBTU/yr)	82,708	20,062	n/a	102,770
Building Site Energy Intensity (MBTU/yr/MGSF)	0.11	0.09	n/a	0.10
Building Site Energy Intensity (% of target)	84%	n/a	n/a	n/a
Building Site Energy Intensity (% of benchmark)	67%	n/a	n/a	n/a
Total Site Energy Use (MBTU/yr)	86,026	20,062	n/a	106,088
Total Site Energy Intensity (MBTU/yr/student)	54	n/a	n/a	67
Building Source Energy Use (MBTU/yr)	178,512	45,241	n/a	223,753
Building Source Energy Intensity (MBTU/yr/MGSF)	0.23	0.21	n/a	0.10
Total Source Energy Use (MBTU/yr)	181,890	45,241	n/a	227,132
Total Source Energy Intensity (MBTU/yr/student)	114	n/a	n/a	142
Building GHG Emissions (metric tons/yr)	6,947	1,740	n/a	8,688
Building GHG Emissions (metric tons/yr/1000 MGSF)	9.0	8.1	n/a	8.8
Total GHG Emissions (metric tons/yr)	7,222	1,740	6,711	15,673
Total GHG Emissions Distribution (%)	46%	11%	43%	100%
Total GHG Emission Intensity (metric tons/yr/student)	4.5	n/a	n/a	9.8

1) 1 MWh = 3.412 MBTU, 1 therm = 0.1 MBTU, 1 gallon propane = 0.0910 MBTU, 1 gallon gasoline = 0.1242 MBTU, 1 gallon diesel = 0.1387 MBTU

2) Source-Site Ratios: for Electricity = 3.340, for Natural Gas = 1.047, for Propane = 1.01, for Gasoline = 1.01, for Diesel = 1.01

3) All ratios are national average source-site ratios reported in Energy Star Performance Ratings Methodology for Incorporating Source Energy Use dated December 2007 , except Gasoline assumed to be equal to Diesel.

4) In one billing month the chillers were operated during the peak period, yielding a peak period demand of 2.8 MW. For other months, chillers were operated off-peak as designed, and the maximum peak period demand was 1.6 MW. Both values are reported for completeness.

TABLE 3: CAMPUS BUILDOUT PROJECTION

FY Beginning	Planning Year	Estimated # of	Students Phase	Estimated Built Sq Ft
2007	1	2,009	1	783,510
2008	2	2,736	1	1,067,040
2009	3	3,418	1	1,333,020
2010	4	4,060	1	1,583,556
2011	5	4,703	1	1,834,092
2012	6	5,345	2	2,084,628
2013	7	5,988	2	2,335,164
2014	8	6,630	2	2,585,700
2015	9	7,370	2	2,874,300
2016	10	8,110	2	3,162,900
2017	11	8,850	2	3,451,500
2018	12	9,590	2	3,740,100
2019	13	10,330	3	4,028,700
2020	14	11,094	3	4,326,660
2021	15	11,985	3	4,673,994
2022	16	12,875	3	5,021,328
2023	17	13,766	3	5,368,662
2024	18	14,656	3	5,715,996
2025	19	15,547	3	6,063,330
2026	20	16,438	3	6,410,664
2027	21	17,328	3	6,757,998
2028	22	18,219	3	7,105,332
2029	23	19,109	3	7,452,666
2030	24	20,000	3	7,800,000
2031	25	20,891	4	8,147,334
2032	26	21,781	4	8,494,668
2033	27	22,672	4	8,842,002
2034	28	23,562	4	9,189,336
2035	29	24,453	4	9,536,670
2036	30	25,000	4	9,750,000

1) Values are based on the EIR/EIS.

TABLE 4: CAMPUS BUILDING ENERGY USE PROJECTION BASED ON BUILDING PERFORMANCE TARGETS

FY Beginning	Peak Period Demand Based on Existing Targets (MW)	Annual Electricity Based on Existing Targets (MWh)	Annual Natural Gas Based on Existing Targets (Therms)	Campus Building Site Energy (MBTU)	Campus Building Source Energy (MBTU)	Campus Building Source Energy (MBTU) per Student	Campus Building Source Energy (MBTU) per Square Foot
2007	1.7	12,204	455,781	87,218	186,798	93	0.24
2008	2.3	15,423	567,719	109,397	235,207	86	0.22
2009	2.9	18,444	672,728	130,203	280,620	82	0.21
2010	3.5	21,289	771,639	149,800	323,396	80	0.20
2011	4.0	24,133	870,551	169,398	366,172	78	0.20
2012	4.6	26,978	969,462	188,996	408,948	77	0.20
2013	5.1	29,823	1,068,374	208,594	451,724	75	0.19
2014	5.7	32,668	1,167,286	228,191	494,500	75	0.19
2015	6.3	35,945	1,281,225	250,767	543,775	74	0.19
2016	6.9	39,222	1,395,164	273,342	593,050	73	0.19
2017	7.6	42,499	1,509,103	295,917	642,325	73	0.19
2018	8.2	45,776	1,623,043	318,492	691,600	72	0.18
2019	8.8	49,053	1,736,982	341,067	740,875	72	0.18
2020	9.5	52,436	1,854,617	364,375	791,749	71	0.18
2021	10.3	56,380	1,991,744	391,544	851,052	71	0.18
2022	11.0	60,324	2,128,872	418,714	910,355	71	0.18
2023	11.8	64,268	2,265,999	445,884	969,658	70	0.18
2024	12.5	68,212	2,403,126	473,053	1,028,961	70	0.18
2025	13.3	72,156	2,540,254	500,223	1,088,264	70	0.18
2026	14.1	76,100	2,677,381	527,392	1,147,567	70	0.18
2027	14.8	80,044	2,814,509	554,562	1,206,870	70	0.18
2028	15.6	83,988	2,951,636	581,732	1,266,174	69	0.18
2029	16.4	87,932	3,088,764	608,901	1,325,477	69	0.18
2030	17.1	91,876	3,225,891	636,071	1,384,780	69	0.18
2031	17.9	95,820	3,363,019	663,240	1,444,083	69	0.18
2032	18.7	99,764	3,500,146	690,410	1,503,386	69	0.18
2033	19.4	103,708	3,637,274	717,580	1,562,689	69	0.18
2034	20.2	107,652	3,774,401	744,749	1,621,992	69	0.18
2035	20.9	111,596	3,911,529	771,919	1,681,295	69	0.18
2036	21.6	114,745	4,021,018	793,612	1,728,646	69	0.18

NOTES:
1) Values in bold are actual, not estimated.
2) Peak Period Demands assume thermal energy storage of energy used to produce cold water.
3) 1 MWh = 3.412 MBTU, 1 therm = 0.1 MBTU
4) Source-Site Ratios are national averages from Energy Star: Electricity = 3.340, for Natural Gas = 1.047.

TABLE 5: BUILDING PERFORMANCE TARGETS

Target	Units	Laboratory/Complex	Classroom/Office	Housing and Services
			100% of Benchmarks	
Max Demand	watts/gsf	6.73	3.65	2.55
Annual kWh	kWh/yr/gsf	40.70	15.10	10.60
Max CHW	tons/kgsf	3.74	2.03	1.42
Max Therms	th/hr/kgsf	0.43	0.12	0.18
Annual Therms	th/yr/gsf	1.82	0.20	0.28
			80% of Benchmarks	
Max Demand	watts/gsf	5.38	2.92	2.04
Annual kWh	kWh/yr/gsf	32.56	12.08	8.48
Max CHW	tons/kgsf	2.99	1.62	1.14
Max Therms	th/hr/kgsf	0.34	0.10	0.14
Annual Therms	th/yr/gsf	1.46	0.16	0.22
			65% of Benchmarks	
Max Demand	watts/gsf	4.37	2.37	1.66
Annual kWh	kWh/yr/gsf	26.46	9.82	6.89
Max CHW	tons/kgsf	2.43	1.32	0.92
Max Therms	th/hr/kgsf	0.28	0.08	0.12
Annual Therms	th/yr/gsf	1.18	0.13	0.18
			50% of Benchmarks	
Max Demand	watts/gsf	3.37	1.83	1.28
Annual kWh	kWh/yr/gsf	20.35	7.55	5.30
Max CHW	tons/kgsf	1.87	1.02	0.71
Max Therms	th/hr/kgsf	0.21	0.06	0.09
Annual Therms	th/yr/gsf	0.91	0.10	0.14

TABLE 6: REDUCTIONS ASSOCIATED WITH IMPROVEMENTS IN BUILDING PERFORMANCE TARGETS

Annual improvement in building energy performance after first 1.2M sq ft	2.0%
Maximum reduction target as a percentage of benchmark	25%

FY Beginning	Reduction in Building Peformance Target As a % of Benchmark	Reduction in Peak Period Demand Based on Existing Targets (MW)	Reduction in Annual Electricity Based on Existing Targets (MWh)	Reduction in Annual Natural Gas Based on Existing Targets (Therms)	Reduction in Campus Site Energy (MBTU)	Reduction in Campus Source Energy (MBTU)
2007	0.0%	0.0	0	0	0	0
2008	0.0%	0.0	0	0	0	0
2009	2.0%	0.1	369	13,455	2,604	5,612
2010	4.0%	0.1	852	30,866	5,992	12,936
2011	6.0%	0.2	1,448	52,233	10,164	21,970
2012	8.0%	0.4	2,158	77,557	15,120	32,716
2013	10.0%	0.5	2,982	106,837	20,859	45,172
2014	12.0%	0.7	3,920	140,074	27,383	59,340
2015	14.0%	0.9	5,032	179,371	35,107	76,129
2016	16.0%	1.1	6,276	223,226	43,735	94,888
2017	18.0%	1.4	7,650	271,639	53,265	115,619
2018	20.0%	1.6	9,155	324,609	63,698	138,320
2019	22.0%	1.9	10,792	382,136	75,035	162,993
2020	24.0%	2.3	12,585	445,108	87,450	190,020
2021	25.0%	2.6	14,095	497,936	97,886	212,763
2022	25.0%	2.8	15,081	532,218	104,679	227,589
2023	25.0%	2.9	16,067	566,500	111,471	242,414
2024	25.0%	3.1	17,053	600,782	118,263	257,240
2025	25.0%	3.3	18,039	635,063	125,056	272,066
2026	25.0%	3.5	19,025	669,345	131,848	286,892
2027	25.0%	3.7	20,011	703,627	138,641	301,718
2028	25.0%	3.9	20,997	737,909	145,433	316,543
2029	25.0%	4.1	21,983	772,191	152,225	331,369
2030	25.0%	4.3	22,969	806,473	159,018	346,195
2031	25.0%	4.5	23,955	840,755	165,810	361,021
2032	25.0%	4.7	24,941	875,037	172,603	375,847
2033	25.0%	4.9	25,927	909,318	179,395	390,672
2034	25.0%	5.0	26,913	943,600	186,187	405,498
2035	25.0%	5.2	27,899	977,882	192,980	420,324
2036	25.0%	5.4	28,686	1,005,255	198,403	432,162

NOTES;

1) Values in bold are actual, not estimated.

2) Peak Period Demands assume thermal energy storage of energy used to produce cold water.

2) 1 MWh = 3.412 MBTU, 1 therm = 0.1 MBTU

3) Source-Site Ratios are national averages from Energy Star: Electricity = 3.340, for Natural Gas = 1.047.

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