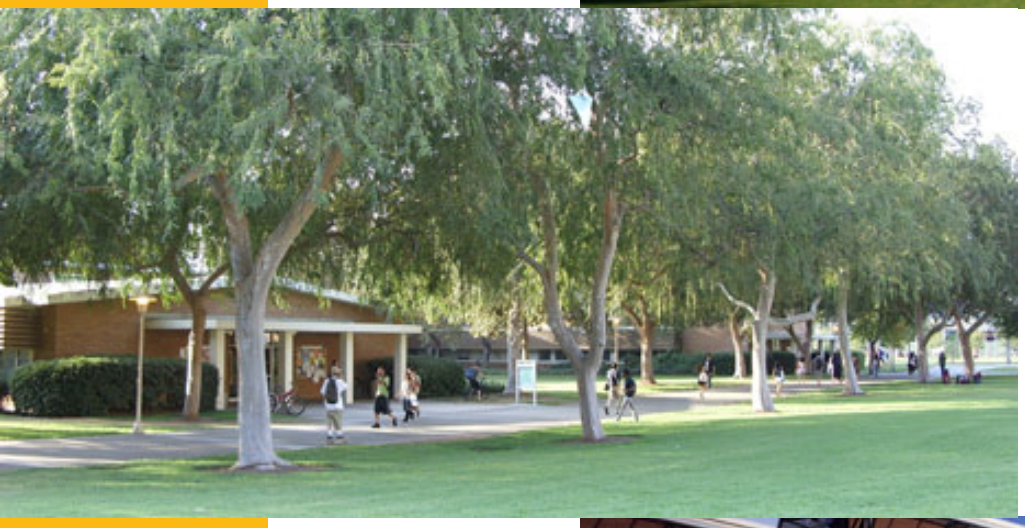
UNIVERSITY OF CALIFORNIA
UC RIVERSIDE

Climate Action Plan



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Acknowledgements

Climate Action Plan

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CLIMATE ACTION PLAN

1.0 INTRODUCTION

This document presents the University of California, Riverside (UCR) Climate Action Plan (CAP). In March 2007, the University of California (UC) signed the American College and University Presidents Climate Commitment (ACUPCC), pledging that all ten UC campuses will maintain greenhouse gas (GHG) emission inventories and achieve climate neutrality as soon as possible. In conjunction with joining the ACUPCC, the University of California adopted system-wide interim climate protection targets to reduce greenhouse gas emissions to 2000 levels by 2014, and 1990 levels by 2020.

The UCR CAP is a strategic roadmap to establish emissions reduction targets and implement strategies to reach UCR's goal of reducing GHG emissions. In addition, as signatories to the ACUPCC, both the UC system and UCR have a long-term goal of becoming carbon neutral by 2050. To achieve this commitment, the CAP presents the campus's baseline, existing, and projected GHG emissions, summarizes UCR's current emissions reduction strategies, and lists additional GHG emissions reduction strategies that UCR plans to implement in the future. The CAP also includes other relevant information such as how UCR plans to monitor its progress towards the reduction goal and potential funding for its GHG reduction strategies.

1.1 Policy and Regulatory Environment

Policies and regulations aimed at controlling GHG emissions and reducing the impacts of climate change are rapidly evolving and thus are in a constant state of flux. New and pending regulations relevant to UCR exist at the federal, state and local levels. At the federal level, the United States Environmental Protection Agency (USEPA) has promulgated both a mandatory greenhouse gas reporting regulation for facilities emitting over 25,000 metric tons of carbon dioxide equivalents ($MTCO_2e$) annually, as well as tailoring a rule aimed at easing the new GHG requirements of Title V and Prevention of Significant Deterioration air quality permitting programs. Additionally there are ongoing efforts in Congress to produce a national cap and trade system for GHG that would likely impact facilities falling under the mandatory reporting rule. At the state level, California has the nation's most sweeping and aggressive GHG legislation. The Global Warming Solutions Act of 2006, otherwise known as Assembly Bill 32 (AB 32), includes mandatory reporting of GHG emissions for large sources, reduction requirements for the State as a whole, and a future cap and trade system. The California Environmental Quality Act (CEQA) guidelines have also been updated to require analysis of GHG emissions for new projects in the context of AB 32 requirements. The UC system has voluntarily pledged to meet the AB 32 reduction target, which requires facilities to reduce their emissions to 1990 levels by 2020. All of the regulations generally require

inventorying and reporting GHG emissions, with the eventual goal of reduction of GHG emissions to net zero.

In addition to external regulations, the UC system has policies of its own intended to catalog and reduce GHG emissions. These include the UC Policy on Sustainable Practices and those provided by the ACUPCC mentioned above. The ultimate goal of the ACUPCC is overall carbon neutrality, though no strict deadline has been provided for achieving this goal. The UC Policy on Sustainable Practices includes measures that reduce GHG emissions from sources that are specific to the University and includes other measures that would minimize the overall environmental impact of UC campuses. This policy requires tracking, reporting, and minimizing GHG emissions in addition to encouraging the use of renewable energy and alternative forms of transport, reducing energy use in general, and reducing waste. For the purposes of tracking GHG emissions, the UC policy requires that individual campuses become members of the California Climate Action Registry (CCAR) or its successor organization The Climate Registry (TCR).

The policy most directly relevant to this CAP is the ACUPCC, which requires signatories to produce a CAP in accordance with the ACUPCC Implementation Guide. The requirements of the ACUPCC CAP are similar to the UC system and TCR, and in fact the former amended its policies to align with ACUPCC guidelines. However, specific elements of the GHG emissions inventory are different among the various programs, and the inventory provided in UCR's CAP was prepared in accordance with ACUPCC guidelines rather than CCAR, state or federal requirements. Consequently, there will be differences between the figures presented in this CAP compared to those in UCR's CCAR reports, though they are relatively minor.

1.2 Context and Setting

1.2.1 Geography

The UCR campus is located to the east of downtown Riverside near Box Springs Mountain. Summers in Riverside are hot and dry with few cloudy days, while winters are cool with occasional periods of heavy precipitation during El Niño events. The hot dry summers and cool winters both contribute to comparatively high GHG emissions through increased demand for resources, such as power for heating and cooling or water for landscape irrigation.

One measure of the relative demands of heating and cooling buildings is heating or cooling degree days; days on which the average temperature is above (for cooling days) or below (for heating days) the standard indoor temperature of 65 degrees Fahrenheit. The daily value is calculated by finding the difference between the average temperature and 65 degrees, with the annual value being the sum of the

daily values for that year. Values for Riverside and other representative locations in 2009 are presented in Table 1 below. As shown, inland locations tend to have higher total heating and cooling requirements than coastal locations due to their greater temperature variances on both the lower and higher side of the 65 degree median mark. To comfortably accommodate its on-campus population throughout the year, UCR must operate heating and air conditioning units on a more frequent basis than many of the other UC campuses.

Table 1
Heating and Cooling Degree Days in 2009

Location	Heating Degree Days	Cooling Degree Days	Total
Riverside	1,779	2,430	4,209
Los Angeles	1,565	815	2,380
Sacramento	3,548	1,557	5,105
San Diego	1,264	1,021	2,285
San Francisco	2,891	449	3,340

Source: Weather Underground and degreedays.net (BizEE software).

1.2.2 UCR Campus

UCR grew out of the UC Citrus Experiment Station, which was founded in 1907 to research agricultural issues of concern to southern California. Since the first classes in 1954 as a new campus in the UC system, UCR has continually expanded. As of 2009, the campus covers almost 1,144 acres with 6.7 million gross square feet (GSF)[1] of development and includes 19,439 students and 5,805 academic and staff employees.[2] The 2005 Long Range Development Plan (LRDP) projects growth through 2015/16 and suggests that an additional 5 million GSF of development will be needed to accommodate an expected increase to 25,000 students and 10,540 academic and staff employees and visitors.[3] The campus is currently undergoing an amendment to the 2005 LRDP to add a new land use designation – School of Medicine (SOM) – to the LRDP land use designation map. Although the student enrollment number is remaining static at 25,000, the SOM will add an additional 3.1 million square feet to the development total and the threshold year is anticipated to be 2020/21 with an additional 5,853

1 Capital and Physical Planning; Fall 2010 Inventory Data

2 Strategic Academic research and Analysis Fall 2009 data

3 2005 Long Range Development Plan

staff/employees/visitors/patients specifically attributed to the medical office building component of the proposed medical school and support facilities.

A significant portion of the existing campus buildings were built during a period of rapid expansion in the 1960s with forty-three percent of the campus building stock is at least forty years old. These buildings were designed and constructed in an era before energy efficiency was a top consideration, and therefore, not only were they not especially efficient to begin with, but they are also becoming less efficient as building systems age. These buildings represent both an opportunity for significant energy savings, if they can be improved, and a significant challenge, as retrofitting and other efficiency improvements can be costly and difficult. The next period of rapid campus expansion occurred in the 1990s, with the construction of buildings that tended to be more efficient in comparison to those built in the 1960s, but still lacking focus on sustainability and efficiency that has come recently with the general recognition of the climate change issue. Though these buildings are newer and more efficient, they still represent an opportunity for energy savings.

While the projected campus growth in development includes several types of buildings, such as student housing, parking, and general facilities, the major focus is on the new development of the West Campus, particularly the SOM, with some potential infill development on the East Campus. As stated above, the SOM is planned to ultimately add 3.1 million GSF[4] of new construction to the campus development. The proposed amendment to the LRDP is anticipating build-out of the SOM by 2020/21 for purposes of analysis in the 2005 LRDP Amendment 2 Environmental Impact Report.

The campus utilities infrastructure is relatively simple, with electricity, water, wastewater and solid waste services provided by the City of Riverside. UCR does not have a landfill or wastewater plant of its own, nor does it generate power. Natural gas is purchased from Southern California Gas Company.

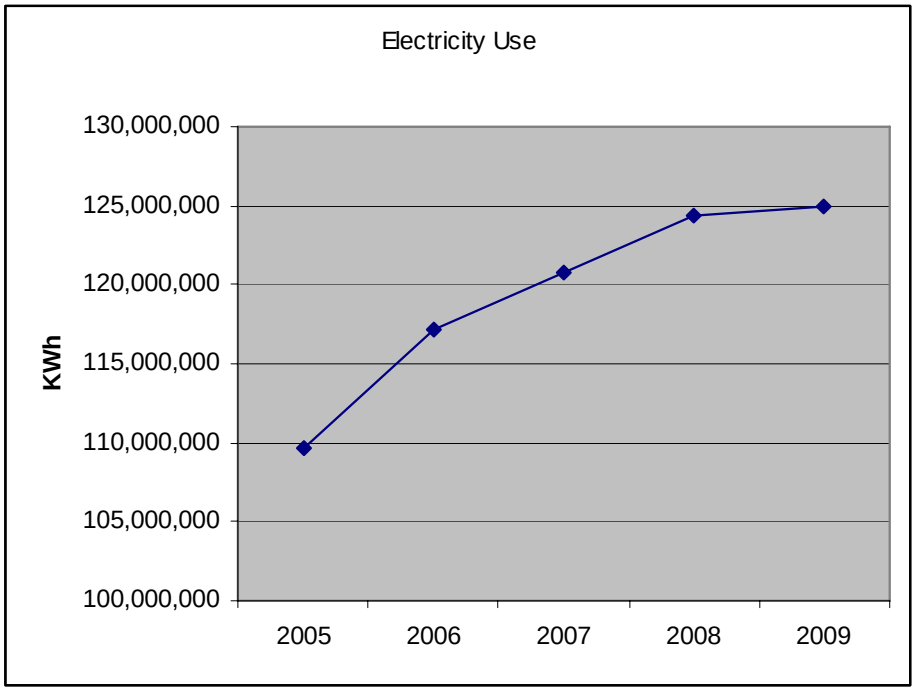
4 2005 Long Range Development Plan Amendment 2 DRAFT

According to their Annual Power Content label,[5] Riverside Public Utilities obtained power in 2009 from the following sources:

- Coal: 66%
- Nuclear: 17%
- Renewable resources: 14%
- Natural gas: 1%
- Hydro: 2%

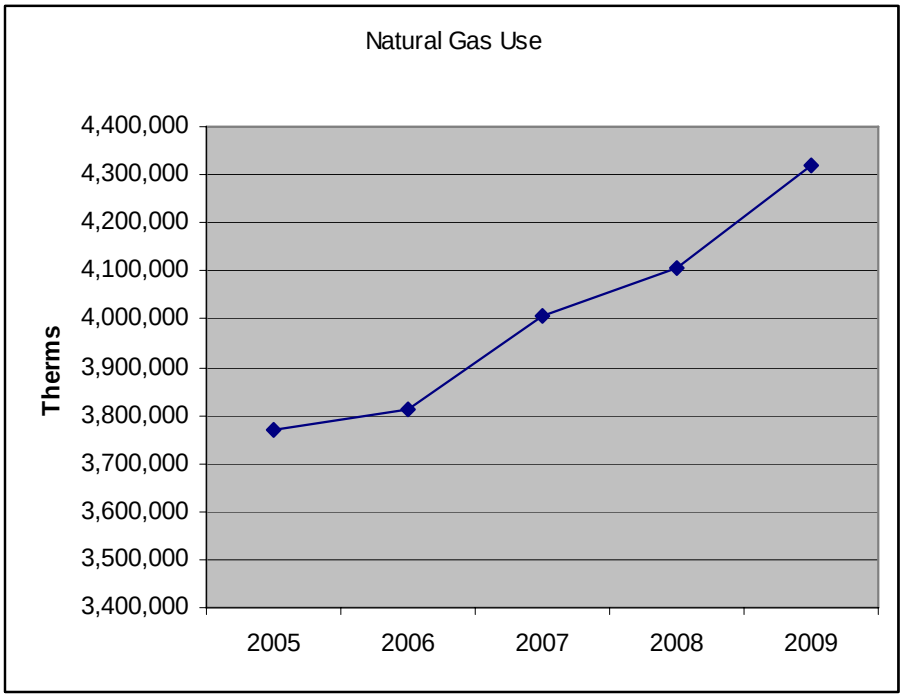
UCR has installed two thermal energy storage tanks with a third underway to make the campus more energy efficient by chilling water off peak thus reducing costs. The campus is exploring options to generate power through solar installations in the near future. Figure 1 below shows electricity use from 2005 to 2009 and Figure 2 shows natural gas use during the same period.

Figure 1
UCR Electricity Use, 2005-2009



5 Data provided by the Riverside Public Utilities, December 10, 2010. Further information on Energy Content can be obtained from RPU Electric: http://www.riversideca.gov/utilities/electric.asp or the California Energy Commission: http://www.energy.ca.gov/consumer

Figure 2
UCR Natural Gas Use, 2005-2009



Along with the increase in the campus population it is expected that there will be an increase in commuter traffic. The campus is currently served by both Riverside Transit Authority (RTA) buses and the campus-run Highlander Shuttle service. Both are free of charge for anyone with a current UCR staff, faculty or student ID. Access to mass transit is part of UCR's planning to reduce the need for personal vehicle travel to and from, and around campus. UCR also works to encourage bicycle use by providing bike lockers on campus as well as end-of-trip facilities such as showers and changing rooms where feasible. The campus is designed to be safe for pedestrians and bicycle riders alike, with vehicle traffic calming measures incorporated into campus planning. The City of Riverside has collaborated with UCR to facilitate bicycle traffic to campus by providing bicycle racks on buses and bicycle lanes. Through an aggressive alternative transportation initiative, demand for parking permits has decreased although the campus population has increased.

2.0 CAMPUS EMISSIONS INVENTORY

Emissions of GHGs result from both on-campus and off-campus activities. GHG emission sources include non-residential buildings, residential buildings, on-site and off-site transportation, and agricultural research activities. The geographic boundary for the inventory is generally defined as those buildings central to fulfilling the University's mission and that are under operational control of the campus. This includes central campus buildings, all student housing, and off-central campus facilities in the Inland Empire and the Coachella Valley owned by the University, including the Natural Reserves, Coachella Valley Agricultural Research Station, and the Palm Desert Graduate Center. Emissions associated with electricity and gas use in buildings leased by the campus are not included in the inventory, as they are not in direct operational control of the campus; however, transportation emissions associated with the occupants of these buildings are included. As the campus population and facilities continue to grow and the emissions inventory is refined, all of these changes will be reflected in the 1990 baseline.

UCR publicly reports its GHG inventory annually to the CCAR, transitioning in 2010 to TCR, and ACUPCC. At the time of writing, UCR has certified emissions from mobile combustion (campus fleet), stationary combustion (natural gas), and purchased electricity. The UCR emissions inventory includes all six GHGs regulated under State law: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6).

To help delineate direct and indirect emission sources, improve transparency, facilitate fair comparisons, and provide data applicable to different types of organizations and different climate policies and goals, ACUPCC utilizes three "scopes" for GHG accounting and reporting purposes. The scopes are defined below.

- Scope I – Direct Emissions: emissions generated by on-campus stationary combustion of fossil fuels, mobile combustion of fossil fuels by institution owned/controlled vehicles, and fugitive emissions (natural gas combustion, campus fleet, refrigeration)
- Scope II – Indirect Emissions (electricity): emissions generated in the production of electricity consumed by the institution (purchased electricity and/or purchased steam)
- Scope III – Indirect Emissions (other): Other indirect emissions generated by institution-related activities (business air travel, student commute, faculty/staff commute).

UCR first reported and certified its GHG emissions in 2006. For the CCAR 2006 reporting year, UCR estimated campus emissions of 22,504 $MTCO_2e$ from direct sources (i.e., mobile combustion and stationary combustion) and 43,694 $MTCO_2e$ from indirect sources (i.e., purchased electricity) for a total of 66,198 $MTCO_2e$. For the CCAR 2007 reporting year, UCR estimated campus emissions of 23,533 $MTCO_2e$

from direct sources and 73,016 $MTCO_2e$ from indirect sources for a total of 96,549 $MTCO_2e$. Beginning in 2008, UCR included Scope 3 emissions in its inventory.

This CAP estimates and reports Scope I, II, and III emissions for UCR. All emissions (current, historical, and projected) are reported in units of $MTCO_2e$, which is the standard unit for reporting GHG emissions.

2.1 Current Emissions

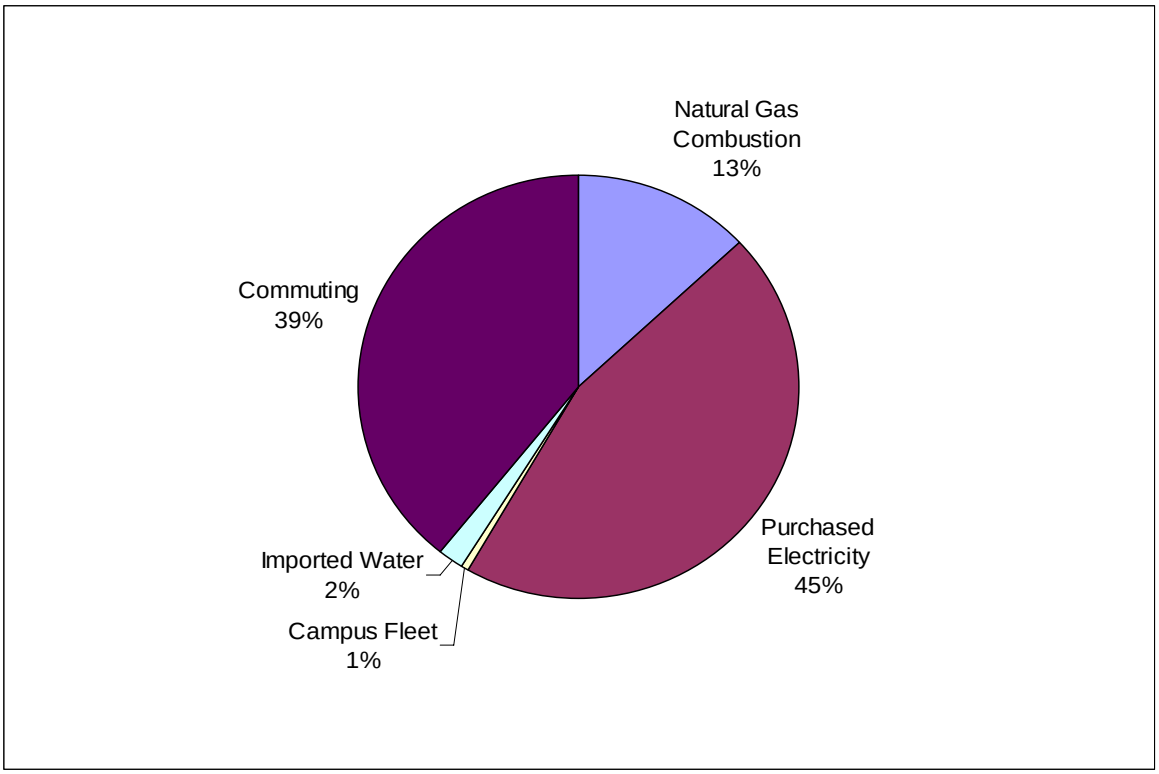
In 2008, UCR emitted approximately 166,902 $MTCO_2e$ of GHGs. The breakdown of these emissions by source is presented in Table 2 and Figure 3. Electricity accounted for 45.2 percent of emissions, while campus commuting constituted 39.1 percent, and natural gas used on the campus produced about 13.1 percent of total emissions. Imported water and campus fleet combined constituted only 2.6 percent of total emissions. UCR will begin capturing air travel emissions and fugitive emissions from coolants during the 2010-11 fiscal year. The data and methodology used to estimate these emissions is presented in Appendix A.

Table 2
UC Riverside's 2008 Greenhouse Gas Emissions by Source

Emissions Source	Metric Tons (CO_2e)	Percentage of Total Inventory
Natural Gas Combustion	21,810	13.1
Purchased Electricity	75,511	45.2
Campus Fleet	1,181	0.7
Imported Water	3,235	1.9
Commuting	65,228	39.1
Total	**166,966**	**100.0**

Source: UC Riverside Environmental Health & Safety, Physical Plant, Transportation and Parking Services, Housing, (2009).

Figure 3
UC Riverside's 2008 Greenhouse Gas Emissions by Source



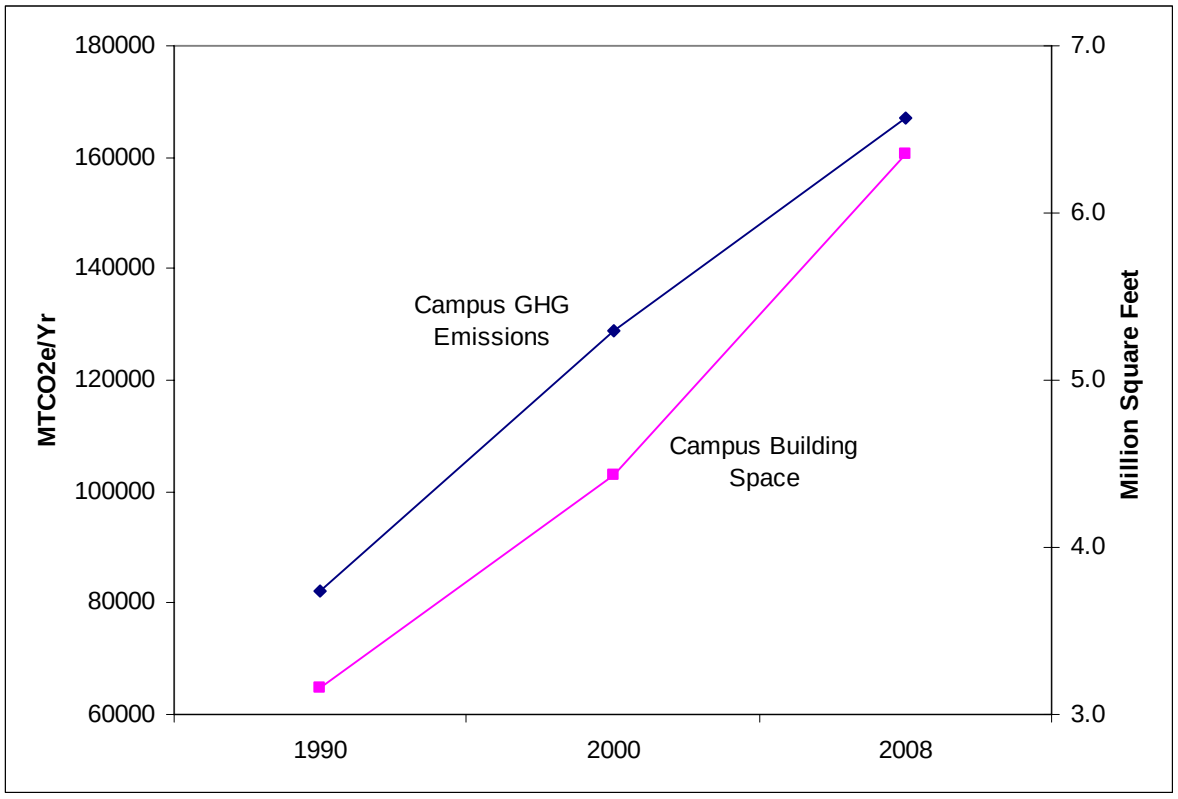
2.2 Historical Emissions

The amount of GHG emissions generated by the campus is directly related to the size of the campus population and the amount of building space on the campus. Both campus population and building space have grown steadily since 1990. During the period 1990 to 2000, the total campus population (students, faculty, and staff) increased from 12,105[6] to 17,695 persons for an increase of approximately 46 percent, while from 2000 to 2008 the total campus population increased from 17,695 to 23,829 for an increase of about 35 percent. During the period 1990 to 2000, building space increased from 3,156,181 gross square feet (GSF) to 4,431,023 GSF for an increase of approximately 40 percent, while from 2000 to 2008 building space increased from 4,431,023 to 6,349,744 for an increase of about 43 percent. Thus, while the increase in campus population has slowed over the last decade, the increase in building space has remained steady, growing at the rate of about 4 percent per annum.

6 Student academic appointment headcounts are counted separately from the student population and have been added in establishing the total campus population throughout this report.

Figure 4 below shows the change in campus GHG emissions and growth in campus building space from 1990 to 2008. Emissions increased by approximately 57 percent between 1990 and 2000 for an average rate of 5.7 percent per year, compared with campus building space which increased by 40 percent over the same period. Between 2000 and 2008, the rate of increase in emissions slowed to 3.7 percent per year on average for a total increase of approximately 30 percent while campus building space increased slightly at a rate of 5.4 percent a year for a total increase of about 43 percent. Despite an increase in the rate of growth in building space, the rate of growth in GHG emissions decreased between 2000 and 2008 due to the implementation of a number of energy efficiency projects on the campus.

Figure 4
Campus GHG Emissions vs. Building Space



2.3 Projected Emissions

In 2005, The Regents of the University of California adopted the 2005 UCR Long Range Development Plan (LRDP) which describes the campus's future growth in terms of student enrollment, faculty and staff levels, building space expansion, and other programs. The 2005 UCR LRDP uses 2001 as the baseline year and describes campus growth through academic year 2015/16. In 2009, in view of the economic

downturn, UCR revisited its growth projections and determined that forecasted levels of enrollment and building space increases will now likely be attained in academic year 2020/21 (five years later than previously projected). Additionally, UCR produced the 2009-19 Capital Financial Plan (Capital Plan). This document provides an overview of planned capital investments in the campus that reflects the current and projected funding environment. Given the uncertainty of funding going forward, and the general economic climate, the development described in the Capital Plan is significantly less than in the 2005 LRDP. The projections in the Capital Plan are considered more likely to be realized than those in the 2005 LRDP. For the purpose of forecasting future emissions for this UCR CAP, the projected increase in campus population and square footage as reflected in the Capital Plan were utilized.

Table 3 and Figure 5 present the campus's projected emissions for 2014 by source. The campus's projected 2014 GHG emissions are considered to occur under "business as usual" (BAU) conditions and do not reflect any reductions that will be achieved as UCR implements its emission reduction strategies. As noted earlier, UCR is expected to begin capturing air travel emissions during the 2010-11 fiscal year and will include the projected emissions from this source in its CAP once verified data and methodology to estimate air travel emissions become available. The data and methodology used to estimate these 2014 BAU emissions are presented in Appendix A.

Table 3
UC Riverside's Projected 2014 Greenhouse Gas Emissions by Source
(Business as Usual Conditions)

Emissions Source	Metric Tons (CO_2e)	Percentage of Total Inventory
Natural Gas Combustion	27,069	13.2
Purchased Electricity	94,623	46.1
Campus Fleet	1,673	0.8
Imported Water	4,096	2.0
Commuting	77,598	37.8
Total[1]	**205,060**	**100.0**

Source: UC Riverside Environmental Health & Safety, Physical Plant, Transportation and Parking Services, Housing, (2009).
[1] *Does not include emissions from Campus-sponsored air travel.*

Figure 5
UC Riverside's Projected 2014 Greenhouse Gas Emissions by Source

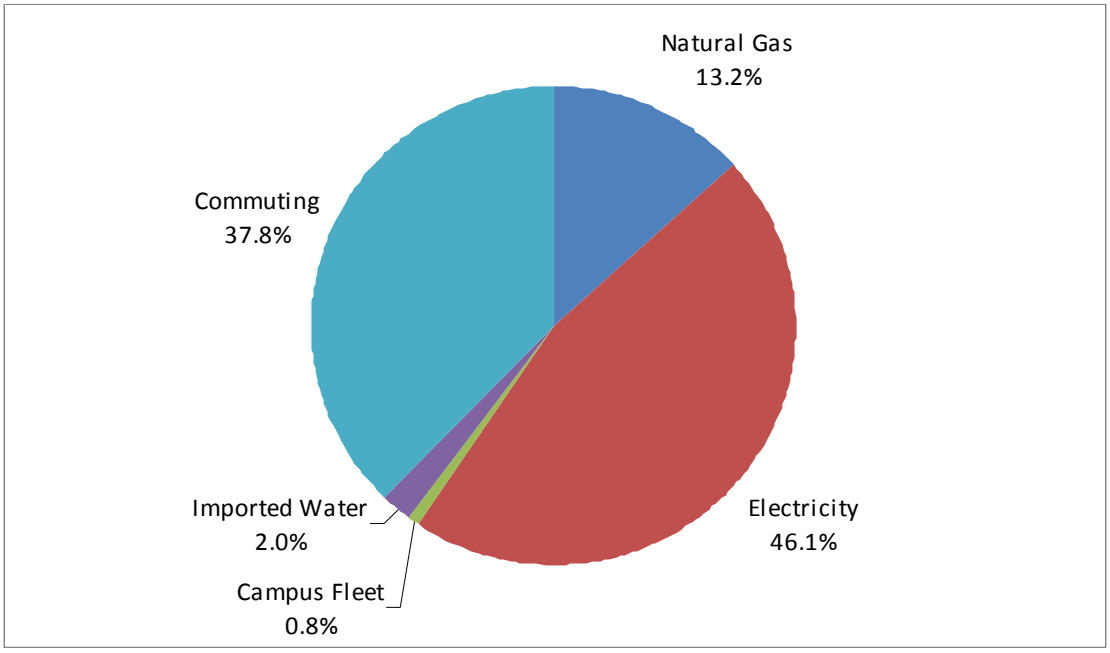


Table 4 and Figure 6 present the campus's projected emissions for 2020 by source. Similar to the 2014 estimates, the campus's projected 2020 GHG emissions are considered to occur under BAU conditions and do not reflect any reductions that will be achieved as the campus implements its emission reduction strategies. The data and methodology used to estimate these emissions are presented in Appendix A.

Table 4
UC Riverside's Projected 2020 Greenhouse Gas Emissions by Source
(Business as Usual Conditions)

Emissions Source	Metric Tons (CO_2e)	Percentage of Total Inventory
Natural Gas Combustion	32,328	13.3
Purchased Electricity	113,735	46.8
Campus Fleet	2,165	0.9
Imported Water	4,957	2.0
Commuting	89,967	37.0
Total[1]	**243,153**	**100.0**

Source: UC Riverside Environmental Health & Safety, Physical Plant, Transportation and Parking Services, Housing, (2009).
[1] *Does not include emissions from campus-sponsored air travel.*

Figure 6
UC Riverside's Projected 2020 Greenhouse Gas Emissions by Source

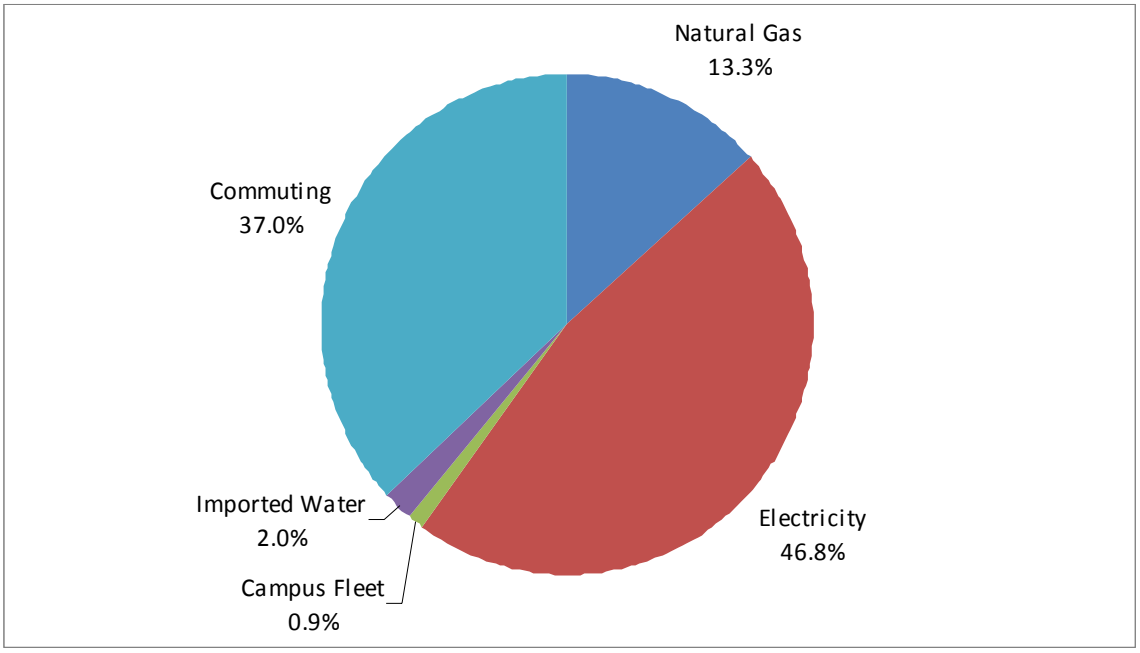
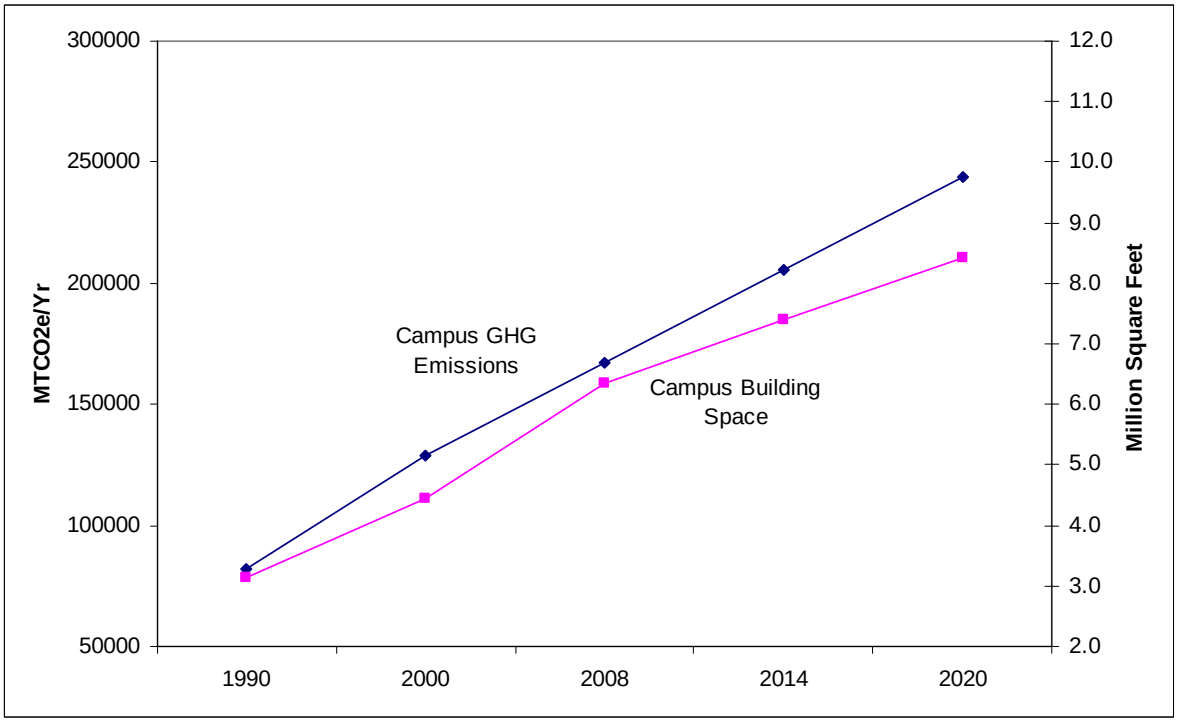


Figure 7 illustrates UCR's past, current, and projected GHG emissions. GHG emissions projected for the campus between 2008 and 2020 are calculated without considerations of future GHG mitigation strategies and based on an expected expansion in campus population from 23,829 to 41,393 persons (per the proposed 2005 LRDP Amendment 2) and an increase in building space of 2,079,479 GSF for a total building space of 8,429,223 GSF (per the Capital Plan). According to Figure 7, GHG emissions on the campus are expected to swell by approximately 46 percent between 2008 and 2020, while building space is expected to increase by 33 percent. The Capital Plan numbers outline the campus's likely growth potential under the current economic and financial conditions. Actual growth may vary considerably if those conditions change, with a resultant variation in GHG emissions from the current projections. UCR will continue to update and refine its inventory as new information and calculation methodologies become available.

Figure 7
Projected Campus GHG Emissions vs. Building Space



3.0 CURRENT CAMPUS EMISSIONS REDUCTION EFFORTS

In order to meet its commitments to the ACUPCC and the UC system, UCR will need to reduce GHG emissions by a significant amount. Some reductions will occur due to programs or regulations imposed at the state or federal level, such as vehicle efficiency requirements, Title 24 building codes, renewable energy portfolio requirements for energy providers, and more stringent Energy Star appliance ratings, etc. However, these programs will not be enough on their own to enable UCR to meet its commitments, requiring the campus to undertake additional internal initiatives to reduce GHG emissions.

As shown in Section 2, electricity consumption is responsible for nearly 50 percent of UCR's GHG emissions. The majority of this power is used to operate campus buildings and equipment. Energy efficiency projects that exceed mandated levels, more aggressive environmentally preferred purchasing guidelines, and concerted conservation efforts are needed to meet UCR's GHG reduction commitment. As these functions are more directly under UCR's control, they are relatively easier to address. This is in contrast to commuting emissions, which are the second largest single source of GHG emissions, but originate in vehicles that UCR has limited direct control over. However, the campus instituted an increased housing goal with the 2005 LRDP. The campus raised the 1990 goal from housing 35% of the

students in on-campus housing to a goal of housing 50%. This could have a significant effect on lowering commuter GHG emissions. Even with the decrease in student commuters, measures to reduce electricity and natural gas consumption are still the most logical choice for producing significant, verifiable and immediate reductions in emissions at UCR. Unfortunately, retrofitting or replacing building systems is also an expensive undertaking and highly contingent on funding from external sources due to limited campus budgets. These projects are therefore pursued with the goal of modernizing energy consuming systems when financially feasible.

Efforts to modify campus culture and behavior are more affordable, but lack the definitive and immediate impact of infrastructure improvements. However, large emissions reductions can be achieved over time through these measures, which can include educational programs, public guidelines, incentives, and other methods to encourage activities or choices that reduce GHG emissions. Many of these programs are underway already at UCR and will continue to be developed as a low carbon culture gains acceptance on campus. As commuting is a large factor in UCR's overall emissions profile, measures to reduce vehicle traffic associated with the campus are a major focus and will continue to be in the future.

Table 5 provides a list of the reduction measures that are either currently being implemented on campus or have been implemented in the past. It should be noted that these measures were not specifically taken into account or otherwise quantified for GHG emissions inventories prior to 2008. Reductions from measures enacted before 2008 are reflected in the total emissions accounted for each inventory respectively.

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Table 5
GHG Reduction Measures Currently in Practice

Reduction Strategy	Targeted Emission Source	Status
Energy-reducing shading mechanisms for windows, porch, patio and walkway overhangs installed either in new buildings or during retrofits.	Energy Consumption	Included in Campus Design Guidelines; ODC works with architects to incorporate these strategies.
Grid power (as opposed to diesel generators) used for job site power needs where feasible during construction.	Energy Consumption	This is a current UCR practice.
75 or more percent of buildings oriented to face either north or south (within 30 degrees of N/S).	Energy Consumption	Campus is on a north-south grid. Most buildings respect this orientation or incorporate remedial measures.
Light-colored pavement (e.g., increased albedo pavement) included as part of project design guidelines.	Energy Consumption	Campus Design Guidelines require the use of "UCR Tan" integral color mixture for all concrete surfaces and limits asphalt surfaces to roads only.
All projects required to obtain LEED, Labs21 or other green building certification.	Energy Consumption	UC policy requires all new projects to achieve LEED Silver, and aim higher where possible.
Efficient lighting and lighting control systems installed in new construction and retrofit projects. Daylight used as an integral part of lighting systems in buildings.	Energy Consumption	All new buildings will continue to adopt this strategy. This strategy is integral to UC's commitment to LEED EBOM.
Trees and vegetation planted near structures to shade buildings and reduce energy requirements for heating/cooling.	Energy Consumption	This is a current UCR practice.
Parking lot areas provided with 50% tree cover within 10 years of construction, in particular, low emitting, low maintenance, low water requiring trees. Open lots may be provided with photovoltaic sun shades.	Energy Consumption	While this strategy is identified in the 2007 Campus Design Guidelines and being followed, the timeframe for establishing 50% tree cover is not established.
All new construction projects required to surpass California Energy Code Title 24 by 20 percent or better.	Energy Consumption	UC Policy requires outperforming Title 24 by 20%.
On-site trees that may be removed due to development replaced or preserved as a means of providing carbon storage.	Energy Consumption	This is a current UCR practice.
Developing on-site renewable energy capacity. Photovoltaic shades to be installed for HEV and PHEV Zipcar parking areas.	Energy Consumption	UCR is in the initial stages of developing on-site solar energy capacity.

Reduction Strategy	Targeted Emission Source	Status
Water-efficient irrigation systems and devices installed, such as soil moisture-based irrigation controls, to create water-efficient landscapes.	Energy Consumption	Both landscapes and irrigations systems on campus are water-efficient.
Heat recovery projects implemented in campus buildings.	Energy Consumption	This is an ongoing practice where feasible. To date UCR has: • Installed an economizer on the central plant's largest boiler, resulting in an efficiency gain of roughly 35%. • Added heat recovery at the Chemical Sciences building by re-circulating the office exhaust air that was originally once-through air. • Installed run-around loop heat recovery at Boyce Hall. • Implemented retro-commissioning for the Science Library and Rivera Library.
Promote "least polluting" ways to connect people and goods to their destinations. Provide information on all options for individuals and businesses to reduce transportation-related emissions. Provide education and information about public transportation.	Motor Vehicles	The Sustainability Coordinator (with ODC) is tasked to work with TAPS to further increase awareness and develop educational material to help reduce transportation related emissions.
Accommodations for car sharing programs include providing parking spaces for the car share vehicles at convenient locations accessible by public transportation.	Motor Vehicles	Zipcars are available on campus. Transportation and Parking Services also administer and incentivize a carpool program.
Purchasing vehicles and buses that use alternatives fuels or technology, such as electric hybrids and CNG. Where feasible, fleet vehicles are required to be low emission vehicles. Promote the use of these vehicles in the general community.	Motor Vehicles	Campus Fleet Services has acquired alternative fuel (CNG) vehicles, hybrid vehicles and EV/HEV/PHEV vehicles amounting to 26% of the current Fleet Services inventory. This strategy will require further educating the campus constituents and a commitment to alternative fuel vehicles, provided they are economically viable.

Reduction Strategy	Targeted Emission Source	Status
Incentives and benefits provided for faculty and staff members who pursue alternative transportation methods.	Motor Vehicles	UCR students, faculty and staff can ride RTA buses at no-cost. Registered participants of the Public Transit Program also receive complimentary parking privileges on campus. When classes are in session, operation of two shuttle routes that service nearby student housing and apartment communities reduce vehicle trips to the campus. Discounted vouchers for Metrolink, a regional commuter rail system, are also available to students. An RTA bus route connects the downtown Riverside Metrolink station with campus.
Bicycle lanes and walking paths designed to facilitate traffic to from and at schools, parks and other community destination points.	Motor Vehicles	UCR works collaboratively with the City of Riverside to facilitate bicycle and pedestrian movement and supports necessary improvements on campus.
Increasing the number of secure bicycle corrals.	Motor Vehicles	Secure bike corrals are being placed on campus at strategic locations based on observed need.
Developing a map for bicycle commuters.	Motor Vehicles	Capital & Physical Planning (CPP) and Transportation and Parking Services (TAPS) are collaborating on a comprehensive map that documents both on and off-campus bike lanes.
Increasing the number of vanpools.	Motor Vehicles	The Vanpool Program is extremely successful and has expanded significantly since its inception. Additional routes are continuously being considered.
Pedestrian/bicycle safety and traffic calming measures in excess of jurisdiction requirements included in project designs. Roadways designed to reduce motor vehicle speeds and encourage pedestrian and bicycle trips by featuring traffic calming measures.	Motor Vehicles	Campus improvement projects always take these factors into consideration.
Providing conductive/inductive electric vehicle charging stations.	Motor Vehicles	Electric vehicle charging stations are being considered in partnership with the City of Riverside.
Increasing on-campus housing for students and staff.	Motor Vehicles	UCR is committed to providing on-campus housing for 50% of its student population. Additionally, UCR owns and manages faculty/staff housing close to campus.

Reduction Strategy	Targeted Emission Source	Status
Implementing land use strategies to encourage jobs/housing proximity, promote transit-oriented development, and encourage high-density development along transit corridors.	Motor Vehicles	UCR owns and manages faculty/staff housing close to campus.
Including mixed-use, infill, and higher density in development projects to support the reduction of vehicle trips, promote alternatives to individual vehicle travel, and promote efficient delivery of services and goods.	Motor Vehicles	UCR is committed to providing on-campus housing for 50% of its student population in the long term. It has promoted the University Village project and continues to work with the City of Riverside on mutually beneficial opportunities.
Construction waste managed during projects.	Solid Waste	UCR is committed to LEED Silver. Major Renovations (MR) credits require careful consideration of waste management protocols.
Uniform outdoor cluster recycling provided.	Solid Waste	Outdoor cluster recycling is available at high intensity use areas on campus. UCR is committed to expanding the program and has recently established a transfer station to separate recycle items.
Introduced campus composting program, including food waste receptacles in appropriate areas with signage.	Solid Waste	UCR has an ongoing composting program.
Developing and implementing sustainable operations in Housing, Dining and Residential Services (HDRS) to include waste reduction, recycling, cleaning supplies, water and energy use.	HDRS Operations	Ongoing initiative that is being expanded when feasible in collaboration with related campus units.
Developing awareness for ongoing and proposed sustainable practices at HDRS.	HDRS Operations	Ongoing initiative that will be advanced in collaboration with the Office of Sustainability.

4.0 FUTURE GHG EMISSIONS REDUCTION STRATEGIES

In addition to the programs and reduction measures currently undertaken by UCR additional GHG reduction strategies have been identified by the campus for future implementation. Table 6 lists and describes these additional strategies to reduce campus GHG emissions. While the strategies have been categorized as targeting particular Scope emissions (i.e., Scope I, Scope II, or Scope III), in some cases the reductions would likely impact more than a single scope of emissions. For example, measures that would reduce the heating and cooling loads for buildings would reduce both Scope I and Scope II emissions as heating is often provided by boilers combusting natural gas (Scope I) and cooling by air conditioning units consuming electricity (Scope II). Similarly for reductions measures aimed at vehicle emissions, the reductions could be to Scope I emissions if the vehicle is campus-owned or –operated or to Scope III emissions if the vehicle is owned or operated by a third party. However, measures have been assigned a single scope to avoid repetition.

As mentioned above, measures to address emissions from campus infrastructure are highly contingent on funding. The measures listed here are those that UCR is committed to pursuing, but is limited due to the current financial position of the campus and UC system as a whole. As economic conditions change, measures may be added to shift more attention on building systems and infrastructure. Further details on these measures, such as estimated reduction effectiveness, can be found in Appendix A.

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Table 6
GHG Reduction Measures for Future Implementation

SCOPE II MEASURES			
Reduction Strategy	**Implementation**	**Targeted Emission Source**	**Status**
Develop a campus certification program for departments or groups meeting sustainability or emissions reductions targets.	Provide targets for departments with official recognition of those departments that meet them.	Energy Consumption	The Office of Sustainability will be in charge of developing this program.
Develop energy intensity standards for the campus's major space usage types.	Include strategy in design and construction guidelines and/or initiate for retrofit projects.	Energy Consumption	Details of administering such a program will be established.
Draft and adopt "cool roof" guidelines, require in all new construction projects and retrofit of existing roofs.	Include strategy in design and construction guidelines and/or initiate retrofit projects.	Energy Consumption	Retrofit of existing roofs will only occur when required as part of deferred maintenance.
Incentive or cost-sharing program to encourage departments or administrative groups to replace older appliances and equipment.	Establish a campus-level fund to support departments in replacing appliances. Consider loan program or joint curricular program to fund operations.	Energy Consumption	Previously implemented when City of Riverside initiatives were available. Future implementation will depend on availability of fiscal incentives.
Install light emitting diodes (LEDs) for traffic, street and other outdoor lighting.	Replace older lighting with modern high-efficiency lighting.	Energy Consumption	The campus is evaluating energy efficient outdoor lighting alternatives including LED and induction lighting and is committed to retrofitting to achieve energy use savings.
Launch fume hood sash management campaign.	Education, signage, and possible installation of sensors to shut off fume hoods when not in use; also deploy a "shut the sash" campaign to shape user behavior and save energy.	Energy Consumption	The Office of Sustainability will manage this campaign.

SCOPE III MEASURES			
Reduction Strategy	**Implementation**	**Targeted Emission Source**	**Status**
Reduce business air travel by developing programs and technologies for remote conferencing.	Purchase equipment for videoconferencing; develop policy encouraging or requiring remote conferencing under specific circumstances (travel distance, type of event, etc). This could work in conjunction with upgraded phone systems, VOIP or computer based programs like Skype, iChat or FaceTime. Cisco TelePresence can also be used; it is expensive but an actual replacement for in-person communication.	Air Travel	UCR has video conferencing facilities that can be set up on location.
Limit idling time for commercial vehicles, including delivery and construction vehicles.	Post signage in loading/unloading zones and loading docks; enforce via campus police.	Motor Vehicles	UCR will develop and enforce an idling policy for both fleet and vendor vehicles.
All truck loading and unloading docks shall be equipped with one 110/208 volt power outlet for every two dock doors. Diesel trucks shall be prohibited from idling and must be required to connect to the 110/208 volt power to run any auxiliary equipment. Signage shall be provided.	Include strategy in campus operations guidelines.	Motor Vehicles	UCR can require vendors to comply with these requirements once the infrastructure is in place at the necessary loading areas.
Implement a pilot program to implement zero waste events.	Include strategy in campus operations guidelines.	Solid Waste	UCR will consider implementing a pilot program.
Work with vendors to reduce unnecessary packaging.	Include strategy in campus purchasing guidelines.	Solid Waste	UCR will develop the methodology for Environmentally Preferable Purchasing (EPP).

SCOPE III MEASURES			
Reduction Strategy	**Implementation**	**Targeted Emission Source**	**Status**
Encourage environmentally responsible purchasing. Require or give preference to products that reduce or eliminate indirect greenhouse gas emissions, e.g., by giving preference to recycled products over those made from virgin materials.	Include strategy in campus purchasing guidelines.	Solid Waste	UCR will develop the methodology for EPP.
Favor projects that use materials that are resource efficient, recyclable, with long life cycles and manufactured in an environmentally friendly way.	Include strategy in campus design and construction guidelines.	Energy Consumption	UCR will work towards creating a protocol, wherein the applicability of this strategy is reviewed on a case by case basis.
Implement a comprehensive food procurement program that supports local and/or sustainable foods. Procure sustainable foods for 30% of total food purchases.	Include strategy in purchasing guidelines.	Dining	UCR will work with its food distributors, local farmers and the UCR Garden to meet demand.
Educate patrons about sustainable food choices.	Develop educational program/campaign.	Dining	Dining will work with various groups/departments to create educational programs.
Certify one restaurant as a green business by December 2011. Work with third-party food service providers on campus to green their operations.	Certify using s selected system such as Green Seal's Restaurants and Food Services Operations certification program, or the Green Restaurant Association certification program. Incorporate requirements in contracts with third party food service providers.	Dining	Principles are contained in the updated Food Services Section of the UC Policy on Sustainable Practices that will be presented to the Regents for approval in 2011. Energy audits of on-campus dining locations will be scheduled for Winter 2011.

SCOPE III MEASURES			
Reduction Strategy	**Implementation**	**Targeted Emission Source**	**Status**
Reduce use of foodstuffs with a large CO_2 footprint.	Include strategy in purchasing guidelines.	Dining	Dining will review menus. Office of Sustainability will perform analysis.
Trayless Dining.	Implement across campus, develop alternatives for the summer quarter.	Dining	Active at all residence hall dining venues. Trays are presently in use at The Barn.

5.0 OFFSETS

Offsets are GHG emissions credits that are created through emissions reductions or carbon sequestration accomplished by a third party. They are available for purchase through various carbon markets and registries. Offsets must represent real and verified reductions or sequestration produced by a project that is monitored and approved by the registry issuing the offsets. They can be applied to UCR's emissions inventory as a simple way to reduce total emissions and meet reduction targets, including carbon neutrality. However, offsets represent a recurring annual cost unless UCR makes actual reductions of its own that would either reduce or make offsets unnecessary in subsequent years. Offsets are therefore generally seen as a stop-gap or temporary measure, especially as the cost for offsets is volatile and may become prohibitive if a significant number are required by the user. This is especially true as California prepares to launch a carbon cap and trade system, which would likely result in a higher price for offsets due to increased demand. Offsets created by the CCAR are trading on the Green Exchange and the Chicago Climate Futures Exchange for between $2 and $3 per $MTCO_2e$ as of October 5, 2010. However, economic modeling conducted by the California Air Resources Board (CARB) in preparation for a cap and trade system predicts allowance[7] prices between $19 and $83 per metric ton of CO_2, depending on the specific elements of the system. While allowances are not the same as offsets, market values would likely follow a comparable trajectory given their similar roles and parallel market pressures. Meeting the 2014 requirement of matching 2000 emissions levels would require a reduction of approximately 75,000 $MTCO_2e$ under BAU conditions, which equates to a $150,000 annual expense at current offset prices or $1,400,000 at the lowest modeled CARB allowance value under a cap and trade system. Meeting 2020 reduction goals (1990 level emissions) would require approximately 160,000 $MTCO_2e$ in annual reductions, costing $320,000 annually at current prices or over $3,000,000 annually at the lowest modeled value for CARB allowances.

6.0 MONITORING

As a member of the ACUPCC, UCR has specific reporting obligations. These obligations in turn create monitoring and tracking needs in order to create the reports. The ACUPCC requires GHG emissions inventories to be reported every other year and narrative reports describing progress towards reduction goals on alternating years. This is in addition to UCR's other GHG reporting requirements, which include annual reports to TCR. Consequently, UCR must track emissions, actual reductions accomplished, and progress towards reductions targets. This will require regular communication and coordination with

7 Under AB 32 facilities that are included in the cap and trade program would be issued a certain number of "allowances" each year. A facility would need to surrender allowances each year equivalent to their GHG emissions in $MTCO_2e$. Allowances would be freely tradable among facilities in an open market similarly to offsets in existing carbon markets.

various campus departments to gather data. Meticulous recordkeeping is also required, especially as TCR reports must undergo a rigorous third-party verification process.

Additionally, the success of UCR policies and guidelines intended to address sustainability issues must be ensured and evaluated. This includes monitoring a wide variety of efforts, including compliance with campus green building design guidelines by contractors, the design team and facility maintenance personnel, the campus composting program, the generation of power through on-site renewable energy projects, utilization of videoconferencing equipment to reduce business travel, expanding the vanpool and Zipcar programs, etc.

These functions are the responsibility of the Office of Sustainability, who will need to gather data from various campus departments and maintain records of data gathered and calculations made. The specifics of the monitoring program will be decided in collaboration with all campus stakeholders under the supervision of the Office of Sustainability.

7.0 FUNDING

Obtaining funding or earmarking existing funds is a key factor in assessing the feasibility of the emissions reduction measures detailed above. Large energy efficiency projects, such as retrofitting of existing building heating and cooling or lighting systems, typically have both the largest impact and the largest cost. For many UC campuses these programs are funded through the UC Strategic Energy Partnership Program (SEPP) in which the local utilities serving the campuses assist with funding through rebates. UCR is served by Riverside Public Utilities, which does not participate in SEPP. This represents a potentially large gap in funding for energy projects at UCR as compared to other campuses that are funded through SEPP, which in some cases totals over $20 million.

Other funding options exist through the state and federal governments. In California, funding for energy efficiency projects is available through the California Energy Commission (CEC), both from their own budget for research and efficiency projects and from the American Recovery and Reinvestment Act, which provides funds for energy efficiency projects to be administered by the CEC. CARB will also be receiving revenue from the AB 32 Cap and Trade program that is to be used for emissions reductions programs or projects. These funds could be allocated to projects at UC campuses, though the process of collection and allocation is yet to begin; it is still unclear how large the potential pool of either funds or applicants will be. The federal government also provides grants for energy efficiency projects through the US Department of Energy (DOE), though these are primarily for research projects.

Already earmarked or allocated funds can also be used for energy efficiency or sustainability projects. Primarily this is done by incorporating sustainability and efficiency standards into new building design

standards as UCR has done. In addition, there is the potential for using regular maintenance or departmental operating budgets for emissions reduction purposes, such as using high efficiency fixtures, appliances or equipment during regularly scheduled maintenance or replacement.

There is also the potential for funding through private donations, grants, and loans. However, this avenue of funding is highly sensitive to the general economic climate and typically cannot be relied upon to provide regular or substantial amounts of funding. Finally, funding through student fees represents a steady but moderate source of funding. In Spring 2010 student at UCR voted in favor of $2.50 per quarter undergraduate fee for four years to fund sustainability initiatives on the campus. The Associated Students of the University of California, Riverside (ASUCR) will administer the fund, known as the Green Campus Action Plan (GCAP) and select grant recipients. The GCAP will also fund educational programs on sustainability, student sustainability internships and on-campus solar photovoltaic projects from Fall 2010 until Spring 2014.

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APPENDIX A

ESTIMATION OF UCR GHG EMISSIONS

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APPENDIX A – ESTIMATIONS OF UCR GHG EMISSIONS

A.1 Past (1990 & 2000) and Present GHG Inventory

Recognizing the potential environmental, social, and economic damage caused by anthropogenic climate change, the University of California adopted system-wide interim climate protection targets to reduce greenhouse gas emissions from its 10 campuses. UCR is actively establishing and pursuing policies to enable it to meet ACUPCC and UC targets for reducing GHG emissions.

As a means towards establishing transparency and a common set of reporting metrics UCR, as well as the other UC system campuses, utilize the California Climate Action Registry ("CCAR" or "Registry") to measure, third party certify, and publicly report its greenhouse gas emissions. The CCAR is a private non-profit organization formed by the State of California to serve as a voluntary greenhouse gas registry charged with promoting and protecting early actions to reduce greenhouse gas emissions. The CCAR has published a General Reporting Protocol, as well as project- and industry-specific protocols for landfill activities, livestock activities, the cement sector, the power/utility sector, and the forest sector.[8] The protocols provide the principles, approach, methodology, and procedures required for participation in the CCAR. Due to the growth of the CCAR, it now operates under the Climate Action Reserve, which is a national offsets program for the United States carbon market. As part of this transition, the CCAR was instrumental in establishing The Climate Registry, with the mission of expanding the CCAR's emissions reporting work to include all of North America. UCR's 2009 GHG report will be the first report submitted to The Climate Registry. All subsequent reports will be registered at TCR.

Based on the data reported to the CCAR for reporting year 2006 and to the ACUPCC for reporting year 2007, UCR determined baseline greenhouse gas emissions utilizing historical metered data and backcasting. A discussion of UCR's past greenhouse gas emissions inventory for 1990 and 2000 is provided below along with UCR's present greenhouse gas emissions inventory.

The UCR Draft Sustainability Action Plan 2009 documented greenhouse gas emissions associated with campus operations from 1990 through 2008. The plan covers both direct and indirect sources including energy, water, transportation, and waste. As mentioned earlier, the ACUPCC separates emissions into three groups called Scopes. Scope 1 emissions consist of on-campus stationary combustion of fossil fuels, mobile combustion of fossil fuels by institution owned/controlled vehicles, and fugitive emissions (natural gas, campus fleet, fugitive emissions–refrigeration). Scope 2 emissions consist of indirect emissions generated in the production of electricity consumed by the institution (purchased electricity).

8 The GRP can be accessed at www.climateregistry.org/resources/docs/protocols/grp/GRP_3.1_January2009.pdf

Scope 3 emissions consist of all other indirect emissions (air travel, commuting). The past and present greenhouse gas emissions are discussed in detail below by source.

A.1.1 Natural Gas Combustion

According to the California Air Resources Board (CARB) Statewide greenhouse gas emissions inventory for 2008, natural gas combustion comprised approximately 20 percent of the total greenhouse gas emissions.[9] Greenhouse gases resulting from natural gas combustion are dependent on the quantity of natural gas combusted.

UCR uses natural gas primarily to generate steam for heating buildings, and to a lesser extent, for cooking in dining facilities, and burners in laboratories. The quantity of natural gas combusted by UCR was based on actual usage as shown on the campus utility bills for 1990, 2000, and 2008. CARB's *Local Government Operating Protocol* provides greenhouse gas emission factors for natural gas combustion, which are applicable to all years.

Table A-1, Natural Gas Combustion Greenhouse Gas Emissions (1990, 2000, and 2008), summarizes the 1990, 2000, and 2008 greenhouse gas emissions for natural gas combustion. The campus significantly reduced its natural gas consumption between 2003 and 2004 by retrofitting its natural gas fired boilers and installing heat recovery. As a result, even though the building space and population on the campus increased between 2000 and 2008, the total emissions from natural gas combustion decreased during this time.

9 California Air Resources Board, "California Greenhouse Gas 2000-2008 Inventory by Scoping Plan Category - Summary," http://www.arb.ca.gov/cc/inventory/data/data.htm. 2010.

Table A-1
Natural Gas Combustion Greenhouse Gas Emissions (1990, 2000, and 2008)

Scenario Year	Units	Annual Natural Gas Combustion (MMBtu)	Annual CO_2e Emissions ($MTCO_2e$)	Per Unit CO_2e Emissions ($MTCO_2e$/unit)
1990				
Gross Building Square Footage	3,156 ksf	316,490	16,836	5.33
Campus Population	12,105	316,490	16,836	1.39
2000				
Gross Building Square Footage	4,431 ksf	449,921	23,934	5.40
Campus Population	17,695	449,921	23,934	1.35
2008				
Gross Building Square Footage	6,350 ksf	410,000	21,810	3.43
Campus Population	23,829	410,000	21,810	0.92

Source: Impact Sciences, Inc., (2010).
ksf = thousand square feet
MMBtu = million British thermal units
$MTCO_2e$ = metric ton carbon dioxide equivalents

A.1.2 Campus Fleet

Greenhouse gases resulting from UCR's fleet are dependent on a multitude of variables, which include the number of daily trips, trip types (primary, diverted, and pass-by), vehicle miles traveled, fleet characteristics (model years and vehicle types), fuel type, and ambient temperatures.

The URBEMIS2007 Environmental Management Software[10] was used to calculate greenhouse gas emissions associated with the campus fleet. URBEMIS2007 is a land use and transportation computer model designed primarily to estimate regional air emissions from new development projects. The model was developed by CARB and incorporates CARB's EMFAC2007 emissions factor model for on-road motor vehicle sources. The model provides values for average daily trips, trip types, vehicle miles traveled, fleet characteristics (model years and vehicle types), fuel type, and ambient temperatures specific to most air basins and/or counties in California. The model was run using values specific to UCR and Riverside County.

10 Rimpo and Associates, "URBEMIS2007 for Windows," http://www.urbemis.com. 2010.

The vehicle miles traveled for the UCR fleet were based on actual data for 2008. Vehicle miles traveled for 1990 and 2000 were projected using linear regressions. Projections were calculated based on staff population. The URBEMIS2007 model provides fleet characteristics for vehicle type and fuel type. These values were adjusted in the model to represent UCR's fleet vehicles. Vehicle types were adjusted to account for only light-duty automobiles, light-duty trucks, and medium-duty trucks. The fuel type was adjusted to account for only gasoline. While UCR maintains alternative-fueled vehicles, URBEMIS2007 does not account for alternative-fueled vehicles in its fleet mix. Alternative-fueled vehicles were included in the model run, but were assigned to the default gasoline fuel type. URBEMIS2007 does account for hybrid vehicles; however it does not allow the user to enter in a specific number of hybrid vehicles. Therefore, hybrid vehicles were included in the model run, but were assigned to the default vehicle fleet mix. The other variables are based on model default values for Riverside County. URBEMIS2007 is able to model emissions for different scenario years; however, the model only incorporates years 2005 through 2040 – the model does not provide emission factors specific to 1990 and 2000. The year selection primarily affects vehicle emissions and vehicle fleet mix. Since 2005 is the closest year to 1990 and 2000 available in the URBEMIS2007 model, 2005 was selected as a best estimate to model emissions for the 1990 and 2000 baseline years.

The emissions of carbon dioxide (CO_2) were estimated using URBEMIS2007. The model does not provide estimates of other GHGs associated with combustion, namely methane and nitrous oxide. Therefore, in order to account for emissions of these compounds, an adjustment was made to the URBEMIS2007 emission calculations. The carbon dioxide emissions associated with campus fleet were multiplied by a factor based on the estimate that carbon dioxide represents 95 percent of the carbon dioxide equivalent emissions associated with passenger vehicles, which account for most of the commuting-related trips. This assumption was based on data provided by the United States Environmental Protection Agency (USEPA).[11]

[11] United States Environmental Protection Agency, Office of Transportation and Air Quality, *Greenhouse Gas Emissions from a Typical Passenger Vehicle (EPA420-F-05-004)*, (2005) 4.

Table A-2, Campus Fleet Greenhouse Gas Emissions (1990, 2000, and 2008), summarizes the 1990, 2000, and 2008 greenhouse gas emissions for commuting.

The URBEMIS2007 model has certain limitations that affect the emission estimates provided below. While the model includes hybrid-electric vehicles, it does not include alternative-fueled vehicles in the fleet mix. Therefore, the emissions, particularly for 2008, may overestimate the actual greenhouse gas emissions to a small degree, resulting in a conservative assessment.

Table A-2
Campus Fleet Greenhouse Gas Emissions (1990, 2000, and 2008)

Scenario Year	Staff and Faculty Population	Annual CO_2e Emissions ($MTCO_2e$)	Per Unit CO_2e Emissions ($MTCO_2e$/unit)
1990	3,389	699	0.21
2000	4,632	955	0.21
2008	5,750	1,181	0.21

Source: Impact Sciences, Inc., (2010).
$MTCO_2e$ = metric ton carbon dioxide equivalents

A.1.3 Purchased Electricity

According to CARB's statewide greenhouse gas emissions inventory for 2006, electricity generation comprised approximately 22 percent of the total greenhouse gas emissions.[12] Greenhouse gases resulting from electricity generation are dependent on the mix of energy sources used to generate electricity and the quantity of electricity generated.

CARB has compiled greenhouse gas emission factors for major utility providers in the State in its *Local Government Operating Protocol*.[13] The protocol was developed in partnership by CARB with the CCAR and ICLEI - Local Governments for Sustainability (ICLEI). It is designed to provide a standardized set of guidelines to assist local agencies in quantifying and reporting greenhouse gas emissions. The cited greenhouse gas emissions factors in the CARB protocol are based primarily on data collected by the

12 California Air Resources Board, "California Greenhouse Gas 2000-2006 Inventory by Scoping Plan Category - Summary," http://www.arb.ca.gov/cc/inventory/data/data.htm. 2009. Emissions include in-state generation and imported electricity.

13 California Air Resources Board, *Local Government Operating Protocol*, Version 1.0, (2008).

CCAR. The emission factor take into account the current mix of energy sources used to generate electricity and the relative carbon intensities of these sources, and includes natural gas, coal, nuclear, large hydroelectric, and other renewable sources of energy.

The Riverside Public Utilities (RPU) provides electricity to the UCR Campus. RPU is a member of the CCAR and began reporting emissions in 2005. The RPU reported a CO_2 emission factor of 1,333.45 pounds per megawatt hour (lbs/MWh) in 2005. Electricity emission factor for 1990 and 2000 are not available from RPU. The CARB protocol calculated a 1990 statewide average CO_2 emissions factor for electricity of 1,031.14 lbs/MWh. This was calculated by dividing the total statewide electricity emissions by the total Statewide consumption; however, this factor is lower than the RPU factor. The CARB protocol also cites a USEPA-derived CO_2 emissions factor for the Western Electricity Coordinating Council (WECC) California sub-region. The recommended USEPA CO_2 emissions factor for 1990 through 2004 is 804.54 lbs/MWh. This factor is based on the USEPA's Emissions and Generation Resource Integrated Database (eGRID) 2002 (version 2.01) model, which provides data on the environmental characteristics of electric power generated in the United States. This factor is also lower than the RPU factor.

According to information conveyed to UCR from RPU, the energy source mix in 1990 was coal-heavy relative to 2005. Electricity that is generated from coal emits greater amounts of greenhouse gas emissions than electricity generated from other sources such as natural gas. Therefore, this implies that both the CARB and USEPA factors are too low to use for calculating electricity related greenhouse gas emissions for 1990 and 2000. Therefore, the 1990 and 2000 baselines are calculated using the 2005 RPU emission factor, as this is the most accurate figure available.

The quantity of electricity used by UCR was based on actual usage from utility bills for 2008. Electricity usage for 1990 and 2000 were projected using linear regressions. Projections were calculated separately based on gross building square footage and population. This was done because campus square footage and population do not necessarily change in proportion to each other. The average of the square footage and population based projections for each year was determined and used as the final baseline emissions. Backcasting emissions inherently result in some degree of error. By backcasting emissions using an average result of two independent variables, the degree of error can be reduced. This methodology assumes that both square footage and population are equally important factors for determining campus energy use.

In 2007, UCR completed a photovoltaic installation at the James San Jacinto Mountain Reserve, a small UC Natural Reserve System field research site located 50 miles east of the campus in the San Bernardino National Forest. The installation allows the facility to be taken completely off the grid. The polycrystalline

silicon panels produce roughly 27 MWh/year. The 2008 emissions were discounted to take credit for 27 MWh/year of renewable energy.

Table A-3, Purchased Electricity Greenhouse Gas Emissions (1990, 2000, and 2008), summarizes the 1990, 2000, and 2008 greenhouse gas emissions for electricity usage.

Table A-3
Purchased Electricity Greenhouse Gas Emissions (1990, 2000, and 2008)

Scenario Year	Units	Annual Electricity Usage (MWh)	Annual CO_2e Emissions ($MTCO_2e$)	Per Unit CO_2e Emissions ($MTCO_2e$/unit)
1990				
Gross Building Square Footage	3,156 ksf	61,881	37,541	11.89
Campus Population	12,105	63,243	38,368	3.17
Average		62,562	37,954	
2000				
Gross Building Square Footage	4,431 ksf	86,877	52,705	11.89
Campus Population	17,695	92,449	56,085	3.17
Average		89,663	54,395	
2008				
Gross Building Square Footage	6,350 ksf	124,469	75,511	11.89
Campus Population	23,829	124,469	75,511	3.17

Source: Impact Sciences, Inc., (2010).
ksf = thousand square feet
MWh = megawatt hours
$MTCO_2e$ = metric ton carbon dioxide equivalents

A.1.4 Water Usage

Substantial amounts of electricity are needed to supply, convey, distribute and treat water. The California Energy Commission (CEC) reports that the energy intensity of water used by southern California communities is approximately 12,700 kilowatt hours per million gallons (kWh/MG).[14] Because water is potentially supplied, conveyed, distributed, and treated from various parts of the State, the greenhouse gas emission factors used in the analysis were based on statewide factors provided by the CEC. CARB's *Local Government Operating Protocol* provides the Statewide CEC factors for 1990 and 2000. The factor for

14 California Energy Commission, *California's Water-Energy Relationship*, CEC-700-2005-011-SF, (2005) 11.

the year 2008 is not provided; therefore, the most recent factor from 2004 was used to estimate 2008 greenhouse gas emissions.

The quantity of water used by UCR was based on actual usage from utility bills for 2008. Water usage for 1990 and 2000 were projected using linear regressions. Projections were calculated separately based on gross building square footage and population. This was done because square footage and population do not necessarily change in proportion to each other. The average of the square footage and population based projections for each year was determined and used as the final baseline emissions. As with electricity, backcasting emissions inherently result in some degree of error. By backcasting emissions using an average result of two independent variables, the degree of error can be reduced. This methodology assumes that both square footage and population are equally important factors for determining campus water use.

Table A-4, Water Usage Greenhouse Gas Emissions (1990, 2000, and 2008), summarizes the 1990, 2000, and 2008 greenhouse gas emissions for water usage.

Table A-4
Water Usage Greenhouse Gas Emissions (1990, 2000, and 2008)

Scenario Year	Units	Total Water Purchases (MG/year)	Annual CO_2e Emissions ($MTCO_2e$)	Per Unit CO_2e Emissions ($MTCO_2e$/unit)
1990				
Gross Building Square Footage	3,156 ksf	290	1,731	0.55
Population	12,105	296	1,769	0.15
Average		293	1,750	
2000				
Gross Building Square Footage	4,431 ksf	407	1,954	0.44
Population	17,695	433	2,079	0.12
Average		420	2,016	
2008				
Gross Building Square Footage	6,350 ksf	583	3,235	0.51
Population	23,829	583	3,235	0.14

Source: Impact Sciences, Inc., (2010)
MG = million gallons

A.1.5 Commuting

CARB's statewide greenhouse gas emissions inventory for 2006 indicates that passenger vehicles comprised approximately 28 percent of the total greenhouse gas emissions.[15] Greenhouse gases resulting from passenger vehicles commuting to and from UCR are dependent on a multitude of variables, which include the number of daily trips, trip types (primary, diverted, and pass-by), vehicle miles traveled, fleet characteristics (model years and vehicle types), fuel type, and ambient temperatures.

The URBEMIS2007 Environmental Management Software[16] was used to calculate greenhouse gas emissions associated with commuting. The model was run using values specific to UCR and Riverside County. The model estimates the number of average daily trips for colleges and universities based on the student population. Therefore, the student population at UCR for 1990, 2000, and 2008 were used as model inputs. The other variables are based on model default values for Riverside County. URBEMIS2007 is able to model emissions for different scenario years; however, the model only incorporates years 2005 through 2040 – the model does not provide factors specific to 1990 and 2000. Therefore, the 2005 year was selected to model emissions for the 1990 and 2000 baseline years.

The emissions of carbon dioxide were estimated using URBEMIS2007. The model does not provide estimates of other GHGs associated with combustion, namely methane and nitrous oxide. Therefore, in order to account for emissions of these compounds, an adjustment was made to the URBEMIS2007 emission calculations. The carbon dioxide emissions associated with commuting were multiplied by a factor based on the estimate that carbon dioxide represents 95 percent of the carbon dioxide equivalent emissions associated with passenger vehicles, which account for most of the commuting-related trips. This assumption was based on data provided by the USEPA.[17]

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15 California Air Resources Board, "California Greenhouse Gas 2000-2006 Inventory by Scoping Plan Category - Summary," http://www.arb.ca.gov/cc/inventory/data/data.htm. 2009.

16 Rimpo and Associates, "URBEMIS2007 for Windows," http://www.urbemis.com. 2008.

17 United States Environmental Protection Agency, Office of Transportation and Air Quality, *Greenhouse Gas Emissions from a Typical Passenger Vehicle (EPA420-F-05-004)*, (2005) 4.

Table A-5, Commuting Greenhouse Gas Emissions (1990, 2000, and 2008), summarizes the 1990, 2000, and 2008 greenhouse gas emissions for commuting.

Table A-5
Commuting Greenhouse Gas Emissions (1990, 2000, and 2008)

Scenario Year	Enrollment Level*	Annual CO_2e Emissions ($MTCO_2e$)	Per Unit CO_2e Emissions ($MTCO_2e$/unit)
1990	8,716	24,928	3.66
2000	13,063	47,585	3.66
2008	18,079	65,228	3.61

Source: Impact Sciences, Inc., (2010).
$MTCO_2e$ = metric ton carbon dioxide equivalents
* *URBEMIS2007 calculates commuting emissions associated with universities based on student enrollment. Therefore, staff and faculty populations were not included in the analysis although commuting emissions generated by those populations are captured in the numbers reported in this table.*

The URBEMIS2007 model has certain limitations that affect the emission estimates provided above. While the model includes hybrid-electric vehicles, it does not include alternative-fueled vehicles in the fleet mix. Therefore, the emissions, particularly for 2008, may overestimate the actual greenhouse gas emissions to a small degree, resulting in a conservative assessment.

A.2 Future Projections of UCR Greenhouse Gas Emissions

In order for UCR to determine the anticipated level of greenhouse gas emission reductions that would be necessary to meet the University of California adopted system-wide interim climate protection targets (i.e., reducing greenhouse gas emissions to 1990 levels by 2020 and to 2000 levels by 2014) and to achieve climate neutrality as soon as possible in accordance with the ACUPCC, it is essential to predict future anticipated emission levels based on "business as usual" practices. Modeling future emissions requires assumptions about population and facilities growth or decline, as well as anticipated changes in society that may alter energy supplies, change energy efficiency and travel behavior. This plan adopts 2020 as the planning horizon, as it is a useful horizon for long-range planning and a target year identified by UC.

In 2005, The Regents of the University of California adopted the 2005 UCR Long Range Development Plan (LRDP) which describes the campus's future growth in terms of increases in student enrollment, faculty and staff population, building square footage, and other programs. The 2005 UCR LRDP uses

2001 as the baseline year and describes campus growth through academic year 2015/16. In 2009, in view of the economic downturn, UCR revisited its growth projections and determined that forecast levels of enrollment and building space increases will now likely be attained by academic year 2020/21 (five years later than previously projected). Additionally, UCR produced the 2009-19 Capital Financial Plan (Capital Plan) which provides an overview of planned capital investments in the campus that reflects the current and projected funding environment. Given the uncertainty of funding going forward and the general economic climate, the development described in the Capital Plan is significantly less than in the 2005 LRDP. The projections in the Capital Plan are considered more likely to be realized than those in the 2005 LRDP. For the purpose of forecasting future emissions for this UCR CAP, the projected increase in campus population and square footage as reflected in the Capital Plan were utilized.

A.2.1 Projected "Business as Usual" emissions through 2020

UCR is anticipated to pursue significant development that will result in future population growth and facilities (building space) growth. By 2020, as identified in the 2005 LRDP Amendment 2 proposal, UCR anticipates having a population of 25,000 students, 12,567 faculty and staff, and 3,826 other individuals for a total of 41,393 people. By 2020, UCR anticipates in the Capital Plan that the campus will have approximately 8,429,223 square feet of gross building space. Compared to 2008 levels, this represents a growth in population of 68 percent and a growth in building space of nearly 33 percent.

Future 2014 and 2020 greenhouse gas emissions from Scope 1, 2, and 3 sources were projected using linear regressions from 2008 data. Projections for natural gas, electricity, and water were calculated separately based on growth in gross building square footage and population. This was done because square footage and population do not necessarily change in proportion to each other. The average of these two projections was determined and used as the final 2014 and 2020 emissions. Projecting emissions inherently results in some degree of error. By projecting emissions using an average result of two independent variables, the degree of error can be reduced. This methodology assumes that both square footage and population are equally important factors for determining campus natural gas, electricity, and water use.

Projections for campus fleet and commuter trips were calculated based on growth in staff population and student population in 2020, respectively. It was assumed that the number of commuter vehicles, whether campus owned or student/staff/faculty owned, is primarily impacted by faculty/staff populations that would be the primary operators of such vehicles. As previously discussed, commuter trips for 2020 are estimated using the URBEMIS2007 model, which estimates trips associated with universities based on student enrollment levels only. Therefore, commuter trips are based on growth in the student population, as calculated by URBEMIS2007. Emissions for 2014 were estimated as a straight-line regression between

2008 and 2020 emissions. This was done due to a lack of information regarding forecast populations specifically for 2014 as well as the very consistent per unit emission levels for vehicle emissions.

Greenhouse gas emissions factors previously identified above were used to estimate the 2014 and 2020 emissions. Because the emissions factors do not account for future anticipated reductions from land use (such as increased on-campus housing) and transportation improvements, technology improvements or regulatory actions, the 2014 and 2020 emissions are considered to be "business as usual." Other assumptions used in the future projections are discussed below.

A.2.2 Natural Gas Combustion

The quantity of natural gas used by UCR in 2014 and 2020 was projected using a linear regression of 2008 data. It was assumed that new building construction would be built to exceed the energy efficiency standards of the existing buildings in accordance with the California Title 24 (2008) building code standards. Data from the California Energy Commission indicates that nonresidential buildings that meet the Title 24 (2008) standards are approximately 9.4 percent more efficient than buildings that were constructed to meet the previous Title 24 (2005) standard with respect to natural gas combustion. Therefore, the quantity of natural gas combusted was reduced by a factor of 9.4 percent for new construction.

A.2.3 Campus Fleet

Future 2020 campus fleet emissions were calculated using URBEMIS2007, as described previously. URBEMIS2007 is able to model emissions for different scenario years. Therefore, the 2020 year was selected to model emissions for the 2020 future year. Year 2014 emissions were calculated as a straight-line regression from 2008 and 2020 given the consistent per unit emissions.

A.2.4 Purchased Electricity

The quantity of electricity to be used by UCR in 2014 and 2020 was projected using a linear regression of 2008 data. It was assumed that new building construction would be built to exceed the energy efficiency standards of the existing buildings in accordance with the California Title 24 (2008) building code standards. Data from the California Energy Commission indicates that nonresidential buildings that meet the Title 24 (2008) standards are approximately 4.9 percent more efficient than buildings that were constructed to meet the previous Title 24 (2005) standard with respect to electricity. Therefore, the quantity of electricity was reduced by a factor of 4.9 percent for new construction.

A.2.5 Water

Future 2014 and 2020 campus water-related electricity emissions were calculated using the methodologies described above.

A.2.6 Commuting

Future 2020 commuting emissions were calculated using URBEMIS2007, as described previously. URBEMIS2007 is able to model emissions for different scenario years. Therefore, the 2020 year was selected to model emissions for the 2020 future year. Year 2014 emissions were calculated as a straight-line regression from 2008 and 2020 given the consistent per unit emissions.

UCR's projected 2020 emissions by source are presented in **Table A-6, UC Riverside's 2020 Greenhouse Gas Emissions by Source**, below.

Table A-6
UC Riverside's 2020 Greenhouse Gas Emissions by Source

Emissions Source	Metric Tons (CO_2e)	Percentage of Total Inventory
Natural Gas Combustion	32,328	13.3
Purchased Electricity	113,735	46.8
Campus Fleet	2,165	0.9
Imported Water	4,957	2.0
Commuting	89,967	37.0
Total	**243,153**	**100.0**

Source: UCR Environmental Health & Safety, Physical Plant, Transportation and Parking Services, Housing, (2009).

Table A-7, UCR Summary of Past, Present, and Future Greenhouse Gas Emissions, summarizes the 1990, 2000, 2008, 2014 and 2020 greenhouse gas emissions for UCR.

Table A-7
UCR Summary of Past, Present, and Future Greenhouse Gas Emissions

Scenario Year	Gross Building Square Feet (ksf)	Population	Total CO_2e Emissions ($MTCO_2e$)	Per Thousand Square Feet CO_2e Emissions ($MTCO_2e$/ksf)	Per Capita CO_2e Emissions ($MTCO_2e$ per capita)
1990	3,156	12,105	82,167	26.03	6.79
2000	4,431	17,695	128,886	29.09	7.28
2008	6,350	23,829	166,966	26.29	7.01
2014 (BAU)	7,389	32,611	205,060	27.75	6.29
2020 (BAU)	8,429	41,393	243,153	28.85	5.87
Reductions from 2020 levels to meet 1990 target:			**160,986**		

Source: Impact Sciences, Inc., (2010).
BAU = business as usual
ksf = thousand square feet
$MTCO_2e$ = metric ton carbon dioxide equivalents

The date presented above illustrates projected "business as usual" greenhouse gas emissions for UCR between 2008 and 2020. These are the emissions levels expected in the future assuming Campus population and building growth, and no further emission reduction efforts on the part of UCR beyond the status quo. The modeling predicts an overall increase in total emissions by 2020, by about 76,187 $MTCO_2e$. In order to meet the 1990 target established by the University of California, UCR must reduce its emissions by approximately 160,986 $MTCO_2e$ from "business as usual" conditions.

A.3 Reduction Measures

UCR completed a survey of GHG emissions reductions measures at the campus (completed, underway or planned) in conjunction with those described by other organizations. These other organizations include universities (especially UC campuses), the California Air Pollution Control Officers' Association (CAPCOA), the California Attorney General (CA AG) and the ACUPCC. Measures undertaken by other universities and those suggested by CAPCOA, the CA AG and the ACUPCC were combined with those already compiled at UCR to generate a master list of reductions measures relevant to the campus. These measures were further refined by examining their feasibility and suitability under the specific current and

near future circumstances at the campus. Those measures that were judged feasible and not already completed or ongoing at UCR are listed below as future reductions measures.

Time frame for the measures reflects both economic feasibility and planning logistics. Ongoing refers to projects already initiated by UCR to mitigate GHG emissions that will be continued into the future. Near-term projects are projects that can be implemented and/or completed in one to two years. Mid-term projects may require two – five years for implementation due to cost, complexity or construction and replacement cycles. Long-term projects are expected to begin or reach their optimal levels after five years due to excessive cost or supply and technological barriers.

Where possible, estimates of cost and reduction effectiveness were included, though these estimates are typically very loose and have large ranges of possible values. This is due both to the limited amount of publicly available information on these factors as well as the unique nature of many of the projects the information was sourced from. For example, the cost and effectiveness of replacing the heating ventilation and air-conditioning system of a building would depend on a number of factors, including building size, function and age, the number of heating and cooling degree days at the location, the thermal characteristics of the building, the type of system installed, and much more. In most cases the only information provided was a total cost and/or emissions reduction along with a very general description of the project. Therefore the cost and effectiveness figures should be taken only as very general indications of the relative size of these parameters among the various measures considered.

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Table A-8
UCR Future GHG Reduction Measures

SCOPE I MEASURES						
Reduction Strategy	**Implementation**	**Targeted Emission Source**	**Status**	**Time Frame**	**Reduction**	**Cost**
Promote "least polluting" ways to connect people and goods to their destinations. Provide information on all options for individuals and businesses to reduce transportation-related emissions. Provide education and information about public transportation.	Produce and distribute literature describing available alternatives and their relative impacts, including instructions for use where applicable.	Motor Vehicles	The Office of Sustainability (with ODC) is tasked to work with TAPS to further increase awareness and develop educational material to help reduce transportation related emissions.	Ongoing	Variable	Minimal

SCOPE II MEASURES						
Reduction Strategy	**Implementation**	**Targeted Emission Source**	**Status**	**Time Frame**	**Reduction**	**Cost**
Develop a campus certification program for departments or groups meeting sustainability or emissions reductions targets.	Provide targets for departments with official recognition of those departments that meet them.	Energy Consumption	The Office of Sustainability will be in charge of developing this program.	Midterm	Variable	Minimal

SCOPE II MEASURES						
Reduction Strategy	**Implementation**	**Targeted Emission Source**	**Status**	**Time Frame**	**Reduction**	**Cost**
Develop energy intensity standards for the campus's major space usage types.	Include strategy in design and construction guidelines and/or initiatesfor retrofit projects.	Energy Consumption	Details of administering such a program will be established.	Midterm	Variable, depending on standards assigned	N/A
Draft and adopt "cool roof" guidelines, require in all new construction projects and retrofit of existing roofs.	Include strategy in design and construction guidelines and/or initiate for retrofit projects.	Energy Consumption	Retrofit of existing roofs will only occur when required as part of deferred maintenance.	Midterm	Low	Minimal
Incentive or cost-sharing program to encourage departments or administrative groups to replace older appliances and equipment.	Establish a campus-level fund to support departments in replacing appliances. Consider loan program or joint curricular program to fund operations.	Energy Consumption	Previously implemented when City of Riverside initiatives were available. Future implementation will depend on availability of fiscal incentives.	TBD	400-500 MT CO_2e per year per 1,000 appliances replaced	$100-500 per appliance
Install light emitting diodes (LEDs) for traffic, street and other outdoor lighting.	Replace older lighting with modern high-efficiency lighting.	Energy Consumption	The campus is evaluating energy efficient outdoor lighting alternatives including LED and induction lighting and is committed to retrofitting to achieve energy use savings.	Midterm	90% reductions, assuming incandescent replaced by LED	N/A

SCOPE II MEASURES						
Reduction Strategy	**Implementation**	**Targeted Emission Source**	**Status**	**Time Frame**	**Reduction**	**Cost**
Launch fume hood sash management campaign.	Education, signage, and possible installation of sensors to shut off fume hoods when not in use; also deploy a "shut the sash" campaign to shape user behavior and save energy.	Energy Consumption	The Office of Sustainability will manage this campaign.	Near-term	2-3 MT CO_2e per year per fume hood	Minimal

SCOPE III MEASURES						
Reduction Strategy	**Implementation**	**Targeted Emission Source**	**Status**	**Time Frame**	**Reduction**	**Cost**
Reduce business air travel by developing programs and technologies for remote conferencing.	Purchase equipment for videoconferencing; develop policy encouraging or requiring remote conferencing under specific circumstances (travel distance, type of event, etc). This could work in conjunction with upgraded phone systems, VOIP or computer based programs like Skype, iChat or FaceTime. Cisco TelePresence can also be used; it is expensive but an actual replacement for in-person communication.	Air Travel	UCR has video conferencing facilities that can be set up on location.	Ongoing	100-200 MT CO_2e per year	$30-40,000 one-time cost for campus-wide videoconferencing system
Limit idling time for commercial vehicles, including delivery and construction vehicles.	Post signage in loading/unloading zones and loading docks; enforce via campus police.	Motor Vehicles	UCR will develop and enforce an idling policy for both fleet and vendor vehicles.	Ongoing	Variable	Minimal

SCOPE III MEASURES						
Reduction Strategy	**Implementation**	**Targeted Emission Source**	**Status**	**Time Frame**	**Reduction**	**Cost**
All truck loading and unloading docks shall be equipped with one 110/208 volt power outlet for every two dock doors. Diesel trucks shall be prohibited from idling and must be required to connect to the 110/208 volt power to run any auxiliary equipment. Signage shall be provided.	Include strategy in campus operations guidelines.	Motor Vehicles	UCR can require vendors to comply with these requirements once the infrastructure is in place at the necessary loading areas.	Midterm	20-70% reduction in emissions during loading/ unloading	N/A
Implement a pilot program to implement zero waste events.	Include strategy in campus operations guidelines.	Solid Waste	UCR will consider implementing a pilot program.	Near-term	Variable	Minimal
Work with vendors to reduce unnecessary packaging.	Include strategy in campus purchasing guidelines.	Solid Waste	UCR will develop the methodology for Environmentally Preferable Purchasing (EPP).	Ongoing	Low	Minimal

SCOPE III MEASURES						
Reduction Strategy	**Implementation**	**Targeted Emission Source**	**Status**	**Time Frame**	**Reduction**	**Cost**
Encourage environmentally responsible purchasing. Require or give preference to products that reduce or eliminate indirect greenhouse gas emissions, e.g., by giving preference to recycled products over those made from virgin materials.	Include strategy in campus purchasing guidelines.	Solid Waste	UCR will develop the methodology for EPP.	Ongoing	Variable	N/A
Favor projects that use materials that are resource efficient, recyclable, with long life cycles and manufactured in an environmentally friendly way.	Include strategy in campus design and construction guidelines.	Energy Consumption	UCR will work towards creating a protocol, wherein the applicability of this strategy is reviewed on a case by case basis.	Near-term	N/A	N/A
Implement a comprehensive food procurement program that supports local and/or sustainable foods. Procure sustainable foods for 30% of total food purchases.	Include strategy in purchasing guidelines.	Dining	UCR will work with its food distributors, local farmers and the UCR Garden to meet demand.	Long-term	Variable	N/A

SCOPE III MEASURES						
Reduction Strategy	**Implementation**	**Targeted Emission Source**	**Status**	**Time Frame**	**Reduction**	**Cost**
Educate patrons about sustainable food choices.	Develop educational program/campaign.	Dining	Dining will work with various groups/departments to create educational programs.	Ongoing	Variable	N/A
Certify one restaurant as a green business by December 2011. Work with third-party food service providers on campus to green their operations.	Certify using s selected system such as Green Seal's Restaurants and Food Services Operations certification program, or the Green Restaurant Association certification program. Incorporate requirements in contracts with third party food service providers.	Dining	Principles are contained in the updated Food Services Section of the UC Policy on Sustainable Practices that will be presented to the Regents for approval in 2011. Energy audits of on-campus dining locations will be scheduled for Winter 2011.	Near-term	Low	N/A
Reduce use of foodstuffs with a large CO_2 footprint.	Include strategy in purchasing guidelines.	Dining	Dining will review menus. Office of Sustainability will perform analysis.	Midterm	Variable	N/A
Trayless Dining.	Implement across campus, develop alternative for Summer.	Dining	Active at all residence hall dining venues. Trays are presently in use at the Barn.	Ongoing	Low	N/A

APPENDIX B

GLOSSARY OF TERMS

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APPENDIX B – GLOSSARY OF TERMS

AASHE	Association for the Advancement of Sustainability in Higher Education. "AASHE's mission is to empower higher education to lead the sustainability transformation" (AASHE, 2011).
ACUPCC	American College and University President's Climate Commitment. Presidents and Chancellors pledge to reduce GHG emissions by 80 percent before mid-century (ACUPCC, 2010).
ASUCR	Associated Students of the University of California, Riverside. Student government at the University of California, Riverside.
BAU	Business as Usual. In the context of this report, greenhouse gas emissions that would occur without further policy intervention.
CA AG	California Attorney General. The Attorney General represents the people of California in civil and criminal matters before trial courts, appellate courts and the supreme courts of California and the United States.
CA-CP	Clean Air-Cool Planet. "Clean Air-Cool Planet creates partnerships in the Northeast to implement solutions to climate change and build constituencies for effective climate policies and actions" (CA-CP, 2004). CA-CP provides a data collecting tool for calculating greenhouse gas emissions from campus activities.
CAP	Climate Action Plan. A plan for measuring and mitigating greenhouse gas emissions produce from university activities, and associated activities that directly relate to the institution.
CAPCOA	California Air Pollution Control Officers' Association. An association of Air Pollution Control Officers representing all thirty-five local air quality agencies throughout California.
CARB	California Air Resources Board. CARB is part of the California Environmental Protection Agency, which "promotes and protects public health, welfare and ecological resources through the effective and efficient reduction of air pollutants while recognizing and considering the effects on the economy of the state" (CARB, 2010).
CCAR	California Climate Action Registry. "The California Climate Action Registry (the Registry) was established by California statute as a non-profit voluntary registry for greenhouse gas (GHG) emissions. The purpose of the Registry is to help companies and organizations with operations in the state to establish GHG emissions baselines against which any future GHG emission reduction requirements may be applied" (CCAR, 2006).
CEC	California Energy Commission. The CEC "is the state's primary energy policy and planning agency" (CEC, 2010).

Glossary of Terms (Cont.)

CEQA	California Environmental Quality Act. "The California Environmental Quality Act is a statute that requires state and local agencies to identify the significant environmental impacts of their actions and to avoid or mitigate those impacts, if feasible" (CEQA, 2010).
CH_4	Methane. One of the six regulated greenhouse gases.
CO_2	Carbon Dioxide. One of the six regulated greenhouse gases.
DOE	Department of Energy. The United States Department of Energy's mission is to advance the national, economic, and energy security of the United States; to promote scientific and technological innovation in support of that mission; and to ensure the environmental cleanup of the national nuclear weapons complex.
eGRID	Emissions and Generation Resource Integrated Database. A model, which provides data on the environmental characteristics of electric power generated in the United States.
EPP	Environmentally Preferred Purchasing. EPP is a policy the requires or encourages the purchasing of goods and services that take into consideration their impact on the natural environment in regards to materials, toxicity, greenhouse gas emissions and waste generation.
GCAP	Green Campus Action Plan. A three-part initiative by the undergraduate students of the University of California, Riverside to help reduce the campus' environmental impact and increase student empowerment.
GHG	Greenhouse Gas. Specifically the 6 gases recognized by the Kyoto Protocol: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6) (IPCC, 2006).
GWP	Global Warming Potential. "Global warming potential is a measure of how much a given mass of greenhouse gas is estimated to contribute to global warming. It is a relative scale which compares the gas in question to that of the same mass of carbon dioxide (whose GWP is by definition 1). A GWP is calculated over a specific time interval and the value of this must be stated whenever a GWP is quoted or else the value is meaningless" (Wikipedia GWP, 2006).
HDRS	Housing, Dining and Residence Services. Responsible for campus housing and dining at the University of California, Riverside.
HFCs	Hydrofluorocarbons. One of the six regulated greenhouse gases.
HVAC	Heating Ventilation and Air Conditioning. HVAC is "a system that provides heating, ventilating, and/or cooling within or associated with a building" (EERE, 2006).

Glossary of Terms (Cont.)

ICLEI	Originally called the "International Council for Local Environmental Initiatives." However, members voted to change the name to "ICLEI – Local Governments for Sustainability." ICLEI is an international association of local governments as well as national and regional local government organizations who have made a commitment to sustainable development. ICLEI provides technical consulting, training, and information services to build capacity, share knowledge, and support local government in the implementation of sustainable development at the local level.
IPCC	Intergovernmental Panel on Climate Change. "The role of the IPCC is to assess on a comprehensive, objective, open and transparent basis the scientific, technical and socioeconomic information relevant to understanding the scientific basis of risk of human induced climate change, its potential impacts and options for adaptation and mitigation"(IPCC, 2006).
kWh	Kilowatt-hour. Equivalent to 1,000 watt-hours: "A heater rated at 1,000 watts (1 kilowatt), operating for one hour uses one kilowatt hour (equivalent to 3,600 kilojoules) of energy. Using a 60 watt light bulb for one hour consumes 0.06 kilowatt hours of electricity. Using a 60 watt light bulb for one thousand hours consumes 60 kilowatt hours of electricity." (Wikipedia Watt-Hour, 2010).
LED	Light Emitting Diode. A high efficient light source which can reduce energy consumption by 90 percent over the life of the bulb in comparison to an incandescent bulb with the same luminosity.
LEED	Leadership in Energy and Environmental Design. LEED "is an internationally recognized green building certification system" (USGBC, 2010). The various classifications of certifications are: • CI – Commercial Interiors • CS – Core and Shell • EBOM – Existing Building Operations and Maintenance • NC – New Construction
LRDP	Long Range Development Program. An LRDP provides a 10-year plan for meeting the needs of expected growth in campus population and associated space needs.
MG	Million Gallons. Large scale water use is measured in MGs.
$MTCO_2e$	Metric Ton Carbon Dioxide Equivalent. Equal to 1,000 kilograms or 2,200 pounds of carbon dioxide (IPCC, 2006).
MW	Megawatt. Equal to 1 million (10^6) watts (Wikipedia, 2010). Utility scale power and large renewable energy projects are measured in MWs.
N_2O	Nitrous Oxide. One of the six regulated greenhouse gases.
PFCs	Perfluorocarbons. One of the six regulated greenhouse gases.

Glossary of Terms (Cont.)

RPU	Riverside Public Utilities. Provides electricity and gas to Riverside County residences and businesses, including the University of California, Riverside.
RTA	Riverside Transit Authority. Provides bus transportation for Riverside County.
SEPP	Strategic Energy Partnership Program. A program in which the local utilities serving the campuses assist with funding through rebates.
SF_6	Sulfur Hexafluoride. One of the six regulated greenhouse gases.
SOM	School of Medicine. The University of California, Riverside School of Medicine.
TAPS	Transportation and Parking Services. "Administers a Transportation Demand Management program that satisfies parking demand while complying with air quality and sustainability goals to reduce the number of single-occupant commuter vehicles and fossil fuel emissions" (TAPS, 2010).
TCR	The Climate Registry. An independent body established to register greenhouse gas emissions from universities, non-profits, governmental organizations and corporate entities in North America.
UCOP	University of California Office of the President. "The system-wide headquarters of the University of California" (UCOP, 2010).
UCR	University of California, Riverside.
URBEMIS	Urban Emissions Model. Air pollutant emissions model developed by the California Air Resources Board.
USEPA	United States Environmental Protection Agency. Established in 1970 to protect human health and the environment.