

2008 GHG Inventory



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Executive Summary

This report is prepared in pursuant to the American College & University Presidents Climate Commitment signed by President Horace Mitchell of California State University, Bakersfield. As part of this commitment, the university has agreed to initiate the following actions to reduce greenhouse gases within two years of the implementation start date of September 2007: (i) establish a policy that all new campus construction will be built to at least the U.S. Green Building Council's LEED Silver standard or equivalent; (ii) adopt an energy-efficient appliance purchasing policy requiring purchase of ENERGY STAR certified products in all areas for which such ratings exist; (iii) within one year of signing the initiative, begin purchasing or producing at least 15% of our institution's electricity consumption from renewable sources; In addition to committing to at least two of the seven listed initiatives, each signatory is required to conduct a greenhouse gas emissions inventory of the campus. The following report is such an inventory.

This report is intended to be a baseline for future emissions inventories. It is intended to serve as a guide for the initiatives leading to greenhouse gas emissions reductions. Towards that end the CSUB campus has already started to implement some of the initiatives it agreed to as a charter signatory. The first new building (the Math/Science building) to be completed after 2007 is built to LEED Silver equivalent standard, as is an upcoming Student Recreation Center; there has also been a purchase of energy-efficient air conditioners for student housing; also, with a new public-private partnership, CSUB will be buying 30% of its electricity generated by solar power. Current practices on the CSUB campus generate approximately 10,709 MT eCO₂, with the largest contributor (55%) to the campus greenhouse gas emissions being purchased electricity. Faculty and staff commuting contributed approximately 30% of the greenhouse gas emissions.

Purpose

In December of 2006, a group of colleges and university presidents launched an initiative called the American College & University Presidents Climate Commitment (ACUPCC). The goal of this initiative was for "...colleges and universities [to] exercise leadership in their communities and throughout society by modeling ways to minimize global warming emissions, and by providing the knowledge and the educated graduates to achieve climate neutrality" (ACUPCC 2007). The signatories to this commitment, agreed to

"... eliminate their campuses' greenhouse gas emissions in a reasonable period of time as determined by each institution. This involves:

- Setting up a mechanism (committee, task force, office, etc.) within 2 months to guide the process.
- Completing an inventory of greenhouse gas emissions within 1 year, from the subsequent of the three annual start-dates: September 15, January 15, or May 15.
- Creating and implementing a climate neutral plan (that includes a target date and interim milestones for achieving campus climate neutrality) within 2 years.
- Taking 2 of 7 immediate steps specified in the commitment to reduce greenhouse gas emissions while the more comprehensive plan is being developed.
- Integrating sustainability into the curriculum and making it part of the educational experience.
- Making the action plan, inventory and periodic progress reports publicly available." (ACUPCC 2007)

President Horace Mitchell is a charter signatory to the ACUPCC, having signed the climate initiative in 2007. As per the agreement, the initial GHG inventory was due by Sept 15, 2008. Due to the late start on our campus, in accordance with ACUPCC rules, CSUB was awarded a four month extension to January 15, 2009. This greenhouse gas inventory report is a first step towards meeting the campus' goal of reducing greenhouse gas (GHG) emissions as dictated by the ACUPCC.

A secondary objective of this report is to provide some information to the CSUB campus community and the Bakersfield community at large in regards to the urgency of climate change and the efforts by California State University, Bakersfield to meet the challenge of reducing its impact on climate change and its attempts at becoming a sustainable campus.

Background

The ACUPCC was motivated to form the climate change initiative because they felt “[t]he unprecedented scale and speed of global warming and its potential for large-scale, adverse health, social, economic and ecological effects threatens the viability of civilization” (ACUPCC 2007). Global warming is the general trend of rising average temperature of the globe (see figure 1). While climate typically changes over time, climate change as it is referred to today, is the change in the earth’s climate mainly as a result of human activities. This rising trend in the earth’s average temperature has been especially prominent over the last century.

Warming Planet

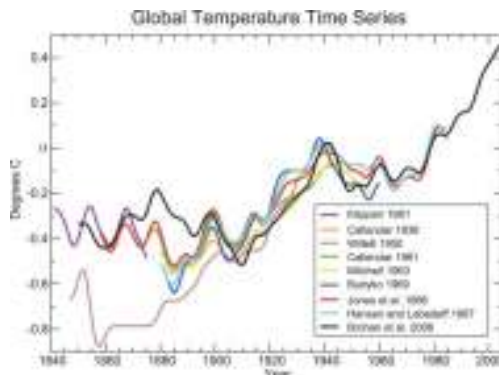


Figure 1: Global Temperature Change

Source: (IPCC 2008)

In order to study this complex issue, the Intergovernmental Panel on Climate Change (IPCC) was formed in 1988. As a scientific intergovernmental body, IPCC provides research on the science of climate change by the global scientific community. The science provided by the IPCC is “...achieved through contributions from experts in all regions of the world and all relevant disciplines including, where appropriately documented, industry literature and traditional practices, and a two stage review process by experts and governments” (IPCC 2008). For “their efforts to build up and disseminate greater knowledge about man-made climate change, and to lay the foundations for the measures that are needed to counteract such change” (Nobel Foundation 2007), the IPCC, along with former Vice-President Al Gore, was awarded the Nobel Peace Prize in 2007.

As can be seen in Figure 1, average global temperatures have risen approximately 1° C (about 1.7° F) over the last one hundred years. While this may not seem a significant change, it has resulted in and will continue to result in the dramatic alteration of life on this planet. In fact the IPCC predicts that global temperatures may rise between 1° C and 6° C over the next hundred years. The IPCC has also found enough scientific evidence to support the theory that these changes are mainly due to anthropogenic activities.

Among the many impacts of climate change are rising sea levels, increasing rainfall in some areas, while at the same time decreasing rainfalls in others. The biggest impact of global warming is expected to be the wide variance in weather patterns, especially the severity of weather disasters. While there are a few scientists who dispute the IPCC’s findings, an overwhelming majority of scientists working on climate change have found supporting evidence of a warming planet.

Causes of climate change

According to the IPCC, the likely cause of global warming is the rising concentration levels of carbon dioxide (CO₂) in the atmosphere. Anthropogenic activities such as the burning of fossil fuels are the primary reasons for the increase in CO₂ levels (BBC News 2005). Figure 2 is a well known graph depicting the atmospheric CO₂ levels over the last two millennia.

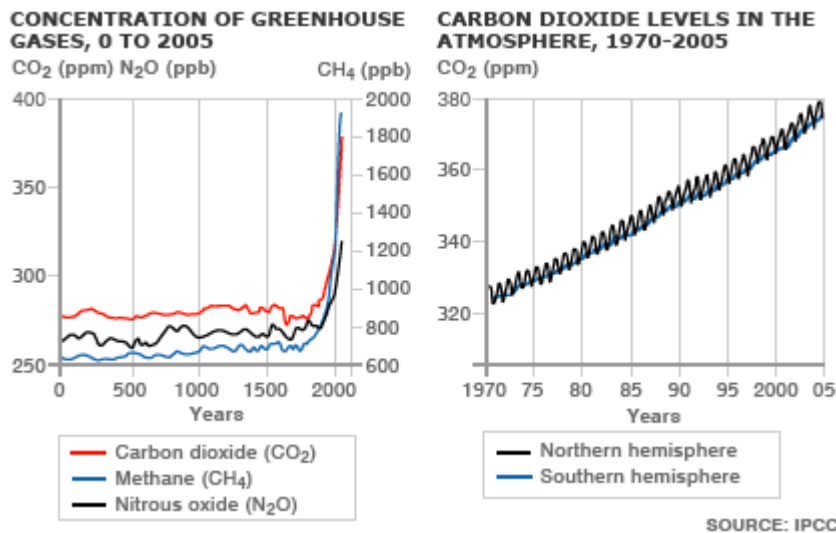


Figure 2: GHG and CO₂ Levels

Greenhouse Effect

The greenhouse effect is the naturally occurring phenomenon which keeps the earth's temperature at current levels, approximately 30° C warmer than it otherwise would have been. The gases which result in the greenhouse effect are known as greenhouse gases (GHG). The four major GHGs are carbon dioxide, methane, nitrous oxide and ozone. Of these GHG, the major contributor to climate change is CO₂. Figure 2 shows the increasing levels of GHG as well as the rapid rise in CO₂ levels. When fossil fuels are burned for energy¹ they release CO₂. As industrial activity has increased over the last few centuries, the world has become ever more reliant on energy, thus speeding up the atmospheric CO₂ concentration levels. As developing countries increase their consumption of global energy, these concentration levels are expected to rise at a faster pace than in the past.

Global Action

The general consensus among scientists is that it is already too late to prevent climate change. However, by reducing GHG the impact of climate change can be limited. In order to accomplish this, activities that release GHG emissions should be curtailed. If societies start moving towards carbon neutrality, the meteoric rise in GHG can be hindered.

Kyoto Protocol

In 1997 many world leaders gathered in Kyoto, Japan, in order to arrive at an action plan to deal with global warming². The resulting treaty, the Kyoto Protocol, was signed by most major countries, with the exception of Australia and the US. However, in the intervening years since Kyoto, both the US and Australia have agreed to the protocol in principle. Most developed countries agreed to reduce their GHG emissions by 5.2%

¹ It is estimated that approximately 90% of the energy used in the world is derived from the burning of fossil fuels.

² Typically the phrases 'global warming' and 'climate change' are used interchangeably. However, climate change is the broader term that includes global warming, which is limited in definition to the warming of the earth.

compared to the levels in 1990, which translates into an approximately 30% reduction in current GHG.

Regional Action

The state of California has also taken a position on climate change, by signing into law AB 32 during the year 2006. AB 32 “[e]stablishes first-in-the-world comprehensive program of regulatory and market mechanisms to achieve real, quantifiable, cost-effective reductions of greenhouse gases (GHG)” (California Air Resources Board 2006). Among other things, it requires California businesses to reduce GHG emissions by 2020, compared to 1990 levels; and requires that by 2020, approximately 30% of energy consumed be produced by renewable sources. The legislation allows for the establishment of market mechanisms towards the goal of capping GHG emissions.

Markets for emissions trading

Both the Kyoto Protocol and AB 32 allow for the emergence of markets to trade GHG emissions permits. The idea behind tradeable permits is that everyone (whether the market is conducted at a national governmental level or at a corporate level) is allowed a certain amount of GHG emissions, the so called ‘cap’. Once an entity exceeds its cap, various penalties would take place. The caps would be reduced periodically so as to keep global levels of GHG emissions at prescribed levels. Those entities, through various measures and policies that reduce their GHG emissions, who find their emissions to be below their respective caps, would then be able to trade the remainder to other entities that exceed their own caps.

Whether it is enacted through legislation or facilitated by a market mechanism, the general consensus among majority of the citizens of the world is that actions must be taken to reduce the impact of human activities on climate change. It is with this notion that President Mitchell, along with 605 other presidents³, signed the ACUPCC climate change initiative. This report is presented in meeting one of the obligations of that commitment.

³ As of January 2009 (Source: (ACUPCC 2007))

The Inventory

The GHG emissions inventory was conducted using the Campus Carbon Calculator™ v6 provided by Clean Air - Cool Planet. This software is an Excel based program that calculates GHG emissions of various activities and converts them into metric tons of equivalent carbon dioxide (MT eCO₂). The spreadsheets within the calculator are based on workbooks by the IPCC. By identifying the major sources of emissions on a campus, the tool allows institutions to better plan a course of action to reach the goal of carbon neutrality.

There are many variables that are used to calculate the net GHG emissions of a campus. Due to some unanticipated constraints in the data gathering process, the CSUB calculations were based on limited variables for the year 2007. The complete list of variables used in our calculations, in addition to the source of the data, is available in Table 1.

Table 1: Variables used in Carbon Calculator

Variable	Data	Source Department
Operating Budget	Dollars	Facilities Planning, Development & Operations
Energy Budget	Dollars	Facilities Planning, Development & Operations
Total Building Space	Square Feet	Facilities Planning, Development & Operations
Research Building Space	Square Feet	Facilities Planning, Development & Operations
Fleet Vehicle Use	Gallons	Facilities Planning, Development & Operations
Hydrofluorocarbons (HFC)		
Purchased Electricity	kWh	Facilities Planning, Development & Operations
Staff Head Count	Number	Human Resources
Faculty Head Count	Number	Human Resources
Student Head Count	Number	Institutional Research, Planning & Assessment

Scopes

Emissions arising out of anthropogenic activities can be divided into three main Scopes, based on operational boundaries: Scope 1, Scope 2 and Scope 3.

Scope 1

These are direct sources of GHG emissions owned or operated by the campus. The applicable Scope 1 sources on CSUB are fleet vehicles and refrigerants.

Scope 2

These are indirect emissions that are generated in the course of electricity produced on behalf of the university's consumption. Applicable Scope 2 source for CSUB is purchased electricity.

Scope 3

These are all other sources of emissions generated as a result of activities associated with the operations of the university. Applicable Scope 3 emissions for CSUB are those related to commuting.

Methodology

The largest obstacle to having a complete GHG inventory on the CSUB campus was the availability of required data. Once appropriate sources for the data were identified, the more difficult task of data gathering fell to the few individuals within the identified units. Since this is a relatively new exercise on the CSUB campus, as is the notion of sustainability and GHG emissions reductions, historic data was hard to come by. In some cases, best estimates had to be made since the data did not exist in the required form. In other cases some assumptions had to be made in order to calculate the needed information. Such was the case with calculating commuting miles for faculty and staff. In the end, we used data for the year 2007 and thus have emissions for that one year.

Faculty/Staff Commuting

The data utilized to calculate commuting emissions for Scope 3 was acquired from the office of Human Resources. They provided a staff and faculty count list arranged by their zip code of residency. Using Google© maps, we calculated the distance from each zip

code. An average number of faculty and staff for the 2007-2008 academic year was then calculated. Using this calculation we multiplied the average number of faculty and staff by the distance of their zip code, and then by two, assuming a round trip to campus. Assuming that faculty/staff travel five days a week for 48 weeks, we calculated the total miles commuted in a year by faculty and staff by adding all the distances per zip code from locations as far as 150 miles away from campus.

The list also provided us with zip codes for student employees; these zip codes were not utilized to calculate student commuting miles because we did not want to double count any students that we also employees when the time came to calculate their commuting miles. In the end we did not acquire this list of student-only zip codes, and therefore do not have any commuting miles for any students.

Results

After all the available data were entered into the carbon calculator, it was found that net GHG emissions on the CSUB campus totaled 10,709 MT eCO₂. The largest contributor to net emissions was purchased electricity, followed by commuting emissions. Table 3 summarizes the pertinent emissions data for CSUB for the year 2007. Figures 3 and 4 display the emissions by sector and scope respectively.

Table 2: GHG Emissions for CSUB, 2007.

Variable	Value	Emissions (MT eCO₂)
<u>Scope 1</u>		
Fleet Vehicles	9, 517 gallons	84.9
Refrigerants	1, 462 pounds	862.1
<u>Scope 2</u>		
Purchased Electricity	14, 758, 856 kWh	5, 890.9
<u>Scope 3</u>		
Faculty/Staff Commuting	8, 144, 640 miles	3, 288.9

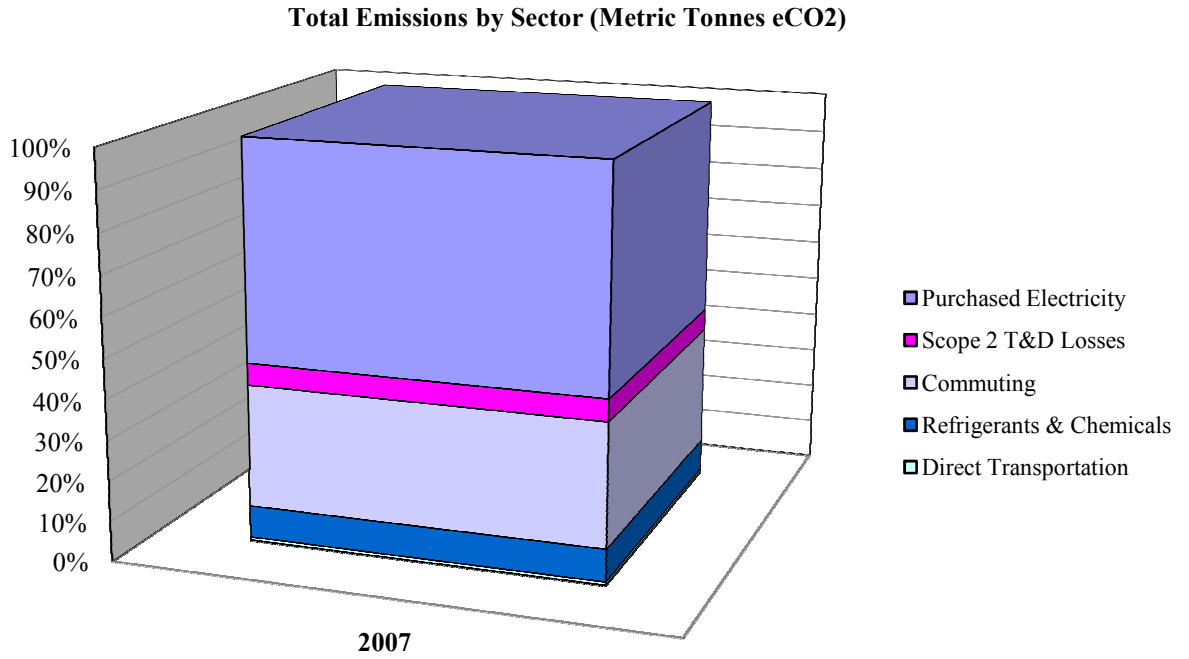


Figure 3: Total Emissions by Sector

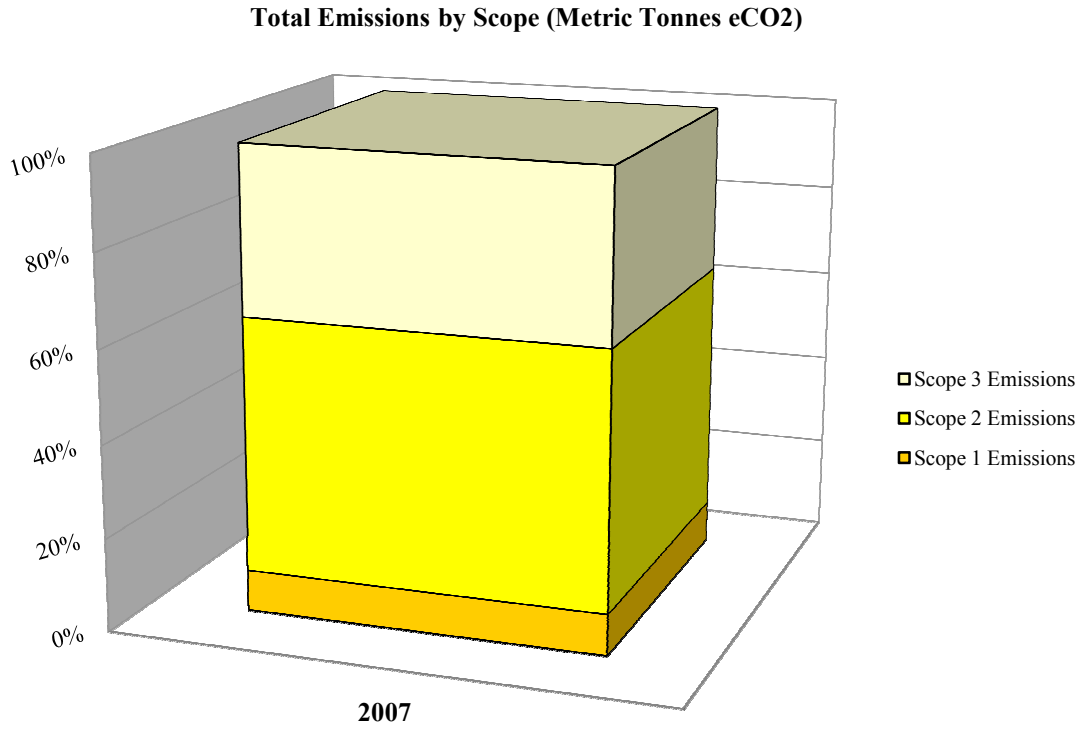


Figure 4: Total Emissions by Scope

Comparing Campuses

At this juncture, we feel it would be a useful exercise to compare the GHG emissions of our campus to some other campuses in the CSU system. Presently, there are three other sister CSU campuses that have completed a GHG inventory. They are CSU-Monterey Bay, CSU – Chico and CS Polytechnic University – Pomona. The following table provides that comparison.

Table 3: Comparing Emissions between three CSU schools

Gross Emissions (Scopes 1 and 2)			
Campus	Total	Per Full-Time Enrollment	Per 1000 Sq Feet
Chico	23, 306	1.6	9.3
Monterey Bay	13, 219	3.2	9.6
Pomona	31, 528	1.9	8.7
Bakersfield	6, 753	1.0	6.7
Gross Emissions (Scopes 1, 2 and 3)			
Chico	35, 803	2.4	14.3
Monterey Bay	22, 348	5.5	16.2
Pomona	64, 688	4.0	17.8
Bakersfield	10, 709	1.6	10.7
Net Emissions			
Chico	35, 803	2.4	14.3
Monterey Bay	22, 348	5.5	16.2
Pomona	64, 203	3.9	17.7
Bakersfield	10, 709	1.6	10.7

All figures are metric tons of CO₂e. Figures for Chico and Pomona are from their 2006 GHG Inventory report, while Monterey Bay’s figures are from the 2007 report.

The above comparison is made for informational purposes only. We understand that the metrics used in arriving at the figures are not normalized. Given the difficulty in collecting extensive data, and the wide range of availability, it stands to reason that measurement errors are rather strong. Nonetheless, it is an interesting exercise to make some comparison of the campuses of the CSU system. However, there are a few figures that can be compared between the campuses without prejudice. They are represented in Table 4. The electricity usage, campus population and building space are all for the most recent year.

Table 4: Comparing other select variables

Variable	CSUMB	Pomona	CSUB
Campus Population	4, 776	22, 500	8, 707
Electricity Usage (kWh)	13, 775, 031	46, 000, 000	14, 758, 856
Electricity Usage (per capita, kWh)	2, 884	2, 044	2, 408
Electricity Emissions (MTeCO ₂)	9, 463	14, 874	6, 128
Electricity Emissions (per capita)	1.98	0.66	0.70
Building Space (sq ft)	1, 377, 982	3, 628, 670	998, 349
Electricity Emissions (per 1000 sq ft)	6.87	4.09	6.14

From Table 4 it is evident that CSUB ranks in between Monterey Bay and Pomona in its electricity consumption and its related emissions. This is also the case when compared on the basis of per capita and per 1000 square feet of building space. With regards to the emissions per 1000 square feet, CSUB is fairly close to CSUMB, indicating that buildings on our campus are as efficient as those on the CSUMB campus, but not as efficient on the larger Pomona campus. However, emissions on a per capita basis are closer to those of Pomona. Given that 50% of our campus' GHG emissions come from electricity usage, it would behoove us to investigate ways in which we can make our buildings more energy efficient. It helps that in the future 30% of our electricity will come from solar power, thus reducing GHG emissions; however, by making our buildings more energy efficient, we can further reduce our GHG emissions. Anecdotal evidence indicates that the Dorothy Donohoe Hall building may be the biggest culprit. A campus wide energy audit, such as one conducted in 2007, would identify further ways of reducing energy consumption.

Reducing GHG Emissions

Over the last year, the CSUB campus has engaged in many actions that will lead to reductions in GHG emission in the future. These endeavors place the campus on a path towards meeting the four AUPCC commitments made by CSUB: (i) green buildings; (ii) energy star appliance procurement; (iii) green power production or purchasing; (iv) waste minimization. Some of those actions taken over the recent past couple of years are highlighted here.

Energy Conservation⁴

CSUB has taken a few measures to reduce the amount of energy consumed on campus.

Central Plant Upgrade

In late 2007, following an energy audit, the campus enacted an aggressive plan to reduce energy consumption from heating and cooling by fifteen percent through modifications and/or upgrades to the central plant. It is expected that this reduction will lead to the elimination of more than two-million pounds of GHG emissions every year (CSUB 2007). The transition is expected to be completed by mid-year 2009. Savings from the reduction in energy are expected to pay for the cost of the project.

Student Housing

During the summer of 2007, the campus replaced almost two-hundred air-conditioning units with new energy efficient models, which over their lifetime will reduce energy consumed as well GHG emitted.

Demand Reduction Program

CSUB is a participant in California Energy Commission's (CEC) Demand Reduction Program, which encourages energy conservation. This is part of the enhanced automation that the CEC provides its participants. This is done through the monitoring of energy usage, especially during peak times when energy costs tend to be higher. When demand reaches peak levels, monitoring systems inform the campus which is then able to reduce usage without adversely impacting vital areas of campus.

⁴ (CSUB 2007)

Future Projects

Future and current projects are being undertaken with the goal of having reduced GHG impact.

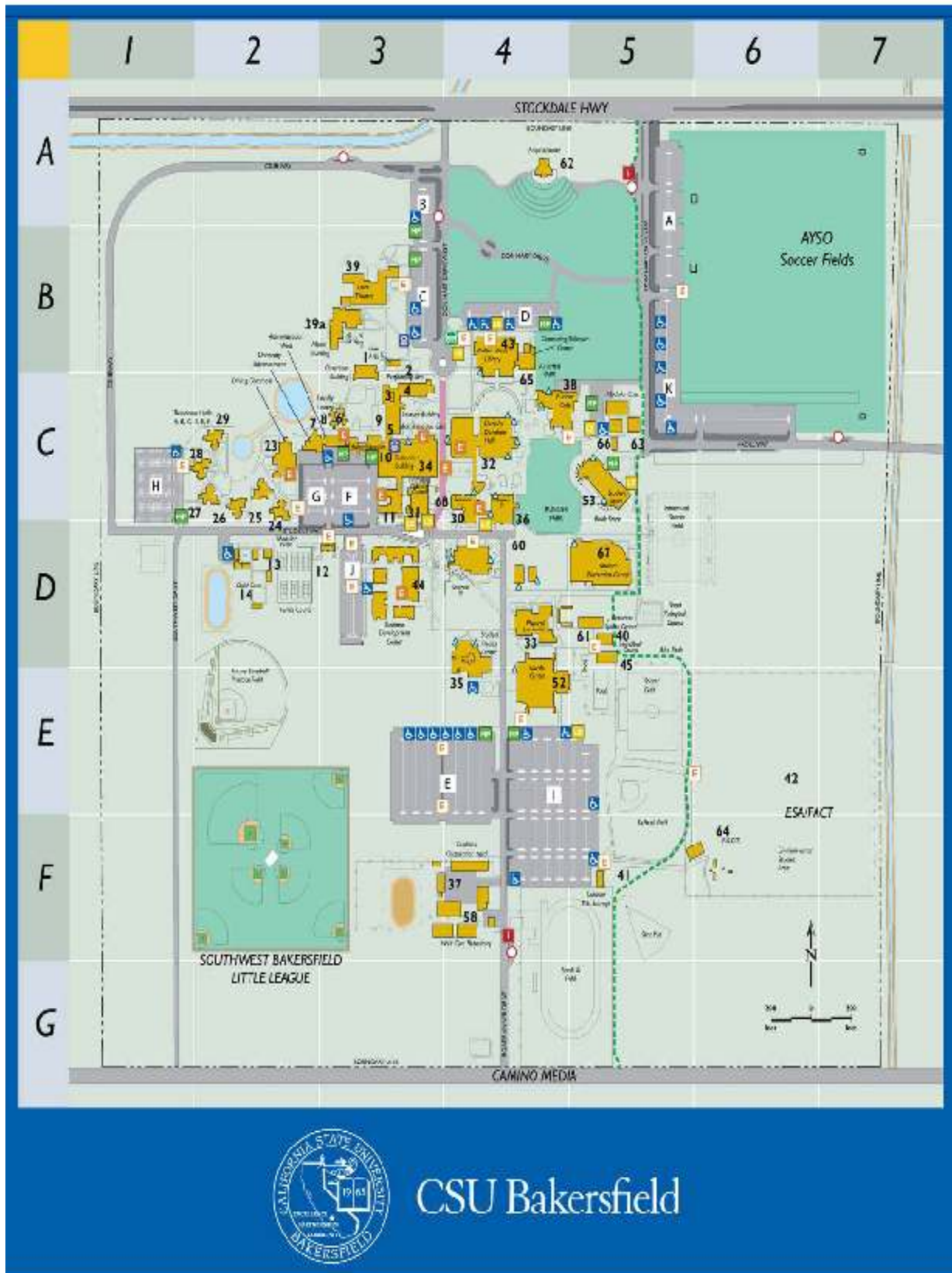
Math and Science Building

A fifty-four thousand square foot Math and Sciences building was completed in the early part of 2008. This building utilizes a thermal energy storage system that charges at night to accommodate peak energy consumption in the afternoon. A new recreation center, that is presently being constructed, is equivalent to Leadership for Energy and Environmental Design (LEED) Silver standards.

Solar Power Generator Project

During the latter part of 2008, CSUB was one of the campuses in the CSU system to be selected to participate in solar photovoltaic power generation project. As a result of this association with Sun-Edison, the campus will be able to purchase up to thirty-percent of its electrical energy generated by solar power. The project is expected to generate approximately 2.1 million kwh per year, thus lowering CSUB's carbon dioxide emissions by approximately fifteen-hundred metric tons, which is equivalent the annual GHG emissions of two-hundred households or roughly three-hundred cars.

* A map of the CSUB campus is included on the next page so as to help the reader contextualize the campus layout.



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