Energy and Climate

Society's patterns of energy use may represent the single greatest environmental impact, with central importance for the economy and consequences for human health. There is a link to energy security nationally and regionally, as the nation attempts to move toward an economy that is more resilient to global energy supply, demand shocks, and geopolitical forces.

Inevitably, energy issues are woven into many aspects of this assessment. This is most obvious with green building and transportation, but it is subtly present in areas such as purchasing and food systems (the embodied energy in the production and delivery of goods), water consumption (the energy used to transport and treat potable water and waste water), and governance (challenges that cross traditional decision-making boundaries).

Summary of Activities and Performance

Policy and Governance:

- The University of California, as a ten-institution system, has signed the **American College and University Presidents Climate Commitment (ACUPCC)**. In January 2008, the Chancellor created the **Chancellor's Council on Climate Change**.
- In conjunction with the city and county of Santa Cruz, UCSC has signed onto the **Climate Action Compact**, which involves creating a greenhouse gas reduction plan and establishing five collaborative partnerships with local public, private, and non-profit organizations. There are therefore a total of three policies concerning climate change to which UCSC has committed. See Appendix D for more information.
- The UC Policy on Sustainable Practices (UC Policy) directly promotes energy efficiency using the **Leadership in Energy Efficiency Design (LEED) system for green building,** requiring energy standards in equipment purchasing, mandating efficiency measures in ongoing operations, promoting sourcing of power from renewables, encouraging the development of onsite renewable energy, etc.
- A **Strategic Energy Plan** focused on energy conservation for UCSC will be developed by July 2008 as part of a systemwide effort.

Generation:

- **100% of UCSC's campus electrical load comes directly or indirectly from renewable sources**, due in large part to a student fee referendum passed in 2006. This is achieved through the procurement of Renewable Energy Credits (RECs) from a variety of sources (wind, solar, biogas, small-scale hydro, and geothermal) to augment the approximately 16% renewables that come from the local utility.
- **UCSC currently generates one-third of its electrical load onsite through two combined heat and power plants** (a process known as co-generation).
- **There are currently no photovoltaic installations on campus**, but opportunities are being explored as part of an electrical master plan.

Current Condition: Buildings, Energy Use, and Greenhouse Gases:

- **Existing green building strategies reinforce the mandate to reduce energy consumption** (see the Green Building section).
- **Lighting retrofits for energy efficiency have been undertaken** for many of the older academic buildings, and there are opportunities for improvement in housing, dining, and residential spaces. Upgrading facilities is an ongoing effort with the innovation of new, more efficient lighting technologies.
- **UCSC energy services staff regularly develops, maintains, and implements a portfolio of potential energy efficiency measures** (EEMs) focusing in three major areas – equipment retrofits, renewable energy technologies, and the commissioning of existing buildings.
- **UCSC participates in the Alliance to Save Energy's Green Campus Program**, an ongoing program through which several student interns install or implement energy-saving equipment and techniques. Total savings as a result of their efforts during 2006-2007 was estimated at $31,000 and came at little cost to the University.
- **UCSC's Physical Plant department staffs two full-time positions** (and additional student interns) to pursue energy efficiency measures. The campus lacks dedicated staff for these functions in other campus units.

2006 Greenhouse Gas (GHG) Emissions Inventory

UCSC's 2006 GHG emissions inventory, verified under the reporting standards of General Reporting Protocol Version 2.2, is officially registered in the California Climate Action Registry database. The 2006 emissions report is available at:

http://www.climateregistry.org/CARROT/public/reports.aspx .

- **The campus completed its first year of greenhouse gas (GHG) reporting for the year 2006.** This reporting is done through the California Climate Action Registry and is third-party certified. Air travel, commuting, and purchases are not included in the boundaries of this inventory.
- **There is currently no climate action plan. However, the Chancellor has appointed a Chancellor's Council on Climate Change,** and an action plan is expected by December 2008. UCSC has programs that ultimately reduce GHG emissions. These include energy efficiency measures, multimodal transportation, and the purchase of electricity from renewable sources, though more can be achieved.
- The UCSC campus has a **"no cooling for comfort"** policy in new and existing buildings. Cooling equipment is limited to areas with high heat loads (e.g., computer rooms), heat-sensitive equipment (e.g., laboratories), or areas where high human occupancy results in high heat loads (e.g., lecture halls).

Challenges

- **UCSC now has three similar, but distinct, institutional commitments to take action on climate protection** (the UC Policy, the ACUPCC, and the Climate Compact). See Appendix D for more information.
  - The campus lacks a unified organizational structure to facilitate GHG reductions.
  - A more comprehensive inventory of UCSC greenhouse gas emissions must be assembled. Some of the necessary data is not tracked consistently and is challenging to collect (faculty and staff travel, commuting, and purchases).
  - Priority must be given and a dedicated funding mechanism provided to facilitate energy efficiency and renewable energy projects on campus.
- **The campus lacks dedicated sustainability staff in its ancillary departments.** This may hinder the application of energy efficiency projects in housing, dining, athletics, and other departments.
- **Establishing on-site generation of renewable energy will require careful planning** and the collaboration of multiple departments (Physical Planning and Construction, the Physical Plant, Purchasing, etc.).

Performance Indicators

Overview

Campus Energy Use
- Total Energy Use
- Energy Use Per Square Foot of Assignable Building Space

Energy Efficiency Efforts
- Retrofits of Existing Buildings
- Planning and Monitoring
- New Construction and Major Renovation Projects
- Other Programs

Electricity from Renewables
- Share of Electricity from Renewables

Utilities Management, Monitoring, and Tracking
- Current Practices

Greenhouse Gas Emissions, 2006
- Tracking and Reporting of Emissions and Sources

✦ *Campus Energy Use*

Why This Indicator?

Despite a frequent focus on alternative fuels and electricity from renewables, overall energy use remains an important indicator of environmental impact. By focusing on total use, attention is drawn first and foremost to efficiency efforts that inherently meet multiple goals simultaneously. Naturally, the campus is also focused on sources of energy – several subsequent indicators address this issue in detail.

Total Energy Use

Total energy use has gradually increased over the past decade, rising in fiscal year 2006-2007 to 30.3% above the 1993-1994 level. This follows the trend in society generally. During this period, building square footage (assignable square feet) has increased 50.9%.

Note: A **BTU**, or British Thermal Unit, is a unit used to measure the amount of heat required to increase the temperature of a pound of water one degree Fahrenheit. BTUs are often used in data collection referencing the energy use related to heating, cooling, and electricity.

Energy Use Per Square Foot of Assignable Building Space

Energy use per square foot has remained generally stable, around 9% lower since 2000 than during the 1990s (see Figure E2). This stability is an impressive efficiency success given expansion in the numbers of computers, labs, equipment, and appliances throughout campus and in dorms over that time.

Figure E1: Total Campus Energy Use (Billions of BTU)
Source: UCSC Physical Plant

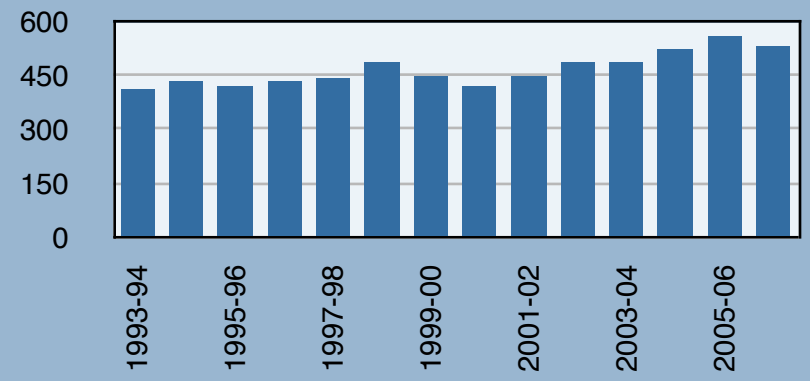
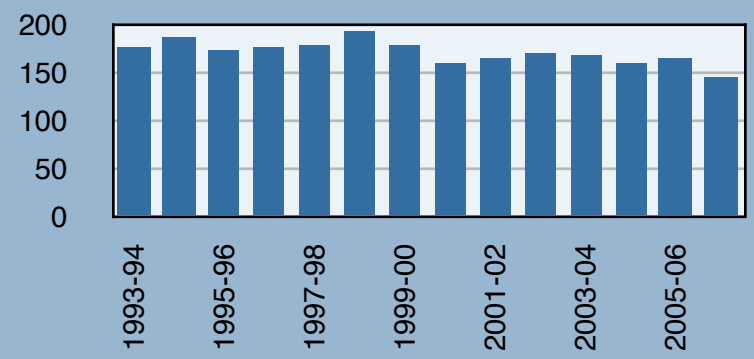


Figure E2: UCSC Campus Energy Intensity, 1993 - 2006 (Thousands of BTU Per Assignable Square Foot)
Source: UCSC Physical Plant



✦ *Energy Efficiency Efforts*

Why This Indicator?

While total energy use, GHG emissions, and other aggregate measures are straightforward, it can be difficult to summarize the efforts that implement an institution's strategy for energy use reduction. This apparently qualitative indicator is included to draw attention to the diverse activities being implemented at UCSC.

UCSC regularly takes actions that gradually reduce the energy needs of the institution by making the local built environment more efficient. These actions form a coherent indicator because they are part of a deliberate strategy to improve performance over time.

Retrofits of Existing Buildings

- Lighting upgrades.
- HVAC upgrades (UCSC won a Best Practices award at the UC/CSU/CCC Sustainability Conference in 2007).
- Building management through upgraded metering and monitoring.

Planning and Monitoring

- Data gathering to prioritize retrofit projects.
- Energy management systems upgrades to increase monitoring capabilities.
- Commissioning of existing buildings.

New Construction and Major Renovation Projects

- Use of LEED and the UCOP-approved Green Building Campus Baseline (see Appendix C).
- Consideration of energy efficiency in new construction required by the Long-Range Development Plan (LRDP).

Other Programs

- Experimentation with new or untapped technologies, such as LED (light emitting diode) lighting, variable-speed drives, or building-integrated photovoltaics.
- Employment of student interns by the Green Campus Program to identify energy efficiency projects. The program saved the campus $31,000 in the 2006-2007 academic year.
- Energy efficiency measures have saved 2,995,000 kWh annually since 2000, reducing CO2-equivalent emissions by 1,585 tons each year.

✦ *Electricity from Renewables*

Why This Indicator?

To meet goals for GHG emissions reduction and for energy security, a need to improve efficiency and foster the transition from fossil fuels to renewable energy sources exists. The purchase of Renewable Energy Credits (RECs) is a crucial step that supports that market transformation.

Share of Electricity from Renewables

In 2006-2007 approximately 16% of the "grid mix" – the composition of the electricity purchased from the utility – came from renewable sources such as hydropower.

In 2005, students voted in a referendum to tax themselves (via student fees) to pay for RECs, or "green tags", to match the remaining 84% of the campus' electricity demand. With this program, all of UCSC's electrical use is from "green" sources.

Figure E3: Electricity from Renewables, Pre-2005
Source: UCSC Physical Plant

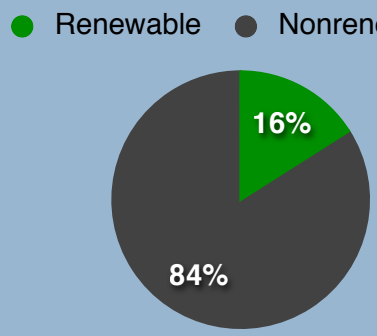
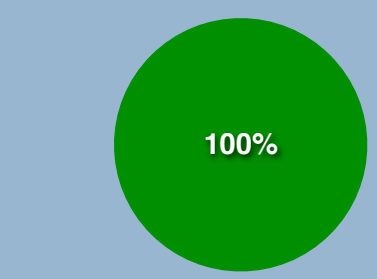


Figure E4: Electricity from Renewables, 2005 to present
Source: UCSC Physical Plant



✦ *Utilities Management, Monitoring, and Tracking*

Why This Indicator?

You cannot manage what you do not measure. Monitoring also serves to measure energy savings. This allows UCSC's Physical Plant to accurately identify problem buildings, identify water/irrigation leaks (and high uses), and measure the efficiency of building equipment.

Monitoring and Tracking Activities
Source: UCSC Facilities

- Data gathering to prioritize retrofit projects.
- Monthly monitoring of electric, natural gas, water, irrigation, hot water, chilled water (ac), and seawater utilities.
- Installation of system that monitors electrical use for major buildings in real time (existing for some buildings, expanding to other buildings).

Current Practices

The campus currently monitors all major and most minor energy uses with very few exceptions. There are approximately 1,450 individual meters, requiring approximately six days for one person to read (see the Opportunities and Recommendations of this section).

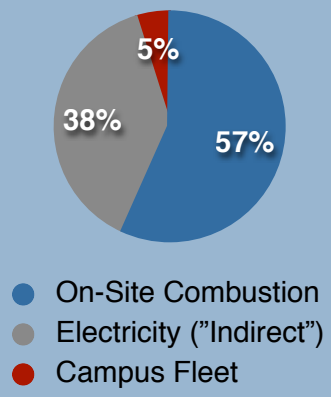
Physical Plant is increasing its effort to capture real-time data across campus through meters and remote sensing. For example, the Physical Sciences Building was equipped with comprehensive metering of electrical and thermal loads. It is hoped that the campus will be able to develop a life-cycle cost analysis, i.e., the initial cost, maintenance costs, and energy costs for this building over its lifetime.

✦ *Greenhouse Gas Emissions, 2006*

Why This Indicator?

Scientists now believe that human-caused emissions are, with at least 90% certainty, a major force in climate change.[1] Measuring emissions is the first step in identifying strategies to mitigate impacts.

Figure E5: Greenhouse Gas Emissions from Campus Operations
Source: UCSC Facilities



Notes:
- This inventory captures only those emissions required by the California Climate Action Registry and other GHG inventory protocols.
- This inventory currently does not include important but harder-to-quantify emissions, such as commute travel and air travel.
- The 38% of emissions resulting from purchased electricity are calculated based on the utility's grid mix. The purchase of RECs effectively cancels out this

Tracking and Reporting of Emissions and Sources

UCSC emitted nearly 40,000 tons of carbon dioxide and CO2-equivalent emissions in 2006 as calculated for emissions related to the use of fossil fuels. More than half of GHG emissions came from on-site burning of fossil fuels, mainly natural gas. The second biggest source was electricity use. UCSC's electricity contract for this period was with Arizona Power Supply, whose "grid mix" included a large share of coal. Beginning in 2008, electricity is provided by the local utility, Pacific Gas and Electric, Co., whose grid mix includes only 2% from coal.

[1] Intergovernmental Panel on Climate Change (IPCC). (2007). Findings of the IPCC Fourth Assessment Report: Climate Change 2007: Climate change impacts, adaptation and vulnerability. Available at http://www.ipcc.ch/SPM6avr07.pdf

Opportunities and Recommendations

Fulfill the requirements of the UC Policy systemwide targets.

- Incorporate energy efficiency into all new capital projects and renovations.
- Implement procedures for Climate Protection Practices.
- Reduce energy consumption 10% or more by 2014 (compared to a year 2000 baseline).

Follow through with climate action commitments.

- Climate action commitments include the UC Policy on Sustainable Practices Climate Protection section, American College and Universities Presidents Climate Commitment, and the Climate Action Compact.
- Once a Climate Action Plan is developed, it will need to be given high priority for the institution.
  - The matrix found in Appendix D comparing the three separate climate commitments can be used to inform climate action planning.
  - Explicitly link climate action planning to other long-term campus planning efforts.
  - Describe the current education and research activities related to climate change and sustainability and set out planned actions to make these a part of the curriculum, research agenda, and other educational experience for all students (as committed to in the ACUPCC).

Increase on-site generation.

- Plan to achieve the institution's share of the total UC goal. (The systemwide goal is 10MW of on-site generation by 2014. There are no specific campus goals to date.)
- Explore options for on-site generation of renewable energy at UCSC including photovoltaics, solar hot water, and wind generation (such as the site on Mt. Hamilton or the Marine Services Campus). This goal will require collaboration of multiple departments on campus (Physical Plant, Physical Planning and Construction, and Purchasing).
- Plan to increase campus co-generation using more efficient, newer technologies such as fuel cells and/or gas turbine recuperating engines.

Acquire a system that allows for real-time and accurate data acquisition.

- Currently staff read individual meters on location. Systems exist that would allow for automated reading without being onsite. Though these systems are expensive, they could save resources spent on fuel, automotive maintenance, personnel time, and wasted energy and water.

Aggressively pursue retrofits (especially lighting and HVAC) and commissioning.

- Increase awareness and funding available for lighting retrofits to other campus entities (housing, dining, faculty/staff housing, etc.). Continue training all lighting personnel on latest technologies. Ensure that, while utility incentives for lighting retrofits are based on energy savings, decisions at the UCSC level be made to consider other factors, such as maintenance costs and indoor environmental quality for occupants.
- Develop and implement a strategic plan for identifying, quantifying, and performing HVAC-related energy efficiency measures and dedicate the appropriate personnel and resources.

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