

University of Redlands

Campus-Related Carbon Dioxide Emissions

Based on 2005-2006 Consumption Levels
EVST 330, Environmental Policy Clinic, Fall 2006

ELECTRICITY (consumption for 2005 ~ 13.5 M kWh)

Only sources of generation that use carbon-based fuels (coal, natural gas) are included. Coal represents 29% of the University's current electrical generation mix; natural gas 45%.

Coal = 29% of 13.5 M kWh → 3.92 M kWh @ 2.15 lbs. CO₂/kWh = 8.42 M lbs. (4,210 tons)

Natural Gas = 45% → 6.08 M kWh @ 1.34 lbs. CO₂/kWh = 8.15 M lbs. (4,070 tons)

TOTAL CO₂ from electricity: **16.57 M lbs. (8,280 tons)**

NATURAL GAS FOR HEATING AND COOLING (annual consumption ~ 83,784 MBtu)

83,784 MBtu x 117.1 lbs. CO₂/MBtu = **9,811,106.4 lbs. (4,905.6 tons)**

CAMPUS SPACE HEATING, COOLING, ELECTRICITY CO₂ total: **13,185.6 tons**

GROUND TRANSPORTATION (annual CO₂ emissions, based on fuel consumption)

Student vehicles: 4,056,480 gallons of gasoline @19.56¹ lbs. CO₂/gallon

University-owned vehicles: 1,544 gallons of gasoline @19.56 lbs. CO₂/gallon

14,480 gallons of diesel @22.38¹ lbs. CO₂/gallon

Faculty/Staff commuting (est.) 77,916.7 gallons of gasoline @19.56 lbs. CO₂/gallon

Avg. U of R employee daily commute is ~18 miles (RT); source: South Coast AQMD (January 2005)

Assumptions:

*550 faculty/staff x 85² miles/week = 46,750 miles commuted weekly. (Assuming the average mpg each car has is approximately 24 mpg) 46,750 miles commuted weekly/ 24 miles per gallon = 1,947.9 gallons used weekly.

1,947.9 gallons used per week x 40 work weeks per year = 77,916.7 gallons used yearly.

Student vehicles = **39,672.4 tons**

University-owned vehicles = **177.1 tons**

Faculty/Staff commuting = **762.03 tons**

CAMPUS CO₂ from GROUND TRANSPORTATION for FACILITIES MANAGEMENT, STUDENTS, FACULTY AND STAFF total: **40,611.53 tons**

¹ Based "Units and Conversions Fact Sheet." Prepared by Derek Supple. MIT Energy Club. http://web.mit.edu/mit_energy.

² Based on 2005 South Coast Air Quality Management District Institutional Commuter Data.

AIR TRAVEL (university study or business related)

Total CO2 from students:

CO2 from student air travel during academic year: 7,872,422 lbs of CO₂ = **3,936.2 tons**

Assumption: according to results of student survey, average student flyer spends 12 hours in air during the academic year.

Study Abroad: 3,186,000 lbs of CO₂ = **1,593 tons**

Assumptions: 590 students go on study abroad trips in a typical year, with total flight times averaging approximately 10 hours, each way.

Total CO2 from Faculty/Staff (est.)

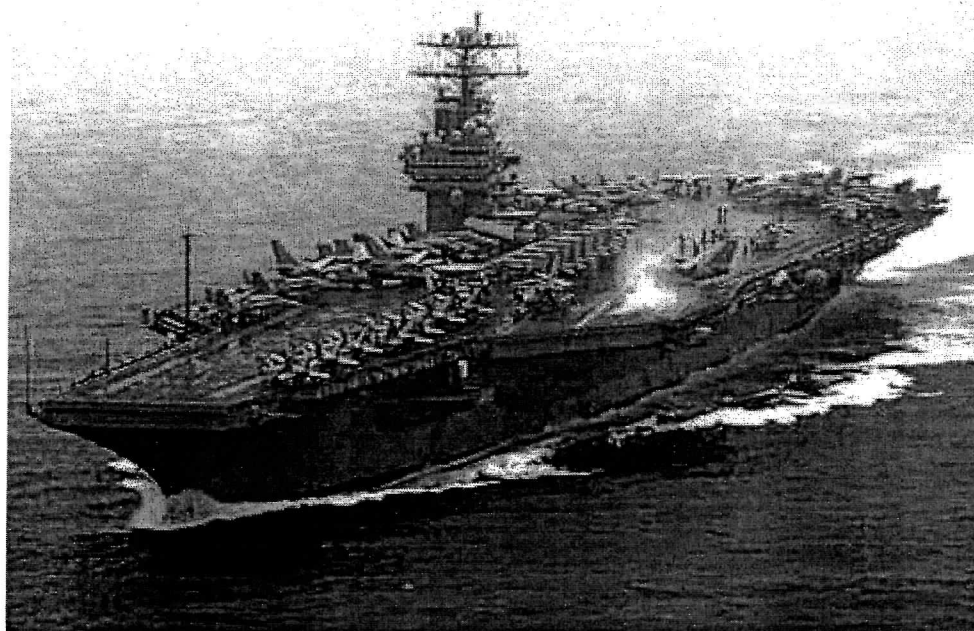
Assumption: 600 total full-time employees; 1/3 are flyers (200); total flight miles per year = 200 x 2,500 mi/flyer/yr. = 500,000 mi./yr

Faculty & staff air travel = ~ 500,000 air miles/year @ 0.4175 lbs CO₂/air mile³ = 208,750 lbs. = **104.4 tons** (using 0.6 lbs CO₂/air mile yields 300,000 lbs or **150 tons**)

TOTAL CO2 FROM CAMPUS AIR TRAVEL: 5,633.6 tons

ESTIMATED TOTAL CO2 EMISSIONS PER YEAR: 59,430.73 tons
(65,511.2 metric tons)

Roughly equivalent to the weight of the U.S.S. Theodore Roosevelt, aircraft carrier pictured below (structural steel of the carrier weighs 60,000 tons).



³ Based on World Resources Institute data, using medium haul flights (283-1,000 mi. trips), Carbonfund.org.

Energy Conservation through Computer Usage

According to the Berkley National Laboratory a desktop computer uses 0.12kWh while turned on. I used the calculators provided by *The Wisdom of Our Choices* because it's the same calculator that other universities have used.¹ The University of Redland's IT department has roughly estimated that there are approximately 1,000 desktop computers on campus in addition to 75 computers used as servers. There is also estimated to be around 1,000 student owned computers on campus. There was no data on the ratio of laptop/desktop computers owned by students but after asking around I am going to assume a ratio of 4:1 respectively.

In order to run the calculations the following assumptions were made. There is 1,075 university owned desktops. There are approximately 800 laptops and 200 desktops owned by students on campus. The cost of 1kWh is thirteen cents and the weight of CO₂ /kWh is 1.45lbs. A desktop uses 0.12kWh and a laptop uses 0.03kWh². The calculations are also operated based on a 250 academic year with 8-hour workdays.

University owned Computers:

kWh/year used:

$1,075 \text{ computers} \times 0.12 \text{ kW} \times 250 \text{ workdays} \times 8 \text{ hours a day} = 258,000 \text{ kWh/year}$

Operating costs for 1,075 computers:

$258,000 \text{ kWh/year} \times \$0.13 = \$33,540/\text{year}$

Amount of CO₂ produced:

$258,000 \text{ kWh} \times 1.45 \text{ lbs CO}_2 / \text{kWh} \text{ (divided by) } 2000 = 174 \text{ tons of CO}_2 / \text{year}$
being put into the atmosphere every year.

To provide an understanding of how much of an increase leaving computers on can cause in the production of CO₂ and operational costs I ran the numbers assuming that 2:9 computers get left on 24 hours a day during a 250 day academic year. It's important to note that the school operates 75 servers that are never shutdown unless maintenance is required.

$275 \text{ computers} \times 0.12 \text{ kW} \times 250 \text{ days} \times 16 \text{ additional hours} = 132,000 \text{ kWh/year}$

$132,000 \text{ kWh} \times \$0.13 = \$17,160$ in additional operational costs

$132,000 \text{ kWh} \times 1.45 \text{ lbs CO}_2 / \text{kWh} \text{ (divided by) } 2000 = 95.7 \text{ tons of additional CO}_2 / \text{year}$

¹ The **Wisdom of Our Choices: Boston's Indicators of Progress, Change and Sustainability** 2000. B Foundation - 2000 - **Boston**, October

² Tufts University Climate Initiative