A supply chain carbon footprint analysis of the University of California, Berkeley

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-Excerpt from working paper draft-
May 3, 2010

In 2007, U.C. Berkeley became the first U.S. university to calculate its supply chain carbon footprint. The genesis of this project was an understanding by some university faculty and staff that the campus' traditional greenhouse gas (GHG) inventory[i] provided an incomplete picture of the university's total contribution to GHG emissions. At the request of the Cal Climate Action Partnership (CalCAP) Steering Committee, researchers at the Berkeley Institute of the Environment conducted a carbon footprint analysis that combined information from the reported emissions inventory with an assessment of indirect emissions from purchased energy, construction and procurement of goods, food and services.[ii] According to this report, the university's total carbon footprint was close to 500,000 metric tons of CO_2e in the year 2006, compared to 204,000 metric tons CO_2e as reported in the official emissions inventory. Only 3% of emissions were direct (Scope 1), 29% were from purchased electricity (Scope 2) and 68% were from other indirect sources (Scope 3).

U.C. Berkeley's carbon footprint analysis provided a new lens by which to view the total climate impact of the university and pointed to supply chain "hot spots" to target mitigation strategies. However, the study was also preliminary in nature, with large uncertainty identified in the size and composition of indirect emissions. It was also unclear how to reduce supply chain emissions without simply reducing consumption, which, with few exceptions such as reusing paper or video conferencing, may not be feasible.

The goals of the current study are 1) to improve upon some of the shortcomings of U.C Berkeley's initial carbon footprint assessment, 2) to provide an updated estimate of U.C. Berkeley's carbon footprint for the years 2006, 2008 and 2009, 3) to ensure the assessment is compliant with the newly proposed World Resources Institute standards for Scope 3 reporting, 4) to suggest potential strategies for supply chain emission reductions, 5) to produce a spreadsheet tool to facilitate annual monitoring of carbon footprint data in the future, 6) to explore uncertainty in the model, and 7) to suggest improvements for future carbon footprint assessments.

The results of this study may help inform future carbon footprint analyses by U.C. Berkeley and other institutions, and ultimately lead to new and creative opportunities to reduce supply chain GHG emissions.

Summary of methods for the 2008 carbon footprint analysis

The fist task was to collect and categorize all U.C. Berkeley expenditures on procurement for the year 2008. There are a total of 453 accounts in the Berkeley Financial System (BFS) accounting package, of which 263 were generated for this report; the other accounts are reportedly not relevant to procurement. A total of 98,700 line item expenditures were collected and 208 accounts were deemed appropriate for use in the procurement carbon footprint analysis. The remaining 55 accounts were related to payroll, air fare, energy, royalties, depreciation or miscellaneous fees.

Construction is listed as a single account in BFS, totaling $143M in 2008. A separate website, fasdi.berkeley.edu, lists approximately $70k in capital projects expenditures. We assume that the fasdi accounting systems is less complete than the BFS accounts and that expenditures listed in these two systems are not additive. We therefore use the higher of the two numbers. More research is required on this point.

Each account was further categorized as goods, services, food, construction or other. Of the 208 categories of expenditures, the top ten categories accounted for two-thirds of all spending, while the top 45 categories accounted for 90% of all expenditures. For simplification purposes, the remaining 163 categories (representing just 10% of all spending) were lumped into a single category called "other," and assigned an average emission factor of 500 $gCO_2e/\$$.

The second task consisted of mapping each category of expenditures to a single economic sector in the 2002 Economic Input Output Life Cycle Assessment (EIO-LCA) model,[iii] developed by Carnegie Mellon University (CMU). We received EIO-LCA results in spreadsheet form directly from the Green Design Institute at CMU. GHG emissions per dollar of expenditure were provided by EIO-LCA for Scope 1 (direct emissions), Scope 2 (Electricity), and Scope 3 (other supply chain emissions).

The following adjustments were then made to EIO-LCA and U.C. Berkeley accounts. All Services and Food were assumed to be produced in California. Since California's electricity generation mix is about 50% less carbon-intensive than the U.S. average,[iv] we reduced Scope 2 emissions for services and food by 50%. Expenditures in 2008 were adjusted to the year 2002 using the Producer Price Index (Industry data). Expenditures were multiplied by the following factors chosen from representative sectors in the PPI: Goods: 0.9; Services: 0.69; Food: 0.76; Construction: 0.91; Other: 0.69. Annual expenditures in each procurement account were then multiplied by the new modified EIO-LCA emission factor to account for total annual GHG emissions from each category.

Results of 2008 carbon footprint model

Results from the 2008 carbon footprint model of U.C. Berkeley are shown in Figure 1. Total emissions are 417,000 $mtCO_2e$. Fully 97% of all emissions are indirect. Direct (Scope 1) emissions from natural gas, motor vehicles and fugitive emissions total 12,000 $mtCO_2e$. Emissions from the production of purchased electricity and steam (Scope 2) total 151,000 $mtCO_2e$, or 37% of total emissions. All other indirect emissions total 249,000, or 60% of total emissions.

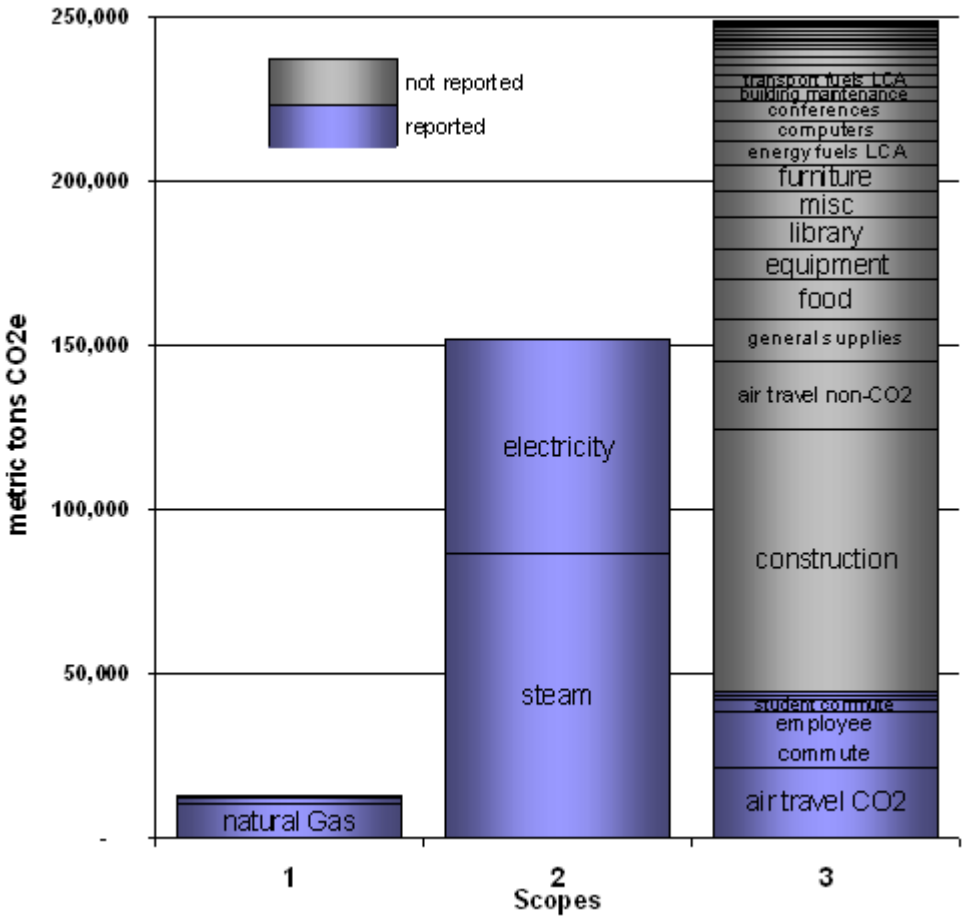

Figure 1. Carbon footprint of U.C. Berkeley, 2008. Scope 1 are direct emissions from purchased fuels. Scope two are emissions from purchased electricity. Scope 3 are other indirect emissions. Reported emissions in blue = 207,000 metric tons CO2e. Unreported emissions = 217,000 metric tons CO2e.

Unreported emissions are shown in more detail in Figure 2. Construction, at 80,000 $mtCO_2e$ is the largest source of unreported emissions (37%) and the second largest sources of emissions overall, accounting for 17% of U.C. Berkeley's total carbon footprint. "Goods," as a category, is the fourth largest source of emissions, after purchased electricity, accounting for 52,000 $mtCO_2e$ (Figure 3). Goods includes general supplies (13 $mtCO_2e$), equipment (10,000 $mtCO_2e$), library books and materials (10,000 $mtCO_2e$), furniture (8,000 $mtCO_2e$), computers (7,000 $mtCO_2e$), software (2,000 $mtCO_2e$), chemicals (2,000 $mtCO_2e$), laboratory instruments (1,000 $mtCO_2e$) and other miscellaneous expenditures. Other significant sources of emissions include all services (28,000 $mtCO_2e$), non-CO_2 air travel emissions (21,000 $mtCO_2e$), food (12,000 $mtCO_2e$), life cycle of energy fuels (7,000 $mtCO_2e$), and the life cycle of transport fuels (4,000 $mtCO_2e$).

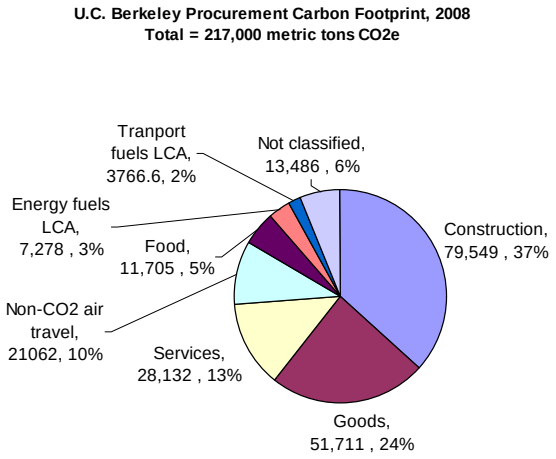

Figure 2. carbon footprint of procurement

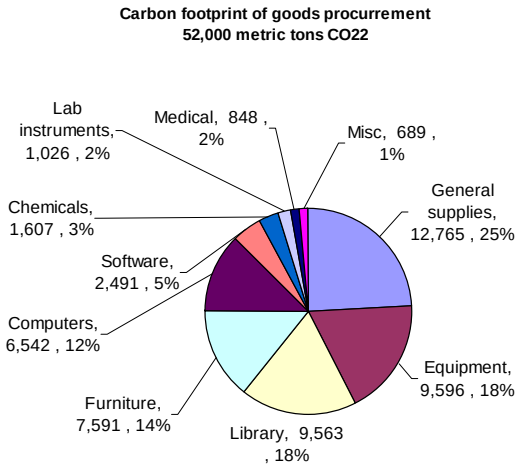

Figure 3. carbon footprint of goods

Note: due to the following, the 2008 analysis is not directly comparable to the 2006 analysis.

- Used updated BFS accounting system for estimates of procurement.
- Used 2002 EIO-LCA database for GHG emission factors, updated from the 1997 EIO-LCA model used previously
- Applied Producer Price Index to adjust prices between reporting year and the 2002 baseline year for each major category of emissions.
- Separated each category of emissions into Scopes 1, 2 and 3, using an updated EIO-LCA database provided under a research agreement with Carnegie Mellon University
- Adjusted Scope 2 emissions for services and construction to account for lower GHG-intensity of California electricity. This reduces emissions by about 1 for construction and between 1 and 25% (average 10%) for services.
- Updated indirect emission factors for electricity, natural gas and transportation fuels

Cited References

[i] Ahmed, F., 2007. Feasibility Study 2006-2007 Final Report. Unpublished report for U.C. Berkeley Climate Action Partnership (CalCAP). 139 pp.

[ii] Jones, Christopher M., 2007. Lifecycle Analysis – U.C. Berkeley Climate Footprint." Appendix R. in Ahmed, F., 2007. Feasibility Study 2006-2007 Final Report.

[iii] Carnegie Mellon University Green Design Institute. (2008) Economic Input-Output Life Cycle Assessment (EIO-LCA), US 2002 Industry Benchmark model [spreadsheet model accessed via license agreement between U.C. Berkeley and CMU], Accessed April 2010.

[iv] US EPA. eGRID2007 Version 1. Available online: http://www.epa.gov/cleanenergy/energy-resources/egrid/index.html (accessed April, 2010)