UC Berkeley's 2009 Supply Chain Carbon Footprint from Campus Procurement and Construction

Executive Summary for Cal CAP

Prepared by Kelley Doyle

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Consolidated from Undergraduate Environmental Sciences Senior Thesis

I calculated UC Berkeley's supply chain carbon footprint in fiscal year 2009 to be 128,590 metric tons CO_2e. I added this to reported emissions and calculated UC Berkeley's total carbon footprint to be 319,064 metric tons CO_2e in 2009. Indirect emissions from procurement represent 39% of UC Berkeley's total emissions. 80% of indirect emissions resulted from the top 5 emitting categories of goods and services. These categories include construction, scientific equipment, office products, IT & telecommunications, and food. The expenses within these 5 categories represent 67% of the procurement budget omitting salaries, benefits, interest, and donations.

Methods

To calculate a supply chain carbon footprint for UC Berkeley, I conducted a top-down hybrid life cycle assessment using the Comprehensive Environmental Data Archive (CEDA) emission factor database, annual procurement reports, and vendor location data. The subject of this study is UC Berkeley, which I define to include all owned property and procured goods and services for campus buildings, dining commons, athletic teams, research facilities, and residential halls. My analysis focused on campus' scope 3 emissions, since scope 1 and 2 emissions are already calculated by campus administrative staff and documented in the Cal CAP annual emission reports.

I received 2009 procurement reports from UC Berkeley's Procurement Services and applied CEDA emission factors to calculate a preliminary footprint estimate. These reports list all campus expenditures in a line item format, which includes the vendor and amount paid for the good or service. I converted all expenditures to 2002 values using the Producer Price Index (PPI) because the emission factors from the CEDA database are based on 2002 US$. I did not include all procurement accounts in this analysis. I selectively omitted the following accounts: benefit and salary payments; government payments; utility services including electricity, natural gas, water and sewage, and waste management; transportation for students, staff, and faculty; depreciation and other negative sum accounts; interest, fines/penalties, and royalties; and research.

I summed line item expenses based on the accounts they were paid to then I mapped each account to a specific category, subcategory, and economic sector based on the account description. I used the same category and subcategory titles from the Cal CAP Feasibility Study. For example, computer equipment was mapped the "IT & Telecommunications" category, "IT Distributors" subcategory, and "Electronic Computer Manufacturing" economic sector. If an account could not be mapped to an economic sector because there was no applicable sector or because of a vague

description, I highlighted the expense and discussed it with procurement staff during the review phase. Based on feedback from the reviewer, I either omitted the expense or mapped it to an appropriate economic sector.

Construction expenses are paid through Capital Projects, not Procurement Services, so I consulted with Capital Projects to assess their FY 2009 project budget. Capital Projects staff categorized each vendor as "General Contracting", "Construction Management", "Architecture", "Engineering", "Interior Design", "Industrial Equipment", "Demolition", or other. All subcategories were mapped to a specific economic sector based on the Cal CAP Feasibility Study. I summed expenses within each category and applied emission factors for the mapped economic sectors.

Each economic sector has an emission factor from the CEDA database in terms of kilograms of CO_2 equivalent emitted per dollar spent in that sector. If an expense could be mapped to more than one economic sector, I used the averaged emission factor between all applicable economic sectors. I calculated indirect emissions produced per account by multiplying the money spent by the corresponding CEDA emission factor for the economic sector mapped to that account. All line item emissions were summed to quantify emissions resulting from construction and procurement.

To account for the potential inflation in emissions from using nationally averaged emission factors during my calculations, I adjusted CEDA scope 2 emission factors based on the location of vendor facilities. Since UC Berkeley's Capital Projects department has a separate, more detailed budget for all campus construction projects, I designated all construction vendors as "California-based" or "Not California-based". For all other procurement accounts within the Procurement Services budget, I compiled location data for vendors in top emitting procurement accounts by searching for vendor websites and designated each vendor within the top 10 emitting accounts as "California-based" or "not California-based". Based on my findings, I assumed that 75% of vendors for services and food expenses were California based whereas 30% of vendors for manufactured goods were California based. I applied these assumptions to scope 2 emissions (S2) in all procurement accounts (except construction). I reduced scope 2 CEDA emission factor by 52.7% if the vendor was located in California because California's energy portfolio is less carbon intense than the national energy portfolio. This adjustment is based on a comparison between California and national CO_2 emission rates per MWh.

Results

Construction expenses produced 30,345 metrics tons CO_2e, representing 37% of procurement expenses, 24% of campus' procurement footprint, and 9.5% of the total footprint in 2009. The average carbon intensity of construction expenses was 0.16 kg CO_2e/$, which is low relative to average construction emission factors because most vendors in 2009 provided management and miscellaneous services. Construction expenses can be broken down into the following subcategories: construction management (36%), mixed construction management and general

contracting (31%), general contracting (20%), industrial equipment (7%), architecture (2%), electricity (2%), electrical services (1%), and HVAC/mechanical services (1%).

Scientific equipment expenses produced 25,725 metrics tons CO_2e, representing 7.7% of procurement expenses, 20% of campus' procurement footprint, and 8.1% of the total footprint in 2009. The average carbon intensity of scientific equipment expenses was 0.66 kg CO_2e/$. Scientific equipment expenses can be broken down into the following subcategories: gases (52%), laboratory equipment and supplies (47%), and animal care (1%).

Office product expenses produced 16,566 metrics tons CO_2e, representing 7.0% of procurement expenses, 13% of campus' procurement footprint, and 5.2% of the total footprint in 2009. The average carbon intensity of office product expenses was 0.47 kg CO_2e/$. Office product expenses can be broken down into the following subcategories: non-paper supplies (97%) and paper supplies (3%). More specific product-level data for the types of office supplies (i.e. pens, staplers, paperclips, printer ink) was not disclosed in the dataset provided by Procurement Services.

IT & telecommunications expenses produced 16,173 metrics tons CO_2e, representing 12% of procurement expenses, 13% of campus' procurement footprint, and 5.0% of the total footprint in 2009. The average carbon intensity of IT & telecommunications expenses was 0.28 kg CO_2e/$. IT & telecommunications expenses can be broken down into the following subcategories: IT goods (49%), equipment and installation (41%), and IT services (10%).

Food expenses produced 15,230 metrics tons CO_2e, representing 3.3% of procurement expenses, 12% of campus' procurement footprint, and 4.7% of the total footprint in 2009. The average carbon intensity of office product expenses was 0.83 kg CO_2e/$. It is difficult to produce an accurate estimate of emissions from food production, since different food types produce significantly different quantities of emissions. Additionally, more specific product-level data for food (i.e. meat, seafood, dairy, produce, baked goods) was not disclosed in the dataset provided by Procurement Services so I did not break up this category into subcategories.

Other miscellaneous expenses produced 24,549 metrics tons CO_2e, representing 33% of procurement expenses, 18% of campus' procurement footprint, and 7.7% of the total footprint in 2009. Most of these expenses were for miscellaneous services (professional, real estate, administrative, medical, facilities maintenance, mail, and insurance.) or categories of manufactured goods with small budgets (library books, materials for facility maintenance and repair, printed materials, apparel, and medical supplies).

Figure 1. UC Berkeley's 2009 Total Carbon Footprint, by Scope.
Emission sources reported in UC Berkeley's 2009 emissions inventory report are shown in black and unreported sources are shown in yellow.

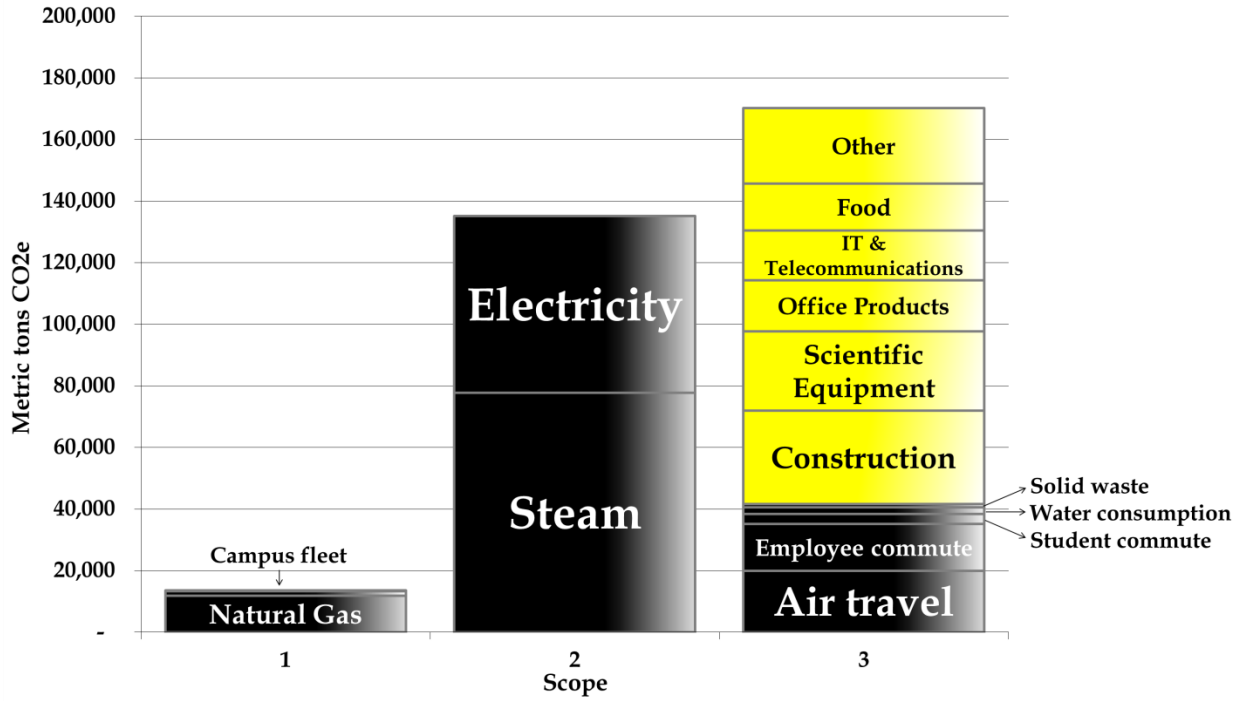


Figure 2. Comparison of category emissions and expenses relative to total procurement emissions and budget.

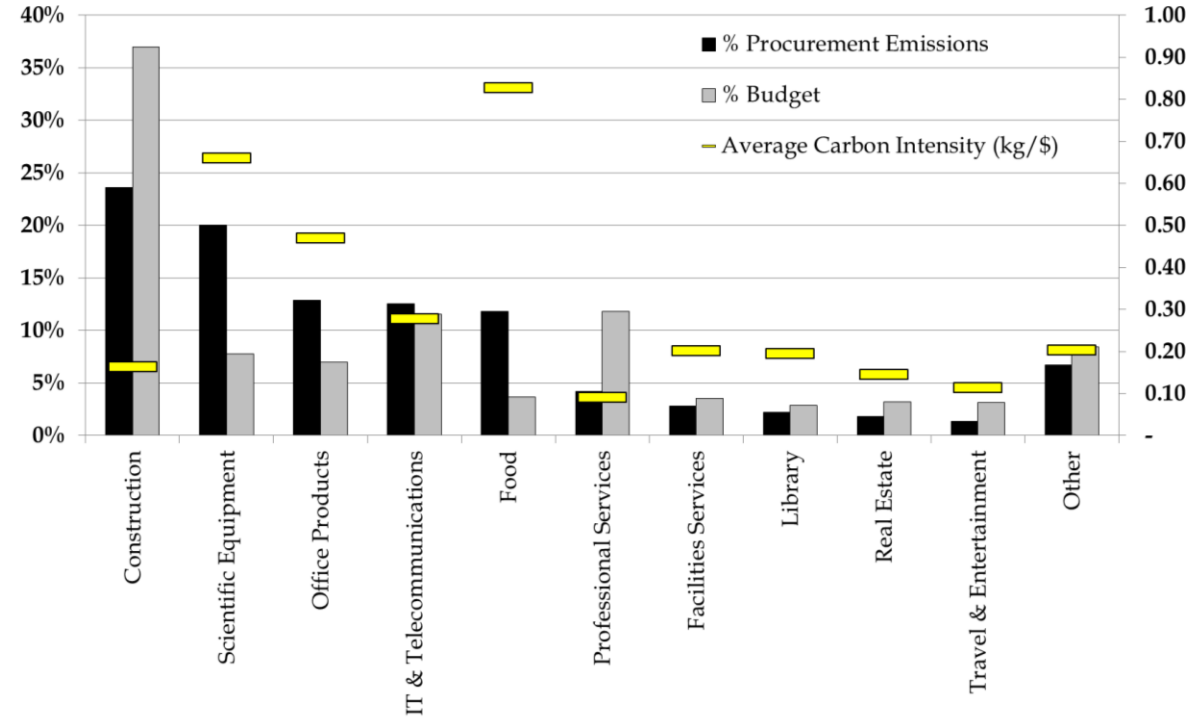


Figure 3. Composition of UC Berkeley's 2009 Procurement Carbon Footprint

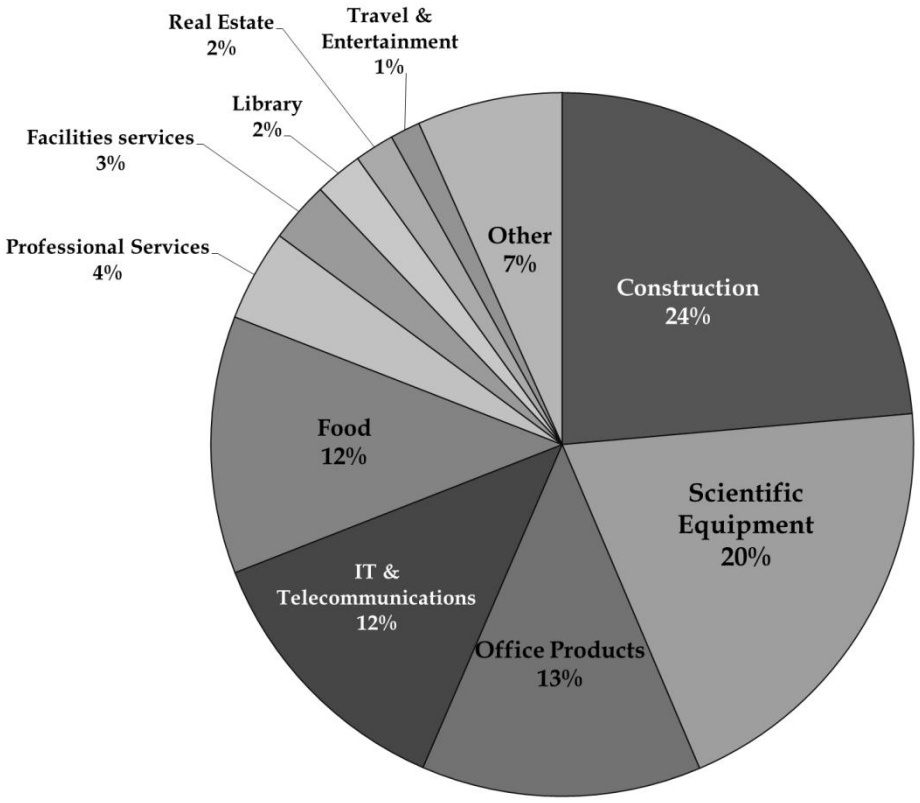
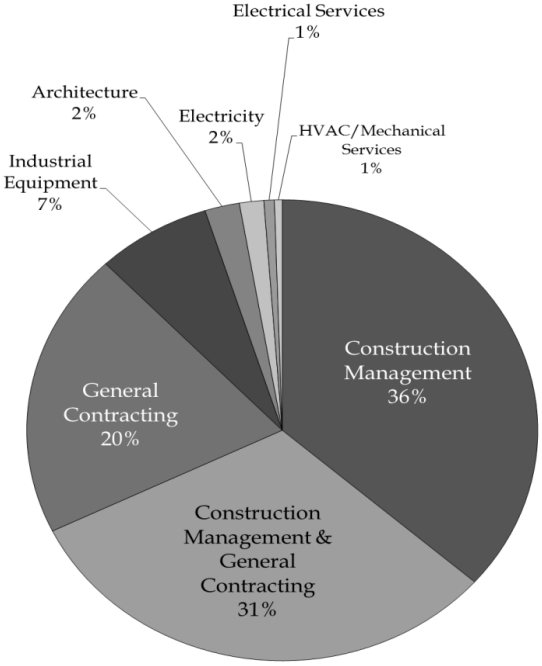
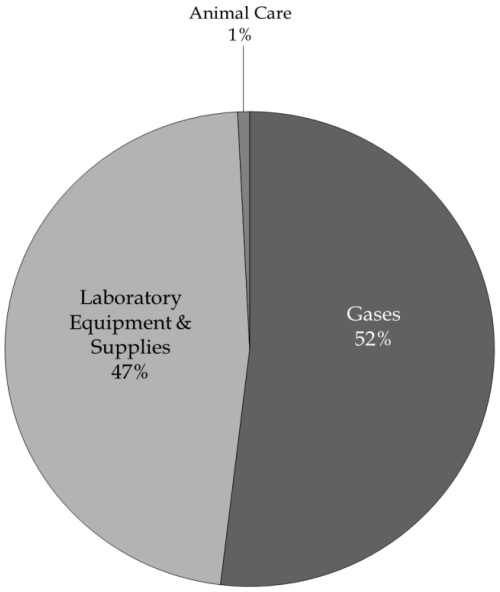


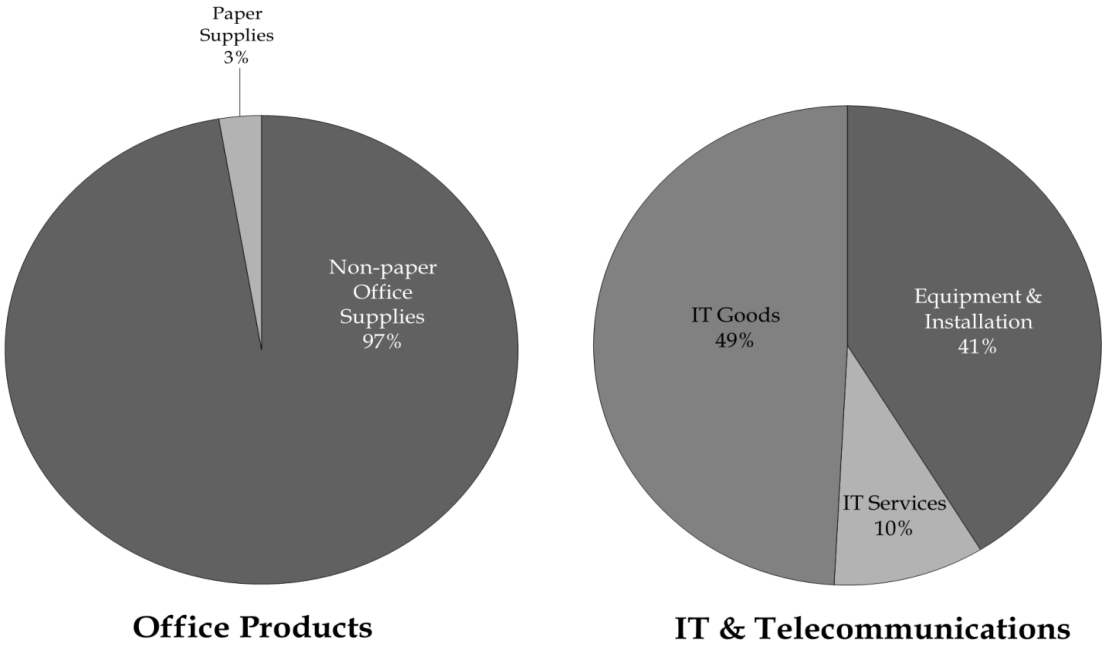
Figure 4. Compositions of Top Emitting Categories, By Subcategory.



Construction

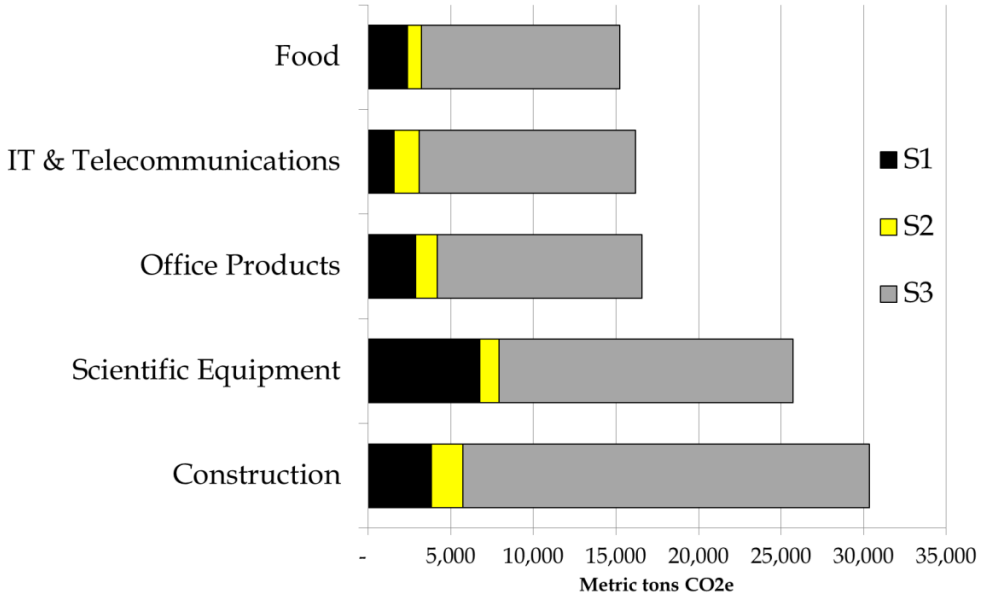


Scientific Equipment



From the vendor perspective, 15% of all procurement emissions were scope 1, 10% were scope 2, and 75% were scope 3. This is important to consider when altering procurement practices to reduce supply chain emissions and I reflect upon this in the Discussion section.

Figure 5. UC Berkeley's 2009 Top 5 GHG Emitting Categories, by Vendor Scope.
Emission scopes 1, 2, and 3 shown below are from the perspective of UC Berkeley vendors to highlight opportunities for reductions in supply chain emissions.



Summary of Recommendations and Opportunities for Future Study

General, in order of priority given current campus resources:

1. Expand reuse initiatives to reduce consumption & do not focus efforts on services.

2. Investigate food procurement with Cal Dining and campus departments.

3. Standardize the process for estimating procurement emissions and include in CalCAP's annual emissions inventory.

4. Survey campus buyers to understand buyer behavior, particularly opportunities and barriers to including an environmental metric in campus' e-procurement system.

5. Include GHG emissions in "green" procurement strategic sourcing plans and develop a "green" vendor scorecard to incentivize environmentally responsible suppliers.

The following ideas and recommendations are intended to reduce emissions or further investigate categories that were identified as high-emitting in this assessment.

Construction

1. Understand what types of services are provided by contracted vendors and be able to distinguish between carbon-intensive practices (i.e. use of industrial equipment) vs. less carbon-intensive practices (i.e. management or architectural services). This will inform future calculations for supply chain emissions resulting from construction expenses.

2. Estimate on-site emissions from construction equipment by requiring contracted vendors to disclose fuel consumption.

3. Conduct pilot life cycle assessment of a specific construction project on campus with student researchers.

Scientific Equipment

1. Collaborate with Berkeley Center for Green Chemistry to evaluate less carbon intense alternatives for chemical reagents and other laboratory supplies.

2. If possible, prioritize buying equipment and supplies from California vendors to reduce supply chain emissions.

3. Ensure that used chemicals and supplies are disposed of properly with EH&S to avoid release of climate forcing gases and mitigate risk of pollution.

Office Products

1. Reduce consumption by encouraging reuse and exchange of office supplies between departments.

2. Evaluate carbon intensity of office supply products when assessing "environmentally-preferable" office supplies in Office Max strategic sourcing contract.

Food

1. Work with Cal Dining and department event planning employees to conduct more detailed assessment of food purchasing habits with product-level data.

2. Buy less meat and dairy products and replace with less carbon intensive alternative such as organic produce.

3. Prioritize organic (no pesticide or fertilizer inputs) food options.

What's different from the 2008 assessment?

In 2008, UC Berkeley researchers from the Renewable and Appropriate Energy Laboratory (RAEL) conducted a pilot study that calculated a supply chain carbon footprint based on campus procurement habits. This assessment improves accuracy of emissions estimates and builds upon the methodology used in the 2008 study by:

- Considering vendor location and adjusting scope 2 emissions for California vendors
- Conducting a more rigorous assessment of construction emissions with Capital Projects
- Specifying scope 1, 2, and 3 emissions from the vendor perspective

Due to differences in methodology, we cannot directly compare results from these assessments. Detailed methods yielded a smaller more accurate estimate for procurement emissions.

Scope	Category	2008 Emissions	2009 Emissions	% Change
1	Natural Gas	11,818	11,820	+6.1%
1	Campus Fleet	1,523	1,546	+0.8%
1	De Minimis	-	283	N/A
1	Fugitive-Refrigeration	213	106	+0.1%
2	Steam	79,852	77,748	-2.6%
2	Electricity	66,374	57,385	-8.1%
3	Air Travel	21,062	19,908	-5.5%
3	Faculty & Staff Commute	17,310	15,229	-12.5%
3	Student Commute	3,172	3,224	+1.7%
3	Water	1,988	2,172	+1.0%
3	Solid Waste	1,006	1,066	+0.6%
3	Construction	80,000	30,345	-164%
3	All Other Procurement	169,000	98,245	-70%

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Questions?

Please contact Kelley Doyle at kdoyle@berkeley.edu.