RD

Contractor: The Regents of the University of California, Berkeley

Contract # 07-344

FUNDING FISCAL YEAR	FY 07/08	FY 08/09	FY 09/10	
TERM	6/30/09 - 6/29/10	6/30/09 - 6/29/10	6/30/09 - 6/29/10	
PCA	72360	72360	72360	
LINE ITEM/OBJECT	398	398	398	
				TOTAL
DESCRIPTION IT System development services				
Contract $	$ 439,805.03	$ 142,197.25	64,666.92	$ 646,669.20
				$ -
				$ -
Total, Contract	$ 439,805.03	$ 142,197.25	$ 64,666.92	$ 646,669.20

Payments to Contractor:							
Inv. #	Inv. Date	Ser Per					C/S
						-	
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Total, Payments			$ -	$ -	$ -	-	

Balance Available to Pay Contractor	$ 439,805.03	$ 142,197.25	$ 64,666.92	$ 646,669.20
Balance Must Be Spent By:	*6/30/2010*	*6/30/2011*	*6/30/2012*	

Notes:

Contract Manager: Mike Guzzeta

RD

Contractor: The Regents of the University of California, Berkeley

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Notes:

Contract Manager: Mike Guzzeta

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11/19/2009

STATE OF CALIFORNIA
STANDARD AGREEMENT
STD 213 (Rev 06/03)

AGREEMENT NUMBER	REGISTRATION NUMBER
07-344	3900090833 1269

1. This Agreement is entered into between the State Agency and the Contractor named below:

STATE AGENCY'S NAME
Air Resources Board (ARB)

CONTRACTOR'S NAME
The Regents of the University of California, Berkeley (UCB or Contractor)

2. The term of this Agreement is: Upon DGS Approval through Or June 30, 2008, whichever occurs sooner Through two (2) Years

3. The maximum of this Agreement is: $ 628,292.90 Six hundred twenty-eight thousand two hundred ninety-two dollars and ninety cents.

4. The parties agree to comply with the terms and conditions of the following exhibits which are by this reference made a part of the Agreement.

Exhibit A – Scope of Work	1 Page
Exhibit A Attachment 1	40 Pages
Exhibit B – Budget Detail and Payment Provisions	2 Page
Exhibit B Attachment 1	27 Pages
Exhibit C* – General Terms and Conditions	GIA 101
Check mark one item below as Exhibit D:	
☒ Exhibit - D Special Terms and Conditions (Attached hereto as	1 Page
☐ Exhibit - D* Special Terms and Conditions	
Exhibit E – Additional Provisions	3 Pages

Items shown with an Asterisk (*), are hereby incorporated by reference and made part of this agreement as if attached hereto. These documents can be viewed at www.ols.dgs.ca.gov/Standard+Language

IN WITNESS WHEREOF, this Agreement has been executed by the parties hereto.

CONTRACTOR

CONTRACTOR'S NAME *(if other than an individual, state whether a corporation, partnership, etc.)*
The Regents of the University of California, Berkeley (UCB or Contractor)

BY *(Authorized Signature)* — DATE SIGNED *(Do not type)*: 6/23/08

PRINTED NAME AND TITLE OF PERSON SIGNING
Jyl Baldwin, Assistant Director of Compliance & Special Projects

ADDRESS
Sponsored Projects Office, 1250 Shattuck Avenue, Suite 313
Berkeley, CA 94704-5940

STATE OF CALIFORNIA

AGENCY NAME
Air Resources Board

BY *(Authorized Signature)* — DATE SIGNED *(Do not type)*: 06.30.08

PRINTED NAME AND TITLE OF PERSON SIGNING
Socorro Watkins, Chief, Business Management Branch

ADDRESS
P.O. Box 2815, Sacramento, CA 95812

California Department of General Services Use Only

APPROVED
AUG 1 2008
DEPT OF GENERAL SERVICES

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AUG 1 2008
DEPT OF GENERAL SERVICES

☐ Exempt per:

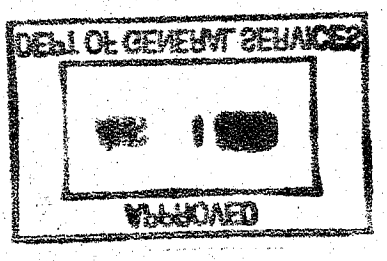


EXHIBIT A

SCOPE OF WORK

1. The Regents of the University of California, Berkeley (UCB, University, or Contractor) agrees to provide the following services for the project entitled "California Carbon Footprint Calculator (Cool California)," which is attached hereto as Exhibit A, Attachment 1, and made a part of this Agreement.

2. The project representatives during the term of this agreement will be:

Requesting Agency: ARB	Providing Agency: The Regents of the University of California, Berkeley
Name: Dr. Ken Bowers	Name: Dr. Daniel M. Kammen
Division/Office: Research Division	Division/Office: Renewable & Appropriate Energy Laboratory (RAEL) - UCB
Phone: 916-323-1510	Phone: 510-642-1139
Fax: 916-322-4357	Fax: 510-643-2243
Email: kbowers@arb.ca.gov	Email: kamenn@berkeley.edu

The ARB Contract Administrator Is: The University's Contract Administrator is:

Requesting Agency: ARB	Providing Agency: The Regents of the University of California, Berkeley
Name: Sally Jorgensen	Name: Jyl Baldwin
Division/Office: Research Division	Division/Office: Sponsored Projects Office
Address: 1001 "I" Street, 5th Floor	Address: 2150 Shattuck Avenue, Suite 313
Sacramento, CA 95814	Berkeley, CA 94704-5940
Phone: 916-327-1500	Phone: 510-642-8117
Fax: 916-322-4357	Fax: 510-642-8236
E-mail: sjorgens@arb.ca.gov	E-Mail: jbaldwin@berkeley.edu

Proposal to: California Air Resources Board

From: Berkeley Institute of the Environment, University of California, Berkeley

Title: California Carbon Footprint Calculator (coolcalifornia.org)

Investigators:

- Principal Investigator: Daniel M. Kammen, Professor, Energy and Resources Group, Public Policy, Nuclear Engineering, UC Berkeley. http://ist-socrates.berkeley.edu/~kammen/
- Researcher/Project Manager: Christopher M. Jones, Staff Research Associate, Berkeley Institute of the Environment, UC Berkeley
- 2 graduate student researchers

Subcontract: Lawrence Berkeley National Laboratory
Subcontract cost: $310.000.00
Subcontract cost: $80,000

Collaborating institution: Next Ten

Project Period: 24 Months

Project Cost: $628,292.90

1. Summary:

This is a proposal by the Berkeley Institute of the Environment (BIE) at the University of California, in collaboration with the Lawrence Berkeley National Laboratory (LBNL), to the California Air Resources Board (ARB) to develop an innovative web-based carbon footprint calculator for use by California individuals, households, businesses and communities. This project is the result of an interagency collaboration called the California Carbon Footprint Working Group (the "Working Group"), which includes the aforementioned organizations, the California Energy Commission, Next Ten, and others.

The goals of this project include:

1) Provide robust, very user friendly, benchmarking tools to evaluate climate-related performance of individual households and businesses,
2) Allow individuals and businesses to make simple (low hanging fruit) early GHG reductions by identifying simple low- or no-cost options.
3) Educate the public on the impact that consumption choices have on GHG emissions, as well as evaluate their cumulative impact relative to others (e.g., in California, the nation, and internationally),
4) Promote specific mitigation actions (relevant to the user) for reducing emissions,

5) Develop customizable tools that can be used by the public and businesses to evaluate and reduce their carbon impact, and
6) Provide materials for California schools and government entities to use the coolcalifornia.org portal as a learning/teaching tool.

A number of existing online carbon footprint assessment tools help individuals, households, and businesses evaluate their carbon footprints,[1] but none offer the advanced and comprehensive functionality proposed by this project. This tool will provide localized emissions estimates for transportation, housing, food, goods and services, as well as resources that can help users make more climate-friendly consumption choices. This tool is expected to play an important role in changing the way Californians think about, monitor and address their personal climate footprints.

2. Background

California has taken a strong national and global leadership position to reduce greenhouse gas emissions. California's Global Warming Solutions Act (AB32) establishes an ambitious target of reaching 1990 greenhouse gas (GHG) levels by 2020. Meeting this target will require action at all levels of society, including consumers. The California Air Resources Board has been charged with implementing AB32. As part of this mandate ARB developed a prototype household carbon footprint calculator, available at http://www.arb.ca.gov/cc/ccc/ccc.htm. ARB seeks to provide an advanced carbon footprint informational and action-oriented tool that can function as a resource for California residents and businesses.

Meeting California's commitment to greenhouse gas reductions will require California residents, businesses and institutions to change everyday behaviors that lead to the emission of greenhouse gases to the atmosphere. The innovative carbon footprint calculator proposed by this project will enable a wide range of users to understand the impact of consumption choices on carbon emissions, and connect users to resources to mitigate this impact.

The Berkeley Institute of the Environment is spearheading an effort at UC Berkeley to develop cutting-edge environmental life cycle assessment accounting tools for use by individuals, retailers, manufacturers, organizations, and governments. BIE extends upon sector-level emissions data provided by input-output life cycle assessment[2] to develop emissions factors appropriate to retail goods and services. These emissions factors are multiplied by consumer expenditures (using the US Consumer Expenditures Survey by the Bureau of Labor Statistics) to form a life cycle assessment (LCA) of everything US households consume. A prototype of our model and calculator is available at http://bie.berkeley.edu/calculator.

BIE is currently undertaking a major update of the LCFC calculator. This new version will allow users to select state or city of residence, number of people in household, and income level. The calculator then

[1] For a number of examples, see http://hes.lbl.gov/hes/carbon-calculators.html
[2] Carnegie Mellon University. Economic Input-Output Life Cycle Assessment. http://www.eiolca.net/

adjusts average default emissions profiles based on the consumption choices of similar households, local prices of goods, food and services and local emissions factors from power providers. The calculator also

incorporates other advanced functionality (e.g. an advanced vehicle emissions calculator) and detailed documentation. BIE is developing versions of this tool for a major environmental NGO, the community of Berkeley (in collaboration with the City of Berkeley and local community-based organizations), and UC Berkeley. BIE has also begun discussions with other cities (within and outside California) that have expressed initial interest in having their own version of the tool. To meet this demand for locally-specific carbon footprint calculators BIE seeks to create a database-driven tool that will allow organizations to develop their own customized calculators based on data maintained at BIE.

Emissions from residential and commercial buildings energy use is not handled in any detail in the existing BIE tool. The Lawrence Berkeley National Laboratory has developed an advanced and widely used online assessment tool that helps users measure and reduce household energy and carbon emissions, called Home Energy Saver (HES, located at http://hes.lbl.gov). This tool provides simple, static default emissions profiles for US households based on typical housing configurations and climate zones. The tool then allows users to customize dozens of variables based on particular configuration of homes and provides a simulation-based ranked assessment of the most cost-effective and energy saving improvements for homes. Each time users run the model, the results are stored in a database and can be recalled by users for future reference. A full description of HES can be found at: http://hes.lbl.gov/hes/about.html. LBNL seeks to develop a robust web-services infrastructure to allow organizations such as CARB to develop customized versions of the tool.

In addition, LBNL is launching a new tool (called *EnergyIQ*) and underlying action-oriented benchmarking (AOB) methods and web service developed in ASP.NET for estimating the carbon footprint of non-residential buildings, and recommending actions that will reduce energy consumption and carbon emissions. The peer-group data are from the CEUS survey, an unparalleled energy end-use characterization of the California commercial buildings stock. The Action-oriented Benchmarking database and web service underlying *EnergyIQ* can be tapped by third party tool (e.g. CARB) developers to create alternative user interfaces.

Next Ten is a key collaborator in the California Carbon Footprint Calculator Working Group. It is envisioned that Next Ten will be responsible for developing a website and hosting the calculator.

3. Project Overview

Developing robust tools will require significant time and effort, suggesting a phased development approach. The California Carbon Footprint Working Group has identified three phases of work:

Phase 1 (launch Feb 19, 2008): Integration of ARB functionality into the emerging BIE tool. Website hosed by Next Ten

Phase 2 (launch September 2008): Development of an advanced database-driven tool for homes; specification for integrating HES functionality; separate or integrated functionality of *EnergyIQ* for businesses

Task 1: Improve the modeling of the household calculator
Task 2: Develop and integrate "things you can do" to reduce your climate footprint
Task 3: Build a separate business tool for rapid Scope 2 & 3 greenhouse gas accounting

Phase 3 (2008-2009): Advanced modeling capability and integration of HES functionality

Task 1. Improve and expand the modeling of the household calculator
Task 2. Turn calculator database into a web services tool
Task 3. Integrate Home Energy Saver web services functionality
Task 4. Create an advanced version of the Cool California Businesses tool
Task 5. Build resources for different user groups

The current proposal covers Phases 2 & 3. The discussion below describes the basic functionality. Figure 1 below describes the basic information flow for the Household Calculator. An additional Businesses calculator will also be integrated into the framework described in Figure 1.

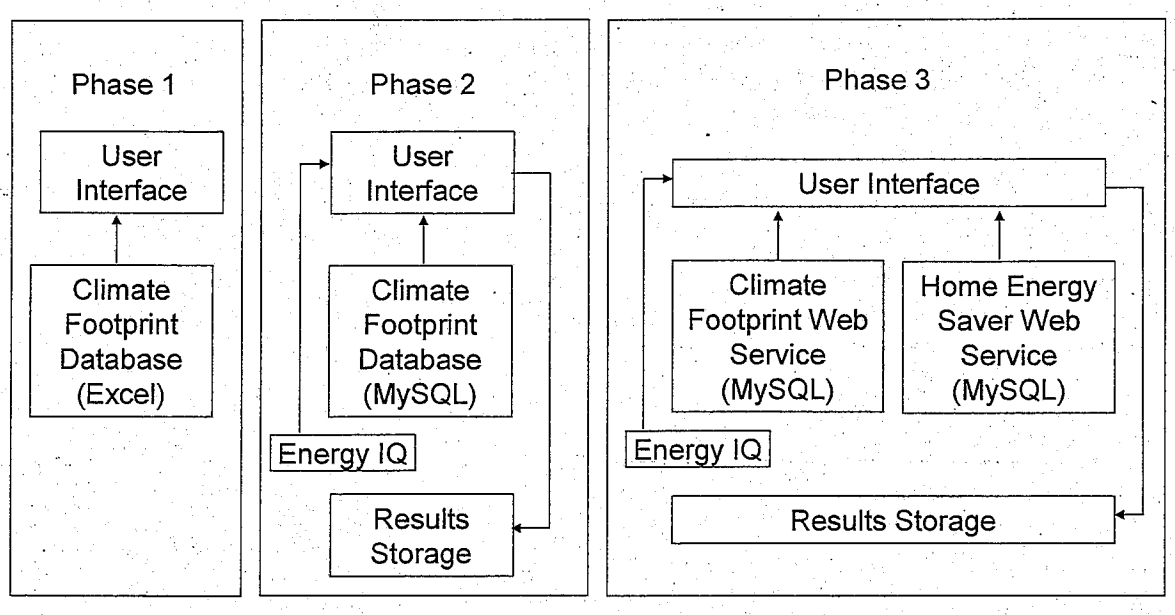


Figure 1: Phased Approach for Development of the Cool California Calculators

The Phase 1 calculator will offer users the ability to estimate emissions from essentially every dollar they spend (from transportation, housing, food, goods and services). The Phase 2 will add a scenario building feature that allows users to understand the annual GHG savings of different options:

- Transportation: ways to reduce emissions from your vehicle, benefits of public transport or telecommuting, how to choose best travel options.
- Home activities: gas/electricity consumption, water use, waste generation

- Non-residential buildings: energy-efficiency improvements
- Food: buying local and/or organic
- Goods & Services: comparing buying online vs. typical shopping, use of high-GWP consumer products such as computer keyboard dusters.

The Phase 3 calculator will also provide specific customized recommendations as to GHG reduction options including:

1) the cost of the option
2) the payback period for the option if applicable
3) how to implement the option (i.e., links to options for subsidizing the options, such as programs available through the applicable utility, links to sites selling services/materials, options for alternative transportation tied to the users zip code, etc.)

(In the case of non-residential buildings energy use, specific measures will be recommended, and the estimated impacts will be qualitative.)

The Phase 2 and 3 calculators will include several other features including:

- Track site traffic and use as well as query users to further improve the site (to be developed by Next Ten)
- An option to save user information – allowing users to revisit the site without having to re-key information (data to be stored on BIE server in Phase 2)
- An option to send periodic emails/links to keep users informed, and promote further GHG reduction behaviors, i.e., promoting references to the calculator in newspapers, local new letters, etc. (to be developed by Next Ten)
- Provide repeat visitors to the calculator with a plot that tracks their progress at reducing GHG emissions over time (Log in developed in Phase 2, dynamic chart to be developed in Phase 3)
- Track self-reported actions taken by users for an estimate of the annual reductions of GHGs (by region and user type) that the calculator has facilitated possibly via periodic user queries. For example, interested users could receive a follow-up questionnaire on the recommendations that they acted on as well as any barriers from acting on others. (the scenario building feature in Phase 2 will allow users to set targets based on recommendations. The Phase 3 version will allow users to track their progress).

- Provide information for businesses and schools to understand where they stand relative to comparable business as well as the opportunities for emission reductions and cost savings (Phase 3)
- Trip planning comparator – using different modes of travel (a simple version to be developed in Phase 2, with more advanced features in Phase 3).

4. Project Tasks and Activities

Phase 1

BIE will launch a national version of its Lifecycle Climate Footprint Calculator along with a coordinated launch of the Cool California Calculator on February 19, 2008. This tool will generate default carbon footprints based on the location (US State or major metropolitan area), number of people in the household and income of users. The model then selects the appropriate level of

consumer expenditures, local energy mix from power providers and local prices. The tool compares users' results to a similar reference group (based on city, household size and income), and typical California, US and global households.

The calculator includes:

1) Transportation
    a. Motor vehicles: fuel (direct and life cycle), manufacturing, and services. (separate advanced module for yr/make/model)
    b. Air transportation: (select total miles, or number of short, medium, long or extended trips; separate advanced module for airport to airport distance)
    c. Public transportation: # of miles traveled. (data is calculated for multiple modes, but is currently not integrated into the tool in order to reduce clutter, save users time, and reduce the total file size).
2) Housing
    a. Electricity
    b. Natural Gas
    c. Other fuels (e.g., propane, gasoline for generators)
    d. Water and sewage
    e. Construction & maintenance
3) Food
4) Goods & Services
5) Total emissions for the above activities
6) Non-residential buildings (not included)

Emissions factors are based on a variety of publicly available sources including Egrid[3] for household energy, GREET[4] for indirect emissions from fossil fuels and EIO-LCA[5,6] for consumer food, goods and services. Other sources of data will be explored in Phase 2 and 3 including LCA of transportation fuels (work being conducted by Sperling and Farrell (PIs) for California's Low Carbon Fuel Standard),

California-specific product-level data (being conducted by Horvath (PI) for ARB proposal), emissions data provided by Next Ten at the zip code level, and other sources.

The calculator employs a Flash interface, enabled by the software tool Chrystal Xcelsius. Versions of this tool can be easily embedded in websites as .swf objects.

The goal of phase one is to launch a fully functioning Cool California Carbon Footprint Calculator with the above-mentioned functionality by February 19, 2008. To facilitate this process, the Working Group is assisting in the development of this tool by providing the following:

1) The development and dissemination of an online survey inviting individuals to evaluate the three (ARB, BIE, LBNL) existing calculators. Feedback from this survey has been tabulated and has been invaluable in the construction of the current calculator.
2) ARB has sent BIE a full copy of its online calculator, as well as supporting materials. BIE has incorporated data from home energy (power providers) and air transportation (airport-to-airport calculator and short, medium and long-haul flights).

Next Ten has provided design guidelines for the Phase 1 calculator, and BIE is working to implement these suggestions. It is anticipated that Next Ten will host the site at http://coolcalifornia.org and provide links to useful resources, including the Home Energy Saver calculator, which will be incorporated in Phase 2 and 3. ARB has agreed to provide a Spanish translation for the calculator, and BIE will develop a separate tool in Spanish. A mockup of the Cool California Calculator is provided in Figures 1 & 2.

[3] US EPA. Emissions and Generation Resource Integrated Database. http://www.epa.gov/cleanenergy/egrid/index.htm
[4] Argonne National Laboratory. The Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) Model. http://www.transportation.anl.gov/software/GREET/
[5] Carnegie Mellon University. Economic Input-Output Life Cycle Assessment. http://www.eiolca.net/
[6] BIE's LEAPS model adjusts sector-level emission factors in 1997 producer dollars given by EIO-LCA to product category-level emission factors in 2007 consumer dollars.

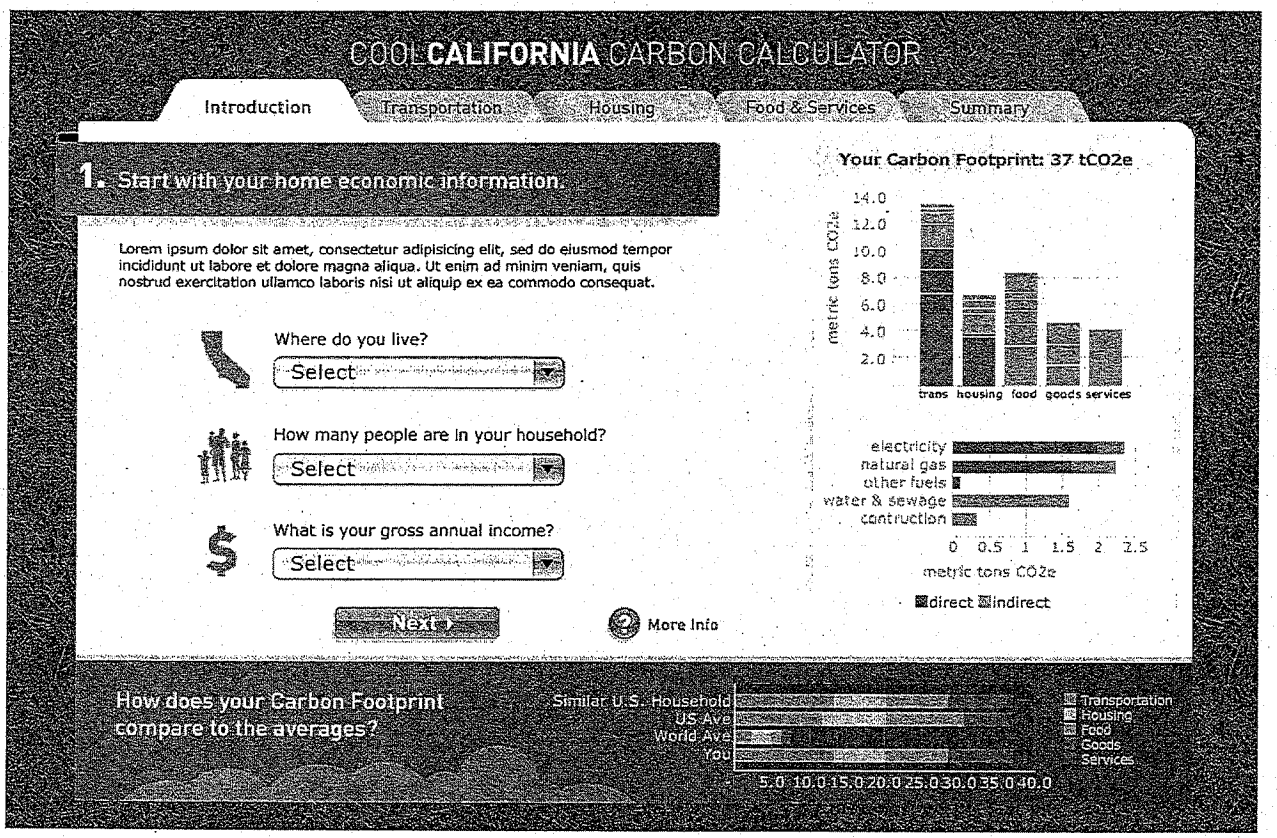


Figure 1. Mockup introduction page of the Cool California Households Calculator

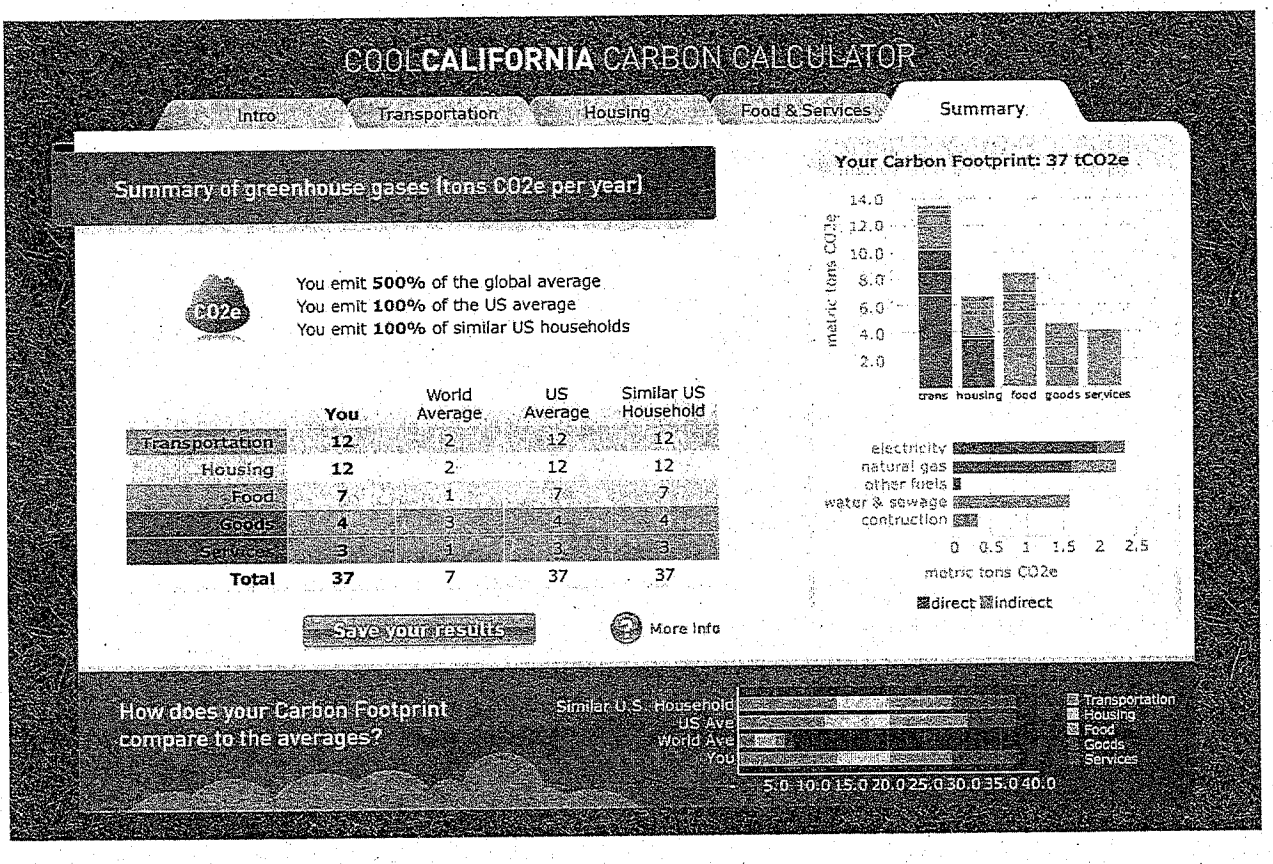


Figure 2. Mockup of summary page of the Cool California Households Calculator

Phase 2

The current proposal will turn the Phase 1 calculator into a more comprehensive, robust, localized, and user-friendly database-driven tool. The calculator will estimate the potential greenhouse gas emissions reductions from everyday activities, as well as the expected GHG savings and cost for recommended mitigation strategies. These recommendations will be prioritized based on the specific climate footprints

of users. As an advanced feature for homes, the calculator will link to pre-generated sessions of the Home Energy Saver tool. Users will be able to either print the results page (and possibly consumer choices and/or recommendations as well) and/or save info to a central database for retrieval at a later date.

In addition to the household calculator, BIE will develop a Cool California Businesses tool that allows for rapid assessment of direct, indirect and life cycle (LCA) emissions from energy, transportation and procurement (construction and inputs to production). As an advanced feature, this tool will integrate LBNL's EnergyIQ web services tool for workplac energy used in non-residential buildings[7]. Based on

identified end-user needs and budget, BIE will either incorporate EnergyIQ as-is or develop a new, abbreviated user interface using the web service.

The calculator(s) will have a user-friendly graphical user interface (GUI) that links to a centralized MySQL database, which will be managed by BIE. Each of these tools will be embedded in a website that will be designed and maintained by Next Ten, with input from the Air Resources Board and the Working Group. The website will provide links to local resources.

Task 1: Improve the modeling

Activity 1: Develop a robust model of California greenhouse gas emissions from consumption

Currently, the Cool California Calculator provides a life cycle climate footprint of 28 U.S. cities, the national average and four major regions: West, Northeast, South and Midwest. These models are based on about 50 individual consumption choices for residents of those areas (from the Consumer Expenditures Survey), local price information, and local energy mix (at the state level). These local models represent the carbon footprints of local regions from a consumption perspective. These assessments count greenhouse gas emissions regardless of where they occur (e.g. emissions embodied in goods and food may occur far away from the point of consumption) and are therefore not comparable to inventories based on production. Comparing the production and consumption footprints of a region will allow for new ways of thinking about greenhouse gas responsibility. Because income is highly correlated with emissions, it may be likely that high income areas will have higher footprints on a consumption perspective, and poorer and industrial areas will have higher footprints from the production perspective. Due to the intellectual and policy implications of these assessments it is importance to get the data right.

Developing a robust model for the California average is particularly important for this project, since the "consumption carbon footprint" of California may become a new policy instrument. This model will allow the Air Resources Board to track and compare the greenhouse gas emissions in the state from both the production (supply) and consumption (demand) perspectives. For example, California's official

[7] The initial version of the LBNL AOB System will not produce quantitative carbon reductions, cost, or payback scenarios. Future versions may include this functionality, but the initial version will provide qualitative indications of the impacts of the likely relevance, impact, and cost-effectiveness of various improvements to the facility.

Greenhouse Gas Inventory[8] counts all emissions from manufacturing and agriculture within the state, regardless of where these goods are purchased. The Cool California calculator will estimate emissions based on consumption of California households, regardless of where supply chain emissions actually occur. The results may be dramatically different. For example Weber and Matthews (2007) use a multi-regional input-output model to calculate that emissions from imports account for 13–30% of total US emissions, largely due to outsourcing of manufactured goods to China and other countries with higher greenhouse gas intensity. .

A similar state-level environmental impact inventory based on consumption was conducted by Morris (et al. 2007) for the State of Washington at the request of the Washington State Department of Ecology. This Consumer Environmental Index uses an approach which is consistent with the Life cycle Climate Footprint Calculator, but includes criteria air pollutions and toxic waste and weights each of these

impacts to create an environmental index that can be tracked over time. The Cool California Calculator could eventually be modified to include an environmental footprint (as apposed to a simple carbon footprint) assessment including these other emission factors. The weighting of emission factors is necessarily subjective, and many approaches are possible (as outlined in Morris, et al 2007). Matthews (1999) suggests weighting impacts based on a mitigation

(offset) cost of GHGs and a health-related external cost for criteria air pollution. Toxic waste could be further evaluated based on health-related and mitigation (cleanup) costs. Such an analysis would provide an assessment of the external cost of California consumption. A future project that combines this assessment with work being conducted by Horvath (PI) to develop an input-output model of California, could determine which impacts occur within California, and which occur elsewhere.

Activity 2: Localization of the Calculator to zip code level

The Phase 2 calculator will localize our model from the regional and metropolitan areas (San Francisco Bay Area, San Diego and Los Angeles) down to the zip code level in California based on income data in those regions and individual scaling factors for each consumer item in the calculator. For some items income does not correlate well to consumption. In economics "non-normal goods" are those for which consumption decreases as consumption increases (hamburger and public transportation –excepting air travel- are good examples). We will use regional and city data as proxies for distribution of consumption at the state level and scale emissions based on local income data[9]. We will also, to the extent possible, use actual consumption data at the local level (e.g. public transportation data, or data currently being collected by Next Ten at the zip code level). Finally, we will develop unique algorithms that combine consumption and income data at the local level for each consumer item in the model.

The Phase 1 version of the calculator will allow users to select one of 6 power providers. The zip code version in Phase 2 will automatically pre-select all possible power providers in that zip code (in some cases, e.g., in Los Angeles, there are more than one provider). We will seek to incorporate additional

[8] http://www.arb.ca.gov/cc/inventory/data/data.htm
[9] Regional consumption data will be used for the population of California not included in metropolitan areas, in a similar approach to Morris, 2007

features of power providers that further modify emissions as advanced options (e.g., being a member or PG&E's Climate Smart program, or selecting SMUD's green supply program). We will provide a link to each utility's website for users to log in to retrieve information from their bills.

Activity 3. Create detailed drill-down feature for household transportation, food, goods and services

The Transportation module in Phase 2 will have several advanced ("drill down") features, including:

1. Select number of vehicles
2. Select year, make and model of vehicles (already under development)
3. Add off-road or recreational vehicles
4. Airport to airport distance calculator (already under development)
5. Public transportation features (heavy rail, light rail, subway, intercity and intercity bus).
6. Trip planning feature that allows users to select a distance and calculate emissions based on different modes of transport

The calculator will also offer advanced drill-down features for food goods and services. BIE's "LEAPS" model (Jones, Kammen, Horvath 2007) contains 1,100 categories of food goods and services, arranged in 4 levels of hierarchy. These data are based on input-output life cycle assessment (EIO-LCA, 2007), but modified to the product category level. We will create the capacity for users to drill down to the product level (e.g., oranges, laptops, t-shirts) based on this modeling effort.

Task 2: Develop and integrate "things you can do" to reduce your climate footprint

The Working Group's survey demonstrates that one of the functions that people most want from a carbon footprint calculator is advice on how to reduce emissions. In short, people want an action-oriented tool. Typically this is done by simply directly people to lists of "things you can do" to reduce your footprint. These lists are frequently commonsensical (e.g. use less water) without a rigorous method for comparing the relative greenhouse gas and economic contribution of each action. Furthermore, these recommended actions are generally not tied to specific consumption choices entered in the model. An exception to this rule is the Home Energy Saver calculator, which creates a unique emission profile for each user and determines which home energy saving activities will save the most energy, greenhouse gas emissions and money. The EnergyIQ methodology will provide specific recommendations with qualitative indications of savings and cost-effectiveness. Future versions of EnergyIQ may provide quantified savings of the sort generated by Home Energy Saver.

Mitigation strategies (recommendations) will not be completed during Phase 2. Each one of these recommendations is itself a research project, some of which will be easier to conduct than others. During Phase 2 the research team will use collect and evaluate available resources to determine which recommendations can be made. Other important recommendations that will require additional research will be tabled for Phase 3.

Activity 1: build the "things you can do" model for all consumption categories

Like the HES, the Cool California Calculator will provide users with recommended carbon reduction strategies based on actual consumer choices entered in the calculator. Information will be provided in terms of greenhouse gases saved and the financial cost of each action, in addition to comparative metrics such as cost of carbon conserved, or payback time, where appropriate. To accomplish this we will develop a model comparing the relative contribution of a long list of typical recommendations (BIE has collected over 100 of these suggestions from other lists already) from a life cycle perspective. For example purchasing energy efficient appliance will also incorporate an estimate of energy required to make the appliance. In such cases, it may be more efficient to continue using an appliance with a higher energy load than throwing it out and purchasing a new one. If, on the other hand, the home owner is seeking a new appliance, purchasing the Energy Star appliance will save money and energy over time. This can only be determined from a life cycle perspective.

Activity 2: Incorporate recommendations into the calculator

Recommendations will move up or down on a list depending on the particular choices of the household. During the Phase 2 calculator we will select 10-20 of the most common action items and these will move up or down on the list of recommended actions based on the relative contribution of consumer choices. During Phase 3 we will develop additional capability to drill down and to further customize consumer choices.

Activity 3: provide users with roadmap to following recommendations

Additionally, we will work with the Air Resources Board and others in the Working Group to provide recommendations on how to proceed with implementing the strategy (e.g., where to acquire the technologies, comparisons of the attributes of various technologies, and incentives provided by various organizations). We will attempt to localize this information to the extent possible.

Activity 4. Access pre-generated reports from Home Energy Saver
During this phase, the conversion ofHome Energy Saver to a "web service" will be initiated, but will not be completed to the point that it can be fully integrated into Cool California Calculator; however, BIE will be able to integrate output from a finite set of HES runs as defaults. We will create a database of saved reports that can be linked to directly from the calculator. For example, a four person household living in Davis earning $110,000 using the Cool California calculator has an estimated living space of 2,200 square feet. Entering zip code, square feet of house and number of household members (2 children, 2 adults) in HES returns the following report:
http://hes3.lbl.gov/hes/status.taf?f=Calc&session_id=1006053&path=Key

Running these scenarios for all possible combinations of climate zones, house sizes and number of household members would truly be a laborious task. BIE will work with LBNL to determine which of these factors contributes most to emissions and will select some reasonable number of default reports to run (on the order of one hundred). It will not be possible to link users directly to the HES tool to view their specific information in detail, since logging in to a pre-existing session would allow users to make modifications to the session, and thus change the profile, which would affect future users. For example the above session can be modified by simply entering the session number 1006053 on the home page of

HES. We will therefore incorporate the recommendations, GHG savings and financial information directly into the Cool California Calculator for each of the scenarios run. Another advantage of incorporating HES results into the household calculator database is we can add an additional calculation for expected life cycle costs for manufacturing the equipment purchased to provide the HES recommendations (e.g., greenhouse gases required to manufacture appliances). We will also provide a prominent link to the Home Energy Saver tool. The Phase 3 calculator will incorporate HES directly as a web services tool, contingent on supplemental funding. The work performed in Phase 2 will allow for the preparation of an accurate budget and schedule for completing the web service and fully integrating it into the CoolCalifornia tool under Phase 3.

Note: BIE and LBL will subcontract to BigHead Technology for the programming work for Tasks 1 and 2. See budget, budget justification, and attached scope of work. .

Task 3: Build a separate business tool for rapid Scope 2 & 3 greenhouse gas accounting

Several tools are already available for businesses to evaluate their carbon footprints using standard reporting protocols. In California, the California Climate Action Registry's "Carrot" software provides a robust and secure platform for businesses to calculate and register their scope 1 & 2 emissions. Scope 1 (direct) emissions result from burning fuel directly, e.g., in boilers or on-site generators. Scope 2 (indirect") emissions result from the consumption of energy (electricity and natural gas). Scope 3 emissions are considered voluntary for reporting purposes and include emissions from vehicle fleet, air travel and procurement (life cycle). Scope 3 emissions are covered in the proposed Cool California calculator for households, but no single tool is available for businesses to track all scope 1,2 & 3 emissions.

We propose the development of a comprehensive and user-friendly tool to be built with the intended goals of:

1) leading more businesses and organizations down the path of registering their GHG emissions with CCAR, and
2) encouraging businesses to track a wider spectrum of emissions

During Phase 2 we will build a simple Cool California Businesses tool (with the energy component based on EnergyIQ) designed to allow organizations to estimate their full climate footprints in less than an hour. This user-friendly tool will give businesses a quick assessment of their climate impact, educate them on the differences between required and voluntary reporting, and direct them to CCAR for official reporting purposes. The Cool California Businesses tool will offer organizations a user-friendly (perhaps even fun) and anonymous way to estimate greenhouse gases from all operations.

The Business tool will follow a similar framework to the household calculator in that all emissions from consumption will be counted. UC Berkeley is, to our knowledge the first University, and one of the first

major institutions[10], to track its emissions on a life cycle basis (Figure 3). As part of the 2006 greenhouse gas inventory analysis, Jones (2007) uses Economic Input-Output Life Cycle Assessment (EIO-LCA) to show that the total campus carbon footprint increases from 210,000 metric tons to ~500,000 tons when considered on a life cycle basis. The embodied emissions in construction materials and processes resulted in 90,000 ton of CO2e, more than the impact of electricity and natural gas combined. UC Berkeley also estimated emissions from its campus fleet, student, staff and faculty commute and air travel, using similar method as the BIE household calculator. It is important that this information be clearly distinguished as voluntary reporting, as upstream emissions will only be estimates and will be double counted if suppliers, or suppliers to suppliers, also count emissions. UC Berkeley, for example, chose not to register the full climate footprint with CCAR but uses the footprint for internal purposes and has posted the results prominently on the GHG inventory website.

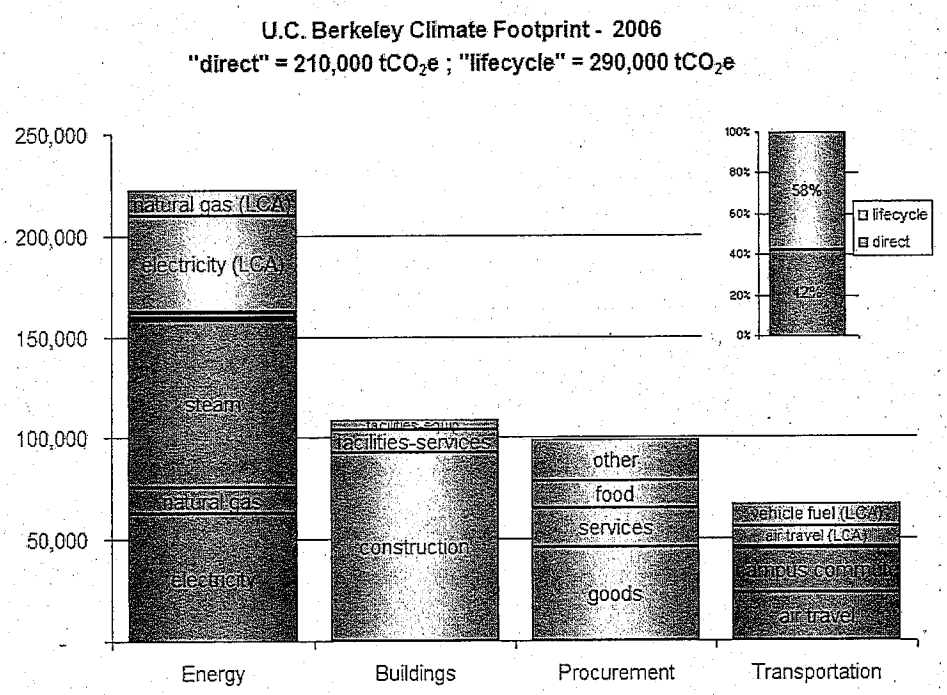
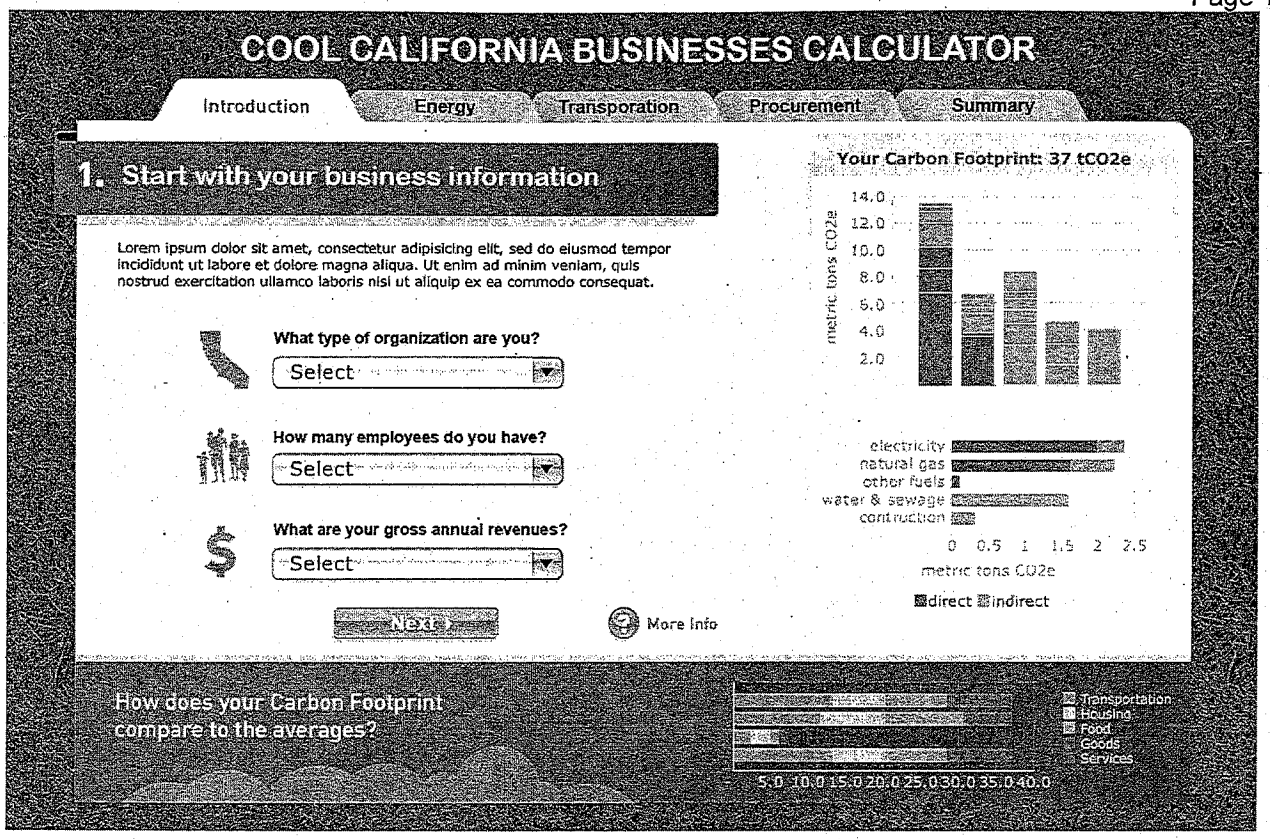


Figure 3. Climate footprint of UC Berkeley, 2006

Functional Specification:

[10] The State of Washington has calculated its climate footprint as part of the Consumer Environmental Index (Morris, 2007)



The Cool California Businesses Calculator will have 5 areas:

1) **Introduction**. Explains the purpose of the tool and asks users for basic company information including the type of business[11], the number of employees and the gross annual revenues. Users seeking to report emissions will be directed to CCAR.

2) **Energy**. Companies can select their power provider and enter energy consumption data from their bills. Users wishing to enter Scope 1 emissions will be directed to CCAR.

   Advanced feature: EnergyIQ (see below) for building efficiency

3) **Transportation**. Includes vehicles, air flights and public transportation. 1) Transportation: users record separate answers for company fleet and employee commute. Users can select the number of vehicles (opens appropriate number of forms) and can select vehicle type (yr/make/model) for each if car or truck, and vehicle type for heavy vehicles; fuel type (data consistent with low carbon fuel standards methodology), number of miles traveled and miles per gallon. 2) Air travel. Users add number of flights. Global airport selector (same as household calculator) estimates miles per flight. Users can select number of stops (refines estimates based on number of take-offs); 3) Public transportation: users select mode of transport and number of miles.

[11] These will be the same as in the CCAR Carrot tool.

4) **Procurement**. Input-output life cycle assessment (I-O LCA) provides emission factors (grams of pollution for dollar of output) based on sector-level data. Similar to the household calculator, this tool will allow users to estimate emissions from major expenditures (metals, chemicals, wood products, parts, construction, office equipment, food, etc.) for a rapid assessment of life cycle emissions from procurement and construction.

5) **Summary**. Results will be compared to similar organizations in total and compared to all organizations based on emissions per dollar of revenue and emissions per employee (using medians, not means, will be used to minimize the effect of outliers from potential misuse of the tool). Users will have the ability to store and print results.

Activity 1: Data Analysis for the Cool California Businesses tool

Much of the data required for the business tool will be the same as for the household calculator. Energy will be identical to the household calculator, with the exception of prices of energy (users will be recommended to enter electricity and fuel for this tool) and the integration of EnergyIQ (Activity 3). Transportation will be identical.

Procurement will require a separate modeling exercise since many goods purchased by businesses are intermediate goods, rather than consumer items as in the household tool. Emissions for intermediate

goods can be estimated using Economic Input-Output LCA. New categorizations of emissions may be required.

Responsibilities. Data analysis will be conducted by a graduate student researcher (100% during summer, 50% during school year), under BIE supervision. This researcher will also be responsible for activity 1 (data analysis) for the household calculator. Data analysis will be conducted in Excel.

Activity 2. Develop Web architecture and interface

BIE and LBL will subcontract to BigHead Technology for the programming work for Task 3. See budget, budget justification, and attached scope of work.

Activity 3: Integrate EnergyIQ Web Services Tool as Advanced Feature

LBNL's non-residential energy and carbon benchmarking tool, *EnergyIQ*, will become available to the public during the course of Phase 2. Like Home Energy Saver, the user interface may be more detailed than desired by the target audience for the CARB tool. *EnergyIQ* will be a database and web service that will enable those at NextTen or elswhereprogramming the overall CARB tool to develop a simplified user interface. The web service makes the data and methods used in *EnergyIQ* available to other websites, with complete flexibility in terms of detail and user interface. This underlying functionality is called the LBNL Action-Oriented Benchmarking System ("AOB System"). In its current form, the

AOB System provides quantitative baseline emissions (footprint), and qualitative recommendations ("Actions") for reducing emissions. The AOB System currently contains extensive California data for about 2800 buildings, but no national data. In Phase 2, LBNL will add data from the national Commercial Buildings Energy Consumption Survey to enable the AOB System to provide national benchmarking comparisons. LBNL will also assist CARB in using the AOB System to establish a highly simplified carbon calculator for businesses (either integral with the "consumer" interface, or separate, as desired by CARB). To provide the US-average reference points (as done elsewhere in the CoolCalifornia site), LBNL will add national CBECS data to the EnergyIQ tool.

Responsibilities. The Working Group will be responsible for determining which elements of EnergyIQ it seeks to integrate into the Cool California Businesses calculator. BIE will then develop a functional specification for this tool. A subcontractor will be responsible for connecting the Businesses calculator to EnergyIQ.

Phase 3:

The primary tasks during Phase three will be to:

1) Improve and expand the modeling of the household calculator
2) Turn the database into a web services tool allowing other states or cities to create their own unique calculators
3) Complete and integrate Home Energy Saver web services functionality

4) Create an advanced version of the businesses tool for all life cycle emissions
5) Create resources and outreach materials for different California user groups

Task 1. Improve and expand the modeling of the household calculator

Activity 1. Improve existing modeling

The primary modeling for the household calculator is expected to be completed during Phase 2; however, there may be additional features that will need improvement. One of the aspects that we can anticipate that will need additional work is the mitigation strategies. Areas that are deemed important for further research during Phase 2 will be undertaken in Phase 3. Each of these will be a mini research project. For example, it may be determined that buying local and buying organic are areas that hold promise as mitigation strategies, but the research in these areas may not be sufficient to make reasonable assumptions. This would be a prime target for research during this phase. The areas that we explore further during this phase will be documented in reports that can be provided on the website as additional supporting information and working papers.

Activity 2. Add criteria air pollutants

Air pollution is a primary concern for the California Air Resources Board, and a serious threat to human and ecological health in California, particularly in the Central Valley, near power plants and in heavily trafficked areas throughout the state. All of the primary data sources used in the Household calculator (Egrid, GREET, EIO-LCA) include criteria air pollution (CO, SO_2, NO_x, PM). ARB would work with the PI to arrive at the applicable emission factors. These will then be applied to each consumption category and totaled on the results page.

Task 2. Turn calculator database into a web services tool

It is expected that other US states or cities will want their own versions of the improved carbon footprint calculator. BIE is already working with a major NGO and the City of Berkeley to test the first of such tools. It is envisioned that cities and states that develop their own versions of the tool will be in some way be linked to the California tool. All of these tools will be able to access a centrally updated (MySQL) database that is maintained by BIE.

Activity 1. Subcontract work to programmer/web developer

BigHead Technology will be hired as a subcontractor (see budget, budget justification and attached scope of work) to convert the household calculator into a fully functioning web services tool. This tool will allow organizations to create their own versions of the calculator by accessing the database directly, or by modifying a template user interface. Cool California Working Group also seeks to have the capability to track statewide reductions made through individual and business commitments. Users that develop their own tools will need to develop their own website on their own server, adding any desired functionality (e.g. storage of user results). The Cool California site will also want to have data storage

capability. This can developed either on the Next Ten server or on the BIE maintained server. A programming and design firm will be contracted to build this web services functionality. This will likely be the same firm that develops the Phase 2 tool. Finding a firm with both programming design skill we be crucial to the success of this project. Care should be taken to research a number of competing companies to choose a group that has the right set of skills, is easy to work with, and with a strong track record of building similar tools. These teams should be interviewed directly by at least one member of ARB, BIE and Next Ten.

Activity 2. Develop technical guidelines

BIE will work with the web development team to develop technical guidelines for cities or states wishing to create their own versions of the calculator.

Task 3. Integrate Home Energy Saver web services functionality

Activity 1. LBNL to build infrastructure

LBNL will be responsible for building the web-service infrastructure associated with the Home Energy Saver website in collaboration with its programming subcontractor, BigHead Technology. See budget, budget justification and attached scope work.

Activity 2. Designating elements for inclusion of HES functionality in new user interface

The Working Group will have the joint responsibility of designating the elements of HES to be included in the Cool California Household tool. The HES will be an advanced feature so we can assume that users that access this tool are serious about making changes to their homes and are looking for energy and money saving advice. The CoolCalifornia implementation of the web service should be built such that users can drill down to get increasingly more detailed information, similar to the existing HES calculator. Results from these queries will be pushed directly to the Cool California Calculator creating a seamless users experience. The design of the user interface itself will be led by NextTen.

BIE will subcontract to BigHead Technology to build the web-service infrastructure for the CoolCalifornia tools and to link the Home Energy Saver tool to the Cool California household tool. See budget, budget justification and attached scope work.

Task 4. Create an advanced version of the Cool California Businesses tool

Businesses have different opportunities and limitations to reduce greenhouse gases than home owners. For example, reducing consumption of inputs to production or encouraging employees to adopt vegetarian diets are typically not options for most businesses. A set of recommendations will need to be developed, incorporating feedback from businesses.

It is important to anticipate the market barriers that currently prevent businesses from adopting energy efficiency measures. Information is not the only barrier. There are also, mixed incentives (e.g. when a

different department pays the energy bill), prioritization (managers have other priorities), lack of technical expertise to carry out efficiency measures, access to credit, transaction costs and others barriers. There are also a number of things businesses can do that are not cost-effective in strictly financial terms but may be attractive for marketing, employee moral, productivity or other purposes. In addition to calculating the impact of mitigation strategies it is important to also provide links to additional information and incentives to reduce emissions.

Activity 1. Model recommendations for different major sectors

During Phase 3 the tool will offer businesses the ability to drill down deeper for each category of emissions, including EnergyIQ for buildings, Input-Output LCA for life cycle emissions, an advanced transportation tool and Carrot software reporting protocols for scope 1 and 2 emissions. This tool may incorporate the ability to export data directly to CCAR.

Activity 2. Incorporate advanced functionality into calculator

The actual integration of EnergyIQ and other web services functionality will be conducted by the same subcontractor developing other aspects of the Cool California calculator tools.

Task 5. Build resources for different user groups

Activity 1. Collect resources for local businesses

The Working Group will be responsible for collecting a wide variety of resource that can be useful for households, businesses and other organizations. These resources will be provided on the main Cool California Portal, with individual links on the calculator itself for each item.

Activity 2. Build how to manuals and educational materials for different user groups.

The household calculator will be sufficiently user-friendly that it will be applicable to a wide range of user groups, including different age groups. However, the way the tool is used will vary depending on the user. Elementary school students will obviously have a different experience using the tool than college students. Because the Phase 3 calculator will be a web services version, other users could conceivably create versions for different age groups.

Finally, it will be necessary to develop an overall users manual, training guides, on-line help, and documentation as well as a manual for future managers of the site to keep the model up-to-date.

5. Timeline and Deliverables

Timeline of Tasks and Activities for Phase 2: To be launched May 2008

Tasks	May	Jun	Jul	Aug	Primary Researcher
Task 1: Improve the modeling					
Activity 1: Develop a robust model of California greenhouse gas emissions from consumption					Jones
Activity 2: Localization of the Calculator to zip code level					Jones
Activity 3. Create detailed drill-down feature for household food, goods and services					Jones
Task 2: Develop and integrate "things you can do" to reduce your climate footprint					
Activity 1: build the "things you can do" model for all consumption categories					Summer GSR1

Activity 2: Incorporate recommendations into the calculator					Consultant
Activity 3: provide users with roadmap to following recommendations					Summer GSR1
Activity 4. Access pre-generated reports from Home Energy Saver					Summer GSR1
Task 3: Build a separate business tool for rapid Scope 2 & 3 greenhouse gas accounting					
Activity 1: Data Analysis for the Cool California Businesses tool					Summer GSR2
Activity 2. Develop Web services architecture and interface					Consultant
Activity 3: Integrate EnergyIQ Web Services Tool as Advanced Feature [may extend into Phase 3]					LBNL/Consultant/

BIE will be responsible for ensuring a final product is available for beta testing on August 15, 2008. This will allow for 3 weeks of testing and refining by the working group, BIE and its subcontractors before an early September launch. ARB will provide a Spanish translation of the final product and BIE will develop a separate interface in Spanish.

Tasks and Timeline for Phase 3:

Tasks	S-O	N-D	J-F	M-A	M-J	J-A	S-O	N-D	Researcher /s
Task 1. Improve and expand the modeling of the household calculator									
Activity 1. Improve existing modeling									Jones/GSR
Activity 2. Add criteria air pollutants									Jones/GSR
Task 2. Turn calculator database into a web services tool									
Activity 1. Subcontract work to programmer/web developer									Consultant
Activity 2. Develop technical guidelines									Jones/GSR
Task 3. Integrate Home Energy Saver web services									

functionality									
Activity 1. LBNL to build infrastructure									LBNL
Activity 2. Designating elements for inclusion of HES functionality in new user interface									Working Group
Task 4. Create an advanced version of the Cool California Businesses tool									
Activity 1. Model recommendations for different major sectors									Jones/GSR
Activity 2. Incorporate advanced functionality into calculator									Jones/GSR
Task 5. Build resources for different user groups									
Activity 1. Collect resources for local businesses									Working Group
Activity 2. Build how to manuals and educational materials for different user groups									Jones/GSR

Phase 3 Calculator to be improved incrementally over time. As individual pieces are built (e.g. advanced business tools) these can be launched independently at any time throughout the contract period. A final product will be available for beta testing by August 1, 2009, for one month of beta testing before the official launch of the calculator. ARB will provide a Spanish translation of the final product and BIE will develop a separate interface in Spanish.

6. Management and Personnel

The research team has the skills, experience, and commitment needed to successfully complete the research tasks outlined herein.

Daniel M. Kammen is the *Class of 1935 Distinguished Professor of Energy* at the University of California, Berkeley, where he holds appointments in the Energy and Resources Group, the Goldman School of Public Policy, and the department of Nuclear Engineering. After postdoctoral work at Caltech and Harvard, Kammen was professor and Chair of the Science, Technology and Environmental Policy at Princeton University, before moving to Berkeley. He is the founding director of the Renewable and Appropriate Energy Laboratory (RAEL) and Co-Director of the Berkeley Institute of the Environment (http://bie.berkeley.edu). He has published five books, over 180 journal articles and 30 research reports. He serves on the board of The Utility Reform Network, the National Advisory Board of the Union of Concerned Scientists, on the Technical Review Board of the Global Environment Facility, and is a Permanent Fellow of the African Academy of Sciences. The focus of his work is on the science and

policy of clean, renewable energy systems, energy efficiency, the role of energy in national energy policy, international climate debates, and the use and impacts of energy sources and technologies on development, particularly in Africa and Latin America.

Christopher M. Jones is Staff Research Associate with the Berkeley Institute of the Environment. He is creator of the initial Lifecycle Climate Footprint Calculator model used as the basis for tools to be developed through this project and is the primary researcher of the LEAPS model. Chris holds an M.S. in Energy and Resources from UC Berkeley and an M.A. in Latin American Studies, also from UC Berkeley.

Two Graduate Student Researchers (GSRs) will be employed during the course of this project (two in summer 2008 and one throughout the remainder of the project.

Appendix A

Estimation of GHGs for U.S. Households

Figure 2 shows our initial estimate (Jones, 2005) of greenhouse gas emissions related to spending decisions of the typical U.S. household. *Direct* emissions are those for which households have direct control, namely transportation and household energy, while *indirect* emissions are those embodied in the various stages of the supply chain as measured by EIO-LCA, with modifications to reflect current prices, and emission factors for transport to market and retail stages.

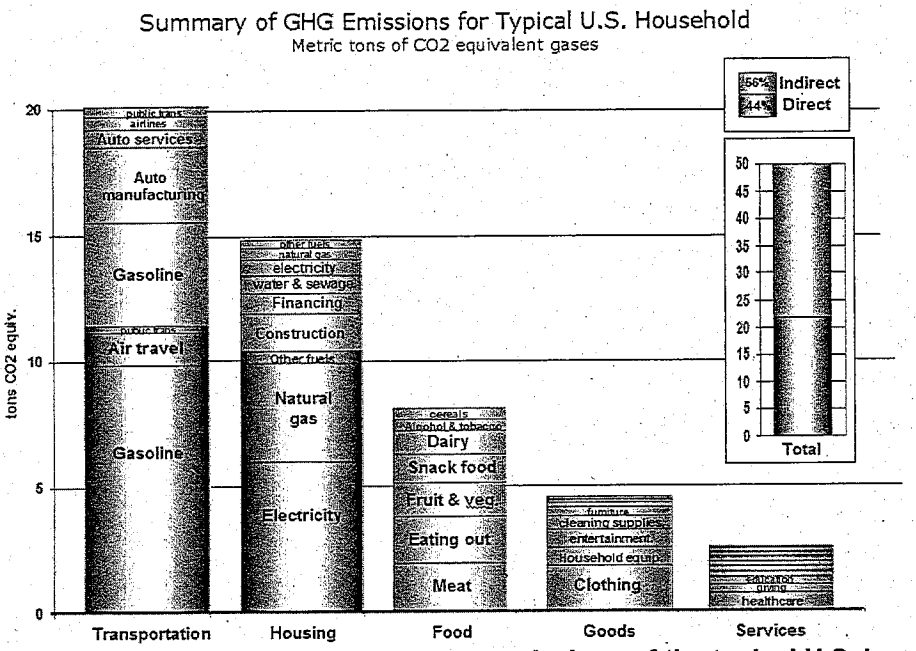


Figure 1. Summary of all major greenhouse gas emissions of the typical U.S. household.

One important initial lesson of our analysis is that every dollar spent has an impact on the climate. Consumer expenditures on food, clothing and manufactured goods result in significant levels of greenhouse gas emissions, on top of emissions from transportation and energy typically measured by greenhouse gas accounting tools. Thus, if the money a household saves by reducing its energy bills is subsequently spent on other – potentially also highly polluting – goods or services, the net reduction on household emissions may be relatively insignificant. A complete understanding of the life-cycle impacts of purchasing decisions is therefore necessary to effectively evaluate the relevance of these decisions and to send the appropriate signals climate conscious consumers.

Our standardized methodology will allow for comparison of the greenhouse gas and criteria pollutant emissions of cities based on changes in local expenditures on the categories of expenditures tracked. The consumer expenditures of the top 28 U.S. cities are updated annually by the Bureau of Labor Statistics through its Consumer Expenditures Survey allowing for annual accounting to be easily monitored. The consumptive behavior of city residents (whether by choice or the limitations placed on them by economic forces or city infrastructure) is reflected in this annual survey. Based on our initial assessment, including local energy mixes, but not local prices, public transportation or building practices, we have

determined the following city rankings:

Efficiency Perspective (GHGs per dollar)		
Rank	City	gCO2/$
1	SFO	839
2	Honolulu	872
3	San Diego	879
4	Seattle	896
5	New York	927
6	LA	946
7	Phoenix	991
8	Boston	1,000
9	Milwaukee	1,013
10	Detroit	1,013
11	Portland	1,014
12	Chicago	1,042
13	Minneapolis-St. Paul	1,048
14	Anchorage	1,056
15	Philadelphia	1,062
	Ave. U.S. cities	**1,070**
	U.S. Ave (all)	**1,078**
16	Pittsburgh	1,095
17	Denver	1,110
18	Dallas-Fort Worth	1,123
19	Atlanta	1,136
20	Baltimore	1,137
21	Houston	1,150
22	D.C.	1,162
23	Cincinnati	1,178
24	Miami	1,179
25	St. Louis	1,217
26	Cleveland	1,274
27	Tampa	1,287
28	Kansas City	1,313

Equity Perspective (GHG's per Household)		
Rank	City	tCO2/HH
1	Tampa	42.1
2	Honolulu	42.1
3	Milwaukee	42.6
4	Portland	42.7
5	Baltimore	42.8
6	Pittsburgh	44.5
7	Atlanta	46.1
8	Phoenix	46.2
9	Boston	46.4
10	Miami	47.0
11	SFO	47.1
12	Cleveland	47.2
13	Philadelphia	47.3
14	Detroit	47.3
15	Seattle	47.4
16	San Diego	47.4
17	Cincinnati	47.8
18	New York	48.2
	Ave. U.S. Cities	**49.5**
	U.S. Ave (all)	**49.8**
19	LA	49.8
20	Chicago	52.8
21	Denver	54.1
22	Houston	55.3
23	Dallas-Fort Worth	56.5
24	Anchorage	56.5
25	St. Louis	58.2
26	Minneapolis-St. Pau	58.6
27	Kansas City	60.8
28	D.C.	61.9

Accounting Perspective (GHG's per City)			
Rank	City	mtCO2e	% of US
1	Anchorage	5,540,926	0.1%
2	Honolulu	11,503,535	0.2%
3	Tampa	37,858,363	0.7%
4	San Diego	43,156,757	0.8%
5	Portland	43,966,698	0.8%
6	Cincinnati	48,155,675	0.8%
7	Kansas City	49,432,456	0.9%
8	Pittsburgh	49,685,895	0.9%
9	Baltimore	53,035,677	0.9%
10	St. Louis	59,699,022	1.1%
11	Cleveland	60,513,694	1.1%
12	Phoenix	61,968,084	1.1%
13	Denver	67,764,505	1.2%
14	Minneapolis-St. Paul	73,808,915	1.3%
15	Seattle	78,135,889	1.4%
16	Atlanta	85,200,192	1.5%
17	Milwaukee	85,847,908	1.5%
18	Miami	87,208,471	1.5%
19	Detroit	95,296,609	1.7%
20	Houston	97,315,180	1.7%
21	Philadelphia	115,343,770	2.0%
22	Dallas-Fort Worth	122,340,097	2.2%
23	Boston	122,379,586	2.2%
24	SFO	124,050,278	2.2%
25	D.C.	141,228,053	2.5%
26	Chicago	166,996,779	2.9%
27	LA	253,418,502	4.5%
28	New York	361,420,536	6.4%
	top 28 cities	92,938,288	45.8%

Figure 2. Greenhouse Gas Emissions of the top 28 Most Populous U.S. Cities

The data are displayed from three distinct perspectives: efficiency, equity and accounting. Cities may choose to favor one approach over another, and to make decisions based a particular approach, yet all perspectives are important. Comparison of the equity and efficiency perspectives is particularly instructive. Cities that have taken the strongest efforts to address climate change from an efficiency perspective, such as San Francisco or Seattle, may still have relatively high emissions on a per household basis due to relatively high overall household expenditures. These cities may be shown to be exporting pollution to areas with high levels of industry and relatively low consumer spending.

Appendix B. Greenhouse Gas Emissions from Household Goods and Food

The following is an excerpt from Jones, Kammen, Horvath (2007)

A sample of GHG emissions from the life cycle of a range of foods and consumer goods sold in the U.S. is shown in Figure 2, and basic statistical results are provided in Table 2.

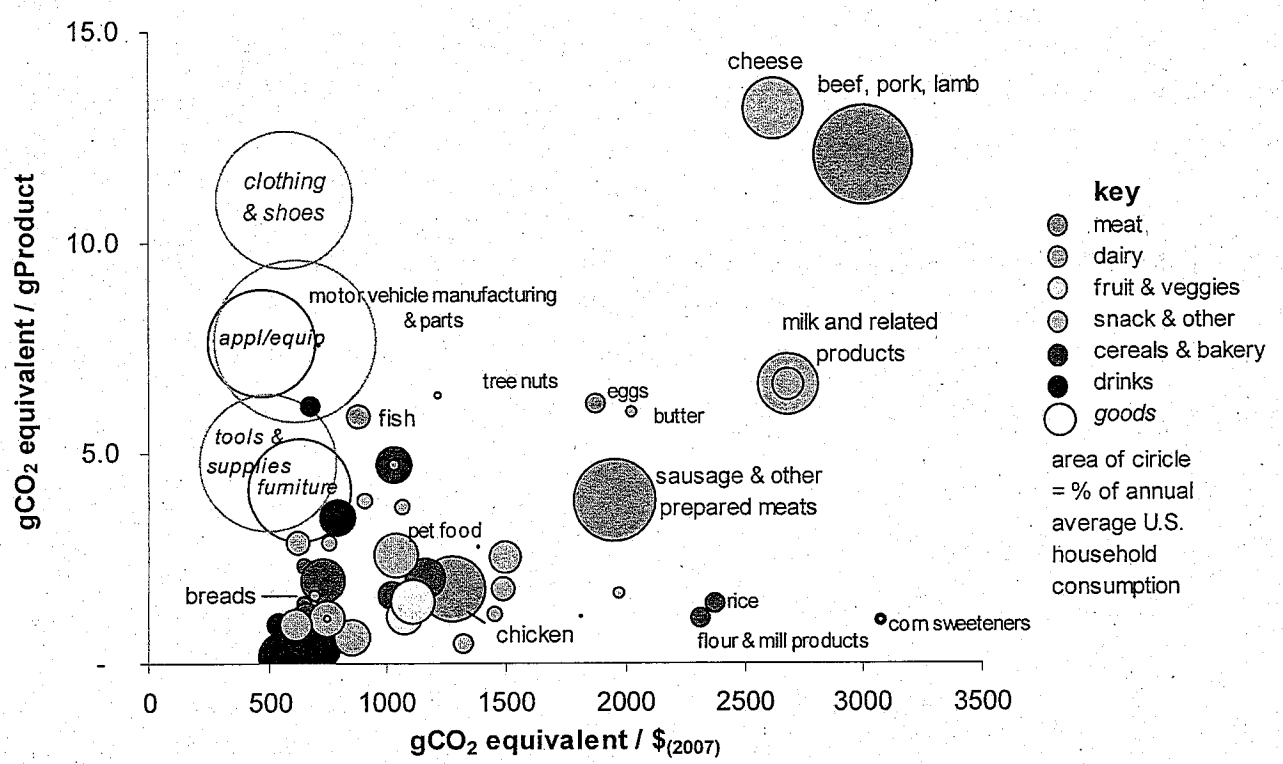


Figure 2. Cradle-to-consumer GHG emissions from consumer products, and specific food groups sold in the United States. LEAPS provides cradle-to-consumer life cycle greenhouse gas emission factors for consumer goods in terms of grams of carbon dioxide equivalents (CO_2e) per dollar spent by consumers and gCO_2e per of unit of product (typically the mass measured in g or kg). The area of circles represents total annual emissions for the typical U.S. household for each item. Goods are aggregated into five major categories for illustrative purposes.

Table 1. Summary of results ($gCO_2e/\$$)

	Food	Goods	Services	Total
median	938	520	401	521
mean (weighted)*	1,018	489	390	524
mean	1,281	514	460	616
standard deviation	981	175	336	534
max	2,786	1,555	2,447	2,447
min	200	222	42	42

*weighted by consumer spending for each product

Food production, distribution and retail requires, on average, about 1,000 gCO_2e for each dollar spent by consumers, while household goods require about 500 gCO_2e /\$. Thus, about every \$1,000 consumers spend on food releases about 1 ton of gCO_2e into the atmosphere, and every \$2,000 spent on goods (motor vehicles, clothes, appliances, household supplies, toys, furniture, etc.) also results in about 1 ton of CO_2. High emissions for food on a per dollar basis are at least partly accounted for by the relatively inexpensive (and frequently subsidized) price of food. Specifically, we calculated means of 1,018 $gCO_2e/\$$ for food, 489 $gCO_2e/\$$ for goods and 390 gCO_2e /\$ for services, weighted by consumer spending in each category of emissions. The standard deviation for consumer goods is relatively low (175) compared to food (981) and services (336), signifying that value-added is highly correlated with GHG emissions from manufacturing.

Considering emissions on a mass basis may be more intuitive, particularly for food items where substitution may be an option. For example, every gram of beef releases nearly 10 times the amount of greenhouse gases into the atmosphere as an equivalent amount of chicken. This estimate includes only emissions related to energy consumption throughout the life cycle of meat production and distribution, and not GHG impacts occurring during land use change (e.g., forest clearing for pastures). Dairy items also have high emissions per unit of product, pointing to cows as the largest direct source of emissions from food. Cereals, fruits and vegetables have consistently low emissions per gram of product, signifying that a vegetarian diet could have significant greenhouse gas benefits, similar to other studies (*16,17*). Household goods have higher emissions per gram of product -about 7 grams of CO_2e compared to 4 grams of CO_2e for food- which can be expected since not all food items require heavy energy inputs, compared to manufactured goods.

Multiplying these emission factors by consumer spending in each category produces over nine metric tons of greenhouse gases for food, 7 tCO_2e for goods and 5 tCO_2e for services for the typical U.S. household per year. Embodied emissions from food, goods and services total 23 tCO_2e per year per household, on average, not including emissions from household energy, transportation and housing construction. This is equivalent to more than the annual average GHG emissions from four cars (*18*). Our results are consistent, but generally higher than other previous studies (*3,19,20*). The difference appears to be that our study uses Personal Consumption Expenditures, rather than the more typical Consumer Expenditures (CE) published by the Bureau of Labor Statistics. A recent BEA paper (*21*) shows that aggregate consumer expenditures in the CES accounts for only 60% of consumer expenditures in the PCE. Since the PCE is created from the same benchmark input-output tables as I-O LCA models, the PCE would seem to be a more accurate assessment of consumer impacts using this approach, indicating that previous studies may have significantly underestimated total life cycle environmental impacts from household consumption.

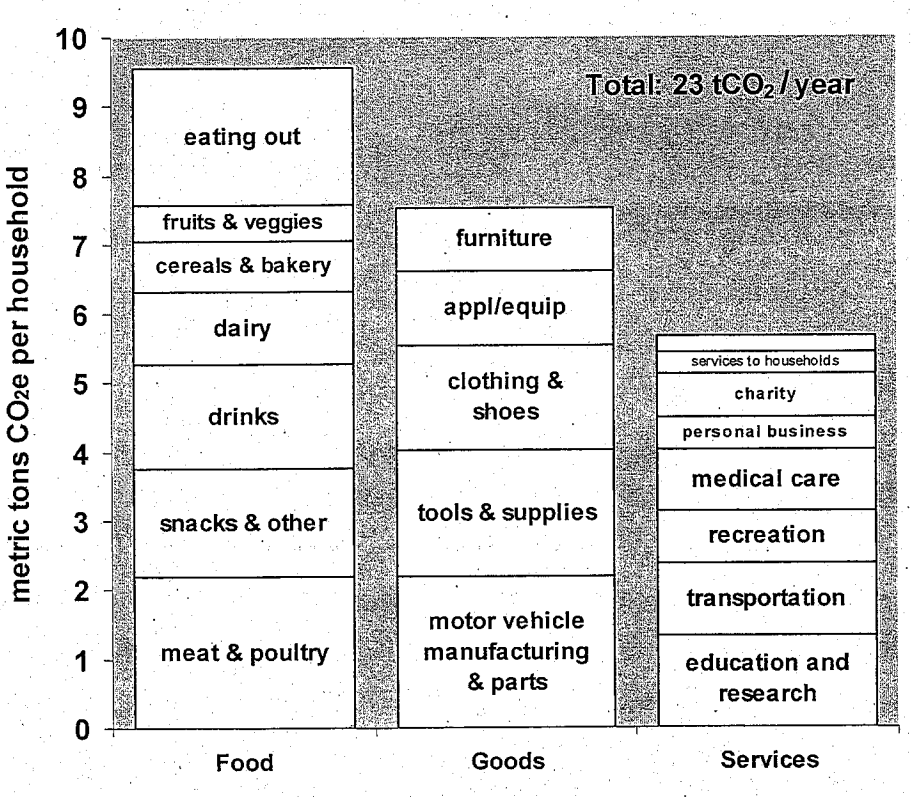


Figure 4. Greenhouse gas emissions from food, goods and services for the typical U.S. household

Drilling down to the product category level, in Figure 5 we present the embodied GHG emissions for a single product, Beer, which is estimated at 626 grams of CO_2e per liter. Emissions from cradle to

manufacturing account for 68% of total impacts; 27% occur during retail/wholesale and only 6% occur during transport to market. Using the LEAPS/EIO-LCA approach we can produce similar results for all 1,100 product categories.

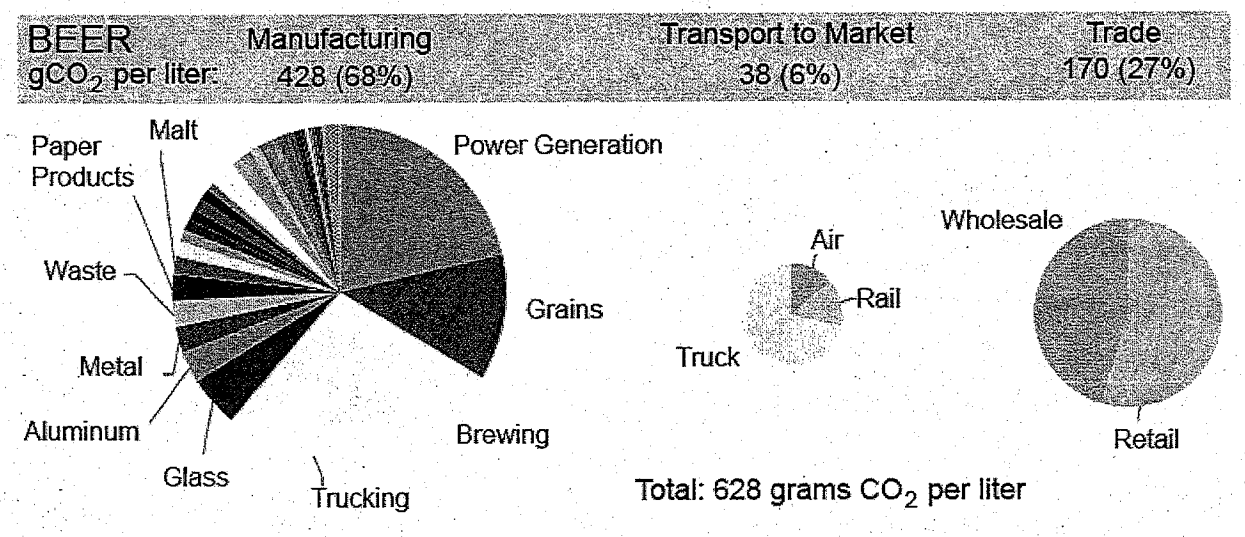


Figure 5. Greenhouse gas emissions from manufacturing, transport and sale of beer

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Jones, C. 2007. Lifecycle Analysis – UC Berkeley Climate Footprint. In Ahmded F. 2007. California Climate Action Partnership: Feasibility Study 2006-2007 Final Report. Available online http://sustainability.berkeley.edu/calcap

Morris, J, Matthews, H.S., Ackerman, F., Morris, M., Hlavka, R., 2007. The Washington Consumer Environmental Index (CEI). Sound Resource Management. Prepared for Washington State Department of Ecology.

Jones, C., Kammen, D, Horvath, A. Driving sustainable consumption through environmental accounting of retail goods and services. Submitted to *Environmental Science and Technology*, July 2007, in review.

Matthews, H.S. (199). The External Costs of Air Pollution and the Environmental Impact of the Consumer in the US Economy. PhD dissertation. Carnegie Mellon University.

Weber, C., and Matthews, H. S. (2007). "Embodied Emissions in U.S. International Trade: 1997-2004." *Environmental Science & Technology*, 41 (14), 4875 -4881, 2007.

RICHARD E. BROWN

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EDUCATION

1993 — UNIVERSITY OF CALIFORNIA, Berkeley, CA
M.A., Energy and Resources Group.
Interdisciplinary energy analysis and environmental studies, with emphasis on energy-efficiency policy analysis.
Master's Project: "The Achievable Potential for Electricity-Efficiency Improvements in U.S. Residences."

1986 — PRINCETON UNIVERSITY, Princeton, NJ
B.S.E., Cum Laude, Engineering and Management Systems.
Coursework in operations research and management science, with emphasis on computer applications of mathematical models.
Honors: Air Force ROTC 4-year scholarship.

EMPLOYMENT

1991-Present — Lawrence Berkeley National Laboratory, Energy Analysis Department.
Scientist (2002-present) and assistant group leader / Staff Research Associate (1996-2002) / Principal Research Associate (1994-96) / Senior Research Associate (1991-94).
Analyze markets and energy savings potential for energy-efficient products; advise U.S. Environmental Protection Agency and U.S. Department of Energy on the design of programs; evaluate energy savings impact of programs. Collect primary and secondary data, build and run energy models, prepare technical reports. Manage 3-6 technical staff; interact with clients to determine needs and plan analyses.

Major accomplishments:

- Initiating LBNL technical support to the U.S. EPA's ENERGY STAR program and helping to manage the growth of that project from one to ten full-time staff members.
- Managing the technical and content development of the Home Energy Saver (hes.lbl.gov), Home Energy Advisor (advisor.lbl.gov) and 20% Solution (savepower.lbl.gov) web sites -- developed by LBNL to help consumers make their homes more energy efficient.
- Leading a team that estimated the carbon dioxide and energy bill savings potential of the ENERGY STAR programs, a summary of which was quoted by President Clinton when he announced the U.S. climate change policy in October, 1997.
- Publishing the most comprehensive historical analysis of electricity use in California leading up to the 2001 power crisis (2002).

- Member Technical Steering Team, National Affordable Housing Design Network, Butte, Montana, USA (1985 - 1987)
- Member, Advisory Board, EcoHome Network, Los Angeles, USA (1995 - 1998)

CONSULTING & ADVISING

- *Armstrong/Energyn (US)*
- *Barakat, Howard & Chamberlin, Inc. (US)*
- *Better Energy Systems (UK)*
- *CalPERS - California Public Employees' Retirement System*
- *Capital-E (US)*
- *Ceres (US)*
- *Connecticut Interlocal Risk Management Agency (US)*
- *CMC Energy Services (US)*
- *Disney Imagineering (US)*
- *Electricity Corporation of New Zealand (New Zealand)*
- *Energy Auditor and Retrofitter Magazine (now Home Energy) (US)*
- *German Marshall Fund (US)*
- *Harvard Medical School - Center for Health and the Global Environment (US)*
- *Hewlett-Packard (US)*
- *Idyllwild School of Music and the Arts (US)*
- *Institute for Environmental Technologies (Netherlands)*
- *Integrated Process Technologies (US)*
- *International Association for Energy-Efficient Lighting (Sweden)*
- *International Project for Sustainable Energy Paths (US)*
- *Investment Research, Inc. (US)*
- *Organization for Economic Co-Operation and Development--Environment Directorate (Group on Urban Affairs) (France)*
- *Peralta Community College District (US)*
- *Regents of the Central European University (Hungary)*

Jacobson, A. and Kammen, D. M. (2005) " Science and engineering research that values the planet", *The Bridge: Journal of the National Academy of Engineering,* Winter, 11 – 17.

Bailis, R., Ezzati, M. and Kammen, D. M. (2005) "Mortality and greenhouse gas impacts of biomass and petroleum energy futures in Africa", **308**,*Sci ence*, 98 – 103.

Ezzati, M. and Kammen, D. (2001) "Indoor air pollution from biomass combustion and acute respiratory infections in Kenya: An Exposure-response study", *The Lancet*, **358**, 619 – 624.

Margolis, R. and Kammen, D. M. (1999) "Underinvestment: The energy technology and R&D policy challenge", *Science,* **285**, 690 – 692.

Baer, P., Harte, J., Herzog, A., Holdren, J., Hultman, N., Kammen, D. M., Haya, B., Norgaard, R., and Raymond, L. (2000) "Equity and greenhouse gas responsibility", *Science* **289**, 2287.

Selected Current Projects

- Daniel Kammen is the founding Editor-in-Chief of *Environmental Research Letters, an open-access* rapid publication journal covering the entire environmental field. ERL, which published it first two issues in 2006 has already climbed to be the most cited journal of those published by the Institute of Physics (UK).

- Kammen is the director of the Urban Sustainability Initiative at the Berkeley Institute of the Environment. The USI project is supported by the Gordon and Betty Moore Foundation. The USI project is focused on bringing science, technology and policy expertise and solutions to address the needs of urban centers in developing nations, where one-half of the global population will soon be living. Initial USI projects are underway in China, South Africa, and Tanzania. Website: **http://bie.berkeley.edu/usi.**

- University of California Berkeley/Lawrence Berkeley National Laboratory/University of Illinois - $500 million Energy Biosciences Institute (EBI) Proposal. This team won the competition to host and develop the instiute. Kammen was the section leader and primary author for the Global Systems Engineering, Economics, and Ethics component of the EBI Proposal submitted to British Petroleum.

- Kammen is working directly with Sir Richard Branson, founder of the Virgin Group to develop a new, zero-carbon, model for communities and nations. Started initially in the British Virgin Islands as a two-island pilot, soon to expand

A packet of press interviews and media events is included as a separate document.

Teaching and Mentoring

Kammen has developed a number of innovative courses, including a new class on Solar Photovoltaics that drew record student enrollment in both its inaugural (2004) and most recent (2006) offering. The course ranges from basic semiconductor physics to practical projects, including the design of solar systems installed on low-income housing projects in Oakland, and the design of business plans for major new clean energy companies.

Kammen's large graduate/advanced undergraduate lecture course on energy, ER100, 'Energy and Society' has expanded to become a 100+ person offering, which is accessed and used for distance learning by over 15 universities, in six countries.

Kammen's students have moved into a wide range of positions, including work at the Natural Resources Defense Council, Greenpeace, and CleanEdge, as well as in commercial energy firms such as Constellation Energy, GE Wind and as the founding partner of SunEdison, the largest installer of solar photovoltaics in the United States. He has former students now working at the United Nations (the Development Programme as well as at the Global Environment Facility) and at the U. S. National Renewable Energy Laboratory.

Kammen's recent doctoral students hold faculty positions at Georgetown's School of Foreign Service, in the School of Forestry and Environmental Studies at Yale University, the Harvard School of Public Health, the Schatz Energy Laboratory/Humboldt State University, the Energy and Environment Program at the University of Wisconsin - Madison, in the Departments of Geography at both Florida State University and the University of Wisconsin, Madison, and in the Greenspun School of Public Policy at the University of Nevada Las Vegas.

Public Policy Service

Kammen is a frequent witness in front of U. S Congressional House (8 appearances), Senate (3 appearances), and State of California (9 appearances) legislative hearings. He works closely with a number of members of the U. S. House and Senate.

In California Kammen worked closely with former California Assemblymember Fran Pavely on the development of both AB1493 (a 30% reduction of greenhouse gas emissions from vehicles in California), and the AB32, the California Global Warming Solutions Act, that calls for a 25% reduction in emissions by 2025. Kammen serves on the environmental advisory committee to the California Public Utilities Commission, and on the Sustainability Committee for San Francisco Mayor Gavin Newsom.

DANIEL T. McGRATH

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dmcgrath@berkeley.edu

Education:

Ph.D., 1996, Economics, University of Illinois at Chicago. Thesis title: The Impact of Hazardous Waste Contamination Risk on Urban Industrial Redevelopment in the City of Chicago.
M.A., 1993, Economics, University of Illinois at Chicago.
M.B.A., 1986, Finance, University of Notre Dame.
B.A., 1983, History, University of Notre Dame.
B.S., 1982, Mechanical Engineering, University of Notre Dame.

Academic Appointments:

Oct, 2007, Executive Director, Berkeley Institute of the Environment, University of California, Berkeley.
June, 2007 – Oct 2007, Visiting Scholar, Institute of Business and Economic Research, Haas School of Business, University of California Berkeley.
2001 – 2007, Associate Director, Institute for Environmental Science and Policy. University of Illinois at Chicago
2001 – 2007, Adjunct Assistant Professor: Department of Urban Planning and Policy, College of Urban Planning and Public Affairs, University of Illinois at Chicago – Taught UPP 504, Economics for Planning and Management. Public Administration – Taught PA 410, Economics for Public Administration and Policy Decisions.
2001 – 2007, Adjunct Lecturer, MBA Program, Liautaud Graduate School of Business, University of Illinois at Chicago - Taught MBA 590, Sustainable Business Practice.
1998 – 2001, Senior Fellow, UIC Great Cities Institute, College of Urban Planning and Public Affairs.
1996 – 1998, Research Economist, UIC Energy Resources Center, UIC College of Engineering.
1994 – 1996, Research Associate, UIC Great Cities Institute, College of Urban Planning.
1993-1996, Visiting Lecturer, UIC Department of Economics. Taught departmental core courses in beginning and intermediate microeconomics and macroeconomics and one elective undergraduate course in American economic history.
1992 –1994, Research Associate, UIC Center for Urban Economic Development.
1991-1992, Assistant Economic Analyst, Technology and Environmental Policy Section, Argonne National Laboratory, Argonne, Illinois.

Christopher M. Jones

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University of California
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a. Professional Preparation

2002 – 2005	M.S. Energy and Resources, University of California, Berkeley
2002 – 2005	M.A. Latin American Studies, University of California, Berkeley
1989 – 1995	B.A. Politics, University of California, Santa Cruz

b. Appointments

6/2006 – present	Berkeley Institute of the Environment, University of California, Berkeley Staff Research Associate	Berkeley
1/2006 – 6/2006	Berkeley Institute of the Environment, University of California, Berkeley Associate Specialist	Berkeley
1/2005 – 12/2005	College of Natural Resources, University of California, Berkeley Graduate Student Researcher	Berkeley
8/2003 – 12/2004	Department of Sociology, University of California, Berkeley Graduate Student Instructor, Sociology 101	Berkeley

c. Selected Publications

1. Christopher M. Jones, Daniel M. Kammen, and Daniel T. McGrath, "Consumer-oriented Life Cycle Assessment of Food, Goods and Services" (March 3, 2008). Berkeley Institute of the Environment. Energy and Climate Change.
   http://repositories.cdlib.org/bie/energyclimate/jones_kammen_mcgrath_030308
   Revised submission to Environmental Science & Technology, February, 2008.

2. Christopher M. Jones, "A Lifecycle Assessment of U.S. Household Consumption: The Methodology and Inspiration Behind the "Consumer Footprint Calculator"" (December 1, 2005). University of California International and Area Studies. Breslauer Symposium. Paper 8.
   http://repositories.cdlib.org/ucias/breslauer/8

3. Christopher M. Jones. "Emissions of CO_2 and Criteria Pollutants from U.S. – Mexico Overland Freight."Masters thesis. Latin American Studies, University of California, Berkeley. December, 2005.

RESUME

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EDUCATION

Ph.D. in Environmental and Energy Systems Studies, University of Lund, Institute of Technology, Faculty of Physics, Lund, Sweden. Degree conferred May 1991

M.Sc. in Energy and Resources, University of California, Berkeley, USA. Degree conferred May 1987

B.Sc. in Conservation and Resource Studies, University of California, College of Natural Resources, Berkeley, USA. Degree conferred May 1985 (with Honors)

PROFESSIONAL APPOINTMENTS

U.S. Department of Energy, Lawrence Berkeley National Laboratory [USA] (1982-1988; 1992-present), Current Position: Staff Scientist, Environmental Energy Technologies Division (Management Positions Held: Head, Center for Building Science; Assistant Division Director; Communications Director)

University of Lund, Department of Environmental and Energy Systems Studies [Sweden] (1988-1991), Visiting Research Scientist

SPECIALTIES

Broad expertise in the economic, environmental, and technical aspects of energy-efficient end-use buildings technologies, with special emphasis on: efficient lighting; energy in laboratory-type facilities; federal energy management; energy in low-income housing; utilization of the Internet for disseminating energy information and distributed computing; advanced data visualization; energy education; energy planning and policy; non-energy benefits of energy-efficient technologies and risk management. Climate change, with emphasis on financial services sector impacts, disaster preparedness/recovery, and mitigation-adaptation synergisms.

SELECTED ACHIEVEMENTS

- Member of the international body of scientists known as the Intergovernmental Panel on Climate Change (IPCC), which collectively shared in the Nobel Peace Prize for 2007 with former U.S. Vice President Albert Arnold (Al) Gore Jr. "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."

- Authored "From the Lab to the Marketplace", a "best-selling" report making the case for energy-efficiency R&D
- Authored approximately 200 publications, including 71 peer-reviewed journal articles or conference proceedings
- Frequent Popular Media Coverage, including: *The Boston Globe, Business Week, CBS Radio, CNN, Discover Magazine, Financial Times, Forbes, The Huffington Post, TheInternational Herald Tribune, Los Angeles Times, Mother Jones, National Public Radio, The New Yorker, Popular Science, Scientific American, Slate, Washington Post, the Wall Street Journal,* and *Wired.*

MAJOR CLIENTS

- California Air Resources Board (CARB)
- California Energy Commission (CEC)
- California Institute for Energy & Environment (CIEE)
- National Science Foundation (NSF)
- U.S. Agency for International Development (AID)
- U.S. Department of Energy (DOE)
- U.S. Department of Housing and Urban Development (HUD)
- U.S. Environmental Protection Agency (EPA)
- U.S. Federal Aviation Administration (FAA)
- U.S. Global Climate Change Research Program (GCRP)

AWARDS

- Collectively shared in the **Nobel Peace Prize for 2007**, awarded to the Intergovernmental Panel on Climate Change (IPCC) and former U.S. Vice President Albert Arnold (Al) Gore Jr. "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."
- Association of Energy Engineers (AEE), 2006 Energy Project of the Year (International)
- Association of Energy Engineers (AEE), Bay Area Chapter: Appropriate Technology Champion of 2005
- Home Energy Saver website (Project leader)
    - Energy 100: One of the best 100 innovations during DOE's 23-year history

Daniel M. Kammen

Brief Biography

Daniel M. Kammen is the Class of 1935 Distinguished Professor of Energy at the University of California, Berkeley, where he holds appointments in the Energy and Resources Group, the Goldman School of Public Policy, and the department of Nuclear Engineering. Kammen is the founding director of the Renewable and Appropriate Energy Laboratory (RAEL). Kammen is also the Co-Director of the Berkeley Institute of the Environment (**http://bie.berkeley.edu**).

Kammen received his undergraduate (Cornell A., B. '84) and graduate (Harvard M. A. '86, Ph.D. '88) training is in physics After postdoctoral work at Caltech and Harvard, Kammen was professor and Chair of the Science, Technology and Environmental Policy at Princeton University in the Woodrow Wilson School of Public and International Affairs from 1993 – 1998. He then moved to UC Berkeley.

Through RAEL **(http://rael.berkeley.edu)** Kammen works with faculty colleagues, postdoctoral fellows, and roughly 20 doctoral students on a wide range of science, engineering, economics and policy projects related to energy science, engineering and the environment. The focus of Kammen's work is on the science and policy of clean, renewable energy systems, energy efficiency, the role of energy in national energy policy, international climate debates, and the use and impacts of energy sources and technologies on development, particularly in Africa and Latin America. His work is interdisciplinary, and extends from theoretical studies to highly practical field projects and the design and development of specific policy initiatives and pieces of legislation. Kammen has published five books, over 200 journal articles and 30 research reports. He has testified many times to the U. S. House and Senate, and to the legislatures in California, Connecticut, Minnesota, New York, and Washington.

Daniel Kammen serves on the National Advisory Board of the Union of Concerned Scientists, on the Technical Review Board of the Global Environment Facility is on the advisory board of the Union of Concerned Scientists, and was a coordinating lead author for the Intergovernmental Panel on Climate Change (IPCC), which won the Nobel Peace Prize in 2007.

Kammen is a primary author and serves on the executive committee of the $500 million Energy Biosciences Institute funded by BP.

During 2007 he was involved in the writing of a $620 proposal requested by the California Public Utilities Commission (CPUC) to establish the California Global Warming Solutions Institute. The CPUC is expected to vote on this proposal on March 13, 2008.

Kammen is the chair of the research board of Enphase Energy, a solar and energy efficiency company.

EXHIBIT B

BUDGET DETAIL AND PAYMENT PROVISIONS

1. Invoicing

A. For services satisfactorily rendered in accordance with this agreement and upon receipt and approval of the invoices, which properly detail all charges, ARB agrees to compensate UCB for actual expenditures incurred in accordance with the rates specified in Exhibit B, Attachment 1, which is attached hereto.

B. Invoices shall include the Agreement Number and shall be submitted in triplicate not more frequently than quarterly in arrears to Ms. Emma Plasencia at the address below:

Emma Plasencia
Research Division
Air Resources Board
P.O. Box 2815
Sacramento, CA 95812

C. University may rebudget funds up to a maximum of ten percent between specified major budget categories with prior written approval from ARB.

D. ARB will give consideration to requests to rebudget funds in excess of ten percent, however, no rebudgeting in excess of ten percent and no rebudgeting of funds into the travel category may be performed without amending this Agreement.

2. Budget Contingency Clause

A. It is mutually agreed that if the Budget Act of the current year and/or any subsequent years covered under this Agreement does not appropriate sufficient funds for the program, this Agreement shall be of no further force and effect. In this event, the State shall have no liability to pay any funds whatsoever to Contractor or to furnish any other considerations under this Agreement and Contractor shall not be obligated to perform any provisions of this Agreement.

B. If funding for any fiscal year is reduced or deleted by the Budget Act for purposes of this program, the State shall have the option to either cancel this Agreement with no liability occurring to the State, or offer an agreement amendment to Contractor to reflect the reduced amount.

EXHIBIT B

3. Payment

A. Costs for this Agreement shall be computed in accordance with State Administrative Manual Sections 8752 and 8752.1.

B. Nothing herein contained shall preclude advance payments pursuant to Article 1, Chapter 3, Part 1, Division 3, Title 2 of the Government Code of the State of California.

C. University may rebudget funds up to a maximum of ten percent between major budget categories with prior notice to ARB's Contract Manager.

D. Upon mutual agreement, ARB will give consideration to requests to rebudget funds in excess of ten percent; however, no rebudgeting in excess of ten percent and no rebudgeting funds into the travel category may be performed without ARB's approval. The total Agreement cost will remain unchanged.

E. The amount to be paid to University under this Agreement includes all sales and use taxes incurred pursuant to this Agreement. University shall not receive additional compensation for reimbursement of such taxes and shall not decrease work to compensate therefore.

Budget Submittal Form

This form is supplied for presenting budget detail to the Air Resources Board.

PLEASE TYPE OR PRINT:

Title of Proposal: California Carbon Footprint Calculators

Total Budget Requested: $ 628,292.90

Period Covered (months): 24 Months

Business or Institution: University of California, Berkeley

Address: Sponsored Projects, 2150 Shattuck Avenue, Suite 313
Berkeley, CA 94704-5940

Name of person authorized to bind this bid:

Title: **Phone:**

Signature of person authorized to bind this bid: _____

Budget Summary

Budget details must be supplied on pages 8-20 and on additional pages if necessary. Instructions and definitions of terms are provided on pages 1-5.

NOTE: Totals in categories in this summary must match totals for categories on pages 8-20.

Direct Costs		
1.	Labor & Employee Fringe Benefits	$201,576.78
2.	Subcontractor(s)/Consultant(s)	$390,000.00
3.	Equipment	$0
4.	Travel & Subsistence	$3,190.00
5.	Electronic Data Processing	$6,000.00
6.	Photocopying & Printing	$1,200.00
7.	Mail, Telephone, and FAX	$1.080
8.	Materials & Supplies	$200
9.	Analyses	$0
10.	Miscellaneous	$0
	Total Direct Cost	$ 603,246.78

Indirect Costs		
11.	Overhead	$25,046.12
12.	General & Administrative Expenses	$
13.	Other Indirect Costs	$
14.	Fee or Profit	$
	Total Indirect Cost	$ 25,046.12

Total Direct and Indirect Cost:	**$628,292.90**

Budget Detail
I. Direct Costs

1a. Labor Charges

Individual's Name	Work Title	Est. Hours	Rate/Hour	Cost
A. Daniel M. Kammen	Professor	176	71.85	12,645.83
B. Daniel T. McGrath	Executive Director	352	37.84	13,320.28
C. Christopher M. Jones	Staff Research Associate	2,640	28.74	75,875.00
D. Administrative Analyst (TBD)		528	25.87	13,657.70
E. Graduate Student Researcher (TBD)		1,176	17.38	20,439.43
F. Graduate Student Researcher (TBD)		1,056	17.38	18,351.90
G. Graduate Student Researcher (TBD)		528	17.38	9,175.95
(use additional page if necessary)				

Subtotal: $163,466.00

Cost justifications. Describe exactly why each individual listed in the Budget Detail is needed in this project (i.e., their role in the project), and why this particular person was chosen for this role, and why their proposed level of effort is necessary. Describe, for each position listed, why the specified rate is reasonable or competitive. (Use additional page if necessary).

All salaries reflect current UC rates per employee plus 3.5% expected pay increase for year 2 (6 months total)

A. Professor Kammen is the principal investigator of this project. Two months of summer salary at 50%FTE are included for 2008 and 1 month summer salary at 50% FTE are included for 2009. Professor Kammen will be responsible for overall project guidance, outreach and will have fiscal responsibility for the project.

B. Dan McGrath is the Executive Director of the Berkeley Institute of the Environment. He will be responsible for managing communication with external parties, ensuring expenditures for all items are in line with the budget, and overseeing administrative activities related to the grant.

C. Chris Jones is Staff Research Associate at BIE. He is the lead researcher on the calculator and will also be responsible for training and managing student researchers. He is the lead researcher on existing versions of the household calculator and has expertise in developing life cycle assessment models of consumer behavior.

D. BIE's administrative analyst (position currently open) will be responsible for processing all payments.

E. One graduate student researcher will be hired throughout the year as a research assistant

F & G. Two graduate student researchers will be hired during the summer in 2008 and one will be hired in summer 2009 as research assistants

1b. Fringe Benefits

	BASE ($)	RATE (%)	COST
A. Kammen	12,645.83	12.7%	1,606.20
B. McGrath	13,320.28	22%	2,930.46
C. Jones 16,692.50	75,875.00	22%	
D. BIE Admin	12,292	22%	3,004.65
E. GSR (academic year)	18,925	1.3%	265.71
F. GSR (summer 2008 & 2009)	18,352	3%	550.56
G. GSR (summer 2008)	9,176	3%	275.28
H. GSR Fee Remission	4,261.87/semester	3 semesters	12,786
(use additional page if necessary)			

Subtotal: $38,110.78

Cost justifications. Provide the Basis for the Fringe Benefit Rates. (Use additional page if necessary).

Per University of California, Berkeley policy:

A. Academic researchers (Kammen) receive 12.7% employee benefits;

B,C,D. Staff (McGrath, Jones, BIE admin) receive 22% employee benefits

E. Graduate students receive 1.3% employee benefits during the academic year (9 months)

F&G. Graduate student researchers receive 3% employee benefits during summer (3 months)

2. Subcontractors & Consultants

List all subcontractors and consultants. **Also submit separate Budget Submittal Form for each subcontractor and consultant.**

Subcontractor or consultant	Cost
A. Lawrence Berkeley National Laboratory	310,000
B. Big Head Technology	80,000
C.	
(use additional page if necessary)	

Subtotal: $390,000

Cost justifications. Describe exactly why each subcontractor is needed in this project (i.e., their role in the project). Describe, for each subcontractor, why the specified rate is reasonable or competitive. (Use additional page if necessary).

Lawrence Berkeley National Laboratory (LBNL) has developed the Home Energy Saver online calculator and EnergyIQ web services assessment tool of non-residential buildings. Throughout this contract period we will progressively incorporate data from these tools into a single framework for household and business carbon accounting.

The primary tasks of LBNL will be:

Task 1. Residential functionality: $250,000
- HES O&M support: $20k [Phase 2]
- HES web service spec and programming plan: $30k [Phase 2]
- HES web service programming: $200k [Phases 2 and 3]

Task 2. Non-Residential functionality: $60,000
- Add capability to produce US-average outputs: $50,000 [Phase 2]
- Supporting role in BIE's programmers in tapping the EnergyIQ web service: $10,000 [Phase 2]

BigHead Technology (BigHead) has been chosen for programming and web design. BigHead has been chose for these tasks because 1) the firm is already working with LBL to design the web-service infrastructure for Home Energy Saver and Energy IQ, ensuring that the Cool California tools will be built with an efficient and compatible infrastructure, 2) BigHead specializes in developing web-services tools, 3) The firm will charge a negotiated and discounted rate of $80/hr. We estimate programming and web service design will require 1000 hours @ $80/hr = $80,000. See attached scope of work and budget for detailed cost justification by task.

3. Equipment (itemize)

Item	Cost
A. None	
B.	
C.	

Subtotal: $0

Cost justifications. Describe exactly why each listed equipment item is needed in this project, and why the cost is reasonable. (Use additional page if necessary.)

N/A

4. Travel and Subsistence (itemize). Use State rates (Appendix IV). NO FOREIGN TRAVEL ALLOWED.

Description	Cost
A. Air transportation 2 trips to East Coast for presentation of calculator at conferences	800
B. Ground transportation. Bus/taxi/rail	240
C. Per Diem or subsistence.	750
D. Other. Conference Fees	600

Subtotal: $3,190

Cost justifications. Describe the purpose and duration of each trip and explain why the travel is necessary. (Use additional page if necessary.)

A. Airfare for presentation of the calculator and results at 2 conferences. Airfare for East Coast trips is estimated at $800 per trip = $1,600
B. Ground transportation includes bus, rail and taxi to and from conference venue, airport and hotel: $40 per day x 6 days (3 days for each conference) = $240
C. Per diem includes $125 (room and board) for 6 days = $750
D. Conferences frequently require fees. We expect to pay $600 for participation in two conferences ($300 each conference).

5. Electronic Data Processing (itemize)

Description	Cost
A. Software : (Xcelsius Professional, Adobe Creative Suite 3 Professional, Filemaker, other)	1,000.00
B. Computer Usage	1,500.00
C. Web hosting	2,500.00

Subtotal: $6,000.00

Cost justifications. Explain the need for the expenditure and the basis for the costs. (Use additional page if necessary.)

Xcelsisus Professional: $500; Adobe Creative Suite 3 Design Professional: $500; Filemaker: $500. Budget for one additional software program: $500 (estimated)

Computer Usage: Throughout the 18 month contract, on average, we will use two computers. We calculate depreciation as: $2k per computer x 2 computers x 1/2 of computer lifetime x 75% usage = $1,500)

A dedicated server (Windows) at UC Berkeley's Information Technology Services is $125 per month.

6. Photocopying & Printing (itemize)

Description of product	Cost
A. Photocopying	0
B. Printing	1,200.00

Subtotal: $1,200.00

Cost justifications. Explain the need for the expenditure and the basis for the costs. (Use additional page if necessary.)

Printing: Two posters: $100 each; Brochures on the Cool California Calculator: $1/unit x 1000 units

7. Mail, Telephone & FAX (itemize)

Item	Cost
A. Data card for laptop	1,080.00
B.	

Subtotal: $1,080.00

Cost justifications. Explain the need for the expenditure and the basis for the costs. (Use additional page if necessary.)

One satellite card (AT&T) for laptop wireless data transfer: $60/month x 18 months. This is necessary for Jones' 3 hour train commute each day from Davis to Berkeley via Amtrak and BART. No cell phone minutes are included.

8. Materials & Supplies (itemize)

Item	Cost
A. Paper	40
B. Printer ink	120
C. General office supplies	40

Subtotal: $200.00

Cost justifications. Describe exactly why each item listed above is needed in this project. Explain why the proposed cost is reasonable. (Use additional page if necessary.)

Paper and paper products used for design team and research is estimated at $40 (from stock room)

One toner cartridge for HP 1250 laser printer is estimated at $120

General office supplies: two flipcharts: $20 each = $40

9. Analyses (itemize)

Description	Cost
A. None	
B.	

Subtotal: $0

Cost justifications. Describe the purpose of each different analysis and explain why it is needed in this project. Explain why the proposed rate is reasonable. (Use additional page if necessary.)

N/A

10. Miscellaneous (itemize)

Item	Cost
A. None	
B.	

Subtotal: $0

Cost justifications. Justify all costs not included in the categories above. Explain the need for the item and why the cost is reasonable. (Use additional page if necessary.)

N/A

Total Direct Cost (add subtotals for categories 1-10): 603,246.78

II. Indirect Costs

11. **Overhead**

Base (Salaries, total direct costs, etc.)	Rate	Cost
A. Total Indirect Cost	10% of modified total direct cost	25,046.12
B.		

Subtotal: $25,046.12

Cost Justifications. Have you used federally approved or lower rates or schedules for computing overhead costs for this proposal? If yes, please include a copy of the letter from the reviewing agency approving the rates used for this proposal. If no, please give the reasons below and explain how your rates are competitive. (Use additional page if necessary.)

Per contract negotiated between the University of California and the California Air Resources Board, all items are subject to University indirect cost of 10%, except equipment over $5k (none), student fees and tuition, and subcontracts up to $25k (LBNL and web services programmer).

12. **General and Administrative Expenses**

Base	Rate	Cost
A. None		
B.		

Subtotal: $0

Cost Justifications. Have you used federally approved or lower rates or schedules for computing general and administrative expenses for this proposal? If yes, please include a copy of the letter from the reviewing agency approving the rates used for this proposal. If no, please give the reasons below and explain how your rates are competitive.

N/A

13. **Other Indirect Costs**

	Base	Rate	Cost
A.	None		
B.			

Subtotal: $0

Cost Justifications. Have you used federally approved or lower rates or schedules for computing other indirect costs for this proposal? If yes, please include a copy of the letter from the reviewing agency approving the rates used for this proposal. If no, please give the reasons below and explain how your rates are competitive.

N/A

14. **Fee or Profit, if applicable** (give details)

Base	Rate	Cost
None		$0

Total Indirect Cost (Add categories 11-14)**: $25,046.12**

Total Project Cost: $628,292.90

Budget Submittal Form

This form is supplied for presenting budget detail to the Air Resources Board.

PLEASE TYPE OR PRINT:

Title of Proposal:	California Carbon Footprint Calculator (coolcalifornia.org)
Total Budget Requested:	$310,000
Period Covered (months):	20 months
University:	Lawrence Berkeley National Laboratory
Address:	Mailcode: 90R2000, 1 Cyclotron Road, Berkeley, CA 94720
Name of person authorized to bind this bid:	Betsy Quayle (BEQuayle@lbl.gov)
Title:	Sponsored Projects Officer
Phone:	(510 486-7391
Signature of person authorized to bind this bid:	_____

Budget Summary

Budget details must be supplied on pages 3-11 and on additional pages if necessary.
Instructions and definitions of terms are provided in Attachment 1 of the Guidelines for Proposals.

NOTE: Totals in categories in this summary are automatically updated from pages 3-11 when using Excel file

Direct Costs

1.	Labor & Employee Fringe Benefits	$102,848
2.	Subcontractor(s)/Consultant(s)	$108,675
3.	Equipment	$0
4.	Travel & Subsistence	$0
5.	Electronic Data Processing	$0
6.	Photocopying & Printing	$0
7.	Mail, Telephone, and Fax	$0
8.	Materials & Supplies	$0
9.	Analyses	$0
10.	Miscellaneous	$6,562
	Total Direct Cost	**$218,085**

Indirect Costs

11.	Overhead	$91,914
	Total Indirect Cost	**$91,914**

Total Direct and Indirect Cost: $310,000

Budget Detail
I. Direct Costs

1a. Labor Charges for Universities and Other State Agencies

Note: Total Salary Requested cells automatically calculate when using Excel file.

	Individual's Name	Work Title	Mo. Salary	Est. Months	% of Effort or % of Salary	Total Salary Requested
A.	Mills, Evan	P.I./Staff Scientist	$9,778.00	2.3045	100.00%	$22,533
B.	Brown, Richard E.	Research Scientist	$9,545.00	2.3045	100.00%	$21,996
C.	Homan, Gregory K.	Principal Research Associate	$7,150.00	2.3045	100.00%	$16,476
D.	Mathew, Paul	Staff Scientist	$9,201.00	2.3045	100.00%	$21,204
E.						$0
F.						$0
G.						$0
H.						$0
I.						$0

(use additional page if necessary)

Subtotal: $82,210

Cost justifications. Describe exactly why each individual listed in the Budget Detail is needed in this project (i.e., their role in the project), why this particular person was chosen for this role, and why their proposed level of effort is necessary. Describe, for each position listed, why the specified rate is reasonable or competitive. (Use additional page if necessary).

Ib. Fringe Benefits

Note: COST cells automatically calculate when using Excel file

	Individual's Name	BASE ($)	RATE (%)	COST
A.	Mills, Evan	$22,533	25.10%	$5,657
B.	Brown, Richard E.	$21,996	25.10%	$5,522
C.	Homan, Gregory K.	$16,476	25.10%	$4,137
D.	Mathew, Paul	$21,204	25.10%	$5,323
E.				$0
F.				$0
G.				$0
H.				$0
				$0

use additional page if necessary)

Subtotal:	$20,639

Cost justifications. Provide the Basis for the Fringe Benefit Rates. (Use additional page if necessary).

2. Subcontractors & Consultants

List all subcontractors and consultants. **Also submit separate Budget Submittal Form for each subcontractor and consultant.**

	Subcontractor or consultant	Cost
A.	Big Head Technologies	$103,500
B.	Procurement Burden (10% of procurement cost)	$5,175
C.		
D.		

(use additional page if necessary)

Subtotal: $108,675

Cost justifications. Describe exactly why each subcontractor is needed in this project (i.e., their role in the project). Describe, for each subcontractor, why the specified rate is reasonable or competitive. (Use additional page if necessary).

BigHead Technology has been chosen as the programming subcontractor. BigHead Technology will be responsible for converting the existing Home Energy Server (HES) online tool into a web-service infrastructure and graphical user interface. This work is estimated to require about 1217.65 hours @ $85/hr = $103,500. LBLNL requires an additional 10% procurement burden for subcontracts.

BigHead has been chosen for this work because 1) the current HES program is written in an obscure programming language (Witango) that few firms understand, and BigHead is among the world's experts in this language, 2) LBNL has existing contracts with BigHead to conduct work on the HES tool and the firm fully understands the background architecture, 3) BigHead Architecture specializes in developing efficient web-services tools, 4) The firm charges a discounted rate of $85/hr.

3. Equipment (Itemize)

	Item	Cost
A.	None	$0
B.		
C.		
D.		

Subtotal: $0

Cost justifications. Describe exactly why each listed equipment item is needed in this project, and why the cost is reasonable. (Use additional page if necessary).

(Refer to Exhibit E, page 19)

. **Travel and Subsistence (Itemize). Use State Rates (Appendix IV). NO FOREIGN TRAVEL ALLOWED.**

	Description	Cost
	None	$0

Subtotal: $0

Cost justifications. Describe the purpose and duration of each trip and explain why he travel is necessary. (Use additional page if necessary).

5. **Electronic Data Processing (Itemize)**

	Description	Cost
A.	None	$0
B.		
C.		
D.		

Subtotal: $0

Cost justifications. Explain the need for the expenditure and the basis for the costs. (Use additional page if necessary).

6. **Photocopying & Printing** (Itemize)

	Description of product	Cost
A.	None	$0
B.		

Subtotal: $0

Cost justifications. Explain the need for the expenditure and the basis for the costs. (Use additional page if necessary).

7. **Mail, Telephone & Fax** (Itemize)

	Item	Cost
A.	None	$0
B.		
C.		

Subtotal: $0

Cost justifications. Explain the need for the expenditure and the basis for the costs. (Use additional page if necessary).

3. Materials & Supplies (Itemize)

	Item	Cost
A.	None	$0
B.		
C.		
D.		
E.		
F.		
G.		
H.		

Subtotal: $0

Cost justifications. Describe exactly why each item listed above is needed in this project. Explain why the proposed cost is reasonable. (Use additional page if necessary).

9. Analyses (Itemize)

	Description	Cost
A.	None	$0
B.		
C.		
D.		
E.		
F.		
G.		
H.		
I.		

Subtotal:	$0

Cost justifications. Describe the purpose of each different analysis and explain why it is needed in this project. Explain why the proposed rate is reasonable. (Use additional page if necessary).

0. Miscellaneous (Itemize)

Item	Cost
Other project expenses include miscellaneous costs such as telephone, copy costs, computer use and fax costs and shared administrative support.	$5,512
Electricity recharges	$1,050

Subtotal: $6,562

Cost justifications. Justify all costs not included in the categories above. Explain the need for the expenditure and the basis for the costs. (Use additional page if necessary).

Total Direct Costs (add subtotals for categories 1-10): $218,085

II. Indirect Costs

11. Overhead and Other Indirect Costs

	Base (Salaries, total direct costs, etc.) ($)	Rate (%)	Cost
A.	$102,848.00	17.00%	$17,483
B.	$131,018.00	6.05%	$7,926
C.	$131,018.00	49.20%	$64,461
D.	$204,455.00	1.00%	$2,045
		Subtotal:	**$91,914**

Total Indirect Cost: $91,914

Total Project Cost: $310,000

BNL Budget Justification

PERSONNEL
This project will take place during FY 2008 through FY 2010; rates are based on actual salaries for the period and are escalated at a rate of 3%.

FRINGE BENEFITS
The scientific staff fringe benefit average rate for FY08 through FY10 is 25.1% for career staff. These rates are standard to all projects and are approve by DOE.

TRAVEL
Travel costs include air transportation, ground transportation, and travel–related costs for a research trip to conduct interviews in one or more target countries. There are no travel costs on this project.

OTHER

Miscellaneous costs include other project expenses include costs such as telephone, copy costs, computer use and fax costs. Shared administrative support and electricity are included in this category.

Travel burden is 14% of total travel cost.

General Overhead at 49.2% of Total Direct Costs. G&A funds the general management and administration of the Lab.

LDRD is 5.40% of total direct costs and burdens minus the subcontract cost and minus electricity. Laboratory Directed Research and Development (LDRD) are indirect costs that are allocated to all direct programs at the laboratory for independent research and development activities in conformance with the guidelines contained in DOE Order 5000.4A.

IGPP is .65% of total direct costs and burdens minus the subcontract cost and minus electricity. Institutional General Plant Project (IGPP) are new construction projects (cost of less than $5M) of a general institutional nature benefiting multiple cost objectives and required for general-purpose site-wide needs. IGPP does not include construction projects that can be directly attributed to benefit a specific or single program.

A Federal Administrative Charge of 3% on the total is charged to non-DOE sponsor. We will request a waiver of this charge on the basis that the sponsor is a state agency.

LBNL Budget Justification (continued)

4. OTHER (continued)

a. Explanation of Line #11. Overheads and Other Direct Costs – Line A

Organization burden is charges at the rate of 17% on salary and fringe benefits only. The rate is standard to all projects and is approved by DOE.

b. Explanation of Line #11. Overheads and Other Direct Costs – Line B and Line C

Line B basis of $131,018 is the sum of:
$82,210 (effort)
$20,639 (fringe)
$17,483 (organization burden)
0 (equipment)
$5,175 (subcontract burden)
0 (purchases with burdens)
0 (travel with burden)
$5,512 (miscellaneous expenses minus electricity)

Line B. The basis is then multiplied by the combined LDRD and IGPP rate of 6.05%

Line C. The basis is then multiplied by the general overhead rate of 49.20%

d. Explanation of Line #11. Overheads and Other Direct Costs – Line D

Securities and Safeguards is a 1% charge on the sum of the project's total cost minus the subcontract cost [1% (307,955 - $103,500)]. S&S is the recovery of safeguards and security costs on non-DOE projects.

BigHead Technology
13653 West Park Dr
Magalia, CA 95954
Ph: 530.645.4040 • Fax: 530.645.4040

BIGHEAD TECHNOLOGY

Berkeley Institute of the Environment
Project overview and general scope of work

Background and expertise
BigHead Technology started in July of 1999 with a primary goal of building ground up custom web and server applications. Over the years we have built many rich applications for the web and desktop. Most of our clients are medium to large corporations, and the end user of the applications range from retail users to sales call centers to corporate professionals.
Every one of our applications uses some sort of xml based web services to allow different platforms and technologies to communicate with each other. To date we have 1000s of web services in production, written in several languages. At BigHead we don't only build solutions, but we are experts at efficiency and infrastructure. We build our code and services with the goal to be deployed in heavily used environments. We also have the knowledge and expertise to build a server infrastructure for deployment that is powerful, reliable, and redundant.
Although we have built many applications in several applications, our expertise is with the LAMP platform (Linux, Apache, MySQL, PHP) and even more specifically the Zend enterprise platform for PHP.

Hourly Rate
Our normal hourly rate is $95/hour. We have agreed to the discount rate of $80/hr for this project.

Assumptions
- For each of the activities outlined below the Berkeley Institute of the Environmnet will provide all data files and formulas in an acceptible format (Excel and/or filemaker), in addition to design guidelines.
- Delays in receiving such documents or other assets may result in delays to project completion.

Approximate hours per major tasks

Phase 2: May 2008 - Sept 2008
Household Calculator **$20,000**
Convert household calculator into database and scenario building (benchmarking) tool. **250 hrs**

Essential Activities
a) Convert household calculator data files into MySQL database (these may or may not be provided by BIE)
b) Create functioning user interface in PHP

c) Add scenario building capacity (similar to Home Energy Saver)
Description of scenario building:
Users will be asked to choose between "I want to save $" and "I want to reduce CO2". The tool generates top 10-15 actions households can do to achieve these goals and the corresponding change in $ and CO2.
d) Coordinate with UC Berkeley to host tool on BIE server
e) Add user functionality including login, security, user data storage & retrieval capacity, user tracking, debugging

Additional Activities (budget permitting)
f) Advanced drill-down features
g) Advanced scenario building features
h) dynamic charts and graphics.

Business Calculator — $20,000 / 250 hrs

Convert business calculator into database and scenario building (benchmarking) tool.

Essential Activities
a) Convert business calculator data files into MySQL database
b) Create graphic user interface for calculator in PHP
c) User interface to access Energy IQ webservice
d) Coordinate with UC Berkeley to host tool on BIE server
e) Add user functionality including login, security, user data storage & retrieval capacity, user tracking, debugging

Additional Activities (budget permitting)
f). Advanced drill-down features
g) Advanced scenario building features
h) dynamic charts and graphics.

Phase 3(1): Sept 2008 - May 2009 — $20,000 / 250 hrs

Essential Activities
a) Create webservices functionality to allow other servers to access data (SOAP)
b) Provide materials for users to access webservices tool
c) Debugging or other changes to tool, as needed

Additional Activities (budget permitting)
d) Add any additional advanced features

Phase 3(2): May 2009 - Sept 2009 — $20,000 / 250 hrs

Essential Activities
a) Integrate Home Energy Saver webservice functionality
b) Debug and improve efficiency of tools.

Additional Activities (budget permitting)

c) improved graphics
d) additional drill-down features
e) develop "widget" for social networking site,

EXHIBIT D

SPECIAL TERMS AND CONDITIONS

1. Termination

A. This Agreement may be canceled at any time by either party, upon thirty (30) days written notice to the other party.

B. In the case of early termination, the performing agency will submit an invoice in triplicate and a report in triplicate covering services to termination date, following the invoice and progress report requirements of this Agreement. A copy and description of any data collected up to termination date will also be provided to ARB.

C. Upon receipt of the invoice, progress report, and data, a final payment will be made to the performing agency. This payment shall be for all ARB-approved, actually-incurred costs in accordance with Exhibits A and B, and shall include labor, and materials purchased or utilized (including all noncancellable commitments) to termination date, and pro rata indirect costs as specified in the proposal budget.

2. Disputes

A. ARB reserves the right to issue an order to stop work in the event that a dispute should arise, or in the event that the ARB gives the performing agency a notice that this Agreement will be terminated. The stop-work order will be in effect until the dispute has been resolved or this Agreement has been terminated.

B. Any dispute concerning a question of fact arising under the terms of this Agreement which is not disposed of within a reasonable period of time by agency employees normally responsible for the administration of this agreement, shall be brought to the attention of the Executive Officer or designated representative of each agency for joint resolution.

3. Amendments

ARB reserves the right to amend this agreement for additional time and/or additional funding.

EXHIBIT E

ADDITIONAL PROVISIONS

1. Reports and Data Compilations

A. With respect to each invoice period, University shall forward to the ARB Contract Administrator, one (1) electronic copy of the progress report and mail one (1) copy of the progress report along with each invoice. (Do not use Express Mail). When emailing the progress report, the "subject line" should state the contract number and the billing period. Each progress report will begin with the following disclaimer:

The statements and conclusions in this report are those of the University and not necessarily those of the California Air Resources Board. The mention of commercial products, their source, or their use in connection with material reported herein is not to be construed as actual or implied endorsement of such products.

B. Each progress report will also include:

1. A brief narrative account of project tasks completed or partially completed since the last progress report;

2. A brief discussion of problems encountered during the reporting period and how they were or are proposed to be resolved;

3. A brief discussion of work planned, by project task, before the next progress report; and

4. A graph showing allocation of the budget and amount used to date.

5. A graph showing percent of completion for each task.

C. If the project is behind schedule, the progress report must contain an explanation of reasons and how the University plans to resume the schedule.

D. Prior to completion of this Agreement, University shall be entitled to release or make available reports, information, or other data prepared or assembled by it pursuant to this Agreement, in scientific journals and other publications and at scientific meetings, provided however, that a copy of the publication be submitted to ARB for review and comment 45 days prior

EXHIBIT E

to such publication. Further, University shall place the disclaimer statement in a conspicuous place on all such reports or publications. Nothing in this provision shall be construed to limit the right of State to release information obtained from the University or to publish reports, information, or data in State publications.

2. Copyrightable Materials

In recognition of the policy of ARB and University to promote and safeguard free and open inquiry by faculty, students and the members of the public and in furtherance of such policy, both parties agree to the following with respect to rights in data and copyrights under this Agreement:

A. The term "Subject Data" shall mean all original and raw research data, notes, computer programs, writings, sound recordings, pictorial reproductions, drawings or other graphical representations, and works of any similar nature, produced by University in performance of this Agreement, but specifically excluding "Reports," as defined in this Agreement. Subject Data also excludes financial reports, cost analyses, and similar information incidental to contract administration.

B. The term "Reports" shall have the meaning assigned to it in this Exhibit F of this Agreement.

C. Ownership of all Subject Data and copyrights arising from Subject Data shall be vested in University while ownership of all Reports and copyrights arising from the Reports delivered under this Agreement shall be vested in ARB. University agrees to make available to the public for public benefit, to the extent the University shall have the legal right to do so, without license or fee, any scholarly articles which are published from the Subject Data.

D. Nothing in this exhibit or Agreement shall be construed to limit the right of University faculty, students or staff to publish the Subject Data in the form of scholarly articles in academic journals nor to affect, abrogate or limit the right of University faculty, staff or students to make use of the Subject Data.

3. Travel & Per Diem

A. Any reimbursement for necessary travel and per diem shall be at the University's approved travel rates.

EXHIBIT E

B. No travel outside the State of California shall be reimbursed unless prior written authorization is obtained from ARB.

4. Meetings

A. Initial meeting. Before work on the contract begins, the Principal Investigator and key personnel will meet with the ARB Contract Manager and other staff to discuss the overall plan, details of performing the tasks, the project schedule, items related to personnel or changes in personnel, and any issues that may need to be resolved before work can begin.

B. Progress review meetings. The Principal Investigator and appropriate members of his or her staff will meet with ARB's Contract Manager at quarterly intervals to discuss the progress of the project. This meeting may be conducted by phone, if appropriate.

C. Technical Seminar. The Contractor will present the results of the project to ARB staff and a possible webcast at a seminar at ARB facilities in Sacramento or El Monte.

5. Confidentiality

A. It is understood that in the course of carrying out this Agreement, State may wish to provide University with proprietary or confidential information of State (Proprietary Information). University agrees to use its best efforts to hold proprietary information in confidence and shall return it to State upon the completion of the project.

B. This obligation shall apply only to proprietary information that is designated or identified as such in writing by State prior to the disclosure thereof. All proprietary information shall be sent only to the Principal Investigator. Moreover, this obligation shall not apply to any proprietary information which: a) is or becomes publicly known through no wrongful or negligent act on the part of University; b) is already known to University at the time of disclosure; c) independently developed by University without breach of this agreement; or d) is generally disclosed to third parties by State without similar restrictions on such third parties.