# RD
## Contractor: CEC
## Contract # 08-314

| FUNDING FISCAL YEAR | | FY 08/09 | FY 09/10 | FY 10/11 | |
|---|---|---|---|---|---|
| TERM | | 06/30/09-06/29/11 | 06/30/09-06/29/11 | 06/30/09-06/29/11 | |
| PCA | | 72380 | 72380 | 72380 | |
| LINE ITEM/OBJECT | | 398 | 398 | 398 | TOTAL |
| DESCRIPTION | AB32 project/study | | | | |
| Contract $ | | 245,000.00 | 70,000.00 | 35,000.00 | 350,000.00 |
| | | | | | - |
| | | | | | - |
| Total, Contract | | 245,000.00 | 70,000.00 | 35,000.00 | 350,000.00 |

Payments to Contractor:

| Inv. # | Inv. Date | Ser Per | | | | C/S |
|---|---|---|---|---|---|---|
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| | | | | | | - |
| Total, Payments | | | - | - | - | - |
| Balance Available to Pay Contractor | | | 245,000.00 | 70,000.00 | 35,000.00 | 350,000.00 |
| *Balance Must Be Spent By:* | | | *06/30/11* | *06/30/12* | *06/30/13* | |

**Notes:**

Contract Manager:

54

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

AGREEMENT NUMBER
**08-314**
REGISTRATION NUMBER

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

STATE AGENCY'S NAME
**Air Resources Board (ARB or State)**

CONTRACTOR'S NAME
**California Energy Commission (CEC or Contractor)**

2. The term of this Agreement is: June 30, 2009 through June 29, 2011

3. The maximum amount of this Agreement is: **$350,000.00** (Three Hundred Fifty Thousand Dollars and No 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 |
| Attachment 1, "Urban/Community Energy and Environmental Efficiency", project description | 23 Pages |
| Exhibit B – Budget Detail and Payment Provisions | 2 Pages |
| Attachment 1, total project budget | 8 Pages |
| Exhibit C* – General Terms and Conditions | GIA 101 |
| Check mark one item below as Exhibit D: | |
| [X] Exhibit - D Special Terms and Conditions (Attached hereto as part of this agreement) | 1 Page |
| [ ] Exhibit - D* Special Terms and Conditions | |
| Exhibit E – Additional Provisions | 2 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 | | California Department of General Services Use Only |
|---|---|---|
| CONTRACTOR'S NAME *(if other than an individual, state whether a corporation, partnership, etc.)* **California Energy Commission (CEC)** | | |
| BY *(Authorized Signature)* | DATE SIGNED *(Do not type)* | |
| PRINTED NAME AND TITLE OF PERSON SIGNING Cheryl Raedel, Contracts Office Manager | | |
| ADDRESS Contracts Office 1516 Ninth Street, Ms – 18, Sacramento, CA 95814 | | |
| **STATE OF CALIFORNIA** | | |
| AGENCY NAME **Air Resources Board** | | |
| BY *(Authorized Signature)* | DATE SIGNED *(Do not type)* | |
| PRINTED NAME AND TITLE OF PERSON SIGNING Socorro Watkins, Chief, Business Management Branch | | [ ] Exempt per: |
| ADDRESS 1001 I Street, 20th Floor Sacramento, CA 95814 | | |

# EXHIBIT A

## SCOPE OF WORK

1. The State Energy Resources Conservation and Development Commission (California Energy Commission or CEC) agrees to provide the Air Resources Board (ARB) with the following services for the project entitled "Urban/Community Energy and Environmental Efficiency," which is attached hereto as Attachment 1 and made a part of this Agreement. ARB is co-sponsoring a portion of Tasks 1 – 3 in the amount of $350,000.

2. Term: The term of this agreement is June 30, 2009 through June 29, 2011; however no work shall commence until receipt of final approval from the Department of General Services (DGS). Consequently, all dates contained in the Exhibits and Attachments shall be considered revised to conform to the actual term of this agreement, and the schedule shall not begin until Contractor receives written notice from ARB of final approval by DGS.

3. The project representatives during the term of this Agreement will be:

| **Requesting Agency: ARB** | | **Providing Agency: CEC** | |
|---|---|---|---|
| Name: | Dr. Ash Lashgari | Name: | Chris Scruton, Project Manager |
| Phone: | 916-323-1506 | Phone: | 916-653-0948 |
| Fax: | 916-322-4357 | Fax: | 916-651-8886 |
| Email: | klashgar@arb.ca.gov | Email: | Cscruton@energy.state.ca.us |

The ARB Contract Administrator is: The CEC Contract Administrator is:

| **Requesting Agency: ARB** | | **Providing Agency: CEC** | |
|---|---|---|---|
| Name: | Sally Jorgensen | Name: | Cheryl Raedel |
| Division/Section: | Research Division | Division/Section: | Contract Office |
| Address: | 1001 "I" Street, 5th Floor | Address: | 1516 Ninth Street, MS-18 |
| | Sacramento, CA 95814 | | Sacramento, CA 94814 |
| Phone: | 916-327-1500 | Phone: | 916-654-4392 |
| Fax: | 916-322-4357 | Fax: | 916-654-4423 |
| Email: | sjorgens@arb.ca.gov | Email: | craedel@energy.state.ca.us |

Prepared by the Lawrence Berkeley National Laboratory
11 December 2008

## I. Title of project : Urban/Community Energy and Environmental Efficiency (UC $E^3$)

## II. Background

The U.S. Department of Energy has directed the University of California to perform the work stated in this Appendix A for the California Energy Commission. Lawrence Berkeley National Laboratory (LBNL), a laboratory owned by the Department of Energy, is located at 1 Cyclotron Road, Berkeley, CA, 94720. The University of California, a not-for-profit corporation organized under the laws of the State of California, with its principal place of business at 1111 Franklin Street, Oakland, CA 94607-5200, manages and operates Lawrence Berkeley National Laboratory under DOE Contract No. DE-AC02-05CH11231.

The California Energy Resources Conservation and Development Commission (Energy Commission) is an agency organized under the laws of the State of California with a principal place of business at 1516 Ninth Street, Sacramento, California 95814.

## III. Project Goals and Objectives

### Problem Statement

Background

The Global Warming Solutions Act of 2006 was signed by California Governor Arnold Schwarzenegger on September 27, 2006. It sets ups an enforceable state-wide program to cap all greenhouse gas emissions from major industries. Chapter 488, Statutes of 2006, of the Act, commencing with Health & Safety Code (H&SC) Section 38500, requires that by 2020 the state's greenhouse gas emissions be reduced to 1990 levels, a roughly 25% reduction under business as usual estimates. H&SC Section 38505(g) defines "greenhouse gases" to include all of the following: carbon dioxide ($CO_2$), methane ($CH_4$), nitrous oxide ($N_2O$), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride ($SF_6$). These are the same gases listed as Greenhouse Gases (GHGs) in the Kyoto Protocol. The California Air Resources Board (ARB) is to prepare plans to achieve the objectives required by statute, and is the state agency responsible for monitoring and regulating GHG emission sources. ARB has specified a voluntary "cool communities" program as an early action program (TIER 1) in support of the Act.

By the year 2020, the State seeks to reduce GHG emissions by 174 MMT $CO_2$e/y (million metric tons of carbon dioxide equivalent per year), of which about 16% (27.3 MMT $CO_2$e/y) are expected to come from voluntary programs (CARB 2008a). ARB staff estimates that about 15% of these voluntary reductions, or 4 MMT $CO_2$e/y, could be achieved through cool-community measures (CARB 2008b). Cool-community efforts would be promoted as part of the Local Government Toolkit. Shade trees and cool roofs specifically have been identified as strategies to improve energy efficiency and meet green building criteria.

For more than two decades, the Heat Island Group (HIG) at Lawrence Berkeley National Laboratory (LBNL) has quantified the abilities of urban vegetation and solar-reflective surfaces to reduce the need for cooling energy, lower the outdoor air temperature, and improve air quality. Many studies have demonstrated building cooling-energy savings in excess of 20% upon raising roof solar reflectance from an existing 0.1 – 0.2 to about 0.6. Installing three shade trees next to a house can reduce its net annual energy consumption by about 10% (Akbari 2002), with the added benefit of sequestering atmospheric carbon. Increasing the solar reflectance of a city and planting vegetation can lower the outdoor air temperature and slow the temperature-dependent formation of smog. Reflecting sunlight from urban surfaces can also slow global warming (Akbari et al. 2008a).

The potential for savings in California is large. Pavements, roofs and urban vegetation collectively cover over 90% of the surfaces of many cities (roofs 20-25%, pavements about 40%, vegetation about 30%). In a typical city, urban vegetative

cover can be increased to 40% from 30%, and the average solar reflectance can be raised by about 0.1 by increasing the solar reflectances of roofs and pavements by 0.3 and 0.1, respectively (Akbari and Rose 2008).

We extrapolate from simulations of mitigation measures in Los Angeles (Rosenfeld et al. 1998) that potential statewide net annual energy savings are worth over $0.5 billion (B) per year. We estimate that these net annual energy savings from cool roofs alone would reduce GHG emissions by about 3 MMT $CO_2$e/y. Increasing the solar reflectance of roofs and pavements statewide would also result in an additional *one-time* GHG offset of 470 MMT $CO_2$e through the process of negative radiative forcing, also known as "global cooling" (Akbari et al. 2008a,b). This would equal 17 times the annual GHG reduction yielded by all voluntary measures.

The installation of cool roofs on nonresidential buildings with low-sloped roofs has been promoted since 2000 through rebate programs offered by the state of California and its utilities, including Pacific Gas & Electric (PG&E), the Sacramento Municipal Utility District (SMUD), and South California Edison (SCE). These rebates were discontinued after the 2005 California Title 24 building energy efficiency standards prescriptively required cool roofs on such buildings in all California climate zones. The number of cool roofs installed on nonresidential buildings in California is unknown. However, since a prescriptive requirement in Title 24 can be met with alternative measures that save the same amount of energy, not all low-sloped roofs installed on nonresidential buildings since 2005 are cool.

Though PG&E, SMUD and SCE currently offer rebates for cool roofs on homes in specific California climates zones (PG&E: 2, 4, 11-13; SMUD: 12; SCE: 8 – 10, 13 – 15) (Figure 1), residential cool roofs are very much in their infancy because cool versions of the most popular residential roofing products (asphalt shingles and concrete tiles) have been available for only a few years. For example, fewer than 1 in 10,000 California homes have participated in a cool roof rebate program. The 2008 Title 24 standards will prescriptively require cool roofs on residential buildings with pitched roofs in zones 10 – 15. However, even after this prescriptive requirement goes into effect in summer 2009, we expect that many homes outside of zones 10 – 15 and even some homes within these zones will select non-cool roofs, either to minimize first cost or for aesthetic design. (In fact, one way to accelerate the adoption of cool residential roofs is to encourage architects and developers to make light colored pitched roofs as common as light colored exterior walls.)

Utility rebate programs and Title 24 promote residential cool roofs in only certain climate zones because they consider only direct energy savings—that is, those that result from cooling the roof—and not those that result from lowering the outside air temperature. Including these "indirect" benefits can increase annual energy savings by about 50% (Rosenfeld et al. 1998), making the economics of residential cool roof more attractive. "Global cooling" is also most effective when solar-reflective

surfaces are applied everywhere. Therefore, there are significant potential GHG reductions to be had by promoting the use of both residential and nonresidential cool roofs on *all* California buildings.

The benefits of cool roofs, cool pavements and vegetation have been extensively simulated using building energy models and mesoscale meteorological models. However, because cool roof technologies for low-sloped roofs (e.g., white elastomeric coatings) have been around longer than those for pitched roofs (e.g., cool colored shingles), cool roof energy savings have been experimentally demonstrated in many nonresidential buildings (Levinson et al. 2005) but in only a handful of homes. One cool pavement technology, light-colored cement concrete, has long been used in applications that require compressive strength, such as well-travelled intersections. However, few experiments have quantified and demonstrated the use of such pavements to cool the urban environment.

A variety of California utilities and non-profit organizations, such as San Diego Gas & Electric (SDG&E) and the Sacramento Tree Foundation (STF), have sponsored the planting of urban shade trees. STF alone has planted several hundred thousand shade trees, suggesting that this is a successful activity that could be implemented statewide.

Previous Research

Berkeley Lab has led California and U.S. efforts to implement cool community technologies, including the publication of *Cooling Our Communities: A Guidebook on Tree Planting and Light-Colored Surfacing* in 1992 (Akbari et al. 1992), the creation of the Cool Roof Rating Council in 1998, the prescription in California's Title 24 building energy code of cool roofs for nonresidential buildings (2005) and some residential buildings (2008), and the creation of various cool roof rebate programs offered over the past decade by the state of California and its utilities. Berkeley Lab has substantially advanced cool roof technologies through a series of industrial collaborations, including a two-phase, $3.3M effort funded by the California Energy Commission since 2002 to develop and deploy cool nonwhite roofing products. Work performed at Berkeley Lab has also led the cement concrete industry to formulate many pavements with high solar reflectance.

Rationale and Significance

Building owners, contractors, developers and urban planners are challenged at times to keep abreast of the wide range of cool technologies, code requirements and incentive programs that have arisen in the past two decades. Thus, while many of the elements needed to cool our communities are now available, a comprehensive informational program is needed to implement cool community technologies on a scale sufficient to achieve substantial statewide energy savings and greenhouse gas reductions.

Developing effective cool community programs requires a complete understanding of cool technologies and the full involvement of many stakeholders who can potentially benefit from and contribute to such programs. Cool community measures include cool roofs, cool walls, cool pavements, and urban vegetation. The nature and ownership of urban surfaces and vegetation can be quite complex. For example, the materials and markets for residential roofing differ from those for commercial roofing. Urban pavements include streets, parking lots, sidewalks, and driveways, each either under public and private ownership. Urban vegetation includes shade trees in private land, shade trees in public areas, street and park trees, and low vegetation (grasses, shrubs and vines).

The stakeholders for cool community measures include private citizens, trade and non-profit organizations, and public agencies such as city governments, counties and state agencies. Some cool community programs (e.g., tree planting) can be implemented either by paid professionals or by unpaid volunteers. Use of volunteers can be very cost effective, but requires motivation, organization, and supervision.

The ultimate goal of this project is to help California policy makers (e.g., CEC and ARB) develop effective implementation programs for cool communities. Programs need input from all stakeholders and should be customized for each locality. We will seek input from trade and non-profit organizations involved in planting trees, installing cool roofs, and installing pavements. We will also coordinate with the policy makers to approach various state and local agencies to seek development of implementation standards and codes. We will conduct technical workshops to provide input to various policy options.

Experimental Plans & Tasks

The objective of this project is to provide technical assistance to California communities for development of "cool community" programs that save energy, reduce emission of greenhouse gases, and improve the urban environment.

The objectives of this project will be carried over three to five years. This particular work plan (activities 1 – 6, below) specifies the activities to be performed *during the first year*. For example, we plan to measure the thermal performance of one cool roof and two cool pavements during the first year. We will add additional cool roof and cool pavement demonstration sites in future years. Similarly, we will expand and maintain the cool-roof retrofit database and cool-roof website in future years.

The initial scope of this project includes the following six activities.

1. **Compile a database of cool roof retrofit projects (both residential and commercial) completed in California.** The database should include information on the age, composition and characteristics of the roof and utility information pre and post installation of the roof. We would also be interested to

add data on cool roof retrofit projects completed outside California. Successful international examples are also of interest.

*Case for a cool roof retrofit database.* Since 2005, cool roofs for nonresidential buildings with low-sloped roofs have been prescribed by California's Title 24 building energy code for both new construction and reroofing. However, since Title 24 offers exemptions and alternative approaches to comply with the standards, the application of cool roofs may have been fairly limited. In the proceedings of the 2008 Title 24 standards, some individual manufacturers and associations of manufacturers asked for more detailed studies to document the costs and benefits associated with the installation of cool roofs.

Cool roofs for residential building with steep-sloped roofs have been prescribed by the 2008 Title 24 code only in the hottest inland areas of California. Few measurements of residential-building cool roof energy savings are available because cool materials for pitched roofs are a relatively new technology.

Between 2000 and 2005, California utilities and the Energy Commission offered cool-roof rebate programs for low-sloped roofs on nonresidential buildings. These incentives were discontinued after such roofs were prescribed by the 2005 Title 24 standards. Since 2006, all major California utilities have offered cool-roof rebate programs for residential buildings. Early indications are that fewer than 300 buildings have participated in these rebate programs.

Neither CEC nor the California utilities have collected data and analyzed the actual performance of the buildings that have participated in their incentive programs. Creating a database that summarizes the outcomes of these projects will be a powerful tool to characterize the (1) the cost effectiveness of cool roofs, (2) the performance of various cool roofing materials, (3) experience with installation of cool roofs, and (4) customer feedback on the actual performance of cool roofs. The ARB considers development of such a database as an essential element of their cool community program.

**2. Cool roof and cool pavement studies and demonstrations.** This activity would experimentally study and demonstrate the energy savings yielded by cool roofs (especially on homes) and cool pavements. Tasks include deploying measurement instruments, gathering data, and sharing reports, data, and in particular energy saving information with ARB.

*Case for cool roof studies and demonstrations.* Cool roofs on homes are an essential element of any cool community program. Few California homeowners are familiar with cool roofs and their performance over time. In fact, demonstration of residential cool roofs in California has been limited to two pairs of houses (where the cool roof and standard roofs have been monitored in a side-by-side experiment) in Sacramento and four houses in southern California. We need to develop more

residential demonstrations in several areas of California where people can observe and witness the performance of cool roofs. These demonstrations should be coordinated with the utilities to increase participation in the program.

*Case for cool pavement studies and demonstrations.* Pavements comprise about 40% of urban surfaces. An effective cool communities program will not exist without addressing the problem of design and installation of cool pavements. We are not aware of a demonstration of cool pavements in California. In addition to cooling the communities (reducing cooling energy use and improving comfort), cool pavements can perform better and last longer than standard pavements. A demonstration can highlight a few potential cool pavement technologies and thereby facilitate implementation of a cool-pavement program. Cool pavement demonstrations should be coordinated with the California Department of Transportation and/or municipal public works departments.

**3. Create a website that serves as a one-stop source of cool roof information for consumers.** The page would identify manufacturers, materials, and color choice, as well as roofers and developers with cool roof experience. It would also include pages which allow residential homeowner input of roof pictures and monthly utility bills, as well as city or neighborhood information that connects to a GIS driven database. Discussions of technical barriers to developers and solutions to overcome them would be included on the web site.

*Case for a cool roof web page.* While many new cool roofing products have become available over the past decade, building owners often have trouble finding cool roofing materials and installers. For example, the product databases provided by the Cool Roof Rating Council and the U.S. EPA Energy Star program detail the radiative properties of several thousand products, but do little to help the consumer identify a product suited to his or her building and/or find an installer. Berkeley Lab's Cool Colors Project website provides general information about cool roofs, but is also not designed for product or service selection. A one-stop source of cool roof information is needed to help building owners learn about cool roofs, select materials and installers, and share their experiences and energy-saving outcomes with other consumers. This is most readily achieved with a new consumer-oriented cool roofing website that combines product information available from existing sources with product selection tools, installer locators, educational materials and the option to share outcomes. This site could also serve designers and contractors, with an interactive page for input from all stakeholders.

**4. Establishment of cool-community courses for builders and contractors.** In cooperation with the California Building Industry Association (CBIA), the Pacific Gas & Electric, and the Sacramento Municipal Utilities District (plus other utilities and other electricity generating, distributing and large user stakeholders), develop instructional materials for builders and contractors, and provide training programs through the local CBIA chapters. (Berkeley Lab would prepare a curriculum and

train instructors, who in turn would teach builders and contractors.)

*Case for instructional materials.* Building owners often rely on contractors to supply and install roofing materials. Like consumers, many builders and contractors are unfamiliar with cool roofing and paving materials. They may also be unaware of cool-roof rebate programs, energy code requirements, and benefits (energy savings, extended lifetimes) that can make cool roofs attractive to customers. Over the past decade, several California utilities have occasionally offered cool-roof training programs for contractors. Comprehensive training courses with updated curricula are needed to keep builders and contractors up to date on the needs, benefits and options for cool community practices, such as the selection of cool roofing and paving materials.

**5. Design survey instrument(s) to collect data on factors affecting the decision to install a cool roof.** Two critical questions are: (1) what parameters play a role in determining the choice of a cool roof and (2) how these parameters might be used to increase the proportion of decision-makers who choose cool roofs. The survey instrument(s) also identifies the potential sources and respondents for conducting the survey.

*Case for a design of a survey instrument.* While a cool-roof database would detail the outcomes of cool-roof installation, it would not establish why people choose to install a cool roof. Policy makers need to how and why building owners decide whether or not to install a cool roof in order to develop strategies that successfully promote their selection. Building owners, builders and contractors responsible for roof selection should be interviewed to determine which criteria were important to their decisions. This information can then be used to design a instrument to be used in a broader survey.

**6. Conduct technology transfer activities.** This year's effort will focus on (1) organizing the Second International Conference for Heat Island Counter Measures, (2) attending conferences to present results of the study, and (3) preparing archival publications.

*Case for technology transfer activities.* California's drive for energy efficiency and need to improve air quality has made it a leader in the development of cool community measures (cool roofs, cool pavements, urban forestry) designed to mitigate urban islands. In 2009 Berkeley Lab will host an international conference to exchange research on heat island countermeasures, including cool community programs. This affords opportunities both to extend the reach of cool community measures developed in this effort and to learn from programs developed in other countries.

**References**

Akbari, H., S. Davis, S. Dorsano, J. Huang, Joe, and S. Winnett, editors. 1992. *Cooling Our Communities: A Guidebook On Tree Planting and Light-Colored Surfacing*. U.S. Environmental Protection Agency, Washington, D.C.

Akbari, H., S. Menon, and A. Rosenfeld. 2008a. Global cooling: increasing world-wide urban albedos to offset $CO_2$, *Climatic Change*, DOI 10.1007/s10584-008-9515-9.

Akbari H., S. Menon, S. and A. Rosenfeld. 2008b. Equivalent $CO_2$ avoided by reflective roofs and pavements in California. A memo to Dr. Bart Croes, CARB, October 21.

Akbari, H. and L. S. Rose. 2008. Urban surfaces and heat island mitigation potentials. *J. of the Human-Environmental System* 11(2): 85-101. Also online at http://repositories.cdlib.org/cgi/viewcontent.cgi?article=7307&context=lbnl .

Akbari, H. 2002. Shade trees reduce building energy use and CO2 emissions from power plants. *Environmental Pollution* 116: S119-S126.

Akbari, H., M. Pomerantz, and H. Taha. 2001. Cool surfaces and shade trees to reduce energy use and improve air quality in urban areas. *Solar Energy* 70(3): 295-310.

CARB. 2008a. *Climate Change Proposed Scoping Plan: a Framework for Change*. California Air Resources Board, October. Online at http://www.arb.ca.gov/cc/scopingplan/document/psp.pdf .

CARB. 2008b. Staff analysis of proposed early action for climate change mitigation in California: cool communities program.

Levinson, R., H. Akbari, S. Konopacki, and S. Bretz. 2005. Inclusion of cool roofs in nonresidential Title 24 prescriptive requirements. *Energy Policy* 33(2):151–170.

Rosenfeld, A., H. Akbari, J. Romm and M. Pomerantz. 1998. Cool communities: strategies for heat island mitigation and smog reduction. *Energy & Buildings* 28:51-62.

Wikipedia. 2007. Global Warming Solutions Act of 2006. Online at http://en.wikipedia.org/wiki/Global_Warming_Solutions_Act_of_2006.

## Figures

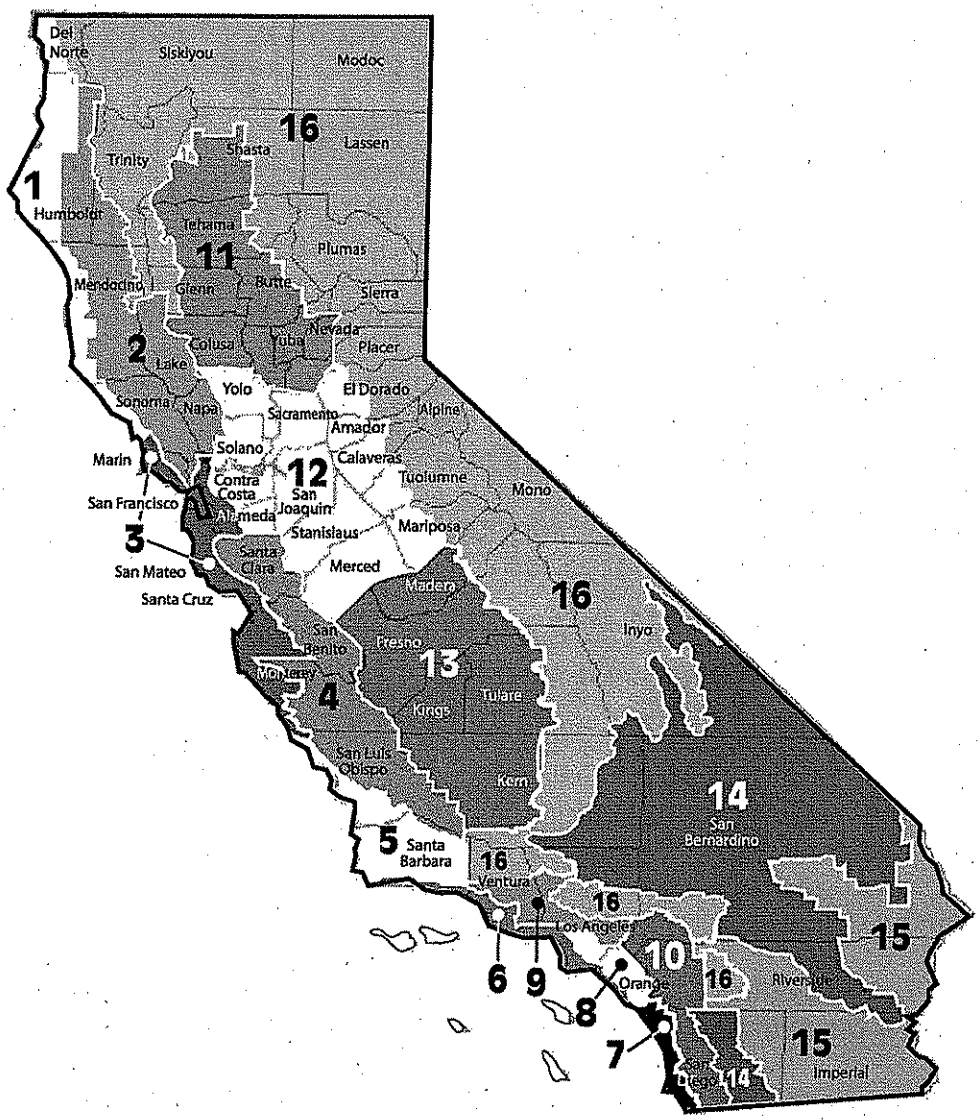


Figure 1. Map of California climate zones.

## V. Technical and economic/cost performance objectives

A. The overall technical goal of this project is to help California policy makers (e.g., CEC and ARB) develop effective implementation programs for cool communities.

The specific, technical objectives upon which this project's success will be evaluated are:

- Compilation of a database of cool roof retrofit projects (both residential and commercial) completed in California.

- Development of cool roof and cool pavement case studies.
- Creation of a one-stop source of cool roof information such as manufacturers, materials, and color choice, as well as roofers and developers with cool roof experience.
- Development of instructional materials for builders and contractors, and provision of training programs through local CBIA chapters.
- Design of survey instrument(s) to collect data on factors affecting the decision to install a cool roof.

B. The overall economic/cost goal of this project is to yield potential statewide net annual energy savings worth over $0.5 billion (B) per year by using vegetation and solar-reflective surfaces to cool communities.

There are no specific economic/cost objectives upon which the project's success is to be evaluated, because the function of this project is to provide the tools and information needed to effectively implement cool communities.

## VI. Preliminary Activities

### 1.1 Attend Kick Off Meeting

The Facility Operator's Project Manager (Principal Investigator) shall attend a "kick off" meeting with the Commission Contract Manager to review the Energy Commission's expectations for: accomplishing tasks described in the work statement; administrative requirements in the terms and conditions of the contract (e.g., invoicing, statements vesting title, prior approvals, data disclosure limitations, monthly progress reporting format and content, etc.); and the Energy Commission's roles and responsibilities. The location of this meeting shall be designated by the Commission Contract Manager.

### 1.2 Describe Synergistic Projects

***(Note: This activity does not apply to projects which did not identify synergistic projects in the proposal.)***
***(Note: Use Attachment A-2 to list the synergistic projects.)***
***(Note: If no synergistic projects are identified to conduct this project, state this finding.)***

Documentation of synergistic project value assessments will be received, reviewed and approved in writing by the Commission Contract Manager before: 1) any PIER funds under this contract are disbursed, and 2) PIER-funded work on Technical Tasks may begin.

Provide the following information about the synergistic projects that will enhance information and technology exchanges with this project:

- Assessed value of each synergistic project.
- Title, contact name, address and telephone number for each identified synergistic project.
- Written concurrence from each technical manager of the identified synergistic projects that information and technology derived from the synergistic project is unrestricted and available for exchange and collaboration in conjunction with this project.

***(Note: The Facility Operator need not resubmit this information if it was provided in the Facility Operator's proposal and the information submitted is still valid. The Facility Operator, however, will assist the Commission Contract Manager in locating this proposal information, upon request.)***

### 1.3 Identify Required Permits

Prepare and submit to the Commission Contract Manager a list of all permits required for construction and/or operation of equipment or the project facility, the name, address and telephone number of the permitting jurisdictions or lead agencies, and the schedule the Facility Operator will follow in applying for and obtaining these permits.

If no permits are required to conduct this project, state this finding.

### 1.4 Obtain Required Permits

Facility Operator will supply written certification that Facility Operator has received all necessary and required permits to construct, operate, or test the proposed equipment or facility as soon as they are received. During this project, the Facility Operator shall comply with all applicable laws, ordinances, regulations and standards. If the Facility Operator is required to obtain permits specifically for performance of this Agreement, such permit expenses shall be separately identified as a cost and shall be reimbursable by the Energy Commission.

### 1.5 Prepare Production Readiness Plan

***(Note: This activity does not apply to projects which do not involve the design, development, or demonstration of energy-related technology.)***

Prepare a written production readiness plan that includes:

- Identification of critical production processes, equipment, facilities, manpower, and support systems that will be needed to produce a commercially viable product;
- Capacity constraints imposed by the design under consideration for internal manufacturing capabilities, as well as suppliers. The project manufacturing effort may include "proof of production processes;"
- Identification of hazardous or non-recyclable materials;
- A projected "should cost" for the product in production at some expected rate;
- The expected investment threshold required to launch the commercial product;
- An implementation plan to ramp up to full production.

***(Note: The degree of detail in the production readiness discussion should be proportional to the complexity of producing the proposed product and its state of development.)***

***(Note: The Production Readiness Plan shall be reviewed by the Commission Contract Manager. If the Commission Contract Manager determines that the plan is unsatisfactory, Facility Operator shall revise it until it meets the Commission Contract Manager's reasonable requirements.)***

## VII. Description of tasks to be performed

***(Note: Please see instructions)***

**TECHNICAL TASKS**

***GLOSSARY***

*Specific terms and acronyms used throughout this work statement are defined as follows:*

| | |
|---|---|
| CPR | Critical Project Review |
| DOE | Department of Energy |
| | |

**SCOPE OF WORK**

This agreement includes a set of administrative tasks and a set of Technical Tasks. The remainder of this work statement defines these Technical Tasks. Task descriptions include goals, Contractor activities, and deliverables. The deliverables, such as test plans, technical reports and other interim deliverables, for each task are defined to the extent possible, but are subject to change based on recommendations from the Project Manager and the approval of the Commission Contract Manager. The Contractor shall submit a draft of each deliverable, unless described differently in the Technical Tasks, to the Commission Contract Manager for review and comment in accordance with the approved Schedule of Deliverables. Deliverables not requiring a draft version are indicated by marking "(no draft)" after the deliverable name.

The Commission Contract Manager will provide written comments back to the Contractor on the draft deliverable within 10 working days of receipt. Once agreement has been reached on the draft, the Contractor shall submit the final deliverable to the Commission Contract Manager. The Commission Contract Manager shall provide written approval of the final deliverable within 5 working days of receipt. Key elements from this deliverable shall be included in the Final Report for this project.

When creating technical deliverables, the Facility Operator shall use and follow, unless otherwise instructed in writing by the Commission Contract Manager, the latest version of the PIER Style Manual published on the Energy Commission's web site:

http://www.energy.ca.gov/contracts/pier/contractors/index.html

**Technical Task List**

| | |
|---|---|
| Task 2.1 | *Cool roof retrofit database* |
| Task 2.2 | *Cool roof monitoring and demonstration* |
| Task 2.3 | *Cool pavement monitoring and demonstration* |
| Task 2.4 | *Cool roof website* |
| Task 2.5 | *Cool roof and cool pavement instructional materials* |
| Task 2.6 | *Cool roof survey instrument* |

**Task 2.1** Cool roof retrofit database

The goal of this task is to develop an extended database of residential and commercial building cool roof retrofit projects in California and assess the energy savings yielded. The database will describe 278 SMUD and PG&E buildings that have participated in the cool roof rebate programs.

**The Contractor shall:**

- Identify CA buildings that have installed cool roofs
- Collect utility bills, building characteristics and roofing characteristics
- Evaluate the cost effectiveness of each cool-roof retrofit
- Develop detailed case studies of the best and worst performing retrofits

**Deliverables:**

- Data base of building characteristics and energy use
- Database analysis tools and summary reports

**Task 2.2** Cool roof monitoring and demonstration

The goal of this task is to develop case studies by carefully instrumenting, measuring, and analyzing the influence of cool roofs on building cooling energy use. Since we already have characterized many nonresidential buildings, this task will focus on homes. To match effort to funding, one residential building would be characterized in the current project.

**The Contractor shall:**

- Identify building to monitor
- Develop a site-specific monitoring plan and protocol
- Specify and procure monitoring system
- Install and calibrate monitoring system at Berkeley Lab
- Install and validate monitor system on site
- Verify data collection procedure
- Collect data before installing cool roof
- Coordinate cool-roof installation with contractor
- Collect data after installing cool roof
- Maintain system during the monitoring period
- Analyze data and report results
- Decommission monitoring system

**Deliverables:**

- A report summarizing measured energy savings and cost/benefit analysis of cool roofs

**Task 2.3** Cool pavement monitoring and demonstration

The goal of this task is to develop case studies by carefully instrumenting, measuring, and analyzing the thermal performance of cool pavements. To match effort to funding, two pavement sites would be characterized in the current project.

**The Contractor shall:**

- Identify pavement sites to monitor
- Develop a monitoring plan and protocol for each site
- Install and calibrate monitoring systems at Berkeley Lab
- Install and validate monitor system on site
- Verify data collection procedure
- Collect data before installing cool pavement
- Coordinate cool-pavement installation with contractors
- Collect data after installing cool pavement
- Maintain system during the monitoring period
- Analyze data and report results
- Decommission monitoring system

**Deliverables:**

- A report summarizing measured energy savings and cost/benefit analysis of cool pavements

**Task 2.4** Cool roof website

The goal of this task is to create a one-stop source of cool roof information in the form of a website that integrates resources from both Berkeley Lab and the Cool Roof Rating Council. Topics addressed would include cool-roof manufacturers, installers, and materials, as well as homeowner experiences.

**The Contractor shall:**

- Organize an advisory panel to guide the design of the website
- Design the website
- Maintain the website

**Deliverables:**

- Design, development, and maintenance of a cool roof web page

**Task 2.5** Cool roof and cool pavement instructional materials

The goal of this task is to work with stakeholders, such as the California Building Industry Association (CBIA) and California utilities, to develop instructional materials for buildings and contractors, and to provide training programs through local CBIA chapters and utility energy centers.

**The Contractor shall:**

- Prepare a syllabus for cool roofing and cool paving technologies, with feedback from stakeholders
- Prepare lecture materials that include and expand upon related courses currently offered by CA utilities
- Conduct teacher-training workshops
- Gather feedback from training workshops to update course materials
- Develop instructional brochures

**Deliverables:**

- Lecture materials for cool roofs and cool pavements

**Task 2.6** Cool roof survey instrument

The goal of this task is to design survey instrument(s) that characterize how building owners decide to install a cool roof. Two critical questions are: (1) what parameters play a role in determining the choice of a cool roof and (2) how these parameters might be used to increase the proportion of decision-makers who choose cool roofs.

**The Contractor shall:**

- Prepare an initial list of factors affecting decision to install cool roofs by interviewing cool roof installers and utility project managers
- Prepare survey instrument(s)
- Identify whom to survey

**Deliverables:**

- Survey instrument and potential respondents

**Task 2.7 Technology Transfer Activities** *(If applicable)*
*The goal of this task is to develop a plan to make the knowledge gained, experimental results and lessons learned available to key decision-makers.*

**The Contractor shall:**

- Prepare a Technology Transfer Plan. The plan shall explain how the knowledge gained in this project will be made available to the public. The level of detail expected is least for research-related projects and highest for demonstration projects. Key elements from this report shall be included in the Final Report for this project.

-
-

- Conduct technology transfer activities in accordance with the Technology Transfer Plan. These activities shall be reported in the Monthly Progress Reports.
- Organize the Second International Conference for Heat Island Counter Measures
- Attend conferences to present results of the study
- Prepare archival publications.

***Deliverables:***

- Draft Technology Transfer Plan
- Final Technology Transfer Plan
- Conference proceedings
- Publication of results in industry magazines and refereed journal articles
- Participation in buildings products exhibition
- Brochure summarizing research results and characterizing the benefits of cool colored roofing materials

***Immediately following the Technical Tasks should be the Reporting Tasks listed below:***

**Task 3.0 Reporting Tasks**

All reports shall be delivered to:

Accounting Office, MS-2
California Energy Commission
1516 9th Street, 1st Floor
Sacramento, CA 95814

**Task 3.1 *Quarterly* Progress Reports**

The Contractor shall prepare *written Quarterly* Progress Reports to the Commission Contract Manager by the 30th of the following month, starting after the Department of General Service's contract approval date and shall continue each month until the Final Report has been accepted by the Commission Contract Manager. Attachment A-1 provides a recommended format and content requirements for the Monthly Progress Report.

**Task 3.2 Final Report**

The Final Report shall be a public document. If the Contractor will be preparing a confidential version of the final report as well, the Contractor shall perform the

following tasks for both the public and confidential versions of the Final Report. When creating the Final Report, the Facility Operator shall use and follow, unless otherwise instructed in writing by the Commission Contract Manager, the latest version of the PIER Style Manual published on the Energy Commission's web site:

http://www.energy.ca.gov/contracts/pier/contractors/index.html

**Subtask 3.2.1 Final Report Outline**

- Contractor shall prepare and submit to the Commission Contract Manager for review an outline of the Final Report describing the original purpose, approach and results of the project.

- The outline shall be submitted to the Commission Contract Manager for review. The Commission Contract Manager shall determine if the outline is satisfactory. If the Commission Contract Manager determines that the outline is unsatisfactory, he or she will, in a timely manner, provide to the Contractor written comments, which indicate how the outline can be improved. The Contractor shall revise the outline to meet the Commission Contract Manager's requirements. Upon finding the final report outline satisfactory, the Commission Contract Manager shall provide to the Contractor written approval of it.

**Subtask 3.2.2 Draft Final Report for Comment**

- The Contractor shall prepare and submit to the Commission Contract Manager a draft Final Report on the project. The format of the report shall follow the approved outline.
- The draft final report shall be submitted to the Commission Contract Manager for review and to determine, in a timely manner, if it is satisfactory. If the Commission Contract Manager determines that it is unsatisfactory, he or she will, provide to the Contractor written comments, which indicate how it can be improved. The Contractor shall revise the draft final report incorporating the Commission Contract Manager's corrections and required changes. Upon finding the revised draft to be satisfactory, the Commission Contract Manager shall provide to the Contractor written approval of it.

**Subtask 3.2.3 Final Report**

- The Contractor shall prepare Final Report and submit it to the Commission Contract Manager after receiving the Commission Contract Manager's written approval of the draft Final Report. This task shall be deemed complete and accepted by the Commission only when the Commission Contract Manager approves the Final Report in writing. Upon approval, the Contractor shall

submit two unbound copies of the Final Report to the Commission Contract Manager.

**Task 3.3 Final Meeting**

Contractor shall meet with the Commission Contract Manager to present findings, conclusions, and recommended next steps (if any) for the project.

Contractor will also discuss with the Commission Contract Manager the following contract close-out items:

- What to do with any state-owned equipment (Options), if applicable
- Commission's request for specific "generated" data (not already provided in contract deliverables)
- Need to document Contractor's disclosure of "subject inventions" developed under the contract
- Need to file UCC-1 form re: Commission's interest in patented technology
- Other "surviving" contracts provisions.

## VIII. Critical Project Reviews

The Energy Commission will conduct critical project reviews at the conclusion of the following tasks:

- <to be completed by the Commission Contract Manager>

***(Note: Critical project reviews are meetings between the Facility Operator, the Energy Commission Contract Manager and other individuals selected by the Commission Contract Manager to provide objective, technical support to the Energy Commission. The purpose of these meetings to discuss with the Facility Operator the status of the project and its progress toward achieving its goals and objectives. These meetings may take place at the Energy Commission offices in Sacramento, or at another, reasonable location determined by the Commission Contract Manager.)***

***(Note: Prior to the critical project review meeting, the Facility Operator will provide the task deliverable(s) to the Commission Contract Manager sufficiently in advance to allow the Contract Manager's review of the deliverable document(s) before the review meeting. If not already defined in the Work Statement, the Commission Contract Manager shall specify the contents of the deliverable document(s).)***

***(Note: At the project review meeting, the Facility Operator shall present the required technical information and participate in a discussion about the project with the Commission Contract Manager and other meeting attendees, if any.***

***(Note: Following the project review meeting, the Energy Commission will determine whether the Facility Operator is complying satisfactorily with the Work Statement and whether the project is demonstrating sufficient progress toward achieving its goals and objectives to warrant continued PIER financial support for the project.)***

## IX. Sponsor's Key personnel and Agreement Management

A. The name and area code/phone number of the California Energy Commission's Contract Manager is listed on Exhibit D and is the official technical contact for the Energy Commission.

The Sponsor's Contract Manager is responsible for the day to day project status, decisions and communications with the Facility Operator Project Manager (Principal Investigator). The Commission Contract Manager will review and approve all project deliverables, reports, and invoices.

The Sponsor may change the Contract Manager by notice given to the Facility Operator at any time signed by the Contract Officer of the Energy Commission.

B. The name and area code/phone number of the California Energy Commission's Contract Officer is listed on Exhibit D and will be the Contract Officer for the Agreement and is the official administrative contact for the Energy Commission.

## X. Facility Operator's Key Personnel and Agreement Administration

The Facility Operator is obligated to comply with the terms and conditions of its Management and Operating (M&O) Contract with the DOE when performing work under this agreement. The DOE may require substitution of the named "key personnel" under this agreement should the DOE determine that the services of the Project Manager (Principal Investigator) or other named key personnel are necessary to meet the Facility Operator's M&O Contract obligations to the DOE. Should the DOE direct the Facility Operator to substitute the named key personnel under this agreement, the Facility Operator shall inform the Energy Commission of the directed substitution in accordance with paragraphs A and B below. In the event that the Energy Commission does not concur with the substitution of named key personnel as directed by the DOE, this agreement shall be terminated under Article XX, Termination, of the modified terms and conditions.

A. The name and area code/phone number of the National Laboratory's Project Manager (Principal Investigator) is on Exhibit D and will be the Project Manager (Principal Investigator) for this project and is the official technical contact for Lawrence Berkeley National Laboratory.

The Facility Operator's Project Manager (Principal Investigator) is responsible for the day to day project status, decisions, and communications with the Sponsor's Contract Manager. The Facility Operator's Project Manager (Principal Investigator) will review and approve all project deliverables and reports.

The Facility Operator's Project Manager (Principal Investigator) is designated as "key personnel" under the Agreement. The Energy Commission reserves the right to prior written concurrence of any substitution of the Project Manager (Principal Investigator).

B. The key personnel are listed on Exhibit D in this agreement.

Facility Operator's key personnel may not be substituted without the Commission Contract Manager's prior written concurrence. Such concurrence shall not be unreasonably withheld. All other personnel may be substituted by Facility Operator, with written notification made to the Commission Contract Manager.

C. The name and area code/phone number of National Laboratory Agreement Administrator is on Exhibit D and will be the Agreement Administrator for this Agreement and is the official administrative contact for Lawrence Berkeley National Laboratory.

## XI. Facility Operator's key subcontractors

The Facility Operator's key subcontractors are listed on Exhibit D in this agreement.

Facility Operator's key subcontractors may not be substituted without the Commission Contract Manager's prior written concurrence. Such concurrence shall be timely provided and not unreasonably withheld. Delay in written concurrence may result in a work stoppage of subcontract work. All other subcontractors may be substituted by Facility Operator, with written notification made to the Commission Contract Manager.

## XII. Report standards

A. The report outline and format will be provided by the Sponsor's Contract Manager to the Facility Operator's Project Manager (Principal Investigator).

B. All reports shall be delivered to the Accounting address shown on Exhibit D.

C. Progress Reports. The Facility Operator shall prepare a Progress Report that summarizes all Agreement activities conducted by the Facility Operator to date, with an assessment of ability to complete the project within the current budget and any anticipated cost overruns. Each Progress Report is due to the Commission Contract Manager within 30 days after the end of the reporting period. The Commission Contract Manager will specify the report format and contents and the number of copies to be submitted.

D. Final Report and Final Meeting. At the conclusion of the Agreement's technical work as provided for this Appendix A Statement and revised project plan, Facility Operator shall prepare a comprehensive written Final Report, including an Executive Summary. The Commission Contract Manager will review and approve the Final Report.

***(Note: Facility Operator will also participate in a Final Meeting with the Energy Commission to present the findings, conclusions, and recommendations. Both the Final Meeting and the Final Report must be consummated on or before the termination date of the Agreement.)***

## XIII. Schedule

The program will continue for 18 months after advance funding is received by the University of California. This Agreement is effective the later date of (1) the date on which it is signed by the last of the parties thereto, or (2) the date on which it is approved by the California Department of General Services as noted on the Standard Agreement, or (3) the date on which the Facility Operator receives advance funding from the Sponsor.

## XIV. Budget

SOW Appendix A, Exhibit C shows Energy Commission's Reimbursable Budget.

SOW Appendix A, Exhibit C shows the assessed value of the Federal Administrative Charge not charged to this project.

SOW Appendix A, Attachment A-2 shows assessed value of synergistic projects. The assessed value of such synergistic projects does not constitute a funding contribution or obligation (either cash or in-kind) on the part of the DOE or the Facility Operator.

# 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, the Air Resources Board agrees to compensate the California Energy Commission an amount not to exceed $350,000 for expenditures incurred in accordance with the rates specified in Exhibit B, Attachment 1, which is attached hereto and made a part of this Agreement.

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

Ms. Emma Plasencia
Air Resource Board
Research Division (5th Floor)
P.O. Box 2815
Sacramento, CA 95812

C. Budget Flexibility: Subject to the prior review and approval of the contract manager, line item shifts of up to $25,000 or ten percent of the annual contract total, whichever is less, may be made up to a cumulative maximum of $25,000 or 10%, whichever is less, for all line item shifts over the life of the contract. There must be a substantial business justification for any shifts made. Fund shifts which increase Indirect, Overhead or General Expense line items are prohibited. Line item shifts may be proposed/requested by either the State or the CEC in writing and must not increase or decrease the total contract amount allocated. Any line item shifts must be approved in writing by the Division Chief of the Research Division, or his or her designee, and must be sent to the Contracts Section within 10 days of approval for inclusion in the contract folder. If the contract is formally amended, any line item shifts agreed to by the parties must be included in the amendment.

### 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

**EXHIBIT B**

and effect. In this event, ARB shall have no liability to pay any funds whatsoever to CEC or to furnish any other considerations under this Agreement and CEC 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, ARB shall have the option to either cancel this Agreement with no liability occurring to the State, or offer an agreement amendment to CEC to reflect the reduced amount.

**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. ARB shall withhold payment equal to ten percent of the total Agreement cost until completion of all work and submission to ARB by CEC of a final report (including computer diskette copy) approved in accordance with Exhibit A, Attachment 1. It is CEC's responsibility to submit an invoice in triplicate with the revised final report for ten percent withheld.

D. CEC will be paid for the payment period completed upon receipt, by ARB, of an invoice and reports satisfying the requirements of this Agreement. The invoice and reports must be deemed by ARB to reflect reasonable work performed in accordance with the Agreement.

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

ARB will fund the following Tasks...

| | | |
|---|---|---|
| Task 1 | ½ of Task 1.1 – 1.5 | $ 9,000 |
| Task 2 | ½ of Task 2.1 – 2.6 | $318,500 |
| Task 3 | ½ of Task 3.1 – 3.3 | $ 22,500 |
| Total ARB Funding | | $350,000 |

| Task Number | Task Name | Deliverable(s) | Planned Start Date | Planned Completion Date | PIER Task Budget |
|---|---|---|---|---|---|
| VI. | **Preliminary Activities** | | | | |
| 1.1 | Attend Kick-off Meeting | Kick-Off Meeting | 2/1/2009 | 2/1/2009 | 18,000 |
| 1.2 | Describe Synergistic Projects | Description of Synergistic Projects | | | 0 |
| 1.3 | Identify Required Permits | List Deliverables if any | | | 0 |
| 1.4 | Obtain Required Permits | List Deliverables if any | | | 0 |
| 1.5 | Prepare Production Readiness Plan | List Deliverables if any | | | 0 |
| | | **Project Start-Up Totals** | | | 18,000 |
| VII. | **Tasks To Be Performed** | | | | |
| | **Technical Tasks** | | | | |
| 2.1 | Compile a database of existing cool roof retrofit | 1. Data base of building characteristics and energy use, 2. Database analysis tools and summary reports | 2/1/2009 | 1/31/2010 | 210,000 |
| 2.2 | Cool Roofs Monitoring and Demonstration (Only for the first demonstation) | A report summarizing measured energy savings and cost/benefit analysis of cool roofs | 2/1/2009 | 1/31/2010 | 122,000 |
| 2.3 | Cool Pavements Monitoring and Demonstration (Only for the first demonstration) | A report summarizing measured energy savings and cost/benefit analysis of cool pavements | 2/1/2009 | 1/31/2010 | 110,000 |
| 2.4 | Cool Roofs Web Page | Design, development, and maintenance of a cool roof web page | 2/1/2009 | 1/31/2010 | 70,000 |
| 2.5 | Cool Roofs and Cool Pavement Instruction Material | Lecture materials for cool roofs and cool pavements | 8/1/2009 | 1/31/2010 | 75,000 |
| 2.6 | Survey Instrument | Survey instrument and potential sources and respondents for conducting the survey | 10/1/2009 | 1/31/2010 | 50,000 |
| 2.7 | Technology Transfer Activities (if applicable) | | | | 50,000 |
| 2.7.1 | Organize the Second International Conference for Heat Island Counter Measures | Conference proceedings | | | |
| 2.7.2 | Publish results in industry magazines and refereed journal articles | Publication of results in industry magazines and refereed journal articles | | | |
| 2.7.3 | Participate in buildings products exhibition | Participation in buildings products exhibition | | | |
| 2.7.4 | Develop a brochure summarizing the research results and characterizing the benefits of cool colored roofing materials | Brochure summarizing research results and characterizing the benefits of cool colored roofing materials | | | |
| | | **Technical Tasks Totals** | | | 687,000 |
| 3.0 | **CPR and Report Tasks** | | | | |
| 3.1 | Quarterly / Monthly Progress Reports | Quarterly / Monthly Progress Reports | | | 10,000 |
| 3.2 | Final Report | | 12/1/2009 | 1/31/2010 | 30,000 |
| 3.2.1 | Final Report Outline | Final Report Outline | | | |
| 3.2.2 | Draft Final Report for Comment | Draft Final Report | | | |
| 3.2.3 | Final Report | Final Report Outline | | | |
| 3.3 | Final Meeting | | | | |
| VIII | **Critical Project Review(s)** | CPR | | | 5,000 |
| | | **CPR and Reporting Totals** | | | 45,000 |

| | |
|---|---|
| **Total** | **750,000** |

**(CEC/Livermore's Budget): Appendix A**
**Exhibit C**
**Budget Summary**



| Summary Project Budget<br>Lawrence Berkeley National Laboratory | | PIER Reimbursable Project Costs |
|---|---|---|
| VI. | Preliminary Activities | 18,000 |
| 2.1 | Compile a database of existing cool roof retrofit projects in California | 210,000 |
| 2.2 | Cool Roofs Monitoring and Demonstration (Only for the first demonstation) | 122,000 |
| 2.3 | Cool Pavements Monitoring and Demonstration (Only for the first demonstration) | 110,000 |
| 2.4 | Cool Roofs Web Page | 70,000 |
| 2.5 | Cool Roofs and Cool Pavement Instruction Material | 75,000 |
| 2.6 | Survey Instrument | 50,000 |
| 2.7 | Technology Transfer Activities (if applicable) | 50,000 |
| 3.1 | Quarterly / Monthly Progress Reports | 10,000 |
| 3.2 | Final Report | 30,000 |
| 3.3 | Final Meeting | 0 |
| VIII | Critical Project Review(s) | 5,000 |

| | Total PIER Cost |
|---|---|
| Program Totals | 750,000 |

**Preliminary Activities**

| Lawrence Berkeley National Laboratory | | Personal Services | | Project Operating Expenses | | | | Indirect Costs (Change headings, if necessary, to match your chart of accounts.) | | | PIER Reimbursable Task Costs |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Task | Task Name | Direct Labor | Fringe Benefits | Materials | Equipment | Travel | Misc. | Overhead | G&A | Profit (1) | |
| 1.1 | Attend Kick-off Meeting | 1,238 | 313 | 0 | 0 | 1,911 | 11,475 | 442 | 2,621 | 0 | 18,000 |
| 1.2 | Describe Synergistic Projects | | | | | | | | | | 0 |
| 1.3 | Identify Required Permits | | | | | | | | | | 0 |
| 1.4 | Obtain Required Permits | | | | | | | | | | 0 |
| 1.5 | Prepare Production Readiness Plan | | | | | | | | | | 0 |
| | Subtotal - Project Start-Up Tasks | 1,238 | 313 | 0 | 0 | 1,911 | 11,475 | 442 | 2,621 | 0 | 18,000 |

(1) Prime Contractor profit not allowed on subcontractor invoices and profit cannot exceed 10% of the PIER funds allocated to the Task.

**Technical Tasks**

| Lawrence Berkeley National Laboratory | | Personal Services | | Project Operating Expenses | | | | Indirect Costs (Change headings, if necessary, to match your chart of accounts.) | | | PIER Reimbursable Task Costs |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Task | Task Name | Direct Labor | Fringe Benefits | Materials | Equipment | Travel | Misc. | Overhead | G&A | Profit (1) | |
| 2.1 | Compile a database of existing cool roof retrofit projects in California | 86,683 | 15,132 | 0 | 0 | 4,632 | 11,417 | 19,387 | 72,749 | 0 | 210,000 |
| 2.2 | Cool Roofs Monitoring and Demonstration (Only for the first demonstation) | 35,676 | 7,535 | 22,000 | 0 | 5,790 | 8,321 | 8,554 | 34,124 | 0 | 122,000 |
| 2.3 | Cool Pavements Monitoring and Demonstration (Only for the first demonstration) | 33,506 | 6,688 | 16,500 | 0 | 5,790 | 8,191 | 7,922 | 31,403 | 0 | 110,000 |
| 2.4 | Cool Roofs Web Page | 26,208 | 5,658 | 0 | 0 | 1,158 | 7,779 | 6,110 | 23,087 | 0 | 70,000 |
| 2.5 | Cool Roofs and Cool Pavement Instruction Material | 30,769 | 6,696 | 0 | 0 | 1,737 | 2,083 | 7,112 | 26,603 | 0 | 75,000 |
| 2.6 | Survey Instrument | 20,363 | 4,233 | 0 | 0 | 1,737 | 1,430 | 4,676 | 17,561 | 0 | 50,000 |
| 2.7 | Technology Transfer Activities (if applicable) | 19,359 | 4,162 | 0 | 0 | 3,474 | 1,472 | 4,494 | 17,039 | 0 | 50,000 |
| | Technical Activities Subtotals | 252,564 | 50,104 | 38,500 | 0 | 24,318 | 40,693 | 58,255 | 222,566 | 0 | 687,000 |

**CPR and Report Tasks**

| Lawrence Berkeley National Laboratory | | Personal Services | | Project Operating Expenses | | | | Indirect Costs (Change headings, if necessary, to match your chart of accounts.) | | | PIER Reimbursable Task Costs |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Task | Task Name | Direct Labor | Fringe Benefits | Materials | Equipment | Travel | Misc. | Overhead | G&A | Profit (1) | |
| 3.1 | Quarterly / Monthly Progress Reports | 4,035 | 1,097 | 0 | 0 | 0 | 280 | 971 | 3,617 | 0 | 10,000 |
| 3.2 | Final Report | 12,396 | 2,929 | 0 | 0 | 0 | 923 | 2,902 | 10,850 | 0 | 30,000 |
| 3.3 | Final Meeting | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| VIII | Critical Project Review(s) | 2,063 | 523 | 0 | 0 | 0 | 116 | 490 | 1,808 | 0 | 5,000 |
| | Subtotal - CPR and Report Tasks | 18,494 | 4,549 | 0 | 0 | 0 | 1,319 | 4,363 | 16,275 | 0 | 45,000 |

| Prime Contractor | Direct Labor | Fringe Benefits | Materials | Equipment | Travel | Misc. | Indirect Overhead | G&A | Profit | Total PIER Reimbursable Cost |
|---|---|---|---|---|---|---|---|---|---|---|
| PIER Reimbursable Totals | 272,296 | 54,966 | 38,500 | 0 | 26,229 | 53,487 | 63,060 | 241,462 | 0 | 750,000 |
| Percent of the Total | 36% | 7% | 5% | 0% | 3% | 7% | 8% | 32% | 0% | 100% |
| | | | | | | | Total overhead & profit = | | 304,522 | |

(1) Prime Contractor profit not allowed on subcontractor invoices and profit cannot exceed 10% of the PIER funds allocated to the Task.

LAWRENCE BERKELEY NATIONAL LABORATORY COSTS BY CATEGORY
**Urban/Community Energy and Environmental Efficiency (UC E3)**

| | | | | | |
|---|---|---|---|---|---|
| **A.** | **DIRECT LABOR** | | | | |
| | | **Effort** | | | **Total** |
| | a. Salaries & Wages | **FTE months** | **Rate** | **Est Cost** | **Cost** |
| | Akbari, Hashem | 3.49 | 13,253 | 46,263 | |
| | Levinson, Ronnen M | 6.98 | 9,341 | 65,213 | |
| | Adams, Barbara J | 3.49 | 4,487 | 15,665 | |
| | Graduate Student Assistant | 12.08 | 2,963 | 35,788 | |
| | Graduate Student Assistant | 12.08 | 2,963 | 35,787 | |
| | Research Associate Sr | 13.96 | 5,270 | 73,580 | |
| | TOTAL Labor | 52.08 | | | $272,296 |
| | b. Fringe Benefits | **Rate** | **Base** | **Est Cost** | |
| | Career | 21.2% | 257,046 | 54,536 | |
| | GSRA | 0.2% | 192,951 | 430 | |
| | TOTAL Fringe Benefits | | | | $54,966 |
| **B.** | **SUBCONTRACTS** | | | | |
| | a. Subcontract | | | | |
| | b. Procurement burden | | | 0 | |
| | TOTAL Subcontract Cost | | | | $0 |
| **C.** | **TRAVEL** | | | | |
| | List locations (See table in the back) | | | 22,650 | |
| | b. Procurement burden | | | 3579 | |
| | | | | | $26,229 |
| **D.** | **EQUIPMENT (purchased by LBNL** | | | | |
| | a. Equipment and materials (See table in the back) | | | 35,000 | |
| | a. Insurance | | | 10,364 | |
| | b. Other procurements | | | 23,100 | |
| | c. Procurement burden | | | 5,324 | |
| | TOTAL Purchases | | | | $73,788 |
| **E.** | **OTHER DIRECT COSTS -- OVERHEADED** | | | | |
| | a. Recharges -electricity | | | 800 | |
| | b. Miscellaneous expenses | | | 17,399 | |
| | 1) Cost to Edit the Final Report (required) | | | 0 | |
| | TOTAL Other Direct Costs, Overheaded | | | | $18,199 |
| **F.** | **OVERHEAD** | **Rate** | **Base** | **Est Cost** | |
| | a. Organization Burden-EETD Burden | 17.0% | 327,262 | 55,635 | |
| | b. Safeguards & Security | 1.00% | 742,574 | 7,426 | |
| | TOTAL Overhead Costs | | | | $63,060 |
| **G.** | **G&A** | | | | |
| | a. General | 51.0% | 409,198 | 208,692 | |
| | b. LDRD | 5.4% | 500,312 | 27,017 | |
| | c. IGPP | 1.15% | 500,312 | 5,754 | |
| | TOTAL Overhead Costs | | | | $241,462 |
| **H.** | **TOTAL LABORATORY COSTS** | | | | $750,000 |
| **I.** | **FEDERAL ADMINISTRATIVE CHARGE (3% of Total Laboratory Costs - waived by DOE)** | | | | $22,500 |

Date prepared: 12/12/2008

**Explanations for Items on Exhibit C: (Attach additional sheets as needed)**

**A. DIRECT LABOR**

Salaries and wages in accordance with costing practice for all DOE programs.

Scientific staff Fringe Benefit rate is 25.3% for FY09, 29% for FY10, and 32% for FY11 for career employees.

**B. SUBCONTRACTS**

NONE

**C. TRAVEL**

Travel: All travelers charges will be within the LBNL travel standard rules based on US DOE approved rates.

| | |
|---|---|
| 2 Roundtrip to Sacramento @ $87/trip | $150 |
| 40 Roundtrip to Los Angeles @ $500/trip | $20,000 |
| 1 Roundrip to East Coast @ $2500/trip | $2,500 |
| Procurement burden | $3,579 |
| | $26,229 |

**D. EQUIPMENT AND PURCHASES**

| | |
|---|---|
| Materials (monitoring system and instruments) | 35,000 |
| Procurement burden | 3,500 |
| Insurance (cost is 1.5% of total project cost) | 10,364 |
| Procurement burden | 1,036 |

**E. OTHER DIRECT COSTS - OVERHEADED**

Miscellaneous Expenses: Miscellaneous charges include electricity charges for laboratory and office space, telephone charges, publication costs, faxes, and general departmental costs.

**F. OVERHEADS**

Organization burden of 17% is a direct cost applied to total salaries plus fringe benefits. Safeguards & Security Charge of 1% is applied to all direct costs and burdens plus indirect costs (excluding subcontracts cost).

**G. G&A**

The General Overhead rate distributes the costs incurred for the general management administration of the Laboratory including the costs of maintaining the Laboratory site. General Overhead is 51% of the sum of Total Direct Costs (excluding travel, electricity and direct cost of material purchases).
LDRD is 5.4% of the sum of Total Directs Costs (excluding subcontracts cost and electricity).
IGPP is 1.15% of Total Direct Costs (excluding subcontracts cost and electricity).

**Pre-approved Travel List ***

| Task No. | Trip Number | Trip Purpose | Location | Who | Amount |
|---|---|---|---|---|---|
| 1.1 | 1.1-1 | to attend kick-off meeting at CEC | Sacramento, CA | Hashem Akbari and Ronnen Levinson | 174 |
| 1.1 | 1.1-2, 1.1-3, 1.1-4 | to attend meetings in Southern California | Los Angeles, CA | Hashem Akbari and Ronnen Levinson | 1,737 |
| 2.1 | 2.1-1, 2.1-2, 2.1-3, 2.1-4, 2.1-5, 2.1-6, 2.1-7, 2.1-8 | to attend meetings in Southern California | Los Angeles, CA | Hashem Akbari and Ronnen Levinson | 4,632 |
| 2.2 | 2.2-1, 2.2-2, 2.2-3, 2.2-4, 2.2-5, 2.2-6, 2.2-7, 2.2-8, 2.2-9, 2.2-10 | to attend meetings in Southern California | Los Angeles, CA | Hashem Akbari and Ronnen Levinson | 5,790 |
| 2.3 | 2.3-1, 2.3-2, 2.3-3, 2.3-4, 2.3-5, 2.3-6, 2.3-7, 2.3-8, 2.3-9, 2.3-10 | to attend meetings in Southern California | Los Angeles, CA | Hashem Akbari and Ronnen Levinson | 5,790 |
| 2.4 | 2.4-1, 2.4-2 | to attend meetings in Southern California | Los Angeles, CA | Hashem Akbari and Ronnen Levinson | 1,158 |
| 2.5 | 2.5-1,2.5-2, 2.5-3 | to attend meetings in Southern California | Los Angeles, CA | Hashem Akbari and Ronnen Levinson | 1,737 |
| 2.6 | 2.6-1,2.6-2, 2.6-4 | to attend meetings in Southern California | Los Angeles, CA | Hashem Akbari and Ronnen Levinson | 1,737 |
| 2.7 | 2.7-1 | to attend meetings in Southern California | Los Angeles, CA | Hashem Akbari and Ronnen Levinson | 579 |
| 2.7 | 2.7-2 | to attend meeting in East Coast | New York, NY | Hashem Akbari and Ronnen Levinson | 2,895 |
| | | | | **Total** | 26,229 |

*** All travelers charges will be within the *Lawrence Berkeley National Laboratory* travel standard rules based on US DOE approved rates.**

**Equipment***

| Task No. | Name of Equip. | Description | Purpose | Amount |
|---|---|---|---|---|
| 2.2 | multiple pieces of equipment | monitoring system and instruments | for use in carrying out task activities | 22,000 |
| 2.3 | multiple pieces of equipment | monitoring system and instruments | for use in carrying out task activities | 16,500 |
| | | | **Total** | 38,500 |

| Exhibit / Attachment Name (e.g., Exhibit B schedule of deliverables) | Note |
|---|---|
| | Task 1.1 Misc. costs includes CEC-required 1.5% insurance cost = $11,400 (includes $1,036 procurement burden) |
| | Task 2 includes $23,888 cost for graduate students tuition |

# 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 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 non-cancelable 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. Copyrightable Materials

In recognition of the policy of ARB and CEC 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 Exhibit A, Attachment 1, of this Agreement.

C. Ownership of all Subject Data and copyrights arising from Subject Data shall be vested in CEC and ownership of all Reports and copyrights arising from the Reports delivered under this Agreement shall be vested in CEC. CEC agrees to make available to the public for public benefit, to the extent CEC 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 CEC staff to publish the Subject Data in the form of scholarly articles in academic journals nor to affect, abrogate or limit the right of CEC staff to make use of the Subject Data.

### 2. Meetings

A. Initial meeting. Before work on the contract begins, CEC's Contract Manager 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

**EXHIBIT E**

personnel or changes in personnel, and any issues that may need to be resolved before work can begin.

B. Progress review meetings. CEC's Contract Manager 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.

**3. Confidentiality**

A. It is understood that in the course of carrying out this Agreement, State may wish to provide CEC with proprietary or confidential information of State (Proprietary Information). CEC agrees to use its best efforts to hold proprietary information in confidence and shall return it to the 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 Contract Manager. 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 CEC; b) is already known to CEC at the time of disclosure; c) independently developed by CEC without breach of this agreement; or d) is generally disclosed to third parties by State without similar restrictions on such third parties.