

**GRANT REQUEST FORM (GRF)**

CEC-270 (Revised 02/13)

CALIFORNIA ENERGY COMMISSION

New Agreement PIR-13-011 (To be completed by CGL Office)

Division	Agreement Manager:	MS-	Phone
ERDD	David Weightman	51	916-327-1631

Recipient's Legal Name	Federal ID Number
Lawrence Berkeley National Laboratory	94-2951741

Title of Project
Demonstration of Industrial System with Real-time Response to Fuel Stock Variability

Term and Amount	Start Date	End Date	Amount
	6/30/2014	3/31/2018	\$ 1,600,000

**Business Meeting Information**
 ARFVTP agreements under \$75K delegated to Executive Director.

Proposed Business Meeting Date	6/18/2014	<input type="checkbox"/> Consent	<input checked="" type="checkbox"/> Discussion
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Business Meeting Presenter	David Weightman	Time Needed:	5 minutes
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Please select one list serve. Research (Energy RDD/PIER Program)

**Agenda Item Subject and Description**

Proposed resolution approving Agreement PIR-13-011 with the Department of Energy's Lawrence Berkeley National Laboratory for a \$1,600,000 grant to demonstrate a pre-commercial combustion system that has real-time fuel switching capability between natural gas, propane and biogas. (PIER natural gas funding) Contact: David Weightman. (5 minutes)

**California Environmental Quality Act (CEQA) Compliance**

1. Is Agreement considered a "Project" under CEQA?  
 Yes (skip to question 2)  No (complete the following (PRC 21065 and 14 CCR 15378)):  
 Explain why Agreement is not considered a "Project":

2. If Agreement is considered a "Project" under CEQA:

a) Agreement **IS** exempt. (Attach draft NOE)

Statutory Exemption. List PRC and/or CCR section number:

Categorical Exemption. List CCR section number: 14 CCR 15302

Common Sense Exemption. 14 CCR 15061 (b) (3)

Explain reason why Agreement is exempt under the above section:

The project involves the development and demonstration of a combustion system at an existing facility.

b) Agreement **IS NOT** exempt. (Consult with the legal office to determine next steps.)

Check all that apply

Initial Study

Environmental Impact Report

Negative Declaration

Statement of Overriding Considerations

Mitigated Negative Declaration

**List all subcontractors (major and minor) and equipment vendors: (attach additional sheets as necessary)**

Legal Company Name:	Budget
Regents of the University of California, Irvine	\$ 629,696.00
Fossil Energy Research Corporation (FERCo)	\$ 12,000.00

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CALIFORNIA ENERGY COMMISSION



<b>List all key partners:</b> (attach additional sheets as necessary)
Legal Company Name:

Budget Information			
Funding Source	Funding Year of Appropriation	Budget List No.	Amount
NG Subaccount, PIERDD	12-13	501.001G	\$1,600,000
R&D Program Area: EERO: IAW		TOTAL:	\$1,600,000
Explanation for "Other" selection			
Reimbursement Contract #:		Federal Agreement #:	

Recipient's Administrator/ Officer		Recipient's Project Manager	
Name:	Betsy Quayle	Name:	Robert Cheng
Address:	Ms 70-108B, 1 Cyclotron Rd 90R1121	Address:	Ms 70-108B, 1 Cyclotron Rd 90R1121
City, State, Zip:	BERKELEY, CA 94720-0001	City, State, Zip:	BERKELEY, CA 94720-0001
Phone:	510 4867391 /	Fax:	- -
E-Mail:	BEQuayle@lbl.gov	E-Mail:	RKCheng@lbl.gov

Selection Process Used	
<input checked="" type="checkbox"/> Competitive Solicitation	Solicitation #: PON-13-501
<input type="checkbox"/> First Come First Served Solicitation	

The following items should be attached to this GRF	
1. Exhibit A, Scope of Work	<input checked="" type="checkbox"/> Attached
2. Exhibit B, Budget Detail	<input checked="" type="checkbox"/> Attached
3. CEC 105, Questionnaire for Identifying Conflicts	<input checked="" type="checkbox"/> Attached
4. Recipient Resolution	<input type="checkbox"/> N/A <input checked="" type="checkbox"/> Attached
5. CEQA Documentation	<input type="checkbox"/> N/A <input checked="" type="checkbox"/> Attached

Agreement Manager

Date

Office Manager

Date

Deputy Director

Date

# ENERGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION GRANTS

## Exhibit A SCOPE OF WORK

PIR-13-011, Lawrence Berkeley National Laboratory

### I. TASK AND ACRONYM/TERM LISTS

#### A. Task List

Task #	CPR <sup>1</sup>	Task Name
1		Project Administration
2		Contract Execution
3		Development of demonstration plan and metrics
4		Engineering design of package burner
5		Expansion of fuel sensor capability for fuel-switching
6		Development of control logic and software for fuel switching
7	X	Design verification through reduced-scale prototype testing
8		Construction of full-scale demonstration unit
9		Preparation and installation of demonstration unit
10		Demonstration or real-time fuel-switching
11		Evaluation of Project Benefits
12		Technology/Knowledge Transfer Activities

#### B. Acronym/Term List

Acronym/Term	Meaning
ADG	Anaerobic Digester Gas
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CPR	Critical Project Review
CWRP	Chiquita Water Reclamation Plant
DOE-EERE	Department of Energy, Office of Energy Efficiency & Renewable Energy
DOE-FE	Department of Energy, Office of Fossil Energy
LBNL	Lawrence Berkeley National Laboratory
LSB	Low-swirl burner
M&V	Measurement and Verification
SMWD	Santa Margarita Water District
TAC	Technical Advisory Committee
UCI	University of California at Irvine

<sup>1</sup> Please see subtask 1.3 in Part III of the Scope of Work (Project Administration) for a description of Critical Project Review (CPR) Meetings.

# ENERGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION GRANTS

## Exhibit A

### SCOPE OF WORK

PIR-13-011, Lawrence Berkeley National Laboratory

## II. PURPOSE OF AGREEMENT, PROBLEM/SOLUTION STATEMENT, AND GOALS AND OBJECTIVES

### A. Purpose of Agreement

The purpose of this Agreement is to fund the demonstration of a combustion system that responds in real-time to biogas fuel-stock variability and availability while meeting system output demand, maintaining system operability with high efficiency, and maintaining low emissions.

### B. Problem/ Solution Statement

#### Problem

California has the potential to produce 500 million therms of biogas from organic waste. Though very little of this potential is being utilized, it could be used to offset natural gas purchases. This can be accomplished by enabling smaller commercial and industrial enterprises (e.g., food processors, restaurant chains, and agriculture) to take advantage of their biogas energy supply potential instead of disposing their waste streams. However, concerns regarding biogas supply quality and availability, its impact on the operation and reliability of power and heat equipment, and limited return-on-investment create barriers for small and medium-sized enterprises to fully realize their biogas potential.

The burning of biogas with variable and inconsistent energy contents also requires dedicated and specialized (thus more complex and costlier) combustion equipment. Because biogas supply can be intermittent, dedicated biogas combustion equipment is not consistently productive. Combustion system operators are reluctant to invest in biogas systems because biogas variability and availability limit the economics of such systems. These are significant barriers to deploying stand-alone biogas power and heat systems in most commercial and small industrial enterprises.

#### Solution

The demonstration and commercialization of a combustion system with the ability to switch in real-time between natural gas and biogas would allow for the flexibility to operate with biogas, supplement with natural gas (by blending biogas with natural gas) when fuel quality and/or quantity is unable to meet output demand, and operate on natural gas as a backup. Real-time fuel-switching means that the equipment has the capability to sense the type of fuel being delivered to the burner, and that the burner can respond to the changing fuel stock and produce the energy needed for the load without sacrificing performance, efficiency, or emissions. Real-time fuel-switching capability is critical for market acceptance of biogas utilization for commercial and industrial customers. Commercial real-time fuel-switching systems will deliver consistent, low-cost

# ENERGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION GRANTS

## Exhibit A

### SCOPE OF WORK

PIR-13-011, Lawrence Berkeley National Laboratory

renewable energy for operators without an extra burden to manage the fuel stocks. They will also expand the biogas market, accelerating the offsetting of natural gas with biogas.

#### C. Goals and Objectives of the Agreement

##### Agreement Goals

The goal of this Agreement is to provide a technological solution to overcome the economic, environmental, and market constraints to the broader use of biogas in California.

##### Agreement Objectives

The objectives of this Agreement are to:

- Merge low-swirl burner (LSB) technology from the Lawrence Berkeley National Laboratory (LBNL) with fuel-sensor technology from the University of California at Irvine (UCI) to engineer the design of a package burner with real-time fuel-switching capability (from biogas to natural gas to propane) that will be adaptable and scalable to heating and power equipment of all sizes.
- Demonstrate an advanced, pre-commercial package burner for a 1.99 MMBtu/hr boiler that responds, in real-time, to biogas fuel-stock and propane.

# ENERGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION GRANTS

## Exhibit A SCOPE OF WORK

PIR-13-011, Lawrence Berkeley National Laboratory

### III. TASK 1 PROJECT ADMINISTRATION

#### **PRODUCTS**

##### **Subtask 1.1 Products**

The goal of this subtask is to establish the requirements for submitting project products (e.g., reports, summaries, plans, and presentation materials). Unless otherwise specified by the Commission Agreement Manager (CAM), the Recipient must deliver products as required below by the dates listed in the **Project Schedule (Part V)**. Products that require a draft version are indicated by marking “**(draft and final)**” after the product name in the “Products” section of the task/subtask. If “(draft and final)” does not appear after the product name, only a final version of the product is required. With respect to due dates within this Scope of Work, “**days**” means working days.

##### **The Recipient shall:**

###### For products that require a draft version

- Submit all draft products to the CAM for review and comment in accordance with the Project Schedule (Part V). The CAM will provide written comments to the Recipient on the draft product within 15 days of receipt, unless otherwise specified in the task/subtask for which the product is required.
- Submit the final product to the CAM once agreement has been reached on the draft. The CAM will provide written approval of the final product within 15 days of receipt, unless otherwise specified in the task/subtask for which the product is required.
- If the CAM determines that the final product does not sufficiently incorporate his/her comments, submit the revised product to the CAM within 10 days of notice by the CAM, unless the CAM specifies a longer time period.

###### For products that require a final version only

- Submit the product to the CAM for approval.
- If the CAM determines that the product requires revision, submit the revised product to the CAM within 10 days of notice by the CAM, unless the CAM specifies a longer time period.

###### For all products

- Submit all data and documents required as products in accordance with the following Instructions for Submitting Electronic Files and Developing Software:

- **Electronic File Format**

# ENERGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION GRANTS

## Exhibit A SCOPE OF WORK

PIR-13-011, Lawrence Berkeley National Laboratory

Submit all data and documents required as products under this Agreement in an electronic file format that is fully editable and compatible with the Energy Commission's software and Microsoft (MS)-operating computing platforms, or with any other format approved by the CAM. Deliver an electronic copy of the full text of any Agreement data and documents in a format specified by the CAM, such as memory stick or CD-ROM.

The following describes the accepted formats for electronic data and documents provided to the Energy Commission as products under this Agreement, and establishes the software versions that will be required to review and approve all software products:

- Data sets will be in MS Excel file format (version 2007 or later), or any other format approved by the CAM.
  - Text documents will be in MS Word file format, version 2007 or later.
  - Documents intended for public distribution will be in PDF file format. The Recipient must also provide the native Microsoft file format.
  - Project management documents will be in Microsoft Project file format, version 2007 or later.
- 
- **Software Application Development**

Use the following standard Application Architecture components in compatible versions for any software application development required by this Agreement (e.g., databases, models, modeling tools), unless the CAM approves other software applications such as open source programs:

    - Microsoft ASP.NET framework (version 3.5 and up). Recommend 4.0.
    - Microsoft Internet Information Services (IIS), (version 6 and up) Recommend 7.5.
    - Visual Studio.NET (version 2008 and up). Recommend 2010.
    - C# Programming Language with Presentation (UI), Business Object and Data Layers.
    - SQL (Structured Query Language).
    - Microsoft SQL Server 2008, Stored Procedures. Recommend 2008 R2.
    - Microsoft SQL Reporting Services. Recommend 2008 R2.
    - XML (external interfaces).

*Any exceptions to the Electronic File Format requirements above must be approved in writing by the CAM. The CAM will consult with the Energy Commission's Information Technology Services Branch to determine whether the exceptions are allowable.*

# ENERGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION GRANTS

## Exhibit A SCOPE OF WORK

PIR-13-011, Lawrence Berkeley National Laboratory

### MEETINGS

#### Subtask 1.2 Kick-off Meeting

The goal of this subtask is to establish the lines of communication and procedures for implementing this Agreement.

#### The Recipient shall:

- Attend a “Kick-off” meeting with the CAM, the Commission Agreement Officer (CAO), and any other Energy Commission staff relevant to the Agreement. The Recipient will bring its Project Manager and any other individuals designated by the CAM to this meeting. The administrative and technical aspects of the Agreement will be discussed at the meeting. Prior to the meeting, the CAM will provide an agenda to all potential meeting participants. The meeting may take place in person or by electronic conferencing (e.g., WebEx), with approval of the CAM.

The administrative portion of the meeting will include discussion of the following:

- Terms and conditions of the Agreement;
- Administrative products (subtask 1.1);
- CPR meetings (subtask 1.3);
- Match fund documentation (subtask 1.7);
- Permit documentation (subtask 1.8);
- Subcontracts (subtask 1.9); and
- Any other relevant topics.

The technical portion of the meeting will include discussion of the following:

- The CAM's expectations for accomplishing tasks described in the Scope of Work;
  - An updated Project Schedule;
  - Technical products (subtask 1.1);
  - Progress reports and invoices (subtask 1.5);
  - Final Report (subtask 1.6);
  - Technical Advisory Committee meetings (subtasks 1.10 and 1.11); and
  - Any other relevant topics.
- Provide an *Updated Project Schedule, List of Match Funds, and List of Permits*, as needed to reflect any changes in the documents.

#### The CAM shall:

- Designate the date and location of the meeting.
- Send the Recipient a *Kick-off Meeting Agenda*.

# ENERGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION GRANTS

## Exhibit A SCOPE OF WORK

PIR-13-011, Lawrence Berkeley National Laboratory

### Recipient Products:

- Updated Project Schedule (*if applicable*)
- Updated List of Match Funds (*if applicable*)
- Updated List of Permits (*if applicable*)

### CAM Product:

- Kick-off Meeting Agenda

### Subtask 1.3 Critical Project Review (CPR) Meetings

The goal of this subtask is to determine if the project should continue to receive Energy Commission funding, and if so whether any modifications must be made to the tasks, products, schedule, or budget. CPR meetings provide the opportunity for frank discussions between the Energy Commission and the Recipient. As determined by the CAM, discussions may include project status, challenges, successes, advisory group findings and recommendations, final report preparation, and progress on technical transfer and production readiness activities (if applicable). Participants will include the CAM and the Recipient, and may include the CAO and any other individuals selected by the CAM to provide support to the Energy Commission.

CPR meetings generally take place at key, predetermined points in the Agreement, as determined by the CAM and as shown in the Task List on page 1 of this Exhibit. However, the CAM may schedule additional CPR meetings as necessary. The budget will be reallocated to cover the additional costs borne by the Recipient, but the overall Agreement amount will not increase. CPR meetings generally take place at the Energy Commission, but they may take place at another location, or may be conducted via electronic conferencing (e.g., WebEx) as determined by the CAM.

### The Recipient shall:

- Prepare a *CPR Report* for each CPR meeting that: (1) discusses the progress of the Agreement toward achieving its goals and objectives; and (2) includes recommendations and conclusions regarding continued work on the project.
- Submit the CPR Report along with any other *Task Products* that correspond to the technical task for which the CPR meeting is required (i.e., if a CPR meeting is required for Task 2, submit the Task 2 products along with the CPR Report).
- Attend the CPR meeting.
- Present the CPR Report and any other required information at each CPR meeting.

### The CAM shall:

- Determine the location, date, and time of each CPR meeting with the Recipient's input.

# ENERGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION GRANTS

## Exhibit A SCOPE OF WORK

PIR-13-011, Lawrence Berkeley National Laboratory

- Send the Recipient a *CPR Agenda* and a *List of Expected CPR Participants* in advance of the CPR meeting. If applicable, the agenda will include a discussion of match funding and permits.
- Conduct and make a record of each CPR meeting. Provide the Recipient with a *Schedule for Providing a Progress Determination* on continuation of the project.
- Determine whether to continue the project, and if so whether modifications are needed to the tasks, schedule, products, or budget for the remainder of the Agreement. If the CAM concludes that satisfactory progress is not being made, this conclusion will be referred to the Deputy Director of the Energy Research and Development Division.
- Provide the Recipient with a *Progress Determination* on continuation of the project, in accordance with the schedule. The Progress Determination may include a requirement that the Recipient revise one or more products.

### Recipient Products:

- CPR Report(s)
- Task Products (draft and/or final as specified in the task)

### CAM Products:

- CPR Agenda
- List of Expected CPR Participants
- Schedule for Providing a Progress Determination
- Progress Determination

### Subtask 1.4 Final Meeting

The goal of this subtask is to complete the closeout of this Agreement.

### The Recipient shall:

- Meet with Energy Commission staff to present project findings, conclusions, and recommendations. The final meeting must be completed during the closeout of this Agreement. This meeting will be attended by the Recipient and CAM, at a minimum. The meeting may occur in person or by electronic conferencing (e.g., WebEx), with approval of the CAM.

The technical and administrative aspects of Agreement closeout will be discussed at the meeting, which may be divided into two separate meetings at the CAM's discretion.

- The technical portion of the meeting will involve the presentation of findings, conclusions, and recommended next steps (if any) for the Agreement. The CAM will determine the appropriate meeting participants.
- The administrative portion of the meeting will involve a discussion with the CAM and the CAO of the following Agreement closeout items:
  - Disposition of any state-owned equipment.

# ENERGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION GRANTS

## Exhibit A SCOPE OF WORK

PIR-13-011, Lawrence Berkeley National Laboratory

- Need to file a Uniform Commercial Code Financing Statement (Form UCC-1) regarding the Energy Commission's interest in patented technology.
  - The Energy Commission's request for specific "generated" data (not already provided in Agreement products).
  - Need to document the Recipient's disclosure of "subject inventions" developed under the Agreement.
  - "Surviving" Agreement provisions such as repayment provisions and confidential products.
  - Final invoicing and release of retention.
- 
- Prepare a *Final Meeting Agreement Summary* that documents any agreement made between the Recipient and Commission staff during the meeting.
  - Prepare a *Schedule for Completing Agreement Closeout Activities*.
  - Provide *All Draft and Final Written Products* on a CD-ROM or USB memory stick, organized by the tasks in the Agreement.

### Products:

- Final Meeting Agreement Summary (*if applicable*)
- Schedule for Completing Agreement Closeout Activities
- All Draft and Final Written Products

## REPORTS AND INVOICES

### Subtask 1.5 Progress Reports and Invoices

The goals of this subtask are to: (1) periodically verify that satisfactory and continued progress is made towards achieving the research objectives of this Agreement; and (2) ensure that invoices contain all required information and are submitted in the appropriate format.

### The Recipient shall:

- Submit a monthly *Progress Report* to the CAM. Each progress report must:
  - Summarize all Agreement activities conducted by the Recipient for the preceding month, including an assessment of the ability to complete the Agreement within the current budget and any anticipated cost overruns. See the Progress Report Format Attachment for the recommended specifications.
  - Provide a synopsis of the project progress, including accomplishments, problems, milestones, products, schedule, fiscal status, and any evidence of progress such as photographs.
- Submit a monthly or quarterly *Invoice* that follows the instructions in the terms and conditions. In addition, each invoice must document and verify:

# ENERGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION GRANTS

## Exhibit A SCOPE OF WORK

PIR-13-011, Lawrence Berkeley National Laboratory

- Energy Commission funds received by California-based entities;
- Energy Commission funds spent in California (*if applicable*); and
- Match fund expenditures.

### Products:

- Progress Reports
- Invoices

### Subtask 1.6 Final Report

The goal of this subtask is to prepare a comprehensive Final Report that describes the original purpose, approach, results, and conclusions of the work performed under this Agreement. The CAM will review and approve the Final Report, which will be due at least **two months** before the Agreement end date. When creating the Final Report Outline and the Final Report, the Recipient must use a Style Manual provided by the CAM.

### Subtask 1.6.1 Final Report Outline

#### The Recipient shall:

- Prepare a *Final Report Outline* in accordance with the *Style Manual* provided by the CAM.
- Submit a draft of the outline to the CAM for review and comment.
- Once agreement has been reached on the draft, submit the final outline to the CAM. The CAM will provide written approval of the final outline within 10 days of receipt.

#### Recipient Products:

- Final Report Outline (draft and final)

#### CAM Product:

- Style Manual

### Subtask 1.6.2 Final Report

#### The Recipient shall:

- Prepare a *Final Report* for this Agreement in accordance with the approved Final Report Outline and the Style Manual provided by the CAM.
- Submit a draft of the report to the CAM for review and comment. Once agreement on the draft report has been reached, the CAM will forward the electronic version for Energy Commission internal approval. Once the CAM receives approval, he/she will provide written approval to the Recipient.
- Submit one bound copy of the Final Report to the CAM.

# ENERGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION GRANTS

## Exhibit A

### SCOPE OF WORK

PIR-13-011, Lawrence Berkeley National Laboratory

#### Products:

- Final Report (draft and final)

### **MATCH FUNDS, PERMITS, AND SUBCONTRACTS**

#### **Subtask 1.7 Match Funds**

The goal of this subtask is to ensure that the Recipient obtains any match funds planned for this Agreement and applies them to the Agreement during the Agreement term.

While the costs to obtain and document match funds are not reimbursable under this Agreement, the Recipient may spend match funds for this task. The Recipient may only spend match funds during the Agreement term, either concurrently or prior to the use of Energy Commission funds. Match funds must be identified in writing, and the Recipient must obtain any associated commitments before incurring any costs for which the Recipient will request reimbursement.

#### **The Recipient shall:**

- Prepare a *Match Funds Status Letter* that documents the match funds committed to this Agreement. If no match funds were part of the proposal that led to the Energy Commission awarding this Agreement and none have been identified at the time this Agreement starts, then state this in the letter.

If match funds were a part of the proposal that led to the Energy Commission awarding this Agreement, then provide in the letter:

- A list of the match funds that identifies:
  - The amount of cash match funds, their source(s) (including a contact name, address, and telephone number), and the task(s) to which the match funds will be applied.
  - The amount of each in-kind contribution, a description of the contribution type (e.g., property, services), the documented market or book value, the source (including a contact name, address, and telephone number), and the task(s) to which the match funds will be applied. If the in-kind contribution is equipment or other tangible or real property, the Recipient must identify its owner and provide a contact name, address, telephone number, and the address where the property is located.
- A copy of a letter of commitment from an authorized representative of each source of match funding that the funds or contributions have been secured.
- At the Kick-off meeting, discuss match funds and the impact on the project if they are significantly reduced or not obtained as committed. If applicable, match funds

# ENERGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION GRANTS

## Exhibit A SCOPE OF WORK

PIR-13-011, Lawrence Berkeley National Laboratory

will be included as a line item in the progress reports and will be a topic at CPR meetings.

- Provide a *Supplemental Match Funds Notification Letter* to the CAM of receipt of additional match funds.
- Provide a *Match Funds Reduction Notification Letter* to the CAM if existing match funds are reduced during the course of the Agreement. Reduction of match funds may trigger a CPR meeting.

### Products:

- Match Funds Status Letter
- Supplemental Match Funds Notification Letter (*if applicable*)
- Match Funds Reduction Notification Letter (*if applicable*)

### Subtask 1.8 Permits

The goal of this subtask is to obtain all permits required for work completed under this Agreement in advance of the date they are needed to keep the Agreement schedule on track. Permit costs and the expenses associated with obtaining permits are reimbursable under this Agreement. Permits must be identified and obtained before the Recipient may incur any costs related to the use of the permit(s) for which the Recipient will request reimbursement.

### The Recipient shall:

- Prepare a *Permit Status Letter* that documents the permits required to conduct this Agreement. If no permits are required at the start of this Agreement, then state this in the letter. If permits will be required during the course of the Agreement, provide in the letter:
  - A list of the permits that identifies: (1) the type of permit; and (2) the name, address, and telephone number of the permitting jurisdictions or lead agencies.
  - The schedule the Recipient will follow in applying for and obtaining the permits.

The list of permits and the schedule for obtaining them will be discussed at the Kick-off meeting (subtask 1.2), and a timetable for submitting the updated list, schedule, and copies of the permits will be developed. The impact on the project if the permits are not obtained in a timely fashion or are denied will also be discussed. If applicable, permits will be included as a line item in progress reports and will be a topic at CPR meetings.

- If during the course of the Agreement additional permits become necessary, then provide the CAM with an *Updated List of Permits* (including the appropriate information on each permit) and an *Updated Schedule for Acquiring Permits*.
- Send the CAM a *Copy of Each Approved Permit*.

# ENERGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION GRANTS

## Exhibit A SCOPE OF WORK

PIR-13-011, Lawrence Berkeley National Laboratory

- If during the course of the Agreement permits are not obtained on time or are denied, notify the CAM within 5 days. Either of these events may trigger a CPR meeting.

### Products:

- Permit Status Letter
- Updated List of Permits (*if applicable*)
- Updated Schedule for Acquiring Permits (*if applicable*)
- Copy of each Approved Permit (*if applicable*)

### Subtask 1.9 Subcontracts

The goals of this subtask are to: (1) procure subcontracts required to carry out the tasks under this Agreement; and (2) ensure that the subcontracts or agreements are consistent with the terms and conditions of this Agreement.

### The Recipient shall:

- Manage and coordinate subcontractor activities in accordance with the requirements of this Agreement.
- Incorporate this Agreement by reference into each subcontract.
- Include any required Energy Commission flow-down provisions in each subcontract, in addition to a statement that the terms of this Agreement will prevail if they conflict with the subcontract terms.
- If required by the CAM, submit a draft of each *Subcontract* required to conduct the work under this Agreement.
- Submit a final copy of the executed subcontract or agreement.
- Notify and receive written approval from the CAM prior to adding any new subcontractors (see the discussion of subcontractor additions in the terms and conditions).

### Products:

- Subcontracts or agreement(s) (*draft if required by the CAM*)

## TECHNICAL ADVISORY COMMITTEE

### Subtask 1.10 Technical Advisory Committee (TAC)

The goal of this subtask is to create an advisory committee for this Agreement. The TAC should be composed of diverse professionals. The composition will vary depending on interest, availability, and need. TAC members will serve at the CAM's discretion. The purpose of the TAC is to:

# ENERGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION GRANTS

## Exhibit A SCOPE OF WORK

PIR-13-011, Lawrence Berkeley National Laboratory

- Provide guidance in research direction. The guidance may include research scope and methodologies, timing, and coordination with other research. The guidance may be based on:
  - Technical area expertise;
  - Knowledge of market applications; or
  - Linkages between the agreement work and other past, present, or future research (both public and private sectors) that TAC members are aware of in a particular area.
- Review products and provide recommendations for needed product adjustments, refinements, or enhancements.
- Evaluate the tangible benefits of project research to the state of California, and provide recommendations as needed to enhance the benefits.
- Provide recommendations regarding information dissemination, market pathways, or commercialization strategies relevant to the research products.

The TAC may be composed of qualified professionals spanning the following types of disciplines:

- Researchers knowledgeable about the project subject matter;
- Members of trades that will apply the results of the project (e.g., designers, engineers, architects, contractors, and trade representatives);
- Public interest market transformation implementers;
- Product developers relevant to the project;
- U.S. Department of Energy research managers, or experts from other federal or state agencies relevant to the project;
- Public interest environmental groups;
- Utility representatives;
- Air district staff; and
- Members of relevant technical society committees.

### **The Recipient shall:**

- Prepare a *List of Potential TAC Members* that includes the names, companies, physical and electronic addresses, and phone numbers of potential members. The list will be discussed at the Kick-off meeting, and a schedule for recruiting members and holding the first TAC meeting will be developed.
- Recruit TAC members. Ensure that each individual understands member obligations and the TAC meeting schedule developed in subtask 1.11.
- Prepare a *List of TAC Members* once all TAC members have committed to serving on the TAC.
- Submit *Documentation of TAC Member Commitment* (such as Letters of Acceptance) from each TAC member.

# ENERGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION GRANTS

## Exhibit A SCOPE OF WORK

PIR-13-011, Lawrence Berkeley National Laboratory

### Products:

- List of Potential TAC Members
- List of TAC Members
- Documentation of TAC Member Commitment

### Subtask 1.11 TAC Meetings

The goal of this subtask is for the TAC to provide strategic guidance for the project by participating in regular meetings, which may be held via teleconference.

### The Recipient shall:

- Discuss the TAC meeting schedule with the CAM at the Kick-off meeting. Determine the number and location of meetings (in-person and via teleconference) in consultation with the CAM.
- Prepare a *TAC Meeting Schedule* that will be presented to the TAC members during recruiting. Revise the schedule after the first TAC meeting to incorporate meeting comments.
- Prepare a *TAC Meeting Agenda* and *TAC Meeting Back-up Materials* for each TAC meeting.
- Organize and lead TAC meetings in accordance with the TAC Meeting Schedule. Changes to the schedule must be pre-approved in writing by the CAM.
- Prepare *TAC Meeting Summaries* that include any recommended resolutions of major TAC issues.

### Products:

- TAC Meeting Schedule (draft and final)
- TAC Meeting Agendas (draft and final)
- TAC Meeting Back-up Materials
- TAC Meeting Summaries

## IV. TECHNICAL TASKS

*Products that require a draft version are indicated by marking “(draft and final)” after the product name in the “Products” section of the task/subtask. If “(draft and final)” does not appear after the product name, only a final version of the product is required.*

**Subtask 1.1 (Products)** describes the procedure for submitting products to the CAM.

### TASK 2 Agreement Execution

The goals of this task are to: (1) confirm the availability of the project demonstration site and a measurement and verification (M&V) agent; and (2) execute any agreements necessary to secure the demonstration site and M&V agent.

# ENERGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION GRANTS

## Exhibit A

### SCOPE OF WORK

PIR-13-011, Lawrence Berkeley National Laboratory

#### Subtask 2.1 Execute an Agreement with the Selected Demonstration Site

##### The Recipient shall:

- Reach agreement with the manager(s) of the selected demonstration site regarding the project timeline, space reserved for the project, equipment installation, permit and insurance requirements, indemnity, and the Recipient's use of any support staff
- If the selected demonstration site becomes unavailable during the project term, work with the CAM to select a new site
- Execute an *Agreement with the Selected Demonstration Site* that confirms the arrangement reached above on the Recipient's use of the site

##### Products:

- Copy of Agreement with the Selected Demonstration Site

#### Subtask 2.2 Execute an Agreement with the Selected M&V Agent

##### The Recipient shall:

- Confirm the selected M&V agent's ability to provide required hardware, software, and staff to conduct the required measurements during the project term
- Confirm that the selected M&V agent will follow utility M&V protocols, and will prepare a detailed analytical report that verifies energy consumption and engineering calculations for energy and cost savings
- If the selected M&V agent becomes unavailable during the project term, the Recipient will work with the CAM to select a new contractor
- Execute an *Agreement with the M&V Agent* that secures the agent's services during the project term and confirms that the agent will follow M&V protocol and prepare the detailed analytical report

##### Products:

- Copy of Agreement with the M&V Agent

#### TASK 3 Development of demonstration plan and metrics

The goals of this task are to:

- Develop a demonstration plan, and define the targets to be achieved by the demonstration and the metrics for measuring the achievements
- Design the overall layout of the system to be installed in the boiler at Chiquita Water Reclamation Plant (CWRP) or other demonstration site with approval from the CAM. The components of the system are: (1) the burner package; (2) an air blower that delivers air to the burner package; (3) a fuel-supply circuit to the burner package; and (4) fuel and air flow controllers connected to a computer processing unit (CPU)

# ENERGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION GRANTS

## Exhibit A SCOPE OF WORK

PIR-13-011, Lawrence Berkeley National Laboratory

### The Recipient shall:

- Meet at the demonstration site to review the floor plan of the boiler room and its infrastructures
- Obtain from the demonstration site the operation profile of the boiler
- Prepare a *Flow Diagram and Site Layout* for the demonstration based on the dimensions of the burner package and the placements of air blower, fuel lines, and fuel-sensor
- Determine the type of hardware to control air and fuel flows
- Use information from the demonstration site to define the operational parameters for the demonstration, including: the operation conditions (i.e. total heat output and turndown) and the scope of the demonstration, including the number of hours of operation on each fuel and the frequency and change rate from one fuel to another
- Define metrics for the demonstration, including:
  - system efficiencies for different fuels and loads
  - system reliability (light-off and shutdown)
  - pollutant emission requirements needed to meet South Coast Air Quality Management District (SCAQMD) Rule 1146.2 and other air regulations
- Prepare a *Demonstration Plan Report* that includes but is not limited to engineering and administrative details, and a definition of the metrics for the demonstration

### Products:

- Flow Diagram and Site Layout
- Demonstration Plan Report

### TASK 4 Engineering design of package burner

The first goal of this task is to develop a package burner that consists of: (1) the burner nozzle with the swirler; (2) a fuel circuit supplying a set of fuel injectors; and (3) a windbox that supplies a uniform flow of air to the burner head. The second goal is to construct a 1/5 scale prototype and verify the design by evaluating it at LBNL.

### The Recipient shall:

- Select the swirler to be used as the burner nozzle
- Design the fuel/air premixing system
- Select an ignition mechanism
- Design a flame quarl to optimize flame impingement in a boiler combustor, and describe this in a *Package Burner Development Report*
- Fabricate a 1/5 scale (400 KBtu/hr) LSB nozzle with quarl (sized for a UCI boiler simulator with glass windows)
- Develop software to control the fuel/air ratio for laboratory testing
- Obtain baseline performance of the LSB nozzle through the use of simulated biogas and natural gas

# ENERGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION GRANTS

## Exhibit A

### SCOPE OF WORK

PIR-13-011, Lawrence Berkeley National Laboratory

- Evaluate the LSB nozzle with various fuel-injectors, premixer, and windbox
  - Measure the flame flow field of the LSB nozzle to verify design integrity
  - Measure the effects of fuel injectors, premixer, and windbox on LSB nozzle performance
  - Describe the evaluation results of the LSB nozzle and the additional components noted above in the Package Burner Development Report
- Document test results in the Package Burner Development Report to include:
  - Recommendations for improvements when fabricating the full-scale package burner, including flame quarl optimization
  - Description of the engineering design of a 1/5 scale package burner, including flame quarl optimization
  - Description of software development to control for fuel-to-air ratio
  - Results of the LSB nozzle evaluation of performance with various fuel injectors, pre-mixer, and windbox

#### Products:

- Package Burner Development Report

#### **TASK 5 Expansion of fuel sensor capability for fuel-switching operation**

The goals of this task are to expand the capability of the speed-of-sound fuel sensor to detect the changing fuel compositions and to develop a fully-functional sensor for deployment in the demonstration unit.

#### The Recipient shall:

- Determine the range of fuels to be included in the new sensor
- Calibrate the sensor to detect the fuel composition, and evaluate the fuel sensor for its sensitivity response time and accuracy
- Report the laboratory test results on the fuel sensor
- Refine the design of the sensor, if needed
- Scale the sensor to the size needed for the boiler
- Construct a full-size sensor for the demonstration unit
- Verify the performance of the full-size sensor in a laboratory setting
- Design and fabricate the fully-functioning fuel sensor
- Install a sensor at the demonstration site to monitor changes in biogas content.
- Prepare a *Fuel Sensor Package Report* describing its design (i.e., development process and schematics), verification processes (laboratory test procedures and results), and installation at the demonstration site

#### Products:

- Fuel Sensor Package Report

# ENERGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION GRANTS

## Exhibit A SCOPE OF WORK

PIR-13-011, Lawrence Berkeley National Laboratory

### **TASK 6 Control logic and software to enable real-time fuel switching**

The goal of this task is to develop control logic and software that use the feedback of the fuel sensor to calculate the fuel-to-air ratio for achieving the desired flame temperature in the boiler.

#### **The Recipient shall:**

- Calculate the adiabatic flame temperatures for the fuel types and fuel/air ratios consistent with those at the demonstration site boiler
- Develop a *Fuel-Loading Map Diagram* for boiler temperature set points
- Incorporate the fuel-loading map diagram into the LBNL burner evaluation test facility
- Test the fuel-loading map with 1/5 scale package burner at LBNL
  - Characterize the flame response to real time fuel switching
  - Determine rate limiting control equipment to establish the control response
- Characterize the current demonstration site boiler control protocol
- Develop a *Description of the Control Software for 1/5 Scale Prototype Burner Package* for Task 8, including the basic logics and algorithm structure
- Determine an approach to incorporate a fuel-loading map into the demonstration site boiler control protocol
- Prepare an *Electronic Hardware Recommendations for Demonstration Site Boiler Report* that includes a discussion of the SPU electronic hardware requirements and other recommendations for the demonstration site (e.g. CPU, Input/Output)
- Incorporate the fuel-loading map into the demonstration site boiler control protocol

#### **Products:**

- Fuel-Loading Map Diagram
- Description of Control Software for 1/5 Scale Prototype
- Electronic Hardware Recommendations for CWRP Demonstration Site Boiler Report

### **TASK 7 Design verification through reduce scale prototype testing**

The goals of this task are to construct a fully functional, reduced 1/5 scale prototype and to verify its performance at the boiler testing facility for finalizing the engineering of the full-scale demonstration unit.

#### **Task 7.1 LBNL verification**

#### **The Recipient shall:**

- Purchase flow controls to match those of the demonstration site boiler
- Integrate a UCI fuel sensor with fuel controllers and software
- Fabricate a 1/5 scale package burner

# ENERGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION GRANTS

## Exhibit A SCOPE OF WORK

PIR-13-011, Lawrence Berkeley National Laboratory

- Conduct a test at LBNL without boiler enclosure to verify integrated system operability and obtain baseline performance
- Identify and resolve hardware and software operational issues
- Prepare a *1/5 Scale Package Burner LBNL test Report* describing the test results
- Ship the 1/5 scale prototype to UCI
- Participate in a 1/5 scale prototype evaluation at UCI
- Analyze the results from UCI, and prepare an *Engineering Guideline* for scaling and developing a fuel-switchable package burner for industrial applications. The Engineering Guideline must include a discussion of the scale-up requirements of the fuel-switchable package with LSB for commercial and industrial installations for heating and power
- With UCI, finalize and provide *Memo on the Design Specifications of the Full-Scale Unit* that includes design parameters and hardware specification

### Products:

- 1/5 Scale Package Burner LBNL Test Report
- Engineering Guideline
- Memo on the Design Specifications of the Full-Scale Unit

### Task 7.2 UCI verification

#### The Recipient shall:

- Install the 1/5 scale unit in the existing enclosed 400 MBTU/hr boiler test facility
- Develop a Test Plan for verification testing
- Conduct tests at UCI following the Test Plan, including:
  - Measure flame stability characteristics for various fuel compositions and loads, and emissions performance for various fuel compositions
  - Demonstrate closed loop performance with fuel composition change from natural gas or propane to biogas
- Identify and resolve hardware and software operation issues
- Prepare a *1/5 Scale Package Burner UCI Test Report* that describes the performance of the 1/5 scale packaged burner and discusses the test plan and results, such as light-off, loading, fuel-switching, and emissions in a simulated boiler environment at UCI and identification of resolutions of hardware and software issues

### Products:

- 1/5 Scale Package Burner UCI Test Report

### TASK 8 Construction of Full-Scale Demonstration Unit

The goal of this task is to construct a full-scale package burner for demonstration.

# ENERGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION GRANTS

## Exhibit A SCOPE OF WORK

PIR-13-011, Lawrence Berkeley National Laboratory

### The Recipient shall:

- Use the design specification from Task 7 to develop a full-scale burner to meet:
  - System configurations established at a tested, scaled level
  - Mechanical interface specifications and configurations to match the demonstration site boiler.
  - Electrical/control interface consistent with the demonstration site boiler and system control.
- Conduct design interface review with the demonstration site to confirm interface and controls
- Fabricate full-scale burner
- Procure necessary ancillary system hardware and components
- Prepare a *Letter of Completion for Full-Scale Burner*

### Products:

- Letter of Completion for Full-Scale Burner

### TASK 9 Site preparation and burner integration at Demonstration Site

The goals of this task are to: (1) prepare the demonstration site; and (2) install the burner.

### The Recipient shall:

- Work with the demonstration site to remove the existing burner
- Install the fabricated LSB system (burner and ancillary controls)
- Interface with boiler fuel lines
- Modify fuel lines (ADG and site propane) to permit the use of controlled blending as part of the demonstration of fuel flexibility
- Confirm the operation of systems at no-fire condition
- Prepare a *Full-Scale Burner Evaluation Plan* that discusses the installation of the LSB system at the demonstration site and fuel line modification at operation at no-fire conditions
- Write a *Letter of Readiness for Full-Scale Host Site Testing*

### Products:

- Full-Scale Burner Evaluation Plan
- Letter of Readiness for Full-Scale Host Site Testing

### TASK 10 Demonstration of Real-time Fuel Switching

The goal of this task is to evaluate and verify the performance of the full-scale package burner for real-time switching from biogas to propane and/or natural gas.

# ENERGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION GRANTS

## Exhibit A SCOPE OF WORK

PIR-13-011, Lawrence Berkeley National Laboratory

### The Recipient shall:

- Operate the burner focusing on ADG operation with intermittent fuel composition variations (provided by mixing propane with the ADG)
- Prepare an *Intermediate Full-Scale Burner Performance Report* that describes the initial results from the tests as defined in the Test Plan and any adjustments and/or modifications to the system and/or burner
- Continue to operate the burner for a period that will be determined by the CAM and Recipient, to assess long-term operation as defined by the test plan; repeat fuel variation tests at random intervals to assess system response and long-term operational durability
- Oversee independent monitoring and evaluation by M&V Agent on the burner performance in terms of fuel switching from ADG to propane and/or natural gas and resultant pollutant emissions from the fuels
- Prepare a *Long-Term Full-Scale Burner Performance Report* upon completion of field testing that includes a discussion of results from the test plan, independent monitoring and evaluation of pollutant emissions from the fuels, and a discussion of aspects of the full-scale package burner that meet, exceed, or fail performance expectations

### Products:

- Intermediate Full-Scale Burner Performance Report
- Long-Term Full-Scale Burner Performance Report

### TASK 11 Evaluation of Project Benefits

The goal of this task is to report the benefits resulting from this project.

### The Recipient shall:

- Complete three Project Benefits Questionnaires that correspond to three main intervals in the Agreement: (1) *Kick-off Meeting Benefits Questionnaire*; (2) *Mid-term Benefits Questionnaire*; and (3) *Final Meeting Benefits Questionnaire*.
- Provide all key assumptions used to estimate projected benefits, including targeted market sector (e.g., population and geographic location), projected market penetration, baseline and projected energy use and cost, operating conditions, and emission reduction calculations. Examples of information that may be requested in the questionnaires include:
  - For Product Development Projects and Project Demonstrations:
    - Published documents, including date, title, and periodical name.
    - Estimated or actual energy and cost savings, and estimated statewide energy savings once market potential has been realized. Identify all assumptions used in the estimates.
    - Greenhouse gas and criteria emissions reductions.

# ENERGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION GRANTS

## Exhibit A

### SCOPE OF WORK

PIR-13-011, Lawrence Berkeley National Laboratory

- Other non-energy benefits such as reliability, public safety, lower operational cost, environmental improvement, indoor environmental quality, and societal benefits.
- Data on potential job creation, market potential, economic development, and increased state revenue as a result of the project.
- A discussion of research product downloads from websites, and publications in technical journals.
- A comparison of project expectations and performance. Discuss whether the goals and objectives of the Agreement have been met and what improvements are needed, if any.
- Additional Information for Product Development Projects:
  - Outcome of product development efforts, such copyrights and license agreements.
  - Units sold or projected to be sold in and outside of California.
  - Total annual sales or projected annual sales (in dollars) of products developed under the Agreement.
  - Investment dollars/follow-on private funding as a result of Energy Commission funding.
  - Patent numbers and applications, along with dates and brief descriptions.
- Additional Information for Product Demonstrations:
  - Outcome of demonstrations and status of technology.
  - Number of similar installations.
  - Jobs created/retained as a result of the Agreement.
- For Information/Tools and Other Research Studies:
  - Outcome of research.
  - Published documents, including date, title, and periodical name.
  - A discussion of policy development. State if the research has been cited in government policy publications or technical journals, or has been used to inform regulatory bodies.
  - The number of website downloads.
  - An estimate of how the information and research have affected energy use and cost, or have resulted in other non-energy benefits.
  - An estimate of energy and non-energy benefits.
  - Data on potential job creation, market potential, economic development, and increased state revenue as a result of research.

# ENERGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION GRANTS

## Exhibit A SCOPE OF WORK

PIR-13-011, Lawrence Berkeley National Laboratory

- A discussion of research product downloads from websites, and publications in technical journals.
- A comparison of project expectations and performance. Discuss whether the goals and objectives of the Agreement have been met and what improvements are needed, if any.
- Respond to CAM questions regarding responses to the questionnaires.

*The Energy Commission may send the Recipient similar questionnaires after the Agreement term ends. Responses to these questionnaires will be voluntary.*

### Products:

- Kick-off Meeting Benefits Questionnaire
- Mid-term Benefits Questionnaire
- Final Meeting Benefits Questionnaire

### TASK 12 Technology/Knowledge Transfer Activities

The goal of this task is to develop a plan to make the knowledge gained, experimental results, and lessons learned available to the public and key decision makers.

#### The Recipient shall:

- Prepare and provide an *Initial Fact Sheet* at start of the project that describes the project research. Use the format provided by the CAM.
- Prepare and provide a *Final Project Fact Sheet* at the project's conclusion that discusses research results. Use the format provided by the CAM.
- Prepare and provide a *Technology/Knowledge Transfer Plan* that includes:
  - An explanation of how the knowledge gained from the project will be made available to the public, including the targeted market sector and potential outreach to end users, utilities, regulatory agencies, and others.
  - A description of the intended use(s) for and users of the project results.
  - Published documents, including date, title, and periodical name.
  - Copies of documents, fact sheets, journal articles, press releases, and other documents prepared for public dissemination. These documents must include the Legal Notice required in the terms and conditions. Indicate where and when the documents were disseminated.
  - A discussion of policy development. State if research has been or will be cited in government policy publications, or used to inform regulatory bodies.
  - The number of website downloads or public requests for research results.
  - Additional areas as determined by the CAM.
- Conduct technology transfer activities in accordance with the Technology/Knowledge Transfer Plan. These activities will be reported in the Progress Reports.

# ENERGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION GRANTS

## Exhibit A

### SCOPE OF WORK

PIR-13-011, Lawrence Berkeley National Laboratory

- Prepare and provide a *Technology/Knowledge Transfer Report* on technology transfer activities conducted during the project.

#### Products:

- Initial Fact Sheet (draft and final)
- Final Project Fact Sheet (draft and final)
- Technology/Knowledge Transfer Plan (draft and final)
- Technology/Knowledge Transfer Report (draft and final)

#### V. PROJECT SCHEDULE

Please see the attached Excel spreadsheet.

**RESOLUTION NO:**

**STATE OF CALIFORNIA**

**STATE ENERGY RESOURCES  
CONSERVATION AND DEVELOPMENT COMMISSION**

**RESOLUTION - RE: LAWRENCE BERKELEY NATIONAL LABORATORY**

**RESOLVED**, that the State Energy Resources Conservation and Development Commission (Energy Commission) adopts the staff CEQA findings contained in the CEC 94 Contract Request Form or CEC 270 Grant Request Form (as applicable).

**RESOLVED**, that the Energy Commission approves Agreement PIR-13-011 with **Lawrence Berkeley National Laboratory** for \$1,600,000 grant Proposed resolution approving Agreement PIR-13-011 with the Department of Energy's Lawrence Berkeley National Laboratory for a \$1,600,000 grant to demonstrate a pre-commercial combustion system that has real-time fuel switching capability between natural gas, propane and biogas.

**FURTHER BE IT RESOLVED**, that the Executive Director shall execute the same on behalf of the Energy Commission.

**CERTIFICATION**

The undersigned Secretariat to the Commission does hereby certify that the foregoing is a full, true, and correct copy of a Resolution duly and regularly adopted at a meeting of the California Energy Commission held on June 18, 2014.

AYE: [List of Commissioners]

NAY: [List of Commissioners]

ABSENT: [List of Commissioners]

ABSTAIN: [List of Commissioners]

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Harriet Kallemeyn,  
Secretariat