

GRANT REQUEST FORM (GRF)

CEC-270 (Revised 02/13)

CALIFORNIA ENERGY COMMISSION



List all key partners: (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	\$775,064
			\$
			\$
			\$
			\$
			\$
R&D Program Area: EGRO: EA		TOTAL:	\$775,064
Explanation for "Other" selection			
Reimbursement Contract #:		Federal Agreement #:	

Recipient's Administrator/ Officer		Recipient's Project Manager	
Name:	Lisa Zaragoza	Name:	Michael Kleeman
Address:	2001 Ghausi Hall	Address:	2001 Ghausi Hall
City, State, Zip:	Davis, CA 95616	City, State, Zip:	Davis, CA 95616
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Selection Process Used	
<input checked="" type="checkbox"/> Competitive Solicitation	Solicitation #: PON-13-502
<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 checked="" type="checkbox"/> N/A <input 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 _____
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ENERGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION GRANTS

Exhibit A SCOPE OF WORK

[PIR-13-001, Regents of the University of California, Davis]

I. TASK AND ACRONYM/TERM LISTS

A. Task List

Task #	CPR ¹	Task Name
1		Project Administration
2		Sample Fresh and Aged Emissions From On-Site Sources at Biogas Production Facilities
3		Collect Biogas With Different Levels of Scrubbing for Mobile Source and Consumer Appliance Testing
4		Sample Fresh and Aged Emissions From Mobile Sources and Consumer Appliances Operated on Biomethane
5		Biological Characterization of Samples
6		Assay / Chemical Characterization of Samples
7	X	Regional Modeling of Results
8		Evaluation of Project Benefits
9		Technology/Knowledge Transfer Activities

B. Acronym/Term List

Acronym/Term	Meaning
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CPR	Critical Project Review
M&V	Measurement and Verification
PSA	Pressure Swing Adsorption
TAC	Technical Advisory Committee

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

A. Purpose of Agreement

The purpose of this Agreement is to measure biogas / biomethane chemical and biological composition over a range of possible adoption strategies. Population exposure to biogas combustion emissions will be quantified to identify the best strategy for widespread adoption of biogas with minimum air quality impact.

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

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B. Problem/ Solution Statement

Problem

Biogas/biomethane has great potential as a source of renewable energy for California but this fuel often contains compounds not found in natural gas that may vary depending on the feedstock and the degree of purification. Some of the biological organisms and trace chemical compounds found in biogas/biomethane have the potential to adversely impact air quality either in their unburned state or after their combustion products age in the atmosphere. Testing of biogas/biomethane combustion exhaust at atmospherically relevant conditions is difficult and has not been carried out to date.

Solution

The Recipient will measure the biological and chemical composition of biogas/biomethane and biogas/biomethane combustion emissions. Emissions will be diluted to atmospherically relevant concentrations and aged in the dark and in photochemical reaction chambers that simulate atmospheric chemical reactions. Biological and chemical analysis will be performed using state-of-the-science instrumentation available at University of California, Davis. Air quality models that track emissions from select sources through chemical reaction systems will be used to estimate population exposure to biogas/biomethane and their combustion emissions under scenarios for widespread adoption.

C. Goals and Objectives of the Agreement

Agreement Goals

The goal of this Agreement is to:

- Identify biogas/biomethane adoption scenarios with the best outcome for air quality experienced by California residents.

Agreement Objectives

The objectives of this Agreement are to:

- Develop raw gas emissions profiles for biogas/biomethane describing chemical composition and develop combustion emissions profiles for biogas/biomethane describing biological and chemical composition
- Identify toxic components of notable concern for biogas/biomethane
- Predict air quality exposure for California residents under different biogas adoption scenarios.

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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**

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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 Access or 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.

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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*.

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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.

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- 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.

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- 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 Commission funds received by California-based entities;

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- 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.

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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

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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*.

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- 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 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.
- 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 (*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:

- 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;

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- 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.

Products:

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

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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

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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 SAMPLE FRESH AND AGED EMISSIONS FROM ON-SITE SOURCES AT BIOGAS PRODUCTION FACILITIES

The goal of this task is to characterize chemical composition of raw biogas from partner production facilities and chemical and biological composition of combustion emissions before and after the biogas has been aged in an atmospheric reaction chamber.

The Recipient shall:

- Prepare an *Emissions Test Plan* along with the five partner biogas production facilities. This plan shall describe each emissions source, how each sample will be taken and how analysis will be completed.
- Obtain written approval from the CAM for the Emissions Test Plan before starting the plan.
- Collect raw gas samples on appropriate sampling media to support chemical analyses.
- Dilute combustion emissions to atmospherically relevant concentrations using a transportable stack dilution sampling system.
- Age emissions in a dark residence time chamber for approximately 2 minutes to allow for rapid chemical reactions to reach an equilibrium state.
- Collect *Emissions Samples* on appropriate sampling media to support chemical and biological analyses.
- Draw a subset of the aged emissions into a photochemical reaction chamber and subject them to an additional 3 hrs of photochemical aging in a simulated California atmosphere.
- Collect photochemically aged *Emissions Samples* on appropriate sampling media to support chemical and biological analyses.

Products:

- Emissions Test Plan

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TASK 3 COLLECT BIOGAS WITH DIFFERENT LEVELS OF SCRUBBING FOR MOBILE SOURCE AND CONSUMER APPLIANCE TESTING

The goal of this task is to scrub biogas with a pressure swing adsorption (PSA) system to produce biomethane suitable for testing with mobile sources and consumer appliances.

The Recipient shall:

- Scrub a sample of biogas from each of the five production facilities using a PSA system for testing with mobile sources and home appliances.
- Store *Scrubbed Biogas* in compressed natural gas tanks for later testing.

Products:

- None

TASK 4 SAMPLE FRESH AND AGED EMISSIONS FROM MOBILE SOURCES AND CONSUMER APPLIANCES OPERATED ON BIOMETHANE

The goal of this task is to characterize chemical and biological composition of biomethane combustion emissions from mobile sources and consumer appliances before and after the biogas has been aged in an atmospheric reaction chamber.

The Recipient shall:

- Prepare a *Mobile Source Emissions Test Plan* along with the California Air Resources Board describing how each emissions test will be carried out for mobile source testing.
- Prepare a *Consumer Appliances Emissions Test Plan* describing how each emissions test will be carried out for consumer appliances testing.
- Obtain written approval from the CAM for the Emissions Test Plans before starting the plan.
- Combust scrubbed biogas from Task 3 per the test plans in mobile source and appliances.
- Dilute combustion emissions to atmospherically relevant concentrations using a transportable stack dilution sampling system.
- Age emissions in a dark residence time chamber for approximately 2 minutes to allow for rapid chemical reactions to reach an equilibrium state.
- Collect *Emissions Samples* on appropriate sampling media to support chemical and biological analyses.
- Draw a subset of the aged emissions into a photochemical reaction chamber and subject them to an additional 3 hrs of photochemical aging in a simulated California atmosphere.
- Collect photochemically aged *Emissions Samples* on appropriate sampling media to support chemical and biological analyses.

ENERGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION GRANTS

Exhibit A SCOPE OF WORK

[PIR-13-001, Regents of the University of California, Davis]

Products:

- Mobile Source Emissions Test Plan
- Consumer Appliances Emissions Test Plan

TASK 5 BIOLOGICAL CHARACTERIZATION OF SAMPLES

The goal of this task is to characterize four different biological indicator organisms contained in biogas / biomethane and biomethane combustion products.

The Recipient shall:

- Prepare *Biological Testing Standard Operating Procedures* describing each analysis to be carried out for each biological test.
- Analyze samples using *Biological Testing Standard Operating Procedures* to determine their biological content.
- Prepare Composition Report describing biological composition of samples taken from Tasks 2, 3 and 4.

Products:

- Biological Testing Standard Operating Procedures
- Composition Report

TASK 6 ASSAY / CHEMICAL CHARACTERIZATION OF SAMPLES

The goal of this task is to characterize the chemical composition of biogas / biomethane and biomethane combustion products.

The Recipient shall:

- Prepare *Chemical Characterization Standard Operating Procedures* describing each analysis to be carried out for each assay/chemical test.
- Analyze samples using *Chemical Characterization Standard Operating Procedures* to determine their assay results and chemical composition.
- Prepare Results Report describing assay results and chemical composition of samples taken from Tasks 2, 3 and 4.

Products:

- Chemical Characterization Standard Operating Procedures
- Results Report

TASK 7 REGIONAL MODELING OF RESULTS

The goal of this task is to evaluate the impact of the biological and chemical emissions associated with different biogas adoption strategies on regional air quality.

The Recipient shall:

- Participate in a CPR meeting and prepare a CPR Report consistent with Task 1.3.

ENERGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION GRANTS

Exhibit A SCOPE OF WORK

[PIR-13-001, Regents of the University of California, Davis]

- Select a set of up to 3 *Scenarios for Biogas Adoption* in consultation with Energy Commission staff.
- Prepare a summary of selected scenarios for biogas adoption.
- Prepare *Emissions Profiles* for biogas / biomethane combustion from various sources.
- Apply *Emissions Profiles* to standard emissions inventories produced by the California Air Resources Board to generate emissions inventories for an air quality model.
- Predict *Population Exposure* to biogas combustion emissions over a year in a future climate using a regional air quality model.
- Prepare a report describing Emissions Profiles and Population Exposure to biogas combustion products.

Products:

- CPR Report (draft and final)
- Summary of Scenarios
- Emissions Profiles and Population Exposure Report

TASK 8 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.
 - Other non-energy benefits such as reliability, public safety, lower operational cost, environmental improvement, indoor environmental quality, and societal benefits.

ENERGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION GRANTS

Exhibit A SCOPE OF WORK

[PIR-13-001, Regents of the University of California, Davis]

- 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 California 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-13-001, Regents of the University of California, Davis]

- 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 9 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 an *Initial Fact Sheet* at start of the project that describes the project research. Use the format provided by the CAM.
- Prepare a *Final Project Fact Sheet* at the project's conclusion that discusses research results. Use the format provided by the CAM.
- Prepare 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-13-001, Regents of the University of California, Davis]

- Prepare 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.

To: Office of Planning and Research
PO Box 3044, 1400 Tenth Street, Room 222
Sacramento, CA 95812-3044

From: California Energy Commission
1516 Ninth Street, MS-48
Sacramento, CA 95814

Project Title: Air Quality Implications of using Biogas (AQIB) to Replace Natural Gas in California

Project Location - Specific: Expect testing will be at UC Davis, Sacramento BioDigester facility, Yolo Landfill, New Hope Dairy, Van Warmerdan Dairy and El Monte

Project Location - City: Davis, CA Project Location - County: Yolo

Description of Project:

The purpose of this research is to identify biological and chemical hazards found in biogas/biomethane that have the potential to adversely impact air quality either in their unburned state or after their combustion products age in the atmosphere. Biological and chemical composition of biogas/biomethane and biogas/biomethane combustion emissions under atmospherically relevant conditions will be measured. Biogas produced at 5 different facilities will be evaluated: one landfill, two organic waste anaerobic digesters, and 2 dairy anaerobic digesters. The chemical and biological analyses of biogas/biomethane gas and combustion emissions will screen for toxic organic compounds, semi-volatile metals, bacteria, viruses, and fungus that could pose an air quality threat for California residents under some adoption scenarios. The health-effects assay results for biogas/biomethane at different stages of utilization will provide an absolute measure of health impacts and a relative ranking for biogas/biomethane. Emissions will be diluted to atmospherically relevant concentrations and aged in the dark and in photochemical reaction chambers that simulate atmospheric chemical reactions. Biological and chemical analysis will be performed using state-of-the-science instrumentation available at UC Davis. Air quality models that track emissions from select sources through chemical reaction systems will be used to estimate population exposure to biogas/biomethane and their combustion emissions under scenarios for widespread adoption. Biogas adoption strategies that best develop this valuable natural resource while protecting air quality for the residents of California will be identified. This project will provide a wealth of new data that will be used to further evaluate constituents in biogas/biomethane that may be introduced into the natural gas pipeline and pose health risks and establishing health protective limits for those constituents.

Name of Public Agency Approving Project: California Energy Commission

Name of Person or Agency Carrying Out Project: The Regents of the University of California on behalf of the Davis campus

Exempt Status: (check one)

- Ministerial (Sec. 21080(b)(1); 15268);
Declared Emergency (Sec. 21080(b)(3); 15269(a));
Emergency Project (Sec. 21080(b)(4); 15269(b)(c));
[X] Categorical Exemption. State type and section number 14 CCR 15306
Statutory Exemptions. State code number.
Common Sense Exemption. 15061(b)(3)

Reasons why project is exempt:

Class 6 - Basic data collection, research, experimental management, and resource evaluation activities that do not result in major disturbances to an environmental resource.

Lead Agency

Contact Person: Marla Mueller **Area code/Telephone/Ext:** 916-327-1716

If filed by applicant:

1. Attach certified document of exemption finding.
2. Has a Notice of Exemption been filed by the public agency approving the project? Yes No

Signature: _____ **Date:** _____ **Title:** _____

Signed by Lead Agency

Signed by Applicant

Date received for filing at OPR: _____

STATE OF CALIFORNIA

STATE ENERGY RESOURCES
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION - RE: THE REGENTS OF UNIVERSITY OF CALIFORNIA ON BEHALF
OF THE DAVIS CAMPUS

WHEREAS THE REGENTS OF UNIVERSITY OF CALIFORNIA ON BEHALF
OF THE DAVIS CAMPUS seek to enter into Agreement PIR-13-001 with the State
Energy Resources and Development Commission (Energy Commission) in the amount
of **\$775,064**;

WHEREAS the purpose of the Agreement is to identify biological and chemical
hazards found in biogas/biomethane that have the potential to adversely impact air
quality either in their unburned state or after their combustion;

WHEREAS the CEC 270 Grant Request Form contains Energy Commission
staff's findings under the California Environmental Quality Act (CEQA);

RESOLVED, that the Energy Commission adopts the staff CEQA findings
contained in the CEC 270 Grant Request Form.

RESOLVED, that the Energy Commission approves Agreement PIR-13-001 with
THE REGENTS OF UNIVERSITY OF CALIFORNIA ON BEHALF OF THE DAVIS
CAMPUS in the amount of **\$775,064**.

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 May 22, 2014.

AYE: [List of Commissioners]

NAY: [List of Commissioners]

ABSENT: [List of Commissioners]

ABSTAIN: [List of Commissioners]

Harriet Kallemeyn,
Secretariat