

**GRANT REQUEST FORM (GRF)**New Agreement PIR-14-021 (To be completed by CGL Office)

Division	Agreement Manager:	MS-	Phone
ERDD	Kevin Uy	43	916-327-1533

Recipient's Legal Name	Federal ID Number
Mosaic Materials, Inc.	47-1033827

Title of Project
Cost Reduction for Biogas Upgrading via a Low-Pressure Solid-State Amine Scrubber

Term and Amount	Start Date	End Date	Amount
	6/30/2015	12/31/2017	\$ 1,000,000

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

Proposed Business Meeting Date	6/10/2015	<input type="checkbox"/> Consent	<input checked="" type="checkbox"/> Discussion
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Business Meeting Presenter	Kevin Uy	Time Needed:	5 minutes
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Please select one list serve. NaturalGas (NG Research Program)

**Agenda Item Subject and Description**

MOSAIC MATERIALS, INC.. Proposed resolution approving agreement PIR-14-021 with Mosaic Materials, Inc. for a \$1,000,000 grant to develop and demonstrate a solid-state amine scrubbing technology for upgrading biogas to renewable natural gas that provides a significant reduction in capital and operating costs compared to current state-of-the-art aqueous amine scrubbers.



**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":  
 Agreement will not cause direct physical change in the environment or a reasonably foreseeable indirect physical change in the environment because

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 15301, 15303, and 15306  
 Common Sense Exemption. 14 CCR 15061 (b) (3)

Explain reason why Agreement is exempt under the above section:  
 This project will research new materials for upgrading biogas to renewable natural gas by conducting laboratory testing at project location 1 (University of California, Berkeley) and demonstration testing at project location 2 (Inland Empires Utility Agency Regional Water Recycling Plant).

At the first location, laboratory testing will occur at an existing inorganic chemistry laboratory on the University of California, Berkeley campus. No new equipment will need to be installed and no building expansion is necessary. Minor alterations may occur including interior alterations to partitions, plumbing, ventilation, or electrical conveyances. New materials will be synthesized in the laboratory. The materials synthesized will be made in several 100-gram batches (with individual material pieces no larger than a piece of chalk). Testing will consist of running the synthesized materials through a bench-scale gas separation unit approximately the size of a desktop computer. For these reasons, the proposed project will not have a significant effect on the environment and falls under the categorical exemption listed in 14 C.C.R. § 15301.

At the second location, demonstration testing will occur at an existing wastewater treatment plant, the Inland Empires Utilities Agency Regional Water Recycling Plant. Testing will consist of taking a slipstream of biogas and upgrading it to renewable natural gas using the demonstration unit to be installed. This project will involve a minimal amount of construction activity. No grading or trenching will be involved. This project will not create any additional noise, except noise that is typical to construction activities. This project will not increase regional traffic, and no traffic will be disrupted during operation of the project. Minor construction will take place at the water recycling plant, involving installation of a demonstration system which consists of a test unit with a footprint approximately 2' X 2.5' and a control cabinet with a footprint approximately 1.5' X 2'. The system may be placed directly on the ground or it is possible that a small (10' X 10') concrete pad will be poured. This minimal construction is well within the size limits listed in the examples given in 14 C.C.R. § 15303 (e.g., it is less than a single-family residence, duplex, and the 2,500 square feet – or 10,000 square feet in urban areas – for a store, motel, office, restaurant, or similar structure). This project will not induce additional operations of the water recycling plant, and the cleaned biogas produced by the test system will be fed to an existing engine-generator. In other words, no additional environmental impact from the biomethane will be introduced. For these reasons, the project will not have a significant effect on the environment and falls under the categorical exemption listed in 14 C.C.R. § 15303.

The work at both the laboratory facility and demonstration site will involve basic data collection, research, and analysis to determine the efficacy of the synthesized materials in upgrading biogas to biomethane. This work includes computer modeling of the separation process, separation system, and capital and operating costs, characterization testing of the synthesized materials, efficacy of upgrading biogas to renewable natural gas, and analysis of the produced renewable natural gas. For this reason, the project will not have a significant effect on the environment and falls under the categorical exemption listed in 14 C.C.R. § 15306.

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

<b>List all subcontractors (major and minor) and equipment vendors: (attach additional sheets as necessary)</b>	
Legal Company Name:	Budget
University of California, Berkeley	\$ 224,204
Partners in Sustainability Integration, LLC	\$ 133,886
	\$



## Exhibit A Scope of Work

### A. Task List

Task #	CPR <sup>1</sup>	Task Name
1		General Project Tasks
2		Contract Execution
3		Adsorbent Design
4		Sorbent Formulation
5	X	Sorbent Scale-up
6		Process and Techno-economic Modeling
7		Separation Process and Prototype Development
8		Slipstream Testing
9		Evaluation of Project Benefits
10		Technology/Knowledge Transfer Activities
11		Production Readiness Plan

### B. Acronym/Term List

Acronym/Term	Meaning
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CO <sub>2</sub>	Carbon Dioxide
CPR	Critical Project Review
g	gram
kg	kilogram
MOF	metal-organic framework
PSA	Pressure Swing Adsorption
Recipient	Mosaic Materials Inc.
TAC	Technical Advisory Committee

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

### A. Purpose of Agreement

The purpose of this Agreement is to fund the development and demonstration of a solid-state amine-scrubbing technology for upgrading of biogas to biomethane that, if successful, would accelerate adoption of biogas upgrade technologies and increase statewide utilization of biogas.

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

## **Exhibit A Scope of Work**

### **B. Problem/ Solution Statement**

#### **Problem**

In California, more than 10% of biogas is flared due to insufficient on-site demand and only 15% (approximately) of overall biogas capacity is utilized. The high carbon dioxide (CO<sub>2</sub>) content in biogas makes upgrading biogas to pipeline-quality biomethane extremely energy intensive. While there are several commercial CO<sub>2</sub> removal technologies, they are cost prohibitive for most facilities and therefore not widely adopted.

#### **Solution**

This project will develop and demonstrate a solid-state amine scrubbing technology for biogas upgrading that provides a 40% reduction in capital and operating costs compared to current state-of-the-art aqueous amine scrubbers.

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

#### **Agreement Goals**

The goals of this Agreement are to:

- Reduce the cost of upgrading biogas to pipeline quality biomethane
- Increase utilization rates of biogas at biogas production facilities
- Increase market penetration of biogas and biomethane in the natural gas market

Ratepayer Benefits: This Agreement will result in the following ratepayer benefits:

- 1) Lower capital and operating costs for production of biomethane, enabling lower cost biogas-derived electricity. The reduced footprint and significant energy saving of solid-amine scrubber technology will bring down both capital and operating costs in biogas upgrading for high quality biomethane (40% reduction compared to current amine scrubbers);
- 2) Increased market penetration for bioenergy, a renewable energy source with the potential for lower electricity costs vs. conventional natural gas.. By significantly reducing the cost of upgrading biogas to pipeline-quality biomethane, the levelized cost of biomethane will be highly competitive for replacing natural gas as energy source, which enables large-scale deployment of bioenergy;
- 3) Greenhouse gas reduction. Increased adoption of renewable biomethane will reduce consumption of conventional natural gas, reducing CO<sub>2</sub> emissions. In addition, cost-effective upgrading technology promotes more biogas facilities to convert biogas to biomethane, reduce flaring and methane and CO<sub>2</sub> emissions from biogas that is currently not utilized as energy. Reduced CO<sub>2</sub> emissions will mitigate the impact of global warming, such as reduced crop yields, drought, and destruction of animal habitats;
- 4) Energy security and diversification. With the penetration of biogas due to improved economics, California will become less dependent on fossil energy, diversifying its renewable portfolio and reducing the risk of disruption from loss of access to fossil fuels; and

Technological Advancement and Breakthroughs: This Agreement will lead to technological advancement and breakthroughs to overcome barriers to the achievement of the State of California's statutory energy goals by reducing the cost of upgrading biogas to biomethane by 40% compared to commercial upgrading technologies, making it more cost effective to produce

## **Exhibit A Scope of Work**

biomethane that complies with the pipeline biomethane standard under Assembly Bill 1900<sup>2</sup>. With this technology and appropriate incentives, biomethane will be competitive as a substitute for natural gas and other energy sources for California. This will accelerate market penetration of bioenergy and help to achieve the 33% renewable energy usage target mandated by the Renewable Portfolio Standard<sup>3</sup>.

At the same time, this technology will reduce California's greenhouse gas emission through three major pathways: 1) reduction in the energy used during biogas upgrading, 2) accelerating the adoption of less emission intensive biogas as a replacement for conventional natural gas by reducing the cost of biogas upgrading and cost of biomethane production, and 3) encouraging distributed bioenergy generation from the construction of mid- and small-sized biogas facilities, which face greater technical and economic hurdles for utilizing biogas than large, centralized facilities. These pathways will help to achieve the greenhouse gas reduction goals specified by Assembly Bill 32.

### **Agreement Objectives**

The objectives of this Agreement are to:

- Optimize and scale the Recipient's solid-state amine sorbent for biogas upgrading at a laboratory facility, achieving a reduction in energy usage of 50% compared to aqueous amine sorbents.
- Use the optimized sorbent to develop a biogas upgrading process and bench-scale prototype separation unit at Mosaic Materials with a 40% reduction in capital and operating costs. Verify and demonstrate the performance of prototype unit in a slip-stream test at a wastewater treatment facility.

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<sup>2</sup> Assembly Bill 1900, <http://www.arb.ca.gov/energy/biogas/biogas.htm>

<sup>3</sup> Renewable Portfolio Standard, <http://www.energy.ca.gov/portfolio/>

# Exhibit A

## Scope of Work

### TASK 1 GENERAL PROJECT TASKS

#### 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**

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

## **Exhibit A Scope of Work**

- (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.

### **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.

## **Exhibit A Scope of Work**

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*.

### **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

## **Exhibit A Scope of Work**

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.
- 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.

## **Exhibit A Scope of Work**

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.
  - 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 project 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.

## **Exhibit A Scope of Work**

- Submit a monthly or quarterly *Invoice* that follows the instructions in the “Payment of Funds” section of the terms and conditions. In addition, each invoice must document and verify:
  - 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
- Comments on Draft Final Report
- Approval of Final Report Outline

#### **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.

##### **Products:**

- Final Report (draft and final)

## Exhibit A Scope of Work

### **CAM Product:**

- Comments on Draft Final Report Outline

### **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 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.

## Exhibit A Scope of Work

### 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 not reimbursable under this Agreement, with the exception of costs incurred by University of California recipients. 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*.
- 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.

## **Exhibit A Scope of Work**

- 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 project direction. The guidance may include scope and methodologies, timing, and coordination with other projects. 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 projects (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 the project 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 project 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.

## **Exhibit A Scope of Work**

### **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

### **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

## Exhibit A Scope of Work

### II. 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 Site Preparation**

The goals of this task are to: (1) confirm the availability of the project deployment site; and (2) execute any agreements necessary to secure the demonstration site.

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

- Reach agreement with the manager(s) of the selected deployment site(s) regarding the project timeline, space reserved for the project, equipment installation, permit and insurance requirements, indemnity, and the Recipient’s use of any removal or support staff. The sites identified as of the commencement date of this grant are:
  - Site 1: University of California Berkeley, 717 Potter Street, Berkeley, CA, 94710
  - Site 2: Inland Empires Utility Agency Regional Water Recycling Plant, 2662 E. Walnut Street, Ontario, CA, 91761
- For any changes in site location, Recipient must check with their CAM or CAO who will provide guidance regarding the level of Commission approval required.
- Prepare and provide a *Site Readiness Verification Document* (e.g. *Copy of Contract, Lease Agreement, Memorandum of Understanding*).

##### **Products:**

- Site Readiness Verification Document (e.g., Copy of Contract, Lease Agreement, Memorandum of Understanding)

#### **TASK 3 Adsorbent Design**

The goal of this task is to select and fully characterize the sorbent material to be used for biogas upgrading.

##### **Subtask 3.1 Selection of Initial Material**

The goal of this subtask is to identify an initial amine-appended metal-organic framework (MOF) adsorbent with an adsorption pressure optimized for biogas upgrading and capacity of >12 wt% CO<sub>2</sub>.

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

- Screen a minimum of 25 amine-appended MOFs with magnesium- or zinc-based inorganic nodes.
- Collect and utilize CO<sub>2</sub> adsorption isotherms of the 25 materials to estimate working capacity and regeneration energy in a biogas upgrading process.
- Select a best-performing material as the initial adsorbent for use in Subtask 3.2.
- Prepare and provide an *Initial Material Design Report* that includes but is not limited to the following:

## **Exhibit A**

### **Scope of Work**

- A description of synthetic and activation conditions used to prepare the base frameworks;
- A description of conditions used for post-synthetic grafting of amines to these base frameworks, as well as for activation of the resulting materials;
- A compilation of CO<sub>2</sub> adsorption isotherms for all 25+ frameworks;
- A compilation of projected working capacity and regeneration energy of each candidate adsorbent, accompanied by a discussion of the method used to determine these estimates; and
- A discussion of the selection of the initial material for additional characterization.

#### **Products:**

- Initial Material Design Report (draft and final)

#### **Subtask 3.2 Detailed Characterization of Initial Material**

The goal of this subtask is to conduct extensive characterization of the MOF material selected in Subtask 3.1.

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

- Synthesize the selected adsorbent on a five-gram scale.
- Collect high-resolution, pure-component isotherms for CO<sub>2</sub> and methane, and utilize these data to evaluate adsorbent enthalpy.
- Conduct mixed-gas testing to quantify selectivity and kinetic parameters.
- Assess adsorbent stability to cycling, high temperatures, and moisture via thermogravimetric cycling experiments and powder x-ray diffraction.
- Prepare and provide an *Initial Material Characterization Report* that includes but is not limited to the following:
  - A description of the synthetic method used to scale the selected adsorbent;
  - A discussion of all thermodynamic, kinetic, and stability data obtained; and
  - Comparison of projected savings in regeneration energy versus currently-employed aqueous amine scrubbers.

#### **Products:**

- Initial Material Characterization Report (draft and final)

#### **Subtask 3.3 Selection of the Optimized Material**

The goal of this subtask is to utilize the results of Subtask 3.1, Subtask 3.2 and feedback from the process model developed in Task 6 to design an optimized adsorbent capable of achieving biogas upgrading with a 50% reduction in cost vs. aqueous amine scrubbers.

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

- Utilize the results of Subtask 3.1, Subtask 3.2, and the process model developed in Task 6 to identify areas for adsorbent improvement and/or further cost reduction.
- Select five materials for assessment in the determined area(s) of improvement (e.g. stability to moisture, reduction in methane uptake, decrease in methane uptake), and evaluate and optimize the target materials.
- Select a best-performing material as the optimized adsorbent for use in Subtask 3.4

## **Exhibit A Scope of Work**

- Prepare and provide a *Optimized Material Design Report* that includes but is not limited to the following:
  - A discussion of identified areas for improvement from the Generation I material, and the approach used to target these improvements;
  - A compilation of all data collected for the five Generation II candidates; and
  - A discussion of improvements offered by each candidate, and a selection of a Generation II material for additional evaluation.

### **Products:**

- Optimized Material Design Report (draft and final)

### **Subtask 3.4 Detailed Characterization of the Optimized Material**

The goal of this subtask is to conduct extensive characterization of the optimized amine-appended MOF material selected in Subtask 3.3.

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

- Synthesize the optimized adsorbent on a five-gram scale.
- Collect high-resolution, pure-component isotherms for CO<sub>2</sub> and methane, and utilize these data to evaluate adsorbent enthalpy.
- Conduct mixed-gas testing to quantify selectivity and kinetic parameters.
- Assess adsorbent stability to cycling, high temperatures, and moisture via thermogravimetric cycling experiments and powder x-ray diffraction.
- Prepare and provide a *Optimized Material Characterization Report* that includes but is not limited to the following:
  - A description of the synthetic method used to scale the selected adsorbent;
  - A discussion of all thermodynamic, kinetic, and stability data obtained; and
  - Comparison of projected savings in regeneration energy versus the initial adsorbent and versus currently-employed aqueous amine scrubbers.

### **Products:**

- Optimized Material Characterization Report (draft and final)

### **TASK 4 Sorbent Formulation**

The goals of this task are to develop and optimize a sorbent formulation to be scaled in Task 5.

#### **Subtask 4.1 Initial Sorbent Formulation**

The goal of this subtask is to develop methods of forming composite, shaped particles of solid-state amine sorbents suitable for use in a separation unit.

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

- Develop a test plan for evaluation of composite materials that includes but is not limited to measurement of sorption selectivity, sorption kinetics, and crush strength for each composite.
- Screen at least 25 binders to identify materials that form strong covalent bonds to the target MOFs without decomposing or blocking the pores of the sorbent.

## **Exhibit A Scope of Work**

- Optimize extrusion conditions for all promising binders.
- Prepare 1 mm diameter extruded composites using the optimized extrusion conditions.
- Execute the test plan for each composite, select the one that gives the best overall performance.
- Prepare and provide a *Composite Performance Report* that includes but is not limited to the following:
  - A discussion of the relative performance and cost of the screened binder materials;
  - A proposed set of binders and formulation conditions for optimization in Subtask 4.2; and
  - A discussion of the expected impact of the observed composite performance on the performance of the separation unit.
- Produce 100 grams (g) of the final selected composite for detailed characterization.

### **Products:**

- Composite Performance Report (draft and final)

### **Subtask 4.2 Optimize Sorbent Formulation**

The goal of this subtask is to optimize the formulation methods developed in Subtask 4.1 for the best-performing sorbent from Task 3.

### **The Recipient shall:**

- Prepare 1 mm diameter extruded composites using the five most promising binders from Task 4.1 with the best performing sorbent from Task 3.
- Execute the test plan from Subtask 4.1 for each composite and select the most promising binder from the data.
- Optimize extrusion conditions for the most promising binder, evaluating selectivity, kinetics, crush strength, and cost and select the binder and formulation conditions for scale-up in Task 5.
- Prepare and provide a *Second Composite Performance Report* that includes but is not limited to the following:
  - A discussion of the relative performance and cost of the screened binder materials;
  - A discussion of the proposed binder and formulation conditions for scale-up in Task 5; and
  - A discussion of the expected impact of the observed composite performance on the performance of the separation unit.
- Produce 100 g of the final selected binder and formulation conditions for detailed characterization.

### **Products:**

- Second Composite Performance Report (draft and final)

### ***TASK 5 Sorbent Scale-up***

The goal of this task is develop conditions for kg-scale production of the target sorbent and produce sufficient quantity for process development and demonstration in Tasks 7 and 8.

## **Exhibit A**

### **Scope of Work**

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

- Develop a test plan for evaluation of synthesized materials that includes but is not limited to matching performance to the gram-scale samples produced in Tasks 3 and 4.
- Optimize synthesis conditions for the MOF identified in Task 3 at 1 g, 10 g, 100 g, and 1 kg batch sizes.
- Produce 5 kg of the MOF.
- Optimize amine impregnation conditions for the best performing amine identified in Task 3.
- Produce 3 kg of amine-impregnated framework using the optimized amine impregnation conditions.
- Produced 2 kg of 1 mm diameter extruded composites using the conditions developed in Task 4.
- After each material synthesis, confirm that the CO<sub>2</sub> capacity and selectivity of the material meets or exceeds that of the gram-scale sample produced in Task 4. If not, then further optimize the synthetic method and remake the material.
- Evaluate the projected cost of the scaled up material.
- Prepare and provide a *Sorbent Scale-up Report* that includes but is not limited to the following:
  - A discussion of the performance and cost of the scaled up material; and
  - A discussion of the expected impact of the observed performance on the performance of the separation unit.
- Prepare and provide a *CPR Report* in accordance with Subtask 1.3.
- Participate in a CPR Meeting in accordance with Subtask 1.3.

#### **Products:**

- Sorbent Scale-up Report (draft and final)
- CPR Report

#### ***TASK 6 Process and Techno-economic Modeling***

The goal of this task is to model the separation process and system, capital, and operating costs to optimize the sorbent material properties and process operating conditions to minimize the levelized cost of biogas upgrading.

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

- Model a breakthrough curve to match lab data and code process model with all ancillary equipment.
- Identify optimal MOF sorbent properties (system performance vs. MOF properties).
- Validate measured laboratory and field performance of separation unit.
- Refine model based on observed performance (account as needed for mass transfer, heat, etc.).
- Quantify capital and operating costs for separation system.
- Optimize process operating conditions for Generation 1 MOF.
- Perform sensitivity analysis to MOF properties and process operating conditions.
- Evaluate options for removal of hydrogen sulfide, water vapor, and other trace contaminants within the gas stream.
- Compare MOF process economics vs. aqueous amine scrubbers.

## **Exhibit A Scope of Work**

- Prepare and provide a *Techno-economic Modeling Report* that includes but is not limited to the following:
  - A discussion of the optimized process and system, capital, and operating costs; and
  - A discussion of the expected impact of projected performance on the economics of biogas upgrading.

### **Products:**

- Techno-economic Modeling Report (draft and final)

### ***TASK 7 Separation Process and Prototype Development***

The goal of this task is to develop a biogas upgrading process and bench-scale separation unit based on the sorbent produced in Task 5 and the process model developed in Task 6.

### **The Recipient shall:**

- Retrofit a commercially available Pressure Swing Adsorption (PSA) separation unit with mass flow controllers and external heating jackets for precise control over operating conditions. Thermocouples and electrical meters will also be added for all key components to monitor electrical and thermal energy usage.
- Optimize temperature, pressure, and flow rates to maximize methane recovery and minimize energy use while achieving the target product purity of >98%. This work will start from and build off the initial process model developed in Task 6.
- Evaluate the separation efficiency and stability of the separation unit with biogas samples from a wastewater treatment facility.
- Prepare and provide a *Process Development Report* that includes but is not limited to the following:
  - A discussion of the performance and the processes evaluated during this task;
  - A discussion of the comparison between the observed performance and the process model from Task 6; and
  - A discussion of the expected impact of the observed performance on the performance of the separation unit and cost of biogas upgrading upon large-scale deployment.

### **Products:**

- Process Development Report (draft and final)

### ***TASK 8 Slipstream Testing***

The goal of this task is to evaluate and demonstrate the performance-optimized process and separation unit developed in Task 7 in a 3-month slipstream test at a wastewater treatment facility.

### **The Recipient shall:**

- Retrofit a commercially-available PSA separation unit to enable usage at the demonstration site with: 1) filters to remove siloxanes and other high molecular weight impurities present in the feed stream; 2) a weather-proof enclosure; 3) an uninterruptible

## Exhibit A Scope of Work

power supply capable of providing at least 12 hours of backup power; and 4) wireless data-loggers for all sensors for remote monitoring.

- Install the modified separation unit at a wastewater treatment facility.
- Monitor the performance of the unit for 3 months, modifying the process and unit to improve performance as needed.
- Prepare and provide a *Slipstream Test Report* that includes but is not limited to the following:
  - A discussion of the performance of the separation unit during the slipstream test;
  - A discussion of plans for further improvements to the sorbent, unit, and process to further improve performance; and
  - A discussion of the expected impact of the observed performance of the separation unit on the performance of the separation unit and cost of biogas upgrading upon large-scale deployment.

### Products:

- Slipstream Test Report (draft and final)

### **TASK 9 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 natural gas, 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.
    - Data on potential job creation, market potential, economic development, and increased state revenue as a result of the project.
    - A discussion of project 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.

## **Exhibit A Scope of Work**

- 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 project.
  - Published documents, including date, title, and periodical name.
  - A discussion of policy development. State if the project 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 project information has affected energy use and cost, or has 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 project.
  - A discussion of project 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 10 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. Use the format provided by the CAM.
- Prepare a *Final Project Fact Sheet* at the project's conclusion that discusses results. Use the format provided by the CAM.

## **Exhibit A Scope of Work**

- 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 project 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 project 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.
- When directed by the CAM, develop *Presentation Materials* for an Energy Commission-sponsored conference/workshop on the results of the project.
- 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)
- Presentation Materials (draft and final)
- Technology/Knowledge Transfer Plan (draft and final)
- Technology/Knowledge Transfer Report (draft and final)

### **TASK 11 Production Readiness Plan**

The goal of this task is to determine the steps that will lead to the manufacturing of technologies developed in this project or to the commercialization of the project's results.

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

- Prepare a *Production Readiness Plan*. The degree of detail in the plan should be proportional to the complexity of producing or commercializing the proposed product, and to its state of development. As appropriate, the plan will discuss the following:
  - Critical production processes, equipment, facilities, personnel resources, and support systems needed to produce a commercially viable product.
  - Internal manufacturing facilities, supplier technologies, capacity constraints imposed by the design under consideration, design-critical elements, and the use of hazardous or non-recyclable materials. The product manufacturing effort may include "proof of production processes."
  - The estimated cost of production.
  - The expected investment threshold needed to launch the commercial product.
  - An implementation plan to ramp up to full production.
  - The outcome of product development efforts, such as copyrights and license agreements.

## **Exhibit A Scope of Work**

- Patent numbers and applications, along with dates and brief descriptions.
- Other areas as determined by the CAM.

### **Products:**

- Production Readiness Plan (draft and final)

### **III. PROJECT SCHEDULE**

Please see the attached Excel spreadsheet.

STATE OF CALIFORNIA

STATE ENERGY RESOURCES  
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION - RE: MOSAIC MATERIALS, INC.

**RESOLVED**, that the State Energy Resources Conservation and Development Commission (Energy Commission) adopts the staff CEQA findings contained in the Agreement Request Form; and

**RESOLVED**, that the Energy Commission approves Agreement PIR-14-021 from PON-14-505 with **Mosaic Materials, Inc.** for a **\$1,000,000** grant to develop and demonstrate a solid-state amine scrubbing technology for upgrading biogas to renewable natural gas that provides a significant reduction in capital and operating costs compared to current state-of-the-art aqueous amine scrubbers; and

**FURTHER BE IT RESOLVED**, that the Executive Director or his/her designee 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 10, 2015.

AYE: [List of Commissioners]

NAY: [List of Commissioners]

ABSENT: [List of Commissioners]

ABSTAIN: [List of Commissioners]

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Harriet Kallemeyn,  
Secretariat