

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	13-14	501.001H	\$1,000,000
			\$
			\$
			\$
			\$
			\$
R&D Program Area: EGRO: Renewables		TOTAL:	\$1,000,000
Explanation for "Other" selection			
Reimbursement Contract #:		Federal Agreement #:	

Recipient's Administrator/ Officer				Recipient's Project Manager			
Name:	Kate Jauridez			Name:	Kate Jauridez		
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Selection Process Used	
<input checked="" type="checkbox"/> Competitive Solicitation	Solicitation #: PON-14-505
<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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EXHIBIT A Scope of Work

A. Task List

Task #	CPR ¹	Task Name
1		General Project Tasks
2		Contract Execution
3		Siloxane/H ₂ S Removal Technology Design
4	X	CO ₂ /N ₂ /O ₂ Technology Development, Design, and Controls
5	X	Site Preparation, Equipment Deployment, and Demonstration
6		Evaluation of Project Benefits
7		Technology/Knowledge Transfer Activities

B. Acronym/Term List

Acronym/Term	Meaning
BOM	Bill-of-Materials
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CO ₂	Carbon Dioxide
CPR	Critical Project Review
GTI	Gas Technology Institute
H ₂ S	Hydrogen Sulfide
M&V	Measurement and Verification
mL	Milliliter
MS	Microsoft
N ₂	Nitrogen
O ₂	Oxygen
P&ID	Process and Instrumentation Diagram
PFD	Process Flow Diagram Piping
SCFM	Standard Cubic Feet per Minute
RNG	Renewable Natural Gas
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 the development and demonstration of a novel biogas cleanup technology consisting of: a) compact liquid scrubber systems, b) organophilic membranes, and c) secondary treatment for sequestration of the contaminant species to produce a purified gas stream of renewable natural gas (RNG).

¹ 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.

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B. Problem/ Solution Statement

Problem

Biogas use in California offers an opportunity for lower cost renewable energy production that has a dramatically reduced carbon footprint when compared to fossil fuels. Currently, the cleaning and upgrading of biogas to high quality RNG can be costly, complex, energy intensive, and often consume raw materials that cannot be easily or cost-effectively regenerated. Sites with sources of biogas have predominately chosen to produce electricity utilizing reciprocating engines. These engines can be very forgiving regarding the constituents and varying energy content of the gas used to power them. To expand the opportunities for RNG use in California including injection into the natural gas pipeline, direct use for transportation, or more sophisticated electric power applications including turbines and fuel cells, RNG will need to more closely resemble pipeline quality natural gas.

Solution

To overcome these above problems, the recipient will develop and demonstrate a novel biogas cleanup system for the separation and removal of hydrogen sulfide (H₂S), siloxanes, carbon dioxide (CO₂), nitrogen (N₂) and oxygen (O₂), to generate RNG. The project team proposes to demonstrate a pilot-scale (100 Standard Cubic Feet per Minute (SCFM) feed) three-stage cleanup system at an existing landfill in California for sequentially removing H₂S and siloxanes (stage 1), CO₂ (stage 2), and N₂/O₂ (stage 3) from the raw landfill gas. The three stages will be combined into two skid-mounted units: the first with a chiller for moisture removal along with an H₂S/siloxane removal system and the second with the two solvent-based CO₂ and N₂/O₂ separation systems. Both the CO₂ and N₂/O₂ systems will first be trialed at the laboratory-scale before testing in the pilot-scale system. By combining these systems, the various undesirable compounds typical of biogas can be removed to generate pipeline quality gas.

C. Goals and Objectives of the Agreement

Agreement Goals

The goal of this agreement is to develop and demonstrate the cost and performance benefits of a novel biogas cleanup technology consisting of: a) compact liquid scrubber systems, b) organophilic membranes and c) secondary treatment for sequestration of the contaminant species to produce a purified gas stream of RNG.

Ratepayer Benefits: This Agreement will result in a number of economic, environmental and security ratepayer benefits. Environmental benefits result from reducing the consumption of fossil fuels that are ordinarily used as fuel for power generation or combined heat and power applications, as well as transportation fuels. Once successfully demonstrated, the energy, emissions, and cost savings associated with replacement of natural gas with RNG can be significant. Not only does advancing production of RNG reduce greenhouse gas emissions by displacing use of fossil fuel, it also has benefit by reducing release of methane to the atmosphere as biogas. Hence, RNG has a very low carbon footprint; it is rated among the lowest carbon-producing fuels under the Low Carbon Fuel Standard. California Investor Owned Utilities are looking to RNG as one means to make their natural gas product more renewable, while lowering its carbon footprint.

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Security benefits of the quality of renewable gases being delivered into the natural gas pipeline system and for use in natural gas vehicle engines is important to overall safety of the equipment. Substandard quality RNG not meeting specifications could damage pipeline systems or end-use products like furnaces, water heaters, or industrial boilers as well as damaging compressed natural gas engines operating in refuse trucks, buses, and other vehicles. Additional security benefits of producing RNG include a more reliable and safe natural gas system, which also benefits water quality by reducing the use/production of fossil fuels that pollute the water.

Economic benefits from biogas cleanup systems that are reliable, effective, and not overly costly will be an important factor in the growth of the RNG market in California. This project will help lead to the commercialization of a system with those attributes. This would also provide a source of revenue for dairy farms and food processors, as well as for governments and agencies that operate wastewater treatment facilities, landfills, and other solid waste facilities while creating jobs in California through expanded use of RNG.

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 developing and demonstrating novel, regenerating organic liquid-scrubber technologies for the production of RNG from biogas. This technology has the potential for significant cost and performance advantages over existing energy-intensive cleanup technologies currently in use such as pressure swing adsorption, membrane separation, and amine and water scrubbing. Except for pressure swing adsorption, none of these technologies effectively remove nitrogen and oxygen from biogas, as in the proposed approach. In addition, the proposed technologies produce saleable sulfur by-products.

The proposed project will lead to an enhanced understanding of the removal of H₂S, siloxanes, CO₂, N₂, and O₂ removal from biogas. Testing newly designed components and solvents, configurations of equipment, durability, and performance of equipment and most importantly quality of RNG produced will lead to the development of lower cost biogas cleanup systems for RNG production. This project will move the bar towards the development of a commercialized, lower cost, fully integrated biogas cleanup system for the RNG production industry. This will lead to expanded production of high quality, low carbon fuel for use in transportation and electricity production.

Agreement Objectives

The objectives of this Agreement are to:

- Design and fabricate a skid-mounted siloxane/H₂S removal subsystem for treating 100 SCFM of raw biogas.
- Design and fabricate a skid-mounted CO₂ and N₂/O₂ removal subsystem and integrate it with the siloxane/H₂S subsystem, including controls and remote monitoring capability.
- Deploy the complete system at a landfill facility.
- Operate the biogas cleanup system at the landfill site to assess economics and meeting or approaching the RNG specifications.
- Report on an assessment of the project's benefits to the natural gas ratepayer.

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- Develop a technology/knowledge transfer plan to make the knowledge gained, experimental results, and lessons learned available to the public and key decision makers.

II. 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.

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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.
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- ***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

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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*.

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

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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.
- 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

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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.
 - 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.

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- 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

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)

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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.

Products:

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

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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.
- 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.

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- 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.

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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

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III. TECHNICAL TASKS

TASK 2 CONTRACT EXECUTION

The goal of this task is to confirm the availability of the project deployment site.

The Recipient shall:

- Reach agreement with the manager(s) of the selected deployment site 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.
- If the selected deployment site becomes unavailable during the project term, work with the CAM to select a new site.
 - The deployment site as of the commencement date of this grant is the Otay Landfill in Chula Vista, CA. For any changes in deployment site location, the Recipient must check with their CAM or CAO who will provide guidance regarding the level of Commission approval required.
- Execute and provide a Copy of a *Contract with the Deployment Site* that confirms the agreement reached above on the Recipient's use of the site.

Products:

- Copy of Contract with the Deployment Site

TASK 3 SILOXANE/H₂S REMOVAL TECHNOLOGY DESIGN

The goal of this task is to design and fabricate a siloxane/H₂S removal subsystem for integration with the CO₂/N₂/O₂ subsystem.

The Recipient shall:

- Design the skid-mounted siloxane/H₂S removal subsystem.
- Prepare and provide a *Siloxane/H₂S Removal Subsystem Design Report* which includes, but is not limited to:
 - A description of the process,
 - Process Flow Diagram (PFD),
 - Piping and Instrumentation Diagram (P&ID),
 - Operating procedure,
 - Bill-of-Materials (BOM),
 - Specifications for the equipment, and
 - Process controls.
- Fabricate the skid-mounted siloxane/H₂S removal subsystem
- Prepare and provide a *Notice of Siloxane/H₂S Removal Subsystem Fabrication Completion* which notifies the CAM that the skid-mounted siloxane/H₂S removal system has been fabricated and is ready for functionality testing.
- Perform functionality testing of the subsystem skid, which includes but is not limited to:
 - Perform gas sampling as needed to determine concentrations of the various species of siloxanes and sulfides (both organic and inorganic).

EXHIBIT A Scope of Work

- Use the obtained concentrations to calculate solvent flow rates and Electro-Catalytic Converter amperages and voltages for efficient reduction of the siloxane and sulfide contaminants
- Prepare and provide a *Siloxane/H₂S Removal Subsystem Functionality Testing Report*, which includes gas analyses and containment reduction efficiency computations over the testing time employed.

Products:

- Siloxane/H₂S Removal Subsystem Design Report
- Notice of Siloxane/H₂S Removal System Subsystem Fabrication Completion
- Siloxane/H₂S Removal Subsystem Functionality Testing Report (draft and final)

TASK 4 CO₂/N₂/O₂ REMOVAL TECHNOLOGY DEVELOPMENT, DESIGN AND CONTROLS

The goals of this task are to design and assemble a CO₂/N₂/O₂ removal subsystem for integration with the siloxane/H₂S removal subsystem fabricated in Task 3.

The Recipient shall:

- Perform laboratory testing of the candidate solvents to determine their effectiveness for removing CO₂/N₂/O₂ from methane for the design and configuration of the skid containing the subsystem.
- Prepare and provide a *CO₂/N₂/O₂ Removal Technology Development Testing Report*, which includes initial gas analysis, final gas analysis, and efficiency computations over various time periods of testing, to determine amounts of CO₂, N₂, and O₂ removal from landfill gas. The goal at the final rounds of testing will be cleaned landfill gas of various contaminants to pipeline gas purity standards.
- Prepare and provide a *Design of Skid-mounted CO₂ and N₂/O₂ Removal Subsystem Report* which includes, but is not limited to:
 - A description of the process,
 - PFD,
 - P&ID,
 - Operating procedure,
 - BOM,
 - Specifications for the equipment, and
 - Process controls.
- Fabricate the skid-mounted CO₂/N₂/O₂ removal subsystem.
- Prepare and provide a *Notice of CO₂/N₂/O₂ Removal Subsystem Fabrication Completion*, which notified the CAM that the skid-mounted CO₂ and N₂/O₂ removal subsystem has been fabricated and is ready for functionality testing.
- Perform functionality testing of the CO₂/N₂/O₂ subsystems to assess proper operation of all components contained in the skids. which includes but is not limited to:
- Prepare and provide a *CO₂/N₂/O₂ Removal Subsystem Functionality Testing Report*, which includes detailed discussion of the two subsystems' operation and any required modifications to meet design specifications for continued operation during demonstration.
- Participate in CPR Meeting #1 in accordance with subtask 1.3.
- Prepare and provide a CPR Report #1 as detailed in Subtask 1.3.

EXHIBIT A

Scope of Work

Product:

- CO₂/N₂/O₂ Removal Technology Development Testing Report
- Design of Skid-mounted CO₂/N₂/O₂ Removal Subsystem Report
- Notice of CO₂/N₂/O₂ Removal Subsystem Fabrication Completion
- CO₂/N₂/O₂ Removal Subsystem Functionality Testing Report (draft and final)
- CPR Report #1

TASK 5 SITE PREPARATION, EQUIPMENT DEPLOYMENT, AND DEMONSTRATION

The goal of this task is to prepare the host landfill site to deploy the two subsystems and integrate them, set up data acquisition and remote monitoring systems, and conduct demonstration testing for twelve months (or a shorter period approved in writing by the CAM). During demonstration testing, perform product gas sampling and analysis to assess meeting RNG specification limits.

SUBTASK 5.1 Site Preparation/Equipment Deployment

The goals of this subtask are to prepare the landfill site for the demonstration and deploy and integrate the two subsystems (*i.e.*, siloxane/H₂S and CO₂/N₂/O₂) for testing.

The Recipient shall:

- Prepare the landfill site for the cleanup system demonstration to include: installation of concrete pad(s) to support the equipment, extension of power for pumps and controls, installation of branch connections and isolation valves within the raw landfill gas feed piping to the existing engine generators, and extension of internet connectivity for remote communication with the equipment.
- Deploy and integrate the two subsystems, siloxane/H₂S and CO₂/N₂/O₂, for demonstration testing
- Prepare and provide a *Site Preparation and Deployment Report* outlining various activities performed.
- Conduct a CPR meeting with the CAM before the onset of the cleanup demonstration at the site.
- Participate in CPR Meeting #2 in accordance with subtask 1.3.
- Prepare and provide a *CPR Report #2* as detailed in Subtask 1.3.

Products:

- Site Preparation and Deployment Report (draft and final)
- CPR Report #2

SUBTASK 5.2 DAC/Remote Monitoring

The goal of this subtask is to install data acquisition and remote monitoring systems on the integrated cleanup system at the landfill site.

The Recipient shall:

- Install data acquisition and remote monitoring systems on the integrated cleanup system to aid data acquisition and logging (including flows, temperatures, pressures, electric power use) and tracking any operational problems.
- Prepare and provide a *Data Acquisition and Remote Monitoring Systems Report* describing the design and installation of the two systems.

EXHIBIT A

Scope of Work

Products:

- Data Acquisition and Remote Monitoring Systems Report

SUBTASK 5.3 Gas Sampling

The goal of this subtask is to prepare a gas analysis sampling plan and perform gas sampling of the cleanup system during demonstration.

The Recipient shall:

- Prepare and provide a *Gas Sampling Plan* for gas analysis to assess the effectiveness of the cleanup system. The plan will include details of the sampling frequency, quantity, location on the cleanup system, and collection methods to be followed during the course of the demonstration.
- Perform gas sampling.

Products:

- Gas Sampling Plan

SUBTASK 5.4 Gas Analysis

The goal of this subtask is to receive and analyze gas samples from the cleanup system.

The Recipient shall:

- Receive and analyze the gas samples acquired per the Gas Sampling Plan in Subtask 5.3 to assess performance of the gas cleanup system for gas separation/removal effectiveness to meet RNG specification limits.
- Prepare and provide a *Gas Analysis Report* detailing the effectiveness of the biogas cleanup system in meeting current RNG specification standards.

Products:

- Gas Analysis Report (draft and final)

SUBTASK 5.5 Cleanup System Demonstration

The goal of this subtask is to operate the biogas cleanup system at the host landfill site to demonstrate its effectiveness for meeting current RNG specification standards.

The Recipient shall:

- Operate the biogas cleanup system for twelve months (or a shorter period approved in writing by the CAM) to demonstrate its effectiveness for meeting current RNG specification standards.
- Prepare and provide a *Demonstration Report* documenting test protocols, gas sampling and analysis, operational data, performance and durability of the cleanup system.

Products:

- Demonstration Report (draft and final)

EXHIBIT A

Scope of Work

SUBTASK 5.6 Decommission Equipment

The goal of this subtask is to decommission and remove the equipment at the landfill and restore the site to its original state.

The Recipient shall:

- Decommission the equipment at the landfill site, disconnect mechanical and electrical connections and restore site to its original state.
- Remove the demonstrated equipment from the site.
- Prepare and provide a *Decommissioning Report* describing the various activities accomplished and the final disposition of the equipment and condition of the site.

Products:

- Decommissioning Report (draft and final)

TASK 6 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.
 - Units sold or projected to be sold in California and outside of California.

EXHIBIT A

Scope of Work

- 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 7 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)

IV. PROJECT SCHEDULE

Please see the attached Excel spreadsheet.

STATE OF CALIFORNIA

STATE ENERGY RESOURCES
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION - RE: GAS TECHNOLOGY INSTITUTE

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-14-019 from PON-14-505 with **Institute of Gas Technology dba Gas Technology Institute** for a **\$1,000,000** grant to develop and demonstrate a novel biogas cleanup technology at a landfill which consists of compact liquid scrubber systems, membranes, and secondary treatment for sequestration of contaminant species to produce a purified stream of renewable natural gas; 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]

Harriet Kallemeyn,
Secretariat