California Energy Commission
May 8, 2025 Business Meeting
Backup Materials for Silicon Valley Clean Water

The following backup materials for the above-referenced agenda item are available in this PDF packet as listed below:

1. Proposed Resolution
2. Grant Request Form
3. Scope of Work

[PROPOSED]

RESOLUTION NO: 25-0508-13

STATE OF CALIFORNIA

STATE ENERGY RESOURCES
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION: Silicon Valley Clean Water

RESOLVED, that the State Energy Resources Conservation and Development Commission (CEC) adopts the staff CEQA findings contained in the Agreement or Amendment Request Form (as applicable); and

RESOLVED, that the CEC approves agreement EPC-24-050 with Silicon Valley Clean Water of an up to $4,000,000 grant. This agreement will fund the demonstration and installation of a predictive Biogas Microgrid Controller that flexibly dispatches 730 kW of clean, renewable generation using three biogas-fueled linear generators at a municipal wastewater treatment facility in Redwood City; and

FURTHER BE IT RESOLVED, that the Executive Director or their designee shall execute the same on behalf of the CEC.

CERTIFICATION

The undersigned Secretariat to the CEC 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 CEC held on May 8, 2025.

AYE:
NAY:
ABSENT:
ABSTAIN:

Dated:

_____
Kristine Banaag
Secretariat

STATE OF CALIFORNIA
CALIFORNIA ENERGY COMMISSION

CEC-270 (Revised 01/2024)

GRANT REQUEST FORM (GRF)

A. New Agreement Number

IMPORTANT: New Agreement # to be completed by Contracts, Grants, and Loans Office.

New Agreement Number: EPC-24-050

B. Division Information

1. Division Name: ERDD
2. Agreement Manager: Baldomero Lasam
3. MS-:43
4. Phone Number: 916-776-0784

C. Recipient's Information

1. Recipient's Legal Name: Silicon Valley Clean Water
2. Federal ID Number: 94-2401137

D. Title of Project

Title of project: Biogas Microgrid for Clean Dispatchable Electricity

E. Term and Amount

1. Start Date: 5/12/2025
2. End Date: 5/1/2028
3. Amount: $4,000,000.00

F. Business Meeting Information

1. Are the ARFVTP agreements $75K and under delegated to Executive Director? No
2. The Proposed Business Meeting Date: 5/8/2025 .
3. Consent or Discussion? Discussion
4. Business Meeting Presenter Name: Baldomero Lasam
5. Time Needed for Business Meeting: 5 minutes.
6. The email subscription topic is: EPIC (Electric Program Investment Charge)

Agenda Item Subject and Description:

Silicon Valley Clean Water. Proposed resolution approving agreement EPC-24-050 with Silicon Valley Clean Water of an up to $4,000,000 grant, and adopting staff's recommendation that this action is exempt from CEQA. This agreement will fund the demonstration and installation of a predictive Biogas Microgrid Controller that flexibly dispatches 730 kW of clean, renewable generation using three biogas-fueled linear generators at a municipal wastewater treatment facility in Redwood City. (EPIC funding) Contact: Baldomero Lasam (Staff Presentation: 5 Minutes)

G. California Environmental Quality Act (CEQA) Compliance

1. **Is Agreement considered a "Project" under CEQA?**
   Yes

   If yes, skip to question 2.

   If no, complete the following (PRC 21065 and 14 CCR 15378) and 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 answer the following questions.**

a) Agreement **IS** exempt?

Yes

Statutory Exemption?
No

If yes, list PRC and/or CCR section number(s) and separate each with a comma. If no, enter "None" and go to the next question.

PRC section number: None

CCR section number: None

Categorical Exemption?
Yes

If yes, list CCR section number(s) and separate each with a comma. If no, enter "None" and go to the next question.

CCR section number: Cal. Code Regs., tit. 14 § 15301; Cal. Code Regs., tit. 14 § 15303; Cal. Code Regs., tit. 14 § 15306; Cal. Code Regs., tit. 14 § 15311; Cal. Code Regs., tit. 14 § 15329.

Cal. Code Regs, tit. 14, §15301, Existing Facilities, provides that projects which consist of the operation, repair, maintenance, permitting, leasing, licensing, or minor alteration of existing public or private structures, facilities, mechanical equipment, or topographical features, and which involve negligible, or no expansion of use are exempt from CEQA. The project will demonstrate and deploy a 730-kW linear generation technology that can run efficiently with biogas. The linear generation system will replace existing cogeneration equipment currently onsite that produces up to 1-MW of energy and will result in lower air emissions and no net increase of overall electric generation at the existing facility. This linear generation system uses pressure variations to extract the chemical energy from fuels at lower temperatures, essentially eliminating NOx and other air contaminant emissions. The system will be deployed at a municipal wastewater treatment plant in Redwood City, CA. For this reason, the project will involve negligible or no expansion of use of the facility and will produce lower emissions and comply with all applicable state, federal and local air quality laws and is categorically exempt from CEQA under California Code of Regulations, title 14, §15301.

California Code of Regulations, title 14, §15303, New Construction or Conversion of Small Structures, provides that projects which consist of the construction and location of limited numbers of new, small facilities or structures; installation of small new equipment and facilities in small structures; and the conversion of existing small structures from one use to another where only minor modifications are made in the exterior of the structure are categorically exempt from CEQA. The power

generation system is a CARB-DG certified solution and holds state and local air quality certifications. This system has undergone rigorous safety testing and complies with relevant environmental codes and standards. A housekeeping pad consisting of concrete slab and walls will be constructed to house the linear generators. This will protect the units from weather and extreme temperatures. The demonstration system will consist of piping, valves, and gas conditioning equipment which will be installed on a concrete slab within the housekeeping pad. The parcel of land, where the housekeeping pad will be constructed, is within the facility and will not result in an increase of the overall facility's footprint. For this reason, the project will not have a significant effect on the environment and is categorically exempt from CEQA under California Code of Regulations, title 14, §15303.

California Code of Regulations, title 14, §15306, Information Collection, provides that projects which consist of basic data collection, research, and resource evaluation activities which do not result in a serious or major disturbance to an environmental resource are categorically exempt from the provisions of CEQA. The work at the project location includes research to determine the performance of the system. This work includes computer modeling to estimate the energy balance of the system and the economic impact if the system is widely adopted in California. Thus, this project consists of basic data collection, research, and evaluation activities related to linear generators installed a wastewater treatment plant and is categorically exempt from CEQA under California Code of Regulations, tit 14, §15306.

California Code of Regulations, title 14, §15311, Accessory Structures, provides that projects which consist of the construction, or placement of minor structures accessory to (appurtenant to) existing commercial, industrial, or institutional facilities are categorically exempt from CEQA. The project will install a housekeeping pad with walls that protect the linear generators from unwanted debris and extreme weather. The fuel gas lines from the plant's anaerobic biogas digester will be connected to the linear generators placed inside the housekeeping pad. The system will be deployed within the facility but will be placed at the exterior of the main building. For this reason, the project will consist of a minor structure accessory to an existing industrial facility and is categorically exempt from CEQA through California Code of Regulations, tit 14, §15311.

California Code of Regulations, title 14, § 15329, Cogeneration Projects at Existing Facilities, provides that projects which install cogeneration equipment with a capacity of 50 megawatts or less at existing facilities will be exempt from CEQA. The project will install a linear generator that will generate 730 kW of electricity that will be consumed by the facility. The system will be integrated into a cogeneration system that consists of electrical and thermal systems that operate the wastewater facility plant. For this reason, the project is categorically exempt from CEQA under California Code of Regulations, tit 14, §15329.

The project will not impact an environmental resource of hazardous or critical concern where designated, precisely mapped, and officially adopted pursuant to law by federal, state, or local agencies; does not involve any cumulative impacts of successive projects of the same type in the same place that might be considered significant; does not involve unusual circumstances that might have a significant effect on the environment; will not result in damage to scenic resources within a highway officially designated as a state scenic highway; the project site is not included on any list compiled pursuant to Government Code section 65962.5; and the project will not cause a substantial adverse change in the significance of a historical resource. Therefore, none of the exceptions to categorical exemptions listed in CEQA Guidelines section 15300.2 apply to this project, and this project will not have a significant effect on the environment.

Common Sense Exemption? 14 CCR 15061 (b) (3)
No

If yes, explain reason why Agreement is exempt under the above section. If no, enter "Not applicable" and go to the next section.

b) Agreement **IS NOT** exempt.
IMPORTANT: consult with the legal office to determine next steps.

No

If yes, answer yes or no to all that applies. If no, list all as "no" and "None" as "yes".

Additional Documents	Applies
Initial Study	No
Negative Declaration	No
Mitigated Negative Declaration	No
Environmental Impact Report	No
Statement of Overriding Considerations	No
None	Yes

H. Is this project considered "Infrastructure"?

No

I. Subcontractors

List all Subcontractors listed in the Budget (s) (major and minor). Insert additional rows if needed. If no subcontractors to report, enter "No subcontractors to report" and "0" to funds. **Delete** any unused rows from the table.

Subcontractor Legal Company Name	CEC Funds	Match Funds
The Leland Stanford Junior University	$ 571,593	$0
TBD - Software Developer	$ 778,407	$0

J. Vendors and Sellers for Equipment and Materials/Miscellaneous

List all Vendors and Sellers listed in Budget(s) for Equipment and Materials/Miscellaneous. Insert additional rows if needed. If no vendors or sellers to report, enter "No vendors or sellers to report" and "0" to funds. **Delete** any unused rows from the table.

Vendor/Seller Legal Company Name	CEC Funds	Match Funds
Mainspring Energy, Inc.	$1,450,000	$1,180,000
TBD - Installation Contractor	$1,200,000	$80,000

K. Key Partners

List all key partner(s). Insert additional rows if needed. If no key partners to report, enter "No key partners to report." **Delete** any unused rows from the table.

Key Partner Legal Company Name
No key partners to report

L. Budget Information

Include all budget information. Insert additional rows if needed. If no budget information to report, enter "N/A" for "Not Applicable" and "0" to Amount. **Delete** any unused rows from the table.

Funding Source	Funding Year of Appropriation	Budget List Number	Amount
EPIC	22-23	301.001J	$ 2,023,696
EPIC	23-24	301.001K	$ 1,976,304

TOTAL Amount: $ 4,000,000

R&D Program Area: ESB: Renewables

Explanation for "Other" selection Not applicable

Reimbursement Contract #: Not applicable

Federal Agreement #: Not applicable

M. Recipient's Contact Information

1. Recipient's Administrator/Officer

Name: Chathu Abeyrathna

Address: 1400 Radio Rd

City, State, Zip: Redwood City, CA 94065-1220

Phone: 415-515-5261

E-Mail: cabey@svcw.org

3. Recipient's Project Manager

Name: Chathu Abeyrathna

Address: 1400 Radio Rd

City, State, Zip: Redwood City, CA 94065-1220

Phone: 415-515-5261

E-Mail: cabey@svcw.org

N. Selection Process Used

There are three types of selection process. List the one used for this GRF.

Selection Process	Additional Information
Competitive Solicitation #	GFO-23-315
First Come First Served Solicitation #	Not applicable
Other	Not applicable

O. Attached Items

1. List all items that should be attached to this GRF by entering "Yes" or "No".

Item Number	Item Name	Attached
1	Exhibit A, Scope of Work/Schedule	Yes
2	Exhibit B, Budget Detail	Yes
3	CEC 105, Questionnaire for Identifying Conflicts	Yes
4	Recipient Resolution	No
5	Awardee CEQA Documentation	No

Approved By

Individuals who approve this form must enter their full name and approval date in the MS Word version.

Agreement Manager: Baldomero Lasam

Approval Date: 3/12/2025

Branch Manager: Kevin Uy

Approval Date: 3/20/2025

Director: Kevin Uy for Jonah Steinbuck

Approval Date: 3/20/2025

Exhibit A
Scope of Work
Silicon Valley Clean Water

I. TASK ACRONYM/TERM LISTS

A. Task List

Task #	CPR[1]	Task Name
1		General Project Tasks
2	X	Gas Conditioning System Installation & Deployment
3		Electrical Switchgear Upgrade
4	X	LG System Installation & Deployment
5		Data-Driven Capacity Planning Tool
6		Data Ingestion & Cleaning
7		Predictive Modeling
8		MPC Backend Development
9		MPC GUI Development
10	X	Hardware Integration & Testing
11		Pilot Demonstration Tests
12		Technology Dissemination & Productization
13		Evaluation of Project Benefits
14		Technology Transfer Activities

B. Acronym/Term List

Acronym/Term	Meaning
AD	Anaerobic Digester
API	Application Programmer Interface
BES	Battery Energy Storage
BMC	Biogas Microgrid Controller
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CEC	California Energy Commission
CPR	Critical Project Review
GUI	Graphical User Interface
IBDR	Incentive-Based Demand Response
ICE	Internal Combustion Engine
IoT	Internet of Things
LCA	Life Cycle Assessment
LG	Linear Generator
MPC	Model Predictive Control
NPV	Net Present Value
PBP	Payback Period
ROI	Return on Investment
SCADA	Supervisory Control And Data Acquisition
SCFM	Standard Cubic Feet Per Minute

[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.

Acronym/Term	Meaning
TAC	Technical Advisory Committee
TEA	Techno-Economic Analysis
WRRF	Water Resource Recovery Facility

II. 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 facility-scale, predictive Biogas Microgrid Controller (BMC) that flexibly dispatches 730 kilowatts (kW) of clean, renewable generation using three biogas-fueled linear generators (LG) installed at the Recipient's municipal wastewater treatment facility. The BMC will coordinate the LGs with the facility's dynamic energy system, that includes the treatment load, anaerobic digesters, 1.25 megawatts (MW) internal combustion engine (ICE) co-generator, and 2 megawatt-hour (MWh)/1 MW battery, to minimize electricity costs and maximize demand response revenues. The expected electricity savings will boost the commercial viability of LG technology, allowing it to scale clean, dispatchable biogas generation across California's wastewater sector.

B. Problem/ Solution Statement

Problem

There is substantial misalignment in the timing of biogas production, the generation capacity, and the energy demand at the plant at most Wastewater Resource Recovery Facility (WRRFs). This misalignment between biogas production and onsite electricity and gas needs also increases the degree to which facilities rely on blending with carbon-intensive fossil gas. Additionally, the biogas renewable energy generation and onsite energy management systems at WRRFs are deeply fragmented and can be unprofitable if not carefully managed. This fragmentation impedes expanded use of WRRFs as centers for organic waste digestion, prevents WRRFs from becoming net energy producers, and impedes integration of clean, dispatchable technologies such as LGs into wastewater treatment plant energy networks.

WRRFs are a large and growing source of greenhouse gas emissions, with Scope 1, 2, and 3 emissions accounting for 2% of the U.S.'s total[2,3,4,5]. WRRFs digest wastewater biosolids, augmented with fats, oils and greases (FOG) and locally collected food waste (FW), to produce biogas. Biogas combusted onsite using ICE co-generators can produce electricity and heat while emitting an estimated 167 g of NO_x and 93 g of VOCs for every MWh they generate[6]

[2] The Estimating Air pollution Social Impact Using Regression (EASIUR) Model. https://barney.ce.cmu.edu/~jinhyok/easiur/.

[3] Mainspring. Product Specifications. https://www.mainspringenergy.com/solutions/#specs.

[4] Rieke, C., Stollenwerk, D., Dahmen, M. & Pieper, M. Modeling and optimization of a biogas plant for a demand-driven energy supply. Energy 145, 657–664 (2018).

[5] Cortés, L. G. et al. Full-Scale Digesters: Model Predictive Control with Online Kinetic Parameter Identification Strategy. Energies 15, 8594 (2022).

[6] Liu, Y. et al. Experiments and Modeling for Flexible Biogas Production by Co-Digestion of Food Waste and Sewage Sludge. Energies 13, 818 (2020).

thereby complicating proposals for expanded operation around historically disadvantaged community impacted by air quality concerns.

Solution

WRRFs need BMC systems for comprehensive plant energy management. A BMC system would deliver value by forecasting plant load and timing biogas production to ensure alignment with that load. It would also integrate native energy flexibility resources at the WRRF (e.g., food waste storage, flow equalization, backup batteries, blending capacity) to minimize energy consumption during time-of-use periods and maximize participation in demand response programs. These systems are critical to eliminating biogas flaring and ensuring compliant, profitable, and clean onsite electricity generation.

LGs can be used as a biogas electricity generation technology that is more efficient and generates significantly less air pollution than ICE co-generators, while being significantly more dispatchable and resilient to variable gas quality than Solid Oxide Fuel Cells. LGs use pressure variations to extract the chemical energy from fuels at lower temperatures, essentially eliminating NOx and other air contaminant emissions[3]. However, widespread deployment of LGs in the wastewater sector is limited by: (1). Their relative novelty in a conservative sector, (2). Their cost disadvantage relative to state-of-the-art ICE co-generators, and (3). Lack of technologies that can demonstrate their dispatchability value by coordinating them with on-site loads and energy storage.

The WRRF has on-site electric load averaging 2 MW and electricity costs averaging roughly $1,500,000 per year. The WRRF will install 730 kW of LG units at its site and work with private companies to develop and deploy a BMC that will coordinate the LGs with 2 ICE co-generators and an on-site Battery Energy Storage (BES). This energy management system delivers value by forecasting plant load and biogas production to ensure alignment with that load. The BMC will use the BES to reduce electricity bills with peak shaving and load shifting, offer demand response to CA's grid, and reduce biogas flaring to ensure compliant, profitable, and clean dispatchable electricity generation. Preliminary estimates for the Recipient's facility indicate coordinated operation of an LG through a BMC could increase the return on investment (ROI) from 2% to 3% and reduce the payback period (PBP) from 12 years to 7 years, giving a net present value (NPV) advantage of $9.7 million relative to ICE co-generators over a 20-year investment horizon.

C. Goals and Objectives of the Agreement

Agreement Goals

The goals of this Agreement are to:

- Design and build a gas conditioning system, that serves as an enhancing feature, capable of treating 275 standard cubic feet per minute (SCFM) of raw anaerobic digestion biogas.
- Deploy and demonstrate 3 clean, dispatchable LG units with 730 kW electric power generation capacity at a WRRF that can generate an average of at least 600 kW of new, behind the meter, biogas-fueled electric power.
- Develop and deploy a BMC as a demand flexibility technology that can manage the load shifting and real-time monitoring and is capable of:

  - Reducing electricity costs by an amount that supports a BES upgrade payback period under 10 years (as estimated in the *Measurement and Verification Plan*).
  - Offering an average of 100-250 kW of demand response to California's grid through one of its Incentive-Based Demand Response (IBDR) programs.
- Demonstrate system emissions compliance with the electric generation emissions standards set by the Bay Area Air Quality Management District.
- Demonstrate an increase in Technology Readiness Level (TRL) for the BMC from its current maturity at TRL 5 and bring it to TRL 8.

Ratepayer Benefits:[7] This Agreement will result in the ratepayer benefits of greater electricity reliability and lower costs by:

1. Reducing GHG emissions and criteria air pollutants with the deployment of novel, clean, dispatchable LG generation using renewable fuels in the wastewater sector and reducing wastewater biogas flaring. The LG technologies have criteria air pollutant emissions that are required for California Air Resources Board's Distributed Generation Certification Program. At the Recipient's facility, criteria air pollutant emissions reduction estimates are 1.1 tons NOx/year from meeting the additional.
2. Maximizing the use of renewable fuel resources for on-site generation by deploying a first-of-a-kind BMC that coordinates a WRRF's LG and on-site BES to achieve load shifting out of CA's peak time-of-use hours (1,100 MWh/year), shave peak demand (600 kW), and supply additional demand responses to CA's grid (100-275 kW). Excess biogas-fueled electricity can be stored when not needed, giving flexibility to follow the variable load demands and offer greater reliability and resiliency to changes in the renewable fuel supply that arise from the complexities of the digestion processes.
3. Establishing economic benefits from job creation and support of local clean energy startups. Installation and operation of the systems will lead to employment of local installers and maintenance technicians and associated local economic benefits to the community.

Technological Advancement and Breakthroughs:[8] 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:

1. Developing new, high-resolution, real-time models of biogas production that can be used in the future to operate biosolids and biogas storage to eliminate GHG emissions and criteria air pollutants from biogas flaring (in the wastewater sector or otherwise).
2. Developing and demonstrating efficient software frameworks with a predictive BMC platform that coordinates a WRRF's energy recovery, generation, and wastewater treatment

[7] California Public Resources Code, Section 25711.5(a) requires projects funded by the Electric Program Investment Charge (EPIC) to result in ratepayer benefits. The California Public Utilities Commission, which established the EPIC in 2011, defines ratepayer benefits as greater reliability, lower costs, and increased safety (See CPUC "Phase 2" Decision 12-05-037 at page 19, May 24, 2012, http://docs.cpuc.ca.gov/PublishedDocs/WORD_PDF/FINAL_DECISION/167664.PDF).

[8] California Public Resources Code, Section 25711.5(a) also requires EPIC-funded projects to lead to technological advancement and breakthroughs to overcome barriers that prevent the achievement of the state's statutory and energy goals.

at facility scale for industrial infrastructure and behind-the-meter distributed energy resources with electricity grids to provide additional energy services to California's electric grid.

3. Demonstrating the still-nascent LG technology at wastewater facilities. LGs produce near-zero NOx emissions, providing clean electricity that is unconstrained by air contaminant emissions permits and does not impair local air quality for surrounding communities. This breakthrough would facilitate the process for air emission permits which are one of the greatest barriers to expanded onsite generation in urban wastewater settings.

Agreement Objectives

The objectives of this Agreement are to:

- Design, build, and deploy a gas conditioning system that cleans biogas to a standard suitable for use in an LG (as detailed in the technology developer's fuel specifications).
- Procure, install, and deploy three biogas-fueled LG generators and demonstrate the system for a minimum of 1,000 hours of testing and data gathering.
- Develop and deploy the BMC to conduct the technical tasks to sufficiently demonstrate the LG commercial viability by tapping its dispatchability value.
- Demonstrate the LG emissions performance by complying with the testing procedures in Attachment 1 "On-Site Off-Grid Electric Power Generation Test Procedures".
- Increase the TRL by implementing the co-generator and battery setpoints recommended by the BMC into the facility's Supervisory Control and Data Acquisition (SCADA) system and battery control system.
- Promote LG + BMC technology by developing a web-based LG + BMC Capacity Planning Application and presenting the application and the LG + BMC demonstration to relevant external stakeholders.
- Develop and execute a detailed safety plan to address safe operation and procedures.
- Conduct the following system studies: Techno-Economic Analysis; Life Cycle Assessment that includes a section for a Carbon Intensity Analysis.

III. 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).** All products submitted which will be viewed by the public, must comply with the accessibility requirements of Section 508 of the federal Rehabilitation Act of 1973, as amended (29 U.S.C. Sec. 794d), and regulations implementing that act as set forth in Part 1194 of Title 36 of the Federal Code of Regulations**.** All technical tasks should include product(s). 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, including the Final Report Outline and Final Report

- 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.
- Consider incorporating all CAM comments into the final product. If the Recipient disagrees with any comment, provide a written response explaining why the comment was not incorporated into the final product.
- Submit the revised product and responses to comments within 10 days of notice by the CAM, unless the CAM specifies a longer time period, or approves a request for additional time.

For products that require a final version only

- Submit the product to the CAM for acceptance. The CAM may request minor revisions or explanations prior to acceptance.

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 California Energy Commission's (CEC) 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.

The following describes the accepted formats for electronic data and documents provided to the CEC 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.
- 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 CEC'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, and other CEC staff relevant to the Agreement. The Recipient's Project Manager and any other individuals deemed necessary by the CAM or the Project Manager shall participate in 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., Teams, Zoom), with approval of the CAM.

  The Kick-off meeting will include discussion of the following:
  - The CAM's expectations for accomplishing tasks described in the Scope of Work;
  - An updated Project Schedule;
  - Terms and conditions of the Agreement;
  - Invoicing and auditing procedures;
  - Travel;
  - Equipment purchases;

- Administrative and Technical products (subtask 1.1);
- CPR meetings (subtask 1.3);
- Monthly Calls (subtask 1.5)
- Quarterly Progress reports (subtask 1.6)
- Final Report (subtask 1.7)
- Match funds (subtask 1.8);
- Permit documentation (subtask 1.9);
- Subawards(subtask 1.10);
- Technical Advisory Committee meetings (subtasks 1.11 and 1.12);
- Agreement changes;
- Performance Evaluations; and
- Any other relevant topics.

- Provide *Kick-off Meeting Presentation* to include but not limited to:
  - Project overview (i.e. project description, goals and objectives, technical tasks, expected benefits, etc.)
  - Project schedule that identifies milestones
  - List of potential risk factors and hurdles, and mitigation strategy

- Provide an *Updated Project Schedule, Match Funds Status Letter,* and *Permit Status Letter*, 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:
- Kick-off Meeting Presentation
- Updated Project Schedule *(if applicable)*
- Match Funds Status Letter (subtask 1.7) *(if applicable)*
- Permit Status Letter (subtask 1.8) *(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 CEC 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 CEC 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 CEC.

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 may 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 CEC, 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 and submit 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.
- 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* with a list of expected CPR participants in advance of the CPR meeting. If applicable, the agenda may 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. A determination of unsatisfactory progress This may result in project delays, including a potential Stop Work Order, while the CEC determines whether the project should continue.
- 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)

CAM Products:

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

  The technical and administrative aspects of Agreement closeout will be discussed at the meeting, which may be divided into two separate meetings at the CAM's discretion.
  - The technical portion of the meeting will involve the presentation of findings, conclusions, and recommended next steps (if any) for the Agreement. The CAM will determine the appropriate meeting participants.
  - The administrative portion of the meeting will involve a discussion with the CAM of the following Agreement closeout items:

  - Disposition of any procured equipment.
  - The CEC'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 copies of *All Final Products* organized by the tasks in the Agreement.

Products:

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

MONTHLY CALLS, REPORTS AND INVOICES

Subtask 1.5 Monthly Calls

The goal of this task is to have calls at least monthly between the CAM and Recipient to verify that satisfactory and continued progress is made towards achieving the objectives of this Agreement on time and within budget.

The objectives of this task are to verbally summarize activities performed during the reporting period, to identify activities planned for the next reporting period, to identify issues that may affect performance and expenditures, to verify match funds are being proportionally spent concurrently or in advance of CEC funds or are being spent in accordance with an approved Match Funding Spending Plan, to form the basis for determining whether invoices are consistent with work performed, and to answer any other questions from the CAM. Monthly calls might not be held on those months when a quarterly progress report is submitted or the CAM determines that a monthly call is unnecessary.

The CAM shall:

- Schedule monthly calls.
- Provide questions to the Recipient prior to the monthly call.
- Provide call summary notes to Recipient of items discussed during call.

The Recipient shall:

- Review the questions provided by CAM prior to the monthly call
- Provide verbal answers to the CAM during the call.

Product:

- Email to CAM concurring with call summary notes.

Subtask 1.6 Quarterly 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 *Quarterly Progress Report* to the CAM. Each progress report must:
  - Summarize progress made on all Agreement activities as specified in the scope of work for the reporting period, including accomplishments, problems, milestones, products, schedule, fiscal status, and an assessment of the ability to complete the Agreement within the current budget and any anticipated cost overruns. Progress reports are due to the CAM the 10th day of each January, April, July, and October. The Quarterly Progress Report template can be found on the ECAMS Resources webpage available at: https://www.energy.ca.gov/media/4691
- Submit a monthly or quarterly *Invoice* on the invoice template(s) provided by the CAM.

Recipient Products:

- Quarterly Progress Reports
- Invoices

CAM Product:

- Invoice template

Subtask 1.7 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. When creating the Final Report Outline and the Final Report, the Recipient must use the CEC Style Manual provided by the CAM.

Subtask 1.7.1 Final Report Outline

The Recipient shall:

- Prepare a *Final Report Outline* in accordance with the *Energy Commission Style Manual* provided by the CAM.

Recipient Products:

- Final Report Outline (draft and final)

CAM Products:

- Energy Commission Style Manual
- Comments on Draft Final Report Outline
- Acceptance of Final Report Outline

Subtask 1.7.2 Final Report

The Recipient shall:

- Prepare a *Final Report* for this Agreement in accordance with the approved Final Report Outline, Energy Commission Style Manual, and Final Report Template provided by the CAM with the following considerations:

- Ensure that the report includes the following items, in the following order:
  - Cover page (**required**)
  - Credits page on the reverse side of cover with legal disclaimer (**required**)
  - Acknowledgements page (optional)
  - Preface (**required**)
  - Abstract, keywords, and citation page (**required**)
  - Table of Contents (**required**, followed by List of Figures and List of Tables, if needed)
  - Executive summary (**required**)
  - Body of the report (**required**)
  - References (if applicable)
  - Glossary/Acronyms (If more than 10 acronyms or abbreviations are used, it is required.)
  - Bibliography (if applicable)
  - Appendices (if applicable) (Create a separate volume if very large.)
  - Attachments (if applicable)
- Submit a draft of the Executive Summary to the TAC for review and comment.
- Develop and submit a *Summary of TAC Comments on Draft Final Report* received on the Executive Summary. For each comment received, the Recipient will identify in the summary the following:
  - Comments the Recipient proposes to incorporate.
  - Comments the Recipient does propose to incorporate and an explanation for why.
- Submit a draft of the report to the CAM for review and comment. The CAM will provide written comments to the Recipient on the draft product within 15 days of receipt.
- Incorporate all CAM comments into the *Final Report*. If the Recipient disagrees with any comment, provide a *Written Responses to Comments* explaining why the comments were not incorporated into the final product.

- Submit the revised *Final Report* electronically with any Written Responses to Comments within 10 days of receipt of CAM's Written Comments on the Draft Final Report, unless the CAM specifies a longer time period or approves a request for additional time.

Products:

- Summary of TAC Comments on Draft Final Report
- Draft Final Report
- Written Responses to Comments *(if applicable)*
- Final Report

CAM Product:

- Written Comments on the Draft Final Report

MATCH FUNDS, PERMITS, AND SUBAWARDS

Subtask 1.8 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. 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 application that led to the CEC 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 application that led to the CEC 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.
    - If different from the solicitation application, provide 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)*

Subtask 1.9 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 1.10 Obtain and Execute Subcontracts and Agreements with Site Hosts

The goals of this subtask are to: (1) procure and execute subrecipients and site host agreements, as applicable, required to carry out the tasks under this Agreement; and (2) ensure that the subrecipients and site host agreements are consistent with the Agreement terms and conditions and the Recipient's own contracting policies and procedures.

The Recipient shall:

- Execute and manage subawards and coordinate subrecipient activities in accordance with the requirements of this Agreement.
- Execute and manage site host agreements, and ensure the right to use the project site throughout the term of the Agreement, as applicable. A site host agreement is not required if the Recipient is the site host.
- Notify the CEC in writing immediately, but no later than five calendar days, if there is a reasonable likelihood the project site cannot be acquired or can no longer be used for the project.
- 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.
- Submit a *Subaward and Site Letter* to the CAM describing the subawards and any site host agreement needed or stating that no subawards or site host agreements are required.
- If required by the CAM, submit a draft of each *Subaward* and any *Site Host Agreement* required to conduct the work under this Agreement.
- If requested by the CAM, submit a final copy of each executed *Subaward* and any *Site Host Agreement*.
- Notify and receive written approval from the CAM prior to adding any new subrecipient (see the discussion subrecipient additions in the terms and conditions).

Products:

- Subaward and Site Letter
- Draft Subawards (if requested by the CAM)
- Draft Site Host Agreement (if requested by the CAM)
- Final Subawards (if requested by the CAM)
- Final Site Host Agreement (if requested by the CAM)

TECHNICAL ADVISORY COMMITTEE

Subtask 1.11 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.
- Help set the project team's goals and contribute to the development and evaluation of its statement of proposed objectives as the project evolves.
- Provide a credible and objective sounding board on the wide range of technical and financial barriers and opportunities.
- Help identify key areas where the project has a competitive advantage, value proposition, or strength upon which to build.
- Advocate, to the extent the TAC members feel is appropriate, on behalf of the project in its effort to build partnerships, governmental support, and relationships with a national spectrum of influential leaders.
- Ask probing questions that insure a long-term perspective on decision-making and progress toward the project's strategic goals.

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

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

- Air district staff; and
- Members of relevant technical society committees.

The Recipient shall:

- Prepare a *List of Potential TAC Members* that includes the names, companies, physical and electronic addresses, and phone numbers of potential members. The list will be discussed at the Kick-off meeting, and a schedule for recruiting members and holding the first TAC meeting will be developed.
- Recruit TAC members. Ensure that each individual understands member obligations and the TAC meeting schedule developed in subtask 1.12.
- 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 1.12 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.

The TAC shall:

- Help set the project team's goals and contribute to the development and evaluation of its statement of proposed objectives as the project evolves.
- Provide a credible and objective sounding board on the wide range of technical and financial barriers and opportunities.
- Help identify key areas where the project has a competitive advantage, value proposition, or strength upon which to build.
- Advocate on behalf of the project in its effort to build partnerships, governmental support and relationships with a national spectrum of influential leaders.
- Ask probing questions that insure a long-term perspective on decision-making and progress toward the project’s strategic goals.
- Review and provide comments to proposed project performance metrics.

- Review and provide comments to proposed project Draft Technology Transfer Plan.

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

Subtask 1.13 Project Performance Metrics
The goal of this subtask is to finalize key performance targets for the project based on feedback from the TAC and report on final results in achieving those targets. The performance targets should be a combination of scientific, engineering, techno-economic, and/or programmatic metrics that provide the most significant indicator of the research or technology's potential success.

The Recipient shall:
- Complete and submit the project performance metrics section of the *Initial Project Benefits Questionnaire*, developed in the Evaluation of Project Benefits task, to the CAM.
- Present the draft project performance metrics at the first TAC meeting to solicit input and comments from the TAC members.
- Develop and submit a *TAC Performance Metrics Summary* that summarizes comments received from the TAC members on the proposed project performance metrics. The *TAC Performance Metrics Summary* will identify:
    - TAC comments the Recipient proposes to incorporate into the *Initial Project Benefits Questionnaire*, developed in the Evaluation of Project Benefits task.
    - TAC comments the Recipient does not propose to incorporate with and explanation why.
- Develop and submit a *Project Performance Metrics Results* document describing the extent to which the Recipient met each of the performance metrics in the *Final Project Benefits Questionnaire*, developed in the Evaluation of Project Benefits task.
- Discuss the *Project Performance Metrics Results* at the Final Meeting.

Products:
- TAC Performance Metrics Summary
- Project Performance Metrics Results

IV. TECHNICAL TASKS

TASK 2: GAS CONDITIONING SYSTEM INSTALLATION & DEPLOYMENT

The goal of this task is to install and deploy 275 SCFM of additional gas conditioning capacity for supplying AD biogas to the WRRF's three new LG units.

The Recipient shall:

- Identify a vendor to prepare *a Draft Gas Conditioning Installation Design Package* to install the gas conditioning system at the WRRF. This package will include, but is not limited to:
    - Design drawings and written summary descriptions that include:
        - Civil- concrete foundation and necessary site improvements;
        - Structural- expansion of the WRRF's gas conditioning capacity by 275 SCFM;
        - Mechanical- new pipelines connecting the Gas Conditioning System to LG units;
        - Electrical- controls wire and conduits;
        - Instrumentation and control elements;
        - Technical specifications.
    - Construction Cost estimate.
    - Construction schedule.
- Prepare a *Final Gas Conditioning Installation Design Package* for Gas Conditioning System Installation. This Package will include a written summary and the final gas conditioning system installation design documents stamped by a Professional Engineer in the State of California.
- Solicit bids and select the lowest responsible bidder.
- Install a Gas Conditioning System and prepare the *Gas Conditioning System As-Built Drawings.* The *Gas Conditioning System As-Built Drawings* will capture and describe the changes to the *Final Gas Conditioning Installation Design Package* during construction.
- Work with a system integrator Subrecipient to:
    - Integrate necessary data points into the WRRF's SCADA system.
    - Prepare a *Gas Conditioning System Control Narrative* that describes the control logic for operating the Gas Conditioning System.
    - Implement the *Gas Conditioning System Control Narrative* in the WRRF's SCADA system.
- Start-up and commission the Gas Conditioning System with biogas produced by the WRRF's 3 ADs.
- Collect samples of output biogas quality and contract a third-party lab to prepare a *Gas Quality Laboratory Analysis Report.* This report will include, but is not limited to descriptions of the collection methods and results for the:
    - Concentrations of methane;
    - Concentrations of hydrogen sulfide (H2S);
    - Concentrations of siloxanes;
    - Concentrations of water vapor.
- Prepare and provide *CPR Report #1* in accordance with Subtask 1.3 (CPR Meetings).
- Participate in a CPR Meeting.

Products:

- Gas Conditioning System Installation Design Package (draft and final)
- Gas Conditioning System As-Built Drawings
- Gas Conditioning System Control Narrative
- Gas Quality Laboratory Analysis Report
- CPR Report #1

TASK 3: ELECTRICAL SWITCHGEAR UPGRADE

The goal of this task is to modify the WRRF's electrical switchgear to allow the LGs to interconnect with the WRRF's existing electricity distribution infrastructure.

The Recipient shall:

- Contract with a Subrecipient to prepare a *Switchgear Upgrade Design Package* that describes the current electrical switchgear layout and the modifications being made. The Package will also include but is not limited to:
    - engineering drawings;
    - technical specifications.
- Solicit bids and select lowest responsible bidder.
- Install Switchgear Upgrade and prepare a *Switchgear-As-Built Drawings* as specified in the Switchgear Upgrade Design Package. The Drawings will capture and clearly describe the changes made to the design package during construction. Start-up and commission the Switchgear Upgrade to connect the LGs to the WRRF's existing distribution infrastructure.
- Perform tests of the Switchgear Upgrade and prepare a *Switchgear Startup Report* that includes startup checklists and test reports.

Products:

- Switchgear Upgrade Design Package
- Switchgear As-Built Drawings
- Switchgear Upgrade Startup Report

TASK 4: LG SYSTEM INSTALLATION AND DEPLOYMENT

The goals of this task are: **(1)** To install and deploy 3 LG units for a 730 kW of additional electricity generation capacity at the project site. **(2)** To complete the Measurement and Verification Plan to establish clear performance metrics and methodologies for data acquisition and analysis. **(3)** To develop and execute a detailed safety plan to address safe operation and procedures.

SUBTASK 4.1: Generation System Installation and Commissioning

The goal of this task is to run the three LG units in parallel mode subject to Net Metering 3.0 rules.

The Recipient shall:

- Contract the LG technology vendor to provide a *LG Facility Installation Design Package* that will describe the process to:
    - Add 730 kW additional electric power generation capacity to the WRRF;
    - Provide specifications to operate LG units in parallel mode;

- Specify ancillary equipment such as inverters and step-up transformers.
- Install LG System and Ancillary Equipment and prepare an *LG System As-Built Document* as specified LG Facility Installation Design Package. This document will include, but is not limited to:
  - Descriptions of the technical specifications of the LG system and ancillary equipment.
  - Technical drawings detailing the installation configuration of the LG system and ancillary equipment.
- Work with its system integrator to:
  - Integrate necessary data points into the WRRF's SCADA system.
  - Implement the *LG System Control Narrative* in the WRRF's SCADA system.
- Start-up and commission the LG system and Ancillary Equipment and provide a *Commissioning Report* that verifies and ensures that the system has been built and assembled as intended.
- Run the LG System and Ancillary Equipment on biogas produced by the ADs.
- Prepare an *LG System Test Report*. This report will include, but is not limited to:
  - A summary of:
    - LG system electrical output;
    - Biogas fuel input and measured heating value;
    - LG downtime.
- Prepare and provide *CPR Report #2* in accordance with Subtask 1.3 (CPR Meetings).
- Participate in a CPR Meeting.

Products:

- LG Facility Installation Design Package
- LG System As-Built Document
- LG System Control Narrative
- Commissioning Report
- LG System Test Report
- CPR Report #2

SUBTASK 4.2: Measurement and Verification
The goal of this task is to ensure that measurements are adequately taken and verified to provide the information required for performance metrics assessment.

The Recipient shall:

- Prepare and provide a *Measurement and Verification Plan* to summarize the performance metrics, data acquisition procedures, and analysis methods. This plan will include, but is not limited to:
  - Baseline Data: Clearly establish what baseline data will be used as a reference for comparison.
  - Measurement Tools and Techniques: Detail the equipment and methodologies that will be used to gather performance data.
  - Data Acquisition Procedures: Set up procedures for consistent data collection, including sampling frequency.
  - Data Analysis Methods:
    - Detail how the data will be processed to derive performance metrics, including each of the Key Performance Indicators (KPIs).

        - Outline the specific methods, formulas, or algorithms that will be used to evaluate the KPIs.
        - Determine accuracy of reported KPIs based on instrumentation specifications for defined system inputs and outputs, using uncertainty propagation techniques.
    - Verification procedure: describe how the analyzed data will be verified.
- Consult with TAC on a *Draft Measurement and Verification Plan* to verify technical feasibility in accordance with subtask 1.11 (Technical Advisory Committee). Incorporate TAC feedback into the *Final Measurement and Verification Plan* as appropriate.

Products:
- Measurement and Verification Plan (draft and final)

SUBTASK 4.3: Safety Plan
The goal of this task is to develop and execute a detailed safety plan to address safe operation and procedures.

The Recipient shall:
- Prepare and provide a *Safety Plan* for safe operation and procedures that include, but is not limited to:
    - Developing standard operating procedures to safely perform work.
    - Identifying leading and lagging indicators to assess safety performance both proactively and retrospectively.
    - Conducting hazard assessments to reduce safety risks.
- Develop and execute the Safety Plan.

Products:
- Safety Plan (draft and final)

TASK 5: DATA-DRIVEN CAPACITY PLANNING TOOL
The goal of this task is to develop a customized, simulation-based energy capacity planning tool for the WRRFs demonstration site that allows them to estimate the financial value of coupled gas conditioning, LG implementation, and BES upgrades given their existing treatment configuration, energy generation and storage infrastructure, and embedded energy flexibility resources. The tool will use operational and design data from the WRRF's SCADA history and design documents, respectively.

The Recipient shall:

- Contract with the Subrecipient to:
    - Develop the Python Source Code for a Model of LG Technology in Python that:
        - Relates biogas fuel input, temperature, and ambient pressure to electrical output.
        - Predicts electrical output with a mean out-of-sample prediction error less than 10%.
    - Add the Python Source Code for a Model of LG Technology to the Subrecipient's flows-design Model Predictive Control (MPC) python package.

- Prepare and provide a *Python Model of LG Technology Report* that describes the predictive performance of the Model of LG Technology's outputs using operational data from SVCW.
- Add the Python Source Code for a Design Module for LG and BES Upgrades to the Subrecipient's flows-design Python package.
- Prepare and provide a *Python Model Upgrades Report* that includes but is not limited to describing the methodology for developing and executing the Python Source Code for a Design Module for LG and BES Upgrades and provides the results and discussion on the upgraded model outputs.
- Prepare and provide a *Techno-Economic Analysis (TEA) Study* that uses the Python Source Code for a Design Module for LG and BES Upgrades that includes, but is not limited to:
  - Estimates on the capital cost, NPV, ROI, and PBP of LG upgrades coupled with upgrades to and operationalization of a WRRF's existing and embedded energy generation and flexibility resources (as specified above).
- Prepare and provide a *Life Cycle Assessment (LCA) Study* that uses the Python Source Code for a Design Module for LG and BES Upgrades that includes, but is not limited to:
  - Estimates on the PBP of LG upgrades coupled with upgrades to and operationalization of a WRRF's existing and embedded energy generation and flexibility resources (as specified above).
  - As part of the LCA, prepare and provide a Carbon Intensity Analysis Study that includes but is not limited to estimates on the carbon emissions from fuel supply chain to downstream emissions to assess environmental impacts associated with the renewable fuel used to generate electricity.

Products:

- Python Model of LG Technology Report
- Techno-Economic Analysis Study
- Life Cycle Assessment Study

TASK 6: DATA INGESTION & CLEANING

The goal of this task is to incorporate additional data points necessary for real-time MPC of the installed LG units, ICE Co-generator, and Tesla Powerpack BES into the Subrecipient's existing data ingestion and cleaning pipeline. Additional data points will include Internet of Things (IoT) sensors measuring: LG temperature, LG fuel input, LG electric output, and BES power. In addition, the Recipient will work with the Subrecipient to create a SCADA tag that facility operators can use to represent planned maintenance events in which its ICE Cogeneration engines and LG units will be offline.

The Recipient shall:

- Contract with the Subrecipient to:
  - Develop Updated Source Code of the Open Source "pype-schema" Python Package and provide an *Updated Source Code Report* that:

        - Includes a description of the schema for the metadata relevant to the LG operation, including, but not limited to:
            - Fuel input;
            - Ambient temperature;
            - Generation capacity;
            - Electric output.
    - Incorporate relevant IoT sensor data into the Subrecipient's data ingestion pipeline, including:
        - LG data points;
        - BES data points;
        - Ambient temperature at the WRRF.
    - Add SCADA tags representing ICE Co-generator and LG system maintenance schedules to its data ingestion pipeline.
- Draft a *BES Operations Report* that summarizes data collection and monitoring effort in real-time, at 5-minute intervals for the BES system.
- Draft an *LG Operations Report* that summarizes data collection and monitoring effort in real-time, at 5-minute intervals for the LG System and Ancillary Equipment.

Products:
- Updated Source Code Report
- BES Operations Report
- LG Operations Report

TASK 7: PREDICTIVE MODELING
The goal of this task is to develop methods for forecasting deliveries of food waste and fats oils and greases to the WRRF and biogas produced by its 3 ADs.

The Recipient shall:
Contract with the Subrecipient to:
- Develop a Python Source Code for an Organic Waste Delivery Forecaster that predicts the timing of food waste and fats oils and greases deliveries to a WRRF.
- Develop a Python Source Code for a Biogas Forecaster that uses models from the Python Source Code for an Organic Waste Delivery Forecaster approaches developed through applied research from the Subrecipient.
- Incorporate the Python Source Code for an Organic Waste Delivery Forecaster and Python Source Code for a Biogas Forecaster into the Subrecipient's "flows-mpc" Python package.
- Draft a *Biogas Predictive Modeling Report* that summarizes the predictive performance of the Python Source Code for an Organic Waste Delivery Forecaster and Python Source Code for a Biogas Forecaster.

Products:
- Biogas Predictive Modeling Report (draft and final)

TASK 8: MPC BACKEND DEVELOPMENT
The goal of this task is to develop the computing infrastructure necessary to securely host the MPC on-site and recover operations after server failure and an on-site power and/or internet

outage. Cloud computing resources will be used to back up necessary data and push updates and/or fixes to the MPC codebase.

The Recipient shall:

- Contract with the Subrecipient to prepare and provide a *Summary of Backend Development Activities Report* that includes, but is not limited to descriptions for:
    - Updating the Subrecipient's *"flows-mpc"* Python package by:
        - Developing Python Source Code for an Outage Planning Module that allows operators to specify planned ICE Co-generator and LG outages to the MPC.
    - Procuring, installing, and configuring three On-Site Servers to host the MPC.
    - Developing an Edge Computing Application that:
        - Periodically syncs relevant data, metadata, and models across all three On-Site Servers.
        - Is part of the WRRF's cybersecure local area network.
        - Has command access to the WWRF's:
            - SCADA system;
            - BES firmware.
    - Developing a Cloud Computing Application that:
        - Periodically pushes relevant data, metadata, and models from the On-Site Servers' MPCs so that MPC operations can resume if all three On-Site Servers fail.
        - Can securely push encrypted MPC updates/fixes through a Virtual Private Network tunnel to the On-Site Servers.

Products:

- Summary of Backend Development Activities Report (draft and final)

TASK 9: MPC GUI DEVELOPMENT

The goal of this task is to develop a Graphical User Interface (GUI) that allows the Recipient's operations and management team to interact with the Subrecipient's BMC. The GUI will also allow the Recipient's operations and management team to notify the BMC of ICE Co-generator and LG unit maintenance events.

The Recipient shall:

- Work with the Subrecipient to prepare and provide an *GUI Development Report* that includes, but is not limited to descriptions for the:
    - Development of an updated Control GUI that allows the recipient's operations and management team to:
        - View or refresh MPC forecasts, setpoints, and energy-relevant data.
        - Disable, or override the MPC setpoints.
    - Development of a Generator Maintenance GUI that:
        - Allows the recipient's operations and management team to represent and/or modify anticipated ICE Co-generator and LG maintenance events.
    - Development if a Demand Response GUI that:
        - Allows the recipient's operations and management team to view, refresh, disable or override planned participation in IBDR events.

Products:

- GUI Development Report (draft and final)

TASK 10: HARDWARE INTEGRATION & TESTING
The goal of this task is to integrate and test the hardware and software and conduct the ICE-co-generator, BES, LG, and ancillary equipment testing.

The Recipient shall:

- Remove BES management hardware and software from the WRRF Tesla Powerpack BES.
- Work with a Subrecipient to develop and provide an *ICE Co-generator Control Narrative* that implements setpoints schedules issued by the BMC. This narrative document will include, but is not limited to descriptions for the:
    - The biogas fuel injection setpoints operated by the BMC.
    - The natural gas fuel injection setpoints operated by the BMC and excess biogas burned in the flares.
- Use a Subrecipient to develop and provide a *Modified LG Control Narrative* that implements setpoints schedules issued by the BMC. This narrative document will include, but is not limited to descriptions for the:
    - The biogas fuel injection setpoints produced by the BMC.
    - The natural gas fuel injection setpoints produced by the BMC and excess biogas burned in the flares.
- Contract with a Subrecipient to:
    - Prepare and provide draft and final Python Source Code for a Scheduling Module that
        - Re-formats MPC battery setpoints into a structure that can be parsed by a Tesla Powerpack's scheduling Application Programmer Interface (API).
        - Reformats MPC ICE co-generator and LG setpoints into a structure that can be parsed by the Recipient's SCADA system.
    - Incorporate the Python Source Code for a Scheduling Module into the Subrecipient's "flows-mpc" codebase.
    - Obtain the Tesla Powerpack BES user license codes necessary for using the Tesla Powerpack BES scheduling API.
    - Run ICE Co-generator setpoint tracking tests and draft an *ICE Co-generator Setpoint Tracking Test Report* showing that relevant ICE Co-generator control points reflect setpoints issued by the BMC.
    - Run BES setpoint tracking tests and prepare and provide a *BES Setpoint Tracking Test Report* showing that relevant BES control points reflect setpoints issued by the BMC.
    - Run LG System and Ancillary Equipment setpoint tracking tests and prepare and provide a *LG Setpoint Tracking Test Report* showing that relevant LG System and Ancillary Equipment control points reflect setpoints issued by the BMC.
- Prepare and provide *CPR Report #3* in accordance with Subtask 1.3 (CPR Meetings).
- Participate in a CPR Meeting.

Products:

- ICE Co-generator Control Narrative
- Modified LG Control Narrative
- ICE Co-generator Setpoint Tracking Test Report
- BES Setpoint Tracking Test Report

- LG Setpoint Tracking Test Report
- CPR Report #3

TASK 11: PILOT DEMONSTRATION TESTS

The goals of this task are: **(1)** to run the Subrecipient's BMC for 1,000 hours of testing and data gathering and **(2)** to monitor the cost and emissions performance to evaluate the feasibility, cost-effectiveness, and overall system performance.

SUBTASK 11.1: Demonstration Testing and Data Gathering

The goal of this task is to run two related 1,000-hour demonstrations that show: (1) the operation of the BMC with the Recipient's ICE Co-generators and Tesla Powerpack BES and (2) the operation of the BMC with the ICE Co-generators, Tesla Powerpack, and LG units. Data collected will be used to quantify the system's impact in electric and fossil fuel savings during peak hours (e.g., 16:00 to 21:00) and include an analysis of the fuel impact on the capacity factor.

The Recipient shall:

- Ensure that the Measurement and Verification Plan is adequately implemented to provide the information required for the performance assessments.
- Analyze experimental data and extract performance metrics as dictated in the Measurement and Verification Plan.
- Coordinate with the Subrecipient to:
    - Run a 1,000-hour demonstration of the BMC with the Recipient's 1.26 MW ICE Co-generators and 2 MWh/1 MW Tesla Powerpack BES.
    - Run a 1,000-hour demonstration of the BMC with the Recipient's 1.26 MW ICE Co-generators, 2 MWh/1 MW Tesla Powerpack BES, and 730 kW LG system.
- Draft two associated reports:
    - *Demonstration Report 1* that includes, but is not limited to:
        - Documenting the performance of a BMC running the recipient's 1.26 MW ICE Co-generators and 2 MWh/1 MW Tesla Powerpack BES.
        - Describing issues and bug fixes affecting operation of the above system.
    - *Demonstration Report 2* that includes, but is not limited to:
        - Documenting the performance of a BMC running the recipient's 1.26 MW ICE Co-generators, 2 MWh/1 MW Tesla Powerpack BES, 730 kW LG system.
        - Describing issues and bug fixes affecting operation of the above system.

Products:

- Demonstration Report 1
- Demonstration Report 2

SUBTASK 11.2: Emissions Testing

The goal of this task is to provide specific emissions data as requested by the California Energy Commission on behalf of the California Air Resources Board.

The Recipient shall:

- Comply with the testing procedures in Attachment #1 "On-Site Off-Grid Electric Power Generation Test Procedures".
- Prepare and provide *Emissions Test Result(s) or Permitting Test Report(s)*. This includes the initial source test report that is prepared for permitting the facility with the Bay Area Air Quality Management District.

Products:

- Emissions Test Result(s) or Permitting Test Report(s)

TASK 12: TECHNOLOGY DISSEMINATION & PRODUCTIZATION

The goal of this task is to: **(1)** Raise awareness of the LG and BMC systems' potential for clean, dispatchable biogas electricity generation and energy cost savings, respectively, and **(2)** Productize the Data Driven Capacity Planning Tool from Task 5 as a web application that any WWRF manager can use to evaluate the financial value of an LG and BES using customizable designs and facility-specific operational data and electricity rates.

The Recipient shall:

- Contract with the Subrecipient to:
  - Develop Python Source Code for a Design Module for LG and BES Upgrades that:
    - Runs control simulations on operational data and other WRRF metadata of LG's coupled with a WRRF's existing and embedded energy generation and flexibility resources, including:
      - BES;
      - ICE Co-generators;
      - Low pressure membrane biogas storage.
    - Estimates the benefits of a BMC, including:
      - Electricity bill savings
      - Revenues from participating in IBDR programs
  - Prepare and provide a *LG + BMC Capacity Planning Summary Report* that describes how the Subrecipient worked to:
    - Develop a cloud-based LG + BMC Capacity Planning Application Backend that implements the computing architecture for hosting and running the Design Module for LG and BES Upgrades.
    - Develop a cloud-based LG + BMC Capacity Planning Application GUI that allows users to:
      - Upload their WRRF'S electricity demand and co-generator electric output data on a comma-separated-value (CSV) format;
      - Specify LG, BES system sizes;
      - Upload electric tariff data in a CSV format;
      - View the capital cost and simulation-based bill savings, NPV, ROI, and PBP of the resulting LG + BES upgrades run on a BMC.
  - Prepare and provide a *BMC Tutorial Markdown Document* providing a step-by-step guide to using its UI to view setpoints and forecasts, plan co-generator outages, and refresh, adjust, override, or disable setpoints.
  - Prepare and deliver a 2-hour *BMC Workshop & Demo Presentation Slides* to the Recipient presenting the *BMC Tutorial Markdown Document* and the BMC application developed in Tasks 7-8.

- Prepare and deliver one 1-hour hybrid in-person/remote *LG + BMC Capacity Planning Workshop & Demo* presenting the LG + BMC demonstration and the LG + BMC Capacity Planning GUI in an open webinar in coordination with the Recipient's management staff and regional WWRF consortia.
- Coordinate with the LG technology Vendor to deliver one 1-hour *LG + BMC Capacity Planning Workshop & Demo* to its sales and management teams.
- Prepare and deliver *Industry Trade Conference Presentations & Demos* presenting the findings of the LG + BMC demonstration and the LG + BMC Capacity Planning GUI at regional wastewater trade conferences.

Products:

- LG + BMC Capacity Planning Summary Report
- BMC Tutorial Markdown Document
- BMC Workshop & Demo Presentation Slides
- LG + BMC Capacity Planning Workshops & Demos
- Industry Trade Conference Presentations & Demos

TASK 13: EVALUATION OF PROJECT BENEFITS

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

The Recipient shall:

- Complete *the Initial Project Benefits Questionnaire*. The Initial Project Benefits Questionnaire shall be initially completed by the Recipient with 'Kick-off' selected for the 'Relevant data collection period' and submitted to the CAM for review and approval.
- Complete the *Annual Survey* by January 31st of each year. The Annual Survey includes but is not limited to the following information:
  - Technology commercialization progress;
  - New media and publications;
  - Company growth;
  - Follow-on funding and awards received.
- Complete the *Final Project Benefits Questionnaire*. The Final Project Benefits Questionnaire shall be completed by the Recipient with 'Final' selected for the 'Relevant data collection period' and submitted to the CAM for review and approval.
- Respond to CAM questions regarding the questionnaire drafts.
- Complete and update the project profile on the CEC's public online project and recipient directory on the Energize Innovation website (www.energizeinnovation.fund), and provide *Documentation of Project Profile on EnergizeInnovation.fund*, including the profile link.
- If the Prime Recipient is an Innovation Partner on the project, complete and update the organizational profile on the CEC's public online project and recipient directory on the Energize Innovation website (www.energizeinnovation.fund), and provide *Documentation of Organization Profile on EnergizeInnovation.fund*, including the profile link.

Products:

- Initial Project Benefits Questionnaire
- Annual Survey(s)
- Final Project Benefits Questionnaire
- Documentation of Project Profile on Energize Innovation.fund

- Documentation of Organization Profile on EnergizeInnovation.fund

TASK 14 TECHNOLOGY TRANSFER ACTIVITIES

The goal of this task is to ensure the technological learning that resulted from the demonstration(s) is captured and disseminated to the range of professions that will be responsible for future deployments of this technology or similar technologies.

The Recipient Shall:

- Develop and submit a *Project Case Study Plan* that outlines how the Recipient will document the planning, construction, commissioning, and operation of the technology or system being demonstrated. The Project Case Study Plan should include:
    - An outline of the objectives, goals, and activities of the case study.
    - The organization that will be conducting the case study and the plan for conducting it.
    - A list of professions and practitioners involved in the technology's deployment.
    - Specific activities the recipient will take to ensure the learning that results from the project is disseminated to those professions and practitioners.
    - Presentations/webinars/training events to disseminate the results of the case study.
    - Develop and submit a *Project Case Study Plan* that outlines how the Recipient will document the planning, construction, commissioning, and operation of the technology or system being demonstrated. The Project Case Study Plan should include:
        - An outline of the objectives, goals, and activities of the case study.
        - The organization that will be conducting the case study and the plan for conducting it.
        - A list of professions and practitioners involved in the technology's deployment.
        - Specific activities the recipient will take to ensure the learning that results from the project is disseminated to those professions and practitioners.
        - Presentations/webinars/training events to disseminate the results of the case study.
- Develop and submit a *Summary of TAC Comments* that summarizes comments received from the TAC members on the draft *Project Case Study Plan*. This document will identify:
    - TAC comments the Recipient proposes to incorporate into the final *Technology Transfer Plan*.
    - TAC comments the Recipient does not propose to incorporate with and explanation why.
- Submit the final *Project Case Study Plan* to the CAM for approval.
- Execute the final Project Case Study Plan and develop and submit a Project Case Study.
- When directed by the CAM, develop presentation materials for a CEC sponsored conference/workshop(s) on the project.
- When directed by the CAM, participate in annual EPIC symposium(s) sponsored by the California CEC.

- Provide at least (6) six High Quality Digital Photographs (minimum resolution of 1300x500 pixels in landscape ratio) of pre and post technology installation at the project sites or related project photographs.

Products:

- Project Case Study Plan (draft and final)
- Summary of TAC Comments
- Project Case Study (draft and final)
- High Quality Digital Photographs

V. PROJECT SCHEDULE

Please see the attached Excel spreadsheet.