STATE OF CALIFORNIA
GRANT REQUEST FORM (GRF)
CEC-270 (Revised 12/2019) CALIFORNIA ENERGY COMMISSION

A) New Agreement # PIR-21-007 (to be completed by CGL office)

B) Division	Agreement Manager:	MS-	Phone
ERDD	Baldomero Lasam	43	916-776-0784

C) Recipient's Legal Name	Federal ID Number
Electro-Active Technologies Inc.	83-3844123

D) Title of Project
Advancing Cost Reductions and Performance Efficiency for Renewable H2 Generation from Organic Wastes via Microbial Electrolysis

E) Term and Amount

Start Date	End Date	Amount
7/5/2022	3/31/2026	$ 573,714

F) Business Meeting Information

☐ ARFVTP agreements $75K and under delegated to Executive Director

Proposed Business Meeting Date 6/8/2022 ☐ Consent ☒ Discussion

Business Meeting Presenter Baldomero Lasam Time Needed: 5 minutes

Please select one list serve. NaturalGas (NG Research Program

Agenda Item Subject and Description:

Electro-Active Technologies Inc. Proposed resolution approving agreement PIR-21-007 with Electro-Active Technologies Inc. for a $573,714 grant to develop and advance microbial electrolysis technology for conversation of 100 percent renewable organic waste into low carbon hydrogen, and adopting staff's determination that this project is exempt from CEQA. This project will significantly reduce electricity consumption for hydrogen production compared to water electrolysis, use food waste, reduce GHGs, and provide a modularized system for onsite or near-site application.

G) California Environmental Quality Act (CEQA) Compliance

1. Is Agreement considered a "Project" under CEQA?
   - ☐ Yes (skip to question 2)
   - ☐ No (complete the following (PRC 21065 and 14 CCR 15378)):

   Explain why Agreement is not considered a "Project":

2. If Agreement is considered a "Project" under CEQA:
   a) ☒ Agreement **IS** exempt.
   - ☐ Statutory Exemption. List PRC and/or CCR section number:
   - ☒ Categorical Exemption. List CCR section number: Cal. Code Regs., tit. 14, § 15303 ; Cal. Code Regs., tit. 14, § 15306
   - ☐ Common Sense Exemption. 14 CCR 15061 (b) (3)

   Explain reason why Agreement is exempt under the above section: Cal. Code Regs., tit. 14 Section 15306 provides that projects which consist of basic data collection, research, experimental management, and resource evaluation activities, and which do not result in a serious or major disturbance to an

environmental resource are categorically exempt from the provisions of the California Environmental Quality Act. Under this grant, first, the microbial electrolysis cell (MEC) technology will be developed and tested at existing laboratory facilities. During the demonstration phase, the containerized mobile system will be installed and integrated in the winery, which will convert the liquid waste stream into renewable hydrogen gas. Hydrogen gas handling safety protocols will be followed. For these reasons, the proposed work will not have any significant effect on the environment and is exempt under Cal. Code Regs., tit 14, Section 15306,

Section 15303, "New Construction or Conversion of Small Structures"; covers construction and location of limited numbers of new, small facilities or structures; and installation of small new equipment and facilities in small structures. The MEC will be constructed in a containerized mobile system that have a total area of 12 square feet and will be installed at an existing winery in Madera, California (E&J Gallo Winery). The system will convert the liquid waste stream into renewable hydrogen gas. After testing, the components will be removed. Hydrogen gas storage safety protocols will be followed. Based on these characteristics, the project is exempt under Section 15303.

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.

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

Check all that apply

- ☐ Initial Study
- ☐ Negative Declaration
- ☐ Mitigated Negative Declaration
- ☐ Environmental Impact Report
- ☐ Statement of Overriding Considerations

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

Legal Company Name:	Budget
Market Potential, Inc.	$ 60,000
T2M Global LLC	$ 30,000
E. & J. Gallo Winery	$ 183,300 (Match Funds)
	$
	$
	$
	$
	$
	$
	$

I) List all key partners: (attach additional sheets as necessary)

Legal Company Name:

J) Budget Information

Funding Source	Funding Year of Appropriation	Budget List Number	Amount
NG Subaccount, PIERDD	20-21	501.001O	$573,714
			$
			$
			$
			$
			$

R&D Program Area: EGRO: Renewables TOTAL: $ 573,714

Explanation for “Other” selection

Reimbursement Contract #: Federal Agreement #:

K) Recipient’s Contact Information

1. **Recipient’s Administrator/Officer**

   Name: Alex Lewis

   Address: 11020 Solway School Rd
   Ste 112A

   City, State, Zip: Knoxville, TN
   37931-2052

   Phone: 916-316 4305

   E-Mail: alewis@electroactive.tech

2. **Recipient’s Project Manager**

   Name: Abhijeet Borole

   Address: 479 Jessie St

   City, State, Zip: San Francisco, CA
   94103-1832

   Phone: 865-898-4316

E-Mail: aborole@electroactive.tech

L) Selection Process Used

☒ Competitive Solicitation Solicitation #: GFO-21-502
☐ First Come First Served Solicitation Solicitation #:
☐ Non-Competitive Bid Follow-on Funding (SB 115)

M) The following items should be attached to this GRF

1.	Exhibit A, Scope of Work		☐ Attached
2.	Exhibit B, Budget Detail		☐ Attached
3.	CEC 105, Questionnaire for Identifying Conflicts		☐ Attached
4.	Recipient Resolution	☐ N/A	☐ Attached
5.	CEQA Documentation	☐ N/A	☐ Attached

_____ _____
Agreement Manager **Date**

_____ _____
Office Manager **Date**

_____ _____
Deputy Director **Date**

Exhibit A
Scope of Work
Electro-Active Technologies Inc.

I. TASK ACRONYM/TERM LISTS

A. Task List

Task #	CPR[1]	Task Name
1		General Project Tasks
2		Investigate utilization of a waste source for production of Low Carbon hydrogen.
3	X	Increase COD removal efficiency via biocatalyst development.
4		Increase electrical efficiency for Microbial Electrolyis.
5		Investigate process variability via a control system for monitoring microbial electrolysis.
6	X	Demonstrate production of 1 kg/day of hydrogen using a pilot module.
7		Investigate life cycle analysis For microbial electrolysis cell technology.
8		Perform levelized cost analysis.
9		Evaluation of Project Benefits
10		Technology/Knowledge Transfer Activities

B. Acronym/Term List

Acronym/Term	Meaning
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CEC	California Energy Commission
COD	Chemical Oxygen Demand
CPR	Critical Project Review
GHG	Greenhouse Gas
GREET	Greenhouse Gases, Regulated Emissions, and Energy Use in Technologies
kg	Kilogram
MEC	Microbial Electrolysis Cell
MT	Metric Ton
Recipient	Electro-Active Technologies Inc.
TAC	Technical Advisory Committee

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

A. Purpose of Agreement

The purpose of this Agreement is to fund applied research and development of the Recipient's microbial electrolysis technology for conversion of organic waste into low carbon hydrogen.

[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.

Exhibit A
Scope of Work
Electro-Active Technologies Inc.

B. Problem/ Solution Statement

Problem

Microbial electrolysis cell (MEC) technology has immense potential as a carbon negative solution for generating low carbon hydrogen as opposed to conventional, fossil-based steam methane reforming process. However, two significant barriers exist to commercializing of MEC technology: low carbon hydrogen production efficiency and process instability. Inefficient hydrogen production has resulted from low efficient electrical usage and poor chemical conversion of organic compounds. Moreover, some organic contaminants create long downtimes affecting microbial community, which will need to be investigated via the process control system the Recipient has developed.

Solution

This project will advance a microbial electrolysis technology by improving efficiency and overcoming performance stability barriers for low carbon hydrogen production. These activities will include, but are not limited to:

- Improving electrical efficiency by reducing electricity consumption and by using intermittent renewable energy.
- Increasing Chemical Oxygen Demand (COD) conversion of organics through targeted development of a microbial community specifically from renewable waste streams.
- Investigating process stability by implementing a process control system.

C. Goals and Objectives of the Agreement

Agreement Goals

The goals of this Agreement are to:

- Advance the readiness of microbial electrolysis technology and demonstrate conversion of waste stream to low carbon hydrogen.
- Improve electrical efficiency of microbial electrolysis technology to achieve the low carbon hydrogen cost targets.
- Improve low carbon hydrogen production and investigate the effect of feed parameters via process monitoring.
- Scale up the current laboratory system to demonstrate renewable waste stream to hydrogen production at 1 kilogram (kg)/day scale.
- Generate environmental and economic data needed to support greater adoption and commercialization of emerging microbial electrolysis technology.

Ratepayer Benefits: This Agreement will benefit the ratepayer by accelerating the commercialization of a clean, low cost, low carbon hydrogen fuel pathway. The development of microbial electrolysis will create an additional clean fuel supply to California's energy system, helping cap market prices for competing fuels such as natural gas and renewable gas.

In addition, this agreement will provide health and environmental benefits by reducing greenhouse gas (GHG) emissions by as much as 280,000 kg of Carbon Dioxide equivalent per kg of hydrogen produced along with the reduction of criteria pollutants.

Technological Advancement and Breakthroughs: This Agreement will advance a novel microbial electrolysis technology that has increased production efficiency and optimized process stability for low carbon hydrogen production.

Agreement Objectives

The objectives of this Agreement are to:

- Advance the development status of the technology from TRL 3 to at least TRL 5.
- Achieve hydrogen costs targets of $2.5 per kg of hydrogen projected at commercial/industrial scale.
- Produce an average rate of 1 kg hydrogen per day over a series of at least 5 testing cycles (or fewer as approved in writing by the CAM).
- Achieve maximum hydrogen purity for end-use operations.
- Demonstrate the project in a natural gas Investor-Owned Utility service territory (Southern California Gas Company).

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.

Exhibit A
Scope of Work
Electro-Active Technologies Inc.

The Recipient shall:

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

  The administrative portion of the meeting will include discussion of the following:
  - Terms and conditions of the Agreement;
  - Invoicing and auditing procedures;
  - 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 (subtask 1.5);
  - Final Report (subtask 1.6);
  - Technical Advisory Committee meetings (subtasks 1.10 and 1.11); 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 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 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 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)

CAM Products:
- CPR Agenda
- 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 and the CAO 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* on a USB memory stick, organized by the tasks in the Agreement.

Products:

- Final Meeting Agreement Summary *(if applicable)*
- Schedule for Completing Agreement Closeout Activities
- All Final 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 progress made on all Agreement activities as specified in the scope of work for the preceding month, 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. See the Progress Report Format Attachment for the recommended specifications.

- Submit a monthly or quarterly *Invoice* that follows the instructions in the "Payment of Funds" section of the terms and conditions, including a financial report on Match Funds and in-state 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. When creating the Final Report Outline and the Final Report, the Recipient must use the CEC 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 *Energy Commission Style Manual* provided by the CAM.

Recipient Products:
- Final Report Outline (draft and final)

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

Subtask 1.6.2 Final Report

The Recipient shall:
- Prepare a *Final Report* for this Agreement in accordance with the approved Final Report Outline, 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* 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
- Draft Final Report
- Written Responses to Comments *(if applicable)*
- Final Report

CAM Product:

- Written Comments on the Draft Final Report

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 CEC 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 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 proposal 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 1.8 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 each executed subcontract.
- Notify and receive written approval from the CAM prior to adding any new subcontractors (see the discussion of subcontractor additions in the terms and conditions).

Products:
- Subcontracts *(draft if required by the CAM)*

TECHNICAL ADVISORY COMMITTEE

Subtask 1.10 Technical Advisory Committee (TAC)
The goal of this subtask is to create an advisory committee for this Agreement. The TAC should be composed of diverse professionals. The composition will vary depending on interest, availability, and need. TAC members will serve at the CAM's discretion. The purpose of the TAC is to:
- Provide guidance in project direction. The guidance may include scope and methodologies, timing, and coordination with other projects. The guidance may be based on:
  - Technical area expertise;
  - Knowledge of market applications; or
  - Linkages between the agreement work and other past, present, or future projects (both public and private sectors) that TAC members are aware of in a particular area.
- Review products and provide recommendations for needed product adjustments, refinements, or enhancements.
- Evaluate the tangible benefits of the project to the state of California, and provide recommendations as needed to enhance the benefits.

- Provide recommendations regarding information dissemination, market pathways, or commercialization strategies relevant to the project products.
- 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 1.11.
- 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.

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 1.12 Project Performance Metrics

The goal of this subtask is to identify key performance targets for the project. 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 draft *Project Performance Metrics Questionnaire* to the CAM prior to the Kick-off Meeting.
- Present the draft *Project Performance Metrics Questionnaire* 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 final *Project Performance Metrics Questionnaire*.
  - TAC comments the recipient does not propose to incorporate with and explanation why.
- Submit a final *Project Performance Metrics Questionnaire* with incorporated TAC feedback.
- 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 Performance Metrics Questionnaire*.
- Discuss the final *Project Performance Metrics Questionnaire* and *Project Performance Metrics Results* at the Final Meeting.

Products:
- Project Performance Metrics Questionnaire (draft and final)
- TAC Performance Metrics Summary
- Project Performance Metrics Results

IV. TECHNICAL TASKS

TASK 2: INVESTIGATE UTILIZATION OF A WASTE SOURCE FOR PRODUCTION OF LOW CARBON HYDROGEN

The goal of this task is to investigate utilization of a biomass waste stream available within California with specific focus on the disadvantaged California community areas of California Central Valley to demonstrate production of low carbon hydrogen from the MEC.

The Recipient shall:
- Obtain a 100 percent renewable waste stream from a California disadvantaged community for use as feedstock for hydrogen production.
- Identify additional food wastes available in the California Central Valley region to demonstrate feedstock flexibility in hydrogen production throughout the year.
- Build MEC for enrichment of anode microbial catalyst using the renewable liquid organic waste feed based on the Recipient's patented technology.
- Conduct 48-72 hour tests in 80ml MEC systems for studying conversion of the waste stream and determine MEC performance parameters including COD removal, anode efficiency, cathode efficiency, current density, hydrogen production efficiency and hydrogen production rate.
- Prepare a *Renewable Liquid Waste Source and Baseline Analysis Report* that includes but is not limited to:
  - Verification of 100 percent renewable waste stream source;
  - Gas product composition;
  - Results and validation of enrichment of anode microbial catalyst; and
  - Validation of MEC performance baseline/benchmarks and other relevant parameters.

Product:
- Renewable Liquid Waste Source and Baseline Analysis Report (Draft/Final)

TASK 3: INCREASE COD REMOVAL EFFICIENCY VIA BIOCATALYST DEVELOPMENT
The goal of this task is to develop a microbial community capable of 80 percent COD removal efficiency using winery waste streams.

The Recipient shall:

- Perform microbial community engineering to develop biocatalyst for improving COD conversion efficiency.
    - Develop small scale MECs for biocatalyst development and enrich biocatalyst using renewable waste from California disadvantaged communities, followed by characterization of the microbial community.
    - Identify pili proteins, cytochrome enzymes and other electron transfer chain candidates from genomic data.
    - Determine MEC performance data for each particulate matter isolated from different food wastes to determine COD removal efficiency and hydrogen production efficiency.
    - Investigate the data for correlations between microbial composition and performance.
    - Combine pools of microbial samples stored from microbial community engineering/evolution runs based on bioinformatics analysis to develop improved biocatalysts.
    - Continue community engineering to achieve at least 80 percent COD conversion efficiency via targeted evolution
- Prepare a *COD Efficiency and Profile of Microbial Community Report* that includes but is not limited to:
    - COD measurements of feeds and effluent;
    - Efficiency of COD removal;
    - Biocatalyst characterization; and
    - MEC performance data.
- Prepare and provide CPR Report #1 in accordance with subtask 1.3 (CPR Meetings).
- Participate in a CPR Meeting.

Product:

- COD Efficiency and Profile of Microbial Community Report (Draft/Final)
- CPR Report #1

TASK 4: INCREASE ELECTRICAL EFFICIENCY FOR MICROBIAL ELECTROLYIS
The goal of this task is to reduce the amount of applied voltage required at target performance from 1.15 to 1.5 Volts.

The Recipient shall:

- Investigate effect of cell voltage and anode voltage on MEC electrical efficiency.
- Investigate effect of charge transfer and cathode operating conditions on improving electrical efficiency.
- Study effect of intermittent operation on hydrogen production.
    - Investigate potential for cost reduction via use of electricity when excess electricity is available, including that from renewable sources.

  - Investigate effect of feed supply on a 24-hour vs. an intermittent feeding mode.
- Integrated efficiency improvements via combined anode and cathode developments.

- Prepare a *Hydrogen Production and Electrical Efficiency Report* that includes but is not limited to:
  - MEC Performance at different applied voltage;
  - Effects of MEC hydrogen production from intermittent electrical inputs; and
  - Performance results from increased efficiency.

Product:
- Hydrogen Production and Electrical Efficiency Report (Draft/Final)

TASK 5: INVESTIGATE PROCESS VARIABILITY VIA A CONTROL SYSTEM FOR MONITORING MICROBIAL ELECTROLYSIS.
The goal of this task is to investigate the effect of feed variables on MEC operation via a process control system.

The Recipient shall:
- Test effect of pH in the range of 2 to 13 on current density of MEC. Determine pH at which current density drops by 50percent and 90 percent.
- Test effect of 0.1 to 1 percent bleach on current density. Determine the percent of bleach at which current density drops by 50 percent and 90 percent.
- Test effect of ethanol at concentrations of 0.1, 1.0 10 and 100 g/L on current density. Determine ethanol concentration at which current density drops by 50 percent and 90 percent.
- Test effect of other chemicals from list at suitable concentrations on current density.
- Compile data from all contaminants to determine process stability and mechanisms to stabilize performance.
- Prepare a *Process Control and Analysis Report* that includes but is not limited to:
  - Effects of feed PH on MEC performance;
  - Effect of chemical composition on MEC performance; and
  - Validation of process control system.

Product:
- Process Control and Analysis Report (Draft/Final).

TASK 6: DEMONSTRATE PRODUCTION OF 1 KG/DAY OF HYDROGEN USING A PILOT MODULE.
The goal of this task is to demonstrate production of low carbon hydrogen with a target of at least 1 kg per day using a food waste source available in California's disadvantaged communities.

The Recipient shall:
- Identify a pilot site and verify renewable waste availability for the project. Obtain process equipment, analytical resources and necessary permits for pilot activity from relevant authorities.

- Construct a module capable of producing at least 1 kg-H2/day based on established design and transport to pilot site. Install the unit and set up data collection system.
- Grow a seed culture using laboratory enrichment and inoculate a stack, followed by daily monitoring with remote access. Inoculate subsequent stacks to reach the target COD intake and allow system to reach steady-state.
- Produce an average rate of 1 kg hydrogen per day over a series of at least 5 testing cycles (or fewer as approved in writing by the CAM).
- Continue measurement of all parameters described in measurement and validation plan.
- Use measurements to determine MEC performance metrics.
- Measure hydrogen purity from MEC system.
- Prepare a *Technology Demonstration Report* that includes but is not limited to:
    - Validation of demonstration site for MEC;
    - Validation of inoculation procedure;
    - Validation of remote data collection from MEC;
    - Validation of low carbon hydrogen production;
    - Validation of performance parameters and electrochemical data from MEC;
    - Validation of hydrogen purity; and
    - Comparison of results and project objectives.
- Prepare and provide CPR Report #2 in accordance with subtask 1.3 (CPR Meetings).
- Participate in a CPR Meeting.

Product:

- Technology Demonstration Report (Draft/Final)
- CPR Report #2

TASK 7: INVESTIGATE LIFE CYCLE ANALYSIS FOR MICROBIAL ELECTROLYSIS CELL TECHNOLOGY.

The goal of this task is to validate methods of carbon sequestration that can used with system and calculate life-cycle emissions from the process to confirm the pathway can be carbon negative.

The Recipient shall:

- Set-up California's Modified Gases, Regulated Emissions, and Energy Use in Technologies (GREET) Model for determining the life cycle assessment of GHG emissions and other pollutants from the Electro-Active microbial electrolysis process
- Determine the life cycle assessment of GHG emissions and other pollutants using the configured California Modified Greenhouse GREET Model.
- Evaluate the impact of the demonstration test on life cycle assessment of GHG and other pollutants.
- Prepare a *Life Cycle Analysis Report* that includes but is not limited to:
    - Parameters of GREET Model;
    - GHG Results;
    - Criteria pollutants; and
    - Other impacts of demonstration test.

Product:

- Life Cycle Analysis Report (Draft/Final).

TASK 8: PERFORM LEVELIZED COST ANAYSIS
The goal of this task is to perform a levelized cost analysis for the MEC system. The levelized cost analysis will forecast the economics to the MEC system operating at scale within 5 years at the performance levels found at the end of this project. This levelized cost analysis will be repeated, modifying performance levels and costs that the Recipient expects to achieve through future cost reduction efforts when operating at commercial scale.

The Recipient shall:
- Set-up levelized cost analysis model.
- Forecast the estimated cost reduction of MEC system.
- Evaluate the impact of demonstration tests on key parameters in the levelized cost analysis.
- Validate MEC's levelized cost analysis model to National Renewable Energy Laboratory 's Hydrogen analysis production economic modeling and case studies[2].
- Refine the levelized cost analysis with updated parameters at the conclusion of each annual demonstration.
- After the final demonstration test, re-run the levelized cost analysis projecting future performance levels and costs at commercial scale.
- Prepare *Economic Analysis Report* that includes but is not limited to:
    - Cost of hydrogen production projected at commercial/industrial scale; and
    - LCOE assumptions.

Product:
- Economic Analysis Report (Draft/Final).

TASK 9 EVALUATION OF PROJECT BENEFITS
The goal of this task is to report the benefits resulting from this project.

The Recipient shall:
- Complete three Project Benefits Questionnaires that correspond to three main intervals in the Agreement: (1) *Kick-off Meeting Benefits Questionnaire*; (2) *Mid-term Benefits Questionnaire*; and (3) *Final Meeting Benefits Questionnaire*.
- Provide a Measurement and Verification Plan that describes how actual project benefits will be measured and quantified, such as by identifying hydrogen cost production ($/kg), rate of hydrogen production (kg/day or g/hr), GHG emission reduction, energy efficiency, energy usage, installation and capital costs (if applicable).
- 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:

    - <u>For Product Development Projects and Project Demonstrations:</u>
        - Published documents, including date, title, and periodical name.

[2] https://www.nrel.gov/hydrogen/h2a-production-models.html

- Estimated or actual energy and cost savings and estimated statewide energy savings once market potential has been realized. Identify all assumptions used in the estimates.
- Greenhouse gas and criteria emissions reductions.
- Other non-energy benefits such as reliability, public safety, lower operational cost, environmental improvement, indoor environmental quality, and societal benefits.
- 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.
    - 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 have resulted in other non-energy benefits.
    - An estimate of energy and non-energy benefits.
    - Data on potential job creation, market potential, economic development, and increased state revenue as a result of 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 CEC may send the Recipient similar questionnaires after the Agreement term ends. Responses to these questionnaires will be voluntary.

Exhibit A
Scope of Work
Electro-Active Technologies Inc.

Products:

- Kick-off Meeting Benefits Questionnaire
- Mid-term Benefits Questionnaire
- Final Meeting Benefits Questionnaire
- Measurement and Verification Plan Report (Draft and Final)

TASK 10 TECHNOLOGY/KNOWLEDGE TRANSFER ACTIVITIES

The goal of this task is to conduct activities that will accelerate the commercial adoption of the technology being supported under this agreement. Eligible activities include, but are not limited to, the following:

- Scale-up analysis including manufacturing analysis, independent design verification, and process improvement efforts.
- Technology verification testing, or application to a test bed program located in California.
- Legal services or licensing to secure necessary intellectual property to further develop the technology
- Market research, business plan development, and cost-performance modeling.
- Entry into an incubator or accelerator program located in California

The Recipient Shall:

- Develop and submit a *Technology Transfer Plan (Draft/Final)* that identifies the proposed activities the recipient will conduct to accelerate the successful commercial adoption of the technology.
- Present the *Draft Technology Transfer Plan* to the TAC for feedback and comments.
- Develop and submit a *Summary of TAC Comments* that summarizes comments received from the TAC members on the *Draft Technology Transfer 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 Technology Transfer Plan* to the CAM for approval.
- Implement activities identified in *Final Technology Transfer Plan.*
- Develop and submit a *Technology Transfer Summary Report (Draft/Final)* that includes high level summaries of the activities, results, and lessons learned of tasks performed relating to implementing the *Final Technology Transfer Plan*. This report should not include any proprietary information.
- When directed by the CAM, develop presentation materials for an CEC- sponsored conference/workshop(s) on the project.
- 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.
- Technology Transfer Plan (Draft/Final)
- Summary of TAC Comments
- Technology Transfer Summary Report (Draft/Final)
- High Quality Digital Photographs

Exhibit A
Scope of Work
Electro-Active Technologies Inc.

V. PROJECT SCHEDULE

Please see the attached Excel spreadsheet.

RESOLUTION NO: 22-0608-10b

STATE OF CALIFORNIA

STATE ENERGY RESOURCES
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION: ELECTRO-ACTIVE TECHNOLOGIES, INC.

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 PIR-21-007 with Electro-Active Technologies Inc. for a $573,714 grant to develop and advance a microbial electrolysis technology for conversion of 100 percent renewable organic waste into low carbon hydrogen. This project will significantly reduce electricity consumption for hydrogen production compared to water electrolysis, use food waste, reduce GHGs, and provide a modularized system for onsite or near-site application; 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 June 8, 2022.
AYE:
NAY:
ABSENT:
ABSTAIN:

_____
Liza Lopez
Secretariat