



STATE OF CALIFORNIA

**GRANT REQUEST FORM (GRF)**

CEC-270 (Revised 12/2019)

CALIFORNIA ENERGY COMMISSION

**A) New Agreement #** PIR-21-005 (to be completed by CGL office)

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

<b>C) Recipient's Legal Name</b>	<b>Federal ID Number</b>
Technology & Investment Solutions, LLC	81-1703675

<b>D) Title of Project</b>
Catalytic Dry Reforming of Biogas to High Purity Hydrogen Using Waste Heat

**E) Term and Amount**

<b>Start Date</b>	<b>End Date</b>	<b>Amount</b>
6/15/2022	3/31/2027	\$ 1,926,287

**F) Business Meeting Information**

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

Proposed Business Meeting Date 5/11/2022 ☐ 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:**

Technology & Investment Solutions, LLC. Proposed resolution approving Agreement PIR-21-005 with Technology & Investment Solutions, LLC, for a \$1,926,287 grant to demonstrate and deploy a pilot-scale low carbon, hydrogen production system in Southern California, and adopting staff's determination that this action is exempt from CEQA. This project will build upon the existing anaerobic digestion and catalytic reformer system. The project will integrate proven process components consisting of a water gas shift reactor, pressure swing adsorption system, and hydrogen storage systems. The integration of these technologies will increase hydrogen production, achieve high hydrogen purity, and allow pipeline injection or local distribution. (PIER NG funding) Contact: Baldomero Lasam.(Staff Presentation: 5 minutes)

**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

☐ Common Sense Exemption. 14 CCR 15061 (b) (3)

Explain reason why Agreement is exempt under the above section: Section 15303, "New Construction or Conversion of Small Structures", covers

**GRANT REQUEST FORM (GRF)**

construction and location of limited numbers of new, small facilities or structures; and installation of small new equipment and facilities in small structures. The project includes preparing and installing a pilot technology demonstration constructed on a skid-mount (mobile trailer) less than 200 square feet in size. The skid-mount will sit on disturbed land near the existing food waste composting digester within the existing facility footprint.

According to the recipient, the unit(s) are self-contained, with minimal fluids. The system is operated by electricity, and breaks down synthetic natural gas into hydrogen and carbon monoxide. Any odor emissions will be controlled by an odor filter or similar device. Hydrogen gas storage safety protocols will be followed. The Mohave Desert Air Quality Management District has issued a construction permit. Based on these characteristics, the project is exempt under Section 15303.

- 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)

<b>Legal Company Name:</b>	<b>Budget</b>
University of Southern California	\$ 800,287
Khalil Kairouz Consulting, LLC	\$ 80,000
Enova Water LLC	\$ 98,000
Finley Industrial Services	\$ 5,000
Electrical Work, Inc.	\$ 75,000
Broadwell Energy LLC	\$ 65,000
CNG Direct LLC	\$ 15,000
Hofman Planning Associates, Inc.	\$ 45,000
CIRCLE GREEN, INC.	\$ 0
Product Slingshot, Inc.	\$ 99,000

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

<b>Legal Company Name:</b>



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CALIFORNIA ENERGY COMMISSION

**J) Budget Information**

Funding Source	Funding Year of Appropriation	Budget List Number	Amount
NG Subaccount, PIERDD	20-21	501.001O	\$1,926,287
			\$
			\$
			\$
			\$
			\$

R&amp;D Program Area: EGRO: Renewables

TOTAL: \$ 1,926,287

Explanation for "Other" selection

Reimbursement Contract #: Federal Agreement #:

**K) Recipient's Contact Information****1. Recipient's Administrator/Officer**

Name: Christian Tasser

Address: 2913 El Camino Real #  
527City, State, Zip: Tustin, CA 92782-  
8909

Phone: 714-702-4943

E-Mail: christian@technology-  
investment.org**2. Recipient's Project Manager**

Name: Christian Tasser

Address: 2913 El Camino Real #  
527City, State, Zip: Tustin, CA 92782-  
8909

Phone: 714-702-4943

E-Mail: christian@technology-  
investment.org**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

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**Agreement Manager**

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**Date**  

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STATE OF CALIFORNIA  
**GRANT REQUEST FORM (GRF)**  
CEC-270 (Revised 12/2019)  
**Office Manager**

CALIFORNIA ENERGY COMMISSION

**Date**

\_\_\_\_\_  
**Deputy Director**

\_\_\_\_\_  
**Date**

**Exhibit A**  
**Scope of Work**  
**Technology & Investment Solutions LLC**

**I. TASK ACRONYM/TERM LISTS**

**A. Task List**

<b>Task #</b>	<b>CPR<sup>1</sup></b>	<b>Task Name</b>
1		General Project Tasks
2	X	Plant Design and Test Plan Development
3		Procurement and Construction
4	X	Delivery, Installation and Commissioning
5		Plant Operations, Data Collection and Reporting
6		Evaluation of Project Benefits
7		Technology/Knowledge Transfer Activities

**B. Acronym/Term List**

<b>Acronym/Term</b>	<b>Meaning</b>
AD	Anaerobic Digestion
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CEC	California Energy Commission
CPR	Critical Project Review
CRS	Catalytic Reformer System
GHG	Greenhouse Gas
M&V	Measurement & Verification
PLC	Programmable Logic Controller
PSA	Pressure-Swing Adsorption
SCFM	Standard cubic feet per minute
SMR	Steam-Methane Reforming
TAC	Technical Advisory Committee
TIS	Technology & Investment Solutions, LLC
USC	University of Southern California
WGSR	Water-Gas Shift Reactor

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

**A. Purpose of Agreement**

The purpose of this Agreement is to demonstrate a cost-efficient, low carbon hydrogen production system in California. This project will build upon the existing anaerobic digestion (AD) and catalytic reformer system (CRS) presently operated by Technology and Investment Solution and University of Southern California (USC) in Phelan, CA by integrating proven process components consisting

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

## **Exhibit A**

### **Scope of Work**

#### **Technology & Investment Solutions LLC**

of a water gas shift reactor (WGSR), a commercial pressure swing adsorption (PSA) system, and storage systems. The integration of these technologies will increase hydrogen production, achieve high hydrogen purity, and allow pipeline injection or local distribution.

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

##### **Problem**

The project team project will aim to address the problems that prevent the wider adoption of low carbon hydrogen production technology such as high production, storage, and transportation costs. The natural gas-fueled steam methane reforming (SMR) process provides low-cost hydrogen in California; however, this process produces high greenhouse gas (GHG) emissions. In addition, hydrogen produced from solar-based electrolysis is carbon neutral, but the production costs far exceed the present cost targets.

##### **Solution**

This project will deploy a pilot-scale demonstration of advanced AD technology that generates a higher energy content biogas to produce affordable low carbon hydrogen via a novel hydrogen generation and purification approach. The proposed process combines the existing CRS at Phelan with a second stage WGSR and a small-scale PSA unit to achieve >99% pure hydrogen, which can then either be compressed to pressures appropriate for transportation for pipeline injection or stored through a novel metal hydride system available on site for later use. The novel integration of AD technology with biomethanation and low carbon hydrogen production can significantly contribute to the overall cost reduction, thus producing low carbon hydrogen at less than \$2.5 per kilogram. In addition, the storage of hydrogen in the low-pressure metal hydride will allow another 20% of overall energy, capital cost and O&M cost savings by avoiding compressors which can reduce the levelized cost of hydrogen to less than \$2 per kilogram.

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

##### **Agreement Goals**

The goals of this Agreement are to:

- Advance the development and commercialization of a novel high purity hydrogen process by integrating USC's catalytic biogas to hydrogen reformer, WGSR and PSA processes to produce low carbon hydrogen from renewable biogas.
- Generate environmental and economic data needed to support upscaling and commercialization of low carbon hydrogen technologies.
- Support the surrounding disadvantaged communities of Phelan and Victorville through their involvement at the host site by utilizing the local work force, providing educational outreach to local high school students, and involving the local leaders and agencies.
- Implement technical outreach via peer-reviewed publications, and participation in technical and trade conferences to advance the public's knowledge about the technology and to further its commercial appeal and implementation.

**Ratepayer Benefits:** This Agreement will provide cost-efficient low carbon hydrogen supply from reliable local biogas sources, lower costs of hydrogen production, increased safety of hydrogen storage, and reduced GHG emissions.

## Exhibit A

### Scope of Work

#### Technology & Investment Solutions LLC

Technological Advancement and Breakthroughs: The key project breakthrough will be the development of the proposed low carbon hydrogen production technology that can produce pure hydrogen (>99%) at a cost of less than \$2.5/kg hydrogen and which achieves cost-competitiveness with the Natural Gas-based SMR pathway.

#### **Agreement Objectives**

The objectives of this Agreement are to:

- Demonstrate an output of 25 kg of hydrogen or more per day continuously for 6 months by project conclusion.
- Achieve or exceed a renewable hydrogen cost targets of \$2.0/kg hydrogen projected at commercial or industrial scale.
- Achieve a maximum hydrogen purity (above 99%) for end-use operations.
- Demonstrate an increase in TRL, from TRL 5 at the beginning of the project to TRL 6 or greater by the end of the project.
- Demonstrate the technology in a relevant field environment for no less than 6 months that is in an industrial or commercial settings and in a natural gas investor-owned utility service territory (Pacific Gas and Electric Company, San Diego Gas & Electric Company, and Southern California Gas Company).
- Assess and incorporate performance metrics that includes, but not limited to hydrogen production costs, hydrogen production capacity, GHG reduction and energy usage and efficiency.

### **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.

## **Exhibit A**

### **Scope of Work**

#### **Technology & Investment Solutions LLC**

- 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).



## Exhibit A Scope of Work Technology & Investment Solutions LLC

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, 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*.

# **Exhibit A**

## **Scope of Work**

### **Technology & Investment Solutions LLC**

#### **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.

# Exhibit A

## Scope of Work

### Technology & Investment Solutions LLC

**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

# Exhibit A

## Scope of Work

### Technology & Investment Solutions LLC

#### 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:

## Exhibit A Scope of Work Technology & Investment Solutions LLC

- 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 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

## Exhibit A Scope of Work Technology & Investment Solutions LLC

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.

## Exhibit A Scope of Work Technology & Investment Solutions LLC

### 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*)



## Exhibit A Scope of Work Technology & Investment Solutions LLC

### **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



## **Exhibit A**

### **Scope of Work**

#### **Technology & Investment Solutions LLC**

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.

## **Exhibit A**

### **Scope of Work**

#### **Technology & Investment Solutions LLC**

##### **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 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* 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 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

**Exhibit A**  
**Scope of Work**  
**Technology & Investment Solutions LLC**

**IV. TECHNICAL TASKS**

**TASK 2: PLANT DESIGN AND TEST PLAN DEVELOPMENT**

The goal of this Task is to complete the design of the overall CRS/WGSR/PSA system for hydrogen production and to develop a test plan.

**The Recipient shall:**

- Prepare and provide a *Parameter Test Plan* that shows the parameters to be tested and the range of test conditions to be evaluated. The Parameter Test Plan shall include but is not limited to the following:
  - A description of the biogas source and how the project achieves at least 500 hours (or shorter period approved in writing by the CAM) of continuous biogas stream for hydrogen production;
  - A description of the processes to be tested;
  - The rationale for why the tests or design are required;
  - Predicted performance based on calculations, modeling, or other analyses;
  - Test objectives and technical approach;
  - A description of the facilities, equipment, instrumentation required to conduct the tests or process procedures;
  - A description of test or process procedures, including parameters to be controlled and how they will be controlled; parameters to be measured and instrumentation to measure them; calibration procedures to be used; recommended calibration interval; and maintenance of the test log;
  - A description of the data analysis procedures;
  - A description of quality assurance procedures; and
  - Contingency measures to be considered if the test objectives are not met.
- Prepare and provide a *Parameter Test Report* for inclusion in the final report that includes but is not limited to the following:
  - Background information about the plant design;
  - Results and analysis of the plant development; and
  - Conclusion about how the results will impact and inform the next project phase.
- Prepare and provide a *Plant Design Report* that includes:
  - Complete design of the integrated CRS/WGSR/PSA unit;
  - Design drawings, mass balances, and layouts and analytical components and system controls;
  - Process optimization procedures and optimize programmable logic controller (PLC) automation system control settings; and
  - State-of-the-art techniques and models leading to potential further improvement of the CRS/WGSR/PSA process.
- Prepare and provide *CPR Report #1* and participate in a CPR Meeting in accordance with subtask 1.3 (CPR Meetings).

## **Exhibit A**

### **Scope of Work**

#### **Technology & Investment Solutions LLC**

#### **Products:**

- Parameter Test Plan (Draft and Final)
- Parameter Test Report (Draft and Final)
- Plant Design Report (Draft and Final)
- CPR Report #1

#### **TASK 3: PROCUREMENT AND CONSTRUCTION**

The goal of this task is to procure and/or fabricate individual components and to assemble and build the complete CRS/WGSR/PSA test system. This will be accomplished by augmenting the existing CRS unit with a WGSR that is presently available and a PSA system to be procured from an external vendor.

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

- Prepare and provide a *Design Basis Summary* that presents the design criteria for the new hydrogen production process that must be met to achieve a success and cost-effective project. The Design Basis Summary will include but is not limited to the following:
  - Description of the integrated CRS/WGSR/PSA test system and component functionality and operability;
  - The expectations for the biogas and hydrogen gas stream (derived from the Parameter Test Report in Task 2);
  - Material design criteria (e.g., using standard components sizes and material grades);
  - Identifications of engineering designs standards that will be applicable; and
  - Discussion about designing for safety.
- Prepare and provide a *Construction Report* for the integrated facility that will evaluate the actual construction activities and list major project changes. The Construction Report will include but is not limited to the following:
  - Equipment specifications for the PSA system;
  - Selection process for the general control architecture including appropriate sensors and gauges;
  - A final schedule of completed milestones;
  - A description of lessons learned;
  - A description of the challenge identified with the original design;
  - A justification for the solution developed;
  - An update on selected equipment/materials;
  - An update, as necessary, to the project schedule; and
  - Documentation for completed demonstration-scale CRS/WGSR/PSA System.
- Once construction has been completed, prepare and provide *Written Notification of Successful Construction* in the form of a letter. The letter shall:
  - Verify that the system is ready for commissioning;
  - Document any significant changes challenges encountered during construction;
  - Identify any changes made to successfully complete construction;
  - Describe the reason for the changes
  - Include all construction plans; and
  - Include pictures and final schematics of the constructed power plant.

#### **Products:**

## Exhibit A Scope of Work Technology & Investment Solutions LLC

- Design Basis Summary (Draft and Final)
- Construction Report (Draft and Final)
- Written Notification of Successful Construction

### **TASK 4: DELIVERY, INSTALLATION AND COMMISSIONING**

The goals of this task are to prepare the site for receipt of the major equipment procured from the selected subcontractors, to install the delivered equipment on site, and to start up the systems. This task will include delivery of other miscellaneous equipment (e.g., foundation slab, canopy/shed, power outlet connection and control systems) and the installation of the hydrogen generation system to the demonstration site.

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

- Prepare site for new equipment installation; receive and inspect equipment delivered onsite.
- Conduct site readiness assessment and provide Site Readiness Memo.
- Install the equipment according to the Parameter Test Plan under Task 2.
- Install piping and sensors and test all new pipe connections for leaks.
- Install PLC.
- Start-up and commission the plant and show that the outputs meet the objectives.
- Prepare and provide a *Commissioning Plan* to summarize the operating parameters that must be validated during system commissioning prior to operations. The Commissioning Plan will include but is not limited to the following:
  - Process flow diagrams;
  - Heat and mass balances;
  - Expected performance characteristics;
  - Process for performance validation;
  - Schedule for commissioning activities; and
  - A commissioning data collection plan.
- Once commissioning has been completed, prepare and provide *Written Notification of Successful Commissioning* in the form of a letter. The letter shall:
  - Verify that the system is ready for operations;
  - Document any significant challenges encountered during commissioning;
  - Identify any changes made to successfully complete commissioning;
  - Describe the reason for the changes; and
  - Include all process and performance data required in the commissioning data collection plan.
- Prepare and provide *CPR Report #2* and participate in a CPR meeting in accordance with subtask 1.3 (CPR Meetings).

#### **Products:**

- Site Readiness Memo
- Commissioning Report (Draft and Final)
- Written Notification of Successful Commissioning (Final)
- CPR Report #2

### **TASK 5: PLANT OPERATION, DATA COLLECTION & REPORTING**

## **Exhibit A**

### **Scope of Work**

#### **Technology & Investment Solutions LLC**

The goals of this task are to demonstrate the long-term operation capability of the new hydrogen production plant and to determine the actual costs associated with the plant operation and verify the target production costs. In addition, this task will complete a demonstration of hydrogen production of 25 kg/day for no less than 6 months while meeting the project's goals and objectives.

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

- Operate the various components and equipment of the hydrogen production system for a minimum of six 6 months or shorter period as approved in writing by the CAM;
- Prepare *Operations Summary and Testing Report* based on the M&V Plan that includes but is not limited to the following tasks and deliverables:
  - Quantity and quality of hydrogen produced ;
  - Energy efficiency in terms of kW of energy input per kg of hydrogen produced;
  - Recommendations on future systems including improvements;
  - A description of the process that were tested;
  - A description of performance based on calculations or other analyses;
  - A long-term test data collection plan;
  - Background information about the pilot-scale design;
  - Materials and methods used during testing;
  - Results and analysis of the testing;
  - Comparison of the results against the project objectives; and
  - Include all process and performance data required in the test data collection plan.
- Provide a *Final Measurement and Verification Report* that includes but not limited to hydrogen production costs, hydrogen capacity production, GHG emissions reductions, energy efficiency, energy usage, installation, and capital costs, as well as how the cost improvements achieved by the innovation will meet this target once applied to a commercial scale system.
- Prepare an *Environmental, Economic and Costs Analysis Report* of the project that includes but not limited to the following tasks and deliverables.
  - Cost efficiency in terms of dollars (or cost) input per kg of hydrogen produced projected at commercial or industrial scale;
  - Performance and cost and benefit targets, and other metrics to be critical indicators of research success and increase probability of market adoption; and
  - Environmental impacts of the project such as GHG emission reduction.

#### **Product:**

- Operations Summary and Testing Report (Draft and Final)
- Measurement and Verification Report (Draft and Final)
- Environmental, Economic and Costs Analysis Report (Draft and Final)

## Exhibit A Scope of Work Technology & Investment Solutions LLC

### TASK 6: 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 December 15th 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 \(www.energizeinnovation.fund\)](http://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 \(www.energizeinnovation.fund\)](http://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 EnergizeInnovation.fund
- Documentation of Organization Profile on EnergizeInnovation.fund

### TASK 7: TECHNOLOGY/KNOWLEDGE TRANSFER ACTIVITIES (*Mandatory task*)

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.



## **Exhibit A**

### **Scope of Work**

#### **Technology & Investment Solutions LLC**

- 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.
- Present the *Draft Project Case Study Plan* to the TAC for review and comment.
- 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 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.

#### **Products:**

- Project Case Study Plan (Draft/Final)
- Summary of TAC Comments
- Project Case Study (Draft/Final)
- High Quality Digital Photographs

#### **V. PROJECT SCHEDULE**

Please see the attached Excel spreadsheet.



STATE OF CALIFORNIA

STATE ENERGY RESOURCES  
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION: TECHNOLOGY & INVESTMENT SOLUTIONS, LLC

**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 PIR-21-005 with Technology & Investment Solutions, LLC, for a \$1,926,287 grant to demonstrate and deploy a pilot-scale low carbon, hydrogen production system in Southern California. This project will build upon the existing anaerobic digestion and catalytic reformer system. The project will integrate proven process components consisting of a water gas shift reactor, pressure swing adsorption system, and hydrogen storage systems. The integration of these technologies will increase hydrogen production, achieve high hydrogen purity, and allow pipeline injection or local distribution; 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 11, 2022.

AYE:

NAY:

ABSENT:

ABSTAIN:

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Liza Lopez  
Secretariat