**California Energy Commission**
**September 13, 2023 Business Meeting**
**Backup Materials for Agenda Item No 05b:**
**Element 16 Technologies, Inc.**

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

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

**RESOLUTION NO: 23-0913-05b**

**STATE OF CALIFORNIA**

**STATE ENERGY RESOURCES**
**CONSERVATION AND DEVELOPMENT COMMISSION**

**RESOLUTION: Element 16 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 agreement EPC-23-012 with Element 16 Technologies, Inc for a $3,000,000 grant to fund the technology development and demonstration of sulfur thermal energy storage and demonstrating flexible operation to support economically feasible electrification and decarbonization of industrial processes in Trona; 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 September 13, 2023.

AYE:
NAY:
ABSENT:
ABSTAIN:

Dated:

_____
Kristine Banaag
Secretariat

STATE OF CALIFORNIA
CALIFORNIA ENERGY COMMISSION

CEC-270 (Revised 9/2022)

# GRANT REQUEST FORM (GRF)

## A. New Agreement Number

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

**New Agreement Number**: EPC-23-012

## B. Division Information

1. Division Name: ERDD
2. Agreement Manager: Anish Gautam
3. MS-:51
4. Phone Number: 916-776-0759

## C. Recipient's Information

1. Recipient's Legal Name: Element 16 Technologies, Inc
2. Federal ID Number: 81-3026272

## D. Title of Project

Title of project: Demonstration of Sulfur Electric Thermal Storage for Industrial Electrification and Decarbonization

## E. Term and Amount

1. Start Date: 9/30/2023
2. End Date: 3/31/2028
3. Amount: $3,000,000.00

## F. Business Meeting Information

1. Are the ARFVTP agreements $75K and under delegated to Executive Director? No
2. The Proposed Business Meeting Date: 9/13/2023 .
3. Consent or Discussion? Discussion
4. Business Meeting Presenter Name: Michael Lozano
5. Time Needed for Business Meeting: 5 minutes.
6. The email subscription topic is: EPIC (Electric Program Investment Charge).

**Agenda Item Subject and Description:**

**Element 16 Technologies, Inc.** Proposed resolution approving agreement EPC-23-012 with Element 16 Technologies, Inc for a $3,000,000 grant to fund the technology development and demonstration of sulfur thermal energy storage and demonstrating flexible operation to support economically feasible electrification and decarbonization of industrial processes in Trona, and adopting staff's determination that this action is exempt from CEQA.

## G. California Environmental Quality Act (CEQA) Compliance

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

If yes, skip to question 2.

If no, complete the following (PRC 21065 and 14 CCR 15378) and explain why Agreement is not considered a "Project":

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

2. **If Agreement is considered a "Project" under CEQA answer the following questions.**

a) Agreement **IS** exempt?

Yes

Statutory Exemption?
No

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

PRC section number: None

CCR section number: None

Categorical Exemption?
Yes

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

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

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

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

The project fits within Cal. Code. Regs. tit. 14, § 15301 because it would only involve the operation and minor alteration of existing private structures and mechanical equipment involving negligible or no expansion of existing or former use. The minor alterations may include installation of electrical enclosures, pumps, heaters, heat exchangers, and valves. On site construction will be minimal and may include welding of pipes, wiring equipment and enclosures, bolting flanges, and welding/bolting support frames. All equipment will be prefabricated, and skid mounted. The equipment will be integrated into the existing facility with bolts and running electrical conduit/wires. Therefore, the proposed project falls within section 15301 of operations and minor alterations to existing structures involving negligible or no expansion of existing or former use and is exempt from CEQA.

This project fits within Cal. Code Regs., tit. 14, sect. 15303 which consist of construction and location of limited numbers of new, small facilities or structures; installation of small new equipment and facilities in small structures; and the conversion of existing small structures from one use to another where only minor modifications are made in the exterior of the structure, are categorically exempt from the provisions of CEQA. The proposed project consists of location of limited number of new small facilities and or structures including a thermal storage unit and installation of small new equipment, including electric heater, heat exchanger, pumps, valves and electrical enclosures. Therefore, the proposed project falls within section 15303 and will not have a significant effect on the environment.

This proposed project does 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.
**IMPORTANT:** consult with the legal office to determine next steps.

Yes or No

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

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

## H. Subcontractors

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

| Subcontractor Legal Company Name | CEC Funds | Match Funds |
|---|---|---|
| Searles Valley Minerals, Inc. | $ 90,000 | **$**50,000 |

## I. Vendors and Sellers for Equipment and Materials/Miscellaneous

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

| Vendor/Seller Legal Company Name | CEC Funds | Match Funds |
|---|---|---|

| | | |
|---|---|---|
| Engineering, Procurement & Construction Firm (TBD) | $ 90,000 | **$**0 |
| TBD - General Contractor | $ 90,000 | **$**0 |
| TBD M&V Contractor | $ 30,000 | **$**0 |
| General Contractor - Electrical (TBD) | $ 60,000 | **$**0 |
| TBD- Engineering Consultants | $ 90,000 | **$**0 |

## J. Key Partners

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

| Key Partner Legal Company Name |
|---|
| No key partners to report |

## K. Budget Information

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

| Funding Source | Funding Year of Appropriation | Budget List Number | Amount |
|---|---|---|---|
| EPIC | 21-22 | 301.001I | $ 3,000,000 |

**TOTAL Amount:** $ 3,000,000

R&D Program Area: EERB: IAW

Explanation for "Other" selection Not applicable

Reimbursement Contract #: Not applicable

Federal Agreement #: Not applicable

## L. Recipient's Contact Information

### 1. Recipient's Administrator/Officer

Name: Hamarz Aryafar

Address: 2038 Buckingham Pl

City, State, Zip: Glendale, CA 91206-1401

Phone: 619-254-4270

E-Mail: hamarz@element16.com

### 3. Recipient's Project Manager

Name: Hamarz Aryafar

Address: 2038 Buckingham Pl

City, State, Zip: Glendale, CA 91206-1401

Phone: 619-254-4270

E-Mail: hamarz@element16.com

## M. Selection Process Used

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

| Selection Process | Additional Information |
|---|---|
| Competitive Solicitation # | GFO-22-301 |
| First Come First Served Solicitation # | Not applicable |
| Other | Not applicable |

## N. Attached Items

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

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

### Approved By

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

**Agreement Manager:** Anish Gautam

**Approval Date:** 06/21/2023

**Branch Manager:** Virginia Lew

**Approval Date:** 08/01/2023

**Director:** Virginia Lew on behalf of Angela Gould

**Approval Date:** 08/01/2023

# Exhibit A
# Scope of Work
# Element 16 Technologies, Inc.

## I. TASK ACRONYM/TERM LISTS

### A. Task List

| Task # | CPR[1] | Task Name |
|---|---|---|
| 1 | | General Project Tasks |
| 2 | | Front End Engineering Design |
| 3 | X | Detailed System Engineering Design |
| 4 | | Installation and Commissioning |
| 5 | X | System Performance Measurement & Verification |
| 6 | | Technoeconomic and Environmental Assessment |
| 7 | | Evaluation of Project Benefits |
| 8 | | Technology Transfer Activities |

### B. Acronym/Term List

| Acronym/Term | Meaning |
|---|---|
| BOS | Balance of System |
| CAM | Commission Agreement Manager |
| CAO | Commission Agreement Officer |
| CEC | California Energy Commission |
| CPR | Critical Project Review |
| FEED | Front End Engineering and Design |
| GHG | Greenhouse Gas |
| HX | Heat Exchanger |
| IPH | Industrial Process Heat |
| LCOE | Levelized Cost of Energy |
| LCOH | Levelized Cost of Heat |
| P&ID | Piping And Instrumentation Diagram |
| PFD | Process Flow Diagram |
| PLC | Programmable Logic Controller |
| PV | Photovoltaics |
| SIS | Safety Instrumented System |
| SETS | Sulfur Electric Thermal Storage |
| TAC | Technical Advisory Committee |
| TES | Thermal Energy Storage |

[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
# Element 16 Technologies, Inc.

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

### A. Purpose of Agreement

The purpose of this Agreement is to fund the technology development and demonstration of sulfur thermal energy storage integrated with electrotechnology powered by renewable energy such as solar Photovoltaics (PV) or low-cost grid electricity, collectively referred to as sulfur electric thermal storage (SETS), with a goal of demonstrating flexible operation to support economically feasible electrification and decarbonization of industrial processes.

### B. Problem/ Solution Statement

**Problem**

Electrifying industrial process heat through leveraging advancements in low-carbon electricity from both grid and onsite renewable energy generation is critical for industrial decarbonization and end fossil-fuel dependency. However, energy supply from renewables such as solar is intermittent and only available during the day, while most industrial processing facilities such as chemicals, foods, plastics, materials, and cement operate 24 hours per day and require continuous energy supply. In the case of grid integration, the fluctuating electricity prices due to the increased penetration of variable renewable energy generation increases the operating cost of electrotechnology for 24-hour industrial process heat applications. Hence, integration of low-cost thermal energy storage (TES) is critical to make electrotechnology powered by low-carbon electricity dispatchable and affordable by storing energy during peak renewable generation or when grid electric prices are low and meet the process heat demand when solar is unavailable or when grid electric prices are high. The most common hot TES uses high-cost ($1100-$1300/ton) molten nitrate salts in expensive two-tank configurations. These salts have high freezing points (~221 °C) that results in significant parasitic loss and high operating cost related to the extensive electrical trace heating of pipes needed to avoid solidification blockages. Therefore, a two-tank solar salt storage concept in the temperature range of interest is expensive.

**Solution**

The Recipient will develop and demonstrate a new type of thermal energy storage, which uses sulfur in a single-tank configuration to store and dispatch energy from renewables efficiently and very inexpensively. The project leverages sulfur's low cost ($60-$80/ton) and the recipient's patented single-tank heat storage design for industrial process heat applications. Sulfur has a lower freezing point than molten salts, and attractive energy capacity and thermal transport properties, which combine to make sulfur TES the best solution for efficient and inexpensive energy storage technology. Sulfur electric thermal storage (SETS) can enable electrification of industrial process heat through integration of a low-cost and dispatchable sulfur thermal energy storage with electrotechnology powered by renewable energy such as solar photovoltaic either directly integrated or charging from the electric grid to support the "duck curve". The concept will increase system resiliency to provide on-demand/flexible heat supply to meet the individual requirements of the industrial process, achieve lower levelized cost of heat from renewable powered electrotechnology, thus enabling electrification and decarbonization of industrial processes. The project will install a 1.5 MWh system at a large chemical/minerals manufacturing

facility in California under real-world settings to increase the TRL (at least one level up) and gather data to facilitate wider industrial sector adoption.

### C. Goals and Objectives of the Agreement

**Agreement Goals**

The goals of this Agreement are to

- Design, fabricate, install and integrate a SETS with 1.5 MWh capacity or greater operating up to 300°C that can be charged using electricity from the grid and discharge heat at a peak heat rate of at least 100 kW at the industrial site.
- Demonstrate the functionality of SETS to supply process steam for operations at the industrial customer's facility and reduce the boiler's fossil fuel usage (therms) at the industrial facility.
- Validate the performance modeling and design tools based on measurements from the pilot-scale demonstration and use the technoeconomic tool to show that levelized cost of heat (LCOH) from SETS is below the LCOH from natural gas.

Ratepayer Benefits:[2] This Agreement will result in the ratepayer benefits of greater reliability and lower costs by reducing gas usage for process heat. This reduces industrial businesses' susceptibility to large variations in fuel prices by switching heat production away from fossil fuels. When paired with solar or low-cost grid electricity, this technology can also generate renewable process heat at a lower LCOH than natural gas, reducing both cost and Greenhouse (GHG) emissions. SETS can charge from the grid during periods of extreme renewable energy overgeneration, effectively acting as a dump load, thereby improving grid stability. SETS does not itself generate additional energy, but it makes it possible to use renewable energy day-and-night by capturing excess energy generation for later reuse, thus matching the operations of large industrial facilities.

The initial target market for SETS are large industrial process heat (IPH) consumers between 80-300°C, such as pulp and paper mills, chemical and food production facilities, mining, and breweries. These industries match the recipient's customer discovery interviews and partnership discussions in programs like NSF i-Corps, Techstars Accelerator, and Creative Destruction Lab Energy. The total fossil-fuel usage in this target temperature range within CA industrial facilities is 3874 million therms per year based on the industrial process heat characterization conducted by National Renewable Energy Laboratory (McMillan, Colin. 2019. "Manufacturing Thermal Energy Use in 2014." NREL Data Catalog. Golden, CO: National Renewable Energy Laboratory. Last updated: September 16, 2022. DOI: 10.7799/1570008) and energy demand for thermal enhanced oil recovery reported by Brandy and Unnasch (Brandt, A.R. and Unnasch, S., 2010. Energy intensity and greenhouse gas emissions from thermal enhanced oil recovery. Energy & Fuels, 24(8), pp.4581-4589). When integrated with solar for IPH applications, SETS is needed to supply heat during the night which amounts to an average of 12 hours or 50 percent of the total daily heat production. Assuming an adoption rate of 20%, solar integrated SETS

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

technology can displace 775 million therms of fossil-fuel use. The potential annual bill savings from having to purchase natural gas is $698 million out of which $349 million is attributed to SETS because it enables industries to avoid natural gas use when solar is unavailable. The cost of natural gas used in this analysis is 7.5 $/MMBTU, which is the last 20-year industrial natural gas price in CA and includes a 29 $/ton carbon emission carbon emission price to the natural gas price based on the recent average auction settlement price in California's Cap and Trade program (https://ww2.arb.ca.gov/our-work/programs/cap-and-trade-program/auction-information). Using emissions factor of 0.005 metric tons of CO2 equivalent per therm of natural gas (https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator), the 775 million therms saved by solar PV integrated SETS equates to 4.1 million metric tons CO2 emissions reduction per year.

Technological Advancement and Breakthroughs:[3] This Agreement will lead to technological advancement and breakthroughs to overcome barriers to the achievement of the State of California's statutory energy goals by developing low-cost SETS powered by renewable energy or off-peak grid electricity for industrial applications. Integration of low-cost SETS enhances system resiliency and flexibility by guaranteeing stable process heat supply that is incumbent for integration with industrial applications. Adoption of SETS enables renewable electrification of industrial fossil-based process heating, thus reducing statewide GHG emissions. This directly addresses energy goals and emissions reduction goals described in the following laws and policies: Assembly Bill (AB) 32 - Global Warming Solutions Act of 2006, Senate Bill (SB) 32 - California Global Warming Solutions Act of 2006. The proposed concept also results in energy efficiency improvement at the industrial facility by utilizing low-grade waste heat from the vented steam, and thereby also achieving water savings. This addresses 2019 California Energy Efficiency Action Plan and Executive Order B-29-15. SETS can decarbonize industrial heat applications by electrifying and firming heat with variable renewable energy sources such as wind and solar to significantly lower the cost of achieving SB-100 goals. The integration and demonstration of low-cost, distributed, behind-the-meter SETS with lower LCOH than natural gas for industrial heat applications provides a strong financial benefit in the upcoming high-renewables, high-electrification scenario thus, directly addressing the following strategic objectives in the CEC's EPIC investments plans: (1) Increase the value proposition of distributed energy resources to customers and the grid, (2) Improve the customer value proposition of end-use efficiency and electrification technologies, and (3) Enable successful clean energy entrepreneurship across California.

**Agreement Objectives**

The objectives of this Agreement are to:

- Complete front-end and detailed engineering, fabrication/procurement, installation and commissioning of the pilot SETS system with 1.5 MWh capacity or greater operating up to 300 °C at the industrial site.
- Experimental testing of the pilot system to characterize performance of the integrated system for various operation modes that include charging using electricity grid and discharging heat for industrial process and demonstrate peak thermal charge and discharge heat rate of at least 100 kW.
- Demonstrate the reliable and flexible operation of the SETS technology in providing dispatchable heat operations at the industrial customer's facility and reduce the industrial boiler's fossil fuel usage by at least 35 therms.

- Quantify and validate the economic benefits, natural gas fuel and energy savings, and greenhouse gas emissions reductions through M&V.
- Technoeconomic modeling validated using the pilot demonstration results to analyze the future projections on cost and performance for large scale system and use the technoeconomic tool to show that levelized cost of heat (LCOH) from SETS is below the LCOH of natural gas.

# Exhibit A
# Scope of Work
# Element 16 Technologies, Inc.

## III. TASK 1 GENERAL PROJECT TASKS

**PRODUCTS**

**Subtask 1.1 Products**

The goal of this subtask is to establish the requirements for submitting project products (e.g., reports, summaries, plans, and presentation materials). Unless otherwise specified by the Commission Agreement Manager (CAM), the Recipient must deliver products as required below by the dates listed in the **Project Schedule (Part V).** All products submitted which will be viewed by the public, must comply with the accessibility requirements of Section 508 of the federal Rehabilitation Act of 1973, as amended (29 U.S.C. Sec. 794d), and regulations implementing that act as set forth in Part 1194 of Title 36 of the Federal Code of Regulations**.** All technical tasks should include product(s). Products that require a draft version are indicated by marking **"(draft and final)"** after the product name in the "Products" section of the task/subtask. If "(draft and final)" does not appear after the product name, only a final version of the product is required. With respect to due dates within this Scope of Work, **"days"** means working days.

**The Recipient shall:**

For products that require a draft version, including the Final Report Outline and Final Report

- Submit all draft products to the CAM for review and comment in accordance with the Project Schedule (Part V). The CAM will provide written comments to the Recipient on the draft product within 15 days of receipt, unless otherwise specified in the task/subtask for which the product is required.
- Consider incorporating all CAM comments into the final product. If the Recipient disagrees with any comment, provide a written response explaining why the comment was not incorporated into the final product.
- Submit the revised product and responses to comments within 10 days of notice by the CAM, unless the CAM specifies a longer time period, or approves a request for additional time.

For products that require a final version only

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

For all products

- Submit all data and documents required as products in accordance with the following:

Instructions for Submitting Electronic Files and Developing Software:

- **Electronic File Format**
  - Submit all data and documents required as products under this Agreement in an electronic file format that is fully editable and compatible with the California Energy Commission's (CEC) software and Microsoft (MS)-operating computing platforms, or with any other format approved by the CAM. Deliver an electronic copy of the full text of any Agreement data and documents in a format specified by the CAM, such as memory stick.

The following describes the accepted formats for electronic data and documents provided to the CEC as products under this Agreement, and establishes the software versions that will be required to review and approve all software products:

- Data sets will be in MS Access or MS Excel file format (version 2007 or later), or any other format approved by the CAM.
- Text documents will be in MS Word file format, version 2007 or later.
- Project management documents will be in Microsoft Project file format, version 2007 or later.

- **Software Application Development**
  Use the following standard Application Architecture components in compatible versions for any software application development required by this Agreement (e.g., databases, models, modeling tools), unless the CAM approves other software applications such as open source programs:
  - Microsoft ASP.NET framework (version 3.5 and up). Recommend 4.0.
  - Microsoft Internet Information Services (IIS), (version 6 and up) Recommend 7.5.
  - Visual Studio.NET (version 2008 and up). Recommend 2010.
  - C# Programming Language with Presentation (UI), Business Object and Data Layers.
  - SQL (Structured Query Language).
  - Microsoft SQL Server 2008, Stored Procedures. Recommend 2008 R2.
  - Microsoft SQL Reporting Services. Recommend 2008 R2.
  - XML (external interfaces).

  Any exceptions to the Electronic File Format requirements above must be approved in writing by the CAM. The CAM will consult with the CEC's Information Technology Services Branch to determine whether the exceptions are allowable.

***MEETINGS***

**Subtask 1.2 Kick-off Meeting**

The goal of this subtask is to establish the lines of communication and procedures for implementing this Agreement.

**The Recipient shall:**

- Attend a "Kick-off" meeting with the CAM, 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(s)
- Progress Determination

**Subtask 1.4 Final Meeting**

The goal of this subtask is to complete the closeout of this Agreement.

**The Recipient shall:**

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

The technical and administrative aspects of Agreement closeout will be discussed at the meeting, which may be divided into two separate meetings at the CAM's discretion.
  - The technical portion of the meeting will involve the presentation of findings, conclusions, and recommended next steps (if any) for the Agreement. The CAM will determine the appropriate meeting participants.
  - The administrative portion of the meeting will involve a discussion with the CAM 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 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 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 <u>no permits</u> 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.

# Exhibit A
# Scope of Work
# Element 16 Technologies, Inc.

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

**The Recipient shall:**

- Complete and submit the project performance metrics section of the *Initial Project Benefits Questionnaire*, developed in the Evaluation of Project Benefits task, to the CAM.
- Present the draft project performance metrics at the first TAC meeting to solicit input and comments from the TAC members.

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

**Products:**

- TAC Performance Metrics Summary
- Project Performance Metrics Results

# Exhibit A
# Scope of Work
# Element 16 Technologies, Inc.

## TECHNICAL TASKS

### TASK 2: FRONT END ENGINEERING DESIGN

The goal of this task is to complete a front-end engineering design, procurement and construction management for the technology demonstration of SETS system at the industrial site. The engineering efforts will lead to establishing the process flow diagrams, piping and instrumentation diagrams with equipment layout, and controls design.

**The Recipient shall:**

- Define and size the major equipment including but not limited to: sulfur thermal energy storage, Heat Exchangers (HX), pumps, and electric heater.
- Complete process flow diagram (PFD) with heat and mass balance for various operating scenarios.
- Complete piping and instrumentation diagram (P&ID).
- Complete electrical system description and one-line diagram
- Complete general arrangement drawing of equipment layout with tie-in points of SETS system to the process heating system at the industrial site.
- Prepare a *Front-End Engineering Design Report* that includes but is not limited to the following:
    - Design basis covering the requirements for the design, fabrication, installation and performance testing of SETS at the industrial site.
    - Summary of the steps taken to reach the final configuration and layout.
    - Discussion on the equipment layout, as well as any special considerations.
    - Discussion of the heat and mass balance for various operation modes.
    - Discussion of the preliminary operational narrative and controls requirements
- Submit the draft *Front-End Engineering Design Report* to the CAM for feedback and incorporate changes as requested in the final *Front-End Engineering Design Report*.

**Products:**

- Front-End Engineering Design Report (draft and final)

### TASK 3: DETAILED SYSTEM ENGINEERING DESIGN

The goal of this task is to complete detailed engineering design of the SETS system for the technology demonstration which includes: (a) Engineering drawing of sulfur TES issued for fabrication, (b) detailed CAD design of the system for installation, and (c) instrumentation/control systems required to safely monitor and control the system operation during charge and discharge.

**The Recipient shall:**

- Finalize design of sulfur TES equipment using in-house computational tools and complete engineering drawing of the prototype issued for fabrication.
- Define instrument and control systems (programmable logical controller (PLC) and safety instrumented systems (SIS), general requirement and configuration, control system cause & effect and loop diagram.
- Generate a detailed CAD design of the SETS system that incorporates vendor drawings of other equipment such as HX(s), pump(s), electric heater(s), etc., and test loop (piping and instrumentation) for pilot testing and demonstration.
- Prepare a *Detailed Systems Engineering Design Report* that includes but is not limited to the following:

  - Summary of the steps taken to reach the final design and final layout;
  - Discussion on the final design as well as any special considerations;
  - Discussion of the predicted system performance, transient heat and mass balance for various operation modes.
- Submit the draft *Detailed Systems Engineering Design Report* to the CAM for feedback and incorporate changes as requested in the final *Detailed Systems Engineering Design Report*.
- Prepare a *CPR Report #1* in accordance with subtask 1.3 (CPR Meetings).
- Participate in a CPR meeting.

**Products:**
- Detailed Systems Engineering Design Report (draft and final)
- CPR Report #1 (draft and final)

**TASK 4: INSTALLATION AND COMMISSIONING**
The goal of this task is to (a) install and integrate all the equipment for pilot demonstration and (b) test the fully constructed system by running a series of predetermined safety and performance checks.

**The Recipient shall:**
- Install and integrate all the equipment.
- Perform pre-testing activities including:
  - Fill sulfur followed by thermal conditioning;
  - Fill heat transfer fluid;
  - Control systems software code review;
  - Tests plans for instrument calibration and pressure testing.
- Start-up and commission equipment:
  - Complete all inspections, including the following:
    - Verify there are no leaks in the system through hydro or pneumatic testing.
    - Conduct a communication test and verify that the controls produce the desired response as stated on the cause-and-effect matrix.
    - Verify sensors are configured properly.
    - Other inspections required as by the host facility's policies
  - Test system response during startup and normal operation processes & safety procedures
- Prepare an *Installation and Testing Report* that shall include, but not be limited to:
  - Installation and Integration procedure;
  - Identification of barriers involved during installation and discuss the steps taken to overcome those barriers;
  - Discuss results of equipment start-up, testing and commissioning.
- Submit the draft *Installation and Testing Report* to the CAM for feedback and incorporate changes as requested in the final *Installation and Testing Report*.

**Products:**
- Installation and Testing Report (draft and final)

**TASK 5: SYSTEM PERFORMANCE MEASUREMENT & VERIFICATION**
The goal of this task is to (a) demonstrate the functioning and performance SETS for various operation modes; and (b) independently verify the system benefits through measurement and verification (M&V) of reduction in natural gas energy consumption and greenhouse gas emissions, and thermal performance.

**The Recipient shall:**

- Create *Demonstration Test Plan* that shall include:
  - Test plans to demonstrate performance and functionality of the complete system.
  - Data collection methodology.
  - Critical metrics being validated.
  - Measurement tools for verification of the system performance, fuel savings, and GHG reductions of the SETS system.
- Collect measurement data over the course of at least six months pre and six months post installation or reasonable time as determined by the CAM to characterize system performance and quantify system benefits.
- Have all results, data and analysis verified by an independent third-party subcontractor.
- Prepare a draft *Demonstration and Measurement & Verification Report* which includes but not limited to:
  - High-level executive summary discussing:
    - Process and results of the final demonstration
    - Testing of the product
    - Technical issues
    - Lessons learned for this phase in the project.
- Submit the draft *Demonstration and Measurement & Verification Report* to the CAM for feedback and incorporate changes as requested in the final *Demonstration and Measurement & Verification Report*.
- Prepare a *CPR Report #2* in accordance with subtask 1.3 (CPR Meetings).
- Participate in a CPR meeting.

**Products:**

- Demonstration Test Plan (draft and final)
- Demonstration and Measurement & Verification Report (draft and final)
- CPR Report #2 (draft and final)

**TASK 6: TECHNOECONOMIC AND ENVIRONMENTAL ASSESSMENT**
The goal of this task is to (a) guide the direction of the technical development for various industrial process heat applications through development of a technoeconomic framework for the SETS integrated with on-site renewable or grid electricity, (b) identify the primary cost and performance drivers for technology adoption in industrial facilities and (c) quantify the economic benefit in terms of levelized cost of energy and the economic value associated with emissions reduction.

**The Recipient shall:**

- Verify the system performance model using data collected from demonstration unit testing (Task 5).
- Refine cost model of the SETS reviewed by experts and fabrication partners to investigate system economics.

- Perform parametric study using the validated technoeconomic model to design industrial scale system to explore possible modes for maximizing system performance and environmental benefits while minimizing levelized cost of heat.
- Prepare a *Technoeconomic and Environmental Assessment Report* that describes:
    - The technoeconomic and environmental framework and modeling assumptions;
    - A discussion of the system performance behavior during charge, discharge and dormant modes of operation;
    - A discussion of the levelized cost of heat;
    - Quantify the performance, energy cost reductions, electricity and thermal savings, and GHG reductions, including whether the goals and objectives in Section I.C. (of GFO-22-301) were achieved.
- Submit the draft *Technoeconomic and Environmental Assessment Report* to the CAM for feedback and incorporate changes as requested in the final *Technoeconomic and Environmental Assessment Report.*

**Products:**

- Technoeconomic and Environmental Assessment Report (draft and final)

**TASK 7: EVALUATION OF PROJECT BENEFITS**

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

**The Recipient shall:**

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

**Products:**

- Initial Project Benefits Questionnaire

- Annual Survey(s)
- Final Project Benefits Questionnaire
- Documentation of Project Profile on EnergizeInnovation.fund
- Documentation of Organization Profile on EnergizeInnovation.fund

**TASK 8: TECHNOLOGY TRANSFER ACTIVITIES**

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

**The Recipient Shall:**

- Develop and submit a *Project Case Study Plan* that outlines how the Recipient will document the planning, construction, commissioning, and operation of the technology or system being demonstrated. The Project Case Study Plan should include:
  - An outline of the objectives, goals, and activities of the case study.
  - The organization that will be conducting the case study and the plan for conducting it.
  - A list of professions and practitioners involved in the technology's deployment.
  - Specific activities the recipient will take to ensure the learning that results from the project is disseminated to those professions and practitioners.
  - Presentations/webinars/training events to disseminate the results of the case study.
- 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 a CEC sponsored conference/workshop(s) on the project.
- When directed by the CAM, participate in annual EPIC symposium(s) sponsored by the California CEC.
- Provide at least (6) six *High Quality Digital Photographs* (minimum resolution of 1300x500 pixels in landscape ratio) of pre and post technology installation at the project sites or related project photographs.

**Products:**

- Project Case Study Plan (draft and final)
- Summary of TAC Comments
- Project Case Study (draft and final)

- High Quality Digital Photographs

## IV. PROJECT SCHEDULE

Please see the attached Excel spreadsheet.