California Energy Commission
May 8, 2025 Business Meeting
Backup Materials for Clairity Technology 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

[PROPOSED]

RESOLUTION NO: 25-0508-03e

STATE OF CALIFORNIA

STATE ENERGY RESOURCES
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION: Clairity Technology 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 CRI-24-007 with Clairity Technology Inc. for a $1,000,000 grant. This agreement will evaluate a series of materials to improve the lifespan and reduce the costs of solid salt-based sorbents used in carbon capture systems and assess new materials that could lower energy use and enhance the efficiency of direct air capture systems in Culver City; and

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

CERTIFICATION

The undersigned Secretariat to the CEC does hereby certify that the foregoing is a full, true, and correct copy of a resolution duly and regularly adopted at a meeting of the CEC held on May 8, 2025.

AYE:
NAY:
ABSENT:
ABSTAIN:

Dated:

_____
Kristine Banaag
Secretariat

STATE OF CALIFORNIA
CALIFORNIA ENERGY COMMISSION

CEC-270 (Revised 01/2024)

GRANT REQUEST FORM (GRF)

A. New Agreement Number

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

New Agreement Number: CRI-24-007

B. Division Information

1. Division Name: ERDD
2. Agreement Manager: Maryam Haddad
3. MS-:None
4. Phone Number: (279) 226-1011

C. Recipient's Information

1. Recipient's Legal Name: CLAIRITY TECHNOLOGY INC.
2. Federal ID Number: 88-4008416

D. Title of Project

Title of project: Composite Sorbent Lifecycle Measurement, Investigation, and Testing of CO2 (LiMIT CO2)

E. Term and Amount

1. Start Date: 7/1/2025
2. End Date: 3/29/2030
3. Amount: $1,000,000.00

F. Business Meeting Information

1. Are the ARFVTP agreements $75K and under delegated to Executive Director? No
2. The Proposed Business Meeting Date: 5/8/2025 .
3. Consent or Discussion? Consent
4. Business Meeting Presenter Name: Maryam Haddad
5. Time Needed for Business Meeting: 0 minutes.
6. The email subscription topic is: Carbon Removal Innovation Support Program (CRISP).

Agenda Item Subject and Description:

Clairity Technology Inc. Proposed resolution approving agreement CRI-24-007 with Clairity Technology Inc. for a $1,000,000 grant and adopting staff's recommendation that this action is exempt from CEQA. The Agreement will evaluate a series of materials to improve the lifespan and reduce the costs of solid salt-based sorbents used in carbon capture systems at a Culver City. (CRISP funding) Contact: Maryam Haddad.

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, § 15306

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.

Regarding direct air capture (DAC) of carbon dioxide from the atmosphere, the grant project will explore methods and materials to accommodate the crystalline expansion of the sorbent during the cycling of solid salt-based sorbents, which will increase its lifespan while reducing cost. The Agreement will evaluate a series of novel materials to characterize and quantify their properties (i.e., develop and test at least 25 novel advanced solid salt-based sorbent materials that minimize the volumetric expansion of sorbents during the CO2 capture cycle, improving the sorbent's lifespan and CO2 capture efficiency). The project includes lab-scale research and testing.

California Code of Regulations, title 14, Section 15301, "Existing Buildings," covers the operation, maintenance, or minor alteration of existing public or private structures, facilities, mechanical equipment, involving negligible or no expansion of existing or former use. The grant activities will be conducted in an existing laboratory. There will be no expansion of the existing use of the facility, and there will not be a significant effect on the environment.

Cal. Code Regs., tit. 14, Section 15306 provides that projects which consist of basic data collection, research, experimental management, and resource evaluation activities, and which do not result in a serious or major disturbance to an environmental resource are categorically exempt from the provisions of the California Environmental Quality Act. This project falls within these parameters.

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

b) Agreement **IS NOT** exempt.

IMPORTANT: consult with the legal office to determine next steps.

No

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

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

H. Is this project considered "Infrastructure"?

No

I. Subcontractors

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

Subcontractor Legal Company Name	CEC Funds	Match Funds
CDTi Advanced Materials, Inc.	$ 100,000	**$**0
Arizona State University	$ 0	**$25,000**

J. Vendors and Sellers for Equipment and Materials/Miscellaneous

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

Vendor/Seller Legal Company Name	CEC Funds	Match Funds
Omega Engineering, Inc.	$0	$6,315
TBD	$0	$6,900
McMaster-Carr Supply Company	$0	$15,000
TBD	$0	$4,656

K. Key Partners

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

Key Partner Legal Company Name
No key partners to report

L. Budget Information

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

Funding Source	Funding Year of Appropriation	Budget List Number	Amount
GGRF	23-24	303.307	$ 1,000,000

TOTAL Amount: $ 1,000,000

R&D Program Area: ICMB: IAW

Explanation for "Other" selection Not applicable

Reimbursement Contract #: Not applicable

Federal Agreement #: 103

M. Recipient's Contact Information

1. Recipient's Administrator/Officer

Name: Geln Meyerowitz

Address: 12031 Jefferson Blvd

City, State, Zip: Culver City, CA 90230-6219

Phone: 631-291-2753

E-Mail: glen@clairitytech.com

3. Recipient's Project Manager

Name: Geln Meyerowitz

Address: 12031 Jefferson Blvd

City, State, Zip: Culver City, CA 90230-6219

Phone: 631-291-2753

E-Mail: glen@clairitytech.com

N. Selection Process Used

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

Selection Process	Additional Information
Competitive Solicitation #	GFO-24-303
First Come First Served Solicitation #	Not applicable
Other	Not applicable

O. Attached Items

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

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

Approved By

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

Agreement Manager: Maryam Haddad

Approval Date: 3/27/2025

Branch Manager: Cody Taylor

Approval Date: 3/28/2025

Director: Johan Steinback delegated to Branch Manager

Approval Date: 3/28/2025

Exhibit A
Scope of Work
Clairity Technology Inc.

I. TASK ACRONYM/TERM LISTS

A. Task List

Task #	CPR[1]	Task Name
1		General Project Tasks
2		Design A Test System For Automated Accelerated Aging Sorbent Samples
3	X	Construct A Test System For Automated Accelerated Aging Sorbent Samples
4		Pre-Operational Troubleshooting & Start-Up Of The Test System
5	X	Test System Operation And Optimization
6	X	Measurement And Verification Plan
7		Analyze The Long-Term Performance Data
8		Life Cycle Assessment (LCA), Techno-Economic Analysis (TEA) & Community Benefits Plan Development Proposal (CBPDP)
9		Evaluation of Project Benefits
10		Technology/Knowledge Transfer Activities

B. Acronym/Term List

Acronym/Term	Meaning
Accelerated Aging	Refers to conditions that accelerate the failure of composite sorbent material, such as an increased CO_2 capture rate, compared to standard environmental conditions.
ASU	Arizona State University
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CBPDP	Community Benefits Plan Development Proposal
CEC	California Energy Commission
CO_2	Carbon Dioxide
CNCE	Center for Negative Carbon Emissions
CPR	Critical Project Review
DAC	Direct Air Capture
H_2O	Water
kWh	Kilo Watt Hour
LCA	Life Cycle Assessment
Material	Refers to the conditions a composite sorbent material faces in real-world environments with atmospheric CO2 and other factors.
MT	Metric Tonne
MVP	Measurement and Verification Plan
PLC	Programmable Logic Controller
PPE	Personal Protective Equipment
TAC	Technical Advisory Committee
TEA	Techno-Economic Analysis

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

Acronym/Term	Meaning
TRL	Technology Readiness Level

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

A. Purpose of Agreement

The purpose of this Agreement is to fund the development of the Recipient's direct air capture (DAC) technology to reduce the cost and energy intensity of capturing carbon dioxide (CO_2) from the atmosphere. This project aims to improve the lifespan of the sorbent material used in DAC systems, ultimately reducing the overall cost of CO_2 removal in alignment with California's ambitious climate goals. By advancing this technology, the project will contribute to lowering the cost of CO_2 capture, enabling scalable solutions to combat climate change.

The Recipient is required to report employment outcomes to CEC annually using the Excel reporting template developed by California Climate Investments. Reports should use the latest version of the Excel template that is available at the time of reporting, supplied by the contract agreement manager.

B. Problem/ Solution Statement

Problem

DAC technologies are currently hindered by high costs and energy intensity, which makes large-scale CO_2 removal economically unfeasible. Specifically, the use of solid salt-based sorbents in DAC systems suffers from a critical issue: the volumetric expansion of the sorbent during the CO_2 capture process, leading to material fracturing. This reduces the lifespan of the sorbent, significantly increasing the cost per ton of CO_2 removed. Despite the potential of these systems, the inability to enhance sorbent longevity and efficiency has limited their effectiveness in achieving the California Climate Crisis Act's goal of achieving carbon neutrality by 2045.

Solution

The Recipient has developed novel materials and methods to mitigate the crystalline expansion of the sorbent, thus improving its lifespan and reducing the energy required for regeneration. The recipient's innovative approach uses alkali carbonate sorbents, which offer low-cost, abundant, and thermally stable alternatives to other DAC technologies. By enhancing sorbent performance and reducing energy intensity per CO_2 captured by 30% or greater by the end of the agreement, the recipient plans to lower the cost of CO_2 capture by up to 37%. The expected outcomes of this agreement would be to reduce the cost per ton of captured CO_2 from $710 / Metric Tonne (MT) CO_2 to $450 / $MTCO_2$; to reduce the energy intensity of the capture process from 2,500 kilowatt hour (kWh) / $MTCO_2$ to 1,750 kWh / $MTCO_2$; and to increase the lifespan of the recipient's composite sorbent material from 1,000 cycles to 10,000 cycles. These advancements will provide a scalable solution to reduce atmospheric CO_2, significantly contributing to the state's climate goals and offering a model for global carbon removal initiatives.

C. Goals and Objectives of the Agreement

Agreement Goals

The goals of this Agreement are to:

- Improve the lifespan and CO_2 capture capacity of the solid salt-based sorbent used in the recipient's DAC technology.
- Reduce the energy consumption and intensity of the DAC process from the current baseline of 2,500 kWh / $MTCO_2$ by at least 30% to a target energy intensity of 1,750 kWh / $MTCO_2$ by the end of the agreement term.
- Achieve a cost reduction of CO_2 capture from \$710 / $MTCO_2$ to \$450 / $MTCO_2$, by the end of the agreement term.
- Develop a novel composite sorbent material that remains chemically and physically stable over 10,000 cycles with high CO_2 capture capacity.

Technological Advancement and Breakthroughs: This Agreement will lead to technological advancement and breakthroughs to overcome barriers to achieving the State of California's statutory energy goals by reducing the cost of direct air capture technology to \$100 / MT CO_2 by 2032. The primary drivers of the cost of CO_2 capture are the cost of sorbent, capital cost, and energy cost. This project will dramatically increase the lifespan of composite sorbent material, thereby decreasing the levelized cost of CO_2 capture. This project will also reduce energy costs by 30%, thereby reducing the operational expense of the recipient's DAC system.

Agreement Objectives

The objectives of this Agreement are to:

- Develop and test at least 25 novel advanced solid salt-based sorbent materials that minimize the volumetric expansion of sorbents during the CO_2 capture cycle, improving the sorbent's lifespan and CO_2 capture efficiency.
- Conduct techno-economic analysis (TEA) to validate the cost reduction potential of the new sorbent materials and DAC process optimizations.
- Demonstrate a reduction in energy intensity of the DAC process by 30%, achieving a target value of 1,750 kWh / $MTCO_2$.
- Conduct pilot testing to demonstrate the scalability of the recipient's DAC system, with a focus on reducing costs and energy usage at larger scales to achieve \$100 / $MTCO_2$ by 2032.

Exhibit A
Scope of Work
Clairity Technology 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, and other CEC staff relevant to the Agreement. The Recipient's Project Manager and any other individuals deemed necessary by the CAM or the Project Manager shall participate in this meeting. The administrative and technical aspects of the Agreement will be discussed at the meeting. Prior to the meeting, the CAM will provide an agenda to all potential meeting participants. The meeting may take place in person or by electronic conferencing (e.g., Teams, Zoom), with approval of the CAM.

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

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

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

- Provide an *Updated Project Schedule, Match Funds Status Letter,* and *Permit Status Letter*, as needed to reflect any changes in the documents.

The CAM shall:
- Designate the date and location of the meeting.
- Send the Recipient a *Kick-off Meeting Agenda*.

Recipient Products:
- Kick-off Meeting Presentation
- Updated Project Schedule *(if applicable)*
- Match Funds Status Letter (subtask 1.7) *(if applicable)*
- Permit Status Letter (subtask 1.8) *(if applicable)*

CAM Product:
- Kick-off Meeting Agenda

Subtask 1.3 Critical Project Review (CPR) Meetings
The goal of this subtask is to determine if the project should continue to receive CEC funding, and if so whether any modifications must be made to the tasks, products, schedule, or budget. CPR meetings provide the opportunity for frank discussions between the CEC and the Recipient. As determined by the CAM, discussions may include project status, challenges, successes, advisory group findings and recommendations, final report preparation, and progress on technical transfer and production readiness activities (if applicable). Participants will include the CAM and the Recipient and may include the CAO and any other individuals selected by the CAM to provide support to the CEC.

CPR meetings generally take place at key, predetermined points in the Agreement, as determined by the CAM and as shown in the Task List on page 1 of this Exhibit.

However, the CAM may schedule additional CPR meetings as necessary. The budget may be reallocated to cover the additional costs borne by the Recipient, but the overall Agreement amount will not increase. CPR meetings generally take place at the CEC, but they may take place at another location, or may be conducted via electronic conferencing (e.g., WebEx) as determined by the CAM.

The Recipient shall:

- Prepare and submit a *CPR Report* for each CPR meeting that: (1) discusses the progress of the Agreement toward achieving its goals and objectives; and (2) includes recommendations and conclusions regarding continued work on the project.
- Attend the CPR meeting.
- Present the CPR Report and any other required information at each CPR meeting.

The CAM shall:

- Determine the location, date, and time of each CPR meeting with the Recipient's input.
- Send the Recipient a *CPR Agenda* with a list of expected CPR participants in advance of the CPR meeting. If applicable, the agenda may include a discussion of match funding and permits.
- Conduct and make a record of each CPR meeting. Provide the Recipient with a schedule for providing a Progress Determination on continuation of the project.
- Determine whether to continue the project, and if so whether modifications are needed to the tasks, schedule, products, or budget for the remainder of the Agreement. A determination of unsatisfactory progress This may result in project delays, including a potential Stop Work Order, while the CEC determines whether the project should continue.
- Provide the Recipient with a *Progress Determination* on continuation of the project, in accordance with the schedule. The Progress Determination may include a requirement that the Recipient revise one or more products.

Recipient Products:

- CPR Report(s)

CAM Products:

- CPR Agenda(s)
- Progress Determination

Subtask 1.4 Final Meeting

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

The Recipient shall:

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

The technical and administrative aspects of Agreement closeout will be discussed at the meeting, which may be divided into two separate meetings at the CAM's discretion.

- The technical portion of the meeting will involve the presentation of findings, conclusions, and recommended next steps (if any) for the Agreement. The CAM will determine the appropriate meeting participants.
- The administrative portion of the meeting will involve a discussion with the CAM of the following Agreement closeout items:
  - Disposition of any procured equipment.
  - The CEC's request for specific "generated" data (not already provided in Agreement products).
  - Need to document the Recipient's disclosure of "subject inventions" developed under the Agreement.
  - "Surviving" Agreement provisions such as repayment provisions and confidential products.
  - Final invoicing and release of retention.

- Prepare a *Final Meeting Agreement Summary* that documents any agreement made between the Recipient and Commission staff during the meeting.
- Prepare a *Schedule for Completing Agreement Closeout Activities*.
- Provide copies of *All Final Products* organized by the tasks in the Agreement.

Products:

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

MONTHLY CALLS, REPORTS AND INVOICES

Subtask 1.5 Monthly Calls

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

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

The CAM shall:

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

The Recipient shall:

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

Product:

- Email to CAM concurring with call summary notes.

Subtask 1.6 Quarterly Progress Reports and Invoices

The goals of this subtask are to: (1) periodically verify that satisfactory and continued progress is made towards achieving the project objectives of this Agreement; and (2) ensure that invoices contain all required information and are submitted in the appropriate format.

The Recipient shall:

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

Recipient Products:

- Quarterly Progress Reports
- Invoices

CAM Product:

- Invoice template

Subtask 1.7 Final Report

The goal of this subtask is to prepare a comprehensive Final Report that describes the original purpose, approach, results, and conclusions of the work performed under this Agreement. When creating the Final Report Outline and the Final Report, the Recipient must use the CEC Style Manual provided by the CAM.

Subtask 1.7.1 Final Report Outline

The Recipient shall:

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

Recipient Products:

- Final Report Outline (draft and final)

CAM Products:

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

Subtask 1.7.2 Final Report

The Recipient shall:

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

Products:

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

CAM Product:

- Written Comments on the Draft Final Report

MATCH FUNDS, PERMITS, AND SUBAWARDS

Subtask 1.8 Match Funds
The goal of this subtask is to ensure that the Recipient obtains any match funds planned for this Agreement and applies them to the Agreement during the Agreement term.
While the costs to obtain and document match funds are not reimbursable under this Agreement, the Recipient may spend match funds for this task. Match funds must be identified in writing, and the Recipient must obtain any associated commitments before incurring any costs for which the Recipient will request reimbursement.

The Recipient shall:

- Prepare a *Match Funds Status Letter* that documents the match funds committed to this Agreement. If no match funds were part of the application that led to the CEC awarding this Agreement and none have been identified at the time this Agreement starts, then state this in the letter.

  If match funds were a part of the application that led to the CEC awarding this Agreement, then provide in the letter:
  - A list of the match funds that identifies:
    - The amount of cash match funds, their source(s) (including a contact name, address, and telephone number), and the task(s) to which the match funds will be applied.
    - The amount of each in-kind contribution, a description of the contribution type (e.g., property, services), the documented market or book value, the source (including a contact name, address, and telephone number), and the task(s) to which the match funds will be applied. If the in-kind contribution is equipment or other tangible or real property, the Recipient must identify its owner and provide a contact name, address, telephone number, and the address where the property is located.
    - If different from the solicitation application, provide a letter of commitment from an authorized representative of each source of match funding that the funds or contributions have been secured.
- At the Kick-off meeting, discuss match funds and the impact on the project if they are significantly reduced or not obtained as committed. If applicable, match funds will be included as a line item in the progress reports and will be a topic at CPR meetings.
- Provide a *Supplemental Match Funds Notification Letter* to the CAM of receipt of additional match funds.
- Provide a *Match Funds Reduction Notification Letter* to the CAM if existing match funds are reduced during the course of the Agreement. Reduction of match funds may trigger a CPR meeting.

Products:

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

Subtask 1.9 Permits
The goal of this subtask is to obtain all permits required for work completed under this Agreement in advance of the date they are needed to keep the Agreement schedule on track. Permit costs and the expenses associated with obtaining permits are not reimbursable under

this Agreement, with the exception of costs incurred by University of California recipients. Permits must be identified and obtained before the Recipient may incur any costs related to the use of the permit(s) for which the Recipient will request reimbursement.

The Recipient shall:

- Prepare a *Permit Status Letter* that documents the permits required to conduct this Agreement. If no permits are required at the start of this Agreement, then state this in the letter. If permits will be required during the course of the Agreement, provide in the letter:
    - A list of the permits that identifies: (1) the type of permit; and (2) the name, address, and telephone number of the permitting jurisdictions or lead agencies.
    - The schedule the Recipient will follow in applying for and obtaining the permits.

  The list of permits and the schedule for obtaining them will be discussed at the Kick-off meeting (subtask 1.2), and a timetable for submitting the updated list, schedule, and copies of the permits will be developed. The impact on the project if the permits are not obtained in a timely fashion or are denied will also be discussed. If applicable, permits will be included as a line item in progress reports and will be a topic at CPR meetings.
- If during the course of the Agreement additional permits become necessary, then provide the CAM with an *Updated List of Permits* (including the appropriate information on each permit) and an *Updated Schedule for Acquiring Permits*.
- Send the CAM a *Copy of Each Approved Permit*.
- If during the course of the Agreement permits are not obtained on time or are denied, notify the CAM within 5 days. Either of these events may trigger a CPR meeting.

Products:

- Permit Status Letter
- Updated List of Permits *(if applicable)*
- Updated Schedule for Acquiring Permits *(if applicable)*
- Copy of Each Approved Permit *(if applicable)*

Subtask 1.10 Obtain and Execute Subawards and Agreements with Site Hosts

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

The Recipient shall:

- Execute and manage subawards and coordinate subrecipients activities in accordance with the requirements of this Agreement.
- Execute and manage site host agreements and ensure the right to use the project site throughout the term of the Agreement, as applicable.
- Notify the CEC in writing immediately, but no later than five calendar days, if there is a reasonable likelihood the project site cannot be acquired or can no longer be used for the project.
- Incorporate this Agreement by reference into each subaward.
- Include any required Energy Commission flow-down provisions in each subaward, in addition to a statement that the terms of this Agreement will prevail if they conflict with the subaward terms.

- Submit a *Subaward and Site Letter* to the CAM describing the subawards and any site host agreement needed or stating that no subawards or site host agreements are required.
- If requested by the CAM, submit a draft of each *Subaward* and any *Site Host Agreement* required to conduct the work under this Agreement.
- If requested by the CAM, submit a final copy of each executed *Subaward* and any *Site Host Agreement*.
- Notify and receive written approval from the CAM prior to adding any new subrecipient (see the terms regarding subrecipient additions in the terms and conditions).

Products:

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

TECHNICAL ADVISORY COMMITTEE

Subtask 1.11 Technical Advisory Committee (TAC)

The goal of this subtask is to create an advisory committee for this Agreement. The TAC should be composed of diverse professionals. The composition will vary depending on interest, availability, and need. TAC members will serve at the CAM's discretion. The purpose of the TAC is to:

- Provide guidance in project direction. The guidance may include scope and methodologies, timing, and coordination with other projects. The guidance may be based on:
  - Technical area expertise;
  - Knowledge of market applications; or
  - Linkages between the Agreement work and other past, present, or future projects (both public and private sectors) that TAC members are aware of in a particular area.
- Review products and provide recommendations for needed product adjustments, refinements, or enhancements.
- Evaluate the tangible benefits of the project to the state of California, and provide recommendations as needed to enhance the benefits.
- Provide recommendations regarding information dissemination, market pathways, or commercialization strategies relevant to the project products.
- Help set the project team's goals and contribute to the development and evaluation of its statement of proposed objectives as the project evolves.
- Provide a credible and objective sounding board on the wide range of technical and financial barriers and opportunities.
- Help identify key areas where the project has a competitive advantage, value proposition, or strength upon which to build.
- Advocate, to the extent the TAC members feel is appropriate, on behalf of the project in its effort to build partnerships, governmental support, and relationships with a national spectrum of influential leaders.
- Ask probing questions that ensure a long-term perspective on decision-making and progress toward the project's strategic goals.

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

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

The Recipient shall:

- Prepare a *List of Potential TAC Members* that includes the names, companies, physical and electronic addresses, and phone numbers of potential members. The list will be discussed at the Kick-off meeting, and a schedule for recruiting members and holding the first TAC meeting will be developed.
- Recruit TAC members. Ensure that each individual understands member obligations and the TAC meeting schedule developed in subtask 1.12.
- Prepare a *List of TAC Members* once all TAC members have committed to serving on the TAC.
- Submit *Documentation of TAC Member Commitment* (such as Letters of Acceptance) from each TAC member.

Products:

- List of Potential TAC Members
- List of TAC Members
- Documentation of TAC Member Commitment

Subtask 1.12 TAC Meetings

The goal of this subtask is for the TAC to provide strategic guidance for the project by participating in regular meetings, which may be held via teleconference.

The Recipient shall:

- Discuss the TAC meeting schedule with the CAM at the Kick-off meeting. Determine the number and location of meetings (in-person and via teleconference) in consultation with the CAM.
- Prepare a *TAC Meeting Schedule* that will be presented to the TAC members during recruiting. Revise the schedule after the first TAC meeting to incorporate meeting comments.
- Prepare a *TAC Meeting Agenda* and *TAC Meeting Back-up Materials* for each TAC meeting.
- Organize and lead TAC meetings in accordance with the TAC Meeting Schedule. Changes to the schedule must be pre-approved in writing by the CAM.

- Prepare *TAC Meeting Summaries* that include any recommended resolutions of major TAC issues.

The TAC shall:

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

Products:

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

Subtask 1.13 Project Performance Metrics

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

The Recipient shall:

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

Products:

- TAC Performance Metrics Summary
- Project Performance Metrics Results **TECHNICAL TASKS**

TASK 2: DESIGN A TEST SYSTEM FOR AUTOMATED ACCELERATED AGING SORBENT SAMPLES

The goal of this task is to design a laboratory-scale DAC Test System that is fully automated and allows for adsorption and desorption testing and characterization of composite sorbent material samples.

The Recipient shall:

- Develop a laboratory-scale testing protocol for accelerated lifecycle aging of 15-gram composite sorbent samples. The *Testing Protocol Memo* includes but not limited to:
    - Objectives and procedures to conduct the accelerated aging tests.
    - Required resources such as compressed air, CO_2, H_2O, electricity, physical space.
    - Operational conditions such as Durations of the testing cycles (30 minutes- 24 hours), temperature(0-250°C), gas compositions (such as air, H_2O, and CO_2), required partial pressures of the gas components (0-1 bar), and gas volumetric flow rates (0-10 liter/minute).
    - Test Matrix: Provides a matrix that details the number of test conditions and the number of replicated runs for each condition.
    - Data Analysis Procedures: Describes how the data collected will be analyzed.
- Create a preliminary design for the automated Test System for the characterization of the composite sorbent samples and assessment of the samples' lifecycle. The *Test System Preliminary Design Report* will include but not limited to:
    - A preliminary equipment list identifying and providing basic specifications for major process equipment and required instrumentation(s).
    - System layout that shows the integration of steps and process flow diagram.
    - Size of the system.
    - Preliminary functional specification documentation for the control system outlining the high-level control philosophy of the automated system.
    - Standard operating procedures.
    - Requirements for instrumentation sufficient to calculate and verify the accuracy of key metrics, including but not limited to measurements of flow rates, temperature, pressure, gas concentration and capture capacity.
    - A preliminary cost estimate of each of the equipment and instrumentations.

Products:

- Testing Protocol Memo (draft & final)
- Test System Preliminary Design Report (draft & final)

TASK 3: CONSTRUCT A TEST SYSTEM FOR AUTOMATED ACCELERATED AGING SORBENT SAMPLES

The goal of this task is to build a wall-mounted laboratory-scale DAC Test System (approximately 1 meter x 1 meter) according to the detailed design developed in Task 2. This includes the procurement of all materials and equipment, fabrication of custom components, development of the control narrative and programmable logic controller (PLC) code for initial operation and future automation, and assembly and integration of all parts into a fully functional Test System.

The Recipient shall:

- Procure all components defined in Task 2, ensuring that they meet project specifications.
- Coordinate with vendors for the timely delivery of required components, monitor procurement progress, and inspect items upon receipt.
- Determine, based on cost and lead time considerations, whether custom components should be fabricated in-house, outsourced, or some combination of both.
- Fabricate custom components according to the detailed design documentation produced in Task 2, documenting fabrication progress.
- Assemble the Test System from procured and fabricated components, ensuring integration and functionality.
- Develop and implement the control system, including but not limited to:
    - Writing the control narrative to define automation sequences, setpoints, and interlocks
    - Programing the PLC, configuring inputs and outputs, and integrating sensors, actuators, and alarms.
- Document the assembly process, challenges encountered, and solutions implemented in a *Test System Assembly Report* that includes:
    - Summary of procurement, fabrication, and assembly progress.
    - Assembly process documentation, integration challenges, and validation steps.
    - Description of issues encountered, and corrective actions taken.
    - Visual documentation (photos of components and Test system).
- Prepare a *CPR Report #1* in accordance with subtask 1.3 (CPR Meetings).
- Participate in a CPR meeting.

Products:

- Test System Assembly Report (draft & final)
- CPR Report #1

TASK 4: PRE-OPERATIONAL TROUBLESHOOTING & START-UP OF THE TEST SYSTEM

The goal of this task is to conduct a pre-start-up safety review for the assembled/built Test System. This will be followed by testing each component to demonstrate their operation under steady-state and boundary conditions. Finally, the recipient will commission, test, and validate the entire system to ensure that all components function together effectively for stable and continuous operation.

The Recipient shall:

- Perform a thorough safety review of all components and the entire Test System unit. This review should include, but is not limited to:
    - Assessment of chemical hazards associated with selected materials.
    - Identification of potential physical hazards from selected equipment and machinery.
    - Evaluation of environmental risks and waste management protocols.
    - Development of emergency response plans.
    - Implementation of worker safety training programs.
    - Specification of personal protective equipment (PPE) requirements.
    - Risk assessment for handling flammable or reactive substances.

- Establish clear communication protocols and implement proper ventilation and fire safety measures, which are crucial for promoting personnel safety and environmental protection during the testing phase.
- Designate a single master shutdown and emergency alarm system for the control system.
- Validate the stable performance of the entire system.
- Test all control loops for continuous operation and adjust as necessary to ensure smooth functionality.
- Prepare and submit the required documentation for automation parameters.
- Commission each component for continued operation.
- Prepare a *Start-Up Safety and Performance Report* detailing stable test runs to support the ongoing operation of the system. This includes but not limited to:
    - A memo of the comprehensive safety review and operation analysis of each individual component and the entire system.
    - Summary of learnings from the commissioning of each component for continued operation of the DAC Test System.

Product:

- Start-Up Safety and Performance Report (draft & final)

TASK 5: TEST SYSTEM OPERATION AND OPTIMIZATION

The goal of this task is to perform accelerated aging testing on at least 25 different composite sorbent material combinations to quantify and optimize the impact that varying material properties (such as porosity, pore size, bulk density, and surface area) on the process performance.

The Recipient shall:

- Perform the commissioning plan developed during Task 2 to initiate the operation of the Test System.
- Identify any near-term opportunities to modify the Test System for optimization for throughput, reliability, and energy. This could include but not be limited to the optimization of:
    - Adsorption process parameters such as cycle time and gas rate
    - Regeneration process parameters such as cycle time and temperature
    - Software improvements such as adjustments to the PLC code or data logging.
- Document the progress of initial material testing and data collection and analyze the data and evaluate the Test System's initial performance in terms of meeting the agreement goals and objectives outlined in section II of this document.
- Prepare an *Initial Commissioning and Testing Report* summarizing the results of the steps above. This report should include but not be limited to:
    - Process and results of Test System commissioning and testing.
    - Results of initial data collection, comprising baseline adsorption and desorption performance data, the impact of variation of key operating parameters.
    - Analysis of performance data to calculate key metrics for production rate and specific energy use.
    - Summary of technical issues, lessons learned, and recommendations.
    - System modifications ahead of long-term testing
- Prepare a *CPR Report #2* in accordance with subtask 1.3 (CPR Meetings).
- Participate in a CPR meeting.

Products:

- Initial Commission and Testing Report (draft & final)
- CPR Report #2

TASK 6: MEASUREMENT AND VERIFICATION PLAN

The goal of this task is to prepare and execute a measurement and verification plan.

The Recipient shall:

- Collaborate with Arizona State University's (ASU's) Center for Negative Carbon Emissions (CNCE) as the 3rd party measurement and verification partner to create a draft *Measurement and Verification Plan (MVP) document* to specify the approach for accurately measuring and verifying performance and energy metrics from Test System operation. Development of the MVP should include but not limited to:
    - Project overview with comprehensive analyses/assessment of energy and resource inputs
    - Steps, milestones, and timeline for Test System commissioning covering:
        - A pre-startup safety review as specified in Task 4 demonstrating compliance with applicable codes and standards from environmental, engineering, safety, and operational fields.
        - Component-level testing of the system.
        - Testing of all control loops and safety systems, and adjustment of automation parameters as necessary.
        - Calibration of analytical instruments.
        - A preliminary dry run without sorbent materials to identify mechanical and control system issues and validate full-cycle operation.
        - First operation of the Test System with sorbent materials to establish baseline operating conditions.
        - Troubleshooting and adjustments in process parameters to identify and resolve performance deviations.
    - Steps, critical metrics, and timeline for initial data collection covering:
        - Baseline adsorption and desorption performance data collection.
        - Validation of data measurement and adjustments or recalibrations to sensor measurements as needed.
        - Testing and analysis of varying operational conditions on energy use, capture cost and system reliability.
        - Analysis of collected data and comparison with design specifications and performance estimates.
    - Overview of measurement and verification activities, which include monitoring key performance indicators such as raw material consumption, and process efficiencies and conducting audits and calibration of measurement instruments to ensure data accuracy. This also involves verifying compliance with relevant standards and environmental regulations.
    - Establish a clear and transparent reporting framework that provides actionable insights for process optimization and scaling.
    - Review and assess the Test Plan with the project team to ensure the appropriateness of instruments, parameters, operating conditions, measurement duration, and procedures planned for comparing both technical and economic performance.

  - High-level overview of test plan and critical metrics to be tested in long-term data collection such as mechanical and performance integrity of the sorbent over repeated cycles, reliability and failure modes and performance over varying ambient conditions.
- Submit the draft *Measurement and Verification Plan* to CAM for feedback.
- Update and finalize *the MVP* to:
  - Incorporate CAM feedback
  - Document any system updates
  - Address notes from the feedback from the MVP verifier
- Prepare a *CPR Report #3* in accordance with subtask 1.3 (CPR Meetings).
- Participate in a CPR meeting.

Product:
- Measurement and Verification Plan *(*MVP) document (draft and final)
- CPR Report #3

TASK 7: ANALYZE THE LONG-TERM PERFORMANCE DATA
The goal of this task is to demonstrate the long-term stability of the lowest-cost, highest-energy efficiency composite sorbent. This includes but not limited to testing the material for at least 500 continuous cycles and further modifications of the Test System and sorbent materials based on the results of Task 5.

The Recipient shall:
- Create an extended and revised test plan that details the goals for testing, performance conditions, predicted technology performance, test matrix, required resources, and test procedures for long-term testing. Review the extended test plan with the project team.
- Collect and examine data on system performance during extended monitoring as described in the extended test plan, including but not limited to:
  - Perform accelerated aging for at least 500 cycles for the lowest-cost composite sorbent material to demonstrate the stability of this material over extended operations. This is equivalent to approximately 6 months of continuous operating time.
  - Observations of the above metrics given changes in sorbent performance over repeated cycles.
  - Reliability and failure mode data for mechanical components such as fans, sorbent transfer actuators, or control valves.
- Analyze the data and modify the operational parameters between automated test runs to enhance the Test System performance and identify the conditions that ensure optimal performance.
- Produce a M*aterial Validation Report,* showing the increased lifespan of the lowest-cost composite sorbent material compared with the Baseline. The Baseline is the Recipient's Generation 1 composite sorbent material. This will include, but is not limited to:
  - Performance stability, indicating that the CO_2 capture capacity of the composite sorbent has remained stable, with a standard deviation of <5%, over the final 20% of cycles.

  - Material integrity indicating that upon visual inspection of the material under optical microscopy that no fracturing is observed.
- Perform an independent third-party review of measurement methods, accuracy, and data collection and generate a summary of the *3rd -Party Review Report* of all findings.
- Prepare a *Long-term Performance Test Memo* summarizing the results of the above steps including but not limited to objectives, methodology, measured performance indicators, environmental impact, significant trends observed in the performance data, potential issues encountered during the testing phase, and their implications for plant operation and material longevity along with recommendations for future modifications based on the data analysis and brief discussion on the decommissioning process. The report should follow all guidelines listed in the MVP.

Products:
- 3rd-Party Review Report Summary (draft & final)
- Material Validation Report (draft & final)
- Long-term Performance Test Memo (draft & final)

TASK 8: LIFE CYCLE ASSESSMENT (LCA), TECHNO-ECONOMIC ANALYSIS (TEA), & Community Benefits Plan Development Proposal (CBPDP)
The goal of this task is to evaluate the impact of the proposed project on techno-economics and the environment by conducting a Life Cycle Assessment (LCA) and a TEA including but not limited to sourcing strategies for alternative materials or energy and supply chain modifications to reduce associated LCA impacts of specific inputs. Additionally, the recipient will create a preliminary community education and outreach plan for the proposed DAC Test System. The outcomes of these analyses will then be broadly disseminated to demonstrate the efficacy of deploying this technology within the California DAC sector.

The Recipient shall:
- Use published protocols to develop TEA and LCA models.
- Incorporate performance and manufacturing data from the DAC Test System development into TEA and LCA models.
- List and justify assumptions for factors that impact the TEA that are outside the Test System development scope, such as electricity price and project financing.
- Assess the techno-economic and environmental impacts of this project on the recipient's technology platform.
- Prepare the final *TEA Report* and *LCA Report* to be delivered to the industrial partner and CEC.
- Discuss the outcomes of TEA and LCA analyses with the industrial partner to detect/identify any new roadblocks to on-site deployment at batch plants uncovered through these analyses.
- Mitigation plans that address any risks or no-go issues uncovered through TEA and LCA. If applicable, this may include a comprehensive review of our baseline LCA and TEA to identify key levers both within and external to the project scope that could improve efficacy, followed by proposed actions or scenarios that could impact these levers. This will be summarized in a *Mitigations Plan Memo*.
- Create a *Community Benefits Plan Development Proposal (CBPDP) Document* as a part of their final deliverables upon the completion of the project. This CBPDP must include but not limited to:
  - Project's plan for outreach and engagement, including community partners

- Project's impact on criteria pollutants, water, and other resources
- Project's potential benefits to local communities
- Approaches for negotiating future Community Benefits Agreements and integrating stakeholder and community feedback to develop and improve ongoing engagement

Products:

- TEA Report (draft and final)
- LCA Report (draft and final)
- Mitigation Plans Memo (draft & final)
- Community Benefits Plan Development Proposal (CBPDP) Documents (draft & final)

TASK 9: EVALUATION OF PROJECT BENEFITS

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

The Recipient shall:

- Complete *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 10: TECHNOLOGY/KNOWLEDGE TRANSFER ACTIVITIES

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

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

The Recipient Shall:

- Develop and submit a *Technology Transfer Plan* that identifies the proposed activities the recipient will conduct to accelerate the successful commercial adoption of the technology.
- Present the draft *Technology Transfer Plan* to the TAC for feedback and comments.
- Develop and submit a *Summary of TAC Comments* that summarizes comments received from the TAC members on the Draft Technology Transfer Plan. This document will identify:
    - TAC comments the Recipient proposes to incorporate into the final *Technology Transfer Plan*.
    - TAC comments the Recipient does not propose to incorporate with and explanation why.
- Submit the final *Technology Transfer Plan* to the CAM for approval.
- Implement activities identified in final *Technology Transfer Plan*.
- Develop and submit a *Technology Transfer Summary Report* that includes high level summaries of the activities, results, and lessons learned of tasks performed relating to implementing the Final Technology Transfer Plan. This report should not include any proprietary information.
- When directed by the CAM, develop presentation materials for an CEC- sponsored conference/workshop(s) on the project.
- When directed by the CAM, participate in annual symposium(s) sponsored by the 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:

- Technology Transfer Plan (draft and final)
- Summary of TAC Comments
- Technology Transfer Summary Report (draft and final)
- High Quality Digital Photographs

IV. PROJECT SCHEDULE

Please see the attached Excel spreadsheet.