California Energy Commission
August 14, 2024 Business Meeting
Backup Materials for The Regents of the University of California, on behalf of the Santa Barbara Campus

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: 24-0814-XX

STATE OF CALIFORNIA

STATE ENERGY RESOURCES
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION: The Regents of the University of California, on behalf of the Santa Barbara Campus

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

RESOLVED, that the CEC approves agreement EPC-24-012 with The Regents of the University of California, on behalf of the Santa Barbara Campus for a $2,420,982 grant. This agreement will demonstrate and enhance the scalability of advanced energy efficiency, load reduction, and thermal load shifting technologies in industrial refrigerated warehouses in Riverside County using artificial intelligence-based control solutions; 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 August 14, 2024.

AYE:
NAY:
ABSENT:
ABSTAIN:

Dated:

_____
Kristine Banaag
Secretariat

STATE OF CALIFORNIA
CALIFORNIA ENERGY COMMISSION

CEC-270 (Revised 01/2024)

GRANT REQUEST FORM (GRF)

A. New Agreement Number

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

New Agreement Number: EPC-24-012

B. Division Information

1. Division Name: ERDD
2. Agreement Manager: Rajesh Kapoor
3. MS-:51
4. Phone Number: 916-776-0778

C. Recipient's Information

1. Recipient's Legal Name: The Regents of the University of California, on behalf of the Santa Barbara campus
2. Federal ID Number: 95-6006145

D. Title of Project

Title of project: Harnessing the Potential of AI in Industrial Refrigeration Systems

E. Term and Amount

1. Start Date: 8/15/2024
2. End Date: 3/31/2027
3. Amount: $2,420,982.00

F. Business Meeting Information

1. Are the ARFVTP agreements $75K and under delegated to Executive Director? No
2. The Proposed Business Meeting Date: 8/14/2024 .
3. Consent or Discussion? Discussion
4. Business Meeting Presenter Name: Christian Fredericks
5. Time Needed for Business Meeting: 10 minutes.
6. The email subscription topic is: EPIC (Electric Program Investment Charge).

Agenda Item Subject and Description:

The Regents of the University of California, on behalf of the Santa Barbara Campus.

Proposed resolution approving agreement EPC-24-012 with The Regents of the University of California, on behalf of the Santa Barbara Campus for a $2,420,982 grant, and adopting staff's determination that this action is exempt from CEQA. This agreement will demonstrate and enhance the scalability of advanced energy efficiency, load reduction, and thermal load shifting technologies in industrial refrigerated warehouses in Riverside County using artificial intelligence-based control solutions. (EPIC funding) Contact: Christian Fredericks

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, § 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.

Cal. Code Regs., tit. 14, sec. 15306 provides that a project that conducts basic data collection, research, experimental management, and resource evaluation which will not result in major disturbances to an environmental resource are exempt from the provisions of CEQA. This project will demonstrate and enhance the scalability of advanced energy efficiency, load reduction, and thermal load shifting technologies in industrial refrigerated warehouses through the use of artificial intelligence-based control solutions. The activities funded by the agreement will not cause a direct physical change in the environment or a reasonably foreseeable indirect physical change in the environment because it only involves a software upgrade (ATLAS Platform) at the facility. There will be no structural changes to the facility.

This project does not involve impacts on any particularly sensitive environment; 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.

For these reasons, the proposed work will not have any significant effect on the environment and falls under section 15306.

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
Crossno & Kaye, Inc.	$ 442,245	**$**35,000

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
Lineage Logistics, LLC	**$**818,905	**$**1,910,777

K. Key Partners

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

Key Partner Legal Company Name
No key partners to report

L. Budget Information

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

Funding Source	Funding Year of Appropriation	Budget List Number	Amount
EPIC	23-24	301.001K	$ 2,420,982

TOTAL Amount: $ 2,420,982

R&D Program Area: ICMB: IAW

Explanation for "Other" selection Not applicable

Reimbursement Contract #: Not applicable

Federal Agreement #: 101

M. Recipient's Contact Information

1. Recipient's Administrator/Officer

Name: Corrin Terrones

Address: 3227 Cheadle Hall, Mc2050

City, State, Zip: Santa Barbara, CA 93106-0001

Phone: 805-893-4359

E-Mail: terrones@research.ucsb.edu

3. Recipient's Project Manager

Name: Jason MardenAddress: 5161 Harold Frank Hall

City, State, Zip: Santa Barbara, CA 93106-0001

Phone: 805-893-2299

E-Mail: jrmarden@ece.ucsb.edu

N. Selection Process Used

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

Selection Process	Additional Information
Competitive Solicitation #	GFO-23-301
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: Rajesh Kapoor

Approval Date: 7/5/2024

Branch Manager: Ilia Krupenich (acting Manager)

Approval Date: 7/5/2024

Director: Delegated to Branch Manager

Approval Date: 7/5/2024

Exhibit A
Scope of Work
The Regents of the University of California Santa Barbara

I. TASK ACRONYM/TERM LISTS

A. Task List

Task #	CPR[1]	Task Name
1		General Project Tasks
2		Installation of ATLAS at the Identified Lineage Site (Mira Loma Lineage Facility)
3	X	Simulated Platform Integration and Assessment of Baseline Performance at Mira Loma Lineage Facility
4		Real-Time Data Ingestion and Digital Twin for Online Calibration
5	X	Demonstration of Energy Efficiency and Load Shifting Capabilities by Manual Calibration Through Aid of CrossnoKaye and Lineage Personnel
6		Offline Training of AI-Based Algorithms for Scalable and Robust Load Shifting
7		Offline Training of AI-Based Algorithms for Scalable and Robust Dynamic Adjustment of Suction and Discharge Pressure in Conjunction with Load Shifting
8	X	Offline Training of AI-Based Algorithms for Scalable and Robust Dynamic Compressor Sequencing in Conjunction with Load Shifting
9		Deployment and Evaluation of AI-Based Algorithms for Scalable and Robust Load Shifting
10		Deployment and Evaluation of AI-Based Algorithms for Scalable and Robust Dynamic Adjustment of Suction and Discharge Pressure in Conjunction with Load Shifting
11		Deployment and Evaluation of AI-Based Algorithms for Scalable and Robust Dynamic Compressor Sequencing in Conjunction with Load Shifting
12		Measurement and Verification of Savings Associated with AI-Based Algorithms for Scalable and Robust Load Shifting
13		Measurement and Verification of Savings Associated with AI-Based Algorithms for Scalable and Robust Dynamic Adjustment of Suction and Discharge Pressure in Conjunction with Load Shifting
14		Measurement and Verification of Savings Associated with AI-Based Algorithms for Scalable and Robust Dynamic Compressor Sequencing in Conjunction with Load Shifting
15		Offline Training of AI-guided Recommendation Systems for Integration of Thermal Energy Storage and Behind-the-Meter Generation Technologies

[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.

Task #	CPR[1]	Task Name
16		Evaluation of Savings Associated with AI-guided Recommendation Systems for Integration of Thermal Energy Storage and Behind-the-Meter Generation Technologies
17		Evaluation of Project Benefits
18		Technology/Knowledge Transfer Activities

B. Acronym/Term List

Acronym/Term	Meaning
AI	Artificial Intelligence
API	Application Programming Interface (a type of software interface that allows a user or a programmer to interact with a system using only the internal system details that matters to them and keeping their experience consistent even if the internal details change later)
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CEC	California Energy Commission
CPR	Critical Project Review
DRL	Deep Reinforcement Learning
GHG	Greenhouse Gas
kW	Kilowatt
MW	Megawatt
SCE	Southern California Edison
TAC	Technical Advisory Committee
TRL	Technology Readiness Level
UCSB	University of California Santa Barbara

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

A. Purpose of Agreement

The purpose of this Agreement is to fund a project that demonstrates and enhances the scalability of advanced energy efficiency, load reduction, and thermal load shifting technologies in industrial refrigerated warehouses through the use of artificial intelligence (AI)-based control solutions.

B. Problem/ Solution Statement

Problem

The wide-scale adoption of load shifting technologies in industrial refrigeration systems is commonly hampered by 1) outdated control infrastructure and 2) the lack of scalable algorithmic solutions that automate the decisions needed for efficient operation and permanent load shifting. This commonly places a substantial demand on the facility staff's time to manually

optimize these decisions. Furthermore, facilities vary in equipment, control, and operational requirements, and the rate structures and grid interaction modes are complex and variable.

Solution

The Recipient will train and demonstrate AI-based control solutions that improve the scalability of energy efficiency and load shifting technologies and enable their quick and easy adoption at many facilities. Two concurrent advances will aid this improvement:

1) Over the past 5 years, project partner Crossno & Kaye, Inc. (CrossnoKaye) has developed the ATLAS Platform as a novel solution to deal with the outdated control infrastructure. The ATLAS Platform is an intelligent cloud control software that transforms outdated facilities into smart facilities by moving the control architecture from the physical plant into the cloud. Through this integration, the ATLAS Platform - currently at Technology Readiness Level (TRL)-8 - can offer important functionalities like remote control and collaboration, data integration from external sources, 24/7 monitoring, and various economic benefits like energy and greenhouse gas (GHG) visualization, rate optimization and load management. While the capabilities of the ATLAS Platform for enabling energy reduction and energy shifting have already been well demonstrated (see Section 1 of project narrative for details), there are still a number of major hurdles to overcome in efforts to make load shifting technologies scalable and easily adoptable across different cold storage facilities. Most notable is the lack of scalable decision-making Application Programming Interface (API)s that can seamlessly integrate with a broad range of industrial refrigeration cycles operating in complex environments to aid facility operators.
2) The Recipient will remedy this scalability issue by bringing advanced AI-based control algorithms to the important and ever-growing sector of industrial refrigeration. Such advancements have the ability to seamlessly identify and exploit opportunities for energy reduction and energy shifting technologies with minimal human oversight. The value of this technology stems from its scalability, as such AI-based technologies can seamlessly adapt to varying operational conditions. Over the past few years, AI and advanced software have transformed nearly every sector of the economy that traditionally relied heavily on human operators to make complex decisions, largely spurred by wider availability of data and core algorithmic advances in reinforcement learning, machine learning, and deep learning, among others. However, it is important to highlight that these algorithmic advances have not yet come to refrigeration and other processes in heavy industries, and this is exactly what this project and its unique partnership aims to bring to the table: experts in optimal control and energy demand management from the Recipient with close ties to CrossnoKaye, an industry modernizer with dedicated intelligent control software and digital twins for the frozen and refrigerated food industry and partnered with Lineage Logistics, a leader in providing highly reliable and cost-effective cold storage solutions.

C. Goals and Objectives of the Agreement

Agreement Goals

The goals of this Agreement are to:

- Install the ATLAS Platform, which is an intelligent cloud control software that transforms outdated facilities into smart facilities. This will also create a digital twin of Lineage's Mira Loma Lineage Facility to enable testing of AI-based control techniques.
- Deploy and refine the following TRL-8 technologies and assess their benefits through demonstrations: 1) thermal load shifting for electricity cost savings, 2) dynamic compressor sequencing through load shifting and 3) dynamic adjustment of suction and discharge pressure through load shifting.
- Train, deploy and evaluate the performance of AI-based algorithms to improve the scalability of the above three technologies by reducing the staff time burden and increasing the speed of adoption across different facilities.
- Improve the robustness of AI-based automated decision making tools to unforeseen or irregular circumstances such as maintenance events or disruptions.
- Develop AI-guided recommendation systems for on-site integration of thermal energy storage and behind-the-meter generation technologies.
- Dissemination of project results to the broader community in order to promote wide scale adoption of the technology through the availability of public guidelines and algorithms.

Ratepayer Benefits:[2] This Agreement will result in the ratepayer benefits of 1) lower electricity costs by reducing the facility's average power demand, reducing peak demand and also shifting the facility's peak power demand away from mid-peak and on-peak periods (estimated annual savings of $744,241 in demand charges for delivery and generation based on an analysis performed on 2023 data) and 2) greater grid reliability by enabling price responsive of the facility to dynamic grid signals and also possible integration of storage and behind-the-meter solar generation technologies.

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 AI-based control systems that will improve the scalability of the adoption of energy efficiency and thermal load shifting technologies across different cold storage facilities quickly and without significant staff effort on a daily basis. The new algorithms will be included as an API in the future installation of the ATLAS cloud based control system and their results will also be disseminated to the broader community via published academic papers.

Agreement Objectives

[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).

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

The objectives of this Agreement are to:

- Demonstrate the following three technologies at the Mira Loma Lineage Facility of Lineage Logistics: 1) thermal load shifting for electricity cost savings, 2) dynamic compressor sequencing through load shifting and 3) dynamic adjustment of suction and discharge pressure through load shifting.
- Deploy and evaluate the performance of AI-based algorithms in improving the adoption scalability of thermal load shifting technologies in industrial cold storage facilities.
- Measure and validate the minimum 20% energy and electricity cost savings of the proposed technologies.
- Measure and validate the minimum 20% reductions in greenhouse gas emissions due to the proposed technologies.
- Measure and characterize the impact of proposed technologies on metrics of interest on various metrics important to stakeholders, including financial costs, rate of return, and peak demand reduction.

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:

<u>For products that require a draft version, including the Final Report Outline and Final Report</u>

- 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).
  - Python
  - Matlab

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 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 Product:
- 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 SUBCONTRACTS

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. 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 1.9 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 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 1.11 Technical Advisory Committee (TAC)
The goal of this subtask is to create an advisory committee for this Agreement. The TAC should be composed of diverse professionals. The composition will vary depending on interest, availability, and need. TAC members will serve at the CAM's discretion. The purpose of the TAC is to:
- Provide guidance in project direction. The guidance may include scope and methodologies, timing, and coordination with other projects. The guidance may be based on:
  - Technical area expertise;
  - Knowledge of market applications; or
  - Linkages between the agreement work and other past, present, or future projects (both public and private sectors) that TAC members are aware of in a particular area.
- Review products and provide recommendations for needed product adjustments, refinements, or enhancements.
- Evaluate the tangible benefits of the project to the state of California, and provide recommendations as needed to enhance the benefits.
- Provide recommendations regarding information dissemination, market pathways, or commercialization strategies relevant to the project products.
- Help set the project team's goals and contribute to the development and evaluation of its statement of proposed objectives as the project evolves.

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

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

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

The Recipient shall:

- Prepare a *List of Potential TAC Members* that includes the names, companies, physical and electronic addresses, and phone numbers of potential members. The list will be discussed at the Kick-off meeting, and a schedule for recruiting members and holding the first TAC meeting will be developed.
- Recruit TAC members. Ensure that each individual understands member obligations and the TAC meeting schedule developed in subtask 1.11.
- 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 1.12 TAC Meetings

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

The Recipient shall:

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

The TAC shall:

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

Products:

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

Subtask 1.13 Project Performance Metrics

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

The Recipient shall:

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

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

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

IV. TECHNICAL TASKS

*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. **Subtask 1.1 (Products)** describes the procedure for submitting products to the CAM.*

TASK 2 INSTALLATION OF ATLAS AT THE IDENTIFIED LINEAGE SITE (MIRA LOMA LINEAGE FACILITY)

The goal of this task is to retrofit the Mira Loma Lineage Facility with the ATLAS cloud control system developed by CrossnoKaye. This system will monitor and control all aspects of the refrigeration cycle.

The Recipient shall:
- Deploy the ATLAS Platform, including:
    - Control System
    - Web-based HMI's
    - Onsite startup and training
- Prepare: *Project Implementation Plan* - A written document describing:
    - On-site access protocols
    - Remote access details
    - Description of equipment and current facility operations

Products:
- Project Implementation Plan (draft and final)

TASK 3 SIMULATED PLATFORM INTEGRATION AND ASSESSMENT OF BASELINE PERFORMANCE AT MIRA LOMA LINEAGE FACILITY

The goal of this task is to perform an initial assessment of the baseline operational modes at the Mira Loma Lineage Facility and to establish a simulated environment of the facility to assess the outcome of different operational strategies we may adopt through the ATLAS Platform. During this task, recipient will have both qualitative and quantitative measures for the performance of the baseline operational modes at the Mira Loma Lineage Facility with regards to energy expenditure and greenhouse gas emissions.

The Recipient shall:

- Establish a simulated environment for operation of the Mira Loma Lineage Facility through the ATLAS Platform.
- Provide an initial assessment of the operational strategies at the Mira Loma Lineage Facility through simulated environment with regards to the following metrics:
    - Average Power (MW)
    - Peak Demand (kW)
    - Energy Expenditure using SCE Rate Structure
    - GHG Emissions
- Prepare an Initial Assessment Report, which will include a high-level executive summary discussing:
    - Existing operational modes of the Mira Loma Lineage Facility
    - Assessment of existing operational mode of the Mira Loma Lineage Facility with regards to the four metrics highlighted above.
    - Technical issues.
    - Lessons learned for this phase of the project.
    - Energy Expenditure using SCE Rate Structure
    - GHG Emissions
- Submit a draft of an *Initial Assessment Report* to the CAM for feedback and incorporate changes as requested.
- Prepare a *CPR Report* in accordance with subtask 1.3 (CPR Meetings).
- Participate in a CPR meeting.

Products:

- Initial Assessment Report
- CPR Report

TASK 4 REAL-TIME DATA INGESTION AND DIGITAL TWIN FOR ONLINE CALIBRATION

The goal of this task is to calibrate a simulated environment, i.e., digital twin, utilizing real-time data ingestion acquired using the ATLAS Platform installed at the Mira Loma Lineage Facility. This calibrated simulated environment will provide a platform for quantitatively evaluating the performance of alternative control strategies at the Mira Loma Lineage Facility.

The Recipient shall:

- Establish a calibrated simulated environment, i.e., a digital twin, for operation of the Mira Loma Lineage facility. This calibrated simulated environment will be continuously tuned using real-time facility data acquired through the ATLAS Platform.
- Provide an initial assessment of the operational strategies at the Mira Loma Lineage facility through this calibrated simulated environment with regards to the following metrics:
    - Average Power (MW)
    - Peak Demand (kW)
    - Energy Expenditure using SCE Rate Structure
    - GHG Emissions
- Prepare a *Real Time Data Initial Assessment Report,* which will include a high-level executive summary discussing:
    - Existing operational modes of the Mira Loma Lineage Facility
    - Assessment of existing operational mode of the Mira Loma Lineage Facility with regards to the four metrics highlighted above.
    - Technical issues.
    - Lessons learned for this phase of the project.
- Revise the draft of *Initial Assessment Report* (Task 3) to include new findings related to calibrated simulation environment and report to the CAM for feedback and incorporate changes as requested.

Products:

- Real Time Data Initial Assessment Report

TASK 5 DEMONSTRATION OF ENERGY EFFICIENCY AND LOAD SHIFTING CAPABILITIES BY MANUAL CALIBRATION THROUGH AID OF CROSSNOKAYE AND LINEAGE PERSONNEL

The goal of this task is to manually calibrate existing CrossnoKaye energy efficiency and load shifting technologies for implementation in the identified Mira Loma Lineage Facility. The resulting calibrated technologies will then be implemented in the identified Mira Loma Lineage Facility for direct evaluation of performance.

The Recipient shall:

- Calibrate current TRL-8 CrossnoKaye energy efficiency and load shifting technologies for implementation in the identified Mira Loma Lineage Facility
- Implement viable technologies at the identified Mira Loma Lineage Facility
- Provide an initial assessment of the performance gains associated with these technologies using either the calibrated twin or actual system data, when compared to the baseline operational mode investigated in Task 3. A central focus will be on the following core metrics:
    - Average Power (MW)
    - Demand (kW), Energy Expenditure using SCE Rate Structure
    - GHG Emissions (lbs CO2)
    - Shifted load (kWh)

- Prepare an *Initial Assessment of Deployment Report,* which will include a high-level executive summary discussing:
    - Existing operational modes of the Mira Loma Lineage Facility
    - CrossnoKaye technologies for energy efficiency and load shifting calibrated for implementation in the identified Mira Loma Lineage Facility
    - Assessment of performance gains of the CrossnoKaye technologies when compared to the existing operation modes.
    - Technical issues.
    - Lessons learned for this phase of the project.
- Submit an *Initial Assessment of Deployment Report* to the CAM for feedback and incorporate changes as requested.
- Prepare a *CPR Report* in accordance with subtask 1.3 (CPR Meetings).
- Participate in a CPR meeting

Products:

- Initial Assessment of Deployment Report
- CPR Report

TASK 6 OFFLINE TRAINING OF AI-BASED ALGORITHMS FOR SCALABLE AND ROBUST LOAD SHIFTING

The goal of this task is to train off-the-shelf AI-based algorithms (reinforcement learning) using real-time data and the calibrated digital twin developed in Task 4. The trained algorithms will focus on scalable and robust methods for load shifting to minimize energy expenditure. The performance of the resulting algorithm will be evaluated using real-time data and the digital twin.

The Recipient shall:

- Train off-the-shelf AI-based control algorithms (reinforcement learning) using real-time data and the calibrated digital twin developed in Task 4. The trained algorithms will focus on scalable and robust methods for load shifting to minimize energy expenditure.
- Implement the trained AI-based algorithm on the simulated platform for performance evaluation.
- Provide an initial assessment of the performance gains associated with the trained AI-based algorithms using the calibrated twin. A central focus will be on the following core metrics:
    - Average Power (MW)
    - Demand (kW)
    - Energy Expenditure using SCE Rate Structure
    - GHG Emissions (lbs CO2)
    - Shifted load (kWh)
- Prepare an Initial Assessment of AI-Based Algorithms, which will include a high-level executive summary discussing:
    - Existing operational modes of the Mira Loma Lineage Facility
    - Manually calibrated CrossnoKaye technologies for load shifting identified in Task 5.

  - Assessment of performance gains associated with AI-based technologies when compared to the existing manually calibrated CrossnoKaye technologies.
  - Technical issues.
  - Lessons learned for this phase of the project.
- Prepare a paper draft (for either conference of journal submission) that discusses the resulting AI-based algorithms and attainable performance via digital twin.

Products:
- None

TASK 7 OFFLINE TRAINING OF AI-BASED ALGORITHMS FOR SCALABLE AND ROBUST DYNAMIC ADJUSTMENT OF SUCTION AND DISCHARGE PRESSURE IN CONJUNCTION WITH LOAD SHIFTING

The goal of this task is to train off-the-shelf AI-based algorithms (reinforcement learning) using real-time data and the calibrated digital twin developed in Task 4. The trained algorithms will focus on the use of load shifting to enable scalable and robust dynamic adjustment of the suction and discharge pressure. The performance of the resulting algorithm will be evaluated using real-time data and the digital twin.

The Recipient shall:
- Train off-the-shelf AI-based algorithms (reinforcement learning) using real-time data and the calibrated digital twin developed in Task 4. The trained algorithms will focus on the use of load shifting to enable scalable and robust dynamic adjustment of the suction and discharge pressure.
- Implement the trained AI-based algorithm on the digital twin for performance evaluation.
- Provide an initial assessment of the performance gains associated with the trained AI-based algorithms using the calibrated twin. A central focus will be on the following core metrics:
  - Average Power (MW)
  - Demand (kW)
  - Energy Expenditure using SCE Rate Structure
  - GHG Emissions (lbs CO2)
  - Shifted load (kWh)
- Include analysis in the draft report Initial Assessment of AI-Based Algorithms, which will include a high-level executive summary discussing:
  - Assessment of performance gains associated with AI-based technologies when compared to the existing manually calibrated CrossnoKaye technologies.
  - Technical issues.
  - Lessons learned for this phase of the project.
- Prepare a paper draft (for either conference of journal submission) that discusses the resulting AI-based algorithms and attainable performance via digital twin
- Submit a revised draft of the report Initial Assessment of AI-Based Algorithms to the CAM for feedback and incorporate changes as requested.

Products:
- *None*

TASK 8 OFFLINE TRAINING OF AI-BASED ALGORITHMS FOR SCALABLE AND ROBUST DYNAMIC COMPRESSOR SEQUENCING IN CONJUNCTION WITH LOAD SHIFTING

The goal of this task is to train off-the-shelf AI-based algorithms (reinforcement learning) using real-time data and the calibrated digital twin developed in Task 4. The trained algorithms will focus on the use of load shifting to enable scalable and robust mechanisms for compressor sequencing. The performance of the resulting algorithm will be evaluated using real-time data and the digital twin.

The Recipient shall:

- Train off-the-shelf AI-based algorithms (reinforcement learning) using real-time data and the calibrated digital twin developed in Task 4. The trained algorithms will focus on the use of load shifting to enable scalable and robust mechanisms for compressor sequencing.
- Implement the trained AI-based algorithm on the digital twin for performance evaluation.
- Provide an initial assessment of the performance gains associated with the trained AI-based algorithms using the calibrated twin. A central focus will be on the following core metrics:
    - Average Power (MW), Demand (kW), Energy Expenditure using SCE Rate Structure, GHG Emissions (lbs CO2), Shifted load (kWh)
- Include analysis in the draft report *Initial Assessment of AI-Based Algorithms,* which will include a high-level executive summary discussing:
    - Assessment of performance gains associated with AI-based technologies when compared to the existing manually calibrated CrossnoKaye technologies.
    - Technical issues.
    - Lessons learned for this phase of the project.
- Prepare a paper *draft of manuscript for conference or journal publication*, that discusses the resulting AI-based algorithms and attainable performance via digital twin
- Submit a revised draft of the report *Initial Assessment of AI-Based Algorithms* to the CAM for feedback and incorporate changes as requested.
- Prepare a *CPR Report* in accordance with subtask 1.3 (CPR Meetings).
- Participate in a CPR meeting.

Products:

- Initial Assessment of AI-Based Algorithms Report
- Draft of manuscript for conference or journal publication
- CPR Report

TASK 9 DEPLOYMENT AND EVALUATION OF AI-BASED ALGORITHMS FOR SCALABLE AND ROBUST LOAD SHIFTING

The goal of this task is to deploy and evaluate the AI-based algorithms developed in Task 6 on scalable and robust methods for load shifting to minimize energy expenditure. The performance of the resulting algorithm will be evaluated using real-time data.

The Recipient shall:

- Deploy the AI-based algorithms developed in Task 6 on scalable and robust methods for load shifting to minimize energy expenditure at the Mira Loma Lineage Facility.
- Provide an initial assessment of the performance gains associated with the trained AI-based algorithms. A central focus will be on the following core metrics:
    - Average Power (MW)
    - Demand (kW)
    - Energy Expenditure using SCE Rate Structure
    - GHG Emissions (lbs CO2)
    - Shifted load (kWh)
- Include analysis in the draft report Initial Assessment of AI-Based Algorithms, which will include a high-level executive summary discussing:
    - Assessment of performance gains associated with the newly deployed AI-based technologies when compared to the existing manually calibrated CrossnoKaye technologies.
    - Technical issues.
    - Lessons learned for this phase of the project.
- Prepare a paper draft (for either conference of journal submission) that discusses the resulting AI-based algorithms and the observed performance
- Submit a revised draft of the report Initial Assessment of AI-Based Algorithms (with new data) to the CAM for feedback and incorporate changes as requested.

Products:
- None

TASK 10 DEPLOYMENT AND EVALUATION OF AI-BASED ALGORITHMS FOR SCALABLE AND ROBUST DYNAMIC ADJUSTMENT OF SUCTION AND DISCHARGE PRESSURE IN CONJUNCTION WITH LOAD SHIFTING

The goal of this task is to deploy and evaluate the AI-based algorithms developed in Task 7 on scalable and robust dynamic adjustment of suction and discharge pressure in conjunction with load shifting to maximize energy efficiency. The performance of the resulting algorithm will be evaluated using real-time data.

The Recipient shall:
- Deploy the AI-based algorithms developed in Task 7 on scalable and robust methods for dynamic adjustment of sanction and discharge pressure (in conjunction with load shifting) to optimize operational efficiency at the Mira Loma Lineage Facility.
- Provide an initial assessment of the performance gains associated with the trained AI-based algorithms. A central focus will be on the following core metrics:
    - Average Power (MW)
    - Demand (kW)
    - Energy Expenditure using SCE Rate Structure
    - GHG Emissions (lbs CO2)
    - Shifted load (kWh)
- Include analysis in the draft report Initial Assessment of AI-Based Algorithms, which will include a high-level executive summary discussing:

  - Assessment of performance gains associated with the newly deployed AI-based technologies when compared to the existing manually calibrated CrossnoKaye technologies.
  - Technical issues.
  - Lessons learned for this phase of the project.
- Prepare a paper draft (for either conference of journal submission) that discusses the resulting AI-based algorithms and the observed performance
- Submit a revised draft of the report Initial Assessment of AI-Based Algorithms (with new data) to the CAM for feedback and incorporate changes as requested.

Products:
- None

TASK 11 DEPLOYMENT AND EVALUATION OF AI-BASED ALGORITHMS FOR SCALABLE AND ROBUST DYNAMIC COMPRESSOR SEQUENCING IN CONJUNCTION WITH LOAD SHIFTING

The goal of this task is to deploy and evaluate the AI-based algorithms developed in Task 8 on scalable and robust dynamic compressor sequencing in conjunction with load shifting to minimize energy expenditure. The performance of the resulting algorithm will be evaluated using real-time data.

The Recipient shall:
- Deploy the AI-based algorithms developed in Task 8 on scalable and robust dynamic compressor sequencing in conjunction with load shifting to minimize the energy expenditure at the Mira Loma Lineage Facility.
- Provide an initial assessment of the performance gains associated with the trained AI-based algorithms. A central focus will be on the following core metrics:
  - Average Power (MW)
  - Demand (kW)
  - Energy Expenditure using SCE Rate Structure
  - GHG Emissions (lbs CO2)
  - Shifted load (kWh)
- Prepare *Evaluation of Deployment of AI-Based Algorithms Report*, which will include a high-level executive summary discussing:
  - Assessment of performance gains associated with the newly deployed AI-based technologies when compared to the existing manually calibrated CrossnoKaye technologies.
  - Technical issues.
  - Lessons learned for this phase of the project.

  Include analysis in the draft report *Initial Assessment of AI-Based Algorithms.*
- Prepare a paper *draft of manuscript for conference or journal publication* that discusses the resulting AI-based algorithms and the observed performance
- Submit a revised draft of the report Initial Assessment of AI-Based Algorithms (with new data) to the CAM for feedback and incorporate changes as requested.

Products:

- Evaluation of Deployment of AI-Based Algorithms Report
- Draft of manuscript for conference or journal publication

TASK 12 MEASUREMENT AND VERIFICATION (M&V) OF SAVINGS ASSOCIATED WITH AI-BASED ALGORITHMS FOR SCALABLE AND ROBUST LOAD SHIFTING

The goal of this task is to conduct a measurement and verification of the savings associated with the AI-Based technologies for scalable and robust load shifting developed in Task 9. The measurement and verification will be conducted by a 3rd party company not affiliated with the project team.

The Recipient shall:

- Hire third party company to conduct measurement and verification of the savings associated with the AI-Based technologies for scalable and robust load shifting developed in Task 9 at the Mira Loma Lineage Facility.
- Provide an initial analysis of the formal measurement and verification findings. A central focus will be on the following core metrics:
    - Average Power (MW)
    - Demand (kW)
    - Energy Expenditure using SCE Rate Structure
    - GHG Emissions (lbs CO2)
    - Shifted load (kWh)
- Include analysis in the draft report Final Assessment of AI-Based Algorithms, which will include a high-level executive summary discussing:
    - Summary of findings in M&V report.
    - Technical issues.
    - Lessons learned for this phase of the project.

  Report will be submitted to CAM for feedback.

Products:

- None

TASK 13 MEASUREMENT AND VERIFICATION OF SAVINGS ASSOCIATED WITH AI-BASED ALGORITHMS FOR SCALABLE AND ROBUST DYNAMIC ADJUSTMENT OF SUCTION AND DISCHARGE PRESSURE IN CONJUNCTION WITH LOAD SHIFTING

The goal of this task is to conduct a measurement and verification of the savings associated with the AI-Based technologies for scalable and robust dynamic adjustment of suction and discharge pressure (in conjunction with load shifting) deployed in Task 10. The measurement and verification will be conducted by a 3rd party company not affiliated with the project team.

The Recipient shall:

- Hire third party company to conduct measurement and verification of the savings associated with the AI-Based technologies for scalable and robust dynamic adjustment of suction and discharge pressure (in conjunction with load shifting) deployed in Task 10 at the Mira Loma Lineage Facility.
- Provide an initial analysis of the formal measurement and verification findings. A central focus will be on the following core metrics:

  - Average Power (MW)
  - Demand (kW)
  - Energy Expenditure using SCE Rate Structure
  - GHG Emissions (lbs CO2)
  - Shifted load (kWh)
- Include analysis in the draft report Final Assessment of AI-Based Algorithms, which will include a high-level executive summary discussing:
  - Summary of findings in M&V report.
  - Technical issues.
  - Lessons learned for this phase of the project.

  Report will be submitted to CAM for feedback.

Products:
- None

TASK 14 MEASUREMENT AND VERIFICATION OF SAVINGS ASSOCIATED WITH AI-BASED ALGORITHMS FOR SCALABLE AND ROBUST DYNAMIC COMPRESSOR SEQUENCING IN CONJUNCTION WITH LOAD SHIFTING

The goal of this task is to conduct a measurement and verification of the savings associated with the AI-Based technologies for scalable and robust dynamic compressor sequencing (in conjunction with load shifting) deployed in Task 11. The measurement and verification will be conducted by a 3rd party company not affiliated with the project team.

The Recipient shall:
- Hire third party company to conduct measurement and verification of the savings associated with the AI-Based technologies for scalable and robust dynamic compressor sequencing (in conjunction with load shifting) deployed in Task 11 at the Mira Loma Lineage Facility.
- Provide an initial analysis of the formal measurement and verification findings. A central focus will be on the following core metrics:
  - Average Power (MW)
  - Peak Demand (kW)
  - Energy Expenditure using SCE Rate Structure
  - GHG Emissions
  - Shifted load (kWh)
- Include analysis in the draft report *Final Assessment of AI-Based Algorithms,* which will include a high-level executive summary discussing:
  - Summary of findings in M&V report.
  - Technical issues.
  - Lessons learned for this phase of the project.

  Report will be submitted to CAM for feedback.
- Prepare a paper *draft of manuscript for conference or journal publication* that discusses the resulting AI-based algorithms and the observed performance

Products:
- Final Assessment of AI-Based Algorithms Report
- Draft of manuscript for conference or journal publication

TASK 15 OFFLINE TRAINING OF AI-GUIDED RECOMMENDATION SYSTEMS FOR INTEGRATION OF THERMAL ENERGY STORAGE AND BEHIND-THE-METER GENERATION TECHNOLOGIES

The goal of this task is to train off-the-shelf AI-based algorithms (reinforcement learning) using real-time data and the calibrated digital twin developed in Task 4. The trained algorithms will focus on evaluating the potential benefits associated with the integration of thermal energy storage and behind-the-meter generation technologies at existing facilities.

The Recipient shall:

- Train off-the-shelf AI-based algorithms (reinforcement learning) using real-time data and the calibrated digital twin developed in Task 4. The trained algorithms will focus on evaluating the benefits associated with the integration of thermal energy storage and behind-the-meter generation technologies at existing facilities.
- Implement the trained AI-based algorithm on the digital twin for performance evaluation using different models of thermal energy storage and behind-the-meter generation technologies.
- Provide an initial assessment of the improvement with new thermal energy storage and behind-the-meter generation technologies. A central focus will be on the following core metrics:
    - Average Power (MW)
    - Peak Demand (kW)
    - Energy Expenditure using SCE Rate Structure
    - GHG Emissions
    - Shifted load (kWh)

Products:

- None

TASK 16 EVALUATION OF SAVINGS ASSOCIATED WITH AI-GUIDED RECOMMENDATION SYSTEMS FOR INTEGRATION OF THERMAL ENERGY STORAGE AND BEHIND-THE-METER GENERATION TECHNOLOGIES

The goal of this task is to evaluate the savings associated with the AI-based guided recommendation system for the integration of thermal energy storage and behind-the-meter generation technologies developed in Task 15. The performance of the resulting algorithm will be evaluated using real-time data.

The Recipient shall:

- Provide an evaluation on the savings associated with this AI-based recommendation system (i.e., cost benefit analysis associated with given integration technologies) at the Mira Loma Lineage Facility. A central focus will be on the following core metrics:
    - Average Power (MW)
    - Peak Demand (kW)
    - Energy Expenditure using SCE Rate Structure
    - GHG Emissions

  - Shifted load (kWh)
- Provide an *Assessment of AI-Based Recommendations System Report,* which will include a high-level executive summary discussing:
  - Assessment of cost benefit analysis associated with given integration technologies.
  - Technical issues.
  - Lessons learned for this phase of the project.

Products:
- Assessment of AI-Based Recommendations System Report

TASK 17 EVALUATION OF PROJECT BENEFITS *(Mandatory task)*
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 18 TECHNOLOGY/KNOWLEDGE TRANSFER ACTIVITIES *(Mandatory task)*

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

The Recipient Shall:

- Develop and submit a *Project Case Study Plan* that outlines how the Recipient will document the planning, construction, commissioning, and operation of the technology or system being demonstrated. The Project Case Study Plan should include:
    - An outline of the objectives, goals, and activities of the case study.
    - The organization that will be conducting the case study and the plan for conducting it.
    - A list of professions and practitioners involved in the technology's deployment.
    - 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 Project Case Study Plan.
    - TAC comments the recipient does not propose to incorporate with and explanation why.
- Submit the final *Project Case Study Plan* to the CAM for approval.
- Execute the final Project Case Study Plan and develop and submit a Project Case Study.
- When directed by the CAM, develop presentation materials for a CEC sponsored conference/workshop(s) on the project.
- When directed by the CAM, participate in annual EPIC symposium(s) sponsored by the California CEC.
- Provide at least (6) six High Quality Digital Photographs (minimum resolution of 1300x500 pixels in landscape ratio) of pre and post technology installation at the project sites or related project photographs.

Products:

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

V. PROJECT SCHEDULE:

Please see the attached Excel spreadsheet.