California Energy Commission
January 21, 2025 Business Meeting
Backup Materials for Lincus, Inc.

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

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

RESOLUTION NO: 25-121-07

STATE OF CALIFORNIA

STATE ENERGY RESOURCES
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION: Lincus, Inc.

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

RESOLVED, that the CEC approves agreement EPC-24-033 with Lincus, Inc. for a $1,758,800 grant. This agreement will fund the development, performance evaluation, and pilot field demonstration of a packaged commercial Heating Ventilation and Air-Conditioning (HVAC) unit that is powered internally through a direct current (DC) power bus; 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 January 21,2025.

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: EPC-24-033

B. Division Information

1. Division Name: ERDD
2. Agreement Manager: Adel Suleiman
3. MS-:51
4. Phone Number: 916-996-1054

C. Recipient's Information

1. Recipient's Legal Name: Lincus, Inc.
2. Federal ID Number: 47-0922198

D. Title of Project

Title of project: DC Nanogrid for Non-Residential HVAC Application

E. Term and Amount

1. Start Date: 02/21/2025
2. End Date: 03/30/2029
3. Amount: $1,758,800.00

F. Business Meeting Information

1. Are the ARFVTP agreements $75K and under delegated to Executive Director? No
2. The Proposed Business Meeting Date: 1/21/2025
3. Consent or Discussion? Discussion
4. Business Meeting Presenter Name: Jason Tancher
5. Time Needed for Business Meeting: 10 minutes.
6. The email subscription topic is: EPIC (Electric Program Investment Charge).

Agenda Item Subject and Description:

Lincus, Inc.
Proposed resolution approving agreement EPC-24-033 with Lincus, Inc. for a $1,758,800 grant, and adopt staff's recommendation that this action is exempt from CEQA. This agreement will fund the development, performance evaluation, and pilot field demonstration of a packaged commercial Heating Ventilation and Air-Conditioning (HVAC) unit that is powered internally through a direct current (DC) power bus. (EPIC funding) Contact: Jason Tancher (Staff Presentation: 5 minutes)

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, § 15302 ;

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, Section 15301 provides that the operation, repair, maintenance, permitting, leasing, licensing, or minor alteration of existing structures, facilities, mechanical equipment or topographical features involving negligible or no expansion of use beyond that existing are categorically exempt from the provisions of CEQA. This project involves a minor alteration of existing facilities and mechanical equipment at a site either in Ventura or San Bernardino.

The planned alterations will replace a HVAC system with an air conditioner, heat pump, and components such as a battery storage system, thermal energy storage system, and the plumbing to support the system. There is negligible expansion of existing use as the new system will be used to heat and cool the same facility. There will be a minor addition of a thermal energy storage device (TES) that is between 6'x6.5'x4 and 7.5'x7.5'x11 (L x W x H). This addition is on the site, at the side of the existing facility.

Solar panels will also be added. The solar panels will be on the roof or over the parking lot. It will only cover land already in use by the facility. Some minor trenching may be required to install the necessary pipelines to support the TES. All required permits for installation and operation of the system will be obtained prior to system installation and demonstration. The demonstration will not have a significant impact on local air quality, noise, or traffic. For these reasons, the project will have a

negligible or no expansion of use and not have a significant effect on the environment and falls under the categorical exemption listed in 14 C.C.R. §15301.

Cal. Code Regs., tit. 14, Section 15302 provides an exemption where the project involved consists of replacement or reconstruction of existing structures and facilities where the new structure will be located on the same site as the structure replaced and will have substantially the same purpose and capacity as the structure replaced. This project involved the replacement of existing mechanical equipment at an existing facility in either Ventura or San Bernardino. The equipment to be replaced is an old HVAC system with a new more energy efficient air conditioner and heat pump as well as a nanogrid in order to run the equipment with renewable energy. The new equipment will be located on the same site as the equipment replaced, at a facility in either Ventura or San Bernardino. The new system has substantially the same purpose and capacity as the equipment replaced because it will heat and cool the same facility. For these reasons, the project falls under categorical exemption listed in 14 C.C.R. §15302.

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
Alliance for Sustainable Energy, LLC	$ 421,175	$ 600,000
Trane U.S. Inc.	$ 337,138	$ 244,037

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
Trane U.S. Inc.	$ 337,138	$ 244,037
Alliance for Sustainable Energy, LLC	$ 421,175	$ 600,000

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	21-22	301.001I	$ 517,250
EPIC	22-23	301.001J	$ 1,241,550

TOTAL Amount: $ 1,758,800

R&D Program Area: ICMB: Buildings

Explanation for "Other" selection Not applicable

Reimbursement Contract #: Not applicable

Federal Agreement #: Not applicable

M. Recipient's Contact Information

1. Recipient's Administrator/Officer

Name: Fiela Vu

Address: 8950 S 52Nd St Ste 415

City, State, Zip: Tempe, AZ 85284-1045

Phone: 1-626-473-2093

E-Mail: fvu@lincus.com

3. Recipient's Project Manager

Name: Sabarish Vinod

Address: 8950 S 52Nd St Ste 415

City, State, Zip: Tempe, AZ 85284-1045

Phone: 1-626-473-2060

E-Mail: svinod@lincus.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-23-308
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: Adel Suleiman

Approval Date: 12/10/2024

Branch Manager: Anthony Ng

Approval Date: 12/16/2024

Director: Anthony Ng for Jonah Steinbuck

Approval Date: 12/16/2024

Exhibit A
Scope of Work
Lincus, Incorporated

I. TASK ACRONYM/TERM LISTS

A. Task List

Task #	CPR[1]	Task Name
1		General Project Tasks
2		Technology Development
3	X	Market Potential Study
4		Lab Evaluation
5	X	Field Demonstration
6		Data Dissemination
7		Evaluation of Project Benefits
8		Technology/Knowledge Transfer Activities

B. Acronym/Term List

Acronym/Term	Meaning
AC	Alternating Current
BESS	Battery Energy Storage System
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CEC	California Energy Commission
CPR	Critical Project Review
CTZ	Climate Zone
DC	Direct Current
DER	Distributed Energy Resources
HP	Heat Pump
HVAC	Heating Ventilation and Air Conditioning
IPMVP	International Performance Measurement and Verification Protocol
M&V	Measurement and Verification
NREL	National Renewable Energy Lab
PV	Photovoltaic Module
SME	Subject Matter Expert
TAC	Technical Advisory Committee

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

A. Purpose of Agreement

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

Exhibit A
Scope of Work
Lincus, Incorporated

The purpose of this Agreement is to fund the development, performance evaluation, and pilot field demonstration of a packaged commercial heating ventilation and air conditioning (HVAC) unit that is powered internally through a direct current (DC) power bus. Native direct current (DC) power sources such as photovoltaic module (PV) and battery energy storage system (BESS) can directly power this heat pump HVAC unit, resulting in increased system efficiency compared to traditional HVAC units.

B. Problem/ Solution Statement

Problem

Commercial buildings use grid-supplied alternating current (AC) power, which is delivered through an existing service entrance, to power building functions and essential systems. Along with the electric grid, commercial buildings can utilize power from multiple onsite distributed energy resources (DER) like PV solar systems, emergency diesel generators, or battery energy storage systems that are mostly native DC systems. In a typical installation, all of these assets are connected through the same AC power grid through appropriate power converter systems.

Currently, all HVAC systems available in the market for commercial buildings are AC powered. Newer HVAC systems use power-electronics based variable frequency drives (VFD) to run motors. A VFD internally converts AC grid power to DC and then convert this DC voltage back to AC with varying voltage levels and frequencies. This ensures variable speed, smooth motor operation, greater controllability, and efficient operation. While this is advantageous over running the motors directly from the AC grid, this results in addition of multiple power conversion stages.

However, power generated from the PV system and/or stored in BESS are natively DC. Inverters convert the DC power supplied by a PV system or BESS into AC power, and this power may be used to meet the HVAC power requirements. A power electronic converter is also required to convert AC to DC to charge the BESS. These multiple power conversion stages reduce overall system efficiency. Power conversion losses in inverters can be as high as 20%, depending on the operating point. This means that AC powered equipment receiving power from onsite DERs with DC outputs have a lower overall efficiency due to conversion losses at multiple stages.

Furthermore, in cases where onsite solar PV system generates more power than is needed, the excess power is either exported to the grid or curtailed. To maintain grid stability and reliability, power exports to the grid must be balanced with other grid resources. Grid operators cannot easily control power production from individual solar systems in real time like traditional power generators and, as a result, balancing the grid becomes a complex problem. This problem becomes exponentially difficult to solve as the installed solar and battery capacities in buildings keeps increasing. The best-case scenario is for all the power generated by the solar PV system to be used up at the site of generation, reducing overall demand and relieving strain on the grid infrastructure.

Solution

Exhibit A
Scope of Work
Lincus, Incorporated

The project team proposes to design, develop and demonstrate a novel DC HVAC Nanogrid Hub for commercial building applications featuring a packaged rooftop air conditioner & heat pump rated up to 12.5 tons with DC backbone, an on-site solar PV interfaced to the DC backbone through a string optimizer, an energy storage device interfaced to the DC-link using a DC-DC converter, and a step-down converter to generate a 48V interface for auxiliary loads like lighting, tools, and electronics.

The Hub connects to a 208V three-phase AC panel through a grid-side disconnect device for protection and islanding, minimizing infrastructure modifications and installation costs. A bidirectional interface fed from the 208V panel generates a regulated DC bus for the components. The DC backbone eliminates the need for multiple back-and-forth AC to DC conversions, improving overall system efficiency. The Nanogrid Hub aims to enhance on-site energy use, grid support during peak demand, affordability, and resilience of commercial buildings by enabling control of the on-site energy generation, storage, and management.

C. Goals and Objectives of the Agreement

Agreement Goals

The goals of this Agreement are to:
Design, develop and demonstrate a novel DC HVAC Nanogrid hub solution for commercial building applications that:

- Consists of a packaged HVAC with heat pump solution and DC backbone connection
- Increases adoption and optimal use of on-site solar PV and energy storage technologies
- Has load shifting capabilities to minimize HVAC loads during pre-programmed critical peak demand period
- Has a higher system efficiency, lower energy use and cost savings for the novel technology against the existing HVAC standard equipment

Ratepayer Benefits:[2] This Agreement will result in the ratepayer benefits of greater electricity reliability and increased safety and resilience by reducing the reliance on grid supplied power for HVAC operations during critical peak grid loading situations.

The electric grid is currently challenged with coordinating intermittent solar PV and other renewable energy sources with traditional power plants. The diminishing solar PV generation coincides with evening peak load forcing the grid to deploy fast responding peaker plants to maintain grid stability. HVAC loads in summer contribute to the peak loading of the grid because of the coincident nature of their operations.

[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).

Technologies that help to shift the contribution of HVAC load to grid peaks and use onsite DERs will vastly improve the reliability and robustness of the grid. The battery energy storage and solar PV generation capabilities integrated with the Nanogrid Hub provide resiliency at a local level as well. Grid resiliency also help recovery of the distribution system after unintentional grid outage or a rolling outage, which can lead to health and safety concerns. This project supports grid reliability, robustness, and resiliency that are critical to improve and sustain the quality of power delivery to California customers.

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 2045. The project team proposes to use a commercially available, certified HVAC / heat pump (HP) product adapted to be powered by a DC bus instead of the AC power grid. This HVAC Hub will use advanced energy and building management algorithms to meet all local loads using onsite solar power generation and energy storage, and through optimization, minimize the power and energy consumption from the grid. Optimal use of on-site energy will reduce the export of energy to the grid thereby can significantly reduce reliance and strain on the grid resources. Using the novel DC backbone to connect all the on-site native DC DERs and HVAC loads, the overall system efficiency not only will be higher but be more reliable. These innovations, coupled with breakthroughs in energy storage and renewable energy integration, promise a future of sustainable and grid-responsive HVAC systems. The project also leverages national renewable energy laboratories (NREL's) expertise and facilities to model the system performance, energy storage sizing and evaluate the innovative technology before deployment, furthering the chance of project success.

Agreement Objectives

The objectives of this Agreement are to:

- Develop a DC HVAC Nanogrid hub for a commercial HVAC heat pump unit with a targeted size of up to 12.5 tons.
- Evaluate a minimum of (10) relevant literature and case studies to determine existing technology barriers.
- Leverage state-of-the-art building energy simulation platforms to model the system performance and size, and design a control scheme.
- Assess the market potential of this technology for commercial applications in terms of coincident peak demand reduction and to estimate the size of the market where this solution can be deployed.
- Set up and conduct lab evaluation of the proposed unit by simulating at least one California climate zone weather similar to field evaluation site climate zone (CTZ) and/or lab conditions set to bound the impacts in the most arid (CTZ 15) and coolest coastal (CTZ06).
- Enroll one customer site for a field demonstration. Establish and implement an M&V plan to evaluate the customer's as-found HVAC operations as a baseline.

[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.

Exhibit A
Scope of Work
Lincus, Incorporated

- Support customer's procurement team with the purchase and install of the novel HVAC unit that utilizes the proposed technology
- Establish and implement an M&V plan to evaluate the customer's new HVAC operations to evaluate performance, energy and cost savings for the novel technology against the current HVAC standard equipment.
- Disseminate information to the public with the intent of increasing technology adoption. Participate in technology/knowledge transfer activities.

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 <u>no match funds</u> 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)*

Task 1.9 Obtain and Execute Subawards and Agreements with Site Hosts

The goal of this task is to ensure quality products and to execute subrecipients and site host agreements, as applicable, required to carry out the tasks under this Agreement consistent with the Agreement Terms and Conditions and the Recipient's own procurement and contracting policies and procedures**.**

The Recipient shall:

- Execute and manage subawards and coordinate subrecipient activities.
- Execute and manage site host agreements, and ensure the right to use the project site throughout the term of the Agreement, as applicable. A site host agreement is not required if the Recipient is the site host.
- 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.
- Submit a letter to the CAM describing the subawards and any site host agreement needed or stating that no subawards or site host agreements are required. For this agreement, Recipient shall submit evidence that the owners or occupants, as applicable, for all homes involved in this Agreement have consented to the project activities being performed therein.
- If requested by the CAM, submit a draft of each subaward and any site host agreement required to conduct the work under this Agreement to the CAM for review.
- If requested by the CAM, submit a final copy of each executed subaward and any site host agreement.
- If Recipient intends to add new subrecipients or change subrecipients, then the Recipient shall notify the CAM.

Products:

- Letter describing the subawards needed, or stating that no subawards are required
- Draft subaward (if requested)
- Final subaward (if requested)
- Draft site host agreement (if requested)
- Final site host agreement (if requested)

Subtask 1.10 Permits

The goal of this subtask is to obtain all permits required for work completed under this Agreement in advance of the date they are needed to keep the Agreement schedule on track. Permit costs and the expenses associated with obtaining permits are not reimbursable under this Agreement, with the exception of costs incurred by University of California recipients. Permits must be identified and obtained before the Recipient may incur any costs related to the use of the permit(s) for which the Recipient will request reimbursement.

Exhibit A
Scope of Work
Lincus, Incorporated

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 1.11Subawards

The goals of this subtask are to: (1) procure subawards required to carry out the tasks under this Agreement; and (2) ensure that the subawards are consistent with the terms and conditions of this Agreement.

The Recipient shall:

- Manage and coordinate subrecipients activities in accordance with the requirements of this Agreement.
- 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.
- If requested by the CAM, submit a draft of each *Subaward* required to conduct the work under this Agreement.
- If requested by the CAM, submit a final copy of each executed subaward.
- Notify and receive written approval from the CAM prior to adding any new subrecipient (see the terms regarding of subrecipient additions in the terms and conditions).
-

Products:

- Subawards *(if requested by the CAM)*

TECHNICAL ADVISORY COMMITTEE

Subtask 1.12 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 1.12.
- 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 1.13 TAC Meetings

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

The Recipient shall:

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

The TAC shall:

- Help set the project team's goals and contribute to the development and evaluation of its statement of proposed objectives as the project evolves.
- Provide a credible and objective sounding board on the wide range of technical and financial barriers and opportunities.

- Help identify key areas where the project has a competitive advantage, value proposition, or strength upon which to build.
- Advocate on behalf of the project in its effort to build partnerships, governmental support and relationships with a national spectrum of influential leaders.
- Ask probing questions that insure a long-term perspective on decision-making and progress toward the project's strategic goals.
- Review and provide comments to proposed project performance metrics.
- Review and provide comments to proposed project Draft Technology Transfer Plan.

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

Subtask 1.14 Project Performance Metrics
The goal of this subtask is to finalize key performance targets for the project based on feedback from the TAC and report on final results in achieving those targets. The performance targets should be a combination of scientific, engineering, techno-economic, and/or programmatic metrics that provide the most significant indicator of the research or technology's potential success.

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

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

Exhibit A
Scope of Work
Lincus, Incorporated

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 TECHNOLOGY DEVELOPMENT

The goal of this task is to design, model, build, and test the DC HVAC Nanogrid Hub system. The Recipient shall use qualified and tested subcomponents to build the DC HVAC Hub to reduce technology risks.

The Recipient shall:

- Create a report called "*Description of Electrical and Thermal System Models*" that contains the following:
  - Perform System Modeling, Sizing, and Evaluation
  - Develop electrical models for the various power components in system to estimate system efficiency
  - Develop physics based, hourly, whole-building energy models that includes heating and cooling load profiles for a selected site in California models
  - Model PV generation to estimate yearly solar power generation of site
  - Calculate energy storage sizing and control strategies for emergency and load shifting conditions
- Create a *One Line Diagram for DC HVAC Nanogrid Hub*
  - Identify hardware, firmware, and software Design Modification Requirements to the HVAC / HP rooftop unit that are necessary to integrate with a regulated DC bus voltage
  - Identify the integration requirements for thermal energy storage ice tanks and develop a design
  - Design and/or select the DC-DC converter solutions for solar PV and battery energy storage systems
  - Design and/or select the AC-DC converter solutions for the Active Front End PWM rectifier
  - Design and/or select the DC-DC converter solutions to create the Low-Voltage DC bus
- Design the Energy Management Controller Algorithm
  - Determine controller inputs and outputs
  - Develop optimization algorithms
  - Integrate the controller with wider building management system and grid control
- Perform engineering work to develop a *Demonstration Prototype DC HVAC Nanogrid Hub*
  - Modify commercial-grade HVAC / HP unit to be DC-fed
  - Integrate the thermal energy storage system to the DC-fed HVAC / HP
  - Build or assemble the DC-DC converter assemblies for solar, battery, and 24V bus applications, and the ac-dc converter for the front-end application
  - Develop the firmware for subsystem-level controls

- Develop System Level Controls in the DC-HVAC Hub to Interface with Energy Management Controller

Products:

- Description of Electrical and Thermal system models
- One Line Diagram for DC HVAC Nanogrid Hub
- Demonstration Prototype DC HVAC Nanogrid Hub

TASK 3 MARKET POTENTIAL STUDY

The goal of this task is to perform a market assessment to evaluate the potential of deploying the proposed technology. During this task, the Recipient will engage with various stakeholders in the HVAC market to understand the barriers and potential for the proposed technology.

The Recipient shall:

- Perform literature review of a minimum of (10) studies
- Develop a *Literature Review Report* to:
  - Note any known market barriers to the proposed technology
  - Identify advantages/disadvantages to the proposed technology.
  - Provide additional guidance to the project on technology development and evaluation
- Develop a report called *"Subject Matter Experts Report"* that contains the following:
  - Identify a minimum of (10) SMEs, such as HVAC manufacturers, contractors, building code officials, and certain end use customers that can contribute to the study
  - An *SME Survey Questionnaire* based on the findings from literature review
  - Mitigation strategies for barriers identified above
  - Strategies to ease adoption of technology once it becomes mainstream
  - Identify additional drivers related to installation and use of technology
  - Installation and commissioning costs estimates
- Conduct interview of SMEs
  - Create *SME Interview Summary Notes* to capture feedback
- Prepare CPR Report #1 and Participate in CPR meetings per task 1.3

Products:

- Literature Review Report
- SME Survey Questionnaire
- Subject Matter Experts Report
- SME Interview Summary Notes
- CPR Report #1

TASK 4 LAB EVALUATION

The goal of this task is to conduct experiments on the novel Prototype DC HVAC Nanogrid Hub prior to installation at the demonstration site. The work performed under this task will evaluate the operation of the proposed unit under simulated conditions. The work will be performed under controlled lab conditions while ensuring repeatability of results.

The Recipient shall:

- Prepare the list of *Building and Grid-Level Impact Potential List* of DC HVAC Hub to:
    - Identify and benchmark key parameters that are expected to be influenced by this technology at a building level and a grid level
    - Prepare the list of laboratory equipment to test the identified parameters
    - Prepare test environment and test setup in accordance with all applicable testing standards
    - Prepare and execute agreement with equipment vendors to procure DC HVAC Nanogrid Hub

Develop a *Laboratory Evaluation Test Plan* to include the test facility, equipment, conditions, procedure and success criteria to:

- Install new HVAC unit and required accessories in the test environment
- Determine reporting periods, the frequency, and the duration of data collection
- Document the IPMVP protocol during the study
- Determine measurement points that must be collected and reported
- Determine the measurement devices that will be used to collect data
- Document measurement instrumentation specifications
- Determine the frequency and the duration of data collection
- Create a plan for missing information
- Document monitoring responsibilities
- Establish an analysis procedure using the data collected during the M&V period
- Establish quality assurance procedures

- Develop a *Laboratory Experiment Plan* that consists of the following:
    - Document all details of the tests that are conducted including experiment details, experiment time, equipment behavior, any issues/ deviation from the evaluation plan.
    - Ensure the experiment is running according to the test plan prior to results being analyzed.

- Conduct the laboratory experiment with the DC HVAC Hub and other Hardware-in-Loop components to evaluate the electrical and thermal performance of the system in accordance with the *Laboratory Experiment Plan*.
    - Calibrate and install necessary measurement devices to capture operational data
    - Perform testing under varying conditions to simulate HVAC operation in at least one California climate zone and a maximum of three climate zones
    - Perform testing to generate statistically significant results
    - Ensure that testing is performed in accordance with the test plan

- Draft *Laboratory Experiment Results* of the Hardware-in-Loop test for DC HVAC Hub
    - Analyze the data collected during the testing period
    - Provide results from testing to document performance of the DC HVAC Nanogrid Hub

Products:

- Building and Grid-Level Impact Potential List

- Laboratory Evaluation Test Plan (draft and final)
- Laboratory Experiment Plan (draft and final)
- Laboratory Experiment Results

TASK 5 FIELD DEMONSTRATION

The goals of this task are to perform a field demonstration and performance evaluation of the proposed technology. During this task, the Recipient will evaluate the real-world performance of the proposed technology and measure key performance metrics such as Energy Efficiency Ratio, customer satisfaction, energy cost savings from the new technology, system cooling and heating performance, and duration of load shifting in hours. To ensure a detailed comparison of the existing HVAC with the proposed technology, the Recipient will perform similar performance measurements on the baseline unit.

The Recipient shall:

- Identify and qualify a suitable site for the project
- Prepare a *Program Participation Agreement* to:
    - Document roles and responsibilities of various parties that are part of this project
    - Document a timeline for engagement
    - Identify authorized personnel for all stakeholders
    - Document terms and conditions
- Prepare a *Site Access Agreement* to:
    - Provide program staff access to customer sites
    - Provide program staff access to customer data including energy data as it pertains to this project
    - Document authorization by customer to allow program staff be on site to conduct program business
- Perform site walk and prepare a *Site Conditions Report* to aid in the development of:
    - An M&V Plan that includes 12-month pre and post installation of data collection and evaluation
    - Decommissioning plan for the existing system
    - Commissioning plan for the proposed system
- Establish an *M&V Plan* to:
    - Determine reporting periods
    - Document the IPMVP protocol during the study
    - Determine measurement points within the baseline and proposed systems
    - Determine the measurement devices that will be used to collect data
    - Document measurement instrumentation specifications
    - Determine the frequency and the duration of data collection
    - Create a plan for missing information
    - Document monitoring responsibilities
    - Establish an analysis procedure using the data collected during the M&V period
    - Establish quality assurance procedures
- Calibrate and install metering equipment and loggers on the baseline unit to continuously store operational data
- Perform baseline monitoring for a period as indicated in the M&V plan and prepare a *Baseline M&V Report* to:

  - Document the performance of the baseline unit
  - Aid in the development of a counterfactual energy model
- Assist in the procurement of the proposed technology
- Assist in installation and commissioning of proposed technology
- Calibrate and install metering equipment and loggers on the new unit to continuously store operational data
- Perform monitoring for a period as indicated in the M&V plan and prepare a *Proposed Technology M&V Report* to:
  - Document the performance of the newly installed unit
  - Aid in the development of an energy model to simulate the equipment's operations under varying temperature conditions
- Prepare CPR Report #2 and Participate in CPR meetings per task 1.3

Products:
- Program Participation Agreement
- Site Access Agreement
- Site Conditions Report
- M&V Plan (draft and final)
- Baseline M&V Report
- Proposed Technology M&V Report
- CPR Report #2

TASK 6: EVALUATION OF PROJECT BENEFITS
The goal of this task is to report the benefits resulting from this project.

The Recipient shall:
- Complete *the Initial Project Benefits Questionnaire*. The Initial Project Benefits Questionnaire shall be initially completed by the Recipient with 'Kick-off' selected for the 'Relevant data collection period' and submitted to the CAM for review and approval.
- Complete the *Annual Survey* by 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 7 TECHNOLOGY/KNOWLEDGE TRANSFER ACTIVITIES

The goal of this task is for the Recipient to ensure that the technological learning resulting 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 name of the organization and the location of the site where the case study will be performed. 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.
    - A list of potential events such as trainings and conferences to disseminate the results of the case study.
- Present the draft *Project Case Study Plan* to the TAC for review and comment.
- Develop and submit a *Summary of TAC Comments* that summarizes comments received from the TAC members on the draft *Project Case Study Plan*. This document will identify:
    - TAC comments the Recipient proposes to incorporate into the final *Technology Transfer Plan*.
    - TAC comments the Recipient does not propose to incorporate with and explanation why.
- Submit the final *Project Case Study Plan* to the CAM for approval.
- Execute the final Project Case Study Plan and develop and submit a Project Case Study.
- When directed by the CAM, develop presentation materials for a CEC sponsored conference/workshop(s) on the project.

- When directed by the CAM, participate in annual EPIC symposium(s) sponsored by the California CEC.
- Provide at least (6) six High Quality Digital Photographs (minimum resolution of 1300x500 pixels in landscape ratio) of pre and post technology installation at the project sites or related project photographs.

Products:

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

V. PROJECT SCHEDULE

Please see the attached Excel spreadsheet