California Energy Commission
November 13, 2024 Business Meeting
Backup Materials for Intertie Incorporated

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: 24-1113-05b

STATE OF CALIFORNIA

STATE ENERGY RESOURCES
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION: Intertie Incorporated

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-24-024 with Intertie Incorporated for a $2,120,879 grant. This agreement will advance and demonstrate a novel direct current (DC) coupled microgrid technology to integrate solar, energy storage, and a grid-tied bidirectional converter to power EV fast chargers at a gas station along Highway 5 in Fresno County and mitigate the need for service upgrades; 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 November 13, 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-24-024

B. Division Information

1. Division Name: ERDD
2. Agreement Manager: Emily Ou
3. MS-:51
4. Phone Number: 916-232-6334

C. Recipient's Information

1. Recipient's Legal Name: Intertie Incorporated
2. Federal ID Number: 35-2569628

D. Title of Project

Title of project: Deployment and Demonstration of a Novel DC-Coupled Fast Charging Technology with Low Grid Impact in the Central Valley

E. Term and Amount

1. Start Date: 11/18/2024
2. End Date: 12/31/2027
3. Amount: $2,120,879.00

F. Business Meeting Information

1. Are the ARFVTP agreements $75K and under delegated to Executive Director? No
2. The Proposed Business Meeting Date: 11/13/2024
3. Consent or Discussion? Discussion
4. Business Meeting Presenter Name: Katelynn Dinius
5. Time Needed for Business Meeting: 5 minutes
6. The email subscription topic is: EPIC (Electric Program Investment Charge)

Agenda Item Subject and Description:
INTERTIE INCORPORATED. Proposed resolution approving agreement EPC-24-139 with Intertie Incorporated for a $2,120,879 grant and adopting staff's recommendation that this action is exempt from CEQA. This agreement will advance and demonstrate a novel direct current (DC) coupled microgrid technology to integrate solar, energy storage, and a grid-tied bidirectional converter to power electric vehicle fast chargers at a gas station along Highway 5 in Fresno County and mitigate the need for service upgrades. (EPIC funding) Contact: Katelynn Dinius

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, 15303, 15304, 15311
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.

California Code of Regulations, title 14, section 15301 provides that projects which consist of the operation, repair, maintenance, permitting, licensing, or minor alteration of existing public or private structures, facilities, mechanical equipment, or topographical features, and which involve negligible or no expansion of existing or former use, are categorically exempt from the provisions of the California Environmental Quality Act (CEQA). This project involves the installation and operation of a DC hub architecture for seven DC fast chargers for charging electric vehicles at an existing retail gas station. The installed equipment includes a solar array, battery storage system, DC hub, EV charge ports and grid connection converter. The minor alteration of the existing retail gas station facility from this project will result in negligible expansion of existing uses as the vehicle traffic will remain the same. Therefore, this project is exempt from the provisions of CEQA under section 15301.

California Code of Regulations, title 14, section 15303 provides that projects which consist of the construction and location of limited numbers of new, small facilities or structures; installation of small new equipment and facilities in small structures; and the conversion of existing small structures from one use to another where only minor modifications are made in the exterior of the structure are categorically exempt from the provisions of CEQA. This project involves the construction and installation of a limited number of new, small facilities and structures, including a battery storage unit

and a series of EV chargers with associated electrical equipment, along with a 200 kW carport mounted solar array, all at an existing site. Therefore, this project is exempt from CEQA under section 15303.

California Code of Regulations, title 14, section 15304 provides that projects which consist of minor public or private alterations in the condition of land, water, and/or vegetation which do not involve removal of healthy, mature, scenic trees except for forestry or agricultural purposes are categorically exempt from the provisions of CEQA. Examples include, among other things, minor trenching and backfilling where the surface is restored. This project involves the construction and installation of a DC hub architecture for seven DC fast chargers for charging electric vehicles at an existing retail gas station. The installed equipment includes a solar array, battery storage system, DC hub, EV charge ports and grid connection converter. The project will involve minor alterations in the condition of land at the project site, including installation of pad mounting of electrical equipment. The project will also involve minor trenching and backfilling of electrical equipment with the surface restored after installation. No trees will be removed. Therefore, this project is exempt from CEQA under section 15304.

California Code of Regulations, title 14, section 15311 provides that projects which consist of the construction, or placement of minor structures accessory to (appurtenant to) existing commercial, industrial, or institutional facilities are categorically exempt from the provisions of CEQA. This project involves the construction and placement of minor structures accessory to (appurtenant to) an existing commercial retail gas station, including a series of EV charge ports, a pad mounted battery system, and a carport solar array along with associated electrical equipment. These installations will be accessory to an existing commercial building and property. Therefore, this project is exempt from CEQA under section 15311.

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.

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"?

Yes

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
Nemat Incorporated	$ 238,072	$38,505
Hodges Electric, Inc.	$ 25,000	$0
Beyond Housing Foundation	$ 10,000	$0
Fresno County Rural Transit Agency	$ 50,000	$0

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
Nemat dba Lean Solar	$0	$300,000
Intertie Incorporated	$45,000	$408,000

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	23-24	301.001K	$ 2,120,879

TOTAL Amount: $ 2,120,879

R&D Program Area: ESTB: Transportation

Explanation for “Other” selection Not applicable

Reimbursement Contract #: Not applicable

Federal Agreement #: 101

M. Recipient’s Contact Information

1. Recipient’s Administrator/Officer

Name: Alexander Mrlik

Address: 475 Coloma St Ste 190

City, State, Zip: Sausalito, CA 94965-3808

Phone: 415-567-0446

E-Mail: zander@intertie.com

2. Recipient’s Project Manager

Name: Richard Mrlik

Address: 475 Coloma St Ste 190

City, State, Zip: Sausalito, CA 94965-3808

Phone: 415-567-0446

E-Mail: rmrlik@intertie.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-23-306
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: Emily Ou

Approval Date: 10/2/2024

Branch Manager: Reynaldo Gonzalez

Approval Date: 10/3/2024

Director: Reynaldo Gonzalez for Jonah Steinbuck

Approval Date: 10/3/2024

Exhibit A
Scope of Work
Intertie Incorporated

I. TASK ACRONYM/TERM LISTS

A. Task List

Task #	CPR[1]	Task Name
1		General Project Tasks
2		Complete Specifications for Advanced PEM with Plug-and-Play Interoperability with Multiple Super-Fast Charging Stations
3		Develop Advanced PEM Product
4	X	Complete Pre-Demonstration Testing and Validation of Advanced PEM
5	X	Complete Engineering, Procurement, and Construction (EPC) and Commissioning of Project
6		Operating Performance Monitoring and Reporting
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
CSMS	Charge Station Management System
DC	Direct Current
EMS	Energy Management System
EV	Electric Vehicle
PEM	Power Electronics Module
TAC	Technical Advisory Committee
UI	C# Programming Language with Presentation

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

A. Purpose of Agreement

The purpose of this agreement is to fund the advancement, deployment and demonstration of the Recipient's novel direct current (DC) microgrid technology. The project will demonstrate a microgrid-boosted electric vehicle (EV) fast charging product that can supply locally-generated power and energy for public EV charging stations while avoiding utility upgrades.

Problem/ Solution Statement

[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
Intertie Incorporated

Problem

California's grid must expand and evolve to achieve the state's transportation electrification and zero-carbon electricity goals. For EVs to be broadly adopted, automakers and policymakers all agree that a convenient network of fast chargers is needed. Most commercially available fast chargers connect directly to the alternating current (AC) grid and have higher power requirements than the spare capacity in most building electric panels and/or utility services. A high-power charging facility offering multiple fast chargers exacerbates this problem by requiring costly electrical upgrades and has higher operating costs due to high demand charges. So far, utilities face challenges in supporting the deployment of direct current fast chargers in a fast or cost-effective manner to keep pace with EV adoption rates. This barrier makes it difficult to install fast chargers where they would be most convenient for drivers, such as gas stations, multi-unit dwellings, and commercial properties. Without this charging infrastructure in place, EV ownership presents convenience and economic viability challenges for many California residents and can impact EV adoption rates.

Solution

The Recipient has advanced its DC hub architecture to directly fast charge one electric vehicle (EV) via its power electronics module (PEM) technology. Compared to conventional AC hub architecture, the novel DC hub architecture in the Recipient's product reduces the required grid capacity for installing DC fast chargers by 85%. Such reduction in grid capacity required for a facility with multiple super-fast chargers (100+ kW) obviates electrical panel and utility infrastructure upgrades, providing California a scalable template to accelerate and broaden transportation electrification.

The PEM is supplied from a high-voltage DC bus connected to energy storage, DC-coupled solar, and a grid-tied bidirectional AC/DC converter sized to available grid capacity. Adding DC-coupled distributed solar to the microgrid improves the economics and resilience of the ultra-fast charging process. Connecting multiple commercially available fast chargers to a DC microgrid requires increasing the DC/DC conversion capacity and firmware, referred to as the advanced PEM. The Project shall productize the advanced PEM, a continuation of the Recipient's strategic focus on standardizing, simplifying, and productizing its offerings to lower costs and improve scalability.

The Recipient developed and validated basic power electronics technology by connecting and successfully powering one standard fast charger from a DC microgrid. The primary function of the power electronics is to pre-charge the circuit between the charger's DC bus and DC source. Most fast chargers expect a 950VDC input for intervening power conversion and firmware that accepts a floating DC input voltage, as provided by a microgrid DC bus tied to battery storage. This integration required close collaboration with the charger manufacturer. The proposed project will advance the Recipient's PEM technology by increasing its power capacity to 1000 kW and charge multiple fast chargers simultaneously, while improving plug-and-play interoperability with multiple commercially available chargers.

B. Goals and Objectives of the Agreement

Agreement Goals

The goals of this Agreement are to:

- Advance PEM technology by increasing conversion capacity to 1000 kW DC/DC that includes pre-charger and firmware functionality to provide integrated solutions for builders of fast charger stations.
- Complete pre-demonstration testing and validation of upgraded PEM to simultaneously charge multiple DC fast charger units. Operate charging using the Recipient's Energy Management System (EMS) & Charge Station Management System (CSMS) platform.
- Build a high-power charging facility that uses the 1000 kW PEM to fast charge a target of 7 EVs simultaneously, energized from a microgrid with DC-coupled solar, battery energy storage system (BESS), and one centralized central bidirectional AC/DC power converter connected to a site's electric panel and utility service.
- Demonstrate a scalable template for deploying high-power charging stations that are National Electric Vehicle Infrastructure (NEVI) compliant and can be located at convenient locations using available electrical capacity.

Ratepayer Benefits:[2]
This Agreement will result in the ratepayer benefits of more convenient and lower-cost fast charging, increased electric reliability, and higher grid utilization. The Recipient's DC hub technology maximizes electric reliability for ratepayers by offering EV fast charging without placing additional strain on the grid, functioning as a source of backup power during grid outages, and by leveraging its integrated microgrid to provide a suite of grid services. The product can be installed in any location without requiring grid upgrades, which significantly lowers costs for ratepayers by deferring or avoiding expensive utility grid upgrades. Further, by being able to opportunistically access the grid, the project will increase the site's load factor, thus increasing grid utilization, which lowers costs as more electricity can be distributed to end-use customers using the same infrastructure.

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 demonstrating that the advanced PEM technology, DC-coupled to a high-power fast charging station and connected to the Recipient's DC hub, enables a more economical and expeditious deployment of a network of super-fast chargers in California. The technological advancement will also enable fast charging at the end of utility distribution circuits, where capacity is generally limited.

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[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.

Exhibit A
Scope of Work
Intertie Incorporated

Agreement Objectives

The objectives of this Agreement are to:

- Design and build advanced PEM Prototype as part of integrated pad-mounted enclosure housing modular DC-DC conversion system, AC/DC conversion, control system, bussing and connection hardware.
- Measure and validate the performance of a cost-effective, modular DC-DC power block that has the capacity to fast charge (100+ kW) a target of 7 EVs, and capability to simultaneously power multiple chargers. Testing to be conducted in the Recipient's power laboratory.
- Demonstrate how productized DC hub combiners provide a reliable, safe, and cost-effective means for high voltage and high-power DC distribution for microgrid distributed energy resources, as required by multi-charger, high-power facilities.
- Demonstrate how the Recipient's DC hub combiner and PEM DC power management technologies provide modularity and help achieve more 'plug and play' installations for DC hub architecture.
- Deploy project that incorporates such DC power management technologies in a DC hub architecture to supply 1000 kW of charging power at 950VDC to a target of 7 100+ kW ports (or at least 14 75+ kW ports), with power and energy supplied to the charger DC hub via the upgraded PEM from a 1500V microgrid DC hub that is powered by carport-mounted solar PV, battery energy storage system, and a bidirectional AC/DC power converter.
- Operate Project controlled by the Recipient's local and cloud EMS with one centralized bidirectional power converter, programmed to only draw available ampacity from the main distribution panel, limited to 300A.

III. TASK 1 GENERAL PROJECT TASKS

PRODUCTS

Subtask 1.1 Products

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

The Recipient shall:

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

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

For products that require a final version only

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

For all products

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

Instructions for Submitting Electronic Files and Developing Software:

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

  The following describes the accepted formats for electronic data and documents provided to the CEC as products under this Agreement, and establishes the software versions that will be required to review and approve all software products:
  - Data sets will be in MS Access or MS Excel file format (version 2007 or later), or any other format approved by the CAM.
  - Text documents will be in MS Word file format, version 2007 or later.
  - Project management documents will be in Microsoft Project file format, version 2007 or later.

- **Software Application Development**
  Use the following standard Application Architecture components in compatible versions for any software application development required by this Agreement (e.g., databases, models, modeling tools), unless the CAM approves other software applications such as open-source programs:
  - Microsoft ASP.NET framework (version 3.5 and up). Recommend 4.0.
  - Microsoft Internet Information Services (IIS), (version 6 and up) Recommend 7.5.
  - Visual Studio.NET (version 2008 and up). Recommend 2010.

- C# Programming Language with Presentation (UI), Business Object and Data Layers.
- SQL (Structured Query Language).
- Microsoft SQL Server 2008, Stored Procedures. Recommend 2008 R2.
- Microsoft SQL Reporting Services. Recommend 2008 R2.
- XML (external interfaces).

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

MEETINGS

Subtask 1.2 Kick-off Meeting

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

The Recipient shall:

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

  The Kick-off meeting will include discussion of the following:
  - The CAM's expectations for accomplishing tasks described in the Scope of Work;
  - An updated Project Schedule;
  - Terms and conditions of the Agreement;
  - Invoicing and auditing procedures;
  - Travel;
  - Equipment purchases;
  - Administrative and Technical products (subtask 1.1);
  - CPR meetings (subtask 1.3);
  - Monthly Calls (subtask 1.5)
  - Quarterly Progress reports (subtask 1.6)
  - Final Report (subtask 1.7)
  - Match funds (subtask 1.8);
  - Permit documentation (subtask 1.9);
  - Subawards(subtask 1.10);
  - Technical Advisory Committee meetings (subtasks 1.11 and 1.12);
  - Agreement changes;
  - Performance Evaluations; and
  - Any other relevant topics.

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

- List of potential risk factors and hurdles, and mitigation strategy

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

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

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

CAM Product:
- Kick-off Meeting Agenda

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

CPR meetings generally take place at key, predetermined points in the Agreement, as determined by the CAM and as shown in the Task List on page 1 of this Exhibit. However, the CAM may schedule additional CPR meetings as necessary. The budget may be reallocated to cover the additional costs borne by the Recipient, but the overall Agreement amount will not increase. CPR meetings generally take place at the CEC, but they may take place at another location, or may be conducted via electronic conferencing (e.g., WebEx) as determined by the CAM.

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

The CAM shall:
- Determine the location, date, and time of each CPR meeting with the Recipient's input.
- Send the Recipient a *CPR Agenda* with a list of expected CPR participants in advance of the CPR meeting. If applicable, the agenda may include a discussion of match funding and permits.

- Conduct and make a record of each CPR meeting. Provide the Recipient with a schedule for providing a Progress Determination on continuation of the project.
- Determine whether to continue the project, and if so whether modifications are needed to the tasks, schedule, products, or budget for the remainder of the Agreement. A determination of unsatisfactory progress This may result in project delays, including a potential Stop Work Order, while the CEC determines whether the project should continue.
- Provide the Recipient with a *Progress Determination* on continuation of the project, in accordance with the schedule. The Progress Determination may include a requirement that the Recipient revise one or more products.

Recipient Products:
- CPR Report(s)

CAM Products:
- CPR Agenda(s)
- Progress Determination

Subtask 1.4 Final Meeting
The goal of this subtask is to complete the closeout of this Agreement.

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

  The technical and administrative aspects of Agreement closeout will be discussed at the meeting, which may be divided into two separate meetings at the CAM's discretion.
  - The technical portion of the meeting will involve the presentation of findings, conclusions, and recommended next steps (if any) for the Agreement. The CAM will determine the appropriate meeting participants.
  - The administrative portion of the meeting will involve a discussion with the CAM of the following Agreement closeout items:
    - Disposition of any procured equipment.
    - The CEC's request for specific "generated" data (not already provided in Agreement products).
    - Need to document the Recipient's disclosure of "subject inventions" developed under the Agreement.
    - "Surviving" Agreement provisions such as repayment provisions and confidential products.
    - Final invoicing and release of retention.
- Prepare a *Final Meeting Agreement Summary* that documents any agreement made between the Recipient and Commission staff during the meeting.
- Prepare a *Schedule for Completing Agreement Closeout Activities*.
- Provide copies of *All Final Products* organized by the tasks in the Agreement.

Products:
- Final Meeting Agreement Summary *(if applicable)*

- Schedule for Completing Agreement Closeout Activities
- All Final Products

MONTHLY CALLS, REPORTS AND INVOICES

Subtask 1.5 Monthly Calls

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

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

The CAM shall:

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

The Recipient shall:

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

Product:

- Email to CAM concurring with call summary notes.

Subtask 1.6 Quarterly Progress Reports and Invoices

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

The Recipient shall:

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

Recipient Products:

- Quarterly Progress Reports
- Invoices

CAM Product:

- Invoice template

Subtask 1.7 Final Report

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

Subtask 1.7.1 Final Report Outline

The Recipient shall:

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

Recipient Products:

- Final Report Outline (draft and final)

CAM Products:

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

Subtask 1.7.2 Final Report

The Recipient shall:

- Prepare a *Final Report* for this Agreement in accordance with the approved Final Report Outline, Energy Commission Style Manual, and Final Report Template provided by the CAM with the following considerations:
  - Ensure that the report includes the following items, in the following order:
    - Cover page (**required**)
    - Credits page on the reverse side of cover with legal disclaimer (**required**)
    - Acknowledgements page (optional)
    - Preface (**required**)
    - Abstract, keywords, and citation page (**required**)
    - Table of Contents (**required**, followed by List of Figures and List of Tables, if needed)
    - Executive summary (**required**)
    - Body of the report (**required**)
    - References (if applicable)
    - Glossary/Acronyms (If more than 10 acronyms or abbreviations are used, it is required.)
    - Bibliography (if applicable)
    - Appendices (if applicable) (Create a separate volume if very large.)
    - Attachments (if applicable)
- Submit a draft of the Executive Summary to the TAC for review and comment.
- Develop and submit a *Summary of TAC Comments on Draft Final Report* received on the Executive Summary. For each comment received, the Recipient will identify in the summary the following:

  - Comments the Recipient proposes to incorporate.
  - Comments the Recipient does propose to incorporate and an explanation for why.
- Submit a draft of the report to the CAM for review and comment. The CAM will provide written comments to the Recipient on the draft product within 15 days of receipt.
- Incorporate all CAM comments into the *Final Report*. If the Recipient disagrees with any comment, provide a *Written Responses to Comments* explaining why the comments were not incorporated into the final product.
- Submit the revised *Final Report* electronically with any Written Responses to Comments within 10 days of receipt of CAM's Written Comments on the Draft Final Report, unless the CAM specifies a longer time period or approves a request for additional time.

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

CAM Product:
- Written Comments on the Draft Final Report

MATCH FUNDS, PERMITS, AND SUBAWARDS

Subtask 1.8 Match Funds

The goal of this subtask is to ensure that the Recipient obtains any match funds planned for this Agreement and applies them to the Agreement during the Agreement term.

While the costs to obtain and document match funds are not reimbursable under this Agreement, the Recipient may spend match funds for this task. Match funds must be identified in writing, and the Recipient must obtain any associated commitments before incurring any costs for which the Recipient will request reimbursement.

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

  If match funds were a part of the application that led to the CEC awarding this Agreement, then provide in the letter:
  - A list of the match funds that identifies:
    - The amount of cash match funds, their source(s) (including a contact name, address, and telephone number), and the task(s) to which the match funds will be applied.
    - The amount of each in-kind contribution, a description of the contribution type (e.g., property, services), the documented market or book value, the source (including a contact name, address, and telephone number), and the task(s) to which the match funds will be applied. If the in-kind contribution is equipment or other tangible or real property, the Recipient must identify its owner and provide a contact name, address, telephone number, and the address where the property is located.

  - If different from the solicitation application, provide a letter of commitment from an authorized representative of each source of match funding that the funds or contributions have been secured.
- At the Kick-off meeting, discuss match funds and the impact on the project if they are significantly reduced or not obtained as committed. If applicable, match funds will be included as a line item in the progress reports and will be a topic at CPR meetings.
- Provide a *Supplemental Match Funds Notification Letter* to the CAM of receipt of additional match funds.
- Provide a *Match Funds Reduction Notification Letter* to the CAM if existing match funds are reduced during the course of the Agreement. Reduction of match funds may trigger a CPR meeting.

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

Subtask 1.9 Permits
The goal of this subtask is to obtain all permits required for work completed under this Agreement in advance of the date they are needed to keep the Agreement schedule on track. Permit costs and the expenses associated with obtaining permits are not reimbursable under this Agreement, with the exception of costs incurred by University of California recipients. Permits must be identified and obtained before the Recipient may incur any costs related to the use of the permit(s) for which the Recipient will request reimbursement.

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

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

Products:
- Permit Status Letter
- Updated List of Permits *(if applicable)*
- Updated Schedule for Acquiring Permits *(if applicable)*

- Copy of Each Approved Permit *(if applicable)*

Subtask 1.10 Subawards
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 1.11 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 1.12.
- Prepare a *List of TAC Members* once all TAC members have committed to serving on the TAC.
- Submit *Documentation of TAC Member Commitment* (such as Letters of Acceptance) from each TAC member.

Products:

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

Subtask 1.12 TAC Meetings

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

The Recipient shall:

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

The TAC shall:

- Help set the project team's goals and contribute to the development and evaluation of its statement of proposed objectives as the project evolves.
- Provide a credible and objective sounding board on the wide range of technical and financial barriers and opportunities.
- Help identify key areas where the project has a competitive advantage, value proposition, or strength upon which to build.
- Advocate on behalf of the project in its effort to build partnerships, governmental support and relationships with a national spectrum of influential leaders.
- Ask probing questions that 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 1.13 Project Performance Metrics

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

The Recipient shall:

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

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

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

TECHNICAL TASKS
*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 – COMPLETE SPECIFICATIONS FOR ADVANCED PEM WITH PLUG-AND-PLAY INTEROPERABILITY WITH MULTIPLE SUPER-FAST CHARGING STATIONS

The goal of this task is to complete specifications for an advanced Power Electronics Module (PEM) with plug-and-play interoperability with multiple super-fast charging stations. The advanced PEM is a software-enabled hardware technology that combines hardware, firmware and software. For this multi-disciplinary project, specifications and requirements for each discipline will be completed. A key high-level task is to ensure the advanced PEM specifications meet the power demands of multiple DC fast chargers and can satisfy anticipated daily energy needs. This task also involves conducting simulations to predict the performance of various distributed energy resources and interconnection capacities to meet power and energy demands of multiple DC fast chargers.

The Recipient shall:
- Prepare and submit V-Model for enhanced PEM showing linear progression and schedule of each product development phase: concept, user level, detailed design, build, testing and validation
- Prepare concept of operation and user requirements document
- Prepare *Site Assessment Report* that determines site electrical interconnection capacity and panel capacity to assess maximum AC interconnection
- Complete market assessment of DC-fed charging stations. Specify isolated DC-DC head-end charging units for multi-charger installation
- Provide specifications in *Advanced PEM Prototype Specifications Report* that includes, but is not limited to the following:

  - Hardware: PEM specifications and schematics: Modular DC-DC power conversion with integrated pre-charger, inductor block and PEM controller. Specify AC/DC battery inverter.
    - Obtain specification for DC-fed charger input (e.g. Tritium PKM150 requires 950Vdc)
    - Identify requirements for multi-charger DC-fed operation such as need for isolated DC-DC conversion at charger DC head end.
  - Firmware: Embedded firmware to specify voltage match range, response time and control algorithm on input to microgrid DC bus; specify power match and voltage range, response time and control algorithm on output to DC fed charging station. PEM control firmware for configuration, testing and control
  - Software: Provide specifications for PEM controller and microgrid controller for system integration and communication with microgrid and electric vehicle supply equipment. Develop comprehensive set of use cases and prepare activity diagrams showing dynamic, coordinated stakeholder interactions for multi-charger charging sessions powered by microgrid.
- Construct use case diagrams for range of power and energy supply cases.
- Create activity diagrams for charging process detailing interaction of actors from EV driver to microgrid supply from PEM perspective.
- Design advanced PEM prototype using modular DC-DC converter hardware and firmware enabling parallel operation to achieve 300 to 1200 kW range of capacity. Identify commercially available components to minimize hardware development and validation time and reduce risk.
- Complete integrated system design of pad mounted enclosure with rack-mounted PEM DC-DC modules, rack-mounted AC-DC converter, control system(s), bussing and connection to DC and AC subsystems.
- Complete system engineering document with schematics of PEM, DC combiners and charging station(s) schematic.
- Use the Recipient's microgrid simulator to complete simulations of the operating performance of varying combinations of modular microgrid components (e.g. installed DC solar capacity, storage size) to determine how effectively it meets the needs of current and future EV charging demands. Develop comprehensive set of use cases that models interactions beginning with EV drivers' request for charge to microgrid supply. Perform first iteration to define scope of EMS and CSMS software requirements for project.
- Prepare *Prototype Requirements Report* that includes, but is not limited to the following:
  - V-Model describing the enhanced PEM development cycle
  - Vision and concept of operation describing target application, solution, and functionality
  - Description of key features, major components and requirements
  - Use case and activity diagrams for software specs
- Prepare *Advanced PEM Prototype Design Report* that includes, but is not limited to the following:
  - Advanced PEM schematics with single power block and 4 power blocks to achieve > 1000 kW
  - System topology and architecture
  - DC-fed charger options and limitations
  - Network communication diagram

- Project electrical single and 3-line diagrams with advanced PEM schematic, grid-tied AC/DC converter, and microgrid

Products:

- Site Assessment Report
- Advanced PEM Prototype Specifications Report (draft and final)
- Prototype Requirements Report
- Advanced PEM Prototype Design Report (draft and final)

TASK 3 – DEVELOP ADVANCED PEM PRODUCT

The goal of this task is to develop a modular advanced PEM product in a standardized IP65-rated enclosure that has plug-and-play functionality and is able to interface with multiple DC fast chargers. The product shall leverage technology proved out in the current PEM and advance the proven technology in a higher power, multi-charger application.

The Recipient shall:

- Procure commercially available, modular DC/DC power converter(s) whose parallel operation can output at least 1000 kW and meet the applicable technical and safety standards for DC-DC converter applications. Modify, if necessary, to meet advanced PEM requirements.
- Implement embedded firmware with control algorithms that enable advanced PEM to interface with and operate autonomously: i) with modular DC microgrid devices at its input and ii) with multiple DC chargers at its output.
- Complete detailed mechanical design of charger DC hub combiner with relevant pre-charging (if needed), overcurrent and overvoltage protection, disconnects, insulation monitoring, etc. to accommodate required current capacity and voltages.
- Complete detailed mechanical design of Microgrid DC hub combiner with relevant pre-charging (if needed), overcurrent and overvoltage protection, disconnects, insulation monitoring etc. to accommodate required current capacity and voltages
- Assemble and connect higher power Enhanced PEM units for parallel operation with at least 1,000 kW capacity inside National Electrical Manufacturers Association (NEMA) 3R enclosure with appropriate communication and power connection, bus bars, disconnects and overcurrent protection devices.
- Develop advanced PEM controller and user interface; test of PEM communication with commercially available DC-fed fast chargers and EMS controller
- Test updated software and firmware for DC fast charger.
- Prepare *Final Advanced PEM Product Design Report* that includes, but is not limited to:
  - Mechanical and electrical design specifications of the charger DC hub combiner and microgrid DC hub combiner.
  - Description of interface connections used for assembly of the PEM prototype inside NEMA enclosure.
  - Summary of DC fast charger software and firmware test results.

Products:

- Final Advanced PEM Product Design Report (draft and final)

TASK 4 – COMPLETE PRE-DEMONSTRATION TESTING AND VALIDATION OF ADVANCED PEM PRODUCT

The goal of this task is to test and demonstrate the actual full-scale system in its intended operational environment. This task should involve testing all of the functionality of the charging (simultaneously charging up to 4 DC fast chargers) and DC power supply from a microgrid that has nearly the same features as the real-world demonstration system, namely DC-coupled solar, identical bidirectional AC/DC power converter, and advanced PEM hardware.

Subtask 4.1: Preliminary Design Support

The goal of this subtask is to upgrade the Recipient's power electronics lab to accommodate higher power transfer levels.

The Recipient shall:

- Complete electrical design and complete permitting and approval
- Install cabling, conduits, overcurrent protection devices and safety switches necessary to connect battery system, charger DC hub combiner connecting 2 to 4 DC fast chargers
- Install cabling, conduits, overcurrent protection devices and safety switches necessary to connect PEM, battery system, DC-coupled solar and bidirectional AC/DC power converter to microgrid DC hub combiner
- Perform safety tests to ensure no short circuit and/or faults on DC and AC systems
- Prepare a *Laboratory Schematic and Single Line Diagram* with advanced PEM, DC-fed charging stations, DC microgrid and AC grid connection

Products:

- Laboratory Schematic and Single Line Diagram

Subtask 4.2: Pre-Demonstration System Design, Build, and Testing

The goal of this subtask is to complete the control system design and validate the system by individually testing firmware and software developed for the PEM, PEM user interface, EMS controller and DC-fed charger.

The Recipient shall:

- Commission Test Facility
  - Install metering and all monitoring equipment
  - Complete phase rotation assessment for AC/DC connection
  - Conduct Megger testing of facility
  - Conduct continuity tests
- Design, Implement and Test Controls
  - Embedded PEM firmware manage pre-charging, contactor and inductor operation
  - Write and test new communication interfaces
    - PEM controller to PEM user interface
    - Recipient EMS controller to PEM controller
    - PEM controller to DC-fed charger
  - Communicate via open charge point protocol between Recipient CSMS network and DC-fed chargers and/or to EMS

  - Coordinate open charge point protocol communications with DC-fed charger original equipment manufacturer
  - Upgrade to appropriate open charge point protocol version to enable power sharing
- Write communication software
- Test and debug communication software
- Write and simulate system controls
- Integrate the Recipient's EMS with PEM control system
- Create human machine interface for testing and monitoring relevant variables
- Prepare *System Validation Test Results*

Products:
- System Validation Test Results

Subtask 4.3: Pre-Demonstration System Integration, Commissioning, and Validation
The goal of this subtask is to complete unit testing, system integration, and system commissioning demonstrating advanced PEM operation intended.

The Recipient shall:
- Complete factory acceptance testing of battery system
- Conduct unit testing of battery inverter
- Conduct high voltage testing and analysis (DC-DC conversion validation test)
  - Demonstrate advanced PEM can deliver up to 1 MW DC power
    - Design and operate test environment that enables target power throughput
- Install and test charger DC hub combiner and microgrid DC hub combiner
- Coordinate with original equipment manufacturer DC-fed fast charger integration
- Commission, test, and monitor for the following scenarios:
  - Single EV
  - 2 EVs
  - >2 EVs (if necessary)
  - All charging started and stopped using application that triggers CSMS open charge point protocol communication with DC-fed charger
- Prepare *Pre-Demonstration Commissioning and Validation Report* that includes, but is not limited to:
  - Safety analysis and emergency conditions
  - Description of connections used for the PEM, DC hub, and charging components
  - Monitoring equipment specifications
  - Summary of communication software
  - Summary of testing results from converter testing and battery system testing
  - Description of conditions and cycles used to commission and monitor the following scenarios:
    - Single EV
    - 2 EVs
    - >2 EVs (if necessary)
  - Summary of commissioning and monitoring results including variables

- Prepare *CPR Report #1* in accordance with Subtask 1.3 and participate in CPR Meeting #1.

Products:

- Pre-Demonstration Commissioning and Validation Report (draft and final)
- CPR Report #1

TASK 5 – COMPLETE ENGINEERING, PROCUREMENT, AND CONSTRUCTION (EPC) AND COMMISSIONING OF PROJECT

The goal of this task is to design, build, commission, and operate a 1000 kW charging facility that uses the advanced PEM to power at least 7 100+ kW DC fast chargers from a microgrid with DC-coupled solar, BESS, and a central bidirectional AC/DC power converter, connected to the demonstration site's electric panel and utility service.

Subtask 5.1 Customer and Community Engagement

The goal of this subtask is to perform customer and community outreach activities and conduct site assessments with customer and community engagement.

The Recipient shall:

- Conduct customer and community outreach activities to inform the following:
  - Final site energy assessment
  - Final site assessment
  - Proposal creation and execution
- Prepare *Customer and Community Outreach and Engagement Plan* that includes, but is not limited to:
  - Description of customer and community outreach and engagement activities
  - Implementation of customer and community feedback into project assessments
- Prepare *Customer and Community Outreach and Engagement Report* that includes, but is not limited to:
  - Summary of feedback from customers and community
  - Guidance from community outreach partners on implementation of community feedback into project site assessments

Products:

- Customer and Community Outreach and Engagement Plan (draft and final)
- Customer and Community Outreach and Engagement Report (draft and final)

Subtask 5.2 Site Planning and Installation

The goal of this subtask is to complete the site planning and installation in preparation for demonstrating and measuring performance of the 1000 kW charging facility.

The Recipient shall:

- Complete a final assessment of site electric distribution panel and interconnection excess capacity, to include the following:
  - Main panel, utility transformer, and service conductor ratings
  - Load study
- Complete site, electrical, structural engineering, and planning including:

  - Electrical single- and three-line diagrams
  - Site plan showing power equipment, disconnects, fusing, grounding, and insulation monitoring required for DC bus operation
  - Structural plan for carport-mounted solar and BESS foundation
  - Drawing views including plan, elevation and section views
  - Appropriate engineering stamps
  - Submit full permit application to authority having jurisdiction to obtain zoning, electrical, structural, fire and hazmat approvals.
- Obtain building permits required to install the charging facility on site
- Submit interconnection application to interconnect the system with the utility
- Procure balance of plant and other equipment necessary for installation
- Install the necessary components that include but are not limited to:
  - Carport-mounted solar array
  - Trenching, conduits, and cabling between:
    - Solar combiners, BESS, and PEM to microgrid DC hub combiner
    - Chargers and PEM to charger DC hub combiner
    - Centralized bidirectional AC/DC power converter to microgrid DC hub and to site main panel
  - Foundations including:
    - Batteries
    - Pad-mounting of PEM
    - Support of AC/DC converter
    - EMS control cabinet
  - Major equipment installations
  - Electrical installations including:
    - Cabling
    - Overcurrent protection devices and safety switches necessary to connect battery system
    - Pad-mounted integrated enclosure with advanced PEM hardware
    - DC-fed fast charger(s)
    - Interconnection with DC-coupled solar onsite
  - Communications installations including metering and all monitoring equipment
- Conduct testing and commissioning
- Conduct PPI Process (if required for backup power) and obtain permission to operate (PTO) from utility
- Prepare *Testing and Commissioning Report* that includes, but is not limited to:
  - Site plans
  - Summary of the component installations
  - Summary of testing and commissioning results
- Prepare *CPR Report #2* in accordance with Subtask 1.3 and participate in CPR Meeting #2.

Products:

- Testing and Commissioning Report (draft and final)
- CPR Report #2

TASK 6 – OPERATING PERFORMANCE MONITORING AND REPORTING

The Recipient's on-premises and cloud EMS and CSMS provide supervisory control and data acquisition (SCADA) functionality for real-time monitoring, data acquisition, control, and operation of charging and microgrid facilities enabling further analytics. The overarching performance metric is how the Recipient's DC hub architecture compares to the most relevant benchmark, standard AC-coupled chargers. The PEM performance metric is how it compares to state-of-the-art DC conversion technology. The goal of this task is to collect and report key operating data over the course of the 12-month real-world demonstration.

The Recipient shall:

- Prepare *Demonstration, Measurement, and Verification Plan* that includes, but is not limited to:
  - Charging requirements and other details specific to the microgrid (DC-coupled solar, BESS, bidirectional AC/DC power converter)
  - All necessary procedures for the demonstration of the charging facility
  - Definition of performance parameters to be collected, including, but not limited to:
    - Charger availability including percentage of time chargers are available to meet EV drivers' demand and charger downtime
    - PEM-enable ultra-fast charging metrics including installation cost and time to deploy ultra-fast charging using PEM technology, impact of ultra-fast charging on grid, size of grid connection required to provide charging, electric cost to supply EV charging
    - PEM module performance including form factor size and power density of DC conversion, cost ($/W), efficiency, reliability
    - Battery operation in boosted charging including roundtrip efficiency, state-of-health, and temperature profile
    - Contribution of solar-provided energy and power
    - Energy deliverability of system versus aggregate energy demand from charging
  - Identification of the method of collection for each performance parameter.
  - Definition of the frequency of collection and method of reporting.
  - Description of maintenance and service to the DC hub architecture, as required.
- Prepare demonstration data in regular *Quarterly Progress Reports* per Subtask 1.6 for a period of 12 months.
- Prepare *Data Analysis Report* that will:
  - Aggregate the data from the quarterly Progress Reports
  - Validate the DC hub's ability to reduce the impact of super-fast charging on the grid
  - Validate design improvements and the DC hub's ability to maximize the site's load factor and supply grid services
  - Compare costs of fast charging with gas station convenience versus gasoline
  - Compare grid-to-wheel charging efficiency versus traditional AC-coupled fast charger

Products:

- Demonstration, Measurement, and Verification Plan (draft and final)
- Data Analysis Report (draft and final)

TASK 7 – EVALUATION OF PROJECT BENEFITS

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

Exhibit A
Scope of Work
Intertie Incorporated

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 Energize Innovation 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 Energize Innovation fund*, including the profile link.

Products:

- Initial Project Benefits Questionnaire
- Annual Survey(s)
- Final Project Benefits Questionnaire
- Documentation of Project Profile on Energize Innovation fund
- Documentation of Organization Profile on Energize Innovation fund

TASK 8 – TECHNOLOGY/KNOWLEDGE TRANSFER ACTIVITIES

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

The Recipient Shall:

- Develop and submit a *Project Case Study Plan* that outlines how the Recipient will document the planning, construction, commissioning, and operation of the technology or system being demonstrated. The Project Case Study Plan should include:
  - An outline of the objectives, goals, and activities of the case study.
  - The organization that will be conducting the case study and the plan for conducting it.
  - A list of professions and practitioners involved in the technology's deployment.

  - Specific activities the recipient will take to ensure the learning that results from the project is disseminated to those professions and practitioners.
  - Presentations/webinars/training events to disseminate the results of the case study.
- Present the draft *Project Case Study Plan* to the TAC for review and comment.
- Develop and submit a *Summary of TAC Comments* that summarizes comments received from the TAC members on the draft *Project Case Study Plan*. This document will identify:
  - TAC comments the Recipient proposes to incorporate into the final *Technology Transfer Plan*.
  - TAC comments the Recipient does not propose to incorporate with and explanation why.
- Submit the final *Project Case Study Plan* to the CAM for approval.
- Execute the final Project Case Study Plan and develop and submit a Project Case Study.
- When directed by the CAM, develop presentation materials for a CEC sponsored conference/workshop(s) on the project.
- When directed by the CAM, participate in annual EPIC symposium(s) sponsored by the California CEC.
- Provide at least (6) six High Quality Digital Photographs (minimum resolution of 1300x500 pixels in landscape ratio) of pre and post technology installation at the project sites or related project photographs.

Products:

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

IV. PROJECT SCHEDULE

Please see the attached Excel spreadsheet.