STATE OF CALIFORNIA

GRANT REQUEST FORM (GRF)

CEC-270 (Revised 02/13) CALIFORNIA ENERGY COMMISSION

New Agreement EPC-14-086 (To be completed by CGL Office)

Division	Agreement Manager:	MS-	Phone
ERDD	Reynaldo Gonzalez	43	916-327-1334

Recipient's Legal Name	Federal ID Number
Electric Power Research Institute, Inc.	23-7175375

Title of Project
Distribution System Aware Vehicle to Grid Services for Improved Grid Stability and Reliability

Term and Amount	Start Date	End Date	Amount
	6/30/2015	6/30/2018	$ 1,499,977

Business Meeting Information

☐ ARFVTP agreements under $75K delegated to Executive Director.

Proposed Business Meeting Date	6/10/2015	☐ Consent	☒ Discussion
Business Meeting Presenter	Reynaldo Gonzalez	Time Needed:	5 minutes

Please select one list serve. Select

Agenda Item Subject and Description

ELECTRIC POWER RESEARCH INSTITUTE. Proposed resolution approving Agreement EPC-14-086 with Electric Power Research Institute for a $1,499,977 grant to develop a vehicle-to-grid (V2G) communication system that will demonstrate grid awareness, self-regulation, and interoperability. The communication technology and interfaces will support V2G information processing to better leverage plug-in electric vehicles and improve renewable generation penetration. (EPIC funding) Contact: Reynaldo Gonzalez. (Staff presentation: 5 minutes)

California Environmental Quality Act (CEQA) Compliance

1. Is Agreement considered a "Project" under CEQA?
   ☐ Yes (skip to question 2) ☒ No (complete the following (PRC 21065 and 14 CCR 15378)):
   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 the project involves the development of a communication system software with data collection and validation conducted on existing electric vehicle supply equipment and electric vehicles. This project does not involve any construction or disruption to any environmental resource.
2. If Agreement is considered a "Project" under CEQA:
   ☐ a) Agreement **IS** exempt. (Attach draft NOE)
   ☐ Statutory Exemption. List PRC and/or CCR section number: _____
   ☐ Categorical Exemption. List CCR section number: _____
   ☐ Common Sense Exemption. 14 CCR 15061 (b) (3)
   Explain reason why Agreement is exempt under the above section:
   _____
   ☐ b) Agreement **IS NOT** exempt. (Consult with the legal office to determine next steps.)
   Check all that apply
   ☐ Initial Study ☐ Environmental Impact Report
   ☐ Negative Declaration ☐ Statement of Overriding Considerations
   ☐ Mitigated Negative Declaration

List all subcontractors (major and minor) and equipment vendors: (attach additional sheets as necessary)

Legal Company Name:	Budget
Energy & Environmental Economics, Inc. (E3)	$ 200,200
Clean Fuel Connection, Inc.	$ 150,000
AeroVironment, Inc.	$ 199,586
Grid2Home	$ 260,360

List all key partners: (attach additional sheets as necessary)

Legal Company Name:

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Budget Information			
Funding Source	**Funding Year of Appropriation**	**Budget List No.**	**Amount**
EPIC	14-15	301.001B	$1,499,977
			$
			$
			$
			$
			$
R&D Program Area: EGRO: Transportation		TOTAL:	$1,499,977
Explanation for "Other" selection			
Reimbursement Contract #:		Federal Agreement #:	

Recipient's Administrator/ Officer				Recipient's Project Manager			
Name:	David Morrison			Name:	Sunil Chhaya		
Address:	942 Corridor Park Blvd			Address:	3420 Hillview Ave		
City, State, Zip:	Knoxville, TN 37932-3723			City, State, Zip:	Palo Alto, CA 94304-1355		
Phone:	865-218-8104 /	Fax:	865-218-8114	Phone:	650-855-2148 /	Fax:	650-855-2002
E-Mail:	dmorriso@epri.com			E-Mail:	schhaya@epri.com		

Selection Process Used

☒ Competitive Solicitation Solicitation #: PON-14-310

☐ First Come First Served Solicitation

The following items should be attached to this GRF		
1. Exhibit A, Scope of Work		☒ Attached
2. Exhibit B, Budget Detail		☒ Attached
3. CEC 105, Questionnaire for Identifying Conflicts		☒ Attached
4. Recipient Resolution	☒ N/A	☐ Attached
5. CEQA Documentation	☒ N/A	☐ Attached

Agreement Manager	Date	Office Manager	Date	Deputy Director	Date

Exhibit A
Scope of Work

A. Task List

Task #	CPR[1]	Task Name
1		General Project Tasks
2	X	Requirements, Architecture, and Design
3	X	Technology Development
4		Deployment, Test and Data Collection
5		Assessment of Incremental Value from V2G Services
6		Evaluate Project Benefits
7		Technology/Knowledge Transfer Activities

B. Acronym/Term List

Acronym/Term	Meaning
CAISO	California Independent System Operator
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CEC	California Energy Commission
CPR	Critical Project Review
CPUC	California Public Utilities Commission
DR	Demand Response
DSO	Distribution System Operator
EPRI	Electric Power Research Institute
EVSE	Electric Vehicle Supply Equipment
HPGP	HomePlug GreenPHY, a form of Power Line Communications protocol
IEEE	Institute of Electrical and Electronics Engineers
ISO	Independent System Operator
M&V	Measurement and Verification
PEV	Plug-in Electric Vehicles
PHEV	Plug-in Hybrid Electric Vehicle
SEP	Smart Energy Profile
TAC	Technical Advisory Committee
V2G	Vehicle to Grid

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

A. Purpose of Agreement

Purpose

The purpose of this Agreement is to fund the technology development and demonstration of end to end Vehicle to Grid (V2G) integrated system that is distribution system and independent system operator (ISO) aware. The project will develop and demonstrate a fully functional, secure, reliable, open-standard based and interoperable grid interactive communication

[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.

technology and interfaces for Plug-in Electric Vehicles (PEVs) to support V2G services that factors in end-to-end information processing.

B. Problem/ Solution Statement

Problem

V2G technology in itself has been around for a long time with several ongoing pilots[2]. These pilots all focus on a large number of PEVs congregated around a substation acting in unison[3]. All the knowledge derived from these experiments is of limited use in real-world scenarios. This scenario is highly unlikely to occur because even fleet garages are rarely going to be in close proximity to substations. Real world scenarios involve V2G capable PEVs scattered around the distribution grid, sending and receiving power through the neighborhood transformer. In the US, an average personal vehicle is on the road only 4–5% of the day, which means that a great majority of the day the vehicles are parked and can be used for storage or ancillary services. The key to dual-purposing the vehicle battery for a storage application is making sure that the customer has a full battery charge when needed for transportation, and the utilities have the ability to use the battery for storage charge and discharge as needed.

The capability to transfer energy from a vehicle to the grid is only a small part of the expected overall technical challenge of a full implementation of V2G. In order to realize a full V2G implementation, a yet-to-be developed information technology solution must be developed which provides high level control capable of aggregating a large number of geographically dispersed vehicles such that they can be considered a single energy resource while taking into account each individual vehicle owner's comprehensive input.

Solution

The Recipient will develop and demonstrate a fully functional, grid-compatible and interoperable V2G system factoring in end-to-end information processing. The technology will focus on a V2G system that is safe, outage-immune and grid-aware through real-time transformer monitoring and access to distribution system information. The V2G-capable vehicle's capabilities to provide bulk and distribution grid benefits will be evaluated through distribution level modeling using Open DSS platform. Other EPRI developed tools will be utilized to further study feeder constraints, distribution asset deferment needs and fulfilment of reserve requirements. Use of Open VGI Platform (to serve as an aggregator and data warehouse) will be demonstrated. The Recipient will demonstrate all of the functionality and application of V2G with an open, interoperable set of prevailing standards based communications.

C. Goals and Objectives of the Agreement

Agreement Goals

The goals of this Agreement are to:

- Develop and demonstrate V2G capable PEVs and communication technologies and interfaces based on open standards

[2] 'The Air Force's Plug-in Electric Vehicle Fleet', US Department of Defense, http://science.dodlive.mil/2014/11/21/the-air-forces-plug-in-vehicle-fleet/ , November 21, 2014

[3] 'EV Grid Supplies 30 MiniEs for Grid On Wheels Project', EV Grid media Release, August 2013, http://www.evgrid.com/blog/item/5179e34aa6c509af0c000006

- Develop and demonstrate an end to end integrated system that is distribution grid and ISO-aware, safe, interoperable and extensible, to be able to offer distribution and ISO grid services
- Prove technical feasibility by testing the system under a variety of use cases and collect operational data utilizing a data warehouse, to correlate system performance with system safety, outage ride-through, stability and reliability.
- Validate the cost/benefit for ratepayers and PEV owners
- Transfer technology to relevant stakeholders.

Ratepayer Benefits:[4] This Agreement will result in ratepayer benefits of greater reliability, lower costs, and increased safety by the following means:

The system will improve reliability by being able to provide ancillary services at the aggregated level by combining V2G enabled vehicles' charge and discharge profiles that are locally and Distribution System Operator (DSO)-wide distribution system constrained, and will alleviate localized hotspots. Furthermore, having bidirectional power flow capability available to balance the 'Duck Curve' effect both during over-generation period (ramp-down) by charging the batteries to absorb power and during the under generation period (ramp-up) by flowing power from the vehicle batteries to the grid. V2G allows the charge power to ramp down or provide generation assistance to smooth bulk generation mismatches with demand during the transitional period.

The proposed system will lower costs for ratepayers by offering extensible and scalable V2G systems that have inherently lower costs to implement, as compared to integrating a set of proprietary and private systems that have fixed capabilities and are expensive to upgrade. Some of these cost savings could be passed on to the V2G system owners in the form of incentives. Furthermore, V2G systems will allow grid operators to reliably use energy storage capacity that has been procured by the customer instead of the utility. In addition, a V2G system that is integrated, interoperable, outage-immune and locally aware (of the local transformer condition) is safe to operate for the owner and the grid through appropriately designed grounding and isolation schemes.

Technological Advancement and Breakthroughs:[5] Advanced development of a grid integrated V2G aggregation control system will lead to technological breakthroughs to overcome barriers to the achievement of the State of California's statutory energy goals. Development of an open standards-based intelligent communications pathway for V2G will provide dynamic grid interactive controls to enable a safe cost effective option for improving grid stability and reliability. The breakthrough will be the implementation of transformer real time monitoring to provide situational awareness of the local distribution grid state to enhance V2G effectivity and efficiency.

[4] 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).

[5] 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

The proposed project seeks to advance the state of the art on several fronts. The scope includes end to end implementation of V2G system that has both ISO and DSO constraints imposed while providing grid services; focuses on local transformer loading to ensure power flow remains constrained by the transformer specifications; grid interconnection as well as open standards-based V2G implementation with on-vehicle bidirectional inverter; and assessing the value of V2G services that can be reliably delivered. The timing of the project is structured to take advantage of the advancing front of open standards for smart grid operations and specifically, for V2G functionality in vehicles. The synergy of a clear understanding of the needs that drive V2G combined with real world battery test data will allow the program to field vehicles and perform V2G experiments with actual hardware in a realistic fashion.

The technology demonstration will be the first of its kind for an end to end system-engineered demonstration involving V2G-capable PEVs that are integrated with local sensing-capable transformers, and are to deliver real time dispatchable load capacity to the DSO as well as ISO. The OpenDSS based distribution system analysis will provide predictions of distribution congestion enabling valuable V2G services to Transmission and Distribution grid operations. This demonstration is intended to facilitate integration of up to one million PEVs into California's grid per Governor's Executive Order[6] as well as compliance with ARB Zero Emission Vehicle mandate and EPA 2025 Clean Air requirements.

The interaction between OEM and utilities are keys for successful demonstration and implementation V2G. This unique interaction will help identify and demonstrate the operational, technical, and economic impacts of using PEV as an ancillary service. The proposed approach will ascertain the market design adaptations that might be necessary to incorporate PEV services into existing markets. The field demonstrations will emphasize real world application of V2G with an end to end control implementation from the utility back-office system. The field demonstrations will determine key technologies, communications, cyber security, and protocols required to enable PEV products and services, and determine the investments in Open Vehicle-Grid Integration Platform facilitating the Grid / aggregated PEV resources needed to integrate the PEVs.

Agreement Objectives

The objectives of this Agreement are to:

- Develop and demonstrate end-to-end integrated system design that is distribution grid-aware and is capable to make V2G scale-up more robust and responsive to real-time grid conditions from the local transformer and the DSO while delivering value-added services to distribution grid as well as ISO
- Develop, and demonstrate the grid-tied V2G system that is capable of being outage-immune and grid compliant
- Demonstrate distribution grid awareness through connectivity to locational demand response (DR) dispatch to be used as an indicator of distribution system congestion status that can be disaggregated through the central aggregation platform (Open VGI Platform).
- Demonstrate V2G system capability and apply distribution capacity constraints while delivering ISO and DSO grid services.

[6] Governor Brown's Executive Order B-16-2012, http://gov.ca.gov/news.php?id=17472

- Perform detailed OpenDSS based distribution circuit analysis for the test locations at SDG&E, PG&E and SCEThe Project will use simulated ISO signal to control two locally connected vehicles.
- Provide test protocols and methods to assess Measurement and Verification of utility program compliance
- Assess costs and benefits of the V2G services to the ratepayers, as well as recommend approaches to enable V2G services adoption.
- Evaluate the performance of the current V2G systems and identify gaps with compliance to Rule 21 requirements.

II. 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).** 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

- 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.
- Submit the final product to the CAM once agreement has been reached on the draft. The CAM will provide written approval of the final product within 15 days of receipt, unless otherwise specified in the task/subtask for which the product is required.
- If the CAM determines that the final product does not sufficiently incorporate his/her comments, submit the revised product to the CAM within 10 days of notice by the CAM, unless the CAM specifies a longer time period.

For products that require a final version only

- Submit the product to the CAM for approval.
- If the CAM determines that the product requires revision, submit the revised product to the CAM within 10 days of notice by the CAM, unless the CAM specifies a longer time period.

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 Energy Commission's 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 or CD-ROM.

The following describes the accepted formats for electronic data and documents provided to the Energy Commission 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.
- Documents intended for public distribution will be in PDF file format. The Recipient must also provide the native Microsoft file format.
- 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 Energy Commission'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.

Exhibit A
Scope of Work

The Recipient shall:

- Attend a "Kick-off" meeting with the CAM, the Commission Agreement Officer (CAO), and any other Energy Commission staff relevant to the Agreement. The Recipient will bring its Project Manager and any other individuals designated by the CAM to this meeting. The administrative and technical aspects of the Agreement will be discussed at the meeting. Prior to the meeting, the CAM will provide an agenda to all potential meeting participants. The meeting may take place in person or by electronic conferencing (e.g., WebEx), with approval of the CAM.

  The administrative portion of the meeting will include discussion of the following:
  - Terms and conditions of the Agreement;
  - Administrative products (subtask 1.1);
  - CPR meetings (subtask 1.3);
  - Match fund documentation (subtask 1.7);
  - Permit documentation (subtask 1.8);
  - Subcontracts (subtask 1.9); and
  - Any other relevant topics.

  The technical portion of the meeting will include discussion of the following:
  - The CAM's expectations for accomplishing tasks described in the Scope of Work;
  - An updated Project Schedule;
  - Technical products (subtask 1.1);
  - Progress reports and invoices (subtask 1.5);
  - Final Report (subtask 1.6);
  - Technical Advisory Committee meetings (subtasks 1.10 and 1.11); and
  - Any other relevant topics.

- Provide an *Updated Project Schedule, List of Match Funds,* and *List of Permits*, 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:

- Updated Project Schedule *(if applicable)*
- Updated List of Match Funds *(if applicable)*
- Updated List of Permits *(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 Energy Commission 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 Energy Commission 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 Energy Commission.

CPR meetings generally take place at key, predetermined points in the Agreement, as determined by the CAM and as shown in the Task List on page 1 of this Exhibit. However, the CAM may schedule additional CPR meetings as necessary. The budget will be reallocated to cover the additional costs borne by the Recipient, but the overall Agreement amount will not increase. CPR meetings generally take place at the Energy Commission, 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 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.
- Submit the CPR Report along with any other *Task Products* that correspond to the technical task for which the CPR meeting is required (i.e., if a CPR meeting is required for Task 2, submit the Task 2 products along with the CPR Report).
- 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* and a *List of Expected CPR Participants* in advance of the CPR meeting. If applicable, the agenda will include a discussion of match funding and permits.
- Conduct and make a record of each CPR meeting. Provide the Recipient with a *Schedule for Providing a Progress Determination* on continuation of the project.
- Determine whether to continue the project, and if so whether modifications are needed to the tasks, schedule, products, or budget for the remainder of the Agreement. If the CAM concludes that satisfactory progress is not being made, this conclusion will be referred to the Deputy Director of the Energy Research and Development Division.
- Provide the Recipient with a *Progress Determination* on continuation of the project, in accordance with the schedule. The Progress Determination may include a requirement that the Recipient revise one or more products.

Recipient Products:

- CPR Report(s)
- Task Products (draft and/or final as specified in the task)

CAM Products:

- CPR Agenda
- List of Expected CPR Participants
- Schedule for Providing a Progress Determination
- 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 Energy Commission staff to present project findings, conclusions, and recommendations. The final meeting must be completed during the closeout of this Agreement. This meeting will be attended by the Recipient and CAM, at a minimum. The meeting may occur in person or by electronic conferencing (e.g., WebEx), with approval of the CAM.

  The technical and administrative aspects of Agreement closeout will be discussed at the meeting, which may be divided into two separate meetings at the CAM's discretion.
  - The technical portion of the meeting will involve the presentation of findings, conclusions, and recommended next steps (if any) for the Agreement. The CAM will determine the appropriate meeting participants.
  - The administrative portion of the meeting will involve a discussion with the CAM and the CAO of the following Agreement closeout items:
    - Disposition of any state-owned equipment.
    - Need to file a Uniform Commercial Code Financing Statement (Form UCC-1) regarding the Energy Commission's interest in patented technology.
    - The Energy Commission'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 *All Draft and Final Written Products* on a CD-ROM or USB memory stick, organized by the tasks in the Agreement.

Products:

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

REPORTS AND INVOICES

Subtask 1.5 Progress Reports and Invoices
The goals of this subtask are to: (1) periodically verify that satisfactory and continued progress is made towards achieving the project objectives of this Agreement; and (2) ensure that invoices contain all required information and are submitted in the appropriate format.

The Recipient shall:

- Submit a monthly *Progress Report* to the CAM. Each progress report must:

  - Summarize all Agreement activities conducted by the Recipient for the preceding month, including an assessment of the ability to complete the Agreement within the current budget and any anticipated cost overruns. See the Progress Report Format Attachment for the recommended specifications.
  - Provide a synopsis of the project progress, including accomplishments, problems, milestones, products, schedule, fiscal status, and any evidence of progress such as photographs.
- Submit a monthly or quarterly *Invoice* that follows the instructions in the "Payment of Funds" section of the terms and conditions. In addition, each invoice must document and verify:
  - Energy Commission funds received by California-based entities;
  - Energy Commission funds spent in California *(if applicable)*; and
  - Match fund expenditures.

Products:
- Progress Reports
- Invoices

Subtask 1.6 Final Report
The goal of this subtask is to prepare a comprehensive Final Report that describes the original purpose, approach, results, and conclusions of the work performed under this Agreement. The CAM will review and approve the Final Report, which will be due at least **two months** before the Agreement end date. When creating the Final Report Outline and the Final Report, the Recipient must use a Style Manual provided by the CAM.

Subtask 1.6.1 Final Report Outline

The Recipient shall:
- Prepare a *Final Report Outline* in accordance with the *Style Manual* provided by the CAM.
- Submit a draft of the outline to the CAM for review and comment.
- Once agreement has been reached on the draft, submit the final outline to the CAM. The CAM will provide written approval of the final outline within 10 days of receipt.

Recipient Products:
- Final Report Outline (draft and final)

CAM Product:
- Style Manual
- Comments on Draft Final Report Outline
- Approval of Final Report Outline

Subtask 1.6.2 Final Report

The Recipient shall:
- Prepare a *Final Report* for this Agreement in accordance with the approved Final Report Outline and the Style Manual provided by the CAM.
- Submit a draft of the report to the CAM for review and comment. Once agreement on the draft report has been reached, the CAM will forward the electronic version for Energy

Commission internal approval. Once the CAM receives approval, he/she will provide written approval to the Recipient.
- Submit one bound copy of the Final Report to the CAM.

Recipient Products:
- Final Report (draft and final)

CAM Product:
- Comments on Draft Final Report

MATCH FUNDS, PERMITS, AND SUBCONTRACTS

Subtask 1.7 Match Funds
The goal of this subtask is to ensure that the Recipient obtains any match funds planned for this Agreement and applies them to the Agreement during the Agreement term.

While the costs to obtain and document match funds are not reimbursable under this Agreement, the Recipient may spend match funds for this task. The Recipient may only spend match funds during the Agreement term, either concurrently or prior to the use of Energy Commission funds. Match funds must be identified in writing, and the Recipient must obtain any associated commitments before incurring any costs for which the Recipient will request reimbursement.

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

  If match funds were a part of the proposal that led to the Energy Commission 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.
  - A copy of a letter of commitment from an authorized representative of each source of match funding that the funds or contributions have been secured.
- At the Kick-off meeting, discuss match funds and the impact on the project if they are significantly reduced or not obtained as committed. If applicable, match funds will be included as a line item in the progress reports and will be a topic at CPR meetings.
- Provide a *Supplemental Match Funds Notification Letter* to the CAM of receipt of additional match funds.

- Provide a *Match Funds Reduction Notification Letter* to the CAM if existing match funds are reduced during the course of the Agreement. Reduction of match funds may trigger a CPR meeting.

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

Subtask 1.8 Permits
The goal of this subtask is to obtain all permits required for work completed under this Agreement in advance of the date they are needed to keep the Agreement schedule on track. Permit costs and the expenses associated with obtaining permits are not reimbursable under this Agreement, with the exception of costs incurred by University of California recipients. Permits must be identified and obtained before the Recipient may incur any costs related to the use of the permit(s) for which the Recipient will request reimbursement.

The Recipient shall:
- Prepare a *Permit Status Letter* that documents the permits required to conduct this Agreement. If 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 1.9 Subcontracts
The goals of this subtask are to: (1) procure subcontracts required to carry out the tasks under this Agreement; and (2) ensure that the subcontracts are consistent with the terms and conditions of this Agreement.

The Recipient shall:

- Manage and coordinate subcontractor activities in accordance with the requirements of this Agreement.
- Incorporate this Agreement by reference into each subcontract.
- Include any required Energy Commission flow-down provisions in each subcontract, in addition to a statement that the terms of this Agreement will prevail if they conflict with the subcontract terms.
- If required by the CAM, submit a draft of each *Subcontract* required to conduct the work under this Agreement.
- Submit a final copy of the executed subcontract.
- Notify and receive written approval from the CAM prior to adding any new subcontractors (see the discussion of subcontractor additions in the terms and conditions).

Products:

- Subcontracts *(draft if required by the CAM)*

TECHNICAL ADVISORY COMMITTEE

Subtask 1.10 Technical Advisory Committee (TAC)

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

- Provide guidance in project direction. The guidance may include scope and methodologies, timing, and coordination with other projects. The guidance may be based on:
  - Technical area expertise;
  - Knowledge of market applications; or
  - Linkages between the agreement work and other past, present, or future projects (both public and private sectors) that TAC members are aware of in a particular area.
- Review products and provide recommendations for needed product adjustments, refinements, or enhancements.
- Evaluate the tangible benefits of the project to the state of California, and provide recommendations as needed to enhance the benefits.
- Provide recommendations regarding information dissemination, market pathways, or commercialization strategies relevant to the project products.

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

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

- Utility representatives;
- Air district staff; and
- Members of relevant technical society committees.

The Recipient shall:

- Prepare a *List of Potential TAC Members* that includes the names, companies, physical and electronic addresses, and phone numbers of potential members. The list will be discussed at the Kick-off meeting, and a schedule for recruiting members and holding the first TAC meeting will be developed.
- Recruit TAC members. Ensure that each individual understands member obligations and the TAC meeting schedule developed in subtask 1.11.
- Prepare a *List of TAC Members* once all TAC members have committed to serving on the TAC.
- Submit *Documentation of TAC Member Commitment* (such as Letters of Acceptance) from each TAC member.

Products:

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

Subtask 1.11 TAC Meetings

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

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.

Products:

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

III. TECHNICAL TASKS

This project takes a holistic approach to understanding and addressing V2G challenges. By carefully modeling and studying the requirements of V2G from the utility point of view and then extending these results into field trials, the project will refine and extend the capabilities of V2G technology. One key aspect of the program is to develop an integrated set of distributed control algorithms that balances the needs of the driver with the storage needs of the grid. Additionally, this project will address and advance the understanding of the economic issues involved in V2G and carrying this through to testing and verification. This project will allow vetting of the initial study assumptions and models and allow a refined understanding of V2G to be developed.
Technical tasks encompass three key phases of any system development: Requirements/Design, Development and Test/Verification. As will be evidenced from the description below, systems engineering principles typical of any aerospace or automotive system design are extensively employed in this project.

TASK 2 Requirements, Architecture, and Design

The goal of this task is to create a set of balanced requirements, system architecture, use cases and design that enables development of end-to-end open-standards-based V2G system communications and control to synthesize DSO and local transformer-aware grid services:

- Define requirements and use cases for V2G capable Plug-in Electric Vehicles
- Develop system architecture and analysis plan to support distribution grid and ISO signal integration to support the use cases
- Define communications requirements and map them onto applicable standards (SAE J1772, J2931/1, J2847/3, J3072 as well as SEP2, and if applicable, OpenADR 2.0b)
- Allocate functional requirements across transformer monitor, V2G capable PHEVs, EVSE as well as distribution / ISO simulators.
- Design the end-to-end communications system.
- Define a cost/benefit assessment framework and data collection requirements.

The Recipient shall:

- Prepare a ***System Requirements Document*** including but not limited to:
    - Define functional requirements at ISO, DSO, local transformer and V2G system level
    - Define use cases under which the system will be exercised.
    - Define a test plan that exercises the system under specific scenarios
    - Define control and operational data signals required to be exchanged among subsystems (ISO, DSO, local transformer monitor/controller, EVSE and V2G capable PHEV)
    - Define data acquisition requirements
    - Define data warehousing plan and a platform
- Prepare a ***System Architecture Document*** that contains the following:
    - Allocation of system functional requirements into different modules of the system being demonstrated, namely, ISO, DSO, local transformer monitor/controller, EVSE and V2G capable PHEV
    - Definition of communications channels in the form of physical connectivity: Wired (Ethernet, *HomePlug GreenPHY, a form of Power Line Communications protocol)(*HPGP) or WiFi or any other appropriate methods

  - Definition of client/server connection protocols among diverse physical and virtual (simulated) actors – server locations, data exchange protocols (HTTP etc) and data security standards (encryption, number of bits, specific algorithms etc)
  - Definition of appropriate open standards that will facilitate communications among all of the actors – these include, but are not limited to: SAE J1772, SAE J2931/1, SAE J2847/3, SEP2 (IEEE 2030.5), SAE J3072 and OpenADR 2.0b
- Prepare a ***System Design Document*** containing the following:
  - ISO modeling requirements including functions implemented and I/O signals
  - DSO actual or simulated requirements and I/O signals
  - Open VGI Platform aggregator functional definition and I/O signals
  - Definition of channels of communications in the form of physical connectivity: Wired (Ethernet, HPGP), WiFi or any other appropriate methods.
- Prepare a ***Test Protocol Document*** containing the following:
  - Test plans to qualify each subsystem before integration: V2G capable PHEVs, Transformer monitor/controller, DSO interface / simulator, ISO simulator as well as Open VGI Platform's aggregator functionality required to carry out this project. This step is to answer this question: Do the individual subsystems perform as expected before they can be tested as an integrated system?
  - Test plans for integrated system functional verification in a phased manner as follows: (1) V2G capable vehicles with local transformer monitor/controller, forming a locally aware V2G system that is safe, outage-immune and interoperable; (2) Locally aware V2G system with Aggregator (3) Aggregator/V2G system with DSO and (4) Aggregator/V2G system with ISO simulator. The purpose of this test plan is to verify whether the subsystems, when combined, will perform as an integrated system so that the use cases can be implemented.
  - Test plans to carry out the use cases to verify all the functional requirements. This step is to answer the question: Is the integrated system capable of performing the required functions to evaluate the proposal's objectives?
- Prepare a ***Measurement & Verification (M&V) Plan*** document that lists the protocol used from end to end to ensure compliance with M&V rules within appropriate ISO (California Independent System Operator)(CAISO) and DSO (PG&E) jurisdictions
- Prepare a *Cost/Benefit Assessment Framework Document* based on the tests being performed and derive the operational data collection reqruiements for performing cost/benefit assessment.
- Participate in the CPR meeting and prepare ***CPR Report #1*** in accordance with subtask 1.3 (CPR Meetings)

Products:

- System Requirements Document
- System Architecture Document
- System Design Document
- Test Protocol Document
- Cost/Benefit Assessment Framework Document
- Measurement & Verification Plan Document
- CPR Report #1

TASK 3 Technology Development
The goal for this task is to create an end-to-end system with open standards communications and interfaces comprising an ISO simulator, DSO interface with a detailed distribution system model, aggregator, transformer monitor-integrated local controller utilizing an EVSE from AeroVironment and a V2G capable PHEV from Via Motors. The EVSE will be retrofitted with control hardware and software required to communicate with on-vehicle inverter (Subtask 3.4 below). The PHEV from Via Motors with on-board inverter will be leveraged from an ongoing EPRI-managed DoE PHEV program, and will be added with software (Subtask 3.3 below) that enables it to communicate with the EVSE.

Subtask 3.1: Integrate Open Standards Communications Interfaces Across the System
The system will be integrated and tested at the sub system level first and will complete final test and safety evaluation before test data will be captured.

The Recipient shall:

- Prepare ***Transformer Monitoring System Integration Test and Evaluation Report***, that will include discussions on the following, but not limited to:
    - Integrating available Communications and an available Communication API onto an external Tatung transformer management platform for:
        - Available SEP2.0 Server with Time, Price, DR, Flow Reservation and DER Function sets for connection to Multiple Level 2 EVSE over HomePlug PLC
        - Available SEP2.0 Client with Time, Price, DR, Flow Reservation and DER Function sets to communicate over external 4G Modem over Ethernet to the EPRI VGI platform.
        - Design and Integrate communication interface to EPRI transformer measurement platform.
    - Designing a downloadable application layer for the Tatung platform that provides the algorithm to manage the charge and discharge of the connected Vehicle via the EVSE based upon:
        - The transformer measurement
        - The load parameters set by the EPRI VGI platform

Products:

- Transformer Monitoring System Integration Test and Evaluation Report

Subtask 3.2: Integrate the Different Algorithms to Test Grid Services (DER, DR, Flow Reservation and Pricing)
The goal of this task is to integrate V2G algorithms into a vehicle charging platform to support grid services and communication.

The Recipient shall:

- Prepare ***PEV and EVSE SEP2 and J3072 Integration Report*** that discusses the following, but not limited to:
    - Supporting a safe EV charging subsystem that meets test site requirements for installed electrical equipment by working with industry partners, utility and where necessary other parties
    - Designing and configuring EV SEP2.0 commands to support J3072 to EVSE for interconnection and to communicate to the Tatung Platform

- Procuring and integrating a local transfer switch that enables safe and outage-immune ride-through capability of the V2G system to connect mains versus V2G generated power locally in a 'break before you make' type connection with appropriate response time to prevent two sources to simultaneously power the local circuits.
- Configuring individual charging station controllers and ensure operational communications with the Tatung Platform.
- Configuring Tatung Platform and ensure operational communications with the EPRI VGI platform.
- Supporting electrical inspectors in assessing installed charging stations for compliance.
- Acquiring appropriate V2G related grid services communications for the relevant Utility services. E.g. OpenADR to the EPRI VGI platform.

Products:

- PEV and EVSE SEP2 and J3072 Integration Report

Subtask 3.3: Extend Functionality of V2G Capable PHEV to Make Its Operation Safe, With Open Standards Interfaces, Interoperable and Outage-Immune

The goal of this task is to take an existing V2G capable vehicle that has open standards-based interfaces and off-board export power capability to be a grid-tied resource that is safe during and after the outage, interoperable and ride-through capable.

The Recipient shall:

- Prepare ***V2G Vehicle Requirements and Algorithm Implementation Document*** that discusses the following, but not limited to:
  - Implementation of SAE J3072 protocol on the PHEV for EVSE communications
  - Designing and Configuring EV SEP2.0 commands to support J3072 to EVSE for Interconnection and to communicate to the Tatung Platform.
  - Procuring and integrating a local transfer switch that enables safe and outage-immune ride-through capability of the V2G system to connect mains versus V2G generated power locally in a 'break before you make' type connection with appropriate response time to prevent two sources to simultaneously power the local circuits.
  - Implementation of any V2G related control algorithms on the vehicle control logic that enables V2G communications processing on the vehicle.
  - Testing the V2G operation with two different vehicles on the same circuit and on different households to ensure they respond to the grid signals in unison.

Products:

- V2G Vehicle Requirements and Algorithm Implementation Document

Subtask 3.4: Develop and Integrate Open Standards Based Communications Within a Production-Viable EVSE

Missing goal description The goal of this subtask is to retrofit hardware and software necessary to an existing EVSE platform (EVSE-RS) form AeroVironment to create an open-standards-capable EVSE that communicates with a V2G converter on-board the vehicle with SAE J3072 protocol that is just being released (expected in 06/2015).

The Recipient shall:

- Prepare ***EVSE Communications Requirements and Design Document*** that discusses the development of a bidirectional-capable EVSE with advanced standards-based communications capabilities based on:
    - A proven EVSE-RS platform, with over 22,000 in use.
    - Grid voltage and current measurement, energy metering, grid frequency measurement to better than 1 mHz, plus serial data interfaces to connect to other systems to enable more advanced features.
    - SEP 2.0 and SAE J2847/3 and SAE J3072.
    - At least ten (10) installations of the Tatung MEVSE module into the EVSE-RS.
        - Developing a custom carrier board that brings out the needed signals from the MEVSE board and interfaces to the control board and to the pilot wire for PLC communications.
        - Selecting a suitable power supply and WiFi card for the MEVSE board The core update software on the control board for bidirectional-capable reporting of AC line current, power, and energy.

Products:

- EVSE Communications Requirements and Design Document

Subtask 3.5: Develop DSO Interface, Distribution Circuit Model, Aggregator Control Algorithms and ISO Simulator

The goal of this task is to account for grid actors that are looking at V2G capable PHEVs to provide value-added services in response to their control signals over open standards-based interfaces. The OpenDSS-based tool under development currently has the capability not only to predict at-risk assets, but hotspots within the distribution system given a specific level of PEV penetration and charging start time assumptions and also estimate the distribution asset replacement costs if the capacity is not managed optimally. This task will also adapt the OpenDSS-based tool to be used to predict at-stress distribution system segments, and then use that information in the form of GIS location to pinpoint V2G assets to be managed differently for their charging and discharging power levels to mitigate distribution system stress.

The Recipient shall:

- Prepare ***Local Transformer and Feeder Optimization Parameter Report*** that documents the following, but not limited to:
    - Development of cost parameters for different grid services and customer smart charging services. These parameters will be used in the EPRI VGI Platform to model the marginal cost of providing each service.
    - Development the application and configure EPRI VGI platform controls to balance customer needs and grid services through the addition of aggregation functionality.
    - Development and adaptation of existing OpenDSS detailed distribution system

circuit model to predict 'hot-spots' as well as mitigation schemes that improve distribution capacity utilization and provide the V2G control system with meaningful control signals that enable it to mitigate distribution grid capacity constraints.
    - Implementation of a control scheme inside the OpenVGI Platform to apply the 'locational distribution' constraints to V2G services signals.
    - Implementation of ISO signal simulator that enables the aggregator function inside the VGI Platform software to disaggregate this signal to communicate it to the V2G capable vehicles.
- Prepare ***Functional End-to-End System (V2G capable PHEVs) Summary Report*** which discusses integrating the subsystems into a cohesive end-to-end system using the system integration requirements and test protocol developed during requirements phase.
- Prepare ***EV Management Test Plan and Report*** that discusses the implementation of M&V Plan required features across the system from V2G to local metering to data warehousing and communications with appropriate agency (CAISO or DSO) for billing settlement purposes.
- Participate in the CPR meeting and prepare ***CPR Report #2*** in accordance with subtask 1.3 (CPR Meetings).

Products:

- Local Transformer and Feeder Optimization Parameter Report
- Functional End-to-End System (V2G capable PHEVs) Summary Report
- EV Management Test Plan and Report
- CPR Report #2

TASK 4 Deployment, Test, and Data Collection

The goals of this task are to commission the complete system at two test sites, test in stages the different algorithms and features developed in the development phase for each test sites, and collect data from the performance evaluation of distribution grid and ISO-aware V2G system that is safe, interoperable and outage-immune.

The Recipient shall:

- Prepare ***Scenario Test Plan*** based upon the Local Transformer and Feeder Optimization Parameter Report and EV Management Test Plan and different algorithms derived in the design phase.
- Prepare ***Scenario Test Report*** which will discuss the following, but will not be limited to:
    - System commissioning and driver education
    - Schedule and analyze a series of 3-month data collections for each algorithm and warehouse each data set.
    - Review and if necessary revisions to the algorithm for each phase.
    - Review with participants and collect and document all responses.

Review and prepare ***Warehoused Data Sets*** and ensure warehoused data is complete and locked.

Exhibit A
Scope of Work

Products:

- Scenario Test Plan
- Scenario Test Report
- Warehoused Data Sets (CD-ROM or memory stick)

TASK 5 Assessment of Incremental Value from V2G Services

The goals of this task are to enhance existing valuation models for storage to include V2G functions, determine distribution avoided cost model using detailed circuit analysis, and assess value of distribution services provided by V2G type system.

Recipient Shall:

- Prepare ***Circuit-Specific Avoided Distribution Cost Estimation Methodology Document*** that translates the EPRI OpenDSS modeling results into quantifiable values in the CPUC Standard Practice Manual Avoided Cost Framework
- Prepare ***Integrated Resource Planning Model Inclusive of V2G*** *Report* that includes, but not limited to the representation of V2G applications in energy storage and/or local integrated resource planning models to model value of V2G in broader portfolio of distributed energy resource technologies
- Prepare ***V2G Extension of Energy Storage Valuation Tool (ESVT) Operation Manual with Use Examples*** that details the following, but limited to:
    - Adding module in the CEC EPIC funded ESVT (led by EPRI with Energy & Environment Economics as subcontractor) to model V2G applications based on program results.
    - Enabling direct comparison of stand-alone energy storage and EVs.
- Prepare ***V2G Incentives and Tariff Quantification Methodology Report*** that discusses the following, but not limited to:
    - Develop and quantify the incentives and tariffs that can be offered to customers to provide V2G services in support of the utility grid with net benefits for customers, ratepayers and the utility.

Products:

- Circuit-Specific Avoided Distribution Cost Estimation Methodology Document
- Integrated Resource Planning Model Inclusive of V2G Report
- V2G Extension of Energy Storage Valuation Tool Operation Manual with Use Examples
- V2G Incentives and Tariff Quantification Methodology Report

TASK 6 Evaluate Project Benefits

The goal of this task is to report the benefits resulting from this project. This will include two tasks on one that is mandatory (Project Benefits) and another that informs the Project Benefit analysis. These are listed below in that order.

Exhibit A
Scope of Work

The Recipient shall:

- Complete three Project Benefits Questionnaires that correspond to three main intervals in the Agreement: (1) *Kick-off Meeting Benefits Questionnaire*; (2) *Mid-term Benefits Questionnaire*; and (3) *Final Meeting Benefits Questionnaire*.
- Provide all key assumptions used to estimate projected benefits, including targeted market sector (e.g., population and geographic location), projected market penetration, baseline and projected energy use and cost, operating conditions, and emission reduction calculations. Examples of information that may be requested in the questionnaires include:

    - For Product Development Projects and Project Demonstrations:
        - Published documents, including date, title, and periodical name.
        - Estimated or actual energy and cost savings, and estimated statewide energy savings once market potential has been realized. Identify all assumptions used in the estimates.
        - Greenhouse gas and criteria emissions reductions.
        - Other non-energy benefits such as reliability, public safety, lower operational cost, environmental improvement, indoor environmental quality, and societal benefits.
        - Data on potential job creation, market potential, economic development, and increased state revenue as a result of the project.
        - A discussion of project product downloads from websites, and publications in technical journals.
        - A comparison of project expectations and performance. Discuss whether the goals and objectives of the Agreement have been met and what improvements are needed, if any.
        - Additional Information for Product Development Projects:
            - Outcome of product development efforts, such copyrights and license agreements.
            - Units sold or projected to be sold in California and outside of California.
            - Total annual sales or projected annual sales (in dollars) of products developed under the Agreement.
            - Investment dollars/follow-on private funding as a result of Energy Commission funding.
            - Patent numbers and applications, along with dates and brief descriptions.
        - Additional Information for Product Demonstrations:
            - Outcome of demonstrations and status of technology.
            - Number of similar installations.
            - Jobs created/retained as a result of the Agreement.

    - For Information/Tools and Other Research Studies:
        - Outcome of project.
        - Published documents, including date, title, and periodical name.
        - A discussion of policy development. State if the project has been cited in government policy publications or technical journals, or has been used to inform regulatory bodies.
        - The number of website downloads.

  - An estimate of how the project information has affected energy use and cost, or have resulted in other non-energy benefits.
  - An estimate of energy and non-energy benefits.
  - Data on potential job creation, market potential, economic development, and increased state revenue as a result of project.
  - A discussion of project product downloads from websites, and publications in technical journals.
  - A comparison of project expectations and performance. Discuss whether the goals and objectives of the Agreement have been met and what improvements are needed, if any.
- Respond to CAM questions regarding responses to the questionnaires.

The Energy Commission may send the Recipient similar questionnaires after the Agreement term ends. Responses to these questionnaires will be voluntary.

Products:
- Kick-off Meeting Benefits Questionnaire
- Mid-term Benefits Questionnaire
- Final Meeting Benefits Questionnaire

TASK 7 Technology/Knowledge Transfer Activities
The goal of this task is to develop a plan to make the knowledge gained, experimental results, and lessons learned available to the public and key decision makers.

The Recipient shall:
- Prepare an *Initial Fact Sheet* at start of the project that describes the project. Use the format provided by the CAM.
- Prepare a *Final Project Fact Sheet* at the project's conclusion that discusses results. Use the format provided by the CAM.
- Prepare a *Technology/Knowledge Transfer Plan* that includes:
  - An explanation of how the knowledge gained from the project will be made available to the public, including the targeted market sector and potential outreach to end users, utilities, regulatory agencies, and others.
  - A description of the intended use(s) for and users of the project results.
  - Published documents, including date, title, and periodical name.
  - Copies of documents, fact sheets, journal articles, press releases, and other documents prepared for public dissemination. These documents must include the Legal Notice required in the terms and conditions. Indicate where and when the documents were disseminated.
  - A discussion of policy development. State if project has been or will be cited in government policy publications, or used to inform regulatory bodies.
  - The number of website downloads or public requests for project results.
  - Additional areas as determined by the CAM.
- Conduct technology transfer activities in accordance with the Technology/Knowledge Transfer Plan. These activities will be reported in the Progress Reports.
- When directed by the CAM, develop *Presentation Materials* for an Energy Commission-sponsored conference/workshop on the results of the project.

- Prepare a *Technology/Knowledge Transfer Report* on technology transfer activities conducted during the project.

Products:

- Initial Fact Sheet (draft and final)
- Final Project Fact Sheet (draft and final)
- Presentation Materials (draft and final)
- Technology/Knowledge Transfer Plan (draft and final)
- Technology/Knowledge Transfer Report (draft and final)

IV. PROJECT SCHEDULE

Please see the attached Excel Spreadsheet.