

**GRANT REQUEST FORM (GRF)**

CEC-270 (Revised 10/2015)

CALIFORNIA ENERGY COMMISSION

New Agreement EPC-16-065 (To be completed by CGL Office)

ERDD	Steve Ghadiri	43	916-327-1623
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Zero Net Energy Alliance, Inc.	47-5562137
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California E-Bus to Grid Integration Project
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6/30/2017	12/31/2020	\$ 3,327,953
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 ARFVTP agreements under \$75K delegated to Executive Director.

Proposed Business Meeting Date	5/10/2017	<input type="checkbox"/> Consent	<input checked="" type="checkbox"/> Discussion
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Business Meeting Presenter	Kiel Pratt	Time Needed:	10 minutes
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Please select one list serve. EPIC (Electric Program Investment Charge)

**Agenda Item Subject and Description**

ZERO NET ENERGY ALLIANCE, INC. Proposed resolution approving agreement EPC-16-065 with Zero Net Energy Alliance for a \$3,327,953 grant to demonstrate E-bus-to-grid integration, quantify the costs and benefits, develop use cases, and document best practices for an E-bus fleet.

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

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:

The City of Lancaster, CA, has obtained the Ministerial Exemption for this project. The City claims that this project pilot study, Wireless Charging Station, is not expanding the capacity of any of the roadways and no sensitive environmental resources were located adjacent to the project site. It is a research demonstration, which is not adding to any building construction, and minor electrical work within the facility will be exempt from the CEQA.

 b) Agreement **IS NOT** exempt. (Consult with the legal office to determine next steps.)

Check all that apply

 Initial Study

 Negative Declaration

 Mitigated Negative Declaration

 Environmental Impact Report

 Statement of Overriding Considerations

Legal Company Name:	Budget
Energy Solutions International	\$ 858,494
Olivine, Inc.	\$ 1,213,090
ASWB Engineers	\$ 163,344
Research Into Action, Inc.	\$ 40,000
Prospect Silicon Valley	\$ 98,000
AVTA	\$ 304,435
School Bus safety, Inc.	\$ 50,000
	\$
	\$



## EXHIBIT A Scope of Work

### I. TASK ACRONYM/TERM LISTS

#### A. Task List

Task #	CPR <sup>1</sup>	Task Name
1		General Project Tasks
2	X	VGI Services and Price Optimization at Scale
3	X	Develop E-Bus Operator Training and Feedback Program
4		Evaluation of Project Benefits
5		Technology/Knowledge Transfer Activities

#### B. Acronym/Term List

Acronym/Term	Meaning
AVTA	Antelope Valley Transit Authority
BYD	Build Your Dreams (EV manufacturer)
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CEC	California Energy Commission
CPR	Critical Project Review
CPUC	California Public Utilities Commission
DER	Distributed Energy Resource
E-Bus	Electric Bus
E-Fleet	Electric Fleet
E-Truck	Electric Truck
EV	Electric Vehicle
ICE	Internal Combustion Engine
LCE	Lancaster Choice Energy
M&V	Measurement and Verification
TAC	Technical Advisory Committee
T&D	Transmission and Distribution system
V2G	Vehicle-to-Grid
VGI	Vehicle-Grid-Integration

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

#### A. Purpose of Agreement

The purpose of this Agreement is to fund the demonstration of an integrated suite of technologies that mitigate customer costs and grid impacts and maximize customer and grid benefits associated with electric bus (E-Bus) charging and operations. This technical solution will overcome key market barriers to scaled adoption of E-buses and other Medium- and Heavy-Duty Electric Vehicles (EV).

<sup>1</sup> 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

### B. Problem/ Solution Statement

#### Problem

Commercial-scale adoption of E-Buses (and other Medium- and Heavy-Duty EVs) has been very slow in California due to: (1) high up-front vehicle and charging infrastructure costs; (2) range anxiety and other operating performance uncertainties; (3) limited data on total cost of ownership, including potentially significant variability in operations and maintenance costs; (4) uncertainty regarding demand charge issues and grid services revenue potential; and (5) limited market awareness and poor packaging of the E-Bus value proposition. These challenges have not yet been addressed by any entity because early-stage deployments of E-Buses and E-Trucks cannot address economic and operational issues that only emerge with larger-scale deployments and related data collection. Thus far, the focus has been solely on technical feasibility. For example, there is a tremendous difference in power infrastructure and operator and mechanic training required deploying 80 E-buses across 100% of the routes in a larger transit agency vs. a few E-buses in a limited pilot program. Furthermore, interconnection processes, rules, and tariff structures have been in the earliest stages of development, which until now have limited opportunities to quantify demand charge implications and grid services revenue potential.

#### Solution

The 29 E-buses currently in the Antelope Valley Transit Authority (AVTA) procurement pipeline will be the largest E-bus deployment in North America, as these are just the first phase in a planned 80 bus deployment by 2018. Thus, the California E-Bus-to-Grid Integration Project addresses the adoption barriers referenced above by demonstrating critical vehicle-grid-integration (VGI) technical solutions at a uniquely large scale. Specifically, the project will develop strategies that are scalable fleet-wide and statewide to: (1) minimize demand charges and demand spikes; (2) enable large-scale E-Bus and E-Truck fleets to provide grid services and capitalize on associated revenues; (3) integrates onsite renewable generation assets to further optimize E-Bus charging; (4) match local energy supply with demand to ease grid congestion; (5) optimize operational parameters and operator performance to maximize fuel economy and minimize operating costs; and (6) establish a transit agency outreach, education and technical assistance platform, known as the “solutionLAB,” to scale-up E-Fleet tools, programs, lessons learned and best practices. Notably, while AVTA will be the primary host site for the demonstration, the E-Bus Operator Training Program and E-Bus Solutions Guide developed in this program will be distributed on a statewide and national basis through The Transit & Paratransit Company TAPTCO. The United States has yet to see an E-Bus demonstration of this scale that requires (and enables) development of both the human and technical resources required to effectively integrate E-Buses with the grid and fully leverage the technical potential of battery electric buses as mobile storage assets.

### C. Goals and Objectives of the Agreement

#### Agreement Goals

The goals of this Agreement are to:

1. Demonstrate technical, operational and behavioral solutions to enable E-Bus VGI;
2. Quantify the costs and benefits of diverse E-Bus VGI use cases; and
3. Disseminate best practices in E-Bus planning, procurement, operations, training, maintenance, and grid-integration to accelerate E-Bus adoption throughout California.

## **EXHIBIT A**

### **Scope of Work**

#### **Ratepayer Benefits:**<sup>2</sup>

This Agreement will result in ratepayer benefits that include lower costs, increased reliability, and reduction of harmful emissions. These results will be achieved by: (1) Enabling load balancing and demand charge mitigation for 29 E-buses during overnight depot charging; (2) Demonstrate VGI strategies to mitigate costly transmission or distribution upgrades needed to serve these new loads by matching electrical supply and demand to ease local grid congestion; (3) Providing additional revenue streams for the AVTA E-bus fleet and additional value to ratepayers and the community; and (4) Improving operator practices to enhance fuel efficiency.

#### **Technological Advancement and Breakthroughs:**<sup>3</sup>

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 integrating onboard telematics with analytics and distributed energy resource (DER) management platforms can unlock even greater value. Manufacturers are acutely aware of this opportunity, as evidenced by many medium- and heavy-duty (MD/HD) vehicles being factory-configured for Smart Charging (SC) and vehicle-to-grid (V2G) operation.<sup>4</sup> The specific technological advancements that will be demonstrated in this Project include, but are not limited to:

- Enabling SC to minimize avoidable demand spikes and charges for in-route and depot charging. Enabling advanced analytics of operating behaviors and environmental conditions to identify and encourage efficient operator behaviors.
- Enabling grid services to provide grid operators with the increased flexibility and resiliency required for the growing demands associated with renewable intermittency, excess generation, and portfolios of DERs.

#### **Agreement Objectives**

The objectives of this Agreement are to:

1. Demonstrate and deploy a VGI-enabled E-Bus platform that integrates real-time data feeds from onboard telematics, route tracking software, charging interfaces and utility and California Independent System Operator (CAISO) systems to optimize charging and provide grid services;
2. Demonstrate a state-of-the-art E-Bus operator training and engagement program to encourage efficient operator behaviors that maximize fuel economy and close the 200%+ performance gap between the least and most efficient operators;
3. Develop and disseminate E-Bus and E-Truck technical, policy and program recommendations to accelerate adoption of E-Buses; and
4. Establish the solutionLAB to disseminate an E-Bus Deployment Guide that educates transit agencies and prospective E-Bus operators on the most cost-effective technical, operational, and behavioral solutions, policies and programs for transitioning to 100% E-Buses.

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<sup>2</sup> 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](http://docs.cpuc.ca.gov/PublishedDocs/WORD_PDF/FINAL_DECISION/167664.PDF)).

<sup>3</sup> 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.

<sup>4</sup> Examples include all BYD truck and bus models, Proterra E-buses, Nohm Medium-Duty buses and trucks, and E-Buses and E-Trucks from Motiv, TransPower, VIA, and others.

# EXHIBIT A

## Scope of Work

### 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)**. 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 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:

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- 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.

#### **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);

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- 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.

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#### **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.

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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 progress made on all Agreement activities as specified in the scope of work for the preceding month, 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. See the Progress Report Format Attachment for the recommended specifications.
- Submit a monthly or quarterly *Invoice* that follows the instructions in the "Payment of Funds" section of the terms and conditions, including a financial report on Match Fund and in-state expenditures.

### Products:

- Progress Reports
- Invoices

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### 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 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 the 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. (See *Task 1.1* for requirements for draft and final products.)

##### Recipient Products:

- Final Report Outline (draft and final)

##### CAM Product:

- Style Manual
- Comments on Draft Final Report Outline
- Acceptance 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, 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)
  - Ensure that the document is written in the third person.
  - Ensure that the Executive Summary is understandable to the lay public.
    - Briefly summarize the completed work. Succinctly describe the project results and whether or not the project goals were accomplished.
    - Identify which specific ratepayers can benefit from the project results and how they can achieve the benefits.

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- If it's necessary to use a technical term in the Executive Summary, provide a brief definition or explanation when the technical term is first used.
- Follow the Style Guide format requirements for headings, figures/tables, citations, and acronyms/abbreviations.
- Ensure that the document omits subjective comments and opinions. However, recommendations in the conclusion of the report are allowed.
- Include a brief description of the project results in the Abstract.
- 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
- Consider incorporating all CAM comments into the Final Report. 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 Final Report 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.
- Submit one bound copy of the *Final Report* to the CAM along with *Written Responses to Comments on the Draft Final Report*.

### Products:

- Final Report (draft and final)
- Written Responses to Comments on the Draft Final Report

### CAM Product:

- Written Comments on the 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

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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.

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#### **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.

## **EXHIBIT A**

### **Scope of Work**

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.

## **EXHIBIT A**

### **Scope of Work**

- 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

#### **IV. TECHNICAL TASKS**

##### **TASK 2: VGI SERVICES AND PRICE OPTIMIZATION AT SCALE**

The goal of this Task is to demonstrate VGI technologies to provide grid services at scale that create additional revenue streams for the AVTA E-Fleet and provide additional value to the community. This value will be achieved by helping match electrical supply and demand to ease local grid congestion caused in part by a high penetration of DERs, and by enabling load balancing by means of smart charging, integration of stationary storage, and potential future V2G operations. A valuation model will be used to analyze the costs and benefits of different VGI opportunities for the AVTA E-Fleet.

##### **Subtask 2.1 Create a VGI Valuation Model**

The goal of this subtask is to develop a framework for assessing the value of using the AVTA E-Fleet to provide VGI services. Having access to the valuation model is essential for the development of viable business models and financial investment to support widespread use of E-Fleets in VGI applications. Leveraging existing valuation models, different E-Bus VGI use cases will be valued in a standardized manner, and will enable transit authorities to effectively compare, select and implement different VGI strategies that are appropriate for their situation. The use cases will be thoroughly evaluated, and lessons learned and best practices will be shared through the solutionLAB platform. Once complete, the model will be disseminated to the group for their use in assessing VGI opportunities in their respective territories.

##### **The Recipient shall:**

- Compile technology research and business model findings into an *E-Bus VGI Market Characterization and Implementation Strategy Report*. This will highlight the current state of the evolving VGI ecosystem (technologies, business models, market opportunities, etc.) for different customer segments, review VGI industry trends and forecasts, identify critical follow-on market facilitation opportunities, and provide strategic considerations for Medium and Heavy-Duty EV fleet deployment and grid-integration. These strategic considerations incorporate public health and safety, economic development, and other objectives relevant to public and private sector actors.
- Identify technical requirements and cost inputs for the integration of VGI using E-Fleets.
- Identify technical requirements and cost inputs for other DERs, including stationary storage and solar PV – that could augment the value of VGI for E-Fleets.
- Identify opportunities for energy cost savings, revenues, and grid benefits from all relevant forms of VGI, including smart one-way charging, V2G, vehicle-to-building, vehicle-to-vehicle and integrating vehicle chargers with stationary storage.
- Develop an *E-Bus VGI Business Model Framework Specification Report* that describes the different business model opportunities for VGI in E-Fleets and the technical requirements to implement each.

## **EXHIBIT A**

### **Scope of Work**

- Develop the *E-Bus VGI Valuation Framework* which will include the methodologies and key cost and savings inputs detailed in the *E-Bus VGI Business Model Framework Specification Report*, and provides an accurate estimation of the value provided by each VGI scenario.
- Develop an *E-Bus VGI Valuation Framework User Manual*. The Manual will combine the results of the business model and valuation frameworks and provide transit authorities a step-by-step guide to using these tools for planning the implementation of VGI strategies for E-Bus fleets.

#### **Products:**

- E-Bus VGI Market Characterization and Implementation Strategy Report (Draft and Final)
- E-Bus VGI Business Model Framework Specification
- E-Bus VGI Valuation Framework
- E-bus VGI Valuation Framework User Manual (Draft and Final)

#### **Subtask 2.2 Evaluate Specific Grid Services for Implementation**

This goal of this task is to evaluate specific grid service implementations for the AVTA E-Fleet to be demonstrated over the course of the project. This analysis will be used in conjunction with the Valuation Framework developed in Subtask 2.1 to determine the best VGI use cases which maximize value for AVTA and the grid. Special attention will be focused on determining potential issues in electrical supply due to the expansion of the fleet which could dramatically increase operating costs for AVTA and increase costs for the community as a whole, such as transmission or distribution upgrades needed to service these new loads. The different VGI use cases that will be evaluated: (1) reducing demand charges and energy price spikes; (2) address renewable resource intermittency and congestion; (3) providing reliability resource services for both localized and whole grid needs; (4) providing ancillary services as a grid resource to limit use of fossil fuel backup generation; and (5) emergency energy assurance for critical facilities.

#### **The Recipient shall:**

- Model the current and future power demand for the AVTA E-Fleet based on review and analysis of the current state of the fleet and future expansion plans. This will include studying and modeling bus routes and daily/weekly charge and discharge cycles. The output of this analysis will be summarized in the *AVTA E-Fleet Energy Requirements Model*.
- Apply the VGI valuation model (developed in Subtask 2.1) to the current and modeled future states of the AVTA fleet to determine opportunities to demonstrate different VGI use cases. The output of this analysis will be provided in the *AVTA E-Fleet VGI Use Cases Report*. The Report will describe all the VGI use cases that may be applicable for large E-Fleets and will include the results of applying the valuation model to these use cases. This report will include near-term opportunities, as well as the longer term opportunities that arise with a 100% E-Fleet. It will identify the services that provide most value to AVTA and its customers, and form the basis for Subtask 2.3.
- Develop the *Potential Value Streams from VGI Services Report* and discuss different options for VGI Demonstration projects with AVTA. This report will summarize the larger VGI opportunities that are available to other transit agencies. To assess opportunities, the team will obtain other transit agency data to model opportunities and to provide a

## **EXHIBIT A**

### **Scope of Work**

“real-world” sensitivity analysis that is drawn out to identify the key drivers and provide lessons learned for broader use cases.

#### **Products:**

- AVTA E-Fleet Energy Requirements Model
- AVTA E-Fleet VGI Use Cases Report (Draft and Final)
- Potential Value Streams from VGI Services Report (Draft and Final)

#### **Subtask 2.3 Integrate Data Sources and Control Systems with the DER Management Platform**

The goal of this task is to enable the VGI use case demonstrations recommended in Subtask 2.2 by integrating the Olivine DER Platform with all necessary data sources and controls systems. The Olivine DER Platform will collect the appropriate data, determine the optimal control parameters to implement the VGI services based on predefined characteristics, and control the appropriate systems as needed. To support many of the VGI use cases, the Olivine DER Platform integration will require, at minimum, near real-time access to data for charging/discharging power and battery state of charge for each bus and charger, as well as aggregated power use of each charging station or the system as a whole. The system will also collect additional bus operational and scheduling information in near real-time, which will help support more complex use cases.

#### **The Recipient shall:**

- Acquire technical specifications and data definitions for each applicable data collection and control protocol for the implementation of the selected demonstrations. Data and control needs will be determined from information on the proposed VGI demonstrations as outlined in Task 2.2.
- Ensure that all applicable standards can be met for each data collection and control protocol.
- Develop a system design and *DER Design Workbook* describing the design, applicable specifications, applicable standards, and a description of the control logic. The DER Design Workbook will be reviewed by all technical partners (including I/O Controls – which provides the E-bus software links, Build Your Dreams (BYD), which manufactures the AVTA E-Buses, and WAVE – which is the manufacturer of the inductive wireless chargers that will supply on-route charging for the E-Buses).
- Develop a *DER Test Plan* that describes how the system will be tested, including test objectives, procedures, conditions, facilities, and equipment needed. The test plan will describe both lab tests and field tests to ensure proper performance.
- Test the Olivine DER Platform design and control logic in a simulated lab environment to ensure it performs as expected under different scenarios. Describe how the system performed and the results of the tests in a *DER Test Report*.
- Integrate the Olivine DER Platform with the AVTA back office systems, the onboard control systems, and the WAVE chargers. The integration process will include:
  - Adapting the system to meet the technical specifications and data definitions of the AVTA system.
  - Testing individual input and output signals between Olivine DER and the AVTA System.
  - Performing controlled simulation tests to ensure the two systems are integrated correctly.

## **EXHIBIT A**

### **Scope of Work**

- Perform tests to see how the system operates in the field.
- Develop a *DER Test Report* describing how the system performed and the results of the tests. This will include a description of the system design and the testing protocols used to test the system, as well as a description of any issues identified during integration and testing and how those issues were addressed. Finally, the report will describe any limitations to the system that may affect the ability to implement any of the use cases and future system adaptations that could address these limitations.

#### **Products:**

- DER Design Workbook
- DER Test Plan
- DER Test Report

#### **Subtask 2.4 Implement Demonstrations and Develop VGI Value Matrix**

The goal of this task is to demonstrate the use cases identified in Subtask 2.2 in real operating conditions. Each VGI demonstration will be tested with multiple configurations and parameters to maximize performance. These configurations are anticipated to include different combinations of buses and chargers and different bus schedules (e.g., weekday, weekend, holiday), as well as any other modifications to the system or operations that can be modified without affecting the operational performance of the bus fleet. In addition, different control parameters of the system (e.g., charge schedules, charging profiles, state of charge cut offs) will be tested to understand the optimal values for the system design.

#### **The Recipient shall:**

- Develop a *VGI Use Case Demonstration Plan* for each use case selected in Subtask 2.3. Each plan will include a description of the use case to be tested and the range of parameters that will be tested to optimize the value of the use case. This will also address the timing of the demonstration, roles and responsibilities of partners, sources and intervals for data collection, and identified limitations on the ability to enact certain control strategies.
- Implement each VGI demonstration with multiple configurations and parameters to optimize performance and collect and store performance data for the third-party measurement and verification (M&V). Data will include, but is not limited to:
  - Demonstrated configurations and parameters,
  - Added value of VGI operations,
  - Operational effect on bus operations, if any, and
  - Data collected from bus operators on how the system affects their operations.
- Develop *VGI Implementation Case Studies* for each VGI demonstration. A case study write up of each VGI use case demonstration will be created describing the demonstration, results, and answers the questions listed above.
- Combine information from the case studies into a *VGI Value Matrix* that displays the applicable conditions for each use case and the range of values determined for each use case. The value matrix will define the relative value of each grid service under the demonstration conditions, and describe optimal operating conditions and ideal use case scenarios for each VGI service.

## **EXHIBIT A**

### **Scope of Work**

#### **Products:**

- VGI Use Case Demonstration Plan
- VGI Implementation Case Studies
- VGI Value Matrix

#### **Subtask 2.5 Evaluate VGI Services and Price Optimization at Scale**

The goals of this task are to determine the cost-effectiveness of the demonstrations, as well to describe barriers and opportunities to VGI services in E-Fleets, using a qualified third-party M&V firm. The third-party evaluator will collect data to quantify both the costs and benefits of the demonstrations and other Task outputs, and to document barriers and opportunities to VGI services in E-Fleets. These costs and benefits will be used as inputs to determine the cost-effectiveness of the demonstrations.

#### **The Recipient shall:**

- Develop an *M&V Plan* prior to full implementation of the VGI demonstration and deployment. The M&V Plan will include:
- Collect the appropriate data, as described in the M&V Plan, over the course of the VGI demonstration. Data inputs will include:
  - Capital, implementation, and operating costs of implementing VGI services,
  - Revenue generated and cost savings from VGI services, and
  - Interviews with relevant demonstration partners from AVTA, Southern California Edison, Lancaster Choice Energy, BYD, I/O Controls, the producer of the software that monitors all relevant E-Bus parameters, including state of charge, use of regenerative braking, HVAC and lighting energy consumption, etc.
- Complete a calculation of the full costs and benefits of the VGI demonstration and deployment as inputs into the cost effectiveness calculation.
- Develop a *VGI Demonstration Cost-Effectiveness Report* with the inputs and outputs of the cost effectiveness calculation for different configurations and operating parameters. While the report describes the actual costs and benefits recognized by AVTA, the Report will also forecast the cost-effectiveness once economies of scale are factored in following the demonstration period.
- Develop a report entitled *Barriers and Opportunities to VGI Services in Large Fleets Report* that covers findings for both large E-Fleets and for other medium- and heavy-duty E-Fleets. This report will include a description of opportunities for VGI services in large fleets, including other medium- and heavy-duty vehicles other than buses. The report will also describe barriers that were identified and overcome during the demonstration, as well as existing barriers and recommendations on how to address these barriers to increase the uptake of VGI services in large fleets.
- Provide a CPR Report #1 and participate in CPR meeting per subtask 1.3.

#### **Products:**

- M&V Plan (Draft and Final)
- VGI Demonstration Cost Effectiveness Report (Draft and Final)
- Barriers and Opportunities to VGI Services in Large Fleets Report (Draft and Final)
- CPR Report #1

## **EXHIBIT A**

### **Scope of Work**

#### **TASK 3: DEVELOP E-BUS OPERATOR TRAINING AND FEEDBACK PROGRAM**

The goals of this task are to maximize E-Bus fuel economy by coupling education and training for E-bus operators with advanced analytics and proven behavior modification strategies. Fuel efficiency on the two E-Buses AVTA currently operates is highly variable based on operator (driver) skill and experience. To ensure that operator efficiency is optimized, an E-Bus Operator Training and Feedback Program will be developed that collects and overlays data from onboard telemetry and the fleet tracking system with static data sources such as topography and operator breaks/schedules, and uses analytics and proven behavior modification strategies to encourage efficient operating habits through strategic messaging. Key operator strategies include optimized patterns of acceleration, coasting, regenerative braking, and interior climate control.

#### **Subtask 3.1 Define Data Needs and Sources for Operator Efficiency Behavioral Program**

The goal of this task is to define the data requirements for the operator efficiency program. This includes defining both the static data that must be sourced (topography, safety policies, school zones, etc.), as well as the continuous data streams (location, fuel economy, etc.). Additional information on schedule and operator rest periods, personnel policies, etc. will be assessed during the project to determine all relevant performance parameters that may influence operator behavior and performance, E-Bus fuel economy, and rider satisfaction.

#### **The Recipient shall:**

- Determine data needs and sources. Data from the following data sources will be collected to inform development and implementation of the operator training program:
  - Health Alert Management System (HAMS): Provided by I/O Controls, HAMS is the onboard telemetry system that interfaces all the electrical sub-systems within the AVTA buses. HAMS includes a multiplexing system that monitors and provides data on regenerative braking operations and inter-lock systems, acceleration patterns, average fuel economy, bus HVAC system operations, state of charge throughout route, time/location/and amount of on-route charging, status of exterior and interior lights, and other operational status and warning systems.
  - Avail: Avail is a software system that tracks driver assignments to buses and routes, uses GPS to track the location of the bus during its route, and forecasts estimated departure times. Through the Avail system, the program will assess the impact of traffic, ridership, and stop duration on fuel economy, and develop best practices for maximizing fuel economy when operators encounter varying levels of congestion.
  - Transit Categorization: In addition to drawing data from on board and remote systems, the Project will capture real-time traffic data to identify slow zones (e.g. hospitals, schools, etc.), and development density factors that may impact E-Bus operational efficiency.
  - Transit Agency/Operator Company/Union Policies and Practices: In addition to monitoring the bus, operator, and roadway conditions, the project will also integrate schedules and breaks, and existing training/guidance provided to operators on driving best practice.
  - Geographic Information Systems (GIS): GIS files will be overlaid to model the route topography in an attempt to understand the impact that hills have on fuel economy – taking into account regenerative braking, acceleration and interior and exterior climate dynamics.

## **EXHIBIT A**

### **Scope of Work**

- Develop *Technical Specification* to integrate and overlay data sources. The specification will include:
  - Detailed design and documentation of the Master Data Model for vehicle and operator reporting, including field names, data categories, relational data structure, and value boundaries;
  - Collated documentation of various input data sources described above (HAMS, Avail, etc.) and mapping of relevant fields from each data source to the Master Data Model;
  - Mechanisms for data collection from input data sources, including automated and manual import procedures, Application Programming Interfaces (APIs), and methodology for acquiring non-electronic data sources, as applicable;
  - Methodology for data aggregation, including both scripted preprocessing as well as database-level pivots and metadata to convert data streams into usable information;
  - Detailed data integrity and quality control parameters to ensure quality of data flow at the source;
  - Information access mechanisms, including any user interface and protocols/APIs for accessing collated data; and
  - A set of standard tabular reports for Excel-compatible access to fundamental statistics (operator performance, vehicle efficiency, ridership, climate, traffic conditions).

#### **Products**

- Technical Specification (Draft and Final)

#### **Subtask 3.2 Establish Baseline Operating Conditions and Barriers to be Addressed**

The goals of this task are to: (1) identify trends and anomalies in the data that result from specific operator behaviors and diverse operating conditions; (2) inform the E-Bus Operator Training Program; and (3) inform which behavioral modification strategies are likely to be the most effective strategies for encouraging efficient operating techniques and customer and operator satisfaction.

#### **The Recipient shall:**

- Integrate and overlay data sources to capture and report on requisite data. Per the Technical Specification developed in Task 3.1, data will be housed in an open source database. The analytical interface will select data from different fields and model dynamic conditions to identify the factors influencing fuel economy. Data and factors collected will include, but not be limited to:
  - Interior and outside temperature,
  - Acceleration, coasting and braking durations,
  - Route typography and distance,
  - Scheduled breaks and breaks for in-route charging,
  - Ridership and number of stops,
  - Operator identifying number, longevity with AVTA and relative experience operating E-Buses, and
  - Vehicle state of charge from stop to stop.

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- Establish quantitative baseline operating conditions. Data specified in the *Final Technical Specification* will be collected daily from all E-Buses in AVTA's fleet and through historical records to maximize the quantity and quality of data that forms the baseline conditions. Data will be analyzed to determine the average conditions on each route (e.g., acceleration and braking patterns, ambient temperature, HVAC utilization, hills, rider load, etc.).
- Interview AVTA operators, OEM test engineers and trainers, supervisory personnel, and other subject matter experts as appropriate to identify behavioral and environmental drivers of fuel economy (e.g., a "qualitative baseline"). The objective of the stakeholder interviews is to expose operator beliefs and behaviors that do not translate to E-Buses and that have been developed through operating internal combustion engine (ICE) buses for several years. At a minimum, this will include:
  - Interviewing OEM test engineers and trainers to identify best practices for operating E-Buses;
  - Interviewing AVTA operators to determine their level of understanding of how efficiently operating E-Buses and ICE buses needs to differ; and
  - Interviewing supervisory personnel at AVTA to determine their perceptions regarding how operator practices need to differ, plans to administer training, barriers limiting delivery of E-Bus operator training (e.g., lack of training programs for E-Bus operator best practices).
- Observe existing operator behaviors on E-Buses and ICE Buses. The recipient shall ride along with a subset of AVTA operators to monitor operating practices, note operator behaviors surrounding acceleration and braking, take temperature readings during the trip, and note any additional abnormalities that may influence fuel economy.
- Compare driving practices on ICE and E-Buses to understand what operating behaviors and characteristics learned from operating ICE vehicles must shift to optimize E-Bus operations. The comparison will:
  - Overlay field observations captured during the ride along with actual performance data streamed from HAMS and route data from the Avail system, and
  - Correlate interview responses with the observed trends in order to connect operator perceptions and level of education with their performance.
- Develop *E-Bus Operator Performance Report – An Assessment of E-Bus Operator Performance and Education Gaps and Opportunities for E-Bus Operators*. This report will summarize the methodology used to establish the quantitative and qualitative baseline conditions, results of the analysis between E-Bus and ICE operator practices, E-Bus operator education needs, limitations and opportunities, and recommendations for the E-Bus Operator Education Program (developed in Task 3.3).
- Develop *Operator Performance Enhancement Logic Model*. The Logic Model will: (1) synthesize the data and analysis conducted during task 3.1 and 3.2 into a coherent statement of the most salient factors influencing E-Bus performance that are within control of the Operator, (2) identify the behaviors and habits that the education and feedback program seeks to encourage and discourage, (3) identify the barriers and limitations to influencing operator behaviors, and (4) propose a series of performance trainings and ongoing behavior modification strategies that are most likely to encourage efficient operating practices. Behavioral strategies that may be proposed include, but are not limited to:

## **EXHIBIT A**

### **Scope of Work**

- Framing: Includes strategies that provide information (e.g., fuel efficiency by driver) in a manner that takes advantage of people's heuristics to influence their behavior. This capitalizes on people's response to messaging designed to encourage self-image or emphasize benefits.
- Commitment: Includes strategies that encourage individuals, teams, or the organization as a whole to commit to executing an action by a specific date.
- Feedback: Includes strategies where information is given to the bus operator frequently (e.g., driver's daily fuel efficiency). This strategy can be coupled with other strategies such as comparative norming. From extensive research in the energy field, we know that feedback and comparative norming worked effectively in encouraging individuals to use energy more efficiently.
- Comparative norming: Includes strategies that activate social norms. When individuals learn what the commonly accepted ways of behaving is, they tend to align their behavior closer to the norm. Thus, comparing a driver's fuel efficiency to the average fuel efficiency of a group or fuel efficiency of top performers could influence a change in a behavior.

#### **Products:**

- E-Bus Operator Performance Report – An Assessment of E-Bus Operator Performance and Education Gaps and Opportunities for E-Bus Operators (Draft and Final)
- Operator Performance Enhancement Logic Model (Draft and Final)

#### **Subtask 3.3 Create Program Design and Evaluation Methodology**

The goal of this task is to develop the program design and the evaluation framework for the E-Bus Operator Training Program. Having developed the program baseline and the logic model in Task 3.2, this task will establish the program's training and operator engagement content and delivery channels, operational procedures and tools, and approach for evaluating the effectiveness of the Operator Training and Feedback Program. Training materials will include comprehensive course content in the form of an instructional video on efficient E-Bus driving practice developed by TAPTCO, the national leader in bus operating training program development. In addition, on-road training protocols will be developed for supervisory and administrative personnel.

#### **The Recipient shall:**

- Develop the *E-Bus Operator Training and Feedback Program Design and Implementation Plan* which outlines the operational sequencing of training events, and roles and responsibilities for different parties. It specifies content required for collateral materials, and identifies existing operational and HR policies that must be upheld, new policies that need to be adopted, and other strategic, operational, legal, and logistical parameters that are key to implementing an optimized program specific to E-Bus operators. The three core elements of the Program Design include:
  - *Analytical Methodology*: The Analytical Methodology defines the data sources and calculation methods for the performance analysis used as the basis for the behavioral modification strategies, and the training content to promote efficient practices. The methods will: (1) calculate operator-level performance, (2) normalize operator performance compared to their peers, and (3) correlate performance trends and anomalies with efficient vs. inefficient operator practices. The analytics will answer questions such as:

## EXHIBIT A

### Scope of Work

- How acceleration, braking, and interior and exterior climate impact fuel economy;
  - How routes impact fuel economy (e.g., topography, exterior climate, urban, rural, highway and suburban travel, etc.);
  - How operators' acceleration and braking practices compare to their peers;
  - How operators' fuel economy varies by route;
  - What operator performance indicates about habits; and
  - What behavioral strategy is having the greatest impact on fuel economy.
- *Operator Training Module:* The Training Module will be developed by TAPTCO, a firm that specializes in instructional design and adult learning principles for the transit industry. Training materials will include, but not be limited to instructional videos on efficient driving, on-road training protocol, and assessment protocol. These materials will be deployed as an online learning module for E-Bus operators and will be made available free of charge to any transit agency in California.
  - *Operator Engagement Strategy:* The Operator Engagement Strategy details how to message the outcomes from the Analytical Methodology in order to maximize the intended benefits (improve fuel economy, rider satisfaction, and other operating practices) of the information flow to operators regarding their performance. The Operator Engagement Strategy will be largely informed by the program logic model, and at a minimum specify the following:
    - Audience (operators, supervisory personnel, public vs. private, etc.);
    - Content (the data, information and exact language that the operator receives);
    - Delivery format (digital dashboard, digital report, printed report, etc.);
    - Delivery channel (included with paycheck, email message, text message, stand-alone printed document, etc.); and
    - Frequency (real-time in route, daily, weekly, monthly, quarterly, etc.).
- *Define Evaluation Methodology.* To assess effectiveness of a program, it is important to plan the data collection and analysis before implementing a program. This requires identifying the data that will be collected and analyzed (Subtask 3.1 references key data needs and sources); identifying the expected outcomes of the proposed program such as achieving, on average, 2.0 kW/mile or better fuel efficiency; and documenting in advance the statistical analyses that will be used to ascertain the effectiveness of the program. This will include the following steps:
    - Review available data and findings on driver behavior to develop and/or refine key metrics for ascertaining the effectiveness of the program strategies. This includes an examination of the relationship(s) between driver behavior indicators (fuel efficiency/battery range, regenerative braking, and acceleration patterns) and conditions that may affect driver behavior (traffic, ridership, route topography, bus climate, and bus type). The objective is to characterize the driving behavior of each driver and in aggregate to identify and/or refine the measurement of program effectiveness. This investigation will also incorporate findings from field observations on existing driving practices noted in Subtask 3.2 referenced above.

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### **Scope of Work**

- Develop a plan to monitor the effectiveness of the selected behavioral modification strategies, drawing upon social science insights and methods to maximize the probability that the selected program strategies yield expected results. To the extent possible, selected program strategies will be mapped to specific outcomes and anticipated magnitude of the effect.
- Establish control and behavior modification intervention groups. This step will include random assignment of bus drivers into control and intervention groups. Note that drivers in the intervention group will be exposed to: (1) a program engagement or behavior modification strategy(s); and/or (2) E-Bus operator training on efficient driving. Anticipated assignments into control and intervention groups may include:
  - Basic operator training without behavioral intervention (Control Group);
  - Basic operator training with behavioral intervention;
  - Enhanced E-Bus operator training without behavioral intervention; or
  - Enhanced E-Bus operator training with behavioral intervention.
- Review effect size and sample size to assess whether the sample size(s) or the number of data points planned are adequate to detect the expected effect of the intervention(s) and/or training by performing a power analysis.<sup>5</sup> AVTA will operate approximately 40 E-Buses.
- Account for possibility of attrition or dropout rates. Drivers could potentially dropout during the intervention period due to unforeseen circumstances such as sickness, termination, etc. Attrition during the intervention period can reduce sample sizes and affect the ability to measure program effectiveness. If dropout rates are expected, an estimate of attrition rates will be included in the sampling plan and sample sizes will increase to account for attrition.
- Establish reference baselines. The evaluation establishes the program effects and effect sizes, which will primarily inform the understanding of program effectiveness. Some aspects of the methodology are persistent over time, while others are sensitive to changes in the operating context. Some aspects of the methodology may need to be adjusted to repeat the evaluation at a future point in time. Thus, a list of contextual factors most likely to impact future evaluations – such as population changes, changes in ridership patterns, or on-route conditions including congestion – will be created to enable sensitivity analysis to the methodology.

#### **Products:**

- E-Bus Operator Training and Feedback Program Design and Implementation Plan (Draft and Final)
- Analytical Methodology (Draft and Final)
- Operator Training Module (Draft and Final)
- Operator Engagement Strategy (Draft and Final)
- Evaluation Methodology (Draft and Final)

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<sup>5</sup> Researchers use power analysis to estimate the minimum sample size required to detect an effect of a given size from an intervention.

## **EXHIBIT A**

### **Scope of Work**

#### **Subtask 3.4 Implement Operator Efficiency Behavioral Program**

The goal of this task is to implement the Operator Training and Feedback Program Design developed in Task 3.3.

#### **The Recipient shall:**

- Introduce the program to AVTA operators and supervisory personnel, defining the goals (e.g., maximizing fuel economy and rider satisfaction), share the results from the initial base lining activities (e.g., habits observed, key drivers of fuel economy, etc.), and introduce the methodology that will be used during the Operator Efficiency Program (e.g., E-Bus operator training, timely information to encourage desired habits, etc.). The introduction will be integrated with an existing AVTA all-staff meeting to minimize disruption to AVTA operations and to maximize the audience.
- Administer training to AVTA operators. The training will be offered two to five times during the demonstration period. It will take place initially in-person, but will also be available as an online video module. Topics covered in the training will include, but not be limited to:
  - Key differences between E-Bus and ICE Bus operations;
  - How to maximize E-Bus fuel economy while safely operating the vehicle;
  - Key drivers of fuel economy and likely opportunities for improvement; and
  - Fuel economy metrics necessary to enable cost-effective E-Bus operations.
- Establish *Fuel Economy Goals for AVTA Operators*. Each operator will be asked to set personal goals for fuel economy. AVTA supervisory personnel will be asked to set goals for the entirety of their operators, as well as by route.
- Develop *Operator Engagement Report Templates*. The Report Templates will be designed so that the program database can automatically create and produce the reports showing analytics on key metrics and customized tips for how to improve performance for each operator. These specific recommendations for improved performance, aligned with the Operator Engagement Strategy defined in Task 3.3, will be similar to the residential energy reports that utilize comparative norming and other behavioral modification strategies to encourage residents to reduce their home energy consumption.
- Collect Vehicle Performance Data. Data specified in the Final Technical Specification (Task 3.1) will be collected (likely on a daily basis) from all E-Buses in AVTA's fleet and from AVTA's back office systems (likely on a weekly or biweekly basis). The data will be stored in the program database for analytics, reporting, and the ex post evaluation.
- Analyze data and produce *Behavioral Modification Media*. Per the Analytical Methodology defined in Task 3.3, behavioral modification media (print and digital reports, digital dashboard, etc.) will be produced and delivered in the form and frequency specified in the Operator Engagement Strategy (Task 3.3) to the treatment group(s) which will be defined in the Evaluation Methodology in Task 3.4.
- Provide as needed support to AVTA operators and supervisory personnel.

#### **Products:**

- Fuel Economy Goals for AVTA Operators
- Operator Engagement Report Templates (Draft and Final)
- Behavioral Modification Media

## **EXHIBIT A**

### **Scope of Work**

#### **Subtask 3.5 Evaluate Operator Efficiency Behavioral Program**

The goals of the evaluation are to: 1) identify the most effective behavioral modification strategies among those tested; 2) measure the effectiveness of the enhanced E-Bus Operator Training Program; and 3) quantify the cost-effectiveness of administering a behavioral modification intervention and driver efficiency training. While the evaluation of this program will include the initial costs to design and run the program, the larger focus will be to assess cost-effectiveness of adopting and administering a behavioral modification program and enhanced E-Bus training. This subtask will assess and convey the economic rationale for administering behavior modification intervention(s), E-Bus operator training, and operator performance tracking to AVTA and other transit authorities.

#### **The Recipient shall:**

- Collect and review feedback from drivers on program elements: behavior modification intervention(s) and E-Bus operator training. Feedback from EV drivers and reviews of program implementation documentation will identify any potential threats to validity from program implementation. If threats are identified to validity techniques will be employed to minimize or control for the effect of validity concerns.
- Prepare data for analysis and analyze the effectiveness of the program. The objective is to quantify differences between control and intervention groups (referenced above) with regard to fuel efficiency and other key metrics or indicators of program performance. In some cases, data cleaning may be necessary to nullify attrition (if drivers dropped out of the study) and other factors compromising validity.
- Analyze program data. After data is cleaned, an analysis will be conducted to quantify program effectiveness and answer the key research questions for this program. At a minimum, the following indicators of program effectiveness will be analyzed:
  - Fuel economy (kW/mile, battery range, regenerative braking and acceleration patterns, and bus climate);
  - Energy cost savings;
  - Lifetime maintenance savings (no oil changes, longer brake pad life, etc.); and
  - Operator satisfaction<sup>6</sup> with E-bus assignments.
- Identify the costs of the program, including:
  - Administrative costs,
  - Deploying the data collection system,
  - Paying operators to attend training,
  - Paying trainers to ride along for onboard training, and
  - Running automated reports that list behavior modification tactics and providing them to operators.

Determine the cost-effectiveness of the driver efficiency program. This analysis will

- Provide a quantitative metric of the effects the pilot interventions have on driver efficiency. Once all quantitative estimates of the metrics in the evaluation have been specified, the cost-effectiveness formula will be applied to measure the unit cost of each aspect of the intervention, and the unit savings (benefit) of the intervention. The unit costs and benefits will be summed to the total per unit cost and total unit benefit, producing a program-specific cost-effectiveness measure.

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<sup>6</sup> When asking for driver feedback about the program, we will ask about satisfaction.

## **EXHIBIT A**

### **Scope of Work**

- Determine the cost-effectiveness of a commercial-scale program. The one-time pilot costs will be removed from the evaluation to assess the cost-effectiveness of a commercial-scale program. The cost-effectiveness estimate will determine the potential savings commensurate with implementation of the commercial-scale program.
- Develop *E-Bus Efficient Operations Challenges and Opportunities Report*. This will be a guidance document targeted to transit authorities and fleet operators outlining (1) the behavioral and environmental factors contributing to E-Bus fuel economy, (2) the program logic model and implementation methodology, (3) results of the operator efficiency behavioral program, and (4) recommendations for how to educate operators on efficient operating practices, how to monitor operational practices and fuel economy, and program designs and messaging strategies that engage and encourage operators to maximize fuel economy.
- Provide a CPR Report #2 and participate in CPR meeting per subtask 1.3.

#### **Products:**

- E-Bus Efficient Operations Challenges and Opportunities Report (Draft and Final)
- CPR Report #2

#### **TASK 4: EVALUATION OF PROJECT BENEFITS**

The goal of this task is to report the benefits resulting from this project. Both Task 2 and Task 3 have third-party M&V incorporated to ensure robust instrumentation, data collection and management practices are upheld. Thus, Task 4 is a matter of compiling the results from the M&V tasks in Task 2 and Task 3 into the model developed for these initial calculations.

#### **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 can be provided in the questionnaires include:
  - 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, identifying 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;

## **EXHIBIT A**

### **Scope of Work**

- A comparison of project expectations and performance, discussing whether the goals and objectives of the Agreement have been met and what improvements are needed, if any;
- The outcome of demonstrations and status of technology;
- The number of similar installations; and
- Jobs created/retained as a result of the Agreement.
- Respond to CAM questions regarding responses to the questionnaires.
- *Electric Vehicle Pilot Survey Response*: Create a project survey entry responding to the California Public Utilities Commission's "Electric Vehicle Pilot Survey" related to Proceeding R.13-11-007, "Alternative Fueled Vehicles Rulemaking" (2013).

#### **Products:**

- Electric Vehicle Pilot Survey Response
- Kick-off Meeting Benefits Questionnaire
- Mid-term Benefits Questionnaire
- Final Meeting Benefits Questionnaire

#### **TASK 5: 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 (using 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 will include the Legal Notice required in the terms and conditions and indicate where and when the documents were disseminated.)
  - A discussion of policy development stating if the 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; and
  - 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(s) on the project.
- When directed by the CAM, participate in annual EPIC symposium(s) sponsored by the California Energy Commission.

## **EXHIBIT A**

### **Scope of Work**

- Provide at least 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.
- 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)
- High Quality Digital Photographs
- Technology/Knowledge Transfer Plan (draft and final)
- Technology/Knowledge Transfer Report (draft and final)

#### **V. Project schedule**

Please see the attached Excel spreadsheet.

STATE OF CALIFORNIA

STATE ENERGY RESOURCES  
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION - RE: ZERO NET ENERGY ALLIANCE

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

**RESOLVED**, that the Energy Commission approves Agreement EPC-16-065 from GFO-16-303 with Zero Net Energy Alliance for a \$3,327,953 grant to demonstrate E-bus-to-grid, quantify the costs and benefits, develop use cases, and document best practices for an E-bus fleet; and

**FURTHER BE IT RESOLVED**, that the Executive Director or his/her designee shall execute the same on behalf of the Energy Commission.

**CERTIFICATION**

The undersigned Secretariat to the Commission 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 California Energy Commission held on May 10, 2017.

AYE: [List of Commissioners]

NAY: [List of Commissioners]

ABSENT: [List of Commissioners]

ABSTAIN: [List of Commissioners]

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Cody Goldthrite,  
Secretariat