California Energy Commission
September 10, 2025 Business Meeting
Backup Materials for The Regents of the University of California on behalf of the Riverside Campus

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

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

[PROPOSED]

RESOLUTION NO: 25-0910-XX

STATE OF CALIFORNIA

STATE ENERGY RESOURCES
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION: The Regents of the University of California on behalf of the Riverside Campus

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

RESOLVED, that the CEC approves agreement EPC-25-021 with The Regents of the University of California on behalf of the Riverside Campus for a $1,500,000 grant. The purpose of this project is to develop and demonstrate innovative strategies at an existing facility in a disadvantaged community in Ontario and technologies to reduce the net cost for medium-duty electric trucks to participate in vehicle-to-everything (V2X) by minimizing battery degradation and by maximizing benefits from offering V2X services; and

FURTHER BE IT RESOLVED, that the Executive Director or their designee shall execute the same on behalf of the CEC.

CERTIFICATION

The undersigned Secretariat to the CEC does hereby certify that the foregoing is a full, true, and correct copy of a resolution duly and regularly adopted at a meeting of the CEC held on September 10, 2025.

AYE:
NAY:
ABSENT:
ABSTAIN:

Dated:

_____
Kim Todd
Secretariat

STATE OF CALIFORNIA
CALIFORNIA ENERGY COMMISSION

CEC-270 (Revised 01/2024)

GRANT REQUEST FORM (GRF)

A. New Agreement Number

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

New Agreement Number: EPC-25-021

B. Division Information

1. Division Name: ERDD
2. Agreement Manager: Ran Laviv
3. MS-:51
4. Phone Number: 916-258-2951

C. Recipient's Information

1. Recipient's Legal Name: The Regents of the University of California on behalf of the Riverside campus
2. Federal ID Number: 95-6006142

D. Title of Project

Title of project: V2X Cost Reduction in Electric Trucks

E. Term and Amount

1. Start Date: 9/15/2025
2. End Date: 3/28/2028
3. Amount: $1,500,000.00

F. Business Meeting Information

1. Are the ARFVTP agreements $75K and under delegated to Executive Director? No
2. The Proposed Business Meeting Date: 9/10/2025 .
3. Consent or Discussion? Discussion
4. Business Meeting Presenter Name: Antonio Gomez
5. Time Needed for Business Meeting: 5 minutes.
6. The email subscription topic is: Electric Program Investment Charge (EPIC)

Agenda Item Subject and Description:

The Regents of the University of California on behalf of the Riverside campus. Proposed resolution approving agreement EPC-25-021 with The Regents of the University of California on behalf of the Riverside campus for a $1,500,000 grant and adopting staff's recommendation that this action is exempt from CEQA. The purpose of this project is to develop and demonstrate innovative strategies at an existing facility in a disadvantaged community in Ontario and technologies to reduce the net cost for medium-duty electric trucks to participate in vehicle-to-everything (V2X) by minimizing battery degradation and by maximizing benefits from offering V2X services. (EPIC funding) Contact: Antonio Gomez

G. California Environmental Quality Act (CEQA) Compliance

Is Agreement considered a "Project" under CEQA?

Yes

If yes, skip to question 2.

If no, complete the following (PRC 21065 and 14 CCR 15378) and explain why Agreement is not considered a "Project":

Agreement will not cause direct physical change in the environment or a reasonably foreseeable indirect physical change in the environment because:

If Agreement is considered a "Project" under CEQA answer the following questions.

a) Agreement **IS** exempt?

Yes

Statutory Exemption?
No
PRC section number:
CCR section number: None

Categorical Exemption?
Yes

Cal. Code Regs., tit 14, sec. 15301 provides that projects which consist of the operation, repair, maintenance, permitting, leasing, licensing, or minor alteration of existing public or private structures, facilities, mechanical equipment, or topographical features, and which involve negligible or no expansion of existing or former use at the time of the lead agency's determination, are categorically exempt from the provisions of California Environmental Quality Act (CEQA). The proposed project consists of research, testing, and data collection at an existing facility in Ontario using temporary electrical connections with no construction or significant site alteration. It will not result in a serious or major disturbance to an environmental resource. The demonstration will occur on a temporary basis and will involve no excavation, structural alteration, or emissions of pollutants. This project has no potential to result in an adverse environmental impact. The demonstration site is already developed; the temporary connection of a mobile bidirectional Electric Vehicle Supply Equipment (EVSE) and testing of electric trucks will not create any new environmental hazard or degradation. This project will result in negligible or no expansion of use beyond that already existing. Therefore, the project falls within section 15301 and will not have a significant effect on the environment.

Cal. Code Reg., tit 14 sec. 15306 provides that projects which consist of basic data collection, research, experimental management, and resource evaluation activities which do not result in a serious or major disturbance to an environmental resource. This project will result in the creation of a software solution, implementing the software solution, and analyzing resulting data to model the effect of submetering of electric vehicles charging stations. There will not be a disturbance to an environmental resource. Therefore, the project is exempt under Cal. Code Regs., tit 14, sec. 15306.

The project does not involve impacts on any particularly sensitive environment; will not impact an environmental resource of hazardous or critical concern where designated, precisely mapped, and officially adopted pursuant to law by federal, state, or local agencies; does not involve any cumulative impacts of successive projects of the same type in the same place that might be considered significant;

does not involve unusual circumstances that might have a significant effect on the environment; will not result in damage to scenic resources within a highway officially designated as a state scenic highway; the project site is not included on any list compiled pursuant to Government Code section 65962.5; and the project will not cause a substantial adverse change in the significance of a historical resource. Therefore, none of the exceptions to categorical exemptions listed in CEQA Guidelines section 15300.2 apply to this project, and this project will not have a significant effect on the environment.

Common Sense Exemption?

No

b) Agreement **IS NOT** exempt.
IMPORTANT: consult with the legal office to determine next steps.

No

If yes, answer yes or no to all that applies. If no, list all as “no” and “None” as “yes”.

Additional Documents	Applies
Initial Study	No
Negative Declaration	No
Mitigated Negative Declaration	No
Environmental Impact Report	No
Statement of Overriding Considerations	No
None	Yes

H. Is this project considered “Infrastructure”?

No

I. Subcontractors

List all Subcontractors listed in the Budget (s) (major and minor). Insert additional rows if needed. If no subcontractors to report, enter “No subcontractors to report” and “0” to funds. **Delete** any unused rows from the table.

Subcontractor Legal Company Name	CEC Funds	Match Funds
Evolectric Incorporated	$ 250,176	$234,880
Tellus Power Green	$ 60,000	$60,425
SBR Express Inc.	$ 0	$342,960

J. Vendors and Sellers for Equipment and Materials/Miscellaneous

List all Vendors and Sellers listed in Budget(s) for Equipment and Materials/Miscellaneous. Insert additional rows if needed. If no vendors or sellers to report, enter “No vendors or sellers to report” and “0” to funds. **Delete** any unused rows from the table.

Vendor/Seller Legal Company Name	CEC Funds	Match Funds
No vendors to report	**$**	**$**

K. Key Partners

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

Key Partner Legal Company Name
No key partners to report

L. Budget Information

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

Funding Source	Funding Year of Appropriation	Budget List Number	Amount
EPIC	24-25	301.001L	$ 1,500,000

TOTAL Amount: $ 1,500,000

R&D Program Area: ESB: Transportation

Explanation for “Other” selection Not applicable

Reimbursement Contract #: Not applicable

Federal Agreement #: Not applicable

M. Recipient’s Contact Information

Recipient’s Administrator/Officer

Name: Tim Wolfe

Address: University Of California, Riverside

City, State, Zip: Riverside, CA 92521-0001

Phone: 951-827-5547

E-Mail: twolfe@ucr.edu

Recipient’s Project Manager

Name: Hamed Mohsenian-Rad

Address: 343 Winston Chung Hall University of California

City, State, Zip: Riverside, CA 92521-0001

Phone: 951-827-2387

E-Mail: hamed@ee.ucr.edu

N. Selection Process Used

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

Selection Process	Additional Information
Competitive Solicitation #	GFO-24-302
First Come First Served Solicitation #	Not applicable
Other	Not applicable

O. Attached Items

1. List all items that should be attached to this GRF by entering “Yes” or “No”.

Item Number	Item Name	Attached
1	Exhibit A, Scope of Work/Schedule	Yes
2	Exhibit B, Budget Detail	Yes
3	CEC 105, Questionnaire for Identifying Conflicts	Yes
4	Recipient Resolution	No
5	Awardee CEQA Documentation	No

Approved By

Individuals who approve this form must enter their full name and approval date in the MS Word version.

Agreement Manager: Ran Laviv

Approval Date: 7/31/2025

Branch Manager: Reynaldo Gonzalez

Approval Date: 7/31/2025

Director: Jonah Steinbuck delated to Branch Manager

Approval Date: 7/31/2025

Exhibit A
Scope of Work
The Regents of the University of California, on behalf of the Riverside campus

I. TASK ACRONYM/TERM LISTS

A. Task List

Task #	CPR[1]	Task Name
1		General Project Tasks
2	X	Developing V2X Cost Reduction Technologies for Electric Trucks through Battery Lifetime Impact Assessment and Mitigation Strategies
3	X	Developing V2X Cost Reduction Technologies for Electric Trucks through Service-Specific Optimization with EV and EVSE Resource Constraints
4	X	V2X Demonstration and Real-World Validation at a DAC Demonstration Site
5		V2X Training for Broader Community Engagement and Technology Adoption
6		V2X Cost Reduction Assessment and Market Pathway Analysis
7		Evaluation of Project Benefits
8		Technology/Knowledge Transfer Activities

B. Acronym/Term List

Acronym/Term	Meaning
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CEC	California Energy Commission
CPR	Critical Project Review
DAC	Disadvantaged Community
DOD	Depth of Discharge
EV	Electric Vehicle
EVSE	Electric Vehicle Supply Equipment
LD	Light Duty
MD	Medium Duty
MORBUG	Mobile Renewable Backup Generation
O&M	Operations and Maintenance
SCE	Southern California Edison
SOC	State-of-Charge
SOH	State-of-Health
TAC	Technical Advisory Committee
V2B	Vehicle-to-Building
V2G	Vehicle-to-Grid
V2V	Vehicle-to-Vehicle
V2X	Vehicle-to-Everything

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

Exhibit A
Scope of Work
The Regents of the University of California, on behalf of the Riverside campus

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

A. Purpose of Agreement

The purpose of this Agreement is to fund the development, deployment, and demonstration of innovative strategies and technologies aimed at reducing the net cost of vehicle-to-everything (V2X) participation for medium-duty electric trucks by minimizing battery degradation from V2X participation and maximizing benefits from offering V2X services, including for the distribution grid.

B. Problem/ Solution Statement

Problem

Despite the many advantages of using electric trucks for V2X services (their large battery capacity, their predictable routes and schedules, and their role as business assets to generate revenues from various V2X applications), V2X services have not yet been adopted at scale for electric trucks due to several challenges, including (1) a lack of understanding of their impact on battery degradation, leading to concerns about the potential effects of V2X participation on total cost of ownership and (2) cost concerns due to the uncertainty surrounding the economic viability of V2X participation across different V2X services and its ability to offset costs. These challenges create barriers to cost-effectively achieving California's statutory energy goals, not only for sustainable transportation but also for reliable, resilient, and equitable energy systems.

Solution

The project will develop and test novel technologies and strategies to overcome both barriers in various V2X scenarios for electric trucks, including V2B, V2G, and V2V applications. This will be achieved through two categories of cutting-edge optimization strategies:

(1) Strategies that minimize battery degradation costs of V2X participation in electric trucks, via adaptive battery-aware V2X rate and schedule optimization, V2X-aware battery pre-conditioning and thermal management, and V2X-aware battery diagnostics and prognostics.

(2) Strategies that maximize revenue and benefits from various V2X services offered by electric trucks through service-specific V2G, V2B, and V2V optimization with EV and EVSE awareness, thereby offsetting the costs of electrification and V2X adoption.

The project will leverage the Recipient's expertise and advanced testing capabilities, along with the innovative, flexible V2X platforms of an EV and EVSE OEM. It also includes a real-world demonstration at a site in a disadvantaged community. The project also includes DAC outreach and V2X training for truck drivers and mechanics at the demonstration site, further encouraging technology adoption and supporting the broader integration of V2X solutions in the trucking industry and the broader transportation sector.

C. Goals and Objectives of the Agreement

Agreement Goals

The goals of this Agreement are to:

- Develop and validate innovative strategies aimed at reducing the net cost of V2X participation for medium-duty electric trucks by minimizing battery degradation from V2X participation and maximizing benefits from offering V2X services.
- Demonstrate and assess the technologies at a real-world demonstration site in a disadvantaged community, with baseline data collection and performance evaluation.
- Conduct V2X training and outreach for truck drivers and mechanics at the demonstration site to support the broader transition toward integrating V2X solutions in trucking industry.
- Conduct a comprehensive assessment of the V2X strategies cost reduction potential, along with a market pathway analysis for scalable and equitable V2X adoption.

Ratepayer Benefits:[2] This Agreement will result in the ratepayer benefit of greater electricity reliability, lower costs, and increased safety, as well as several other major benefits:

- ***Reliability and Resiliency***: By addressing cost barriers to V2X for electric trucks, this project will enable these vehicles to enhance the reliability and resilience of host facility or electric grid. This includes providing backup power to buildings during outages and supporting distribution circuits during overloading conditions or power quality issues, particularly at the end of long distribution circuits. Notably, the demonstration site is strategically located to offer voltage support through V2G at the end of a circuit.
- ***Lower Costs and Affordability***: By reducing the overall cost of EV ownership and V2X services, particularly for medium-duty truck owners and fleet operators, the project will help make electrification and V2X more accessible. Electrifying transportation and enabling medium-duty EVs to support the grid through V2X participation can contribute to downward pressure on rates.
- ***Safety***: This project's extensive tests and assessments will provide opportunities to evaluate the potential impact of V2X services on battery safety, such as thermal runaway. Additionally, the mitigation strategies will offer valuable insights into safety improvements.

[2] California Public Resources Code, Section 25711.5(a) requires projects funded by the Electric Program Investment Charge (EPIC) to result in ratepayer benefits. The California Public Utilities Commission, which established the EPIC in 2011, defines ratepayer benefits as greater reliability, lower costs, and increased safety (See CPUC "Phase 2" Decision 12-05-037 at page 19, May 24, 2012, http://docs.cpuc.ca.gov/PublishedDocs/WORD_PDF/FINAL_DECISION/167664.PDF).

- ***Equity***: Many owners and operators of trucks are self-employed individuals or workers in industries such as logistics and delivery. They face tight profit margins and financial constraints, making them vulnerable to high costs of adopting new technologies. Reducing the cost of truck electrification can alleviate financial pressures. This project also directly benefits the disadvantaged communities at the demonstration site, who will benefit from the air quality improvements due to the transition to truck electrification and from the improved reliability of the distribution circuit at the demonstration site.

Technological Advancement and Breakthroughs:[3] This Agreement will drive strategies and technological advancements and breakthroughs to overcome barriers to California's statutory energy goals by developing, laboratory-testing, and demonstrating innovative V2X cost reduction technologies for electric trucks. These strategies will reduce the net cost of V2X participation for electric truck owners and fleet operators by minimizing battery degradation and maximizing benefits from V2X services.

The equity-focused real-world demonstration of these technologies at a site in a disadvantaged community, along with the project's DAC outreach and V2X training for truck drivers and mechanics, will advance California's energy equity objectives. By validating the V2X cost reduction technologies in a real-world setting, this project will generate data to support commercialization and expand V2X adoption in trucking. Despite their advantages (large battery capacity, predictable routes, and revenue potential) electric trucks remain underutilized for V2X services. This project will bridge that gap.

Agreement Objectives
The objectives of this Agreement are to:

- Develop and validate three innovative strategies that significantly (up to 50%) reduce the battery degradation cost from V2X participation in electric trucks, through a combination of adaptive battery-aware V2X rate and schedule optimization, V2X-aware battery pre-conditioning and thermal management, and real-time battery pack diagnostics and prognostics, thereby reducing V2X participation costs for electric trucks.
- Develop and validate three additional innovative strategies to reduce the net cost of V2X participation for electric trucks by increasing revenue and financial benefits (up to 50%) from V2X services through service-specific V2B, V2G, or V2V optimizations with EV and EVSE awareness, thereby offsetting electrification and V2X adoption costs.
- Demonstrate the V2X technologies and their cost reduction capabilities at a real-world demonstration site in a disadvantaged community, supporting baseline analysis, field testing, data gathering, and performance evaluation, as well as showcasing a new modular 120 kW discharge rate and dynamic charge capabilities for electric trucks with various V2X service capabilities, targeting a 95% round-trip efficiency at the DC level and approximately 90% AC-to-AC efficiency, and ≥20% peak demand reduction in a building's load.

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

- Collect and analyze operational data, during both laboratory testing (Tasks 2 and 3) and real-world demonstration (Task 4), to confirm the performance, replicability, scalability, and cost-effectiveness of the V2X cost reduction technologies.
- Conduct a comprehensive assessment of the V2X technologies' cost reduction potential, along with a market pathway analysis for scalable and equitable V2X adoption.

III. TASK 1 GENERAL PROJECT TASKS

PRODUCTS

Subtask 1.1 Products

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

The Recipient shall:

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

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

For products that require a final version only

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

Exhibit A
Scope of Work
The Regents of the University of California, on behalf of the Riverside campus

For all products

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

- Instructions for Submitting Electronic Files and Developing Software:

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

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

  - **Software Application Development**
    Use the following standard Application Architecture components in compatible versions for any software application development required by this Agreement (e.g., databases, models, modeling tools), unless the CAM approves other software applications such as open source programs:
    - Microsoft ASP.NET framework (version 3.5 and up). Recommend 4.0.
    - Microsoft Internet Information Services (IIS), (version 6 and up) Recommend 7.5.
    - Visual Studio.NET (version 2008 and up). Recommend 2010.
    - C# Programming Language with Presentation (UI), Business Object and Data Layers.
    - SQL (Structured Query Language).
    - Microsoft SQL Server 2008, Stored Procedures. Recommend 2008 R2.
    - Microsoft SQL Reporting Services. Recommend 2008 R2.
    - XML (external interfaces).

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

MEETINGS

Subtask 1.2 Kick-off Meeting

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

The Recipient shall:

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

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

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

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

The CAM shall:

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

Recipient Products:

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

CAM Product:

- Kick-off Meeting Agenda

Subtask 1.3 Critical Project Review (CPR) Meetings

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

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

The Recipient shall:

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

The CAM shall:

- Determine the location, date, and time of each CPR meeting with the Recipient's input.
- Send the Recipient a *CPR Agenda* with a list of expected CPR participants in advance of the CPR meeting. If applicable, the agenda may include a discussion of match funding and permits.
- Conduct and make a record of each CPR meeting. Provide the Recipient with a schedule for providing a Progress Determination on continuation of the project.
- Determine whether to continue the project, and if so whether modifications are needed to the tasks, schedule, products, or budget for the remainder of the Agreement. A determination of unsatisfactory progress This may result in project delays, including a potential Stop Work Order, while the CEC determines whether the project should continue.
- Provide the Recipient with a *Progress Determination* on continuation of the project, in accordance with the schedule. The Progress Determination may include a requirement that the Recipient revise one or more products.

Recipient Products:

- CPR Report(s)

CAM Products:

- CPR Agenda(s)
- Progress Determination

Subtask 1.4 Final Meeting

The goal of this subtask is to complete the closeout of this Agreement.

The Recipient shall:

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

  The technical and administrative aspects of Agreement closeout will be discussed at the meeting, which may be divided into two separate meetings at the CAM's discretion.
  - The technical portion of the meeting will involve the presentation of findings, conclusions, and recommended next steps (if any) for the Agreement. The CAM will determine the appropriate meeting participants.
  - The administrative portion of the meeting will involve a discussion with the CAM of the following Agreement closeout items:
    - Disposition of any procured equipment.
    - The CEC's request for specific "generated" data (not already provided in Agreement products).
    - Need to document the Recipient's disclosure of "subject inventions" developed under the Agreement.
    - "Surviving" Agreement provisions such as repayment provisions and confidential products.
    - Final invoicing and release of retention.

- Prepare a *Final Meeting Agreement Summary* that documents any agreement made between the Recipient and Commission staff during the meeting.
- Prepare a *Schedule for Completing Agreement Closeout Activities*.
- Provide copies of *All Final Products* organized by the tasks in the Agreement.

Products:

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

MONTHLY CALLS, REPORTS AND INVOICES

Subtask 1.5 Monthly Calls

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

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

The CAM shall:

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

The Recipient shall:

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

Product:

- Email to CAM concurring with call summary notes.

Subtask 1.6 Quarterly Progress Reports and Invoices

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

The Recipient shall:

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

Recipient Products:

- Quarterly Progress Reports
- Invoices

CAM Product:

- Invoice template

Subtask 1.7 Final Report

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

Subtask 1.7.1 Final Report Outline

The Recipient shall:

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

Recipient Products:

- Final Report Outline (draft and final)

CAM Products:

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

Subtask 1.7.2 Final Report

The Recipient shall:

- Prepare a *Final Report* for this Agreement in accordance with the approved Final Report Outline, Energy Commission Style Manual, and Final Report Template provided by the CAM with the following considerations:
  - Ensure that the report includes the following items, in the following order:
    - Cover page (**required**)
    - Credits page on the reverse side of cover with legal disclaimer (**required**)
    - Acknowledgements page (optional)
    - Preface (**required**)
    - Abstract, keywords, and citation page (**required**)
    - Table of Contents (**required**, followed by List of Figures and List of Tables, if needed)
    - Executive summary (**required**)
    - Body of the report (**required**)
    - References (if applicable)
    - Glossary/Acronyms (If more than 10 acronyms or abbreviations are used, it is required.)
    - Bibliography (if applicable)
    - Appendices (if applicable) (Create a separate volume if very large.)
    - Attachments (if applicable)
- Submit a draft of the Executive Summary to the TAC for review and comment.
- Develop and submit a *Summary of TAC Comments on Draft Final Report* received on the Executive Summary. For each comment received, the Recipient will identify in the summary the following:
  - Comments the Recipient proposes to incorporate.
  - Comments the Recipient does propose to incorporate and an explanation for why.
- Submit a draft of the report to the CAM for review and comment. The CAM will provide written comments to the Recipient on the draft product within 15 days of receipt.
- Incorporate all CAM comments into the *Final Report*. If the Recipient disagrees with any comment, provide a *Written Responses to Comments* explaining why the comments were not incorporated into the final product.
- Submit the revised *Final Report* electronically with any Written Responses to Comments within 10 days of receipt of CAM's Written Comments on the Draft Final Report, unless the CAM specifies a longer time period or approves a request for additional time.

Products:

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

CAM Product:

- Written Comments on the Draft Final Report

MATCH FUNDS, PERMITS, AND SUBAWARDS

Subtask 1.8 Match Funds

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

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

The Recipient shall:

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

  If match funds were a part of the application that led to the CEC awarding this Agreement, then provide in the letter a list of the match funds that identifies:
  - The amount of cash match funds, their source(s) (including a contact name, address, and telephone number), and the task(s) to which the match funds will be applied.
  - The amount of each in-kind contribution, a description of the contribution type (e.g., property, services), the documented market or book value, the source (including a contact name, address, and telephone number), and the task(s) to which the match funds will be applied. If the in-kind contribution is equipment or other tangible or real property, the Recipient must identify its owner and provide a contact name, address, telephone number, and the address where the property is located.
  - If different from the solicitation application, provide a letter of commitment from an authorized representative of each source of match funding that the funds or contributions have been secured.
- At the Kick-off meeting, discuss match funds and the impact on the project if they are significantly reduced or not obtained as committed. If applicable, match funds will be included as a line item in the progress reports and will be a topic at CPR meetings.
- Provide a *Supplemental Match Funds Notification Letter* to the CAM of receipt of additional match funds.
- Provide a *Match Funds Reduction Notification Letter* to the CAM if existing match funds are reduced during the course of the Agreement. Reduction of match funds may trigger a CPR meeting.

Products:

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

Subtask 1.9 Permits

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

The Recipient shall:

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

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

Products:

- Permit Status Letter
- Updated List of Permits *(if applicable)*
- Updated Schedule for Acquiring Permits *(if applicable)*
- Copy of Each Approved Permit *(if applicable)*

Exhibit A
Scope of Work
The Regents of the University of California, on behalf of the Riverside campus

Subtask 1.10 Obtain and Execute Subawards and Agreements with Site Hosts

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

The Recipient shall:

- Execute and manage subawards and coordinate subrecipients activities in accordance with the requirements of this Agreement.
- Execute and manage site host agreements, and ensure the right to use the project site throughout the term of the Agreement, as applicable. A site host agreement is not required if the Recipient is the site host.
- Notify the CEC in writing immediately, but no later than five calendar days, if there is a reasonable likelihood the project site cannot be acquired or can no longer be used for the project and as a result, tasks under this Agreement are unable to be carried out or the Agreement is at-risk of not achieving its goals and objectives.
- Incorporate this Agreement by reference into each subaward.
- Include any required Energy Commission flow-down provisions in each subaward, in addition to a statement that the terms of this Agreement will prevail if they conflict with the subaward terms.
- Submit a *Subaward and Site Letter* to the CAM describing the subawards and any site host agreement needed or stating that no subawards or site host agreements are required.
- If requested by the CAM, submit a draft of each *Subaward* and any *Site Host Agreement* required to conduct the work under this Agreement.
- If requested by the CAM, submit a final copy of each executed *Subaward* and any *Site Host Agreement*.
- Notify and receive written approval from the CAM prior to adding any new subrecipient (see the terms regarding of subrecipient additions in the terms and conditions).

Products:

- Subaward and Site Letter
- Draft Subawards (if requested by the CAM)
- Draft Site Host Agreement (if requested by the CAM)
- Final Subawards (if requested by the CAM)
- Final Site Host Agreement (if requested by the CAM)

TECHNICAL ADVISORY COMMITTEE

Subtask 1.11 Technical Advisory Committee (TAC)

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

- Provide guidance in project direction. The guidance may include scope and methodologies, timing, and coordination with other projects. The guidance may be based on:
    - Technical area expertise;
    - Knowledge of market applications; or
    - Linkages between the Agreement work and other past, present, or future projects (both public and private sectors) that TAC members are aware of in a particular area.
- Review products and provide recommendations for needed product adjustments, refinements, or enhancements.
- Evaluate the tangible benefits of the project to the state of California, and provide recommendations as needed to enhance the benefits.
- Provide recommendations regarding information dissemination, market pathways, or commercialization strategies relevant to the project products.
- Help set the project team's goals and contribute to the development and evaluation of its statement of proposed objectives as the project evolves.
- Provide a credible and objective sounding board on the wide range of technical and financial barriers and opportunities.
- Help identify key areas where the project has a competitive advantage, value proposition, or strength upon which to build.
- Advocate, to the extent the TAC members feel is appropriate, on behalf of the project in its effort to build partnerships, governmental support, and relationships with a national spectrum of influential leaders.
- Ask probing questions that ensure a long-term perspective on decision-making and progress toward the project's strategic goals.

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

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

The Recipient shall:

- Prepare a *List of Potential TAC Members* that includes the names, companies, physical and electronic addresses, and phone numbers of potential members. The list will be

discussed at the Kick-off meeting, and a schedule for recruiting members and holding the first TAC meeting will be developed.
- Recruit TAC members. Ensure that each individual understands member obligations and the TAC meeting schedule developed in subtask 1.12.
- Prepare a *List of TAC Members* once all TAC members have committed to serving on the TAC.
- Submit *Documentation of TAC Member Commitment* (such as Letters of Acceptance) from each TAC member.

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

Subtask 1.12 TAC Meetings
The goal of this subtask is for the TAC to provide strategic guidance for the project by participating in regular meetings, which may be held via teleconference.

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

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

Products:
- TAC Meeting Schedule (draft and final)

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

Subtask 1.13 Project Performance Metrics
The goal of this subtask is to finalize key performance targets for the project based on feedback from the TAC and report on final results in achieving those targets. The performance targets should be a combination of scientific, engineering, techno-economic, and/or programmatic metrics that provide the most significant indicator of the research or technology's potential success.

The Recipient shall:

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

Products:

- TAC Performance Metrics Summary
- Project Performance Metrics Results

IV. TECHNICAL TASKS

TASK 2: DEVELOPING V2X COST REDUCTION TECHNOLOGIES FOR ELECTRIC TRUCKS THROUGH BATTERY LIFETIME IMPACT ASSESSMENT AND MITIGATION STRATEGIES

The goals of this task are to **(1)** conduct a detailed assessment of the impact of V2X services on electric trucks by leveraging onboard EV telematics, combined with extensive battery pack data collection and data-driven impact analysis; and **(2)** develop and evaluate fundamental battery lifetime impact mitigation strategies to minimize battery degradation costs from V2X participation. It includes using historical real-world EV telematics data, and an electric truck in a laboratory-testing environment.

Subtask 2.1. Baseline Battery Lifetime Assessment of Electric Truck Batteries

The goal of this subtask is to analyze real-world electric truck telematics data, which includes pack current, pack voltage, pack temperature, state of charge (SOC), state of health (SOH), depth of discharge, and various fault indicator flags. This unique dataset will serve as the baseline for our subsequent *Baseline Battery Lifetime* Assessment and subsequent performance evaluation.

The Recipient shall:

- Prepare the *Initial Report on Baseline Battery Lifetime Assessment*, detailing the process and metrics of the baseline assessment based on analyzing real-world EV telematics data.
- Conduct baseline assessment by analyzing existing real-world electric truck telematics data.
- Identify the parameters of the baseline battery degradation and lifetime assessment model by examining the aforementioned EV telematics data, include pack current, pack voltage, pack temperature, SOC, SOH, and fault indicators, during various operating conditions.
- Prepare the *Final Report on Baseline Battery Lifetime Assessment*, summarizing the results from the analysis of the existing real-world electric truck telematics data during normal operation (i.e., in the absence of V2X), as well as the results on identifying the parameters of the baseline battery degradation and lifetime assessment mode.

Products:

- Initial Report on Baseline Battery Lifetime Assessment
- Final Report on Baseline Battery Lifetime Assessment

Subtask 2.2. Set Up Laboratory Testing for V2X Impact Mitigation Strategy Development

The goal of this subtask is to prepare the laboratory environment to support the project activities in Task 2. Lab testing will be supported by installing V2X EVSE on an existing mobile renewable backup generator (MORBUG) unit integrated to enable various V2X services and charge an electric truck. The V2X EVSE on the MORBUG trailer will connect to the facility's electrical infrastructure using industry-standard short-term 480V AC power connectors. Power monitoring and energy control will be set up to match facility requirements and truck operations and will provide a unified and reliable platform for both laboratory testing and a real-world demonstration.

The Recipient shall:

- Prepare and finalize the *Laboratory Test Plan for Battery Lifetime Impact Mitigation Development* detailing three battery lifetime impact mitigation strategies: 1) adaptive battery-aware V2X rate and schedule optimization, 2) V2X-aware battery pre-conditioning and thermal management, and 3) V2X-aware real-time battery pack diagnostics and prognostics.
- Setup the laboratory testing environment to utilize and customize UC Riverside's MORBUG for the research and development activities in this project, including access to onboard EV telematics for battery pack data collection and data-driven impact assessment, as well as bidirectional EVSE communications.
- Prepare the *Laboratory Test Environment Readiness Report,* detailing the setup of the EVSE, EV connection, and the arrangements for data collection and communications.
- Prepare a *CPR Report #1* in accordance with Subtask 1.3 (CPR Meetings)
- Participate in a CPR #1 meeting.

Products:

- Laboratory Test Plan for Battery Lifetime Impact Mitigation Development
- Laboratory Test Environment Readiness Report
- CPR Report #1

Subtask 2.3. Strategy 1: Adaptive Battery-Aware V2X Rate and Schedule Optimization

The goal of this subtask is to develop a V2X cost reduction strategy to mitigate the battery lifetime impact of V2X on electric trucks through adaptive battery-aware charge and discharge rates. The developed adaptive algorithms will dynamically adjust charging and discharging rates based on the aging and other physical characteristics of the battery pack. The model will determine the optimal profiles based on the pack's state of health and the V2X application requirements.

The Recipient shall:

- Develop adaptive algorithms that dynamically adjust V2X charging and discharging rates based on real-time SOH monitoring, battery age, temperature, and operation conditions.
- Conduct laboratory tests using the electric truck and the EVSE on the MORBUG platform to validate the adaptive V2X rate optimization strategies.
- Prepare the *Adaptive Battery-Aware V2X Optimization Methodology Report,* detailing the methodology and the algorithms for adaptive rate and schedule optimization.

Products:

- Adaptive Battery-Aware V2X Optimization Methodology Report

Subtask 2.4. Strategy 2: V2X-Aware Battery Pre-Conditioning and Thermal Management

The goal of this subtask is to develop a V2X cost reduction strategy that mitigates the battery lifetime impact on electric trucks through battery pre-conditioning and V2X-aware thermal management. This subtask will co-optimize dynamic rate control with active cooling on hot days and warm-up cycling on cold days, accounting for the battery's thermal status and weather conditions to minimize V2X-related battery degradation and extend battery life.

The Recipient shall:

- Develop thermal management algorithms to optimize battery pre-conditioning for V2X operations, including active cooling on hot days and warm-up cycles on cold days.
- Evaluate pre-conditioning strategies such as active cooling on hot days and warm-up cycles on cold days to improve energy efficiency.
- Conduct laboratory testing to validate the effectiveness of battery pre-conditioning in reducing thermal stress and degradation during V2X events.
- Prepare the *Battery Pre-Conditioning and Thermal Management Methodology Report*, detailing the methodology and the algorithms for V2X-aware thermal management.

Products:

- Battery Pre-Conditioning and Thermal Management Methodology Report

Subtask 2.5. Strategy 3: V2X-Aware Real-time Battery Pack Diagnostics and Prognostics

The goal of this subtask is to develop a V2X cost reduction strategy that mitigates the battery lifetime impact of V2X on electric trucks through real-time battery pack diagnostics and prognostics. The algorithms will utilize real-time and historical fault indicators from the onboard battery monitoring system to dynamically adjust V2X service parameters, such as limiting the frequency and depth of charging and discharging cycles. The algorithms will also detect early signs of cell degradation during V2X services, thermal anomalies, and abnormal impacts that cause SOC imbalances across battery modules to reduce strain on weaker cells, slow down degradation, and help battery longevity.

The Recipient shall:

- Develop real-time battery diagnostics algorithms using predictive analytics to detect early signs of cell degradation, SOC imbalances, and thermal anomalies, enabling optimized V2X participation while maintaining battery health requirements.
- Conduct laboratory validation tests to measure the effectiveness of diagnostics and prognostics algorithms in extending battery life and reducing degradation risks.
- Prepare the *V2X-Aware Battery Pack Diagnostics and Prognostics Methodology Report*, detailing the methods and algorithms for V2X-aware battery diagnostics and prognostics.
- Prepare the *Performance Assessment Report for Strategies 1, 2, and 3,* summarizing the results on impact of the three strategies on cost reduction and battery performance.

Products:

- V2X-Aware Battery Pack Diagnostics and Prognostics Methodology Report
- Performance Assessment Report for Strategies 1, 2, and 3

TASK 3: DEVELOPING V2X COST REDUCTION TECHNOLOGIES FOR ELECTRIC TRUCKS VIA SERVICE-SPECIFIC OPTIMIZATION WITH EV AND EVSE RESOURCE AWARENESS

The goals of this task are to: (1) Develop service-specific optimization strategies for V2X technologies that consider the unique operational requirements of various V2X services while maintaining awareness of EV and EVSE constraints. The algorithms developed in Task 2 will be integrated to ensure that optimization strategies effectively balance performance, longevity, and cost-effectiveness. (2) Refine control and optimization methodologies for EV and EVSE operation to tailor V2X services, including V2B, V2G, and V2V. Each V2X service has distinct technical and economic requirements, such as power flow constraints, response time, and coordination with the

grid or other connected systems. The testing and assessment activities in this task will be conducted through simulations and using an electric truck in a laboratory-testing environment.

Subtask 3.1. Strategy 4: V2G Service-Specific Optimization with EV and EVSE Awareness

The goal of this subtask is to develop a V2X net cost reduction strategy by maximizing revenue and benefits from V2X services through service-specific V2G optimization, while maintaining awareness of EV and EVSE resource constraints and impact mitigation considerations. The optimization will include strategies for electric trucks to participate in select grid services such as voltage support, frequency regulation, peak shaving, and demand response, aligning with the spatial and temporal needs of the power grid. Additionally, it will minimize EV battery wear and movement constraints.

The Recipient shall:

- Develop V2G optimization algorithms that maximize economic benefits while minimizing EV battery degradation, integrating dynamic dispatch for grid services such as frequency regulation, peak shaving, voltage support, and demand response.
- Integrate EV and EVSE real-time monitoring to optimize charging/discharging cycles based on grid conditions and V2G services pricing signals.
- Conduct laboratory testing and simulations to evaluate V2G optimization strategies.
- Prepare the *V2G Service-Specific Optimization Methodology Report*, detailing the methodology and the algorithms for optimizing the electric trucks' participation in grid services such as voltage support, frequency regulation, peak shaving, and demand response, aligning with the spatial and temporal needs of the power grid.

Products:

- V2G Service-Specific Optimization Methodology Report

Subtask 3.2. Strategy 5: V2B Service-Specific Optimization with EV and EVSE Awareness

The goal of this subtask is to develop a V2X net cost reduction strategy by maximizing revenue and benefits from V2X services through service-specific V2B optimization. The strategy will optimize power dispatch strategies for buildings by leveraging electric trucks as backup power sources or for energy cost savings through peak load management. Additionally, the optimization will enhance resilience support, such as providing power during outages for critical building loads, and adapt to dynamic energy pricing for improved cost efficiency.

The Recipient shall:

- Develop V2B-specific power dispatch optimization algorithms to optimize electric trucks for backup power, peak load management, and resilience support for critical building loads.
- Enhance resilience support mechanisms for critical building loads by integrating intelligent V2B controls for power outage scenarios.
- Conduct laboratory testing and simulations to validate V2B service-specific optimizations and evaluate economic and reliability benefits.
- Prepare the V2B Service-Specific Optimization Methodology Report, detailing the methodology and the algorithms for optimizing the electric trucks' participation in building load management and reliability and resiliency enhancement.

Products:

- V2B Service-Specific Optimization Methodology Report

Subtask 3.3. Strategy 6: V2V Service-Specific Optimization with EV and EVSE Awareness

The goal of this subtask is to develop a V2X net cost reduction strategy by maximizing revenue and benefits from V2X services through service-specific V2V optimization. The strategy will optimize energy transfer mechanisms to enable direct power sharing from an electric truck to other electric vehicles, such as personnel LD EVs (passenger cars), with a focus on emergency charging and operational resilience scenarios.

The Recipient shall:

- Develop V2V-specific optimization strategies for direct energy transfer, including dynamic power-sharing for emergency charging and operational resilience.
- Conduct laboratory testing and simulations to validate V2V optimization models and assess the economic and technical viability of vehicle-to-vehicle energy sharing.
- Prepare the *V2V Service-Specific Optimization Methodology Report*, detailing the methodology and the algorithms for optimizing the electric truck's participation in vehicle charging with a focus on emergency charging and operational resilience scenarios.

Products:

- V2V Service-Specific Optimization Methodology Report

Subtask 3.4. Multi-Service Co-Optimization and V2X Revenue and Benefits Maximization

The goal of this subtask is to investigate the potential for additional V2X net cost reduction opportunities through developing strategies for multi-service operation that allow electric trucks to dynamically allocate resources across multiple V2X services based on real-time conditions, such as simultaneously balancing grid needs, building load demands, and supplying LD EV charging.

The Recipient shall:

- Co-optimize Strategies 4, 5, and 6 to develop algorithms that simultaneously balance grid needs, building load demands, and supplying LD EV charging.
- Conduct laboratory testing and simulations to validate multi-service V2X optimization models and assess the economic and technical viability of such simultaneous services
- Prepare the *Multi-Service V2X Co-Optimization Methodology Report*, detailing the methodology and the algorithms for simultaneous offering of different V2X services.
- Prepare the *Performance Assessment Report for Strategies 1, 2, 3, and their Co-Optimization*, summarizing the results on the potential for additional V2X net cost reduction through developing strategies for multi-service operation that allow electric trucks to dynamically allocate resources across multiple V2X services based on real-time conditions.
- Prepare a *CPR Report #2* in accordance with subtask 1.3 (CPR Meetings).
- Participate in a CPR #2 meeting.

Products:

- Multi-Service V2X Optimization Methodology Report
- Performance Assessment Report for Strategies 1, 2, 3, and their Co-Optimization
- CPR Report #2

TASK 4: V2X DEMONSTRATION AND VALIDATION AT A DAC DEMONSTRATION SITE

The goal of this task is to implement the V2X cost reduction technologies in a field demonstration environment to assess their real-world performance. The demonstration will take place at the fleet demonstration partner's site that is located towards the end of the circuit, which is well-suited for testing V2G technology. The demonstration will focus on V2B and V2G services, including multi-service operation, to evaluate their impact on both the grid and truck operations. The MORBUG platform will be deployed for real-world demonstration at the site, providing a unified and reliable platform for testing and performance evaluation.

Subtask 4.1. Baseline Data Gathering and Definition of Performance Metrics

The goal of this subtask is to collect baseline data from the demonstration site (such as voltage measurements, power quality, daily load profiles, etc.) as well as to define the key performance metrics to evaluate the effectiveness of the V2X cost reduction technologies. This subtask includes measuring initial grid conditions before V2X implementation, site-specific energy usage patterns before V2X implementation, and truck operational parameters. These baseline measurements will serve as a reference point for assessing improvements in cost savings, battery performance, and grid support capabilities throughout the demonstration.

The Recipient shall:

- Develop the *Measurement and Verification Plan*, including data gathering plan and procedures (e.g., to measure voltage, power quality, and load profiles), system performance metrics (e.g., discharge duration, energy savings, operational efficiencies), and data retention strategies (e.g., data organization and public data sharing).
- Collect baseline assessment data in accordance with the Measurement and Verification Plan. The data will be gathered from the demonstration site before starting the V2X operations.
- Analyze the collected data to obtain the baseline model and baseline cost assessment.
- Prepare the Demonstration Site *Baseline Assessment Report* to summarize voltage statistics, power quality statistics, load profiles, and other operational data in the absence of V2X operations.

Products:

- Measurement and Verification Plan
- Demonstration Site Baseline Assessment Report

Subtask 4.2. Field Testing, Data Assessment, and Real-World Validation

The goal of this subtask is to conduct field testing, analyze collected data, and validate the real-world performance of the V2X cost reduction technologies. This will involve executing select

scenarios for V2B and V2G service operations at the demonstration site, monitoring the results under various load and grid conditions, and assessing key performance indicators such as energy cost savings, battery degradation impact, and grid reliability improvements.

The Recipient shall:

- Install, commission, and interconnect the equipment required to conduct the demonstration including:
  - Bidirectional EVSE, to be installed on the MORBUG and connected at the site;
  - Bidirectional-capable electric truck is connected to the EVSE at the site.
- Prepare the *Demonstration Site Implementation, Measurements, and Readiness Report,* confirming readiness for field testing.
- Operate the MORBUG at the demonstration site to support various V2X services, including V2B and V2G services and multi-service V2X operation during different operating conditions. The bidirectional EVSE equipment will be installed on UC Riverside's MORBUG to provide a mobile bidirectional EVSE, to be transported and connected to the demonstration site during the delivery of this subtask. The bidirectional EVSE on the MORBUG will connect to the building's electrical infrastructure using industry-standard short-term 480V AC power connectors. Power transfer and data communications between the bidirectional EVSE and the bidirectional-capable electric truck will be monitored. Power grid conditions as well as demonstration site's building load will also be monitored. Accordingly, the bidirectional EVSE will support V2G, such as by responding to the fluctuations in voltage or other grid conditions, as well as to support V2B, by responding to the changes in the building load conditions, such as the building's peak load.
- Collect and analyze operational data on a monthly basis, with real-time monitoring of:
  - EV onboard telematics (EV data)
  - EVSE telematics (EVSE data)
  - Site measurements (grid and building data)
- Demonstrate and validate V2X cost reduction technologies for electric trucks by assessing battery lifetime impacts, implementing mitigation strategies, and optimizing service-specific operations with EV and EVSE resource awareness based on the specific needs of the real-world demonstration site.
- Prepare the *Demonstration Site Performance Assessment Report* summarizing data analysis, together with a high-level executive summary discussing:
  - Process and results of the final demonstration
  - Testing of the V2X cost reduction technologies
  - Technical issues and how they were addressed
  - Lessons learned for this phase in the project
- Prepare a *CPR Report #3* in accordance with subtask 1.3 (CPR Meetings).
- Participate in a CPR #3 meeting.

Products:

- Demonstration Site Implementation, Measurements, and Readiness Report
- Demonstration Site Performance Assessment Report
- CPR Report #3

TASK 5: V2X TRAINING FOR BROADER COMMUNITY ENGAGEMENT AND TECHNOLOGY ADOPTION

The goal of this task is to promote broader community engagement and technology adoption by providing V2X training for truck drivers and mechanics at the demonstration site. Training will be delivered through a combination of presentations by the project team and observership at the various activities at the demonstration site. These activities will help drive long-term technology adoption beyond the duration of this project and facilitate knowledge transfer to support the broader integration of V2X solutions in the trucking industry and the transportation sector.

The Recipient shall:

- Develop a *Community Engagement and Training Plan*, to disseminate information through V2X training, promote community understanding, and gather inputs from stakeholders.
- Plan and the content for the V2X training efforts to maximize community understanding.
- Prepare the *V2X Training Summary Report* at the end of this task to provide a summary of training activities, topics covered during training, and the number of participants.

Products:

- Community Engagement and Training Plan
- V2X Training Summary Report

TASK 6: V2X COST REDUCTION ASSESSMENT AND MARKET PATHWAY ANALYSIS

The goals of this task are to: **(1)** Conduct a cost assessment by leveraging extensive testing and data collection from Tasks 2, 3, and 4 to quantify the overall net cost reduction achieved through the adoption of the technologies. **(2)** Combine cost-assessment findings with technical results and stakeholder input to identify a viable market pathway for widespread V2X adoption. **(3)** Develop recommendations for stakeholders, including state and local policymakers, to support policies and strategies that facilitate the adoption of V2X in the electric truck industry.

Subtask 6.1. Analysis of Cost Reduction Achieved by the V2X Technologies

The goal of this subtask is to conduct a cost assessment to determine the trade-offs and the best cost-revenue considerations for large-scale adoption of V2X technologies.

The Recipient shall:

- Conduct a cost assessment to determine the degradation cost of providing different V2X services in the absence of mitigation strategies.
- Determine the reduction in the degradation cost, and any cost trade-off, in implementing each mitigation strategy when providing each V2X service.
- Determine the revenue and benefits to fleets from each type of V2X service analyzed in this project, considering the existing or foreseen compensation programs, including separate compensation models for V2B, V2G, and V2V, under different service conditions.
- Determine potential benefits to ratepayers from each type of V2X service analyzed in this project, such as V2G export from commercial EV fleets located on the ends of distribution feeders.
- Prepare the *V2X Cost Reduction Assessment Report*, which will document the assessed overall reduction in ownership cost of electric trucks with V2X capabilities. The results will identify the trade-offs and the best cost-benefit considerations for large-scale adoption of V2X technologies.

Product:

- V2X Cost Reduction Assessment Report

Subtask 6.2. Market Pathway Analysis for Scalable Equitable V2X Technology Adoption

The goal of this subtask is to combine cost-assessment findings with technical results and stakeholder input to identify a viable market pathway for widespread V2X adoption. This subtask will also develop recommendations for stakeholders, including state and local policymakers, to support policies and strategies that facilitate the adoption of V2X in the electric truck industry.

The Recipient shall:

- Collect inputs from project partners, including EV OEM, EVSE OEM, demonstration site, and utility stakeholders, with regard to the market pathway challenges and opportunities.
- Compile the inputs to conduct the market pathway analysis. This includes identifying the challenges and opportunities for scalable and equitable technology adoption.
- Prepare the *Market Pathway Assessment and Stakeholder Recommendation Report*, which will document the approach and results of the market pathway analysis.

Products:

- Market Pathway Assessment and Stakeholder Recommendation Report
- Final Verification Report

TASK 7: EVALUATION OF PROJECT BENEFITS

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

The Recipient shall:

- Complete *the Initial Project Benefits Questionnaire*. The Initial Project Benefits Questionnaire shall be initially completed by the Recipient with 'Kick-off' selected for the 'Relevant data collection period' and submitted to the CAM for review and approval.
- Complete the *Annual Survey* by January 31st of each year. The Annual Survey includes but is not limited to the following information:
  - Technology commercialization progress
  - New media and publications
  - Company growth
  - Follow-on funding and awards received
- Complete the *Final Project Benefits Questionnaire*. The Final Project Benefits Questionnaire shall be completed by the Recipient with 'Final' selected for the 'Relevant data collection period' and submitted to the CAM for review and approval.
- Respond to CAM questions regarding the questionnaire drafts.
- Complete and update the project profile on the CEC's public online project and recipient directory on the Energize Innovation website (www.energizeinnovation.fund), and provide *Documentation of Project Profile on EnergizeInnovation.fund*, including the profile link.
- If the Prime Recipient is an Innovation Partner on the project, complete and update the organizational profile on the CEC's public online project and recipient directory on the Energize Innovation website (www.energizeinnovation.fund), and provide *Documentation of Organization Profile on EnergizeInnovation.fund*, including the profile link.

Products:

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

TASK 8 TECHNOLOGY/KNOWLEDGE TRANSFER ACTIVITIES

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

The Recipient Shall:

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

Products:

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

V. PROJECT SCHEDULE

Please see the attached Excel spreadsheet.