California Energy Commission
July 08, 2026 Business Meeting
Backup Materials for The Regents of the University of California, on behalf of the Irvine 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

CALIFORNIA ENERGY COMMISSION

PROPOSED RESOLUTION: The Regents of the University of California, on behalf of the Irvine Campus

RESOLUTION NO: 26-0708-XX

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-26-002 with The Regents of the University of California, on behalf of the Irvine Campus for a $3,000,000 grant. This project will develop actionable intelligence (AI)-based advanced multi-horizon net-load forecasting models that explicitly predict Behind-the-Meter (BtM) distributed energy resource behaviors, including solar photovoltaic (PV), battery energy storage systems (BESS), and electric vehicles (EV), with focus on improving short-term forecasting accuracy under high-variability events. This will help grid operators efficiently improve California's grid resilience and flexibility and deliver significant cost savings for ratepayers through enhanced load shifting and demand response; and

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

APPROVED AND ADOPTED this 08 day of July 2026, by the following vote:

AYE:
NAY:
ABSENT:
ABSTAIN:

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 approved and adopted by affirmative vote of the CEC at a meeting held on July 08, 2026.

Kim Todd
Secretariat

STATE OF CALIFORNIA
CALIFORNIA ENERGY COMMISSION

CEC-270 (Revised 01/2026)

GRANT REQUEST FORM (GRF)

A. New Agreement Number

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

New Agreement Number: EPC-26-002

B. Division Information

1. Division Name: ERDD
2. Agreement Manager: Alejandra Rios
3. MS-:None
4. Phone Number: Enter Phone Number

C. Recipient's Information

1. Recipient's Legal Name: The Regents of the University of California, on behalf of the Irvine Campus

D. Title of Project

Title of project: Socioeconomic-geographic Intelligence for Grid Net-load Analytics and Learning (SIGNAL)

E. Term and Amount

1. Start Date: 8/1/2026
2. End Date: 3/31/2030
3. Amount: $3,000,000

F. Business Meeting Information

1. Are the ARFVTP agreements $75K and under delegated to Executive Director? No
2. The Proposed Business Meeting Date: 7/8/2026 .
3. Consent or Discussion? Discussion
4. Business Meeting Presenter Name: Alejandra Rios
5. Time Needed for Business Meeting: 5 minutes.
6. The email subscription topic is: EPIC

Project Description:

The Regents of the University of California, on behalf of the Irvine Campus. Proposed resolution approving agreement EPC-26-002 with The Regents of the University of California, on behalf of the Irvine Campus for a $3,000,000.00 grant, and adopting staff's recommendation that this action is exempt from CEQA. This project will develop actionable intelligence (AI)-based advanced multi-horizon net-load forecasting models that explicitly predict Behind-the-Meter (BtM) distributed energy resource behaviors—solar photovoltaic (PV), battery energy storage systems (BESS), and electric vehicles (EV)—with focus in improving short-term forecasting accuracy under high-variability events, which will help grid operators to efficiently improve California's grid resilience and flexibility and deliver significant cost savings for ratepayers through enhanced load shifting and demand response. (EPIC funding) Contact: Alejandra Rios

G. California Environmental Quality Act (CEQA) Compliance

1. **Is Agreement considered a "Project" under CEQA?**
   Yes

If yes, skip to question 2.

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

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

a) Agreement **IS** exempt?

Yes

Statutory Exemption?
No

If yes, list PRC and/or CCR section number(s) and separate each with a comma. If no, enter "None" and go to the next question.

PRC section number:

CCR section number: CCR section number 1, CCR section number 2. Or, None

Categorical Exemption?
Yes

If yes, list CCR section number(s) and separate each with a comma. If no, enter "None" and go to the next question.

CCR section number: Cal. Code Regs., tit. 14, § 15306

Common Sense Exemption? 14 CCR 15061 (b) (3)
No

If yes, explain reason why Agreement is exempt under the above section. If no, enter "Not applicable" and go to the next section.

Cal. Code Regs., tit. 14, sec. 15306 provides that the project 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 are exempt from the provisions of CEQA. The project involves only basic data collection at the Laguna Woods Village site. Activities are limited to gathering information from interested households with behind-the-meter resources such as rooftop solar (PV), battery energy storage systems (BESS), and electric vehicles (EVs). Accordingly, this activity will not have physical alterations to any environmental resources and falls under categorical exemption Section 15306.

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

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

No

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

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

H. Is this project considered “Infrastructure”?

No

I. Subcontractors

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

Subcontractor Legal Company Name	CEC Funds	Match Funds
The Regents of the University of California as Management and Operating Contractor for the Ernest Orlando Lawrence Berkeley National Laboratory	$ 500,000	**$**0
The Regents of the University of California, on behalf of the San Diego campus	$ 249,466	**$**50,533
Derapi, Inc.	$ 195,840	**$**132,000

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	22-23	301.001J	$ 3,000,000

TOTAL Amount: $ 3,000,000

R&D Program Area: ESB: Renewables

Explanation for "Other" selection Not applicable

Reimbursement Contract #: Not applicable

Federal Agreement #: Not applicable

M. Recipient's Contact Information

1. Recipient's Administrator/Officer

Name: Danelle Jobe

Address: Calit2 Building #4106

City, State, Zip: Irvine, CA 92697-0001

Phone: 949-824-7586

E-Mail: jobed@uci.edu

2. Recipient's Project Manager

Name: G.P. Li

Address: 4100 Calit2 Building

City, State, Zip: Uc Irvine, CA

Phone: 949-824-9073

E-Mail: gpli@calit2.uci.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-25-303
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: Alejandra Rios

Approval Date: 5/28/26

Branch Manager: Kevin Uy

Approval Date: 5/29/26

Director: Jonah Steinbuck delegated to the Branch Manager

Approval Date: N/A

Exhibit A
Scope of Work
The Regents of the University of California on behalf of the Irvine Campus

I. TASK AND ACRONYM/TERM LISTS

A. Task List

Task #	[1][2]	Task Name
1		General Project Tasks
2		Stakeholder Coordination and Engagement
3	X	Data Source Identification and Long-Term Accessibility Assessment
4	X	Development of Standardized Data Workflow Framework
5		Data Collection and Processing via Standardized Pipeline
6	X	Data Analysis and Advanced Learning Model Development
7		Model Training, Validation, and Performance Optimization
8		Development of Bidirectional DER Communication API for BtM-device Integration
9	X	Community-Scale Demonstration and Validation of the Developed Forecasting Model
10		Integration of Developed Forecasting Model into Existing Net-Load Forecasting Tools
11		Evaluation of Project Benefits for Ratepayers
12		Technology/Knowledge Transfer Activities

B. Acronym/Term List

Acronym/Term	Meaning
AI	Actionable Intelligence
AMI	Advanced metering infrastructure
API	Application Programming Interface
BESS	Battery energy storage systems
BtM	Behind-the-Meter
CAISO	California Independent System Operator
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CCSC	California Center for Sustainable Communities
CEC	California Energy Commission
CPR	Critical Project Review
DER	Distributed energy resources
DR	Demand Response
EV	Electric vehicles
GRU	Gated Recurrent Unit

[2] 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.

Acronym/Term	Meaning
HRRR	High-Resolution Rapid Refresh
IOU	Investor-Owned Utilities
LADWP	Los Angeles Department of Water and Power
LBNL	Lawrence Berkeley National Laboratory
LLM	Large Language Models
LSTM	Long Short-Term Memory
LWV	Laguna Woods Village
MAPE	Mean Absolute Percentage Error
ML	Machine learning
NDP	National Data Platform
NOAA	National Oceanic and Atmospheric Administration
NREL	National Renewable Energy Laboratory
NSRDB	National Solar Radiation Database
POU	Public Owned Utilities
PV	Photovoltaic
RNN	Recurrent Neutral Networks
SCE	Southern California Edison
SDG&E	San Diego Gas & Electric
SIGNAL	Socioeconomic-Geographic Intelligence for Grid Net-load Analytics and Learning,
TAC	Technical Advisory Committee
TCG	Technical Consultation Group
UCSD	University of California, San Diego
UCI	University of California, Irvine
UCLA	University of California, Los Angeles

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

A. Purpose of Agreement

The purpose of this Agreement is to fund development of actionable intelligence (AI)-based advanced multi-horizon net-load forecasting models that explicitly predict Behind-the-Meter (BtM) distributed energy resource (DER) behaviors—solar photovoltaic (PV), battery energy storage systems (BESS), and electric vehicles (EV)—with focus in improving short-term forecasting accuracy under high-variability events, which will help grid operators to efficiently improve California's grid resilience and flexibility and deliver significant cost savings for ratepayers through enhanced load shifting and demand response.

B. Problem/ Solution Statement

Problem

California's electric grid faces an escalating forecasting crisis as BtM DERs —1.5 million solar PV systems (13+ GW), 150,000+ battery storage units, and 1+ million electric vehicles—remain invisible to utility operators. Current forecasting methods treat BtM DERs as a "black box," producing errors exceeding 15-25% during high-variability events. The problem is compounded by wildfire smoke events causing unpredicted 20-50% solar output reductions, creating dangerous "forecast cliffs" during peak demand. Utilities also lack cost-effective methods to identify BtM locations and behaviors, especially for BESS and EVs, which are not directly visible to grid operators. As California accelerates toward SB 100 goals, the inaccurate forecast of BtM resources could bring significant challenge to maintain a reliable and sustainable grid including scheduling generation reserves, real-time dispatch, and renewable curtailment.

This problem persists because no entity possesses the required combination of data access including advanced metering infrastructure (AMI) and other emerging data sources to identify the real-time BtM behaviors. Individual utilities who own the AMI data usually lack research capacity, cross-utility data access, and advanced AI/Machine Learning (ML) expertise, while proprietary approaches prevent knowledge sharing. The lack of a standardized data collection/generalization/analysis workflow framework and model validation protocols continues to hinder collaboration and data sharing across agencies, utilities, and researchers. There is a need for a more consistent, privacy-compliant data infrastructure to support improved forecasting. The problem must be addressed now because: (1) California's 2020 blackouts demonstrated catastrophic consequences of inadequate forecasting; (2) BtM DER growth accelerates 15-20% annually, worsening the problem exponentially; (3) increasing wildfire frequency creates urgent need for smoke-aware forecasting; (4) utilities are making billion-dollar infrastructure decisions based on flawed forecasts; and (5) the 2024-2030 period is critical for achieving California's legally mandated 2030 climate targets and SB 100 milestones.

Solution

Project SIGNAL - Socioeconomic-Geographic Intelligence for Grid Net-load Analytics and Learning - uniquely assembles a multi-disciplinary team with University of California Irvine (UCI) and LBNL Lawrence Berkeley National Laboratory (LBNL) members knowledgeable in AI/ML for energy and load forecasting models, University of California San Diego (UCSD) members knowledgeable in data infrastructure, Derapi members knowledgeable in DER data analysis and API development, together with partnership commitments from major California utilities (more focus on SoCal region by partnering with SCE, SDG&E, LADWP, with potential expansion to other California regions with PG&E) to deliver open-source solutions to short-term net-load forecasting benefiting all California utilities and ratepayers.

Project SIGNAL intends to address the challenge of California's BtM forecasting through three groundbreaking innovations. First, a standardized data workflow framework for data collection, generalization and analysis from multiple data sources will be established, achieving efficient data intake and processing time and a standardized data format and time interval across diverse datasets. The data workflow framework will be built on the National Data Platform (NDP)'s Grid Data Hub to serve as a fundamental platform to facilitate the development of a

load forecasting model. Second, a state-of-the-art multi-horizon forecasting model will be developed by integrating traditional ML models and advanced deep learning algorithms to enable prediction of BtM resources from five-minute to day-ahead time horizons. The model focuses on providing probabilistic behavioral inputs through extracting socioeconomic and geographic information from the AMI-based datasets to transform static assumptions into dynamic probability distributions based on real-time data inputs to achieve accuracy improvement, providing actionable intelligence for distribution planning, demand response, and real-time operations.
Third, a comprehensive multi-stage validation approach is adopted to ensure the model's seamless integration with California Independent System Operator's (CAISO's) existing forecasting system. The model will first be tested using private DER smart meter data with known DER status to evaluate detection accuracy. Then a community-scale demonstration will be conducted at Laguna Woods Village, or another site deemed appropriate by the CAM in writing, with component-level monitoring of 300-500 households' usage of PV, BESS and EV to evaluate model efficiency and effectiveness based on ground-truth usage patterns and trends using a DER communication API developed for interaction between grid operators and BtM device end users. Eventually the model will be integrated with CAISO's existing operational system implementing real-time data feeds and conducting limited operational pilots at 2-3 substations. The number of forecasting decisions and effectiveness of DER scheduling due to improved forecasts will be measured during the pilot activities.

These breakthroughs directly overcome barriers to California's statutory energy goals. For SB 100 (100% clean energy by 2045): Improved forecasting enables higher renewable penetration by reducing reserve requirements (≥50 MW, $5-10M/year savings), avoiding curtailment (≥20 GWh/year, $2-4M/year), and optimizing storage dispatches to maximize renewable utilization. Component-level BESS forecasting transforms storage from an unpredictable variable into a reliable grid asset. For transportation electrification (5M EVs by 2030): EV charging forecasting enables proactive distribution management, optimized rate design for off-peak charging, and infrastructure planning before capacity constraints emerge. For climate resilience: Smoke-aware forecasting maintains reliability during increasingly frequent wildfires, preventing rolling blackouts that harm disadvantaged communities. Economic benefits total $10-20M annual statewide savings, ≥10,000 MT CO_2/year avoided emissions, and 0.5-1.5% operational cost reductions for ratepayers.

The open-source deliverables from Project SIGNAL—forecasting model, data workflow frameworks, DER communication API, training documentations—create a replicable blueprint accelerating the entire utility sector toward energy goals without prohibitive individual development costs. By solving BtM visibility during the critical 2024-2030 period, SIGNAL removes a fundamental barrier limiting renewable integration and grid reliability, transforming behind-the-meter resources from invisible liabilities into visible, predictable assets that enable California's clean energy transition while positioning the state as the national leader in advanced DER forecasting.

C. Goals and Objectives of the Agreement

Agreement Goals
The goals of this Agreement are to:

- Establish open source, standardized and efficient data workflow framework with data processing efficiency improved by up to 40% for ongoing data collection and capability of integrating new data resources in an efficient manner (in weeks).
- Develop accurate forecasting models to predict locations and behaviors of BESS and EV in short-term targeting five-minute to day-ahead forecasting time horizons with less than 10% mean absolute percentage error (MAPE).
- Develop accurate forecasting models to predict solar irradiance and PV production under conditions with heavy clouds and wildfire smoke in short-term targeting five-minute to day-ahead forecasting time horizons with less than 10% MAPE.
- Conduct comprehensive model validation including ground-truth community-scale demonstration and pilot operation testing with integration of the existing CAISO forecasting system.

Ratepayer Benefits:[3] This Agreement will result in the ratepayer benefits of greater electricity reliability and lower costs by directly enhancing electricity reliability and providing utilities with unprecedented BtM visibility, achieving up to ≤5% MAPE for day-ahead forecasts—a 30-40% improvement eliminating forecast errors that contributed to California's 2020 rolling blackouts (1,000+ MW deviations). Wildfire smoke-aware forecasting prevents dangerous 20-50% solar overestimations during smoke events, while improved 5-15 minute real-time forecasts enable proactive supply-demand balancing, reducing voltage fluctuations and avoiding emergency conditions during heatwaves and extreme weather. For residential customers, this means fewer outages, reduced rolling blackout risk, and greater confidence that their solar panels, batteries, and EVs enhance rather than destabilize grid operations.

The project delivers $10-20M annual statewide cost savings (0.5-1.5% operational cost reduction) passed to ratepayers through multiple mechanisms: reduced reserve requirements (≥50 MW, $5-10M/year), avoided renewable curtailment (≥20 GWh/year, $2-4M/year), improved load balancing reducing imbalance charges by ≥30% ($2-3M/year), and deferred infrastructure upgrades ($1-3M/year) through accurate hosting capacity analysis. Privacy-preserving AMI inference eliminates $50K-200K annual telemetry costs per utility without requiring ratepayer-funded monitoring infrastructure. For a typical residential customer (7,000 kWh/year), these savings translate to approximately $3-8 annually in avoided costs while receiving more reliable service and better integration of their own distributed energy resources.

Technological Advancement and Breakthroughs:[4] 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 delivering several first-of-its-kind technological breakthroughs overcoming critical barriers to California's statutory energy goals (SB 100: 100%

[3] 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).
[4] 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.

clean energy by 2045; SB 350: 50% renewables by 2030; EO B-48-18: 5M zero-emission vehicles by 2030). Wildfire smoke-aware solar forecasting—the first integration of smoke plume models and real-time smoke monitoring camera systems with physics-informed neural networks—solves California's unique barrier where increasing wildfire frequency causes unpredictable 20-50% solar losses that destabilize operations and force renewable curtailment or excessive fossil reserves. Privacy-preserving AMI-based data workflow framework overcomes barriers of lacking a unified standardized data-centered platform among different utilities for BtM DER performance analysis. Unified component-level forecasting achieving 30-40% accuracy improvements enables battery storage optimization (critical for SB 100's 100% clean energy), proactive EV charging management (essential for 5M ZEV goal), and $1-3M annual savings through accurate hosting capacity analysis.

These advances transform BtM resources from invisible barriers into visible clean energy enablers. Current limitations force utilities to maintain 500-1,000 MW excess fossil reserves statewide ($50-100M annually) to cover uncertainties—directly conflicting with SB 100 decarbonization. Project SIGNAL's accurate forecasting model can result in immediate reduction in generation reserves (potential 50-200 MW in scale), acceleration of fossil retirement and decarbonization. Component-level BESS forecasting creates "virtual power plants" from distributed batteries supporting renewable integration without costly centralized infrastructure. EV signature detection enables targeted infrastructure investments and managed charging programs turning EVs into grid assets, directly supporting California's 5M ZEV goal while maintaining reliability and affordability. Open-source delivery ensures all California utilities adopt these breakthroughs regardless of size, accelerating statewide progress toward statutory energy goals.

Agreement Objectives

The objectives of this Agreement are to:

- Achieve coordinated consistent engagement with all interested parties including public and private data providers and stakeholders.
- Establish standardized data workflow framework for data collection, generalization and analysis pipeline with reduced data collection and processing time up to 40% reduction and short integration time for new data sources.
- Develop forecasting models with prediction accuracy of less than 10% MAPE in 5-minute to day-ahead horizons in identifying locations and behaviors of BESS and EV and measuring PV production under challenging conditions.
- Validate the effectiveness and efficiency of the forecasting model through ground-truth community-scale demonstration and pilot testing after integration with the existing CAISO model.
- Evaluate the economic benefits for ratepayers from improved demand response and reduced procurement.

III. TASK 1 GENERAL PROJECT TASKS

PRODUCTS

Subtask 1.1 Products

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

The Recipient shall:

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

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

For products that require a final version only

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

For all products

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

Instructions for Submitting Electronic Files and Developing Software:

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

The following describes the accepted formats for electronic data and documents provided to the CEC as products under this Agreement, and establishes the software versions that will be required to review and approve all software products:

- Data sets will be in MS Access or MS Excel file format (version 2007 or later), or any other format approved by the CAM.
- Text documents will be in MS Word file format, version 2007 or later.
- Project management documents will be in Microsoft Project file format, version 2007 or later.

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

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

MEETINGS

Subtask 1.2 Kick-off Meeting

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

The Recipient shall:

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

  The Kick-off meeting will include discussion of the following:
  - The CAM's expectations for accomplishing tasks described in the Scope of Work;
  - An updated Project Schedule;

- Terms and conditions of the Agreement;
- Invoicing and auditing procedures;
- Travel;
- Equipment purchases;
- Administrative and Technical products (subtask 1.1);
- CPR meetings (subtask 1.3);
- Monthly Calls (subtask 1.5)
- Quarterly Progress reports (subtask 1.6)
- Final Report (subtask 1.7)
- Match funds (subtask 1.8);
- Permit documentation (subtask 1.9);
- Subawards(subtask 1.10);
- Technical Advisory Committee meetings (subtasks 1.11 and 1.12);
- Agreement changes;
- Performance Evaluations; and
- Any other relevant topics.

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

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

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

Recipient Products:
- Kick-off Meeting Presentation
- Updated Project Schedule *(if applicable)*
- Match Funds Status Letter (subtask 1.8) *(if applicable)*
- Permit Status Letter (subtask 1.9) *(if applicable)*

CAM Product:
- Kick-off Meeting Agenda

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

will include the CAM and the Recipient and may include the CAO and any other individuals selected by the CAM to provide support to the CEC.

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

The Recipient shall:

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

The CAM shall:

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

Recipient Products:

- CPR Report(s)

CAM Products:

- CPR Agenda(s)
- Progress Determination

Subtask 1.4 Final Meeting

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

The Recipient shall:

- Meet with CEC staff to present project findings, conclusions, and recommendations. The

final meeting must be completed during the closeout of this Agreement. This meeting will be attended by the Recipient and CAM, at a minimum. The meeting may occur in person or by electronic conferencing (e.g., WebEx), with approval of the CAM.

The technical and administrative aspects of Agreement closeout will be discussed at the meeting, which may be divided into two separate meetings at the CAM's discretion.

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

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

Products:

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

MONTHLY CALLS, REPORTS AND INVOICES

Subtask 1.5 Monthly Calls

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

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

The CAM shall:

- Schedule monthly calls.
- Provide questions to the Recipient prior to the monthly call.

- Provide call summary notes to Recipient of items discussed during call.

The Recipient shall:

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

Product:

- Email to CAM concurring with call summary notes.

Subtask 1.6 Quarterly Progress Reports and Invoices
The goals of this subtask are to: (1) periodically verify that satisfactory and continued progress is made towards achieving the project objectives of this Agreement; and (2) ensure that invoices contain all required information and are submitted in the appropriate format.

The Recipient shall:

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

Recipient Products:

- Quarterly Progress Reports
- Invoices

CAM Product:

- Invoice template

Subtask 1.7 Final Report
The goal of this subtask is to prepare a comprehensive Final Report that describes the original purpose, approach, results, and conclusions of the work performed under this Agreement. When creating the Final Report Outline and the Final Report, the Recipient must use the CEC Style Manual provided by the CAM.

Subtask 1.7.1 Final Report Outline

The Recipient shall:

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

Recipient Products:

- Final Report Outline (draft and final)

CAM Products:

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

Subtask 1.7.2 Final Report

The Recipient shall:

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

Products:

- Summary of TAC Comments on Draft Final Report

- Draft Final Report
- Written Responses to Comments *(if applicable)*
- Final Report

CAM Product:
- Written Comments on the Draft Final Report

MATCH FUNDS, PERMITS, AND SUBAWARDS

Subtask 1.8 Match Funds

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

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

The Recipient shall:

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

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

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

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

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

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

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

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

Subtask 1.10 Obtain and Execute Subawards and Agreements with Site Hosts
The goals of this subtask are to: (1) procure and execute subrecipients and site host agreements, as applicable, required to carry out the tasks under this Agreement; and (2) ensure

that the subrecipients and site host agreements are consistent with the Agreement terms and conditions and the Recipient's own contracting policies and procedures.

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.
- 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 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* for each TAC Meeting 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

*Products that require a draft version are indicated by marking **"(draft and final)"** after the product name in the "Products" section of the task/subtask. If "(draft and final)" does not appear after the product name, only a final version of the product is required. **Subtask 1.1 (Products)** describes the procedure for submitting products to the CAM.*

TASK 2 STAKEHOLDER COORDINATION AND ENGAGEMENT

The goals of this task are to establish coordination with interested parties and stakeholders including state and federal agencies (CEC, NOAA), California grid operators (CAISO), California IOUs and POUs (SCE, SDG&E, PG&E and LADWP), industrial participants (DER device manufacturing consultant(s)), local communities and research organizations, and reach a standard engagement plan to maintain regular communication and consulting during project period.

The project team will first identify critical stakeholders and interested parties for Project Signal, including but not limited to, CEC technical staff, CAISO short-term forecasting team, CPUC Data Working Group (California Center for Sustainable Communities (CCSC) team at the University of California, Los Angeles (UCLA)), utility AMI team from SCE, PG&E, SDG&E and LADWP, and community representatives from the demonstration site of the project. All these parties will be coordinated to establish standard communication and engagement protocols during the project period. A technical working group will be formed and oversee the project's progress in a monthly group meeting. In particular, a regular communication and information exchange mechanism will be established with the CAISO load forecasting model team at the early stage of the project to identify the priority BtM prediction needs and the most challenging data acquisition of the existing model. Annual workshops will be organized at the end of each year to showcase the project progress and benefits for stakeholders.

The Recipient shall:

- Identify stakeholders that are relevant to the project, including both public and private organizations, to form the technical consultation group (TCG).
- Set a *Quarterly TCG meeting schedule* as the approach to overseeing the project's progress and outcomes.
- Form a technical working group with leading staff and researchers from UCI, LBNL, UCSD, and Derapi to coordinate efforts to meet the milestones of each project stage.
- Set a *Monthly Technical Working Group Meeting Schedule* to ensure the deliveries of each task are met as scheduled.
- Establish standard communication and engagement protocols with all parties involved during the project period.
- Establish early and consistent communication with the CAISO forecasting model team to identify the priority BtM prediction needs and the most challenging data acquisition of the existing model.
- Organize and set an *Annual Stakeholder Workshop Schedule* for the end of each year to showcase the project's progress and benefits for stakeholders.

Products:

- Quarterly TCG meeting schedule
- Monthly Technical Working Group Meeting Schedule

- Annual Stakeholder Workshop Schedule (draft and final)

TASK 3 DATA SOURCE IDENTIFICATION AND LONG-TERM ACCESSIBILITY ASSESSMENT

The goals of this task are to identify and assess all data sources that will serve as inputs for the load forecasting model development and validation, evaluate data formats, accessibility, and integration requirements for all data sources, and evaluate long-term data accessibility. The project team will first leverage its existing strong connections with three major SoCal-based utilities: SCE, SDG&E and LADWP, and also seek close collaboration with PG&E who has more experience working with CEC data. These efforts will ensure the project team to obtain enough support from utilities across the entire California regions and receive sufficient and diverse utility AMI data as the fundamental input data for the forecasting model.

The Recipient shall:

- Identify public data sources serving as input datasets for load forecasting model (completion by Month 4) and create a *Data Source Inventory.*
- Connect with major California utilities (SCE, SDG&E, LADWP and PG&E) to request AMI data samples, which will be used to compare the data status between different utility organizations and prepare for establishing the data workflow pipeline, with the goal of generating the *AMI Data Scope and Format Assessment Report,* and the *Utility AMI Data Sharing Agreements.*
- Evaluate real-time wildfire smoke monitoring data from ALERTCalifornia for integration feasibility.
- Assess real-time weather data from NOAA's High-Resolution Rapid Refresh (HRRR) model.
- Evaluate satellite-based solar data from NREL's National Solar Radiation Database (NSRDB).
- Assess accessibility of private smart meter data from solar PV, BESS, and EV manufacturers/vendors or directly from end users.
- Assess privacy compliance with the usage of all datasets and generate a *Privacy Compliance Evaluation.*
- Evaluate the long-term accessibility of all data sources beyond the project period and generate a *Long-term Data Integration Feasibility Assessment Report*.
- Catalog all confirmed data sources in the Grid Data Hub for workflow framework integration
- Prepare a *CPR Report* and participate in CPR meeting in accordance with subtask 1.3.

Products:

- Data Source Inventory
- Utility AMI Data Sharing Agreements (draft and final)
- AMI Data Scope and Format Assessment Report (draft and final)
- Privacy Compliance Standard
- Long-term Data Integration Feasibility Assessment Report
- CPR #1 Report

TASK 4 DEVELOPMENT OF STANDARDIZED DATA WORKFLOW FRAMEWORK

The goals of this task are to establish a comprehensive, transparent, and reproducible data workflow framework built on UCSD's Grid Data Hub in the National Data Platform (NDP) and evaluate its efficiency of data processing with a variety of diverse data sources and formats.

The Recipient shall:

- Integrate cataloged data sources into the NDP Grid Data Hub platform.
- Design a *Standardized Data Workflow Framework* tailored for optimal collection, transfer, and processing efficiency.
- Evaluate effectiveness of extracting social, economic, and geographic information from datasets for BtM forecasting.
- *Develop NDP Workspace and Interface Customized for Project SIGNAL.*
- Validate data workflow framework effectiveness through preliminary sample dataset testing and generate *Preliminary Data Collection Validation Report.*
- Generate *Training Documentation for Data Collection and Processing* ensuring transparency and reproducibility of approach.
- Prepare *CPR Report* and participate in CPR meeting in accordance with subtask 1.3.

Products:

- Standardized Data Workflow Framework
- NDP Workspace and Interface Customized for Project SIGNAL
- Training Documentation for Data Collection and Processing
- Preliminary Data Collection Validation Report
- CPR #2 Report

TASK 5 DATA COLLECTION AND PROCESSING VIA STANDARDIZED PIPELINE

The goals of this task are to implement a standardized data collection pipeline across all data sources to enable continuous, ongoing data acquisition and processing throughout the project period, and conduct standard data processing including, but not limited to, cleaning, normalization to consistent time intervals, and organizing for multi-horizon forecasting model development (5-minute to day-ahead) with ongoing quality assurance ensuring consistent inputs.

The Recipient shall:

- Implement a standardized data collection pipeline using NDP workspace across all data sources.
- Clean collected raw data through anomaly detection, gap filling, and format standardization.
- Normalize all datasets with consistent time intervals (generalization).
- Regroup data to prepare *Cleaned and Normalized Training Datasets in Different Time Horizons* for model development across different time horizons (5-minute, 15-minute, 1-hour, day-ahead).
- Conduct ongoing data quality assurance and monitoring to ensure consistent inputs.
- Manage data storage and archival following standard procedures, and generate *Data Quality Monitoring Reports.*
- Complete historical data collection (3+ years) and create *Historical Data Archive*
- Maintain continuous real-time data collection throughout project period.

Products:

- Data Processing and Sampling Report for Cleaned and Normalized Training Datasets in Different Time Horizons
- Data Quality Monitoring Reports
- Historical Data Archive

TASK 6 DATA ANALYSIS AND ADVANCED LEARNING MODEL DEVELOPMENT

The goals of this task are to develop advanced AI/ML forecasting models combining large language models (LLM), sequential models, causality models to determine relationships between BESS/EV locations/behaviors and socioeconomic-geographic factors and develop accurate solar PV forecasting model through integration of satellite-based solar irradiance maps and real-time wildfire smoke monitoring data to accurately predict generation under challenging conditions including heavy cloud cover and wildfire smoke events.

The Recipient shall:

- Apply advanced machine learning algorithms combining sequential and causality models
- Implement sequential models (recurrent neutral networks (RNN), long short-term memory (LSTM), gated recurrent unit (GRU)) to extract patterns and identify trends from historical data
- Develop *Location and Behavior Forecasting Model for BESS and EV* to determine relationships between BESS/EV short-term performance and socioeconomic-geographic factors.
- Enhance solar PV forecasting by integrating satellite-based solar irradiance maps
- Integrate real-time wildfire smoke monitoring data into PV production models
- Emphasize solar availability variation modeling under heavily cloudy weather conditions
- Model solar generation impacts during wildfire smoke events
- Develop *Smoke-Aware Solar Forecasting Model*
- Integrate the developed BESS/EV and solar models to establish *Multi-horizon Net-load Forecasting Model*
- Prepare *CPR Report* and participate in CPR meeting in accordance with subtask 1.3.

Products:

- BESS and EV Location and Behavioral Forecasting Model Performance Report
- Smoke-Aware Solar Forecasting Model Performance Report
- Multi-horizon Net-load Forecasting Model Performance Report
- CPR #3 Report

TASK 7 MODEL TRAINING, VALIDATION, AND PERFORMANCE OPTIMIZATION

The goals of this task are to train forecasting models using 3+ years of historical AMI data supplemented with socioeconomic and geographic information, validate models using hold-out utility meter datasets with known DER status with accuracy evaluation across all time horizons, optimize multi-horizon performance through dynamic probability distributions and real-time data integration.

The Recipient shall:

- Train models using 3+ years historical AMI data from utilities with supplemental socioeconomic-geographic datasets.
- Implement "transfer learning" approach for BtM detection, adapting high-frequency field data signatures to 15-minute utility data.
- Split training data chronologically with seasonal stratification ensuring peak period coverage.
- Validate using hold-out utility or private meter datasets with known DER status (confirmed via interconnection records/surveys).
- Evaluate prediction precision and MAPE across different time horizons for BESS/EV locations and behaviors.
- Assess PV generation prediction accuracy under cloudy and wildfire smoke conditions.
- Implement dynamic evolution based on real-time data intake to improve time sensitivity and generate *Model Accuracy Validation Report*
- Optimize multi-horizon forecasting (5-minute to month/year-ahead) using dynamic probability distributions and generate *Performance Benchmarking Documentation*
-

Products:

- Model Accuracy Validation Report (draft and final)
- Performance Benchmarking Documentation

TASK 8 DEVELOPMENT OF BIDIRECTIONAL DER COMMUNICATION API FOR BTM-DEVICE INTEGRATION

A standardized DER Communication API will be developed to enable secure bidirectional communication between grid operators and BtM end users, serving as the critical interface connecting SIGNAL's forecasting models with real-world DER operations in support of efficient, accurate, and privacy-compliant collection of ground-truth data during community-scale demonstration (Task 8) and operational integration (Task 9). The developed API is expected to provide the pathway for grid operators to gain visibility of BTM device behavior for augmenting dispatch capabilities with component-level forecasting intelligence. The API also facilitates future participation for customer-owned resources not currently enrolled in grid services programs, enhancing existing Virtual Power Plant (VPP) and Demand Response (DR) dispatch mechanisms that empowers customers to actively contribute to grid flexibility.

The Recipient shall:

- Provide a cloud-based API capable of securely collecting data from a variety of BTM end-user DER devices from various manufacturers, presented in a resolution and format relevant for validating and refining forecast models. Such API may make use of existing commercially- or publicly available API products and services, with augmentations, adaptations, or customizations appropriate for the needs of the Tasks.
- Provide a secure, programmatic means of obtaining end user consent and authorization to collect, store, and use BtM device data.
- Provide the API as a REST interface using JSON format, developed on Linux and hosted on AWS.

Products:

- DER Communication API user manual

- DER Communication API validation report (draft and final)
- Standard dataset templates needed for Task 9

TASK 9 COMMUNITY-SCALE DEMONSTRATION AND VALIDATION OF THE DEVELOPED FORECASTING MODEL

The goals of this task are to conduct ground-truth validation of forecasting model effectiveness and efficiency through community-scale demonstration at Laguna Woods Village (LWV), and collect participant feedback to validate model accuracy and document ratepayer benefits to ensure real-world performance verification across diverse conditions including high-variability events.

The Recipient shall:

- Establish *Community Collaboration Agreement* and *Community Engagement Plan* with Village Management Services at LWV.
- Conduct survey-based investigation among LWV residents to assess interest and DER ownership and generate *Participant Survey Report.*
- Organize community information session to recruit 300-500 household participants.
- Deploy DER API as data collection and communication tool for participating households.
- Install necessary monitoring systems at each participating household for PV, BESS, and EV measurements.
- Collect ground-truth data for 6-12 months covering high-variability events (peak demand, smoke events, extreme weather).
- Validate forecasting model accuracy and effectiveness against actual component-level performance.
- Collect participant feedback after demonstration period.
- Document ratepayer benefits based on demonstration results and participant experiences and generate *Community Demonstration Report.*
- Prepare *CPR Report* and participate in CPR meeting in accordance with subtask 1.3.

Products:

- Community Collaboration Agreement (draft and final)
- Community Engagement Plan (draft and final)
- Participant Survey Report
- Community Demonstration Report (draft and final)
- CPR #4 Report

TASK 10 INTEGRATION OF DEVELOPED FORECASTING MODEL INTO EXISTING NET-LOAD FORECASTING TOOLS

The goals of this task are to seamlessly integrate SIGNAL forecasting models (BESS/EV location and behavior predictions, smoke-aware PV production) into existing utility operational forecasting systems, conduct 6-12 month operational pilot testing at 2-3 selected substations to validate net-load accuracy, operational efficiency, and effectiveness, and collect continuous feedback from grid operators (utilities and CAISO) and market participants to facilitate ongoing model maintenance and upgrades, ensuring successful operational deployment.

The Recipient shall:

- Assess system status and integration feasibility of existing utility/CAISO forecasting models, and generate *Integration Feasibility Assessment Report*.
- Determine optimal integration approach for SIGNAL models with existing utility systems.
- Seamlessly integrate BESS/EV location and behavior prediction models into existing forecasting tools.
- Integrate smoke-aware PV production models into existing solar forecasting systems.
- Conduct operational pilot testing at 2-3 selected substations for 6-12 months.
- Generate *Deployment Documentation.*
- Analyze predicted net-load accuracy during utility operational pilot testing at substation level and generate *Operational Pilot Testing Report*.
- Validate operational efficiency and effectiveness of integrated model in real-world conditions.
- Collect continuous feedback from grid operators (CAISO and utilities) during pilot testing and generate *Grid Operator Feedback Report*.
- Gather revision suggestions from market participants and all other stakeholders, and provide *Final Integration Report*.
- Facilitate ongoing model maintenance and upgrade procedures based on operational feedback.

Products:

- Integration Feasibility Assessment Report (draft and final)
- Deployment Documentation
- Operational Pilot Testing Report (draft and final)
- Grid Operator Feedback Report
- Integration Report (draft and final)

TASK 11: 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 12 TECHNOLOGY/KNOWLEDGE TRANSFER ACTIVITIES

The goal of this task is to ensure the scientific and techno-economic analysis and tools developed under this agreement are utilized in the energy policy, and/or planning decisions at the state and/or local levels, academic community and/or commercial sector.

The Recipient Shall:

- Develop and submit a *Knowledge Transfer Plan* that identifies the proposed activities the recipient will conduct to meet the goal of the task. The *Knowledge Transfer Plan* should include at a minimum:
    - Specific policy and planning efforts this project is expected to inform.
    - Specific stakeholder groups and energy policy and planning practitioners who will utilize the results of this project.
    - Proposed activities the Recipient will conduct to ensure the tools and results from this project will be utilized and adopted by the groups identified above.
- Present the *Draft Knowledge Transfer Plan* to the TAC for feedback and comments.
- Develop and submit a *Summary of TAC Comments* that summarizes comments received from the TAC members on the *Draft Knowledge Transfer Plan*. This document will identify:
    - TAC comments the Recipient proposes to incorporate into the *Final Knowledge Transfer Plan*.
    - TAC comments the Recipient does not propose to incorporate with and explanation why.
- Submit the *Final Knowledge Transfer Plan* to the CAM for approval.
- Implement the activities as described in the *Final Knowledge Transfer Plan.*

- Develop a *Knowledge Transfer Summary Report* that includes high level summaries of the activities, results, and lessons learned of tasks performed relating to implementing the Final Technology Transfer Plan. This report should not include any proprietary information.
- When directed by the CAM, develop presentation materials for an 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:

- Knowledge Transfer Plan (draft and final)
- Summary of TAC Comments
- Technology Transfer Summary Report (draft and final)
- High Quality Digital Photographs

V. PROJECT SCHEDULE

Please see the attached Excel spreadsheet.