



# GRANT REQUEST FORM (GRF)

## A) New Agreement # EPC-20-025

B) Division	Agreement Manager:	MS-	Phone
ERDD	Matthew Fung	43	916-776-0757

C) Recipient's Legal Name	Federal ID Number
DOE- Lawrence Berkeley National Laboratory	94-2951741

D) Title of Project
Achieving Integrated and Equitable Decarbonized Loads with CalFlexHub

## E) Term and Amount

Start Date	End Date	Amount
5/1/2021	3/31/2025	\$ 16,000,000

## F) Business Meeting Information

ARFVTP agreements \$75K and under delegated to Executive Director

Proposed Business Meeting Date 4/14/2021  Consent  Discussion

Business Meeting Presenter Matthew Fung Time Needed: 5 minutes

Please select one list serve. EPIC (Electric Program Investment Charge)

### Agenda Item Subject and Description:

LAWRENCE BERKELEY NATIONAL LABORATORY. Proposed resolution approving Agreement EPC-20-025 with Lawrence Berkeley National Laboratory for a \$16,000,000 grant to establish the California Flexible Load Research and Deployment Hub to develop, demonstrate, and deploy multiple demand flexible technologies as electric grid resources, and adopting staff's determination that this action is exempt from CEQA. (EPIC funding) Contact: Matthew Fung (Staff Presentation: 5 minutes).

## G) California Environmental Quality Act (CEQA) Compliance

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

Yes (skip to question 2)

No (complete the following (PRC 21065 and 14 CCR 15378)):

Explain why Agreement is not considered a "Project":

2. If Agreement is considered a "Project" under CEQA:

a)  Agreement **IS** exempt.

Statutory Exemption. List PRC and/or CCR section number:

Categorical Exemption. List CCR section number: Cal. Code Regs., tit. 14, § 15301 ; Cal. Code Regs., tit. 14, § 15303 ; Cal. Code Regs., tit. 14, § 15306

Common Sense Exemption. 14 CCR 15061 (b) (3)

Explain reason why Agreement is exempt under the above section: This project will develop, test and deploy a number of pre-commercial, signal-responsive technologies as electric grid resources to accelerate the ability to provide dynamic price and GHG signals. Technologies such as refrigeration equipment, air conditioners, water heaters, heat pumps, HVAC and thermostat controls, plug



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load control devices, battery storage and EV charging systems will be tested in an existing laboratory and then integrated into existing residential and commercial buildings. Some minor retrofits will be needed in order to integrate some of the technologies into the existing buildings and/or integrate technologies with existing equipment in those buildings. This project does not involve any construction activities, none of the proposed sites are environmentally sensitive, no historic buildings or resources are involved, and project activities will not result in noise or odors in excess of permitted levels at any of the sites.

This project is therefore categorically exempt from environmental review pursuant to CEQA Guidelines section 15301 as minor alterations to existing facilities that involve negligible or no expansion of an existing or former use at the sites. The project is also categorically exempt pursuant to CEQA Guidelines section 15303 as the installation of small new equipment in small structures. This project is also categorically exempt pursuant to CEQA Guidelines section 15306 as it involves basic data collection, research and resource evaluation activities which will not result in a serious or major disturbance to an environmental resource. The project does not involve any unusual circumstances, will not result in damage to any scenic resources within a highway officially designated as a state scenic highway, none of the installation sites are 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 exemptions listed in CEQA Guidelines section 15300.2 apply to this project and the project, when considered as a whole, will not result in a cumulative impact that is significant on the environment.

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

Check all that apply

- Initial Study
- Negative Declaration
- Mitigated Negative Declaration
- Environmental Impact Report
- Statement of Overriding Considerations

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

<b>Legal Company Name:</b>	<b>Budget</b>
Build Momentum	\$ 600,000
The Regents of the University of California on behalf of the Davis campus	\$ 3,013,675
Olivine, Inc.	\$ 985,000
Energy and Environmental Economics, Inc.	\$ 475,000
SkyCentrics, Inc.	\$ 366,600



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Legal Company Name:	Budget
The Regents of the University of California, Berkeley Campus	\$ 270,000
The Regents of the University of California on behalf of the Riverside campus	\$ 98,000
WattTime	\$ 96,000
Navigant Consulting, Inc.	\$ 95,000
e-Radio	\$ 95,000

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

Legal Company Name:
DOE- Lawrence Berkeley National Laboratory
The Regents of the University of California on behalf of the Davis campus

### J) Budget Information

Funding Source	Funding Year of Appropriation	Budget List Number	Amount
EPIC	19-20	301.001G	\$16,000,000
			\$

R&D Program Area: EERO: Buildings

TOTAL: \$ 16,000,000

Explanation for "Other" selection

Reimbursement Contract #:      Federal Agreement #:

### K) Recipient's Contact Information

#### 1. Recipient's Administrator/Officer

Name: Joanna Santoro  
Address: 1 Cyclotron Rd,  
MS 64-0240A  
City, State, Zip: Berkeley, CA  
94720-0001  
Phone: 510-486-6824  
E-Mail: jlsantoro@lbl.gov

#### 2. Recipient's Project Manager

Name: Mary Ann Piette  
Address: 1 Cyclotron Rd,  
MS 90R400  
City, State, Zip: Berkeley, CA  
94720-8099  
Phone: 510-486-6286  
E-Mail: MAPiette@lbl.gov

### L) Selection Process Used

- Competitive Solicitation      Solicitation #: GFO-19-309  
 First Come First Served Solicitation Solicitation #:



STATE OF CALIFORNIA

# GRANT REQUEST FORM (GRF)

CEC-270 (Revised 12/2019)

CALIFORNIA ENERGY COMMISSION

## M) The following items should be attached to this GRF

- |   |                                     |          |
|---|-------------------------------------|----------|
| 1. Exhibit A, Scope of Work                         | <input checked="" type="checkbox"/> | Attached |
| 2. Exhibit B, Budget Detail                         | <input checked="" type="checkbox"/> | Attached |
| 3. CEC 105, Questionnaire for Identifying Conflicts | <input checked="" type="checkbox"/> | Attached |
| 4. Recipient Resolution                             | <input checked="" type="checkbox"/> | N/A      |
| 5. CEQA Documentation                               | <input type="checkbox"/>            | N/A      |

\_\_\_\_\_  
**Agreement Manager**

\_\_\_\_\_  
**Date**

\_\_\_\_\_  
**Office Manager**

\_\_\_\_\_  
**Date**

\_\_\_\_\_  
**Deputy Director**

\_\_\_\_\_  
**Date**

**Prime Recipient:** Lawrence Berkeley National Laboratory

**Project Title:** Achieving Integrated and Equitable Decarbonized Loads with CalFlexHub

<b>Subcontractor Company Name</b>	<b>Budget</b>
Harvest Thermal, Inc	\$90,000
The Regents of the University of California, San Diego	\$90,000
Rising Sun Center for Opportunity	\$80,000
TeMix, Inc	\$73,000
Humboldt State University	\$65,000
Extensible Energy, Inc.	\$50,000
Argenox	\$90,000
Aermec	match only
To Be Determined	\$736,000

**Exhibit A**  
**Scope of Work**  
**Lawrence Berkeley National Laboratory**

**I. TASK ACRONYM/TERM LISTS**

**A. Task List**

<b>Task #</b>	<b>CPR<sup>1</sup></b>	<b>Task Name</b>
1		General Project Tasks
2		Conduct Needs Assessment, Usability Analysis, and Hub Stakeholder Survey
3		Ecosystem Engagement and Develop a Sustainable CalFlexHub Design
4	X	Develop Valuation Methods and Metrics, Assess Pathways and Impact, and Prioritize Portfolio
5		Develop and Demonstrate Load Management Standards Compatible Communications Technologies
6	X	Develop and Validate Advanced Flexibility Technologies
7	X	Demonstrate and Deploy Flexibility Technologies
8		Evaluation of Project Benefits
9		Technology/Knowledge Transfer Activities

**B. Acronym/Term List**

<b>Acronym/Term</b>	<b>Meaning</b>
ARD	Applied Research and Development
Berkeley Lab	Lawrence Berkeley National Laboratory
CalFlexHub	California Load Flexibility Research and Deployment Hub
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CEC	California Energy Commission
CPR	Critical Project Review
CPUC	California Public Utilities Commission
DA	Disadvantaged
DAC	Disadvantaged Communities
DER	Distributed Energy Resources
EPIC	Electric Program Investment Charge
GHG	Greenhouse Gas
GW	Gigawatt
GWh	Gigawatt-hours
HVAC	Heating, Ventilation and Air Conditioning
KPM	Key Performance Metric
LMS	Load Management Standards
LMS-P	Load Management Standards Prototype System
R&D	Research and Development

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

**Exhibit A**  
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RDD&D	Research Development Demonstration and Deployment
TAC	Technical Advisory Committee
TDD	Technology Demonstration and Deployment
TRL	Technology Readiness Level
VPP	Variable Peak Pricing

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

**A. Purpose of Agreement**

The purpose of this Agreement is for the Recipient (Lawrence Berkeley National Laboratory) to develop the California Load Flexibility Research and Deployment Hub (CalFlexHub) as described in the California Energy Commission’s EPIC solicitation, GFO-19-309. The CalFlexHub will develop a set of activities to accelerate the ability of customer loads to be flexible resources that are integrated with electricity supply. This process will advance decarbonization while ensuring affordable, equitable, and reliable energy systems. CalFlexHub’s public-private partnership will conduct data-driven and customer-centric research, development, demonstration, and deployment (RDD&D) activities.

**B. Problem/ Solution Statement**

**Problem**

The CalFlexHub will address 7 barriers hindering the scaled adoption of flexible customer loads:

1. **Deficiency of Capability** - There is a need for more flexible load, but current building technologies have limited flexibility and signal responsiveness. Expanded technological capabilities are necessary to facilitate innovative business models and increase utility engagement. Furthermore, current responsive load is often not predictable, reliable, or persistent. Utilities and grid operators do not trust the capability of load flexible (LF) technologies to provide deep, consistent response.
2. **Lack of Signal Reception** - Not every customer has the ability to receive price, environmental, and other grid signals over the internet, which is both an equity and a technology issue.
3. **Insufficient Valuation Criteria** - There is a knowledge gap on how to evaluate which pathways are most promising for cost-effective mass adoption of flexible load. This gap is related to the lack of field performance and cost-benefit data of various technologies and strategies, barriers to customer adoption, value to ratepayers, load serving entities, and grid operators, and lack of understanding of the environmental impacts of various technologies and research pathways.
4. **Lack of Understanding and Usability** - While new technologies are developed to support LF, customers may not understand how to use them, and they may not be adopted due to lack of usability.
5. **Severe Financial and Health Burdens** - Disadvantaged and low-income (LI) communities often suffer from financial hardships and energy burdens related to electricity cost, inability to respond to time-varying rates, lack of affordability of energy efficiency and LF technologies, and health issues related to poor air quality. These communities may also lack the internet connectivity necessary for many LF technologies.

## Exhibit A Scope of Work Lawrence Berkeley National Laboratory

6. **Insufficient Investment** - There has been minimal investment in LF technologies, largely due to low demand related to the unclear value proposition such technologies have for customers.
7. **Siloed Knowledge and Information Not Actionable** - While California has numerous research projects and demonstrations of LF technology, lessons learned on performance and customer feedback are not shared, resulting in inefficient knowledge transfer and lack of progress. Lessons from a broad set of activities throughout the US are not shared effectively, and raw data, field demo results, and research reports may not be in an actionable form.

### **Solution**

The Recipient will form CalFlexHub to facilitate / accelerate the ability of customer loads to provide dynamic load flexibility. CalFlexHub will achieve this solution by equipping customers with the technologies and incentives they need to provide that flexibility, and then increasing knowledge and understanding of customer needs through field research and customer surveys.

Once technologies are pilot tested and usability research is complete, CalFlexHub will support commercialization of LF technologies that are proven to be usable and effective through completed field research. Targeted technologies will include building and end-use efficiency equipment, storage technologies, and electric vehicle (EV) systems.

CalFlexHub will develop, demonstrate, and evaluate complementary technology platforms to actuate these flexible loads using technology compatible with the CEC's Load Management Standards (LMS) platform, which will be used to communicate the prices, grid signals, and greenhouse gas (GHG) emissions signals. The team will pilot test and demonstrate new technologies compatible with the LMS platform to enable affordable flexible loads.

One key element of decarbonization is electrification of space heating, water heating, and transportation. Electrification of these new loads will strain our electric systems unless they are capable of automatically responding to digital tariffs and other signals to create responsive flexible loads. Furthermore, as our climate changes and temperatures rise, cooling loads grow. Creating flexible heating and cooling will be a key piece of CalFlexHub's technology RDD&D.

CalFlexHub will develop and deploy practical solutions to ensure California's customer loads evolve from static demand to become integrated, flexible, price responsive, and reliable resources for demand flexibility modes. The team will establish a CalFlexHub clearinghouse of critical RDD&D results and a practical CalFlexHub Solutions Center to ensure that the research moves from the lab to the market accelerated by continuous feedback between theory and practice, research, and field demonstration. The CalFlexHub Navigator is specially focused on investment in new technologies evaluated within CalFlexHub.

A key principle of this effort is to incorporate partner and stakeholder feedback at all levels of CalFlexHub research, including vetting of early-stage R&D, guiding selection of demonstration sites, and supporting evaluation and results analysis. These research results will be shared with policy makers to explore policy implications and market impact. They also will be vetted with affected disadvantaged communities (DACs) and low-income (LI) communities to ensure equitable opportunities and impacts that can inform policymakers and market actors.



**Exhibit A**  
**Scope of Work**  
**Lawrence Berkeley National Laboratory**

**C. Goals and Objectives of the Agreement**

Table 1. Summary of Goals and Objectives of the CalFlexHub

Goal	Objective
<p><b>Develop new demand flexibility technologies consistent with California’s building energy efficiency, appliance, and load management standards.</b> Develop and demonstrate user friendly, cost-effective, scalable technologies that provide flexible loads to shift demand to the lowest GHG (cleanest) times of day, reduce renewable curtailment, improve grid reliability, and provide ramping services.</p>	<p><b>Identify, develop, evaluate, demonstrate and deploy cost-effective, scalable, building load-flexible (LF) technologies</b> that are consistent with building energy efficiency, appliance, and load management standards, to provide continuous load shaping from dynamic price and GHG response: 10 gigawatt-hours per day (GWh/day) of daily shift and 4–6 GW of peak load reduction during peak by 2025. Enabling doubling of this capability by 2030. Document detailed technical specifications for communications and response requirements.</p>
<p>Research, develop, and deploy flexible demand technologies for the buildings sector, including residential, multifamily, and commercial buildings. Facilitate the integration, aggregation, and scalability of flexible and interoperable demand technologies with efficiency measures, distributed generation, storage, and electric vehicle charging strategies with the goals of optimizing customer load shapes, bills, and productivity while reducing greenhouse gas emissions and providing operational savings to the grid.</p>	<p>Create a portfolio of LF RDD&amp;D technology projects across various building types and sizes including single family residential, multi-family, commercial buildings and integrated campuses. These technologies will include building end-uses and other DERS such as PV, thermal and electric storage, and EVs. Evaluate the performance of integrated control and optimization of these technologies to reduce customer bills and GHG emissions.</p>
<p><b>Mass-market technology advancement.</b> Enable widespread adoption and reliable reception of LMS signals that allow buildings, storage systems, and EVs to automatically respond to these signals with predictable and persistent changes in load. Develop and demonstrate additional environmental signals as feasible and cost-effective.</p>	<p><b>Deploy LF technologies to demonstrate the ability for 99% of the state’s customers to receive the LMS price and marginal GHG signals</b> at five-minute increments and report statistical significance. Demonstrate that load-responsive technologies can receive and respond to the signals.</p>
<p><b>Mitigate Financial and Health Burdens.</b> Mitigate the financial and health impacts of electrification and time-varying rates on disadvantaged (DA) and low-income (LI) communities. Consider utility bills, LF technology costs, air quality, and extreme heat. Pilot test the capability of FM and other low-cost signals to enable LF technologies.</p>	<p><b>Deploy key technologies for DA and LI communities</b> to overcome financial and health burdens. Develop plans to build capacity through innovation and targeted deployment of those technologies. Our objective is to have an Equity First strategy in CalFlexHub, operationalized by principles that crosscut projects.</p>

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Goal	Objective
<p><b>Customer interface and experience understanding.</b> Evaluate barriers to customer adoption and acceptance of flexible demand technologies, including usability, and develop strategies to overcome these barriers considering financial and other incentives.</p>	<p><b>Identify ways to improve usability of technology solutions to increase ratepayer benefits.</b> During deployment, score the usability of each LF technology on a statistically supportable sample of customers using the System Usability Scale (SUS)<sup>2</sup> and collect input from customers and end users to develop strategies to improve device usability and customer engagement strategies.</p>
<p><b>Mitigate Financial and Health Burdens.</b> Mitigate the financial and health impacts of electrification and time-varying rates on disadvantaged (DA) and low-income (LI) communities. Consider utility bills, LF technology costs, air quality, and extreme heat. Explore the capability of FM and other low-cost signals to enable LF technologies.</p>	<p><b>Evaluate and demonstrate key technologies for DA and LI communities</b> to overcome financial and health burdens, and develop plans to build capacity through innovation and targeted deployment of those technologies. Our objective is to have an Equity First strategy in CalFlexHub, operationalized by principles that crosscut projects.</p>
<p><b>Foster Investment.</b> Develop methods to attract additional funding in technologies and practices to improve load flexibility.</p>	<p><b>Create a CalFlexHub Navigator</b> to leverage additional public and private funding to accelerate deployment of flexible technologies and strategies to the market.</p>
<p><b>Value and Prioritize LF Technologies.</b> Develop a robust methodology and key performance metrics (KPMs) to value and prioritize the pilot-tested and other available LF technologies and strategies, and identify high-priority pathways. Ensure these KPMs are linked to California’s policy and valuation systems. Document the performance, consumer acceptance, and the value of the economic and environmental benefits to the customer and the system, of flexible demand technologies and strategies;</p>	<p><b>Research and create a database of KPMs,</b> including the SUS scores described above (where applicable), for 20–50 technology and strategy pathways and generate these metrics for 2025, 2030, and 2040. Publish summaries as part of the annual report for CalFlexHub stakeholders. Evaluate how these technologies perform in the CalFlexHub field tests.</p>
<p><b>LF Technology Commercialization.</b> Develop a set of strategies and methods to organize knowledge and lessons on “what works” to share with stakeholders. Draw on California and national knowledge from RDD&amp;D. Develop a strategy to grow and sustain CalFlexHub</p>	<p>Develop and deploy the <b>CalFlexHub Solutions Center</b> website and a <b>clearinghouse</b> to disseminate information, technology reports, and case studies to report on “what works,” sharing California and national R&amp;D. Create a sustainable partner engagement platform and</p>

<sup>2</sup> See for example: [Bangor, Kortum, and Miller. “An Empirical Evaluation of the System Usability Scale.” 2008](#), and [Kortum and Bangor. “Usability Ratings for Everyday Products Measured With the System Usability Scale.” 2013](#)

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Goal	Objective
research. Ensure stakeholders and innovators have clear information on best practices for technology transfer opportunities.	stakeholder engagement ecosystem. Develop a <b>Technology Transfer Best Practices Manual</b> for CalFlexHub Innovators. Develop a <b>newsletter</b> , workshops, and a seminar series to ensure outreach.

Ratepayer Benefits:<sup>3</sup> This Agreement will result in the ratepayer benefits of greater electricity reliability and lower costs. The project will result in direct benefits to the demonstration sites and to the local distribution grid. However, the greatest benefits from the project are expected to come from improved ability to promote load flexibility for customer loads and the use of a Load Management Standards (LMS) signal at scale throughout California. The CalFlexHub is designed to provide benefits to the distribution grid and bulk power system. Widespread adoption of flexible load will provide power system services that are cost competitive with conventional alternatives and help decrease the GHG intensity of California’s power grid.

Technological Advancement and Breakthroughs: 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 implementing several agile, data-driven, and stakeholder-informed strategies. The CalFlexHub will work closely with the critical stakeholders who are engaged and interested in advancing load flexibility in the building sector. CalFlexHub will have numerous methods to test technologies, partner with key technology developers, and ensure we are identifying and investing in the most important research pathways to reach mass market adoption. Low Technology Readiness Level (TRL) projects to be deployed under the Agreement have been selected based on partners that have demonstrated experience in bringing technology to market. Similarly, the higher TRL projects selected to be deployed will leverage prior investments that utilities and technology innovators have made in LF programs. CalFlexHub’s annual assessment of key performance metrics will increase a comprehensive understanding of the energy performance and market potential of new LF technologies. The CalFlexHub Solutions Center will provide practical and actionable recommendations and methods based on identifying “what works” and helping to overcome customer adoption barriers and usability issues.

**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

<sup>3</sup> California Public Resources Code, Section 25711.5(a) requires projects funded by the Electric Program Investment Charge (EPIC) to result in ratepayer benefits. The California Public Utilities Commission (CPUC)<sup>17</sup>, which established the EPIC in 2011, defines ratepayer benefits as greater reliability, lower costs, and increased safety (See CPUC “Phase 2” Decision 12-05-037 at page 19, May 24, 2012, [http://docs.cpuc.ca.gov/PublishedDocs/WORD\\_PDF/FINAL\\_DECISION/167664.PDF](http://docs.cpuc.ca.gov/PublishedDocs/WORD_PDF/FINAL_DECISION/167664.PDF)).

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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**

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

The administrative portion of the meeting will include discussion of the following:

- Terms and conditions of the Agreement;
- Invoicing and auditing procedures;
- Administrative products (subtask 1.1);
- CPR meetings (subtask 1.3);
- Match fund documentation (subtask 1.7);
- Permit documentation (subtask 1.8);
- Subcontracts (subtask 1.9); and
- Any other relevant topics.

The technical portion of the meeting will include discussion of the following:

- The CAM's expectations for accomplishing tasks described in the Scope of Work;
- An updated Project Schedule;
- Technical products (subtask 1.1);

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- Progress reports (subtask 1.5);
- Final Report (subtask 1.6);
- Technical Advisory Committee meetings (subtasks 1.10 and 1.11); 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 will be reallocated to cover the additional costs borne by the Recipient, but the overall Agreement amount will not increase. CPR meetings generally take place at the 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.

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- 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 will include a discussion of match funding and permits.
- Conduct and make a record of each CPR meeting. Provide the Recipient with a schedule for providing a Progress Determination on continuation of the project.
- Determine whether to continue the project, and if so whether modifications are needed to the tasks, schedule, products, or budget for the remainder of the Agreement. If the CAM concludes that satisfactory progress is not being made, this conclusion will be referred to the Deputy Director of the Energy Research and Development Division.
- Provide the Recipient with a *Progress Determination* on continuation of the project, in accordance with the schedule. The Progress Determination may include a requirement that the Recipient revise one or more products.

**Recipient Products:**

- CPR Report(s)

**CAM Products:**

- CPR Agenda
- 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 and the CAO 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.

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- 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* on a USB memory stick, organized by the tasks in the Agreement.

**Products:**

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

**REPORTS AND INVOICES**

**Subtask 1.5 Progress Reports and Invoices**

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

**The Recipient shall:**

- Submit a monthly *Progress Report* to the CAM. Each progress report must:
  - Summarize progress made on all Agreement activities as specified in the scope of work for the preceding month, including accomplishments, problems, milestones, products, schedule, fiscal status, and an assessment of the ability to complete the Agreement within the current budget and any anticipated cost overruns. See the Progress Report Format Attachment for the recommended specifications.
- Submit a monthly or quarterly *Invoice* that follows the instructions in the “Payment of Funds” section of the terms and conditions, including a financial report on Match Funds and in-state expenditures.

**Products:**

- Progress Reports
- Invoices

**Subtask 1.6 Final Report**

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

**Subtask 1.6.1 Final Report Outline**

**The Recipient shall:**

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

**Recipient Products:**

- Final Report Outline (draft and final)



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**CAM Product:**

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

**Subtask 1.6.2 Final Report**

**The Recipient shall:**

- Prepare a *Final Report* for this Agreement in accordance with the approved Final Report Outline, 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* 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
- Draft Final Report
- *Written Responses to Comments* (*if applicable*)
- Final Report

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**CAM Product:**

- Written Comments on the Draft Final Report

**MATCH FUNDS, PERMITS, AND SUBCONTRACTS**

**Subtask 1.7 Match Funds**

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

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

**The Recipient shall:**

- Prepare a *Match Funds Status Letter* that documents the match funds committed to this Agreement. If no match funds were part of the proposal that led to the 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 proposal 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*)

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

**Subtask 1.8 Permits**

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

**The Recipient shall:**

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

The list of permits and the schedule for obtaining them will be discussed at the Kick-off meeting (subtask 1.2), and a timetable for submitting the updated list, schedule, and copies of the permits will be developed. The impact on the project if the permits are not obtained in a timely fashion or are denied will also be discussed. If applicable, permits will be included as a line item in progress reports and will be a topic at CPR meetings.

- If during the course of the Agreement additional permits become necessary, then provide the CAM with an *Updated List of Permits* (including the appropriate information on each permit) and an *Updated Schedule for Acquiring Permits*.
- Send the CAM a *Copy of Each Approved Permit*.
- If during the course of the Agreement permits are not obtained on time or are denied, notify the CAM within 5 days. Either of these events may trigger a CPR meeting.

**Products:**

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

**Subtask 1.9 Subcontracts**

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

**The Recipient shall:**

- Manage and coordinate subcontractor activities in accordance with the requirements of this Agreement.
- Incorporate this Agreement by reference into each subcontract.
- Include any required Energy Commission flow-down provisions in each subcontract, in addition to a statement that the terms of this Agreement will prevail if they conflict with the subcontract terms.

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- If required by the CAM, submit a draft of each *Subcontract* required to conduct the work under this Agreement.
- Submit a final copy of each executed subcontract.
- Notify and receive written approval from the CAM prior to adding any new subcontractors (see the discussion of subcontractor additions in the terms and conditions).

#### **Products:**

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

#### **TECHNICAL ADVISORY COMMITTEE**

##### **Subtask 1.10 Technical Advisory Committee (TAC)**

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

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

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

- Researchers knowledgeable about the project subject matter;
- Members of trades that will apply the results of the project (e.g., designers, engineers, architects, contractors, and trade representatives);
- Public interest market transformation implementers;
- Product developers relevant to the project;

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- U.S. Department of Energy research managers, or experts from other federal or state agencies relevant to the project;
- Public interest environmental groups;
- Utility representatives;
- Air district staff; and
- Members of relevant technical society committees.

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

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

#### **Products:**

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

#### **Subtask 1.11 TAC Meetings**

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

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

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

#### **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.

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- Help identify key areas where the project has a competitive advantage, value proposition, or strength upon which to build.
- Advocate on behalf of the project in its effort to build partnerships, governmental support and relationships with a national spectrum of influential leaders.
- Ask probing questions that insure a long-term perspective on decision-making and progress toward the project's strategic goals.
- Review and provide comments to proposed project performance metrics.
- Review and provide comments to proposed project Draft Technology Transfer Plan.

**Products:**

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

**Subtask 1.12 Project Performance Metrics**

The goal of this subtask is to identify key performance targets for the project. 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 draft *Project Performance Metrics Questionnaire* to the CAM prior to the Kick-off Meeting.
- Present the draft *Project Performance Metrics Questionnaire* 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 final *Project Performance Metrics Questionnaire*.
  - TAC comments the recipient does not propose to incorporate with and explanation why.
- Submit a final *Project Performance Metrics Questionnaire* with incorporated TAC feedback.
- 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 Performance Metrics Questionnaire*.
- Discuss the final *Project Performance Metrics Questionnaire* and *Project Performance Metrics Results* at the Final Meeting.

**Products:**

- Project Performance Metrics Questionnaire (draft and final)
- TAC Performance Metrics Summary
- Project Performance Metrics Results

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**IV. TECHNICAL TASKS**

**TASK 2 CONDUCT NEEDS ASSESSMENT, USABILITY ANALYSIS, AND HUB STAKEHOLDER SURVEY**

The goal of this task is to conduct a needs assessment to help guide prioritization of research pathways within CalFlexHub and determine usability needs. This task will also evaluate market opportunities for technologies evaluated in CalFlexHub.

**Subtask 2.1 Stakeholder Needs Assessment**

**The Recipient shall:**

- Prepare *Initial Needs Assessment Memo* that describes and summarizes the following activities:
  - Conduct in-depth interviews with key representatives from target stakeholder groups (e.g., utilities, controls and equipment manufacturers, and large customers including affordable housing advocates and developers). This will identify their needs, priorities, and constraints related to individual technology groups, to: (1) guide technology prioritization for Year 2–4 demonstrations, (2) inform design of load flexibility signal and receiver capabilities in accordance with stakeholder needs; and (3) inform the design of stakeholder surveys.
  - Survey stakeholder groups with many members (e.g., customers, manufacturers, installers) to estimate the prevalence of the needs, priorities, and constraints identified in the stakeholder interviews (Year 1).
- Gather input from target stakeholder groups on an annual basis to identify important shifts in the needs, priorities, and constraints. Document in annual *Needs Assessment Update Memos*.
- Compile all the feedback on stakeholder needs compiled during CalFlexHub implementation into a *Stakeholder Needs Assessment Report*.

**Products:**

- Initial Needs Assessment Memo
- Needs Assessment Update Memo (Year 2)
- Needs Assessment Update Memo (Year 3)
- Stakeholder Needs Assessment Report

**Subtask 2.2 User Assessment of Technologies Demonstrated in Tasks 6 and 7**

**The Recipient shall:**

- Create and compile technology-specific user assessment findings and summaries for each researched technology tested at a demonstration or deployment site in an *Annual User Assessment Memo* to include, but not limited to:
  - Develop a protocol to gather data on user experience and usability to identify potential design improvements to ensure the technology meets user needs and will be met with user acceptance. (*User* is broadly defined as anyone that interacts with the technology, e.g., customer, installer, building occupant, building manager).
  - Implement user experience and system usability scale testing protocol during the field test of each technology.

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- Draft results and recommendations for each technology evaluated.

**Products:**

- Annual User Assessment Memo (Years 1, 2, and 3)

**Subtask 2.3 Market Assessment Studies for Demonstrated Technologies**

**The Recipient shall:**

- Create an *Annual Market Assessment Report* that compiles technology-specific market assessment analyses which lay out barriers to and opportunities for the adoption of technologies, drawing from tasks that include, but are not limited to:
  - Characterize the baseline of technology adoption trends, updating it over time, through innovation landscaping from primary and secondary sources.
  - Conduct consumer valuation of benefits, losses, and/or design elements tied to load flexibility associated with demonstrated technologies (e.g., HVAC, EV service equipment) based on surveys of a range of customer groups (e.g., small-medium commercial businesses, affordable housing developers, university campus, residential utility customers, EV drivers).
  - For each technology whose market potential was assessed, a technology-specific analysis will be prepared and included in the *Annual Market Assessment Report* on barriers to and opportunities for technology adoption, synthesizing findings from innovation landscape analysis, stakeholder needs assessment, human factors design analysis, and surveys.

**Products:**

- Annual Market Assessment Report (Produced for Years 1, 2 and 3)

**TASK 3 ECOSYSTEM ENGAGEMENT AND SUSTAINABLE CALFLEXHUB DESIGN**

The goal of this task is to create an organizational blueprint for attracting and developing new public and private funding commitments to support the long-term viability of CalFlexHub.

**The Recipient shall:**

- Develop a *CalFlexHub Funding Blueprint* that includes, but is not limited to:
  - Identification and engagement of market participants across the entire supply chain.
  - Mapping anticipated values that CalFlexHub brings to major stakeholders and ecosystem actors.
  - Engagement plan for ecosystem participants and stakeholders to vet and validate funding models required to sustain the CalFlexHub program.
  - Target funding programs and potential private investors.
  - A multi-year fund development plan and sustainable funding models.
- Refine the *CalFlexHub Funding Blueprint* annually to reflect lessons learned and stakeholder input.
- Submit a *Sustainable CalFlexHub Annual Progress Report* documenting the efforts, successes, challenges, and barriers towards long-term program sustainability. Will include reporting on additional leveraged funds raised to support activities beyond this Scope of Work to improve the reach and/or longevity of the program.



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#### Products:

- CalFlexHub Funding Blueprint (Updated Annually)
- Sustainable CalFlexHub Annual Progress Report

#### **TASK 4 DEVELOP VALUATION METHODOLOGY AND METRICS, ASSESS RESEARCH PATHWAYS AND IMPACTS, AND PRIORITIZE PORTFOLIO**

##### **Subtask 4.1 Develop a Valuation Methodology and Metrics for Candidate Research Pathways**

The goal of this subtask is to develop a scoring framework to evaluate candidate technologies or strategies for achieving load flexibility according to a consistent set of metrics. The framework will value and compare load flexibility technologies across a wide range of dimensions and levels of aggregation, ranging from impacts on individual representative buildings and customers to impacts on the power system and environment (including GHG and air quality).

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

- Develop a *Prioritization Metrics Memo* of key performance metrics (KPMs) documenting a set of metrics to evaluate each candidate CalFlexHub technology and strategy on a variety of dimensions and scales. The metrics will be used for prioritization of research pathways, with documentation of the rationale for each. These metrics will be calculated for specific DAC populations where relevant, as guided by Subtask 4.3. Metrics may differ by TRL categories and may consider topics including, but not limited to, the following:
  - Customer benefit-cost ratio (energy bill savings and/or market revenue compared to up-front cost)
  - Technology usability (SUS scores), customer acceptance of the technology
  - Impact on customer participation in load flexibility programs (e.g. real-time pricing)
  - Non-energy benefits to the customer (e.g., comfort, convenience)
  - Impacts on equipment useful life
  - Energy efficiency impacts (energy use per unit of end-use consumption)
  - Path-to-market timescale and potential speed and breadth of deployment in the building stock
  - End use demand reduction capacity (kilowatts, kW) and load shifting capability (kilowatt-hours, kWh), on a seasonal and annual basis
  - Interoperability with other flexible technologies within a portfolio of buildings
  - Impacts on load factor at the facility, distribution, and/or transmission level
  - Potential for deployment and customer benefits in disadvantaged communities
  - Impacts on local air pollution from fossil generation
  - Greenhouse gas emissions impacts
  - Changes in spatially resolved distribution system capacity required to accommodate new load flexibility technologies
  - Changes in distribution-system related costs associated with adoption of load flexibility technologies
  - Power system benefit-cost ratio (avoided grid capital investment, capacity procurement, and energy costs, compared to the total resource cost for load flexibility)
  - Implications for system reliability

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- Changes to system load shape, including peak reduction and load shifting to improve utilization of renewables (accounting for efficiency losses from storage or flexibility utilization)
- Utilization of current and future renewable generation output potential.
- Develop an *Evaluation Framework Report* documenting the tools and methods to compute the prioritization metrics for each technology and strategy.
- Solicit input and feedback from the TAC and the CAM regarding the relative importance of different metrics and the appropriateness of proposed evaluation methods.
- Determine the key input data requirements needed to compute metrics and develop a *Technology Characterization Template* to be used for characterizing each candidate technology or strategy, to be used in Tasks 6 and 7.

**Products:**

- Prioritization Metrics Memo
- Evaluation Framework Report (draft and final)
- Technology Characterization Template

**Subtask 4.2 Calculate Metrics, Assess and Prioritize Research Pathways, and Recommend Research Portfolio**

The goals of this subtask are to apply the evaluation framework developed in Subtask 4.1 to candidate CalFlexHub research pathways and calculate metrics for prioritization, then rank and prioritize candidate technologies and strategies for achieving load flexibility on an annual basis and recommend a selected research portfolio for each year of the project.

**The Recipient shall:**

- Compile characterization data for current and candidate CalFlexHub technologies and strategies (as computed in subtasks 6.2 and 7.1) on an annual basis.
- Produce evaluation metrics.
- Organize results into a *Matrix of Prioritization Metrics Memo* for further assessment and prioritization, for each candidate technology or strategy, updated annually.
- Define a protocol to rank and prioritize each technology, strategy, and pathway based on the evaluation metrics.
- Solicit input and feedback from the TAC and the CAM on the relative importance of key metrics and the overall approach to prioritization.
- Develop an *Annual Prioritization of Research Pathways and Recommended Portfolio Report* consisting of a prioritized list of technologies and strategies updated annually. Include both ARD and TDD projects.
- Conduct a load flexibility needs assessment to establish the quantity of flexible load that will be required to meet the State's goal of a carbon-free grid by 2045, based on literature review and limited modeling efforts as needed.
- Incorporate the results from the load flexibility needs assessment to evaluate which technology are prioritized for each future year's research in the *Annual Prioritization Research Pathways and Recommended Portfolio Reports*.
- Conduct CPR meeting and prepare *CPR Report #1* in accordance with subtask 1.3

**Products:**

- Matrix of Prioritization Metrics Memo (Years 1, 2 and 3)

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- Annual Prioritization of Research Pathways and Recommended Portfolio Reports (Years 1, 2 and 3) (draft and final)
- CPR Report #1

### **Subtask 4.3 Evaluate Issues and Build a Research Plan to Build Capacity in Underserved Communities**

The goal of this subtask is to evaluate both beneficial and adverse impacts on disadvantaged and low-income communities and to build a research plan to build capacity in these communities

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

- With input from the CAM, form a DAC and LI Equity Advisory Committee (EAC) composed of both technical experts with experience working with DAC and LI communities and community representatives to guide activities in this task.
- Work with EAC to provide input into the DAC performance metrics developed in Task 4.1.
- Review the DAC and LI projects within Tasks 6 and 7, and produce an *Annual DAC and LI Research Memo*, describing the DAC and LI elements in the technology portfolio.
- Prepare a *Research Plan to Build Capacity in DAC and LI Communities* that describes how the needs of DAC and LI communities will be met through the assessment, identification, and research toward equitably advancing load flexible technologies.

#### **Products:**

- Annual DAC and LI Research Memo (Years 1, 2, and 3)
- Research Plan to Build Capacity in DAC and LI Communities

## **TASK 5 DEVELOP AND DEMONSTRATE LOAD MANAGEMENT STANDARDS COMPATIBLE COMMUNICATIONS TECHNOLOGIES**

The goals of this task are to define the technology infrastructure needed for comprehensive distribution of time-varying prices and GHG signals that are compatible with the CEC Load Management Standards. To the extent that the Load Management Standards rulemaking is successful in timely implementation of the statewide rate database and price distribution system, the CalFlexHub research projects will be compatible with and make use of the data resulting from the Load Management Standards and include use of the resulting statewide rate database for automation signaling, as required by the solicitation. This task will cover system architecture, communication protocol standards, signal reception, and infrastructure devices.

### **Subtask 5.1 Establish Load Management Standards (LMS) System Foundations**

The goals of this subtask are to develop and deploy technologies consistent with California's building energy efficiency, appliance, and load management standards, as required by the solicitation. To be consistent with CEC standards, and where feasible, the signals will originate from the CEC's LMS system and be received by LF technologies in the same format. These efforts will support sufficient technology infrastructure to enable the reliable and secure delivery of price and GHG signals to laboratory and field test sites for Tasks 6 and 7, and to field test technologies and methods that are compatible with the statewide system. This will include engagement with CEC staff to understand their questions and concerns and to provide ongoing insight and support.

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

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- Develop a *Price/GHG Communications Architecture Report* to summarize and document research on an LMS prototype communication system (LMS-P) that will be compatible with the CEC's price and GHG automated, statewide price signaling platform, including but not limited to:
  - Overall system architecture of actors, subsystems, entities, data communicated, and core technologies.
  - Sources of GHG emission data and common usage scenarios.
  - Price server basic features and capabilities and additional needs for research use.
  - How users will utilize the future system to achieve device flexibility.
  - Known detailed implementation issues for all parties involved.
  - Overview of internal structure of the price server, including input paths, output paths, data stores, historical data, and management interfaces
  - Core data models for communicating TOU, CPP/VPP, and real-time price streams
  - Key communication protocols and their usage
- Prepare a *Price/GHG Communications Foundations Report* to discuss and summarize the results of the following research activities:
  - Use the CEC's Load Management Standards communication platform for disseminating price and GHG signals, where feasible, for research and development (R&D) purposes.
  - Develop an LMS communication system (the LMS-P) that is compatible with the CEC's Load Management Standards automated signaling rate database platform for price and GHG signals to be used for R&D purposes by CalFlexHub partners and interested manufacturers. The communication system will include, but not be limited to:
    - The ability to take in price and GHG signals in multiple formats (current, historic, or hypothetical).
    - The ability to stream out the data over multiple communication technologies.
    - The ability to support individualized research-defined price playback mechanisms.
    - A flexible building gateway device that supports receiving the data over multiple communication technologies.
  - Analyze known issues with price communication and identify solutions as feasible, including:
    - Cybersecurity
    - Building owner usage models and use cases
    - Technology standards gaps
    - Intra-building coordination and communication
  - Interview future users of the system including technology providers, manufacturers, standards organizations, and building operators for concerns or needs they may have.
  - Add data to the LMS rate database using the CEC's rate data upload tool, as needed to complete the CalFlexHub research projects.
  - Identify further technology development needs and prioritize activities for the coming year.
  - Recommendations for the following year work topics, broadly categorized as:
    - Price and GHG emission data provision and utilization
    - Price Server and data model development
    - Communication technology standards development

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- Building infrastructure device development
- Cybersecurity and privacy
- User needs and considerations
- Atypical conditions operation
- Annually (Years 2–4) prepare a *Price Communications Technology Report* to update and expand upon all items in the *Architecture* and *Foundations* specifications as research progresses.
  - Conduct priority topic research as identified in *Price Communications Foundations Report*, and any prior *Price Communications Technology Reports*.
  - Make recommendations for the following year work topics broadly categorized as above.

**Products:**

- Price/GHG Communications Architecture Report (Year 1)
- Price/GHG Communications Foundations Report (Year 1)
- Price/GHG Communications Technology Report (Years 2, 3, and 4)

**Subtask 5.2 Signal Reception Analysis and Comparison**

The goal of this subtask is to develop a comprehensive analysis of the ability of California buildings and Distributed Energy Resources (DER) within them to receive price and GHG signals and to guide Years 2-4 CalFlexHub technology development and deployment. Where feasible, signals will originate from the CEC's LMS system.

**The Recipient shall:**

- Prepare a *Signal Reception Survey Considerations Memo* to report on the results of the following:
  - Review general considerations and goals for understanding price/GHG signal reception throughout California including at LF technology deployments, and include a description of each communication technology to be tested.
  - Consult with CEC staff to record their intentions and uses for the survey results.
- Prepare a *Signal Reception Survey and Analysis Plan* to lay out the communications research in this subtask and to be included in deployment plans, including essential components, optional ones, and analysis methods.
  - Create a detailed plan for surveying the ability of electricity customer devices to successfully receive price/GHG signals, including but not limited to:
    - Communication technologies to be assessed, including cellular, Internet, FM, and possibly others.
    - Description of methods used for testing key communication technologies.
    - Approaches to compare coverage and other performance characteristics.
  - Goals for geographical coverage and number of sites assessed, including discussion of statistical interpretation and implications for sample sizes.
    - Consider specific effects on DER signal reception, e.g. geographical location, location in a building, building envelope materials, local interference issues, etc.
    - Central infrastructure needed to enable the survey (e.g., signal for cellular reception, RDS signal for FM reception; price server for Internet Protocol communication).
- Prepare a *Signal Reception Survey Analysis* as an annual (end of Years 2-4) report on the year's findings and the updated overall conclusions.

**Exhibit A**  
**Scope of Work**  
**Lawrence Berkeley National Laboratory**

- Conduct the activities outlined in the *Signal Reception Survey and Analysis Plan* taking into account any recommendations from the annual *Signal Reception Survey Analysis* reports.
- Include a detailed comparison between all Internet and broadcast communications technologies.
- Assess the effectiveness of using one or a combination of the technologies to send price/GHG signals to customer devices including the deployed LF technologies (Task 6).
- Make recommendations for adjustments to the *Annual ARD Project Update Report* (Task 6) and other future work

**Products:**

- Signal Reception Survey Considerations Memo
- Signal Reception Survey and Analysis Plan
- Signal Reception Survey Analysis (Years 2, 3 and 4)

**TASK 6 RESEARCH AND DEVELOP ADVANCED FLEXIBILITY TECHNOLOGIES (ARD)**

**Subtask 6.1 Technology Portfolio Management**

The goal of this subtask is to coordinate and manage the portfolio of projects conducted by all the project partners.

**The Recipient shall:**

- Develop a general methodology for experimental design, and for measurement and verification (M&V) for all Task 6 and 7 projects. The M&V assessment will define the baseline conditions and estimate the performance of the technology and load impacts in accordance with the Technology Characterization Template defined in Task 4.1. and provide data relevant to the performance metrics in Exhibit A-3 (Year 1).
- Define a data management strategy for collecting, storing and processing raw data from all the projects in the portfolio (Year 1).
  - Develop tools to implement this strategy including databases and software to automatically transfer data and compute metrics (Year 1).
  - Document the strategy and the tools developed in a *Data Management Report*.
- Develop an annual workplan for both Task 6 ARD and Task 7 TDD projects:
  - Confirm the initial portfolio of projects and coordinate research activities with project partners (Year 1).
  - Update the portfolio of technologies after the annual prioritization process in Task 4.2 (Year 2-4).
    - Define the final deliverables for projects that are not selected for continuation.
    - Work with partners to develop a new project plan for the new projects.
- Collect data from each project periodically or continuously and store it in the centralized database (Years 1-4)
- Prepare a *Technology Portfolio and Workplan Memo* (Years 1-3) to update the list of projects and organizations working on them.

**Products:**

- Data Management Report

## **Exhibit A**

### **Scope of Work**

#### **Lawrence Berkeley National Laboratory**

- Annual Technology Portfolio and Workplan Memo (Years 1, 2, 3 and 4) (draft and final)

#### **Subtask 6.2 Applied Research and Development Project-Specific Activities**

The goal of this subtask is to conduct applied research and development (ARD) activities for each of the projects in the project portfolio, which may include but is not limited to:

- P1: Smart Fan and Thermostat Integration for Load Shed & Resilience in Existing Homes
- P2: Optimizing Heat Pump Load Flexibility in Response to a Real-Time Price Signal
- P3: Evaluating Price-Algorithm in Controlling Commercial Heating, Ventilation, and Air Conditioning (HVAC) Heat Pumps
- P4: Grid responsive all-electric HVAC with Thermal Energy System (TES) for small and medium commercial buildings
- P5: Connected Communities – Model Predictive Controls (MPC) Development for Price & GHG-responsive Large Commercial Buildings and District Energy Systems
- P6: Home Energy Management System to Maximize Electrical Panels and Service Levels

The Recipient will research and develop new demand flexibility technologies consistent with California's building energy efficiency, appliance, and load management standards as required by the GFO-19-309 solicitation manual, Section I.C.

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

Conduct research for year one that may include but is not limited to the following:

- Develop plans to integrate and validate smart ceiling fans with multiple thermostat platforms, networked house exhaust fans, and sensors, and create open source algorithms to optimize fan cooling with ventilation and energy savings with reduced and shiftable HVAC to consider pre-cooling. Year 1 will consist of design of software and hardware and lab research. (P1)
- Develop coordinated water heater design and controls to respond to price signals using open-source heat pump models developed under to study the response of HPWH and space conditioning systems to real-time price signals. Year 1 will consist of design of software and hardware and lab research. (P2)
- Develop, evaluate and test advanced control algorithms for small commercial buildings that respond to GHG emissions and price signals to enable demand flexibility and electrification of natural gas end uses, using FLEXLAB®. Year 1 will consist of design of software and hardware and lab research. (P3)
- Develop and test a variable speed HP space conditioning unit with phase change TES for heating and cooling. The system will be installed in a small modular office and operated to shift loads, support utilization of renewables, and reduce annual energy costs for the site. Year 1 will consist of design of software and hardware and lab research. (P4)
- Develop a set of novel control strategies to increase load flexibility in large connected communities (campuses), then evaluate the performance of these algorithms on multiple sites, including their ability to save utility costs, improve load flexibility, and reduce GHG emissions. Year 1 will consist of software design and field testing. (P5)
- Develop and lab test a Home Energy Management Systems to reduce panel upgrade costs to advance end-use electrification. Year 1 will consist of design of software and hardware and lab research. (P6)

Conduct ARD research in Years 2-4 based on results of the Annual Prioritization of Research Pathways and Recommended Portfolio Reports prioritization from Task 4.2

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For each current and potential future project in the portfolio:

- Confirm the project timeline and deliverables (Years 1–4).
- Develop a detailed test plan in accordance with the general M&V methodology from Task 6.1. (Year 1). The plan needs to specify:
  - A method to calculate the baseline to be compared with measured flexible load.
  - The detailed prices/GHG values that need to be sent by the Price server.
  - How test results can inform the signal reception analysis in Task 5.
- For projects that require software development (e.g., new optimization algorithms):
  - Define the software specifications.
  - Develop the software according to the specifications.
  - Test the software (through bench, lab or field test) to evaluate its functionality.
  - Document the results in a technology-specific chapter in the *Annual ARD Project Update Report*.
- For projects that require hardware development (e.g., manufacture of a new LF technology or construction of a new electrical panel):
  - Define the hardware specifications.
  - Procure the materials and construct hardware.
  - Conduct hardware testing (through bench, lab, or field tests) to evaluate its functionality.
  - Document the results in a technology-specific chapter in the *Annual ARD Project Update Report*.
- For projects that include a field test:
  - Collect detailed information about the site and its baseline operation.
  - Install the hardware and software on site.
  - Commission the technology.
  - Conduct tests of the technology based on the detailed test plan.
  - Monitor the technology and collect data on load flexibility for the required performance period.
  - Identify and troubleshoot possible issues that emerge during the tests.
  - Implement the user experience and usability protocol defined in Task 2.2.
  - Document the results in a technology-specific chapter in the *Annual ARD Project Update Report*.
- For projects that include a laboratory test:
  - Collect detailed information about the lab and the experimental setup.
  - Install the hardware and software in the laboratory.
  - Commission the technology and conduct tests based on the detailed test plan.
  - Monitor the technology and collect data on load flexibility for the required performance period.
  - Identify and troubleshoot possible issues that emerge during the tests.
  - Implement the user experience and usability protocol defined in Task 2.2.
  - Document the results in a technology-specific chapter in the *Annual ARD Project Update Report*.
- For projects that use the LMS signal:
  - Create a method to receive and interpret the new price/GHG signal generated by the Price Server, as described in Task 5.2.
  - Document the process and lessons learned in a technology-specific chapter in the *ARD Project Update Report*. To support the CEC’s Demand Flexible Appliance



# Exhibit A

## Scope of Work

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Standards, the report will document the following for each end-use technology investigated:

- Relevant goals or requirements (functional and non-functional);
  - A high-level description of the algorithms used to achieve LF;
  - How entities, consumers and devices will utilize the system to achieve LF;
  - Known detailed implementation issues for all parties involved.
- Finalize the *Annual ARD Project Update Report* that documents the development, test, and deployment plan of the ARD technology portfolio (Year 1-4).
  - Conduct CPR meeting and prepare *CPR Report #2* in accordance with subtask 1.3

#### **Products:**

- Annual ARD Project Update Report (Years 1, 2, 3 and 4) (draft and final)
- CPR Report #2

### **TASK 7 DEMONSTRATE AND DEPLOY FLEXIBLE TECHNOLOGIES (TDD)**

#### **Technology Deployment and Demonstration Project-specific Activities**

The goal of this task is to conduct technology demonstration and deployment (TDD) activities for each of the projects in the project portfolio, which may include but is not limited to:

- P7: Price Response Emerging Small Commercial Energy Management
- P8: Price Responsive Integrated Heat Pump (HP) for Domestic Hot Water (DHW) and Space Conditioning
- P9: Price Responsive Affordable Home HVAC and Hot Water Using the Harvest Pod TES
- P10: Household Flexible EV Charging
- P11: Bi-Directional EV Charging
- P12: Control and Coordination of Distributed Flexible Loads Using Scalable Solutions: technologies may include but not limited to HP water heater, HVAC controls, refrigeration, pool pumps, EV charging, electric batteries and thermal storage.

This task will demonstrate and deploy advanced technologies and operational strategies that increase demand flexibility with a goal of mass-market technology advancement, customer interface and experience understanding, and commercialization, as required by the GFO-19-309 solicitation manual, Section I.C.

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

Conduct research for year one that may include but is not limited to the following:

- Develop and demonstrate building systems, including HVAC, stationary batteries, and on-site renewable generation, integrated with the LMS to act as flexible DER to reduce electric bills and maintain normal operations. (P7)
- Develop and demonstrate a residential system that uses one HP for both hot water heating and space conditioning, integrated with the LMS. (P8)
- Develop and demonstrate residential, all-electric TES for space and water heating, integrated with the LMS signal to shift load effectively. (P9)
- Develop and demonstrate flexible household EV charging systems integrated with the LMS. (P10)
- Develop and demonstrate bi-directional V2G charging integrated with the LMS. (P11)

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- Develop and demonstrate multiple types of commercially available building equipment receiving and responding to the LMS signal through a variety of control architectures, including cloud-based aggregation, on-site energy management gateways, and native device-integrated controls. The task will include large numbers of devices, ranging from the tens to thousands of units, to verify load flexibility performance across climates, building types, and occupant behavior. Multiple demonstration sites will be deployed, including for PV integration and customers with HPWH, EVs, smart thermostats, thermal storage, and pool pumps. (P12)

Conduct TDD research in Years 2 -4 based on results of the Annual Prioritization of Research Pathways and Recommended Portfolio Reports prioritization from Task 4.2.

For each current and potential future project in the portfolio:

- Confirm the project timeline and deliverables (Years 1–4).
- Develop a detailed test plan in accordance with the general M&V methodology from Task 6.1. (Year 1). The plan will specify:
  - A method to calculate the baseline to be compared with measured flexible load.
  - The detailed prices/GHG values that need to be sent by the LMS Price server.
- For projects that require software development (e.g., new optimization algorithms):
  - Define the software specifications.
  - Develop the software according to the specifications.
  - Test the software (through bench, lab, or field test) to evaluate its functionality.
  - Document the results in a technology-specific chapter in the *Annual TDD Project Update Report*.
- For projects that require hardware development (e.g., construction of a new electrical panel):
  - Define hardware specifications.
  - Procure the materials and construct hardware.
  - Conduct hardware testing (through bench, lab, or field test) to evaluate its functionality.
  - Document the results in a technology-specific chapter in the *Annual TDD Project Update Report*.
- Field demonstrations or deployment project activities will include:
  - Collect detailed information about the site and its baseline operation.
  - Install the hardware and software on site.
  - Commission the technology and conduct tests based on the detailed test plan.
  - Monitor the technology and collect data on load flexibility for the required performance period.
  - Identify and troubleshoot possible issues that emerge during the tests.
  - Implement the user experience and usability protocol defined in Task 2.2.
  - Document the results in a technology-specific chapter in the *Annual TDD Project Update Report*.
- To interact with the LMS signal:
  - Create a method to receive and interpret the price and GHG signals generated by the LMS Price Server, as described in Task 5.2.
  - Document the process and lesson learned in a technology-specific chapter in the *Annual TDD Project Update Report*. To support the CEC's Demand Flexible Appliance Standards, the report will document the following for each end-use technology investigated:

**Exhibit A**  
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- Relevant goals or requirements (functional and non-functional);
- A high-level description of the algorithms used to achieve LF;
- How entities, consumers and devices will utilize the system to achieve LF;
- Known detailed implementation issues for all parties involved.
- Finalize the *Annual TDD Project Update Report* that documents the demonstration and deployment of the TDD technology portfolio (Years 1-4). This will include load impact evaluation where available.
- For each TDD Project conduct a *Deployment Project Load Impact Evaluation* in Year 4, to quantify the direct load impact from the TDD projects (not extrapolated to the building stock as a whole) in accordance with the general M&V methodology developed in Task 6. Provide all key assumptions used to estimate actual load impact and benefits, including baseline, actual, and projected energy use and cost, energy and cost impacts, operating conditions, and emission reduction calculations.
- Conduct CPR meeting and prepare *CPR Report #3* in accordance with subtask 1.3.

**Products:**

- Annual TDD Project Update Report (Years 1, 2, 3, and 4) (draft and final)
- Deployment Project Load Impact Evaluation (Year 4)
- CPR Report #3

**TASK 8 EVALUATION OF PROJECT BENEFITS**

The goal of this task is to report the benefits resulting from this project. The CalFlexHub will document the performance, consumer acceptance, and the value of the economic and environmental benefits to the customer and the system of flexible demand technologies and strategies, as required by the solicitation.

**The Recipient shall:**

- Complete three Project Benefits Questionnaires that correspond to three main intervals in the Agreement: (1) *Kick-off Meeting Benefits Questionnaire*; (2) *Mid-term Benefits Questionnaire*; and (3) *Final Meeting Benefits Questionnaire*.
  - Examples of information that may be requested in the questionnaires include:
  - For Product Development Projects and Project Demonstrations:
    - Published documents, including date, title, and periodical name.
    - Estimated baseline and actual energy and cost savings and estimated statewide energy savings once market potential has been realized. Identify all assumptions used in the estimates. Include ratepayer benefits.
    - Greenhouse gas and criteria emissions reductions.
    - Other non-energy benefits such as reliability, public safety, lower operational cost, environmental improvement, indoor environmental quality, and societal benefits.
    - Data on potential job creation, market potential, economic development, and increased state revenue as a result of the project.

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- A discussion of project product downloads from websites, and publications in technical journals.
- A comparison of project expectations and performance. Discuss whether the goals and objectives of the Agreement have been met and what improvements are needed, if any.
- Additional Information for Product Development Projects:
  - Outcome of product development efforts, such copyrights and license agreements.
  - Units sold or projected to be sold in California and outside of California.
  - Total annual sales or projected annual sales (in dollars) of products developed under the Agreement.
  - Investment dollars/follow-on private funding as a result of Energy Commission funding.
  - Patent numbers and applications, along with dates and brief descriptions.
- Additional Information for Product Demonstrations:
  - Outcome of demonstrations and status of technology.
  - Number of similar installations.
  - Jobs created/retained as a result of the Agreement.
- For Information/Tools and Other Research Studies:
  - Outcome of project.
  - Published documents, including date, title, and periodical name.
  - A discussion of policy development. State if the project has been cited in government policy publications or technical journals, or has been used to inform regulatory bodies.
  - The number of website downloads.
  - An estimate of how the project information has affected energy use and cost, or have resulted in other non-energy benefits.
  - An estimate of energy and non-energy benefits.
  - Data on potential job creation, market potential, economic development, and increased state revenue as a result of the project.
  - A discussion of project product downloads from websites, and publications in technical journals.  
A comparison of project expectations and performance. Discuss whether the goals and objectives of the Agreement have been met and what improvements are needed, if any.
- Conduct a CalFlexHub *Program Load Flexibility Impact and Benefits Evaluation* in Year 4, to estimate the quantity of flexible load that CalFlexHub has enabled in comparison to the state's needs. Include documented ratepayer benefits. Include documented ratepayer benefits and an updated statewide load flexibility needs assessment.
- Respond to CAM questions regarding responses to the questionnaires.

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

**Products:**

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- Kick-off Meeting Benefits Questionnaire
- Mid-term Benefits Questionnaire
- Final Meeting Benefits Questionnaire
- Program Load Flexibility Impact and Benefits Evaluation

**TASK 9 TECHNOLOGY AND KNOWLEDGE TRANSFER ACTIVITIES**

The goal of this task is to accelerate the commercial adoption of the technologies being supported in CalFlexHub by communicating and engaging successes of the program to stakeholders, prospective customers, and members of the public. Each activity will serve the greater purpose of facilitating the integration, aggregation, and scalability of flexible and interoperable demand technologies with efficiency measures, distributed generation, storage, and electric vehicle charging strategies, with the intent of optimizing customer load shapes, bills, and productivity while reducing GHG emissions and providing operational savings to the grid.

The Recipient shall:

- Develop, manage and implement a *CalFlexHub Navigator Plan* to guide innovators and entrepreneurs through the existing innovation ecosystem in California and evaluate emerging funding opportunities.
- Provide support to innovators to ensure that validated technical opportunities have the supporting elements of a sustainable business model to bring technology from the lab to commercial application. This support will include:
  - Assessments of startup levels, including evaluations of the team, product, market, and financials to identify and prioritize areas of improvement.
  - Business model advisory services and investor pitch training.
  - Networking support to engage with investors and corporate strategic partners.
  - Identification of funding opportunities that can support and accelerate technology commercialization beyond CalFlexHub.
  - Assistance with applications to incubators and accelerators, particularly existing commercialization and procurement resources established through already funded California Energy Commission programs, including:
    - The California Sustainable Energy Entrepreneur Development (CalSEED) Initiative
    - California Test Bed Initiative (New Energy Nexus)
    - Regional Energy Innovation Clusters, including Los Angeles Cleantech Incubator (LACI), Bay Area Regional Energy Innovation Cluster, CSU Fresno BlueTechValley, and Southern California Innovation Network.
    - California Energy Product Evaluation Hub (UC Davis).
    - California Opportunities for Procurement (Prospect Silicon Valley).
    - Advance Innovations in Software to Streamline Customer Procurement (Energy Solutions and Berkeley Lab)
- Host quarterly Topic Funding Webinars for CalFlexHub innovators to present current issues in fund development and current opportunities and distribute relevant funding opportunity announcements to innovators.
- Provide entrepreneurs and innovators with private consultations to:
  - Further explore funding topics.
  - Support product and technology commercialization.
  - Provide instruction in proposal score optimization.
  - Ideate, plan, and design funding submissions.

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- Develop Socialization Plans for CalFlexHub innovators to introduce them to agency and elected stakeholders, including GO-Biz, California Air Resources Board (CARB), CEC, California Department of Food and Agriculture (CDFA), CalRecycle, and others.
- Create a *Technology Transfer Best Practices Manual for CalFlexHub Innovators* to manage their own Technology Transfer Plans in support of their distinct technologies.
- Coordinate with the CEC on annual workshops to exchange research and market findings from CalFlexHub with California and national load flexibility and energy efficiency experts and stakeholders as determined and directed by the CAM.
- Develop and submit a CalFlexHub *Technology Transfer Plan (Draft)* that identifies the proposed activities the recipient will conduct to accelerate the successful commercial adoption of the technologies. These activities will include, but are not limited to:
  - Network engagement, organization, and communication that builds the capabilities for establishing commercial partners across the supply chain and value chain, such as profiles for participating projects designed to convey information about the technology commercial readiness to OEMs, utilities, Community Choice Aggregators, corporate partners, end users, investors, equity partners, and policymakers.
  - Producing infographics to visually demonstrate the value of the technologies in an easily understandable format for the average consumer to learn about new technical opportunities.
  - Conducting an annual CalFlexHub Symposium in coordination with the CEC.
  - Developing at least six 30- to 60-second video profiles of CalFlexHub projects and successes for website and social media.
- Developing a CalFlexHub Website that includes:
  - A searchable CalFlexHub Clearinghouse for research on new load flexibility technologies that are consistent with California's building energy efficiency, appliance, and load management standards and current demand-side management program and policies.
  - A CalFlexHub Solutions Center offering practical guides and case studies, specifications, and data to promote adoption of LF technologies.
  - A News section providing updates on project progress and significant milestones achieved by the Recipient, project partners, or participating innovators.
- Present the *Technology Transfer Plan (Draft)* to the TAC for feedback and comments.
- Incorporate TAC comments into *Technology Transfer Plan (Final)*. This document will identify TAC comments the recipient proposes to incorporate into the *Technology Transfer Plan (Final)* and comments the recipient does not propose to incorporate with and explanation why.
- Submit the *Technology Transfer Plan (Final)* to the CAM for approval.
- Implement activities identified in *Technology Transfer Plan*.
- Develop and submit a *Technology Transfer Summary Report (Draft/Final)* that includes high-level summaries of the activities, results, and lessons learned about tasks performed relating to implementing the *Technology Transfer Plan*. This report will not include any proprietary information.
- 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 CEC.

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- Provide at least six *High Quality Digital Photographs* (minimum resolution of 1,300 x 500 pixels in landscape ratio) of pre- and post-technology installation at the project sites or related project photographs.
- Submit a *Sustainable CalFlexHub Annual Report* documenting the efforts, successes, challenges, and barriers towards long-term program sustainability.

**Products:**

- CalFlexHub Navigator Plan
- Technology Transfer Best Practices Manual for CalFlexHub Innovators
- Technology Transfer Plan (Draft/Final)
- Technology Transfer Summary Report (Draft/Final)
- High-Quality Digital Photographs

**V. PROJECT SCHEDULE**

Please see the attached Excel spreadsheet.

STATE OF CALIFORNIA

STATE ENERGY RESOURCES  
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION - RE: LAWRENCE BERKELEY NATIONAL LABORATORY

**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-20-025 with Lawrence Berkeley National Laboratory for a \$16,000,000 grant to establish the California Flexible Load Research and Deployment Hub to develop, demonstrate, and deploy multiple demand flexible technologies as electric grid resources; and

**FURTHER BE IT RESOLVED**, that the Executive Director or his/her 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 April 14, 2021.

AYE:

NAY:

ABSENT:

ABSTAIN:

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Patricia Carlos  
Secretariat