STATE OF CALIFORNIA
GRANT REQUEST FORM (GRF)
CEC-270 (Revised 02/13) CALIFORNIA ENERGY COMMISSION

New Agreement EPC-15-020 (To be completed by CGL Office)

Division	Agreement Manager:	MS-	Phone
ERDD	Brad Williams	51	916-327-3312

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

Title of Project

Intelligent HVAC controls for Low Income Households: A low cost non-connected device that understands consumer preferences and performs adaptive optimization

Term and Amount	Start Date	End Date	Amount
	2/10/2016	3/30/2020	$ 2,705,759

Business Meeting Information

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

Proposed Business Meeting Date	2/10/2016	☐ Consent	☒ Discussion
Business Meeting Presenter	Brad Williams	Time Needed:	5 minutes

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

Agenda Item Subject and Description

Proposed resolution approving Agreement EPC-15-020 with Electric Power Research Institute (EPRI) for a $2,705,759 grant to develop a prototype thermostat for low income households that will overcome the lack of broadband access. The thermostat will reduce HVAC runtime and energy use, have diagnostic capabilities and provide consumers with access to energy use information. The prototypes will be tested in low income, multifamily units in Northern and Southern California. (EPIC funding) Contact: Brad Williams. (Staff presentation: 5 minutes)

California Environmental Quality Act (CEQA) Compliance

1. Is Agreement considered a "Project" under CEQA?
   ☒ Yes (skip to question 2) ☐ No (complete the following (PRC 21065 and 14 CCR 15378)):
   Explain why Agreement is not considered a "Project":
   Agreement will not cause direct physical change in the environment or a reasonably foreseeable indirect physical change in the environment because

2. If Agreement is considered a "Project" under CEQA:
   ☒ a) Agreement **IS** exempt. (Attach draft NOE)
   ☐ Statutory Exemption. List PRC and/or CCR section number:
   ☒ Categorical Exemption. List CCR section number: Cal. Code Regs., tit 14, § 15301, § 15306
   ☐ Common Sense Exemption. 14 CCR 15061 (b) (3)
   Explain reason why Agreement is exempt under the above section:
   Developing and pilot testing a new smart thermostat design to benefit disadvantaged and elderly communities. This project will replace thermostats in up to 20 households at each project site. There will be no other alterations to the building structure or site. Information will be collected on the performance of the HVAC systems before and after the new smart thermostats have been installed.
   ☐ b) Agreement **IS NOT** exempt. (Consult with the legal office to determine next steps.)
   Check all that apply
   ☐ Initial Study ☐ Environmental Impact Report
   ☐ Negative Declaration ☐ Statement of Overriding Considerations
   ☐ Mitigated Negative Declaration

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

Legal Company Name:	Budget
Regents of the University of California/California Institute for Energy	$ 494,545
The Regents of the University of California on behalf of the Davis	$ 409,214
	$
	$
	$
	$
	$
	$
	$

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

Budget Information

Funding Source	Funding Year of Appropriation	Budget List No.	Amount
EPIC	14-15	301.001B	$2,705,759
			$
			$
			$
			$
			$
R&D Program Area: EERO: Buildings		TOTAL:	$2,705,759
Explanation for "Other" selection			
Reimbursement Contract #:		Federal Agreement #:	

Recipient's Administrator/ Officer				**Recipient's Project Manager**			
Name:	David Morrison			Name:	Omar Siddiqui		
Address:	942 Corridor Park Blvd			Address:	3420 Hillview Ave		
City, State, Zip:	Knoxville, TN 37932-3723			City, State, Zip:	Palo Alto, CA 94304-1355		
Phone:	865-218-8104 /	Fax:	- -	Phone:	650-855-2328 //	Fax:	- -
E-Mail:	dmorriso@epri.com			E-Mail:	osiddiqui@epri.com		

Selection Process Used

☒ Competitive Solicitation Solicitation #: PON-13-301

☐ First Come First Served Solicitation

The following items should be attached to this GRF

1. Exhibit A, Scope of Work		☒ Attached
2. Exhibit B, Budget Detail		☒ Attached
3. CEC 105, Questionnaire for Identifying Conflicts		☒ Attached
4. Recipient Resolution	☒ N/A	☐ Attached
5. CEQA Documentation	☐ N/A	☒ Attached

Agreement Manager	Date	Office Manager	Date	Deputy Director	Date

EXHIBIT A
Scope of Work

I. TASK ACRONYM/TERM LISTS

A. TASK LIST

Task #	CPR[1]	Task Name
1		General Project Tasks
2		Development of Requirements of HVAC Controller
3	X	Bench-Scale Prototype Development
4		Pilot Testing with Multiple Low-Income Market Segments
5		Evaluation of Project Benefits
6		Technology/Knowledge Transfer Activities
7		Production Readiness Plan

B. ACRONYM/TERM LIST

Acronym/Term	Meaning
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CPR	Critical Project Review
DR	Demand Response [2]
EE	Energy Efficiency
FDD	Fault Detection and Diagnostics
HVAC	Heating, Ventilation, and Air Conditioning
TAC	Technical Advisory Committee
The Cloud	*Cloud Computing* [3]
UI	User Interface
USB	Universal Serial Bus

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

A. Purpose of Agreement

The purpose of the agreement is to the fund the development of an intelligent Heating, Ventilation and Air Conditioning (HVAC) control system for low income households. This controller will be designed to overcome lack of broadband access, consumer awareness and access to energy use information in low income households.

[1] Please see subtask 1.3 in Part III of the Scope of Work (General Project Tasks) for a description of Critical Project Review (CPR) Meetings.
[2] Changes in electric usage by end-use customers from their normal consumption patterns in response to changes in the price of electricity over time, or incentive payments designed to induce lower electricity use at times of high wholesale market prices or when system reliability is jeopardized.
[3] Cloud computing and storage solutions provide users and enterprises with various capabilities to store and process their data in third-party data centers which are accessed via broadband connection

EXHIBIT A
Scope of Work

B. Problem/ Solution Statement

Problem

In low income housing, HVAC energy use, in many cases, is the largest component of energy use due to a combination of factors:

- Air leaks in the building envelope
- Air leaks in the HVAC duct system
- Poorly maintained HVAC units
- Lower use of plug and lighting loads results in increased heating need

For example, in a current low income project in Lancaster, funded by the Energy Commission (PIR12-025), heating and cooling account for 50% of the source energy consumed in a tenant unit. Improved HVAC controls such as smart thermostats could provide energy efficiency at low cost and also provide awareness of energy use to tenants. Smart thermostats allow users to manage their home's temperature based on the time of day and from a remote location, using a smartphone, tablet or desktop. A key feature to smart thermostats is their ability to learn and adapt to the homeowners behavior. This learning ability helps homeowners reduce energy bills and provide a more comfortable living environment.

Lack of access to broadband in low income communities is creating an efficiency digital divide, especially with the current trend of efficiency measures being delivered through the internet (e.g., Home Energy Reports and smart thermostat efficiency programs). In the low income market, smart thermostats offer a viable option for low cost energy savings, but their application has been limited due to lack of broadband access.

To overcome market barriers such as the split incentive issue, utility programs provide a basket of "free" tenant measures implemented through property owners. In California, these programs include measures such as compact fluorescent lamps CFLs and showerheads. Some programs such as the Massachusetts LEAP (Low-income Energy Assistance Program) program and Austin's Energy's program include free programmable thermostats (with demand response) as part of tenant measures. However, energy savings with programmable thermostats have been disproven and are no longer provided by utility programs. Beyond low income, the same lack of broadband access issue affects many small commercial customers as well as other demographic segments such as rural customers and urban cord cutters (users whose primary broadband connection is the smartphone). In addition, the importance of cost effective demand response (DR) can increase grid reliability. However, customers that lack broadband are unable to participate in DR programs.

Solution

This project will develop an intelligent HVAC control unit in which the "intelligence" is embedded on the local hardware. The controller will be designed to operate for a minimum of 6 months on batteries (ease of scheduled maintenance). Current and historical detailed data on HVAC operation and energy use will be freely available to both tenants and property owners. At the same time, the device will have the capability to add connectivity for DR programs, with the utility bearing the cost of adding connectivity and enrolling the customer. This controller will improve system efficiency by:

1. Reducing HVAC runtime using learnt occupant behavior to optimize indoor temperature settings.
2. Detecting problems with the HVAC system itself that could impact energy efficiency of operation and communicating it to the property manager and tenants. Early surveys of property managers have indicated that it would be of great assistance to them to have diagnostic information on the state of the HVAC systems.
3. Providing easy access to energy use information to consumers that could result in modification of behavior.

The controller will be also be designed to hit a price point of $60 in volume, which could make it viable for both off-the-shelf purchases as well as being a part of utility low-income tenant programs. Many low income communities have a property manager capable of installing these units, and if the first cost is deferred by utility programs and the savings proven, it could lead to rapid market adoption. The same device can find greater adoption beyond the low income community in small commercial, rural households, and demographic segments such as urban cost cutters who face the same technological barriers. The project addresses a market gap as the smart thermostat market is currently not focused on "non-connected" devices, as the data and services are not easily monetized.

C. Goals and Objectives of the Agreement

Agreement Goals

The goals of this Agreement are to:

- Conduct market and customer research to better understand the needs for cost containment, comfort, and other factors affecting affordability of the proposed thermostat.
- Develop requirements for and test a user interface (UI) and hardware.
- Develop a prototype intelligent HVAC control system for low-income households.
- Test the prototype in the field with manufacturer collaboration.

Ratepayer Benefits:[4] This Agreement will result in the ratepayer benefit of lower electricity cost by providing the design for an intelligent HVAC control system for low income households. HVAC is often the largest electrical load in low-income households, and one of the greatest causes of HVAC inefficiency are the occupant settings of the thermostat. Several high-tech thermostats offer efficient control of HVAC systems by learning occupant behaviors, adapting automated thermostatic control to optimize efficiency for those behaviors, and empowering consumers with smart controls using broadband communication. However, many low-income residents cannot afford broadband Internet service and cannot therefore participate in energy-saving control functions available for smart-phone apps. An intelligent HVAC control system for low-income households will obviate the need for broadband service by combining intelligent learning functions with Bluetooth and/or Wi-Fi communication software and hardware, enabling the consumer to directly control the thermostat via the thermostat's dashboard or via a smart-phone app used in the residence.

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

Technological Advancement and Breakthroughs:[5] This Agreement will lead to technological advancement and breakthroughs to overcome barriers to the achievement of the State of California's statutory energy goals by integrating algorithms that maximize HVAC efficiency. The algorithms learn occupant preferences and display feedback on a UI. The UI will be designed such that it does not rely on The Cloud to program and customize the thermostat. This novel approach enables low-income residents—who traditionally have not had the opportunity to participate in saving energy through intelligent HVAC control—to save energy and reduce their utility bills.

Depending on the features that the consumer desires, the thermostat will cost from $25 to $60. A basic thermostat will include programmable control of cooling and heating through a monochrome UI in a compact form factor. The thermostat will operate on battery power, but the monochrome interface and a Bluetooth/Wi-Fi radio that offers a sleep mode will ensure long battery life, which benefits property managers by reducing the frequency of battery replacements.

Agreement Objectives

The objectives of this Agreement are to:

- Develop algorithms and hardware to increase the energy-saving functionality of low-cost thermostats.
- Develop an onboard UI to enable consumers to program and interact with their thermostats without relying on broadband and Cloud services.
- Develop communication hardware and software to enable consumers to use smart-phone apps to program and interact with their thermostats in their homes.
- Develop a thermostat that will cost less than $60.00
- Monitor and verify energy savings in low-income households associated with the newly developed smart thermostat

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

EXHIBIT A
Scope of Work

II. TASK 1 GENERAL PROJECT TASKS

PRODUCTS

Subtask 1.1 Products
The goal of this subtask is to establish the requirements for submitting project products (e.g., reports, summaries, plans, and presentation materials). Unless otherwise specified by the Commission Agreement Manager (CAM), the Recipient must deliver products as required below by the dates listed in the **Project Schedule (Part V).** Products that require a draft version are indicated by marking **"(draft and final)"** after the product name in the "Products" section of the task/subtask. If "(draft and final)" does not appear after the product name, only a final version of the product is required. With respect to due dates within this Scope of Work, **"days"** means working days.

The Recipient shall:

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

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

For products that require a final version only

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

For all products

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

Instructions for Submitting Electronic Files and Developing Software:

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

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

- Data sets will be in MS Access or MS Excel file format (version 2007 or later), or any other format approved by the CAM.
- Text documents will be in MS Word file format, version 2007 or later.
- Documents intended for public distribution will be in PDF file format.
- The Recipient must also provide the native Microsoft file format.
- Project management documents will be in Microsoft Project file format, version 2007 or later.

o **Software Application Development**

Use the following standard Application Architecture components in compatible versions for any software application development required by this Agreement (e.g., databases, models, modeling tools), unless the CAM approves other software applications such as open source programs:

- Microsoft ASP.NET framework (version 3.5 and up). Recommend 4.0.
- Microsoft Internet Information Services (IIS), (version 6 and up) Recommend 7.5.
- Visual Studio.NET (version 2008 and up). Recommend 2010.
- C# Programming Language with Presentation (UI), Business Object and Data Layers.
- SQL (Structured Query Language).
- Microsoft SQL Server 2008, Stored Procedures. Recommend 2008 R2.
- Microsoft SQL Reporting Services. Recommend 2008 R2.
- XML (external interfaces).

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

MEETINGS

Subtask 1.2 Kick-off Meeting

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

The Recipient shall:

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

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

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

- Provide an *Updated Project Schedule, List of Match Funds,* and *List of Permits*, as needed to reflect any changes in the documents.

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

Recipient Products:
- Updated Project Schedule *(if applicable)*
- Updated List of Match Funds *(if applicable)*
- Updated List of Permits *(if applicable)*

CAM Product:
- Kick-off Meeting Agenda

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

CPR meetings generally take place at key, predetermined points in the Agreement, as determined by the CAM and as shown in the Task List on page 1 of this Exhibit. However, the CAM may schedule additional CPR meetings as necessary. The budget will be reallocated to cover the additional costs borne by the Recipient, but the overall Agreement amount will not increase. CPR meetings generally take place at the Energy Commission, but they may take

place at another location, or may be conducted via electronic conferencing (e.g., WebEx) as determined by the CAM.

The Recipient shall:

- Prepare a *CPR Report* for each CPR meeting that: (1) discusses the progress of the Agreement toward achieving its goals and objectives; and (2) includes recommendations and conclusions regarding continued work on the project.
- Submit the CPR Report along with any other *Task Products* that correspond to the technical task for which the CPR meeting is required (i.e., if a CPR meeting is required for Task 2, submit the Task 2 products along with the CPR Report).
- Attend the CPR meeting.
- Present the CPR Report and any other required information at each CPR meeting.

The CAM shall:

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

Recipient Products:

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

CAM Products:

- CPR Agenda
- List of Expected CPR Participants
- Schedule for Providing a Progress Determination
- Progress Determination

Subtask 1.4 Final Meeting

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

The Recipient shall:

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

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

- The technical portion of the meeting will involve the presentation of findings, conclusions, and recommended next steps (if any) for the Agreement. The CAM will determine the appropriate meeting participants.
- The administrative portion of the meeting will involve a discussion with the CAM and the CAO of the following Agreement closeout items:
  - Disposition of any state-owned equipment.
  - Need to file a Uniform Commercial Code Financing Statement (Form UCC-1) regarding the Energy Commission's interest in patented technology.
  - The Energy Commission's request for specific "generated" data (not already provided in Agreement products).
  - Need to document the Recipient's disclosure of "subject inventions" developed under the Agreement.
  - "Surviving" Agreement provisions such as repayment provisions and confidential products.
  - Final invoicing and release of retention.

- Prepare a *Final Meeting Agreement Summary* that documents any agreement made between the Recipient and Commission staff during the meeting.
- Prepare a *Schedule for Completing Agreement Closeout Activities*.
- Provide *All Draft and Final Written Products* on a CD-ROM or USB memory stick, organized by the tasks in the Agreement.

Products:

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

REPORTS AND INVOICES

Subtask 1.5 Progress Reports and Invoices

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

The Recipient shall:

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

EXHIBIT A
Scope of Work

Products:

- Progress Reports
- Invoices

Subtask 1.6 Final Report

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

Subtask 1.6.1 Final Report Outline

The Recipient shall:

- Prepare a *Final Report Outline* in accordance with the *Style Manual* provided by the CAM. *(See Task 1.1 for requirements for draft and final products.)*

Recipient Products:

- Final Report Outline (draft and final)

CAM Product:

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

Subtask 1.6.2 Final Report

The Recipient shall:

- Prepare a *Final Report* for this Agreement in accordance with the approved Final Report Outline, Style Manual, and Final Report Template provided by the CAM with the following considerations:
  - Ensure that the report includes the following items, in the following order:
    - Cover page (**required**)
    - Credits page on the reverse side of cover with legal disclaimer (**required**)
    - Acknowledgements page (optional)
    - Preface (**required**)
    - Abstract, keywords, and citation page (**required**)
    - Table of Contents (**required**, followed by List of Figures and List of Tables, if needed)
    - Executive summary (**required**)
    - Body of the report (**required**)
    - References (if applicable)
    - Glossary/Acronyms (If more than 10 acronyms or abbreviations are used, it is required.)
    - Bibliography (if applicable)

  - Appendices (if applicable) (Create a separate volume if very large.)
  - Attachments (if applicable)
- Ensure that the document is written in the third person.
- Ensure that the Executive Summary is understandable to the lay public.
  - Briefly summarize the completed work. Succinctly describe the project results and whether or not the project goals were accomplished.
  - Identify which specific ratepayers can benefit from the project results and how they can achieve the benefits.
  - If it's necessary to use a technical term in the Executive Summary, provide a brief definition or explanation when the technical term is first used.
- Follow the Style Guide format requirements for headings, figures/tables, citations, and acronyms/abbreviations.
- Ensure that the document omits subjective comments and opinions. However, recommendations in the conclusion of the report are allowed.
- Include a brief description of the project results in the Abstract.

- Submit a draft of the report to the CAM for review and comment. The CAM will provide written comments to the Recipient on the draft product within 15 days of receipt
- Consider incorporating all CAM comments into the Final Report. If the Recipient disagrees with any comment, provide a written response explaining why the comment was not incorporated into the final product
- Submit the revised Final Report and responses to comments within 10 days of notice by the CAM, unless the CAM specifies a longer time period or approves a request for additional time.
- Submit one bound copy of the *Final Report* to the CAM along with *Written Responses to Comments on the Draft Final Report*.

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

CAM Product:
- Written Comments on the Draft Final Report

MATCH FUNDS, PERMITS, AND SUBCONTRACTS

Subtask 1.7 Match Funds

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

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

reimbursement.

The Recipient shall:

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

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

Products:

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

Subtask 1.8 Permits

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

The Recipient shall:

- Prepare a *Permit Status Letter* that documents the permits required to conduct this Agreement. If no permits are required at the start of this Agreement, then state this in the letter. If permits will be required during the course of the Agreement, provide in the letter:

- A list of the permits that identifies: (1) the type of permit; and (2) the name, address, and telephone number of the permitting jurisdictions or lead agencies.
- The schedule the Recipient will follow in applying for and obtaining the permits.

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

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

Products:

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

Subtask 1.9 Subcontracts

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

The Recipient shall:

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

Products:

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

TECHNICAL ADVISORY COMMITTEE

Subtask 1.10 Technical Advisory Committee (TAC)

The goal of this subtask is to create an advisory committee for this Agreement. The TAC should be composed of diverse professionals. The composition will vary depending on interest,

availability, and need. TAC members will serve at the CAM's discretion. The purpose of the TAC is to:

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

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

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

The Recipient shall:

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

Products:

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

EXHIBIT A
Scope of Work

Subtask 1.11 TAC Meetings
The goal of this subtask is for the TAC to provide strategic guidance for the project by participating in regular meetings, which may be held via teleconference.

The Recipient shall:

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

Products:

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

EXHIBIT A
Scope of Work

III. TECHNICAL TASKS

TASK 2 DEVELOPMENT OF REQUIREMENTS FOR HVAC CONTROLLER

The goals of this task are to identify market size and market potential of the proposed HVAC controller and develop functional requirements of the HVAC controller for the targeted market. The task will be completed through activities listed in Subtasks 2.1, 2.2, 2.3, and 2.4.

Subtask 2.1 Target Market and Customer Research

The goals of this subtask are to identify the available market size for the proposed device. Informational interviews will be conducted with sample households in these segments to understand customer usage. Property Manager and manufacturer input will also be used to guide product commissioning and deployment strategies.

The Recipient shall:

- Prepare and provide a *Target Market and Consumer Research Report* that shall include, but not be limited to, the following:
  - Market Analysis:
    - Analysis of market size of the low income and rural (community < 2500 people) segments without broadband access.
    - Analysis of market size of the small commercial customers without broadband access.
    - Projections for product adoption at various product cost levels and energy efficiency savings levels.
    - Analysis of low-income, rural and small commercial market potential for demand response capabilities.
  - Customer HVAC Usage:
    - Copy of interview questions.
    - Results of telephonic and in-person customer interviews within the various market segments identified in the market analysis to understand usage of HVAC system settings and expectations for comfort (such as multilingual capabilities, visual impairments, auditory and mobility impairments).
    - Analysis of consumer willingness to adopt new technology, and their preferences for connected vs. non-connected devices
  - HVAC Contractor Survey:
    - Copy of survey.
    - Results of contractor surveys aimed to gather expectations on residential and light-commercial HVAC controls from an industry perspective.
    - Analysis of contractor preferences for installation process and customer on-boarding process.
  - Multifamily Property Manager Survey:
    - Copy of survey.
    - Results of property manager surveys aimed to gather expectations on residential and light-commercial HVAC controls from a property management perspective.
    - Analysis on the need for property manager insight into HVAC system operations.

        - Analysis on the ability of the property manager to manage and guide customer settings and energy use.
        - Analysis and recommendations for property manager preferences for installation process and customer on-boarding process.
    - Identify a list of market segments where a product with the consumer, contractor and property manager preferences identified in this task could apply. This could include segments such as low-income families, senior living, small commercial customers, rural customers, etc[6].

Products:

- Target Market and Consumer Research Report (Draft and Final)

Subtask 2.2 Develop User Interface Requirements

The goals of this subtask are to understand how low-income customers interact with HVAC controls, how they perceive comfort, and to gather insight on comfort preferences. This work will leverage previous research and information from Subtask 2.1 and this task. This subtask will assess usability and other factors that influence customer adoption of enabling devices such as smart thermostats. Customer surveys will be developed and distributed to the different demographic groups within the low-income housing segment (e.g. families, seniors, high contact[7]).

The Recipient shall:

- Develop and provide a *User Interface Development Report* that shall include, but not be limited to*:*
    - Secondary Research:
        - Summary of previously conducted research on improving smart thermostat usability.
        - Summary of updated device and product trends as a result of smart thermostat manufacturers and service provider engagement.
    - Usability Metrics
        - Summary of research to refine the current usability metric developed for the low income segment by the California Institute for Energy and Environment (CIEE)[8] and leveraging information from subtask 2.1.
    - Customer Survey
        - Copy of survey listing questions.
        - Results of customer surveys through telephone and in-person interviews to:
            - Identify actual operation and set points with thermostats for affordable housing consumers; and
            - Obtain insight into user preferences for level of control over HVAC systems, propensity for control, desired simplicity or complexity of control, as well as comfort patterns.

[6] http://www.cpuc.ca.gov/NR/rdonlyres/858DE52A-1967-4CD4-9526-545AF570FDF6/0/CABroadbandReportJune2012.pdf
[7] "High Contact" refers to the segment of customers that would have frequent interaction with the device. The High Contact customer segment can cut across traditional demographic classifications of customers.
[8] http://eec.ucdavis.edu/files/Usability_of_residential_thermostats.pdf

- Preliminary UI Requirements
  - Summary of several candidate UI design elements, along with requirements for a successful and usable thermostat for low-income users. (such as multilingual capabilities, visual impairments, auditory and mobility impairments).
- Summary of analysis on the penetration of smartphones and the acceptability of control and UI operation through smartphones in the low income segment.

Products:

- User Interface Development Report (Draft and Final)

Subtask 2.3 Develop Hardware Requirements

The goal of this subtask is to develop and validate the hardware requirements of the product as described in subtasks 2.1 and 2.2. The device should be designed to operate without power from the HVAC system, but have the sophisticated analytics capability which drives processor power usage. In addition, it is desired that the device have both embedded communications for smart phone UIs and a USB port for managing data.

The Recipient shall:

- Develop and provide a *Hardware Requirements Report* that provides a detailed list of hardware product requirements and addresses key considerations, including but not limited to a discussion of the following:
  - Product should be capable of hitting $60 retail in volume.
  - Processor should be capable of running sophisticated Energy Efficiency (EE) analytics that can ascertain consumer preferences and provide energy savings.
  - UI for consumer to be simplistic with basic functions determined in Subtask 2.2.
  - Control of HVAC systems with up to 3-stage heating and 2-stage cooling.
  - Humidity sensing and control cost driven options.
  - Fresh air control integrated using either American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE) 62.2 or ASHRAE 62.1.
  - Data collection and storage of system run time, indoor set points, indoor temperature, and stage operation for up to 1 year of historical data.
  - 1 USB port minimum, 2 preferred. USB ports can be used both for data collection as well as connectivity to utility systems.
  - Operate on 3 AA batteries for 6 months
  - Near Field Communications (NFC) with smartphones will be integrated. The communications will be very basic, possibly driven by the smartphone, with the wireless in the device in “sleep” mode. The radio technology selected will have low power usage.
  - Identify data management strategies and how data is made available to occupants

- Prepare and provide a *Grid Connectivity and Demand Response Options Report* that will discuss the requirements for grid connectivity and demand response capability and the added cost.

Products:

- Hardware Requirements Report
- Grid Connectivity and Demand Response Options Report

Subtask 2.4: User Interface Design and Testing

The goal of this subtask is to validate UI requirements identified in the *User Interface Development Report* in Subtask. 2.2 through long-term UI design and testing. This task will work with tenants from at least 2 properties (low income and/or senior housing). Several methods will be used to assess usability of the low-income prototype thermostat; this process is iterative with results from testing used to further adjust and improve the UI design. Focus groups will be conducted using example UIs that could be simple apps developed for tablets and/or smartphones.

The Recipient shall:

- Develop and provide an *Interface Design and Testing Report* that shall include, but not be limited to:
  - Usability Test Plan:
    - Identify how actual use may differ from intended and determine necessary design changes to adjust for behavioral adaptation.
  - Tablet App / Smartphone App Testing:
    - Identify a Tablet App/Smartphone App capable of supporting several candidate UI design elements. This application will be capable of presenting "mockup" images of different design concepts, and soliciting and collecting feedback on usage, preferences, and responses to survey questions.
    - Summarize the other applications disqualified during the evaluation process.
  - User Testing:
    - Summarize the recruitment of UI testing subjects from a range of potential end-users including but not limited to:
      - Low-Income community users
      - Hearing, visual and auditory impaired users
      - Mobility impaired users
      - Non-English speaking users
    - Summarize the results of testing in the low-income communities. Testing will consist of several UI design elements in at least 2 different locations. These will be hosted as a "kiosk" in the public spaces in at least 2 different low-income housing communities. The App will be in the field for approximately one month, after which the units will be recovered and the data downloaded and analyzed.
  - UI Testing and Requirements
    - Develop a final UI design using responses from user testing.

- Summarize the usage of the various UI elements and the process in deriving the final UI design.

Products:

- Interface Design and Testing Report

Subtask 2.5: Software Requirements & Development

The goal of this subtask is to develop software requirements for the device. The full capability of the device is dependent on integrated key software elements for enabling energy efficiency, DR and fault detection and diagnostics (FDD). Requirements will be mapped in detail to ensure good implementation. The software requirements will include data acquisition, data management and data analysis.

The Recipient shall:

- Create and provide a *Software Development Report* that includes, but is not limited to:
  - How the software will utilize data to determine energy usage.
  - Minimum set of data points required for analysis.
  - Algorithms that can be implemented to analyze energy savings.
  - Discussion of the implementation of optional DR capability.
  - Discussion of the implementation of FDD capability.
  - Software Development Plan
    - Summary of key goals and dates needed to meet the prototype development schedule in subtask 3.2.

Products:

- Software Development Report

TASK 3 BENCH-SCALE PROTOTYPE DEVELOPMENT

The goals of this task are to develop and bench test a control hardware platform, algorithms, and UI.

Subtask 3.1: Hardware Unit Development

The goal of this subtask is to develop a “reference design” hardware platform that can meet the requirements in subtask 2.3. The hardware and software design team will focus on developing a prototype that has all the functional elements of a low-cost thermostat. Additional focus will be to ensure that the software developed will reside on the thermostat and is portable to the final smart thermostat design. The TAC will provide inputs to ensure the technology developed here can be transferred to a low-cost, low-power platform.

The Recipient shall:

- Develop reference design hardware platform that meets the requirements of subtask 2.3 and 2.4.
- Create and provide a *Hardware Unit Development Report* which shall include but not limited to:

- Hardware Architecture:
  - Results of the evaluation of various off-the-shelf options for the hardware platform and the customization required to develop the reference design.
  - Results of the development of input/output mapping and logic flow.
  - Description of the final hardware platform.
- Hardware Development:
  - Summary on the development of the prototype hardware system.
  - Develop and document a Hardware Test Plan that provides details on how hardware will be tested to meet criteria as defined in subtask 2.3
- Hardware Testing
  - Results of tests (input/output to HVAC system, data storage and retrieval, etc.) to evaluate that the components and the hardware design meet the requirements.
  - Document how the hardware platform meets the reference design requirements, and its capability to meet the cost target in subtask 2.3.

Product:

- Hardware Unit Development Report

Subtask 3.2: Software Development

The goal of this subtask is to develop system-level software functionality that enables basic thermostat functions, plus communications capability to be implemented on the thermostat itself, plus UI, data analytics and data visualization as well as optional utility interface on a smartphone. The smart thermostat UI will be developed based on results from subtask 2.4 and will be designed to operate without a smartphone.

The project team will develop and evaluate algorithms and work with smart thermostat manufacturers and service providers.

The Recipient shall:

- Prepare and provide a *Software Systems Design Report* that includes but is not limited to*:*
  - Discussion of the system level software functionality, including how the software will:
    - Enable basic thermostat functions such as user climate controls.
    - Collect and store thermostat data such as indoor temperature setpoint.
    - Support UI concepts determined in Subtasks 2.2 and 2.4.
    - Support user connectivity interfacing with or without mobile application.
    - Provide appropriate software security algorithms that comply with current industry protocols.
    - Maximize portability and code reuse
    - Minimize code footprint and latencies in response
  - System Optimization:
    - Discuss and detail the optimization algorithms.
  - Fault Detection Diagnostic Capability:
    - Discuss and detail the FDD capabilities and related algorithms.

        - Discuss the capabilities of the software to provide FDD.
        - Document how FDD software will be integrated into the device.
        - Document current and potential partners who have sophisticated FDD algorithms to embed appropriate FDD capability.
        - Report results of testing the devices FDD capabilities.
    - Discuss the development of a web application or similar applications that can transmit and potentially display certain thermostat parameters through mobile devices. Include information on the embedding of UI developed through customer testing in Task 2.4 and the development platform for enabling UI on mobile devices.
    - Discuss how analytics will be built in that enable better understanding of user preferences and utilization of these learnt behaviors to automatically adjust thermostat setpoints for energy efficiency.
    - Discuss the development of algorithms to implement such approaches and the final algorithm product of this development.

Products:

- Software Systems Design Report

Subtask 3.3: Prototype Testing

The goal of this subtask is to build and test at least 2 prototype thermostats both for hardware functionality and for UI and operation.

The prototypes will be tested at up to 3 different locations in Northern and Southern California for a total of up to 6 test sites. The testing is proposed to be installed and conducted in the common areas of low income housing properties owned by LINC. LINC will assist in customer recruitment and setting up focus groups. After the user testing is complete, the units located in common areas will be left to run for a minimum of 3 months to understand its learning capabilities and also understand user fatigue.

The Recipient shall:

- Develop and provide a *Laboratory Test Report* that includes but not limited to:
    - Laboratory Test Plan:
        - Document a laboratory test plan that includes the evaluation of HVAC operation using the basic thermostat interface as well as the capability of the thermostat for data management, smartphone communications and demand response.
    - Lab Test:
        - Discuss results of implementation of the laboratory testing according to the developed laboratory test plan.
        - Published results from the lab testing.
    - Test Site Plan
        - Document a test site evaluation plan.
    - Recruitment Plan
        - Document a recruitment plan for low-income customers for user testing.
    - Prototype Test
        - Document the recruitment of low-income customers according to the recruitment plan.

        - Discuss the results of the prototype testing per the test site plan. Discuss how the thermostat performs in real world conditions.
    - User Focus Groups
        - Document the results of user focus groups/ usability testing of complete system including how the test subjects view the impacts of changes.
    - Iterative Testing
        - Discuss the iterative testing and product improvements at test site (s) to the thermostat.
- Participate in a Critical Project Review and prepare a *CPR Report* as described in Task 1.3.

Product:

- Laboratory Test Report
- CPR Report

TASK 4 PILOT TESTING WITH MULTIPLE LOW-INCOME MARKET SEGMENTS

The goals of this task are to develop a test plan for pilot testing, engage manufacturers and conduct pilot tests.

Subtask 4.1: Prototype Field Testing

The goals of this subtask are to implement the prototype thermostats, and identify any issues with technology application, suitability, usability, efficacy, and energy savings. This will be done in a small number of cases in three different climate zones, to gauge regional and climatic variations in response to the prototype. This will demonstrate that it is possible to provide improved thermostats that allow low-income residents to control their HVAC as they would like, and that the thermostat is capable of saving energy in a range of scenarios.

The Recipient shall:

- Develop, implement and provide a *Prototype Field Test Report* that shall include:
    - Test Site Evaluation & Selection Plan:
        - Document a test site evaluation plan for evaluating test sites suitable for prototype field testing.
        - Identify three sites, in each of three different climates zones per the recruitment test plan (total of nine).
    - Recruitment Plan:
        - Document a recruitment and test plan detailing recruitment of low income customers for testing the devices functionality.
    - Recruitment of low-income customers:
        - Document results of the recruitment of low-income customers according to the Recruitment plan including informed consent documentation for participating in the pilot test for approximately one year.
    - On-site Testing:
        - Document results of testing at each of the sites to identify system performance before and after the thermostat retrofit.
    - Focus Groups / Usability Testing:
        - Document results of user focus groups/usability testing of complete system where subjects are able to see the impacts of changes.
    - Fatigue Testing:

        - Document results of user fatigue testing.
    - Iterative Testing and Product improvement:
        - Document results of Iterative testing and product improvement at test site(s).
    - Pilot Test Analysis:
        - Document results of analysis on data collected from the pilot tests.
    - User Interface Update:
        - Document the results of refinement to the UI to adapt it for summer cooling.
    - Usability and User Engagement:
        - Document the results detailing the usability and user engagement of the designed devices.
    - Prototype Field Test:
        - Document results of prototype field testing that captures the impacts of the thermostat on HVAC system performance.

Product:

- Prototype Field Test Report

Subtask 4.2: Manufacturer Engagement and Pilot Testing

The goals of this subtask are to take lessons learned in Subtask 4.1 (Prototype Field Testing) and to transfer them to commercialization.

The Recipient shall:

- Document results from the screening and identification of process manufacturers to build 50 prototype units based on reference design selected from subtask 4.1.
- Develop, document and provide a *Product Production Plan* that discusses engagement with manufacturers to build 50 prototype units and the best methods to produce them cost effectively.
- Develop, document and provide a *Risk Management Plan* Develop to include, but not limited to: a) detailed analysis of potential project risks associated with recruitment, data collection, hardware issues, support, human subjects protection, and other areas; and b) details on addressing the potential issue of getting acceptance to install the 50 prototype units.
- Develop, document and provide a *Field Test Plan* which will include, but not limited to:
    - Details of the test methods for EE and DR evaluation including data monitoring and acquisition strategies and accounts for different customer segments.
    - Summarize the development of any recruitment, education, or feedback materials that will describe the technology and the pilots.
    - Summarize the recruitment of pilot sites spread across California climate zones.
- Develop, document and provide a *Pilot Baseline and Performance Report* for the 50 smart thermostats to include, but not be limited to:
    - Baseline Field Performance
        - Summarize results from monitored pilot sites during the project term to obtain one year of baseline HVAC operational data.
    - Pilot Sites Performance
        - Document the identification of three applicable sites to be evaluated over a Winter season during the project term.
        - Document the installation of pilot units at test locations.

- Summarize the management and the pilot testing evaluation during the chosen Summer season.
- Collect data from the thermostats on customer preferences on an aggregate basis as well as long term performance.
- Document the analysis of data collected from Summer (and Winter) pilots including conclusions on the technologies suitability, usability, efficacy, and energy savings.

Product:

- Product Production Plan
- Risk Management Plan
- Field Test Plan
- Pilot Baseline and Performance Report (Draft and Final)

TASK 5 EVALUATION OF PROJECT BENEFITS

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

The Recipient shall:

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

  o <u>For Product Development Projects and Project Demonstrations:</u>
    - Published documents, including date, title, and periodical name.
    - Estimated or actual energy and cost savings, and estimated statewide energy savings once market potential has been realized. Identify all assumptions used in the estimates.
    - Greenhouse gas and criteria emissions reductions.
    - Other non-energy benefits such as reliability, public safety, lower operational cost, environmental improvement, indoor environmental quality, and societal benefits.
    - Data on potential job creation, market potential, economic development, and increased state revenue as a result of the project.
    - A discussion of project product downloads from websites, and publications in technical journals.
    - A comparison of project expectations and performance. Discuss whether the goals and objectives of the Agreement have been met and what improvements are needed, if any.
    - <u>Additional Information for Product Development Projects</u>:
      - 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.

o For Information/Tools and Other Research Studies:
- Outcome of project.
- Published documents, including date, title, and periodical name.
- A discussion of policy development. State if the project has been cited in government policy publications or technical journals, or has been used to inform regulatory bodies.
- The number of website downloads.
- An estimate of how the project information has affected energy use and cost, or have resulted in other non-energy benefits.
- An estimate of energy and non-energy benefits.
- Data on potential job creation, market potential, economic development, and increased state revenue as a result of project.
- A discussion of project product downloads from websites, and publications in technical journals.
- A comparison of project expectations and performance. Discuss whether the goals and objectives of the Agreement have been met and what improvements are needed, if any.

- Respond to CAM questions regarding responses to the questionnaires.

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

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

TASK 6 TECHNOLOGY/KNOWLEDGE TRANSFER ACTIVITIES

The goal of this task is to develop a plan to make the knowledge gained, experimental results, and lessons learned available to the public and key decision makers.

The Recipient shall:
- Prepare an *Initial Fact Sheet* at start of the project that describes the project. Use the format provided by the CAM.
- Prepare a *Final Project Fact Sheet* at the project's conclusion that discusses results. Use the format provided by the CAM.
- Prepare a *Technology/Knowledge Transfer Plan* that includes:

  - An explanation of how the knowledge gained from the project will be made available to the public, including the targeted market sector and potential outreach to end users, utilities, regulatory agencies, and others.
  - The initial project plan will start technology/knowledge transfer activities after Task 1 is completed and continue until the end of the contract.
  - Target markets will include low income households, low income developments, low income assistance programs, utilities, California regulatory agencies, non-governmental organizations, and other stakeholders
  - Presentations, papers, workshops, webinars, and other methods will be used for communicating the results.
  - Potential outreach activities could include presentations at Low income Community meetings, American Council for and Energy-Efficient Economy (ACEEE), Building Summer Study, Emerging Technologies Summit, Western Cooling Efficiency Center, California Emerging Technology Coordination Council, Utility Energy Forum, EPRI, CIEE and WCEC meetings, American Council for an Energy Efficient Economy, New Buildings Institute and other venues.
  - EPRI, CIEE, WCEC and LINC will all have information from this project on their web sites and will help leverage the technology transfer by presenting the information from this project to their various members.
- Conduct technology transfer activities in accordance with the Technology/Knowledge Transfer Plan. These activities will be reported in the Progress Reports.
- When directed by the CAM, develop *Presentation Materials* for an Energy Commission-sponsored conference/workshop on the results of the project.
- Identify opportunities for presentation in conferences targeted low-income development
- Identify opportunities to work with low income utility programs with California Investor Owned Utilities (IOU's) and municipalities.
- When directed by the CAM, participate in annual EPIC symposium(s) sponsored by the California Energy Commission.
- Provide at least (6) six *High Quality Digital Photographs* (minimum resolution of 1300x500 pixels in landscape ratio) of pre and post technology installation at the project sites or related project photographs.
- Prepare a *Technology/Knowledge Transfer Report* on technology transfer activities conducted during the project.

Products:

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

TASK 7 PRODUCTION READINESS PLAN

The goal of this task is to determine the steps that will lead to the manufacturing of technologies developed in this project or to the commercialization of the project's results.

The Recipient shall:

- Prepare a *Production Readiness Plan*. The degree of detail in the plan should be proportional to the complexity of producing or commercializing the proposed product, and to its state of development. As appropriate, the plan will discuss the following:
  - Critical production processes, equipment, facilities, personnel resources, and support systems needed to produce a commercially viable product.
  - Internal manufacturing facilities, supplier technologies, capacity constraints imposed by the design under consideration, design-critical elements, and the use of hazardous or non-recyclable materials. The product manufacturing effort may include "proof of production processes."
  - The estimated cost of production.
  - The expected investment threshold needed to launch the commercial product.
  - An implementation plan to ramp up to full production.
  - The outcome of product development efforts, such as copyrights and license agreements.
  - Patent numbers and applications, along with dates and brief descriptions.
  - Other areas as determined by the CAM.

Products:

- Production Readiness Plan (draft and final)

IV. PROJECT SCHEDULE

Please see the attached Excel spreadsheet.

RESOLUTION NO: 16-0210-2a

STATE OF CALIFORNIA

STATE ENERGY RESOURCES
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION - RE: ELECTRIC POWER RESEARCH INSTITUTE

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

RESOLVED, that the Energy Commission approves Agreement EPC-15-020 from PON-13-301 with Electric Power Research Institute (EPRI) for a $2,705,759 grant to develop a prototype thermostat for low-income and senior housing that will overcome the lack of broadband access. The thermostat will reduce HVAC runtime and energy use, have diagnostic capabilities and provide consumers with access to energy use information. The prototype will be tested in low income and senior housing units in Northern and Southern California; and

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

CERTIFICATION

The undersigned Secretariat to the Commission does hereby certify that the foregoing is a full, true, and correct copy of a Resolution duly and regularly adopted at a meeting of the California Energy Commission held on February 10, 2016.

AYE: [List of Commissioners]
NAY: [List of Commissioners]
ABSENT: [List of Commissioners]
ABSTAIN: [List of Commissioners]

Tiffani Winter,
Secretariat