





## EXHIBIT A Scope of Work

### I. TASK/ACRONYM TERM LISTS

#### A. Task List

Task #	CPR	Task Name
1		General Project Tasks
2		Landscape Analysis and Conceptual Development
3		SWH Technology and Industry Mapping, Assessment and Data Collection
4	X	Household Energy Use Data Collection Plan
5		Engage with SWH System Adopters, Owners and Users
6		Acquire Technical Data from Actual SWH Installations
7	X	Analysis and Reporting
8		Evaluation of Project Benefits
9		Technology/Knowledge Transfer

#### B. Acronym/Term List

Acronym/Term	Meaning
CALSEIA	California Solar Energy Industries Council
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CO <sub>2</sub>	Carbon Dioxide
CPR	Critical Project Review
CPUC	California Public Utilities Commission
CSI-T	California Solar Initiative Thermal program to incentivize new residential installations of solar water heating technology
GHG	Greenhouse Gas
HVAC	Heating, Ventilating, and Air Conditioning
IM	Integrated Model
IRB	Institutional Review Board
M&E	Measurement and Evaluation
NO <sub>x</sub>	Oxides of nitrogen
RASS	Residential Appliance Saturation Study
RD&D	Research, Development and Demonstration
SWAP	Solar Water Heating Assessment Project
SWH	Solar (Thermal) Water Heating or Heater
TAC	Technical Advisory Committee
UCD	University of California Davis

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

#### A. Purpose of Agreement

The purpose of this Agreement is to fund research on the environmental benefits of residential solar water heating (SWH) and to identify opportunities to increase adoption and effective use of SWH technology. The outcomes of this project will include:

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- A much more in-depth and accurate understanding of the California residential solar water heating marketplace.
- Accurate information regarding SWH performance, including energy performance, environmental benefits (e.g., reduced NO<sub>x</sub> and CO<sub>2</sub> emissions), and barriers and drivers of adoption and effective use.
- Evaluation of the implications of the research findings for technology RD&D, programs, policies, and societal reactions.

#### **B. Problem/ Solution Statement**

##### **Problem**

The State of California has made a significant commitment to increasing the use of SWH to reduce CO<sub>2</sub> emissions from natural gas combustion in residential water heating. The reduction is also accompanied by reduced NO<sub>x</sub> emissions. The primary policy mechanism to achieve these goals is the California Solar Initiative Thermal Program, which has reached only a very small proportion of its target of 200,000 residential SWH installations by 2017. The market place has shown little enthusiasm for SWH and the reasons are not well understood. The dominant low-cost natural gas-fueled form of water heating generally requires a much smaller capital investment. However, that conventional technology also requires ongoing fuel costs that SWH can reduce or eliminate. Furthermore, low cost SWH technologies have been demonstrated in the past that are no longer found in the market; adoption has been much greater in other states and nations with climates very similar to California's; and a small number of installation firms in the state have built very successful businesses supplying SWH in the residential sector. So there is a significant knowledge gap regarding the market factors that influence SWH adoption and may be responsible for the current low levels of uptake in California.

##### **Solution**

Very little research has previously been conducted in this area. It will be necessary to assess current and past SWH technology and users' experiences with that technology. Research is required on the actual performance of SWH systems in use, as well as the technology choices made by hot water end users. The practices of industry actors, supply chains and professions that influence SWH development and deployment need to be better understood. Also, a range of institutional factors, from codes and permitting, to licensing and regulation, as well as SWH incentive policies and community/local government dynamics may also play an important part and need to be much better understood. While the proposed research may not solve the current SWH adoption problem in the state, results should help explain the mechanics of the problem—and will inform policies focused on new opportunities for SWH diffusion in California.

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

##### **Agreement Goals**

The goals of this Agreement are to:

- Provide in-depth understanding of the organization and functioning of the California residential solar water heating marketplace, including SWH technology selection processes, supply chain dynamics and homeowner/end user interest in SWH.
- Address specific questions posed by the Commission regarding SWH performance with respect to GHG-emissions reductions and other environmental benefits and costs, user experience, problems limiting adoption, opportunities and niches for expansion, and potential contributions to energy modeling.

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- Assess the implications of the research findings for SWH technology RD&D, program implementation, policy development, and the potential evolution of new forms of environmentalism and green technology.

**Ratepayer Benefits:** This Agreement will result in the ratepayer benefits of greater energy supply system reliability, lower costs, and increased safety in the following ways. Increased penetration of residential SWHs in the water heating market would result in reduced levels of natural gas used for water heating in California homes. This lowers utility costs to consumers as well as providing GHG emissions reductions, which benefit individual ratepayers through long-term improvements in the resilience and reliability of the supply system. In addition, any concomitant substitutions of SWH for electric water heating would increase electric grid reliability and reduce the need for natural gas-fired electricity generation, which accounts for most of California's electricity supply on the margin. Furthermore, a number of SWH designs can provide hot water even in the case of major supply disruptions, leading to higher reliability of residential water heating overall, with health, safety and community resilience benefits in the event of natural disasters.

**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 taking a novel "grounded technology assessment" approach to provide a clearer picture of SWH technology strengths and weaknesses, especially technology adoption issues and usage/behavior issues related to the performance of SWH. This grounded technology assessment will offer an integrated perspective to technology assessment and development, compiling and analyzing empirical evidence to find the best opportunities for technological change based on economic, performance, behavioral, and cultural characteristics, but without adopting an advocacy perspective

The barriers to stronger performance and wider adoption of SWH are poorly understood and only incidentally addressed in past SWH regulatory evaluations. A breakthrough to this impasse is only plausible if a more comprehensive and detailed understanding of a complex SWH market system is developed—one that takes a social approach to the social shaping of technology and SWH system choice, and one that appreciates the limitations of traditional energy efficiency industry paradigms.

#### **Agreement Objectives**

The objectives of this Agreement are to:

- Apply new, broader theoretical perspectives on complex socio-technical systems that draw on the best available social science.
- Build upon and extend prior work by the team that has joined to undertake the Solar Water Heating Assessment Project (SWAP) described in this Scope of Work. The team's prior work relates to consumer choice, energy use behavior, residential technologies, and supply chains.
- Apply next generation analytic tools to the research.
- Assure that hypotheses, conceptual models and findings are evidence-based and make use of the best available empirical information.
- Apply objective approaches that do not favor particular SWH technologies, and, in fact, suspend judgment about the viability of residential SWH in California until the full analysis is completed.

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### III. TASK 1 GENERAL PROJECT TASKS

#### PRODUCTS

##### Subtask 1.1 Products

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

##### The Recipient shall:

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

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

For products that require a final version only

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

For all products

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

Instructions for Submitting Electronic Files and Developing Software:

- **Electronic File Format**

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

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

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

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- Text documents will be in MS Word file format, version 2007 or later.
  - Documents intended for public distribution will be in PDF file format. The Recipient must also provide the native Microsoft file format.
  - Project management documents will be in Microsoft Project file format, version 2007 or later.
- **Software Application Development**

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

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

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

## **MEETINGS**

### **Subtask 1.2 Kick-off Meeting**

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

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

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

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

- Terms and conditions of the Agreement;
- Administrative products (subtask 1.1);

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- 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:**

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- 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.

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- The administrative portion of the meeting will involve a discussion with the CAM and the CAO of the following Agreement closeout items:
  - Disposition of any state-owned equipment.
  - Need to file a Uniform Commercial Code Financing Statement (Form UCC-1) regarding the Energy Commission's interest in patented technology.
  - The Energy Commission's request for specific "generated" data (not already provided in Agreement products).
  - Need to document the Recipient's disclosure of "subject inventions" developed under the Agreement.
  - "Surviving" Agreement provisions such as repayment provisions and confidential products.
  - Final invoicing and release of retention.
- Prepare a *Final Meeting Agreement Summary* that documents any agreement made between the Recipient and Commission staff during the meeting.
- Prepare a *Schedule for Completing Agreement Closeout Activities*.
- Provide *All Draft and Final Written Products* on a CD-ROM or USB memory stick, organized by the tasks in the Agreement.

### Products:

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

## REPORTS AND INVOICES

### Subtask 1.5 Progress Reports and Invoices

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

#### The Recipient shall:

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

### Products:

- Progress Reports
- Invoices

### Subtask 1.6 Final Report

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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.

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- 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

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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.

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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:

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- 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

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

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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

## IV. TECHNICAL TASKS

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

To provide an overview of the information that will be used throughout the project, the table below summarizes the nature of the sources of information (including secondary sources [collected by others, and publicly available], primary sources [quantitative and qualitative data collected by the research team and partners], and “value-added” sources, [secondary sources, but for which the project’s compiling the available data provides a benefit to the market and the state]).

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Key:	Prior CSI-T Participating Installations			New CSI-T Prospects and Customers		Other data sources described in Scope of Work
	Northern California	Los Angeles	Monitoring & Verification Data	Northern California	Los Angeles	
<i>S=Secondary Data (Publicly Available),</i>						
<i>V=Value Added to Secondary Data,</i>						
Literature search, International, Technology inventory						S
Data collected for evaluation of CSI-T			S			
Metered data from utility sources	V	V		V	V	V
Utility billing data	V	V		V	V	
Data collected by partner contractors on their installations	V	V		V	V	
Instrumented measurement of system performance				P	P	
Interview and/or survey responses from owners, contractors				P	P	
Interview and/or survey responses from Industry Experts						P
Charrettes including Industry experts and other stakeholders						P

These data will be compiled and analyzed to shed light on impacts and benefits, technology and industry structure, factors affecting adoption and performance, recommendations for improving adoption and performance, and system scale potentials.

### **TASK 2: LANDSCAPE ANALYSIS AND CONCEPTUAL DEVELOPMENT**

The goal of this task is to develop a foundational understanding of SWH technology and the SWH market place.

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

- Conduct literature review of scientific literatures related to SWH, solar technology choice, home improvement and residential scale renewable energy technology markets, and hot water usage behavior. Scan gray literatures (e.g., energy efficiency program evaluation reports, industry press, public interest reports, solar advocacy websites and blogs) for additional insights.
- Conduct exploratory interviews with industry stakeholders, academic experts, solar market observers, and other relevant parties to collect preliminary insights into industry organization, real-world consumer choice and behavior, technology performance, industry innovation, supply chain dynamics, and the role of policy and regulations.
- Conduct data scoping and data planning process to identify existing data on SWH technology and performance, the solar industry, California SWH installations, and consumer choice and behavior. Assess data strengths, weaknesses, availability, gaps, and needs for primary data collection.
- Develop working conceptual model of SWH market place to inform secondary analysis of existing data and to guide field studies.
- Prepare and provide an “SWH Landscape Memo” that offers a first of its kind multi-disciplinary review of issues, critical questions and unknowns related to SWH technology and environmental performance in California.

#### **Products:**

- SWH Landscape Memo

### **TASK 3: SWH TECHNOLOGY AND INDUSTRY MAPPING, ASSESSMENT, AND DATA COLLECTION**

## **EXHIBIT A**

### **Scope of Work**

The goals of this task are to develop more in-depth knowledge of the California SWH market place, to explore alternative SWH implementation, and to generate grounded ideas about the opportunities for SWH expansion in California through innovative problem-solving methods.

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

- Develop industry map and identify key nodes in actor networks (e.g., contractor types, technologies, consumer groups, supply chain intermediaries, policy actors, program delivery agencies). This map will be used to help understand networks and processes of consumer adoption, their relationship to policy and market conditions, and to provide insight into where the expertise can be located to contribute further input to the research.
- Scope SWH markets outside of California where SWH has achieved significant market penetration. Conduct key informant/expert interviews and collect data from documentary sources (e.g., government documents, industry reports, trade press, media reports) to produce case studies of 2-3 successful SWH markets in similar environmental contexts.
- Inventory SWH technologies and design options, including three types: (1) SWH system designs currently on the market (e.g., integrated collector storage, thermosyphon, forced circulation, evacuated tube collectors), (2) low-cost and abandoned technologies (e.g., batch systems, geyser pump, DIY systems), and (3) promising emerging technologies (e.g. solar hot water heat pump).
- Identify a broad range of industry observers and other experts through the Technical Advisory Committee (TAC), partner organizations, and other key experts identified in the exploratory information gathering in Task 2.
- Develop detailed interview guides and obtain UCD Institutional Review Board (IRB) approvals for those instruments and for data collection protocols.
- Recruit, schedule, and conduct in-depth interviews with industry experts.
- Conduct problem-solving charrettes to gain insights into SWH opportunities.
- Prepare and provide a “SWH Technology and Industry Mapping, Assessment, and Data Collection Memo” that summarizes salient findings from industry mapping, scoping of SWH markets, inventory of technologies and design options, and interviews of industry experts.

#### **Products:**

- SWH Technology and Industry Mapping, Assessment and Data Collection Memo

#### ***TASK 4: HOUSEHOLD ENERGY USE AND DATA COLLECTION PLAN***

The goal of this task is to develop an optimally effective strategy, as governed by the UCD campus IRB protocols, for collecting needed primary data on household adoption and use of SWH services.

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

- Inventory existing data on domestic hot water and energy consumption (e.g., RECS, RASS, CSI-Thermal, CPUC evaluation data, utility RD&D experimental data, solar contractor customer contact information). Assess data quality and availability. Compare information and measurement in existing data sources with variables included in integrated model and key PON research elements. Identify data gaps and data collection needs.

## **EXHIBIT A**

### **Scope of Work**

- Develop sampling strategies to represent key types of SWH systems in use (see Task 3 above) and salient end-user types (e.g., based on demographics and/or high/medium/low overall natural gas consumption levels).
- Prepare and provide a “Data Collection Plan Memo” that includes specific research questions and tentative hypotheses, identifies household level social and technical data priorities, and identifies existing data collection instruments to be evaluated and used as a basis of interview guides as well as survey instruments for use in primary household level data collection.

#### **Products:**

- Data Collection Plan Memo

#### ***TASK 5: ENGAGE WITH SWH SYSTEM ADOPTERS, OWNERS, AND USERS***

The goal of this task is to collect fine-grained data, in accordance with UCD campus IRB protocols, on actual household SWH decisions and practices using a combination of appropriate data collection methods. The research will seek to discover homeowners’ experiences with SWH, how they think it works, problems that they may have encountered, and how SWH system performance syncs with their behaviors and hot water needs.

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

- Create sampling frame drawing upon from available CSI data, SWH contractor client databases, City of Davis solar inventory, and other public sources.
- Select samples for interviews, surveys and site visits.
- Contact SWH end users and recruit for SWAP participation in accord with “Data Collection Plan” developed in Task 4.
- Collect field data in accord with “Data Collection Plan” developed in Task 4.
- Process data and prepare for analysis.
- Prepare and provide “Household Data Collection Process Memo” that details the methodology employed.

#### **Products:**

- Household Data Collection Process Memo

#### ***TASK 6: ACQUIRE TECHNICAL DATA FROM ACTUAL SWH INSTALLATIONS***

The goal of this task is to collect fine-grained data on actual household SWH technology installation and performance.

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

- Obtain metered data from utility sources, including data on experimental installations of combined hydronic heating and domestic hot water systems with additional SWH, supplied by Southern California Gas Company. The research team will clean these data, prepare it for analysis, and store it in accordance with data security protocols.
- Obtain CSI Thermal Measurement and Evaluation (M&E) data under the auspices of a data sharing agreement between the California Public Utilities Commission and the California Energy Commission, along with metered data from M&E contractor who will simultaneously be conducting evaluation activities with samples of CSI-T incentivized

## **EXHIBIT A**

### **Scope of Work**

SWH installations. The research team will clean these data, prepare it for analysis, and store it in accordance with data security protocols.

- Prepare and provide a “Technical Data Acquisition Memo” describing the acquisition of technical data.

#### **Products:**

- Technical Data Acquisition Memo

#### **TASK 7: ANALYSIS AND REPORTING**

The goal of this task is to develop valid and useful findings about key questions of interest to the Commission and provide this information in as detailed a form as possible, given the limitations of primary and secondary data.

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

- Analyze to validate and disaggregate SWH impacts and benefits, specifically, analyze empirical measurement data obtained in Task 5 to clarify environmental benefits (e.g., GHG and NO<sub>x</sub> reductions) from current residential SWH installations. Focus particularly on variations in natural gas demand reduction. Consider benefits in addition to GHG and NO<sub>x</sub> reductions (e.g., resilience and disaster response), with attention to the ways in which variation in demand affect these benefits as well. Prepare and provide analytic “SWH Impacts and Benefits Memo” that describes GHG and NO<sub>x</sub> benefits as well as variability.
- Analyze factors affecting SWH adoption and performance, specifically; identify technical and human factors that affect environmental and economic performance of residential SWH. Incorporate results from empirical SWH analysis (Task 6) along with existing data from other sources (Task 6) and SWH owner/user interview/survey results (Task 5) into a new multi-scale integrated model (IM) of SWH adoption and use. Use IM in both statistical and simulation modes to characterize performance differences and uncertainties for each of four or five target SWH technologies, for different installation designs, under differing household behavior regimes/practices and varying environmental conditions. Compare SWH environmental and economic performance for significantly different clusters of technical+environment+behavioral conditions. Prepare and provide analytic “SHW Adoption and Performance Factors Memo” describing human factors’ impact on environmental and economic performance.
- Analyze opportunities for improving SWH adoption and performance, and identify preliminary opportunities for SWH adoption and performance improvement. Use TAC input to refine understandings of opportunities and barriers to enhanced SWH adoption and performance.
- Analyze SWH niche opportunities, characterized by physical factors, socioeconomic characteristics, consumer preferences, expectations, and/or usage patterns, where residential SWH could garner substantial, cost-effective environmental benefits.
- Prepare and provide “SWH Opportunities and Niches Memo” that describes conclusions from the sub-tasks described in the prior two bullets.
- Analyze system scale potentials, specifically, provide illustrative findings related to sensitivity of models to issues in data quality, and the variability in both SWH user demands for hot water and differential uptake of the technology across user groups, some experimental modeling will need to be performed. Prepare and provide a “SWH and Energy System Modeling Memo” describing findings from simplified demand modeling based on existing energy and emissions modeling systems.

## **EXHIBIT A**

### **Scope of Work**

#### **Products:**

- SWH Impacts and Benefits Memo
- SWH Adoption and Performance Factors Memo
- SWH Opportunities and Niches Memo
- SWH and Energy System Modeling Memo

#### **TASK 8: 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:
  - For Product Development Projects and Project Demonstrations:
    - 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.
    - 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.

## EXHIBIT A Scope of Work

- 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 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 9: 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.
  - A description of the intended use(s) for and users of the project results.
  - Published documents, including date, title, and periodical name.

## **EXHIBIT A**

### **Scope of Work**

- Copies of documents, fact sheets, journal articles, press releases, and other documents prepared for public dissemination. These documents must include the Legal Notice required in the terms and conditions. Indicate where and when the documents were disseminated.
- A discussion of policy development. State if project has been or will be cited in government policy publications, or used to inform regulatory bodies.
- The number of website downloads or public requests for project results.
- Additional areas as determined by the CAM.
- Conduct technology transfer activities in accordance with the Technology/Knowledge Transfer Plan. These activities will be reported in the Progress Reports.
- When directed by the CAM, develop *Presentation Materials* for an Energy Commission-sponsored conference/workshop on the results of the project.
- 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)
- Technology/Knowledge Transfer Plan (draft and final)
- Technology/Knowledge Transfer Report (draft and final)

#### **V. Project Schedule**

Please see the attached Excel spreadsheet.

STATE OF CALIFORNIA

STATE ENERGY RESOURCES  
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION - RE: THE REGENTS OF THE UNIVERSITY OF CALIFORNIA  
ON BEHALF OF THE DAVIS CAMPUS

**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 PIR-15-002 from PON-14-507 with The Regents of the University of California on behalf of the Davis campus for a \$500,000 grant to improve understanding of installed performance of solar water heating systems in California single-family homes and develop recommendations for improving penetration and environmental benefits of this technology in 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 November 12, 2015.

AYE: [List of Commissioners]

NAY: [List of Commissioners]

ABSENT: [List of Commissioners]

ABSTAIN: [List of Commissioners]

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Tiffani Winter,  
Secretariat