

GRANT REQUEST FORM (GRF)CEC-270 (Revised 10/2015)
COMMISSION

CALIFORNIA ENERGY

New Agreement PIR-18-007 (To be completed by CGL Office)

Division	Agreement Manager:	MS-	Phone
ERDD	Abigail Jacob	51	916-327-1314

Recipient's Legal Name	Federal ID Number
The Regents of the University of California, on behalf of the Davis campus	94-6036494

Title of Project
Phase Change Material-Enhanced Insulation for Residential Exterior Wall Retrofits

Term and Amount	Start Date	End Date	Amount
	6/28/2019	3/31/2023	\$ 1,570,000

Business Meeting Information

☐ ARFVTP agreements under \$75K delegated to Executive Director.			
Proposed Business Meeting Date	6/12/2019	☐ Consent	☒ Discussion
Business Meeting Presenter	Amir Ehyai	Time Needed:	10 minutes
Please select one list serve. NaturalGas (NG Research Program)			

Agenda Item Subject and Description

THE REGENTS OF THE UNIVERSITY OF CALIFORNIA, ON BEHALF OF THE DAVIS CAMPUS. Proposed resolution approving Agreement PIR-18-007 with the Regents of the University of California, on behalf of the Davis campus for a \$1,570,000 grant to develop and test a cost-effective, phase change material-enhanced insulation solution for existing homes, and adopting staff's determination that this action is exempt from CEQA.

California Environmental Quality Act (CEQA) Compliance

1. Is Agreement considered a "Project" under CEQA?
☒ Yes (skip to question 2) ☐ No (complete the following (PRC 21065 and 14 CCR 15378)):
 Explain why Agreement is not considered a "Project":

2. If Agreement is considered a "Project" under CEQA:
☒ a) Agreement **IS** exempt. (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:
 Cal. Code Regs., Title 14, section 15301 This project consists of the operation, repair, maintenance, or minor alteration of existing private structures, facilities, or mechanical equipment, and involves negligible or no expansion of use beyond that existing. Specifically, the project will involve two phases. First, insulation solutions will be developed and laboratory-tested at an existing 2,000-square-foot laboratory facility on the UC Davis campus, using equipment which already exists in the laboratory. Second, insulation solutions will be installed in three existing single-family homes in Vallejo, Sacramento, and Los Angeles. The three single-family homes (807, 1110, and 1500 sq. ft.) will have their exterior walls retrofitted to seal and insulate the wall cavities with loose-fill insulation. Phase change material will be added either to the insulation material or applied to the interior wall surface. The interior walls will be repaired/painted. The project will not involve expansion of existing use or capacity and will not have a significant effect on the environment, and therefore falls within section 15301.

 Cal. Code Regs., Title 14, section 15306 The purpose of installing insulation solutions in private homes is to monitor and analyze the thermal performance and electricity consumption of the homes' HVAC and the efficiency of the insulation solutions. The project is strictly for information gathering purposes and involves basic data collection with no serious or major disturbance to an environmental resource. Therefore, the project falls within section 15306.

☐ 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)

GRANT REQUEST FORM (GRF)CEC-270 (Revised 10/2015)
COMMISSION

CALIFORNIA ENERGY



Legal Company Name:	Budget
TRC Engineers, Inc.	\$ 530,000
TBD	\$ 30,000

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

Legal Company Name:

Budget Information

Funding Source	Funding Year of Appropriation	Budget List No.	Amount
NG Subaccount, PIERDD	17-18	501.001L	\$1,570,000
			\$
R&D Program Area: EERO: Buildings		TOTAL:	\$1,570,000
Explanation for "Other" selection			
Reimbursement Contract #:		Federal Agreement #:	

Recipient's Administrator/ Officer

Name: Jasen Okunnuga
 Address: 215 Sage St Ste 100
 Regents of the University of California
 (UC Davis), Western Cooling Efficiency
 Center
 City, State, Zip: Davis, CA 95616-7379
 Phone: 530-752-2659 / Fax: - -
 E-Mail: jdokunnuga@ucdavis.edu

Recipient's Project Manager

Name: Theresa Pistochini
 Address: 215 Sage St Ste 100
 Regents of the University of California
 (UC Davis), Western Cooling Efficiency
 Center
 City, State, Zip: Davis, CA 95616-7379
 Phone: 530-752-3262 / Fax: - -
 E-Mail: tepistochini@ucdavis.edu

Selection Process Used

- ☒ Competitive Solicitation
☐ First Come First Served Solicitation

Solicitation #: GFO-18-503

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		Market Characterization
3		Energy and Heat Transfer Modeling
4	X	Product Development and Laboratory Testing
5	X	Pilot Site Testing
6		Commercialization Assessment
7		Evaluation of Project Benefits
8		Technology/Knowledge Transfer Activities

B. Acronym/Term List

Acronym/Term	Meaning
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CPR	Critical Project Review
CZ	Climate Zone
PCM	Phase Change Material
TAC	Technical Advisory Committee

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

A. Purpose of Agreement

The purpose of this Agreement is develop, test, and measure the benefits of a retrofit insulation solution that combines the technical and practical benefits of sealing, blown-in insulation, and phase change materials (PCMs).

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

Exhibit A

Scope of Work

B. Problem/ Solution Statement

Problem

Many existing homes in California have uninsulated exterior wall cavities that contribute to unwanted thermal losses and gains and air leakage, wasted energy, and introduction of outdoor air pollutants. Existing insulation solutions are either expensive (spray foam) or do not address leakage (blown-in insulation). Collaboration across technology spheres is needed to produce an innovation that saves energy and improves comfort and indoor air quality but is still cost-effective, durable, and practical. Such cross-cutting collaborations are unlikely to occur among siloed industries without the guidance and direction of credible, expert third parties that understand both public policy goals and industry capabilities.

Solution

The recipient will use modeling and selected laboratory testing to determine the most cost-effective application of PCMs to the retrofit-wall assembly in a range of California climate zones (CZs). The process for installing the insulation solution, including aerosol sealing, will be tested and refined prior to field testing. The optimized PCM-enhanced insulation solution (including sealing, blown-in insulation, and PCM) will be evaluated through field testing in at least three homes, where the three homes are in different California climate zones. The energy savings and other benefits (e.g., comfort, indoor air quality) of the PCM-enhanced insulation solution will be estimated. The market potential, as well as barriers to and opportunities for widespread deployment of the optimized PCM-enhanced insulation solution, will be identified.

C. Goals and Objectives of the Agreement

Agreement Goals

The goals of this Agreement are to:

- Develop and test an insulation solution that is enhanced with PCM to reduce heat transfer in existing homes with no wall insulation;
- Demonstrate the insulation solutions in at least 3 homes, where the 3 homes are in different California climate zones, and document energy savings and other benefits, costs, and implementation issues with the goal of achieving a 10-year simple payback compared to existing uninsulated walls; and
- Identify the market potential and promising pathways to deployment at scale.

Ratepayer Benefits: This Agreement will result in the customer benefits of lower costs by reducing heating and cooling loads, ratepayer benefits of reduced procurement costs and deferred infrastructure investment, and societal benefits of reduced GHG emissions. Over the next 30 years, it is estimated that PCM-enhanced insulation retrofits could save 5.0 billion therms of natural gas and 16.0 terawatt-hours of electricity across the state due to reduced heating and cooling loads. This equates to \$9.8 billion savings for the ratepayers and 30 million metric tons of CO₂eq emissions savings.

In addition, PCM-enhanced insulation retrofits are expected to significantly improve thermal comfort and satisfaction for occupants by moderating radiant temperature, reducing drafts, and reducing infiltration of particulate matter from outdoors.

Technological Advancement and Breakthroughs: This Agreement will lead to technological advancement and breakthroughs that can overcome barriers to the achievement of the State of

Exhibit A

Scope of Work

California's statutory energy goals by leveraging the expertise and other resources of the team and its partners. Preliminary modeling work suggests the proposed approach is feasible and provides a head-start. The PCMs themselves will be designed and fine-tuned for a specific melting point to be determined using thermostat data from >10,000 homes that will be provided by a smart thermostat company. The Recipient will also will work with a PCM Partner to develop novel application methods for installing PCM as part of an exterior wall retrofit. The Recipient will work with sealing and insulation manufacturing partners to refine both the aerosol sealing and PCM-enhanced insulation injection techniques to minimize post-treatment repair costs and disruption for residents.

Agreement Objectives

The objectives of this Agreement are to:

- Determine, through modeling of all California climate zones and selected laboratory testing, the most cost-effective application of PCMs to wall assemblies in existing buildings.
- Develop, test, and evaluate the process for aerosol sealing wall cavities in retrofit applications prior to installing cellulose or fiberglass insulation.
- Evaluate, through field testing in three residential homes in three climate zones (Bay Area coastal (CZ3), Central Valley (CZ12), and Southern CA coastal (CZ9), or as otherwise approved by the CAM), the optimized PCM-enhanced insulation solution (including sealing, blown-in insulation, and PCM).
- Estimate the energy savings and other benefits (e.g., comfort, indoor air quality) of the PCM-enhanced insulation solution.
- Identify the market potential, as well as barriers to and opportunities for widespread deployment of the optimized PCM-enhanced insulation solution.

Exhibit A Scope of Work

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:

o **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.

Exhibit A

Scope of Work

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.

Exhibit A

Scope of Work

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

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

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

- o The CAM's expectations for accomplishing tasks described in the Scope of Work;
- o An updated Project Schedule;
- o Technical products (subtask 1.1);
- o Progress reports and invoices (subtask 1.5);
- o Final Report (subtask 1.6);
- o Technical Advisory Committee meetings (subtasks 1.10 and 1.11); and
- o 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

Exhibit A

Scope of Work

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.

Exhibit A

Scope of Work

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.

- o 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.
- o 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:
 - o 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

Exhibit A Scope of Work

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:
 - o 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)
 - o Ensure that the document is written in the third person.
 - o 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.

Exhibit A

Scope of Work

- 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.
- o Follow the Style Guide format requirements for headings, figures/tables, citations, and acronyms/abbreviations.
- o Ensure that the document omits subjective comments and opinions. However, recommendations in the conclusion of the report are allowed.
- o 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:

- o A list of the match funds that identifies:
 - The amount of cash match funds, their source(s) (including a contact name,

Exhibit A Scope of Work

address, and telephone number), and the task(s) to which the match funds will be applied.

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

Products:

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

Subtask 1.8 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:
 - o 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.
 - o 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.

Exhibit A

Scope of Work

- 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:
 - o Technical area expertise;
 - o Knowledge of market applications; or
 - o 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.

Exhibit A

Scope of Work

- 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

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.

Exhibit A

Scope of Work

- Organize and lead TAC meetings in accordance with the TAC Meeting Schedule. Changes to the schedule must be pre-approved in writing by the CAM.
- Prepare *TAC Meeting Summaries* that include any recommended resolutions of major TAC issues.

The TAC shall:

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

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

IV. TECHNICAL TASKS

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

TASK 2: MARKET CHARACTERIZATION

The goal of the market characterization will be to estimate the potential for market penetration and costs (including labor and materials) of PCM-enhanced insulation products.

The Recipient shall:

- Estimate current market penetration for advanced insulation products under multiple categories – fraction of eligible homes, market potential, and energy savings potential. This will be based on information from manufacturers and vendors, as well as data on existing homes by vintage from the Energy Commission and other sources,
- Develop preliminary estimates of costs of materials and labor for advanced insulation, including different estimates by climate zone, based on a manufacturer and vendor interviews, internet research, literature review, and RSMeans estimates (to be refined in Task 6 based on inputs from Task 5). These refined values on PCM-enhanced insulation products will be added to RSMeans database.
- Prepare the report, *Market Characterization of Advanced Insulation Products for Single Family Residences in California*, which will include a discussion of market barriers and drivers for manufacturing, selling, and installing advanced insulation products, market potential, and cost estimates for advanced insulation products. Estimates will be further refined, based on data from Task 5, and reported in Task 6.

Products:

- Market Characterization of Advanced Insulation Products for Single Family Residences in California (draft and final)

TASK 3: ENERGY AND HEAT TRANSFER MODELING

The goal of this task is to use finite element analysis and whole building simulations to determine the thermal performance of each PCM application strategy. Results of this task will be used to identify cost-optimized PCM application strategies for each of California's 16 climate zones.

The Recipient shall:

- Analyze different application parameters including, but not limited to, the PCM chemistry, melting point, amount, location, and encapsulation size, and the effective leakage area of the wall cavity.
- Develop whole building models of single-family residential buildings with PCM enhanced insulation solutions.
- Develop three-dimensional finite element models of PCM enhanced insulation solutions.
- Prepare a *Finite Element Analysis of PCM Enhanced Insulation Solutions Memo*, which will characterize the thermal performance of a range of potential PCM Enhanced Insulation Solutions.
- Refine models using data from the three-dimensional finite element analysis and laboratory tests (Task 4).

Exhibit A

Scope of Work

- Prepare a *Whole Building Modeling of PCM Enhanced Insulation Solutions Memo*, which will estimate and compare the annual energy savings achieved by a range of potential PCM Enhanced Insulation Solutions.
- Identify cost-optimized PCM application strategies for each of California's 16 climate zones.
- Prepare an *Energy and Heat Transfer Modeling Report*, which will summarize the Finite Element Analysis and Whole Building Modeling results and recommend cost optimized PCM Enhanced Insulation Solutions with specific physical and thermal properties for lab and field testing, and cost-optimized PCM application strategies.

Products:

- Finite Element Analysis of PCM Enhanced Insulation Solutions Memo
- Whole Building Modeling of PCM Enhanced Insulation Solutions Memo
- Energy and Heat Transfer Modeling Report (draft and final)

TASK 4: PRODUCT DEVELOPMENT AND LABORATORY TESTING

The goals of this task are to design and build a dynamic hot box wall testing apparatus, develop aerosol sealing techniques for wall cavities, and experimentally verify thermal performance for the top ranked PCM-enhanced insulation solutions from the modeling conducted as part of Task 3. Wall sections representative of the baseline empty wall cavity condition, as well as the baseline cavity plus blown-in insulation, will also be laboratory tested to further enhance the accuracy of modeled energy savings predictions.

The Recipient shall:

Design dynamic hot box testing apparatus consisting of two chambers representing the outside and inside conditions with the test wall between the two chambers (structure, heating/cooling and air movement equipment, thermal measurement sensors, data acquisition and control equipment and software).

Prepare a Laboratory Test Plan Memo, to include test objectives, procedures, conditions, facilities, and equipment.

Construct and commission hot box apparatus and document completion and results in Completion of Laboratory Test Apparatus Memo.

Build test wall sections to match expected existing construction materials and design for houses of the appropriate vintage that have no wall insulation and retrofit wall sections.

Develop aerosol sealing application technique and protocols and measure cavity sealing rates.

Work with PCM partner(s) to develop PCM application methods for preferred PCM material placement and format.

- Test wall sections in dynamic hot box apparatus:
 - o Baseline empty cavity
 - o Blown-in insulation
 - o PCM-enhanced insulation solutions
- Analyze test data to:
 - o Verify thermal performance: total heating energy consumption, peak heating load, and time shift of heating loads, as well as co-benefit cooling energy consumption, peak cooling load, and time shifting of cooling loads
 - o Verify rank of each PCM-enhanced insulation solution versus the other solutions

Exhibit A

Scope of Work

- Choose the preferred PCM-enhanced insulation solution and work with vendor to perform flammability testing according to ASTM standards, including E84 - 18b and potentially others deemed relevant.
- Fine tune aerosol sealing, insulation, and PCM installation procedures with full scale run through.
- Prepare a memo discussing *Summary Findings of Laboratory Test Results* including a summary of thermal performance and preference rank of the tested PCM-enhanced insulation solutions.
- Prepare *Laboratory Testing Results Report* including detailed thermal performance and preference rank of the tested PCM-enhanced insulation solutions.
- Prepare *CPR Report #1* and participate in CPR meeting in accordance with subtask 1.3.

Products:

- Laboratory Test Plan Memo
- Completion of Laboratory Test Apparatus Memo
- Summary Findings of Laboratory Test Results
- Laboratory Testing Results Report (draft and final)
- CPR Report #1

TASK 5: PILOT SITE TESTING

The goal of this task is to field test the installation method for the PCM-enhanced insulation solution and to obtain empirical data from field demonstration sites to quantify the energy and comfort benefits.

The Recipient shall:

- Manage communications and scheduling with pilot test site occupants, field researchers, and contractors.
- Survey demonstration site characteristics including building envelope properties and heating system types and capacity.
- Measure baseline building envelope air leakage
- Identify, procure, and install baseline energy metering and thermal monitoring equipment and configure data platform and cloud data capture for continuous monitoring
- Prepare a memo which discusses the *Pilot Site Baseline Conditions Assessment and Monitoring Plan*, which will include a description of pilot site characteristics, results of baseline testing, and a monitoring plan, for each pilot site.
- Prepare a memo which discusses *Documentation of Installation of Monitoring Equipment*, which will include a description of the monitoring equipment installed at each pilot site.
- Track monitoring data quality and rectify any issues that occur
- Prepare a memo which discusses, *Analysis of Baseline Energy Use*, which will include a summary of baseline data collected, summary of data quality review, and preliminary baseline M&V modeling results.
- Prepare *PCM-Enhanced Insulation Solution Design and Installation Report* which identifies and discusses installation designs and issues based on outcomes of Tasks 2-4.
- Retrofit homes based on design specifications, securing materials and installation contractors.
- Prepare a memo which discusses, *PCM-Enhanced Insulation Solution Design and Installation*, which will include a description of the retrofit work performed at each test site,

Exhibit A

Scope of Work

an assessment of the installation process, and a summary of issues, impact, (and mitigation strategies) on occupants.

- Reconfigure monitoring equipment for post-retrofit monitoring
- Remove monitoring equipment at the end of the post-retrofit monitoring period
- Analyze data per the M&V plan, including comparison of results to laboratory and field testing results
- Prepare *Pilot Site Testing Results Report* which discusses the work completed in Task 6
- Prepare *CPR Report #2* and participate in CPR meeting in accordance with subtask 1.3.

Products:

- Pilot Site Baseline Conditions Assessment and Monitoring Plan
- Documentation of Installation of Monitoring Equipment
- Analysis of Baseline Energy Use
- PCM-Enhanced Insulation Solution Design and Installation Report
- Pilot Site Testing Results Report (draft and final)
- CPR Report #2

TASK 6: COMMERCIALIZATION ASSESSMENT

The goal of the commercialization assessment is to describe the current landscape and outline a pathway for commercialization of the PCM-enhanced insulation solution.

The Recipient shall:

- Collect data from public sources (e.g., utility programs, commercial websites) and compile a brief analysis of the existing market for insulation retrofits
- Conduct interviews with manufacturers and installers to: map the landscape of goods and services offered; understand drivers and barriers to sell, install, and purchase advanced insulation, from the supplier perspectives and that of their customers; and identify opportunities to mitigate negative impacts (e.g., inconvenience, install/repair costs) on occupants and homeowners
- Investigate customer drivers and barriers (including cost and inconvenience) and opportunities to address them, drawing from data collected in Task 2 and Task 5, as well as supplier interviews
- Prepare the report, *Commercialization Assessment of PCM-Enhanced Insulation Solution for Single Family Residences in California* detailing: the findings from public sources, field tests, and supplier interviews with respect to barriers and opportunities for commercializing the PCM-enhanced insulation solution; cost estimates for materials and labor; and how these may change if PCMs are more widely adopted. This report will leverage preliminary cost and penetration estimates from Task 2, but include refined estimates collected in Tasks 5 and 6.

Products:

- Commercialization Assessment of PCM-Enhanced Insulation Solution for Single Family Residences in California (draft and final)

Exhibit A Scope of Work

TASK 7: 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 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.
 - 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.

Exhibit A

Scope of Work

- 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 8: 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:
 - o 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.
 - o A description of the intended use(s) for and users of the project results.
 - o Published documents, including date, title, and periodical name.
 - o 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.
 - o A discussion of policy development. State if project has been or will be cited in government policy publications, or used to inform regulatory bodies.
 - o The number of website downloads or public requests for project results.
 - o 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(s) on the project.

Exhibit A

Scope of Work

- 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)

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-18-007 with The Regents of the University of California, on behalf of the Davis campus for a \$1,570,000 grant to develop and test a cost-effective, phase change material-enhanced insulation solution for existing homes, and adopting staff's determination that this action is exempt from CEQA; 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 June 12, 2019.

AYE: [List of Commissioners]

NAY: [List of Commissioners]

ABSENT: [List of Commissioners]

ABSTAIN: [List of Commissioners]

Cody Goldthrite,
Secretariat