



STATE OF CALIFORNIA

GRANT REQUEST FORM (GRF)

CEC-270 (Revised 12/2019)

CALIFORNIA ENERGY COMMISSION

A) New Agreement # PIR-21-008 (to be completed by CGL office)

B) Division	Agreement Manager:	MS-	Phone
ERDD	Maninder Thind		916-776-0819

C) Recipient's Legal Name	Federal ID Number
The Regents of the University of California as Management and Operating Contractor for the Ernest Orlando- Lawrence Berkeley National Laboratory	94-2951741

D) Title of Project
California Residential Methane Emissions Characterization (CARMEC)

E) Term and Amount

Start Date	End Date	Amount
7/5/2022	3/31/2026	\$ 2,000,000

F) Business Meeting Information

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

Proposed Business Meeting Date 6/8/2022 ☐ Consent ☒ Discussion

Business Meeting Presenter Maninder Thind Time Needed: 5 minutes

Please select one list serve. NaturalGas (NG Research Program

Agenda Item Subject and Description:

THE REGENTS OF THE UNIVERSITY OF CALIFORNIA AS MANAGEMENT AND OPERATING CONTRACTOR FOR THE ERNEST ORLANDO- LAWRENCE BERKELEY NATIONAL LABORATORY Proposed resolution approving Agreement PIR-21-008 with The Regents of the University of California as Management and Operating Contractor for the Ernest Orlando- Lawrence Berkeley National Laboratory for a \$2,000,000 grant to conduct applied research to improve the characterization of residential methane emissions in California homes, and adopting staff's determination that this action is exempt from CEQA. The study will help improve California's methane emission inventory, quantify the benefits of decarbonization in buildings, and inform the development of cost-effective programs to reduce methane emissions from the residential building sector. (Gas R&D Funding) Contact: Maninder Thind (Staff presentation 5 minutes)

G) California Environmental Quality Act (CEQA) Compliance

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

☒ Yes (skip to question 2)

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

Explain why Agreement is not considered a "Project":

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

a) ☒ Agreement **IS** exempt.

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

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

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

Explain reason why Agreement is exempt under the above section: Cal. Code Regs., tit. 14, § 15306 exempts basic data collection, research, experimental management, and resource evaluation activities which do not result in a serious or major disturbance to an environmental resource. These may be strictly for information gathering purposes, or as part of a study leading to an action which a public agency has not yet approved, adopted, or funded.

The proposed activities are to conduct applied research to improve the characterization of residential methane emissions in California homes, which falls within this categorical exemption. The activities consist of data collection, paper studies, and laboratory work, including documenting, analyzing, and reporting results; conducting instrument cross-calibrations and analysis of methane samples and, collecting methane and other data samples from various indoor residential locations throughout California. Data collection will take place at residential homes and units in multifamily buildings. Laboratory testing and report writing will take place at the Lawrence Berkeley National Laboratory main campus in Alameda.

The project will not impact an environmental resource of hazardous or critical concern where designated, precisely mapped, and officially adopted pursuant to law by federal, state, or local agencies; does not involve any cumulative impacts of successive projects of the same type in the same place that might be considered significant; does not involve unusual circumstances that might have a significant effect on the environment; will not result in damage to scenic resources within a highway officially designated as a state scenic highway; the project site is not included on any list compiled pursuant to Government Code section 65962.5; and the project will not cause a substantial adverse change in the significance of a historical resource. Therefore, none of the exceptions to categorical exemptions listed in CEQA Guidelines section 15300.2 apply to this project and this project will not have a significant effect on the environment.

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

Check all that apply

☐ Initial Study

☐ Negative Declaration

☐ Mitigated Negative Declaration

☐ Environmental Impact Report

☐ Statement of Overriding Considerations



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

Legal Company Name:	Budget
The Regents of the University of California on behalf of Berkeley campus (Renewable and Appropriate Energy Laboratory)	\$ 80,000
Richard Heath & Associates, Inc.	\$ 400,000
Physicians, Scientists, and Engineers for Healthy Energy	\$ 40,000
University of Illinois at Urbana-Champaign (UIUC)	\$ 35,000

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

Legal Company Name:

J) Budget Information

Funding Source	Funding Year of Appropriation	Budget List Number	Amount
NG Subaccount, PIERDD	20-21	501.001OS	\$2,000,000

R&D Program Area: EGRO: EA

TOTAL: \$ 2,000,000

Explanation for "Other" selection

Reimbursement Contract #: Federal Agreement #:

K) Recipient's Contact Information**1. Recipient's Administrator/Officer**

Name: Monique Fix

Address: 1 Cyclotron Rd

City, State, Zip: Berkeley, CA 94720-8099

Phone: 510-486-5068

E-Mail: MFix@lbl.gov

2. Recipient's Project Manager

Name: Brett Singer

Address: 1 Cyclotron Rd

City, State, Zip: Berkeley, CA 94720-8099

Phone: 510 486 4779

E-Mail: BCSinger@lbl.gov

L) Selection Process Used

- ☒ Competitive Solicitation Solicitation #: GFO-21-505
- ☐ First Come First Served Solicitation Solicitation #:
- ☐ Non-Competitive Bid Follow-on Funding (SB 115)

M) The following items should be attached to this GRF

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



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- 4. Recipient Resolution
- 5. CEQA Documentation

☒ N/A
☒ N/A

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☐ Attached
☐ Attached

Agreement Manager

Date

Office Manager

Date

Deputy Director

Date

Exhibit A
Scope of Work
Lawrence Berkeley National Laboratory

I. TASK ACRONYM/TERM LISTS

A. Task List

Task #	CPR ¹	Task Name
1		General Project Tasks
2		Synthesize Existing Information and Identify Data Priorities
3	X	Measurement Methods and Field Study Preparations
4		Measure Methane Emissions and Appliance Operation in Homes
5		Analysis and Technical Manuscripts
6		Evaluation of Project Benefits
7		Technology/Knowledge Transfer Activities

B. Acronym/Term List

Acronym/Term	Meaning
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CARMEC	California Residential Methane Emission Characterization
CBO	Community Based Organization
CEC	California Energy Commission
CH ₄	Chemical formula for methane
CO ₂	Chemical formula for carbon dioxide
CPR	Critical Project Review
GHG	Greenhouse Gas
Recipient	Lawrence Berkeley National Laboratory
PSE	Physicians, Scientists and Engineers for Healthy Energy
RHA	Richard Heath & Associates, Inc.
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 to conduct applied research to improve the characterization of residential methane emissions in California homes. The study will identify robust and accurate field measurement methods, apply the methods to quantify emissions under quiescent conditions and during appliance operation in a diverse sample of homes, monitor burner operating patterns and analyze factors that may contribute disproportionately to population emissions.

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.

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B. Problem/ Solution Statement

Problem

Leakage of natural gas from infrastructure and appliances within residential buildings releases methane, a greenhouse gas which has a warming effect that is 25 times as potent as carbon dioxide over a 100-year time horizon. Methane leakage occurs when equipment is off (quiescent or resting conditions), when burners start and stop, and during steady burner operation. Emissions during resting conditions and during steady burner operation were measured in a pioneering study led by Lawrence Berkeley National Laboratory (Recipient) with help from Richard Heath & Associates, Inc. (RHA). In a previous study, the Recipient and RHA measured emissions from 75 houses located throughout coastal and central California and from over 100 appliances in the homes. Subsequent studies have measured emissions during start/stop events, steady burner operation, and in some cases also resting emissions for hundreds of burners on various types of natural gas appliances in California, Boston, Illinois, Indiana, and New York. These studies have consistently found that methane emission rates are highly skewed, which means that overall emissions from the population are driven by very high emissions from a small fraction of the homes and appliances. The skewed nature of the emission distribution means that an accurate estimate of the overall emission inventory requires more robust data about the frequency and magnitude of high emission equipment. Knowledge of the factors that predict or are associated with high emissions could be used to develop cost-effective programs to identify and replace high-emitting equipment. Accurate emissions data are also important for quantifying the expected benefits of policies that accelerate replacement or avoidance of natural gas infrastructure, e.g., through electrification retrofits or via restrictions on natural gas in new construction. Critical deficiencies in the data that have been collected to date limit our knowledge of overall methane emissions from the residential sector and the best approaches to reducing these emissions.

Solution

The project will quantify and elucidate the sources of methane emissions from post-meter natural gas infrastructure in California's residential sector. The foundation of the study will be a field sampling campaign in a large and diverse sample of homes that include owner- and renter-occupied houses and multifamily units in the Los Angeles and San Francisco Bay Area urban centers as well as areas in and around Fresno, Stockton, Sacramento, and Chico, with at least 50 percent of the sample in disadvantaged communities. The study will synthesize methane emissions data that have been collected previously in homes and coordinate with an ongoing study of methane emissions in Bakersfield. The study will greatly expand and improve the quality of available data on emissions from residential gas distribution systems and equipment used for space heating, water heating, cooking, clothes drying, aesthetics and leisure. Data collection and analysis will aim to identify building, appliance technology, and household characteristics that can be used to screen for high emissions to design efficient decarbonization programs and improve the state's methane inventory. Findings will be translated for stakeholders, validated via scientific manuscripts submitted to peer-reviewed journals and shared with the public as open access datasets.

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C. Goals and Objectives of the Agreement

Agreement Goals

The goals of this Agreement are to collect data and conduct analyses to:

- Improve California's methane emission inventory;
- Quantify the benefits of decarbonization in buildings; and
- Inform the development of cost-effective programs to reduce methane emissions from the residential building sector.

Ratepayer Benefits: This Agreement will result in the ratepayer benefits of lower costs and increased safety by providing the data and analysis needed to improve cost-effectiveness of programs designed to reduce greenhouse gas emissions, support targeted residential electrification retrofits which will reduce harmful air pollutant emissions inside homes and in neighborhoods, and quantify the benefits of accelerating all-electric new construction standards.

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 2030. This Agreement will provide improved information for California's methane emission inventory, providing better information on emissions from all subsectors, including multifamily and other rental units and homes in disadvantaged communities. The Agreement also will provide solid data to quantify the benefits of transitioning from mixed-fuel to all-electric homes, motivating more rapid adoption of all-electric new construction, and increasing the pace of replacing gas appliances with electric alternatives in retrofits. In addition, this Agreement will measure methane emissions from a large sample of gas appliances of different types, features, and vintage, thus informing program designs so that electrification programs can more effectively target homes or appliances that are more likely to be high methane emitters. This will improve the overall cost-effectiveness of electrification programs in reducing methane emissions.

Agreement Objectives

The objectives of this Agreement are to:

- Synthesize existing information to consolidate what is currently known and to identify priority data and analysis needed to improve quantitative understanding of post-meter methane emissions from the residential sector;
- Design and implement a recruitment and measurement plan to include variations in building, equipment and household characteristics that may cause or be associated with exceptionally high methane emission rates that drive population averages;
- Measure emissions under quiescent conditions in a diverse sample of houses and apartments and from varied natural gas appliances during steady burner operation and from ignition and extinguishment events;
- Monitor and record burner operating patterns from the most common appliances and configurations to capture geographic, seasonal, building and household variations;
- Analyze data to estimate aggregate emissions and to identify factors that can be used to develop efficient decarbonization programs and to track the benefits of those programs; and
- Provide information to the public via technical manuscripts and open access databases.

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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)**. All products submitted which will be viewed by the public, must comply with the accessibility requirements of Section 508 of the federal Rehabilitation Act of 1973, as amended (29 U.S.C. Sec. 794d), and regulations implementing that act as set forth in Part 1194 of Title 36 of the Federal Code of Regulations. All technical tasks should include product(s). Products that require a draft version are indicated by marking “**(draft and final)**” after the product name in the “Products” section of the task/subtask. If “(draft and final)” does not appear after the product name, only a final version of the product is required. With respect to due dates within this Scope of Work, “**days**” means working days.

The Recipient shall:

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

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

For products that require a final version only

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

For all products

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

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

- Data sets will be in MS Access or MS Excel file format (version 2007 or later), or any other format approved by the CAM.
 - Text documents will be in MS Word file format, version 2007 or later.
 - Project management documents will be in Microsoft Project file format, version 2007 or later.
- **Software Application Development**
- Use the following standard Application Architecture components in compatible versions for any software application development required by this Agreement (e.g., databases, models, modeling tools), unless the CAM approves other software applications such as open-source programs:
- Microsoft ASP.NET framework (version 3.5 and up). Recommend 4.0.
 - Microsoft Internet Information Services (IIS), (version 6 and up) Recommend 7.5.
 - Visual Studio.NET (version 2008 and up). Recommend 2010.
 - C# Programming Language with Presentation (UI), Business Object and Data Layers.
 - SQL (Structured Query Language).
 - Microsoft SQL Server 2008, Stored Procedures. Recommend 2008 R2.
 - Microsoft SQL Reporting Services. Recommend 2008 R2.
 - XML (external interfaces).

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

MEETINGS

Subtask 1.2 Kick-off Meeting

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

The Recipient shall:

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

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

- Terms and conditions of the Agreement;
- Invoicing and auditing procedures;
- Administrative products (subtask 1.1);
- CPR meetings (subtask 1.3);

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- 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 (subtask 1.5);
 - Final Report (subtask 1.6);
 - Technical Advisory Committee meetings (subtasks 1.10 and 1.11); and
 - Any other relevant topics.
- Provide *Kick-off Meeting Presentation* to include but not limited to:
 - Project overview (i.e. project description, goals and objectives, technical tasks, expected benefits, etc.)
 - Project schedule that identifies milestones
 - List of potential risk factors and hurdles, and mitigation strategy
 - Provide an *Updated Project Schedule*, *Match Funds Status Letter*, and *Permit Status Letter*, as needed to reflect any changes in the documents.

The CAM shall:

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

Recipient Products:

- Kick-off Meeting Presentation
- Updated Project Schedule (*if applicable*)
- Match Funds Status Letter (subtask 1.7) (*if applicable*)
- Permit Status Letter (subtask 1.8) (*if applicable*)

CAM Product:

- Kick-off Meeting Agenda

Subtask 1.3 Critical Project Review (CPR) Meetings

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

CPR meetings generally take place at key, predetermined points in the Agreement, as determined by the CAM and as shown in the Task List on page 1 of this Exhibit. However, the CAM may schedule additional CPR meetings as necessary. The budget will be reallocated to

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cover the additional costs borne by the Recipient, but the overall Agreement amount will not increase. CPR meetings generally take place at the CEC, but they may take place at another location, or may be conducted via electronic conferencing (e.g., WebEx) as determined by the CAM.

The Recipient shall:

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

The CAM shall:

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

Recipient Products:

- CPR Report(s)

CAM Products:

- CPR Agenda
- Progress Determination

Subtask 1.4 Final Meeting

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

The Recipient shall:

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

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

- The technical portion of the meeting will involve the presentation of findings, conclusions, and recommended next steps (if any) for the Agreement. The CAM will determine the appropriate meeting participants.

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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 procured equipment.
 - The CEC's request for specific "generated" data (not already provided in Agreement products).
 - Need to document the Recipient's disclosure of "subject inventions" developed under the Agreement.
 - "Surviving" Agreement provisions such as repayment provisions and confidential products.
 - Final invoicing and release of retention.
- Prepare a *Final Meeting Agreement Summary* that documents any agreement made between the Recipient and Commission staff during the meeting.
- Prepare a *Schedule for Completing Agreement Closeout Activities*.
- Provide copies of *All Final Products* on a USB memory stick, organized by the tasks in the Agreement.

Products:

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

REPORTS AND INVOICES

Subtask 1.5 Progress Reports and Invoices

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

The Recipient shall:

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

Products:

- Progress Reports
- Invoices

Subtask 1.6 Final Report

The goal of this subtask is to prepare a comprehensive Final Report that describes the original purpose, approach, results, and conclusions of the work performed under this Agreement.

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When creating the Final Report Outline and the Final Report, the Recipient must use the CEC Style Manual provided by the CAM.

Subtask 1.6.1 Final Report Outline

The Recipient shall:

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

Recipient Products:

- Final Report Outline (draft and final)

CAM Product:

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

Subtask 1.6.2 Final Report

The Recipient shall:

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

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were not incorporated into the final product.

- Submit the revised Final Report electronically with any Written Responses to Comments within 10 days of receipt of CAM's Written Comments on the Draft Final Report, unless the CAM specifies a longer time period or approves a request for additional time.

Products:

- Summary of TAC Comments on Draft Final Report
- Draft Final Report
- Written Responses to Comments (*if applicable*)
- Final Report

CAM Product:

- Written Comments on the Draft Final Report

MATCH FUNDS, PERMITS, AND SUBCONTRACTS

Subtask 1.7 Match Funds

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

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

The Recipient shall:

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

If match funds were a part of the proposal that led to the CEC awarding this Agreement, then provide in the letter:

- A list of the match funds that identifies:
 - The amount of cash match funds, their source(s) (including a contact name, address, and telephone number), and the task(s) to which the match funds will be applied.
 - The amount of each in-kind contribution, a description of the contribution type (e.g., property, services), the documented market or book value, the source (including a contact name, address, and telephone number), and the task(s) to which the match funds will be applied. If the in-kind contribution is equipment or other tangible or real property, the Recipient must identify its owner and provide a contact name, address, telephone number, and the address where the property is located.
 - If different from the solicitation application, provide a letter of commitment from an authorized representative of each source of match funding that the funds or contributions have been secured.

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- At the Kick-off meeting, discuss match funds and the impact on the project if they are significantly reduced or not obtained as committed. If applicable, match funds will be included as a line item in the progress reports and will be a topic at CPR meetings.
- Provide a *Supplemental Match Funds Notification Letter* to the CAM of receipt of additional match funds.
- Provide a *Match Funds Reduction Notification Letter* to the CAM if existing match funds are reduced during the course of the Agreement. Reduction of match funds may trigger a CPR meeting.

Products:

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

Subtask 1.8 Permits

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

The Recipient shall:

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

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

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

Products:

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

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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 each executed subcontract.
- Notify and receive written approval from the CAM prior to adding any new subcontractors (see the discussion of subcontractor additions in the terms and conditions).

Products:

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

TECHNICAL ADVISORY COMMITTEE

Subtask 1.10 Technical Advisory Committee (TAC)

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

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

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- Advocate, to the extent the TAC members feel is appropriate, on behalf of the project in its effort to build partnerships, governmental support and relationships with a national spectrum of influential leaders.
- Ask probing questions that insure a long-term perspective on decision-making and progress toward the project's strategic goals.

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

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

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meeting.

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

The TAC shall:

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

Products:

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

Subtask 1.12 Project Performance Metrics

The goal of this subtask is to finalize key performance targets for the project based on feedback from the TAC and report on final results in achieving those targets. The performance targets should be a combination of scientific, engineering, techno-economic, and/or programmatic metrics that provide the most significant indicator of the research or technology's potential success.

The Recipient shall:

- Complete and submit the project performance metrics section of the *Initial Project Benefits Questionnaire*, developed in the Evaluation of Project Benefits task, to the CAM.
- Present the draft project performance metrics at the first TAC meeting to solicit input and comments from the TAC members.
- Develop and submit a *TAC Performance Metrics Summary* that summarizes comments received from the TAC members on the proposed project performance metrics. The *TAC Performance Metrics Summary* will identify:
 - TAC comments the Recipient proposes to incorporate into the *Initial Project Benefits Questionnaire*, developed in the Evaluation of Project Benefits task.
 - TAC comments the Recipient does not propose to incorporate with and explanation why.
- Develop and submit a *Project Performance Metrics Results* document describing the extent to which the Recipient met each of the performance metrics in the *Final Project Benefits Questionnaire*, developed in the Evaluation of Project Benefits task.
- Discuss the *Project Performance Metrics Results* at the Final Meeting.

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Products:

- TAC Performance Metrics Summary
- Project Performance Metrics Results

IV. TECHNICAL TASKS

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

TASK 2: SYNTHESIZE EXISTING INFORMATION AND IDENTIFY DATA PRIORITIES

The goals of this task are to synthesize existing data on methane emissions in homes and identify priorities for new data collection in the California Residential Methane Emissions Characterization (CARMEC) study.

The Recipient shall:

- Compile methane emissions data collected in previous field studies.
- Construct two linked databases—one organized by device and one organized by housing unit—and populate the database with data from previous field studies.
- Analyze the existing data to identify common findings and any apparent inconsistencies.
- Construct a database for appliance burner monitoring data and populate with any data that are available and relevant.
- Review available information about current natural gas appliance saturations in California homes, and projected trends of new appliance shipments.
- Identify gaps and uncertainties that remain after consolidating existing data and determine data collection priorities for the CARMEC projects.
- Develop a *Synthesis of Existing Data on Methane Emissions from Residential Sources Technical Manuscript*.
- Develop a *Proposed Field Study Data Collection Priorities Presentation* for TAC review.

Products:

- Synthesis of Existing Data on Methane Emissions from Residential Sources Technical Manuscript.
- Proposed Field Study Data Collection Priorities Presentation

TASK 3: MEASUREMENT METHODS AND FIELD STUDY PREPARATIONS

The goals of this task are to experimentally compare methods used in prior studies of residential methane emissions, specify a suite of methods that will be used to measure emissions from all targeted appliances in the field study that will occur in Task 4, prepare protocols and conduct all required training for the field study.

The Recipient shall:

- Identify test homes that collectively contain the full suite of appliances that will need to be measured in Task 4, and that can be accessed repeatedly for repeat measurements.
- Prepare the equipment needed to conduct the cross-comparison experiments.
- Conduct experiments to compare methods used in prior field studies to measure the same appliances under the same operating modes and calculate emission rates for each.

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- Adapt existing methods or develop new methods as needed to measure appliances that have not been previously measured.
- Identify approaches and data-logging sensors to record burner operating patterns on all appliances for which burner patterns are determined to be uncertain, variable and substantial enough to require field monitoring.
- Prepare a *Technical Memorandum on Methods for Measuring Methane Emissions from Residential Natural Gas Appliances*.
- Develop field experimental protocols including quality assurance procedures.
- Prepare a *Draft Recruitment Plan* that identifies outreach methods and targets for sample characteristics.
- Develop a *Draft Human Subjects Protocol for Methane Emissions in Homes* that includes experimental procedures, recruitment materials, consent forms, etc. and make revisions as needed to obtain approval of the Recipient's institutional review board (IRB).
- Develop an institutional agreement with RHA to rely on the Recipient's IRB and ensure that all field staff have required human subjects training and are knowledgeable about the IRB-approved protocol.
- Prepare *CPR Report #1* and participate in a CPR meeting, per subtask 1.3.

Products:

- Technical Memorandum on Methods for Measuring Methane Emissions from Residential Natural Gas Appliances
- Recruitment Plan (Draft)
- Human Subjects Protocol for Methane Emissions in Homes (Draft)
- CPR Report #1

TASK 4: MEASURE METHANE EMISSIONS AND APPLIANCE OPERATION IN HOMES

The goals of this task are to measure methane emissions in residential spaces and from individual natural gas appliances, monitor in situ burner operation, and record characteristics of the appliances, buildings and households that could be associated with high methane emissions or appliance use rates.

The Recipient shall:

- Work with RHA and partnering Community Based Organizations (CBOs) to implement the recruitment plan.
- Implement the first campaign of field data collection to recruit and conduct measurements from at least 80 sites (or fewer number approved in writing by the CAM), measure emissions from at least 160 appliances (or fewer number approved in writing by the CAM) and monitor burner operation over multiple weeks from at least 200 appliances (or fewer number approved in writing by the CAM).
- Prepare a *Campaign 1 Summary Presentation* to communicate information to the TAC about the characteristics of the homes, household and appliances from which methane emissions were measured and the appliances from which operating cycles were monitored.
- Present to the TAC to obtain feedback and input on the plan for Campaign 2.
- Review and update recruitment and sampling plans.
- Update the human subject protocol with any changes that impact participants.
- Implement the second campaign of field data collection to recruit and conduct measurements from at least 80 sites (or fewer number approved in writing by the CAM), measure emissions from at least 160 appliances (or fewer number approved in writing by the CAM).

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the CAM) and monitor burner operation over multiple weeks from at least 200 appliances (or fewer number approved in writing by the CAM).

- Conduct quality assurance review and transfer data into the databases constructed in Task 2.
- Prepare a *Final Recruitment Plan* incorporating feedback from TAC.
- Prepare a *Final Human Subjects Protocol for Methane Emissions in Homes* incorporating feedback from TAC.

Products:

- Campaign 1 Summary Presentation
- Recruitment Plan (Final)
- Human Subjects Protocol for Methane Emissions in Homes (Final)

TASK 5: ANALYSIS AND TECHNICAL MANUSCRIPTS

The goals of this task are to analyze the data obtained from measurements, device monitoring, and the recording of building, household and device characteristics to produce scientific findings about the distributions of emissions from homes and appliances and potential explanatory or associated factors.

The Recipient shall:

- Process, review for quality assurance, and add the primary data collected in Task 4 to the databases for devices, housing units, households, and operating patterns developed in Task 2; this will occur on an ongoing basis through the sampling campaigns.
- Write computer codes to analyze the data to calculate outcome metrics such as quiescent emission rates from housing units and during steady burner operation, and those associated with burner firing events.
- Develop and apply analysis algorithms to determine burner firing based on data collected with logging sensors placed on appliances in homes.
- Explore associations between resting, operating, and burner firing emission rates with device, housing, and household characteristics. Present data and results and conduct statistical analyses.
- Develop a *Report on Methane Emissions from Post-meter Natural Gas Infrastructure in Houses and Apartments* to document the results of methane emissions from buildings and appliances.
- Prepare *Manuscripts that Document Study Results* and submit to journals.

Products:

- Report on Methane Emissions from Post-meter Natural Gas Infrastructure in Houses and Apartments
- Manuscripts that Document Study Results

TASK 6: EVALUATION OF PROJECT BENEFITS

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

The Recipient shall:

- Complete the *Initial Project Benefits Questionnaire*. The Initial Project Benefits Questionnaire shall be initially completed by the Recipient with 'Kick-off' selected for the 'Relevant data collection period' and submitted to the CAM for review and approval.

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- Complete the *Annual Survey* by July 15th of each year. The Annual Survey includes but is not limited to the following information:
 - Technology commercialization progress
 - New media and publications
 - Company growth
 - Follow-on funding and awards received
- Complete the *Final Project Benefits Questionnaire*. The Final Project Benefits Questionnaire shall be completed by the Recipient with 'Final' selected for the 'Relevant data collection period' and submitted to the CAM for review and approval.
- Respond to CAM questions regarding the questionnaire drafts.
- Complete and update the project profile on the CEC's public online project and recipient directory on the [Energize Innovation website](http://www.energizeinnovation.fund) at www.energizeinnovation.fund and provide *Documentation of Project Profile on EnergizeInnovation.fund*, including the profile link.
- If the Prime Recipient is an Innovation Partner on the project, complete and update the organizational profile on the CEC's public online project and recipient directory on the [Energize Innovation website](http://www.energizeinnovation.fund) at www.energizeinnovation.fund and provide *Documentation of Organization Profile on EnergizeInnovation.fund*, including the profile link.

Products:

- Initial Project Benefits Questionnaire
- Annual Survey(s)
- Final Project Benefits Questionnaire
- Documentation of Project Profile on EnergizeInnovation.fund
- Documentation of Organization Profile on EnergizeInnovation.fund

TASK 7: TECHNOLOGY/KNOWLEDGE TRANSFER ACTIVITIES

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

The Recipient Shall:

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

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- Submit the *Final Knowledge Transfer Plan* to the CAM for approval.
- Implement the activities as described in the *Final Knowledge Transfer Plan*.
- Develop a *Knowledge Transfer Summary Report* that includes high level summaries of the activities, results, and lessons learned of tasks performed relating to implementing the *Final Technology Transfer Plan*. This report should not include any proprietary information.
- When directed by the CAM, develop presentation materials for an CEC- sponsored conference/workshop(s) on the project.
- Provide at least (6) six *High Quality Digital Photographs* (minimum resolution of 1300x500 pixels in landscape ratio) of pre and post technology installation at the project sites or related project photographs.

Products:

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

V. PROJECT SCHEDULE

Please see the attached Excel spreadsheet.

STATE OF CALIFORNIA

STATE ENERGY RESOURCES
CONSERVATION AND DEVELOPMENT COMMISSION

**RESOLUTION: THE REGENTS OF THE UNIVERSITY OF CALIFORNIA AS
MANAGEMENT AND OPERATING CONTRACTOR FOR THE ERNEST ORLANDO
LAWRENCE BERKELEY NATIONAL LABORATORY**

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

RESOLVED, that the CEC approves Agreement PIR-21-008 with The Regents of the University of California as management and operating contractor for the Ernest Orlando Lawrence Berkeley National Laboratory for a \$2,000,000 grant to conduct applied research to improve the characterization of residential methane emissions in California homes, and adopting staff's determination that this action is exempt from CEQA. The study will help improve California's methane emission inventory, quantify the benefits of decarbonization in buildings, and inform the development of cost-effective programs to reduce methane emissions from the residential building sector; and

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

CERTIFICATION

The undersigned Secretariat to the CEC does hereby certify that the foregoing is a full, true, and correct copy of a Resolution duly and regularly adopted at a meeting of the CEC held on June 8, 2022.

AYE:

NAY:

ABSENT:

ABSTAIN:

Liza Lopez
Secretariat