STATE OF CALIFORNIA

GRANT REQUEST FORM (GRF)

CEC-270 (Revised 10/2015) CALIFORNIA ENERGY COMMISSION

New Agreement EPC-15-081 (To be completed by CGL Office)

Division	Agreement Manager:	MS-	Phone
ERDD	Susan Wilhelm	43	916-327-1545

Recipient's Legal Name	Federal ID Number
Ghoulem Research	27-4932496

Title of Project

Historical Insights for Technology Adoption Scenarios in California and Flexible Energy Demand Modeling for Residential Air Conditioning with Improved Behavioral Specificity

Term and Amount	Start Date	End Date	Amount
	6/13/2016	6/28/2019	$ 400,000

Business Meeting Information

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

Proposed Business Meeting Date	5/17/2016	☐ Consent	☒ Discussion
Business Meeting Presenter	Susan Wilhelm	Time Needed:	5 minutes

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

Agenda Item Subject and Description

GHOULEM RESEARCH. Proposed resolution approving agreement EPC-15-081 with Ghoulem Research for a $400,000 grant to analyze histories of selected energy technology changes with respect to their implications for planning future technological transitions toward a low-carbon electricity sector and develop a flexible household-level air conditioning (AC) demand simulation modeling system to offer improved behavioral specificity in the context of electricity sector transitions.

California Environmental Quality Act (CEQA) Compliance

1. Is Agreement considered a "Project" under CEQA?
   ☐ Yes (skip to question 2) ☒ No (complete the following (PRC 21065 and 14 CCR 15378)):
   Explain why Agreement is not considered a "Project":
   Agreement will not cause direct physical change in the environment or a reasonably foreseeable indirect physical change in the environment because it involves a study to analyze the histories of selected energy technologies, development of improved technology scenarios, and development of conceptual as well as computational frameworks for flexible modeling of demand-response with regard to residential air conditioning demand, none of which constitute a project under CEQA.
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: _____
   ☐ Common Sense Exemption. 14 CCR 15061 (b) (3)
   Explain reason why Agreement is exempt under the above section:
   ☐ b) Agreement **IS NOT** exempt. (Consult with the legal office to determine next steps.)
   Check all that apply
   ☐ Initial Study ☐ Environmental Impact Report
   ☐ Negative Declaration ☐ Statement of Overriding Considerations
   ☐ Mitigated Negative Declaration

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

Legal Company Name:	Budget
Tbd	$ 8,620
Tbd	$ 8,800
Tbd	$ 2,020
	$
	$
	$
	$
	$
	$

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

Budget Information

Funding Source	Funding Year of Appropriation	Budget List No.	Amount
EPIC	14-15	301.001B	$400,000
			$
			$
			$
			$
			$
R&D Program Area: EGRO: EA		TOTAL:	$400,000
Explanation for "Other" selection			
Reimbursement Contract #:		Federal Agreement #:	

Recipient's Administrator/ Officer				**Recipient's Project Manager**			
Name:	Mithra Moezzi			Name:	Mithra Moezzi		
Address:	43 BAYO VISTA WAY			Address:	43 BAYO VISTA WAY		
City, State, Zip:	SAN RAFAEL, CA 94901-1619			City, State, Zip:	SAN RAFAEL, CA 94901-1619		
Phone:	415-747-8722 /	Fax:	- -	Phone:	415-747-8722 /	Fax:	- -
E-Mail:	mmmoezzi@ghoulemresearch.com			E-Mail:	mmmoezzi@ghoulemresearch.com		

Selection Process Used

☒ Competitive Solicitation Solicitation #: GFO-15-309

☐ First Come First Served Solicitation

The following items should be attached to this GRF

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

Agreement Manager	Date	Office Manager	Date	Deputy Director	Date

Exhibit A
Scope of Work

I. TASK ACRONYM/TERM LISTS

A. Task List

Task #	CPR[1]	Task Name
1		General Project Tasks
2		Analyze Energy Histories for Selected Technologies
3	**X**	Assess Current Transition Planning
4		Use History to Improve Environmental Benefits
5		Assemble Data, Conduct Statistical Analysis
6	**X**	Construct, Test and Deploy Household-Level AC Demand Simulation Tool
7		Apply Findings to Energy and Climate Policy
8		Evaluation of Project Benefits
9		Technology/Knowledge Transfer Activities

B. Acronym/Term List

Acronym/Term	Meaning
AB 32	Assembly Bill 32, also known as "California's Global Warming Solutions Act"
AB 758	Assembly Bill 758
AC	Air Conditioning
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CPR	Critical Project Review
CPUC	California Public Utility Commission
DFM	Demand Forecasting Model
GHG	Greenhouse Gas
HVAC	Heating, Ventilation, and Air Conditioning
IPCC	Intergovernmental Panel on Climate Change
NOAA	National Oceanic and Atmospheric Administration
PV	Photovoltaic
RASS	Residential Appliance Saturation Survey
RECS	Residential Energy Consumption Survey
TAC	Technical Advisory Committee
TOU	Time-of-use
ZNE	Zero Net Energy (buildings)

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

A. Purpose of Agreement

The purpose of this Agreement is to fund research to analyze and interpret histories of selected energy technology changes with respect to their implications for planning future changes in

[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.

technological transitions as well as research resulting in a flexible household-level air conditioning (AC) demand simulation modeling system as a proof of concept. Products will include quantitative-qualitative analyses of past changes in technology penetrations, energy use, and associated social characteristics; a summary of insights and principles deduced from these analyses; examples of how these can be concretely applied to create improved scenarios for energy and environmental planning and forecasting; and development of a demand simulation model that enables analysis of complex interactions among influences on AC demand and evaluation of "what if" scenarios about the effects of alternative technological, environmental, policy, and social trajectories.

B. Problem/ Solution Statement

Problem

Energy and climate change planning depend tremendously on anticipated changes in technology. In turn the benefits from this planning depend on how and how well these technologies are adapted into society. History has a great deal to say about how technological and social transitions—both planned and unplanned—actually happen. Scholars in history of technology, social studies of technology, and the sociology of transitions have been working on using this information to help support the ability of policy makers, industry, and society as a whole achieve desired outcomes. While the schema of "diffusion of innovation" is fairly well known, the energy efficiency field has as not yet benefitted much from the texture and details of histories of technologies that use energy or of other technical and social changes affecting this use. There are several reasons for this: a lack of detailed quantitative-qualitative studies on energy technology history, the relatively small role that social sciences and especially history play in this largely engineering- and economics-dominated domain, and the fact that substantial effort may be required for non-specialists to interpret and apply insights from these histories. Providing this information is urgently needed as energy planners and researchers continue to transform the field from a focus on energy efficiency and meeting energy demand to the broader challenges of climate change.

One area in which the prevailing, ahistorical perspective of energy and climate change planning manifests is in current demand forecasting models (DFMs). DFMs provide only rough approximations of future household energy use and carbon emissions. Also, the dynamism and diversity of residential demand is not treated in any detail in DFMs. Climate change policy now requires more dynamic and flexible simulation tools to address a range of questions about complex social-technological-environmental system dynamics under uncertain conditions.

Solution

The Recipient will analyze quantitative and qualitative data to provide histories of selected key energy technology changes, both planned and unplanned. It will interpret these histories in the context of transitions theories and provide examples, principles and insights that can be used in future planning. It will produce example scenarios that illustrate the differences that these insights can make in planning and technology design. It will pay special attention to developing and disseminating this information in usable ways, via dialogue with policy makers and planners, and through communications with other stakeholders.

Leveraging insights from historical technology transitions, the Recipient will design, deploy and test a flexible modeling platform or "simulation sandbox" with which researchers and Energy Commission demand modeling and forecasting staff can draw upon the best available empirical

data to simulate dynamic residential demands for AC, as a proof of concept that might later be broadened to other energy uses and demand sectors.

C. Goals and Objectives of the Agreement

Agreement Goals

The goals of this Agreement are to:

- Use the history of past changes in energy technologies in society to deduce principles that can improve the success of future technology transitions;
- Based on historical experience, develop sample technology scenarios that can be used for energy technology planning and forecasting;
- Address significant knowledge gaps and weaknesses in DFM and climate modeling practice by developing, testing and providing proof of concept of an alternative flexible simulation tool with which researchers, forecasters and policy makers can better investigate possible energy demand futures;
- Develop pathways for expanding and integrating the sandbox approach into existing energy research, planning activities and policy development.

Ratepayer Benefits:[2] This Agreement will result in ratepayer benefits from improved energy forecasting that will lead to greater electricity reliability and lower long-run costs, by improving the ability of planning agencies and researchers to foster beneficial technology transitions and to estimate the timing, financial costs, and other costs and benefits of these transitions; and by offering more accurate dynamic models that will result in more effective programs, policies, and targeting of consumer sub-segments. This Agreement will also contribute to the efficient use of ratepayer monies as well as to Greenhouse Gas (GHG) emissions reductions.

Technological Advancement and Breakthroughs:[3] 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 providing insights and evidence that substantially improve the ability to successfully promote desirable residential sector energy technologies. In addition, it will improve the ability to estimate the timing, benefits, and costs of these technologies, and to develop scenarios and policy portfolios that better reflect policy and technology impacts. These results, at a minimum, will support the GHG emissions reductions goals stipulated in AB 32 and improve the performance of efficiency measures outlined in AB 758 and the California Energy Code. They are expected to also provide a basis to improve the state's ability to reach the goals outlined in CPUC's Energy Efficiency Strategic Plan, and inform updated estimates of timing and benefits as appropriate. The results are also expected to be of direct use in the scenario development used in the Integrated Energy Policy Report. The Agreement will also foster attainment of the state's statutory energy goals by providing a more complete understanding of residential consumer demand dynamics, which will, in turn, provide a foundation for

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

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

improvements in policy analysis, selection among policy options, offer a wider range of program options for energy efficiency interventions, and deliver more accurate inputs to California climate modeling and forecasting systems.

Agreement Objectives

The objectives of this Agreement are to:

- Produce compressed histories for a selection of energy-relevant technologies, demographic (e.g., household size) and behavioral (e.g., time use, indoor temperature) changes, combining quantitative data with historical and social sciences-based explanations;
- Interpret these examples and existing work on technological transitions with respect to characteristics (e.g., blocked transitions, wildly successful cases, niche transformations) and insights that can be applied to current energy and climate change planning;
- Assess the construction of scenarios used in forecasting, climate modeling, goal setting, and modeling policy interventions (e.g. by the Energy Commission or the Intergovernmental Panel on Climate Change (IPCC));
- Based on the above information, develop alternative scenarios for selected examples;
- Foster dialogue on scenario development, on the evaluation of ongoing technology diffusion efforts, and on bringing a broader set of information from past experience to bear on shaping, implementing, and anticipating future changes and their effects.
- Design an architecture for proof-of-concept of a flexible residential demand simulation tool that can provide AC-specific results and can be generalized to other end-uses.
- Implement the design, test and refine using a variety of data sources and specifications of interactions among factors.
- Explore a range of plausible “what if” questions about policies, technologies, environmental, and behavioral changes at relatively short (5-10 year) time scales. Examples might include: effects of extremes in thermostat-setting practices on averaged DFM AC estimates; different consumer responses to extreme weather events; AC technology innovations; TOU pricing; effects of photovoltaic (PV) on AC demand; changes in cooling practices across subpopulation segments.
- Compare relative effects on energy demand, interactions among factors, and sensitivity to data inputs and model assumptions.
- Consult with forecasters, policy planners and other stakeholders throughout the process to assure high quality design and data, and to determine how such tools can be most useful in energy policy research and planning.

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:

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

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

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

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

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

MEETINGS

Subtask 1.2 Kick-off Meeting
The goal of this subtask is to establish the lines of communication and procedures for implementing this Agreement.

The Recipient shall:

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

  The <u>administrative portion</u> of the meeting will include discussion of the following:

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

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

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

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

The CAM shall:

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

Recipient Products:

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

CAM Product:

- Kick-off Meeting Agenda

Subtask 1.3 Critical Project Review (CPR) Meetings

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

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

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

The Recipient shall:

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

The CAM shall:

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

Recipient Products:

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

CAM Products:

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

Subtask 1.4 Final Meeting

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

The Recipient shall:

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

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

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

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

Products:

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

REPORTS AND INVOICES

Subtask 1.5 Progress Reports and Invoices

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

The Recipient shall:

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

Exhibit A
Scope of Work

Products:
- Progress Reports
- Invoices

Subtask 1.6 Final Report
The goal of this subtask is to prepare a comprehensive Final Report that describes the original purpose, approach, results, and conclusions of the work performed under this Agreement. The CAM will review and approve 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 a Style Manual provided by the CAM.

Subtask 1.6.1 Final Report Outline

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

Recipient Products:
- Final Report Outline (draft and final)

CAM Product:
- Style Manual
- Comments on Draft Final Report Outline
- Acceptance of Final Report Outline

Subtask 1.6.2 Final Report

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

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

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

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

CAM Product:
- Written Comments on the Draft Final Report

MATCH FUNDS, PERMITS, AND SUBCONTRACTS

Subtask 1.7 Match Funds
The goal of this subtask is to ensure that the Recipient obtains any match funds planned for this Agreement and applies them to the Agreement during the Agreement term.

While the costs to obtain and document match funds are not reimbursable under this Agreement, the Recipient may spend match funds for this task. The Recipient may only spend

match funds during the Agreement term, either concurrently or prior to the use of Energy Commission funds. Match funds must be identified in writing, and the Recipient must obtain any associated commitments before incurring any costs for which the Recipient will request reimbursement.

The Recipient shall:

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

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

Products:

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

Subtask 1.8 Permits

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

Exhibit A
Scope of Work

The Recipient shall:

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

  The list of permits and the schedule for obtaining them will be discussed at the Kick-off meeting (subtask 1.2), and a timetable for submitting the updated list, schedule, and copies of the permits will be developed. The impact on the project if the permits are not obtained in a timely fashion or are denied will also be discussed. If applicable, permits will be included as a line item in progress reports and will be a topic at CPR meetings.
- If during the course of the Agreement additional permits become necessary, then provide the CAM with an *Updated List of Permits* (including the appropriate information on each permit) and an *Updated Schedule for Acquiring Permits*.
- Send the CAM a *Copy of Each Approved Permit*.
- If during the course of the Agreement permits are not obtained on time or are denied, notify the CAM within 5 days. Either of these events may trigger a CPR meeting.

Products:

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

Subtask 1.9 Subcontracts

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

The Recipient shall:

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

Products:

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

Exhibit A
Scope of Work

TECHNICAL ADVISORY COMMITTEE

Subtask 1.10 Technical Advisory Committee (TAC)
The goal of this subtask is to create an advisory committee for this Agreement. The TAC should be composed of diverse professionals. The composition will vary depending on interest, availability, and need. TAC members will serve at the CAM's discretion. The purpose of the TAC is to:

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

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

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

The Recipient shall:

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

Exhibit A
Scope of Work

Products:

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

Subtask 1.11 TAC Meetings

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

The Recipient shall:

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

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 Analyze Energy Histories for Selected Technologies

The goal of this task is to collect detailed information on theoretical foundation of transitions studies, energy histories and trends in the US and California; also to conduct in-depth studies of a select number of key residential energy technologies.

The Recipient shall:

- Review literature in history of technology, sociology, anthropology, energy efficiency research, and policy studies, as they pertain to the recent history of energy use, energy technology evolutions, and scenario development and application. Recipient will produce an *Interdisciplinary Literature Review of Recent Residential Energy Transitions* to offer a high-level summary of knowledge on residential energy technology history.
- Use established data sources from the Energy Information Administration, the Census Bureau, the Energy Commission, NOAA, and other agencies, provide quantitative analysis of patterns and trends in energy use, building characteristics, key demographics, technology saturations, and other factors relevant to GHG emissions, and analyze these data with respect to shifting social systems of energy use. Salient findings from this task will be summarized in a *Trends and Transitions Case Studies Report*.
- Supplement trends analysis with information from written sources, interviews, and historical data on energy technologies to develop a series of transitions case study histories for selected energy use technologies, along with related demographic, behavioral, and structural elements. Develop and illustrate insights based on these histories that can be applied to energy and climate change planning.

Products:

- Interdisciplinary Literature Review of Recent Energy Transitions
- Trends and Transitions Case Studies Report

TASK 3 Assess Current Transition Planning

The goals of this task are to relate findings from Task 2 studies to current energy and climate modeling and forecasting use of scenarios in California, as well as to develop scenarios based on historical evidence, in collaboration with Commission forecasting staff.

The Recipient shall:

- Use both written documents and conversations with policy makers, researchers, community planners, and other climate change and energy professionals, to investigate how technology scenarios and plans are currently constructed, how results are interpreted, and what information from history would be most helpful. This will include analysis of a selection of scenarios currently in use and comparisons to information developed from Task 2.
- Develop scenarios for selected residential energy technologies and building energy

management strategies, focusing on those with key roles in GHG emissions reductions and climate change management, such as air conditioning, building retrofits, and Zero Net Energy (ZNE) construction (including performance of ZNE buildings).
- Produce a *Current Scenarios and Alternatives Report* to summarize current construction of technology scenarios, interpretation of results, and historical knowledge gaps, as well as alternative scenarios for selected residential technologies.
- Prepare *CPR Report* per Subtask 1.3.
- Participate in the CPR Meeting.

Products:
- Current Scenarios and Alternatives Report
- CPR Report

TASK 4 **Use History to Improve Environmental Benefits**
The goal of this task is to develop applications for finding from this research to current residential sector energy and climate policy deliberations in California.

The Recipient shall:
- Work with energy policy and research communities to make recommendations for how energy and climate change planning and forecasting can incorporate the principles and patterns revealed in the results of Tasks 2 and 3.
- Consult with CAM as well as representatives selected by the CAM from the Energy Commission's Energy Efficiency Research Office, Energy Assessment Division, and Efficiency Division regarding the choice of technologies selected for further analysis and application of findings.
- Identify opportunities to apply findings from studies of past residential energy technology transitions to current policy deliberations and energy efficiency programs (e.g., focused on high-efficiency housing codes, residential market transformation initiatives, various 'smart' systems efforts focusing on 'smart cities,' 'smart grids,' and 'smart consumer control' of household technologies). Determine how insights about how resistance to change, pacing of change, roles of external drivers, interdependencies between system elements, etc. can inform more effective policy and implementation.
- Produce a *Technical Memo on Policy Applications for Scenario Improvement* detailing how findings from studies of past residential energy technology transitions can be applied to current policy deliberations and implementations.
- Produce and present *Slides for a Briefing for Commission Staff*, to communicate findings to Energy Commission Staff in an interactive manner.
- Produce, submit, and publish a peer-reviewed *Journal Article or a Conference Proceedings Paper* regarding how energy and climate change planning and forecasting can incorporate the principles and patterns revealed in Tasks 2 and 3 and/or regarding additional findings from Task 4.

Products:
- Technical Memo on Policy Applications for Scenario Improvement
- Slides for a Briefing for Commission Staff
- Journal Article or Conference Proceedings Paper

TASK 5 **Assemble Data, Conduct Statistical Analysis**

The goal of this task is to collect and analyze the best quality existing data on California residential air conditioner use and cooling energy demand.

The Recipient shall:

- Create a database of empirical information on dynamism of demand at the individual household level, variations across subpopulations, and interactions among demand factors (building, HVAC system, weather, occupant behavior). Data sources include: RASS, RECS, utility load research samples, pilot/program AC sub-metered samples.
- Assess data quality, comparability and currency. Use statistical analysis to investigate relationships among AC loads, and factors contributing to dynamism, variability and uncertainty.
- Produce a *Data Quality Assessment and Statistical Analysis Memo* to summarize key findings regarding quality, comparability, currency, and important relationships among AC loads and factors contributing to dynamism, variability and uncertainty.

Products:

- Data Quality Assessment and Statistical Analysis Memo

TASK 6 **Construct, Test and Deploy Household-Level AC Demand Simulation Tool**

The goal of this task is to design, construct and test a flexible dynamic AC demand simulation platform; also to use the platform to examine the effects of interactions among key influences on residential AC demand, as well as to explore "what if" scenarios about possible social and technological trajectories, policy alternatives, and environmental conditions.

The Recipient shall:

- Construct and test a modeling system, using empirical data from Task 5 to inform model architecture, inputs, and relationships among factors. Maintain close collaboration with Commission staff to assure that system is designed for usability.
- Test model performance, assess modeling results, summarize findings related to AC loads, peaks, total demand, and carbon emissions under varying conditions and using plausible "what if" scenarios about future conditions, policies and interactions among influential factors.
- Produce a *Model Design, Performance, and Simulation Findings Report* to offer a concise description of the design, performance, and key findings associated with the model.
- Prepare *CPR Report* per Subtask 1.3.
- Participate in the CPR Meeting.

Products:

- Model Design, Performance and Simulation Findings Report
- CPR Report

TASK 7 **Apply Findings to Energy and Climate Policy**

The goal of this task is to apply findings to current forecasting and policy problems.

The Recipient shall:

- Produce *Slides for a Final Energy Commission Staff Briefing* to communicate findings and discuss with Commission staff and other stakeholders the implications for innovation and improvement in modeling, forecasting and policy development.
- Produce a *Publication of Project Findings* in the form of a conference paper or scientific publication to disseminate results to scientific and public audiences.
- Explore follow-on work, if indicated by the findings. Prepare *Summary of Possible Follow-on Research* that could extend the model to other residential end-uses, climate areas and housing types in a manner that benefits ratepayers.

Products:

- Slides for Final Energy Commission Staff Briefing
- Publication of Project Findings
- Summary of Possible Follow-on Research

TASK 8 **Evaluation of Project Benefits**

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

The Recipient shall:

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

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

- Total annual sales or projected annual sales (in dollars) of products developed under the Agreement.
- Investment dollars/follow-on private funding as a result of Energy Commission funding.
- Patent numbers and applications, along with dates and brief descriptions.

- Additional Information for Product Demonstrations:
  - Outcome of demonstrations and status of technology.
  - Number of similar installations.
  - Jobs created/retained as a result of the Agreement.

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

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

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

TASK 9 **Technology/Knowledge Transfer Activities**

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

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

- Prepare a *Technology/Knowledge Transfer Plan* that includes:
  - An explanation of how the knowledge gained from the project will be made available to the public, including the targeted market sector and potential outreach to end users, utilities, regulatory agencies, and others.
  - A description of the intended use(s) for and users of the project results.
  - Published documents, including date, title, and periodical name.
  - Copies of documents, fact sheets, journal articles, press releases, and other documents prepared for public dissemination. These documents must include the Legal Notice required in the terms and conditions. Indicate where and when the documents were disseminated.
  - A discussion of policy development. State if project has been or will be cited in government policy publications, or used to inform regulatory bodies.
  - The number of website downloads or public requests for project results.
  - Additional areas as determined by the CAM.
- Conduct technology transfer activities in accordance with the Technology/Knowledge Transfer Plan. These activities will be reported in the Progress Reports.
- When directed by the CAM, develop *Presentation Materials* for an Energy Commission-sponsored conference/workshop on the results of the project.
- When directed by the CAM, participate in annual EPIC symposium sponsored by the California Energy Commission.
- Provide at least six *High Quality Digital Photographs* (Minimum Resolution of 1300x500 Pixels in Landscape Ratio) of Pre and Post Technology Installation at the Project Sites.
- Provide signed photo waiver release form by the Energy Commission.
- 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.

RESOLUTION NO: 16-0517-16j

STATE OF CALIFORNIA

STATE ENERGY RESOURCES
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION - RE: GHOULEM RESEARCH

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

RESOLVED, that the Energy Commission approves Agreement EPC-15-081 from GFO-15-309 with Ghoulem Research for a $400,000 grant to analyze histories of selected energy technology changes with respect to their implications for planning future technological transitions toward a low-carbon electricity sector and develop a flexible household-level air conditioning demand simulation modeling system to offer improved behavioral specificity in the context of electricity sector transitions; 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 May 17, 2016.

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

Cody Goldthrite,
Secretariat