STATE OF CALIFORNIA
GRANT REQUEST FORM (GRF)
CEC-270 (Revised 10/2015) CALIFORNIA ENERGY COMMISSION

New Agreement PIR-17-012 (To be completed by CGL Office)

ERDD	Susan Wilhelm	43	916-327-1545

The Regents of the University of California on behalf of the Berkeley campus	94-6002123

Developing Next-generation Cal-Adapt Features to Support Natural Gas Sector Resilience

	5/7/2018	3/31/2022	$ 1,000,000

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

Proposed Business Meeting Date	4/11/2018	☐ Consent	☒ Discussion
Business Meeting Presenter	Katharina Snyder	Time Needed:	5 minutes

Please select one list serve. NaturalGas (NG Research Program)

Agenda Item Subject and Description

UNIVERSITY OF CALIFORNIA, BERKELEY. Proposed resolution approving agreement PIR-17-012 with The Regents of the University of California, on behalf of the Berkeley campus for a $1 million grant to enhance the Cal-Adapt platform through the integration of new research results (including results from California's Fourth Climate Change Assessment), and to add new visualizations and custom tools that are tailored to specific needs and requirements of natural gas sector stakeholders. Results from this research will provide actionable information on energy infrastructure and climate-related vulnerabilities, and resilience to natural gas sector stakeholders.

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 the proposed work consists only of paper- and computer-based research and development involving no physical construction. The proposed work will have no physical impact on the environment.
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

Legal Company Name:	Budget
	$
	$
	$
	$

Legal Company Name:

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Budget Information			
Funding Source	**Funding Year of Appropriation**	**Budget List No.**	**Amount**
NG Subaccount, PIERDD	17-18	500.001L	$1,000,000
			$
			$
			$
R&D Program Area: EGRO: EA			$1,000,000
Explanation for "Other" selection			
Reimbursement Contract #:		Federal Agreement #:	

Name:	Shoshana Lavinghouse	Name:	Nancy Thomas
Address:	1608 4th Street, suite 220	Address:	111 Mulford Hall, UC Berkeley
City, State, Zip:	Berkeley 94710-3391	City, State, Zip:	Berkeley, CA 94720-3114
Phone:	510-643-3391 / Fax: - -	Phone:	510-643-4539 / Fax: - -
E-Mail:	spoawards@berkeley.edu	E-Mail:	nethomas@berkeley.edu

☒ Competitive Solicitation — Solicitation #: GFO-17-502
☐ First Come First Served Solicitation

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		Expand Cal-Adapt's Data Infrastructure
3	X	Develop New Visualizations and Custom Tools
4		Engage Stakeholders through Outreach and Collaboration
5		Evaluation of Project Benefits
6		Technology/Knowledge Transfer Activities

B. Acronym/Term List

Acronym/Term	Meaning
API	Application Programming Interface
Fourth Assessment	California's Fourth Climate Change Assessment, a coordinated research effort led by California's Natural Resources Agency in collaboration with the Governor's Office of Planning and Research and the California Energy Commission to provide science to inform planning for climate-related risks and implementing resilience options.
Cal-Adapt	An interactive web-site, developed with funding from the California Energy Commission, to enable exploration and visualization of climate-related risks to the energy system based on peer-reviewed data.
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CPR	Critical Project Review
Energy Commission	California Energy Commission
GCM	Global Circulation Models (often referred to as Global Climate Models), which employ mathematical models for computational simulation of the Earth's atmosphere or oceans and are can be used for clarifying weather and climatic patterns and projecting climate change.
GeoTIFF	GeoTIFF is a public domain standard that enables georeferencing information to be embedded within a common file format for exchanging images known as Tag Image File Format. This georeferencing information and related metadata include map projection, coordinate systems, ellipsoids, datums, and everything else necessary to establish the exact spatial reference for the file.
GHG	Greenhouse Gas
GIF	Geospatial Innovation Facility
GIS	Geographic Information System
IOU	Investor-Owned Utility

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

EXHIBIT A
Scope of Work

Acronym/Term	Meaning
Mapnik	A free resource of computational tools used to support mapping applications and fast-paced development for web applications.
netCDF	Network Common Data Format, a data format that supports the creation, access, and sharing of array-oriented scientific data.
TAC	Technical Advisory Committee
Recipient	The Regents of the University of California on behalf of the Berkeley Campus
USGS	United Stated Geological Survey

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

A. Purpose of Agreement

The purpose of this Agreement is to fund the development of next-generation enhancements to Cal-Adapt that integrate new research results (including results from California's Fourth Climate Change Assessment ("Fourth Assessment")) and expand the decision-support capabilities of Cal-Adapt to provide actionable information on energy infrastructure and climate-related vulnerabilities and resilience to natural gas sector stakeholders.

B. Problem/ Solution Statement

Problem

Energy sector operations, management, and planning require best-available and peer-reviewed information on projected climate and weather-related risks to maintain safe, reliable, and affordable energy for California's current and future populations. California's energy infrastructure, including facilities and pipelines that store, transmit, and distribute natural gas, is vulnerable to extreme weather events that may differ significantly from historical records as a result of changes in our climate. Understanding projected climate-related risks is critical to energy sector resilience and planning.

Solution

With funding and oversight from the Energy Commission, Recipient's Geospatial Innovation Facility (GIF) developed Cal-Adapt to provide visualizations of locally relevant climate-related risks including sea level rise, storms, wildfire, and extreme heat events. These simple, accessible tools enable decision makers to turn research results and climate projections into effective adaptation decisions and policies.

This project will provide actionable information on energy infrastructure and climate-related vulnerabilities to natural gas sector stakeholders, expanding the decision-support capabilities of Cal-Adapt in several ways: 1) by developing a more sophisticated and powerful data infrastructure that will increase computational power and advance user-defined variables for data processing, visualization, and downloads; 2) by building expanded data visualizations and custom tools so that users may explore new high-resolution data sets and examine projected climate risks to the natural gas sector and other assets or regions of interest; and, 3) by collaborating closely with key stakeholders including the Energy Commission, Investor-Owned Utilities (IOUs), other natural gas sector stakeholders, and the Technical Advisory Committee (see Task 1.10) to develop tools

and associated training materials that directly support natural gas operations, management, and critical planning needs.

C. Goals and Objectives of the Agreement

Agreement Goals

The goal of this Agreement is to develop next-generation enhancements to Cal-Adapt that integrate new research results, including those from the Fourth Assessment, and expand the decision-support capabilities of Cal-Adapt to provide actionable information on energy infrastructure and climate-related vulnerabilities and resilience to natural gas sector stakeholders.

Ratepayer Benefits: This Agreement will result in the ratepayer benefits of greater energy reliability and increased safety by supporting natural gas sector planning, management, and adaptation. Climate change is expected to impact California's natural gas and energy infrastructure through projected increased temperatures, sea level risk, wildfire risk, and severe droughts. Preserving reliable, safe, and cost-effective operations in the face of a changing climate requires integration of projected climate and weather-related parameters into decision making.

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 providing crucial actionable information on climate change consequences on natural gas storage and distribution infrastructure. Specifically, enhancements to Cal-Adapt will provide data access, tools, and visualizations customized to the natural gas system in a manner that supports attainment of important climate, energy, air quality, and other environmental goals while also maintaining safe, reliable, and affordable energy for California.

Agreement Objectives

The objectives of this Agreement are to build on the GIF's past successful work with Cal-Adapt and to develop an expanded suite of visualization, analytical tools and outreach approaches to provide natural gas sector stakeholders with actionable data pertaining to local climate risks through the following:

- Expand Cal-Adapt's Data Infrastructure to improve usability and accessibility by making available to natural gas sector stakeholders and other users new, high resolution and high fidelity data developed through the Fourth Assessment and other research efforts. In addition, capabilities for custom data downloading will be significantly enhanced. A key component of this task is to leverage big data technologies including cloud-based data storage and distributed processing that will expand the computational power available through Cal-Adapt to incorporate processing and visualization of high resolution geospatial datasets.
- Develop New Visualizations and Custom Tools (see Task 3) that are tailored to specific needs and requirements of natural gas sector stakeholders to support planning and protection of energy infrastructure. New data visualizations will allow users to explore high-resolution data, including projections of population and land use. In addition, the Recipient will expand the flexibility of current tools.
- Engage Stakeholders through Outreach and Collaboration with key natural gas sector stakeholders including IOUs and also with a range of climate practitioners, planners, managers, educators and ratepayers of the state through targeted workshops, webinars, and presentations. The GIF will collaborate closely with IOUs to develop tools and workflows that will generate climate-related parameters needed for resilience 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.

o **Software Application Development**

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

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

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

MEETINGS

Subtask 1.2 Kick-off Meeting

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

The Recipient shall:

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

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

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

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

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

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

CAM Product:
- Kick-off Meeting Agenda

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

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

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

The Recipient shall:

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

The CAM shall:

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

Recipient Products:

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

CAM Products:

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

Subtask 1.4 Final Meeting

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

The Recipient shall:

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

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

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

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

Products:

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

REPORTS AND INVOICES

Subtask 1.5 Progress Reports and Invoices

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

The Recipient shall:

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

EXHIBIT A
Scope of Work

Products:

- Progress Reports
- Invoices

Subtask 1.6 Final Report

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

Subtask 1.6.1 Final Report Outline

The Recipient shall:

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

Recipient Products:

- Final Report Outline (draft and final)

CAM Product:

- Style Manual
- Comments on Draft Final Report Outline
- Approval 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 is 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.
  - If different from the solicitation application, provide a letter of commitment from an authorized representative of each source of match funding that the funds or contributions have been secured.

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

Products:

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

Subtask 1.8 Permits

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

The Recipient shall:

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

  The list of permits and the schedule for obtaining them will be discussed at the Kick-off meeting (subtask 1.2), and a timetable for submitting the updated list, schedule, and copies of the permits will be developed. The impact on the project if the permits are not

obtained in a timely fashion or are denied will also be discussed. If applicable, permits will be included as a line item in progress reports and will be a topic at CPR meetings.

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

Products:

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

Subtask 1.9 Subcontracts

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

The Recipient shall:

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

Products:

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

TECHNICAL ADVISORY COMMITTEE

Subtask 1.10 Technical Advisory Committee (TAC)

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

- Provide guidance in project direction. The guidance may include scope and methodologies, timing, and coordination with other projects. The guidance may be based on:
  - o Technical area expertise;
  - o Knowledge of market applications; or

  - Linkages between the agreement work and other past, present, or future projects (both public and private sectors) that TAC members are aware of in a particular area.
- Review products and provide recommendations for needed product adjustments, refinements, or enhancements.
- Evaluate the tangible benefits of the project to the state of California, and provide recommendations as needed to enhance the benefits.
- Provide recommendations regarding information dissemination, market pathways, or commercialization strategies relevant to the project products.

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

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

The Recipient shall:

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

Products:

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

Subtask 1.11 TAC Meetings

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

The Recipient shall:

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

Products:

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

IV. TECHNICAL TASKS

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

TASK 2: EXPAND CAL-ADAPT'S DATA INFRASTRUCTURE

The goals of this task are to improve usability and accessibility for natural gas sector stakeholders and other users by: (1) making new, high spatial and temporal resolution data developed through research efforts such as the Fourth Assessment available through Cal-Adapt; (2) building enhanced data download capabilities to include preprocessing of data; and, (3) augmenting the computational power available through Cal-Adapt by leveraging big data technologies.

The Recipient shall:

- Incorporate high-resolution geospatial data related to climate vulnerability of the natural gas system and ratepayers, including population projections, land use/land cover, observed and projected climate data, and hydrological data from the United States Geological Survey (USGS) or other sources.
    - Reprocess these new data products as needed into formats suitable to ingest within the application web services (API) and/or host these data on the Cal-Adapt Climate Data Server to make accessible to researchers, energy sector stakeholders, and the public.
- Enhance data download tools to include preprocessing of data and to provide data in GeoTIFF and netCDF formats and text files so a variety of natural gas sector stakeholders can directly query for specific subsets of data to vastly simplify their analyses and processing.

  - Investigate whether netCDF will be an acceptable data storage format within the Cal-Adapt API without a loss of the performance achieved using GeoTIFF. This will include testing netCDF performance within the API against current high-performance GeoTIFF format.
  - Expand data capabilities through the Cal-Adapt API that more easily enable users to select regions of interest, temporal interval, and level of temporal aggregation (monthly, annual, or decadal averages).
- Develop methods to scale up Cal-Adapt, so natural gas sector IOUs and other natural gas stakeholders can leverage big data (for example, datasets related to operations and consumption, or datasets related to projected or historical observed climate) through the Cal-Adapt platform.
- Improve dynamic map algebra capability with tiled image outputs from the API. With the current architecture, Cal-Adapt generates full extent images from a time-series stack to drive map animations as seen in the snowpack and wildfire map tools. The Recipient shall investigate additional map algebra libraries or extend the underlying Mapnik package to generate dynamic spatial distributions of change and climate anomalies.
- Develop data sharing needed for tool development through the web API and data hosted on Amazon Web Services' Elastic Compute Cloud (also known as the EC2) instance or other new site as determined by the Cal-Adapt site host.
- Prepare a *New Data Availability Memo* when significant new datasets become available through Cal-Adapt, which the Recipient shall include in Cal-Adapt newsletter and blog posts to be published under grant EPC-17-033.
- Prepare and provide a *Data Download Tools Memo* that describes the new download tools and guides users on how to download various types of data from Cal-Adapt.
- Prepare a *Next-Generation Cal-Adapt Memo* which details the methods and results used to scale-up Cal-Adapt to increase data processing power.

Products:

- New Data Availability Memo
- Data Download Tools Memo
- Next-Generation Cal-Adapt Memo

TASK 3: DEVELOP NEW VISUALIZATIONS AND CUSTOM TOOLS

The goals of this task are to: (1) build custom tools that are tailored to specific needs and requirements of natural gas sector stakeholders to support planning and protection of energy infrastructure; (2) create data visualizations for new data from research efforts including the Fourth Assessment and including projections of population and land use; and, (3) expand the functionality of existing tools to include more user-driven input and to display additional metrics on summary statistics.

The Recipient shall:

- Develop tools based on data and results from new research as identified through ongoing discussions with the Energy Commission, IOU's, and other key natural gas stakeholders. The Recipient shall develop new data visualizations to support action based on Fourth Assessment research and other planned or ongoing efforts, including:
  - Incorporating high-resolution datasets of population and land use/land cover projections produced by the USGS.

  - Identify specific climate-related parameters (e.g., ambient temperature, wind speed, relative humidity) that are important in determining current and future impacts of climate change for planning, designing, building, operating, and maintaining existing and new natural gas infrastructure. Integrate these datasets into new or existing tools where relevant, such as incorporating relative humidity into the extreme heat tool.

- Design and build new tools and visualizations for climate relevant parameters in close collaboration with IOUs and with input from the CAM. The Recipient will work closely with natural gas stakeholders to identify and build specific tools and visualizations that provide information to feed directly into their operations, management, and planning processes. The Recipient shall:
  - Build a new tool to support demand forecast calculations that enable energy sector users to answer questions related to projected energy supply and demand for future time periods.
  - Develop a new tool to visualize and identify changes in precipitation patterns and extreme precipitation events using daily-downscaled localized constructed analogs (LOCA) data. Increased frequency and severity of storm events has the potential to significantly impact natural gas operations and infrastructure in the form of flooding, landslides, and other natural hazards.
  - Develop climate relevant parameters for the natural gas sector informed by engineering standards that will support the design, management, operation, and planning of natural gas infrastructure. Parameters might include:
    - Frequency and duration of extreme cold weather events and heat waves that are significantly above or below normal (outside the 90th/10th percentile value) over the selected time period, which can be used to consider the supply capacity of natural gas infrastructure to serve core customers.
    - Identify parameters of interest to IOUs such as the highest precipitation occurring within one week, or the highest running average temperature for one week or over a user-specified number of days.

- Continue to develop Cal-Adapt's current tools to meet needs expressed by stakeholders during a User Needs Assessment Workshop (see Task 4), identified by the Technical Advisory Committee (see Task 1.10), and through discussions with the CAM. The Recipient shall:
  - Improve interactivity across existing tools. Allow for user-specified thresholds for calculating frequency of extreme events (e.g. extreme heat), cooling degree days, and heating degree days (and user-specified time spans for calculating duration of extreme events. For example, users may want to identify frequency of events that exceed some temperature threshold over several consecutive days.
  - Develop a visualization to show extreme precipitation events and relationship to atmospheric rivers. One option is to add time series representing annual precipitation contributed by top five percent of wet days versus the other 95 percent to the Annual Precipitation Tools and show association with the number of "Pineapple Express" storms.
  - Develop a visualization for displaying climate anomalies between future time periods and historical normal similar to the Degree of Change map on Cal-Adapt 1.0. Add functionality for users to dynamically select time periods and climate

variables of interest and view the difference relative to baseline conditions in values or as percentages.
  - Improve the presentation of summary metrics included in charts. Currently tools show averages of selected global climate models (GCMs). Options could include providing a table of commonly used statistical summary measures, such as mean, median, and standard deviation to communicate distribution, or provide functionality for adding user defined measures such as 90th percentile for different GCM's. Once we design the presentation and layout of these additional metrics this information could be included across all of the relevant climate tools on Cal-Adapt.
  - Generate reports of select climate related parameters for user's area of interest in different formats such as PDF or spreadsheet.

- Prepare and provide a *Land Use/Land Cover and Population Projections Toolkit Memo* that describes the new data visualizations and tools built to showcase these new data generated through the Fourth Assessment and related research, which the Recipient shall publish through the Cal-Adapt Newsletter and the Cal-Adapt blog.

- Prepare an *Extreme Climate Events Update Memo* that details new improvements and additions to the extreme heat tool as well as additional "extreme" visualizations such as new visualizations of extreme precipitation events.

- Prepare and provide additional *Cal-Adapt Update Memos* that describe major new tools and features as they are made available, which the Recipient shall publish through the Cal-Adapt Newsletter and the Cal-Adapt blog.

- Prepare a *CPR Report* in accordance with subtask 1.3 (CPR Meetings).

- Participate in a CPR meeting.

Products:
- Land Use/Land Cover and Population Projections Toolkit Memo
- Extreme Climate Events Update Memo
- Cal-Adapt Update Memos
- CPR Report

TASK 4: ENGAGE STAKEHOLDERS THROUGH OUTREACH AND COLLABORATION

The goals of this task are to: (1) engage with key natural gas sector stakeholders including IOUs and also with a range of climate practitioners, planners, managers, educators and ratepayers of the state through targeted workshops, webinars, and presentations; and (2) to develop training tools and workflows that will generate climate-related parameters needed for resilience planning.

The Recipient shall:
- Hold on-site meetings or webinars with California's natural gas sector IOUs designed to identify, discuss, and develop useful customized tools that will inform IOU efforts to plan for and adapt to climate change.

EXHIBIT A
Scope of Work

- Host and facilitate a minimum of two User Needs Assessment Workshops focused on the natural gas sector and open to the public to introduce users to new tools and features and elicit stakeholder comments and insights to help guide Cal-Adapt web site development. The audience will be selected in consultation with the CAM, the Technical Advisory Committee, IOUs, and other energy sector partners.
    - Develop and provide all *Workshop Presentation Materials* to the CAM.
- Provide *Webinar Presentation Materials* for outreach and training of potential new users by developing and facilitating a series of virtual workshops (Webinars) that will target practitioners involved in the natural gas and energy sector. These meetings will serve to introduce specific tools still in development to elicit feedback from a range of users early in the design stage.
    - Develop a webinar designed to introduce users to new Cal-Adapt features that allow for a more tailored user experience, including user-defined thresholds and advanced data download capabilities.
    - Host a webinar in partnership with USGS team members to introduce user to new Fourth Assessment data tools based on population and land cover projections.
    - Host and facilitate additional informal webinars, to be held on a quarterly basis, that engage stakeholders early in design stage (as indicated above) and to enhance training support for use of the Cal-Adapt API (as described below)
- Develop expanded training materials focused on the Cal-Adapt API. Cal-Adapt's web service architecture is designed to allow users to have considerable control over aggregating, exporting, and displaying climate variables of interest which allows for advanced analysis beyond what is in the Cal-Adapt web-based tools. However, some familiarity with using a representational state transfer (REST) API and a scripting or programming language such as Python, R, or JavaScript is required to make full use of the API features. Users have noted that it would be helpful to develop more how-to training guides around making use of the API particularly for geospatial information system GIS users.
    - The GIF has authored several examples on using the Cal-Adapt API with Python and Jupyter notebooks. The Jupyter Notebook is an open-source web application that allows a user to create and share documents that contain live code, equations, visualizations and narrative text which makes it ideal for rapid prototyping and sharing of data analysis. In addition to these notebooks the Recipient shall develop how-to guides for ArcGIS users and (if identified as helpful by users) a guide for R users.
- Develop *Presentation Visuals* and graphics as needed to support training and outreach efforts targeting energy sector stakeholders.
- Present website development and results at relevant conferences to promote the new Cal-Adapt natural gas sector visualizations and tools.
    - Provide regular memos and information pertaining to new data, visualizations, and tools to be included within the Cal-Adapt Newsletter that the Recipient will publish under EPC-17-033.

Products:

- Workshop Presentation Materials
- Webinar Presentation Materials
- Presentation Visuals

EXHIBIT A
Scope of Work

TASK 5: EVALUATION OF PROJECT BENEFITS
The goal of this task is to report the benefits resulting from this project.

The Recipient shall:

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

    - o <u>For Product Development Projects and Project Demonstrations:</u>
        - Published documents, including date, title, and periodical name.
        - Estimated or actual energy and cost savings, and estimated statewide energy savings once market potential has been realized. Identify all assumptions used in the estimates.
        - GHG 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.
        - <u>Additional Information for Product Demonstrations</u>:
            - Outcome of demonstrations and status of technology.
            - Number of similar installations.
            - Jobs created/retained as a result of the Agreement.

    - o <u>For Information/Tools and Other Research Studies:</u>
        - Outcome of project.
        - Published documents, including date, title, and periodical name.
        - A discussion of policy development. State if the project has been cited in government policy publications or technical journals, or has been used to inform regulatory bodies.
        - The number of website downloads.

  - An estimate of how the project information has affected energy use and cost, or have resulted in other non-energy benefits.
  - An estimate of energy and non-energy benefits.
  - Data on potential job creation, market potential, economic development, and increased state revenue as a result of project.
  - A discussion of project product downloads from websites, and publications in technical journals.
  - A comparison of project expectations and performance. Discuss whether the goals and objectives of the Agreement have been met and what improvements are needed, if any.
- Respond to CAM questions regarding responses to the questionnaires.

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

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

TASK 6: TECHNOLOGY/KNOWLEDGE TRANSFER ACTIVITIES
The goal of this task is to develop a plan to make the knowledge gained, experimental results, and lessons learned available to the public and key decision makers.

The Recipient shall:
- Prepare an *Initial Fact Sheet* at start of the project that describes the project. Use the format provided by the CAM.
- Prepare a *Final Project Fact Sheet* at the project's conclusion that discusses results. Use the format provided by the CAM.
- Prepare a *Technology/Knowledge Transfer Plan* that includes:
  - An explanation of how the knowledge gained from the project will be made available to the public, including the targeted market sector and potential outreach to end users, utilities, regulatory agencies, and others.
  - 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(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.
- 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: 18-0411-9b

STATE OF CALIFORNIA

STATE ENERGY RESOURCES
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION - RE: UNIVERSITY OF CALIFORNIA, BERKELEY

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

RESOLVED, that the Energy Commission approves Agreement PIR-17-012 from GFO-17-502 with University of California, Berkeley for $1,000,000, to enhance the Cal-Adapt platform through the integration of new research results (including results from California's Fourth Climate Change Assessment), and to add new visualizations and custom tools that are tailored to specific needs and requirements of natural gas sector stakeholders. Results from this research will provide actionable information on energy infrastructure and climate-related vulnerabilities, and resilience to natural gas sector stakeholders; 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 April 11, 2018.

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

Cody Goldthrite,
Secretariat