

**GRANT REQUEST FORM (GRF)**

CEC-270 (Revised 02/13)

CALIFORNIA ENERGY COMMISSION

New Agreement EPC-14-074 (To be completed by CGL Office)

Division	Agreement Manager:	MS-	Phone
ERDD	Guido Franco	43	916-327-2392

Recipient's Legal Name	Federal ID Number
The Regents of the University of California, Irvine Campus	95-2226406

Title of Project
Building a Climate Change Resilient Electricity System for Meeting California's Energy and Environmental Goals

Term and Amount	Start Date	End Date	Amount
	6/30/2015	7/31/2018	\$ 698,792

**Business Meeting Information**
 ARFVTP agreements under \$75K delegated to Executive Director.

Proposed Business Meeting Date	5/13/2015	<input type="checkbox"/> Consent	<input checked="" type="checkbox"/> Discussion
Business Meeting Presenter	Guido Franco	Time Needed:	5 minutes

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

**Agenda Item Subject and Description**

REGENTS OF THE UNIVERSITY OF CALIFORNIA, IRVINE. Proposed resolution approving agreement EPC-14-074 with the Regents of the University of California, Irvine for a \$698,792 grant to characterize the climate change impacts on different components of the electricity system to understand the effect of climate change on the system's ability to meet long term greenhouse emission reduction goals. (EPIC funding) Contact: Guido Franco. (staff presentation 5 minutes)

**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 this project consists of a broad-scale, detailed modeling study and does not include the installation of any equipment or facilities that have a physical footprint.
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
	\$

**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	13-14	301.001A	\$698,792
			\$
R&D Program Area: EGRO: EA		TOTAL:	\$698,792
Explanation for "Other" selection			
Reimbursement Contract #:	Federal Agreement #:		

**GRANT REQUEST FORM (GRF)**

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CALIFORNIA ENERGY COMMISSION



Recipient's Administrator/ Officer				Recipient's Project Manager			
Name:	Natalie Nodianos			Name:	Scott Samuelsen		
Address:	University of California, Irvine Office of Research Administration 5171 California Ave., Suite 150			Address:	University of California, Irvine		
City, State, Zip:	Irvine, CA 92697-7600			City, State, Zip:	Irvine, CA 92697-3550		
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E-Mail:	Natalie.nodianos@uci.edu			E-Mail:	gss@apec.uci.edu		

Selection Process Used	
<input checked="" type="checkbox"/> Competitive Solicitation	Solicitation #: PON-14-309
<input type="checkbox"/> First Come First Served Solicitation	

The following items should be attached to this GRF	
1. Exhibit A, Scope of Work	<input checked="" type="checkbox"/> Attached
2. Exhibit B, Budget Detail	<input checked="" type="checkbox"/> Attached
3. CEC 105, Questionnaire for Identifying Conflicts	<input checked="" type="checkbox"/> Attached
4. Recipient Resolution	<input checked="" type="checkbox"/> N/A <input type="checkbox"/> Attached
5. CEQA Documentation	<input checked="" type="checkbox"/> N/A <input type="checkbox"/> 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 <sup>1</sup>	Task Name
1		General Project Tasks
2		Determine Effects of Climate Change on Atmospheric and Hydrologic Conditions
3		Determine Climate Change Impacts on Electricity Generation
4		Determine Climate Change Impacts on Renewable Capacity Potential
5	x	Determine Climate Change Impacts on Electricity Demand
6		Evaluate Combined Impacts on Electricity System GHG Emissions and RPS Performance
7		Develop Climate Change Resilient Grid Resource and Technology Portfolios
8		Develop Climate Change Resiliency Roadmaps for IOUs and Policymakers
9		Evaluation of Project Benefits
10		Technology/Knowledge Transfer Activities

#### B. Acronym/Term List

Acronym/Term	Meaning
AB 32	Assembly Bill 32, the California Global Warming Solutions Act of 2006 (2020 greenhouse gas emissions target)
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CPR	Critical Project Review
EO S-21-09	Executive Order S-21-09 (2050 greenhouse gas emissions target)
GHG	Greenhouse Gas
HiGRID	Holistic Grid Resource Integration and Deployment
RCP	Representative Concentration Pathways
RPS	Renewable Portfolio Standard
SB X1-2	Senate Bill X1-2 (33% Renewable Portfolio Standard)
TAC	Technical Advisory Committee

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

#### A. Purpose of Agreement

The purpose of this Agreement is to fund applied research that quantifies the impacts of climate change on electricity generation, renewable potential, demand, and its overall ability to meet the State's energy and environmental goals. This research will additionally determine the steps necessary to ensure that the ability to meet the State's energy and environmental goals are not compromised due to climate change and provide recommendations for each investor-owned

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

## **EXHIBIT A**

### **Scope of Work**

utility for building climate change resilience into the electric system in their respective service territories.

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

##### **Problem**

Climate change has the potential to affect ambient temperatures, precipitation, water availability, and streamflows in California. Many of these impacts have implications for the electricity system. Impacts on generation include affecting (1) the dependability of hydropower for providing carbon-free generation and grid ancillary services and (2) the efficiency and net output of thermal power plants due to temperature anomalies. Impacts on renewable capacity potential include constraining solar thermal and geothermal resource potential due to increased droughts in high potential resource areas limiting water availability for cooling. Impacts on demand include increased cooling loads in residential and commercial sectors in excess of population growth.

The combined effect of these impacts can potentially compromise grid reliability and the ability of currently projected strategies for meeting California's current and future greenhouse gas (GHG) reduction and Renewable Performance Standards (RPS) targets. While some of these impacts have been discussed individually, there has not been any effort which quantifies their extent and explicitly models their impact on electricity system GHG emissions, potential renewable resource utilization, reliability, and electricity cost. Additionally, the effect on how strategies to meet long term GHG emissions reduction and RPS targets have also not yet been examined in this context, which is important for utilities and policymakers to incorporate into policies and compliance plans for the future.

##### **Solution**

To ensure that the ability of the electricity system to contribute towards meeting the State's energy and environmental goals, the character and extent of climate change impacts must be determined and quantified. The recipient will integrate spatially and temporally resolved climate models with electricity system dispatch and operation models to 1) characterize the extent of climate change impacts, 2) translate these impacts to electricity system performance impacts, and 3) determine necessary steps for building resilience against these impacts into the electricity system. This will allow the development of plans for resource and technology deployment on the electricity system which allow the reliability of electricity service and the ability to meet State energy and environmental goals to be resilient against the impacts of climate change, specifically focusing on GHG reduction (Assembly Bill 32, the California Global Warming Solutions Act of 2006, Executive Order S-21-09) and RPS targets.

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

##### **Agreement Goals**

The goals of this Agreement are to:

- Characterize and quantify the impacts of climate change on the California electricity system.
- Develop a plan for utilities and policymakers on how to build an electricity system that is resilient to the impacts of climate change and capable of meeting the State's environmental and energy targets.

## **EXHIBIT A**

### **Scope of Work**

**Ratepayer Benefits:**<sup>2</sup> This Agreement will result in the ratepayer benefits of increased electricity service reliability and reduced electricity costs. The benefit of increased electricity service reliability will be accomplished by quantifying the impact of climate change on the ability of hydropower to provide ancillary services such as regulation and spinning reserve capacity, which maintains the reliability of electricity service. This will allow the development of informed plans to provide these services with other resources (i.e., biogas-fired combined-cycle power plants) or technologies (i.e., demand response) and maintain the reliability of future electricity service in the face of climate change conditions. This project will also quantify and characterize the effect of climate change on the availability of hydropower, solar thermal, and geothermal resources. This will allow utilities and policymakers to procure a future resource mix that can more robustly meet the load demand, as well as the State's energy and environmental goals.

The benefit of reduced electricity costs will be accomplished by providing a more accurate estimate of the usable potential of solar thermal and geothermal resources, such that utilities can plan on a more appropriate investment in transmission system expansion and prevent over-expansion of the system. These savings will allow electricity costs to be reduced compared to a business-as-usual case or can be applied to more productive projects. Additionally, the assessment of the impact on resource availability allows utilities and policymakers to understand and implement the lowest-cost strategy for building resilience to climate change into the electricity system.

**Technological Advancement and Breakthroughs:**<sup>3</sup> 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 quantifying and characterizing the extent of climate change-induced impacts on the GHG emissions, electricity cost, and renewable utilization potential of the electricity system. These impacts can significantly alter the preferred strategies regarding resource and technology deployment to meet the State's current and future GHG reduction (AB 32, EO S-21-09) and RPS targets.

With a quantitative understanding of how climate change impacts electricity generation, renewable capacity potential, and electricity demand, utilities can develop plans for compliance with the State's energy and environmental goals which will succeed under climate-change affected conditions. Additionally, policymakers can develop more appropriate policies to support compliance plans which resist climate change impacts.

#### **Agreement Objectives**

The objectives of this Agreement are to:

- Determine the spatially and temporally resolved changes in hydrology and temperature due to climate change in California.
- Determine the impacts of climate change on hydropower and thermal power plant generation.

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<sup>2</sup> 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](http://docs.cpuc.ca.gov/PublishedDocs/WORD_PDF/FINAL_DECISION/167664.PDF)).

<sup>3</sup> 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.

## EXHIBIT A Scope of Work

- Determine the impacts of climate change on solar thermal and geothermal resource potential.
- Determine the impacts of climate change on the magnitude and distribution of the electricity demand
- Assess the climate-change affected GHG and renewable utilization performance of currently projected strategies to meet GHG reduction and RPS targets.
- Identify and evaluate modifications to strategies for meeting GHG reduction and RPS targets which allow the electricity system resist the impacts of climate change.
- Develop a roadmap for the evolution of the electricity system resource mix for building an electricity system which is resilient against climate change impacts for State policymakers and each investor-owned utility.

### 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 IV)**. 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

- Submit all draft products to the CAM for review and comment in accordance with the Project Schedule (Part IV). 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.
- Submit the final product to the CAM once agreement has been reached on the draft. The CAM will provide written approval of the final product within 15 days of receipt, unless otherwise specified in the task/subtask for which the product is required.
- If the CAM determines that the final product does not sufficiently incorporate his/her comments, submit the revised product to the CAM within 10 days of notice by the CAM, unless the CAM specifies a longer time period.

###### For products that require a final version only

- Submit the product to the CAM for approval.
- If the CAM determines that the product requires revision, submit the revised product to the CAM within 10 days of notice by the CAM, unless the CAM specifies a longer time period.

###### For all products

- Submit all data and documents required as products in accordance with the following Instructions for Submitting Electronic Files and Developing Software:

## **EXHIBIT A**

### **Scope of Work**

- **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.

## **EXHIBIT A**

### **Scope of Work**

#### **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

## **EXHIBIT A**

### **Scope of Work**

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

## EXHIBIT A Scope of Work

### 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:

## **EXHIBIT A**

### **Scope of Work**

- Summarize all Agreement activities conducted by the Recipient for the preceding month, including 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.
- Provide a synopsis of the project progress, including accomplishments, problems, milestones, products, schedule, fiscal status, and any evidence of progress such as photographs.
- Submit a monthly or quarterly *Invoice* that follows the instructions in the “Payment of Funds” section of the terms and conditions. In addition, each invoice must document and verify:
  - Energy Commission funds received by California-based entities;
  - Energy Commission funds spent in California (*if applicable*); and
  - Match fund expenditures.

#### **Products:**

- Progress Reports
- Invoices

#### **Subtask 1.6 Final Report**

The goal of this subtask is to prepare a comprehensive Final Report that describes the original purpose, approach, results, and conclusions of the work performed under this Agreement. 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.
- Submit a draft of the outline to the CAM for review and comment.
- Once agreement has been reached on the draft, submit the final outline to the CAM. The CAM will provide written approval of the final outline within 10 days of receipt.

#### **Recipient Products:**

- Final Report Outline (draft and final)

#### **CAM Products:**

- 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 and the Style Manual provided by the CAM.
- Submit a draft of the report to the CAM for review and comment. Once agreement on the draft report has been reached, the CAM will forward the electronic version for Energy

## EXHIBIT A Scope of Work

Commission internal approval. Once the CAM receives approval, he/she will provide written approval to the Recipient.

- Submit one bound copy of the Final Report to the CAM.

### Products:

- Final Report (draft and final)

### CAM Products:

- Comments on 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.

## EXHIBIT A Scope of Work

- Provide a *Match Funds Reduction Notification Letter* to the CAM if existing match funds are reduced during the course of the Agreement. Reduction of match funds may trigger a CPR meeting.

### Products:

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

### Subtask 1.8 Permits

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

### The Recipient shall:

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

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

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

### Products:

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

### 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.

## **EXHIBIT A**

### **Scope of Work**

#### **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:
  - 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;

## **EXHIBIT A**

### **Scope of Work**

- 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

## 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 DETERMINE EFFECTS OF CLIMATE CHANGE ON ATMOSPHERIC AND HYDROLOGIC CONDITIONS**

The goal of this task is to determine the spatially and temporally-resolved changes in precipitation, runoff, streamflow, and ambient temperature in California due to climate change under different timeframes and climate change scenarios.

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

- Obtain projected precipitation, temperature and streamflow from 1/8<sup>th</sup> degree downscaled Climate Model Intercomparison Program 5 climate simulations.
- Obtain historical records of precipitation, temperature and streamflow as baseline.
- Analyze changes in precipitation, temperature, and streamflow different Representative Concentration Pathways (RCPs) namely RCP2.6, RCP4.5, RCP6, and RCP8.5.
- Analyze changes in frequency, duration and severity of droughts based on climate model simulations.
- Input the above data sets to the Holistic Grid Resource Integration and Deployment (HiGRID) model to evaluate the effect of climate variability and droughts on energy production.
- Prepare and provide a *Climate Change Conditions Summary Report* that includes:
  - A summary description of the changes in atmospheric and hydrologic conditions due to climate change.

##### **Products:**

- Climate Change Conditions Summary Report

#### **TASK 3 DETERMINE CLIMATE CHANGE IMPACTS ON ELECTRICITY GENERATION**

The goals of this task are to determine the impacts of climate change conditions from Task 2 on (1) the magnitude and profile of hydropower generation, (2) the ability of hydropower to provide ancillary services, and (3) the efficiency and net power output of thermal power plants.

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

- Determine the impacts of climate change on hydropower.
  - Identify the locations and capacities of large hydropower and pumped hydropower facilities in California.
  - Perform a water balance assessment of surface reservoirs with significant hydropower capacity to determine water reservoir levels.
- Determine the impacts of climate change on conventional generation.
  - Model the effect of climate change-impacted reservoir levels on bulk hydropower generation and ancillary service provision using the HiGRID Hydropower Module.
  - Identify the locations and capacities of thermal-based power plants in California.
  - Model the impact of ambient temperature on the efficiency and net power output of power plants at identified locations using developed representative gas-turbine, steam-turbine, and combined-cycle power plant models.

## **EXHIBIT A**

### **Scope of Work**

- Prepare and provide a *Climate Change Impacts on Electricity Generation: Assessment Report* that includes:
  - A description of the hydropower generation profile under each climate change scenario compared to historical profiles.
  - A description of hydropower ancillary services provision under each climate change scenario compared to historical provision.
  - A discussion of the role of hydropower in the future electricity mix.
  - A description of thermal power plant efficiency and net power output changes under each climate change scenario.

#### **Products:**

- Climate Change Impacts on Electricity Generation: Assessment Report

#### **TASK 4 DETERMINE CLIMATE CHANGE IMPACTS ON RENEWABLE CAPACITY POTENTIAL**

The goal of this task is to determine the impacts of climate change conditions from Task 2 on the maximum allowable solar thermal and geothermal resource capacity based on water availability and land use.

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

- Determine the maximum allowable water consumption rates in areas of high solar thermal and geothermal resource potential under current conditions and under each climate change scenario.
  - Model water availability in high solar thermal and geothermal resource potential areas using drought information obtained from climate model simulations.
- Determine the maximum allowable land use for solar thermal and geothermal power plants in high resource areas based on data for prohibited development lands.
- Develop dynamic models of solar thermal and geothermal power plants using recirculating water cooling and dry cooling.
  - Determine the land use and water consumption footprint of solar thermal and geothermal power plants as a function of plant capacity.
- Determine the maximum allowable solar thermal and geothermal resource capacity in high resource areas based on water availability and use of recirculating cooling.
- Determine the maximum allowable solar thermal and geothermal resource capacity in high resource areas based on land use and use of dry cooling.
- Prepare and provide a *Climate Change Impacts on Solar Thermal and Geothermal Capacity Potential: Assessment Report* that includes:
  - A description of solar thermal, geothermal, and cooling system models.
  - A description of the solar thermal and geothermal resource potential without land or water use constraints.
  - A description of solar thermal and geothermal resource potential with land and water use constraints, but no climate change impacts.
  - A description of solar thermal and geothermal resource potential with land and water use constraints, but with climate change impacts.

#### **Products:**

- Climate Change Impacts on Solar Thermal and Geothermal Capacity Potential: Assessment Report

## **EXHIBIT A**

### **Scope of Work**

#### **TASK 5 DETERMINE CLIMATE CHANGE IMPACTS ON ELECTRICITY DEMAND**

The goal of this task is to determine the impacts of climate change conditions from Task 2 on the magnitude and spatial/temporal distribution of the electricity demand, specifically with regards to cooling loads.

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

- Develop representative models of cooling and electricity-related heating loads in representative commercial and residential buildings.
  - Utilize the(Quick Energy Simulation Tool (eQUEST) building simulation tool to construct models
  - Leverage data for building load character as a function of temperature from past Advanced Power & Energy Program projects including.
  - Leverage previous work in building modeling (CEC PIR-08-033, DOE 09EE0001113, CEC PIR-09-013)
  - Leverage data collected in past projects (CEC 500-02-004) for verification of building models.
- Determine the change in cooling loads for residential and commercial buildings in different major cities.
  - Simulate building cooling and heating loads for buildings located in different population centers across the State under historical and climate-change affected temperature conditions.
  - For each utility planning area, use population weighting to determine the absolute change in the statewide load demand profile.
- Prepare and provide a *Climate Change Impacts on Electricity Demand: Assessment Report* that includes:
  - A description of the residential and commercial building models.
  - A description of the change in the magnitude of the load demand.
  - A description of the implications for each investor-owned utility and the variability of impacts between utilities.
- Participate in CPR meeting and prepare and provide a *CPR Report* as per task 1.3.

##### **Products:**

- Climate Change Impacts on Electricity Demand: Assessment Report
- CPR Report

#### **TASK 6 EVALUATE COMBINED IMPACTS ON ELECTRICITY SYSTEM GHG EMISSIONS AND RPS PERFORMANCE**

The goal of this task is to determine the effect of the impacts identified in Tasks 3, 4, and 5 on the ability of currently projected resource deployment strategies to meet current and future GHG reduction and RPS targets.

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

- Develop interim RPS and GHG Emissions targets for the years of 2030, 2040, and 2050.
  - RPS targets based on extension of the 33% RPS dictated by SB X1-2.
  - GHG emissions targets based on 2020 (AB 32) and 2050 (EO S-21-09) policies.
- Determine baseline resource and technology portfolios which satisfy GHG emissions and RPS targets without climate change.

## **EXHIBIT A**

### **Scope of Work**

- Use the HiGRID model to determine the portfolio of renewable resources and complementary technologies which meet the established targets.
- Include the impact of transportation electrification and load growth due to population.
- Evaluate the performance of the baseline portfolios with the impacts of climate change using the HiGRID model.
  - Determine impacts on GHG emissions, renewable utilization, and electricity cost.
- Prepare and provide a Report entitled *Climate Change Implications for RPS Compliance and GHG Emissions Reduction Strategies: Part 1 - Impacts* that includes:
  - A description of the interim GHG emissions and RPS targets for 2030, 2040, and 2050.
  - A description of the performance of baseline resource and technology portfolios with and without climate change.

#### **Products:**

- Climate Change Implications for RPS Compliance and GHG Emissions Reduction Strategies: Part 1 - Impacts Report

#### **TASK 7 DEVELOP CLIMATE CHANGE RESILIENT GRID RESOURCE AND TECHNOLOGY PORTFOLIOS**

The goal of this task is to develop modifications to the baseline resource and technology portfolios that allow the system to satisfy the established RPS and GHG reduction targets.

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

- Develop alternative grid resource mixes which satisfy the established RPS and GHG reduction targets with climate change impacts.
  - Include at a minimum a lowest-cost scenario.
- Evaluate any tradeoffs between different aspects of electricity system performance for the different scenarios.
- Prepare and provide a Report entitled *Climate Change Implications for RPS Compliance and GHG Emissions Reduction Strategies: Part 2 – Adapting to Climate Change* that includes:
  - A description of the different resource and technology portfolios which are able to satisfy the established RPS and GHG goals.
  - A discussion of the tradeoffs between different pathways in terms of grid performance and electricity cost.

#### **Products:**

- Climate Change Implications for RPS Compliance and GHG Emissions Reduction Strategies: Part 2 – Adapting to Climate Change Report

#### **TASK 8 DEVELOP CLIMATE CHANGE RESILIENCY ROADMAPS FOR IOUs AND POLICYMAKERS**

The goal of this task is to develop roadmaps for the steps that need to be taken regarding resource procurement and infrastructure development to build resilience to climate change into the provision of electricity service for each IOU (PG&E, SCE, SDG&E) and also for state policymakers.

## **EXHIBIT A**

### **Scope of Work**

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

- Develop a climate adaptation Roadmap with recommendations for resource procurement and infrastructure deployment for achieving climate change resilience in SCE's service territory. This "Climate adaptation roadmap for SCE" must suggest strategies on how this electric utility could successfully adapt to a changing climate.
- Develop recommendations for resource procurement and infrastructure deployment for achieving climate change resilience in PG&E's service territory. This "Climate adaptation roadmap for PG&E" must suggest strategies on how this electric utility could successfully adapt to a changing climate.
- Develop recommendations for resource procurement and infrastructure deployment for achieving climate change resilience in SDG&E's service territory. This "Climate adaptation roadmap for SDG&E" must suggest strategies on how this electric utility could successfully adapt to a changing climate.
- Develop recommendations for policy incentives to achieve climate change resilience for state policymakers. This "Climate adaptation roadmap for California Policymakers" will identify potential policies and programs that would assist in implementing adaptation options for the energy sector.

#### **Products:**

- Climate Adaptation Roadmap for SCE
- Climate Adaptation Roadmap for PG&E
- Climate Adaptation Roadmap for SDG&E
- Climate Adaptation Policy Roadmap for California Policymakers

#### **TASK 9 EVALUATION OF PROJECT BENEFITS**

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

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

- Complete three Project Benefits Questionnaires that correspond to three main intervals in the Agreement: (1) *Kick-off Meeting Benefits Questionnaire*; (2) *Mid-term Benefits Questionnaire*; and (3) *Final Meeting Benefits Questionnaire*.
- Provide all key assumptions used to estimate projected benefits, including targeted market sector (e.g., population and geographic location), projected market penetration, baseline and projected energy use and cost, operating conditions, and emission reduction calculations. Examples of information that may be requested in the questionnaires include:
  - For Product Development Projects and Project Demonstrations:
    - Published documents, including date, title, and periodical name.
    - Estimated or actual energy and cost savings, and estimated statewide energy savings once market potential has been realized. Identify all assumptions used in the estimates.
    - Greenhouse gas and criteria emissions reductions.
    - Other non-energy benefits such as reliability, public safety, lower operational cost, environmental improvement, indoor environmental quality, and societal benefits.
    - Data on potential job creation, market potential, economic development, and increased state revenue as a result of the project.

## **EXHIBIT A**

### **Scope of Work**

- A discussion of project product downloads from websites, and publications in technical journals.
- A comparison of project expectations and performance. Discuss whether the goals and objectives of the Agreement have been met and what improvements are needed, if any.
- Additional Information for Product Development Projects:
  - Outcome of product development efforts, such copyrights and license agreements.
  - Units sold or projected to be sold in California and outside of California.
  - Total annual sales or projected annual sales (in dollars) of products developed under the Agreement.
  - Investment dollars/follow-on private funding as a result of Energy Commission funding.
  - Patent numbers and applications, along with dates and brief descriptions.
- Additional Information for Product Demonstrations:
  - Outcome of demonstrations and status of technology.
  - Number of similar installations.
  - Jobs created/retained as a result of the Agreement.
- 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

## **EXHIBIT A**

### **Scope of Work**

#### **TASK 10 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.
- Prepare a *Technology/Knowledge Transfer Report* on technology transfer activities conducted during the project.

##### **Products:**

- Initial Fact Sheet (draft and final)
- Final Project Fact Sheet (draft and final)
- Presentation Materials (draft and final)
- Technology/Knowledge Transfer Plan (draft and final)
- Technology/Knowledge Transfer Report (draft and final)

#### **V. PROJECT SCHEDULE**

Please see the attached Excel spreadsheet.

STATE OF CALIFORNIA

STATE ENERGY RESOURCES  
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION - RE: UNIVERSITY OF CALIFORNIA, IRVINE

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

**RESOLVED**, that the Energy Commission approves Agreement EPC-14-074 from PON-14-309 with the **Regents of the University of California, on behalf of the Irvine Campus** for a **\$698,792** grant to characterize climate change impacts on different components of the electricity system to understand the effect of climate change on the system's ability to meet long-term greenhouse gas emission reduction goals; 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 13, 2015.

AYE: [List of Commissioners]

NAY: [List of Commissioners]

ABSENT: [List of Commissioners]

ABSTAIN: [List of Commissioners]

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Harriet Kallemeyn,  
Secretariat