

**GRANT REQUEST FORM (GRF)**

CEC-270 (Revised 02/13)

CALIFORNIA ENERGY COMMISSION

New Agreement EPC-14-001 (To be completed by CGL Office)

Division	Agreement Manager:	MS-	Phone
ERDD	Michael Sokol	43	916-327-1416

Recipient's Legal Name	Federal ID Number
Itron Inc., which will do business in California as IBS	91-1011792

Title of Project
Improving Solar & Load Forecasts: Reducing the Operational Uncertainty Behind the Duck Chart

Term and Amount	Start Date	End Date	Amount
	1/15/2015	6/29/2018	\$ 998,926

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

Proposed Business Meeting Date	12/10/2014	<input type="checkbox"/> Consent	<input checked="" type="checkbox"/> Discussion
Business Meeting Presenter	Michael Sokol	Time Needed:	5 minutes

Please select one list serve. EPIC

**Agenda Item Subject and Description**

ITRON, INC. WHICH WILL DO BUSINESS IN CALIFORNIA AS IBS. Proposed resolution approving Agreement EPC-14-001 with Itron Inc., which will do business in California as IBS for a \$998,926 grant to use high-fidelity solar forecasting to predict net load impacts on the California electricity grid and reduce operating uncertainty. Contact: Michael Sokol. (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 agreement is not considered a project under CEQA. The proposed project involves mathematical modeling and does not require installation of any equipment or materials. The proposed project will not result in direct or indirect changes to 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

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

Legal Company Name:	Budget
Clean Power Research	\$ 448,964

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

Legal Company Name:  
Itron Inc., which will do business in California as IBS

**Budget Information**

Funding Source	Funding Year of Appropriation	Budget List No.	Amount
EPIC	13-14	301.001A	\$998,926
			\$
R&D Program Area: EGRO: Renewables		TOTAL:	\$998,926
Explanation for "Other" selection			
Reimbursement Contract #:		Federal Agreement #:	

**Recipient's Administrator/ Officer**

Name:	Traci Meyer-Jones	Name:	Stephan Barsun
Address:	603 OFFICERS ROW	Address:	330 MADSON PL
City, State, Zip:	VANCOUVER, WA 98661-3837	City, State, Zip:	DAVIS, CA 95618-6599
Phone:	360-906-0616 / Fax: - -	Phone:	509-891-3187 / Fax: - -
E-Mail:	Traci.Meyer-Jones@itron.com	E-Mail:	stephan.barsun@itron.com

**Selection Process Used**

Competitive Solicitation Solicitation #: PON-13-303  
 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		Improve Data Acquisition Capabilities, Reliability, and Cost Effectiveness of Ground-mounted Solar Instrumentation
3	X	Develop & Refine Solar Forecasting Tools
4		Improve Net Load Forecast Accuracy and Metrics
5		Apply Research to Improve Solar Integration
6		Evaluation of Project Benefits
7		Technology/Knowledge Transfer Activities

#### B. Acronym/Term List

Acronym/Term	Meaning
AOD	Aerosol Optical Depth (a measure of the amount of dirt, dust, smog, etc. in the air)
CAISO	California Independent System Operator
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CPR	Critical Project Review
Energy Commission	California Energy Commission
MW	Megawatt
PV	Photovoltaic
Recipient	Itron Inc., which will do business in California as IBS
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 the development of improved forecasting of solar generation and its impact on the California Independent System Operator (CAISO) and electric utility net loads.

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

# Exhibit A

## Scope of Work

### B. Problem/ Solution Statement

#### Problem

California is on the way to procuring a minimum of 33 percent of the state's electricity supplies from renewable resources, most of which will come from utility-scale photovoltaic (PV) systems and PV located on the customer side of the meter. As the amount of PV capacity increases, the operational and economic issues associated with the intermittent nature of PV becomes much more significant. In 2013, the CAISO introduced the "Duck Chart," which shows the potential impacts of increasing amounts of PV capacity on over-generation; the need for quick-ramping balancing capacity; and sharper net load peaks later in the day.

Currently, errors in forecasting solar power can be as high as ten percent and cost tens of millions of dollars in scheduling operations. These costs could be avoided with reduced forecasting errors. While disparate efforts are underway to improve prediction of embedded solar; grid connected solar; and wind generation, they fail to address one of the core challenges facing grid operators: uncertainty in net load forecasts. A holistic approach that links improved solar forecasting to net loads (which is unlike anything currently available) is needed to maximize the benefits of solar generation on California's electricity grid.

#### Solution

The proposed work will reduce the operational uncertainty behind the "Duck Chart" by producing high accuracy solar generation forecasts for utilities and the CAISO, and linking these generation forecasts to methods for forecasting net loads at higher temporal resolution. This increased fidelity and connection to net load forecasts will provide critical insights to better manage the rapidly evolving grid in California.

This scope of work will improve forecasts of solar generation and net load and then apply the research to utility and CAISO operations. The approach will leverage metered irradiance, generation, and load data to improve forecasts. These data will allow the team to tune and improve simulations of solar generation and net load based on historical data. Some of these data will then be used in real time to dynamically tune forecasts.

### C. Goals and Objectives of the Agreement

#### Agreement Goals

The goal of this Agreement is to improve the accuracy of solar and net load forecasting, and thereby significantly increase the efficiency of integrating large amounts of PV generation into the grid and provide significant cost savings.

Ratepayer Benefits:<sup>2</sup> This Agreement will result in the ratepayer benefits of improved electricity reliability and lower costs. Improvements in solar and net load forecasts will help the CAISO and

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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)).

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## Scope of Work

electric utilities to more accurately schedule regulation and spinning reserve assets. This will help reduce congestion and allow better allocation of ancillary services, thereby increasing overall system reliability. In addition, improvements in solar and net load forecasts will reduce ratepayer costs by millions of dollars annually by avoiding procurement of costly ancillary services; reducing transmission and distribution system operational costs; and avoiding the construction of additional spinning reserves.

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 developing improved solar and net load forecast methodologies. These methodologies will provide a means of improving the use of existing PV data acquisition systems that is unlike anything currently available, enabling increased improvements in solar and net load forecasting with little or no additional hardware requirements, and establishing a set of metrics for evaluating the effectiveness of solar and net load forecasts that can be applied throughout areas facing increased PV penetration.

### Agreement Objectives

The objectives of this Agreement are to:

- Improve data acquisition capabilities, reliability, and cost-effectiveness of ground-mounted solar instrumentation by integrating data from CAISO sensors at grid-connected plants and metering at embedded (distributed) solar generators, into solar forecasts.
- Develop improved solar forecasting tools that increase the temporal resolution of forecasts at the 5-minute-ahead level as well as hour and days ahead, targeting a 10-15% relative improvement over interpolated 5-minute resolution forecasts.
- Improve accuracy of long term solar forecasts by integrating effects from module degradation, soiling and shading based on metered PV performance data, targeting a 2-5% relative improvement over forecasts applying no such corrections. This improvement will become more significant with time as PV systems age.
- Integrate the improved solar forecasts and improve the accuracy and metrics of net load forecasts.
- Apply research work to demonstrate improved solar forecasting and integration and quantify the value, to grid operators, utilities, and ratepayers, of improved forecasts.

### 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

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<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.

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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 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.
- 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:

- **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.

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- **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.

## **Exhibit A**

### **Scope of Work**

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.
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- 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.

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- 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:

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- 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 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

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### 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 Product:**

- Style Manual

#### 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 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)

## **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.

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#### The Recipient shall:

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

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

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

#### Products:

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

#### Subtask 1.8 Permits

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

#### 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:

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- 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,

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availability, and need. TAC members will serve at the CAM's discretion. The purpose of the TAC is to:

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

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

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

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

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

#### **Products:**

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

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### 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: Improve Data Acquisition Capabilities, Reliability, and Cost Effectiveness of Ground-mounted Solar Instrumentation**

The goal of this task is to integrate real-time irradiance measurements from CAISO’s reporting system to improve Aerosol Optical Depth (AOD) and cloud albedo aspects of Clean Power Research’s forecasts. Accurate PV power forecasts require: (1) accurate solar irradiance data; (2) accurate PV system specifications; and (3) an accurate model to convert irradiance data to estimates of PV power and energy production, ranging from a single system to a fleet of PV systems distributed across a geographic region.

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

- Work with CAISO to determine data availability and take steps necessary to ensure data integrity.
- Obtain CAISO data and upload to Clean Power Research data servers.
- Integrate real-time irradiance measurement feeds into FleetView software to improve FleetView accuracy, incorporating:
  - Known and scheduled plant availability
  - Improved AOD modeling
- Validate FleetView forecasting improvements due to incorporation of real-time data.
- Prepare a *Real-time Data Forecasting Accuracy Improvement Report*. This report shall include, but not be limited to, the following:
  - a description of the model used
  - a description of the data sources
  - a description of the analysis process
  - validation results

##### **Products:**

- Real-Time Data Forecasting Accuracy Improvement Report (Draft and Final)

#### **TASK 3: Develop & Refine Solar Forecasting Tools**

The goals of this task are to (1) incorporate near real-time metered PV generation data to fine-tune fleet forecasts of both grid-connected and embedded PV solar, (2) implement regional PV fleet forecasting model improvements.

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

- Obtain grid connected and embedded PV metered production data and upload to Clean Power Research data servers.
- Implement algorithms to estimate regional PV fleet capacity and operating status.
- Implement various solar forecasting model improvements, including but not limited to:

## Exhibit A

### Scope of Work

- Work with the California Investor Owned Utilities and key Publically Owned Utilities to obtain the number and capacity of new PV systems on a regular basis to capture any PV systems and their associated capacity not captured in PowerClerk.
- PV system specification inference and correction from measured irradiance and measured production for utility-scale PV systems;
- Use real-time PV system production data to infer real-time system operating status and generation, and include inferred operating status in solar forecasts;
- Use embedded system production data to statistically model embedded system fleet operational status. This will include accounting for long-term effects like system availability, module degradation, and shading and soiling;
- Use forecast blending techniques to produce enhanced ensemble forecasts.
- Validate FleetView forecasting improvements due to incorporation of new methodologies and real-time data.
- Prepare a *Grid-Connected and Embedded PV Fleet Forecasting Accuracy Report*. This report shall include, but not be limited to, the following:
  - a description of the model used
  - a description of the data sources
  - a description of the analysis process
  - validation results
- Participate in CPR Meeting per Task 1.3, and prepare a *CPR Report*

#### **Products:**

- Grid-Connected and Embedded PV Fleet Forecasting Accuracy Report (Draft and Final)
- CPR Report

#### **TASK 4: Improve Net Load Forecast Accuracy and Metrics**

The purpose of this task is to improve net load forecast accuracy and metrics. Net load is defined by the CAISO as measured load less behind-the-meter solar generation. This task will increase net load forecast accuracy by incorporating the impact of embedded solar generation into the existing ramp rate forecast models. This is important because the five minute-ahead CAISO load forecast does not currently reflect the impact of embedded solar generation. This task will also improve net load forecasting metrics by developing a framework for evaluating the net load forecast improvements resulting from the work completed under Task 2, Task 3 and early efforts in Task 4.

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

- Develop more accurate net load forecast by:
  - Developing an historical time series of 5-minute level embedded solar generation by region using PowerClerk and FleetView simulations. The time series will be at the 5 minute time resolution and will cover 2010 through 2013.
  - Revising existing ramp rate models using embedded solar generation.
- Develop an improved framework for evaluating net load forecast metrics by:
  - Developing metrics for evaluating improvements in forecasting net load, including the mean absolute deviation, mean absolute percentage error, and mean error for key near-term forecast horizons of up to two hours ahead.

## Exhibit A

### Scope of Work

- Forecast performance improvements will be tracked by comparing forecast simulations using CAISO ramp rate forecast models with and without embedded solar generation. Data for calendar year 2014 will be used for the forecast simulations.
- Developing forecast performance metrics to quantify the reduction of net load forecast uncertainty. Forecast error distributions will be constructed using the 2013/2014 forecast simulations. Metrics that measure the improvement in the forecast error distribution between the existing and new model will be developed. The improvement in the forecast error distribution will be translated into a MW reduction in generation reserves and translated to actual cost savings using reserve margin costs.
- Prepare a Draft and Final *Improving Net Load Forecast Accuracy by Incorporating Embedded Solar Generation Forecasts into the Load Forecast Framework Report* that documents:
  - The net load forecast problem and the impact behind-the-meter solar generation has on net load forecast accuracy;
  - The revised net load forecast framework, ramp rate model specifications, in-sample model fit statistics;
  - The time series of historical five minute embedded solar generation by region;
  - The forecast simulation approach;
  - The results of the forecast simulation comparisons;
  - The cost savings calculations; and
  - A summary of the cost savings findings.

#### **Products:**

- Improving Net Load Forecast Accuracy by Incorporating Embedded Solar Generation Forecasts into the Load Forecast Framework Report (Draft and Final)

#### **TASK 5: Apply Research to Improve Solar Integration**

The goals of this task are 1) to leverage the improved forecasts and data from the earlier tasks to help utilities and the CAISO better integrate increasing amounts of renewables on the grid with lower costs; and 2) to run utility production cost models to determine the value of utilizing improved PV solar forecasts to utilities, grid operators, and California IOU ratepayers.

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

- Apply the results from tasks 2, 3, and 4 to help improve integration of solar PV into the grid by:
  - Developing an operational framework for using improved solar and net load forecasts in specific ways that provide CAISO and utility partners with better visibility into future grid conditions;
  - Simulating grid conditions with and without the forecast improvements to test the ability of the framework to easily identify critical changes in operations.
- Apply results from solar power and irradiance forecasting accuracy studies at utility partners to production cost models to:

## Exhibit A

### Scope of Work

- Identify how changes in forecast accuracy and improved resolution affect the economics associated with utility management of generation assets and carrying reserves;
- Estimate the monetary value of the forecasts for dispatching traditional generating units and minimizing the need for excessive reserves based on the production cost modeling; and
- Identify possible approaches that can be used to help optimize the dispatch of generating units needed to firm the intermittency associated with solar PV production.
- Develop a series of lessons learned to help in refining forecasts of power production of grid-connected and embedded PV systems. An example of a likely possible refinement to the forecasts would be developing ways to improve the spatial resolution of the forecasts (i.e., down to specific areas in a utility with high concentrations of solar and significant intermittency issues).
- Provide utility partners with data for an assessment of dependability of solar output in forecasts over a longer-term (e.g., 5-10 years).
- Prepare a Draft and Final *Solar Forecasting Production Cost Analysis Report* that includes:
  - Identification of how changes in forecast accuracy and improved resolution affect the economics associated with utility management of generation assets and carrying reserves. In particular, different levels of forecast accuracy developed from the benchmarking project will be used in production cost models, including but not limited to:
    - Estimation of the monetary value of the forecasts for dispatching traditional generating units and minimizing the need for excessive reserves based on the production cost modeling; and
    - Identification of the possible approaches that can be used to help optimize the dispatch of generating units needed to firm the intermittency associated with solar PV production.
- Prepare a Draft and Final *Applications of Improved PV and Net Load Forecasts in Improving PV Integration Report* that includes:
  - A discussion and examples of ways to provide utilities and the CAISO with improved visibility into impacts of grid-connected and embedded PV systems.
  - Lessons learned from the utilities on the operational aspects of integrating higher levels of renewable generation, and impacts on scheduling, of balancing resources;
  - Assessment of forecasts over a longer term (e.g., 5-10 years) and a discussion of the potential impacts of these forecasts in reducing the costs of managing the CAISO “Duck Curve.”

#### **Products:**

- Solar Forecasting Production Cost Analysis Report (Draft and Final)
- Applications of Improved PV and Net Load Forecasts in Improving PV Integration Report (Draft and Final)

# Exhibit A

## Scope of Work

### TASK 6: 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.
    - 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.

## Exhibit A

### Scope of Work

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

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

#### Products:

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

#### TASK 7: 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.

# Exhibit A

## Scope of Work

### ***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: ITRON, INC., dba IBS

**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-14-001 with **Itron, Inc.** for a **\$998,926** grant to use high-fidelity solar forecasting to predict net load impacts on the California electricity grid and reduce operating uncertainty; 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 December 10, 2014

AYE: [List of Commissioners]

NAY: [List of Commissioners]

ABSENT: [List of Commissioners]

ABSTAIN: [List of Commissioners]

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Harriet Kallemeyn,  
Secretariat