STATE OF CALIFORNIA

GRANT REQUEST FORM (GRF)

CEC-270 (Revised 12/2019) CALIFORNIA ENERGY COMMISSION

A) New Agreement # EPC-20-031 (to be completed by CGL office)

B) Division	Agreement Manager:	MS-	Phone
ERDD	Adel Suleiman	51	916-996-1054

C) Recipient's Legal Name	Federal ID Number
The Regents of the University of California, on behalf of the Davis Campus	94-3067788

D) Title of Project
Renewable Energy & Advanced Lighting Systems for Exterior Applications

E) Term and Amount

Start Date	End Date	Amount
6/1/2021	3/31/2025	$ 4,166,306

F) Business Meeting Information

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

Proposed Business Meeting Date 4/14/2021 ☐ Consent ☒ Discussion

Business Meeting Presenter Adel Suleiman Time Needed: 5 minutes

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

Agenda Item Subject and Description:

The Regents of The University of California, On Behalf of The Davis Campus. Proposed resolution approving Agreement EPC-20-031 with The Regents of the University of California, on behalf of the Davis Campus, for a $4,166,306 grant to fund the development and demonstration of a novel hybrid power (solar and grid-tied) exterior LED lighting system that includes a unique integrated solar panel with embedded sensors, smart controls, and battery storage, and adopting staff's determination that this project is exempt from CEQA. This project will be demonstrated in seven low-income or disadvantaged communities.

G) California Environmental Quality Act (CEQA) Compliance

1. Is Agreement considered a "Project" under CEQA?
   ☒ Yes (skip to question 2)
   ☐ No (complete the following (PRC 21065 and 14 CCR 15378)):

   Explain why Agreement is not considered a "Project":

2. If Agreement is considered a "Project" under CEQA:
   a) ☒ Agreement **IS** exempt.
      ☐ Statutory Exemption. List PRC and/or CCR section number:
      ☒ Categorical Exemption. List CCR section number: Cal. Code Regs., tit. 14, § 15301, Cal. Code Regs., tit. 14, § 15306
      ☐ Common Sense Exemption. 14 CCR 15061 (b) (3)

      Explain reason why Agreement is exempt under the above section: CEQA exemptions under California Code of Regulations, title 14, sections 15301 and

15306 apply. Section 15301, "Existing Buildings," covers the operation, maintenance, or minor alteration of existing public or private structures, facilities, mechanical equipment, involving negligible or no expansion of existing or former use. This project would replace existing exterior luminaires at various existing structures (e.g., on top of parking lot light poles) with more energy efficient, hybrid luminaires. Therefore, the project is exempt within section 15301 and will not have a significant effect on the environment. Section 15306 covers basic data collection, research, experimental management, and resource evaluation activities which do not result in a serious or major disturbance to an environmental resource. This project will involve the development and evaluation of a hybrid powered area luminaire that lowers the energy consumption of exterior lighting compared to existing, grid-tied, non-dimmable, high-intensity discharge lighting. Prototype designs will be lab tested in a research laboratory, prior to their use to replace existing exterior luminaires. This work will not result in a serious or major disturbance to an environmental resource. Therefore, the proposed project will have no significant effect on the environment and is categorically exempt under section 15306.

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

Check all that apply

- ☐ Initial Study
- ☐ Negative Declaration
- ☐ Mitigated Negative Declaration
- ☐ Environmental Impact Report
- ☐ Statement of Overriding Considerations

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

Legal Company Name:	**Budget**
TRC Engineers, Inc.	$ 340,145
TBD1-Algorithm Development	$ 80,000
TBD2- Design Build Contractors	$ 1,199,674
TBD3- Code Development	$ 90,000
TBD4- Community Based Organizations	$ 350,000
The Bit Bazaar L.L.C. (match only)	$ 50,000
LED Greenlight CA LLC (match only)	$ 250,000
City of West Sacramento (match only)	$ 200,000
California State University, Dominguez Hills (match only)	$ 30,000
Efficiency Forward, Inc. (d.b.a. DesignLights Consortium (match only)	$ 161,780
ICF incorporated L.L.C. (d.b.a. ICF Consulting Group, Inc.) (match only)	$ 312,495
16500 SIXTEEN FIVE HUNDRED (match only)	$ 50,000

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

Legal Company Name:

J) Budget Information

Funding Source	Funding Year of Appropriation	Budget List Number	Amount
EPIC	19-20	301.001G	$4,166,306
			$
			$
			$
			$
			$

R&D Program Area: EERO: Buildings TOTAL: $ 4,166,306

Explanation for "Other" selection

Reimbursement Contract #: Federal Agreement #:

K) Recipient's Contact Information

1. Recipient's Administrator/Officer

Name: Nicole Hathaway
Address: 633 PENA DR

City, State, Zip: DAVIS, CA 95618-6570
Phone: 530-902-9822
E-Mail: nehathaway@ucdavis.edu

2. Recipient's Project Manager

Name: Nicole Hathaway
Address: 633 PENA DR

City, State, Zip: DAVIS, CA 95618-6570
Phone: 530-902-9822
E-Mail: nehathaway@ucdavis.edu

L) Selection Process Used

☒ Competitive Solicitation Solicitation #: GFO-20-303
☐ First Come First Served Solicitation Solicitation #:

M) The following items should be attached to this GRF

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

Agreement Manager	**Date**
Office Manager	**Date**
Deputy Director	**Date**

Exhibit A
Scope of Work
The Regents of the University of California, on behalf of the Davis campus

I. TASK ACRONYM/TERM LISTS

A. Task List

Task #	CPR[1]	Task Name
1		General Project Tasks
2	X	System Design
3	X	Integration & Field Readiness
4		Field Demonstrations
5		Evaluation of Project Benefits
6		Technology & Knowledge Transfer Activities

B. Acronym/Term List

Acronym/Term	Meaning
AC	Alternating Power
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CEC	California Energy Commission
CPR	Critical Project Review
M&V	Measurement and Verification
PII	Personally Identifiable Information
REAL	Renewable Energy & Advanced Lighting Systems for Exterior Applications
TAC	Technical Advisory Committee
IOU	Investor Owned Utility

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

A. Purpose of Agreement

The purpose of this Agreement is to fund the design, development and demonstration of renewable energy and advanced lighting (REAL) hybrid power luminaire (solar and grid tied) for exterior applications that can operate on integrated batteries and significantly reduce nighttime utility energy consumption. The system specification and associated demonstrations will address general exterior lighting (e.g., walkways, building exterior walls, parking lots) and streetlights.

B. Problem/ Solution Statement

Problem

Exterior lighting generally operates from early evening through early morning, a period of little to no renewable energy generation, which means this lighting is primarily powered by carbon-dense

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

fossil fuels. Fossil fuel use is a significant contributor to greenhouse gas emissions (GHG), poor air quality, water pollution and land degradation. In addition, low-quality exterior lighting characterized by poor color, inappropriate light distribution, and inadequate light levels has also been linked to increased crime rates and reduced physical activity within the surrounding community. For many California cities, antiquated electrical infrastructure combined with aging fixtures and sources has created insurmountable maintenance challenges resulting in inoperable luminaires that further exacerbate already poor exterior lighting conditions. Combine these conditions with Public Safety Power Shutoffs (PSPS), which are increasingly common, and you have a carbon-intensive system that disproportionally impacts disadvantaged and low-income communities already suffering from an unsafe exterior environment with substandard lighting.

Solution
The Regents of the University of California, on behalf of the Davis Campus proposes to design and demonstrate REAL Systems equipped with many of the advanced features absent from today's commercial exterior lighting systems. The work will be coordinated by the California Lighting Technology Center (CLTC) at the Davis Campus. These features include best-in-class energy-efficiency; distributed renewables for power; control systems equipped with two-way communication between the grid/utility and the lighting network; predictive and adaptive occupancy-based dimming; battery energy storage (BES) and use of circadian-appropriate lighting spectrums. REAL systems are designed specifically to have hybrid power (solar and grid-tied), smart controllers for best battery charging time, light and health, reduced carbon emissions, reliability and community safety. More importantly, this project re-invents lighting design practices specifically for low-income and disadvantaged communities by engaging residents and business owners directly in a series of local community studies and technology demonstrations. Only by pursuing this inclusive, community-focused relighting strategy can the true potential of energy-efficient, demand-flexible, exterior lighting for improved safety and health be realized.

C. Goals and Objectives of the Agreement

Agreement Goals
The agreement goal is to demonstrate and validate a comprehensive exterior lighting system that contributes to grid flexibility while providing the community with high-quality, reliable exterior lighting that encourages outdoor activity, increases business investments in the community, improves safety and potentially reduces crime. CLTC will collaborate with its industry partners and demonstration communities to ensure REAL systems meet community technical and cost effectiveness needs, including:

- Reduced energy use of at least 20% compared to each community's baseline;
- Stored solar electricity in an integrated battery that can power the luminaires at night;
- Integrated adaptive, networked controls to enable grid flexibility capabilities that maximize the use of low-or-no carbon electricity sources;
- Occupancy and schedule-based dimming;
- Interconnection with utility to participate in net energy metering or similar utility programs, where available
- Safety and security, glare reduction, enhanced visibility and safety for drivers and pedestrians; and.
- Potential for deployment in other communities besides those participating in the grant

Ratepayer Benefits:[2] This Agreement will result in the ratepayer benefit of greater electricity reliability and reduced costs for ratepayers by enabling comprehensive, optimized, integrated control of REAL systems in disadvantaged and low-income communities. The proposed research will result in reduced exterior lighting loads, increased grid-resiliency and grid-flexibility, and the use of low/no carbon electricity sources for exterior lighting loads. A 2-percent market penetration of this technology in California IOU territories is estimated to save ratepayers $15.5M annually.

Technological Advancement and Breakthroughs:[3] This Agreement will lead to technological advancement and breakthroughs that will overcome barriers to the achievement of the State of California's statutory energy goals by significantly lowering the amount of carbon-based electricity consumed by exterior lighting loads. REAL systems include integrated distributed energy resources (DERs) such as PV generation and BES. This significantly reduces the net energy use of the lighting system, while simultaneously shifting the carbon composition of energy used to low- or no-carbon sources. REAL systems also have the ability to respond to utility signals, and they provide remote monitoring and data collection features. DER integration also reduces the societal impact of PSPS by enabling off-grid lighting system operation. Use of these technologies and strategies, when paired with dimmable LED light sources, results in the most energy-efficient and demand flexible lighting system available.

Agreement Objectives

The objectives of this Agreement are to:

- Determine how the new systems will minimize electricity cost and provide energy benefits to the electric grid and non-energy benefits to the community.
- Collaborate with industry partners, manufacturers, communities and applicable regulatory agencies to produce and demonstrate integrated renewable energy and advanced LED lighting systems that meet the system requirements.
- Demonstrate technical, economic and commercial viability for widespread application and deployment in other communities, including measurement and verification of energy and cost savings at the demonstration sites.
- Identify and implement manufacturing and installation cost reductions needed to increase penetration in communities, such as integrating the controls into existing building energy management systems.
- Test and demonstrate a minimum of 200 smart luminaires in a minimum of seven disadvantaged or low-income communities.

III. TASK 1 GENERAL PROJECT TASKS

PRODUCTS

Subtask 1.1 Products

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

Exhibit A
Scope of Work
The Regents of the University of California, on behalf of the Davis campus

The goal of this subtask is to establish the requirements for submitting project products (e.g., reports, summaries, plans, and presentation materials). Unless otherwise specified by the Commission Agreement Manager (CAM), the Recipient must deliver products as required below by the dates listed in the **Project Schedule (Part V).** All products submitted which will be viewed by the public, must comply with the accessibility requirements of Section 508 of the federal Rehabilitation Act of 1973, as amended (29 U.S.C. Sec. 794d), and regulations implementing that act as set forth in Part 1194 of Title 36 of the Federal Code of Regulations**.** All technical tasks should include product(s). Products that require a draft version are indicated by marking **"(draft and final)"** after the product name in the "Products" section of the task/subtask. If "(draft and final)" does not appear after the product name, only a final version of the product is required. With respect to due dates within this Scope of Work, **"days"** means working days.

The Recipient shall:

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

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

For products that require a final version only

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

For all products

- Submit all data and documents required as products in accordance with the following:

Instructions for Submitting Electronic Files and Developing Software:

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

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

- Data sets will be in MS Access or MS Excel file format (version 2007 or later), or any other format approved by the CAM.
- Text documents will be in MS Word file format, version 2007 or later.
- Project management documents will be in Microsoft Project file format, version 2007 or later.

- **Software Application Development**

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

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

MEETINGS

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

The Recipient shall:

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

  The administrative portion of the meeting will include discussion of the following:
  - Terms and conditions of the Agreement;
  - Invoicing and auditing procedures;
  - Administrative products (subtask 1.1);
  - CPR meetings (subtask 1.3);

- Match fund documentation (subtask 1.7);
- Permit documentation (subtask 1.8);
- Subcontracts (subtask 1.9); and
- Any other relevant topics.

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

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

- Provide *Kick-off Meeting Presentation* to include but not limited to:
  - Project overview (i.e. project description, goals and objectives, technical tasks, expected benefits, etc.)
  - Project schedule that identifies milestones
  - List of potential risk factors and hurdles, and mitigation strategy

- Provide an *Updated Project Schedule, Match Funds Status Letter,* and *Permit Status Letter*, as needed to reflect any changes in the documents.

The CAM shall:

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

Recipient Products:

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

CAM Product:

- Kick-off Meeting Agenda

Subtask 1.3 Critical Project Review (CPR) Meetings

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

CPR meetings generally take place at key, predetermined points in the Agreement, as determined by the CAM and as shown in the Task List on page 1 of this Exhibit. However, the CAM may schedule additional CPR meetings as necessary. The budget will be reallocated to cover the additional costs borne by the Recipient, but the overall Agreement amount will not increase. CPR meetings generally take place at the CEC, but they may take place at another location, or may be conducted via electronic conferencing (e.g., WebEx) as determined by the CAM.

The Recipient shall:

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

The CAM shall:

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

Recipient Products:

- CPR Report(s)

CAM Products:

- CPR Agenda
- Progress Determination

Subtask 1.4 Final Meeting

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

The Recipient shall:

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

The technical and administrative aspects of Agreement closeout will be discussed at the meeting, which may be divided into two separate meetings at the CAM's discretion.
  - The technical portion of the meeting will involve the presentation of findings, conclusions, and recommended next steps (if any) for the Agreement. The CAM will determine the appropriate meeting participants.
  - The administrative portion of the meeting will involve a discussion with the CAM and the CAO of the following Agreement closeout items:
    - Disposition of any procured equipment.
    - The CEC's request for specific "generated" data (not already provided in Agreement products).
    - Need to document the Recipient's disclosure of "subject inventions" developed under the Agreement.
    - "Surviving" Agreement provisions such as repayment provisions and confidential products.
    - Final invoicing and release of retention.
- Prepare a *Final Meeting Agreement Summary* that documents any agreement made between the Recipient and Commission staff during the meeting.
- Prepare a *Schedule for Completing Agreement Closeout Activities*.
- Provide copies of *All Final Products* on a USB memory stick, organized by the tasks in the Agreement.

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

REPORTS AND INVOICES

Subtask 1.5 Progress Reports and Invoices
The goals of this subtask are to: (1) periodically verify that satisfactory and continued progress is made towards achieving the project objectives of this Agreement; and (2) ensure that invoices contain all required information and are submitted in the appropriate format.

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

Products:
- Progress Reports

- Invoices

Subtask 1.6 Final Report
The goal of this subtask is to prepare a comprehensive Final Report that describes the original purpose, approach, results, and conclusions of the work performed under this Agreement. When creating the Final Report Outline and the Final Report, the Recipient must use the CEC Style Manual provided by the CAM.

Subtask 1.6.1 Final Report Outline

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

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

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

Subtask 1.6.2 Final Report

The Recipient shall:
- Prepare a *Final Report* for this Agreement in accordance with the approved Final Report Outline, Energy Commission Style Manual, and Final Report Template provided by the CAM with the following considerations:
  - Ensure that the report includes the following items, in the following order:
    - Cover page (**required**)
    - Credits page on the reverse side of cover with legal disclaimer (**required**)
    - Acknowledgements page (optional)
    - Preface (**required**)
    - Abstract, keywords, and citation page (**required**)
    - Table of Contents (**required**, followed by List of Figures and List of Tables, if needed)
    - Executive summary (**required**)
    - Body of the report (**required**)
    - References (if applicable)
    - Glossary/Acronyms (If more than 10 acronyms or abbreviations are used, it is required.)
    - Bibliography (if applicable)
    - Appendices (if applicable) (Create a separate volume if very large.)
    - Attachments (if applicable)
- Submit a draft of the Executive Summary to the TAC for review and comment.
- Develop and submit a *Summary of TAC Comments* received on the Executive Summary. For each comment received, the recipient will identify in the summary the following:

  - Comments the recipient proposes to incorporate.
  - Comments the recipient does propose to incorporate and an explanation for why.
- Submit a draft of the report to the CAM for review and comment. The CAM will provide written comments to the Recipient on the draft product within 15 days of receipt.
- Incorporate all CAM comments into the *Final Report*. If the Recipient disagrees with any comment, provide a *Written Responses to Comments* explaining why the comments were not incorporated into the final product.

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

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

CAM Product:
- Written Comments on the Draft Final Report

MATCH FUNDS, PERMITS, AND SUBCONTRACTS

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

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

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

  If match funds were a part of the proposal that led to the CEC awarding this Agreement, then provide in the letter:
  - A list of the match funds that identifies:
    - The amount of cash match funds, their source(s) (including a contact name, address, and telephone number), and the task(s) to which the match funds will be applied.
    - The amount of each in-kind contribution, a description of the contribution type (e.g., property, services), the documented market or book value, the source

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

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

Subtask 1.8 Permits
The goal of this subtask is to obtain all permits required for work completed under this Agreement in advance of the date they are needed to keep the Agreement schedule on track. Permit costs and the expenses associated with obtaining permits are not reimbursable under this Agreement, with the exception of costs incurred by University of California recipients. Permits must be identified and obtained before the Recipient may incur any costs related to the use of the permit(s) for which the Recipient will request reimbursement.

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

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

- If during the course of the Agreement permits are not obtained on time or are denied, notify the CAM within 5 days. Either of these events may trigger a CPR meeting.

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

Subtask 1.9 Subcontracts
The goals of this subtask are to: (1) procure subcontracts required to carry out the tasks under this Agreement; and (2) ensure that the subcontracts are consistent with the terms and conditions of this Agreement.

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

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

TECHNICAL ADVISORY COMMITTEE

Subtask 1.10 Technical Advisory Committee (TAC)
The goal of this subtask is to create an advisory committee for this Agreement. The TAC should be composed of diverse professionals. The composition will vary depending on interest, availability, and need. TAC members will serve at the CAM's discretion. The purpose of the TAC is to:
- Provide guidance in project direction. The guidance may include scope and methodologies, timing, and coordination with other projects. The guidance may be based on:
  - Technical area expertise;
  - Knowledge of market applications; or
  - Linkages between the agreement work and other past, present, or future projects (both public and private sectors) that TAC members are aware of in a particular area.
- Review products and provide recommendations for needed product adjustments, refinements, or enhancements.

- Evaluate the tangible benefits of the project to the state of California, and provide recommendations as needed to enhance the benefits.
- Provide recommendations regarding information dissemination, market pathways, or commercialization strategies relevant to the project products.
- Help set the project team's goals and contribute to the development and evaluation of its statement of proposed objectives as the project evolves.
- Provide a credible and objective sounding board on the wide range of technical and financial barriers and opportunities.
- Help identify key areas where the project has a competitive advantage, value proposition, or strength upon which to build.
- Advocate, to the extent the TAC members feel is appropriate, on behalf of the project in its effort to build partnerships, governmental support and relationships with a national spectrum of influential leaders.
- Ask probing questions that insure a long-term perspective on decision-making and progress toward the project's strategic goals.

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

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

The Recipient shall:

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

Products:

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

Subtask 1.11 TAC Meetings
The goal of this subtask is for the TAC to provide strategic guidance for the project by participating in regular meetings, which may be held via teleconference.

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

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

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

Subtask 1.12 Project Performance Metrics
The goal of this subtask is to identify key performance targets for the project. The performance targets should be a combination of scientific, engineering, techno-economic, and/or programmatic metrics that provide the most significant indicator of the research or technology's potential success.

The Recipient shall:

- Complete and submit the draft *Project Performance Metrics Questionnaire* to the CAM prior to the Kick-off Meeting.
- Present the draft *Project Performance Metrics Questionnaire* at the first TAC meeting to solicit input and comments from the TAC members.
- Develop and submit a *TAC Performance Metrics Summary* that summarizes comments received from the TAC members on the proposed project performance metrics. The *TAC Performance Metrics Summary* will identify:
  - TAC comments the recipient proposes to incorporate into the final *Project Performance Metrics Questionnaire*.
  - TAC comments the recipient does not propose to incorporate with and explanation why.
- Submit a final *Project Performance Metrics Questionnaire* with incorporated TAC feedback.
- Develop and submit a *Project Performance Metrics Results* document describing the extent to which the recipient met each of the performance metrics in the final *Project Performance Metrics Questionnaire*.
- Discuss the final *Project Performance Metrics Questionnaire* and *Project Performance Metrics Results* at the Final Meeting.

Products:

- Project Performance Metrics Questionnaire (draft and final)
- TAC Performance Metrics Summary
- Project Performance Metrics Results

IV. TECHNICAL TASKS

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

Note: Under the grant agreement's terms and conditions, the solicitation and the Recipient's proposal under that solicitation are incorporated by reference into the grant agreement (Exhibit C, section 2). The original Recipient's proposal included more and/or different work and equipment, than reflected in this Scope of Work. Where there are differences in the number or characteristics of work or equipment, the description in this Scope of Work supersedes the description in the original proposal. For example, the proposal discusses solar PV and electricity storage that is separately located from the luminaires. This idea is not part of the Scope of Work. Instead, solar panels with embedded sensors, controls, and battery storage will be integrated in the luminaires. In conclusion, by mutual agreement, conflicting numbers or characteristics of work and equipment in the original proposal are not incorporated by reference from the Recipient's original proposal.

TASK 2 SYSTEM DESIGN

The goal of this task is to design and develop a *Renewable Energy & Advanced Lighting Systems for Exterior Applications (REAL)* design and specification criteria based on the collective results from a literature review, market assessment, and preliminary feedback from community-based outreach (Task 6.2).

Subtask 2.1 Literature Review

The goal of this task is to compile existing research related to REAL systems and identify gaps in published findings. Examples of topics that will be included in the literature review are: hybrid power exterior lighting (solar and grid), smart charging controllers, light quality issues such as light trespass, glare and color discrimination; light at night issues; safety and security lighting-related issues; and actual and simulated energy savings of advanced exterior lighting systems. Findings will inform specific research questions for the design and prototype phases of REAL systems.

The Recipient shall:

- Compile published research related to REAL systems
- Identify gaps in published findings
- Develop list of key research questions to guide system design and prototype
- Document results in *Key Research Questions Memo*

Products:

- Key Research Questions Memo

Subtask 2.2 Market Assessment

The goals of this task are to identify devices appropriate for use in REAL system(s), quantify the potential energy savings for REAL system(s), identify typical exterior light asset ownership models, and assess existing utility programs related to REAL systems to determine existing incentives and/or program areas ready for growth and development.

The Recipient shall:

- Identify exterior applications appropriate for using REAL systems, such as general exterior lighting (e.g., walkways, building exterior walls, parking lots) and streetlights.
- Collect energy use data for identified exterior applications
- Identify luminaire form factors, devices and system components that are commercially available to use in REAL system(s) that are capable of the following:
  - Reduce nighttime utility energy consumption by at least 20% compared to the baseline per luminaire
  - Store solar electricity in an integrated battery that can power the luminaire at night
  - Use adaptive and advanced networked controls to enable grid flexibility to maximize use of low/no carbon electricity sources with potential for dimming during low use times
  - Interconnect with utility to participate in net energy metering or similar utility programs, where available
  - Use designs that provide for security, and glare reduction, enhanced visibility and safety for drivers and pedestrians, and meet or exceed the Illuminating and Engineering Society lumen output, performance, and quality recommendations
  - Use luminaires, including lamps, drivers, diodes, batteries, solar panel and all other components that are the highest quality available on the market.
- Collect performance characteristics and energy savings/load reduction capabilities for technology components appropriate for use in a REAL systems, such as dimmable luminaires, advanced lighting control systems, environmental sensors, renewable energy devices, energy storage, smart charging controllers and auxiliary devices (e.g. electric vehicle chargers, illuminated signage)
- Calculate the potential energy savings and lifecycle cost analysis for typical REAL system design approaches and market penetration rates (Outcomes will inform demonstration site selection in Task 4.1)
- Determine how the REAL system(s) will minimize electricity cost and provide energy benefits to the electric grid and non-energy benefits to the community
- Compile information on existing utility programs related to REAL systems
- Identify exterior light asset ownership models
- Identify market and system needs for each ownership model
- Document results in *Market Assessment Report*

Products:

- Market Assessment Report

Subtask 2.3 Control Switch Development

The goal of this subtask is to develop the control technology to intelligently switch the luminaire between solar charging and grid charging.

The Recipient shall:

- Design a method to monitor solar output and battery charge state
- Write code to implement autonomous switching through a solid-state relay
- Prepare a *Battery Charging Controller Design Memo* which includes a discussion of the design process.

Products:
- Battery Charging Controller Design Memo

Subtask 2.4 Concept Design & Model Specification Development
The goal of this task is to establish the concept design and develop a model specification working document based on the outcomes from literature review, market assessment, and control switch development, as well as community input gathered in Task 6.2. To address short-, mid- and long-term markets, the concept design/model specification will include options for varying site applications, design considerations and project budgets, where the best-in-class solution will meet the minimum criteria for the REAL system. A companion document will be developed to provide guidance on anticipated REAL system integration and construction requirements to be updated with lessons learned from Task 4.

The Recipient shall:
- Determine exterior applications and system implementation strategies that will be included in the model specification based on outcomes from Task 2.2
- Develop good, better, best exterior lighting approaches with the best system that meets or exceeds the following criteria for each application:
  - Reduces nighttime utility energy consumption by at least 20% compared to the baseline per luminaire
  - Stores solar electricity in an integrated battery that can power the luminaire at night
  - Uses adaptive and advanced networked controls to enable grid flexibility to maximize use of low/no carbon electricity sources with potential for dimming during low use times
  - Uses a smart controller to power the luminaire primarily from the integrated solar and battery energy but also has a utility grid AC backup.
  - Interconnect with utility to participate in net energy metering or similar utility programs, where available
  - Uses designs that provide for security, and glare reduction, enhanced visibility and safety for drivers and pedestrians, and meet or exceed the IES lumen output, performance, and quality recommendations
  - Uses luminaires, including lamps, drivers, diodes, batteries, solar panel and all other components, that are cost effective and high quality
- Document concept design findings in *Model Specification Working Document*
- Circulate findings to TAC for their review and input
- Circulate findings to CBOs for their review and input
- Update *Model Specification Working Document* with feedback from TAC and CBOs

- Document the known REAL system integration and construction requirements in *REAL System Installation Guidance Memo* to be updated in Task 4.3
- Prepare a *Concept Design Memo which* includes a discussion of the design process, final design of the concept luminaire and includes the component and sub assembly list and the final detail drawings.
- Prepare CPR Report #1 and Participate in CPR meetings per subtask 1.3

Products:

- Concept Design Memo (Draft and Final)
- Model Specification Working Document (Draft and Final)
- REAL System Installation Guidance Memo
- CPR Report #1

TASK 3 INTEGRATION & FIELD READINESS

The goal of this task is to address key research questions identified in Task 2.1, assess occupant feedback in exterior lighting mock-ups, evaluate lighting quality issues, develop control algorithms and application-appropriate hardware platforms to integrate REAL system prototypes that meet the *Model Specification Working Document*, verify REAL system prototype performance in the laboratory, and refine the *Model Specification Working Document* with outcomes from laboratory testing.

Subtask 3.1 System Component Testing

The goal of this task is to address the key research questions established in Task 2.1, evaluate system components to ensure they are the highest quality available on the market, and to determine if system components are appropriate for integration into REAL system platform.

The Recipient Shall:

- Develop methodology to address key research questions and Agreement objectives related to system components, evaluate quality of system components, and determine additional requirements for system components to be successfully integrated into the REAL system platform
- Procure representative, commercially available REAL system components identified in Task 2.2
- Test system components according to test methodology
- Document results in REAL *System Component Testing Report*

Products:

- REAL System Component Testing Report

Subtask 3.2 Occupant View Assessment

The goal of this task is to determine what sensor response characteristics optimize the visual environment and energy usage for end users.

The Recipient Shall:

- Identify a cross-section of real-world, controllable exterior lighting applications to use as test sites
- Develop a matrix of occupancy sensor response characteristics considering existing technologies and human physiology
- Develop a control platform that will allow researchers to repeatedly manipulate light levels to simulate the occupancy sensor response matrix
- Equip each test site with visual references such as cameras or laser gates to collect data
- Recruit human subjects to "occupy" each test site as they would typically use that type of space while being subjected to a range of sensor behaviors by researchers
- Ensure that personally identifiable information (PII) will be handled and kept confidential in accordance with Exhibit D of the grant agreement.
- Document the outcomes from the study in *Occupant View Assessment Results Memo* that includes performance characteristics recommendations

Products:
- Occupant View Assessment Results Memo

Subtask 3.3 Lighting Quality Enhancements
The goal of this task is to explore potential lighting quality enhancements for exterior lighting applications.

The Recipient Shall:
- Research light at night disruption, light trespass, and glare issues
- Develop strategies to mitigate issues with LED lighting systems that maintain color discrimination and visual acuity
- Prototype systems for evaluation in laboratory in representative exterior lighting mock-ups
- Develop methodology to assess color discrimination and visual acuity of prototype systems
- Recruit human subjects to experience each strategy in laboratory
- Document the outcomes from the study in *Lighting Quality Assessment Results Memo* that includes performance characteristic recommendations

Products:
- Lighting Quality Assessment Results Memo

Subtask 3.4 Networked Control System Optimization
The goals of this task are to 1) establish communication and validate data sharing capabilities among the different device types necessary to achieve successful REAL system(s); and 2) develop and verify performance of control algorithms to optimize REAL system efficiency, reliability and performance. One example of an optimization control algorithm includes occupant tracking to more intelligently control exterior lighting.

The Recipient Shall:

- Identify system components ready for inclusion in communication platform and optimization algorithms
- Validate data sharing capabilities among the REAL system components in laboratory
- Develop optimization algorithms to improve the reliability, efficiency and performance of the REAL system
- Validate system performance in laboratory
- Document results in *Networked Control System Optimization Results Memo*

Products:

- Networked Control System Optimization Results Memo

Subtask 3.5 Prototype Development, Integration & Testing

Per CAM approval, the goal of this task is to develop REAL system prototypes, in collaboration with industry partners, to meet the minimum performance criteria established in the *Model Specification Working Document*. Prototypes will be verified in the laboratory environment to ensure they meet the minimum performance criteria established in Task 2.3.

The Recipient Shall:

- Develop REAL system prototypes in collaboration with industry partners
- Develop methodology to address key research questions, such as grid-flexibility and system performance, related to integrated REAL systems and verify that REAL system(s) prototypes meet model specification criteria developed in Task 2.3
    - Develop test procedure to quantify the efficiency of REAL systems by considering each sub-system and then combining them for the purpose of objectively comparing delivered lighting service with the goal of comparing delivered service between any two REAL systems regardless of technology. By defining delivered lighting service as the intended function of an exterior lighting system, a test procedure that quantifies maintained service per unit duration allows for performance criteria to be defined based on the renewable energy source and geographical location
- Test REAL system(s) prototypes in the laboratory per test methodology
- Document outcomes in *Prototype Integration & Testing Report*

Products:

- REAL System Prototype Specifications
- Prototype Integration & Testing Report

Subtask 3.6 Model Specification Refinements

The goal of this task is to refine the *Model Specification Working Document* established in Task 2.3 based on outcomes from component testing, prototype integration and system performance verification.

The Recipient Shall:

- Update *Model Specification Working Document* with lessons learned from Tasks 3.1-3.3
- Provide refined *Model Specification Working Document* to TAC for review

- Provide refined *Model Specification Working Document* to CBOs for review
- Update *Model Specification Working Document* with input from TAC and CBOs

Products:

- Refined Model Specification Working Document (Draft and Final)

3.7 REAL Systems – Industry Product Development

The goal of this task is to transfer the successful REAL system(s) prototypes to the project's industry partners for further refinement and product development necessary to produce cost effective, field-ready products for installation at each demonstration site.

The Recipient Shall:

- Provide prototype drawings and specifications to industry partners for further refinement and product development
- Support industry partners in development and safety certification for emerging REAL system(s) to be installed at the project demonstration sites
- Provide photos and specification sheets of pre-commercial REAL system(s) to be installed at the project demonstration sites.
- Prepare CPR Report #2 and Participate in CPR meetings per subtask 1.3

Products:

- REAL System Pre-commercial Product Specification Sheets
- CPR Report #2

TASK 4 FIELD DEMONSTRATIONS

The goal of this task is to demonstrate REAL systems (200 luminaires total) in disadvantaged or low-income communities throughout California in electric IOU service territories. This will be done in collaboration with industry partners, manufacturers, disadvantaged or low-income communities and applicable regulatory agencies to produce and demonstrate REAL systems that meet the requirements established in the refined model specification from Task 3.6. The CAM must approve the list of all demonstration sites before any installations or retrofits.

4.1 Demonstration Site Analysis

The goal of this task is to work with site partners to finalize and analyze existing conditions of the demonstration site portfolio.

The Recipient Shall:

- Final demonstration site portfolio must include a minimum of seven test sites, with the following attributes:
  - Each site must have at least 10 luminaires
  - All sites must collectively total at least 200 luminaires
  - All sites must be located in a disadvantaged community (score of 75+) or a low-income community
  - All sites must have at least one community-based organization (CBO) that commits to participate in surveys, round tables and site walks for the project duration
  - Demonstration sites must be located in California electric IOU service territories

  - Existing lighting must operate continuously throughout the night
  - Demonstration site portfolio must include a variety of applications (i.e. streets, paths/trails, nonresidential hardscape, and general park applications) to be determined using information gathered during market assessment in Task 2.2
  - Demonstration site portfolio must include a variety of light fixture form factors (i.e. cobra head, shoebox, post top, wall pack, bollard, etc.) to be determined using information gathered during market assessment in Task 2.2. Portfolio of luminaires types must be approved by CAM before any deployment and installations.
- Document recommended demonstration site locations and characteristics, subject to CAM approval
- Collect operation data for each approved test site, such as purpose of the area; age; use; square footage; and annual operating hours.
- Conduct in-depth site analysis for each approved site to determine energy using systems currently installed; historical energy use of systems; and operating patterns, hours, and associated operating costs related to the building systems to be retrofitted.
- If approved site requires new construction components, develop application-appropriate lighting design for LED baseline lighting system to use in REAL system analysis.
- Document all subtask activities in *Existing Conditions of Demonstration Sites Memo*

Products:

- Demonstration Site Selection Recommendations Memo
- Existing Conditions of Demonstration Sites Memo

4.2 Measurement & Verification Plan

The goal of this task is to develop a measurement and verification (M&V) plan to quantify energy performance, potential for grid flexibility and other criteria to be determined in partnership and coordination with low income and/or disadvantaged communities. The same M&V plan will be used at each demonstration site for consistency in resulting data.

The Recipient Shall:

- Identify key performance criteria of REAL systems to monitor and from which to collect data to characterize the baseline system performance and REAL system performance. At a minimum, the key performance criteria must facilitate the evaluation of technical performance; end user acceptance; energy savings; peak demand reduction; potential for grid-flexibility and economic potential of the system, compared to the baseline system.
- Conduct electrical audit of each demonstration site to identify necessary equipment required to document key performance criteria.
- Identify measurement and verification equipment needed to monitor and collect data on the key performance criteria.
- Prepare a memorandum describing the measures taken to protect PII (*Summary of Actions Taken to Protect Personally Identifiable Information*).
- Document findings in *Measurement and Verification Plan* for test sites that includes, but is not limited to:

- Identification of key performance criteria needed to evaluate technical performance; end user acceptance; energy savings; peak demand reduction; potential for grid flexibility, and economic (e.g., energy cost savings) potential of the system, compared to the baseline system. The plan should include all measurements needed to verify whether the goals and objectives in Section II.C have been met.
- Identification of equipment needed to complete the M&V plan

Products:

- Measurement and Verification Plan (Draft and Final)
- Summary of Actions Taken to Protect Personally Identifiable Information

4.3 Demonstration System Specification, Procurement, Installation and Commissioning

The goal of this task is to develop the site-specific design and engineering specifications required for the REAL system for each of the demonstration sites. Based on the specification, system components will be procured, installed and commissioned by the design build contractors.

The Recipient Shall:

- Work with each demonstration site facility team to gather site plans required to design the system. If documentation is not available, recipient shall conduct site visits to gather required information.
- Determine if site is appropriate for good, better, or best solution in *Model Specification Working Document*
- Develop appropriate *System Specification* for each demonstration site to be used as RFP with local, minority-owned design build contractors who employ apprentices from the installer training program detailed in Task 6.3
- Coordinate procurement, installation, and commissioning of the REAL systems with design build contractor(s).
- Document lessons learned during the specification, procurement, install and commissioning process in the *Model Specification Working Document* and *REAL System Installation Guidance Memo* update.

Products:

- System Specification, Per Demonstration Site
- Model Specification Working Document Update
- REAL System Installation Guidance Memo Update

4.4 Data Collection & Analysis

The goal of this task is to collect data per the *Measurement and Verification Plan* developed in Subtask 4.2. Using the collected data, the performance of the installed REAL systems will be evaluated and documented to assess the technical performance, end-user acceptance, energy savings, peak demand reduction, and economic potential of the system as compared to the baseline system for each demonstration site.

The Recipient shall:

- Procure the equipment defined in the *Measurement and Verification Plan* (Subtask 4.2) for each demonstration site
- Install the equipment defined in the *Measurement and Verification Plan* (Subtask 4.2) for each demonstration site
- Collect data at necessary intervals to compile at least 12 months of consecutive data for each key performance criteria (i.e. energy use) specified in the *Measurement and Verification Plan* (Subtask 4.2)
- Analyze collected data to evaluate technical performance, end user acceptance; energy savings; peak demand reduction; potential for grid flexibility, and economic (e.g., energy cost savings) potential of the system, compared to the baseline system. Discuss whether the goals and objectives in Section II.C have been met.
- Develop *REAL System Performance Report* that compiles the results of the work associated with this subtask and compares outcomes to the Agreement objectives in Section II.C and the *Model Specification Working Document Update (Subtask 4.3)*.

Products:

- REAL System Performance Report (Draft and Final)

TASK 5 EVALUATION OF PROJECT BENEFITS

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

The Recipient shall:

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

    - <u>For Product Development Projects and Project Demonstrations:</u>
        - Published documents, including date, title, and periodical name.
        - Estimated or actual energy and cost savings and estimated statewide energy savings once market potential has been realized. Identify all assumptions used in the estimates.
        - Greenhouse gas and criteria emissions reductions.
        - Other non-energy benefits such as reliability, public safety, lower operational cost, environmental improvement, indoor environmental quality, and societal benefits.
        - Data on potential job creation, market potential, economic development, and increased state revenue as a result of the project.

- A discussion of project product downloads from websites, and publications in technical journals.
- A comparison of project expectations and performance. Discuss whether the goals and objectives of the Agreement have been met and what improvements are needed, if any.
- 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 CEC 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
- Project Benefits Report (Draft/Final)

TASK 6 TECHNOLOGY/KNOWLEDGE TRANSFER ACTIVITIES
The goal of this task is to demonstrate technical, economic and commercial viability for widespread application and deployment of REAL systems in other communities.

Subtask 6.1 General Technology & Knowledge Transfer Activities
The goal of this task is to ensure the technological learning that resulted from the demonstration(s) is captured and disseminated to the range of professions that will be responsible for future deployments of this technology or similar technologies.

The Recipient Shall:

- Develop and submit a *Technology & Knowledge Transfer Plan (Draft/Final)* that identifies the proposed activities the recipient will conduct, such as those in Task 3.7 and Task 6.2-6.8. The *Technology & Knowledge Transfer Plan* should include at a minimum:
    - Efforts this project will take to address product optimization and cost effectiveness with industry.
    - Policy and planning efforts this project is expected to inform.
    - Stakeholder groups and energy policy and planning practitioners who will utilize the results of this project.
    - Activities the recipient will conduct to ensure the tools and results from this project be utilized and adopted by the groups identified above.
    - A detailed vision on how to move the technology developed under this research from the laboratory and demonstration sites out to the market place, including: 1) the next steps for commercialization of the technology, including plans for future deployment to other communities; 2) what are the target markets that would benefit the most from adopting the technology; and 3) how the plan will address and overcome potential barriers to increase penetration and further deployment of the technology.
- Develop and submit a *Project Case Study Plan (Draft/Final)* that outlines how the Recipient will document the planning, construction, commissioning, and operation of the technology or system being demonstrated. The *Project Case Study Plan* should include:
    - An outline of the objectives, goals, and activities of the case study.
    - The organization that will be conducting the case study and the plan for conducting it.
    - A list of professions and practitioners involved in the technology's deployment.
    - Specific activities the recipient will take to ensure the learning that results from the project is disseminated to those professions and practitioners.
    - Presentations/webinars/training events to disseminate the results of the case study.
- Present the *Draft Project Case Study Plan* to the TAC for review and comment.

- Develop and submit a *Summary of TAC Comments* that summarizes comments received from the TAC members on the *Draft Project Case Study Plan*. This document will identify:
  - TAC comments the recipient proposes to incorporate into the *Final Technology Transfer Plan*.
  - TAC comments the recipient does not propose to incorporate with and explanation why.
- Submit the *Final Project Case Study Plan* to the CAM for approval.
- Execute the *Final Project Case Study Plan* and develop and submit a *Project Case Study (Draft/Final)*
- When directed by the CAM, develop presentation materials for a CEC- sponsored conference/workshop(s) on the project.
- When directed by the CAM, participate in annual EPIC symposium(s) sponsored by the California CEC.
- Provide at least (6) six *High Quality Digital Photographs* (minimum resolution of 1300x500 pixels in landscape ratio) of pre and post technology installation at the project sites or related project photographs.

Products:

- Technology & Knowledge Transfer Plan (Draft/Final)
- Project Case Study Plan (Draft/Final)
- Summary of TAC Comments
- Project Case Study (Draft/Final)
- High Quality Digital Photographs

Subtask 6.2 Community Based Outreach

The goal of this task is to engage with community based organizations in the regions of the field demonstrations deployed in Task 4. Additional California-based communities and key community stakeholders such as police and fire departments will be invited to participate in system design roundtables.

The Recipient Shall:

- Develop and facilitate up to four roundtables to solicit feedback and recommendations for REAL systems performance criteria from community-based organizations and key community stakeholders from regions of demonstration sites and other areas throughout California as able
- Develop surveys to solicit feedback and recommendations for REAL systems from community-based organizations, community residents, and key community stakeholders for each demonstration site region
- Collaborate with community-based organizations to disseminate surveys to community residents
- Identify system benefits and develop community outreach and education materials to disseminate via community-based organizations, such as flyers, short videos, radio interviews with stakeholders and social media campaigns
- Develop a post-retrofit survey to gather feedback and recommendations about

installations from community-based organizations, community residents and key community stakeholders
- Include mechanism for implementing critical feedback in demonstrations and/or the model specification outcome prior to the end of project

Products:
- Roundtable meeting materials & meeting notes/recording, per roundtable
- Pre-retrofit Survey Results and Analysis Memo
- Community-based Outreach Materials
- Post-retrofit Survey Results and Key Lessons Memo

Subtask 6.3 Installer Training
The goal of this task is to train installers in California on the installation of REAL systems by taking a zero-trust approach, and applying multi-path electrical wiring (i.e. linking segmented electrical circuits with smart switches to provide multiple paths for electricity to flow in the event of line failure in one or more segments) with granular networking and cybersecurity controls. This approach minimizes the cyberattack surfaces and builds resilience against cascading failures. Installer training will focus on exterior lighting power system networking and cybersecurity; integration with building automation systems or energy management systems; grid interactions and demand flexibility including integration with renewable energy resources; and advanced lighting control systems for exterior applications.

The Recipient Shall:

- Develop theory-based training curriculum that will:
  - Provide an overview of technology components typical in today's exterior lighting systems including luminaires, advanced controls, renewable energy resources, batteries, and integration hardware.
  - Include electrical design, installation, programming and maintenance methods that can better fortify smart city infrastructure from cyberattacks, specifically addressing
    - Exterior lighting systems and design including:
    - Lighting layouts and critical design criteria
    - Exterior lighting integration with building automation systems or energy management systems
    - Smart inverters + solar panels + electric storage
    - Metering features of advanced lighting control systems
    - Light pole integrated, electrical vehicle charging stations
  - Address networking and cybersecurity principles for exterior lighting systems
  - Develop project management skills for interfacing with power systems, networking and cybersecurity design teams to understand cybersecurity requirements
- Develop application-based training curriculum that will:
  - Provide application-based training on how to logically configure and secure the power systems supporting the use cases associated with exterior lighting systems, specifically on:
    - Exterior lighting integration with building automation systems

        - Smart inverters + solar panels + electric storage
        - Metering features of advanced lighting control systems
        - Light pole integrated, electrical vehicle charging stations
    - Provide opportunities for students to install and configure electrical, networking and cybersecurity technologies for exterior lighting applications in an integrated manner as part of field demonstrations.
- Train California workforce to install cyber-secure exterior lighting systems
- Conduct periodic curriculum maintenance and updates to ensure training covers current best practices

Products:
- Training Program Statistics Memo for 2022
- Training Program Statistics Memo for 2023

Subtask 6.4 Stakeholder Education
The goal of this task is to develop and disseminate educational materials related to the design, specification, installation, costs and benefits of the REAL systems approach. This includes hosting a series of educational webinars with a target audience of future REAL system implementers such as city managers/staff, city planners, lighting designers/engineers and the manufacturing community.

The Recipient Shall:
- Develop *REAL Systems Best Practices Guide* that includes system design, specification, installation, and benefits, as well as features case studies from system demonstrations developed as part of subtask 6.1
- Publish the educational materials and promote the materials in collaboration with local, state and national partners
- Develop and publish webinar materials
- Promote and host webinars that share educational materials with a target audience consisting of city managers/staff, city planners, lighting designers/engineers and the manufacturing community

Products:
- REAL Systems Best Practices Guide
- Webinar materials and recording(s)

Subtask 6.5 Utility Program Assessment & Development
The goal of this task is to assess existing utility programs related to REAL systems, identify areas appropriate for inclusion of REAL systems in program development and/or updates, and host a utility roundtable to transfer knowledge and recommendations to California IOU utility program leads.

The Recipient Shall:
- Identify existing utility programs related to REAL systems to determine current practices related to rebates and incentives for similar technologies; program product and participation requirements; and related information

- Analyze existing utility program findings; local, state and federal carbon-based electricity/GHG reduction policies and goals; community action and environmental plans and similar drivers (Ex: Executive Order B-30-15 and Executive Order B-55-18) to determine which practices would be successful for California electric IOUs
- Develop recommendations for utility working papers addressing topics such as technology performance and incentive structures to help increase technology adoption in support of California policy
- Identify appropriate contacts at California electric IOU and nationwide utilities
- Host a utility roundtable to collect feedback on recommended program development and implementation strategies for REAL systems

Products:

- REAL System Working Paper & Program Development Recommendations
- REAL System Utility Roundtable Participant List, Meeting Materials and Minutes/Recording

Subtask 6.6 Codes & Standards Development

The goal of this subtask is to identify relevant codes and standards programs, such as local or state reach codes, municipal standards, California Department of Transportation standards, or appliance standards, which may support current or future requirements for cost effective REAL systems. Additionally, the goal is to develop model language, code change proposal components and similar support materials necessary for transitioning the technology into the identified codes and standards.

The Recipient Shall:

- Identify codes and standards sections related to technologies that are part of the REAL systems model specification (i.e. PV, energy storage, luminaires, integration hardware, occupancy sensors, control systems, etc.) at the municipal, state and/or national level
- Identify key gaps in the codes and standards for the technology and document in a *Codes & Standards Gap Analysis Memo*
- Host industry-based events to develop a plan of action for addressing the identified gaps
- Develop *Draft Code & Standards Proposal Components* such as model language and code change proposal components to support development of code measure proposals for future code cycles

Products:

- Codes & Standards Gap Analysis Memo
- Industry-based meeting minutes/recording
- Draft code and standards proposal components

Subtask 6.7 Technology Adoption via Policy Pathways

The goal of this task is to advance the adoption of the REAL system model specification in California and nationwide via policy pathways.

The Recipient Shall:

- Identify key information gaps in the policy community and develop a plan of action for policy-related materials that fill those gaps
- Propose specific municipal and state policies that can promote advanced lighting systems for exterior applications at a state and national level in a way that improve equity and justice
- Engage with local, California, and national decision makers to promote the plan of action and help inform better energy and environmental policy

Products:

- Policy Goals and Needs Assessment Memo
- Technology Adoption Plan of Action Memo
- Decision Maker Engagement Summary Memo

Subtask 6.8 Specification Launch
The goal of this task is to engage with the DesignLights Consortium (DLC) to standardize and launch the REAL system model specification nationwide.

The Recipient Shall:

- Co-host industry and community roundtable events with DLC to compile input from key stakeholders to inform the model specification
- Attend DLC Stakeholder meetings and sharing key findings from this project
- Compile key findings from *Subtask 6.2 Community Based Outreach* to inform the DLC standardization process with input from demonstration communities (disadvantaged and low-income)
- Provide feedback on DLC standards during comment period
- Support DLC during launch of model specification
- Collaborate with DLC on educational materials and webinars to launch the model specification

Products:

- CLTC/DLC Roundtable meeting recording/minutes
- DLC Stakeholder meeting minutes
- DLC Standards with CLTC feedback
- DLC Specification launch webinar recording

V. PROJECT SCHEDULE

Please see the attached Excel spreadsheet.

RESOLUTION NO: 21-04-14-21b

STATE OF CALIFORNIA

STATE ENERGY RESOURCES
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION - RE: THE REGENTS OF THE UNIVERSITY OF CALIFORNIA, ON BEHALF OF THE DAVIS CAMPUS

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

RESOLVED, that the CEC approves Agreement EPC-20-031 with The Regents of the University of California, on behalf of the Davis Campus, for a $4,166,306 grant to fund the development and demonstration of a novel hybrid power (solar and grid tied) exterior LED lighting system that includes a unique integrated solar panel with embedded sensors, smart controls, and battery storage. This project will be demonstrated in seven low-income or disadvantaged communities; and

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

CERTIFICATION

The undersigned Secretariat to the CEC does hereby certify that the foregoing is a full, true, and correct copy of a Resolution duly and regularly adopted at a meeting of the CEC held on April 14, 2021.

AYE:
NAY:
ABSENT:
ABSTAIN:

_____
Patricia Carlos
Secretariat