



**CALIFORNIA
ENERGY COMMISSION**



**California Energy Commission
July 26, 2023 Business Meeting
Backup Materials for Agenda Item No 08a:
RAND Corporation**

The following backup materials for the above-referenced agenda item are available in this PDF packet as listed below:

1. Proposed Resolution
2. Grant Request Form
3. Scope of Work

STATE OF CALIFORNIA
STATE ENERGY RESOURCES
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION: RAND Corporation

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 approving agreement EPC-23-004 with RAND Corporation for a \$798,348 grant to assess the potential role of hydrogen production from renewable electricity and end-use conversion technologies for electric sector applications in California's decarbonizing electric system. The project will evaluate the underlying physics of key hydrogen technologies, assess complementary and competitor technologies, determine performance and cost metrics, and inform future EPIC research and policy recommendations; and

FURTHER BE IT RESOLVED, that the Executive Director or their 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 July 26, 2023.

AYE:
NAY:
ABSENT:
ABSTAIN:

Dated:

Kristine Banaag
Secretariat



GRANT REQUEST FORM (GRF)

A. New Agreement Number: EPC-23-004

B. Division Information

1. Division Name: ERDD
2. Agreement Manager: Jeffrey Sunquist
3. MS-43
4. Phone Number: 916-776-0816

C. Recipient's Information

1. Recipient's Legal Name: RAND Corporation
2. Federal ID Number: 95-1958142

D. Title of Project

Title of project: Assessing the Role of Hydrogen in California's Decarbonizing Electric System

E. Term and Amount

1. Start Date: 8/1/2023
2. End Date: 7/31/2025
3. Amount: \$798,348.00

F. Business Meeting Information

1. Are the ARFVTP agreements \$75K and under delegated to Executive Director? No
2. The Proposed Business Meeting Date: 7/26/2023
3. Consent or Discussion? Discussion
4. Business Meeting Presenter Name: Jeffrey Sunquist
5. Time Needed for Business Meeting: 5 minutes
6. The email subscription topic is: EPIC (Electric Program Investment Charge).

Agenda Item Subject and Description:

RAND Corporation. Proposed resolution approving agreement EPC-23-004 with RAND Corporation for a \$798,348 grant to assess the potential role of hydrogen production from renewable electricity and end-use conversion technologies for electric sector applications in California's decarbonizing electric system, and adopting staff's determination that this action is exempt from CEQA. The project will evaluate the underlying physics of key hydrogen technologies, assess complementary and competitor technologies, determine performance and cost metrics, and inform future EPIC research and policy recommendations. (EPIC funding)
Contact: Jeffrey Sunquist

G. California Environmental Quality Act (CEQA) Compliance

1. Is Agreement considered a "Project" under CEQA?

Yes

If yes, skip to question 2.

If no, complete the following (PRC 21065 and 14 CCR 15378) and 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:

2. If Agreement is considered a “Project” under CEQA answer the following questions.

a) Agreement **IS** exempt?

Yes

Statutory Exemption?

No

If yes, list PRC and/or CCR section number(s) and separate each with a comma. If no, enter “None” and go to the next question.

PRC section number: None

CCR section number: None

Categorical Exemption?

No

If yes, list CCR section number(s) and separate each with a comma. If no, enter “None” and go to the next question.

CCR section number: None

Common Sense Exemption? 14 CCR 15061 (b) (3)

Yes

If yes, explain reason why Agreement is exempt under the above section. If no, enter “Not applicable” and go to the next section.

This project involves only computer modeling and paper studies of hydrogen-based technologies. No physical construction will occur as part of this project. Therefore, it falls under the common sense exemption.

The activity is covered by the general rule that CEQA applies only to projects which have the potential for causing a significant effect on the environment. Where it can be seen with certainty that there is no possibility that the activity in question may have a significant effect on the environment, the activity is not subject to CEQA.

b) Agreement **IS NOT** exempt.

IMPORTANT: consult with the legal office to determine next steps.

No

If yes, answer yes or no to all that applies. If no, list all as “no” and “None” as “yes”.

Additional Documents	Applies
Initial Study	No
Negative Declaration	No
Mitigated Negative Declaration	No
Environmental Impact Report	No
Statement of Overriding Considerations	No
None	Yes

H. Subcontractors



List all Subcontractors listed in the Budget (s) (major and minor). Insert additional rows if needed. If no subcontractors to report, enter “No subcontractors to report” and “0” to funds. **Delete** any unused rows from the table.

Subcontractor Legal Company Name	CEC Funds	Match Funds
No subcontractors to report	\$	\$

I. Vendors and Sellers for Equipment and Materials/Miscellaneous

List all Vendors and Sellers listed in Budget(s) for Equipment and Materials/Miscellaneous. Insert additional rows if needed. If no vendors or sellers to report, enter “No vendors or sellers to report” and “0” to funds. **Delete** any unused rows from the table.

Vendor/Seller Legal Company Name	CEC Funds	Match Funds
Universal Hydrogen Co.	\$0	\$80,000

J. Key Partners

List all key partner(s). Insert additional rows if needed. If no key partners to report, enter “No key partners to report.” **Delete** any unused rows from the table.

Key Partner Legal Company Name
No key partners to report

K. Budget Information

Include all budget information. Insert additional rows if needed. If no budget information to report, enter “N/A” for “Not Applicable” and “0” to Amount. **Delete** any unused rows from the table.

Funding Source	Funding Year of Appropriation	Budget List Number	Amount
EPIC	21-22	301.001I	\$ 798,348

TOTAL Amount: \$ 798,348

R&D Program Area: ESRB: ETSI

Explanation for “Other” selection Not applicable

Reimbursement Contract #: Not applicable

Federal Agreement #: Not applicable

L. Recipient’s Contact Information

1. Recipient’s Administrator/Officer

Name: Robert Hickam

Address: 4570 5Th Ave Ste 600



STATE OF CALIFORNIA
CALIFORNIA ENERGY COMMISSION

Grant Request Form
CEC-270 (Revised 9/2022)

City, State, Zip: Pittsburgh, PA 15213-2665

Phone: 412-683-2300

E-Mail: rhickam@rand.org

3. Recipient's Project Manager

Name: Andrew Star

Address: PO Box 2138 1776 Main Street,

City, State, Zip: Santa Monica, CA 90407-2138

Phone: 310-393-0411

E-Mail: astar@rand.org

M. Selection Process Used

There are three types of selection process. List the one used for this GRF.

Selection Process	Additional Information
Competitive Solicitation #	GFO-22-304
First Come First Served Solicitation #	Not applicable
Other	Not applicable

N. Attached Items

1. List all items that should be attached to this GRF by entering "Yes" or "No".

Item Number	Item Name	Attached
1	Exhibit A, Scope of Work/Schedule	Yes
2	Exhibit B, Budget Detail	Yes
3	CEC 105, Questionnaire for Identifying Conflicts	Yes
4	Recipient Resolution	Yes
5	Awardee CEQA Documentation	No

Approved By

Individuals who approve this form must enter their full name and approval date in the MS Word version.

Agreement Manager: Jeffrey Sunquist

Approval Date: 5/26/2023

Branch Manager: Reynaldo Gonzalez

Approval Date: 6/2/2023



STATE OF CALIFORNIA
CALIFORNIA ENERGY COMMISSION

Grant Request Form
CEC-270 (Revised 9/2022)

Director: Delegated to Branch Manager

Approval Date: 6/2/2023

Exhibit A Scope of Work RAND Corporation

I. TASK ACRONYM/TERM LISTS

A. Task List

Task #	CPR ¹	Task Name
1		General Project Tasks
2	X	Technology Landscape
3	X	Performance and Cost Modeling
4		Recommendations
5		Evaluation of Project Benefits
6		Technology/Knowledge Transfer Activities

B. Acronym/Term List

Acronym/Term	Meaning
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CEC	California Energy Commission
CPR	Critical Project Review
EPIC	Electric Program Investment Charge
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 an assessment of the potential role of hydrogen production from renewable electricity and end-use conversion technologies for electric sector applications in California's decarbonizing electric system. To achieve this, the project will evaluate the underlying physics of key hydrogen technologies, assess complementary and competitor technologies, determine performance and cost metrics, and inform future Electric Program Investment Charge (EPIC) research and policy recommendations.

B. Problem/ Solution Statement

Problem

A wide range of decarbonization technologies are required for California to meet the climate goals of SB 100. Hydrogen will certainly be one of the key technologies involved, but the relative role of hydrogen technologies in the energy transition is still unclear.

This problem has not been thoroughly addressed because the climate goals are new, the technologies are nascent, and the physics of the technologies are subtle and complex. As a result,

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

Exhibit A Scope of Work RAND Corporation

their anticipated contribution to SB 100 goals remains unknown. This question must be addressed now because decarbonization of the electricity sector is well underway and the role of hydrogen must be determined so that hydrogen technologies can be integrated into the ongoing transition.

Solution

This research will use empirical data, modeling and simulation, technology performance, cost, and subject matter expert input to help determine which parts of the electricity system hydrogen is best suited for and how much of the system hydrogen should represent. The determination will be based on considerations of technical capabilities, cost, spatial and temporal distribution requirements, resiliency, equity, and justice.

For each consideration, the Recipient will evaluate the strengths and weaknesses of hydrogen technologies relative to alternative zero emission technologies. The evaluation will account for the extent to which these relative strengths and weakness are anticipated to evolve with technological advancement and hydrogen use in non-electricity sectors (e.g., transportation and industry).

C. Goals and Objectives of the Agreement

Agreement Goals

The goals of this Agreement are to:

- Determine which parts of the electricity system hydrogen is best suited for
- Determine how much of the electricity system hydrogen should represent
- Identify which hydrogen applications to prioritize
- Develop recommendations for prioritizing future EPIC hydrogen related research

Ratepayer Benefits:² This Agreement will result in the ratepayer benefits of greater electricity reliability and lower costs. Our analysis of the role of hydrogen technologies in California's electricity system will pave the way for the deployment of those technologies, which will increase the diversity and resilience of rate payers' electricity supply. A well-known weakness of wind and solar is their intermittent nature. Current battery technologies can compensate for this intermittency for shorter durations, but limited in timescale of hours. Hydrogen has the potential to be stored indefinitely and converted to electric power as firm, dispatchable generation. Hence, hydrogen can address both supply and demand variations on the days–months timescale. This capability is critical for an electrical system to respond to major power outages and seasonal demand variations.

One of the key considerations in the analysis of the role of hydrogen technologies in the electricity system is cost—hydrogen can only be included in roles that are cost-competitive with alternative technologies. The results will therefore indicate adoption of hydrogen technologies only in roles and conditions in which they decrease overall system costs, resulting in lower prices to rate payers.

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 RAND Corporation

Technological Advancement and Breakthroughs:³ This Agreement will lead to technological advancement and breakthroughs to overcome barriers to the achievement of the State of California's statutory energy goals by identifying the most promising roles for hydrogen technologies in the electricity system and prioritizing the research and development needs to advance those technologies to deployment-ready status.

Agreement Objectives

The objectives of this Agreement are to:

- Evaluate emerging and nascent hydrogen technologies as may be used in the electric sector, competitor energy storage and conversion technologies, and the impact of complementary technologies on hydrogen adoption in the electric sector.
 - Key metrics include: levelized cost of hydrogen (\$/kg), levelized cost of energy storage (\$/kWh), electrolyzer peak and annual average efficiency (%), hydrogen turbine peak and annual average efficiency (%), fuel cell peak and annual average efficiency (%).
- Estimate current and future values for several cost and performance metrics pertinent to achieving California statutory climate and energy goals while minimizing cost and maximizing resiliency for ratepayers.
- Provide recommendations, guidelines, and evidence-based suggestions for coordinating future investments and future research priorities.

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

Exhibit A

Scope of Work

RAND Corporation

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)**. 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.

Exhibit A Scope of Work RAND Corporation

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);

Exhibit A Scope of Work RAND Corporation

- 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.

Exhibit A Scope of Work RAND Corporation

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(s)
- 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.

Exhibit A Scope of Work RAND Corporation

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

Exhibit A Scope of Work RAND Corporation

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 on Draft Final Report* 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.

Exhibit A Scope of Work RAND Corporation

- 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 on Draft Final Report
- 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.

Exhibit A Scope of Work RAND Corporation

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

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

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

Products:

- Permit Status Letter
- Updated List of Permits (*if applicable*)

Exhibit A Scope of Work RAND Corporation

- 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.

Exhibit A Scope of Work RAND Corporation

- 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.

Exhibit A Scope of Work RAND Corporation

- 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 finalize key performance targets for the project based on feedback from the TAC and report on final results in achieving those targets. 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 project performance metrics section of the *Initial Project Benefits Questionnaire*, developed in the Evaluation of Project Benefits task, to the CAM.
- Present the draft project performance metrics 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 *Initial Project Benefits Questionnaire*, developed in the Evaluation of Project Benefits task.

Exhibit A
Scope of Work
RAND Corporation

- TAC comments the Recipient does not propose to incorporate with and explanation why.
- 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 Benefits Questionnaire*, developed in the Evaluation of Project Benefits task.
- Discuss the *Project Performance Metrics Results* at the Final Meeting.

Products:

- TAC Performance Metrics Summary
- Project Performance Metrics Results

Exhibit A

Scope of Work

RAND Corporation

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 TECHNOLOGY LANDSCAPE

The goal of this task is to characterize the technology landscape for hydrogen in California’s electric sector. This characterization will address hydrogen use in other sectors, comparison of hydrogen to alternative zero carbon technologies, technological advances needed to integrate hydrogen technologies, environmental impacts of hydrogen use, and cost and performance metrics for hydrogen use. This task will assess how hydrogen’s competitiveness in electric sector applications is affected by its use in other sectors, including transportation and industry; examine advances in technology that will make hydrogen production from renewable energy more cost effective; evaluate hydrogen’s performance and cost compared to other zero carbon technologies, considering factors like oxides of nitrogen emissions and global warming potential; and review environmental impacts and mitigation strategies for hydrogen production and usage across different technologies.

The Recipient shall:

- Review literature related to technical readiness of hydrogen technologies; hydrogen technology use and prospects; cost, performance, and environmental impacts of hydrogen technologies; and comparison of performance and cost of hydrogen and alternative zero carbon technologies.
- Conduct subject matter expert interviews related to technical readiness of hydrogen technologies; hydrogen technology use and prospects; cost, performance, and environmental impacts of hydrogen technologies; and comparison of performance and cost of hydrogen and alternative zero carbon technologies.
- Use literature and open-source models to establish forecasted demand scenarios for hydrogen
- Identify hydrogen technology deficiencies and required advances.
- Characterize current and future performance characteristics of hydrogen technologies.
- Corroborate, augment, and contextualize findings with input from the technical advisory committee.
- Prepare a *Technology Metrics Report* detailing the economic, performance, and environmental impact metrics associated with hydrogen technologies and infrastructure, including the sources, methods, ranges, and modeling assumptions for each metric.
- Prepare an *Interview List* including the names and associations of subject matter experts and the dates on which the interviews take place.
- Prepare *PowerPoint Briefing A: Summary of Results of Task 2*, which will integrate the findings on the technical landscape for hydrogen technologies in California’s electricity sector and present findings to staff.
- Prepare and submit a *CPR Report #1* in accordance with subtask 1.3 (CPR Meetings)
- Participate in a CPR meeting.

Products:

- Technology Metrics Report (draft and final)
- Interview List (draft and final)

Exhibit A Scope of Work RAND Corporation

- Powerpoint Briefing A: Summary of Results of Task 2.
- CPR Report #1

TASK 3 PERFORMANCE AND COST MODELING

The goal of this task is to synthesize the findings from Task 2 to inform low/medium/high scenarios of hydrogen technology adoption each for modest and impressive technology advances. From these, the Recipient will model costs over the near-, mid-, and long-term time horizons. Environmental calculations will also be provided including GHG abated, water consumed, and criteria pollutants avoided in absolute amounts and amounts per kWh. This task will identify which electric sector applications for hydrogen have the potential to become cost-competitive in the near-term (within 5 years), mid-term (5-10 years), and long-term (10 or more years), and the necessary market conditions and infrastructure requirements for their adoption in California.

The Recipient shall:

- Synthesize findings from Task 2 to inform low/medium/high scenarios of hydrogen technology adoption each for modest and impressive technology advances.
- Model costs over the near-term (within 5 years), mid-term (5-10 years), and long-term (10 or more years) time horizons.
- Determine the infrastructure needs including electric sector cost/resiliency tradeoffs.
- Calculate environmental impacts including GHG abated, water consumed, and criteria pollutants avoided.
- Quantitatively assess the benefit/burden to disadvantaged communities.
- Prepare *PowerPoint Briefing B: Summary of Results of Task 3*, which will utilize performance and cost models of hydrogen technologies to quantify least-cost scenarios, cost-resiliency tradeoffs, environmental impacts, and extent of benefits accrued to disadvantaged communities. Present findings to staff.
- Prepare and submit a *CPR Report #2* in accordance with subtask 1.3 (CPR Meetings).
- Participate in a CPR meeting.

Products:

- PowerPoint Briefing B: Summary of Results of Task 3
- CPR Report #2

TASK 4 RECOMMENDATIONS

The goal of this task is to translate the results of Tasks 2 and 3 describing the performance, costs, and prospects for nascent, complementary, and competitor technologies into preferred options for funding and deploying hydrogen technologies in California's electric sector. These results will then be synthesized with existing programs and policies to determine their combined effect on the electric sector. This task will examine how the EPIC Program can coordinate investments and align research goals, over varying timeframes, with complementary programs including the Clean Hydrogen Program and U.S. Department of Energy Hydrogen Hubs. This task will develop applied research and development, technology demonstration and deployment, scientific and techno-economic analysis, and market facilitation recommendations for the EPIC program.

The Recipient shall:

Exhibit A Scope of Work RAND Corporation

- Perform a policy analysis of existing programs, legislation, and rulemaking that affects or interacts with the technologies evaluated and modeled in Tasks 2 and 3.
- Incorporate the impacts of existing programs, legislation, and rulemaking on cost and generation extent of hydrogen technologies in the electric sector.
- Provide recommendations to EPIC regarding future investment coordination.
- Provide quantitative, physics- and evidence-based suggestions for future research planning and prioritization.
- Prepare *PowerPoint Briefing C: Summary of Results of Task 4*, which will summarize the recommendations and associated rationale for how they were derived, and present findings to staff.

Products:

- PowerPoint Briefing C: Summary of Results of Task 4

TASK 5: EVALUATION OF PROJECT BENEFITS

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

The Recipient shall:

- Complete the *Initial Project Benefits Questionnaire*. The Initial Project Benefits Questionnaire shall be initially completed by the Recipient with 'Kick-off' selected for the 'Relevant data collection period' and submitted to the CAM for review and approval.
- Complete the *Annual Survey* by January 31st of each year. The Annual Survey includes but is not limited to the following information:
 - Technology commercialization progress
 - New media and publications
 - Company growth
 - Follow-on funding and awards received
- Complete the *Final Project Benefits Questionnaire*. The Final Project Benefits Questionnaire shall be completed by the Recipient with 'Final' selected for the 'Relevant data collection period' and submitted to the CAM for review and approval.
- Respond to CAM questions regarding the questionnaire drafts.
- Complete and update the project profile on the CEC's public online project and recipient directory on the [Energize Innovation website \(www.energizeinnovation.fund\)](http://www.energizeinnovation.fund), and provide *Documentation of Project Profile on EnergizeInnovation.fund*, including the profile link.
- If the Prime Recipient is an Innovation Partner on the project, complete and update the organizational profile on the CEC's public online project and recipient directory on the [Energize Innovation website \(www.energizeinnovation.fund\)](http://www.energizeinnovation.fund), and provide *Documentation of Organization Profile on EnergizeInnovation.fund*, including the profile link.

Products:

- Initial Project Benefits Questionnaire
- Annual Survey(s)
- Final Project Benefits Questionnaire
- Documentation of Project Profile on EnergizeInnovation.fund
- Documentation of Organization Profile on EnergizeInnovation.fund

Exhibit A Scope of Work RAND Corporation

TASK 6: KNOWLEDGE TRANSFER ACTIVITIES

The goal of this task is to ensure the scientific and techno-economic analysis and tools developed under this agreement are utilized in the energy policy, and/or planning decisions at the state and/or local levels, academic community and/or commercial sector.

The Recipient Shall:

- Develop and submit a *Knowledge Transfer Plan* that identifies the proposed activities the recipient will conduct to meet the goal of the task. The *Knowledge Transfer Plan* should include at a minimum:
 - Specific policy and planning efforts this project is expected to inform.
 - Specific stakeholder groups and energy policy and planning practitioners who will utilize the results of this project.
 - Proposed activities the recipient will conduct to ensure the tools and results from this project will be utilized and adopted by the groups identified above.
- Present the draft *Knowledge Transfer Plan* to the TAC for feedback and comments.
- Develop and submit a *Summary of TAC Comments* that summarizes comments received from the TAC members on the draft *Knowledge Transfer Plan*. This document will identify:
 - TAC comments the recipient proposes to incorporate into the final *Knowledge Transfer Plan*.
 - TAC comments the recipient does not propose to incorporate with an explanation why.
- Submit the final *Knowledge Transfer Plan* to the CAM for approval.
- Implement the activities as described in the final *Knowledge Transfer Plan*.
- Develop a *Knowledge Transfer Summary Report* that includes high-level summaries of the activities, results, and lessons learned of tasks performed relating to implementing the final *Knowledge Transfer Plan*. This report should not include any proprietary information.
- When directed by the CAM, develop presentation materials for CEC sponsored conference/workshop(s) on the project.
- When directed by the CAM, participate in annual EPIC symposium(s) sponsored by the 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:

- Knowledge Transfer Plan (draft and final)
- Summary of TAC Comments
- Knowledge Transfer Summary Report (draft and final)
- High Quality Digital Photographs

V. PROJECT SCHEDULE

Please see the attached Excel spreadsheet.