STATE OF CALIFORNIA

CONTRACT REQUEST FORM (CRF)

CEC-94 (Revised 12/2019) CALIFORNIA ENERGY COMMISSION

A) New Agreement # 600-22-003 (to be completed by CGL office)

B) Division	Agreement Manager:	MS-	Phone
600 Fuels and Transportation	Phil Cazel	6	916-897-3619

C) Contractor's Legal Name	Federal ID #
The Regents of the University of California, on Behalf of the Irvine Campus	95-2226406

D) Title of Project
UC Irvine Green Hydrogen Commercialization and Deployment Assessment

E) Term and Amount

Start Date	End Date	Amount
10 / 12 / 2022	2 / 28 / 2024	$ 250,000

F) Business Meeting Information

☐ Operational agreement (see CAM Manual for list) to be approved by Executive Director

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

Proposed Business Meeting Date 10 / 12 / 2022 ☒ Consent ☐ Discussion

Business Meeting Presenter: Time Needed: minutes

Please select one list serve. Alt Fuels (AB118- ARFVTP)

Agenda Item Subject and Description:

The Regents of the University of California, on Behalf of the Irvine Campus. Proposed resolution approving Agreement 600-22-003 with The Regents of the University of California, on behalf of the Irvine Campus for a $250,000 contract to analyze and update the projected cost and performance status of current and emerging green hydrogen production technology to support decarbonization strategies that promote deployment of heavy-duty fuel cell electric vehicles, and support CEC planning aimed at maximizing the successful scale-up of the green hydrogen sector in California, and adopting staff's determination that this action is exempt from CEQA. (Clean Transportation Program Funding) Contact: Phil Cazel

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: 15306

   ☐ Common Sense Exemption. 14 CCR 15061 (b) (3)

Explain reason why Agreement is exempt under the above section: Agreement will not cause direct physical change in the environment or a reasonably foreseeable indirect physical change in the environment because it is for a paper study and computational analyses, encompassing basic data collection, research, experimental management, and resource evaluation activities that do not result in major disturbances to an environmental resource (Categorical Exemption under CEQA Guidelines §15306. Information Collection).

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
	$ 0.00
	$ 0.00
	$ 0.00

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
ARFVTP	FY 20/21	600.118J	$250,000
Funding Source			$
Funding Source			$
Funding Source			$
Funding Source			$

R&D Program Area: Select Program Area TOTAL: $250,000

Explanation for “Other” selection

Reimbursement Contract #: Federal Agreement #:

K) Contractor's Contact Information

1. Contractor's Administrator/Officer

Name: Jeff Wojciechowski
Address:
221 Engineering Laboratory Facility
City, State, Zip: Irvine, CA, 92697
Phone: 949-824-7302
E-Mail: jsw@apep.uci.edu

2. Contractor's Project Manager

Name: Jeff Reed
Address:
221 Engineering Laboratory Facility
City, State, Zip: Irvine, CA, 92697
Phone: 858-735-7590
E-Mail: jgreed@uci.edu

L) Selection Process Used

☐ Solicitation Select Type Solicitation #: - - # of Bids: Low Bid ☐ No ☐ Yes
☐ Non Competitive Bid *(Attach DGS-GSPD-09-007 https://www.dgs.ca.gov/PD/Forms)*
☒ Exempt Interagency

M) Contractor Entity Type

☐ Private Company *(including non-profits)*
☒ CA State Agency *(including UC and CSU)*
☐ Government Entity *(i.e. city, county, federal government, air/water/school district, joint power authorities, university from another state)*

N) Is Contractor a certified Small Business (SB), Micro Business (MB) or DVBE?

If yes, check appropriate box(es): ☐ SB ☐ MB ☐ DVBE

O) Civil Service Considerations

☒ Not Applicable (Agreement is with a CA State Entity or a membership/co-sponsorship)
☐ Public Resources Code 25620, et seq., authorizes the Commission to contract for the subject work. (PIER)
☐ The Services Contracted:
- ☐ are not available within civil service
- ☐ cannot be performed satisfactorily by civil service employees
- ☐ are of such a highly specialized or technical nature that the expert knowledge, expertise, and ability are not available through the civil service system.

☐ The Services are of such an:
- ☐ urgent
- ☐ temporary, or
- ☐ occasional nature

that the delay to implement under civil service would frustrate their very purpose.

Justification:

STATE OF CALIFORNIA

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P) Payment Method

1. ☒ Reimbursement in arrears based on:
   ☒ Itemized Monthly ☐ Itemized Quarterly ☐ Flat Rate ☐ One-time
2. ☐ Advanced Payment
3. ☐ Other, explain:

Q) Retention

Is Agreement subject to retention? ☒ No ☐ Yes

If Yes, Will retention be released prior to Agreement termination? ☐ No ☐ Yes

R) Justification of Rates

Standard Energy Commission-University of California negotiated personnel and overhead rates for projects were applied.

S) Disabled Veteran Business Enterprise Program (DVBE)

1. ☒ Exempt (Interagency/Other Government Entity)
2. ☐ Meets DVBE Requirements DVBE Amount:$ 0 DVBE %:
   a. ☐ Contractor is Certified DVBE
   b. ☐ Contractor is Subcontracting with a DVBE: Name of DVBE Company
3. ☐ Contractor selected through CMAS or MSA with no DVBE participation
4. ☐ Requesting DVBE Exemption (attach CEC 95)

T) Miscellaneous Agreement Information

1. Will there be Work Authorizations? ☒ No ☐ Yes
2. Is the Contractor providing confidential information? ☒ No ☐ Yes
3. Is the contractor going to purchase equipment? ☒ No ☐ Yes
4. Check frequency of progress reports
   ☐ Monthly ☒ Quarterly ☐ Other...
5. Will a final report be required? ☐ No ☒ Yes
6. Is the Agreement, with amendments, longer than three years? If yes, why? ☒ No ☐ Yes

U) The following items should be attached to this CRF (as applicable)

1.	Exhibit A, Scope of Work	☐ N/A	☒ Attached
2.	Exhibit B, Budget Detail	☐ N/A	☒ Attached
3.	DGS-GSPD-09-007, NCB Request	☒ N/A	☐ Attached
4.	CEC 95, DVBE Exemption Request	☒ N/A	☐ Attached
5.	CEQA Documentation	☒ N/A	☐ Attached
6.	Resumes	☒ N/A	☐ Attached
7.	CEC 105, Questionnaire for Identifying Conflicts		☒ Attached

Phil Cazel — 10/03/2022

Agreement Manager **Date**

Elizabeth John — 10/3/2022

Office Manager **Date**

MWail — 10/3/2022

Deputy Director **Date**

Exhibit A – Scope of Work

TASK LIST

Task #	Task Name
1	Agreement Management
2	Electrolytic Green Hydrogen Production Cost Progress Update
3	Thermochemical and Photochemical Hydrogen Commercialization and Cost Progress Update
4	Green Hydrogen Production Water and Land Use Impacts Assessment
5	Hydrogen Supply Chain Cost Progression Update
6	Hydrogen Supply Chain Reliability Status and Outlook
7	High-Horsepower and High-Fuel-Volume Applications Opportunities and Barriers Assessment
8	Report Documentation

BACKGROUND

Assembly Bill (AB) 118 (Núñez, Chapter 750, Statutes of 2007), created the Clean Transportation Program. The statute authorizes the California Energy Commission (CEC) to develop and deploy alternative and renewable fuels and advanced transportation technologies to help attain the state's climate change policies. AB 8 (Perea, Chapter 401, Statutes of 2013) re-authorized the Clean Transportation through January 1, 2024. The Clean Transportation program has an annual budget of approximately $100 million and provides financial support for projects that:

- Reduce California's use and dependence on petroleum transportation fuels and increase the use of alternative and renewable fuels and advanced vehicle technologies.
- Produce sustainable alternative and renewable low-carbon fuels in California.
- Expand alternative fueling infrastructure and fueling stations.
- Improve the efficiency, performance and market viability of alternative light-, medium-, and heavy-duty vehicle technologies.
- Retrofit medium- and heavy-duty on-road and non-road vehicle fleets to alternative technologies or fuel use.
- Expand the alternative fueling infrastructure available to existing fleets, public transit, and transportation corridors.
- Establish workforce training programs and conduct public outreach on the benefits of alternative transportation fuels and vehicle technologies.

In June 2020, the CEC published the *Roadmap for the Deployment and Buildout of Renewable Hydrogen Production Plants in California* (RH2 Roadmap), developed under agreement 600-17-008.[1] The study assessed the potential evolution of the renewable hydrogen production and supply chain to reach cost parity with petroleum fuels by the mid to late 2020's. The analysis

[1] Reed, Jeffrey, Emily Dailey, Brendan Shaffer, Blake Lane, Robert Flores, Amber Fong, G. Scott Samuelsen. 2020. *Roadmap for the Deployment and Buildout of Renewable Hydrogen Production Plants in California.* CEC. Publication Number: CEC-600-2020-002.

included benchmarking of global progress on hydrogen production technologies and a projection of future costs based on several forecasting approaches. The research also projected supply chain costs from plant gate through dispensing. In the context of the cost forecast range, low, medium and high renewable hydrogen demand scenarios were developed. The principal conclusion of the work was that fuel-economy adjusted pump-price parity with gasoline and diesel ($6 to $8/kg dispensed) could be achieved before 2030 and potentially as early as 2025.

Because sufficient time has passed since the 2018 cost and performance benchmarking, an update of cost and performance status and projections is warranted. In addition, several topics that were beyond the scope of the RH2 Roadmap including emerging production technologies, water and land use impacts, and supply chain reliability are timely to address. Given their emerging importance in global decarbonization strategies, high-horsepower and high-fuel-volume applications, such as medium and heavy-duty vehicles, rail locomotives, maritime harbor craft, and cargo/container ships, will require a deeper assessment.

GOALS AND OBJECTIVES OF THE AGREEMENT

The goal of this agreement is to supplement and update key elements of the RH2 Roadmap. The objective of this agreement is to support CEC planning aimed at maximizing the successful scale-up of the green hydrogen sector in California.[2] In this context, successful means achieving cost and performance parity (including user operational and duty-cycle requirements) with next-best alternative zero-emissions technologies in the vocations served.

The following guiding principles will be applied in the execution of the tasks of the agreement:

- Apply a uniform definition of green hydrogen consistent with and transparently mapped to those used by the CEC, California Air Resources Board (CARB), and other stakeholders.
- Conduct the analysis in the context of the evolution of global markets for green and clean hydrogen and the scale benefits and learning that can advance progress in the California market.
- Base assumptions on most-likely rather than optimistic fuel cell electric vehicle (FCEV) deployment projections. For example, pursuant to AB 8, vehicle Original Equipment Manufacturers (OEM) report on their projected hydrogen vehicle sales, which tend to be overly optimistic as are projections from other industry groups. While AB 8 and industry group projections are important data points, they should not be taken as definitive.
- Include evolving and potential use of green and clean hydrogen across all sectors, globally to capture production and supply chain synergies (and challenges) relevant to evolution of the California green hydrogen sector (not limiting the analysis to the beachhead light-duty passenger vehicle sector that currently anchors the market).
- Make full use of other CEC funded research efforts to avoid overlap and to integrate ongoing and recent CEC-supported studies including Guidehouse Inc's. Work Authorization NAV-15-057 for market and infrastructure analysis for implementation of

[2] For purposes of this agreement, green hydrogen (alternatively renewable hydrogen) is defined as hydrogen produced from 100% renewable feedstock, specifically: 100% renewable electricity, waste biomass and solar energy.

hydrogen to support electrical grid reliability, and the University of California, Davis Agreement 600-20-009 for studying the role of light-, medium-, and heavy-duty vehicles and infrastructure in a California hydrogen transition.

FORMAT/REPORTING REQUIREMENTS

Deliverables/Reports

When creating reports, the Contractor shall use and follow, unless otherwise instructed in writing by the Commission Agreement Manager (CAM), the latest version of the Consultant Reports Style Manual published on the Energy Commission's web site:

http://www.energy.ca.gov/contracts/consultant_reports/index.html

Each final deliverable shall be delivered as one original, reproducible, 8 ½" by 11", camera-ready master in black ink. Illustrations and graphs shall be sized to fit an 8 ½" by 11" page and readable if printed in black and white.

Electronic File Format

The Contractor shall deliver an electronic copy (CD ROM or memory stick or as otherwise specified by the CAM) of the full text in a compatible version of Microsoft Word (.doc).

The following describes the accepted formats of electronic data and documents provided to the CEC as contract deliverables and establishes the computer platforms, operating systems and software versions that will be required to review and approve all software deliverables.

- Data sets shall be in Microsoft (MS) Access or MS Excel file format.
- PC-based text documents shall be in MS Word file format.
- Documents intended for public distribution shall be in PDF file format, with the native file format provided as well.
- Project management documents shall be in MS Project file format.

TASK 1- AGREEMENT MANAGEMENT

Task 1.1 Kick-off Meeting

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

The Contractor shall:

- Attend a "kick-off" meeting with the CAM, the Contracts Officer, and a representative of the Accounting Office. The meeting will be held via Web-Ex or teleconference. The Contractor shall include their Project Manager, Contracts Administrator, Accounting Officer, and others designated by the CAM in this meeting. The administrative and technical aspects of this Agreement will be discussed at the meeting.
- If necessary, prepare an updated Schedule of Deliverables based on the decisions made in the kick-off meeting.

Contractor Deliverable:

- An Updated Schedule of Deliverables (if applicable).

CAM Deliverables:

- Arrange the meeting including scheduling the date and time.
- Provide an agenda to all potential meeting participants prior to the kick-off meeting.

Task 1.2 Invoices

The Contractor shall:

- Prepare invoices for all reimbursable expenses incurred performing work under this Agreement in compliance with the Exhibit B of the Terms and Conditions of the Agreement. Invoices shall be submitted with the same frequency as progress reports (task 1.4). Invoices must be submitted to the CEC's Accounting Office.

Contractor Deliverable:

- Invoices.

Task 1.3 Final Meeting

The goal of this task is to closeout this Agreement.

The Contractor shall:

- Meet with CEC staff to present the findings, conclusions, and recommendations. The final meeting must be completed during the closeout of this Agreement.
- This meeting will be attended by, at a minimum, the Contractor and the CAM. The technical and administrative aspects of Agreement closeout will be discussed at the meeting, which may be two separate meetings at the discretion of the CAM.
- The technical portion of the meeting shall present an assessment of the degree to which project and task goals and objectives were achieved, findings, conclusions, recommended next steps (if any) for the Agreement, and recommendations for improvements. The CAM will determine the appropriate meeting participants.
- The administrative portion of the meeting shall be a discussion with the CAM about the following Agreement closeout items:
    - What to do with any equipment purchased with CEC funds (Options)
    - CEC request for specific "generated" data (not already provided in Agreement deliverables)
    - Need to document Contractor's disclosure of "subject inventions" developed under the Agreement
    - "Surviving" Agreement provisions
    - Final invoicing and release of retention
- Prepare a schedule for completing the closeout activities for this Agreement.

Contractor Deliverables:

- Written documentation of meeting agreements.
- Schedule for completing closeout activities.

Task 1.4 Quarterly Progress Reports

The goal of this task is to periodically verify that satisfactory and continued progress is made towards achieving the objectives of this Agreement on time and within budget.

The objectives of this task are to summarize activities performed during the reporting period, to identify activities planned for the next reporting period, to identify issues that may affect performance and expenditures, and to form the basis for determining whether invoices are consistent with work performed.

The Contractor shall:

- Prepare a Quarterly Progress Report which summarizes all Agreement activities conducted by the Contractor for the reporting period, including an assessment of the ability to complete the Agreement within the current budget and any anticipated cost overruns. Each progress report is due to the CAM the 10th day of each January, April, July, and October. The recommended specifications for each progress report are contained in Section 6 of the Public/Governmental Entity Special Terms and Conditions of this Agreement.
- In the first Quarterly Progress Report and first invoice, document and verify match expenditures and provide a synopsis of project progress, if match funds have been expended or if work funded with match share has occurred after the notice of proposed award but before execution of the grant agreement. If no match funds have been expended or if no work funded with match share has occurred before execution, then state this in the report. All pre-execution match expenditures must conform to the requirements in the Governmental/Public Entity Special Terms and Conditions of this Agreement.

Contractor Deliverable:

- Quarterly Progress Reports.

Task 1.5 Final Report

The goal of the Final Report is to assess the project's success in achieving the Agreement's goals and objectives, advancing science and technology, and providing energy-related and other benefits to California.

The objectives of the Final Report are to clearly and completely describe the project's purpose, approach, activities performed, results, and advancements in science and technology; to present a public assessment of the success of the project as measured by the degree to which goals and objectives were achieved; to make insightful observations based on results obtained; to draw conclusions; and to make recommendations for further projects and improvements to the FTD project management processes.

The Final Report shall be a public document. If the Contractor has obtained confidential status from the CEC and will be preparing a confidential version of the Final Report as well, the Contractor shall perform the following activities for both the public and confidential versions of the Final Report.

The Contractor shall:

- Prepare an Outline of the Final Report, if requested by the CAM.
- Prepare a Final Report following the latest version of the Final Report guidelines which will be provided by the CAM. The CAM shall provide written comments on the Draft Final Report

within fifteen (15) working days of receipt. The Final Report must be completed at least 60 days before the end of the Agreement Term.

- Submit one bound copy of the Final Report with the final invoice.

Contractor Deliverables:

- Outline of the Final Report, if requested.
- Draft Final Report.
- Final Report.

Task 1.6 Identify and Obtain Matching Funds

The goal of this task is to ensure that the match funds planned for this Agreement are obtained for and applied to this Agreement during the term of this Agreement.

The costs to obtain and document match fund commitments are not reimbursable through this Agreement. Although the CEC budget for this task will be zero dollars, the Contractor may utilize match funds for this task. Match funds shall be spent concurrently or in advance of CEC funds for each task during the term of this Agreement. Match funds must be identified in writing and the associated commitments obtained before the Contractor can incur any costs for which the Contractor will request reimbursement.

The Contractor shall:

- Prepare a letter documenting the match funding committed to this Agreement and submit it to the CAM at least two working days prior to the kick-off meeting. 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 such 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 each cash match fund, its source, including a contact name, address and telephone number and the task(s) to which the match funds will be applied.
    - Amount of each in-kind contribution, a description, documented market or book value, and its 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 Contractor shall identify its owner and provide a contact name, address and telephone number, and the address where the property is located.
- Provide a copy of the letter of commitment from an authorized representative of each source of cash match funding or in-kind contributions that these funds or contributions have been secured. For match funds provided by a grant a copy of the executed grant shall be submitted in place of a letter of commitment.
- Discuss match funds and the implications to the Agreement if they are reduced or not obtained as committed, at the kick-off meeting. If applicable, match funds will be included as a line item in the progress reports and will be a topic at CPR meetings.
- Provide the appropriate information to the CAM if during the course of the Agreement additional match funds are received.
- Notify the CAM within 10 days if during the course of the Agreement existing match funds are reduced. Reduction in match funds must be approved through a formal amendment to the Agreement and may trigger an additional CPR meeting.

Contractor Deliverables:

- A letter regarding match funds or stating that no match funds are provided.
- Copy(ies) of each match fund commitment letter(s) (if applicable).
- Letter(s) for new match funds (if applicable).
- Letter that match funds were reduced (if applicable).

Task 1.7 Identify and Obtain Required Permits

The goal of this task 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. Although the CEC budget for this task will be zero dollars, the Contractor may budget match funds for any expected expenditures associated with obtaining permits. Permits must be identified in writing and obtained before the Contractor can make any expenditure for which a permit is required.

The Contractor shall:

- Prepare a letter documenting the permits required to conduct this Agreement and submit it to the CAM at least two working days prior to the kick-off meeting. If there are no permits required at the start of this Agreement, then state such in the letter. If it is known at the beginning of the Agreement that permits will be required during the course of the Agreement, provide in the letter:
    - A list of the permits that identifies the:
        - Type of permit
        - Name, address and telephone number of the permitting jurisdictions or lead agencies
    - The schedule the Contractor will follow in applying for and obtaining these permits.
- Discuss the list of permits and the schedule for obtaining them at the kick-off meeting and develop a timetable for submitting the updated list, schedule, and the copies of the permits. The implications to the Agreement 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 the Progress Reports and will be a topic at CPR meetings.
- If during the course of the Agreement additional permits become necessary, provide the appropriate information on each permit and an updated schedule to the CAM.
- As permits are obtained, send a copy of each approved permit to the CAM.
- If during the course of the Agreement permits are not obtained on time or are denied, notify the CAM within five working days. Either of these events may trigger an additional CPR.

Contractor Deliverables:

- Letter documenting the permits or stating that no permits are required.
- A copy of each approved permit (if applicable).
- Updated list of permits as they change during the term of the Agreement (if applicable).

- Updated schedule for acquiring permits as changes occur during the term of the Agreement (if applicable).
- A copy of each final approved permit (if applicable).

Task 1.8 Obtain and Execute Subcontracts
The goal of this task is to ensure quality deliverables and to procure subcontractors required to carry out the tasks under this Agreement consistent with the Agreement Terms and Conditions and the Contractor's own procurement policies and procedures. It will also provide CEC an opportunity to review the subcontracts to ensure that the tasks are consistent with this Agreement, and that the budgeted expenditures are reasonable and consistent with applicable cost principles.

The Contractor shall:

- Manage and coordinate subcontractor activities.
- Submit a draft of each subcontract required to conduct the work under this Agreement to the CAM for review.
- Submit a final copy of the executed subcontract.
- If Contractor decides to add new subcontractors, then the Contractor shall notify the CAM.

Contractor Deliverables:

- Letter describing the subcontracts needed, or stating that no subcontracts are required.
- Draft subcontracts.
- Final subcontracts.

Executive Order N-6-22 – Russia Sanctions

On March 4, 2022, Governor Gavin Newsom issued Executive Order N-6-22 (the EO) regarding Economic Sanctions against Russia and Russian entities and individuals. "Economic Sanctions" refers to sanctions imposed by the U.S. government in response to Russia's actions in Ukraine, as well as any sanctions imposed under state law. The EO directs state agencies to terminate contracts with, and to refrain from entering any new contracts with, individuals or entities that are determined to be a target of Economic Sanctions. Accordingly, should the State determine Contractor is a target of Economic Sanctions or is conducting prohibited transactions with sanctioned individuals or entities, that shall be grounds for termination of this agreement. The State shall provide Contractor advance written notice of such termination, allowing Contractor at least 30 calendar days to provide a written response. Termination shall be at the sole discretion of the State.

TECHNICAL TASKS

TASK 2: ELECTROLYTIC GREEN HYDROGEN PRODUCTION COST PROGRESS UPDATE
The goal of this task is to track the progression of electrolyzer capital cost from 2018 through 2022, compare the cost progression to the forecast in RH2 Roadmap, and update the cost forecast range.

The Contractor shall:

- Gather data on electrolyzer project costs over the past five years from public data sources, interviews with developers and electrolyzer manufacturers, and public-record bid data for projects in California (such as GFO-19-602) and other jurisdictions to the extent such data are available.
- Update the capital cost component splits (electrolyzer system, balance of plant, “soft costs” etc.) developed in RH2 Roadmap to provide a basis for adjusting data collected from projects of different scope.
- Adjust all gathered data to 2018 U.S. dollars and full, installed system cost.
- Plot the data to overlay the 2018 analysis and assess the cost progression versus forecast
- Assess the difference between forecast and actual in terms of expected versus actual learning rate and market growth
- Update the future cost forecast ranges focusing on the most-likely case with low and high uncertainty bands as context
- Develop a graphical summary of the cost and performance analysis and the interview input, and provide a narrative discussion of the implications of the results

Deliverables:

- Project cost data report including “raw” and adjusted data
- Summary of cost and performance analysis and interview input, with narrative discussion of the implications of the results
- Electrolytic Green Hydrogen Status and Outlook final report chapter containing all data and analysis described above.

TASK 3: THERMOCHEMICAL AND PHOTOCHEMICAL HYDROGEN COMMERCIALIZATION AND COST PROGRESS UPDATE

The goal of this task is to assess the commercialization and deployment status of non-electrolysis green hydrogen production pathways such as thermochemical, biochemical and photochemical technologies.

The Contractor shall:

- Review the current literature (academic, lab and industry) on the relevant hydrogen production technologies
- Develop current-state summaries of commercialization status including active and planned pilot and commercial projects, and commentary/assessment from the literature review
- Evaluate the economic viability for repurposing past, non-operating state-funded projects
- Project the timing for potential full-scale commercial development of each technology and potential impact on green hydrogen production cost

Deliverables:

- Literature review and current-state of commercialization status summaries
- Emerging Green Hydrogen Production Technologies final report chapter containing all data and analysis described above.

TASK 4: GREEN HYDROGEN PRODUCTION WATER AND LAND USE IMPACTS ASSESSMENT

The goal of this task is to assess water and land-use impacts of electrolytic and woody biomass green hydrogen production pathways.

The Contractor shall:

- Review published lifecycle analyses (LCA) addressing water impacts and water stress associated with green hydrogen production pathways leveraging recent work performed by UCI on behalf of the EPRI/GTI low-carbon resources initiative (LCRI)
- Profile the key findings and dependencies of production pathways (e.g., water stress and land use prior to RH2 deployment)
- Map findings and dependencies to the California context
- Develop conclusions and recommendations to minimize negative water and land-use impacts of green hydrogen deployment

Deliverables:

- Literature review summary of LCA.
- Minimizing Negative Water and Land-use Impacts of Green Hydrogen Deployment final report chapter containing all data and analysis described above.

TASK 5: HYDROGEN SUPPLY CHAIN COST PROGRESSION UPDATE

The goal of this task is to track the progression of hydrogen supply chain costs for vehicle fueling from 2018 through 2022, compare the cost progression to the prior forecast, and update the cost forecast range from the RH2 Roadmap and the current pump prices for new-vintage stations.

The Contractor shall:

- Review non-confidential data from recent CEC hydrogen refueling station grant applications
- Gather and review published reports and studies on supply chain costs
- Interview station developers to gather perspectives on supply chain cost evolution
- Compare current cost benchmarks to pump prices for new-vintage stations
- Update supply-chain cost projections developed under the RH2 Roadmap

Deliverables:

- Updated supply chain cost curve projections
- Hydrogen Refueling Station Supply Chain Cost Status and Outlook final report chapter containing all data and analysis described above.

TASK 6: HYDROGEN SUPPLY CHAIN RELIABILITY STATUS AND OUTLOOK

The goal of this task is to benchmark the reliability of the FCEV hydrogen fuel supply chain from production through dispensing and develop recommendations to enhance reliability.

The Contractor shall:

- Review published reports, academic literature and news articles addressing hydrogen supply chain reliability

- Review available supply chain reliability data from the CEC, National Renewable Energy Laboratory, the California Fuel Cell Partnership, and hydrogen supply chain operators
- Solicit and summarize best-practices recommendations from station operators and other supply chain participants
- Compile any quantitative reliability metrics gathered or developed for enhancing hydrogen supply chain reliability

Deliverables:

- Summary of best-practices recommendations from all supply chain participants
- Hydrogen Refueling Station Supply Chain Reliability final report chapter containing all data and analysis described above.

TASK 7: HIGH-HORSEPOWER AND HIGH-FUEL-VOLUME APPLICATIONS OPPORTUNITIES AND BARRIERS ASSESSMENT

The goal of this task is to identify and describe opportunities and barriers for hydrogen-fuel-cell drivetrain adoption for Medium-Duty/Heavy-Duty (MD/HD) applications including ports, rail, and maritime uses such as harbor craft, locomotives, and cargo/container ships.

The Contractor shall:

- Review prior and ongoing projects conducted by the UCI Advanced Power and Energy Program, published reports, and academic literature addressing the adoption of hydrogen for the relevant vocations
- Identify MD/HD uses with the highest potential (best economics and operational fit) for hydrogen adoption
- Solicit input from stakeholders on barriers to adoption
- Develop recommendations for addressing barriers

Deliverables:

- Opportunities and Barriers for Hydrogen Adoption in Medium and Heavy-Duty Transportation Applications final report chapter containing all data and analysis described above.

TASK 8: REPORT DOCUMENTATION

The goal of this task is to develop a final report describing the project, analyses conducted, and the results of the study.

The Contractor shall:

- Prepare a draft report and a final report for the project

Contractor Deliverables:

- A draft report and a final report for the project

RESOLUTION NO: 22-1012-01g

STATE OF CALIFORNIA

STATE ENERGY RESOURCES
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION: The Regents of the University of California, on behalf of the Irvine 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 600-22-003 with The Regents of the University of California, on behalf of the Irvine Campus for a $250,000 contract to analyze and update the projected cost and performance status of current and emerging green hydrogen production technology to support decarbonization strategies that promote deployment of heavy-duty fuel cell EVs, and support CEC planning aimed at maximizing the successful scale-up of the green hydrogen sector in California; 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 October 12, 2022.

AYE:
NAY:
ABSENT:
ABSTAIN:

Dated:

_____
Liza Lopez
Secretariat