NREL
NATIONAL RENEWABLE ENERGY LABORATORY

California Hydrogen Research Consortium

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National Renewable Energy Laboratory
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DOE Hydrogen and Fuel Cells Program
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Project ID h2041

Overview

Timeline and Budget

- Project start date: 8/1/2018 (estimated)
- Project end date: 8/1/2020 (estimated)
- Total project budget: $840k
  - Total recipient share: $300k
  - Total federal share: $540k
  - Total DOE funds spent*: $0

* As of 4/17/18

Barriers

- Reliability and Costs of Hydrogen Compression (Delivery B)
- Other Fueling Site/Terminal Operations (Delivery I)
- Hydrogen from Renewable Resources (TV G)

Partners

- California Governor's Office for Economic Development, Tyson Eckerle
- California Air Resources Board, Andrew Martinez
- California Energy Commission, Jean Baronas
- South Coast Air Quality Management District, Naveen Berry
- Jennifer Kurtz, NREL, PI

Relevance

Hydrogen and fuel cell stakeholders worldwide are using California's experience as a model case, making success in California paramount to market acceleration and adoption. The technical research capability of the National Renewable Energy Laboratory will be used to assist California in decisions and evaluations, as well as to verify solutions to problems impacting the industry. Because these challenges cannot be addressed by one agency or one laboratory, a hydrogen research consortium has been organized to combine and collaborate. The collaboration aims to:

- Ensure that data are available to evaluate projects and inform decision makers
- Independently verify and validate component solutions
- Provide experimental results for future hydrogen infrastructure
- Increase the availability of technical experts for quick-need issues for California hydrogen infrastructure development, deployment, operation, and technology advances.

Approach

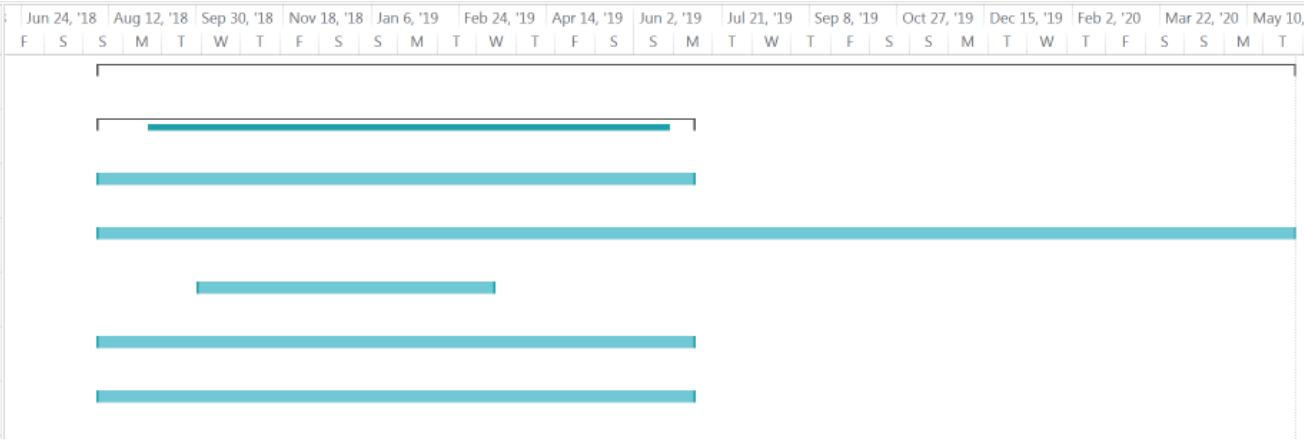
The proposed tasks include data collection from operational stations, component failure fix verification (i.e. nozzle freeze lock), new fueling methods for medium and heavy duty applications, and ensuring hydrogen quality is maintained.

Data Collection & Analysis	Perform analysis and aggregation of station performance, operation, and maintenance data.
Medium-/HeavyDuty Fueling	Perform analysis and reporting of retail and experimental fueling data to inform fueling-method decision makers and fueling system design.
H_2 Contaminant Detector	Complete verification of in-line hydrogen quality detectors prior to validation at retail hydrogen stations.
Nozzle Freeze-Lock Evaluation	Create an environmentally controlled test setup for identifying conditions leading to nozzle freeze-lock and for verifying solutions. This task will be implemented upon industry budget and DOE approval to begin work.
CA Hydrogen Integration	Identify the top priorities for data share and experimental scenarios to integrate hydrogen into California's energy management strategies.
Technical Assistance	National laboratory technical experts will be available for California infrastructure development, deployment, and operation.

Approach – Integrating individual research tasks to address hydrogen infrastructure challenges

- In development of of the task schedule and deliverables
- In development of the method for measuring impact and integration of research reporting

Task Name	Duration	Start	Finish
CA H2 Research Consortium	**480 days**	**Mon 8/6/18**	**Fri 6/5/20**
Q1 - (Data Collection & Analysis, $80k)	**12 mons**	**Mon 8/6/18**	**Fri 7/5/19**
Q2 - (M/HD Fueling Data, $200k)	12 mons	Mon 8/6/18	Fri 7/5/19
Q3 - (H2 Contaminant Detector, $400k)	24 mons	Mon 8/6/18	Fri 6/5/20
Q4 - (Nozzle Freeze-Lock Evaluation,	6 mons	Mon 10/1/18	Fri 3/15/19
Q5 - (CA Hydrogen Integration, $50k)	12 mons	Mon 8/6/18	Fri 7/5/19
Q6 - (Technical Assistance, $40k)	12 mons	Mon 8/6/18	Fri 7/5/19



Approach – Task 1
Station Data Collection & Analysis

- Through the National Fuel Cell Technical Evaluation Center (NFCTEC), NREL will continue to provide composite data products that measure a variety of key metrics of concern to the State of California, station operators, auto original equipment manufacturers, and the DOE.
- These products include metrics such as operation and maintenance costs, reliability, filling behavior, filling amounts, and fill pressures. NREL will assist the State of California with developing targets and measuring progress for station performance.

Approach – Task 2
Medium-/Heavy-Duty Vehicle Fueling

- This task will provide fill performance data by compiling fill data from existing medium/heavy duty fleets and making it publicly available, and also leveraging existing infrastructure at NREL to perform and evaluate fills of representative systems.
- NREL will leverage the NFCTEC data collection system and contact current and potential partners to compile fill performance data. In this task, NREL will: 1) collect all available time resolved from these fills; 2) determine the key parameters of medium- and heavy-duty filling; 3) identify improvements for medium-/heavy-duty filling work; 4) disseminate the results to the public; 5) leverage its H35/70, T40 hydrogen fueling station to simulate medium- and heavy-duty fueling scenarios.
- A variety of fill data (station and on-board tanks) will be compiled and analyzed for input to the industry teams responsible for developing a fueling protocol.

Approach – Task 3
Hydrogen Contaminant Detector

- This task will develop an integration device for hydrogen contaminant detectors.
- The project will also support developers of existing and future hydrogen contaminant detectors to validate their technology at NREL's dual-pressure (35/70 MPa) hydrogen fueling station.
- Technologies successfully verified at NREL may then be transitioned to retail stations for a trial period.
- The project will demonstrate feasibility and performance of in-line H_2 fuel-quality detection and control at an operating fueling station, while helping developers of hydrogen contaminant detectors make their products ready for retail hydrogen stations.
- Data collected and analyzed will form the basis for understanding the best practices for maintaining hydrogen-quality requirements.

Approach – Task 4
Nozzle Freeze-Lock Evaluation

- NREL will develop a baseline capability to evaluate the performance of nozzles and freeze lock occurrences. An existing environmental chamber will be retrofitted to test nozzles with -40˚C H2 at pressures up to 87.5 MPa, with ambient conditions up to 95% humidity and 30˚C.
- NREL will evaluate the probability of the nozzle sticking and the conditions that make it more likely, and will then create a test matrix to verify possible solutions. Baseline nozzles (2 nozzles expected) will complete the test protocol per ISO/DIS 17268 for baseline data. This capability will then be made available to all nozzle manufacturers and station operators to test new and existing nozzles.
- Manufacturers will be able to use the data to design improved nozzles and verify improvements.
- This work will be collaborative with CSA personnel who are knowledgeable about the ISO/DIS 17268 standard and the working group.

Approach – Task 5
CA Grid Integration and Energy Storage

- NREL will provide data to inform California decision/policy makers about the benefits and gaps of integrating hydrogen into the state energy management plans.
- For these data, NREL will use existing hydrogen grid integration and energy storage projects—e.g., for this data, as well as potential experimental scenarios to run in the future.
- For example, data will be collected from real-time dynamic control of electrolyzers with INL/NREL and energy dispatch control with NREL/PNNL, as well as potential experimental scenarios to run in the future. In addition, NREL will identify the top priority gaps for data sharing and messaging.

Approach – Task 5
Technical Assistance

- The need is for a neutral, third-party party to evaluate and provide an opinion on deployed stations. This need will likely increase as new companies enter the market who may not be as familiar with hydrogen at the retail level and with jurisdictions that do not have prior hydrogen experience.
- National laboratory experts, based on the request, will be leveraged for investigation of technical issues such as:
  - Technical and processing software upgrades or questions about HySTEP
  - Issues with component requirements, verification of selected materials, siting, and system integration
  - Permitting topics such as issues causing common delays
  - Reliability and low-utilization operation strategies

Accomplishments and Progress

- Finalizing details of agreement

Collaboration and Coordination

The California Air Resources Board (CARB), California Energy Commission (CEC), South Coast Air Quality Management District (SCAQMD) and California Governor's Office for Economic Development (GO-Biz) identified a need to leverage national laboratory research capabilities and staff to support their hydrogen efforts. This research consortium identified the tasks summarized in slide 4 based on research needs and priorities for the California agency partners. Specific focus will be placed on sharing and translating lessons learned to other jurisdictions, which is a priority in a partnership between state and federal agencies and laboratories.

Remaining Challenges and Barriers

- The set of tasks focuses on the challenges for California infrastructure development, deployment, and operation.
- California is pursuing the tasks for the benefit of state and national efforts for a robust hydrogen fueling infrastructure.
- Integration of multiple research topics

Proposed Future Work

- Complete agree and begin project
- The consortium will use these tasks as the first step in a strategic partnership, balancing near-term research needs with accelerating earlier-stage research into the market.

Technology Transfer Activities

- None at this time

Summary

- The benefits of this consortium begin with coordinated research efforts that:
  - support the DOE's and CA energy goals and requirements.
  - share lessons learned with other states to inform implementation efforts outside of California.
  - support shifting the hydrogen infrastructure progress from a government push into a market pull.
  - advance the station technology and operation to meet the next waves of vehicle demand
  - local sourcing for increased renewable hydrogen.

Thank You

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Publication Number

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