California Energy Commission

FINAL PROJECT REPORT

North Coast and Upstate Fuel Cell Vehicle Readiness Project

California Energy Commission

Edmund G. Brown Jr., Governor

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- Glenn County Air Pollution Control District
- Governor's Office of Business and Economic Development
- Local Government Commission
- Mendocino Council of Governments
- North Coast Unified Air Quality Management District
- Shasta Regional Transportation Agency
- Siskiyou Economic Development Council
- Tehama County Air Pollution Control District
- and the many potential hydrogen fueling station site host businesses and organizations

PREFACE

Assembly Bill 118 (Nüñez, Chapter 750, Statutes of 2007), created the Alternative and Renewable Fuel and Vehicle Technology Program (ARFVTP). The statute, subsequently amended by AB 109 (Nuñez Chapter 313, Statutes of 2008), authorizes the Energy Commission to develop and deploy alternative and renewable fuels and advanced transportation technologies to help attain the state's climate change policies. The Energy Commission has an annual program budget of approximately $100 million and provides financial support for projects that:

- Develop and improve alternative and renewable low-carbon fuels;
- Optimize alternative and renewable fuels for existing and developing engine technologies;
- Produce alternative and renewable low-carbon fuels in California;
- Decrease, on a full fuel cycle basis, the overall impact and carbon footprint of alternative and renewable fuels and increase sustainability;
- Expand fuel infrastructure, fueling stations, and equipment;
- Improve light-, medium-, and heavy-duty vehicle technologies;
- Retrofit medium- and heavy-duty on-road and non-road vehicle fleets;
- Expand infrastructure connected with existing fleets, public transit, and transportation corridors; and
- Establish workforce training programs, conduct public education and promotion, and create technology centers.

The California Energy Commission (Energy Commission) issued solicitation PON-14-607 to fund Zero Emission Vehicle (ZEV) Readiness activities. To be eligible for funding under PON-14-607, the proposed projects needed to be consistent with the Energy Commission's ARFVTP Investment Plan, which is updated annually. In response to PON-14-607, the Redwood Coast Energy Authority (Recipient) submitted application number 11, which was proposed for funding in the Energy Commission's Notice of Proposed Awards on March 17, 2015 and is incorporated by reference to this Agreement in its entirety.

ABSTRACT

The North Coast and Upstate regions comprise over 17% of the land area of California and include several key transportation corridors including Highway 101 and Interstate 5. These two arteries carry the vast majority of road travel between California and destinations in Oregon and Washington. Fuel cell electric vehicles (FCEVs) may prove to be a critical long-term solution for sustainable transportation objectives of rural communities. This is largely driven by dependence on passenger vehicles due to intraregional travel distances between communities and limited public transit services in diffused and lightly populated regions.

The *North Coast and Upstate Fuel Cell Vehicle Readiness Project* builds on the efforts of the *Northwest California Alternative Fuels Readiness Project*[1,2] to create a coordinated effort throughout an 8-county North Coast and Upstate region[3]. The goals of the project are to support the successful introduction of FCEVs, plan for the wise and effective deployment of hydrogen fueling infrastructure (HFI) and help catalyze a robust regional market for FCEVs.

The project team key tasks:

- Create the *Regional Hydrogen Infrastructure Plan*[4] as the result of collaboration across the 8-county North Coast and Upstate Region (Task 2.1 of ARV-14-055 grant agreement[5]).
- Promote FCEVs through a variety of engagement methods. (Task 2.2 of grant agreement).
- Make progress toward FCEV fleet adoption through relationships with municipal fleet managers (Task 2.3 of grant agreement).
- Identify sites for future hydrogen fueling stations through micro-siting analyses (Task 2.4 of grant agreement).

This report summarizes the methods and results of these tasks.

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1 Biondini, Lori (Ed.). (Redwood Coast Energy Authority). 2016. Northwest California Alternative Fuels Readiness Project. California Energy Commission. Publication Number: CEC-ARV-13-012.

2 https://redwoodenergy.org/wp-content/uploads/2017/08/ARV-13-012_Readiness-Plan-FINAL_2017-02-23-small.pdf

3 The project originally included a 9-county region, but was reduced to 8 counties due to wildfire impacts.

4 Goodrich, E. 2017. North Coast and Upstate Fuel Cell Vehicle Readiness Project – Task 2.1 Regional Hydrogen Infrastructure Plan. California Energy Commission.

5 Carman, Jerome. 2014. Agreement Number ARV-14-055. California Energy Commission.

Keywords: Fuel cell electric vehicles, Alternative Fuels Readiness Plan, hydrogen, permitting, codes, standards, fleet vehicles, outreach, education, fuel cell vehicle infrastructure, planning, rural, hard-to-reach, transportation corridor

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EXECUTIVE SUMMARY

Introduction

The goal of this project is to create a coordinated effort within the eight-county North Coast and Upstate regions[6] to build on the efforts of the *Northwest California Alternative Fuels Readiness Project*[1]. Hydrogen-powered fuel cell electric vehicles (FCEVs) are in the family of zero-emission vehicles (ZEVs), along with battery-electric vehicles (BEVs). Consequently, the project also builds on the *North Coast Plug-in Electric Vehicle Readiness Plan*[7] and *Implementation*[8] projects.

The core project team for this project includes the Redwood Coast Energy Authority (RCEA), the Schatz Energy Research Center (SERC), and the Local Government Commission (LGC). The term "project team" throughout this document refers to these three organizations.

The project facilitates coordination through a coalition of interregional partners to support the introduction of FCEVs, complete siting analyses to plan for the wise and effective deployment of hydrogen fueling infrastructure, and to engage numerous sector stakeholders to build a regional foundation for the FCEV market. Interregional partners include the Glenn County Air Pollution Control District (GCAPCD), Mendocino Council of Governments (MCOG), North Coast Unified Air Quality Management District (NCUAQMD), Shasta Regional Transportation Agency (SRTA), Siskiyou Economic Development Council (SEDC), and Tehama County Air Pollution Control District (TCAPCD). This group of partners is "the coalition" throughout this document.

Project Results

The project team followed a "Turn-key Station" model to engage with as many of the required stakeholders in this model as possible; see Figure 1. The engagement status uses the following key: "E" represents the status for Eureka and "R" represents the status for Redding, green circles indicate completed/near completed tasks/engagements, orange circles indicate tasks/engagements which are partially complete, and red circles indicate tasks/engagements for which little to no work is complete.

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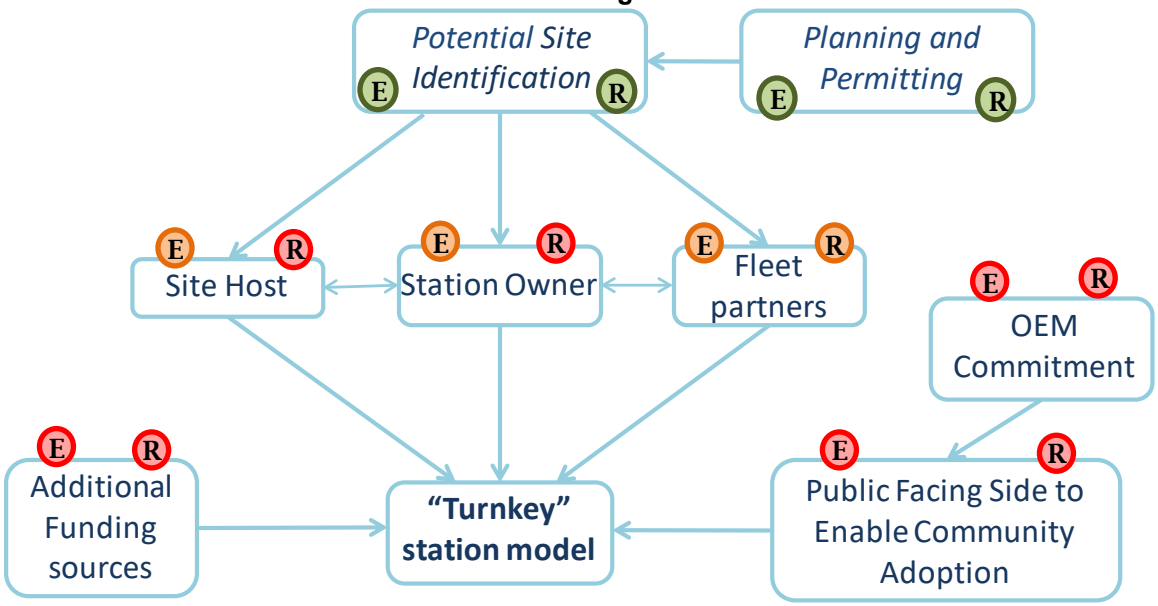
6 Originally, 9 counties were solicited to participate in the project, but Lake County ultimately could not participate due to extensive wildfires in their region.

7 Zoellick, Jim, David Carter, Colin Sheppard, Jerome Carman. 2014. North Coast Plug-in Electric Vehicle Readiness Project. California Energy Commission. Publication Number: CEC-ARV-11-006.

8 Boudreau, Dana, Jerome Carman, Greg Chapman, Elliot Goodrich, Andrew Harris, Kristen Radecsky, Pierce Schwalb. Redwood Coast Energy Authority, Schatz Energy Research Center. 2017. PEV Readiness Plan Implementation. California Energy Commission. Publication Number: CEC-ARV-14-046.

Figure 1: Turnkey Station Model, and Status of Stakeholder Engagement in Eureka and Redding



Source: RCEA, 2017

Promotion of FCEVs

The coalition included one to three individuals from each county and met periodically to receive training and provide feedback on project activities. Each coalition member had a key task to complete county-specific outreach activities. To support these tasks, the project team developed various educational media including a hydrogen "101" presentation, a website[9], and a handout with current FCEV models with financial and training resources. A total of 21 community events, four earned media events, and 14 presentations specific to hydrogen and fuel cell electric vehicle promotion were conducted throughout the project region.

Infrastructure Planning

The Schatz Energy Research Center (SERC) performed infrastructure siting analyses, which were distributed to the coalition. The approach to infrastructure planning included both a macro-level and micro-level analysis. The macro-level analysis merged macrositing criteria created by the project team with results from the CHIT[10] model to determine two key anchor cities (Redding and Eureka) and the overall need for five fueling stations in the region. The term "anchor" in this report is used to refer to

9 Redwood Coast Energy Authority. https://redwoodenergy.org/services/transportation/fuel-cell-electric-vehicle-readiness/

10 California Air Resources Board, http://californiaarb.maps.arcgis.com/apps/webappviewer/index.html?id=99be905d3127405e81851fd60b19cda2

priority locations that are identified as critical to initiating regional supply and catalyzing the FCEV market in Oregon and Washington. “Phase I” is mostly synonymous with the term “anchor site” but has a time-connotation; “phase I anchor sites” are poised to be developed before any others. “Anchor sites” and “phase one” sites are used interchangeably in this report. In the micro-level analysis, SERC developed a set of parcel-specific criteria that could be used to narrow down possible locations. These criteria were referenced in conjunction with Google Maps to list 20 potential locations in Redding and Eureka for early infrastructure deployment. These criteria were used to develop guidelines (*Task 2.3 Summary Report* and the *Micrositing Analysis Summary Report*) for the North Coast and Upstate region, which can support the need for future funding and installation of fueling stations.

The project team met with planning and permitting officials in Redding and Eureka to discuss permitting guidelines and address any permitting hurdles. Because FCEVs and retail hydrogen fueling stations are relatively new to the mass market, planning and building department staff are often unfamiliar with the technology, which can delay and increase costs for permitting of station installations. During these Redding and Eureka meetings, the officials confirmed no zoning or permitting updates would be necessary for the hydrogen station installation. In summary, planning and permitting agencies in phase one locations are prepared to support local infrastructure development.

Fleet Engagement

The project team also worked to promote the adoption of FCEVs in local vehicle fleets. Team members compiled FCEV materials and provided it to fleet operators, who also received one-on-one engagement through informational interviews to create a picture of their unique needs for fuel cell electric vehicle readiness. The California Department of Transportation (Caltrans), the California Department of Fish and Wildlife (DFW), the California Government Operations Agency (GovOps), and the Department of General Services (DGS) were identified as promising fleet partners for future FCEV adoption and infrastructure development.

Specifically, Caltrans District 1 would likely adopt FCEVs and provide fuel demand should a Eureka station be installed. The project team continues to engage with DFW and DGS regarding a potential station site in Redding. DFW owns a property in Yreka as well, which has ample land for station development. Other State agencies and regional organizations have participated in meetings to further scope these sites. Scoping is in a very early stage; nascent conversation indicates interest in serving both state and public vehicles. If station development is ultimately successful, it could prove to be a precedent-setting model for other State agencies and local governments.

Conclusions and Recommendations

The project team’s efforts resulted in the fusion of siting analyses, stakeholder engagement, and advocacy to demonstrate the region’s readiness for hydrogen fueling infrastructure.

For the first time since AB8 was passed, and in parallel with the closing of this grant, ARB called for the development of stations in Eureka and Redding by 2024[32].

Developing these locations will facilitate the expansion of California's hydrogen highway into Oregon, Washington, and beyond which will be critical to successful FCEV deployment and wide-scale commercial adoption.

The project team's macro- and micro-siting analyses prioritize which cities in the region should be developed first and provide industry stakeholders with 20 sites to consider for the roll-out of stations in the North Coast and Upstate regions.

Fleet engagement was key and must be sustained for eventual project success. Caltrans District 1, the California Department of Wildlife, and the California Department of General Services were instrumental to building a foundation for station development in the region. These stakeholders are vital to ensuring station development progress does not terminate along with the grant. Relationships with local fleets should be fostered to fortify regional readiness.

The North Coast and Upstate provides unique business opportunities for renewable and decarbonized hydrogen production. The Redwood Coast Energy Authority Community Choice Aggregation program provides a substantial revenue stream for the local procurement of renewable energy resources. Hydrogen could serve as a medium to store excess renewable energy. The Trinity Public Utilities District (TPUD) owns Trinity Dam, which has excess hydropower to support an approximately 20MW hydrogen electrolyzer facility. Additional detail regarding this opportunity is explained later in this report, but TPUD and commercial hydrogen producers have expressed interest in pursuing this zero-carbon hydrogen production opportunity.

The project team recommends that others pursuing regional readiness work refer to this report, as well as the *Tri-Counties Readiness Plan* to inform their efforts. Planning entities can use the report appendices as templates and examples.

The project team also recommends that the California Energy Commission, the Governor's Office of Business and Economic Development, and the California Air Resources Board utilize the findings of this report to guide infrastructure roll-out in the project region. The project team has provided contact information for critical contacts in Table 9 toward the end of this report. In addition, potential low carbon energy sources were identified that could be explored for generating low carbon hydrogen fuel.

Lastly, the project team encourages any interested hydrogen production companies, station developers, potential site hosts, automobile OEMs, property owners, and other industry stakeholders to reach out to the project team regarding interest in furthering the efforts documented in this final report.

Next Steps

The project team aspires to assist where possible with these next steps, but as the grant concludes, funding will expire for extensive work. Therefore, the project team directs these next steps at the stakeholders mentioned above. This is not an exhaustive list but encapsulates near-term priority tasks, in no order, which will catalyze infrastructure development and the FCEV market maturation:

- Facilitate the installation of a station in Redding on the DFW and DGS co-owned parcel, if possible. This involves confirming the strategy for applying for funding in response to the upcoming California Energy Commission hydrogen fueling infrastructure solicitation.
- Obtain fuel commitments from Caltrans District 1 and other State fleets in Redding.
- Connect with automobile OEMs to discuss a FCEV procurement strategy for Redding fleets, and to inform regional FCEV deployment strategic plans.
- Initiate the Eureka site development process by contacting station developers and other stakeholders.
- Once the Eureka site development process has gained momentum, obtain fuel commitments from Eureka fleets.
- Expand education and promotional FCEVs to target governing bodies of local municipal bodies, emergency first responders, dealerships, and mechanics.
- Revitalize fleet outreach and re-engage with current fleet contacts and create new ones. Focus on municipal and transit fleets.
- Connect with hydrogen production companies to explore the feasibility of renewable hydrogen production opportunities with the Trinity Public Utilities District, and renewable energy storage applications with the Redwood Coast Energy Authority Community Choice Aggregation program.
- Identify private investor collaboration opportunities to fund station development.
- Research additional funding opportunities.

CHAPTER 1: Introduction

Background

In 2016 the Redwood Coast Energy Authority (RCEA), in collaboration with the Schatz Energy Research Center (SERC) at Humboldt State University and other regional partners, completed the *Northwest California Alternative Fuels Readiness Plan* (*AFRP*)[1] through CEC-ARV-13-012[11], which identified potential hydrogen demand and required infrastructure targets by 2020 that would help meet Low Carbon Fuel Standard (LCFS) targets in the Northwest region.

The *AFRP* describes comprehensive strategies to overcome barriers to low carbon fuel infrastructure (LCFI) deployment. The main analytical component of the project includes an assessment of the alternative fuels infrastructure and deployment needs in the Northwest region. (The term "advanced fuels" is used synonymously with "alternative fuels" throughout this paper). The *AFRP* assessment includes three parts to:

- Characterize the status of low carbon fuels in the region;
- Analyze potential low carbon fuel portfolios with the lowest marginal cost that can help the region meet the State's 2020 LCFS goals; and
- Identify challenges and best practices for planning, permitting, deployment, maintenance, and inspection of LCFI in the study region.

While developing the *AFRP*, the project team created and distributed comprehensive educational materials, conducted targeted outreach to entities throughout the region, and engaged stakeholders to implement the identified strategies.

The *AFRP* addressed a portfolio of low-carbon fuels, including hydrogen. The *North Coast and Upstate Fuel Cell Vehicle Readiness Project* (*FCEV Readiness Project*) expands specifically on the hydrogen component of the *AFRP*. The *FCEV Readiness Project* further develops and adapts the infrastructure planning and stakeholder engagement that was completed for the *AFRP*.

The following opportunities, strengths, and barriers were identified by the *AFRP* final report and the *FCEV Readiness Project* team.

11 This number refers to the California Energy Commission grant agreement number for the *Northwest California Alternative Fuels Readiness Plan.* CEC grant agreements define awardee grant tasks (in this case RCEA and SERC) required by the Energy Commission.

Opportunities and Strengths

Our region has a history of localized hydrogen expertise for fuel applications and non-fuel applications. Several notable past projects include the Humboldt State University hydrogen fueling station which operated between 2008 and 2015, a fuel cell/photovoltaic integrated power system for a remote telecommunications station on the Yurok Reservation[12], solar storage used to power aeration of the aquaria at the Telonicher Marine Laboratory[13], and a renewable biomass gasifier fuel cell combined heat and power system at the Blue Lake Rancheria[14]. SERC played a central role in each of these projects.

Thanks in part to aggressive California legislation, hydrogen vehicles are now commercially available and fueling technology is also commercial-ready. Although the capital and operating and maintenance costs (O&M) of the vehicles and fueling infrastructure still need to decrease for the technology to be competitive with fossil fuels, consumers in specific regions can now choose hydrogen to fuel their fuel cell electric vehicles.

Information, training materials, and regulatory codes already exist for multiple stakeholder groups to facilitate the successful integration of hydrogen technology into society. Fire and safety codes needed for permitting, educational materials for local government officials, information for first responders and fire marshals, and training curriculum for workforce development all exist and are actively updated[15].

Barriers to FCEV Adoption

The State of California has set ambitious goals for reducing greenhouse gas emissions (GHGs) in the transportation sector through the adoption of a low carbon fuel standard (LCFS) and the promotion of alternative fuels for transportation. The State's *2018 ZEV Action Plan*[16] goals include widespread use of ZEVs for public transportation and freight transport by 2020 and easy access to ZEV infrastructure for all Californians by 2025.

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12 Lehman, P.A., Chamberlin, C.E., Zoellick, J.I., and Engel, R.A., A Photovoltaic/ Fuel Cell. Power System for a Remote Telecommunications Station, 2002. Humboldt State University Schatz Energy Research Center.

13 Lehman, P.A., Chamberlin, C.E., Pauletto, G., Rocheleau, M.A. Operating Experience with a Photovoltaic-Hydrogen Energy System. International Journal of Hydrogen Energy, 1997.

14 Zoellick, Jim. (Schatz Energy Research Center, Humboldt State University). 2015. Repowering Humboldt with Community-Scale Renewable Energy. California Energy Commission. Publication number: CEC-500-2016-055.

15 The U.S. Department of Energy and California Fuel Cell Partnership websites effectively serve as clearinghouses for these resources.

16 2018 ZEV Action Plan, http://www.business.ca.gov/ZEV-Action-Plan

Governor Brown's recent Executive Order B-48-18 calls for 200 hydrogen fueling stations in California by 2025 and 500,000 ZEVs on California roads by 2030.

The project area currently has 0 hydrogen fueling stations, FCEV dealers, or registered FCEVs, presumably due to a sparse population and the rural, isolated geography of the region. The region's low population and isolated geography underscores the need for connector and destination stations within the North Coast and Upstate region.

Infrastructure development to date has focused on the San Francisco and Los Angeles metropolitan regions. The northernmost hydrogen fueling station as of this writing is in Truckee, California. With current installations, FCEV drivers can technically complete a round trip from Mill Valley (nearest retail fueling station) to Ukiah. For other micro/metropolitan locations in the project region, FCEV drivers cannot successfully complete a trip at the time of writing for this report. The project region comprises over 17% of the land area of California and includes several key transportation corridors including Highway 101 and Interstate 5. These two arteries carry the majority of road travel between California and destinations in Oregon and Washington. Figure 2 to the right shows the major state vehicle arteries, with the project region outlined in blue. It is important to fill the hydrogen fueling infrastructure gap in the project region to ensure connectivity of the fueling station network throughout all of California, and to neighboring states.

Figure 2: Major Transportation Corridors in California and ARV-14-055 Project Region

Source: RCEA, adapted from geology.com

The *California Statewide Plug-In Electric Vehicle Infrastructure Assessment*[17], prepared for the California Energy Commission (CEC) by the National Renewable Energy Laboratory (NREL), predicts 500 FCEVs on the road in the North Coast and Upstate regions by 2024 based on earlier and less aggressive legislation[18]. As California accelerates its zero emission vehicle objectives, local and regional entities must be prepared to engage with infrastructure development and readiness initiatives appropriate for their region. Localized approaches are key; while there are resources and information available to stakeholders, these resources must be more broadly disseminated to accelerate the achievement of adoption goals.

Other barriers include:

- Zoning and permitting: Hydrogen fuel poses zoning and permitting challenges given these physical characteristics: it is a gas, is dispensed at up to 10,000 pound-force per square inch (psig) and has different flammability characteristics when compared with existing transportation fuels.
- Lack of existing infrastructure: Hydrogen fuel distribution infrastructure and services must be built largely from the ground up, whereas electric vehicles have the advantage of widespread electrical infrastructure.
- Awareness: As a fuel, hydrogen is less understood by the general public.
- Towing companies: There is a lack of information among towing and salvage companies regarding potential safety considerations associated with towing/hauling FCEVs and response to FCEVs when they run low on fuel.
- Training: Training materials from vehicle manufacturers and fueling station manufacturers are not widely available for mechanics, emergency first responders, and other auto industry professionals—specifically in the project region.
- Standardization: The Division of Measurement Standards (DMS) has yet to fully develop and adopt standards for hydrogen fueling stations. DMS has adopted the National Institute of Standards and Technology (NIST) Handbook 44 to support early market development[19].

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17 Melaina, Marc, Michael Helwig. (National Renewable Energy Laboratory). 2014. California Statewide Plug-In Electric Vehicle Infrastructure Assessment. California Energy Commission. Publication Number: CEC-600-2014-003.

18 Assembly Bill 8 (Perea, Chapter 401, Statutes of 2013.)

19 Division of Measurement Standards, https://www.cdfa.ca.gov/dms/hydrogenfuel/hydrogenfuel.html

Project Approach

The *AFRP* identifies hydrogen as a key long-term alternative fuel for the region. This *FCEV Readiness Project* identifies specific hydrogen fueling infrastructure sites required to support the region's share of FCEVs and to support full state-wide access to fueling.

To this end, the project team developed stakeholder relationships across a broad landscape. These relationships lead to an integrated and coordinated regional effort to plan, fund, and implement targeted FCEV and hydrogen infrastructure deployment.

The general approach was to:

- Conduct outreach activities throughout the region to address the early market barriers to FCEV adoption;
- Identify characteristics such as the probable early-market FCEV vehicle classes within the region through consultations with local fleets, the volume of local, destination, and transient travel, and the ability to generate, import, or move fuel in the study region;
- Use macrositing methodology to estimate fuel requirements and infrastructure placement to meet the needs of early market participants within geophysical constraints and land use patterns;
- Use micrositing methodology to further refine plausible fueling infrastructure siting within selected target markets; and
- Develop several model station designs and a selection rubric to identify compatible site host locations.

Emerging Trends

To provide background for the project's work over the three-year grant period, this section describes recent trends in the FCEV industry.

Adoption and Deployment Trends

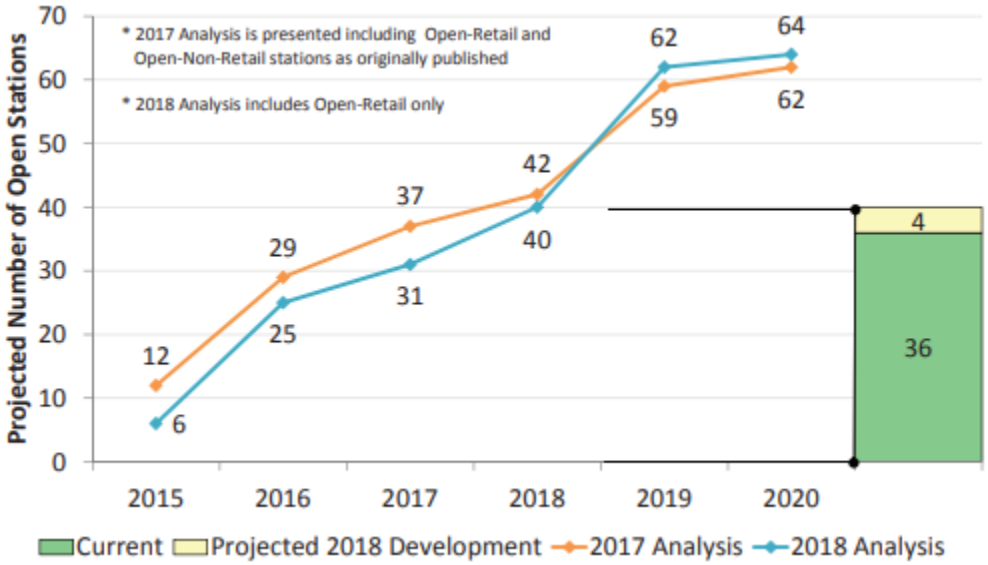
As of January 2019, there were 39 retail stations open throughout the State, and 5,899 FCEVs on California roads[20]. In 2015, there were 11 reported demonstration[21] retail stations, and 179 FCEVs registered in California. The Governor's mandate requires 200 stations by 2025 and five million ZEVs; however, it does not designate how many vehicles should be FCEVs, BEVs, or PHEVs. The California Fuel Cell Partnership (CaFCP) proposed an ambitious vision for one million FCEVs on the road by 2030, supported by

20 California Fuel Cell Partnership, https://cafcp.org/by_the_numbers

21 California Air Resources Board. May 2015. 2015 Annual Evaluation of Hydrogen Fuel Cell Electric Vehicle Deployment and Hydrogen Fuel Station Network Development (p. 62). https://ww2.arb.ca.gov/sites/default/files/2018-12/ab8_report_2015.pdf

a network of 1,000 hydrogen fueling stations. ARB analysis forecasts 64 operational retail stations by the end of 2020.

Figure 3 CARB projections for retail station development.



Source: CARB

Improvements in Station Design

This project conducted station design and footprint analysis, which shows significant progress in the last decade to reduce the overall space requirements of fueling stations. This expands station hosting opportunities to more existing commercial sites, and specifically helps the study region where smaller units are preferable for early-adoption siting. Figure 4 shows an analysis of project footprints of proposals submitted to the CEC in 2016.

Figure 4: Hydrogen Station Equipment Footprints

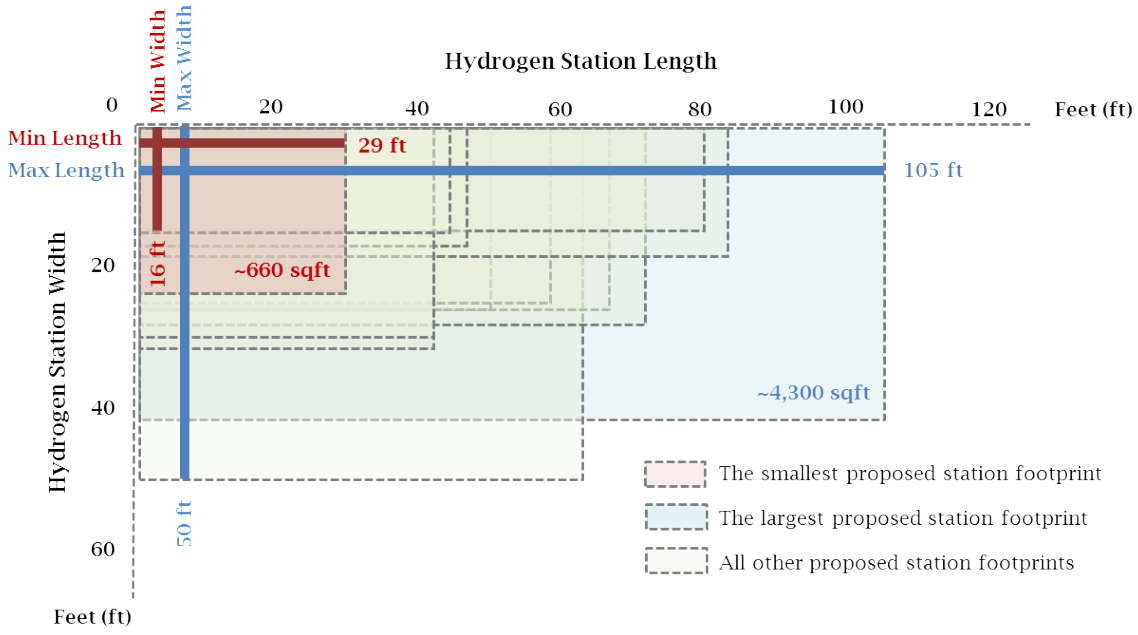


Image is comprised from a sampling of CEC proposals. Distances do NOT include NFPA 2 setbacks. Source: Baronas, J., Achtelik, G., 2017a. Joint Agency Staff Report on Assembly Bill 8: 2016 Annual Assessment of Time and Cost Needed to Attain 100 Hydrogen Refueling Stations in California (No. CEC-600-2017-002). California Energy Commission and California Air Resources Board – reprint of Figure E-2.

In recent years, the Sandia National Labs and the California Energy have reported extensive station footprint analysis work. This work shows progress made by station developers, equipment manufacturers and permitting agencies to reduce the size of the equipment footprints, thus improving the chances of integrating hydrogen at more retail gas stations.

In a 2014 study, researchers at Sandia National Labs defined a new metric to characterize the impact and success in the development of codes relevant for hydrogen refueling stations as the "number of (gasoline) fueling stations that can readily accept hydrogen". As noted in the study, a site can readily accept hydrogen when no statutory, regulatory or local ordinance barriers exist, and a viable business case can be made.[22]

22 Harris, A.P., Dedrick, D.E., LaFleur, C., Marchi, C.S., 2014. Safety, Codes and Standards for Hydrogen Installations: Hydrogen Fueling System Footprint Metric Development (No. SAND2014-3416). Sandia National Laboratories (SNL-CA), Livermore, CA (United States).

Cost Reductions and Technology Improvements

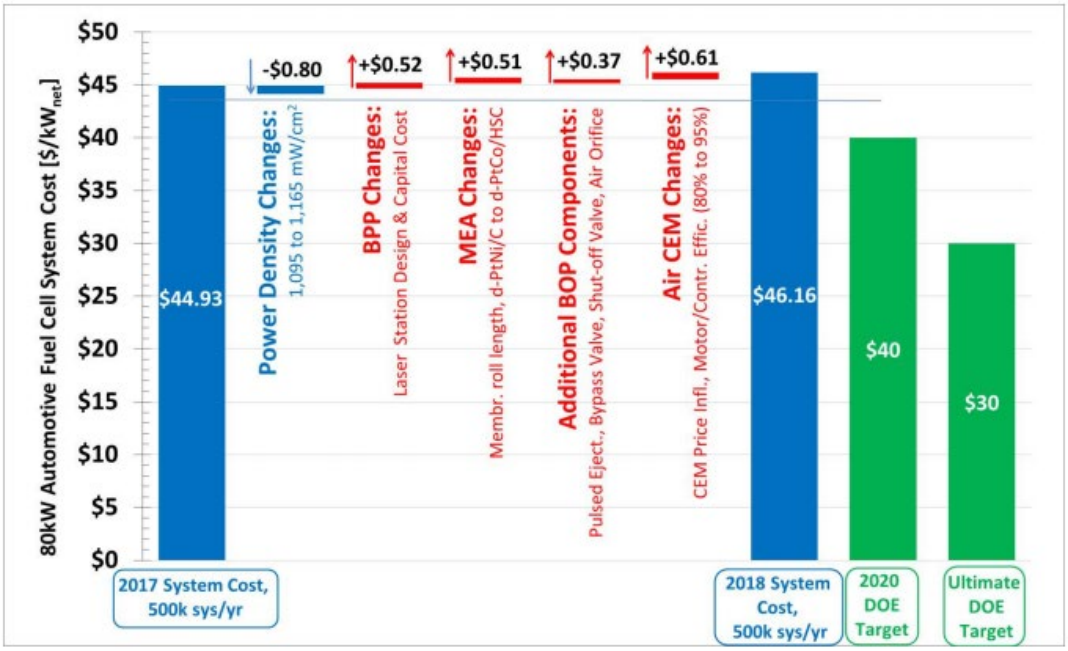
Fuel cell stacks have both improved in quality and come down in cost over the past several years. The U.S. Department of Energy states that "costs have decreased significantly are approaching DOE's goal for 2020". Platinum is traditionally the main catalyzing component of fuel cell stacks, but other less-expensive substitutes have been developed recently, bringing down the overall costs of FCEVs. U.S. DOE projects further decreases in system costs between now and 2025. For further details regarding the changes in system costs, refer to the sources cited below.

Table 1: Fuel Cell System Costs

Characteristic	Units	2012	2013	2014	2015	2016	2017	2018
System Cost (500,000 systems/year)	$/kW$_{net}$	47	55	55	53	53	45	46

Source: Adapted from the DOE Hydrogen and Fuel Cells Program Record (2017)[23] and the U.S. Department of Energy Presentation: Cost Projections of PEM Fuel Cell Systems for Automobiles and Medium-Duty Vehicles (2018) [24]

Figure 5: 2018 Cost Projections of PEM Fuel Cell Systems for Automobiles and Medium-Duty Vehicles



23 US Department of Energy, https://www.hydrogen.energy.gov/pdfs/17007_fuel_cell_system_cost_2017.pdf
24 US Department of Energy, https://www.energy.gov/sites/prod/files/2018/04/f51/fcto_webinarslides_2018_costs_pem_fc_autos_trucks_042518.pdf

Source: US Department of Energy Presentation [25]

In addition to declining costs, the lifetime of fuel cell stacks is increasing. According to the U.S. Department of Energy, fuel cell durability quadrupled between 2006 and 2015 from 37,500 to 120,000 miles, and vehicles are on track to meet the 150,000 mile target for 2020[26].

Finally, one of the major market spoilers for FCEVs is the public's perception of hydrogen as a dangerous fuel. Marred by flashbacks to the Hindenburg, or retellings of the fate of the 1966 GM Electron, the public periodically questions the safety of FCEVs. However, FCEVs are subject to the same safety tests as regular internal combustion engine vehicles[27]. The California Fuel Cell Partnership (CaFCP), in conjunction with the Pacific Northwest National Laboratory, has carefully developed and distributed outreach on solenoid technology and other safety features[28]. Progress is being made with respect to safety, but more work is required to inform and grow awareness that hydrogen is a safe transportation fuel.

Figure 6: The Renewable Energy Base Oostende, highlighting the extensive port services to support offshore wind facilities

Source: Renewable Energy Base Oostende, Belgium

Business Opportunities

Currently, most hydrogen is produced via steam methane reformation. Per California law, at least 33% of hydrogen fuel dispensed at publicly funded – and soon, all stations – must come from renewable sources (wind, solar, biogas, etc.). In 2019, that requirement will increase to 40% with the implementation of the new infrastructure credit under the Low Carbon Fuel Standard[29], which is expected to help spur greater private investment[30] and

25 https://www.energy.gov/sites/prod/files/2018/04/f51/fcto_webinarslides_2018_costs_pem_fc_autos_trucks_042518.pdf

26 https://www.energy.gov/eere/fuelcells/fuel-cell-technologies-office-accomplishments-and-progress

27 https://www.driveclean.ca.gov/Search_and_Explore/Technologies_and_Fuel_Types/Hydrogen_Fuel_Cell.php

28 https://cafcp.org/emergency-responders

29 California Air Resources Board, https://ww2.arb.ca.gov/news/ARB-amends-low-carbon-fuel-standard-wider-impact

30 Forbes Magazine, https://www.forbes.com/sites/danielsperling/2018/10/17/how-almost-everyone-came-to-love-low-carbon-fuels-in-california/#c836f125e848

greater capacity to stay ahead of anticipated consumer need.

In September 2018, the California Energy Commission funded a renewable hydrogen production road map to inform and help guide policy on hydrogen production[31]. In line with this roadmap, the Energy Commission funded two renewable hydrogen production demonstration projects in the Central Valley and the Inland Empire.

Private industry is matching the State's commitment to renewable hydrogen production as well. While 33% of hydrogen must be produced from renewable resources, in 2018 and 2019 numerous businesses announced a joint commitment to completely decarbonize hydrogen production by 2030.[32,33]

In line with State and industry strides, several regional business opportunities emerged during this project. Detailed in Chapter 5, the most promising opportunities at present relate to energy storage for the Redwood Coast Energy Authority Community Choice Aggregation program, and the Trinity Public Utilities District hydroelectric dam.

31 California Energy Commission, https://www.energy.ca.gov/contracts/GFO-17-602_NOPA_revised.pdf

CHAPTER 2:
Regional Hydrogen Infrastructure Plan

The goal of Task 2.1, as enumerated in the CEC grant agreement between the CEC and RCEA, is to develop a regional hydrogen infrastructure plan to identify macro-level siting of essential hydrogen infrastructure. State planning efforts, localized market opportunities, and corridor fueling potential are analyzed to determine two high-priority phase one anchor sites for near-term infrastructure development.

Regional Targets

Regional targets for this project focus primarily on light duty vehicles (LDVs) for several reasons. Industrial hydrogen applications and fuel cell forklifts have penetrated the commercial sector, but LDVs have not done so yet. LDVs constitute most California's transportation emissions, and three LDV models are available on the current retail market.

Medium-duty (MDV) and heavy-duty vehicles (HDV), such as delivery trucks, long haul trucks, street sweepers and curbside collection trucks, have characteristics that are conducive to hydrogen fuel and are worth future evaluation Although the region includes a working port, it currently lacks the scale needed to support hydrogen infrastructure for drayage and similar shore-side operations. Plans for offshore wind show potential for marine applications, but completion of this project remains 5-10 years in the future. As such, the plan focuses exclusively on light-duty FCEV passenger vehicles.

FCEV adoption projections for the *Regional Hydrogen Infrastructure Plan*[4] were based on ARB's most recent analysis at the time, the *2016 Annual Evaluation of Hydrogen Fuel Cell Electric Vehicle Deployment and Hydrogen Fuel Station Network Development*[32]: This evaluation indicated 43,600 FCEVs will be on California Roads by 2022, and extrapolated that figure to 63,667 FCEVs by 2024[32]. The *Regional Hydrogen Infrastructure Plan* estimated that 0.51% of FCEVs in 2024 will be in the project region, resulting in a projection of 325 vehicles.

The *AFRP* estimated hydrogen demand by assuming 1kg per day per vehicle. Using this approach, the extrapolated hydrogen demand for 325 vehicles is roughly 120,000 kg per year.

32 California Air Resources Board. 2016. 2016 Annual Evaluation of Hydrogen Fuel Cell Electric Vehicle Deployment and Hydrogen Fuel Station Network Development.
https://www.arb.ca.gov/msprog/zevprog/ab8/ab8_report_2016.pdf

To project how many hydrogen fueling stations would be required, the *AFRP* assumed the smallest station size of 70kg/day. Furthermore, the *AFRP* projected station requirements for 200 vehicles across a five-county region, increasing the number of stations beyond projected demand in order to achieve sufficient geographic distribution. These estimates and methods are used and expanded to predict the requirement of two additional stations supporting the remaining 125 vehicles across the counties of Shasta, Tehama, Colusa, and Lake. Table 2 summarizes these estimates.

Table 2: FCEV, Hydrogen Volume, and Station Estimates for 2024.

	FCEVs	H_2 Volume (kg/yr)	Stations
Total for Project Region	325	120,000	7

Source: SERC, 2019

The *Regional Hydrogen Infrastructure Plan* addressed the following questions:

- What does vehicle and fuel demand in the eight-county project region look like in the near- to medium-term?
- Which areas of the region are most likely to experience growth in near- to medium-term demand for FCEVs?
- What kinds of site characteristics are appropriate for FCEV infrastructure?
- What kinds of site characteristics are most likely to catalyze demand for FCEVs in the region?
- How can we best accommodate demand for FCEV infrastructure from out-of-region drivers?
- How do FCEVs and FCEV infrastructure in this region fit into the broader landscape of FCEV market development in California, the greater west coast, and the United States as a whole?

The project team used model results from the ARB's California Hydrogen Infrastructure Tool (CHIT)[10] to evaluate fuel demand and vehicle count projections for the region. The team then used the results of this process to conduct a two-step analysis resulting in the identification of hydrogen fueling station site locations.

The first step, termed "macrositing", provided high-level regional insight regarding development efforts for first phase critical anchor sites that will kick start regional supply. Recommendations on key second and third phase connector sites were provided that will solidify a fueling network for a stable early market. The macrositing approach combines local knowledge with state-level modeling results provided by the CHIT model.

The second step, termed "micrositing", translated the macrositing results into on-the-ground locations that address the many variables that impact the feasibility of station development.

Macrositing Activities and Results

For this report, "macrosite" is defined as a census-designated micro- or metropolitan statistical area. Within the largely-rural eight-county project area, there are five such census-designated areas. These five areas are Clearlake, Crescent City, Eureka-Arcata-Fortuna, Redding-Red Bluff, and Ukiah. While Clearlake is a metropolitan statistical area, it is outside of the study region.

Macrositing criteria were compiled to inform infrastructure site selection, followed by consultation with a researcher working on the California Air Resources Board's California Hydrogen Infrastructure Tool (CHIT). The four criteria are:

- Location on a major highway;
- Distance from the nearest existing FCEV market;
- Consistent with the Federal Highway Administration's Alternative Fuels Corridors;
- Significant capacity need identified by the California Hydrogen Infrastructure Tool.

The coalition provided feedback to the draft macrositing criteria. The project team also reviewed ARB's *2016 Annual Evaluation of FCEV Deployment and Hydrogen Fuel Station Network Development*[15], and applicable elements were incorporated into the regional macrositing criteria.

To promote consistency with other state efforts, the team met with Santa Barbara County Air Pollution Control District regarding their methodology for the Tri-Counties regional hydrogen infrastructure plan[33] and best practices for macro- and micrositing.

Macrositing Results

Using the four macrositing criteria detailed above, the project team identified the Redding-Red Bluff and Eureka-Arcata-Fortuna census-designated areas as phase one anchor sites for the region in the *Regional Hydrogen Infrastructure Plan*.

33 https://www.ourair.org/hydrogen-fuel-cells/

Table 3: Macrositing Results From *Regional Hydrogen Infrastructure Plan*.

Criteria:	Significant CHIT capacity need	Located on major highway	Distance from existing market *	Part of potential interregional network*	Priority one?
Redding-Red Bluff	Y	Y - 5	163 miles+	Y - 149 miles to Medford (178 miles to Grants Pass)	Y
Eureka-Arcata-Fortuna	Y	Y - 101	225 miles++	Y - 164 miles to Grants Pass	Y
Ukiah	N	Y - 101	69 miles++	N	N
Crescent City	N	Y - 101	309 miles++	Y- 82.5 miles to Grants Pass	N
Clearlake	N	N	63 miles++	N	N

*The largest city in the metropolitan or micropolitan statistical areas was used to determine distance.

+ The northernmost FCEV fueling station in the Sacramento area was used.

++ This table is dated and was based-on the northernmost FCEV fueling station in the San Francisco Bay Area at the time, which was Rohnert Park, CA. Rohnert Park is no longer being developed. Currently, Mill Valley is the closest station in the Bay Area. Mill Valley is 105 miles from Ukiah, and still well within the range of modern FCEV models.

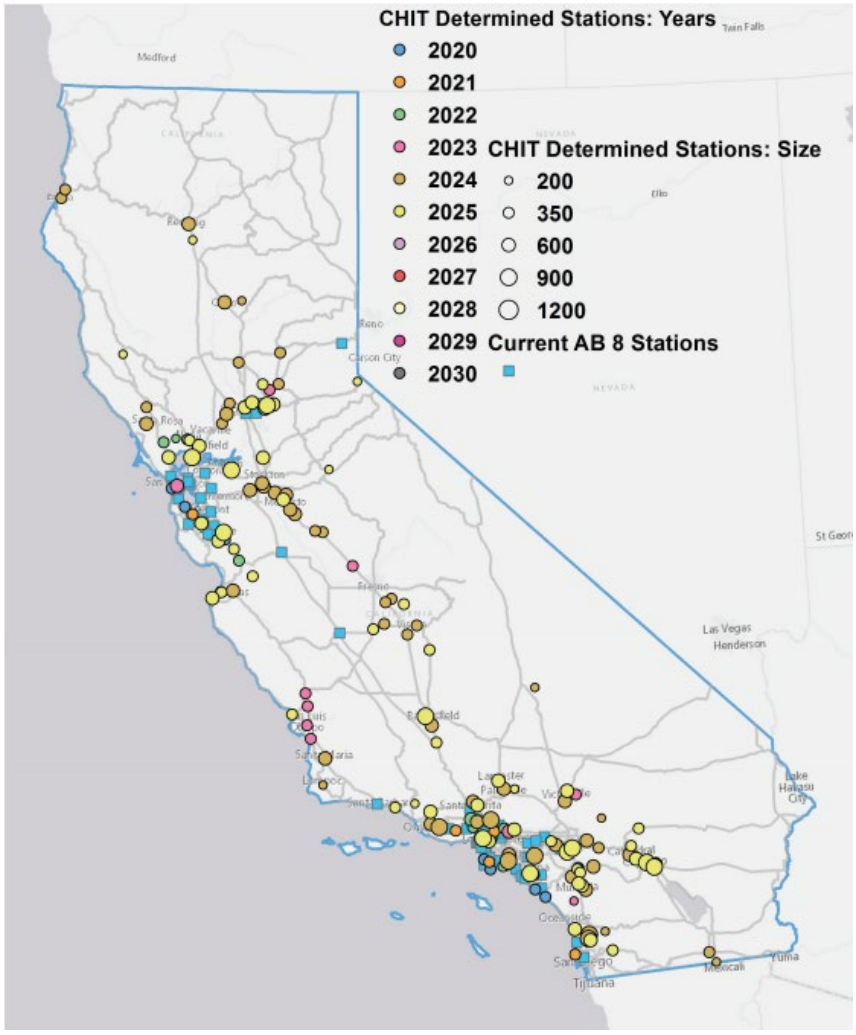
Source: RCEA 2019.

Redding-Red Bluff satisfies all four criteria for an FCEV fueling infrastructure macrosite. Parts of the metropolitan area, namely Redding, were identified by the CHIT tool as having a need for FCEV fueling capacity. It is located along Interstate 5 and is about 163 miles from Sacramento, within the range of existing FCEVs. It is roughly 149 miles from Medford and 178 miles from Grants Pass, Oregon also within FCEV range.

Eureka-Arcata-Fortuna also satisfied all four criteria. Eureka is the other city in the eight -county region where FCEV infrastructure capacity need was identified through CHIT. This micropolitan area is located along Highway 101 and is about 225 miles from San Francisco, within the range of new FCEV models. It is about 164 miles from Grants Pass, Oregon also well within the range of currently available FCEVs. Since the project

team's macrositing effort was completed in 2016/2017, ARB has officially identified Redding and Eureka as site locations to be added to the California hydrogen station network in 2024[34].

Figure 7: CHIT Results Identify Eureka And Redding As Site Locations for Development In 2024.



Source: California Air Resources Board

Crescent City met three of the macrositing criteria, while Ukiah met two. They should be considered the top macro-level candidates for phase two and phase three hydrogen fueling stations. These areas are lower priority for detailed micrositing analysis and site readiness activities but will be critical areas for hydrogen infrastructure as regional saturation of FCEVs increases. Siting stations in these areas will alleviate range anxiety, as current distances between priority-one microsites and existing market areas approach the upward limits of current FCEVs.

Ukiah is also located on Highway 101. At just 69 miles from Rohnert Park[35] and 156 miles from Eureka, it is well within the range of current FCEV models. A station in Ukiah would also serve as a valuable part of an interregional network, enabling roundtrip travel to and from Ukiah to other key areas in the North Coast region. A station in Ukiah would also help

34 California Air Resources Board, https://www.arb.ca.gov/msprog/zevprog/ab8/ab8_report_2018_print.pdf

35 This information is dated and was based-on the northernmost FCEV fueling station in the San Francisco Bay Area at the time, which was in Rohnert Park, CA. Currently, Mill Valley is the closest station in the Bay Area. This analysis was not redone to incorporate this recent development. It should be noted that Mill Valley is 105 miles from Ukiah; however this does greatly alter project results as 105 miles is still well within the range of current FCEV models.

reduce range anxiety for drivers travelling between San Francisco, Sacramento, and the North Coast.

Micrositing Activities and Results

Using the macrositing results presented in Table 3, the project team conducted micrositing analysis for the two priority macrositing areas. Within the Redding-Red Bluff and Eureka-Arcata-Fortuna statistical areas, Redding and Eureka were identified as the priority areas for in-depth analysis due to higher forecasted demand, population density, and regional significance.

To date, most retail hydrogen fueling stations have been installed at existing conventional gas stations. The North Coast Unified Air Quality Management District (NCUAQMD) and Shasta County Air Pollution Control provided lists of operating retail gas stations in Eureka and Redding.

Three spatial attributes were identified within the greater Eureka and Redding areas to guide the phase one site identification process. These attributes were:

- Existing retail gas stations,
- Appropriate municipal zoning for retail fueling stations, and
- CHIT capacity need results.

These three attributes were overlaid on a map to identify priority zones for station deployment. Existing gas stations were ranked based on their CHIT score. Together, these analyses guided the scope of the Task 2.4 *Site Readiness Report*. Priority zones were identified by overlaying applicable zoning layers with CHIT capacity need. Areas with a capacity need of greater than 90% of the maximum capacity need for the region were considered priority.

Existing Retail Gas Stations

The project team used gas station lists obtained from the Shasta Air Quality Control, North Coast Unified Air Quality Management District (covering three counties), and the Mendocino County Air Quality Management District to develop a preliminary summary of potential site hosts in the default macrositing radii.

Municipal Zoning and Permitting

The team developed a list to document land use and other restrictions applicable to hydrogen siting for state land and state agencies regarding public and private fueling. From a planning and permitting perspective, hydrogen stations are typically subject to the same zoning constraints as gasoline stations. Station footprint is guided by NFPA 2 Hydrogen Technologies Code, subject to modifications by the permitting authority.

Following a municipal code review, zoning classifications that list retail gasoline stations as a permitted use were identified. In the case of Eureka, only commercial zones list gas stations as a permitted use. The same is true for contiguous areas of

Eureka that are administered by Humboldt County. In the case of Redding, both commercial and industrial zoning classifications permit retail gas stations. Vacant lots in permittable zones may also be considered.

CHIT Fueling Capacity

The project team then added CHIT fueling capacity need scores as an overlay to indicate relative priority among different areas of the two target jurisdictions. CHIT outputs reflect projected demand for hydrogen fuel and the ability of existing and proposed stations to meet that demand. The most relevant output to this project was the capacity need projection. This model result spatially allocates ARB's estimate of 43,600 FCEVs in 2022 based on a suite of FCEV adoption proxy variables. These proxy variables include adoption rates for other green vehicles, such as hybrid-electric vehicles (HEVs), plug-in hybrid electric vehicles (PHEVs), and battery-electric vehicles (BEVs), as well as income, education, vehicle MSRPs, and concentrations of luxury vehicles. The result is a projected fuel capacity need, expressed in kilograms per day, for all areas of California.

Fuel capacity need projections were determined to be meaningful in the context of both fueling capacity needed and FCEVs served. To produce the latter estimate, average daily fuel consumption was estimated for one FCEV. According to findings from the American Driving Survey, the average American drives thirty miles per day[36]. Combining this information with an estimated sixty miles per kilogram fuel efficiency for currently available FCEVs, a daily fuel use of 0.5 kilograms per day per vehicle was estimated. Therefore, every kilogram of projected fueling capacity need would indicate the presence of two FCEVs in each area in 2022.

Preliminary Site Ranking

A preliminary ranking of gas stations was then conducted to determine locations for phase one, two, and three sites. Gas stations in Eureka and Redding were ranked by CHIT score. This ranked list will serve as the basis for the site readiness task; see page 31 of the *Regional Hydrogen Infrastructure Plan.*

The project team evaluated individual stations based on a suite of qualitative criteria. Qualitative criteria evaluation, in combination with CHIT model results, informed Task 2.4 activities.

Micrositing Rubrics

36 Triplett, Santos, Rosenbloom (AAA). June 2015. American Driving Survey. http://newsroom.aaa.com/wpcontent/uploads/2015/04/REPORT_American_Driving_Survey_Methodology_and_year_1_results_May_2013_to_May_2014.pdf

With a preliminary list of sites, the team then developed a micrositing rubric to identify key criteria for an initial siting of a fueling station. Leveraging existing resources on hydrogen station development, the following steps were selected to continue the micrositing work:

- Develop a rubric for multiple potential station designs with different space, regulatory, and economic constraints.
- Develop a comparative feature list of different station designs to enable stakeholder engagement and start the design process. Consider trade-offs such as delivery vs. on-site generation, space requirements, on-site power constraints, O&M staff availability, and reliability.
- Use the rubric in a two-step process to first pre-assess potential site hosts with regards to a specific subset of critical variables, then conduct a second assessment to identify a short list of potential site hosts.
- Engage with short list of potential station owner/operators. If needed, branch out to other potential site hosts depending on results of initial stakeholder engagement. Identify a potential site host in each macrositing region.

The results of this analysis are in Section 2.4.

Project Partner Engagement

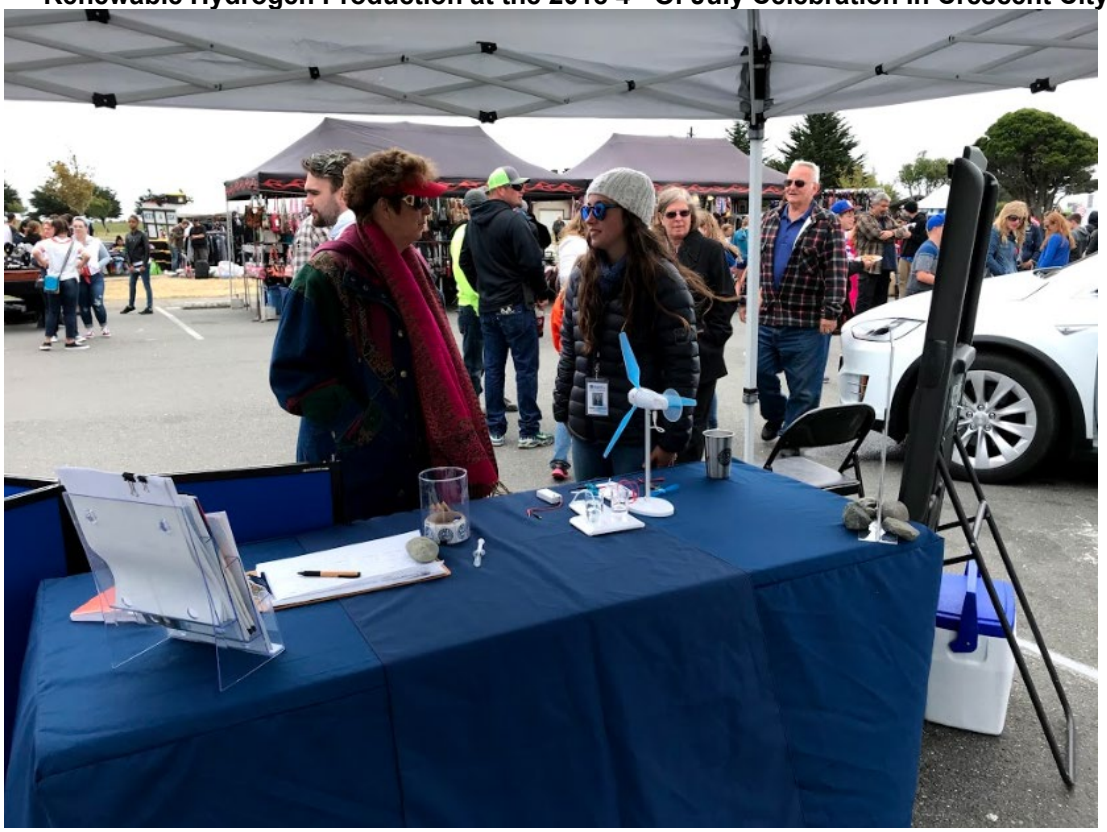
The coalition members received a draft *Regional Hydrogen Infrastructure Plan* and feedback was incorporated into the final plan. MCOG and NCUAQMD provided feedback in a Coastal Partner meeting on August 22nd, 2017, and other project partners provided feedback through e-mail. Additional information about collaborative work is detailed in the following chapters of this report.

CHAPTER 3: Promotion of FCEV Use

FCEVs and infrastructure planning efforts were promoted via handouts, banners, tabling events, and a hydrogen-fueled shuttling service at 21 different events from September 2015 through October 2018.

Community Events

Figure 8: Redwood Coast Energy Authority Staff (Right) Inform the Public About Renewable Hydrogen Production at the 2018 4th Of July Celebration In Crescent City.



Source: RCEA 2018

This project took advantage of BEV-specific promotion efforts in the region to inform the public about the project. A major challenge is the lack of locally-available FCEVs on the market, and SERC's vehicle testing contracts ended in December 2015, which made subsequent FCEV expos difficult to host. The project team did engage with mobile refueling companies, but the cost to bring a mobile refueler to the region far exceeded the project budget (the project team was quoted $50,000 to deploy a mobile refueler for a weekend ride-and-drive event). Instead of showing vehicles, the project team purchased wind-to-hydrogen kits to demonstrate renewable hydrogen production pathways. These kits were used at several community events and served as effective

avenues for engaging the public in conversation. Additional photos from engagement events can be found in the *Task 2.2 Summary Report*.

Table 4: List of ARV-14-055 Community Events

Stakeholder Event	Location	Date	Summary
North Country Fair (Humboldt County)	Arcata, CA (Humboldt County)	September 2015	Through partnerships with Hyundai and Toyota, an FCEV and fuel cell hybrid vehicle participated in an EV Ride and Drive event. The FCEVs served as shuttles between a local annual fair and the ride and drive venue.
Sustainable Living Expo	Arcata, CA (Humboldt County)	October, 2015	Through partnership with Toyota, demonstrated the Toyota Highlander FCHV and educated the general public.
Redwood Acres Home Garden and Recreation EV Expo (Humboldt County)	Eureka, CA (Humboldt County)	April 2016	Distributed FCEV program information (FCEV fueling network and available models) at EV expo event.
Eureka Natural Foods EV Expo	Eureka, CA (Humboldt County)	April 2016	Distributed FCEV program information (FCEV fueling network and available models) at EV expo event.
Oyster Fest	Arcata, CA (Humboldt County)	June 2017	Distributed FCEV program information at EV expo event.
Pony Express Days	McKinleyville, CA (Humboldt County)	June 2017	Distributed FCEV program information at EV expo event.
Hybrid and Electric Drag Race	Samoa, CA (Humboldt County)	June 2017	Distributed FCEV program information at EV expo event.
Fish Festival	Trinidad, CA (Humboldt County)	June 2017	Distributed FCEV program information at EV expo event.

Stakeholder Event	Location	Date	Summary
Eureka 4th of July Festival	Eureka, CA (Humboldt County)	July 2017	Distributed FCEV program information (FCEV fueling network and available models) at EV expo event.
Turtle Bay Expo	Redding, CA (Shasta County)	August 2017	RCEA partnered with the Siskiyou Economic Development Council to provide FCEV program information (FCEV fueling network and available models) at an EV expo event.
Siskiyou County Chamber of Commerce Business Expo	City name N/A (Siskiyou County)	February 2018	Staff educated the public on how FCEVs work, the benefits of FCEVs, and informed them about all alternative fuels planning projects that SEDC is working on. Staff provided the public with several handouts, including a summary slide from the RCEA "Train-the-Trainer" (Appendix A) presentation as well as other resources from the California Fuel Cell Partnership.
Humboldt State University Career Fair	Arcata, CA (Humboldt County)	February 2018	Discussed FCEV technology, status of hydrogen fueling infrastructure, and project developments with 25-50 students.
Samoa Open House	Samoa, CA (Humboldt County)	March 2018	Discussed FCEV technology, current available models, status of hydrogen fueling infrastructure, and project developments with members of the public.

Stakeholder Event	Location	Date	Summary
Glenn County Fair	Orland (Glenn County)	May 2018	The Glenn County Department of Agriculture maintained a booth at the Glenn County Fair from May 17-20th in Orland, Ca. Prominently displayed on the booth was information specific to FCEV's. The rotating staff members of the booth were given resources to answer the public's questions. Feedback was generally good.
Crescent City 4th of July Celebration	Crescent City, CA (Del Norte County)	July 2018	Staff educated the public (100+ individuals) about renewable hydrogen production using the wind-to-hydrogen kit. Staff provided hand-outs educating the public about available models, FCEV versus BEV technology, costs of vehicles, and other FAQs.
Siskiyou County 4th of July Event	City name N/A (Siskiyou County)	July 2018	Discussed FCEV technology, current available models, status of hydrogen fueling infrastructure, and project developments with members of the public.
Siskiyou County Trail Town Celebration	City name N/A (Siskiyou County)	July 2018	See above.
Eureka 4th of July Celebration (Humboldt County)	Eureka, CA (Humboldt County)	July 2018	Staff educated the public (100+ individuals) about available FCEV models, FCEV versus BEV technology, costs of vehicles, and other FAQs.
Humboldt State University Alternative Transportation Fair (Humboldt County)	Arcata, CA (Humboldt County)	August 2018	HSU hosted an Alternative Transportation Fair for incoming freshman. Staff educated 100+ freshman about FCEV technology and fueling infrastructure, using the wind-to-hydrogen kit to discuss

Stakeholder Event	Location	Date	Summary
			production pathways. Staff had an EV on display and used it to compare BEV to FCEV technology.
Shasta Lake Farmer's Market	City name N/A (Shasta County)	September 2018	Used wind to hydrogen educational kit to perform demos for the public about hydrogen production. Shared information about FCEV models, planning efforts, and current infrastructure.

Source: RCEA 2019

Earned Media

Educating and promoting new technology requires a multi-faceted approach. Attending community events builds rapport with the general public, which is key when discussing plans that may affect that community. In this case, hydrogen fueling stations and vehicles will ultimately be present in communities throughout the project region. Naturally, the public has questions regarding the safety of the vehicles and infrastructure. Addressing them requires tactful and personable communication. Meeting individuals on their terms, rather than expecting them to attend a meeting during the middle of the work day, also increases the likelihood of positive engagement and education. For all these reasons, tabling at community events is a frequently used approach.

However, tabling at community events is not always the most effective way to reach a large demographic. This is where earned media earns a place at the table, as opposed to owner-generated or paid media.[37]

Earned media is advantageous when compared to the other two forms as it is free, results in more impressions, and tends to be less influenced by the biases of the information generator, which can mitigate potential mistrust of the content.

The project team secured the following earned media events, in accordance with grant objectives:

[37] Yu, Jim. 2013. "Earned Media Rising - The Earned Media Ripple Effect". *Marketing Land*.

1) The project team was interviewed by Channel 3 News (Humboldt County TV station) about the FCEV shuttles used for Oyster Fest in June 2015 (no file found in archives)
2) The project was featured in an article in the Schatz Energy Research Center newsletter distributed in October 2018
3) The project team was interviewed in an episode of Access Humboldt's "Community Voices" program. This episode was televised and broadcasted through radio in October 2018.
4) The project was featured in a Times Standard (newsprint and online publication) article titled, "Local energy partnership readying North Coast for hydrogen powered cars" in October 2018.

The project team was unable to retrieve a video file of the 2015 interview. The other earned media products can be found on page 31 the *Task 2.2 Summary Report.*

While the nature of earned media tends to be serendipitous, press releases and newsletters have proven to be a reliable way to capture the attention of local media outlets, which then are more likely to reach audiences outside of the local region. One example of this from the project came from the Times Standard article. After it was published, station developers and other entities outside the region reached out to the project team to learn more about the North Coast and Upstate project.

Attending community events generated additional earned media opportunities as local outlets frequently cover community events, no matter how large or small. The lists of media outlets is not documented here but can be shared on a case-by-case basis should localized community engagement be pursued in the future.

Presentations

To round-out the trifecta of engagement methods, 14 presentations were delivered throughout the region to a variety of stakeholders.

"Train-the-Trainer" Webinar

RCEA created a "Train-the-Trainer" presentation (Appendix A). This presentation is a high-level introduction to hydrogen fuel and fuel cell electric vehicles and provides the audience with sufficient information to be ambassadors in their own communities. A comprehensive master slide deck was developed to facilitate the creation of different presentations for varying audiences.

The coalition received the first presentation of "Train-the-Trainer"; thereafter coalition members were invited to submit questions and requests for additional materials to use in their engagement activities. Coalition members were encouraged to use and adapt the presentation material to suit their own outreach goals and audiences.

Regional Presentations

Project partners adapted the "Train-the-Trainer" presentation to conduct engagement in their own counties. Other targeted presentations were delivered during the project period as well; presentation files are referenced in Table 5.

Figure 9: Janet Orth Delivers a Presentation About The Fuel Cell Readiness Planning Project to the Mendocino Council of Governments' Board

Attendee numbers were recorded for some, but not all presentations. Specific city locations for presentations were also partially included. Where attendee counts and specific locations were recorded, they are included below.

Table 5: List of Presentations

Stakeholder Event	Location	Date	Summary/Results
Combined Meeting of North Coast Super Region and CA Rural Counties Task Force (Appendix B)	Yreka, CA	September 2015	Provided an overview of the project to transportation planning agencies in the region.
Local Government Sustainable Energy Coalition Meeting	N/A	May 2016	Provided summary of alternative fuel activities
North Coast Super Region Meeting	Redding, CA	May 2016	Presented summary of *Regional Hydrogen Infrastructure Plan* to transportation planners and fleet operators representing a 16 county region
California Air Pollution Control Officers Association Annual Meeting (Appendix C)	Lake Tahoe, CA	May 2017	Presented hydrogen infrastructure planning summary to air pollution control officers
Coastal Partners Meeting (Appendix D)	Eureka, CA	August 2017	Met with the North Coast Unified Air Quality Management District and Mendocino Council of Governments to receive input on infrastructure planning approach and outcomes

Stakeholder Event	Location	Date	Summary/Results
"Train-the-Trainer" Webinar	N/A	April 2018	See previous description in this section. All project partners attended; input from partners informed an extended FAQ sheet and additional stakeholder resources. Attendance was ~10 individuals.
North Coast Super Region Meeting	Clear Lake, CA	April 2018	Presented briefly on FCEV planning efforts. Attendance was ~10 individuals.
Siskiyou County Local Transportation Commission	N/A	June 2018	Generally, the audience thought that FCEVs were still too early in the development stages to be embraced locally at present.
North Coast Air Quality Management District Board Meeting	Eureka, CA	September 2018	NCUAQMD staff had questions about what micrositing entailed and why a consumer would choose FCEVs. The presenter and Board also discussed implementation ideas and if getting fleet interest prior to public interest would be beneficial to the adoption of FCEVs. The idea of seeing fleet vehicles (package delivery or Caltrans) supporting the technology may make consumers feel less anxiety about choosing an alternatively fueled vehicle. Information presented during the Train-the Trainer webinar and general knowledge about the Project provided answers to all staff questions. Attendance was ~8 individuals.

Stakeholder Event	Location	Date	Summary/Results
Far North Regional GIS Council Meeting	Redding, CA	July 2018	The presentation was well-received, and attendees were interested in the information being presented. Most were unaware of efforts to bring FCEVs to the region but were interested and intrigued by the information. The presentation was delivered in a casual manner, with opportunities for the attendees to ask questions throughout the presentation. This allowed for a collaborative, conversational presentation, and engaged the attendees. The questions received were expected (isn't this technology dangerous, who is driving these vehicles, where are the vehicles, etc.). The presentation had several slides built in that addressed the questions. Attendance was ~20 individuals.
Glenn County Fuel Cell Electric Vehicle Workshop	N/A	August 2018	The Glenn County Air Pollution Control District hosted a workshop presenting information related to the technology and current status of the Fuel Cell Electric Vehicle industry. The invitation was distributed to fleet manager and fuel distributer contact lists as well as to the Transportation Commission and the public. The presentation given was a variation of the "train the trainer" presentation. Turnout was low but some good questions were asked.
Tehama County Fuel Cell Electric Vehicle Workshop	N/A	September 2018	The Tehama County Air Pollution Control District hosted a workshop presenting information related to the technology and current status of the FCEV industry. The invitation was distributed to fleet manager and fuel distributer contact lists as well as to the Transportation Commission and the public. Turnout was low but good questions were asked pertaining to vehicle and fueling technology.

Stakeholder Event	Location	Date	Summary/Results
Mendocino Council of Governments Board Meeting	N/A	August 2018	MCOG staff made a presentation to the Council's board of elected officials representing the five local governments in the joint powers authority. There were about twelve engaged attendees and several good questions were asked regarding the technology. Overall, this was a good introduction to the technology for policy-makers.
Sustainable Futures Speaker Series ZEV Panel Discussion	Arcata, CA	October 2018	RCEA and SERC partnered to host a panel discussion as part of Humboldt State University's Sustainable Futures Speaker Series. The panel discussion focused on 2030 ZEV adoption goals in California, and panelists weighed-in on how the region could achieve said goals. Panelists were the following: • Leslie Baroody, California Air Resources Board • Anthony Harrison, ChargePoint, Inc. • Greg Pratt, Humboldt Transit Authority • Jerome Carman, Schatz Energy Research Center • Aisha Cissna, Redwood Coast Energy Authority • Keith Malone, California Fuel Cell Partnership Attendance was ~50 individuals and the content was well-received. The promotional flyer used for this event can be found in the Appendix J.

Source: RCEA 2018

Figure 10: Dr. Kevin Fingerman Posing a Question to Panelists at the Sustainable Futures Speaker Series Panel Discussion on California ZEV Mandate Implementation.

Source: RCEA 2018

CHAPTER 4: Incorporation of FCEVs into Municipal Fleets

Vehicle fleets have the potential to play an important role in developing the early FCEV market in the project region. Currently, there are no FCEVs or hydrogen fueling stations in the North Coast and Upstate. Consequently, establishing a "seed" population of vehicles would create dependable demand and prevent stranded assets. Given the initial high capital costs of installing a hydrogen fueling station, establishing a base level of demand for the fuel in conjunction with station installation is necessary to achieve a minimum level of return on investment and provide an incentive for station developers and operators. Fleet use of FCEVs would establish this base level of demand.

There are many advantages of engaging fleets to deploy FCEVs. These advantages are described in detail in the *Task 2.3 Summary Report*, but essentially constitute the following:

- Centralized operation and maintenance.
- Consistent and well-understood usage profiles and business case.
- Simplified refueling at a central depot.
- Consistent tracking and evaluation of vehicle operating costs and total cost of ownership.

To promote the adoption of FCEVs in local vehicle fleets, the project team proposed the following objectives in the ARV-14-055 grant agreement:

- Work with municipal fleet managers and public transit operators, targeting those that operate within the municipalities of phase-one anchor sites identified in Task 2.1, to conduct fleet vehicle assessments on the feasibility of switching to FCEVs;
- Assist fleet managers with fleet replacement strategies;
- Communicate potential fleet fuel demand to local fuel distributors and/or potential fueling site hosts;

To achieve these objectives, the project team completed the following activities:

- Identified fleets in the region;
- Distributed a Request for Information (RFI) seeking information and interest from fleets throughout the region (page 32 of the *Micrositing Analysis Summary Report*);
- Compiled resources for fleet managers;

- Evaluated the application of a fleet analysis tool to determine the economic feasibility of FCEV integration for local fleets;
- Surveyed local fleet operators;
- Educated fleet operators about the benefits of FCEVs;
- Focused follow-up efforts on engagement with phase-one (Eureka and Redding) fleet managers; and,
- Offered fleet evaluations to the contacted parties.

Fleet Vehicle Assessments

To facilitate the incorporation of FCEVs into municipal fleets, each coalition member identified ten key fleets in their respective County and engaged with three of those fleets to assess the feasibility of FCEV integration.

All coalition members participated in the ""Train-the-Trainer"" webinar so they could speak with confidence to fleet managers regarding the status of FCEV and hydrogen fueling station technology. The webinar revealed that coalition members required training and information on basic terms and concepts. The webinar also allowed time for questions and dynamic discussion which proved important for ensuring participant engagement and understanding of concepts. Coalition members also communicated that the webinar was important for providing the confidence they needed to engage in outreach efforts.

Each partner also had a fleet-specific handout (Appendix F) to share with managers which outlined the current models, incentives, and training resources for FCEV fleet applications. Thereafter, each partner sought to directly engage managers through informational interviews (page 20 of the *Task 2.3 Summary Report*) that gathered information such as the number and types of vehicles in each fleet, interest and knowledge of FCEVs, interest in hosting a hydrogen fueling station, and interest in receiving a fleet assessment. In conjunction with the informational interviews, all project partners were asked to distribute the Request for Information (RFI) throughout their regional network.

Fleet Information Gathering

Ten key fleets were identified for each County. Direct engagement with fleets was met with varied levels of success. The major conclusions drawn from these informational interviews were:

- Few fleets engaged through these informational interviews expressed interest in receiving a detailed assessment since the vehicles and fueling stations are not available locally;
- And, most fleets did not have sufficient funds to cover capital costs.

These results are similar to those described in Chapter 6 of the *Tri-Counties Hydrogen Readiness Plan*[38].

Fleet Evaluations

In 2017, the project team considered revamping an internal fleet analysis tool to include all ZEV vehicle options—namely fuel cell electric vehicles— in consultation with the City of Arcata, a municipality in Humboldt County. The project team was conducting a quantitative fleet assessment for Arcata and sought to do a pilot assessment of FCEV replacements. After evaluating this application, the team determined that it would not be prudent to do quantitative assessments since the payback period for FCEVs would not be low enough to justify a departure from municipalities' default replacement ICE vehicles.

With this lesson learned, the project team determined that qualitative assessments would be provided instead of robust economic analyses. These "qualitative" assessments took the following form:

1) Approach fleet operators with requests for vehicle types and number of each class. If the fleet operator responded favorably to this data request and expressed interest in exploring replacement options, then step #2 was taken.
2) Assess vehicles in each class and replacement year, and compare to current market availability of FCEV options to determine to what extent FCEVs could be incorporated, and
3) Inform the fleet manager of this assessment and determine next steps to expedite the adoption of FCEVs.

Results of Fleet Evaluations and Assessments

Caltrans

The Caltrans Division of Equipment (DOE) purchased 20 FCEVs for the 2016-2017 fiscal year. Following this development, the Schatz Energy Research Center (SERC) engaged Caltrans regarding siting potential fueling stations in Districts 1 and 2. District 1 covers Del Norte, Humboldt, Lake, and Mendocino Counties. District 2 covers Lassen, Modoc, Plumas, Shasta, Siskiyou, Tehama, and Trinity Counties. Glenn County is the only ARV-14-055 project partner that was not covered by this district engagement.

SERC decided *not* to offer a fleet vehicle assessment since Caltrans Districts 1 and 2 staff stated that Caltrans State headquarters would provide one or more vehicles to District 1 fleet if local fueling stations were installed. The benefit of a

38 Santa Barbara County Air Pollution Control District. 2017. *Tri-Counties Hydrogen Readiness Plan.* California Energy Commission. Publication Number: CEC-XXX-XXXX-XXX.

fleet assessment is to determine the type and number of fleet vehicles that would be eligible for replacement by an organization. The ultimate end goal of a fleet assessment is to expedite the adoption of FCEVs, and in this instance, infrastructure was the primary hurdle—not accessibility or knowledge of FCEVs.

California Department of Fish and Wildlife

The California Department of Fish and Wildlife (CDFW) participated in an informational interview in July 2018. Initially, the Eureka CDFW office was approached for a localized fleet assessment, and the local office communicated that all purchases are coordinated at the State level. As a result, the project team conducted the informational interview with the CDFW Department of Fleet and Asset Management headquartered in Sacramento.

The survey answers indicated that the CDFW owns 9 sedans, 31 SUVs, and 78 light-duty pick-up trucks in the Northern California region. CDFW is enthusiastic about incorporating FCEVs but has yet to do so in the project region due to a lack of infrastructure as well as limited commercial vehicle options. CDFW is particularly interested in medium-duty FCEVs, specifically large pick-up trucks with 4x4 capability.

Overall, CDFW was well-informed of the applicability of FCEVs and the major hurdle to fleet incorporation was infrastructure availability. As such, the project team focused engagement efforts on identifying sites in the project region that could provide fuel for CDFW fleets.

CDFW identified two potential properties for station installation; one in Yreka (1625 South Main Street) in Siskiyou County, and the other in Redding (601 Locust Street) in Shasta County. While the CDFW offices are located on these parcels, they are technically owned by the California Department of General Services (DGS) and several other agencies. To accelerate CDFW FCEV adoption, the project team engaged, and continues to engage, with both CDFW and DGS.

California Department of General Services

The four key goals of DGS engagement included identifying if DGS would be able to host fueling stations on DGS-owned land, identifying land suitable for hydrogen station development, determining if public access to stations on DGS land is possible, and identifying DGS vehicles that would be candidates for FCEV replacement.

At the time this report was prepared, the Redding parcel was determined to be owned by CDFW, DGS, and the Department of Motor Vehicles (DMV). Next steps involve determining the logistics of a lease agreement between a State agency (or multiple State agencies) and a private station developer. This effort would be the first of its kind and possibly set a precedent for other local governments and State agencies throughout California. The City of Riverside's station development

serves as a useful model, and the project team is currently contacting relevant staff in Riverside to determine next steps.

DGS returned State-wide fleet characterization data for all vehicles owned and identified which vehicles are targeted for immediate replacement, and which are eligible for long-term replacement.

The intent behind this activity is to evaluate DGS LDVs that could potentially be replaced by FCEVs within the next 5 years, and a list of LDVs, MDVs and HDVs that could be replaced by FCEVs in the more distant future (i.e. 5 to 10+ years). Next steps involve engaging with MDV/HDV experts at the California Fuel Cell Partnership (FCP) to assist with this, and hopefully other fleet, vehicle assessments.

City of Arcata

The project team considered conducting an in-depth quantitative economic analysis for FCEV integration for the City, as mentioned above, but it was ultimately deemed infeasible. The City is interested in engaging on this topic. RCEA will continue to work with the City when possible on fleet replacement options when tools become available.

Humboldt Transit Authority

Of the FCEV options available to fleet managers, fuel cell electric buses (FCEBs) are particularly attractive since they qualify for numerous financial incentives and have been successfully deployed by transit agencies in California.

There are two main financial incentives available to transit agencies

- The Federal Transit Administration's Low/No Emission grant which can be applied toward the lease or purchase of a FCEB, and associated infrastructure.

- The Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP)

The Humboldt Transit Authority expressed interest in incorporating FCEBs into their fleet but expressed that they had applied twice for the FTA grant for battery electric bus funding without success. Again, conducting a vehicle assessment would not have expedited the integration of FCEBs. Instead, access to fueling infrastructure and grant funding are the primary hurdles.

The project team engaged with Sunline Transit, who has successfully integrated FCEBs into their fleet to obtain best practices regarding funding acquisition and general lessons learned. Minutes from this meeting are included in Appendix G.

Following conversations with Sunline Transit, the project team contacted the Center for Transportation and Environment (CTE). In the meeting with CTE, the project team learned that CTE offers technical support for FTA grants, specifically assisting applicants through the application process for the Low/No program. The project team informed HTA of this resource and, in conjunction with engagement with RCEA and the California Fuel Cell Partnership, HTA expressed nascent interest in being connected with CTE for future potential applications.

Fleet Replacement Strategies

The second task activity, which consisted of assisting fleet managers with fleet replacement strategies, was initially envisioned to be a follow-up activity to the assessment. Outside of the stakeholders covered in the previous chapter, most of the project region was not interested in discussing fleet replacement strategies as they could not access the vehicles in the first place. This is due to lack of fueling infrastructure and, as such, no auto manufacturers will sell these vehicles to local commercial fleets.

Instead of replacement strategy assistance, project partners used the informational surveys to educate fleets and evaluate the steps necessary to make replacement strategy discussions pragmatic. Several coalition members hosted workshops in their counties and invited fleet managers as well. A list of fleets for each county can be found on page 30-33 of the *Task 2.3 Summary Report*. In addition to gathering information from the operators, project partners also educated interviewees about the current vehicles on the market, financial incentives, and training resources.

The other benefit of this exercise was a consolidated contact list for use by station developers, auto OEMs, and other stakeholders who desire local contacts. The project team held initial conversations with one station developer in particular who has interest in Redding as a future site; the developer expressed that having local contacts makes the site scoping process much easier. Next steps pertaining to developer engagement are further discussed in Chapter 6 of this report.

Results of Fleet Interviews

The key take-aways gained from the informational interviews across the entire project region include:

- Rural government fleet managers are very busy people who often fill multiple professional positions. For the vast majority of local government fleet managers, motivation to adopt FCEVs in an early market will need to come in the form of regulatory pressure such as funded mandates, or incentives.

- Historic wildfires in the project region made it difficult to engage government fleet operators.
- Even with available rebates, FCEV costs are still too high. Budgeting for current fleet vehicles is difficult, let alone finding excess funds to incorporate the marginal cost of new technology. Additional grant funding would help address this issue.
- FCEVs are not available on the local market, and if a fleet were to purchase an FCEV, they would not have access to a fueling station or a mechanic with specialized FCEV expertise. Of the fleet operators who were responsive to survey requests, none were interested in hosting a fueling station aside from the California Department of Fish and Wildlife.
- Some operators voiced concerns regarding reliability, uncertainty, and dependability of FCEVs. Operators were informed of basic safety mechanisms in place for FCEVs, but additional information regarding safety features (i.e. solenoid fail-safes) is necessary. Providing more fleet case studies demonstrating successful use of FCEVs would also help address this issue. Current state fleet mandates can be leveraged to accomplish this.
- Accessibility to training was another concern. The handout provided to fleet operators included training resources, but additional and targeted training that is easily accessible would presumably address this issue.

Fleet Fuel Demand

At the beginning of the grant term, the project team hoped to gather the following information to deduce fuel demand for the region:

- Number of LDVs eligible for immediate replacement and their usage profiles
- Number of MDVs and HDVs eligible for future replacement and their usage profiles

Once fuel demand was deduced, fuel distributors would be informed of this potential demand.

The project team gathered vehicle counts from several fleets, but it was not comprehensive enough to project fuel demand for the entire region. Without concrete fuel demand, the project team determined it was not practical to engage with distributors at this time.

Nevertheless, the project team did gather contacts for regional retail and wholesale fuel distributors in each county. Future developers and planners can leverage this contact information to engage with these businesses as the market matures. Fuel distributor contact lists can be obtained on request from the primary authors. These project partner reports were technically created to inform the *Task 2.2 Summary Report*, but chapters 3 and 4 contain relevant information for task 2.3 tasks.

While not scaled to specific fleet demand, the team's *Regional Hydrogen Infrastructure Plan*[4] did estimate fuel demand and FCEV adoption at a macro-level for the project region.

Table 6: Estimates of Local FCEV Adoption Based on Statewide Adoption

Year	California	North Coast and Upstate Regions
2018	10,500 FCEVs	54 FCEVs
2019	13,500 FCEVs	69 FCEVs
2020	18,465 FCEVs	94 FCEVs
2021	34,300 FCEVs	175 FCEVs
2022	43,600 FCEVs	222 FCEVs
2023	53,633 FCEVs (extrapolated)	274 FCEVs
2024	63,667 FCEVs (extrapolated)	325 FCEVs

Source: California Air Resources Board and Redwood Coast Energy Authority Analysis. 2016 Annual Evaluation of Hydrogen Fuel Cell Electric Vehicle Deployment and Hydrogen Fuel Station Network Development.

The project team also approached fleets who demonstrated the greatest interest in FCEVs with a letter-of-intent to demonstrate fuel demand which could then be used to draw developer interest. While rough fuel demand estimates demonstrate regional need to developers, tangible fleet commitments offer assurance that a station will continue to operate once CEC funding expires for capital expenditures and start-up operations and maintenance. The current process for funding stations, at a high-level:

1) California Energy Commission posts solicitation for hydrogen station capital and time-bound O&M funding
2) Station developers (most common applicant for solicitations) apply for funding, asking for location-specific funding
3) CEC awards capital funds to developer, with some O&M funds for a 3-year period

Caltrans District 1 executed a letter-of-intent (Appendix I). Caltrans, CDFW, and DGS continue to be the most promising leads for station developers as they seek a foothold in the region.

CHAPTER 5: Hydrogen Fueling Site Readiness

The project team devoted significant effort to preliminary identification of potential locations for early market fueling stations. The intent was to reduce the amount of initial groundwork needed to identify viable development projects in the region, help attract private and/or public investment, and inform key stakeholders in the region. This effort included:

- Stakeholder engagement and input regarding site host interest, city planning needs and preferences, and fleet fuel demand potential;
- Development of preliminary site evaluation criteria for identifying potential fuel station site locations;
- Development of a micrositing summary report to document overall efforts; and
- Development of a *Site Readiness Report* that documents site evaluation criteria, station design recommendations, and a preliminary list of recommended sites to be pursued in future efforts.

The following sections document this work and refer to the Site Readiness Report for additional detail.

Stakeholder Input

Stakeholder engagement regarding fuel station siting focused on City planning officials. Additional efforts included Request for Information (RFI) distribution, and engagement with Caltrans and local transit agencies.

City Planning Officials

The task 2.1 macrositing effort identified the cities of Redding and Eureka as key early market locations[4]. Therefore, the project team met with planning officials from these two cities. These meetings were intended to inform each jurisdiction about the status and findings of this project, receive input from each jurisdiction regarding planning or permitting needs, and identify preferences for the location of hydrogen fueling stations. Results of this input can be found in the *Task 2.4 Micrositing Summary Report* described later in this section and included in the *Micrositing Analysis Summary Report*.

Request For Information

The project team released a public Request for Information, which was distributed by the coalition throughout the project region in April 2018. The goal of this RFI was to solicit information and interest from potential stakeholders that the project had not already considered. The initial intention was to only disseminate the RFI in the anchor site jurisdictions, but the project team decided it would be prudent to disseminate in all

jurisdictions, even if no response was garnered. There was minimal response and few actionable items resulted from this effort. Additional details can be found in the *Task 2.4 Micrositing Summary Report* described later in this section and included in Micro.

State and Local Government Fleets

As mentioned in the previous chapter, the project team engaged with various state and local government fleets. One goal of this engagement was to determine interest and feasibility regarding hosting fueling infrastructure on state and local government property. Apart from the California Department of Fish and Wildlife, no agency was interested in locating fueling infrastructure on government property.

A key lesson learned is that the directors and managers of each state and local government location or district ultimately make the decision regarding FCEV consideration and site host participation. For satellite offices of State agencies, garnering support at the state level is important, but fleet decisions are ultimately made by each regional office or district. For local government fleets, garnering support at the City or County level is also important, but the fleet manager makes the ultimate decision.

For numerous reasons regional districts and fleet managers are given significant autonomy, and blanket ZEV adoption mandates to date have been intentionally structured to maintain this autonomy. Because of this, fleet adoption mandates typically create the incentive to consider, not adopt, FCEVs and hydrogen fueling infrastructure. As such, engagement with each individual fleet is essential for pursuing state and local property as potential locations for fueling infrastructure.

Fleet mandates are providing an important foot in the door to discuss FCEVs and fueling infrastructure with fleet managers, but they have yet to catalyze action. It is difficult to find a state or local fleet that is willing to host fueling infrastructure. Lack of familiarity or case studies lead government fleet managers to push perceived risk onto the private sector or other government entities. The project team sees fleet mandates as a critical lever to pull to catalyze early market adoption in rural areas. However, to move from interest to action, these mandates must be followed with a dependable funding stream for fueling infrastructure that address both the marginal capital and O&M expenses, and the uncertainty associated with new technology in an early market.

A more tractable near-term strategy for locating fueling infrastructure on government property may be to create a precedent for private sector leasing of government-owned land to host fueling infrastructure. Since CEC solicitations are proving successful in attracting private investment in fueling infrastructure, this approach may strike the right balance in reducing the barrier in identifying willing site hosts in rural areas while also offloading early market risk to the private sector. The company StratosFuel has accomplished this with the City of Riverside. Other state and local governments may be able to leverage this example to pursue this strategy.

Additional details regarding Caltrans engagement are provided in Chapter 5 of *Micrositing Analysis Summary Report*.

Preliminary Site Factor Evaluation

The project developed preliminary screening criteria for potential fuel station site locations. These are:

- Located within or near the Priority Zones: *Task 2.1 Regional Hydrogen Infrastructure Plan* identified priority regions within the cities of Redding and Eureka. These regions are the recommended focal areas for initial market development.
- Sufficient Space for Delivered Hydrogen: for a site to accommodate a station that receives delivered gas, it must have an open area with dimensions of at least 15' x 45' or 29' x 31' for the hydrogen equipment. It is assumed that additional space will be available for dispensing and electrical equipment. Note that these dimensions do not address NFPA or electrical classification requirements. These dimensions were based on preliminary recommended fueling station designs included in the *Task 2.4 Site Readiness Report.*
- Sufficient Space for On-site Generation: for a site to accommodate a station that generates gas on-site, it must have an open area with dimensions of at least 19' x 75'. It is assumed that additional space will be available for the dispensing and electrical equipment. Note that these dimensions do not address NFPA or electrical classification requirements. These dimensions were based on preliminary recommended fueling station designs included in the *Task 2.4 Site Readiness Report.*
- Proximity: an ideal site will be near major regional highways and/or high-use traffic routes within city limits.
- Accessibility: sites must have convenient access to and from the site based on traffic patterns and in the case of delivered hydrogen, they must have sufficient space for a gas delivery truck to navigate the site safely.
- Visibility: ideal sites are located along high-use traffic routes.

The qualitative criteria (proximity, accessibility, and visibility) were judged by viewing the sites in Google Maps in relationship to the priority zone and surrounding traffic routes. The quantitative criteria (i.e. "Sufficient Space") provided a discreet metric in the process. If a site had insufficient open space to fit the equipment, the site was screened out. These criteria were used to develop a list of potential site locations. See the *Task 2.4 Site Readiness Report* for additional details.

Additional important criteria needed for station development, including environmental compliance and site host willingness, were not included in this project. The project was not able to advance the micrositing process to the point of engaging site hosts or initiating more detailed site analyses.

The *Micrositing Summary Report* documents the planned stakeholder outreach strategy in the Eureka and Redding areas. The results presented in the *Summary Report* focus on engagement with permitting officials and fleet partners. Subsequent outreach, following the submission of the *Summary Report*, focused on fleet partners, potential site hosts, station owners, and station developers.

For the *Micrositing Summary Report*, identifying key partnerships was emphasized over specific property or equipment owners.

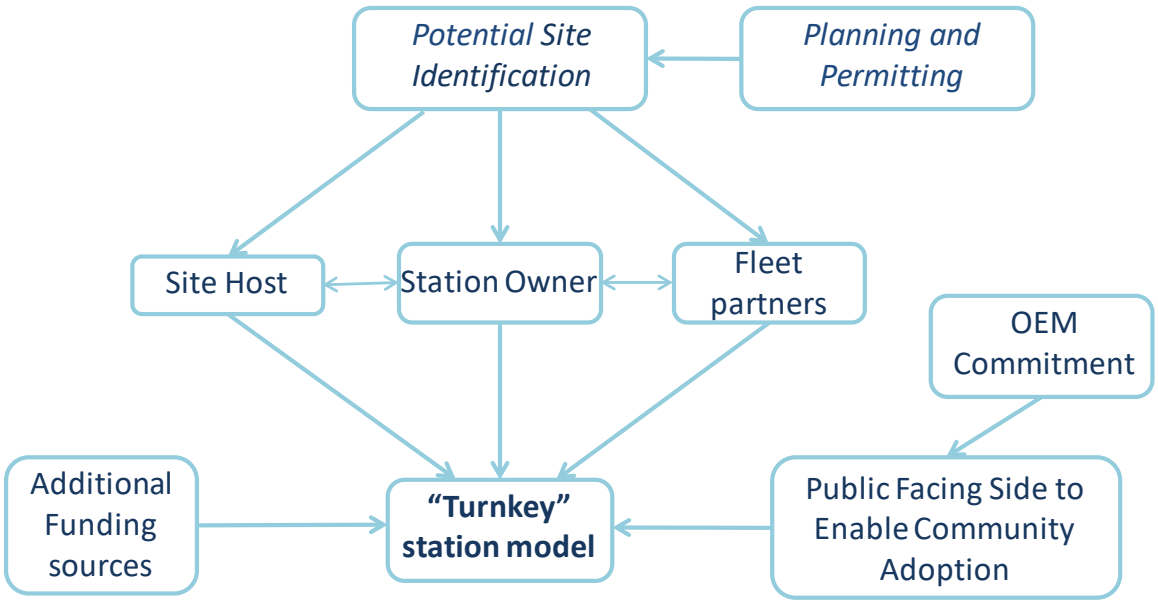
As shown in Figure 11, these partnerships include the:

- Site host (which could also be the station owner);
- Station owner (which could also be the site host or a station developer);
- Committed local fleet demand;
- Engagement with automobile original equipment manufacturers (OEM) in discussions regarding the sale of FCEVs in the local region, and during station commissioning to ensure compliance with OEM fueling requirements.

Since the submission of the *Micrositing Summary Report*, other stakeholder relationships have been defined and cultivated including hydrogen producers, local government/organization engagement, and public education which is not linked OEM commitment.

As described in the fleet section above, the project team engaged key fleet partners including HTA, Caltrans, CDFW, and DGS. We did not pursue contact with the 20 sites listed in the micrositing summary report, as it was determined this would be prudent after gaining buy-in from a station developer. The team held initial conversations with one station developer regarding potential sites in Redding, and they expressed interest in connecting with other potential site hosts and viewing the list of Redding locations. The most tangible engagement we had with a potential site host was with CDFW regarding a parcel in Redding. DGS and GovOps were also brought into the conversation. The project team introduced CDFW and DGS staff with the station developer so conversations can continue past the lifetime of this grant. Further engagement with other potential site hosts was not pursued.

Figure 11: Conceptual Relationship of Key Stakeholders in Site Identification



Source: RCEA and SERC, 2017

Site Readiness Report

The *Site Readiness Report* identified potential locations for installing a hydrogen fueling station anchor site around Eureka and Redding. The *Report* includes:

- A detailed review of the current state of the art of commercial public hydrogen fueling stations in California;
- A review of the *National Fire Protection Association 2 Hydrogen Technologies Code*, 2016 Edition;
- Recommended station designs and features that consider anticipated regional demand and hydrogen sourcing constraints, and associated space and setback requirements; and
- A list of pre-screened potential locations that included feedback from city planners.

Review of Station Design and Costs

The project team conducted a detailed review of the state of the art of station design to inform site evaluation criteria. Two sets of resources were used: reports developed by Sandia National Laboratory, and reports developed jointly by the California Energy Commission (CEC) and ARB. The project team used these resources to develop informed

recommendations on station footprint and design appropriate for the project region, and to develop high level cost estimates that can be communicated to interested site hosts and/or station owners.

Review of Safety Code Requirements

The project team reviewed the *National Fire Protection Association 2 Hydrogen Technologies Code 2016 Edition*[39] was done to update the safety offset specifications that impact the station footprint. This review updated the information from the station design review and informed the recommendations on station footprint and design.

Analysis of Recommended Station Footprint

A station footprint is influenced by the state of the technology, equipment layout options and choices, and local, state, and federal requirements. To inform recommendations on station footprint and design, the project team performed a detailed review of literature and of recently installed fueling stations in California.

Station Design Recommendations and Estimated Cost

The project team used the above reviews and information to develop station design recommendations for the phase one anchor sites in Eureka and Redding, and to develop preliminary generic site layout designs.

The project team recommended two retail station design options for Eureka: a modular 180 kg/day system with delivered gaseous system, or a modular 130 kg/day system using on-site hydrogen production through electrolysis.

The team recommended a retail station design option for Redding: a modular 180 kg/day system with delivered gaseous system.

Based on these recommendations, the team developed three generic equipment layout designs (these designs are included on page 26-27 in the *Site Readiness Report*). Key dimensions were pulled from these designs to inform the "Sufficient Space" screening criteria. The three station layouts and the key dimensions (shown in bold below) used in the site screening criteria are:

- Modular 180 kg/day system with gas-delivered station with the compressor and storage modules in an end-to-end configuration: **15' x 45'**
- Modular 180 kg/day system with gas-delivered station with the compressor and storage modules in a side-by-side configuration: **29' x 31'**
- Modular 130 kg/day system with on-site generation station with a linear layout for the electrolyzer, compressor module, and storage module: **19' x 75'**

39 National Fire Protection Association, 2016. NFPA 2: Hydrogen Technologies Code, 2016 ed. National Fire Protection Association.

The project team used literature-based values to provide a high-level capital cost estimate of $2.4M for the modular 180 kg/day system with delivered gaseous system, and $2.9M for the modular 130 kg/day system using on-site hydrogen production via electrolysis.

Hydrogen Sourcing and Production Plan

The *Site Readiness Report* deduced that hydrogen production through on-site electrolysis may be appropriate for Eureka stations given the remoteness of the location and the frequent highway closures The report also deduced that delivered hydrogen may be more appropriate for Redding stations.

Insofar as local hydrogen production goes, regional research in the past has explored the possibility of hydrogen production through biomass gasification. The North Coast and Upstate Fuel Cell Readiness Plan findings did not demonstrate great potential for this production pathway.

The North Coast and Upstate regions are home to abundant supplies of other untapped renewable energy resources including wind, wave, solar, hydropower, and biomass.

These resources should be further developed to help the State and private industry meet their renewable hydrogen production goals and decarbonization goals, respectively.

The Redwood Coast Energy Community Choice Aggregation Program and the Trinity Public Utilities District are two entities with control over several renewable resources in the region.

Humboldt County's Community Choice Aggregation Program

In May 2017, RCEA launched Humboldt County's Community Choice Aggregation program. The Community Choice Aggregation program is developing regional renewable energy resources with a current emphasis on wind, biomass, and solar energy. The *Guidelines for the Redwood Coast Energy Authority Community Energy Program Launch-Period Strategy and Targets* (Appendix H) call for 20MW of local biomass energy, 2MW of existing small hydro, and <1MW of small/medium renewable generators under a feed-in-tariff program. The production of renewable hydrogen through electrolysis could serve as an important hydrogen source for the region. This production method can be used as an energy storage mechanism, balancing the intermittent production of renewables like wind and solar. It has been estimated that there is greater than 400 MW of onshore wind resource in the Cape Mendocino area alone.[40] As of this writing, a 135MW project is being proposed for the Monument Ridge area near Scotia, CA, and a pilot 70-100MW offshore floating wind project is in early exploration off Humboldt Bay. An electrolysis production facility in the region could convert excess wind energy into

40 California Department of Water Resources, 1985. "California Wind Atlas," prepared for the California Energy Commission, Contract Number P-500-82-044.

hydrogen during peak production times, and meet a large percent of regional vehicle fueling requirements, among other uses.

Given abundant renewable resources, it is possible that regional production will exceed local energy requirements in the near future as renewable energy technologies continue to mature. Humboldt County is constrained to roughly 70MW of transmission capacity to the western electric grid, and hydrogen may prove to be a cost-effective method to convert, store, and transport renewable energy to regions lacking direct access to renewable energy resources.

Trinity Public Utilities District (TPUD)

On January 30, 2017, the CEC hosted a workshop to evaluate hydrogen production technology, identify available feedstock resources, and develop strategies that will lead to the increased in-state production of renewable hydrogen transportation fuel. Among the workshop participants were companies involved in the production of renewable hydrogen using electrolysis. During the workshop, the CEC solicited feedback from these companies on the best ways to support their efforts and increase the production of renewable hydrogen in the state. Access to lower cost electricity was frequently cited as the most critical component to their success.[41]

A potential source of this lower-cost electricity in the region is hydropower from the Trinity Dam. Trinity County in the North Coast region enjoys access to abundant, low-cost hydropower thanks to a congressional act. In 1955, Congress passed the Trinity River Division (TRD) Act that provided for the United States Government to build Trinity Dam. The Act reserves, in perpetuity, the first twenty-five percent of the resulting energy generated to be sold at cost for use in, and only within, Trinity County.[42] Initial conversations with Paul Hauser, the general manager for the Trinity Public Utilities District (Trinity P.U.D.), reveal the district has excess hydropower to support an approximately 20 MW hydrogen electrolyzer facility. Mr. Hauser had preliminary discussions with True Zero regarding production opportunities.

Hydrogen Business Council and UC Irvine Renewable Fuels and Energy Storage

The project team attended a webinar on stationary fuel use as energy storage for microgrids and larger grids. Dr. Reed of the UC Irvine Renewable Fuels and Energy Storage program offered to conduct an analysis for the RCEA CCA program (and other CCAs) to help RCEA determine how to better integrate hydrogen into our portfolio as a storage mechanism for growing renewable energy power resources. The project team

41 Comments provided by hydrogen production and distribution companies during the CEC's renewable hydrogen workshop can be found here: http://www.energy.ca.gov/altfuels/2017-HYD-01/documents/2017-01-30_workshop/2017-01-30_presentations.php

42 Trinity Public Utilities District. 2017. District History. http://trinitypud.com/about-tpud/district-history/

recommends following-up with Dr. Reed to conduct this analysis for RCEA, and for other CCAs the readers of this final report who may be working with other CCAs.

Site Evaluations

Similar to those used in past hydrogen integration studies, the project team created a site screening process to analyze the existing retail gasoline fueling stations and open parcels in the Eureka and Redding areas for possible hydrogen integration. The process steps included:

- Pre-screen retail gasoline stations: locate the retail gasoline stations identified in the Task 2.1 *Regional Hydrogen Infrastructure Plan* using Google Maps and conduct a preliminary screening based on available open space and proximity to the priority zone.
- Identify commercial parcels or open lots with available open space: survey the priority zone using Google Maps and identify commercial lots with available open space.
- Perform a basic site assessment of the potential sites: assess the potential sites and document general site information (business name, address, type of business) and a description of the land and surrounding area. Also, obtain images of the sites, measure the available space, and identify any site-specific issues that may make hydrogen integration difficult. Summarize this information in a Potential Sites List.
- Conduct site screening and select candidate sites: screen the potential sites using the developed criteria.

See Table 7 and Table 8 for the preliminary list of potential site locations. Note that additional details such as addresses, satellite photos, and additional comments can be found in the Task 2.4 report appendices.

The identified locations present a starting point for station developers interested in the region. None of the property owners were engaged regarding their interest, so further efforts are needed should developers be interested in these sites. Furthermore, zoning regulations, CEQA requirements, and additional setback requirements need to be considered to determine if these sites are appropriate for a particular project.

Table 7: Top Candidate Sites for Eureka

Business	Type	Priority Zone	Space for Delivered Gas	Space for Onsite Generation	Comments/Concerns
Shell Station -Myrtle	gas station	yes	yes	no	<1 mile south of Hwy 101 at the north end of Eureka
Humboldt Plaza Chevron	gas station	yes	possibly	no	good location, potential sewer access complications
Renner Petroleum Eureka North	gas station	yes	possibly	no	possible interested host, storm drain access complications
Cash & Carry	commercial	yes	yes	yes	ideal location, additional work needed to meet ADA
Bracut Industrial Park	commercial	yes	yes	yes	ideal location, additional work needed to meet ADA
Pacific Outfitters	commercial	yes	yes	no	good visibility, possible loss of parking
Target	commercial	yes	yes	yes	good visibility, lots of space
Humboldt Plaza Lot	parking lot	yes	yes	yes	large private lot, secluded location
Shell/Pacific Pride	gas station	no	yes	no	sufficient space, outside of priority zone
Broadway Gas 76	gas station	no	yes	no	open space, outside of priority zone

Business	Type	Priority Zone	Space for Delivered Gas	Space for Onsite Generation	Comments/Concerns
Renner Petroleum Eureka South	gas station	no	possibly	no	limited space, possible interested party
Undeveloped	empty lot	no	yes	no	outside of priority zone, possible ingress and egress complications
Renner Arcata	gas station	no	possibly	possibly	constrained space, possible storm drainage complications
Renner McKinleyville	gas station	no	possibly	possibly	excellent space if open lot is developable. Otherwise space constrained. Long distance for Eureka and Arcata drivers

Source: RCEA and SERC, 2019.

Table 8: Top Candidate Site for Redding

Business	Type	Priority Zone	Space for Delivered Gas	Space for Onsite Generation	Comments/Concerns
Hilltop Food & Fuel	gas station	yes	yes	--	limited space - parking impact, potential lot line complications
Arco Am/Pm #83205	gas station	yes	yes	--	limited space - parking impact, potential lot line complications
Tesoro #68192	gas station	yes	yes	--	limited space - parking impact, potential lot line complications, potential ingress / egress complications
Ball Park 76	gas station	yes	yes	--	limited space - parking impact, potential lot line complications
Colonial Energy	gas station	yes	yes	--	open space
Churn Creek Chevron	gas station	yes	yes	--	open space
Turtle Bay Mini Mart	gas station	yes	yes	--	sufficient space good location
Tesoro #68194	gas station	yes	yes	--	limited space - parking impact, potential lot line complications
Speedy Valero at 2026 Eureka Way	gas station	yes	yes	--	limited space - parking impact, potential lot line complications, potential ADA access impact
Chevron at 1650 Hilltop	gas station	yes	yes	--	limited space - parking impact, potential lot line complications, potential design complication with adjacent motel

Source: RCEA and SERC, 2019.

CHAPTER 6:
Conclusions and Recommendations

Assessment of Project Success

The project team's efforts resulted in the fusion of siting analyses, stakeholder engagement, and advocacy to demonstrate the region's readiness for hydrogen fueling infrastructure.

For the first time since AB8 was passed, and in parallel with the closing of this grant, ARB called for the development of stations in Eureka and Redding by 2024[38].

Prior to project launch, State and industry stakeholders generally recognized that Northern California would need to be developed to facilitate the hydrogen highway from California to Oregon, and beyond. Then, there was no strategy to match this hazy acknowledgement. Now, the *North Coast and Upstate Fuel Cell Electric Vehicle Readiness Project* effectively serves as a roadmap to fill this gap.

The project team's macro- and micro-siting analyses prioritize which cities in the region should be developed first and enumerate 20 sites that can be considered by industry stakeholders to guide the roll-out of stations in the North Coast and Upstate. Furthermore, the project developed a coalition of allies in eight counties who have introduced their communities to FCEV and hydrogen fueling station technology. Site identification is a vital step for any infrastructure development effort, but the absence of localized knowledge and relationships can hinder the transition of infrastructure planning to infrastructure implementation. Coalition contacts, as well as the project contacts listed in Table 9, should be leveraged to maintain the momentum created by this project.

Fleet engagement was key to project success and must be sustained. Caltrans District 1, the California Department of Wildlife, and the California Department of General Services were instrumental to building the foundation for station development in the region. These stakeholders are vital to ensuring station development progress does not terminate along with the grant. Relationships with local fleets should be fostered to strengthen regional readiness.

Assessment of project success as it pertains to the goals outlined in the grant agreement is summarized below.

Assessment of Grant Task Completion

Task 2.1: Regional Hydrogen Infrastructure Plan

The project team developed a regional hydrogen infrastructure plan for the project region. This plan considered localized market opportunities which mostly pertained to

renewable hydrogen production. This plan built-upon corridor fueling potential identified by ARV-13-012 (*AFR Readiness Plan)* as well as CARB analyses performed at the State-level. Beyond the *AFR Readiness Plan*, there were few other local planning efforts which related to the project. Two phase-one priority sites (Eureka and Redding) were identified for near-term infrastructure development. Site selection was determined by prioritizing criterion that supported interregional travel support and kick-staring the regional FCEV market.

The project team identified two phase-2 and phase-3 target areas for future infrastructure deployment: Crescent City and Ukiah. The project team originally planned to identify eight target areas, but other cities in the study area were not identified by the CHIT model as having demand in the near future.

Cities in Glenn, Del Norte, Tehama, Trinity, and Siskiyou will eventually need fueling infrastructure, but due to the near-term scope of the *North Coast and Upstate FCEV Readiness Plan*, micrositing was not pursued.

Task 2.2: Promotion of FCEVs

The project team successfully completed all task 2.2 requirements including tabling at community events, securing 4 earned media spots, and engaging community organizations through presentations.

These tasks were important for introducing the region to FCEV technology, but more expanding engagement to target local governments, potential private investors, and other ZEV stakeholders as station development activities progress. The public displays trepidation toward BEV adoption, and even more trepidation toward FCEV adoption. Continuing to educate the public about the technology, infrastructure developments, and safety mechanisms should be sustained so consumers are primed to ideologically embrace the vehicles when they come to market.

Task 2.3: Fleet Engagement

The goals of fleet engagement, as described in the grant contract, were satisfied.

Municipal fleet managers and transit operators were engaged, but limited funding, infrastructure, and FCEV models resulted in few immediate fleet replacement strategies.

Nevertheless, fleet operators across all counties in the project region were informed of current FCEV models, incentives, and educational resources.

Consequently, fleet fuel demand was not calculated and communicated to local fuel distributors.

The project team initiated efforts to calculate fleet fuel demand with Caltrans District 1 and the Department of General Services. DGS provided vehicle characterization data for the State fleet. DFW shared estimated fleet characterization for their State and local

fleets. The project team is still waiting to receive fleet characterization numbers from Caltrans.

The project team had insufficient time to translate this data into an analysis that could determine replacement strategies for LDV, MDV, and HDV vehicles. Planned next steps were to work with the CaFCP to confirm a replacement strategy and timeline.

Beyond this fleet engagement, near-term recommendations include obtaining fuel commitments from other State fleets in Redding to initiate fuel distributor communications and inform FCEV procurement and deployment plans.

The project team worked with coalition members to aggregate contacts for fuel distributors in each County.

Task 2.4: Micrositing and Site Readiness

The project team prepared a micrositing analysis and site readiness report to satisfy grant contract requirements.

The project team completed micrositing evaluations for Redding and Eureka. The project team collected input from stakeholders pertaining to planning and siting.

The project team developed siting criteria to complete an evaluation of site factors related to safety, surrounding land use, etc.

The project team shared The *Site Readiness* Report with permitting officials. The local community and emergency responders were not engaged.

Insofar as sourcing and production plans, the *Regional Hydrogen Infrastructure Plan* evaluated high-level planning. The *Site Readiness Report* evaluated site-specific sourcing options. This evaluation resulted in the recommendation of on-site electrolysis for Eureka and hydrogen delivery for Redding.

The project team analyzed site designs, projected development costs, and economic costs. Analysis results can be found in Appendices D and E.

Future Work and Recommendations

Site Evaluations

The previously mentioned successes are meaningful milestones and, in combination with the task-specific evaluations, further define the future work that is necessary to realize FCEV market maturation.

The station footprint and screening criteria developed for the site evaluation process present a useful first step for communities to identify potential locations for station development. While station developers have their preferred methods that cater to their specific station designs, the criteria developed here offer a productive path for communities to initiate dialogue with potential site hosts before engaging with station

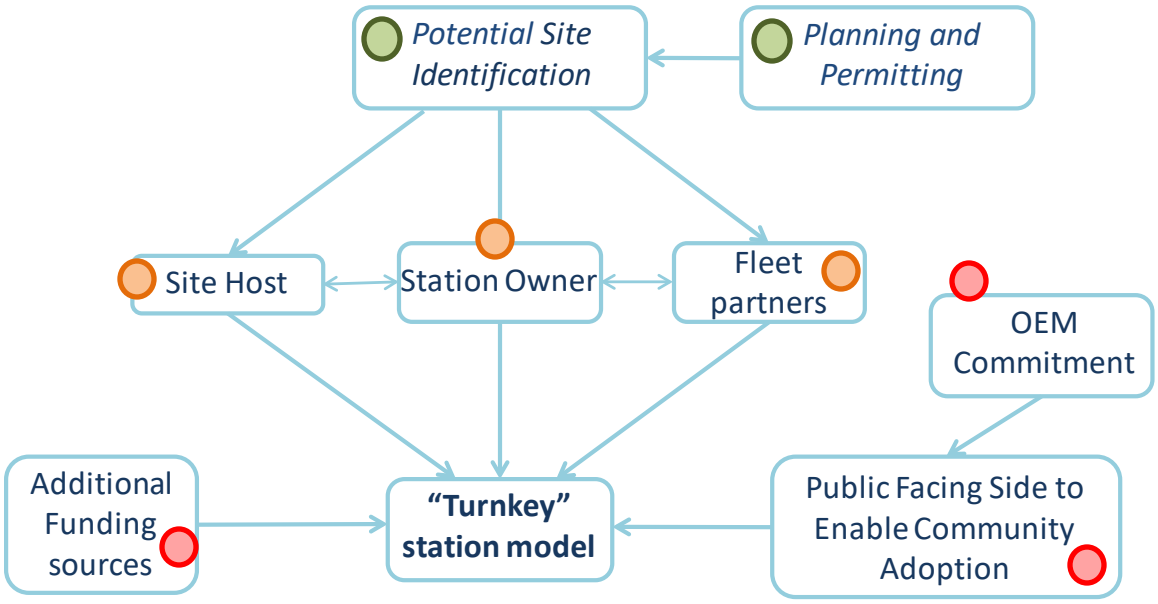
developers. These criteria can be coupled with feedback by planning departments to determine zoning constraints, and fire marshals to include additional setback constraints. This can help bring down the barrier to entry for station developers in more rural and lower population areas during early market funding cycles.

Anchor Site Station Development

Redding

Figure 12 demonstrates the status of critical stakeholder engagements and tasks for Redding site development. Green circles indicate completed/near completed tasks/engagements, orange circles indicate tasks/engagements which are partially complete, and red circles indicate tasks/engagements for which little to no work has been completed.

Figure 12: Current Status of Redding Stakeholder Engagement



Source: RCEA and SERC, 2018

DFW and DGS are two promising fleet partners which double as potential site hosts for a hydrogen fueling station on their co-owned parcel in Redding. As it stands, DFW and DGS have little interest in serving as the station owner for several reasons. Current stations are commonly owned by station development companies who have specialized expertise in securing funding, installing hydrogen stations, and conducting operations and maintenance. Additionally, pursuing State agency ownership of a hydrogen fueling station will likely create unique hurdles that add time to the already lengthy process that culminates in the opening of a retail fueling station.

Future work, in no particular order, as it pertains to developing the State-owned property in Redding entails:

- Determining the contractual relationship between the site developer and State as it pertains to leasing the property,
- Determining how to establish public access to the station,
- Confirming an order of operations regarding the State's public bid requirement;
- Issuing an RFP to ensure the fair selection of a station developer and attracting station developer interest,
- Obtaining signed fuel purchase commitments by State fleets in Redding;
- Obtaining funding for station installation.

Procuring FCEVs is also necessary but is outside the direct scope of station development. FCEV deployment is acknowledged in the following sections.

Eureka

Eureka station development has progressed more slowly than Redding station development. The disparity in progress between the anchor sites can be explained by briefly summarizing the project team's DFW fleet engagement.

The project team interviewed Don Ronalter, the DFW State-wide fleet manager, in 2018. While Mr. Ronalter indicated agency interest in developing DFW land in Eureka, this possibility was dismissed after determining Eureka DFW properties were too small to satisfy station footprint space requirements. DFW-owned properties in Redding, however, did have sufficient space.

The other relevant fleet partner is Caltrans District 1, headquartered in Eureka. District 1 staff signed a letter-of-intent for fuel demand and has expressed interest in procuring FCEVs through Caltrans State headquarters (Mirais) but is not interested in hosting a site.

Figure 13 demonstrates the current status of critical stakeholder engagement/tasks in Eureka. Future work to catalyze station development in Eureka involves further discussions with station developers, site hosts, and auto OEMs.

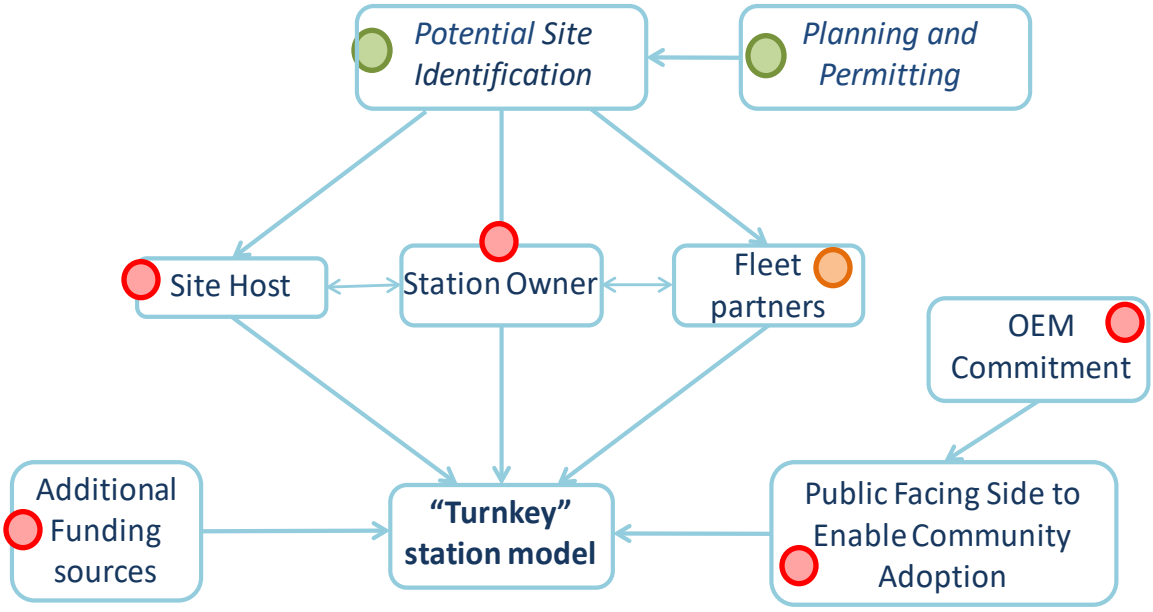


Figure 13: Current Status of Eureka Stakeholder Engagement

Source: RCEA and SERC, 2018

The ongoing work in Redding will provide lessons learned that can be applied to Eureka site pursuit, and hopefully result in a more expeditious process. The project team also expects relationships formed through the Redding project can dovetail with future Eureka development.

Future work, in no particular order, as it pertains to promoting site development in Eureka entails:

- Initiating conversations with station developers,
- Sharing the ten-screened Eureka sites with station developers and other relevant stakeholders to determine the feasibility of the ten pre-screened sites,
- Connecting station developers to pre-screened potential site hosts of interest,
- Confirming fuel commitment and FCEV procurement from Caltrans, and other fleets as applicable,
- Initiate conversations with auto OEMs to determine a strategy for FCEV deployment.

These lists are not exhaustive and will inevitably lead to additional and more detailed steps. Nevertheless, they serve as an immediate guide for those wishing to continue the project where the project team left-off.

Automobile OEMs

Automobile OEM engagement was not included in the project's original scope of work but plays a critical role in FCEV market maturation.

To avoid the possibility of a stranded asset, auto OEM engagement must be initiated. The project team has obtained auto OEM contacts (see Table 9) but had insufficient time before the end of the grant term to establish contact. There are no dealers in the region that sell FCEVs. State agencies can obtain fleet FCEVs through DGS's "Drive Green California" program, but a local retail supply will eventually be necessary to support and maintain regional market maturation. Prior to selling FCEVs on a local market, OEMs have stated that 2 stations must be installed. When OEM engagement is pursued, this claim needs to be verified. Overall, the goal of OEM engagement is to inform a strategy for regional FCEV deployment.

Hydrogen Production/Sourcing

The Trinity Public Utilities District (TPUD), who operates the Weaverville Hydroelectric Dam, engaged in conversations with True Zero regarding hydrogen production through electrolysis that could utilize excess electricity generation. These conversations occurred around Spring 2016, according to the TPUD general manager. The project team reached out to True Zero several times to evaluate the status of this possibility during the grant period, but currently there are no plans to continue this work. Any parties pursuing hydrogen production potential in the project region should reach out to with the general manager of TPUD to build on these initial discussions.

Electrolyzers could be part of a portfolio of options that manage transmission and distribution challenges associated with a high penetration of renewable sources in the North Coast region. Humboldt County's Community Choice Energy program is aggressively pursuing local renewable generation such that innovative solutions will be needed given the constrained transmission capacity serving the County. Del Norte and Mendocino Counties may also face this challenge should similar efforts be pursued. High penetration of local renewables in the Upstate region is not expected to present significant transmission-level challenges since the region hosts major transmission hubs that serve entire West Coast. However, electrolyzers could play an important role at the distribution-level.

Dr. Reed of the UC Irvine Renewable Fuels and Energy Storage program offered to conduct an analysis for the RCEA CCA program (and other CCAs) to help RCEA determine how to better integrate hydrogen into our portfolio as a storage mechanism for growing renewable energy power resources.

Non-Transportation Fuel Demand

Transportation may not prove to be the first industry to introduce hydrogen in selected regions. Opportunities for non-vehicular hydrogen applications within the study area, such as fertilizer production and ammonia-based refrigeration, should be evaluated in future work.

Next Steps

This section is intended to provide a quick snap-shot of the recommendations and future work described in narrative form above.

Task 2.1

- Identify six additional phase two and phase three target areas to support local FCEV adoption and more robust interregional travel.

Task 2.2

- Continue outreach to general public to educate them about FCEV and station technology.
- Expand outreach to local dealerships, governing bodies for cities and counties in the project region.
- Obtain more earned media spots to increase recognition of project efforts and facilitate partnerships with experts and industry professionals outside of the project region who can serve as allies for future work.

Task 2.3

- Re-strategize approach to local and municipal fleets to garner interest in detailed vehicle assessments.
- Connect transit operators to the Center for Transportation and Environment to obtain application and technical support for future FTA grants for fuel cell transit buses.
- Encourage fuel cell bus manufacturers to develop fuel cell electric school buses. State funding is available for ZEV school buses, but no models are on the market at present.
- Develop strategies to incentivize fleet participation in infrastructure and FCEV deployment planning.
- Initiate conversations with automobile OEMs to inform FCEV deployment and infrastructure planning.

Task 2.4

- Work with DFW, DGS, and other stakeholders to pursue Redding site development.

- Initiate Eureka site development by contacting station developers and other stakeholders.
- Initiate micrositing for Del Norte, Glenn, Mendocino, Tehama, Trinity, and Siskiyou as market develops.
- Meet with permitting and planning officials in Del Norte, Glenn, Mendocino, Tehama, Trinity, and Siskiyou to determine permitting and planning readiness for hydrogen fueling infrastructure.
- Initiate conversations with more station developers, to share current micrositing work and determine interest.
- Initiate conversations with potential private investors.
- Initiate conversations with potential site hosts in Eureka.
- Identify regional sites that co-locate cost-effective hydrogen production and industrial application and establish public-private or other business models to develop a nascent hydrogen economy that can eventually complement expansion of FCEVs.
- Connect with UC Irvine and the Hydrogen Business Council to evaluate opportunities for hydrogen to serve as a storage medium for surplus renewable energy routinely undergoing curtailment.
- Connect hydrogen production companies to TPUD and the RCEA CCA program.

Other

- Develop state agency public access incentives/policies for new technology support.
- Disseminate this final report to station developers, hydrogen production facilities, potential private investors, automobile OEMs, planning officials, permitting officials, potential site hosts, potential fleet partners, and other potential funding sources (grant administrators, etc.).

Project Contacts

These individuals and organizations should be utilized by those wishing to learn more about this project's efforts, and those interested in continuing the work summarized herein. Titles are included in case of staff turnover. This list is not exhaustive; for any further inquiries or requests regarding contacts, the Energy Commission Advanced Vehicle Infrastructure Office or the Redwood Coast Energy Authority Transportation team should be contacted.

Table 9: Key Project Contacts.

NAME	DESCRIPTION
Name ***Title*** ***Location***	***What was their role in the project, how can they help, etc.***
Paul Hauser General Manager Trinity Public Utilities District	Mr. Hauser is interested in using TPUD's excess power produced from the Weaverville Dam to produce hydrogen. Hydrogen production facilities and station developers interested in pursuing this business opportunity should contact Mr. Hauser.
Steve Jones ITM	Mr. Jones reached out to the project team following the release of the Times Standard news article. ITM expressed interest in electrolyzer development in the project region. The project team connected Mr. Jones with Mr. Hauser at TPUD.
Joel Ewanick Founder and CEO	Mr. Hauser met with Mr. Ewanick and the three individuals below from True Zero. True Zero indicated interest in hydrogen production but did not follow-up with Mr. Hauser. The project team attempted contacting the True Zero team in a liaison capacity to determine next steps.
Dr. Shane Stephens Founder and CEO	See above.
Isaac Kim CFO	See above.
Dr. Tim Brown Founder and COO	See above.
Jeff Reed, Ph.D. Chief Scientist Renewable Fuels and Energy Storage	A good contact for CCAs wanting to learn more about using hydrogen as a storage mechanism for excess renewable hydrogen. Generally, a good contact to discuss hydrogen as an energy storage solution.

Matthew Marshall Executive Director Redwood Coast Energy Authority	The Redwood Coast Community Choice Aggregation program is aggressively pursuing renewables and has several projects in the pipeline that may benefit from hydrogen as energy storage. Hydrogen production facilities who are interested in pursuing this business opportunity should contact Mr. Marshall.
Sebastian Serrato Contract Agreement Manager California Energy Commission	Mr. Serrato can speak to the California Energy Commission's participation on this project. He is also a good resource for other industry professionals.
Jean Baronas Supervisor, Hydrogen Unit California Energy Commission	The project team participated in a phone call with Ms. Baronas. Specifically, we discussed the Redding parcel and inquired about the grant funding process. Ms. Baronas is a good resource for industry professionals, CEC funding mechanisms, and other State hydrogen programs.
Keith Malone Public Affairs California Fuel Cell Partnership	Mr. Malone is a great resource for all things hydrogen. He has served as an ally, technical expert, and liaison between the project team and other industry professionals. He works for CaFCP, who hosts a breadth and depth of educational and technical hydrogen references. To learn about recent industry developments or up-to-date FCEV and station counts, contact Keith.
Ivor John Independent Consultant No organization affiliation	Ivor heavily contributed to the Tri-Counties Fuel Cell Readiness Plan and has a wealth of technical expertise when it comes to fuel cell electric vehicles and station development. He is well-informed of readiness planning efforts and has shared many lessons learned and best practices. He is a particularly valuable contact for local governments/organizations pursuing this work.
Janet Orth Deputy Director/CFO Dow&Associates/Mendocino Council of Governments	Ms. Orth facilitated Mendocino County's participation in project outreach, information gathering, and fleet interviews. She also contributed to the *Alternative Fuels and Readiness Plan* project, and has knowledge pertaining to alternative fuels/battery electric vehicle efforts in Mendocino County.
Joseph Tona Air Pollution Control Office Tehama County Air Pollution Control District	Mr. Tona facilitated Tehama County's participation in project outreach, information gathering, and fleet engagement.
Erin Squire Special Projects Coordinator North Coast Air Quality Management District	Erin Squire facilitated Del Norte and Trinity County's information gathering efforts for this project. RCEA's territory overlapped with the AQMF, do outreach tasks and fleet engagement were performed by RCEA instead of the AQMD.
Sean Tiegden Senior Transportation Planner	Mr. Tiegden facilitated Shasta County's participation in the project. His insights were particularly valuable to planning effort surrounding the DFW/DGS Redding parcel. Sean has

Shasta Regional Transportation Agency (SRTA)	connections with local planning and permitting officials, which will become important as the scoping process for the Redding parcel evolves. Sean also coordinated outreach, information gathering, and fleet engagement efforts.
Ian J. Ledbetter Environmental Program Manager Glenn County Air Pollution Control District Glenn County Certified Unified Program Agency	Mr. Tona facilitated Tehama County's participation in project outreach, information gathering, and fleet engagement.
Tonya Dowse N/A Siskiyou Economic Development Council	Logan Smith originally facilitated Siskiyou County's participation in project outreach, information gathering, and fleet engagement. Mr. Smith also contributed to the *Alternative Fuels and Readiness Plan* project, and has knowledge pertaining to alternative fuels/battery electric vehicle efforts in Siskiyou County. His replacement is Tonya Dowse.
Don Ronalter Fleet and Asset Management California Department of Fish and Wildlife	The project team interviewed Mr. Ronalter as part of fleet engagement. Mr. Ronalter was a wealth of information on State mandates as they pertain to ZEVs and FCEVs. Mr. Ronalter connected the project team to Ms. Brown-Tapia who initiated the scoping process for the Redding parcel.
Diane Brown-Tapia Sustainability Manager Administration Division California Department of Fish and Wildlife	Ms. Brown-Tapia has been key to facilitating the scoping process of the Redding parcel. Ms. Brown-Tapia connected the project team to other relevant State agency stakeholders and continues to engage with the project team as this site is further pursued.
Matt Henigan Deputy Secretary, Sustainability California Government Operations Agency	Mr. Henigan has been key to facilitating the scoping process of the Redding parcel. He connected the project team to other relevant State agency stakeholders and continues to engage with the project team as this site is further pursued.
Aisha Cissna	Ms. Cissna served as the project manager for the *North Coast and Upstate Fuel Cell Electric Vehicle Readiness Plan.* She can be

Transportation Specialist Redwood Coast Energy Authority	contacted for any follow-up questions pertaining to the contents of this report.
Dana Boudreau Director of Operations Redwood Coast Energy Authority	Mr. Boudreau served on the *North Coast and Upstate Fuel Cell Electric Vehicle Readiness Plan* project team for the entirety of the grant period. He is a wealth of institutional knowledge on this grant, as well as RCEA renewable energy projects.
Jerome Carman Senior Research Engineer Schatz Energy Research Center	Mr. Carman served as the technical lead for the *North Coast and Upstate Fuel Cell Electric Vehicle Readiness Plan.* Mr. Carman was key to obtaining funding for this project and served on the project team for the entire grant term. He can be contacted for any follow-up questions. pertaining to the contents of this report.
Elliot Goodrich Transportation Planner Caltrans, District 4	Mr. Goodrich coordinated the completion of the *Regional Hydrogen Infrastructure Plan* and participated in the early stages of the grant. Mr. Goodrich no longer works with the Local Government Commission or RCEA but can be contacted for questions pertaining to the *Regional Hydrogen Infrastructure Plan.*
Brad Mettam Deputy District Director for Planning and Local Assistance Caltrans, District 1	Mr. Mettam serves as a key contact for Caltrans District 1. He has institutional knowledge specific to conversations with the project team pertaining to D1 FCEV procurement, the feasibility of site-hosting, and fuel demand. Mr. Mettam is the signatory for the letter-of-intent.
Suresh Ratnam Transportation Planner District 1- Planning and Local Assistance California Department of Transportation (Caltrans)	Mr. Ratnam assisted the project team by providing fleet characterization data for District 1 and facilitating the signing of the D1 letter-of-intent for fuel demand.
Jesse Robertson Transportation Planning Caltrans District 1	Mr. Robertson assisted the project team by providing fleet characterization data for District 1 and facilitating the signing of the D1 letter-of-intent for fuel demand.
Kevin Tucker Planning North Branch Chief	Mr. Tucker assisted the project team by facilitating early meetings between the project team and D1 regarding FCEV procurement, the feasibility of site-hosting, and fuel demand.

District 1- Planning and Local Assistance California Department of Transportation (Caltrans)	Mr. Tucker has since been replaced by Mr. Robertson and Mr. Ratnam in this role.
Lisa Kunzman Supervising Equipment Engineer California Department of Transportation HQ Division of Equipment	Ms. Kunzman responded to the regional Request for Information. She expressed interest and support for local Caltrans FCEV procurement and station siting. As conversations proceed with local Caltrans districts, Lisa should be engaged.
Steve Ellis Manager, Fuel Cell Vehicle Marketing American Honda Motor Co.	The project team did not engage with Mr. Ellis, but he should be contacted when automobile OEM engagement is initiated.
Matt McClory Senior Principal Engineer, Fuel Cell Vehicle Development Toyota	The project team did not engage with Mr. McClory, but he should be contacted when automobile OEM engagement is initiated.
Gilbert Castillo Sr. Manager, Alternative Vehicle Strategy Hyundai Motor America	The project team did not engage with Mr. Castillo, but he should be contacted when automobile OEM engagement is initiated.
Tim Brown FirstElement	Project team did not engage with this stakeholder. This is provided for future reference.
Nitin Natesan Linde	Project team did not engage with this stakeholder. This is provided for future reference.
Jennifer Yan Linde	Project team did not engage with this stakeholder. This is provided for future reference.
Dwight Zuck Air Liquide	Project team did not engage with this stakeholder. This is provided for future reference.

Edward Heydorn Air Products	Project team did not engage with this stakeholder. This is provided for future reference.
Wayne Leighty Shell	Project team did not engage with this stakeholder. This is provided for future reference.
Omar Shkeir Shell	Project team did not engage with this stakeholder. This is provided for future reference.
Jonathan Palacio-Avila StratosFuel	StratosFuel has indicated particular interest in Redding site development. The project team had initial conversations with Mr. Palacios introducing him to the siting work completed to date.

Source: RCEA, 2019.

In closing, the project team extends a hearty thank you to the California Energy Commission for funding this important planning work and hopes to collaborate in the future on infrastructure implementation and FCEV deployment in the rural North Coast and Upstate region.

ACRONYMS AND ABBREVIATIONS

ARB	California Air Resources Board
BEV	battery-electric vehicles
CaFCP	California Fuel Cell Partnership
Caltrans	California Department of Transportation
CCA	Community Choice Aggregation
CDFW	California Department of Fish and Wildlife
CEC	California Energy Commission
CHIT	California Hydrogen Infrastructure Tool
CTE	Center for Transportation and Environment
DGS	California Department of General Services
DMS	United States Division of Measurement Standards
DMV	Department of Motor Vehicles
DOE (Caltrans)	Division of Equipment
FCEB	Fuel cell electric bus
FCEV/FCV	Fuel cell electric vehicle/fuel cell vehicle
FTA	Federal Transit Administration
GCAPCD	Glenn County Air Pollution Control District
GHGs	Greenhouse gas emissions
GovOps	California Government Operations Agency
H2 or H_2	Hydrogen
HDV	heavy-duty passenger vehicles
HEV	hybrid-electric vehicle
HFI	Hydrogen fueling infrastructure
HVIP	Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project

LCFI	Low Carbon Fueling Infrastructure
LCFS	Low Carbon on Fuel Standard
LDVs	light-duty passenger vehicles
MCOG	Mendocino Council of Governments
MDV	Medium-duty passenger vehicles
MSRP	Manufacturer Suggested Retail Price
NCUAQMD	North Coast Unified Air Quality Management District
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology
NREL	National Renewable Energy Laboratory
O&M	Operation and maintenance
OEM	Original equipment manufacturer
PHEV	plug-in hybrid electric vehicle
PSIG	Pound-force per square inch
RCEA	Redwood Coast Energy Authority
REC	Renewable Energy Credit
RFI	Request for Information
SEDC	Siskiyou Economic Development Council
SERC	Schatz Energy Research Center
SRTA	Shasta Regional Transportation Agency
TCAPCD	Tehama County Air Pollution Control District
TPUD	Trinity Public Utilities District
TRD	Trinity River Division
US DOE	United States Department of Energy
ZEV	Zero-Emissions Vehicle

Appendix

All appendices files are sent as separate attachments to the ARV-14-055 CAM.

APPENDIX A: Train-the-Trainer Presentation

APPENDIX B: North Coast Super Region and Rural Task Force Joint Meeting Presentation

APPENDIX C: California Air Pollution Control Officers Association Presentation

APPENDIX D: Coastal Partners Presentation

APPENDIX E: Sustainable Speaker Series Poster

APPENDIX F: Fleet Engagement Flyer

APPENDIX G: Sunline Transit Meeting

APPENDIX H: RCEA Community Choice Aggregation Program Guidelines

APPENDIX I: Caltrans District 1 Executed Letter of Intent for Fuel Demand