North Coast and Upstate FCEV Readiness Plan

ARV-14-055

Regional Hydrogen Infrastructure Plan

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Local Government Commission

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Prepared for:

The California Energy Commission

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Executive Summary

While the roughly 1,400 FCEVs currently on the road in California are concentrated in urban centers, hydrogen refueling opportunities in rural, destination communities will be critical to sustained FCEV adoption. The North Coast and Upstate FCEV Fuel Cell Electric Vehicle (FCEV) Readiness Plan aims to prepare nine of California's northernmost counties for the introduction of FCEVs. The counties of Del Norte, Siskiyou, Humboldt, Trinity, Shasta, Mendocino, Tehama, Lake, and Colusa were included in the planning effort. Starting with existing plans, including the California ZEV Action Plan, and utilizing results from the Northwest California Alternative Fuels Readiness Plan, the project team conducted targeted modeling and analysis to extrapolate key regional hydrogen hotspots.

These hotspots were identified by comparing the five census-designated micro- or metropolitan statistical areas within the project region to a set of qualitative criteria. Statistical areas were evaluated based on proximity to major corridors, distance from existing FCEV markets, consistency with the Federal Highway Administration's Alternative Fuel Corridor designation, and level of future hydrogen demand identified through the CHIT model. The Redding-Red Bluff and Eureka-Arcata-Fortuna census-designated areas were identified as phase 1 macrosites for the region.

The project team has begun to evaluate gas stations within these larger macrosites, using municipal zoning and CHIT capacity need results as a guide. Additional qualitative criteria will be used to identify priority sites for detailed analysis.

Introduction

Figure 1: Project Region

The North Coast and Upstate regions are two of three regions that were awarded FCEV readiness grants under the California Energy Commission's Alternative and Renewable Fuels and Vehicle Technology Program. The scope of the project includes development of an infrastructure deployment plan, a plan to assist fleet managers to incorporate FCEVs, an education and outreach effort, and detailed site analysis.

Adoption of ZEVs in the United States has dramatically increased in recent years, with over 572,000 ZEVs currently on the road. California is a key early adopter of both plug-in electric (PEV) and FCEVs, with roughly half of all ZEVs in the US on California roads.

Electric vehicles currently dominate the ZEV market, with over 20 PEV models available in California[1]. However, momentum is building in the FCEV market as major manufacturers such as Hyundai, Toyota, Honda, and Mercedes release new models. Hydrogen is an appealing alternative fuel because it can be produced using almost any existing energy source. Benefits of hydrogen include the ability to produce it from renewable biomass feedstocks or from renewable electricity. Hydrogen fuel cell vehicles produce zero tailpipe emissions with the exception of water.

FCEVs are a long-term solution for sustainable transportation objectives of rural communities due to community dependence on passenger vehicles as a result of intra-regional travel distances between communities. This dependence on passenger vehicles is also promulgated by limited public transit services, a lack of infrastructure for alternative transportation methods such as walking or bicycling, and highly limited and expensive inter-regional travel options to urban areas.

[1]Governor's Interagency Working Group on Zero-Emission Vehicles. 2016. ZEV Action Plan an updated road map toward 1.5 million zero emission vehicles on California roadways by 2025, October 2016. https://www.gov.ca.gov/docs/2016_ZEV_Action_Plan.pdf

1.1 Background

The Redwood Coast Energy Authority (RCEA), in collaboration with the Schatz Energy Research Center (SERC) at Humboldt State University and other regional partners, completed a Northwest California Alternative Fuels Readiness Plan through ARV-13-012, which identified potential near-term hydrogen demand and required infrastructure needs. Additionally, since 2008, SERC has maintained and operated the Humboldt State University Hydrogen Fueling Station, the northernmost site on California's Hydrogen Highway. The Regional Hydrogen Infrastructure Plan builds on this existing planning work and expertise to identify specific hydrogen fueling infrastructure sites required to support the region's share of fuel cell vehicles as defined by state-level goals and to support full state-wide access to fueling.

The North Coast and Upstate regions comprise over 17% of the land area of the State 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.

Siting hydrogen refueling stations in the project region will enable FCEV travel north of San Francisco and Sacramento, linking North Coast and Upstate population centers with the rest of the state. Development of stakeholder relationships across a broad landscape that contains limited governmental services, and coordinated regional efforts to plan, fund, and implement targeted FCEV and hydrogen infrastructure deployment will be critical to the success of this plan.

1.2 Existing Infrastructure

The North Coast is home to the Northernmost hydrogen fueling station in California. Hosted at Humboldt State University, the HSU hydrogen fueling station serves as a testing ground for both hydrogen fueling and FCEV technology. The station was designed and built in 2008 by SERC as part of the Hydrogen Highway program. SERC equipped the station with an electolyzer (splitting water into hydrogen and oxygen), compressor, storage tanks, and a dispenser. In 2012, the station was upgraded to provide 700 bar fueling capability by adding a high-pressure compressor and dispensing system.[2]

Figure 2: HSU Hydrogen Fueling Station

Photo Credit: Humboldt State University ETaP Program

The station was funded through contributions by the California Department of Transportation (Caltrans), the California Air Resources Board (CARB), Chevron Technology Ventures, SERC and HSU. SERC has used the station to fuel a variety of vehicles including a converted Toyota Prius, numerous Toyota Highlander FCEV's and a Hyundai Tucson, providing SERC and students with opportunities to test the technology.

[2] Chapman, Greg. Peter Lehman. (Schatz Energy Research Center). 2012. Developing a Hydrogen Transportation Infrastructure. Final Report, Contract No. 65A0402.

While still operational, the fueling station currently is not being utilized for vehicle testing purposes because FCEVs are now a commercially viable technology. The station has completed the objective of supporting the advancement of fuel cell technology towards commercial readiness. Because the fueling station was not designed to function as a retail station in support of public demand for fuel, there is a need for planning and implementation work to bring retail infrastructure to the North Coast region. In addition, the Upstate region is also in need of planning and implementation work as currently no fueling infrastructure exists.

1.3 Research Objectives

This plan provides a near- and medium-term roadmap for accommodating FCEVs in the North Coast and Upstate regions. The results will inform both the build-out of FCEV infrastructure and development of an FCEV market in the region.

This plan seeks to answer the following questions:

1. What does vehicle and fuel demand in the nine-county project region look like in the near- to medium-term?
2. Which areas of the region are most likely to experience growth in near- to medium-term demand for FCEVs?
3. What kinds of site characteristics are appropriate for FCEV infrastructure?
4. What kinds of site characteristics are most likely to catalyze demand for FCEVs in the region?
5. How can we best accommodate demand for FCEV infrastructure from out-of-region drivers?
6. 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?

Model results from the California Air Resources Board's California Hydrogen Infrastructure Tool (CHIT), were used to evaluate fuel demand and vehicle count projections for the region. The project team will use 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", provides high-level regional insight into where to focus development efforts for first phase critical anchor sites that will kick start regional supply. Furthermore, recommendations on key second and third phase connector sites are provided that will solidify a fueling network that supports a robust early market. The macrositing

approach combines local knowledge with state-level modeling results provided by the CHIT model.

The second step, termed "micrositing", involves translating the macrositing results into on-the-ground locations that address the many nuanced variables that impact the feasibility of station development. This report only briefly discusses this step, details of which will follow in a future interim deliverable.

CHAPTER 2:
Regional Hydrogen Infrastructure Plan

2.1 Regional Targets

In March 2012 Governor Brown established a target of 1.5 million zero-emission vehicles (ZEVs) on California roadways by 2025, through Executive Order B-16-2012. To further this objective the State has set the supporting goal of having California's ZEV infrastructure able to support 1 million vehicles by 2020.

In response to Executive Order B-16-2012, in 2013 the California Energy Commission and the National Renewable Energy Laboratory (NREL) released the California Statewide Plug-In Electric Vehicle Infrastructure Assessment. In this assessment, NREL estimated the North Coast and Upstate regions will require infrastructure to support roughly 500 hydrogen vehicles by 2023-2024 (Table 1)[3]. This estimate represents the region's share of the governor's ZEV target.

Table 1: 2024 Anticipated Distribution of ZEVs by Region Required to Meet 1 Million ZEVs

Planning Region	Nominal Number of ZEVs Deployed by 2023-2024			
	PHEVs	BEVs	FCEVs	Total ZEVs
Southern California	279,000	137,000	45,100	461,000
Bay Area	149,000	74,000	24,200	247,000
San Joaquin Valley	25,000	12,000	4,100	41,000
San Diego	55,000	27,000	8,900	91,000
Capital Area	31,000	15,000	5,000	51,000
Coachella Valley	26,000	13,000	4,300	43,000
Central Coast (S.)	18,000	9,000	2,900	30,000
Monterey Bay	9,000	4,000	1,500	14,000
Central Coast	9,000	5,000	1,500	15,000
Upstate	2,000	1,000	300	3,000
North Coast	1,000	1,000	200	2,000
TOTAL	**605,000**	**297,000**	**98,000**	**1,000,000**

Note: PHEVs: plug-in hybrid electric vehicles; BEVs: battery electric vehicles; FCEVs: fuel cell electric vehicles; ZEVs: zero-emission vehicles

Source: National Renewable Energy Laboratory Analysis. 2014. California Statewide Plug-In Electric Vehicle Infrastructure Assessment.

[3] 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

In 2014, Assembly Bill 8 provided another important driver for FCEV adoption. AB 8 allocates up to $20 million per year toward hydrogen stations, until at least 100 are operational. AB 8 also requires the California Air Resources Board (CARB) to annually evaluate the status of FCEV adoption and revise FCEV adoption projections. CARB's most recent evaluation, the "2016 Annual Evaluation of Hydrogen Fuel Cell Electric Vehicle Deployment and Hydrogen Fuel Station Network Development" provides the most up-to-date projections on FCEV adoption.

According to the 2016 Annual Evaluation, CARB projects 43,600 FCEVs will be on California Roads by 2022, extrapolated to 63,667 FCEVs by 2024. This equates to a 35% reduction in NREL's estimate of 98,000 FCEVS by 2023-2024. The ratio NREL calculated for the Upstate and North Coast region's share of total FCEVs was .0051. Table 2 provides CARB's most recent FCEV adoption projections by year, along with the Upstate and North Coast region's share based on NREL's ratio calculation. Years 2023-2024 were extrapolated, assuming an increase by 10,033 vehicles per year (based on the rate of change from 2019 to 2022, CARB analysis years)[4].

Table 2: CARB estimates of FCEV adoption, adjusted by population.

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.

[4] 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

Most of the counties in the Upstate and North Coast regions have completed differing levels of planning to prepare for ZEVs. A non-exhaustive list of regional planning documents mentioning ZEVs is included as Appendix A. One regional planning document particularly applicable to FCEV readiness is the Northwest California Alternative Fuels Readiness Plan. This plan provides the most cost effective way for the region (the counties of Del Norte, Siskiyou, Humboldt, Trinity, and Mendocino) to meet the Low Carbon Fuel Standard goal of a 10% reduction in the carbon intensity of fuels by 2020. AB 32 initiated the Low Carbon Fuel Standard program as part of a suite of activities to reduce greenhouse gas emissions to 1990 levels by the year 2020.[5]

To determine the most cost-effective way to achieve this 10% reduction, the project team developed a model that compared the lifecycle impact of every alternative fuel with that of its equivalent fossil fuel. The model incorporated vehicle cost, fueling infrastructure cost, and fuel cost with its associated distribution cost. Using the impact results from this exercise, the project team determined how many of each vehicle type would be required in the region to meet the LCFS target. Results are shown in Table 3.

Table 3: Estimated number of vehicles in Northwest California running an alternative fuel in 2020

	Light Duty						Heavy Duty	
	BEV	**PHEV**	**E15**	**E85**	**B20 / RD**	**H_2**	**E15**	**B20 / RD**
Total	19,400	600	1,500	350	100	200	2,800	1,650
% of All On-Road Vehicles in 2020	17% of LDVs						2.7% of HDVs	

Note: BEV: battery electric vehicle, PHEV: plug-in hybrid electric vehicle, E15: 15% ethanol gasoline, E85: 85% ethanol gasoline, B20/RD: 20% biodiesel diesel fuel/renewable diesel, H_2: hydrogen.

Source: Adapted from Redwood Coast Energy Authority, Schatz Energy Research Center. Northwest California Alternative Fuels Readiness Plan.

As shown in the above table, BEV's make up a much larger portion of the alternative fuel vehicle count that hydrogen vehicles in the lowest cost scenario. This is due mostly to the lower cost of fueling infrastructure.

[5] AB 32, Nunez. Air pollution: greenhouse gases: California Global Warming Solutions Act of 2006. https://www.arb.ca.gov/fuels/lcfs/ab32.pdf

Additionally, achieving the LCFS target requires offsetting the consumption of fossil fuels. The project team estimated a total of 17 million gallons of gas, and 4 million gallons of diesel, would need to be offset to achieve this goal. The following table (Table 4) provides a breakdown of the least-cost mix of alternative fuels.[6]

Table 4: Estimated quantity of alternative fuels in Northwest California to be sold in 2020

	Electricity End-use MWh/year	**Liquid Fuels Unblended Gallons / year**			**H_2 kg / year**
		E15	**E85**	**B20 / RD**	
Total	131,100	425,100	249,700	806,100	73,100
% Impact	~6% increase in regional electricity consumption	~10% reduction in regional consumption of gasoline and diesel			

Source: Adapted from Redwood Coast Energy Authority, Schatz Energy Research Center. Northwest California Alternative Fuels Readiness Plan.

To project how many alternative fueling stations would be required, the project team estimated the total fuel demand in 2020. Following the least-cost scenario, the region will require:

- 20,000 home EV charging stations
- 339 public EV charging stations
- 13 renewable diesel stations
- 6 ethanol fuel pumps
- 5 hydrogen fuel dispensers

The project team incorporated this rough target of 73,000 kg of hydrogen per year through 5 hydrogen dispensing stations in the macrositing strategy.

[6] Redwood Coast Energy Authority, Schatz Energy Research Center. Northwest California Alternative Fuels Readiness Plan. 2016. http://redwoodenergy.org/images/Files/Transportation/ARV-13-012_Readiness-Plan-FINAL_2017-02-23-small.pdf

2.2 Region-Wide Macrositing Analysis

2.2.1 Introduction

To inform a detailed siting analysis of locations within the nine-county project region, the project team divided siting efforts into two phases: macrositing and micrositing. Given the broad geographic region covered by this plan, it was important to narrow the focus for siting analysis to priority "macrosites" before focusing on evaluating priority sites at a micro-scale.

First, a macrositing analysis to guide site-level micrositing efforts was conducted. This analysis determined which areas within the project region would be further analyzed at city, zone, and site levels. For the purpose of this report, "macrosite" is defined as a census-designated micro- or metropolitan statistical area. Within the largely-rural nine-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.

2.2.2 Criteria

The relative priority of the five macrosites were evaluated based on four qualitative criteria. These criteria, detailed below, were chosen to reflect both interregional demand (i.e. utility of a fueling station as a destination station for out-of-region drivers, or as a connector station between existing or projected core market areas) and regional demand for hydrogen fueling infrastructure (i.e. utility of a fueling stations to projected FCEV drivers living in the region on a near- to medium-term time scale).

The following are the four criteria used to evaluate the five regional macrosites:

1. **Location on a major highway:** FCEV fueling infrastructure should be located near high-volume highways in order to serve the largest number of consumers. Proximity to major highways is important for the utilization of stations as connectors between destinations for drivers from out of the region. However, services near highways also have the potential to serve the greatest share of regionally-based FCEV drivers. For the purpose of this analysis, US Highway 101 and Interstate 5 were identified as the relevant major highways, as they are the highways that lead directly to and from the nearest existing FCEV market areas, San Francisco and Sacramento.

2. **Distance from the nearest existing FCEV market:** It is critical that a proposed macrosite be within driving range of the nearest existing FCEV market area. This ensures that proposed hydrogen fueling stations capitalize on existing market demand for FCEVs as

connector stations, alleviate range-anxiety, and ensure that automakers are comfortable selling their vehicles in the region.

The closest existing market areas are San Francisco and Sacramento. The three available FCEVs - the Honda Clarity, Toyota Mirai, and Hyundai Tucson – have an EPA estimated range of 366 miles, 312 miles, and 265 miles, respectively as of February, 2017.

3. **Consistent with FHWA's Alternative Fuels Corridors:** The Federal Highway Administration (FHWA) designates highways capable of providing alternative fuel vehicle drivers with necessary services as "alternative fuels corridors." This designation reflects the ability of certain routes to enable AFV travel.

   As FCEV markets develop in other cities on the west coast, a cohesive network of fueling infrastructure between market areas will be increasingly important. The Highway 101 and Interstate 5 corridors are crucial connecting routes between California metropolitan areas and Seattle/Portland. FCEV infrastructure locations in this region should be within FCEV driving range of southern Oregon cities that are most likely to serve as refueling points, such as Grants Pass or Medford.

4. **Significant capacity need identified by the California Hydrogen Infrastructure Tool (CHIT):** The California Air Resources Board (CARB) created a comprehensive tool, the California Hydrogen Infrastructure Tool, for identifying priority areas for FCEV infrastructure. This tool allocated projected FCEV adoption numbers across the state based on a number of factors for a given area, including income and education level, number of luxury vehicles and vehicles with MSRPs similar to projected MSRPs of FCEVs, rate of first adopters for hybrid and plug-in hybrid vehicles, and market share of projected statewide FCEV adoption weighted by population distribution. Significant capacity need was defined as demand greater than twenty-five kilograms per day.

2.2.3 Results

Using the four macrositing criteria detailed above, the Redding-Red Bluff and Eureka-Arcata-Fortuna census-designated areas were identified as phase one anchor sites for the region. Redding-Red Bluff satisfies all four criteria for a 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, also within FCEV range.

Eureka-Arcata-Fortuna also satisfied all four criteria. Eureka is the other city in the nine-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, also well within the range of currently available FCEVs. Table 5 summarizes the results of this analysis.

Table 5: Comparison of regional metro/micropolitan area with macrosite criteria

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.
++ The northernmost FCEV fueling station in the San Francisco Bay Area was used. This station is in Rohnert Park, CA.

Source: Redwood Coast Energy Authority.

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 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.

Crescent City is located on Highway 101 and is potentially within maximum driving distance for high-range FCEVs, at 309 miles from Rohnert Park. It is also halfway between Eureka and Grants Pass. Due to small population, this area is not identified by the CHIT model as having significant demand, meaning there is not a strong likelihood that the city will develop a regional market in the near term.

Ukiah is also located on Highway 101. At just 69 miles from Rohnert Park 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 reduce range anxiety for drivers travelling between San Francisco, Sacramento, and the North Coast.

2.3 Micrositing Analysis of Anchor Station Regions

2.3.1 Introduction

Using the macrositing results presented in section 2.2, a detailed micrositing analysis was conducted 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.

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 CHIT score. Together, these analyses will guide the site readiness task.

2.3.2 Analysis

An important advantage of FCEVs is the ability to fuel quickly. The business model for a hydrogen fueling station parallels that of existing gasoline stations. This allows hydrogen station developers to leverage existing fueling infrastructure, which is usually located at high-visibility and easily-accessed locations. To date, the majority of retail hydrogen fueling stations have been installed at existing conventional gas stations. The North Coast Unified Air Quality Management District and Shasta County Air Pollution Control provided lists of operating retail gas stations in Eureka and Redding.

From a planning and permitting perspective, hydrogen stations are typically subject to the same zoning constraints as gasoline stations. 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 need scores were then added 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 CARB'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.

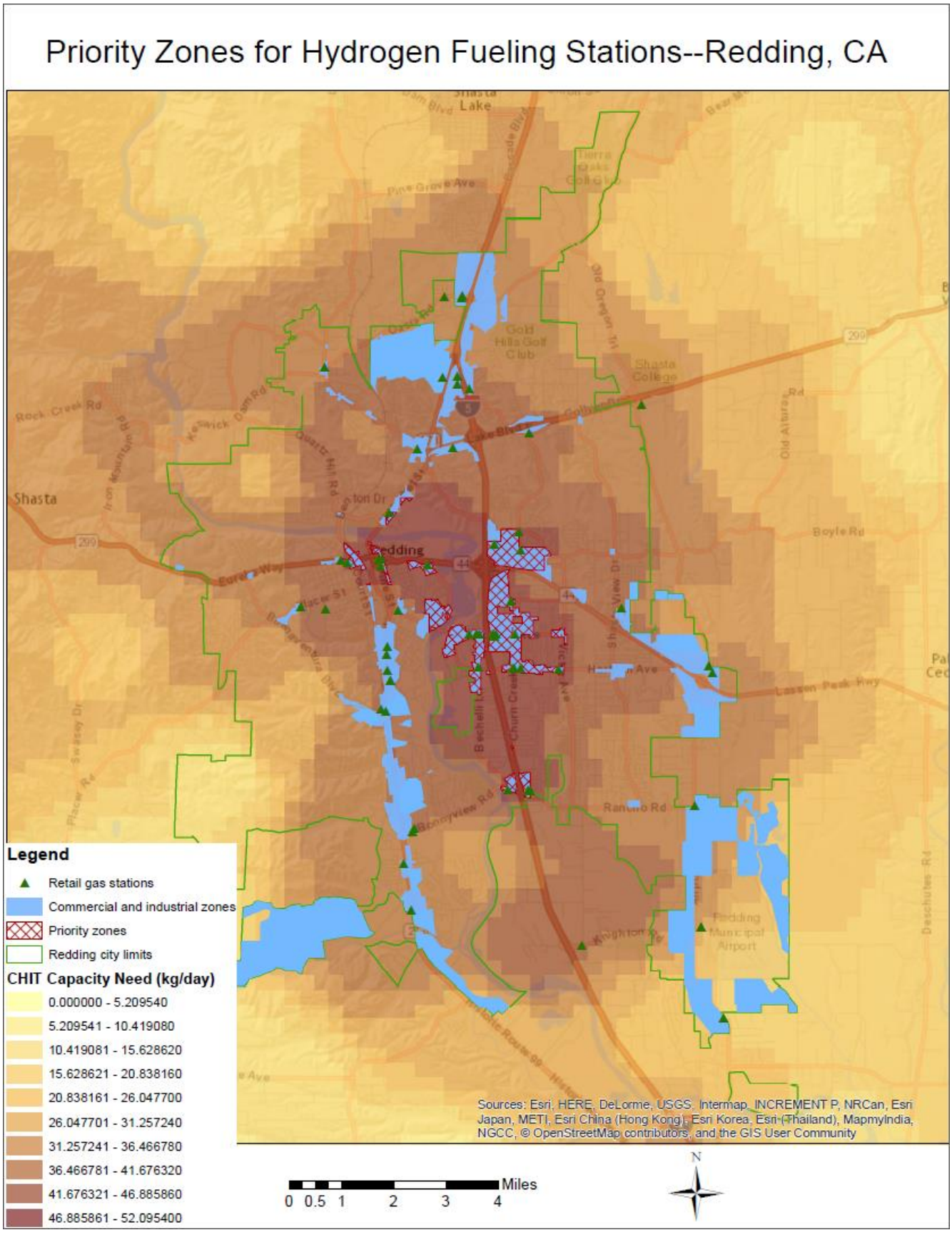
Fuel capacity need projections were determined to be meaningful in the context of both fueling capacity needed and FCEVs served. To produce the latter estimate, average daily fuel consumption was estimated for one FCEV. According to findings from the American Driving Survey, the average American drives thirty miles per day[7]. 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 a given area in 2022.

[7] 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

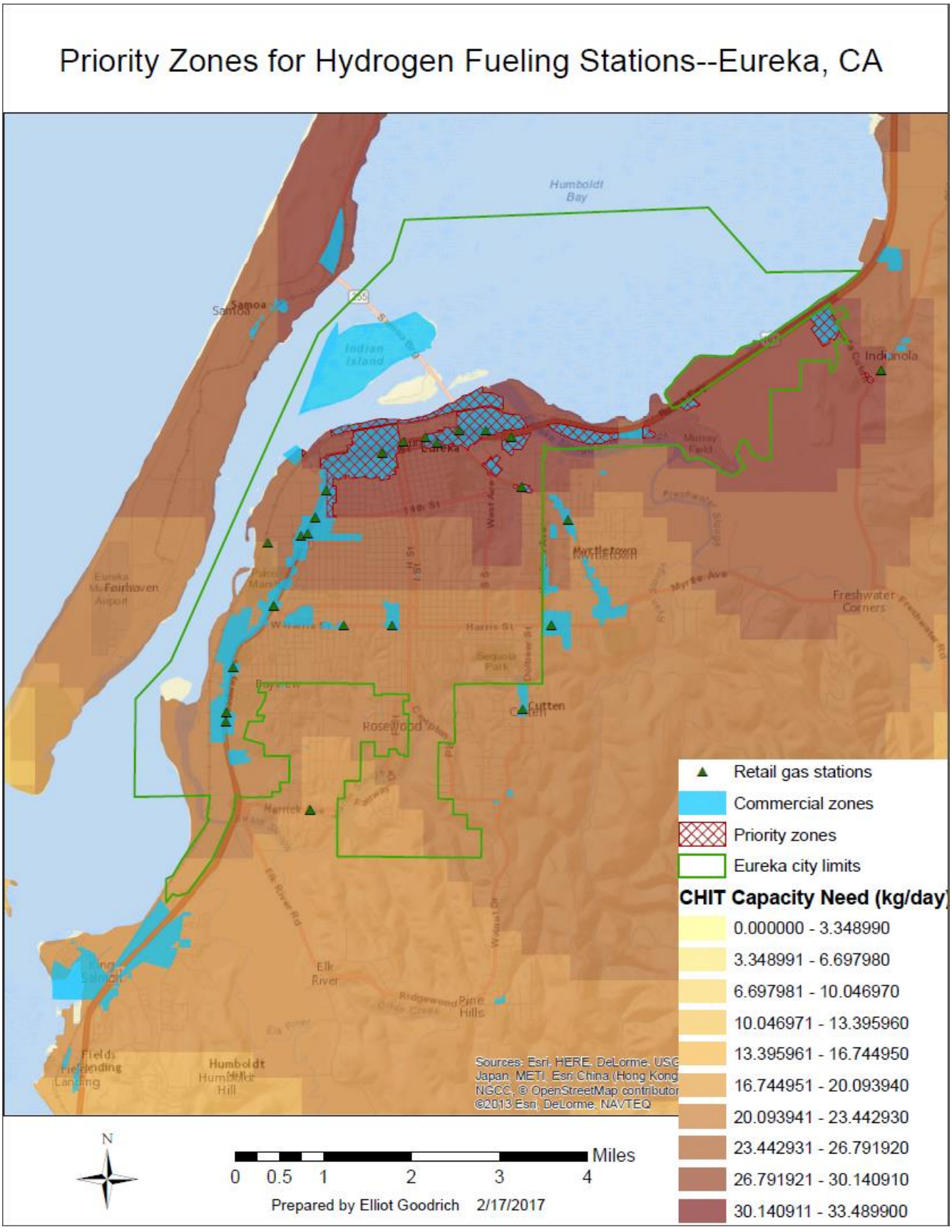
2.3.3 Results

These three attributes, detailed above, were aggregated in ESRI ArcGIS to create priority zoning maps for the greater Redding and Eureka areas. 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. Figure 3 illustrates the results of this effort.

Figure 3: Priority zones within regional macrosites



Source: Redwood Coast Energy Authority



Source: Redwood Coast Energy Authority

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, and is included as Appendix B.

In addition to CHIT score, the project team will evaluate individual stations based on a suite of qualitative criteria.

These qualitative criteria include:

- Proximity to major regional highways,
- Station accessibility,
- Station visibility to public,
- Interest from station owner,
- Proximity to potential fleet partners, and
- Space available in station forecourt.

Qualitative criteria evaluation, in combination with CHIT model results, will inform final priority for site-specific readiness activities, including:

- Station operator engagement,
- Preliminary municipal permitting department engagement, and
- Completion of 10% engineering drawings.

An important consideration for determining phase one, two, and three microsites is the need for station redundancy. Hydrogen as a fuel is a developing technology and currently operational hydrogen stations have not yet achieved the reliability that drivers expect from conventional fueling infrastructure. Dependency on a single station in a region can cause concern to potential hydrogen fuel consumers. Additionally, redundancy is needed to ensure that automakers are willing to sell their vehicles in a given market. Although a single station could meet fuel demand as a "destination" or "connector" for out-of-region drivers, it likely would not be enough to kick start a regional FCEV market.

At this time, public funding for hydrogen stations is limited and private investment has not materialized. Until the hydrogen fuel market matures in other parts of the state, it may be difficult to fund two stations in Eureka and/or Redding. Priority station site identification should acknowledge both the need for redundancy and the reality that redundancy may not be economically feasible in this region in the near term.

2.3.4 Next Steps

A micrositing rubric will be developed to identify key criteria for an initial siting of a fueling station. Leveraging existing resources on hydrogen station development, the following steps will be used to continue the micrositing work:

- Develop rubrics for multiple potential station designs between which space, regulatory, and economic constraints differ. Also determine design approach to achieve target % up-time with consideration of vehicle manufacturer and dealership requirements.
- Develop a comparative feature list of different station designs to enable stakeholder engagement and start the design process. 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.

2.4 Site Readiness

Following completion of a comprehensive micrositing analysis and identification of potential site hosts, the next step will be site readiness assessments for priority sites. SERC will lead this effort and will leverage their engineering expertise to evaluate these priority sites for suitability for hydrogen infrastructure integration. The ultimate goal of the site readiness task is to develop engineering drawings for each priority site. The following steps will comprise the site readiness process:

- Identify key requirements and challenges of interested site hosts. Engage with permitting agencies and identify their key requirements and challenges.
- Engage with industry to obtain insight on addressing site host AHJ key requirements and challenges.
- Based on stakeholder engagement and design decisions, develop 10% designs for locations within each macrositing region.

2.5 Opportunities for Regional Hydrogen Production

The majority of hydrogen in the US is produced by reforming natural gas. However, two alternative methods for hydrogen production, electrolysis and biomass gasification, are well suited to take advantage of the region's unique resources. Electrolysis uses electricity to split water into oxygen and hydrogen, while biomass gasification uses heat to volatize off hydrogen-rich producer gas which could be cleaned to FCEV purity standards.

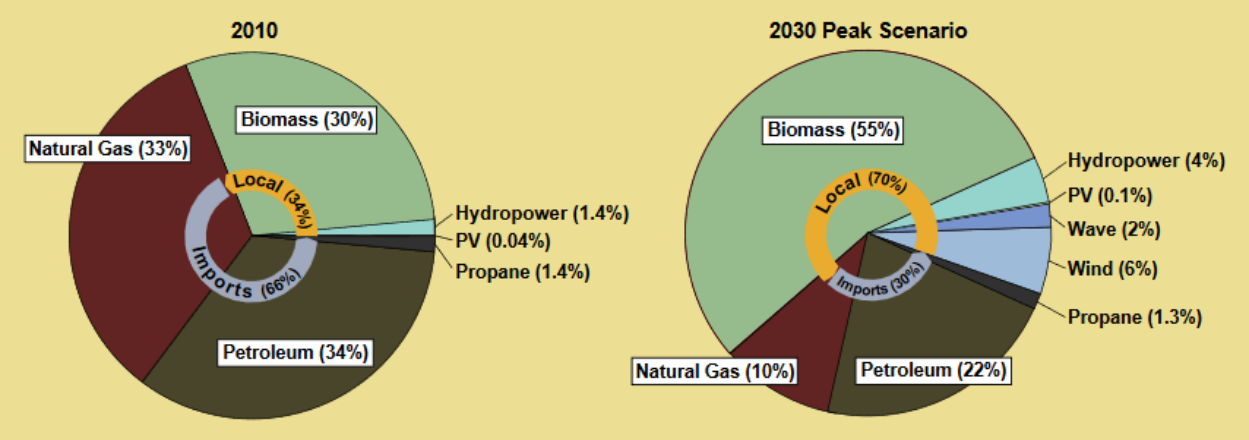
SB 1505 provides an important driver for these two alternative hydrogen production methods. SB 1505 was passed on September 30, 2006, and requires 33% of all hydrogen dispensed through state-funded hydrogen fueling stations to be produced using renewable sources of energy.[8] By requiring this 33% threshold, the state is spurring innovation in renewable hydrogen production, and encouraging development of renewable energy resources.

In March of 2013, SERC, RCEA, and PG&E released the RePower Humboldt Plan. The project was funded by the CEC as part of the Renewable Energy Secure Communities Program (RESCO), which aims to address issues with the deployment and integration of renewable energy at the community scale. The purpose of RePower Humboldt was to identify ways to develop Humboldt County's renewable energy resources: wind, wave, hydropower and biomass. A 2030 power mix scenario was developed, with biomass supplying 55% of the energy used in the County. Hydropower, solar, wave, and wind supplied 12% (figure 4).[9]

[8] SB 1505 Environmental Performance Standards for Hydrogen Fuel. http://www.leginfo.ca.gov/pub/05-06/bill/sen/sb_1501-1550/sb_1505_bill_20060930_chaptered.pdf

[9] Schatz Energy Research Center. March 2013. RePower Humboldt. http://www.schatzlab.org/docs/RePower_Humboldt_Strategic_Plan.pdf. California Energy Commission Public Interest Energy Research program Grant #PIR-08-034.

Figure 4: RePower Humboldt analysis of current and projected (2030) power mix scenarios.



Source: Schatz Energy Research Center. RePower Humboldt.

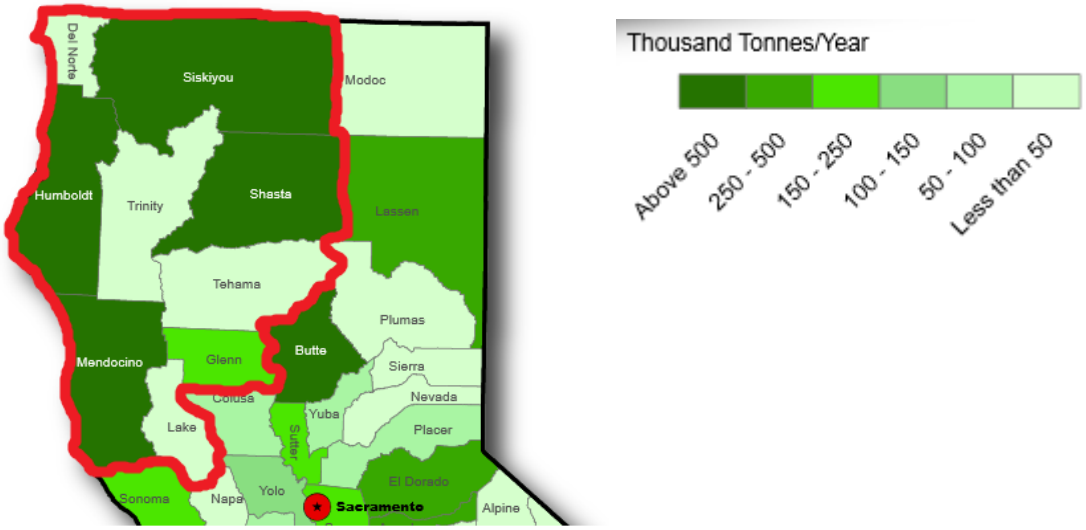
The North Coast and Upstate regions are home to abundant supplies of untapped renewable energy resources including wind, wave, solar, hydropower, and biomass. These resources are distributed throughout the project region, with coastal counties rich in wave and wind energy, and inland counties with abundant solar. Other resources, like biomass power, are distributed based on unique ecological characteristics. In Humboldt County alone, it is estimated that there is sufficient biomass to support 220 MW of electricity generating capacity.[10] Diverting some of this abudant biomass resource to biomass gasification could become an important source of hydrogen for FCEVs in the region.

The National Renewable Energy Laboratory analyzed biomass resources available in the US, identifying biomass resources broken down by thousand metric tons per year of biomass per county.[11] Figure 5 shows the biomass potential throughout the project region. Four counties, Humboldt, Mendocino, Siskiyou, and Shasta, are in the highest resource category listed (greater than 500,000 metric tons per year).

[10] Williams, Robert. (California Biomass Collaborative, University of California, Davis). March 2008. An Assessment of Biomass Resources in California, 2007 – Draft Report.

[11] Milbrandt, A. 2005. A Geographic Perspective on the Current Biomass Resource Availability in the United States, NREL/TP-560-39181, December 2005, http://www.nrel.gov/docs/fy06osti/39181.pdf.

Figure 5: Biomass resource potential for the nine-county region.



Source: Adapted from: www.nrel.gov/gis/pdfs/eere_biomass/eere_biomass_h_california.pdf.

The production of renewable hydrogen through electrolysis could also 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.[12] An electolysis production facility in the region could convert excess wind energy into hydrogen during peak production times.

2.5.1 Trinity Public Utilities District

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

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

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.[13]

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.[14] 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.

[13] 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

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

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Schatz Energy Research Center. March 2013. RePower Humboldt. http://www.schatzlab.org/docs/RePower_Humboldt_Strategic_Plan.pdf. California Energy Commission Public Interest Energy Research program Grant #PIR-08-034.

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Appendix A

The following information is taken as an excerpt from the Northwest California Alternative Fuels Readiness Plan.[15]

Del Norte County

- **County General Plan** (2003)
  - Goal 8.D: "To maximize the efficient use of transportation facilities so as to … 3) reduce the quantity of emissions of pollutants from automobiles."
- **County Regional Transportation Plan Update** (2016)
  - Policy 3.9.3.2.2: "Promote projects that can be demonstrated to reduce air pollution, such as active transportation projects and alternative fuel programs."

Humboldt County

- **County General Plan Update**
  - E-P4: "...Support the development and implementation of Electric Vehicle (EV) charging stations and other alternative fueling infrastructure."
  - E-P5: "Recognize the Redwood Coast Energy Authority (RCEA) as the regional energy authority, which will foster, coordinate, and facilitate countywide strategic energy planning, implementation and education through a Comprehensive Action Plan for Energy."
  - E-P7: "The County government shall reduce building and transportation energy consumption by implementing energy conservation measures and purchasing renewable energy and energy efficient equipment and vehicles whenever cost-effective. Conservation and renewable energy investments should be planned and implemented in accordance with and performance-based action plan and County Greenhouse Gas Emission Reduction goals."
  - E-P10: "Major commercial, business, industrial, or mixed-use facility developments shall be required to submit a transportation management plan that addresses energy conservation measures such as … alternative fueling stations;"

[15] Redwood Coast Energy Authority, Schatz Energy Research Center. Northwest California Alternative Fuels Readiness Plan. 2016. http://redwoodenergy.org/images/Files/Transportation/ARV-13-012_Readiness-Plan-FINAL_2017-02-23-small.pdf

- AQ-P10: "To lead by example, the County of Humboldt shall reduce its 2003 greenhouse gas emissions from governmental operations consistent with the state Global Warming Solutions Act and subsequent implementing legislation and regulations."
- AQ-P14: "Encourage and provide incentives for commercial and residential design that supports the charging of electric vehicles."
- AQ-IM4: "The County shall prepare a Climate Action Plan for its governmental operations consistent with the Countywide Climate Action Plan that seeks emission reductions in the following areas:
  - E. Renewable Energy and Low-Carbon Fuels
  - F. Efficient Transportation"

- **Comprehensive Action Plan for Energy** (2012)
  - "Vehicle Fleets: Encourage local government and private fleets to maximize the use of high-efficiency vehicles and alternative fuels."
  - "Alternative Fuels: Encourage when appropriate the use of alternative fuels that will reduce greenhouse gas emissions, which may include hydrogen, biodiesel, ethanol and natural gas."
- **County Regional Transportation Plan** (2014)
  - PT-11: "Support the transition to alternative fuels for transit fleet."
- **City of Arcata – Community Greenhouse Gas Reduction Plan** (2006)
  - Goal C-1: "Incorporate energy and climate policy into the city's transportation plan and encourage policies at all levels for efficient and non-polluting transportation."
  - Goal C-5: "For both health and environmental reasons, the City should promote … alternatively fueled vehicles. …"
  - Goal C-7: "Green the City Fleet. Use fuels or energy sources which emit fewer greenhouse gases, such as electricity or natural gas. Create a purchasing policy for acquiring new City vehicles that are more fuel efficient such as hybrids. The City should purchase a variety of vehicles, such as bicycles, electric bicycles, small electric vehicles, and energy efficient automobiles, and should institute policies that require that the most energy-efficient vehicle be used for each City purpose."
- **City of Arcata – General Plan** (2008)
  - RC-8a: "…The City shall convert City vehicle fleets to a mix of fuels that best meets the objectives of this policy."
  - RC-8c: "Promotion of Energy Efficiency in Transportation …"
- **City of Blue Lake – Climate Action Plan**

- LG.3: "Purchase alternative fuel and/or hybrid vehicles to replace current fleet vehicles."
- AT1.a: "Public education and promotion of low-carbon transportation options, including alternative fuels."

- **City of Fortuna – General Plan** (2010)
  - HS-3.6: "Increase clean-fuel use, ..."
  - LU-1/10: "The City shall monitor technological advances — such as, electric vehicle use increases, … in order to plan for changes that may affect land use."

Mendocino County

- **County of Mendocino – General Plan** (2009)
  - RM-45: "Encourage the use of alternative fuels, energy sources and advanced technologies that result in fewer airborne pollutants."
  - DE-161: "The County will demonstrate leadership in the implementation of programs encouraging the use of alternative modes of transportation by its employees, as well as the use of alternative fuels. Example programs may include:
    - A purchasing program that favors hybrid, electric, or other energy-efficient vehicles;
    - Assisting in the development of demonstration projects for alternative fuel technologies such as ethanol, hydrogen, and electricity; and
    - Transit incentives."
- **Mendocino Council of Governments (MCOG)– Regional Transportation Plan** (2011)
  - "Evaluate transportation projects based on their ability to reduce Mendocino County's transportation-related greenhouse gas emissions."
  - "Monitor new technologies and opportunities to implement energy efficient and nonpolluting transportation infrastructure."
- **MCOG – ZEV Regional Readiness Plan** (2013)
  - "The purpose of this effort is to provide regional transportation planning to build on previous work and participate in ongoing statewide and nationwide transitions to new vehicle technologies and renewable energy infrastructure in response to health and environmental impacts, energy issues, and climate change."
- **MCOG – Zero Emission Vehicle (ZEV) Regional Readiness Plan Phase 2 – Final Feasibility Report** (2015)
  - "This plan begins where the Mendocino County ZEV Regional Readiness Plan Phase 1 leaves off. It focuses on the following two implementation steps:

        - Engaging the community and soliciting public input on the location of the PEV Charging Stations as well as alternative sites, and to hear community preferences.
        - Determining the feasibility and planning-level costs of each preferred station location, including maps of each site."

- **City of Ukiah – General Plan** (1995)
    - Goal EG-2: "Improve the efficiency of energy use within the private transportation system."
    - Policy EG-2.1: "Encourage the use of alternatively powered vehicles."
    - Goal EG-3: "Improve the efficiency of energy use within the City's and County's vehicle fleet."
    - Policy EG-3.1: "The City and County shall serve as models for programs to operate fleet vehicles at maximum fuel efficiency."
    - Goal OC-37: "Support programs that reduce PM10 emissions."
- **City of Ukiah – Climate Action Plan** (2013)
    - Action TL-3.1a: "Participate in City-wide marketing efforts for Clean Air Days, Bike-to-Work Days, Sunday Streets/Car-Free Sundays, etc."
    - Action TL-3.1b: "Consider setting aside funding and/or pursuing grant funding to replace the City fleet vehicles with additional electric, hybrid-electric, and alternative fuel vehicles."
- **City of Fort Bragg – Draft Climate Action Plan** (2012)
    - Goal 3: Expand transportation alternatives by encouraging an alternative fueling station, coordinating with the Regional Blueprint Planning effort to improve transportation choices and reduce GHGs.

Siskiyou County

- **Siskiyou County – General Plan** (1993)
    - Energy Element: "Shifting to cost effective alternative fuels."
    - Energy Element: "Commercialization of alternative fueled/powered vehicles."
    - Energy Element: "Transportation fuels can be diversified through the introduction of alternative fuels such as methanol and electric-powered vehicles. There is also a need for a local contingency plan in the event outside supplies are disrupted, e.g. gasoline shortage as a result of an international oil crisis."

- Energy Element: “Improving the efficiency of the transportation sector …” (intended meaning is reducing the number of Single Occupancy trips, but could also be extrapolated to mean increased vehicle efficiency).
- Energy Element: "The County Planning Department shall maintain and distribute basic reference information and referrals for persons interested in energy efficient land-use and transportation techniques."
- Energy Element - Implementation Measure N: "In recognition of new federal legislation requiring federal government purchase of clean-fuel vehicles, and inasmuch as the Forest Service operates the largest public vehicle fleet in the County, the County shall seek a joint clean-fuel demonstration project with the Forest Service to create the basis for wider availability of clean fuels in the County."

- **Siskiyou County – Strategic Plan** (2008)
  - F-6 Strategy: “Help develop County policy with regard to climate change and greenhouse gases. Assist in the development of database to help inform County action relative to AB 32…”

Trinity County

- **Trinity County – General Plan** (2002)
  - Circulation Element – Goal 3: “Maintain and upgrade the existing transportation system to prevent costly deterioration, to ensure that efficiency of the system does not decline, to maintain air quality and conserve energy, and to increase mobility and reduce travel time within Trinity County and adjacent regions.”
- **Weaverville – Community Plan** (1990)
  - Goal 7 of the Transportation Section: “To maintain the high air quality in the Weaverville basin while expanding the transportation network.”

Appendix B

Redding Gas Station Priority by CHIT Capacity Need Score

Name	Address	City	Capacity Need (kg/day)
CIRCLE K/76 - HARTNELL	1015 HARTNELL AVENUE	REDDING	**51.9557**
TESORO #68193	2998 CHURN CREEK ROAD	REDDING	**51.9557**
SAFEWAY FUEL CENTER #1826	1010 E. CYPRESS AVENUE	REDDING	**51.8414**
VASU GAS & FOOD	1120 HARTNELL AVENUE	REDDING	**51.6636**
CYPRESS CHEVRON	765 E. CYPRESS AVENUE	REDDING	**51.4477**
HILLTOP FOOD & FUEL	2604 HILLTOP DRIVE	REDDING	**51.4477**
HILLTOP VALERO	722 E CYPRESS AVENUE	REDDING	**51.4477**
ARCO #05797	2010 CHURN CREEK ROAD	REDDING	**51.2953**
JINDRA'S AUTO SERVICE INC	482 E CYPRESS AVENUE	REDDING	**50.6095**
LANE CHEVRON	510 EAST CYPRESS AVENUE	REDDING	**50.6095**
ARCO AM/PM #83205	2951 BECHELLI LANE	REDDING	**50.5968**
TESORO #68192	382 E. CYPRESS AVENUE	REDDING	**50.2285**
BALL PARK 76	1275 CHURN CREEK ROAD	REDDING	**49.0093**
BROWNING STREET MINI MART	1120 CHURN CREEK ROAD	REDDING	**48.5521**
COLONIAL ENERGY CE 20110	1670 HARTNELL AVENUE	REDDING	**48.2219**
FOOD EXPRESS #5	5150 CHURN CREEK ROAD	REDDING	**48.2092**
CHURN CREEK CHEVRON	4746 CHURN CREEK ROAD	REDDING	**48.1584**
FUELGOOD	1279 PINE STREET	REDDING	**48.1203**
GAS 4 LESS	1409 PINE STREET	REDDING	**48.1203**
SHASTA STREET VALERO	1220 SHASTA STREET	REDDING	**48.1203**
TURTLE BAY MINI MART	1801 PARK MARINA DRIVE	REDDING	**48.0314**
TESORO #68194	1233 HILLTOP DRIVE	REDDING	**47.6758**
UNITED GAS FOOD MART	732 N MARKET STREET	REDDING	**47.0408**
BONNYVIEW CHEVRON	5001 BECHELLI LANE	REDDING	**46.9519**
EUREKA WAY CHEVRON	1905 EUREKA WAY	REDDING	**46.9265**
SAFEWAY FUEL CENTER #1954	980 CYPRESS AVENUE	REDDING	**46.8503**
SPEEDY VALERO	2026 EUREKA WAY	REDDING	**46.4947**
PACIFIC PRIDE CARDLOCK	5292 CATERPILLAR ROAD	REDDING	**46.0375**
TIME TO STOP MARKET	5425 MOUNTAIN VIEW DRIVE	REDDING	**45.9105**
FAST STOP MINI MART	11113 BLACK MARBLE WAY	REDDING	**45.8724**
FAST STOP MINI MART #2	3101 S. MARKET STREET	REDDING	**45.6438**
SURE STOP	3212 S MARKET STREET	REDDING	**45.6438**
WAYNE'S CHEVRON	101 LAKE BOULEVARD	REDDING	**45.339**
FLYERS #460	5204 CATERPILLAR ROAD	REDDING	**45.0215**
NORTH REDDING 76	1191 PRESTIGE WAY	REDDING	**44.9453**
MISSION MART	3440 S MARKET STREET	REDDING	**44.6024**
INTERSTATE OIL COMPANY	2341 WYNDHAM LANE	REDDING	**43.6753**
NORTHERN LIGHTS ENERGY	2340 WYNDHAM LANE	REDDING	**43.6753**
UNIVERSITY VALERO	1292 COLLEGE VIEW DRIVE	REDDING	**43.3197**
CITY REDDING - BENTON AIRPARK	2600 GOLD STREET	REDDING	**43.2054**
SHASTA VIEW CHEVRON	2505 TARMAC ROAD	REDDING	**43.0784**

REDDING TRAVEL CENTER	19483 KNIGHTON ROAD	REDDING	**43.0022**
CROSS PETROLEUM	3560 S. MARKET STREET	REDDING	**42.6466**
SANDHU GAS & MINI MART	4095 RAILROAD AVENUE	REDDING	**42.6466**
ZIPPY FOOD MART	1750 PLEASANT STREET	REDDING	**42.545**
FLYERS #459	5895 EASTSIDE ROAD	REDDING	**41.8084**
WIN RIVER MINI MART	2415 S. BONNYVIEW ROAD	REDDING	**40.6527**
CIRCLE K-76 #173	2220 WESTWOOD AVENUE	REDDING	**39.7002**
RANCHO MARKET	8510 AIRPORT ROAD	REDDING	**39.624**
CLEAR CREEK GROCERY & LOCKER	7036 WESTSIDE ROAD	REDDING	**39.5605**
COLLEGE KNIGHTS MINI MART INC	19973 COLLEGE VIEW DRIVE	REDDING	**39.2176**
FLYERS #458	3025 CROSSROADS DRIVE	REDDING	**39.2049**
COLONIAL ENERGY CE 20111	1495 LAKE BLVD.	REDDING	**39.1287**
HILLTOP CHEVRON	18575 OASIS ROAD	REDDING	**38.8112**
ARCO #06106	2402 CASCADE BLVD.	REDDING	**38.2016**
OASIS SHELL MINI MART	18850 OLD OASIS ROAD	REDDING	**38.2016**
FAST TRACK FOOD & FUEL	9539 OLD OREGON TRAIL	REDDING	**37.5793**
AIR SHASTA ROTOR & WING	3770 FLIGHT AVENUE	REDDING	**32.4231**
REDDING JET CENTER	3775 FLIGHT AVENUE	REDDING	**32.4231**
KC'S CORNER MART	14361 HOLIDAY ROAD	REDDING	**25.6921**
SPORTSMAN'S EXPRESS	14385 WONDERLAND BLVD.	REDDING	**23.6347**
KENT'S MEATS & GROCERIES	8080 AIRPORT ROAD	REDDING	**19.7612**
BRIDGE BAY RESORT & MARINA	10300 BRIDGE BAY ROAD	REDDING	**10.541**
SILVERTHORN RESORT	16250 SILVERTHORN ROAD	REDDING	**2.9083**

Eureka Gas Station Priority by CHIT Capacity Need Score

Name	Address	City	Capacity Need (kg/day)
GAS-N-GO PATRIOT	1711 4TH STREET	EUREKA	**33.4899**
PATRIOT GASOLINE	1679 MYRTLE AVE	EUREKA	**33.2994**
FAIRWAY MARKET (PATRIOT)	590 HERRICK AVE	EUREKA	**33.2105**
BROADWAY GAS & DELI	4050 BROADWAY	EUREKA	**33.2105**
COSTCO GAS STATION #125	1006 W WABASH AVE	EUREKA	**32.5247**
PERFORMANCE FUELS (HP #1)	1125 4TH ST	EUREKA	**32.0548**
CUTTEN SHELL (HP #4)	3973 WALNUT DRIVE	EUREKA	**32.0548**
HARRIS STREET SHELL (HP #2)	111 W HARRIS STREET	EUREKA	**31.3182**
MYRTLE AVENUE SHELL (HP #5)	1434 MYRTLE AVE	EUREKA	**30.2768**
SHELL PETRO MART (HP #9)	1310 5TH STREET	EUREKA	**29.9974**
BROADWAY TEXACO (HP #14)	1007 BROADWAY	EUREKA	**29.3116**
4TH STREET SHELL (HP#10)	2111 4TH ST	EUREKA	**27.8892**
HP #17 (SHELL)	3505 BROADWAY	EUREKA	**27.8892**
INDIANOLA MARKET	7769 MYRTLE AVE	EUREKA	**27.7241**
NORTH EUREKA CHEVRON	2480 6TH STREET	EUREKA	**26.7716**
EUREKA CHEVRON	2806 BROADWAY	EUREKA	**26.5938**
EUREKA EAST CARDLOCK	2600 HARRIS STREET	EUREKA	**25.9588**
EUREKA NORTH CARDLOCK	501 5TH STREET	EUREKA	**25.9207**
EUREKA SOUTH CARDLOCK	1176 W DEL NORTE STREET	EUREKA	**25.5397**
COURTHOUSE UNION 76	803 4TH STREET	EUREKA	**24.5237**
FAIRWAY PLUS TWO	1411 BROADWAY	EUREKA	**24.3078**
FAIRWAY PLUS (PATRIOT)	1723 BROADWAY	EUREKA	**24.3078**
HENDERSON CENTER PATRIOT	414 HARRIS STREET	EUREKA	**23.9649**
SOUTH BROADWAY PATRIOT	4175 BROADWAY	EUREKA	**23.1013**