Santa Barbara County
Air Pollution Control District

TRI-COUNTIES HYDROGEN READINESS PLAN

ARV-14-038

REGIONAL HYDROGEN REFUELING INFRASTRUCTURE PLAN

JUNE 30, 2016

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EXECUTIVE SUMMARY

ES-1 INTRODUCTION

Hydrogen has long been regarded as a clean alternative fuel for transportation. To this end, the California Fuel Cell Partnership (CaFCP) has been in existence for over 15 years stewarding collaboration among interested parties, and developing a "roadmap" for the State to become a world leader in the use of hydrogen as a fuel. The primary focus of the CaFCP has been on the potential use of hydrogen in fuel cells and in the use of fuels cells in vehicles. Many other parties have contributed to the significant progress made including the California Energy Commission (CEC), the California Air Resources Board (CARB), Energy Independence Now (EIN), and several leading automobile manufacturers.

While most progress has been made at the State level and in the major cities, there has been less emphasis on hydrogen infrastructure planning in regional communities. This has been recognized by the State, as the Central Coast Tri-Counties were recently funded to develop a readiness plan for the Tri-Counties region (Santa Barbara, Ventura and San Luis Obispo). Through a well-designed and coordinated planning effort, there is a potential to accelerate the introduction and use of hydrogen in the Tri-Counties region, and one with great potential for the adoption of Hydrogen Fuel Cell Electric Vehicles (FCEVs), based on past experience with other forms of advanced vehicle technologies.

ES-2 PLANNING GOALS AND OBJECTIVES

The goal for this grant is to prepare a hydrogen infrastructure readiness plan for the Tri-Counties, which is supported by strong proactive leadership throughout the region. By accomplishing this goal, our intent is to position this region for moving efficiently down a well-planned and synchronized pathway for introducing hydrogen-fueled transportation.

The challenge to be addressed in the project is how to best extend the network of hydrogen refueling infrastructure out from the major urban clusters to a more regional level. The California Energy Commission (CEC) recognizes the need for hydrogen infrastructure readiness planning in regional communities, as well as the major urban areas. The counties of Ventura, Santa Barbara and San Luis Obispo (Tri-Counties) represent a critical corridor for travel between the Bay Area and Southern California, and the region is a proven location for "early adoption" of alternative fuel technologies. Existing barriers to successful implementation include market limitations – specifically, the availability of FCEVs and hydrogen infrastructure – and also financial barriers, including vehicle cost and the significant investment needed for reliable refueling stations. To allow FCEVs to be operational in a community, the infrastructure needs to be available at the same time as the vehicles are offered for sale.

The hydrogen readiness work outlined in this plan is a critical first step in this process. In addition to sound technical analyses, the planning effort includes promotional activities in local communities, which will highlight the many environmental benefits of using hydrogen as a fuel compared with traditional fuels. To date, local communities have very little experience with hydrogen, so awareness building, highlighting advantages, and managing concerns will be essential for gaining public acceptance. Training permitting staff and first responders provides another critical need to help communities to become better prepared for this new fuel. Given that hydrogen refueling stations are costly, a readiness plan will provide a regional foundation for the strategic introduction of FCEVs together with the necessary refueling infrastructure.

This plan draws extensively from the existing body of information that is now available from statewide planning and installation efforts to date (including the annual CARB progress reports on FCEV deployment and hydrogen station development), and also from multiple local sources. This experience-based information will form the foundation for addressing the unique challenges that are anticipated in successfully achieving both an incipient and long-term hydrogen fueling network for the Tri-Counties region. We see this effort as a critical step for expanding the reach of hydrogen infrastructure beyond the main urban centers of California.

The objectives of this project were to:

- Develop a Tri-Counties Hydrogen Refueling Infrastructure Plan that includes analysis of hydrogen siting options, a prioritized list of potential sites for hydrogen refueling stations, and assessment of site readiness.
- Develop a list of key public and private stakeholders specific for each municipality and county in the region that need to be included in the hydrogen infrastructure discussion. Many of the key stakeholders have already been identified in the Plug-in Central Coast EV Readiness Plan and the Central Coast Alternative Fuel Vehicles Readiness Plan.
- Assess potential barriers to the efficient and timely permitting and construction of hydrogen stations, and provide recommendations for avoiding or mitigating these barriers.
- Compile a “Tri-Counties Hydrogen Station Permitting Manual” which includes resources to help streamline the Permitting Process for Hydrogen Refueling Stations, including checklists for permitting and safety assessments for hydrogen stations. In addition, city and county planning issues including zoning and CEQA will also be reviewed.
- Summarize the potential for use of FCEVs in local municipal fleets, assess safety concerns at potential fueling sites, and make presentations for the orientation of civic leaders.
- Develop a range of hydrogen refueling technology options that would be candidates for local agencies or private companies to select from, including renewable hydrogen, onsite reforming, and offsite hydrogen transport.
- Compile presentation materials that can be used to train local first responders and technicians at vehicle repair facilities and with emergency towing companies.
- Develop outreach strategies targeted to potential FCEV owners and fleets to promote the use of FCEV vehicles and the benefits of using hydrogen as a fuel.
- Prepare a plan for rolling out the hydrogen fuel infrastructure plan to local communities.
- Develop and track performance metrics for each task included in this preparedness plan to ensure that resources are applied and used effectively.

The project work tasks were in alignment with the CEC's Program Opportunity Notice which was the basis of funding for this work (PON-14-603), as follows:

Task 3	Regional Hydrogen Refueling Infrastructure Plan
Task 4	Streamlining the Permitting Process for Hydrogen Refueling Stations
Task 5	Promotion of FCEV Use
Task 6	Training
Task 7	Safety Assessments
Task 8	Incorporation of FCEVs in Municipal Fleets

A Work Plan was developed with sections that cover project objectives (Section 2), project management (Section 3), detailed work activities (Section 4), and a section on the schedule and deliverables (Section 5). The Work Plan addressed each of the tasks listed above with a description of the task, the objective of the task, how the task was to be conducted, who the task lead was, and which parties had a role in performing the task.

This planning work was collaborated and coordinated with the existing hierarchy of regional planning documents that are now adopted or in development to foster the use of Alternative Fuels and Alternative Fuel Vehicles in the Tri-Counties Region. Existing plans are in place in the form of County and City General Plans and Climate Action Plans. A summary of applicable planning documents is provided in Appendix 1. The work did not duplicate any activities in the Tri-Counties that have been previously funded by CEC. On the contrary, this work is complementary to other plans and projects developed in the Tri-Counties/Central Coast region, including the following:

- Tri-Counties Alternative Fuels Readiness Plan
- Tri-Counties PEV Readiness Planning
- First hydrogen station constructed in Santa Barbara (opened in May 2016)

Note: The following four subsections will be completed when the final report to the Energy Commission is finalized in early 2017.

ES-3. Infrastructure Siting

The project resulted in the development of a Tri-Counties Infrastructure Plan that outlines how the region will facilitate the installation of hydrogen refueling stations over time, and determine where those stations will be most effectively sited.

This plan was developed through application of UC Irvine's Spatially and Temporally Resolved Energy and Environment Tool (STREET) model at the regional and municipal level, together with extensive work locally to review siting options.

ES-4. Permitting Guidelines

The project resulted in the development of a Hydrogen Station Permitting Manual for our local municipalities and government agencies to use as a reference document when permitting a range of new hydrogen fueling station types in this region. It is expected that the manual will also be a useful resource for infrastructure providers.

ES-5. Safety and First Responder Training

ES-6. PROMOTION OF FCEVS

ES-7. NEXT STEPS

PART 1 – HYDROGEN STATION SITING ANALYSIS

1. STATEWIDE CONTEXT

To assess the future potential of hydrogen vehicles in the Tri-Counties region, and the actions that regional and local stakeholders can take to support FCEV readiness, it is helpful to provide some context of the statewide policy and planning efforts for hydrogen fuel to date[1]. As such, this chapter gives an overview of the following issues:

- Development of FCEV technology and the California ZEV mandate
- Overview of California's Hydrogen Infrastructure Strategy
- Statewide hydrogen fueling infrastructure

1.1 Development of FCEV Technology and the California ZEV Mandate

Fuel cells have been under development for many years, and over the last twenty years, a vast amount of work has been devoted to making fuel cells commercially viable and cost-effective in vehicles. The California ZEV mandate has played a key role in driving this development, and auto manufacturers have collaborated closely with government agencies in California through the California Fuel Cell Partnership.

While manufacturers have been developing the vehicle technologies, the state has begun a diligent program to establish a hydrogen refueling infrastructure across the state, with the initial priority of supporting FCEV clusters in the two primary urban areas – the Bay Area to the north, and the Los Angeles basin to the south. This investment program is discussed in more detail in the next section.

1.2 Overview of California's Hydrogen Infrastructure Strategy

The California Hydrogen Highway Network was initiated in April of 2004 by Executive Order S-07-04 under then Governor Arnold Schwarzenegger. The intent of the Order and associated investments in FCEV technology by the California Energy Commission has been to ensure that hydrogen fueling stations will be in place to meet the needs of future FCEV drivers, and to facilitate the advancement of hydrogen vehicles as projected under the Zero Emission Vehicle (ZEV) mandate. Over the medium-term (5-10 years), hydrogen technologies also have potential to be deployed in medium and heavy duty vehicle segments, as well as the light-duty sector.

To provide an overall strategic framework for FCEV deployments across all vehicle types, the California Fuel Cell Partnership published *A California Road Map: The Commercialization of Hydrogen Fuel Cell Electric Vehicle* in 2012.[2] This Road Map and subsequent updates have articulated the core policy and program framework for FCEV market development, including the all-important development of a new hydrogen fueling infrastructure.

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[1] *Note. More detail of the background and context for hydrogen fuel development in California is included in the Central Coast Alternative Fuels Plan.*

[2] *A California Road Map: The Commercialization of Hydrogen Fuel Cell Vehicles, June 2012 http://cafcp.org/sites/files/A%20California%20Road%20Map%20June%202012%20%28CaFCP%20technical%20version%29_1.pdf*

The *Road Map* in turn served as a basis for Governor Jerry Brown's March 2012 Executive Order that directed California state agencies to support the accelerated deployment of the full range of zero-emission vehicles (ZEVs), including FCEVs.[3] The state's comprehensive 2013 *ZEV Action Plan* provided further guidance on bringing FCEVs to market.[4] Most recently, the passage of Assembly Bill 8 (Perea, 2013) was another pivotal step in FCEV development, extending through 2023 the Air Resources Board's Air Quality Incentive Program (AQIP) and the Energy Commission's Alternative and Renewable Fuel & Vehicle Technology Program. AB 8 included a crucially important provision to fund at least 100 hydrogen stations with up to $20 million a year. Since the passage of AB 8, three automakers (Honda, Toyota, and Hyundai) have moved ahead and introduced FCEVs to the California market, and other automakers are expected to enter the market in the 2017-2022 timeframe. FCEVs have been embraced by key state policy makers because -- once an appropriate fueling infrastructure is in place -- they will combine the convenience and utility of conventional Internal Combustion Engine (ICE) vehicles with the quiet and clean attributes of electric vehicles.

The majority of the hydrogen fuel produced in California is currently derived from natural gas, though current state law mandates that 33% of the hydrogen supplied for FCEVs must be from renewable sources (SB 1505 [5]). With the potential to develop a supply chain for renewable and low-carbon hydrogen fuel, the state has produced another key policy document known as the *Vision for Clean Air* -- developed by several leading air quality management agencies -- to highlight strategies to accelerate the introduction of FCEVs as well as EVs in the context of air quality policy and goals.

While policies for FCEV promotion are developed primarily at the state level, local and regional stakeholders can work together with hydrogen fuel suppliers and the California Fuel Cell Partnership to support and accelerate existing plans for hydrogen fueling station deployment.

1.3. Statewide Hydrogen Fueling Infrastructure

The *Road Map* and *ZEV Action* Plan together prescribe a minimum network of hydrogen stations to establish the foundation for robust, commercial-scale FCEV adoption. Focused on "early adopter" areas in Southern California and the San Francisco Bay Area, the FCEV station network includes "connector" and "destination" stations intended to anchor the evolving statewide network and enable north-south travel.

In 2015, the CEC announced funding for 28 new stations, which – when constructed – will result in 51 total stations. Additional stations will be funded by the CEC until there are at least 100 stations across the state by 2020. Current information on the status of stations is provided by the California Fuel Cell Partnership and the Governor's Office for Business (GoBiz).

The *Hydrogen Progress, Priorities and Opportunities Report* was recently published by the CaFCP and its *Original Equipment Manufacturers (OEM) Advisory Group* – including Honda, General Motors, Hyundai, Mercedes-Benz, Nissan, Toyota and Volkswagen. The report included a consensus list of recommended priority locations for the next 19 hydrogen

[3] *Executive Order B-16-2012, March 23, 2012. http://gov.ca.gov/news.php?id=17472*
[4] *ZEV Action Plan A roadmap toward 1.5 million zero-emission vehicles on California roadways by 2025, February 2013. http://opr.ca.gov/docs/Governor's_Office_ZEV_Action_Plan_(02-13).pdf*
[5] *SB 1505 Environmental Performance Standards for Hydrogen Fuel*

stations to be built in the state. While these are simply recommendations, it is of relevance to the Tri-Counties in that the city of Thousand Oaks was recommended as a Primary Priority, and the city of Ventura or Oxnard was recommended as a Secondary Priority.

The first hydrogen system to be installed in the Tri-Counties is located in Santa Barbara at the Conserv Fuels station at 150 South La Cumbre Road. The system was developed by First Element Fuels with funds awarded by the California Energy Commission in 2014. The station construction was managed by Black and Veatch, and began operating in May 2016.

In its first two years of operation, fuel for the station will be provided by Air Products and Chemicals. As is the case for most early hydrogen fueling stations, the California Energy Commission will also be providing Operations and Maintenance (O&M) funding for at least the first three years of operation, with the expectation that the station will become commercially sustainable in later years as demand for hydrogen grows.

The Santa Barbara station is a starting point for the development of the hydrogen infrastructure in the region. This is the first step for the region to develop a regional network in the next few years.

2 TRI-COUNTIES REGIONAL DEMAND ANALYSIS

As a basis for developing the infrastructure plan for the Tri-Counties region, it is necessary to assess the potential need for hydrogen fuel in the years to come. In turn, for transportation, this is dependent on the FCEVs sales projections for the region, and the anticipated need for hydrogen fuel by vehicles traveling to the region or in-transit through the region. To make this assessment, the ZEV mandate projections for the state were used as a starting point, and pro-rated for the region. Projected sales by the OEMs were also factored into this initial assessment.

2.1 California Fuel Cell Electric Vehicle Sales Projections

For many years, the California Zero Emission Vehicle (ZEV) mandate has played a key role in setting targets for ZEV sales in California. However, the ability to meet those targets has been limited by the challenges of manufacturing vehicles that attain the ZEV standards and, at the same time, meet customer expectations. FCEVs are still in the early stages of commercialization, and there are many barriers to implementation that can impede the speed at which a new technology can be deployed. For this reason, the ZEV mandate targets should be considered targets or goals, rather than projections of actual sales.

A more realistic estimate of projected sales numbers can be obtained from the OEM survey conducted by CARB in 2014 and discussed in detail in the July 2015 Annual Evaluation of FCEV Deployment and Hydrogen Fuel Station Network Development report (CARB Hydrogen Report 2015). Mandatory surveys were distributed to 16 auto manufacturers requesting information on planned deployment of FCEVs. Data reported back to CARB from the OEMs forecast an acceleration in the number of vehicles made available for sale in California from present to 2021 (the last year included in the survey). CARB has recently projected, from the results of this survey, that the state's fleet of FCEVs is expected to grow to nearly 35,000 vehicles by 2021. (Refer to Table 1.)

The same report stated that a minimum of 51 stations would be needed to service an expected demand of 13,500 vehicles, so the assumption is made here that a single station could serve about 265 vehicles on a consistent basis. Table 1 includes a separate analysis to show that this number is corroborated by a simple projection of station use based on hydrogen consumption data now available for vehicles coming to market.

2.2 Analysis of Hydrogen Fuel Demand from Personal Vehicles in Tri-Counties Region

Projections of vehicle numbers, hydrogen fuel demand and refueling infrastructure requirements were made for the Tri-Counties region based upon "best estimates" for the statewide data presented above. Using the CARB survey data, the prorated sales projections would be approximately 1,000 vehicles by 2020 and 3,000 vehicles by 2025. Table 2 provides a summary of these projections. Table 2 also shows that the Tri-Counties would need about four stations (minimum) to meet the projected retail demand in 2020, and about eleven stations by 2025, which assumes that vehicle owners work or live near station sites.

While the projections appear to be very precise, it is simply due to the prorating process that was used to develop the estimates. In reality, it would be prudent to use a range in the projections for planning purposes, with lower and higher estimates of the number of stations needed for planning refueling infrastructure needs.

Of course, these demand projections assume that the auto manufacturers promote sales in this region, consistent with other target sales locations. On the contrary, vehicle sales in a region depend on the availability of infrastructure, so it could substantially impede sales potential if the infrastructure were not planned and installed.

Table 1
California ARB: 2015 Annual Projection of FCEV Deployment and Hydrogen Fuel Station Network Development

Projected Number of FCEVs in California Fleet

Year End	Vehicles	Source/Derivation
2018	10,500	CARB Hydrogen Report 2015, 2nd bullet, page 3
2019	18,433	interpolated
2020	26,367	interpolated
2021	34,300	CARB Hydrogen Report 2015, 2nd bullet, page 3
2022	42,800	extrapolated, assuming additional 8,500 new vehicles per year
2023	51,300	extrapolated, assuming additional 8,500 new vehicles per year
2024	59,800	extrapolated, assuming additional 8,500 new vehicles per year
2025	68,300	extrapolated, assuming additional 8,500 new vehicles per year

Hydrogen Stations Operational by Year-End 2016

51	stations	CARB Hydrogen Report 2015, 3rd bullet, page 3
9,400	kg per day	CARB Hydrogen Report 2015, 3rd bullet, page 3
13,500	vehicles	CARB Hydrogen Report 2015, 3rd bullet, page 3
254	kg/vehicle/year	derived from information provided
265	vehicles per stn	derived from information provided
184	kg/station/day	derived from information provided

Vehicle-Station Projection Check

15000		Vehicle miles per year
300	mi	Range (Toyota Mirai)
50		Fuel stops per year (once per week)
20	min	Time to refuel (conservative estimate, more likely to be 5-10 min)
3	veh/hr	Single station capacity
12	hr	Time actively used each day
36		Vehicles filled per day
252		Vehicles per week (Vehicles per Station)

Compares well with CARB report which indicates an average of 265 vehicles per station

Table 2
Tri-Counties Regional Projections (Minimum Requirements)

Population Data for Pro-rating	Population (2015 est)		
California	38,000,000	100%	(1)
Santa Barbara County	450,000	1.2%	
Ventura County	840,000	2.2%	
San Luis Obispo County	280,000	0.7%	
Tricounties	1,570,000	4.1%	

FCEV Numbers Pro-rated based on Population	2020	2025	
California	26,367	68,300	(2)
Santa Barbara County	312	809	
Ventura County	583	1,510	
San Luis Obispo County	194	503	
Tricounties	1,089	2,822	

Pro-rated Number of Stations	2020	2025	
California	100	258	(2)
Santa Barbara County	1	3	
Ventura County	2	6	
San Luis Obispo County	1	2	
Tricounties	4	11	

Annual Fuel Use (kg)	2020	2025	
California	6,701,040	17,358,319	(2), (3), (4)
Santa Barbara County	79,354	205,559	
Ventura County	148,128	383,710	
San Luis Obispo County	49,376	127,903	
Tricounties	276,859	717,173	

2.3 Other Demand for Hydrogen

Other potential demand for hydrogen could arise from fleet operations using FCEVs, heavy duty vehicles (including buses and drayage vehicles), and with turnkey fork lift operations using hydrogen. As and when additional demand occurs for these potential needs, then the fueling equipment and infrastructure would likely be different from that used for FCEV refueling especially for heavy duty vehicles; and when the equipment is similar, it may not be available to the general public.

The possibility of siting hydrogen stations at dealerships that sell FCEVs is another consideration. This may provide an alternative source of hydrogen when primary stations are offline, which is a concern for high pressure hydrogen stations.

2.4 Base Case Planning Scenario[6]

This section presents a summary of the FCEV retail sales projections for the Tri-Counties and the infrastructure that will be needed to meet projected demand. Based primarily on the CARB 2015 report and the OEM survey data, it is assumed that there will be a minimum need for an additional three or four hydrogen refueling stations by 2020 to service approximately 500 to 1,000 FCEVs that could be operating in the region by that time. It is anticipated that at least two or three stations will be needed in Ventura County, and one additional station in Santa Barbara County.

Beyond 2020, it is assumed that the number of FCEVs in the Tri-Counties will grow further, and that additional build-out of the refueling infrastructure will be needed. Based on the data available during the planning process, it is reasonable to assume that the number of FCEV sales would increase to about 2,500 or 3,000 by 2025. Overall this would require at least ten to 12 stations in the region by that time, with one or two stations in San Luis Obispo County.

While there are many uncertainties that factor into this analysis, these projections provide a rationale for local decision-makers to promote this new vehicle technology, and to support the goals of the state in the development of FCEV technology.

2.5 Accelerated FCEV Adoption Scenario

With increased promotion locally and support from the auto manufacturers, it is assumed that the Tri-Counties could accelerate the FCEV adoption rate by a factor of two or three times. This accelerated adoption rate would depend greatly on concurrent investment in refueling station infrastructure to keep pace with demand. For example, increasing sales by a factor of three could result in a scenario where there are about 2,500 vehicles in the region by 2020 (10 stations), and 7,500 or more by 2025 (30 stations). To accomplish this would require an investment of about $20 million by 2020 and about $60 million by 2025, split among the three counties (prorated by population).

Assuming that a conventional car driven 12,000 miles per year would emit about 5 tonnes of carbon dioxide, replacing 1,000 vehicles with hydrogen would reduce tailpipe emissions by 5,000 tonnes per year, or about 60,000 tonnes over the life of the vehicle (12 years). With an accelerated adoption scenario and a total of 7,500 FCEVs (by 2025), the yearly carbon dioxide emissions reduction would be 38,000 tonnes and 450,000 tonnes over 12 years.

Some studies indicate that an alternative fuel like hydrogen would need to be available at a minimum of 5% of the existing gasoline stations to alleviate driver concerns about fuel availability. With about 540 gasoline stations in the Tri-Counties, this suggests that about 27 stations would need to have hydrogen to satisfy achieve this.[7][8] Other research indicates that

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[6] *Projections based on OEM survey data reported by ARB. Approach is consistent with analysis by Ogden at al in Joan Ogden, Christopher Yang, Michael Nicholas, Lew Fulton , NextSTEPS White Paper: The Hydrogen Transition, Institute of Transportation Studies University of California, Davis, July 29, 2014, p. 15 http://steps.ucdavis.edu/files/08-13-2014-08-13-2014-NextSTEPS-White-Paper-Hydrogen-Transition-7.29.2014.pdf*

[7] *M. Nicholas, S. Handy, and D. Sperling, "Using Geographic Information Systems to Evaluate Siting and Networks of Hydrogen Stations," Transp. Res. Rec. J. Transp. Res. Board, vol. 1880, pp. 126–134, Jan. 2004.*

it would take 10% for it to become “a minor consideration”, and that it may take 15% for successful penetration (page 3, section 2.2).[9] Thus, in the longer term the number of stations with hydrogen in the Tri-Counties would likely have to increase to 70 or more to support a mature hydrogen fuel transportation system.

[8] *M. W. Melaina, “Initiating hydrogen infrastructures: preliminary analysis of a sufficient number of initial hydrogen stations in the US,” Int. J. Hydrogen Energy, vol. 28, no. 7, pp. 743–755, 2003.*

[9] *https://www.researchgate.net/publication/222697006_Initiating_hydrogen_infrastructures_Preliminary_analysis_of_a_sufficient_number_of_initial_hydrogen_stations_in_the_US*

3. TRI-COUNTIES SITING ANALYSIS

3.1 Introduction

Section 2 (above) includes a summary of the statewide strategy for FCEV deployment with the initial effort focused on vehicle sales and infrastructure development in the two primary urban areas of the state – the Bay Area in the north, and the Los Angeles basin in the south. In the initial "roadmap analysis", Santa Barbara was identified as a "destination station", primarily for vehicles traveling north from Los Angeles.

With this initial station now in operation in Santa Barbara, there is potential to build out a local infrastructure to support additional FCEV deployment in the Tri-Counties region. The strategy for local infrastructure development is principally driven by the availability and demand for retail vehicles, but also to increase the reliability of supply in the local area for destination travelers, and also for establishing north-south connectivity along the Highway 101 corridor. At this time, the station in Santa Barbara theoretically allows for hydrogen vehicles to travel north to San Jose – the next nearest station to the north along the 101 – but the distance is about 280 miles, which is close to the maximum range for most early FCEVs.

For these reasons, the refueling station siting analysis for the Tri-Counties region has accounted for three main factors when considering spatial distribution of sites:

- To serve the projected growth of retail sales (discussed in Section 2);
- To increase the appeal of the region as a destination for FCEV drivers (mainly from the Los Angeles area initially); and
- To provide reliable connectivity between Los Angeles and the Bay Area along the 101 corridor[10].

3.2 Market Demand for FCEVs and Hydrogen Fueling Infrastructure

As part of the planning effort, a detailed analysis was conducted of the current situation in the Tri-Counties region relative to population and economic demographics, and sales potential for FCEVs in the region. This analysis was used to develop hydrogen infrastructure "build-out" scenarios for the next five to ten years. The approach used is described below.

Projecting market demand for FCEVs is essential for assessing the need for refueling stations in the region over the near term. To assess this, staff at the University of California Irvine (UCI) Advanced Power and Energy Program (UCI-APEP) were asked to adapt their STREET model to the Tri-Counties region. The STREET model (Spatially and Temporally Resolved Energy and Environment Tool) was developed by UCI-APEP to provide insight and information to help decision-makers plan for infrastructure investments related to alternative fuels transportation. The primary objective for applying the STREET model was to develop a strategic approach to the siting of hydrogen refueling stations across the Tri-Counties using FCEV market proxy data.

[10] *To fully utilize a station takes about 250 fueling events per week, so this would require 125 round trips per week by FCEVs with no additional local demand (assuming they fill at this location both ways).*

The STREET model was used to identify 20 “high priority” gasoline stations in the Tri-County area. The analysis was based on several different sets of Alternative Fuel Vehicle (AFV) sales registration data that serve as proxies for FCEVs. Connectivity between northern California and southern California was also analyzed. The STREET results were then compared to the Station Coverage Value given by the California Hydrogen Infrastructure Tool (CHIT). The CHIT Station Coverage Value is the ability of the proposed station to fill an identified gap in refueling coverage.

Three different sets of AFV sales registration data were used: (1) battery electric vehicles (BEVs), (2) plug-in hybrid electric vehicles (PHEVs) combined with hybrid electric vehicles (HEVs), and (3) BEVs combined with PHEVs and HEVs. The AFV sales registration data, obtained from IHS Automotive, show the number of a type of vehicle registered in a zip code tabulation area (ZCTA). The spatial resolution of this data set is rather coarse, so it was combined with high resolution population data (1km x 1km) to evaluate potential station locations. In essence, this approach allows for counting potential vehicle sales (demand points) in each grid cell. Existing gasoline refueling stations were used as candidate locations for siting future hydrogen fueling stations. Station addresses were obtained from the APCDs in the three counties.

The final “demand weight” for each cell is the product of the cell population weight and the number of registrations in the ZCTA.

$$Demand\ Weight = ZCTA\ AFVs * Cell\ Weight = ZCTA\ AFVs * \frac{Cell\ Population}{ZCTA\ Population}$$

The “demand point” for each cell is represented by the point location of its centroid. Potential hydrogen refueling stations are then identified using a Maximize Market Share algorithm in the GIS system. This algorithm seeks to place a given number of stations (set at 20) to maximize the demand (i.e., FCEV proxy) on the stations within a given service coverage area. This is the area that is served by a station and can be defined by drive time or distance. In these analyses, drive time was used, and based on previous studies, this was chosen to be six minutes. It appears to be a good compromise between parity with the convenience of gasoline service, and minimization of infrastructure investment.

Once the station locations are allocated using the Maximize Market Share algorithm, they are ranked according to the total demand points (FCEV proxy) covered by a six minute drive time from the gasoline station.

A detailed report of the STREET modeling analysis is included in Appendix 2, and this includes results for the three different sets of AFV registration data. In general, there was not much difference between the results using the different data sets (HEV+PHEV) and (HEV+PHEV+BEV) data sets, since the number of HEVs and PHEVs is larger than the number of BEVs. However, using BEV sales alone, as the proxy shows slightly different results than for the other two data sets, with more demand indicated for San Luis Obispo county. The results – expressed as the number of stations by county – are summarized below:

	Ventura	**Santa Barbara**	**San Luis Obispo**
HEV + PHEV	13	5	3
HEV + PHEV + BEV	13	5	3
BEV	11	5	5

With 21 stations (20 additional stations plus the existing La Cumbre station) these would cover 80% of total sales within the 6 minute radius (i.e., 7,386 out of 9,223 in the Tri-Counties). These are shown in Table 3 below. The CHIT Station Coverage Values are also shown for each suggested station in Table 3. This is the California Hydrogen Infrastructure Tool (CHIT) coverage gap score. The CHIT Station Coverage Value is the ability of the proposed station to fill an identified gap in refueling coverage.

The spatial distribution of proxy demand and possible station locations are shown for the Tri-Counties in Figure 1. (Note that these results are based on modelling analysis of potential FCEV sales based on proxy data, and not guaranteed to reflect actual sales that may occur.)

3.3 Further Assessment of Candidate Stations

Given that the STREET model projects the best locations for hydrogen refueling infrastructure using a theoretical analysis and mathematical algorithms, it does not account for physical characteristics of the existing stations, such as space availability (for the hydrogen refueling system), access and curb-appeal. For this reason, the project team used the modelling results presented in Table 3 to develop a more realistic assessment of station alternatives.

The intent of this assessment was to reconcile the "preferred" station locations from the model with real-world options, thus giving options to decision makers for identifying stations, while staying consistent with the projections of market demand from the STREET analysis. For example, the STREET model may have selected a specific station on a given street based on the allocation algorithm, yet there may be an alternative station in close proximity with more space, better access and with less permitting constraints. This alternative would satisfy the intent to site a hydrogen station within that general location, and at the same time offer a more suitable site alternative.

To accomplish this, the team looked at station alternatives in the high market potential areas and conducted a screening analysis to assess site characteristics. The local Air Districts provided addresses of the active-permit gasoline fueling stations in the three counties – Ventura (259), Santa Barbara (154), and San Luis Obispo (127) – with a total of 540 stations in the Tri-Counties. Non-commercial fueling stations (e.g. golf course fueling stations, city fleets, water districts, Cal-trans, fire stations etc., about 130 facilities) were disregarded (for retail sales potential), and remaining retail fueling station locations were retained.

Stations within the high market potential areas and in close proximity to the primary freeways (Hwy 101 and Hwy 118) were visited. UCI data showed high FCEV sales potential around Thousand Oaks, Simi Valley, Camarillo, Ventura and Oxnard (in Ventura County), and along the south coast of Santa Barbara County. In San Luis Obispo, the higher sales potential areas are along Highway 101 from Arroyo Grande through the City of San Luis Obispo and on to Atascadero. As such, stations in these areas were carefully reviewed, and multiple high-scoring stations were identified for these areas. In total, 183 stations were visited, 92 in Ventura, 60 in Santa Barbara and 31 in San Luis Obispo.

These stations were numerically rated, using five qualitative criteria as follows:

- Space available on the forecourt (maximum of 6)
- Appearance (6)
- Neighborhood (3)
- Ease of Access (3)
- Proximity to Freeway (3)

With this approach, space and appearance carried twice the weight of other criteria. Stations that ranked low in these two primary criteria were not closely investigated.

Stations north of Atascadero were not visited at this time, but they are nonetheless areas where connectivity could be relevant in the final analysis. Stations identified in the UCI report in these areas were reviewed via satellite imagery for size and freeway accessibility. Nipomo stations were not considered due to the town's small size, and proximity to larger population centers in Santa Maria and Arroyo Grande, both communities with high-ranking viable station options.

Stations that had a total rating score of 17 or higher were identified as good potential alternatives to those identified by UCI. The results are summarized in Tables 4, 5 and 6, for Ventura, Santa Barbara and San Luis Obispo counties, respectively. Complete results of the field assessment are included in Appendix 3.

It should be emphasized that the station prioritization shown in Tables 4-6 does not mean to imply that the highest ranked stations would be the first for hydrogen fueling placement, nor does it imply that only the sites shown would be considered and supported. The qualitative assessment and prioritization does, however, indicate that there are good options for siting hydrogen fueling dispensers at existing gasoline stations in all three counties.

Table 3
Results of UCI-APEP Spatial Modeling (grouped by cluster)[11]

Group	Rank	Street Address	City	County	Zip Code	AFVs Covered	Total AFVs Covered	CHIT Coverage Gap Score [x100]	Total CHIT Score
1	2	45 N. REINO RD	Thousand Oaks	Ventura	91320	607	2308	1.78	7.00
1	4	1152 E AVENIDA DE LOS ARBOLES	Thousand Oaks	Ventura	91360	571		1.90	
1	3	293 S MOORPARK RD	Thousand Oaks	Ventura	91361	596		1.45	
1	*5*	*4500 E THOUSAND OAKS BLVD*	*Thousand Oaks*	Ventura	*91362*	*534*		*1.87*	
2	17	507 E THOMPSON BLVD	Ventura	Ventura	93001	173	1403	0.39	6.15
2	15	7700 TELEGRAPH RD	Ventura	Ventura	93004	266		1.56	
2	13	522 N LAS POSAS RD	Camarillo	Ventura	93010	303		0.97	
2	8	4870 SANTA ROSA RD	Camarillo	Ventura	93012	419		0.84	
2	20	246 W EL ROBLAR DR	Meiners Oaks, Ojai	Ventura	93023	106		0.27	
2	18	655 S VENTURA RD	Oxnard	Ventura	93030	136		2.13	
3	11	50 W NEW LOS ANGELES AVE	Moorpark	Ventura	93021	339	1363	0.35	2.36
3	10	2627 YOSEMITE AVE	Simi Valley	Ventura	93063	346		0.84	
3	1	1196 E LOS ANGELES AVE	Simi Valley	Ventura	93065	678		1.17	
4	21	4401 VIA REAL	Carpinteria	Santa Barbara	93013	102	1706	0.54	2.73
4	6	101 W CARRILLO ST	Santa Barbara	Santa Barbara	93101	505		1.24	
4	*7*	*150 S LA CUMBRE RD*	*Santa Barbara*	*Santa Barbara*	*93105*	*434*		*0.26*	
4	9	1476 E VALLEY RD	Montecito	Santa Barbara	93108	350		0.54	
4	12	5960 CALLE REAL	Goleta	Santa Barbara	93117	315		0.15	
5	16	296 SANTA ROSA RD	San Luis Obispo	San Luis Obispo	93401	213	606	0.78	1.18
5	14	100 BARNETT ST	Arroyo Grande	San Luis Obispo	93420	275		0.22	
5	19	2000 EL CAMINO REAL	Atascadero	San Luis Obispo	93422	118		0.18	

[11] *It should be emphasized that the station prioritization shown in Tables 4-6 does not mean to imply that the highest ranked stations would be the first for hydrogen fueling placement, nor does it imply that only the sites shown would be considered and supported.*

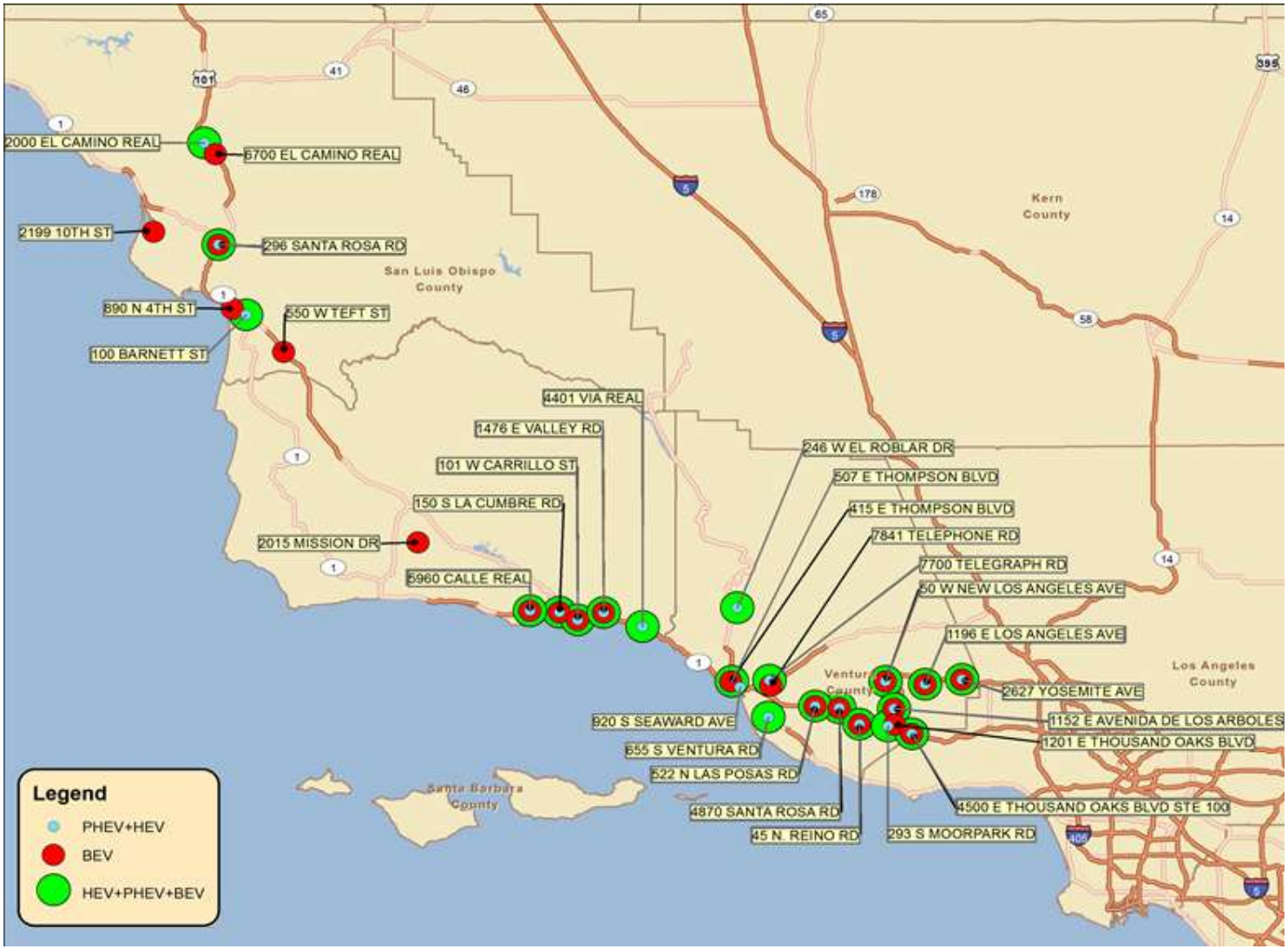

Figure 1 Tri-County Network of potential hydrogen refueling stations based on STREET modeling

Table 4a
Existing Gas Stations with High Suitability Ratings for Adding Hydrogen
(East Ventura County)

Name	Address	City	Zip	SCORE
Hampshire Road Shell	395 Hampshire Road	Thousand Oaks	91360	18
7-Eleven #33162	609 Rancho Conejo Blvd.	Thousand Oaks	91320	18
Jenda, Inc.	3995 Thousand Oaks Blvd.	Thousand Oaks	91362	17
Rolling Oaks 76	293 S. Moorpark Rd.	Thousand Oaks	91361	17
Oaks Shell	56 E. Thousand Oaks Blvd.	Thousand Oaks	91360	17
Westlake Chevron	225 Hampshire Rd.	Westlake Village	91361	17
Borchard Arco AM/PM	2305 Borchard Rd.	Newbury Park	91320	21
GSE 76 Ventu Park	575 N. Ventu Park Rd.	Newbury Park	91320	20
Newbury 76	848 Wendy Dr.	Newbury Park	91320	18
USA Gasoline #68174	518 Rancho Conejo Blvd.	Newbury Park	91320	18
S & G Energy, Inc.	445 North Ventu Park Rd	Newbury Park	91320	18
Wendy Drive Chevron	2870 Camino Dos Rios	Newbury Park	91320	17
Borchard Chevron	2290 W. Borchard Rd.	Newbury Park	91320	17
Campus Plaza Shell	6599 Collins Dr.	Moorpark	93021	20
Moorpark Chevron	502 Los Angeles Ave.	Moorpark	93021	18
Union 76	550 W. Los Angeles Av	Moorpark	93021	17
Yosemite Shell	2627 Yosemite Ave.	Simi Valley	93063	21
Circle K #2211185	5195 East Cochran	Simi Valley	93063	20
Swank's Chevron	2449 Stearns Street	Simi Valley	93063	20
Chevron #9-1024	2568 Sycamore Drive	Simi Valley	93065	19
Apro LLC dba United Oil #10	108 Cochran Street	Simi Valley	93065	19
RJR Enter. dba Simi Valley Arco	25 Tierra Rejada Rd.	Simi Valley	93065	17
Kam's Canyon Mobil Service Ctr	2500 Tapo Canyon Rd	Simi Valley	93063	17

Table 4b
Existing Gas Stations with Higher Suitability Ratings for Adding Hydrogen
(West Ventura County)

Name	Address	City	Zip	SCORE
Arneill Chevron	255 Arneill Rd.	Camarillo	93010	20
Proud Auto	4676 Adolfo Rd.	Camarillo	93012	18
Las Posas Mobil, Inc.	501 Las Posas Road	Camarillo	93010	18
Chevron #200209	4870 Santa Rosa Road	Camarillo	93010	18
Tesoro Shell #68511	107 W. Ventura Blvd.	Camarillo	93010	18
Hilu Chevron	522 N. Las Posas Rd.	Camarillo	93010	17
Circle K #2709460	2200 N. Rose Ave.	Oxnard	93030	20
Chevron SS #20-8020	1900 N. Rose Ave.	Oxnard	93030	20
Circle K #2709483	490 S. Victoria Ave.	Oxnard	93030	19
7-Eleven Facility #33399	2201 E. Gonzales Rd.	Oxnard	93036	18
S & S Chevron	2901 Saviers Road	Oxnard	93033	18
Vineyard Mobil	2851 E. Vineyard Ave.	Oxnard	93036	17
Oxnard Vineyard Chevron	2251 N. Oxnard Blvd.	Oxnard	93036	17
Rose Shell	1901 N. Rose Ave.	Oxnard	93030	17
Chevron #9-0576	920 S Seaward Ave	Ventura	93003	21
California Chevron	507 E Thompson Blvd.	Ventura	93001	20
Johnson Drive Carwash & Gas	2757 Johnson Dr.	Ventura	93003	19
Seaward Oil, Inc.	779 South Seaward Ave.	Ventura	93001	19
Johnson Oil Corp. Fac. 309330	6762 North Bank Dr.	Ventura	93003	18
Zaitoon Inc	605 S. Mills Rd.	Ventura	93003	17
Arco AM/PM	5669 Valentine Rd.	Ventura	93003	17
Tesoro Arco #42054	2124 East Harbor Blvd	Ventura	93001	17

Table 5
Existing Gas Stations with Higher Suitability Ratings for Adding Hydrogen
(Santa Barbara County)

Name	Address	City	Zip	SCORE
Circle K Stores, Inc.	402 W. Mission Street	Santa Barbara	93101	19
Circle K Stores, Inc.	4801 Hollister Avenue	Santa Barbara	93111	18
Turnpike Fuel Partners, LP	250 N. Turnpike Road	Santa Barbara	93111	18
Janda Partners, L.P.	1085 Coast Village Road	Santa Barbara	93108	18
Tesoro Refining & Marketing Company LLC	340 W. Carrillo Street	Santa Barbara	93101	18
Chevron USA Products Company	115 S. La Cumbre Road	Santa Barbara	93105	17
World Oil Marketing Company	1800 State Street	Santa Barbara	93101	17
World Oil Marketing Company	5960 Calle Real	Goleta	93117	18
Circle K Stores, Inc.	49 N. Glen Annie Road	Goleta	93117	17
76 (Next to old Carrows)	4401 Via Real	Carpinteria	93013	19
Chevron	4290 Via Real	Carpinteria	93013	19
seven eleven	4410 Via Real	Carpinteria	93013	18
Moller Retail, Inc.	89 E. Highway 246	Buellton	93427	19
USA Gas	197 E Highway 246	Buellton	93427	19
Pacific Fuel Group	206 E. Hwy 246	Buellton	93427	19
Aljnar, Inc.	188 E. Highway 246	Buellton	93427	19
Tom's Gas	230 E Highway 246	Buellton	93427	17
ERN Oil, Inc.	605 Bell Street	Los Alamos	93440	17
Moller Retail, Inc.	910 E. Betteravia Rd.	Santa Maria	93454	20
Valley Pacific Petroleum Services, Inc.	1155 E. Betteravia Rd	Santa Maria	93455	19
Circle K Stores, Inc.	1220 E. Betteravia Rd	Santa Maria	93454	18
Main Street Shell Service	1204 E. Main St	Santa Maria	93454	17
Main Street Petroleum	1038 E. Main St	Santa Maria	93454	17

Table 6
Existing Gas Stations with Higher Suitability Ratings for Adding Hydrogen
(San Luis Obispo County)

Name	Address	City	Zip	County	SCORE
Mission Station, Inc.	328 Marsh Street	San Luis Obispo	93401	SLO	19
Tesoro Station No. 68613	296 Santa Rosa Street	San Luis Obispo	93405	SLO	17
Chevron # 98169 (Trett's)	3180 S. Broad Street	San Luis Obispo	93401	SLO	17
Refuel	2211 Broad Street	San Luis Obispo	93401	SLO	17
ARCO - Arroyo Grande AM/PM	100 Barnett Street	Arroyo Grande	93420	SLO	19
Mobil (Petro Grande)	525 Traffic Way	Arroyo Grande	93420	SLO	17
Chevron - Kautz	1284 Grand Avenue	Grover Beach	93433	SLO	20
Grover Beach Flyers	684 West Grand Avenue	Grover Beach	93433	SLO	17
Five Cities Chevron	340 Five Cities Drive	Pismo Beach	93449	SLO	19
Spyglass Shell (AU Energy)	2699 Shell Beach Road	Pismo Beach	93449	SLO	17
Atascadero 76	6305 Morro Road	Atascadero	93422	SLO	19

3.4 Reliability and Redundancy

The initial experience with FCEV refueling in California has raised concerns about the reliability of the refueling infrastructure while it is still in its embryonic stages. This fragility is a concern for potential vehicle owners if there is complete dependency on a single station in a given area. Even with optimal reliability, there are going to be times when stations are out of service for one reason or another.

This draws attention to the need for incorporating a "reliability strategy" into the analysis. While this can be most simply established by offering redundant stations in reasonable proximity, this, by itself, can be uneconomic when funding for new stations is limited. That said, the placement of initial stations in growth areas should be clustered if feasible to account for this as well as supporting expansion of the market.

Some of the other factors considered in this plan as possible ways for dealing with the reliability issue are as follows:

- Support the efforts of station manufacturers and installers in technology improvement to further enhance the dispensing technology to increase station reliability.
- Incorporate a limited number of lower pressure stations – at lower cost – when there are other reasons for pursuing this. For example, at dealerships or fleet locations where there could be other fuel cell vehicle types with additional demand.
- Consider supporting pilot projects for emerging technologies for hydrogen production where it makes sense to design for lower demand.
- Continue to support online applications and communication systems that provide FCEV owners current and very specific information about station status. This would allow them to plan carefully for their refueling needs when there are system limitations. For example, this could include an interactive capability that could be implemented when an owner expresses an intent to use a station during an extended trip, so that if the station does go down there is clear information available about the repair plan, or if the stations are networked provide real time availability information via smartphone apps.

3.5 Avoiding Stranded Assets

Clearly, there is a vital need for stations to be built in sync with the growing number of FCEVs in the region, but it would not make financial sense to build "too many" refueling stations if FCEVs were not available for sale, or if they were not in demand by potential customers in this region.

The data included in Tables 1-3 above, can be used to project the pace of build-out necessary to support the growing demand for FCEVs. However, projections are notoriously unreliable for newly deployed vehicle types, and for any new technology there is a proving and acceptance period through which the technology has to go before it does (or does not) become mainstream. (Refer to Figure 2).

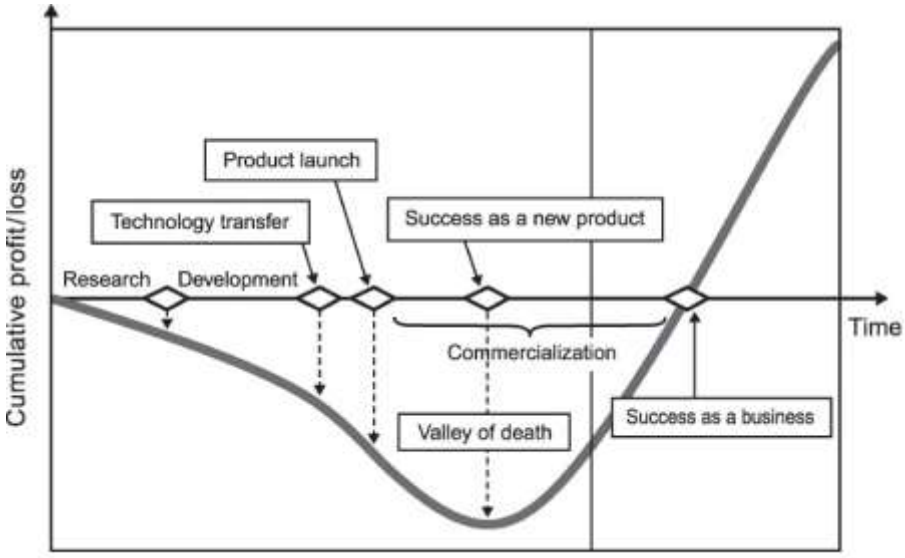

Figure 2 – Phases in the Commercialization of a New Technology

The sales projections which the OEMs have collectively shared with the state are probably the best indication of sales potential at this stage, so the numbers given above have been used as the basis for planning infrastructure needs in the Tri-Counties from present out to 2025.

This further emphasizes the need for close coordination in the planning and implementation process between the local communities, the vehicle manufacturers, and the government agencies that provide funding support for station construction and operation.

3.6 Hydrogen Station Priorities

The market proxy data summarized in Table 3 indicate that there are likely to be strong markets in several cluster areas of the Tri-Counties, with highest demand projected in the eastern end of Ventura County, both in the Westlake/Thousand Oaks/Newbury Park area (1,927) and also Simi Valley/Moorpark (1,275). Third and fourth highest rankings using the proxy metric are the Santa Barbara County South Coast (1,242) and Camarillo/Ventura/ Oxnard (1,226) in western Ventura County. Stations in these four areas cover 90% of the initial FCEV demand projected for the Tri-Counties.

Thus, based on market demand potential alone, the initial station priorities for the Tri-Counties should be:

1. Thousand Oaks/Newbury Park/ Westlake (eastern Ventura County)
2. Simi Valley/Moorpark (eastern Ventura County)
3. Santa Barbara County South Coast (now in place and operational)
4. Camarillo/Ventura (western Ventura County)
5. San Luis Obispo County

Since the first station is already operational in Santa Barbara, the initial priorities to maximize potential are in Ventura County. With stations in these first four general locations, there would be sufficient coverage to provide a reasonable level of redundancy since the stations in Ventura County would be within about 20 to 30 miles of each other, and for vehicle

owners in Santa Barbara, there could be an alternative station reasonably close by as soon as one is in place in the Camarillo/Ventura area.

Since each County is likely to set its own priorities for establishing hydrogen infrastructure, there is potential for Santa Barbara to address the redundancy issue more immediately by pursuing options for a second station somewhere between Goleta and Carpinteria.

After this initial round, the subsequent priorities would be to install additional stations to meet growing demand or to focus on a connector station in San Luis Obispo County to provide access to the Bay area along the 101 corridor. This would serve all vehicle owners to the south in this respect as well as serving local demand. The proxy data suggest that subsequent build out to meet demand is likely to be most needed in the following areas:

1. Thousand Oaks/Newbury Park/ Westlake – second station
2. Simi Valley/Moorpark – second station
3. Santa Barbara – second station
4. Camarillo/Ventura/Oxnard – second station

The main conclusions from this are that the Thousand Oaks area is clearly a top priority, and the second priority could be Simi Valley/Moorpark based on demand alone, or Camarillo/Ventura to meet demand and provide broader redundancy in the early years. Subsequently, the need for additional stations to meet demand in Ventura will be considered as well as the needs for a connector station in San Luis Obispo and a second station for local redundancy in Santa Barbara. Both of these latter locations would also serve growing local demand.

The field work done locally has shown that there are favorable gas stations having the necessary attributes for siting hydrogen dispensers in each of the priority areas. (Refer to Tables 4, 5 and 6 above).

4. HYDROGEN PRODUCTION AND DISTRIBUTION

This section provides an overview of the production options for generating hydrogen with an indication of the most prevalent technologies in use today, and a summary of a few emerging technologies for hydrogen production. Some of the reasons for including this type of assessment are listed below:

- There is a California mandate that requires 33 percent of all hydrogen produced for use in FCEVs must come from renewable sources. Over time, this percentage is likely to increase as the state moves to achieve its goal of 80% reduction in GHG emissions by 2050.[12]
- There are multiple production pathways for hydrogen, and each option is associated with pros and cons. For example, offsite or onsite steam reformation of natural gas, solar electrolysis, and gasification. For the steam reformation pathway, renewable natural gas (i.e. biomethane) or conventional, non-renewable natural gas can be used.
- Long-term, there is a possibility that distributed hydrogen production will become an option, for example through "compact onsite reformation". The implication of this is that there would be a reduced need for transporting hydrogen from central production facilities.
- Stranded investments should be avoided. Refueling technologies are expected to change and improve, so it would be prudent not to move too fast in one particular technology direction. As such, it may be advantageous to keep options open with respect to production technology and fuel source.

The Department of Energy (DOE) maintains a website that provides a comprehensive summary of the available hydrogen production pathways including near-term, mid-term and long-term pathways as shown in Figure 3 below[13].

Summarized below are some of the production alternatives likely to be of most relevance to the Tri-Counties in the near term.

4.1 Steam Methane Reforming of Natural Gas

The primary method of producing hydrogen today is through natural gas reformation, which accounts for about 95 percent of domestic production. With this pathway, the gas is mixed with high-temperature steam in the presence of a catalyst to separate the hydrogen. Most of the hydrogen used for industrial processes and in the refining of crude oil is produced by steam methane reformation.

A recent report by the Institute for Transportation Studies at UC Davis indicates that natural gas will continue to be the least expensive and most energy-efficient resource from which to produce hydrogen through the 2020s.[14] These conclusions are based on "well-to-wheels" analysis including fuel distribution from production to dispensing.

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[12] *SB 1505 Environmental Performance Standards for Hydrogen Fuel*

[13] *http://energy.gov/eere/fuelcells/hydrogen-production-pathways*

[14] *Joan Ogden, Christopher Yang, Michael Nicholas, Lew Fulton , NextSTEPS White Paper: The Hydrogen Transition, Institute of Transportation Studies University of California, Davis, July 29, 2014, p. 15 http://steps.ucdavis.edu/files/08-13-2014-08-13-2014-NextSTEPS-White-Paper-Hydrogen-Transition-7.29.2014.pdf*

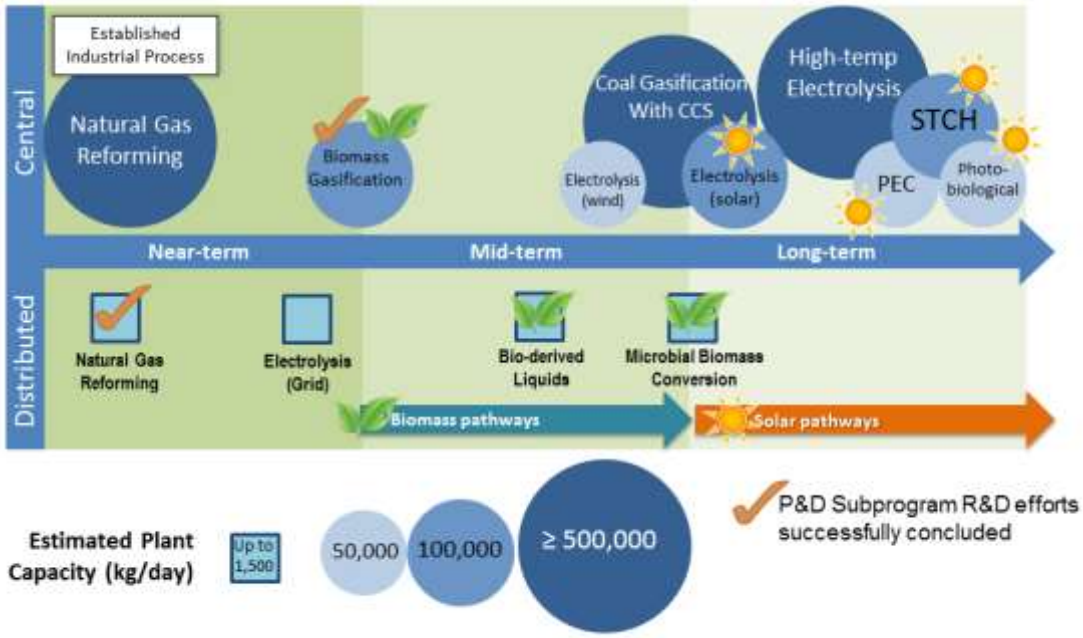

Figure 3 Hydrogen Production Pathways

Source: Department of Energy Office of Energy Efficiency and Renewable Energy
http://energy.gov/eere/fuelcells/hydrogen-production-pathways

4.2 Use of Biogas for Hydrogen Production

The steam reforming process can be used to produce renewable hydrogen when the natural gas feedstock is replaced with biogas or landfill gas. A biogas system can be used to create hydrogen with net zero GHG emissions, though the gas treatment process has to be reliable to avoid contamination of the fuel call catalyst. In the Tri-Counties, the amount of biogas is limited and landfill gas is being used for power generation. As such the amount of hydrogen that could be produced through this method would also likely be rather limited. However, it may be the least cost alternative for producing renewable hydrogen in the near term.

4.3 Onsite Production of Hydrogen Using Electrolysis

Electrolysis of water is a less common production method. Through this process, an electric current splits water into hydrogen and oxygen. With electrolysis, traditional methods use purified water and power from the grid. If the electricity is from a renewable source, then the hydrogen is also said to be renewable. Some experts maintain that onsite electrolysis is up to twice as expensive as hydrogen produced by steam reformation of natural gas.[15]

4.4 Emerging Technologies for Hydrogen Production

[15] *Julia Pyper, "Is electrolysis the pathway to reach totally carbon-free hydrogen fuel?," Climatewire, November 20, 2014. http://www.eenews.net/stories/1060009250*

The development of clean, sustainable, and cost-competitive hydrogen production processes is essential to the success of hydrogen powered transportation. California State has a requirement that, on average, 33% of the hydrogen produced must come from renewable sources. This provides an incentive for the development of new approaches for manufacturing hydrogen using sustainable approaches.

Research and Development of alternative ways to produce hydrogen have been ongoing for several years, and continue to this day. In 2009, the Freedom Car and Fuel Partnership issued a paper called “Hydrogen Production – Overview of Technology Options” which included a summary of seven key production technologies in three broad categories (listed below).[16] Some of these approaches are approaching commercialization, but further research is ongoing at the national laboratories, universities and in the commercial sector.

Thermal Process

- Distributed natural gas reforming
- Bio-derived liquids reforming
- Coal and biomass gasification
- Thermochemical production

Electrolytic Processes

- Water electrolysis

Photolytic Processes

- Photoelectrochemical hydrogen production[17]
- Biological hydrogen production

Another potential technology development that could be relevant in the near term is Carbon Capture and Sequestration (CCS). The first commercial scale carbon capture and sequestration projects are now operational, and steam reformation for hydrogen production is one process where carbon capture can be accomplished at a reasonable cost, especially when there is a price on carbon emissions. New technologies are also emerging in which a CO_2 stream is converted directly to carbon, avoiding the need to inject and store underground. One example is the LytEn carbon sequestration system[18].

[16] *Freedom Car & Fuel Partnership, "Hydrogen Production – Overview of Technology Options”, 2009.*
[17] *The photoelectrochemical production pathway is being pursued by several R&D groups including one local start-up in Santa Barbara called HyperSolar (hypersolar.com)*
[18] *LytEn Low Carbon Fuel Standard Pathway for the Production of Hydrogen from Natural Gas and Renewable Natural Gas. https://www.arb.ca.gov/fuels/lcfs/2a2b/apps/lyt-H2-rpt-121715.pdf*

4.5 Resource Requirements

An important consideration in the development of new production pathways is the resources that are needed to produce the hydrogen. In particular, the transition from petroleum to hydrogen is less beneficial if the hydrogen is derived from natural gas – another fossil fuel – and electrolysis may be less appealing but only if the demand for water is going to compete with existing needs for potable water, which is not necessarily the case, as shown in Table 7.

Table 7 compares the resource requirements for hydrogen produced from steam reforming (natural gas and water) with the water needed for hydrogen produced by electrolysis. In general, it is apparent that the water requirements for either pathway are not substantial when compared with existing water uses. This concern is further mitigated if non-potable sources of water can be used to produce the hydrogen in due course.

4.6 Hydrogen Distribution

Once hydrogen is produced, there are several ways to deliver it to vehicles. It can be produced regionally in large plants, stored as a compressed gas or as a cryogenic liquid (at -253˚C), and distributed by truck or gas pipeline to the refueling station. Or the hydrogen can be produced on-site at the refueling station (or even homes and commercial facilities) from natural gas or electricity.

Hydrogen delivery technologies are well established in the merchant hydrogen and chemical industries today. While most industrial hydrogen is produced and used onsite, a significant fraction is delivered by pipeline or truck to more distant users. In the near term, most hydrogen delivered to the Tri-Counties would likely come by truck from the sources in the Los Angeles area that currently produce hydrogen for other users.

Note that there has been some discussion of using mobile hydrogen fueling trucks to service initial (lower) demand for fuel. This could be an approach used by the Tri-Counties to provide temporary fueling capability in new market areas, and also as a way to service vehicles if primary stations are inoperable.

- ## 4.7 Hydrogen Dispensing

FCEVs are designed to accept hydrogen in gaseous form pressurized at two levels, either 350 bar (5,000 psi) -- known as H35 -- or 700 bar (10,000 psi) – known as H70. Currently, 700 bar (H70) gaseous on-board storage has been chosen for the first generation of commercial vehicles, while 350 bar (H35) is typically used for buses, forklifts, and other lift trucks. A full tank of hydrogen on a light duty FCEV (usually about 4 to 6 kilograms) provides range of approximately 300 miles, which is almost comparable to a conventional vehicle.

Hydrogen fueling stations can be co-located with regular gasoline stations or they can be operated in stand-alone locations. Hydrogen dispensing equipment is similar in appearance to gasoline dispensers, although hydrogen fuel is delivered to vehicles in a gaseous state. Stations are designed for unattended operation.

- ## 4.8 Summary of Production and Distribution Pathways

Figure 4 below presents a summary of the GHG emissions for the various hydrogen production options, including distribution (Well to Pump).

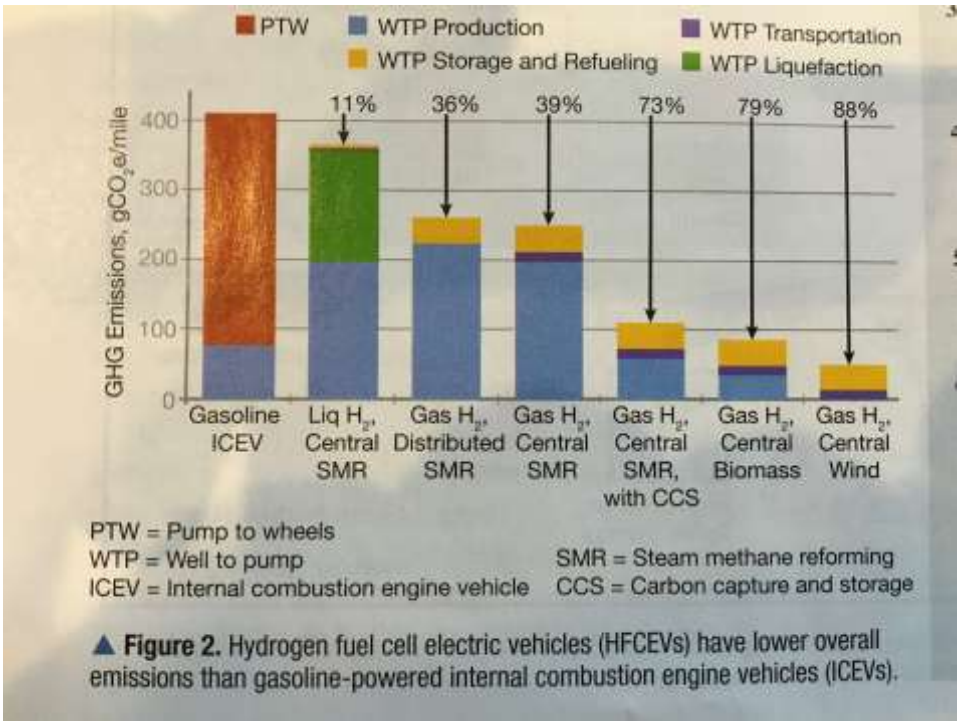

Figure 4 Comparison of GHG Emissions for Various Production and Distribution Combinations

Source: Reddi, Krishna; Amgad Elgowainy and Michael Wang, Argonne National Laboratory; Chemical Engineering Progress, AIChE, July 2016, page 51.

Hydrogen dispensers being installed today usually have one hose and nozzle for each of the two standard delivery pressures. Users cannot attach the high-pressure nozzle to a lower pressure receptacle, so there is no chance of fueling at the wrong pressure level. When a driver activates the dispenser, hydrogen flows from the storage tanks and through the nozzle into the vehicle's on-board storage tanks. If filling with H70 (light-duty vehicle standard), the hydrogen passes through a booster compressor and chiller before entering the dispenser.

The dispensers are designed to accept credit cards and display sales information conforming to state weights and measures requirements. Volume is displayed in kilograms (kg). Fueling time is approximately 5 minutes per tank for a typical light duty vehicle.

Table 7
Fuel Production Resource Projections

(a) Steam Reforming							
	Use 2(H2O) + CH4 = CO2 + 4(H2)						
		MW					
Ideal	H - 8 atoms	8	1	kg	Production of 1kg of hydrogen		
	C - 1 atom	12	1.5	kg			
	O - 2 atoms	28	3.5	kg			
	CH4	16	2	kg	Needs 2kg of Natural Gas (CH4)		
	2 (H2O)	32	4	kg	Needs 4kg of Water (H20)	1.1	gallon
	CO2	40	5	kg	Generates 5kg of CO2		
Add process heat - assume this doubles the quantity of methane needed (actual data); assume 50% steam overfeed							
	CH4		4	kg	Needs 4kg of Natural Gas (CH4)		
	2 (H2O)		6	kg	Needs 6kg of Water (H20)	1.6	gallon
	CO2		10	kg	Generates 10kg of CO2		
(b) Electrolysis							
	Use 2(H2O) = O2 + 2(H2)						
		MW					
	H - 4 atoms	4	1	kg	Production of 1kg of hydrogen		
	O - 2 atoms	28	7	kg	Generates 7kg of oxygen; no CO2		
	2 (H2O)	32	8	kg	Needs 8kg of water	2.1	gallon
Assume electrolysis is 70% conversion rate from water to hydrogen/oxygen							
	2 (H2O)		11.4	kg	Needs 8kg of water	3.0	gallon
(c) Resource Needs (minimum) assuming 100% efficiency of hydrogen conversion process							
	Number of FCEVs	1	1000		Estimate for Tri-Counties, 2020		
	Hydrogen per year	254	254,148	kg	CARB 2015 Report		
	Steam Reforming:	1,017	1,016,593	kg NG			
		517	516,904	therm NG			
		1,525	1,524,889	kg water			
		404	404,187	gall water			
	Electrolysis	2,905	2,904,550	kg water			
		770	769,881	gallons, total			
Unit Conversion factors							
	Density of water	8.3	lb/gall	3.77	kg/gall		
	Natural Gas	1,017	kg NG	per vehicle per year			
		0.712	kg/m3				
		1,428	m3 NG				
		50,430	ft3 NG				
		1025	btu/scft				
		52	MMBtu	per vehicle per year			
		517	therms	per vehicle per year			
For Comparison							
	Typical Household in SB	500	therms per year (NG)				
		60,000	gallons water per year				

Appendices

Appendix 1

Summary of County Plans Adopted

County/ City	Plan?	Date Adopted	Details
SLO County	EnergyWise Plan (Their version of a Climate Action Plan)	Nov 2011	5.16: Encourage the installation of alternative fueling stations and sites that are available for use by public and private vehicles, including waste fleets. 5.25: Continue to expand the use and availability of alternative and low carbon fuels for vehicles and equipment. Supporting Actions: Participate in countywide efforts to establish an alternative fuel infrastructure network. Support and facilitate the development of alternative fuel technologies such as the installation of new or retrofit of electric vehicle charging stations and alternative fueling stations. Ensure that alternative fuel stations and support facilities are allowed uses in land use designations that currently allow gas and service stations. 6.17: Explore the use of alternative fuels in County vehicles and support the development of alternative fueling stations in the county through participation in the Central Coast Clean Cities Coalition (C5).
City of SLO	Climate Action Plan	July 2012	3.3.2- TLU 2: Alternative Vehicles Promote clean air vehicles (CAV), and expand the network of electric car charging stations and car-sharing parking spaces.
City of Arroyo Grande	Climate Action Plan	Nov 2013	3.3.2- TLU 6: Electric Vehicle Network and Alternative Fueling Stations [Continue to develop and implement the electric vehicle readiness plan through expanding the use of alternative fuel vehicles and fueling stations in the community (e.g., through identifying and zoning locations for fueling stations, offering incentives for alternative fuel vehicles, etc.).] *All SLO City Climate Action Plans have similar statements—focus

			does appear to be on electric vehicles but framework is suggested for CAV and alternative fuel vehicles (e.g. hydrogen fuel cell)*
City of Atascadero	Climate Action Plan	Jan 2014	3.3.2- TLU 7: Electric Vehicle Network and Alternative Fueling Stations
City of Grover Beach	Climate Action Plan	Sept 2014	3.3.2- TL 7: Electric Vehicle Network and Alternative Fueling Stations
City of Morro Bay	Climate Action Plan	Jan 2014	3.3.2- TL 5: Electric Vehicle Network and Alternative Fueling Stations
City of Paso Robles	Climate Action Plan	Nov 2013	3.3.2- TL 7: Electric Vehicle Network and Alternative Fueling Stations
City of Pismo Beach	Draft Climate Action Plan	Not Yet Adopted?	*3.3.2- TL 8: Electric Vehicle Network and Alternative Fueling Stations*
SB County	*Energy and Climate Action Plan*	May 19, 2015	*IV. Greenhouse Gas Reduction Strategy* *4-7. T 3: Alternative-Fuel Vehicles and Incentives* *-Increase the use of alternative-fuel vehicles, and plan for the development of alternative-fuel infrastructure.* *GO 3: Fuel-Efficient and Alternative Fuel Vehicle Fleet* http://longrange.sbcountyplanning.org/programs/climateactionstrategy/climateaction.php
	General Plan	Adopted 1994 Republish July 2014	Energy Element Goal 5: Alternative Energy POLICY 5.6: ALTERNATIVE FUEL REDUCTION CREDITS - Provide regulatory flexibility for use of mobile source Emission Reduction Credits in meeting County clean air goals. POLICY 5.10: ALTERNATIVELY FUELED VEHICLES - The County shall

			encourage the use of alternatively fueled vehicles by individuals. Public Service 5.10.1: The County should gather data that quantifies the cost of operating alternatively fueled vehicles. The County should request that this information be distributed by the Department of Motor Vehicles, California Energy Commission, and other organizations. Regulatory Incentive 5.10.1: The County shall request the Santa Barbara County Association of Governments to amend the Transportation Demand Management (TDM) Ordinance to provide credit to business-supporting clean-fuel vehicle efforts.
City of SB	Climate Action Plan	Sept 2012	2.3.2 Renewable Energy Measures 9. Alternative/advanced fuels (City program; GP policy ER6.2; target 2020) Support and implement the California Energy Commission and State Air Resources Board goal for alternative/advanced fuels set forth in AB 1007, for non-petroleum fuel use of 20% by 2020 and 30% by 2030. 10. Incentives for alternative fuel infrastructure (City program; GP policy ER6.3; target 2015) Give priority through expedited processing to projects providing infrastructure for alternative/advanced fuels. **Also suggests future Climate Plan guidelines* *Measure 12- Incentives for alternative fuel infrastructure*
City of SB	General Plan	2011	Environmental Resources Element: Air Quality Policies ER8: Low-Emission Vehicles and Equipment. Expand infrastructure and establish incentives for use of lower emission vehicles and equipment…
City of Goleta	Climate Action Plan	July 2014	-nothing about alt transportation here
Ventura County	Annual Climate Protectio	April 2012	#13: The CPP team recommended a change to the wording of this commitment, from “Integrate a suite of green vehicles policies to promote efficiency, alternative fuels, and the infrastructure required

	n Plan		for alternative travel modes" to the one shown above.
City of Oxnard	Energy Action Plan (Component of Climate Action and Adaptation Plan)	June 2013	5. EAP Community Programs C-7: Support Electric Vehicle Infrastructure Working with the community, especially the service station operators, to identify locations for alternative fuel and EV fueling stations that encourage local public and commercial use of alternative fuel vehicles.
City of Oxnard	General Plan	2011	ICS-6.6 Alternative Transportation Options Utilize, where feasible, environmentally clean transit vehicles such as a liquefied natural gas and hybrids.
City of Simi Valley	Climate Action Plan	June 2012	R2-T8/MT-T8: Expand Renewable Fuel/Low-Emission Vehicle Use Collaboration between local and regional governments and business to foster the increased use of renewable fuels through the siting of new alternative fueling/recharging locations; Collaboration with energy providers to ensure the availability of necessary facilities and infrastructure to encourage the use of privately owned zero emission vehicles. This can be accomplished by having conveniently located charging and fueling stations for these vehicles;

Appendix 2

Application of STREET for Tri-Counties Hydrogen Readiness Plan

Application of STREET for Tri-Counties Hydrogen Readiness Plan

Prepared by: James Soukup, Brendan Shaffer, G. Scott Samuelsen

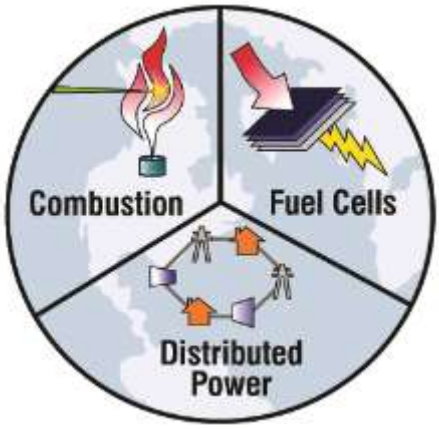

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Table of Contents

The Spatially and Temporally Resolved Energy and Environment Tool (STREET) was used to identify the top 20 gasoline stations in the Tri-County area based on several different sets of alternative vehicle sales registration data (IHS Automotive) that serve as proxy for fuel cell electric vehicles (FCEVs). Connectivity between northern California and southern California was also analyzed. Finally, these STREET results were compared to the Station Coverage Value given by the California Hydrogen Infrastructure Tool (CHIT). The CHIT Station Coverage Value is the ability of the proposed station to fill an identified gap in refueling coverage.

Methodology:

Three different sets of alternative vehicle sales registration data were used. Battery electric vehicles (BEVs), plug-in hybrid electric vehicles (PHEVs) combined with hybrid electric vehicles (HEVs), and BEVs combined with PHEVs and HEVs. These different sets of alternative vehicle sales registration data allow comparison of different FCEV market proxies. The alternative vehicle sales registration data shows the number of a type of vehicle registered in a zip code tabulation area (ZCTA). This spatial resolution is too coarse, so another data set is combined with the alternative vehicle sales registration data, i.e., high resolution population data (1km x 1km). The population data used are LandScan Population density from Oak Ridge National Laboratory [1], [2]. Using the combined alternative vehicle registration data and population data, a high enough spatial resolution exists to evaluate gasoline stations based on this high resolution combined data set, i.e., counting vehicles (demand points) in proximity.

The basic methodology for station siting based on demand points (vehicle proxy) is broken into three steps. First the Network Model is built including the roadways, the existing infrastructure, and the spatially distributed demand (demand points or FCEV proxy). Next, Location-Allocation algorithms are applied to the network model producing locations for stations based on the scenario parameters.

Network Model

Four datasets compose the Network Model: (1) the roadway network; (2) the existing refueling infrastructure which includes existing hydrogen refueling stations (in this case, only the station in Santa Barbara), and the existing gasoline stations which serve as candidate locations for expanding the network; and (3) the demand points that represent the FCEVs.

Roadway Network

The roadway network used comes from ESRI's database of streets in North America [3]. This network dataset includes speed limits of individual streets as well as classifications of what types of turns can be made at intersections throughout the network. This provides for usage of ESRI's Network Analyst toolset that provides implementation of the travel time algorithms leveraged for the analysis [4].

Existing Infrastructure (Existing Infrastructure and Candidate Sites)

Existing hydrogen refueling structure is modeled based on information from ARB's AB 8 Report as well as from the Governor's Office of Business and Economic Development (GOBIZ) [5], [6]. Existing gasoline

refueling stations are chosen as the candidate locations for sites of future hydrogen fueling stations and were obtained from the Tri-Counties. **Figure 2** shows a map of the locations of existing infrastructure.

Demand Points (Proxy FCEVs)

The demand points are derived from registrations of BEVs, HEVs and PHEVs in the Tri-Counties and LandScan Population density from Oak Ridge National Laboratory [1], [2]. The vehicle registrations are provided by IHS Automotive for Zip Code Tabulation Areas (ZCTAs). These registrations are distributed to LandScan cells (1km x 1km cell size) based on the cell's relative contribution to the population of the ZCTA using a weighted distribution methodology. This methodology assigns a weight to each LandScan cell based on its relative contribution to the population of the ZCTA in which its centroid lies.

$$Cell\ Weight = \frac{Cell\ Population}{ZCTA\ Population}$$

The final demand weight for each cell is the product of the cell weight and the number of HEV registrations in the ZCTA.

$$Demand\ Weight = ZCTA\ HEVs * Cell\ Weight = ZCTA\ HEVs * \frac{Cell\ Population}{ZCTA\ Population}$$

Finally, the LandScan cells are represented in the Network by the point location of their centroid in order to provide an exact location for the Network algorithms. The point locations combined with the underlying demand weights are referred to as *demand points*. **Figure 3** shows the mapping of the weighted distribution methodology for the City of Santa Barbara.

Location-Allocation Algorithm

The stations are allocated using a Maximize Market Share algorithm in ArcGIS. This algorithm seeks to place a given number of stations to maximize the demand (i.e., FCEV proxy) on the stations. A service coverage needs to be prescribed. The service coverage is the area that is served by a station and can be defined by drive time or distance. In these analyses, drive time was used. Previous analyses [7] have shown that a 6 minute service coverage represents a tipping between an inconvenient refueling experience (driving more than 10 min to get to refueling station from house) and the current convenience of gasoline refueling (2-3 min from house to refueling station).

Six Minute Drive Time

The following analysis from [7] of past existing and planned hydrogen stations in the Santa Monica region (4 total) provide a maximum travel time from anywhere in the region to a hydrogen station in 10 minutes. The addition of just one more station (5 total) can drop this travel time down to 9 minutes. Two more stations (7 total) reduces the time to 7 minutes, and an additional station (8 total) reduces the travel time to 6 minutes. Two more (10 total) can reach coverage in just 5 minutes, and a final 9 additional stations (19 total) are required to reach 4 minute travel time in parity with the 126 existing gasoline stations. This trend is shown in **Figure 1**.

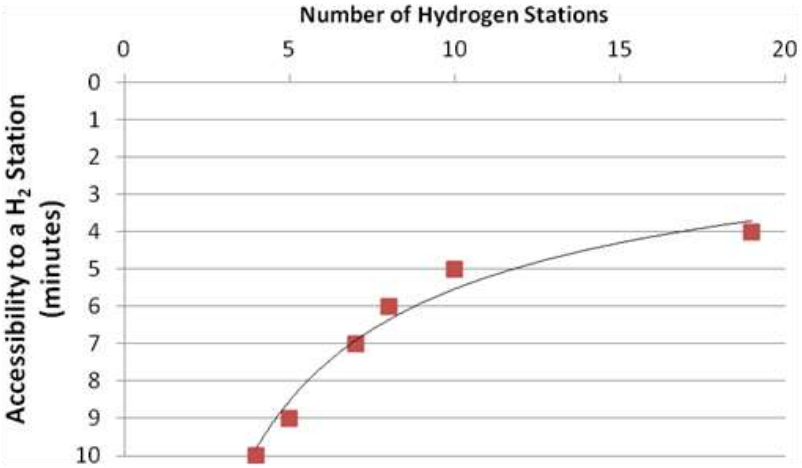

Figure 1 Decrease in maximum travel time to a hydrogen station in the Santa Monica region with increasing numbers of stations **[7]**

On examination of **Figure 1**, service coverage of 6 minutes appears to be a good compromise between parity with gasoline and minimization of infrastructure investment. With 126 existing gasoline stations in the Santa Monica region, 8 hydrogen stations represents just 6.3% of the total. This result matches well with previous research in the field of fueling infrastructure which indicate that 5% of gasoline fueling locations require alternative fuel in order to alleviate driver concerns about fuel availability [8], [9].

Figure 2 Existing Infrastructure (Gasoline and Hydrogen Stations) in Tri-Counties Area

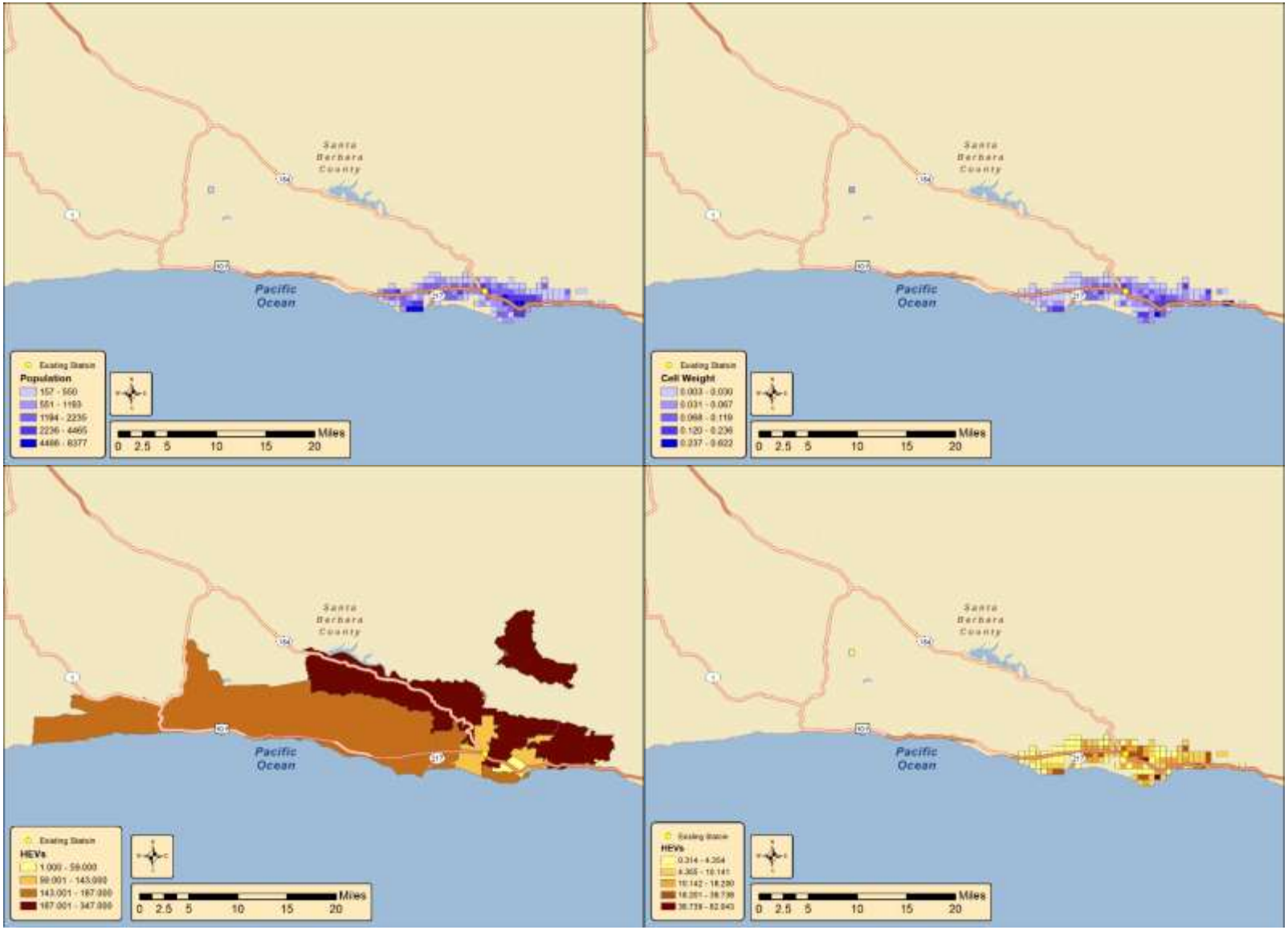

Figure 3 Weighted Distribution Methodology Example for Santa Barbara

Station Ranking

Once the station locations are allocated using the Maximize Market Share algorithm, they are ranked according to the total demand points (FCEV proxy) covered by a six minute drive time from the gasoline station. Because the Location-Allocation GIS tool applies heuristics on fringe cases, a more robust tool is used. This tool builds an Origin-Destination Cost Matrix (ODCM) for each station and all of the demand points in the stations' 6-minute service coverage, including all fringe cases. The tool has been custom adapted for usage by STREET in order to properly account for the covered demand points (FCEV proxy).

Results:

The results for the three different sets of alternative vehicle registration data sets used are shown in **Figure 4** with the number of FCEV proxy covered and the California Hydrogen Infrastructure Tool (CHIT) coverage gap score shown in

Table 1 (BEV as FCEV proxy), **Table 2** (PHEV+HEV as FCEV proxy), and **Table 3** (HEV+PHEV+BEV as FCEV proxy). **Figure 4** allows comparison between using different data sets as FCEV proxy in siting hydrogen refueling stations. In general, there is not much difference between using the HEV+PHEV and HEV+PHEV+BEV data sets as FCEV proxy since the number of HEVs and PHEVs is so much larger than the BEVs. However, the BEVs as FCEV proxy is different than the other two data sets considered with more hydrogen stations being sited in San Luis Obispo county. For both the HEV+PHEV and HEV+PHEV+BEV as FCEV proxy cases, there are 13 stations located in Ventura county, 5 (4 additional) in Santa Barbara county, and 3 in San Luis Obispo county, but for the BEV as FCEV proxy case there are 11 located in Ventura county, 5 (4 additional) in Santa Barbara county, and 5 in San Luis Obispo county. This is a result of a proportionally higher occurrence of BEVs in San Luis Obispo county. In terms of ranking stations by FCEV proxy covered, there are also differences. The HEV+PHEV and HEV+PHEV+BEV as FCEV proxy cases result in the top 5 stations in terms of FCEV proxy covered being in Ventura county. However, the BEV as FCEV proxy case results in the top 5 stations being in Ventura and Santa Barbara counties with two in Ventura county and three in Santa Barbara county.

BEVs as FCEV Proxy

20 additional stations plus the existing La Cumbre station cover 738 of Tri-Counties' 868 BEVs (85%). 11 are located in Ventura county, 5 (4 additional) in Santa Barbara county, and 5 in San Luis Obispo county.

Table 1 shows the FCEV proxy (as BEVs) covered within a 6 minute drive time from each station. The CHIT coverage gap score is also shown.

HEVs and PHEVs as FCEV Proxy

20 additional stations plus the existing La Cumbre station cover 6665 of Tri-Counties' 8355 HEVs & PHEVs (80%). 13 are located in Ventura county, 5 (4 additional) in Santa Barbara county, and 3 in San Luis Obispo county. **Table 2** shows the FCEV proxy (as HEV+PHEVs) covered within a 6 minute drive time from each station. The CHIT coverage gap score is also shown.

BEVs, HEVs, and PHEVs as FCEV Proxy

20 additional stations plus the existing La Cumbre station cover 7386 of Tri-Counties' 9223 BEVs, HEVs, & PHEVs (80%). 13 are located in Ventura county, 5 (4 additional) in Santa Barbara county, and 3 in San Luis Obispo county. **Table 3** shows the FCEV proxy (as HEV+PHEV+BEVs) covered within a 6 minute drive time from each station. The CHIT coverage gap score is also shown.

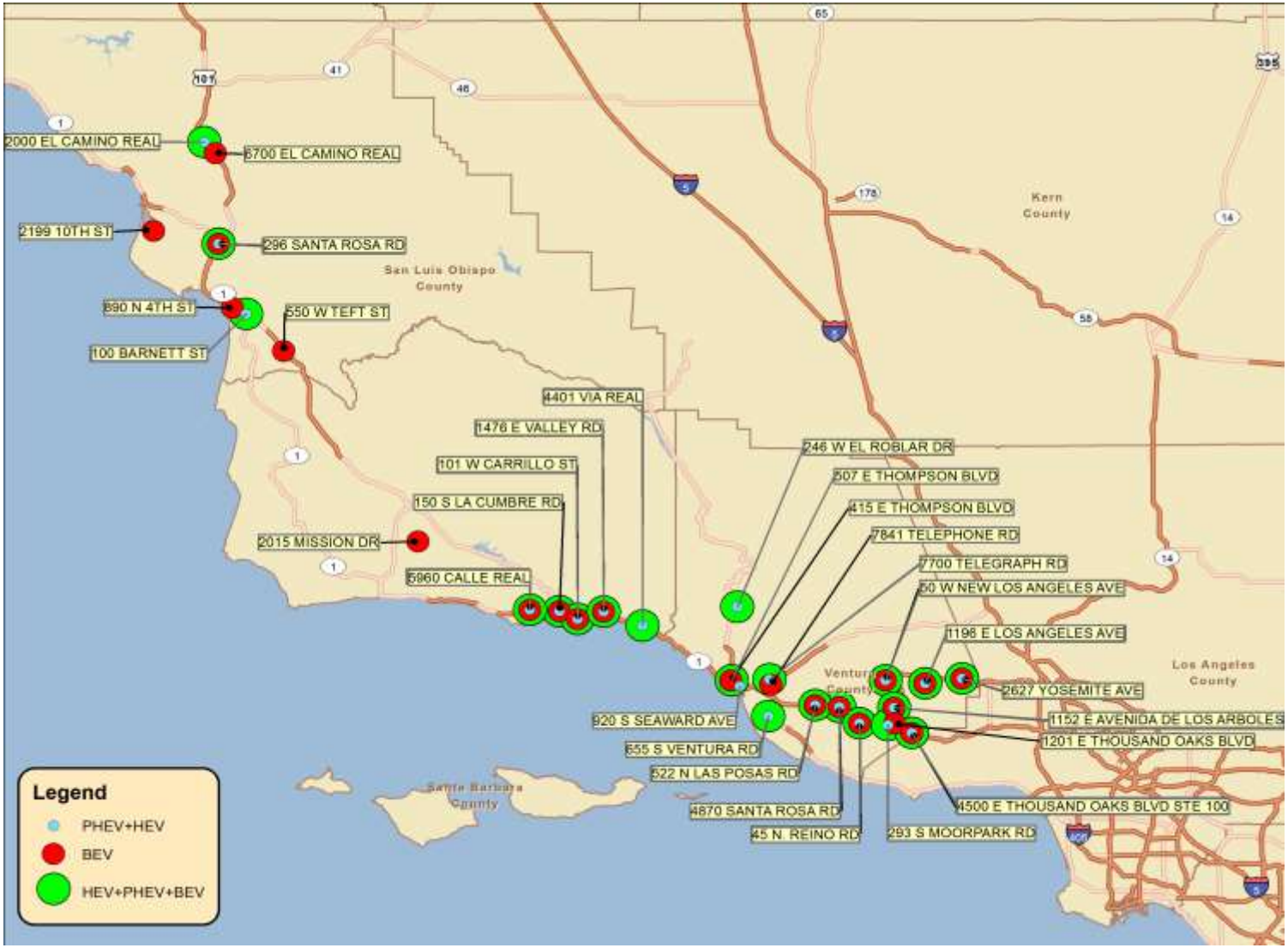

Figure 4: Siting of 20 additional Hydrogen stations (21 in total including the existing La Cumbre station in Santa Barbara) to the tri-county hydrogen refueling network using three different alternative vehicle registration datasets (BEV, HEV, and HEV+BEV)

Table 1: Tabulation of Maximize Market Share algorithm siting of 20 additional hydrogen stations based on BEVs as FCEV proxy data ranked in order of FCEV proxy within 6 minute drive time (Note: 150 S La Cumbre Rd is an existing hydrogen station)

Street Name	City	County	Zip Code	BEVs Covered	CHIT Coverage Gap Score [x100]
1201 E THOUSAND OAKS BLVD	Thousand Oaks	Ventura County	91362	65	1.9224
1476 E VALLEY RD	Montecito	Santa Barbara County	93108	65	0.5375
45 N. REINO RD	Thousand Oaks	Ventura County	91320	60	1.7843
101 W CARRILLO ST	Santa Barbara	Santa Barbara County	93101	59	1.2389
150 S LA CUMBRE RD	Santa Barbara	Santa Barbara County	93105	57	0.2603
1152 E AVENIDA DE LOS ARBOLES	Thousand Oaks	Ventura County	91360	47	1.895
4500 E THOUSAND OAKS BLVD STE 100	Thousand Oaks	Ventura County	91362	45	1.8683
5960 CALLE REAL	Goleta	Santa Barbara County	93117	42	0.1546
1196 E LOS ANGELES AVE	Simi Valley	Ventura County	93065	42	1.1712
4870 SANTA ROSA RD	Camarillo	Ventura County	93012	36	0.8419
890 N 4TH ST	Pismo Beach	San Luis Obispo County	93449	34	0.4227
2627 YOSEMITE AVE	Simi Valley	Ventura County	93063	29	0.8417
296 SANTA ROSA RD	San Luis Obispo	San Luis Obispo County	93401	29	0.7755
50 W NEW LOS ANGELES AVE	Moorpark	Ventura County	93021	28	0.349
7841 TELEPHONE RD	San Buenaventura (Ventura)	Ventura County	93004	23	1.3381
522 N LAS POSAS RD	Camarillo	Ventura County	93010	20	0.9674
415 E THOMPSON BLVD	San Buenaventura (Ventura)	Ventura County	93001	15	0.3905
2015 MISSION DR	Solvang	Santa Barbara County	93463	13	0.1949
2199 10TH ST	Los Osos	San Luis Obispo County	93402	10	0.3924
6700 EL CAMINO REAL	Atascadero	San Luis Obispo County	93422	10	0.1791
550 W TEFT ST	Nipomo	San Luis Obispo County	93444	8	0.1454

Table 2: Tabulation of Maximize Market Share algorithm siting of 20 additional hydrogen stations based on HEVs+PHEVs as FCEV proxy data ranked in order of FCEV proxy within 6 minute drive time (Note: 150 S La Cumbre Rd is an existing hydrogen station)

Street Name	City	County	Zip Code	HEV+PHEVs Covered	CHIT Coverage Gap Score [x100]
1196 E LOS ANGELES AVE	Simi Valley	Ventura County	93065	636	1.1712
45 N. REINO RD	Thousand Oaks	Ventura County	91320	552	1.7843
293 S MOORPARK RD	Thousand Oaks	Ventura County	91361	540	1.451
1152 E AVENIDA DE LOS ARBOLES	Thousand Oaks	Ventura County	91360	520	1.895
4500 E THOUSAND OAKS BLVD STE 100	Thousand Oaks	Ventura County	91362	478	1.8683
101 W CARRILLO ST	Santa Barbara	Santa Barbara County	93101	447	1.2389
4870 SANTA ROSA RD	Camarillo	Ventura County	93012	384	0.8419
150 S LA CUMBRE RD	Santa Barbara	Santa Barbara County	93105	377	0.2603
2627 YOSEMITE AVE	Simi Valley	Ventura County	93063	317	0.8417
50 W NEW LOS ANGELES AVE	Moorpark	Ventura County	93021	311	0.349
1476 E VALLEY RD	Montecito	Santa Barbara County	93108	286	0.5375
522 N LAS POSAS RD	Camarillo	Ventura County	93010	283	0.9674
5960 CALLE REAL	Goleta	Santa Barbara County	93117	273	0.1546
100 BARNETT ST	Arroyo Grande	San Luis Obispo County	93420	241	0.2215
7700 TELEGRAPH RD	San Buenaventura (Ventura)	Ventura County	93004	225	1.5554
296 SANTA ROSA RD	San Luis Obispo	San Luis Obispo County	93401	184	0.7755
920 S SEAWARD AVE	San Buenaventura (Ventura)	Ventura County	93001	179	0.7797
655 S VENTURA RD	Oxnard	Ventura County	93030	128	2.1266
2000 EL CAMINO REAL	Atascadero	San Luis Obispo County	93422	111	0.1791
246 W EL ROBLAR DR	Meiners Oaks	Ventura County	93023	100	0.2665
4401 VIA REAL	Carpinteria	Santa Barbara County	93013	94	0.5422

Table 3: Tabulation of Maximize Market Share algorithm siting of 20 additional hydrogen stations based on HEV+PHEV+BEVs as FCEV proxy data ranked in order of FCEV proxy within 6 minute drive time (Note: 150 S La Cumbre Rd is an existing hydrogen station)

Street Name	City	County	Zip Code	HEV+PHEV+BEVs Covered	CHIT Coverage Gap Score [x100]
1196 E LOS ANGELES AVE	Simi Valley	Ventura County	93065	678	1.1712
45 N. REINO RD	Thousand Oaks	Ventura County	91320	607	1.7843
293 S MOORPARK RD	Thousand Oaks	Ventura County	91361	596	1.451
1152 E AVENIDA DE LOS ARBOLES	Thousand Oaks	Ventura County	91360	571	1.895
4500 E THOUSAND OAKS BLVD STE 100	Thousand Oaks	Ventura County	91362	534	1.8683
101 W CARRILLO ST	Santa Barbara	Santa Barbara County	93101	505	1.2389
150 S LA CUMBRE RD	Santa Barbara	Santa Barbara County	93105	434	0.2603
4870 SANTA ROSA RD	Camarillo	Ventura County	93012	419	0.8419
1476 E VALLEY RD	Montecito	Santa Barbara County	93108	350	0.5375
2627 YOSEMITE AVE	Simi Valley	Ventura County	93063	346	0.8417
50 W NEW LOS ANGELES AVE	Moorpark	Ventura County	93021	339	0.349
5960 CALLE REAL	Goleta	Santa Barbara County	93117	315	0.1546
522 N LAS POSAS RD	Camarillo	Ventura County	93010	303	0.9674
100 BARNETT ST	Arroyo Grande	San Luis Obispo County	93420	275	0.2215
7700 TELEGRAPH RD	San Buenaventura (Ventura)	Ventura County	93004	266	1.5554
296 SANTA ROSA RD	San Luis Obispo	San Luis Obispo County	93401	213	0.7755
507 E THOMPSON BLVD	San Buenaventura (Ventura)	Ventura County	93001	173	0.3905
655 S VENTURA RD	Oxnard	Ventura County	93030	136	2.1266
2000 EL CAMINO REAL	Atascadero	San Luis Obispo County	93422	118	0.1791
246 W EL ROBLAR DR	Meiners Oaks	Ventura County	93023	106	0.2665
4401 VIA REAL	Carpinteria	Santa Barbara County	93013	102	0.5422

STREET Compared to CHIT

The CHIT Station Coverage Value is the ability of the proposed station to fill an identified gap in refueling coverage. **Figure 5** shows the STREET suggested hydrogen station sites on top of the CHIT Station Coverage Values. The CHIT Station Coverage Values are also shown for each suggested STREET stations in

Table 1 through **Table 3**.

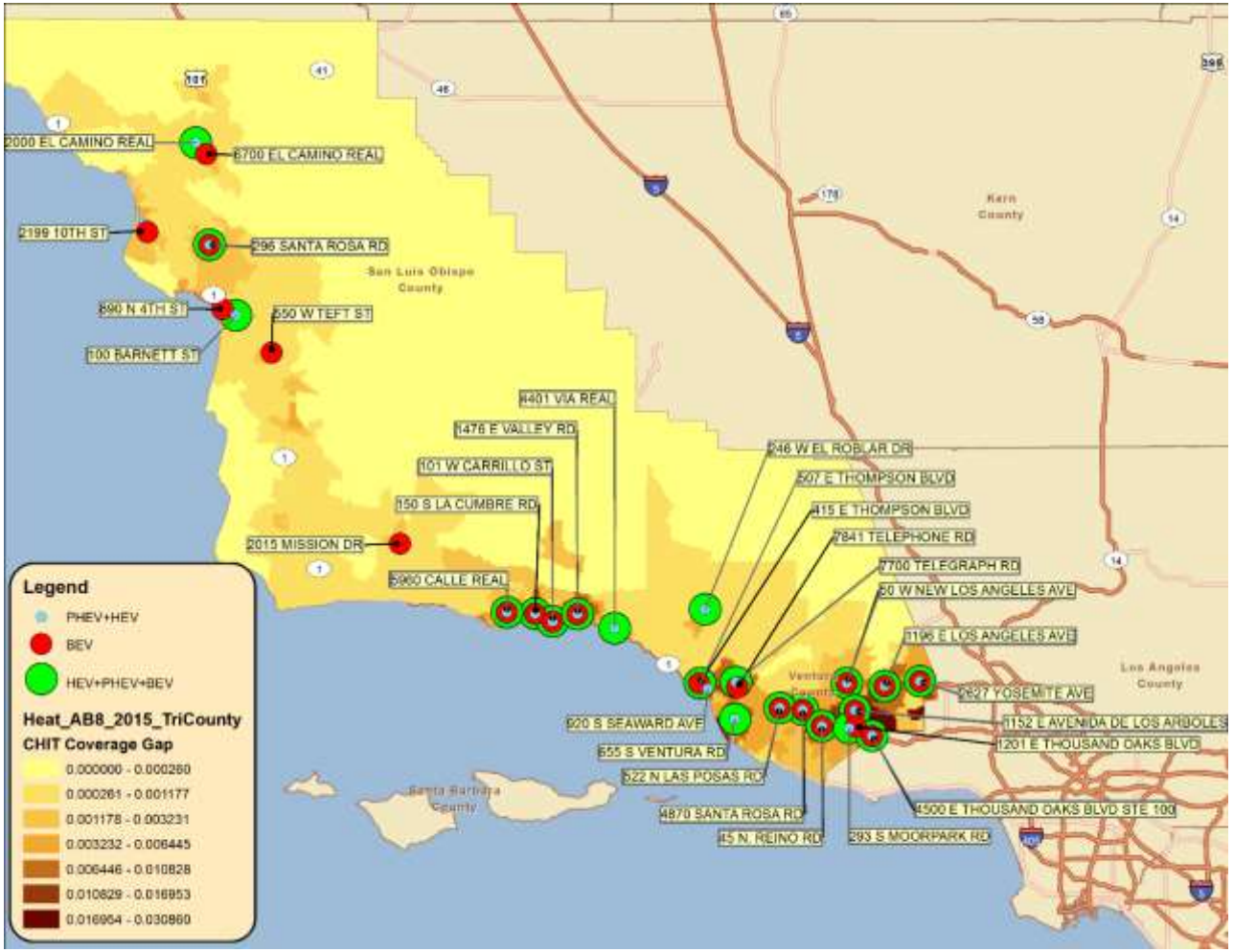

Figure 5 Suggested STREET hydrogen refueling stations overlaid on top of the CHIT Station Coverage Value map

Figure 6 CHIT Station Coverage Value map

Connectivity

Figure 7 and **Figure 8** show the existing and potential future connectivity along Highway 101 provided by the existing Santa Barbara hydrogen station on 150 S La Cumbre Rd and the suggested STREET hydrogen stations, respectively.

Figure 7 Current connectivity between northern and southern California along Highway 101 provided by the existing Santa Barbara hydrogen station on 150 S La Cumbre Rd.

Figure 8 Future possible connectivity between northern and southern California along Highway 101 provided by suggested STREET hydrogen stations

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[9] M. W. Melaina, “Initiating hydrogen infrastructures: preliminary analysis of a sufficient number of initial hydrogen stations in the US,” *Int. J. Hydrogen Energy*, vol. 28, no. 7, pp. 743–755, 2003.

Appendix

Figure 9 Distribution of BEVs after the application of the Weighted Distribution Method described in Demand Points (Proxy FCEVs) section

Figure 10 Distribution of HEVs+PHEVs after the application of the Weighted Distribution Method described in Demand Points (Proxy FCEVs) section

Figure 11 Distribution of HEVs+PHEVs+BEVs after the application of the Weighted Distribution Method described in Demand Points (Proxy FCEVs) section

Appendix 3

Field Assessment of Existing Retail Fueling Stations

Qualitative Screening of Suitability for Adding Hydrogen Fueling System

Table A3-1 – Ventura County Stations Visited and Scored

Name	Address	City	Zip	Space	Appearance	Neighbourhood	Ease of Access	Proximity to Freeway	Overall Score
Yosemite Shell	2627 Yosemite Ave.	Simi Valley	93063	6	6	3	3	3	21
Chevron #9-0576	920 S Seaward Ave	Ventura	93003	6	6	3	3	3	21
Circle K #2211185	5195 East Cochran	Simi Valley	93063	6	5	3	3	3	20
Swank's Chevron	2449 Stearns Street	Simi Valley	93063	6	5	3	3	3	20
Circle K #2709460	2200 N. Rose Ave.	Oxnard	93030	5	6	3	3	3	20
Chevron SS #20-8020	1900 N. Rose Ave.	Oxnard	93030	5	6	3	3	3	20
Campus Plaza Shell	6599 Collins Dr.	Moorpark	93021	5	6	3	3	3	20
Arneill Chevron	255 Arneill Rd.	Camarillo	93010	6	5	3	3	3	20
California Chevron	507 E Thompson Blvd.	Ventura	93001	6	6	2	3	3	20
GSE 76 Ventu Park	575 N. Ventu Park Rd.	Newbury Park	91320	5	6	3	3	3	20
Borchard Arco AM/PM	2305 Borchard Rd.	Newbury Park	91320	5	5	3	3	3	19
Chevron #9-1024	2568 Sycamore Drive	Simi Valley	93065	6	5	2	3	3	19
Apro LLC dba United Oil #10	108 Cochran Street	Simi Valley	93065	4	6	3	3	3	19
Circle K #2709483	490 S. Victoria Ave.	Oxnard	93030	6	6	3	3	1	19
Johnson Drive Carwash & Gas	2757 Johnson Dr.	Ventura	93003	5	6	2	3	3	19
Seaward Oil, Inc.	779 South Seaward Ave.	Ventura	93001	6	4	3	3	3	19
7-Eleven Facility #33399	2201 E. Gonzales Rd.	Oxnard	93036	4	6	3	3	2	18
S & S Chevron	2901 Saviers Road	Oxnard	93033	5	5	3	3	2	18
Moorpark Chevron	502 Los Angeles Ave.	Moorpark	93021	4	5	3	3	3	18

Table A3-1 – Ventura County Stations Visited and Scored

Name	Address	City	Zip	Space	Appearance	Neighbourhood	Ease of Access	Proximity to Freeway	Overall Score
Proud Auto	4676 Adolfo Rd.	Camarillo	93012	4	5	3	3	3	18
Las Posas Mobil, Inc.	501 Las Posas Road	Camarillo	93010	4	5	3	3	3	18
Tesoro Shell #68511	107 W. Ventura Blvd.	Camarillo	93010	3	6	3	3	3	18
Chevron #200209	4870 Santa Rosa Road	Camarillo	93010	4	5	3	3	3	18
Johnson Oil Corp. Fac. No. 309330	6762 North Bank Dr.	Ventura	93003	5	5	2	3	3	18
Hampshire Road Shell	395 Hampshire Road	Thousand Oaks	91360	5	5	3	3	2	18
7-Eleven #33162	609 Rancho Conejo Blvd.	Thousand Oaks	91320	4	5	3	3	3	18
Newbury 76	848 Wendy Dr.	Newbury Park	91320	5	4	3	3	3	18
S & G Energy, Inc.	445 North Ventu Park Road	Newbury Park	91320	4	5	3	3	3	18
USA Gasoline #68174	518 Rancho Conejo Blvd.	Newbury Park	91320	4	5	3	3	3	18
RJR Enter. dba Simi Valley Arco	25 Tierra Rejada Rd.	Simi Valley	93065	4	5	3	3	2	17
Kam's Canyon Mobil Service Center	2500 Tapo Canyon Road	Simi Valley	93063	5	4	2	3	3	17
Vineyard Mobil	2851 E. Vineyard Ave.	Oxnard	93036	4	5	3	3	2	17
Rose Shell	1901 N. Rose Ave.	Oxnard	93030	5	4	2	3	3	17
Union 76	550 W. Los Angeles Avenue	Moorpark	93021	5	5	3	3	1	17
Hilu Chevron	522 N. Las Posas Rd.	Camarillo	93010	3	5	3	3	3	17
Arco AM/PM	5669 Valentine Rd.	Ventura	93003	3	6	2	3	3	17
Zaitoon Inc	605 S. Mills Rd.	Ventura	93003	4	4	3	3	3	17
Tesoro Arco #42054	2124 East Harbor Blvd	Ventura	93001	5	4	2	3	3	17

Table A3-1 – Ventura County Stations Visited and Scored

Name	Address	City	Zip	Space	Appearance	Neighbourhood	Ease of Access	Proximity to Freeway	Overall Score
Jenda, Inc.	3995 Thousand Oaks Blvd.	Thousand Oaks	91362	4	4	3	3	3	17
Westlake Chevron	225 Hampshire Rd.	Westlake Village	91361	3	5	3	3	3	17
Rolling Oaks 76	293 S. Moorpark Rd.	Thousand Oaks	91361	5	3	3	3	3	17
Oaks Shell	56 E. Thousand Oaks Blvd.	Thousand Oaks	91360	4	4	3	3	3	17
Wendy Drive Chevron	2870 Camino Dos Rios	Newbury Park	91320	3	5	3	3	3	17
Borchard Chevron	2290 W. Borchard Rd.	Newbury Park	91320	4	4	3	3	3	17
Oxnard Vineyard Chevron	2251 N. Oxnard Blvd.	Oxnard	93036	4	5	3	2	3	17
Chevron Stations Inc. #202037	2395 Erringer Road	Simi Valley	93065	4	5	2	3	2	16
Alliance	5803 East Los Angeles Ave.	Simi Valley	93063	3	4	3	3	3	16
Stearns Petroleum, Inc.	2605 Stearns St.	Simi Valley	93063	5	3	2	3	3	16
Stearns Alliance Gas Minimart	2404 Stearns St.	Simi Valley	93063	3	4	3	3	3	16
HDOC #093	3402 Vineyard Ave	Oxnard	93030	5	4	3	3	1	16
Arco/AMPM	500 S. Victoria Ave.	Oxnard	93030	4	5	3	3	1	16
Moorpark Petroleum	50 W. New Los Angeles Ave.	Moorpark	93021	4	5	3	3	1	16
Main & Mills Mobil	3500 E Main St	Ventura	93003	3	4	3	3	3	16
Victoria Chevron	2199 S. Victoria Avenue	Ventura	93003	4	5	2	2	3	16
Market Street Carwash & Gas	4411 Market St.	Ventura	93003	4	5	3	2	2	16
Rafi's Chevron #6	1152 Avenida De Los Arboles	Thousand Oaks	91360	4	4	3	3	2	16
Circle K #2211092	855 North Wendy Dr.	Newbury Park	91320	3	4	3	3	3	16

Table A3-1 – Ventura County Stations Visited and Scored

Name	Address	City	Zip	Space	Appearance	Neighbourhood	Ease of Access	Proximity to Freeway	Overall Score
Sycamore Shell	2405 N. Sycamore Dr.	Simi Valley	93065	4	5	2	3	1	15
Tesoro USA #63217	2211 Tapo St.	Simi Valley	93063	4	4	3	3	1	15
Shell #68621	2390 Tapo St.	Simi Valley	93063	4	5	2	3	1	15
Shell #68580	2460 E. Vineyard Ave.	Oxnard	93036	4	4	2	2	3	15
Universal Victoria Inc.	2440 S. Victoria Ave.	Ventura	93003	3	4	2	3	3	15
Seaward Inc.	2099 E. Harbor Blvd.	Ventura	93001	2	5	2	3	3	15
Harbor Valero / Subway	2121 East Harbor Blvd	Ventura	93001	5	2	2	3	3	15
Dalex Chevron	172 N. Moorpark Rd.	Thousand Oaks	91360	4	4	3	2	2	15
Oxnard Arco AM/PM	1132 S. Oxnard Blvd.	Oxnard	93030	3	5	3	3	1	15
Simi Shell Food Mart	1120 Los Angeles Ave.	Simi Valley	93065	4	3	3	2	3	15
Tesoro USA #63215	706 Los Angeles Ave.	Simi Valley	93063	5	4	2	2	2	15
Oxnard Service Station LLC	2850 S. Rose Ave.	Oxnard	93033	3	5	2	3	1	14
Victoria Oil Corp. #255523	1121 S. Victoria Ave.	Ventura	93003	3	4	3	2	2	14
T. O. Oil, Inc. dba T. O. Chevron	3505 N. Moorpark Road	Thousand Oaks	91360	3	5	3	2	1	14
Simi Gas	501 E. Los Angeles Ave.	Simi Valley	93065	5	3	2	2	2	14
Silvas Oil Company, Inc.	6417 Ventura Blvd.	Ventura	93002	6	2	1	2	2	13
Thousand Oaks Union 76	2861 Moorpark Rd	Thousand Oaks	91360	4	4	2	2	1	13
Simi Valley Union 76	2706 E. Los Angeles Ave.	Simi Valley	93065	4	3	2	2	2	13
Tesoro USA #68232	2661 E. Thompson Blvd.	Ventura	93003	4	3	2	2	1	12

Table A3-1 – Ventura County Stations Visited and Scored									
Name	Address	City	Zip	Space	Appearance	Neighbourhood	Ease of Access	Proximity to Freeway	Overall Score
H.D.O.C. #106	774 North Ventura Avenue	Ventura	93001	6	2	1	2	1	12
Kassra Inc.	2292 Thompson Blvd.	Ventura	93001	2	5	2	2	1	12
Anita Spirit	415 E. Thompson Blvd.	Ventura	93001	2	3	2	2	3	12
Simi Valley Circle K	510 E. Los Angeles Ave.	Simi Valley	93065	3	3	2	2	2	12
HD Fuel	2399 Tapo St.	Simi Valley	93063	2	3	2	3	1	11
Moorpark Service Inc.	13800 Princeton Ave.	Moorpark	93021	4	3	2	1	1	11
Rafi's Chevron #5	3477 Telegraph Road	Ventura	93003	4	3	2	1	1	11
Tesoro USA #68233	1717 S. Victoria Ave.	Ventura	93003	2	3	2	2	2	11
G & M Oil Co./Chevron #308293 #152	2314 E. Thompson Blvd.	Ventura	93003	3	3	2	2	1	11
Sycamore Union 76	2383 Sycamore Drive	Simi Valley	93065	2	2	2	2	2	10
Auto Fuels, Inc.	2460 Auto Center Dr.	Oxnard	93030	2	2	2	1	2	9
Oxnard Arco	700 South Oxnard Blvd	Oxnard	93030	2	3	1	2	1	9
Ventura Gas & Mini Mart	2599 East Main St.	Ventura	93003	2	3	2	1	1	9
Valero	2689 N. Moorpark Rd	Thousand Oaks	91360	2	2	2	2	1	9
Oxnard EZ Gas	303 N. Oxnard Blvd.	Oxnard	93030	2	3	1	2	1	9
USA Gasoline #63036	887 N. Ventura Ave.	Ventura	93001	2	2	1	2	1	8

Table A3-2 – Ventura County, Other Retail Stations Not Visited									
Name	Address	City	Zip	Space	Appearance	Neighbourhood	Ease of Access	Proximity to Freeway	Score
Circle K #2211246	45 N. Reino Rd.	Newbury Park	91320						
Thousand Oaks / Public Works	1993 Rancho Conejo Blvd.	Thousand Oaks	91320						
Arco Smog Pros	600 Moorpark Rd	Thousand Oaks	91360						
Thousand Oaks Chevron	1201 E. Thousand Oaks Blvd.	Thousand Oaks	91360						
USA Gasoline #68224	1640 N. Moorpark Rd.	Thousand Oaks	91360						
Wendy Auto Center Inc.	420 E. Thousand Oaks Blvd.	Thousand Oaks	91360						
Circle K #2211126	942 Westlake Blvd.	Westlake Village	91361						
Michael E. Ply Hampshire 76	3102 East Thousand Oaks Blvd.	Thousand Oaks	91362						
ProGas, Inc dba Thousand Oaks Arco	2473 Thousand Oaks Blvd.	Thousand Oaks	91362						
TR Oil	3050 E. Thousand Oaks Blvd.	Thousand Oaks	91362						
USA Gasoline #63211	1715 East Thousand Oaks Blvd.	Thousand Oaks	91362						
Silvas Oil Company, Inc.	50 Julian Street	Ventura	93001						
Silvas Oil Company, Inc.	2191 N. Ventura Ave.	Ventura	93001						
College Shell	4111 Telegraph Road	Ventura	93003						
TBA Enterprises Inc	7700 Telegraph Rd.	Ventura	93003						
Telephone Road Chevron	9460 Telephone Rd.	Ventura	93004						
Tesoro Shell #68632	7841 Telephone Rd.	Ventura	93004						

Note – Stations listed in this table were not assessed because of time limitations and a preliminary screening based on satellite imagery and subjective criteria such as proximity to freeway and primary demand areas. This does not imply that these stations would not be eligible for station funding opportunities that could materialize.

Table A3-2 – Ventura County, Other Retail Stations Not Visited									
Name	Address	City	Zip	Space	Appearance	Neighbourhood	Ease of Access	Proximity to Freeway	Score
Ventura 76	11008 Citrus Drive (Wells)	Ventura	93004						
Ventura Valero	11005 Citrus Dr.	Ventura	93004						
7-Eleven Store #33567	255 N. Carmen Drive	Camarillo	93010						
Arco Facility #83345	650 N. Arneill Rd.	Camarillo	93010						
Auto Tech Gas Buster Mart	2157 Las Posas Rd.	Camarillo	93010						
Carmen Auto Center	256 Carmen Dr.	Camarillo	93010						
Shell Camarillo	1604 Ventura Blvd.	Camarillo	93010						
USA Gasoline #68115	4418 E. Central Ave.	Camarillo	93010						
USA Gasoline #68116	305 Carmen Dr.	Camarillo	93010						
Dawson Carwash	2911 Petit St.	Camarillo	93012						
7-Eleven #33513	903 Ventura St.	Fillmore	93015						
Chevron #9-7983	704 W. Ventura St.	Fillmore	93015						
Fillmore Shell Inc	1107 W. Ventura St.	Fillmore	93015						
Saif's Food Mart	423 W. Ventura St.	Fillmore	93015						
Tesoro USA #68135	660 Ventura St.	Fillmore	93015						
Valero Corner Store #3751	117 E. Ventura St.	Fillmore	93015						
Moorpark #6	7150 Walnut Canyon	Moorpark	93021						

Note – Stations listed in this table were not assessed because of time limitations and a preliminary screening based on satellite imagery and subjective criteria such as proximity to freeway and primary demand areas. This does not imply that these stations would not be eligible for station funding opportunities that could materialize.

Table A3-2 – Ventura County, Other Retail Stations Not Visited									
Name	Address	City	Zip	Space	Appearance	Neighbourhood	Ease of Access	Proximity to Freeway	Score
Shell #68564	301 W. New Los Angeles Ave.	Moorpark	93021						
Oak View Shell	905 Ventura Ave.	Oak View	93022						
USA Gasoline #63207	795 Ventura Ave.	Oak View	93022						
A & I Mini Mart & Gas	246 W. El Roblar Dr.	Meiners Oaks	93023						
Circle K #01045	11408 Ventura Avenue	Ojai	93023						
Ojai Chevron #9-0478	360 East Ojai Ave.	Ojai	93023						
Ojai Gas Inc.	1124 Maricopa Rd.	Ojai	93023						
Valero Corner Store #3754	616 E. Ojai Ave.	Ojai	93023						
7-Eleven #33159	1501 W. 5th Street	Oxnard	93030						
Alliance Station	1861 N. Ventura Rd.	Oxnard	93030						
Chevron	877 S. Ventura Rd.	Oxnard	93030						
Costco Wholesale Corp. #420	2001 E. Ventura Blvd.	Oxnard	93030						
Del Norte Shell	200 Del Norte Boulevard	Oxnard	93030						
El Rio Vineyard Shell & Foodmart	2778 Vineyard Avenue	Oxnard	93030						
Lashkari's Service Station	105 North Oxnard Boulevard	Oxnard	93030						
Nissim Tovim, Inc.	1400 S. Oxnard Blvd.	Oxnard	93030						
Offshore Gas	1050 S. Ventura Road	Oxnard	93030						

Note – Stations listed in this table were not assessed because of time limitations and a preliminary screening based on satellite imagery and subjective criteria such as proximity to freeway and primary demand areas. This does not imply that these stations would not be eligible for station funding opportunities that could materialize.

Table A3-2 – Ventura County, Other Retail Stations Not Visited									
Name	Address	City	Zip	Space	Appearance	Neighbourhood	Ease of Access	Proximity to Freeway	Score
Oxnard Ultramar Carwash	655 South Ventura Road	Oxnard	93030						
Rose & 5th Inc.	501 S. Rose Ave.	Oxnard	93030						
Tesoro USA #68182	1790 E. Pleasant Valley Rd.	Oxnard	93030						
USA Gasoline #63208	1501 W. Gonzales Rd.	Oxnard	93030						
Ventura Road Chevron #9-7423	1860 N. Ventura Road	Oxnard	93030						
Wooley Gas Faal Corporation	1060 South J Street	Oxnard	93030						
Convenience Retailers, LLC #5696	1445 W. Channel Islands Blvd.	Oxnard	93033						
Fred's Gas & Food Mart	3211 Saviers Road	Oxnard	93033						
Joe's Gas & Smog	1720 S. Oxnard Blvd.	Oxnard	93033						
Saviers 76	3650 Saviers Rd.	Oxnard	93033						
Shell #68579	1440 W. Channel Islands Blvd.	Oxnard	93033						
USA Gasoline #68183	5040 Saviers Rd.	Oxnard	93033						
Ventura Co. CI Harbor Fuel Dock	3855 Pelican Way	Oxnard	93035						
Food 4 Less Fuel Center #335	190 W. Esplanade Dr.	Oxnard	93036						
Arco AM/PM #06516	3907 E. Telegraph Rd.	Piru	93040						
USA Gasoline #68189	2651 N. Ventura Rd.	Port Hueneme	93041						
ADAR Chevron	983 E. Harvard Blvd.	Santa Paula	93060						

Note – Stations listed in this table were not assessed because of time limitations and a preliminary screening based on satellite imagery and subjective criteria such as proximity to freeway and primary demand areas. This does not imply that these stations would not be eligible for station funding opportunities that could materialize.

Table A3-2 – Ventura County, Other Retail Stations Not Visited									
Name	Address	City	Zip	Space	Appearance	Neighbourhood	Ease of Access	Proximity to Freeway	Score
Circle K #05238	765 W. Harvard Boulevard	Santa Paula	93060						
Fastlane 76	206 E. Harvard Blvd.	Santa Paula	93060						
Golden State Petroleum	55 Hallock Dr.	Santa Paula	93060						
Peck Oil Corp.	806 W. Harvard Blvd.	Santa Paula	93060						
Santa Paula Shell	100 S. Hallock Dr.	Santa Paula	93060						
Valero of Santa Paula	145 S. 10th St.	Santa Paula	93060						
Chevron Car Wash	1196 E. Los Angeles Ave.	Simi Valley	93063						
Circle K #2211127	2340 N. Kuehner Dr.	Simi Valley	93063						
USA Gasoline #63216	1356 N. Erringer Rd.	Simi Valley	93063						
1st Noor LLC	1099 East Los Angeles Avenue	Simi Valley	93065						
7-Eleven, Inc.	1369 Erringer Road	Simi Valley	93065						
Costco Wholesale Corp. #128	2660 Park Center Dr.	Simi Valley	93065						
Plaza Food Mart	1695 Royal Ave.	Simi Valley	93065						
Valley Shell	1220 Sycamore Dr	Simi Valley	93065						

Note – Stations listed in this table were not assessed because of time limitations and a preliminary screening based on satellite imagery and subjective criteria such as proximity to freeway and primary demand areas. This does not imply that these stations would not be eligible for station funding opportunities that could materialize.

Table A3-3 – Santa Barbara County (South) Stations Visited and Scored

Name	Address	City	Zip	Space	Appearance	Neighbourhood	Ease of Access	Proximity to Freeway	Overall Score
Circle K Stores, Inc.	402 W. Mission Street	Santa Barbara	93101	5	5	3	3	3	19
Chevron USA Products Company	4290 Via Real	Carpinteria	93013	6	5	3	3	2	19
Carpinteria Car Care	4401 N. Via Real	Carpinteria	93013	6	5	3	3	2	19
Seven-Eleven, Inc.	4410 Via Real	Carpinteria	93013	6	4	3	3	2	18
Tesoro Refining & Marketing Company LLC	340 W. Carrillo Street	Santa Barbara	93101	6	3	3	3	3	18
Janda Partners, L.P.	1085 Coast Village Road	Santa Barbara	93108	5	6	3	2	2	18
Circle K Stores, Inc.	4801 Hollister Avenue	Santa Barbara	93111	4	5	3	3	3	18
Turnpike Fuel Partners, LP	250 N. Turnpike Road	Santa Barbara	93111	5	4	3	3	3	18
World Oil Marketing Company	5960 Calle Real	Goleta	93117	5	4	3	3	3	18
World Oil Marketing Company	1800 State Street	Santa Barbara	93101	5	5	3	3	1	17
Chevron USA Products Company	115 S. La Cumbre Road	Santa Barbara	93105	2	6	3	3	3	17
Circle K Stores, Inc.	49 N. Glen Annie Road	Goleta	93117	5	4	3	2	3	17
Conico State, LLC.	3060 State Street	Santa Barbara	93105	3	5	3	3	2	16
Sancino Oil Corporation	6895 Hollister Avenue	Goleta	93117	4	4	3	2	3	16
Convenience Retailers, LLC.	165 N. Fairview Avenue	Goleta	93117	4	4	3	2	3	16
Tesoro Refining & Marketing Company LLC	8 S. Milpas Street	Santa Barbara	93101	5	3	2	2	3	15
Montecito Harbor Chevron	401 W. Montecito Street	Santa Barbara	93101	4	5	3	1	2	15
Channel Auto Services, LP.	101 W. Carrillo Street	Santa Barbara	93101	2	5	3	3	2	15

Table A3-3 – Santa Barbara County (South) Stations Visited and Scored

Name	Address	City	Zip	Space	Appearance	Neighbourhood	Ease of Access	Proximity to Freeway	Overall Score
Tesoro Refining & Marketing Company LLC	3618 State Street	Santa Barbara	93105	3	4	3	3	2	15
Olive Oil & Gas LP	1298 Coast Village Road	Santa Barbara	93108	4	3	3	2	3	15
Jemesa, LLC	1929 Cliff Drive	Santa Barbara	93109	3	6	3	2	1	15
Walnut Wash Partners	5097 Hollister Avenue	Santa Barbara	93111	3	5	3	2	2	15
North Turnpike Partners, LP	175 N. Turnpike Road	Goleta	93111	3	4	3	2	3	15
North Fairview Properties	42 N. Fairview Avenue	Goleta	93117	4	4	3	1	3	15
Icon Oil Company, Inc.	1935 State Street	Santa Barbara	93101	4	5	3	1	1	14
Four Jays, LP.	3898 State Street	Santa Barbara	93105	3	5	3	1	2	14
World Oil Marketing Company	2837 De La Vina Street	Santa Barbara	93105	2	5	2	3	2	14
The Village Service Station	1476 E. Valley Road	Santa Barbara	93108	3	5	3	2	1	14
Fairview Auto Care, Inc.	55 N. Fairview Avenue	Goleta	93117	3	3	3	2	3	14
Tesoro Refining & Marketing Company LLC	636 W. Carrillo Street	Santa Barbara	93101	2	4	1	3	3	13
Merpour Enterprises, Inc.	303 W. Carrillo Street	Santa Barbara	93101	2	2	3	3	3	13
Thrifty Oil Company	231 N. Milpas Street	Santa Barbara	93103	5	3	2	2	1	13
Circle K Stores, Inc.	2299 Las Positas Road	Santa Barbara	93105	4	2	2	2	3	13
CST California Stations, Inc.	5661 Calle Real	Goleta	93117	3	3	3	2	2	13
World Oil Marketing Company	5648 Hollister Avenue	Goleta	93117	4	3	2	2	2	13
Convenience Retailers, LLC.	200 S. Milpas Street	Santa Barbara	93103	3	3	1	2	3	12

Table A3-3 – Santa Barbara County (South) Stations Visited and Scored

Name	Address	City	Zip	Space	Appearance	Neighbourhood	Ease of Access	Proximity to Freeway	Overall Score
Educated Car Wash/Wasem Family Partners	3735 State Street	Santa Barbara	93105	3	4	3	1	1	12
American Fuel	2234 De La Vina Street	Santa Barbara	93105	3	1	2	3	2	11
Fast Lane Arco Gas-Mart	180 N. N Fairview Avenue	Goleta	93117	3	1	3	2	2	11
Stop & Shop Gas 2	134 S. Milpas Street	Santa Barbara	93103	1	3	1	2	3	10
Goleta Properties, LLC.	5755 Hollister Avenue	Goleta	93117	3	2	1	2	2	10
El Ranchero Market	1502 San Andres Street	Santa Barbara	93101	2	2	1	2	1	8
Thrifty Oil Company	4069 State Street	Santa Barbara	93110	2	2	1	1	2	8

Table A3-4 – Santa Barbara County (South), Other Retail Stations Not Visited									
Name	Address	City	Zip	Space	Appearance	Neighbourhood	Ease of Access	Proximity to Freeway	Score
Carpinteria 76	5085 Carpinteria Avenue	Carpinteria	93013						
Shoreline Oil, Inc.	1116 Casitas Pass Road	Carpinteria	93013						
Summerland Gas & Liquor	2285 Lillie Avenue	Summerland	93067						
Moller Retail, Inc.	150 S. La Cumbre Road	Santa Barbara	93105						
Seven-Eleven, Inc.	7390 Calle Real	Goleta	93117						
Winchester 76 & Market	20 Winchester Canyon Road	Goleta	93117						

Note – Stations listed in this table were not assessed because of time limitations and a preliminary screening based on satellite imagery and subjective criteria such as proximity to freeway and primary demand areas. This does not imply that these stations would not be eligible for station funding opportunities that could materialize.

Table A3-5 – Santa Barbara County (North) Stations Visited and Scored

Address	City	Zip	Space	Appearance	Neighbourhood	Ease of Access	Proximity to Freeway	Overall Score	Score
Moller Retail, Inc.	910 E. Betteravia Road	Santa Maria	93454	5	6	3	3	3	20
Valley Pacific Petroleum Services, Inc.	1155 E. Betteravia Road	Santa Maria	93455	6	4	3	3	3	19
Aljnar, Inc.	188 E. Highway 246	Buellton	93427	5	5	3	3	3	19
Thrifty Oil Company	197 E. Highway 246	Buellton	93427	5	5	3	3	3	19
Pacific Fuel Group	206 E. Hwy 246	Buellton	93427	5	5	3	3	3	19
Moller Retail, Inc.	89 E. Highway 246	Buellton	93427	5	5	3	3	3	19
Circle K Stores, Inc.	1220 E. Betteravia	Santa Maria	93454	5	4	3	3	3	18
Conico Buellton LLC	90 E. Hwy 246	Buellton	93427	4	5	3	3	3	18
Main Street Petroleum	1038 E. Main Street	Santa Maria	93454	4	4	3	3	3	17
Au Energy, LLC.	1204 E. Main Street	Santa Maria	93454	4	4	3	3	3	17
ERN Oil, Inc.	605 Bell Street	Los Alamos	93440	5	4	3	2	3	17
Tom's Gas & Market	230 E. Highway 246	Buellton	93427	4	4	3	3	3	17
Santa Maria Petroleum	2404 S. Broadway	Santa Maria	93454	4	4	3	3	2	16
Orcutt 76	100 E. Clark Avenue	Orcutt	93455	4	4	3	3	1	15
Jims Service Center	2015 Mission Drive	Solvang	93463	3	3	3	3	2	14
Circle K Stores, Inc.	1104 E. Clark Avenue	Santa Maria	93455	4	3	3	3	1	14

Table A3-6 – Santa Barbara County (South), Other Retail Stations Not Visited									
Name	Address	City	Zip	Space	Appearance	Neighbourhood	Ease of Access	Proximity to Freeway	Score
New Cuyama Gas Station	5007 Highway 166	Cuyama	93254						
Guadalupe '76	1080 Guadalupe Street	Guadalupe	93434						
Lou's Chevron Service	1100 E. Ocean Avenue	Lompoc	93436						
Seven-Eleven, Inc.	1337 N. H Street	Lompoc	93436						
Tesoro Refining & Marketing Company LLC	1000 N. H Street	Lompoc	93436						
Pommerville's Automotive & Gas	1001 N. H Street	Lompoc	93436						
Circle K Stores, Inc.	1400 N. H Street	Lompoc	93436						
Vons - A Safeway Company	603 N. "H" Street	Lompoc	93436						
Stuart's Petroleum	940 N. "H" Street	Lompoc	93436						
Sunshine Market & Gas	719 W. Laurel Avenue	Lompoc	93436						
Circle K Stores, Inc.	1421 E. Ocean Avenue	Lompoc	93436						
Moller Retail, Inc.	801 East Ocean	Lompoc	93436						
Anishan Services, Inc.	3705 Constellation Road	Vandenberg Village	93437						
CST California Stations, Inc.	1216 E. Ocean Avenue	Lompoc	93438						
Collins Market	290 Bell Street	Los Alamos	93440						
Santa Maria Alliance	1519 N. Broadway	Santa Maria	93454						
Moller Retail, Inc.	1027 Stowell Road	Santa Maria	93454						

Note – Stations listed in this table were not assessed because of time limitations and a preliminary screening based on satellite imagery and subjective criteria such as proximity to freeway and primary demand areas. This does not imply that these stations would not be eligible for station funding opportunities that could materialize.

Table A3-6 – Santa Barbara County (South), Other Retail Stations Not Visited									
Name	Address	City	Zip	Space	Appearance	Neighbourhood	Ease of Access	Proximity to Freeway	Score
Ralphs Grocery Co./Food4Less	1493 S. Broadway	Santa Maria	93454						
Pepper Tree Chevron	1601 N. Broadway	Santa Maria	93454						
Sofijon, LLC.	1606 N. Broadway	Santa Maria	93454						
Anita's Spirit	1611 S. Broadway	Santa Maria	93454						
Easy Gas	1901 S. Broadway	Santa Maria	93454						
Tesoro Refining & Marketing Company LLC	2164 S. Broadway	Santa Maria	93454						
Santa Maria Car Wash	2301 S. Broadway	Santa Maria	93454						
Santa Maria Petroleum	2404 S. Broadway	Santa Maria	93454						
SLO Gas & Mart, Inc.	739 E. Donovan Road	Santa Maria	93454						
Gasco Auto Care	740 E. Donovan Road	Santa Maria	93454						
Fastrip Oil Company, L.P.	751 Guadalupe Street	Guadalupe	93454						
High Desert Oil Company Inc.	815 W. Main Street	Santa Maria	93454						
Trojan Petroleum	1665 W. Betteravia Road	Santa Maria	93455						
SLO Gas & Mart, Inc.	1101 E. Clark Avenue	Santa Maria	93455						
ChevronTexaco Products Company	3580 Santa Maria Way	Santa Maria	93455						
NAPHT LLC (ampm)	1611 S. Blosser	Santa Maria	93458						
Tesoro Refining & Marketing Company LLC	1144 W. Main Street	Santa Maria	93458						

Note – Stations listed in this table were not assessed because of time limitations and a preliminary screening based on satellite imagery and subjective criteria such as proximity to freeway and primary demand areas. This does not imply that these stations would not be eligible for station funding opportunities that could materialize.

Table A3-6 – Santa Barbara County (South), Other Retail Stations Not Visited									
Name	Address	City	Zip	Space	Appearance	Neighbourhood	Ease of Access	Proximity to Freeway	Score
Chumash CA Gas Station, LLC.	990 Edison Street	Santa Ynez	93460						
Chumash CA Gas Station, LLC.	3101 Mission Drive	Santa Ynez	93460						
J. Winther Chevron	3595 Sagunto Street	Santa Ynez	93460						

Note – Stations listed in this table were not assessed because of time limitations and a preliminary screening based on satellite imagery and subjective criteria such as proximity to freeway and primary demand areas. This does not imply that these stations would not be eligible for station funding opportunities that could materialize.

Table A3-7 – San Luis Obispo County Stations Visited and Scored

Address	City	Zip	Space	Appearance	Neighbourhood	Ease of Access	Proximity to Freeway	Overall Score	Score
Chevron - Kautz	1284 Grand Avenue	Grover Beach	93433	6	6	3	3	2	20
ARCO - Arroyo Grande AM/PM	100 Barnett Street	Arroyo Grande	93420	5	5	3	3	3	19
Five Cities Chevron	340 Five Cities Drive	Pismo Beach	93449	5	5	3	3	3	19
Mission Station, Inc.	328 Marsh Street	San Luis Obispo	93401	5	5	3	3	3	19
Atascadero 76	6305 Morro Road	Atascadero	93422	5	5	3	3	3	19
Chevron # 98169 (Trett's)	3180 S. Broad Street	San Luis Obispo	93401	5	5	3	3	1	17
Grover Beach Flyers	684 West Grand Avenue	Grover Beach	93433	5	5	3	3	1	17
Mobil (Petro Grande)	525 Traffic Way	Arroyo Grande	93420	4	4	3	3	3	17
Refuel	2211 Broad Street	San Luis Obispo	93401	4	5	3	3	2	17
Spyglass Shell (AU Energy)	2699 Shell Beach Road	Pismo Beach	93449	5	3	3	3	3	17
Tesoro Station No. 68613	296 Santa Rosa Street	San Luis Obispo	93405	4	5	3	3	2	17
ARCO - BNB Gas & Mart	12424 Los Osos Valley Road	San Luis Obispo	93405	4	3	3	3	3	16
Arroyo Grande Chevron	251 Grand Avenue	Arroyo Grande	93420	3	4	3	3	3	16
Arroyo Grande Shell	222 Grand Ave.	Arroyo Grande	93420	3	4	3	3	3	16
Chevron # 91717 (Foothill)	151 N Santa Rosa Street	San Luis Obispo	93405	3	5	3	3	2	16
Conserv Fuel	254 Santa Rosa Street	San Luis Obispo	93405	4	4	3	3	2	16
Edna Valley Shell	4021 Broad Street	San Luis Obispo	93401	4	6	3	2	1	16
Laguna Shell	11590 Los Osos Valley Road	San Luis Obispo	93405	3	5	3	3	2	16

Table A3-7 – San Luis Obispo County Stations Visited and Scored

Address	City	Zip	Space	Appearance	Neighbourhood	Ease of Access	Proximity to Freeway	Overall Score	Score
Madonna Shell	204 Madonna Road	San Luis Obispo	93401	3	4	3	3	3	16
Miller's 76	542 Five Cities Drive	Pismo Beach	93449	4	4	3	3	2	16
San Luis Chevron dba Coast Investments, Inc.	2000 Monterey Street	San Luis Obispo	93401	4	4	2	3	3	16
Tesoro Station No. 68614	3 Santa Rosa Street	San Luis Obispo	93405	4	4	3	3	2	16
ARCO #5779 (Pismo Beach)	890 Fourth Street	Pismo Beach	93449	2	4	3	3	3	15
Katch-Go Petroleum	1294 Grand Avenue	Arroyo Grande	93420	4	3	3	3	2	15
Gill's Market	1490 E. Grand Ave.	Arroyo Grande	93420	2	4	3	3	2	14
Arroyo Grande Valero	610 Grand Avenue	Arroyo Grande	93420	3	3	2	3	2	13
Valley Convenience Stores #10	200 Five Cities Drive	Pismo Beach	93449	3	4	2	2	2	13
Broad St. 76 Express	2015 Broad Street	San Luis Obispo	93401	1	4	3	3	1	12
University Spirit Gas & Mini Mart	1756 Monterey Street	San Luis Obispo	93401	2	2	2	2	2	10
7-Eleven (Pismo Beach)	99 S Dolliver St	Pismo Beach	93449	2	2	2	2	1	9

Table A3-8 – San Luis Obispo County, Other Retail Stations Not Visited

Name	Address	City	Zip	Space	Appearance	Neighbourhood	Ease of Access	Proximity to Freeway	Score
John's 76	157 Higuera Street	San Luis Obispo	93401						
Golden Gate Chevron (Los Osos)	995 Los Osos Valley Road	Los Osos	93402						
Valley Liquor	2199 10th Street	Los Osos	93402						
Costco Gasoline	1540 Froom Ranch Way	San Luis Obispo	93405						
Mesa View Market	610 Mesa View Drive	Arroyo Grande	93420						
7-Eleven Citgo (Atascadero)	8000 El Camino Real	Atascadero	93422						
AA Mini Mart	6700 El Camino Real	Atascadero	93422						
Atascadero Gas & Mart, Inc.	6280 Morro Road	Atascadero	93422						
Circle K # 2701197	6930 Morro Road	Atascadero	93422						
Circle K # 2701232	4381 El Camino Real	Atascadero	93422						
Golden Gate Shell (Atascadero)	2000 El Camino Real	Atascadero	93422						
Golden Rissco Inc. dba Atascadero Chevron	8955 Montecito Avenue	Atascadero	93422						
Hitching Post Shell	8000 Morro Road	Atascadero	93422						
Jaco Hill Company (Chalk Mountain Liquor)	9990 El Camino Real	Atascadero	93422						
Neena Enterprises, Inc.	6100 San Anselmo Road	Atascadero	93422						
San Anselmo Chevron	6105 San Anselmo Rd.	Atascadero	93422						
Stagecoach Liquor	5145 El Camino Real	Atascadero	93422						
Tesoro Station Number 68505	9155 San Gabriel Road	Atascadero	93422						

Table A3-8 – San Luis Obispo County, Other Retail Stations Not Visited

Name	Address	City	Zip	Space	Appearance	Neighbourhood	Ease of Access	Proximity to Freeway	Score
Pacific Gas & Electric Company - Diablo Canyon	P.O. Box 65	Avila Beach	93424						
Cambria General Store	850 Main Street	Cambria	93428						
Chevron (Cambria)	2194 Main Street	Cambria	93428						
Old Cambria Marketplace (Cambria Shell)	589 Main Street	Cambria	93428						
Cayucos Gas	198 North Ocean Avenue	Cayucos	93430						
ARCO (Morro Bay AM/PM)	940 Morro Bay Boulevard	Morro Bay	93442						
Lucky 7 Mini Mart & Gas	1860 Main Street	Morro Bay	93442						
Morro Bay Chevron	1798 Main Street	Morro Bay	93442						
Stuart's Petroleum Station	911 Morro Bay Boulevard	Morro Bay	93442						
Valero Corner Store #3556	900 Morro Bay Boulevard	Morro Bay	93442						
Chevron # 95867 (Ellenson's Nipomo)	460 West Tefft Street	Nipomo	93444						
Naojo, Inc. dba La Placita Market	515 Orchard Road	Nipomo	93444						
SLO Gas Mart (Nipomo)	501 West Tefft Street	Nipomo	93444						
Stop N Buy	459 West Tefft Street	Nipomo	93444						
Vons - Safeway # 4607 (GDF-Nipomo)	550 West Tefft Street	Nipomo	93444						
Oceano Market and Gas	1711 Front St.	Oceano	93445						
7-Eleven - Paso Robles	2331 Spring Street	Paso Robles	93446						
ARCO #42072	195 Niblick Road	Paso Robles	93446						

Table A3-8 – San Luis Obispo County, Other Retail Stations Not Visited

Name	Address	City	Zip	Space	Appearance	Neighbourhood	Ease of Access	Proximity to Freeway	Score
ARCO #42093	1201 Ysabel Avenue	Paso Robles	93446						
Chevron (South Paso)	1849 Ramada Drive	Paso Robles	93446						
Chevron (Woodland)	190 Niblick Road	Paso Robles	93446						
Chevron #98013 (Dorsey)	1302 24th Street	Paso Robles	93446						
Fill & Save	1493 Creston Road	Paso Robles	93446						
Golden Hill Mobil	2401 Golden Hill Road	Paso Robles	93446						
Jaco Hill Company (Appy's Liquor)	2816 Spring Street	Paso Robles	93446						
Jaco Hill Company (Wayside Liquor & Deli)	703 Creston Road	Paso Robles	93446						
Mobil (Spring Street)	1339 Spring Street	Paso Robles	93446						
Oak Hill Center	2150 Heritage Loop Road	Paso Robles	93446						
One Stop Food Store	1924 Creston Road	Paso Robles	93446						
One Stop Store	703 Spring Street	Paso Robles	93446						
Paco AMPM	1900 Ramada Drive	Paso Robles	93446						
Paso Robles Jet Center	4810 Wing Way	Paso Robles	93446						
Paso Robles Public Schools	2910 Union Road	Paso Robles	93446						
Pioneer Food Mart	1145 Spring Street	Paso Robles	93446						
Spirit Gas Station	1637 Spring Street	Paso Robles	93446						
Steve's Gas	1441 Spring Street	Paso Robles	93446						

Table A3-8 – San Luis Obispo County, Other Retail Stations Not Visited									
Name	Address	City	Zip	Space	Appearance	Neighbourhood	Ease of Access	Proximity to Freeway	Score
Tesoro Station No. 68584	1244 24th Street	Paso Robles	93446						
Valero Corner Store #3557	2340 Spring Street	Paso Robles	93446						
Wine Country Gateway RV Park, LLC	81 Wellsona Road	Paso Robles	93446						
Chevron (San Miguel)	998 K Street	San Miguel	93451						
Ragged Point Inn (Union 76)	19019 State Highway One	San Simeon	93452						
Pintor's Tire & Fuel	22301 El Camino Real	Santa Margarita	93453						
Singh Chevron	701 Las Tablas Road	Templeton	93465						
Templeton Market & Deli	390 N Main St	Templeton	93465						