

## IX.14 Retail Marketing Analysis: Hydrogen Refueling Stations

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Project End Date: December 17, 2014

- Ranked 30,620 traffic points
- As a complement to Spatially & Temporally Resolved Energy & Environmental Tool (STREET) and cluster studies, proposed locales for refueling stations based on rankings
  - Identified attractive areas outside a competitive distance from current/existing and planned hydrogen refueling stations (Coverage Network)
  - Identified attractive areas in the major urban areas of Los Angeles and San Francisco, offering minimal competition with current/existing and planned hydrogen refueling stations (Urban Incremental Network)



### INTRODUCTION

The availability and proper placement of retail hydrogen refueling stations is critical to the successful market adoption of fuel cell electric vehicles (FCEVs) by consumers and to ensure successful transition to hydrogen as a viable transportation fuel. It is important to establish a network of hydrogen refueling stations that will instill confidence in consumers that they can travel throughout the marketplace with minimal concern about where they can refuel their FCEVs. As of October 6, 2014, there were only 10 hydrogen refueling stations available to the public in the state of California and 42 planned stations that were not yet operational. The only other states having at least one public hydrogen refueling station were South Carolina and Connecticut. In September 2013, the California state legislature approved a bill to fund at least 100 hydrogen refueling stations in California with a commitment of up to \$20 million a year to 2023 through the California Energy Commission's Alternative and Renewable Fuel and Vehicle Technology Program (ARFVTP).

For this project, Kalibrate is challenged with determining the key factors for introducing the hydrogen refueling station infrastructure so that FCEVs can gradually replace gasoline internal combustion engine vehicles. As an application of this analytic capability, these key factors are used to determine the number of hydrogen refueling stations required to establish a refueling infrastructure in California, prioritizing the best locations for new station networks. Results from this analytic capability can contribute to stakeholder efforts to determine the best locations for additional hydrogen refueling stations in preparation for the widespread release of FCEVs to the public.

### Overall Objectives

- Develop an analytic approach to prioritize and identify the best locations for hydrogen refueling stations
- Apply this framework to California to prioritize station network expansion beyond existing and planned locations

### Fiscal Year (FY) 2015 Objectives

This project is complete.

### Technical Barriers

This project addresses the following technical barriers from the Systems Analysis section (4.5) of the Fuel Cell Technologies Office Multi-Year Research, Development, and Demonstration Plan:

- (A) Future Market Behavior
- (D) Insufficient Suite of Models and Tools
- (E) Unplanned Studies and Analysis

### FY 2015 Accomplishments

- Objectively evaluated locations
  - Determined supply and demand variables
  - Determined dependent and independent variables
  - Identified competitive area or trading area size for aggregating data
  - Established weights on variables

## APPROACH

- Through detailed statistical analysis, determine a set of supply and demand variables suitable for evaluating locations for hydrogen refueling stations
- Then, using a ranking tool, rank locations throughout the State of California based on these variables
- Apply the ranking to determine areas most attractive for hydrogen refueling stations

## RESULTS

- Identified dependent and independent variables necessary to develop model for ranking locations for hydrogen refueling stations
- Ranked 30,620 geographic points across the State of California according to their attractiveness for hydrogen fuel cell electric vehicle refueling (Figure 1)
- Building on the STREET model results and cluster strategies, used the rankings of 30,620 points to identify attractive areas that are unlikely to compete with current/existing and planned hydrogen refueling stations (Coverage Network) (Figure 2) and to identify attractive areas in the major urban areas of Los Angeles and San

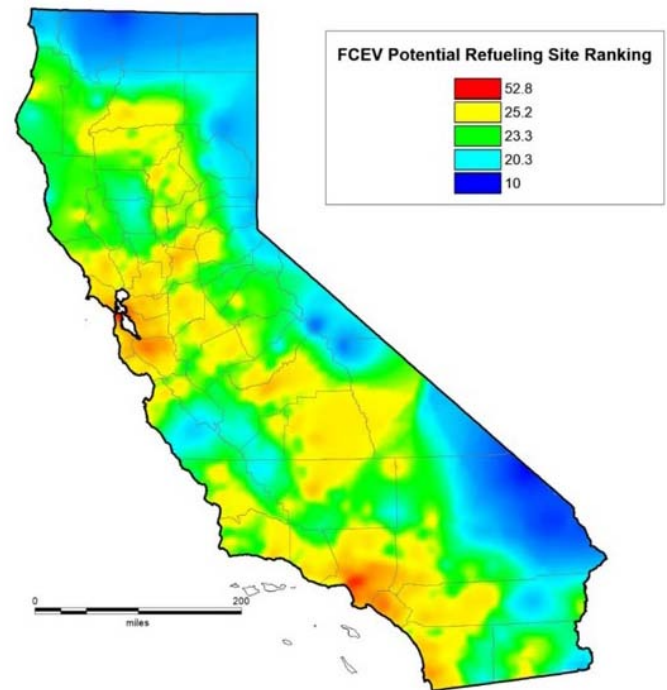


FIGURE 1. Thermal map of ranked locations across the State of California

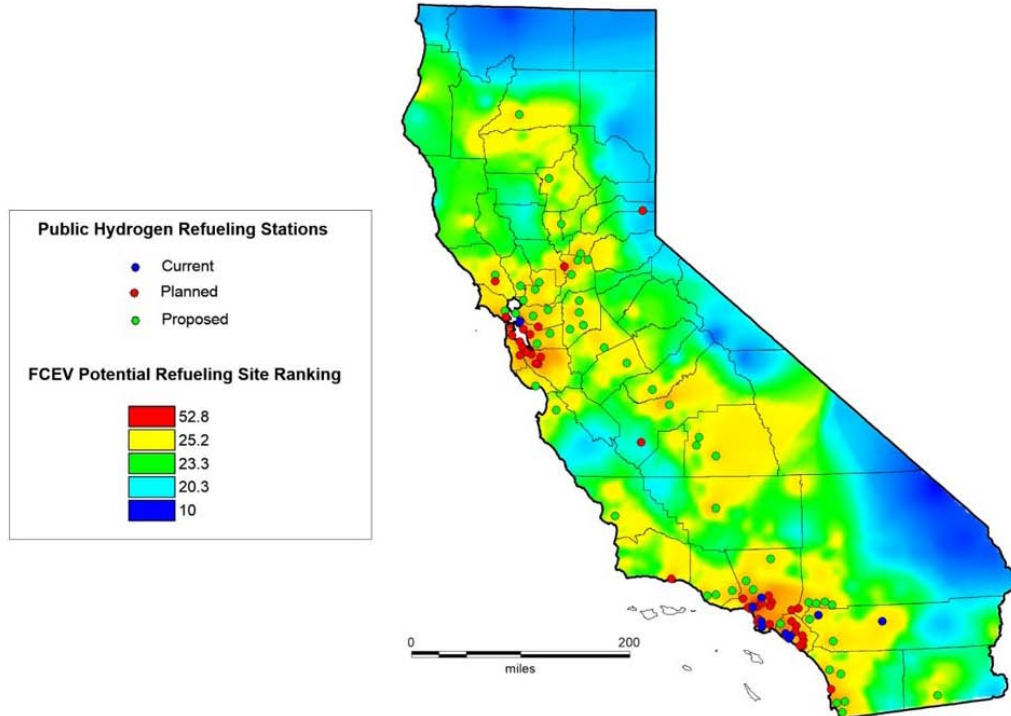


FIGURE 2. Thermal map of ranked locations with proposed coverage network as a complement to current and planned stations

Francisco, offering minimal competition with current/ existing and planned hydrogen refueling stations (Urban Incremental Network) (Figure 3 and 4)

### CONCLUSIONS AND FUTURE DIRECTIONS

This specific project, “Retail Marketing Analysis: Hydrogen Refueling Stations” for the State of California, is complete.

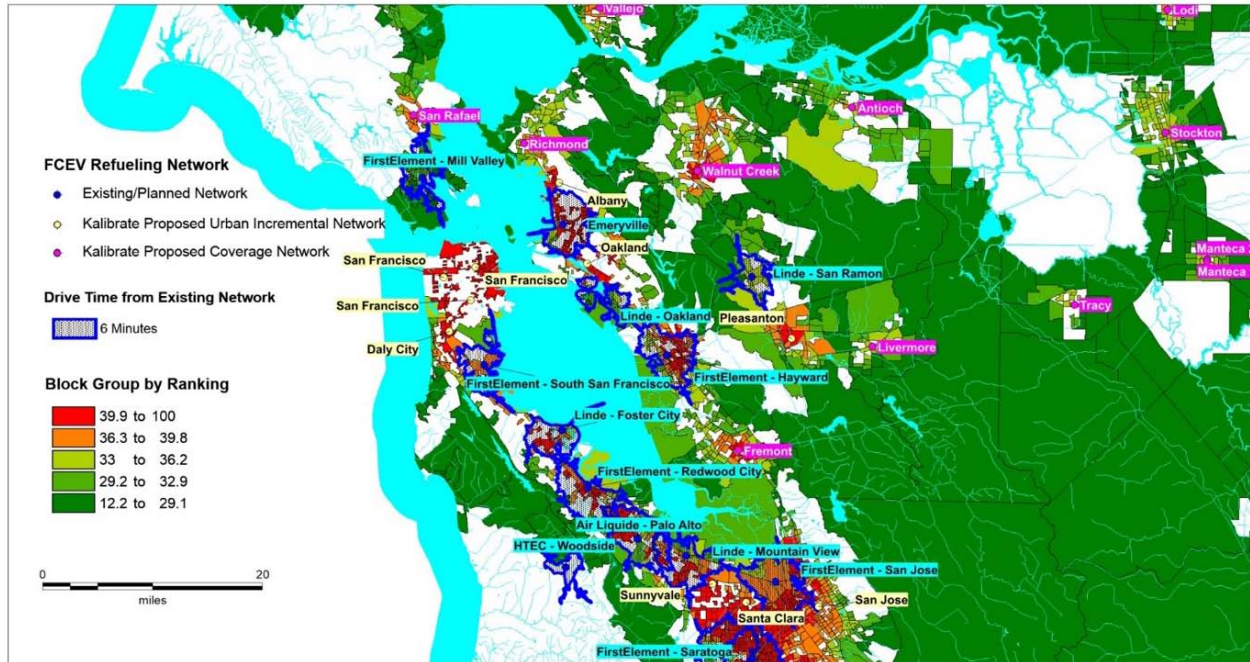


FIGURE 3. Urban Incremental Network and Coverage Network relative to six minute drive time around existing and planned hydrogen refueling stations in San Francisco Bay Area

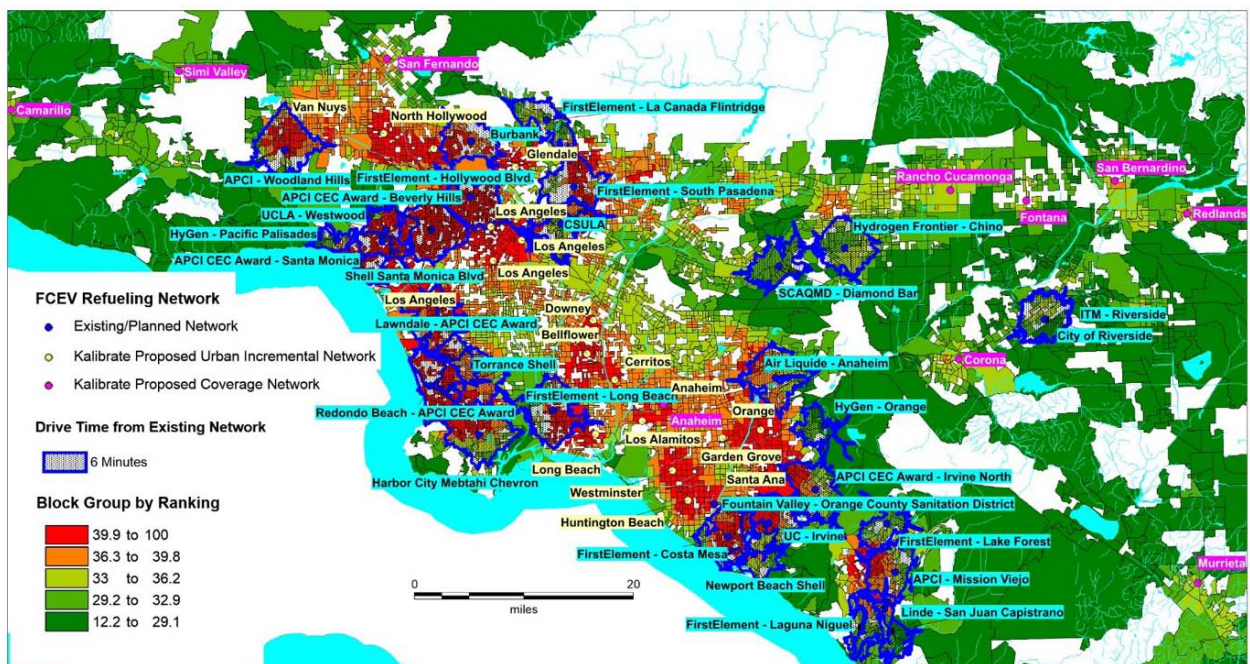


FIGURE 4. Urban Incremental Network and Coverage Network relative to six minute drive time around existing and planned hydrogen refueling stations in Greater Los Angeles Area

Given the opportunity for additional work, Kalibrate can assist with additional projects.

- Similar work in other geographies, other U.S. states or regions
- Develop a tool to provide instant analysis of ranked map points
- Given a sufficiently developed infrastructure of hydrogen refueling stations, creation of a full featured network planning tool for the industry
- Contribute to National Renewable Energy Laboratory infrastructure simulation capabilities by improving on station sizing, footprint restrictions, market saturation, and inter-station demand shifting algorithms

## **FY 2015 PUBLICATIONS/PRESENTATIONS**

1. Thompson, I., “Retail Marketing Analysis: Hydrogen Refueling Stations,” 2015 DOE Hydrogen and Fuel Cells Program Annual Merit and Peer Evaluation Meeting, June 2015 (presentation).
2. Kalibrate Technologies plc, “Retail Marketing Analysis Hydrogen Refueling Stations,” NREL Subcontract No.: AFC-4-23056-01, December 2014 (report).