Hydrogen Station “Polygon Methodology”

OVERVIEW

Collaboration between the Advanced Power and Energy Program (APEP) at UC Irvine and automaker members of the California Fuel Cell Partnership (CaFCP) lead to the development of an optimized hydrogen station “Roadmap” for the state of California. The development relied heavily on the use of APEP’s Spatially and Temporally Resolved Energy and Environment Tool (STREET) and calls for 68 hydrogen stations located throughout the state to provide the service coverage required by initial fuel cell vehicle drivers. The location of these stations is shown in the figure below and outlined in two publications from the CAFCP.

68 Hydrogen stations in CA needed to meet coverage requirements for early fuel cell vehicle market

GOALS

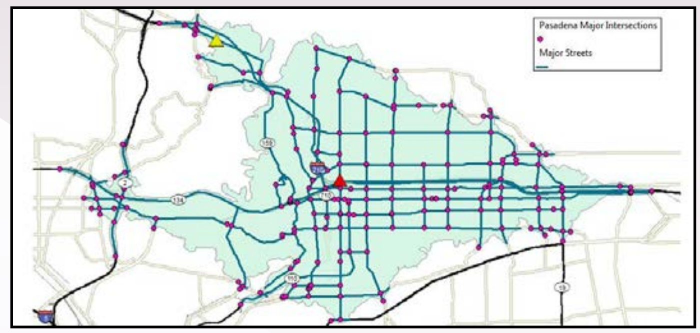
The California Roadmap specifies 68 mathematically optimized points as ideal locations for hydrogen refueling dispensers. However, there are numerous reasons which warrant more flexibility in those results. For example, actual site location must account for physical and market realities such as:

- Land availability and zoning
- Available land size
- Business relationships
- Permitting
- Nearby landowners and residents
- Station branding
- Consumer interest
- Ensuring fair access and competition for public funding
- Environmental justice

Now, the extent of that flexibility and ability to deviate from those 68 exact optimized points becomes the question at hand. Should we deviate too far from those locations, we then risk compromising the robustness of our network as well as its effectiveness in servicing the early FCV adopter market. It is this core problem where the “Polygon Model” was effectively able to step in. It provided appropriate flexibility while simultaneously being a transparent and reducible methodology.

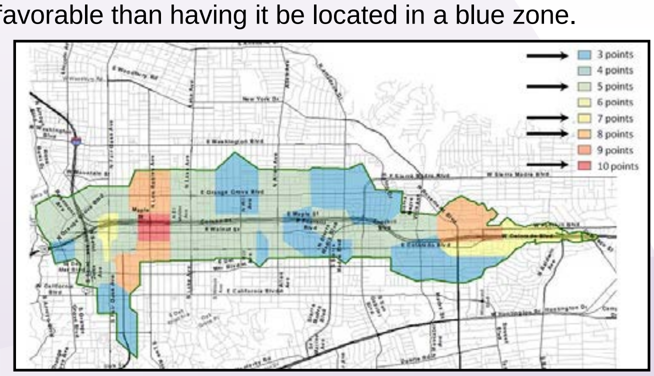
RESULTS

For each of the specified 68 station locations, nearby major intersections were identified. Each intersection was then awarded points based on proximity to freeways, highways, gasoline station density, and proximity to demand regions which themselves were identified using demographic data such as median household income, population density, and vehicles per household.



Major intersections in the Pasadena region (Note: colored triangles indicate original optimized points as shown in the roadmap)

After the intersections were scored, Voronoi polygons were formulated for each intersection and the top ranking polygons were selected. The end result was that we now had a robust and novel methodology for assessing candidate hydrogen dispensing sites for each of the 68 locations specified by the roadmap. As shown in the example below for Pasadena, situating a H_2 station located in an orange zone is more favorable than having it be located in a blue zone.



Polygon for the Pasadena region used by the California Energy Commission (CEC) in its 2012 solicitation

RECENT PUBLICATIONS/PAPERS

A California Roadmap: The Commercialization of Hydrogen Fuel Cell Vehicles (Technical Version). California Fuel Cell Partnership. June 2012.

Shane D. Stephens-Romero, Tim M. Brown, Jee E. Kang, Wilfred W. Recker, G. Scott Samuelsen, Systematic planning to optimize investments in hydrogen infrastructure deployment, International Journal of Hydrogen Energy, Volume 35, Issue 10, May 2010, Pages 4652-4667, ISSN 0360-3199,

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