IX.10 The Business Case for Hydrogen-powered Passenger Cars: Competition and Solving the Infrastructure Puzzle

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Overall Objectives

- Establish the competitive posture of hydrogen fueled private vehicles in the current market place.

Fiscal Year (FY) 2016 Objectives

- Establish the conditions under which a business case can be made for private unsubsidized investment in hydrogen fueling capability, at the time of the 101st station in California.

Technical Barriers

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

(A) Future Market Behavior: for example, (a) the number of hydrogen-powered cars sold in target markets and (b) the competition posed by battery-powered electric vehicles (BEVs)

(A) Future Market Behavior: for example, technological developments for high throughput cryo pumps at reasonable costs are uncertain, resulting in uncertainties in the business case for liquid hydrogen fueling stations

(C) Inconsistent Data, Assumptions and Guidelines: for example, large variations in existing literature, for both hydrogen filling station construction and operating costs

(E) Unplanned Studies and Analysis: Lack of existing market experience for hydrogen-powered passenger vehicles – and the as-yet unanswered question of market acceptability for hydrogen-fueled passenger vehicles.

Contribution to Achievement of DOE Systems Analysis Milestones

A key question for the success of hydrogen-fueled vehicles is whether a plausible business case can be made for building out the hydrogen filling station network, once the initial subsidies phase out. This kind of analysis will be needed in order to have venture capitalists consider investing in this market without counting on subsidies. This is a key economic milestone for the DOE Hydrogen and Fuel Cells Program.

FY 2016 Accomplishments

- Given the lack of extensive experience on the economics of hydrogen fueling stations, we examined the economics of E85 filling capability at existing gasoline stations. This was done in order to establish the conditions under which unsubsidized private investment would move forward in add a green fueling capability to an existing gasoline station.
- We confirmed that, by and large, the retail operation of the fuel vending side of a gasoline station is "junior partner" to the retail operation of the on-site convenience store, with the fuel filling operation largely serving to bring in the customer base for the high-margin convenience store.
- Applying this insight to possible addition of hydrogen fueling capability to an existing gasoline station, we established the tipping point in the construction cost of such an additional capability, which we estimate to be of order $2,100,000 (2009 dollars).

INTRODUCTION

We consider the economics governing the installation of a hydrogen fueling station at an already existing gasoline filling station. Our aim is to establish whether a private investment in such an operation that is *not* partnered with governmental subsidy would make business sense.

APPROACH

In order to establish the conditions that would lead to private, unsubsidized, investment, we did the following.

- We examined the financial issues surrounding investments in E85 fueling capability at existing filling stations. E85 is also viewed as a relatively green fuel, and therefore shares with hydrogen some of the patina of promoting an environmentally benign transport sector. Our assumption is thus that the economics governing the installation of E85 fueling capability is very likely to be similar to that governing the addition of hydrogen fueling capability.
- We used existing literature [2–4] in order to identify the least expensive technical route to a retail hydrogen fueling capability of 300 kg/d, which we viewed as appropriate for the 101st station. This station design uses gaseous hydrogen, delivered on site using tube trailers, and uses a cascade-based fueling design.
- We used the National Renewable Energy Laboratory (NREL) Hydrogen Financial Analysis Scenario Tool (H2FAST) to establish the tipping point at which private investment in the absence of subsidy no longer makes sense. The key point of our analysis is the recognition that, assuming that the fueling operation of a filling station is not the primary contributor to the operating margin of a station, the break-even point of a hydrogen fueling operation may only require a very modest return on investment.

RESULTS

Our preliminary analysis showed the following.

- Examination of the fueling station literature confirmed that the dominant contributor to the operating margin of a filling station is the associated convenience store; the filling operations, independent of the nature of the fuel being dispensed, tends to be a very low-margin business activity [1]. This implies that any kind of filling operation, including a hydrogen fueling station, that does not include a retail convenience store is very unlikely to be an attractive target for venture capitalist investments, especially in the absence of governmental subsidies.
- By conducting a bounding financial analysis of a hydrogen fueling capability, using NREL H2FAST modeling, we established:
  - Adding a hydrogen fueling capability to an existing gasoline station has a substantial advantage over creating a "green field" site. Advantages include sharply reduced frictions involved with site preparation and licensing, lowered tensions with potential site neighbors, reduced impacts of real estate costs (such as rents, taxes, and fees), and lowered staff costs. Thus, it does not make sense for the 101st hydrogen station to be built at a green field site.
  - Because the key determinant of the financial success of a fueling station is the retail operation of the on-site convenience store, the key financial contribution of a new fuel filling capability (e.g., E85 or hydrogen fueling) to an existing station is the additional traffic brought on site, traffic that would contribute to the convenience store operations. Thus, the retail margin of the "green fuel" operation is not only likely to be always small, but is likely to be small enough that it does not really contribute in a significant way to the business case of the station taken as a whole (meaning, fueling and convenience store operations considered together). Certainly, one would not want to be losing money on the sale of the fuel, but this does imply that the threshold for the return on investment required in order to make an investment plausible can be much lower than would be expected if one were to operate a fueling operation in the absence of an onsite convenience store.
  - Using H2FAST, we then determined the tipping point in construction costs at which the retail hydrogen fueling operation would no longer make sense in the absence of subsidies. The input data assumed the afore-mentioned station filling design and capacity, and took into account the cost reductions in both construction and operation that flow from using an existing filling station as the hydrogen fueling site. We currently estimate that tipping point in construction costs to be $2,100,000 (2009 dollars).

CONCLUSIONS AND FUTURE DIRECTIONS

The key missing elements of our study are:

- A detailed analysis of the progress made in selling hydrogen fuel cell vehicles in the California marketplace over the next two years.
- An analysis of the cost reductions in hydrogen fueling stations, again over the next two years.
- An analysis of the changes in retail conditions at California gasoline stations that feature a commercial hydrogen fueling island.

These elements are essential to validating the fundamentals of our study, namely the assertions that a hydrogen fueling operation only needs to break even in its economics in order to be attractive to private investment, as long as it successfully serves as part of a rebranding strategy for the filling station, serving to increase its customer base for its convenience store operation.

FY 2016 PUBLICATIONS/PRESENTATIONS

1. Presentation at the 2016 U.S. Department of Energy Hydrogen and Fuel Cells Program Annual Merit Review (sa052_rosner_2016_o.ppt).

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