Hydro-Honda Gets Help from Trains

By John Benson

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1. Introduction

I frequently write about transportation (or, as I prefer, mobility). However, it is rarely that I see one flavor of the mobility-industry interact with a completely different flavor. Like, for instance, light road-going electric vehicles interacting with rail-vehicles. This is one of those times.

The second back-story for this post in that I really like Honda Cars. This is mainly because I am the proud-owner of a 1993 Honda Civic with over 300,000 miles on it. Also, it still runs much like it did when it first rolled new off the dealer's lot (a Honda Dealer in Dublin, CA, near Livermore, CA where I live). Also considering its mileage, it has had very low maintenance cost (ditto fuel-costs).

In the past Honda has been enamored with hydrogen fuel-cell cars. Although they still are to a degree, they seem to be shifting some of their affection to other products in their corporate network.

Next back story: as I mentioned above, I live in Livermore, CA. A few years ago, the City of Livermore in Alameda County, the county to the east (San Joaquin) and other governmental agencies started a short commuter rail project (26 miles long) called Valley Link. In the short-term this rail link will connect the Altamont Corridor Express (ACE) to the large Bay Area Rapid Transit (BART) System.

ACE goes from San Joaquin County to San Jose, and thus is a major rail asset for both areas. The good news is that it also goes through the Livermore Valley. The bad news is that it doesn't get anywhere near the BART tracks or stations in Livermore Valley. Thus Valley Link will join two important regional transit systems, and also ease the gridlock between the Livermore and San Joaquin Valleys (through the Altamont Pass).

In the long run it will also link into the California High Speed Rail (HSR) via ACE's planned expansion to link to this major project. The first HSR Segment (Merced to Bakersfield, 171 miles) is planned to be completed by 2030.

A major part of Valley Link is a solar powered green-hydrogen production facility in Tracy (Just east of the Altamont Pass in San Joaquin County). This will fuel the Valley Link trains, local hydrogen-fueled busses, and other hydrogen fueling facilities, perhaps including those that fuel light vehicles. It may also fuel other trains (see last section).

California currently has only 63 operating light duty vehicle (LDV) hydrogen refueling stations, and 29 additional planned LDV hydrogen refueling stations.[1] None of these are in the Livermore or San Joaquin Valleys. Thus the above described green hydrogen production facility will enable many smaller hydrogen refueling stations in our area. Phase 1 of this facility is planned to be operational in 2025.

[1] California Energy Commission, "ZEV and Infrastructure Stats Data," Hydrogen Refueling Stations last updated on Jan 30, 2023, https://www.energy.ca.gov/files/zev-and-infrastructure-stats-data

As a payback for creating this interesting link between rail-vehicles and road vehicles, the last section of this post explores the decarbonization of rail-vehicles and how my former employer, Siemens, plans to help.

2. Hydrogen Refueling Stations in California

The California Energy Commission (CEC) Clean Transportation Program has invested nearly $166 million and plans to invest a total of $279 million in public hydrogen infrastructure primarily for light duty vehicles through fiscal year 2023-2024. These investments, combined with investment from the Volkswagen Mitigation Trust Fund and the private sector, are expected to support 200 hydrogen refueling stations in California. All of these stations scheduled to open by 2027.[2]

There were 12,169 light duty fuel cell electric vehicles (FCEVs) on the road as of September 2022, and the 62 open retail stations can serve as many as 51,000 FCEVs when operating at capacity – about four times the fueling needs of the current on-road fleet. However, customer experience is undermined by a variety of factors, including station downtime, hydrogen supply disruptions, and other factors.

Author's comment: The "…variety of factors," include sparse distribution, with no stations in the Livermore or San Joaquin Valleys. Hopefully this will be remedied in the next few years.

The CEC estimates the network of 200 stations will have the capacity to serve nearly 274,000 light-duty FCEVs. At least 13 of these stations will have the capability to serve medium- or heavy-duty vehicles. Planned station development should be sufficient to enable growing FCEV sales beyond auto manufacturers' projections in the near term. CEC and CARB staffs intend to continue evaluating the FCEV market as it evolves.

Author's comment: Although there are many other factors driving the adoption of FCEVs, one is certainly the convenience of having an open refueling station nearby and otherwise available.

One of the main barriers to drivers embracing battery electric vehicles (BEVs) are related to their relatively short range and time to recharge. Although these concerns will be mitigated in the next few years via more and faster recharging stations plus more advanced battery technologies with higher energy-capacities and faster charge-times, FCEVs will still be greatly superior verses these BEVs limitations.

The real question for each driver becomes, can you live with the BEV range issues (I could, but don't need a new car right now). If so, A BEV is probably the best choice for a very-low-CO_2 personal vehicle, especially if you can recharge at home a large majority of the time. I would guess less than 10% (perhaps much less) of light-vehicle-owners cannot live with the above range issues. Considering there are currently over 35 million

[2] Jane Berner, Miki Crowell, California Energy Commission (CEC) and Andrew Martinez, California Air Resources Board (CARB), "Joint Agency Staff Report on Assembly Bill 8: 2022, Annual Assessment of Time and Cost Needed to Attain 100 Hydrogen Refueling Stations in California," Dec 2022, https://www.energy.ca.gov/sites/default/files/2022-12/CEC-600-2022-064.pdf

light vehicles registered in California, the future market for FCEVs will still be substantial.[3]

3. Honda Fuel Cell Strategy

Although Honda is a major auto manufacturer, they also make many other (non-automotive) major products, whereas most other auto manufacturers don't. Thus they potentially have other products to apply their fuel cell expertise to.

Honda has been one of the leading proponents of automotive hydrogen fuel cells for more than two decades. It's one of only three automakers to offer such vehicles to consumers in any appreciable numbers along with Toyota and Hyundai. Despite the company's efforts to convince everyone that hydrogen is a better solution for zero emission vehicles than batteries, the world has not been convinced…[4]

Honda and GM have been collaborating since 2013 on development of next-generation (now current generation) fuel cell systems and have established a joint production facility in Brownstown Township, just south of Detroit. GM is marketing its fuel cell stacks under the Hydrotec brand, but Honda hasn't announced any special branding yet.

Honda isn't entirely giving up on the automotive market, despite having discontinued its most recent hydrogen powered model, the Clarity FCV in 2021. The new generation fuel cell system is claimed to be less than 1/3 of the cost of the system in the Clarity, have more than double the durability and be able to start much more quickly in temperatures as low as -30° C (-22°F).

Sometime in 2024, Honda will begin production of a new variant of the CR-V at the Ohio factory that recently ended production of the Acura NSX. Along with the new generation fuel cell, the CR-V will actually be a plug-in hybrid model. All FCVs utilize a small hybrid style battery (typically around 1.5 kWh) for regenerative braking to help improve efficiency and range.

However, the new CR-V will have a larger battery to provide an as yet undisclosed range that will probably be somewhere around 30 miles provided by plugging in. The fuel cell will act as a range extender for longer trips although the battery can also provide power for acceleration, allowing the fuel cell to operate in a more efficient steady state mode. Unless there is a sudden spree of building hydrogen fuel stations across the US, the CR-V will still be limited to sales in California like the Toyota Mirai and Hyundai Nexo.

Starting from mid-decade, Honda is also hoping to sell these fuel cells into three new markets, commercial vehicles, construction machinery, and stationary power stations. The commercial vehicle market is one that is already starting to develop with trucks in service from Hyundai and Daimler and products in development from Volvo, Nikola and Paccar in partnership with Toyota…

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[3] U.S. DOE, Alternative Fuels Data Center, "Vehicle Registration Counts by State," 2021, https://afdc.energy.gov/vehicle-registration . Note that there were 563,100 BEVs and 11,800 FCEVs registered in California in 2021.

[4] Sam Abuelsamid, Forbes, "Honda Recommits To Fuel Cells As It Looks For New Markets," Feb 8, 2023, https://www.forbes.com/sites/samabuelsamid/2023/02/08/honda-recommits-to-fuel-cells-as-it-looks-for-new-markets/?utm_source=newsletter&utm_medium=email&utm_campaign=currentclimate&cdlcid=628673ca6e1a1d1211f1d747&sh=5dd619a02c7f

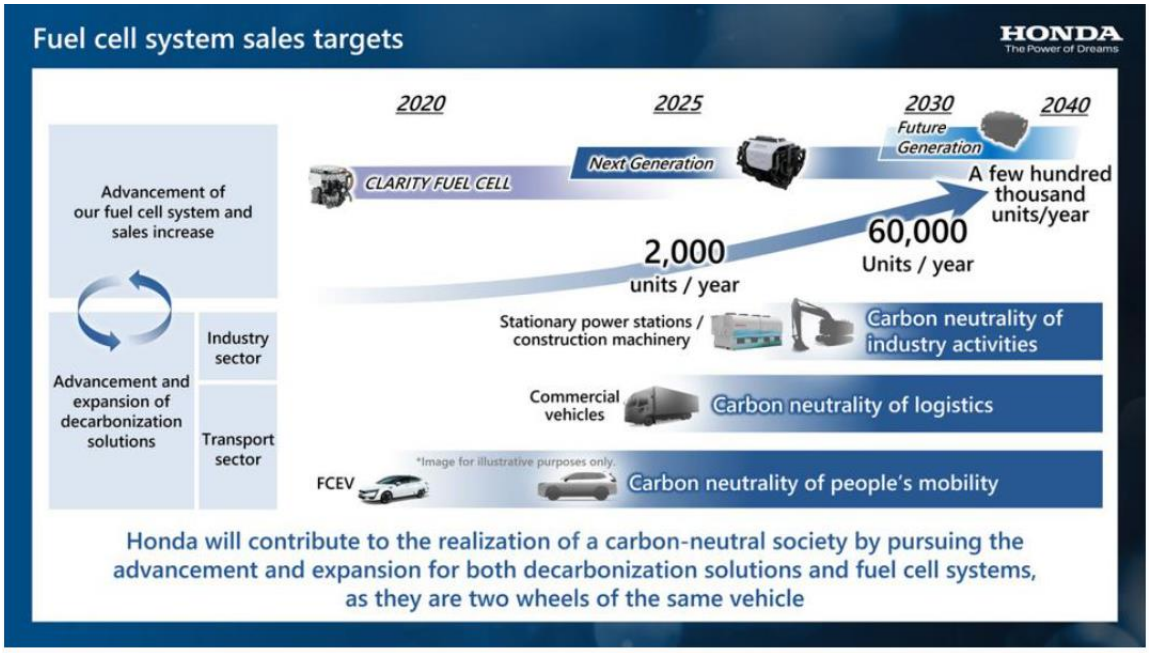
Construction machinery is another interesting market where fuel cells would enable the equipment to run all day with no emissions, something that's not currently possible with a battery powered vehicle.

Author's comment: Also consider that Honda in a leading manufacturer of stationary generators and portable generators.[5] The GM Hydrotec Fuel Cell will also address this market (see next section).

Finally, stationary power stations are being developed as an alternative to fossil-fuel-powered systems that typically run on either diesel or natural gas. A demonstration system has already installed a 500 kW system to provide backup power for the data center at Honda's US headquarters in Torrance, California. Since energy density is not so much of an issue for a stationary system, and battery storage systems are already being widely deployed, Ryan Harty, head of Honda Energy Systems addressed the question of whether fuel cells offer any cost advantage.

"Large scale battery systems are fabulous for relatively short duration energy storage for backup power applications. Once you start getting into the need for backup power in the eight hours and greater timeframe, there's a crossover point where fuel cells and hydrogen storage make tremendous sense," said Harty. The increasing cost of storage and duration is related to the hydrogen storage and not the mass of battery materials that you have to assemble. And so that's really the key driver, is the longer duration backup power needs for data centers and critical infrastructure."

See the image below for a high-level picture of Honda's strategy.



Honda is targeting modest initial sales that grow significantly through 2040 for its fuel cell

[5] See https://www.hondagenerators.net/

4. GM Hydrotec Fuel Cell

General Motors (GM) announced plans to manufacture mobile power generators using its Hydrotec-branded hydrogen fuel cells.[6]

The aim is to replace polluting gas- and diesel-powered generators with zero-emission hydrogen-powered ones. Hydrogen is the most abundant element in the universe, so its appeal to an industry that's trying to pivot away from dirty internal combustion engines is obvious…

Hydrogen fuel cells — which use compressed hydrogen as their fuel and release only water vapor — have been in development for decades. GM has condensed its Hydrotec system into a "power cube" encompassing 300 individual hydrogen fuel cells. The cubes can then be deployed in a variety of applications, including mobile generators and temporary EV chargers. The company is working Renewable Innovations, a Utah-based company that will manufacture the generators.

The hydrogen-powered generators will only be sold to commercial and military customers to start out, but the automaker said it plans on offering versions for residential use in the future. GM said the ideal application would be at an outdoor concert venue, thanks to the hydrogen generator's much lower noise profile as compared to gas-powered power sources. Another use case would involve temporary electric vehicle chargers installed at locations where demand for charging hasn't yet resulted in a permanent charging station.

"Hydrotec power generators can quickly be deployed for disaster relief," said Charlie Freese, executive director of GM's Hydrotec division, in a call with reporters, "or it can provide backup for the electrical grid in areas that are experiencing rolling blackouts."

GM's Mobile Power Generator can fast-charge EVs without having to expand the grid or install permanent charge points in places where there is only a temporary need for power GM

[6] Andrew J. Hawkins, The Verge, "GM announces plans to make mobile power generators using hydrogen fuel cells," Jan 10, 2022, https://www.theverge.com/2022/1/19/22891368/gm-hydrotec-hydrogen-fuel-cell-mobile-power-generators

GM is planning on offering these generators in multiple sizes for a variety of uses. Each unit will put out power ranging from 60kW to 600kW, depending on size and use case. They also will use a different number of Hydrotec power cubes. The company's Mobile Power Generator, for example, relies on one power cube, while the Empower rapid chargers will use eight cubes.

5. Moving Hydrogen

When researching this paper I found a really good resource at Valley Link: their feasibility study for hydrogen production, referenced here.[7] This included a short snippet of text and two pictures showing how hydrogen can be transported from the production facility to a small user. I was curious about this, and I thought readers would be also. Thus I put these below.

For off-site hydrogen sales to local bus transit operators, gaseous hydrogen will be transported using mobile hydrogen storage units mounted on top of a tractor trailer and delivered by a contracted trucking operator. Figures below shows two commercially mobile storage systems, the HTEC PowerCube unit and the Hexagon Purus X-Store unit, which are both capable of transporting hydrogen at 450 bar (6,527 PSI).

[7] Prepared For: Tri-Valley San Joaquin Valley Regional Rail Authority
"Valley Link Hydrogen Production and Energy Farm Feasibility Study," September 2022, https://www.valleylinkrail.com/_files/ugd/95df9a_094b25dbfbc7407f9eb1bf8e30171a82.pdf Although there was no author of this study listed, there was a logo on the cover for "Zen and the Art of Clean Energy Solutions Inc." This was apparently acquired by HTEC in 2022.

6. Hydrail

The title of this section is both the title of an earlier post from a bit over a year ago (described and linked below), and a reasonable title of a report on my former employer (Siemens) that is pushing hard to expand their rail business in the U.S.

Hydrail: *The one word title of this post is an abbreviation for Hydrogen Rail, and I found much information about this subject for this post.*

https://energycentral.com/c/ec/hydrail

As we saw from earlier parts of this post, there now appears to be a linkage between hydrogen-fueled rail projects and the hydrogen refueling infrastructure for road vehicles.

Let's take a step back and discuss the decarbonization of our rail infrastructure. There are two ways to do this: (1) fueling trains with green hydrogen (hydrogen produced by electrolysis using renewable and other very low carbon electricity); (2) use very-low carbon electricity directly (through the grid) to power the trains, as used by BART, and as will be used by California's High Speed Rail,

Right now a large majority of passenger rail systems and all of our cargo rail systems are powered by diesel locomotives, and these will need to be converted to very low carbon operation by either method (1, most likely) or (2) above. In either case, the rail infrastructure companies have much work to do. In the U.S. this will be by 2050, to meet current federal decarbonization goals. In California, the goal is by 2035 (see section 2 of the earlier Hydrail post linked above).

Siemens Mobility is one of the largest rail infrastructure companies in the World and is already heavily invested in the U.S. with a major mobility factory in Sacramento, CA.

Siemens Mobility has had a manufacturing presence in Sacramento since the mid-1980s, with a national supply chain that has ensured full compliance with Buy-America requirements.[8]

Our 583,000 square-foot facility is our North American rail manufacturing hub and headquarters for rolling stock. The facility is almost entirely solar powered and boasts full manufacturing capabilities, including design, engineering, testing, car-shell, bogies, subassembly, and final assembly. The plant has manufactured more than 2,700 vehicles for 30 transit agencies in the U.S. and Canada.

Now they are expanding to the East Coast.

Siemens AG announced on Tuesday it is investing over $220 million to build a rail car manufacturing facility in North Carolina.[9]

[8] Siemens, Northern California. https://www.siemens.com/us/en/company/siemens-in-the-usa/northern-california.html

[9] Nandita Bose and Lisa Baertlein, Reuters, "Siemens will invest $220 mln in North Carolina rail car factory, March 7, 2023, https://www.reuters.com/business/autos-transportation/siemens-invest-220-million-north-carolina-rail-car-factory-2023-03-07/

The excerpt below and image is from the earlier Hydrail post.

Recently two industrial heavyweights: Ballard Power Systems, a major producer of fuel cells, and one of my former employers, Siemens, came together to manufacture the first production hydrail commuter rail train (below), the Mireo Plus H.[10]

[10] https://www.mobility.siemens.com/global/en/portfolio/rail/rolling-stock/commuter-and-regional-trains/mireo/mireo-plus-h.html