NEGATIVE: Hydrogen Fuel Cells in Mass Transit

By “Coach Vance” Trefethen

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Negative: Hydrogen Fuel Cells in Mass Transit

NEGATIVE PHILOSOPHY

Hydrogen fuel cells are based on misdirection and lobbying by special interest – not any actual public benefit

Julian Cox 2014 (electric vehicle expert at CleanTechnia ) 4 June 2014 " Time To Come Clean About Hydrogen Fuel Cell Vehicles" <https://cleantechnica.com/2014/06/04/hydrogen-fuel-cell-vehicles-about-not-clean/>

Nevertheless Hydrogen Fuel Cell Vehicles are without equal when it comes to misdirection and as a tool for extracting public funds from officials only too ready to be blind-sided by pseudo-science and the lobbying of vested interests in a nation struggling to triage the cost of foreign oil and consumer environmental concerns while newly awash with abundant cheap Natural Gas from hydraulic fracturing of shales. It is just that the false promise of hydrogen is such a dangerous deception in environmental terms that it cannot be allowed to go undetected at the eleventh hour for the environment and on the eve of genuine progress with simultaneous break throughs in [solar energy costs](http://static2.businessinsider.com/image/5346a722ecad044e6855604c-800-531/screen%20shot%202014-04-10%20at%209.56.09%20am.png) and Electric Vehicles capable of addressing the mid market.

SOLVENCY

1. Seven barriers to widespread use of hydrogen fuel cell vehicles

All 7 barriers must be overcome, with evidence, in the AFF plan

Dr. Joseph Romm 2015 (PhD in physics from M.I.T.; a senior fellow at American Progress; former acting assistant secretary at the U.S. Department of Energy’s Office of Energy Efficiency and Renewable Energy) 5 Apr 2015 Tesla Trumps Toyota: The Seven Reasons Hydrogen Fuel Cell Cars Are Stalled <https://thinkprogress.org/tesla-trumps-toyota-the-seven-reasons-hydrogen-fuel-cell-cars-are-stalled-56d71312e6bf/> (brackets added)

A 2013 study by independent research and advisory firm Lux Research [concluded](http://www.luxresearchinc.com/news-and-events/press-releases/read/hobbled-high-cost-hydrogen-fuel-cells-will-be-modest-3-billion) even more pessimistically that despite billions in research and development spent in the past decade, “The dream of a hydrogen economy envisioned for decades by politicians, economists, and environmentalists is no nearer, with hydrogen fuel cells turning a modest $3 billion market of about 5.9 GW in 2030.” The lead author explains, “High capital costs and the low costs of incumbents provide a nearly insurmountable barrier to adoption, except in niche applications.” To understand why this is true, you need to understand why, until very recently, alternative fuel vehicles (AFVs) of all kinds haven’t had much success. A significant literature emerged to explain that lack of success by AFVs — as I discussed in my book and a 2005 journal article, “[The car and fuel of the future](http://thinkprogress.org/climate/2009/06/11/204226/hydrogen-fuel-cell-cars-dead-end-steven-chu-plug-in-hybrid-electric-vehicles/)” There have historically been seven major (interrelated) barriers to AFV success in the U.S. market:  
**1. High first cost for vehicle**: Can the AFV be built at an affordable price for consumers? Can that affordable AFV be built profitably?   
**2. On-board fuel storage issues (i.e. limited range)**: Can enough alternative fuel be stored onboard to give the car the kind of range consumers expect — without compromising passenger or cargo space? Can the AFV be refueled fast enough to satisfy consumer expectations?   
**3. Safety and liability concerns**: Is the alternative fuel safe, something typical users can easily handle with special training?   
4. High fueling cost (compared to gasoline): Is the alternative fuel’s cost (per mile) similar to (or cheaper than) gasoline? If not, how much more expensive is it to use?   
5. Limited fuel stations (the chicken and egg problem): On the one hand, who will build and buy the AFVs in large quantity if a broad fueling infrastructure is not in place to service them? On the other, who will build that fueling infrastructure — taking the risk of a massive stranded investment — before a large quantity of AFVs are built and bought, that is, before these particular AFVs have been proven to be winners in the marketplace?   
6. Improvements in the competition: If the AFV still needs years of improvement to be a viable car, are the competitors — including fuel-efficient gasoline cars — likely to improve as much or more during this time? In short, is it likely competitors will still be superior vehicles in 2020 or 2030?   
7. Problems delivering cost-effective emissions reductions: Is the low-emission or emission-free version of the alternative fuel affordable? Are fueling stations for that version of the fuel affordable and practical?  
Every AFV [alternative fueled vehicle] introduced in the past three decades has suffered from at least three of those problems. Besides the tough competition (like the Prius), EVs have suffered most from #1 (high first cost) and #2 (limited range and slow speed of recharging). But major progress is being made in both areas. FCVs [fuel cell vehicles] suffer from all of them — and still do!

All barriers remain, but for sure Fuel Cell Vehicles (FCVs) haven't solved barriers #2 or #7

Dr. Joseph Romm 2015 (PhD in physics from M.I.T.; a senior fellow at American Progress; former acting assistant secretary at the U.S. Department of Energy’s Office of Energy Efficiency and Renewable Energy) 5 Apr 2015 Tesla Trumps Toyota: The Seven Reasons Hydrogen Fuel Cell Cars Are Stalled <https://thinkprogress.org/tesla-trumps-toyota-the-seven-reasons-hydrogen-fuel-cell-cars-are-stalled-56d71312e6bf/>

As an aside, if you think FCVs have solved #2, the onboard storage issue, they have not — even though this is considered their big advantage over electric vehicles. In fact, they are probably a breakthrough away from doing so, as Ford Motor Company has acknowledged. Infrastructure (#5) remains the most intractable barrier for FCVs. It is far less of a problem for EVs (as I noted [here](http://thinkprogress.org/climate/2014/08/25/3470965/toyota-tesla-electric-vehicles-hydrogen-cars/)). For governments and climate hawks, problem #7 may be the most important. As of today, it remains entirely possible that hydrogen fuel cell cars will never solve the problem of delivering cost-effective emissions reductions in the transportation sector — a problem EVs do not have.

2. Tried & Failed already in Mass Transit

Pilot project in British Columbia, Canada, used Hydrogen Fuel Cell buses… and had lots of problems. Had to double the maintenance staff to deal with frequent breakdowns, expensive and lengthy repairs

US National Renewable Energy Laboratory 2014 (written by L. Eudy and M. Post, employees of the US Dept of Energy) Sept 2014, BC Transit Fuel Cell Bus Project Evaluation Results: Second Report <https://www.nrel.gov/docs/fy14osti/62317.pdf>

One technician remarked that the system did not appear to be designed with maintenance in mind. Some issues were difficult and time consuming to repair because major dismantling or removal of other components was required to reach the affected part. The technician suggested that maintenance requirements should be considered carefully when new designs are being developed. Management Perspective Whistler Transit management reports that the FCEB [Fuel Cell Electric Bus] project was a great learning experience and that the technology was embraced by staff even though it was new. The technical difficulties, especially during the early part of the demonstration, made the program a challenge to operate. During the first year, Ballard, New Flyer, and ISE had support staff on site in Whistler to help with troubleshooting and maintenance. They also provided training to Whistler Transit staff. By the end of 2011, the transit maintenance technicians were comfortable working on the buses and needed less on-site support. Management felt this transition went well considering the new technology was more technically advanced compared to the diesel buses the staff was used to maintaining. Maintaining the FCEBs took more technicians than was needed for an all-diesel fleet—12 mechanics for the FCEBs compared to 6 for diesel buses. Operational issues with the buses meant the schedulers and other support staff needed to be flexible to ensure that the fleet could meet daily service requirements. Weather conditions caused issues such as cold start failures in winter and air conditioning failures in the summer. Transit staff adjusted procedures to address these problems. For example, Whistler Transit addressed the cold start issue by starting the buses earlier in the day and reallocating which buses were used for the early routes to give time to get the other buses started. Some repairs resulted in lengthy downtimes, requiring Whistler Transit to shift buses to other routes or bring in backup buses. Many times these situations were supply-chain issues where less common parts had long lead times and were costly to replace.

FAILED: British Columbia gave up and removed the buses from service. They might convert them to diesel!

US National Renewable Energy Laboratory 2014 (written by L. Eudy and M. Post, employees of the US Dept of Energy) Sept 2014, BC Transit Fuel Cell Bus Project Evaluation Results: Second Report <https://www.nrel.gov/docs/fy14osti/62317.pdf>

As of March 31, 2014 (the recognized end of the project), BC Transit has removed all 20 buses from service. The buses are currently parked at the Whistler Transit facility. BC Transit is addressing options for selling the buses or for converting them to a diesel propulsion system.

British Columbia town tried fuel cell buses and gave up: they were too expensive. They're switching back to diesel

Scientific American 2013. (journalist Julia Pyper ) 16 Dec 2013 Hydrogen Buses Struggle with Expense <https://www.scientificamerican.com/article/hydrogen-buses-struggle-with-expense/>

The ski resort town of Whistler, British Columbia, is ending its hydrogen fuel-cell bus program, the world's largest demonstration of its kind, and switching back to diesel. The 20-bus project was launched ahead of the 2010 Winter Olympics to showcase the technology before an international audience in a location with challenging terrain and climatic conditions. This month, the British Columbia Ministry of Transportation and Infrastructure confirmed it will not be continuing with the demonstration project after it concludes in March 2014. The ministry refused an offer from the Canadian fuel-cell module provider Ballard Power Systems to run the buses for an additional five years, on account of the cost.

3. Efficient technology just isn't ready yet

Lots of high-powered engineers tried to make hydrogen fuel cells competitive with gasoline engine, but can't do it yet

Dr. Jack Winnick 2017 (*M.S. and PhD. in Chemical Engineering from the University of Oklahoma. He has worked as an expert consultant at the NASA Johnson Space Center, and as a professor of chemical engineering at several universities.* ) THE HILL Fuel cell cars aren't as efficient as they seem, 14 March 2017 <http://thehill.com/blogs/pundits-blog/energy-environment/323889-fuel-cell-cars-arent-as-efficient-as-they-seem>

Well, a lot of very smart, dedicated engineers and scientists worked very hard (and spent a lot of money) trying to get the scheme to work. Several large companies, along with the government labs, competed to find a successful process. And they came pretty close. In the end it was the fussy nature of the hydrogen fuel cell that killed it. The expensive, precious-metal fuel cell catalyst wouldn't tolerate even the tiny amounts of contaminants in the hydrogen produced in the reforming reactor. The system grew too big and too expensive to ever compete with the gasoline-driven internal combustion engine. Another example of how nature can tantalize us, but ultimately bring us to our knees.

DISADVANTAGES

1. Masking Disad: Fuel Cell Vehicles (FCVs) are worse than all other choices

Whatever problem AFF is trying to solve, going with FCVs will set us back further from solving it, because FCVs are the worst possible choice

Dr. Joseph Romm 2015 (PhD in physics from M.I.T.; a senior fellow at American Progress; former acting assistant secretary at the U.S. Department of Energy’s Office of Energy Efficiency and Renewable Energy) 5 Apr 2015 Tesla Trumps Toyota: The Seven Reasons Hydrogen Fuel Cell Cars Are Stalled <https://thinkprogress.org/tesla-trumps-toyota-the-seven-reasons-hydrogen-fuel-cell-cars-are-stalled-56d71312e6bf/>

It is very safe to say that FCVs are the most difficult and expensive kind of alternative fuel vehicle imaginable. While R&D; into FCVs remains worthwhile, massive investment for near-term deployment makes no sense until multiple R&D; breakthroughs have occurred. They are literally the last alternative fuel vehicle you would make such investments in — and only after all the others failed.

AFF plan wastes money and moves us away from the real solution: Electric Vehicles (EVs)

Dr. Joseph Romm 2015 (PhD in physics from M.I.T.; a senior fellow at American Progress; former acting assistant secretary at the U.S. Department of Energy’s Office of Energy Efficiency and Renewable Energy) 5 Apr 2015 Tesla Trumps Toyota: The Seven Reasons Hydrogen Fuel Cell Cars Are Stalled <https://thinkprogress.org/tesla-trumps-toyota-the-seven-reasons-hydrogen-fuel-cell-cars-are-stalled-56d71312e6bf/>

But the United States, Japan, and other countries — and many automakers — continue to misallocate funds toward near-term deployment of deeply flawed hydrogen fuel cell vehicles. Because of that, and because after 25 years of dawdling on climate action we lack the time to keep making such multi-billion dollar mistakes, I will discuss the 7 barriers FCVs still face today in more detail in subsequent posts. I will also discuss how EVs have been tearing down the few remaining barriers to their marketplace success.

Massive waste of resources: EV's are much more efficient at energy usage than hydrogen fuel cells

Joe Romm 2015 (PhD in physics from M.I.T.; a senior fellow at American Progress; former acting assistant secretary at the U.S. Department of Energy’s Office of Energy Efficiency and Renewable Energy) 12 Feb 2015 Elon Musk Is Right: Hydrogen Is ‘An Incredibly Dumb’ Car Fuel  
<https://thinkprogress.org/elon-musk-is-right-hydrogen-is-an-incredibly-dumb-car-fuel-d0f37a4c9bee/>

In a 2006 [Scientific American article](http://www.calcars.org/sci-am-romm-frank-apr06.pdf) I wrote with advanced-hybrid guru Andy Frank, we explain that “The entire process of electrolysis, transportation, pumping and fuel-cell conversion would leave only about 20 to 25 percent of the original zero-carbon electricity to drive the motor.” But in an EV or plug-in hybrid, “the process of electricity transmission, charging an onboard battery and discharging the battery would leave 75 to 80 percent of the original electricity to drive the motor.” So the hydrogen car is more like one third as efficient as the EV.

2. Backsliding on climate change

Link: Hydrogen fuel cell vehicles (FCVs) reverse progress in the fight against climate change pollution

Joe Romm 2015 (PhD in physics from M.I.T.; a senior fellow at American Progress; former acting assistant secretary at the U.S. Department of Energy’s Office of Energy Efficiency and Renewable Energy) 12 Feb 2015 Elon Musk Is Right: Hydrogen Is ‘An Incredibly Dumb’ Car Fuel  
<https://thinkprogress.org/elon-musk-is-right-hydrogen-is-an-incredibly-dumb-car-fuel-d0f37a4c9bee/>

The situation is actually worse for FCVs, or what the figure calls Fuel Cell Electric Vehicles (FCEVs). The two best cases for FCEVs in the chart — a hydrogen pipeline system from central station renewable generation and onsite renewable generation and electrolysis — are wildly implausible for many decades to come, if ever. In any case, we have this huge global warming problem going on right now. We aren’t going to go to all the trouble of creating a premium solution — zero-carbon electricity — only to throw away most of it as part of some elaborate hydrogen FCV scheme, a scheme that also requires the creation of an elaborate and expensive new system of green hydrogen production and/or delivery infrastructure. That’s particularly true when we can just run EVs on the premium carbon-free power directly (or, for that matter, simply continue to slash vehicle CO2 emissions through the straightforward continuation of fuel economy improvements). So yes, hydrogen Is “an incredibly dumb” car fuel, especially if you are concerned about global warming.

Impact: Human health

US Environmental Protection Agency 2017. " Understanding the Connections Between Climate Change and Human Health" <https://19january2017snapshot.epa.gov/climate-indicators/understanding-connections-between-climate-change-and-human-health_.html>

Climate change poses many threats to the health and well-being of Americans, from increasing the risk of extreme heat events and heavy storms to increasing the risk of asthma attacks and changing the spread of certain diseases carried by ticks and mosquitoes. Some of these health impacts are already happening in the United States.

3. Doubled operating cost

Link: British Columbia, Canada, test project found: Hydrogen fuel cell buses cost double compared to diesel. $1.34 per kilometer for fuel cell compared to $0.65 for diesel

Canadian Broadcasting Corporation 2014. " BC Transit's $90M hydrogen bus fleet to be sold off, converted to diesel" 4 Dec 2014 <http://www.cbc.ca/news/canada/british-columbia/bc-transit-s-90m-hydrogen-bus-fleet-to-be-sold-off-converted-to-diesel-1.2861060>

According to Burnaby's Ballard Power Systems, which manufactures fuel cell engines, Whistler's hydrogen buses cost $1.34 per kilometre to maintain, versus 65 cents per kilometre for diesel-powered buses. The federal government contributed $45 million and the B.C. government provided $44.5 million for the manufacture of the buses and to cover some of the capital and operating expenses.

Link & Brink: Cutting something else to pay the doubled operating cost would be devastating for local transit systems

Yonah Freemark 2013 (Master of Science in Transportation, Department of Civil and Environmental Engineering; Master of City Planning, Department of Urban Studies and Planning at MIT.) 25 Jan 2013 “The Federal Role in Surface Transportation Funding” <http://www.thetransportpolitic.com/2013/01/25/the-federal-role-in-surface-transportation-funding/>

The problem with this whole line of discussion is that it would likely be devastating for transit systems in major cities, particularly in conservative states with no history of state support for public transportation. One major advantage of the current federal finance system is that it devotes a fifth of all transportation funding to transit. The consequence is that cities are awarded funds for maintaining their bus and rail systems by formula at about $8 billion a year (and that’s not even including the $2 billion annually devoted to new transit construction). That funding plays an essential part in ensuring cities can keep their systems up to date.

Link: Poorer cities can’t afford to fund their transit systems

Yonah Freemark 2013 (Master of Science in Transportation, Department of Civil and Environmental Engineering; Master of City Planning, Department of Urban Studies and Planning at MIT.) 25 Jan 2013 “The Federal Role in Surface Transportation Funding” <http://www.thetransportpolitic.com/2013/01/25/the-federal-role-in-surface-transportation-funding/>

There is some argument to be made that cities that [want to invest in public transportation should simply pay for it themselves](http://www.thetransportpolitic.com/2012/02/16/clearing-it-up-on-federal-transportation-expenditures/), yet that approach has a number of serious flaws. First, it would be a serious impediment for poorer cities to continue the funding of their transit systems, since they lack adequate local funds; there is a [very strong correlation between metropolitan-area income and the amount of money cities spend on transit operations, producing highly inequitable results](http://www.thetransportpolitic.com/2011/12/28/local-funding-for-public-transportation-operations-producing-inequitable-results/). Second, cities in low-tax states may find their ability to actually raise taxes locally stymied by state legislatures that believe that any tax increase should be prevented.

Impact: Poor harmed. Public transit is essential to daily needs for large numbers of poor who don’t have cars

Kevin DeGood and Andrew Schwartz 2016 (DeGood - Director of Infrastructure Policy at the Center for American Progress. Schwartz - Research Associate on the Economic Policy team at the Center) “Can New Transportation Technologies Improve Equity and Access to Opportunity?” 27 Apr 2016 <https://www.americanprogress.org/issues/economy/reports/2016/04/27/135425/can-new-transportation-technologies-improve-equity-and-access-to-opportunity/>

Public transportation is an essential part of our surface transportation system. For many families, especially those without access to a car, public transportation is that critical link to employment, education, and child care facilities, among other services. In 2014, the last year for which complete data are available, more than 2,100 public transit operators provided 10.5 billion unlinked trips, carrying passengers more than 57 billion miles. Nationwide, 20 percent of households at or below the federal poverty line lack access to a car. The percentages of low-income African American and Latino households without a car are even higher at 33 percent and 25 percent, respectively. For these families, public transportation provides the only way to meet daily needs.

Impact: Harms the disadvantaged. Some can only hold jobs if they can access subsidized public transit

Prof. David Levinson and Prof. David King 2013 (Levinson -  [School of Civil Engineering](http://sydney.edu.au/engineering/civil/) at the University of Sydney, Australia. King – Assistant Professor of Urban Planning, Columbia Univ.) The case for (and against) public subsidy for public transport) 22 Apr 2013 <https://streets.mn/2013/04/22/the-case-for-and-against-public-subsidy-for-public-transport/>

Transit helps the transportation disadvantaged. Equity or welfare has often been an argument in favor of subsidy, that we do it to provide benefits for people unable to afford otherwise, or transportation for the disadvantaged. This gets more into values than economics, but there are some people who would be employed but for their ability to access jobs, so some subsidy on the transportation front is at least partially repaid by more economic productivity.

Impact: Trapped in poverty. Transit is the ticket out of poverty for many urban poor

Kevin DeGood and Andrew Schwartz 2016 (DeGood - Director of Infrastructure Policy at the Center for American Progress. Schwartz - Research Associate on the Economic Policy team at the Center) “Can New Transportation Technologies Improve Equity and Access to Opportunity?” 27 Apr 2016 <https://www.americanprogress.org/issues/economy/reports/2016/04/27/135425/can-new-transportation-technologies-improve-equity-and-access-to-opportunity/> (brackets in original)

Decades of research show that access to affordable transportation—either an automobile or public transportation—is an essential part of moving out of poverty. A recent major study by Raj Chetty, a professor of economics at Stanford University, and his colleagues found that geographic isolation—as measured by lengthy commute times— was a significant factor in people’s ability to leave poverty. The authors concluded that “upward mobility is higher in cities with less sprawl, as measured by commute times to work. These findings lead us to identify segregation as the first of five broad factors that are strongly correlated with [economic] mobility.” Other research demonstrates that the presence of public transit improves access to employment at all levels and that transit reduces the geographic mismatch between households and employment.

4. Increased pollution.

Link: The hydrogen cell itself is clean, but you have to produce the hydrogen somehow. Producing the hydrogen involves fossil fuels (i.e., pollution)

Dr. Jack Winnick 2017 (*M.S. and PhD. in Chemical Engineering from the University of Oklahoma. He has worked as an expert consultant at the NASA Johnson Space Center, and as a professor of chemical engineering at several universities.* ) THE HILL Fuel cell cars aren't as efficient as they seem, 14 March 2017 <http://thehill.com/blogs/pundits-blog/energy-environment/323889-fuel-cell-cars-arent-as-efficient-as-they-seem>

The fuel-cell cars don't use the electricity produced by central power plants, fossil-fuel or not. The only require hydrogen, a clean-burning fuel that yields only water when combusted in oxygen. No carbon dioxide, no global warming.  Unfortunately, you can't harvest pure hydrogen by drilling a hole in the ground. It has to be produced from some other source; that source is almost always a fossil fuel.

Impact: Worse pollution. Government dollars spent on hydrogen fuel cells move us away from Electric Vehicles, that are actually clean

Julian Cox 2014 (electric vehicle expert at CleanTechnia ) 4 June 2014 " Time To Come Clean About Hydrogen Fuel Cell Vehicles" <https://cleantechnica.com/2014/06/04/hydrogen-fuel-cell-vehicles-about-not-clean/>

Hydrogen from Natural Gas is currently posing a considerable threat in terms of diverting State and Federal budgets ostensibly intended for environmental improvement to fossil fuel based hydrogen infrastructure where at best very large amounts of public funds are at risk of going to waste assuming consumers do reject low-performance FCVs. At worst public funds will embolden the Natural Gas industry and Auto Industry to press for far-reaching delays in EV developments and even lobby for effectively the society-wide derailment of progress towards renewable energy in transportation. 90% of the Californian Energy Commission hydrogen infrastructure budget has been earmarked for non-sequestered fossil fuel production of Hydrogen in return for [lip service of future environmental benefits](http://www.energy.ca.gov/contracts/notices/draft_solicitation_concepts_12-hyd-01/comments/2013-10-16_FirstElement_Fuel_Incs_Comments_to_the_Draft_Hydrogen_Solicitation_TN-72102.pdf) that can never be forthcoming. Meanwhile marketers of FCVs actively and openly target Electric Vehicles (not gasoline or diesel vehicles) with claims of convenient access to lowered green house gas emissions similar to a pure Electric Vehicle. Claims that are simply not true.

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