11 August 2010

Fuel cell electric and battery electric vehicles: hitting the roads to zero emission transport

Countries around the world are facing the challenges of harmful carbon emissions, dependency on imported oil and urban air pollution that in part are caused by motor vehicles. As energy demands increase, industry, government and the public need to take into consideration these challenges when making decisions regarding a sustainable transportation sector. Electric mobility consisting of fuel cell electric vehicles (FCEVs,) plug-in hybrids and battery-electric vehicles have the capacity to address these challenges.

PATH, an international coalition of hydrogen and fuel cell associations consisting of 29 countries and representing 79% of the world's GDP supports the important movement in vehicles towards electric mobility.

Dr. Sandy Thomas, a consultant and member of the U.S. National Hydrogen Association's Board of Directors, found that in order to meet societal goals of environmental sustainability and energy independence, conversion of most vehicles to all-electric operation over the next few decades will be needed[1]. These all electric vehicles could be powered by advanced batteries and/or by a hydrogen-powered fuel cell. In order to obtain a sustainable system of transportation that meets new expectations, a multitude of new available innovations should be utilized to their strengths.

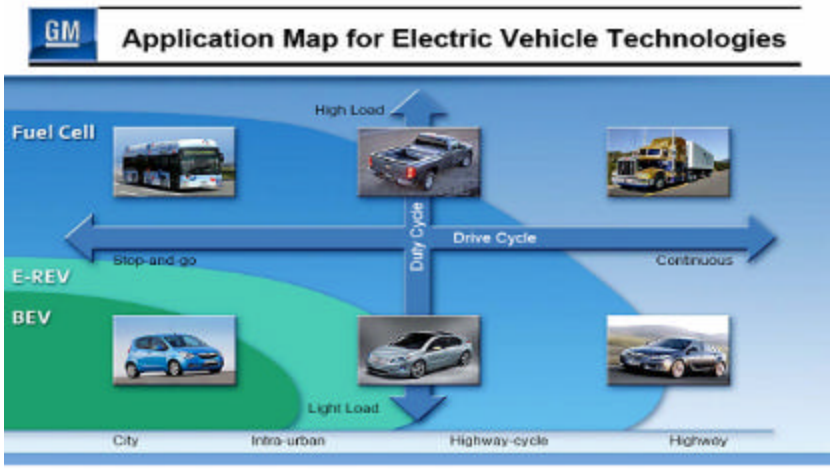

Figure 1 presented by Charlie Frees, Executive Director of Fuel Cell Activities. General Motor Electrification of the Automobile. General Motors. Department of Energy Hydrogen and Fuel Cell Technical Advisory Committee meeting. 10 June 2010.

Figure 1 demonstrates a network of electric technologies that could meet a wide spectrum of needs for the consumer. FCEVs cover all driving ranges from city to highway driving and meet the needs of higher loads for full-function passenger vehicles, trucks and buses. FCEVs can meet the expectations and standards set by internal combustion engine (ICE) vehicles.

International auto manufacturers agree that FCEVs will be a vital option in the future of sustainable transportation. On 9 September 2009 in Stuttgart, Germany; Daimler AG, Ford Motor Company, General Motors Corporation/Opel, Honda Motor Co., Ltd., Hyundai Motor Company, Kia Motors Corporation, the alliance Renault SA, Nissan Motor Corporation and Toyota Motor Corporation signed a Letter of Understanding regarding development and market introduction of fuel cell electric vehicles[2]. They agree to commercialize FCEVs and call for countries to setup hydrogen infrastructures along with their vehicle fleets.

Automobile OEMs envision that FCEVs will meet long range, full-function vehicle expectations with Hybrid Electric Vehicles and Plug-in Hybrid Electric Vehicles meeting short-range light load city car needs[3].

FCEVs have been widely researched and tested for decades. After extensive experiments, tests, and analysis of technological capabilities and consumer expectations, the industry is ready and in the process of mass commercialization of the FCEV; **the first large fleet is targeted for 2015**. Germany, a leader in fuel cell electric vehicle development and deployment, has planned for 1000 hydrogen fueling stations by 2017 to match its commercial launch of vehicles in 2015. Similar launches are planned in Japan and Korea in 2015. A U.S. launch in two large centres is also planned around this time. Denmark has plans to continue a tax exemption for electric and hydrogen cars through 2015 and to also build additional hydrogen fueling stations and vehicles[4].

Call to Action

The hydrogen and fuel cell sector is global and growing. It will contribute to the **reduction of carbon emissions, urban air pollution, and dependency on imported oil and it will create new jobs**. In order for FCEVs to be the environmental and energy solution that only FCEVs can achieve, government support is needed now. It is the media's responsibility and duty to accurately communicate the technological advances, progress and benefits. In this early stage of commercialization all electric mobility technologies should be considered, explored and recognized for their strengths.

Governments at the national, state/provincial and local levels should aggressively support fuel cell electric vehicle research and development, early deployment and market transition efforts, and education now so that society can utilize all the essential benefits of hydrogen economy by 2050.

FCEVs will:

- **Reduce Greenhouse Gas Pollutants**
  - Can cut GHG pollution in the transportation sector by 80 percent below 1990 levels.
    - This can be achieved by mid-century with a swift market penetration and application.
  - The two to three time greater efficiency of a FCEV as compared to an ICE vehicle will ensure that hydrogen from low carbon sources, like natural gas, will reduce GHG emissions by 50 percent.
  - Hydrogen from renewable energy sources will ensure zero carbon-emission
- **Nearly Eliminate Urban Pollution**
  - Automotive exhaust emissions are the largest single source of air pollution in the world today, especially in urban areas. FCEVs only release water vapor as its only by-product thus eliminating pollution. [5]
- **Reduce Societal Cost**
  - Accounting for costs of greenhouse gases, urban air pollution, oil consumption (including strategic costs associated with maintaining safe imported oil supply); FCEV scenario can reduce societal costs more than $600 billion per year in the U.S. by 2100 when compared to gasoline ICE vehicles, and provide similar benefits in all countries. [6]
- **Achieve Energy Independence**
  - Hydrogen can be derived from an abundant amount of sources from carbon-based fossil fuels, biomass and water. This allows hydrogen fuel to be produced from local sources and ensure energy source diversification that make the most environmental and economic sense for the region, which enables greater energy security and less dependency on foreign energy sources (oil).
- **Create New Businesses and Jobs**
  - New hydrogen markets in the mass transit fleet, decentralized power plants, emergency backup power and other applications continue to emerge. This development contributes to new jobs, more manufacturing, and increased economic benefit.
- **Provide the Driving Experience that Consumers Demand**
  - FCEVs have extended driving range, quick and easy fueling, and are safe, comfortable and quiet.

COMMON MISCONCEPTIONS [7]

Hydrogen is too expensive to compete with petroleum

Hydrogen can be affordable with today's technology. Since a fuel cell is twice as efficient as a gasoline engine, hydrogen can cost the equivalent of US $3 to $6 per gallon (1 gallon= 3.78 liters) of gasoline at the pump, not including taxes[8]. Hydrogen can be delivered at the pump within this equivalent price range when made from natural gas, water (using electricity from wind), biomass and coal.

FCEVs are too expensive to purchase

FCEVs have gone through many learning cycles and have become more cost-effective through each process. Opponents look at the price of today's hand-built prototypes and conclude that they will not be cost-competitive. However, like with all new technologies the price will come down through innovations and economies of scale. For example, Toyota Motor Corp., the biggest seller of hybrid cars, said it has cut the cost of making fuel-cell vehicles by about *90 percent* since the mid-2000s and estimates that its first retail hydrogen model will cost about $50,000[9].

Hydrogen is dangerous

Hydrogen is four times more diffusive than natural gas and twelve times more than gasoline fumes, so leaking hydrogen rapidly disperses into the atmosphere. If ignited, hydrogen burns quickly and cannot scorch you from a distance. In a majority of the cases, leaking hydrogen, if lit, will burn but not explode. And in the rare cases where it might explode, its theoretical explosive power per unit volume of gas is 22 times weaker than that of gasoline vapor.[10]

Hydrogen technology is for future applications, so little should done now

Hydrogen-powered products are available today in the sectors of grid-connected and off-grid power, portable electronics, and transportation. Furthermore, long term goals can only be reached if progress is initiated today.

PATH Associations

Asociación Argentina del Hidrógeno (Argentina)
Australia Association for Hydrogen Energy
Development Commerce Transport Energia* (Brazil)
The Canadian Hydrogen and Fuel Cell Association
China Association for Hydrogen Energy
Taiwan Association for Hydrogen Energy and Fuel Cell
Deutscher Wasserstoff- und Brennstoffzellen-Verband (Germany)
European Hydrogen Association
Association Française de l'Hydrogène (France)
Italian Hydrogen Forum
Italian Hydrogen and Fuel Cell Association
Hydrogen Energy Systems Society of Japan
Universiti Teknologi Malaysia* (Malaysia)
Sociedad Mexicana del Hidrógeno (Mexico)
Massey University Centre for Energy Research* (New Zealand)
Polish Hydrogen and Fuel Cell Association
Sahara Wind* (Morocco)
Asociación Española del Hidrógeno (Spain)
UK Hydrogen and Fuel Cell Association
National Hydrogen Association (United States)
(**Interim Members*)

[1] Thomas, Sandy. Alternative Vehicle Comparisons. 2009-2010.<http://www.cleancaroptions.com/ > 16 July 2010.
[2]Major car manufacturers sign Letter of Understanding on fuel cell electric vehicles. FuelCellWorks. 9 September 2009. < http://fuelcellsworks.com/news/2009/09/09/major-car-manufacturers-sign-letter-of-understanding-on-fuel-cell-electric-vehicles/> 16 July 2010
[3] USCAR. Hydrogen Research for Transportation: The USCAR Perspective. July 2009. <http://www.cleancaroptions.com/Hydrogen_Research_for_Transportation-The_USCAR_Perspective.pdf>
[4] Denmark publishes plan for promoting electric, hydrogen, fuell cell cars. European Hydrogen Association. 30 Nov. 2009. <http://www.h2euro.org/2009/11/2359> 16 July 2010
[5] Harnessing Hydrogen: The Key to Sustainable Transportation. Inform Inc. 2009. <http://www.informinc.org/xsum_hydrogen.php> June 2010
[6] Energy Evolution: an Analysis of Alternative Vehicles. National Hydrogen Association. 2009
[7] Lovins, Armory. Twenty Hydrogen Myths. Rocky Mountain Institute.17 Feb 2005. <http://www.rmi.org/rmi/Library/E03-05_TwentyHydrogenMyths>. 7 July 2010.
[8]10 Things You Didn't Know About Hydrogen. H_2 & you. < http://h2andyou.org/facts.asp> 7 June 2010.
[9] Ohnsman, Alan. Toyota Targets $50,000 Price for First Hydrogen Car. Bloomberg LP. 6 May 2010. <http://www.bloomberg.com/apps/news?pid=20601093&sid=aLfTTiIVws3s> 15 June 2010.
[10] Three Hydrogen Myths. Hydrogen Energy Center. 2010. <http://www.hydrogenenergycenter.org/content.aspx?page_id=22&club_id=108367&module_id=8624> June 2010.