



2007 Light Duty Vehicle Survey

Gemma Crawley, Fuel Cell Today -
February 2007



Introduction

Since the production of the 2006 Fuel Cell Today Light Duty Vehicle Survey, it would appear that alternative fuels and sustainable transport are increasingly being put in to the public eye. With films such as "Who Killed the Electric Car?" and Al Gore's "An Inconvenient Truth" being released over the past twelve months, it seems that climate change and sustainability issues have never had such a high profile. In terms of fuel cell vehicles, and in keeping with this trend, 2007 looks set to be a positive year for fuel cell cars. Many of the key automotive manufacturing companies have announced plans for fuel cell concept vehicles and some have even gone as far as proposing dates for commercialisation much earlier than had previously been anticipated.

Honda for example, started 2006 by announcing that it will launch fuel cell vehicles on the global market 'in three to four years time' (2009-2010). The Japanese car manufacturer said that the vehicle will be based on the FCX concept. At the same time, the company president stated that the automotive industry needed to 'act as one in assisting the development of the fuel cell' reflecting the company's commitment to the technology.

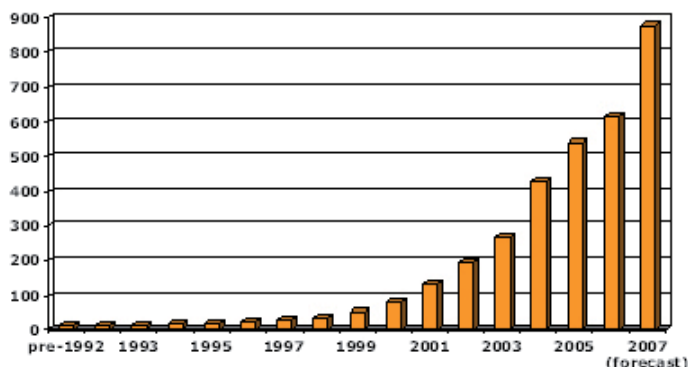
In addition, General Motors announced in 2006 that it had made major steps in developing a commercially viable fuel cell vehicle and expects to place emission free cars in to dealerships in the next four to nine years (2010 – 2015). Furthermore, the company stated that it expects to equal or better gas engines in terms of cost, durability and performance once it increases production volume to 500,000 vehicles per annum.

Not only has there been a push from automotive manufacturers in terms of fuel cell vehicle (FCV) development, but there also seems to be a greater demand from consumers for such cars and increasing support from governments to help achieve commercial fuel cell vehicle fleets.

For example, at the 2006 Greater Los Angeles Auto Show, there was a notable increase in the number of lean, clean cars on display and consumers at the show were showing an increased interest in these vehicles. In addition there are an increasing number of prototype hydrogen powered cars appearing on the roads of California including a number of fuel cell vehicles.

Government bodies have also been publicly promoting the merits of environmentally friendly technologies. In the US for example, the Department of Energy awarded the Central Coast Clean Cities Coalition its official Clean Cities designation for its work in promoting alternative fuelled vehicles and energy independence.

These observations are reinforced when looking at the number of new units released. Fuel Cell Today forecasts that by the end of 2007 there will be over 250 new vehicles built. Whilst a handful of these will naturally be concept models and cars designed by various research and academic institutes, the majority will be vehicles which will be operated in real-world conditions and designed to be used in practical applications.



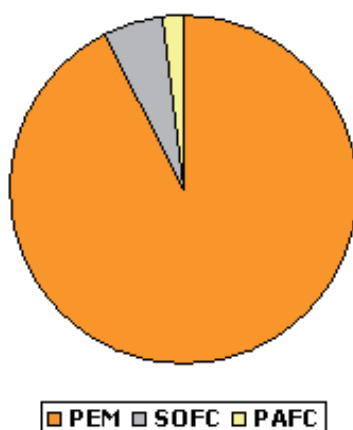
Cumulative Number of Fuel Cell Vehicles

The outlook for the light duty passenger FCV market in 2007 is very positive and the significant increase in new units forecast for this year is clearly visible from the graph above. The large increase from 2006-2007 can be attributed to a significant rise in vehicle numbers from California, Japan and Germany.

Auto manufacturers appear to be maintaining the opinion that fuel cell powered cars will be available on an initial basis by 2010-2015 and some have even gone as far as stating that this date will be earlier. Predictions for the number of new units expected by the end of 2007 are also encouraging. All that remains to be seen is if these goals will indeed be met.

Technology Type and Fuel Choice

As has historically been the case, the greatest interest in technology type from the automotive sector remains to be generated by polymer electrolyte membrane (PEM) fuel cells. However, there is some interest in solid oxide fuel cell (SOFC) and phosphoric acid fuel cell (PAFC) technology for use in light duty passenger vehicles, although in comparison to PEM this is rather limited. The graph below shows new units introduced in 2006 by technology type. It is clear that in this year the majority of vehicles used a PEM based fuel cell system.



New units introduced in 2006 by technology type

Of the new units identified and forecast for 2007, we expect them all to use a PEM stack with compressed hydrogen.

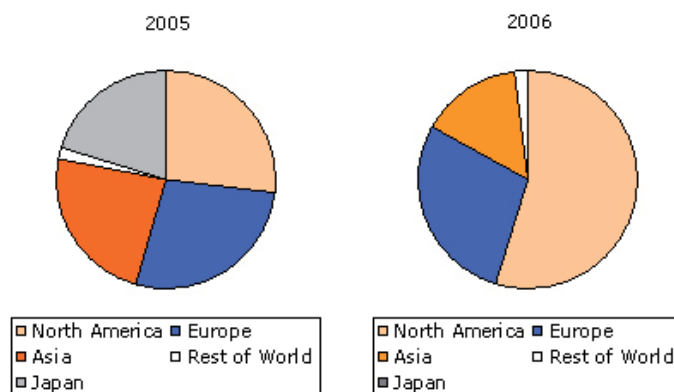
In terms of other technological developments, Ford unveiled the new Ford Airstream motor-home in January 2007 and with it an advanced drivetrain system known as the HySeries Drive. The plug-in hydrogen hybrid fuel cell works as a portable generator designed to recharge the vehicle's lithium ion battery pack. If successful, this technology could be applied to a wider range of vehicles.

Other technological advancements include the development of an advanced air delivery compressor by Eaton Corporation for use in Ford's FreedomCAR, the introduction of Honda's new fuel cell stack for the FCX concept vehicle and the delivery of a new hydrogen fuel storage system to General Motors by Quantum Fuel Systems Technologies. Hoku Scientific has also tested advanced hydrocarbon based membranes and MEAs for Nissan's fuel cell cars and trucks.

Region of Development and Use

Whilst it is a relatively easy task to identify where in the world a vehicle is being developed, it is becoming increasingly difficult to establish where that same vehicle is then being used. Vehicles are often moved, scrapped or re-launched in varying global locations and it is often hard to establish from press releases and company statements if a new car has been produced or if an old unit has simply been re-launched.

In terms of development, North America was the dominant region in 2006 with over half of the vehicles counted in this year being developed in this region. European development was a close second. In comparison with the data from 2005 there are two interesting observations. The first is that in 2006, there was no activity from Japan. This is in stark contrast to the data set from 2005. The second observation is that in 2005, development appeared to be spread fairly evenly between Asia (not including Japan), Europe, Japan and North America. Looking at the 2006 data it is clear to see that the distribution has changed completely, indicating that at this stage there are no set trends and that market dynamics are changing year-on-year.



Region of development in 2005 and 2006

Examining where the vehicles are currently in use, there is once again a strong dominance from North America. In this region, there is strong support for demonstration projects and a keen enthusiasm to get fuel cell vehicles on the road. Support from States such as California and schemes operating in Canada such as the Vancouver Fuel Cell Vehicle Programme have enabled the roll out of initial fuel cell cars used in applications as diverse as the US Postal Service, to employment at airports and by the US Military. Throughout 2007 we expect to see more vehicles being used in Europe, particularly in Germany. We also expect the number of vehicles being used in Japan to grow significantly.

Regional Development

It seems that many key global regions have been keen to progress fuel cell vehicle development over the past twelve months.

On a State level, US researchers in Chattanooga, Tennessee started 2006 by announcing plans to use the Tennessee Valley Authority's test track to test fuel cell and hybrid vehicles in a bid to make America more energy independent. In addition, the California Fuel Cell Partnership continues to promote the commercialisation of fuel cell vehicles in the state of California. Currently there are well over 100 fuel cell passenger cars on the roads of California and the Partnership has announced intentions to ensure there are up to 300 vehicles by the end of 2007.

In the UK, London Mayor, Ken Livingston, committed to introducing 70 hydrogen and fuel cell vehicles in to London by 2010. At least four of these vehicles will be light duty passenger cars which will be used by the Metropolitan police force. We do not expect to see the vehicles on the road until at least 2008. In the Shetland Islands of Scotland, the PURE project operating in Unst, still boasts Britain's only road-legal hydrogen fuel cell car. The vehicle is truly remarkable as the hydrogen utilised by the fuel cell is created from wind power.

Elsewhere in Europe, Germany has committed to investing 500 million Euros over the next decade in developing vehicles powered by hydrogen.

In Japan, plans to cut energy consumption per unit of gross domestic product by 30% from current levels by 2030 will direct the automotive industry towards the development of fuel cells. Several Japanese government departments are to become involved in setting up a new panel to oversee the nationwide expansion of fuel cell and hybrid vehicle use, with the authorities aiming to have 50,000 fuel cell cars on the roads by 2010. The Japanese Ministry of Economy, Trade and Industry (METI) further hopes that up to five million fuel cell vehicles will be in use in Japan by 2020. In order to achieve this goal, the Ministry has requested that technology researchers join forces with battery makers and government organisations in order to develop new, cheaper fuel cells to enable the mass production of such vehicles.

The Indian government has produced a roadmap for the use of non-conventional resources, detailing that by 2020, the country expects to have one million hydrogen powered internal combustion engine vehicles running on the roads. In China, the Shanghai and Technology Commission put forward an online call for tenders for several fuel cell vehicle projects seen to be critical for new energy vehicle development. Up to CNY 1.5 billion (~US\$1.9 billion) will be invested within a three year period and the money will be funded by local government and a special fund for auto industry development in Shanghai.

Activity has also been occurring in Australia. In June 2006 the Fuel Cell Vehicle Alliance of Australia (FCVAA) project was launched in New South Wales. The scheme is designed to increase state and national awareness for fuel cell vehicles.

The Competition

The petrol/diesel internal combustion engine (ICE) continues to represent competition for the fuel cell powered vehicle. ICEs fuelled by hydrogen pose a significant threat to fuel cells. These engines would allow drivers to simply switch fuels and this could be a potentially attractive option if the price is right.

Hybrid cars remain to be one of the strongest forms of competition for fuel cell vehicles. Sales continue to rise and the majority of automotive manufacturers have some form of hybrid development programme. However, as reported in the 2006 light duty survey, hybrids are seen by many not as a direct competitor to fuel cells but rather as a technology which can be used to bridge the gap until fuel cell vehicle commercialisation is realised.

For example, both General Motors and Hyundai have stated intentions to place fuel cell cars in China by 2010. In the meantime, the market for hybrid vehicles has grown significantly with vehicles being released in late 2006/early 2007.

Furthermore, Energy Conversion Devices reported in 2006 that it had modified a Toyota Prius to run on hydrogen as well as battery power as a bridge to increase the public's awareness and use of hydrogen and, in the future, fuel cells.

These trends reflect the observation that hybrids are being used to fill the medium term technology gap whilst fuel cells will provide longer-term automotive power.

Mazda has been developing rotary-engine hydrogen vehicles with a dual-fuel system which allows the vehicle to run on either hydrogen or gasoline. The company appears to be committed to continuing its efforts in developing this technology and if others follow suit this could be a potential threat to fuel cell technology.

The main development in the past year has, however, been the changing opinions of many within the automotive industry. Increasingly, manufacturers and consumers alike are looking at the bigger picture and what had previously been labelled as competing technologies are now being seen as complimentary solutions to providing energy requirements of the future.

Discussion

The Manufacturers

Once again, the key automotive manufacturers have been very vocal in expressing opinions as to when consumers can expect to see mass production of fuel cell vehicles. Many of the big players continue to state that 2012 – 2015 will be the critical time frame for the vehicles despite the fact that many industry commentators believe mass scale commercialisation is more likely to occur around 2020-2025.

In 2006, BMW announced plans to start rolling out hydrogen fuelled internal combustion engine vehicles within two years and not the four year time frame that had previously been announced.

In February 2007, reports were made that General Motors is planning to begin production of its fuel cell powered Chevrolet Sequel car by 2010. It is thought that technicians at the company have been working to have car production capabilities ready by the end of the decade but there was still some doubt from General Motors as to whether the required hydrogen infrastructure would be ready at this time.



GM's HydroGen3 fuel cell vehicle about to be taken for a test drive at the 2007 FC Expo in Japan

Source: Fuel Cell Today)

Hyundai is currently working with Linde AG to promote fuel cell vehicles and their adoption. Linde has developed a mobile refuelling station that dispenses either liquid or gaseous hydrogen to fuel cell cars and Hyundai is using the site to refuel some of its fleet. Hyundai is currently testing 32 fuel cell vehicles across Korea and the USA. The automaker is hoping to enlarge this fleet and has said it wants to sell a hydrogen powered vehicle at an affordable price by 2015. In addition, the company is planning to introduce fuel cell cars to China with its joint venture with Beijing Automotive Industry. The venture is expected to begin making hydrogen powered fuel cell cars by 2010.

In a bold statement, Hyundai was reported as saying that it saw no future in hybrid technology and would instead concentrate development efforts on fuel cell vehicles. The company is forecasting that by the middle of this century, fuel cell vehicles will command a 90% share of the world's new vehicle market and, based on this assumption, will move out of hybrid research and focus on fuel cell technology.

Honda has had a very positive year. Steve Ellis, Manager of Fuel Cell Marketing for American Honda Motor, was reported as saying that it was not critical to be first but more important that whatever is first is done with extremely high quality and with products that leave a positive lasting impression on the customer. This statement emphasises just how committed Honda is to producing a quality fuel cell product that will be well received by consumers and industry alike. The company also announced plans to introduce a limited number of second generation FCX vehicles to the Japanese and US markets in 2008, again illustrating that it is well ahead of the game. Furthermore, it would seem that Honda is looking more closely at the overall consumer package and in May 2006 announced that it had succeeded in developing a bio-fabric for use in fuel cell automobile interiors.

Nissan announced plans to launch a next generation fuel cell vehicle in the early 2010s in Japan and North America as part of its mid-term environmental strategy. In the meantime however, the company plans to focus on the internal combustion engine as the primary power source for its vehicles, thus suggesting a reluctance to fully commit to fuel cell technology at this stage. Furthermore, the company has recently announced plans to develop a new line of electric cars powered by lithium-ion batteries within the next three years.

In 2006, Toyota announced plans to further develop its fuel cell passenger vehicles and stated that it had reduced the time required for sub-zero temperature start-up for such cars. In addition the company announced a successful start up at -300C. However, at the time of announcing these significant developments no detail was given as to when the vehicles might be commercially available. In a separate statement, the company discussed plans for mass production of hybrid vehicles in what some may see as a move away from the development of fuel cell technology.



**Toyota's FCHV fuel cell hybrid vehicle being refuelled at a Tokyo Gas fuelling station in Nimami-Senju, Japan
(Source: Fuel Cell Today)**

The past year has seen some interesting activity from China, India and other Rest of the World regions and it should not be forgotten that whilst North America and Europe dominate the scene in terms of big auto manufacturers, these other regions continue to develop novel and valuable technologies.

Political Support

Political support for fuel cell vehicles has been strong in the United States over the past twelve months. In April 2006, US President George Bush urged the nation to shift from traditional cars to hydrogen fuel cell vehicles. Support for fuel cell technology remains particularly strong in California where the California Fuel Cell Partnership (composed of car makers, energy providers, government agencies and fuel cell companies) works to promote the commercialisation of hydrogen fuel cell vehicles. For example, partnership members, including many of the key manufacturers, provided a fleet of vehicles to transport guests to and from Governor Arnold Schwarzenegger's inauguration.

In terms of financial support, US Energy Secretary, Samuel Bodman, told the auto industry in 2006 that the US government would award US\$52.5 million in grants over the next three years for research in to making hydrogen vehicles a reality. Bodman hopes to see hydrogen vehicles on the road in sizable numbers by 2020.



Each year members of the California Fuel Cell Partnership put their vehicles on the state's roads to allow the public first hand experience of the cars in their local communities (Source: the California Fuel Cell Partnership).

In Canada, the government will commit up to CDN\$36 million (~ US\$30.8 million) to two projects aimed at encouraging drivers to choose more environmentally friendly vehicles. As part of the government's ecoTransport Strategy, the two programmes aim to raise awareness and increase the availability of 'greener' cars and trucks. The ecoTechnology for Vehicles programme will receive up to CDN\$15 million (US\$12.8 million) to enable purchasing and testing of a range of advanced technologies including fuel cell powered vehicles.

In 2007 the European Commission is set to propose a new law regarding motor vehicles using hydrogen either in liquid or compressed gas form and thus, potentially impact the FCV market.

Finally, it would seem that over the past twelve months industry has taken a more active role in lobbying governments for support. Rick Wagoner, Chairman and Chief Executive of General Motors urged the US government to continue to support the development of alternative energy technologies. In addition, Tim Leuliette of Metaldyne Corporation called on the same government to raise taxes on petrol in order to help fund fuel cell research and development.

Consumers

Fuel Cell vehicles have been heavily publicised in the past year and the cars have been pushed to the forefront of consumers' minds. For example, in August 2006, Daimler Chrysler and Ford both exhibited hydrogen fuel cell cars at the annual Woodward Dream Cruise weekend in the USA. Traditionally a show case for classic cars from the '50s and '60s the presence of these clean vehicles highlighted a change in consumer opinion and allowed manufacturers to show the public that these vehicles really are becoming closer to reality.

Elsewhere in the US, hydrogen power appears to be replacing solar energy in national automobile competitions for engineering students at universities across the United States. This is a new trend and one which is seeing the increasing design and engineering of fuel cell powered cars from university students across North America.

In Europe, it would seem that motorists are becoming increasingly aware of fuel cell technology as a future option for car buying. A third party Europe wide study conducted in February 2007 showed that nearly a third of car owners questioned would consider fuel cell technology in their next car purchase. However, cost remains a significant concern for many consumers and when asked to take this in to account the number of people who would purchase a fuel cell vehicle dropped considerably.

Other consumer frustrations have been voiced from the Australian market with environmental campaigners in this region complaining that car manufacturers are being slow to introduce alternative fuel-powered cars to the Australian car market. Australian drivers complain that despite increasing demand for fuel cell cars there remains unwillingness from manufacturers to make significant investments in the area. This has been blamed partly to the costs associated with altering left-hand drive cars to suit Australian roads.

Conclusions

Fuel cell cars still have big hurdles to overcome before mass commercialisation can be reached. Although consumers are keen to drive cleaner cars, the cost of fuel cell vehicles must be significantly reduced and the driving range must be increased before they will seriously consider purchasing a FCV. In response, BMW has been reported as predicting that the cost of hydrogen (ICE) technology could be reduced to levels affordable for individual consumers by 2015 and most of the key car manufacturers continue to work towards meeting DOE cost requirements (General Motors has in fact stated that they can meet these standards in the required timeframe and was reported as saying that fuel cell cars should cost the same as petrol fuelled models once production volumes reach one million units per year).

In terms of infrastructure, more hydrogen filling stations are required to fuel increasing numbers of vehicles. This is an issue which has long been debated. Car manufacturers will not mass produce vehicles until there is sufficient infrastructure to service them, whilst governments and companies do not want to pay for the construction of filling stations if there are no cars to use them. Although demonstration programmes have promoted joint development of infrastructure and vehicles neither industry has yet taken a positive step to proceed independently on a mass scale.

In terms of fuel cell vehicle development, it is fair to say that much progress has been made over the past few years. Fuel cell cars are continually evolving and new concept models are being unveiled at an increasing rate. Stack development is also ongoing although there are still some challenges to be faced with regard to durability, driving range and performance.

Increasingly, car manufactures are realising that fuel cells are not a short term answer for reducing dependency on oil and are beginning to look at the technology as part of the overall solution and a longer term option. Companies remain as vocal as ever in terms of fuel cell development activity and dates for commercial production and the forecast for new units in 2007 is particularly encouraging. However, year-on-year there are still no clear trends arising for regional development or mass manufacturing and only time will tell which company will be the first to market and when this might occur.

Key Players

The following section provides an outline of the main players over the preceding twelve months.

In February 2007, Ballard Power Systems announced that it had sold its electric drive operations to Siemens VDO Automotive Corporation. Ballard stated that the operations were not core to its fuel cell stack strategy.

Daimler Chrysler handed over the keys to five hydrogen fuel cell power cars to Los Angeles World Airports officials at Los Angeles International Airport (LAX). The cars are intended for general transportation requirements around the airport and will be used over a two year period. The five prototype vehicles cost approximately US\$1 million each to develop. In addition, the company delivered three hydrogen fuel cell (F-Cell) vehicles to the Pacific Gas and Electric Company (PG&E) in February 2006. A variety of PG&E employees will drive the F-Cell vehicles to gather operational data and determine if the technology will meet fleet operations needs in the future. The companies are hoping to average at least 35 miles per day on each of the three vehicles.

One of the Daimler Chrysler F-Cell cars at Los Angeles airport (Source: Daimler Chrysler)

In what was reported as a world first, Daimler Chrysler introduced a fuel cell powered police vehicle in April 2006. The Wayne State University Police Department in Detroit will operate the Mercedes F-Cell as a supervisor's vehicle

on and in the immediate vicinity of the campus located in Detroit's Cultural centre.

Eaton Corporation announced that it is to provide Ford Motor Company with advanced air delivery compressors for its fuel cell vehicle demonstration programmes. The compressors will be used in fuel cell vehicle systems for the FreedomCAR and Fuel Partnership fuel cell demonstration programmes.

The Energy Research Centre of the Netherlands reportedly built the first car to be powered by a Dutch fuel cell system. The PEM stack was developed entirely in Petten and the vehicle is a modified version of the Daimler Chrysler GEM and has been called the HydroGEM.

Enova Systems announced in 2006 that it had taken orders for four high voltage energy converters from Ford. The components are designed to transfer power between the fuel cell, drive system and battery in Ford's vehicles. Enova's components are currently used in around 30 Ford Focus hydrogen fuel cell vehicles.

The Fiat Panda Hydrogen was unveiled as the first vehicle to feature Nuvera's new Andromeda II fuel cell stack at the HyPark exhibition area during the Winter Olympic Games in Turin, Italy.

Although the vehicle will be counted in our niche transport survey, it is worth noting that Ford unveiled a concept touring vehicle powered by a plug-in hydrogen hybrid fuel cell in January 2007. Developed in conjunction with Airstream the motor-home is powered by an advanced fuel cell system called HySeries Drive.



The Ford Airstream Concept Vehicle (pictures courtesy of Ford)

General Motors announced plans to open a new R&D office in Moscow which will focus, among other things, on fuel cells and hydrogen storage for fuel cell applications. In August 2006, the company also announced that it had achieved a milestone in fuel cell vehicle development by producing a drivable version of its Sequel concept car. The Sequel has a driving range of 300 miles but is still a long way from achieving mass production volume.

The US army is to collaborate with General Motors in testing hydrogen fuel cell vehicles which may be rolled out for use in battlefields. Soldiers have begun a year of tests on the Chevrolet Equinox fuel cell vehicle to establish whether hydrogen powered cars would be suitable for use by the armed forces in the future. General Motors has pledged to build over 100 Equinox fuel cells, which will be available on the market from 2007.

In another partnership, General Motors extended an agreement with the United States Postal Service to deploy fuel cell vehicles for use in delivery. The two companies agreed to add another fuel cell vehicle to the fleet in Irving, California as well as agreeing to continue to test the van in Washington DC's metro area for a further year.

A collaborative agreement between Think Technology and H2 Logic will see H2 Logic develop hydrogen-powered fuel cell city cars using stacks supplied by Ballard Power Systems. The TH!NK hydrogen city vehicle contains a battery which can be powered either by the national grid or by a hydrogen-powered fuel cell and has an operating range of almost 300km.

In February 2006, Hoku Scientific announced that it has been awarded a new contract by Nissan for the development of advanced hydrocarbon based membranes and MEAs for Nissan's fuel cell cars and trucks. Joint testing of the components was completed in September 2006.

Honda announced that the new fuel cell stack used in the FCX concept features a metal separator structure that cuts the number of parts by 50% over its predecessor and is capable of operating at temperatures as low as -300C

and as high as 950C. The stack is reported to be 20% smaller and 30% lighter than the current FCX stack but with increased output of 15 kW. In other news, following a successful trial in the USA in which Honda provided a Californian family with a fuel cell car, the company announced plans for a possible extension of the scheme to Britain. In June 2006, the US trial marked the one-year anniversary of the world's first lease of a hydrogen fuel cell powered vehicle to an individual retail customer.



**Honda's FCX fuel cell vehicle on display at the 2007 FC Expo in Japan
(Source: Fuel Cell Today)**

Honda's company president, Takeo Fukui, said that in 2008 the company will begin lease sales of a new fuel cell car and that mass production of fuel cell vehicles will occur within the next ten years. The carmaker has yet to disclose the scale of production and the pricing of the vehicle, but its design is said to be close to the FCX concept model. The vehicle is also reported to come with lithium ion batteries as a secondary power source.

Hyundai delivered the first of ten fuel cell electric vehicles to the Alameda-Contra Costa Transit District (AC Transit), a Californian public transport group. AC Transit has begun a five year demonstration and validation project designed to evaluate fuel cell vehicles and hydrogen infrastructure technologies. In addition, Hyundai announced plans to place fleets at a utility company in Southern California and at US Army facilities in Detroit.



**An AC Transit Hyundai-Tuscon hydrogen fuel cell SUV at a Chevron hydrogen station in Oakland, California
(Source: AC Transit)**

Intelligent Energy announced a working programme with PSA Peugeot Citroen to test and integrate Intelligent Energy's fuel cell systems with Peugeot's electric vehicles. Intelligent Energy will deliver a series of 10 kW systems based on the company's PEM fuel cell technology.

Taiwan's MingDao University introduced its fourth generation fuel cell vehicle in January 2007. The MHV-4 vehicle can reach speeds of up to 30 km per hour.

The Ministry of Economy, Trade and Industry (METI) in Japan is paving the way for fuel cell vehicles by allowing people in Osaka prefecture to test drive fuel cell cars. As part of a five year scheme (started in fiscal year 2006), METI will invite companies to file applications to manufacture fuel cell powered cars and wheelchairs in Osaka. Other firms selected by the Ministry will be tasked with selecting dozens of people to use the fuel cell vehicles. In the first year of the programme (April 2006-March 2007) METI will set aside a total of 300 million yen as part of the state budget to finance the scheme. The Ministry will also construct appropriate infrastructure.

Nissan Motor announced plans to launch a next generation fuel cell vehicle in the early 2010s. The vehicle is intended to be launched in Japan and North America as part of the company's mid-term environmental strategy, "Nissan Green Program 2010". Earlier in 2006 the company started testing of its latest generation X-Trail FCV. The vehicle is powered by a Nissan developed fuel cell stack which the company claim is around 60% smaller than in the 2003 FCV model. The new stack has a power generation capacity of 90kW and the vehicle can travel up to 150 km/h. In the more immediate time frame, Nissan offered its X-Trail for test drives in Japan for up to a year as part of its efforts to learn more about the practical use of the hydrogen fuelled vehicles.

In December 2006, media reports suggested that Nissan was in talks with Japanese electronics company NEC over a joint venture to develop lithium ion batteries for use in fuel cell, hybrid and electric cars. The Japanese media reported that Nissan and NEC were planning to construct a factory and begin mass production of by 2010. In February 2007, Nissan provided one of its X-Trail vehicles to a chauffer driven Japanese hire car fleet. The vehicle features an original Nissan fuel cell stack which works in conjunction with a lithium-ion battery.

Students from the Ohio State University's College of Engineering began a project to design, build and race the world's first hydrogen fuel cell powered land speed research vehicle. The scheme is being supported by over 50 industrial sponsors.

PSA Peugeot Citroen unveiled its new fuel cell concept car in 2006. The vehicle, developed in partnership with the French Atomic Energy Commission is reported to have a greater electrical power output, be more energy efficient and is more compact than previous fuel cells used in other Peugeot concept car demonstrations. The 207 Epure model uses the Genepac 20 fuel cell system which produces 20 kW of power. The drive range is 500 km with a top speed of 130 km/h.



PSA Peugeot Citroen's Genepac fuel cell system (Source: PSA Peugeot Citroen)

Quantum Fuel Systems Technologies is to supply hydrogen fuel storage systems to General Motors for its Chevrolet Equinox fuel cell vehicle programme. Quantum announced that a "multimillion-dollar" purchase order had been received for the storage systems, although no specific figures or unit numbers have been given. The systems are to be produced specifically for the GM fuel cell vehicle programme, which is due to deliver a fleet of hydrogen-powered vehicles in 2007. In February 2006, Quantum began selling fleets of hydrogen fuelled hybrid vehicles. The

company has sold five hydrogen hybrid vehicles to the city of Riverside in the USA.

According to local media reports, Renault is to begin production of fuel cell cars in India by 2010. The French car manufacturer is also reported to be planning the establishment of a joint plant with Nissan to cater for European markets with the fuel cell vehicles targeted at urban users.

Based on a report commissioned by Skoda the company unveiled its vision for the future of vehicle use and commented that fuel cell technology would play a central role.

The State Power Authority and Electric Power Research Institute in California announced a project which will explore using local hydropower to produce hydrogen for a fleet of emission free vehicles to be used in Niagara Falls State Park.

Having presented an artists impression of its concept fuel cell car at the Tokyo Motor Show, Suzuki appears to have produced a concept model of the MR Wagon which was on display at the FC Expo in February 2007.



**Suzuki's concept fuel cell vehicle on display at the 2007 FC Expo in Japan
(Source: Fuel Cell Today)**

Toyota and General Motors announced the end of their joint fuel cell research partnership in March 2006. The original partnership was established in 1999 when the two companies decided to work together in developing fuel cell technology. Although the two companies will no longer work together to develop fuel cell technology, they will continue to focus on industry codes and standards until March 2008.

In 2006, Tsinghua University, Chery Automobile and J&K Technologies completed development of China's first hydrogen fuel cell car with complete independent intellectual property rights. Following prototype tests in January 2006 the vehicle passed examination by Chinese authorities.

Volkswagen announced the development of a smaller high temperature fuel cell that it claims to be more powerful than its predecessors and may be made available to other car manufacturers. While officials remain reluctant to discuss the plans openly, one of the carmaker's leading fuel cell researchers has admitted the proposals are being considered. It is thought that the new fuel cell contains a newly developed membrane and electrodes. Volkswagen believes that the first affordable VW fuel cell car for everyday use could be on the market in 2020.

Westport Innovations has teamed up with Ford to develop and demonstrate an advanced direct injection fuel system for vehicles powered by engines operating on pure hydrogen. The US Department of Energy is also joining the project in what is expected to be a two year programme to develop hydrogen direct injection. Canada's national government has contributed CDN\$250,000 for initial start up.

About the author

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