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analyst view

Fuel Cell Electric Vehicles: Turns in the Road

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Honda's FCX Clarity FCEV (Source: Honda)

At the end of August 2012, Fuel Cell Today published '*Fuel Cell Electric Vehicles: The Road Ahead*'. The report reviewed the need for zero-emission transport, the application and history of fuel cells in electric powertrains, and the planned market introduction of fuel cell electric vehicles (FCEV) by seven major global automotive OEMs – Daimler, Ford, General Motors, Honda, Hyundai, Nissan, and Toyota. These are the parties that co-signed a letter of understanding in September 2009, signalling their intent to commercialise a significant number of FCEV from 2015 – a date now solidified in the industry consciousness – and urging for the development of appropriate infrastructure to support this initial rollout. As well as the cars themselves, the report looked at the progress of hydrogen refuelling infrastructure and domestic support in five key early markets – Japan, Germany, Scandinavia, the United Kingdom, and California.

Unfortunately, such reports are by nature almost immediately out of date; a few weeks after publication, and after five years without a new fuel cell concept car, Nissan introduced the world to its TeRRA concept – a design study for a zero-emission evolution of the company's Juke and Qashqai SUV crossovers. In the six months since the report was published there have been a series of further substantive and notable developments in the FCEV arena.

Starting with the automakers, two major collaborative efforts have been announced within the last month. On the 24th January it was announced that Toyota and BMW will be sharing a number of technologies and jointly developing a fundamental fuel cell vehicle platform by 2020 – including not only a fuel cell stack and system, but also a hydrogen tank, electric motor and supporting battery system. Germany is an important early market for fuel cell electric vehicles, and Toyota can lend to

BMW years of experience and expertise in the development of fuel cell and battery powered drivetrains. This was preceded in September 2012 by Toyota announcing a new fuel cell stack with more than twice the power density of the stack currently used in the FCHV-adv fuel cell vehicle prototype, at approximately half the size and weight.

Less than a week later, in an interview with a German business news magazine, Toyota Europe's head of powertrain development, Gerald Killmann, indicated that Toyota is planning to begin series production of a fuel cell Prius in 2014, and from 2015 to market the car in Japan, the US and Europe. Countries to be targeted for early marketing of fuel cell vehicles would depend on how well development of hydrogen infrastructure has gone – policy support is needed in the early phases – and the main challenge in launching such a vehicle is cost reduction: if the car were series produced now it would cost just under €100,000; this would have to fall by 30 to 40% before it could be marketed.

The second major automotive collaboration was announced a mere four days after the Toyota–BMW announcement, with Daimler, Ford and Renault-Nissan agreeing to jointly develop a common fuel cell system for use in separate mass-market cars from 2017. Readers of '*The Road Ahead*' will remember that: Daimler had been planning to commercialise its third-generation F-CELL (the 2009 B-Class F-CELL) in a limited capacity from 2014, followed by true volume production with a fourth-generation F-CELL c. 2017; Ford has continued to express its fuel cell interests through its activities with Daimler in the Automotive Fuel Cell Cooperation (AFCC) though expressed unwillingness to lose money on FCEV before profiting from them and suggested a 2020 commercialisation timeframe; Nissan has been working on its stack technology rather than demonstrating vehicles and claimed industry-leading performance from a stack it announced in October 2011, as well as cost reductions of 600% against its previous stack, with intent to apply it commercially from 2016.

Daimler's decision to forego its limited 2014 production run is certainly disappointing for the fuel cell industry and early adopters; however, the combination of currently limited hydrogen infrastructure and high vehicle prices makes for an unfeasible proposal for many. By jointly lowering the cost of the core technology, and waiting until series production can be achieved, where economies of scale play to their advantage, the three automakers should be able to substantially lower the cost of their offerings; add to this the many hydrogen stations that are due to be constructed in Germany in the coming years and a 2017 launch seems a pragmatic move.

Others are less willing to wait. In particular, Hyundai has continued to ratchet up the progression of its fuel cell programme. The Korean automaker has been extensively demonstrating its ix35 FCEV in Europe and North America over the last two years, with plans to make 1,000 units available before 2015, at which point limited mass production of 10,000 units would begin. Keeping to its schedule, series production of the ix35 FCEV began at Hyundai's Ulsan manufacturing plant in late January.

This influx of vehicles from Hyundai has meant that the automaker has been involved in a large number of regional demonstrations and initiatives. Scandinavia was highlighted as a key early launch market in *'The Road Ahead'*, and one month after its publication it was announced that the City of Copenhagen had signed a contract with Hyundai for the provision of fifteen FCEV and three hydrogen refuelling stations (HRS), co-funded by the European HyTEC project, which will also see FCEV and Suzuki Burgman fuel cell scooters deployed in London later this year. A European Hydrogen Road Tour, organised by H_2moves Scandinavia culminated in October 2012 with Hyundai, Honda, Toyota, Nissan, and a number of infrastructure companies and Nordic NGOs signing a memorandum of understanding to bring FCEV to Scandinavia from 2014–2017; Daimler, whose B-Class F-CELL featured on the tour, is notable in its absence from this agreement. Shortly afterwards, Skåne Regional Council signed a contract securing two Hyundai ix35 FCEV, the first of their kind in Sweden.

Last week the initial findings of the first phase of the government–industry UK H_2Mobility project were revealed. The study sees up to 1.6 million FCEV on UK roads by 2030, with annual sales of more than 300,000. It further found that 10% of new car customers would be receptive to FCEV when first introduced and that an initial rollout of 65 HRS in heavily populated areas and along national trunk routes would provide sufficient coverage for these early vehicle sales. Hydrogen should be cost-competitive with diesel immediately, with 60% lower CO_2 emissions than diesel by 2020; as the fuel mix becomes more renewable this improves to 75% lower by 2030 and would be on course for 100% by 2050. As vehicle sales grow, the number of refuelling sites would increase to 1,150 by 2030; by that time 51% of the fuel mix should be coming from water electrolysis, contributing to an annual total vehicle CO_2 emissions reduction of up to three million tonnes by FCEV in 2030. Furthermore, FCEV could have a UK market share of 30–50% by 2050.

The UKH_2Mobility project partners will now focus on methods and business cases for delivering an initial network of HRS. The first steps have already begun: last month it was announced last month that a consortium led by Air Products will deliver at least one new 700 bar hydrogen refuelling station and upgrade the existing two in London to 700 bar, as well as the station at the nearby Millbrook Proving Ground. These will be complemented by a number of Hyundai ix35 FCEV and Revolve HICE vans. Dr. Klaus Bonhoff, director of NOW (the German National Organisation for Hydrogen), noted in an October 2012 presentation to the FCH-JU that similar studies are being considered for the French and Swiss markets.

In America, California continues to lead the USA in the adoption of FCEV. The Office of California Governor Edmund G. Brown published its 2013 Zero Emissions Vehicle (ZEV) Action Plan last week, which includes a roadmap towards putting 1.5 million ZEV on Californian roads by 2025. The Plan aims to aid a reduction in transport emissions to 80% below 1990 levels by 2050; it mandates that by 2015 major metropolitan areas in California are to be 'ZEV ready', including suitable funding for infrastructure for both FCEV and BEV/PHEV, as well as streamlined permitting. The plan incorporates the findings of the California Fuel Cell Partnership's California Road Map, which suggests that 68 HRS would be needed for an initial launch of vehicles in 2015, with 100 required to support full commercialisation. This Californian mandate is an important step forward for the country as a whole: because the California Air Resources Board predates it, the US Clean Air Act allows California to determine its own air quality standards – other states may choose either federal standards or Californian standards, but not set their own. This allows willing states to adopt more progressive Californian standards, and this unique model could speed up FCEV adoption within the USA.

Japan has historically been one of the most proactive countries in the world in regard to FCEV, and this position has not weakened. Toyota and Honda have remained resolute in their 2015 timeframe for commercialising FCEV, by which time 100 hydrogen stations should be in operation across Tokyo, Nagoya, Osaka, and Fukuoka – last month, it was revealed that JX Nippon Oil & Energy Corp. plans to construct and open 40 of these stations, still by 2015.

As we edge ever nearer to 2015 we can expect updates from automakers, energy companies, and governments to increase in frequency; indeed, the commercialisation of FCEV is at long last just around the corner.

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