Media Information

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Lighthouse in Berlin: Shedding Light on Hydrogen Road Ahead

- GM/Opel supports hydrogen fuel pilot project in Europe with 10 HydroGen4
- Hydrogen supply infrastructure 'economically viable at scale and doable'
- Part of GM's alternative fuels strategy for sustainable mobility

Berlin. Hydrogen, a fuel of tomorrow, is available today at filling stations in Berlin as part of an innovative lighthouse project designed to demonstrate the viability of hydrogen as a clean fuel of the future.

The Clean Energy Partnership (CEP), supported by GM/Opel, fuel companies, utilities, other automakers and the German government, provides customers with hydrogen-powered vehicles and fueling stations for day-to-day testing. The project will run until 2016.

GM will add 10 HydroGen4 vehicles to the CEP test fleet. Nine large corporations – ADAC, Allianz, Axel Springer AG, Coca-Cola, Hilton, Linde, Schindler, Total, and Veolia – will be the first business partners to test the vehicles in day-to-day operation.

Globally, GM deploys more than 100 vehicles of this type in its Project Driveway testing program. In the U.S., mainstream drivers in New York, Washington D.C. and southern California, where hydrogen fueling stations are available, are using the cars as part of their normal daily routine. The internet-based recruitment program has received over 100,000 inquiries and more than 3,400 individuals have already driven the vehicle, either in short drives or as a Project Driveway loan. Thirty families also used the vehicle on a daily base in a 2-3 month deployment.

"The HydroGen4 test program now marks an important milestone on the road towards offering completely emission-free, competitive fuel cell technology for the automobile. This technology shows how we can reduce our dependency on oil while preserving the high degree of personal mobility that we all value," says Carl-Peter Forster, President of General Motors Europe.

Hydrogen as a fuel offers great potential to enable sustainable, carbon-free mobility without greenhouse gas emissions. Like electricity, it can be produced from a wide range of different primary energy sources. In the long term, hydrogen can also serve as a storage medium for fluctuating renewable energy at large scale, thus improving the usage potential of renewables.

“Generated from renewable energies and used in fuel cell vehicles without producing any greenhouse gas emissions, hydrogen ultimately has the power to remove the car from the environmental equation,” says Dr. Thomas Johnen, Director, GM Europe Fuel Cell Activities.

It is a view shared by EUCAR, the European Council for Automotive Research and Development, whose well-to-wheel study has confirmed that hydrogen-powered vehicles offer the potential to greatly reduce greenhouse gas emissions and could eliminate these emissions completely in the long term.

Fuel cells: part of GM strategy to pursue a range of alternative propulsions

While hydrogen is a long-term solution for sustainable, emission-free mobility, GM is committed to a range of technologies that will be effective in the short and medium term. These technologies can reduce and ultimately displace oil dependency, minimize CO_2 emissions and encourage energy diversity.

In the near term, GM continues to improve the efficiency of its internal combustion engines and transmissions. This is carried out in parallel with an increasing deployment of E85 flex-fuel and gasoline-electric hybrid vehicles.

In the longer term, GM believes the adoption of pure electric propulsion is an unrivalled technology that will lead to diversified energy sources and zero vehicle emissions. Batteries and fuel cells both provide on-board electric power and when electricity or hydrogen is produced from a renewable source – wind, solar, or hydro-power – the entire source-to-wheel pathway is effectively free from greenhouse gas emissions. Hydrogen can also be extracted easily from water using electrolysis, so any renewable pathway to electricity is also a renewable pathway to hydrogen.

Fuel Cell and Battery: Two sides of the same electric coin

GM is developing hydrogen-powered fuel cell vehicles in parallel with the advancement of its battery-powered electric vehicle program. Both are alternative, complementary routes to the same ultimate destination: Zero-emissions, and zero-petroleum transportation.

Pure battery electric vehicles (BEVs) have a limited range and require a relatively long recharge time. They can provide an adequate means of transportation for short distance commuters only. GM has alleviated the range problem with its extended-range electric vehicle (E-REV) technology by installing a small combustion engine as a generator to power the car's electric motor. E-REV technology is featured in the Chevrolet Volt that will be introduced in 2010 in the US. Opel plans to launch its E-REV car in late 2011.

Fuel cell electric vehicles (FCEVs) have a greater range than BEVs, offer shorter fueling times compared to the battery recharging of a BEV or E-REV, and are true zero emission vehicles (ZEVs) under all operating conditions. But they require a new way to fuel. That, in turn, requires a new refueling infrastructure.

Thus, each technology – extended range and fuel cell electric vehicles – makes a contribution to the success of the other. There are cost savings from synergies and economies of scale. Both benefit from advances in the development of electric motors and onboard electronic control systems.

On the road with hydrogen

HydroGen4, GM's fourth generation FCEV is the culmination of more than 10 years development work with hydrogen and fuel cell technology. It features improvements in everyday usability, such as performance and durability.

The fuel cell stack converts the stored chemical energy from hydrogen into electrical power by combining it with oxygen from the air. This means no combustion or any CO_2 emissions. Heat and water vapor are the only by-products.

HydroGen4's fuel cell stack uses 440 single cells providing the electric energy for the 73 kW synchronous electric motor, delivering zero to 100 km/h acceleration in around 12 seconds. The electric motor's instant torque characteristics also give the vehicle an excellent pick-up from low speed.

GM has opted for fueling with compressed hydrogen, overcoming boil off leakage when using hydrogen in cryogenic liquid form. HydroGen4's three carbon-fiber composite tanks hold 4.2 kg of hydrogen, sufficient for an operating range of up to 320 kilometers.

The HydroGen4 is fitted with a 1.8 kWh buffer battery to cover peak electrical loads and store energy from the vehicle's regenerative braking system.

HydroGen4 can start and run in sub-zero temperatures, a considerable advance over its predecessor and an important benefit for everyday usability. It is designed to be as safe as conventional vehicles and includes unique hydrogen safety features in each of its major systems.

Getting hydrogen to the road

Hydrogen is an abundant element that is commonly found in a wide range of compounds and substances, including water and all forms of biomass and fossil fuels. More than 56 million tons of hydrogen are produced globally each year – enough to theoretically fuel 180 million FCEVs – through well-established processes such as reforming natural gas. This means a supply of hydrogen fuel for automobiles can be generated from natural gas to kick-start a supply infrastructure.

In the longer term, the potential to extract hydrogen from water through electrolysis – the fuel cell process in reverse – with electricity generated renewably makes hydrogen even more attractive as an energy carrier.

A research study in the United States by General Motors and Shell shows that hydrogen at scale can be produced, transported and dispensed at a cost of $4-6 per kilogram, using today's known technology. Thus, on a fuel cost-per-kilometer basis, hydrogen can be competitive with a gasoline retail price at $2–3 per gallon when used in a Fuel Cell Electric Vehicle.

The challenge ahead for the introduction of hydrogen is not, ultimately, one of scale or even cost, but one of enacting a commitment from all stakeholders, public and private, to 'make it happen'.

Both the GM/Shell study and the EU-funded HyWays research project foresee a retail infrastructure building up organically after initially targeting a few specific geographical regions. Tank trucks would carry hydrogen from production centers to filling stations with these trucks later being progressively replaced by supply pipelines as hydrogen demand increases. Depending on the region, on-site hydrogen production from natural gas or through electrolysis of water could also become an option.

How to make it happen

In the initial stages, a careful balance needs to be struck between the volume of fuel cell vehicles deployed and the availability of stations to fuel them. To minimize capital costs, there should be enough stations to meet demand, while also ensuring a reasonable rate of refueling infrastructure utilization. At the same time, to encourage the growth of FCEV sales, consumers need to be confident that they have access to a sufficient number of stations covering a large enough area to provide adequate mobility.

Both the GM/Shell and HyWays studies point out that government must play a key role in fostering early growth by providing support. This would include the favorable taxation of hydrogen fuel, tax incentives for the purchase of FCEVs and the encouragement of research and development.

The GM/Shell study concludes that a hydrogen infrastructure “is economically viable at scale and doable.” However, it requires “a collective will by automakers, energy suppliers, and the government to overcome initial capitalization risks, motivate early movers and manage the transition.”

The HyWays Roadmap also concludes that “as a result of the introduction of hydrogen, CO_2 emissions from road transport can be reduced by over 50% by 2050 in a cost effective way. The introduction of hydrogen in road transport also contributes to improving air quality in the short to medium term, specifically in the most polluted areas such as city centers where the sense of urgency is greatest. In addition, security of supply is improved since hydrogen can be produced universally from many different energy sources, thus decoupling energy demand from a specific feedstock and production method.”

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