

The Beginning of the End of Fossil Fuel Addiction?

Hydrogen fuel cell buses enter circulation in Stockholm

By Eric Paglia

Stockholm- On January 7th a mini-fleet of three hydrogen fuel cell-powered buses entered traffic as part of a European Union initiative called CUTE- Clean Urban Transport for Europe- where Stockholm is one of nine cities across the union that has been chosen to take part. If the “Hydrogen Economy” will become the next economic organizing principle after “The End of the Oil Age”, as *The Economist* puts it, then the future is now driving around in circles on the streets of Sweden’s capital.

Clean source of onboard energy

As the name of the project implies, CUTE’s mission is to mitigate the negative environmental impacts that are inherent in today’s transportation sector. Currently the largest initiative of its kind in the world, CUTE has launched buses powered by hydrogen fuel cells in Amsterdam, Barcelona, Hamburg, London, Luxembourg, Madrid, Porto and Stuttgart, as well as Stockholm.

Hydrogen fuel cells, and the electric motors they provide power for, are a substitute for traditional internal combustion engines, which today almost exclusively run on gasoline and produce air-polluting emissions, including the “greenhouse gas” carbon dioxide that is the main cause of global warming.

In contrast, hydrogen fuel cell vehicles are considered emission-free. Inside the onboard fuel cells, hydrogen is combined with oxygen, causing a chemical reaction where the electricity that powers the bus is generated. All that is left over is harmless water vapour.

Platinum used in fuel cell construction

Polymer electrolytic fuel cells- the variety used in the buses built by Daimler-Chrysler for CUTE- operate at a relatively low temperature (80 to 90° C) and therefore require the use of platinum in their construction as a catalyst. Eliminating or minimizing the use of platinum- an expensive metal with a limited world supply- in fuel cells is an important area of research that could eventually bring down the cost and weight of the fuel cell stacks on vehicles.

Each bus carries two fuel cell stacks that weigh 330 kg and cost 333,000 USD each. Financing for the project in Sweden, totalling 5.5 million USD, comes from the European Union, the Swedish Agency for Innovation Systems, the Swedish Energy Agency, Stockholm Transport and Birka Energy.

Climate an important factor in fuel cell performance

It was not by chance that Stockholm was selected to participate in CUTE. Low emissions vehicles have been part of city policy since 1994; large investments in biogas buses have been made, and Stockholm deploys the world’s largest fleet of ethanol-powered buses, with 250 currently in circulation. But most importantly, the cold climate of Sweden played a pivotal role in Stockholm’s selection.

Since the entire system comes down to a chemical reaction, the effect climatic factors have on the performance of hydrogen fuel cell vehicles needs to be investigated thoroughly. Being the world's first large-scale hydrogen fuel cell initiative- spanning cities with dramatically different climates- CUTE is essentially a test-run of the technology under various climatic conditions. Both warm and cold climates were needed to test fuel cell performance, and Stockholm in effect became CUTE's low-temperature "laboratory".

(It should also be mentioned that Iceland, in some ways a model for CUTE, has made a strong commitment to becoming the first 'hydrogen economy' and is a world leader in deploying hydrogen fuel cell vehicles.)

Data on the buses' driving cycle- acceleration, deceleration, stopping- and fuel consumption is constantly accumulated in onboard computers. It is then compared with weather data, allowing the effect of climatic conditions on the performance and fuel efficiency of the fuel cells to be evaluated. This analytical dimension of CUTE is being handled in Stockholm by the Royal Institute of Technology's chemical engineering department, which will also monitor weather-related data on fuel cell performance in Porto, London and Barcelona for climate-comparison purposes.

Hydrogen produced from water

One of the great advantages of using hydrogen as an energy carrier is that the fuel can be produced wherever water and electricity are accessible. All hydrogen used to power the fuel cell buses in Stockholm is produced on location at the bus depot in a special fuelling station built by Stuart Energy, a Canadian company specializing in hydrogen-based transportation systems. The key piece of equipment is the electrolyser, which produces hydrogen by separating it from water molecules (the H from the H₂O).

It is in this process of electrolysis where hydrogen's image of being a "clean" energy source requires further investigation. On a local level, hydrogen fuel cell vehicles produce no pollution (not even noise pollution, as the motors are almost totally silent). Electricity, however, is needed to produce hydrogen through electrolysis. If that electricity is itself produced by burning "dirty" fossil fuels (like coal, oil or natural gas), then the loop is not as green as it might otherwise appear to be.

In order to maximize the positive PR of the project, the parties involved have made a total commitment to renewable energy. Therefore all electricity used to power the electrolyser comes from Sweden's abundant hydro power resources, making the Stockholm dimension of CUTE entirely free of carbon dioxide emissions.

Beyond the two-year CUTE project period, the future of hydrogen fuel cell transport is less certain. With its centralised fuelling infrastructure, public transport is ideally suited for hydrogen fuel cell vehicles. But for hydrogen to become a realistic option for private vehicles, a costly large-scale infrastructure of fuelling stations would have to be built. Other alternative fuels have existed for some time without reaching widespread use. Hydrogen, however, seems to have captured the imagination of policy makers (even President Bush, not known as an environmental champion, mentioned hydrogen in a State of the Union address), as well as the media and the scientific community. It perhaps offers the world a way to cure itself of its addiction to fossil fuel.