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# analyst view

## Methanol and Fuel Cells: Range Extenders for BEV?

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*Small family car fitted with high-temperature PEM fuel cell range extender (Credit: Serenergy)*

Methanol is an attractive fuel for a wide variety of fuel cell applications. It is currently enjoying success across the world in various stationary applications, is of interest to the military in a number of countries to fuel portable fuel cells and is also extending the range and operational lifetime of batteries powering a small number of niche transport applications, such as materials handling vehicles. We have written a number of Analyst Views on the subject over the past two years covering the applications mentioned above, discussing methanol's environmental credentials and the potential to generate renewable methanol, and most recently the work by Danish company Serenergy which was demonstrating the potential for methanol to power range extenders for small battery electric city cars. The major automotive OEMs however have not shown interest in the technology for many years, instead focussing on compressed hydrogen storage in combination with low-temperature fuel cells; that is until earlier this year.

One of the main barriers to the widespread adoption of fuel cell electric vehicles has been the lack of readily available infrastructure. This problem is starting to be addressed, but mainly in areas which have long been supportive of fuel cell technology, such as California, or in countries and regions which either have a domestic automotive industry or companies involved in developing the hydrogen refuelling technology itself. It is popularly accepted that fuel cell technology will not be the only option on the market, but that over the coming decades biofuels, battery electric vehicles, hybrids and many other technologies will contribute to decarbonising transport. The choice of technology will largely be dictated by the driving cycles in each region and by the availability of the different fuels. Countries with low-carbon electricity, such as Norway, have already begun widespread adoption of electric vehicles which can be fuelled using grid electricity and which produce very low well-to-wheels carbon emissions. Indeed the all-electric Nissan Leaf was the top selling car in Norway during October 2013 accounting for 5.6% of the market and outselling conventional internal combustion engine vehicles.

At the 2013 Hannover Messe in Germany a launch event was held for an innovative project which aims to develop efficient regional mobility in Germany's Baden-Württemberg region by the year 2030. Dubbed REM 2030 (Regional Eco Mobility) the project is a building block for the development of futuristic mobility concepts, which is funded by the Fraunhofer-Gesellschaft and the Ministry of Economics of Baden-Württemberg. It will run until 2016 and plans to present concrete results of its development work to the public. Fraunhofer is the largest research organisation for applied research in Europe and is one the main partners on the project alongside the Karlsruhe Institute of Technology; the project also involves a close cooperation with a number of industrial partners. Primary objectives of the project are to develop innovative and efficient drive systems for electric vehicles which can provide emission-free operation of cars in cities and metropolitan areas; these goals are sub-divided into three core topics of hardware, software and orgware.

Within the framework of REM 2030, the German researchers are working together with German and Danish developers from the companies Fischer Eco Solution GmbH and Serenergy A/S in order to demonstrate the opportunities presented by new, lower-emission drive technologies, and to prepare and demonstrate their integration into future electric vehicles. This joint investigation concerns the use of methanol-driven fuel cells as possible range extenders for electrically-propelled vehicles. At the launch event in Hannover, a range-extended small family car was on display (pictured). The car body was donated by Audi to support the challenge of packaging this technology for use in future electric vehicle models. The so-called reformed-methanol fuel cell (RMFC) is a system with attractive electrical efficiency and power density, which is suitable for the range extension of battery-electrical vehicles. Integration of the electric drivetrain with high-temperature polymer electrolyte membrane fuel cells (HT-PEMFCs) not only extends the range of these vehicles by hundreds of kilometres with just one tank of methanol mixture, but also enables the efficient utilisation of waste heat for interior heating, facilitating an integrated, intelligent and active thermal management system.

Dr. Ing. Lars Fredrik Berg, coordinator of the core topic hardware within the innovation cluster REM 2030 and employee of the Fraunhofer Project Group for New Drive Systems commented "The cooperation with Serenergy A/S and Fischer Eco Solutions GmbH has decisively increased the value of the innovation cluster. The utilisation of RMFC technology enables us to present novel range extender solutions within this project, which emit considerably fewer pollutants in comparison to conventional range extender systems based on combustion engine concepts."

Mads Friis Jensen, Commercial Group Manager for Serenergy A/S added: "There is still progress to be made on a technical level, as with other alternative drivetrains, but not having to worry about refuelling infrastructure and logistics or high fuel costs is a compelling argument for a vehicle concept."

So the prospects for methanol fuel cells as range extenders for battery electric vehicles are not confined to niche vehicle applications after all. This is not the first time Audi has trialled range extenders for its electric vehicles either. It has previously demonstrated its A1 e-tron which contained a small, 245 cc Wankel engine. Successful demonstrations of fuel cell technology like this with high-profile partners such as Audi could pave the way for methanol to contribute to eco-mobility in the future.

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