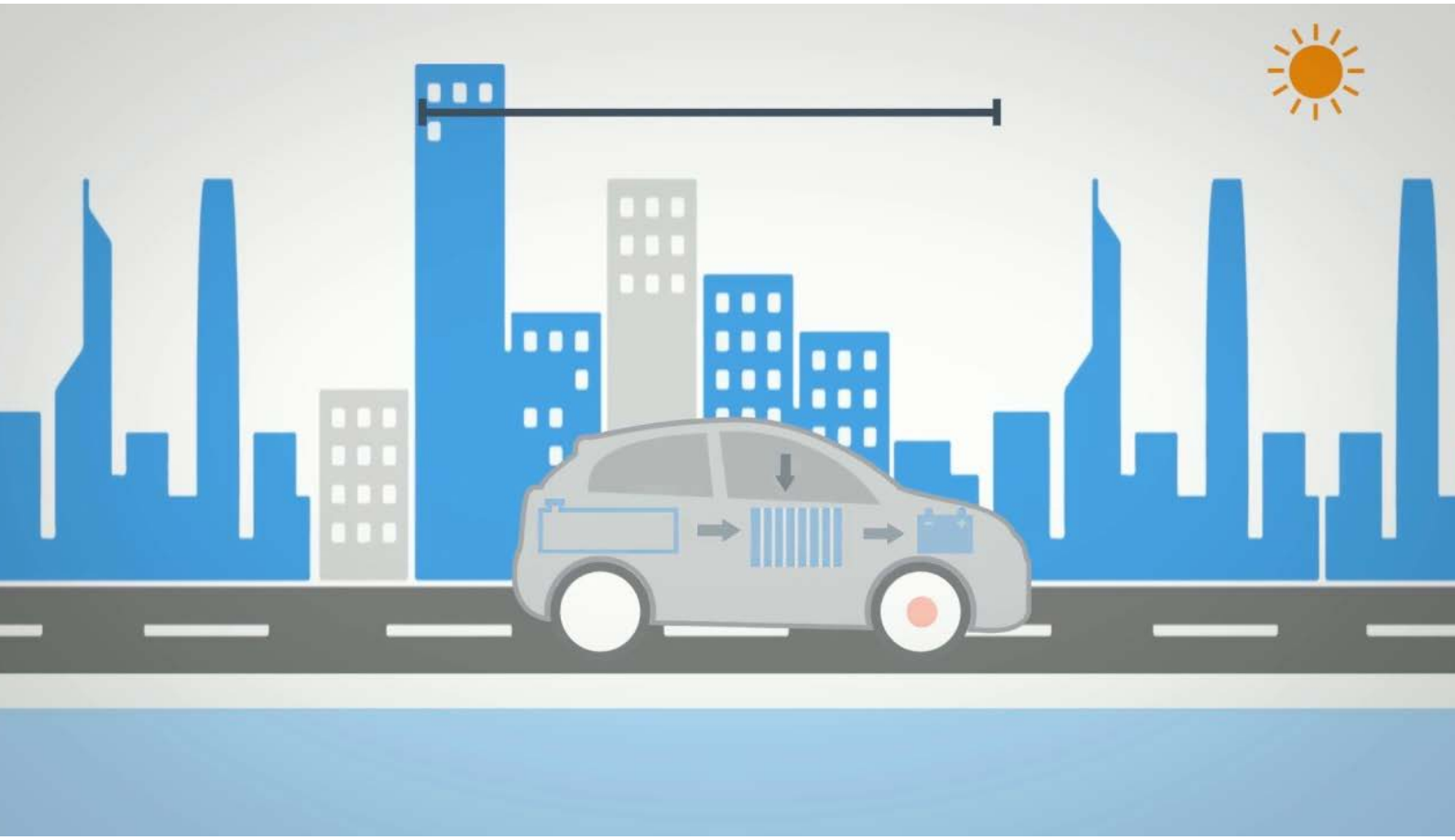
Danish Methanol Association

IEA-AMF Annex 56 Methanol as Motor Fuel – Annex 5 Fuel Cell



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Fuel Cell

Source: Blue World Technologies ApS

Danish Production

29. November 2018 Blue World Technologies presented plans for the world's largest methanol fuel cell factory located at the Port of Aalborg ready for global export of clean energy technology. Methanol fuel cell components will be produced in high volume enabling electric vehicles to have a 1000km range with 3 minutes refueling time.

Methanol is clean, cheap and simple to store and distribute – but more importantly, it can be made from electricity and clear air. This is key in a world where the production of renewable energy is increasingly electricity from wind and solar power.

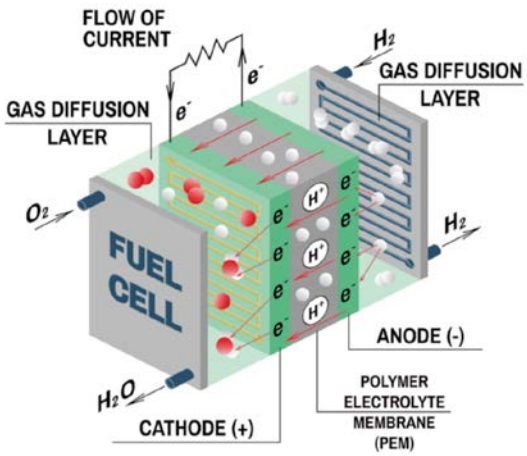
The real challenge is to match the energy consumption with the production of energy combined with a simple long-term storage solution.

Infrastructure is critical for all change, here methanol can be used today in existing bulk storage, trucks and stations around the world – there is no need to invest heavily in this area and no chicken/egg issues.
The Blue World Technologies concept is to utilize a hybrid platform that takes the best from direct electric plug-in charging and supplement it with power from a methanol fuel cell when taking longer trips or charging is not feasible. This enables 1000 km range with 3 minutes refueling in a light and competitive drivetrain platform.

Blue World Technologies is focused on the High-Temperature PEM-technology combined with methanol reforming. The combination ensures a simple system design with high conversion efficiency and compliance with automotive design requirements. The end solution is a vehicle with all benefits; long range, fast refueling, zero harmful emissions, and low fuel cost.

High-Temperature PEM fuel cells.

The HT PEM-technology operates at 160-180 °C and has a high resistance to impurities in reformat gas which makes it ideal to combine with fuel reformers. The combination can be done without the implementation of expensive and cumbersome clean-up technologies which enables a simple and cost-effective system design.



The HT PEM-technology is characterized by simple heat management and a minimum balance of plant components which in turn reduces the parasitic losses to run the system. The simple system design enables a high total system power density although the stack power density is lower than generic stack designs.

Methanol reforming

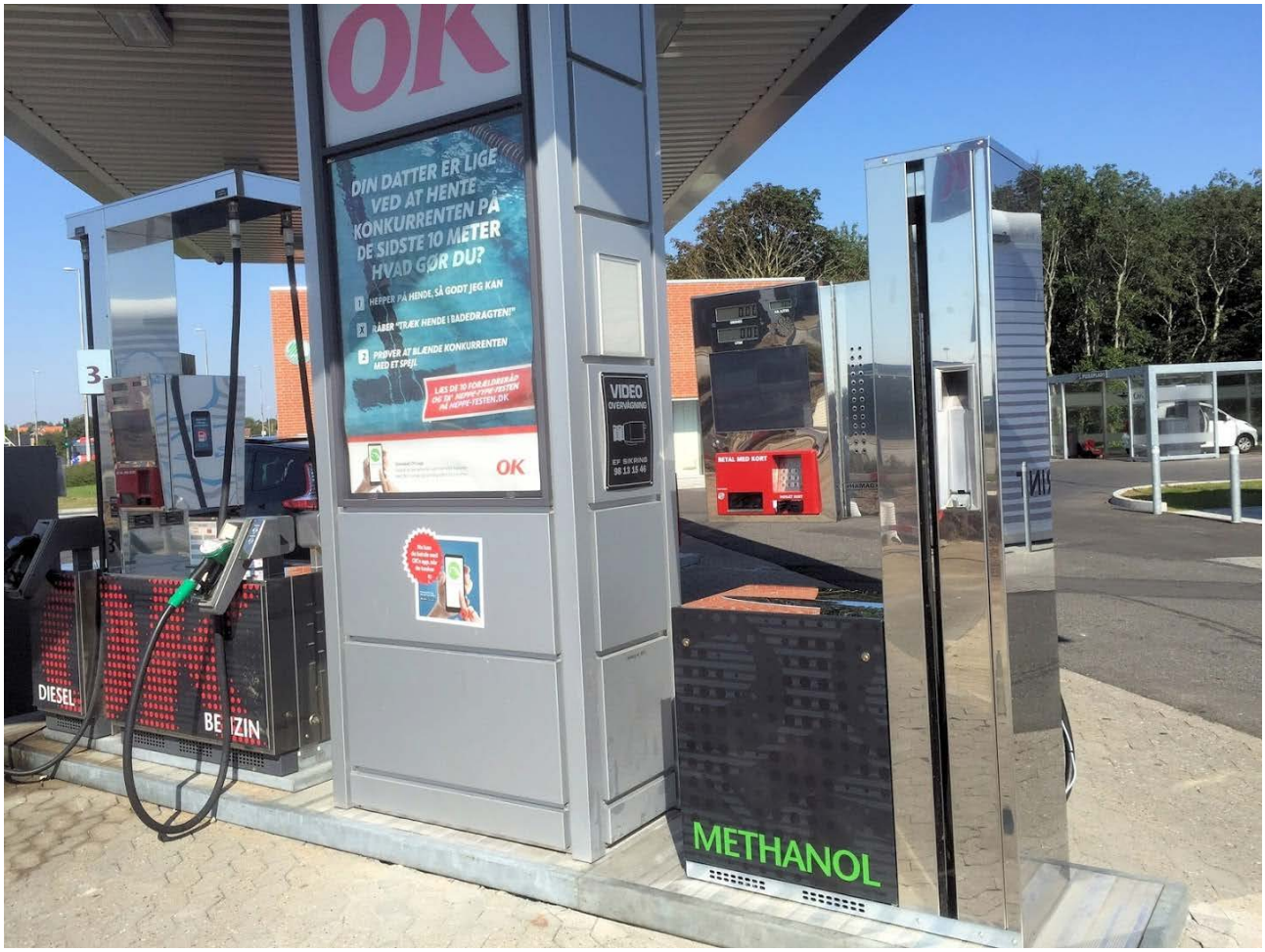
Methanol reforming is a relatively simple process that converts a mix of methanol and water into a hydrogen-rich gas. Before the reforming can take place, the fuel needs to go from liquid to gas form by evaporation, a process that requires energy and in a generic system

would mean using primary fuel, leading to lower efficiency. In the combination with HT PEM the waste heat is of sufficient temperature to drive this process, meaning an energy-free process which leads to a superior overall efficiency.

The fundamental chemical process, which takes place in the reformer is: $CH_3OH + H_2O \rightarrow CO_2 + 3\ H_2$. The hydrogen ($H_2$) produced is subsequently used in the fuel cell to produce electricity.

Battery hybridization

The Methanol Fuel cells are always implemented in a hybrid configuration thereby complementing a battery system. The battery is very good for short high-power needs and the fuel cell for an extended need of energy. By combining the two technologies both can be downsized considerably so only a relatively small battery pack and fuel cell compared with a single technology scenario. Furthermore, this enables a plugin option for e.g. daily use where a small battery pack is enough to cover the range need of a passenger car.



Zero harmful emissions

The methanol fuel cell has zero harmful emissions and upholds the World Health Organisations limits for office working environments except for the lower O_2/higher CO_2 content in the air. The fuel conversion does release CO_2 in which hydrogen has been contained to form a liquid – however this CO_2, when using renewable methanol, has been obtained from biomass thus closing a CO_2 neutral loop. Furthermore, CO_2 can be extracted from thin air and used in the methanol production consequently binding free CO_2 in fuel. Together carbon dioxide and water are the fundamental core of all life on earth – the source of the carbon, however, which often today is fossil, is the problem.

Methanol as a fuel

Methanol is already a widely used transportation fuel primarily as an additive or derivative and in China alone accounts for more than 7% of all transportation fuel. As a fuel methanol has many of the same characteristics as known logistical fuels with some exceptions. Methanol is biodegradable and fully solvable in water which means spills although not desired is naturally correctable. Methanol is safe in handling when implementing proven engineering spill free solutions preventing the user from coming into contact with the fuel or fumes. Efficiency.

The fuel cell can make 45% - 50% electrical efficiency with inverter. Inclusive motor and drivetrain the tank to wheel efficiency is 40-45%

Distribution

HAMAG has blender pumps enabling a variety of blends for both ICE and fuel cells engines. This allow distribution through same channels as 105 Octane M85.

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