# Fuel cell systems and hydrogen supply for early markets

## INTRODUCTION

The European FP7 project Liquid Power is coming to an end after 5 years of developing a new generation of fuel cell systems for back-up power markets and for material handling vehicles, as well as developing new innovative hydrogen supply methods for onsite methanol reforming.

The present report illustrates the development of an integrated fuel processor (FP) and pressure swing adsorption (PSA) system for onsite hydrogen production to fuel cell systems. In this project, Catator is responsible for the development and delivery of the pressurized FP system. ZBT is responsible for the development and delivery of the PSA system as well as for the integration and evaluation of both FP and PSA systems. Dantherm Power is responsible for the development of fuel cell systems for back-up power and for material handling vehicles.

A new generation fuel cell system for backup power has been developed in the project.

The fuel cell system is constructed in such a way that it is scalable in nominal output power from 1.6kW to 5.0kW. Also, the system can be modified with an add-on Cold Climate Kit, which enables the system to operate at very low ambient temperatures (-40 degrees Celsius).

## ONSITE FUEL PROCESSOR SYSTEM

The fuel processor which has been developed is based on a coil-concept, where a steam reforming catalyst is inserted into a helix shaped tube (Optifomer design). The basic idea is to minimize thermal stress on the steam reformer section. The overall dimension of the reactor is ca. diameter 312 x length 415 (mm) and its weight is ca. 50 kg, which makes it suitable for onsite fuel reforming.

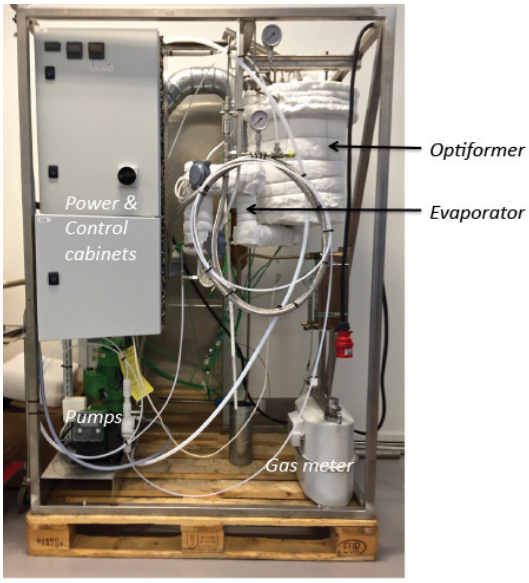
## PRESSURE SWING ADSORPTION SYSTEM

On an industrial scale, state of the art pressure swing adsorption plants have typical outputs of up to 100,000 m³/h of pure hydrogen. Small to medium hydrogen production plants in the range of 10 m³/h commonly apply alternative purification technologies, which often lack in hydrogen purity or have to employ very costly materials like Palladium/Silver (Pd/Ag)-membranes. This is the target for the Liquid Power project.

The main challenge for the development of the PSA is the technical and economic feasibility of the small scale PSA in the context of pressurized methanol reforming. The nominal capacity is in a range of 10 m³/h (30 kW) pure hydrogen and the design pressure is 12 bar, suitable for onsite hydrogen production. The PSA contains commercially available components, and the system design makes it capable of achieving a following third party CE certification. The application of both the Machinery Directive and the Pressure Equipment Directive specify a clearly structured roadmap for a future commercial launch of the PSA.

## ONGOING WORK

The present work is focused on commissioning and evaluating the fuel processor and pressure swing absorption as an integrated system as well as evaluating the new fuel cell systems for back-up power and material handling vehicles for the markets. The final results are expected to be available in the spring of 2016.




*The FP system during verification tests*

*Assembly of Pressure Swing Adsorption System (rights by Photograph: www.eventfotograf.in / ©JRF e.V.)*

## CONTACT DETAILS

**Dantherm Power**
Majsmarken 1, DK-9500 Hobro, Denmark
www.dantherm-power.com