

## Hydrogen - A Competitive Energy Storage Medium To Enable the Large Scale Integration of Renewable Energies

Seville, 15-16 November 2012

# Pressurised PEM Electrolyser stack [PrimoLyzer]

### Overall Objectives and Budget

The primary objective of the PrimoLyzer project was to develop, construct, and test a cost-minimised highly efficient and durable PEM-Electrolyser stack aimed for integration with domestic  $\mu$ CHPs. This was achieved through a combination of the following activities:

- Basic material R&D on catalyst and membrane
- Process development to fabricate high performance MEAs
- Stack engineering
- Continuous test

**A low cost PEM electrolyser stack aimed for direct high pressure H<sub>2</sub> production has been developed.**

### Technical Barriers and Targets

The state-of-the-art PEMEC stack cost is currently prohibitively expensive mainly due to a high MEA precursor cost and expensive bipolar plates. The overall aim of PrimoLyzer was to reduce the stack cost to less than 5,000 € [1 Nm<sup>3</sup>/h] in small scale production [100 units] by basic material R&D on MEA precursors, MEA optimisation, and stack design.

### Technical accomplishments / progress / results

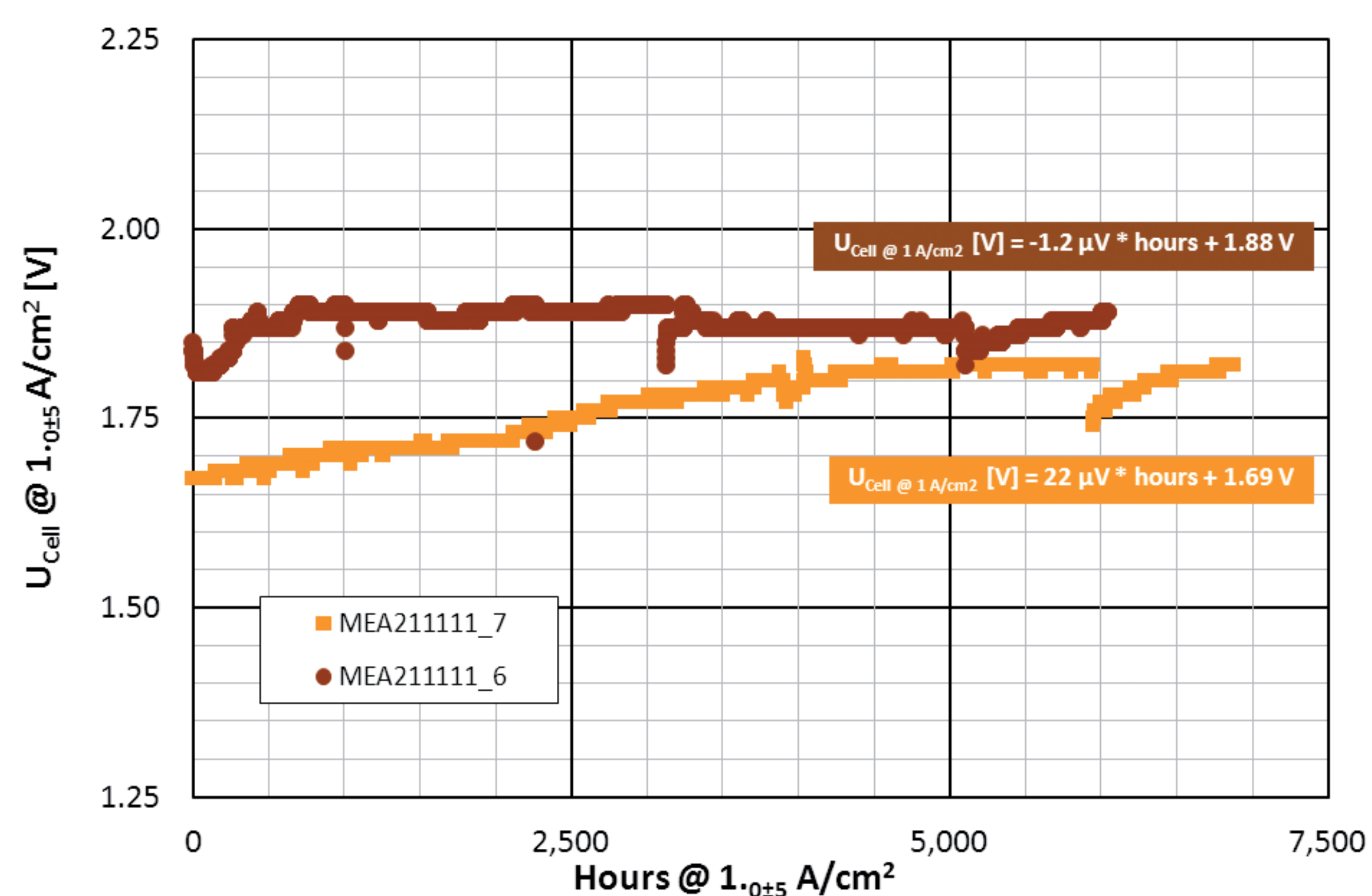
The work was initiated by an analysis of a PEM electrolyser aimed for integration with surplus wind and solar power. The results made base for the stack specification [input power: 4 kW & input voltage: 48 VDC].

The basic MEA precursor R&D includes:

- Development of multi walled carbon nanotube supported Pt & PtPd catalysts
- OER catalysts developed on basis of molecular modelling and experimental verification
- Development of a new reinforced PFSA membrane with improved properties



The 29-cell PrimoLyzer stack with a production capacity of 1 Nm<sup>3</sup> H<sub>2</sub>/h.



Examples of long-time single PEMEC cell durability.

Several MEAs have been manufactured and tested for longer periods [in total  $\approx$ 17,000 test hours]. The best performing MEAs are equipped with the PrimoLyzer OER catalyst and the PrimoLyzer membrane. The single cell IR-corrected polarisations of optimised MEAs show a better performance than targeted [1.64 V @ 1.2 A/cm<sup>2</sup>] for MEAs with less than the targeted catalyst loadings [actual An./Cat. loading: 0.3/0.5 mg per cm<sup>2</sup>]. A PEMEC stack for direct high pressure H<sub>2</sub>-production was designed and tested.

### Future Work

The Partners aim to continue the work in a PrimoLyzer II project that will include system integration and field test together with RES.

### Conclusions and major findings

The developed PEM electrolyser stack cost is well below 5,000 € in small scale production [100 units]. The concluding stack test showed the following efficiencies:

- PEMEC stack:  $P_{AC} \rightarrow H_2$ : 60%
- PEMEC system:  $P_{AC} \rightarrow H_2 + P_{TH}$ : 96%

### Project Overview

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- ECN, VTT, Fuma-Tech, Abengoa Hidrógeno & Åbo Akademi
- 1-Jan-2010 to 1-Jul-2012
- www.primolyzer.ird.dk