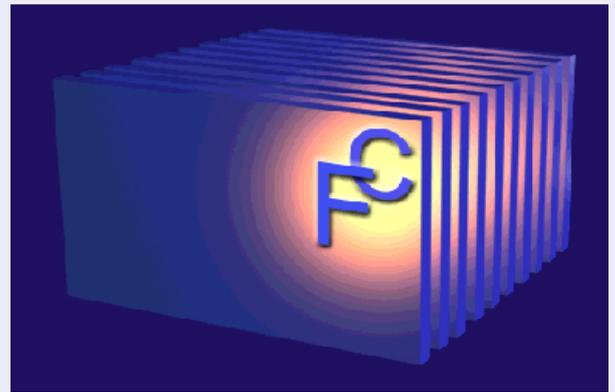




IEA Advanced Fuel Cells

Implementing Agreement



AUTUMN NEWSLETTER

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ExCo meeting – Salzburg, Austria – May 2013

The 46th Executive Committee (ExCo) meeting took place during May 2013 in Salzburg, Austria where key representatives from the Advanced Fuel Cells group were warmly welcomed. We had an excellent two-day meeting at Salzburg AG and were well looked after by the Austrian Energy Agency.

Our meeting focused on current Annex activities, with reports given by Annex 22: PEFC, Annex 23: MCFC, Annex 24: SOFC, Annex 25: Stationary Fuel Cells, Annex 26: Fuel Cells for Transportation, Annex 27: Fuel Cells for Portable Applications and Annex 28: Systems Analysis.

It was agreed at this meeting to progress the topic of creating a new Annex to encompass the design and requirements of electrolysis systems.

Below are a few highlights and discussion points from the Annex Reports. For more detail on our Annex work and our priorities, please see our [Annual Report](#) and visit our [website](#) for details of how to become involved.

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Annex 22 – Polymer Electrolyte Fuel Cells (PEFC)

The long-term performance and stability of PEFC are critical to the successful commercialisation of the technology. Annex 22 has seen a greater emphasis of R&D focused on membrane electrode assembly (MEA) component degradation – including catalyst, catalyst support and the proton exchange membrane – with the use of more advanced characterisation tools to reveal the mechanisms occurring. Significant knowledge and insights into the degradation mechanisms have been gained with the recent research focus, which will help to design systems with reduced degradation rates and improved lifetimes. It is expected that this topic will continue to be one of the research focuses going forward in this area.

PEFC is the technology used in fuel cell electric vehicles (FCEV). Continuous improvements in the fuel cells, the systems and the successful development of hydrogen pressure tanks have allowed a range of 560km for a FCEV to be achieved. Cold weather performance of FCEV is now equivalent to that of gasoline-powered vehicles. A number of automobile manufacturing companies are planning to launch FCEVs, targeting widespread commercialisation by 2015. Therefore, the demand for fuel cells (typically PEFC) is expected to increase in the automobile sector. It is also expected that demand for portable fuel cells (mainly direct methanol fuel cells (DMFC)) will increase, especially in the consumer and industrial electronics sectors.

Annex 23 – Molten Carbonate Fuel Cells (MCFC)

Annex 23 works to expedite commercialisation of MCFC systems. Use of MCFC systems for generating baseload electricity for a national or regional electricity grid is accelerating. An 11.2MW fuel cell park was installed at Daegu city in Korea, with POSCO Energy. The company is also successfully running 17 separate sites across Korea with a combined installed capacity of 52.2MW. A 14.9MW fuel cell park is now under construction in Connecticut, USA and the largest MCFC plant to date at 58MW is under construction in Hwasung, Korea. The new ‘golden age of gas’ may be a big opportunity for fuel cells, particularly for MCFC.

Artist's impression of the Hwasung 58MW site in South Korea, currently under construction

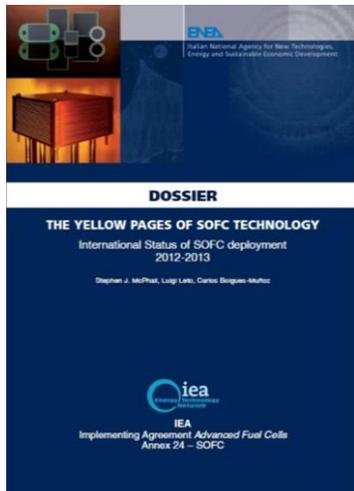


Developments in MCFC technology are closely followed by the work of this Annex. Recent advances from the partnership of KIST, POSCO Energy and Doosan Heavy Industry include a 300kW MCFC energy recovery generation system, which includes a turbo expander to prolong fuel-cell life expectancy and increase energy efficiency of the system.

MCFC technology can be used for applications beyond baseload grid power. Examples of this include POSCO Energy developing large-scale sea-vessel applications for launch by 2016 and Doosan Heavy Industry's MCFC desalination plant in Korea. There is continued work with MCFC for CO₂ capture and separation with ENEA in Italy, particularly looking at performance and cathode-side contaminants (SO_x, NO_x, etc) and poisoning mechanisms of H₂S.



Annex 24 – Solid Oxide Fuel Cells (SOFC)



SOFC are characterised by high efficiency and fuel flexibility, with efficiencies achieved ranging from 40% to 60% in a full system. SOFC's efficiency is unique in being practically independent from the system's scale, with 1kW power output systems being demonstrated to have 60% net efficiency.

SOFC can serve a large variety of applications and, in particular, the most promising areas for their immediate use are:

- Mobile, military and strategic (less than 1kW_e).
- Auxiliary power units (APU) and back-up power (1kW_e - 250kW_e).
- Stationary small-scale combined heat and power (m-CHP) (1kW_e - 5kW_e)
- Stationary medium - large scale (100kW_e - 10MW_e)

This Annex recently published the [Yellow Pages of SOFC: International Status of SOFC Deployment](#), which is publicly available on our [website](#).

Annex 25 – Stationary Fuel Cells

Annex 25 studies stationary fuel cell systems, with a particular focus on renewable fuels for fuel cells. The work also focuses on market variations and obstacles that need to be overcome to enable further market penetration.

Stationary fuel cells have undergone remarkable expansion recently. Installations of Toshiba's Ene-Farm domestic-scale fuel cells for distributed electricity generation continue to expand rapidly, with over 42,000 systems installed between 2009 and 2012. Demand for this product is expected to remain high in 2013.

Toshiba's Ene-Farm domestic fuel cell product for Japanese households



Uptake of domestic-scale fuel cells for microCHP in Europe are picking up – with the Callux Programme

installing 800 fuel-cell heating appliances and the FuelCell@Home Programme installing 200 domestic SOFC systems in Germany, 20 pilot systems installed in Denmark and the European ene.field programme installing 1,000 fuel cell microCHP appliances from a range of manufacturers across Europe. A recent review of the conditions for [microCHP in Germany](#) was published by this Annex and is available on our [website](#).

There has also been significant expansion in the use of fuel cells for back-up power. Dantherm Power has provided 1,500 systems in Europe for use in cell phone towers, over 650 publicly declared installations in the USA, and many more across India and Canada.

kW – kilowatt, kW_e – kilowatt electric: one thousand watts of electric capacity.



Annex 26 – Fuel Cells for Transportation

Research and development in the area of fuel cells for transportation is extremely active, with many demonstration projects underway and some initial market penetration. There is a consensus that automotive manufacturers are aiming at 2015 as the year to begin wide-scale introduction of FCEVs after several years of successful demonstration projects and programmes.

Annex 26 looks at the rapidly developing automotive fuel-cell technology, energy efficiency, emissions and economics. A highlight identified recently is that FCEV have achieved more than twice the efficiency of today's gasoline vehicles with average refuelling times of five minutes for four kilograms of hydrogen (US DOE Controlled Hydrogen Fleet and Infrastructure Validation and Demonstration Project¹). In addition, the 2nd generation buses in the US Fuel Cell Electric Bus Program are achieving double the fuel economy of conventional buses and meeting the target of 8 miles per diesel gallon equivalent – the average availability is 53% and improving, the distance between road calls has shown a 38% improvement over the 1st generation buses and the top fuel cell power plant has surpassed 12,000 hours demonstrated lifetime. All of these results demonstrate that fuel-cell powered transportation is a very real option for the near future.

Hyundai's ix35 powered by fuel cells



Vehicles powered by fuel cells need a hydrogen infrastructure to allow for refuelling. One cannot occur without the other. Therefore, many countries have committed to installing hydrogen refuelling stations by 2015. This includes 100 stations in Japan, 50 in Germany and plans to allow country-wide navigation in Denmark.

Annex 27 – Fuel Cells for Portable Applications

Recently, it has become apparent that portable fuel cells have made significant inroads into military applications. It is interesting to observe the developments as such products are driven by function to a greater extent and less by cost. Such deployments have been identified to include:

- Soldier-worn systems that generate between 20W and 50W that can be used by the systems carried on an individual soldier. These systems are often integrated with a portable energy management system.
- Battery chargers providing power in the range of 90W to 500W and are, in most cases, used by entire squads.
- Tactical generators that provide power in the range of 1kW to 5kW to forward operating dismantled troops.

¹Wipke, K., et al, 2012. National Fuel Cell Electric Vehicle Learning Demonstration Final Report. National Renewable Energy Laboratory, Golden, Colorado, USA



Portable fuel cells for public use are beginning to gain markets. A recently released product is myFC – a small, portable, fuel-cell system generating 5W_e from a PEFC. This system is fuelled by hydrogen, instantly generated from a fuel puck when water is added. The intention is to start with sales in Europe, the USA and Japan in 2013.

The myFC portable charger for electronic gadgets and the power puck



Within medium-size systems suitable for hybridisation with batteries, SFC Energy AG has sold more than 20,000 DMFC-Systems and is the market leader. Its EFOY range is designed for industry and recreational applications, including recreational vehicles, boats and cabins. The EFOY Comfort is intended to provide on-board battery recharging, with an electrical power output of 105W and a runtime of more than 3,000 hours.

Annex 28 – Systems Analysis

The aim of the Annex is to gather together a competent and factual information base for technical and economic studies, in a technical reference book. The book will look in detail at the technology readiness level (TRL) through test and demonstration data, comparing fuel cells with traditional batteries, internal combustion engines or turbines. It will also cover other fuel cell issues such as system components and key infrastructure technologies. The main chapters of the book have been agreed.

OUR ACTIVITIES

Forthcoming Annex Meetings

- Annex 22: 10-12 December 2013, Tokyo, Japan.
- Annex 23: November 2013, Columbus, Ohio, USA.
- Annex 24: 5 October 2013, Okinawa, Japan – in conjunction with the 13th International Symposium on Solid Oxide Fuel Cells.
- Annex 25: 23-24 April 2014, Trento, Italy – followed by Fall Meeting in Denmark at Dantherm Power.
- Annex 26: 14th May 2013, Arlington, USA.
- Annex 27: 11-12 September 2014, Messina, Italy.

The next Executive Committee meeting will be held from 18 to 20 November 2013 in Jerusalem, Israel. Members will benefit from visits to the Israeli fuel cell companies of Celleria and Gencell.



NOT TO BE MISSED

The 20th World Hydrogen Energy Conference 2014 (WHEC2014) hosted by the International Association for Hydrogen Energy (IAHE) is to be held between the 15 and 20 June 2014 at the KDJ Convention Center, Gwangju Metropolitan City, Korea.

Join our Work!

We welcome new participants to our work, at the expert level, company level and country level. Participants from member countries (ieafuelcell.com/contact) may join the work of our Annexes, please contact the following:

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Annex 25: Stationary Fuel Cells, Bengt Ridell: bengt.ridell@grontmij.se

Annex 26: Fuel Cells for Transportation, Dr Rajesh Ahluwalia walia@anl.gov

Annex 27: Fuel Cells for Portable Applications, Dr Martin Müller: mar.mueller@fz-juelich.de

Annex 28: Systems Analysis, Dr Can Samsun: r.c.samsun@fz-juelich.de

If you are from a non-member country, please contact Dr Louise Evans at Secretariat-AFCIA@ricardo-aea.com who would be delighted to discuss membership with you, either on a country basis or on a company basis. To see the benefits of joining our work, visit ieafuelcell.com/joining

Special thanks to the following companies and organisations for their permission to use the pictures in this Newsletter.

- KIST and POSCO for the artist's impression of the Hwasung site.
- Toshiba for use of its Ene-Farm product picture
- Hyundai for pictures of the ix35 fuel cell car
- myFC for use of its PowerTrek pictures