


IEA Advanced Fuel Cells Implementing Agreement (IA)

U.S. Senate
July 31, 2009

Dr. Mark C. Williams
Visiting Professor, Fellow of the
Electrochemical Society


1



New Industrial Revolution

- We will always have chemical energy from sunlight on this planet
 - Coal, petroleum and natural gas are stored chemical energy from the past
 - Methane from human, animal and plant residues and wastes captured from sunlight will be available for tomorrow
- Fuel cells technology transforms electricity production in stationary and transportation applications because it is the **most efficient** way to convert chemical energy to electricity
- Fuel cells are the enabler for all types of primary energy - coal, NG, biomass. When fuel cells are placed in systems converting the chemical energy of these primary energies to electricity, fuel cells make all the systems more efficient.

2



IA Aims, scope & participation

- The IA aims to advance knowledge in the field of (advanced) fuel cells.
- Task shared R&D + information exchange
- Covers technologies and applications for:
 - Polymer Fuel Cells (PEFC)
 - Solid Oxide Fuel Cells (SOFC)
 - Molten Carbonate Fuel Cells (MCFC)
- 19 participating countries including USA, EU members, Japan


3



Participating countries



4




Annexes List / Operating Agents – 2008

- Annex XVI Polymer Electrolyte Fuel Cells (US DOE, Argonne National Laboratory)
- Annex XVII Molten Carbonate Fuel Cells (KIST, Korea)
- Annex XVIII Solid Oxide Fuel Cells (varies between the member countries – now Finland)
- Annex XIX Fuel Cells for Stationary Applications (Eon, Sweden – SOFC, MCFC, PEFC)
- Annex XX Fuel Cells for Transportation (ECN, Netherlands ^[1] PEFC, MCFC and SOFC (APU))
- Annex XXI Fuel Cells for Portable Power (Forschungszentrum Jülich, Germany - PEFC)

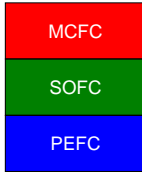
^[1] ^[1] Operating Agent for Annex XX was TU Berlin, Germany until November 2006

5

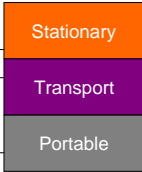


Annex structure

Technology annexes



Application annexes



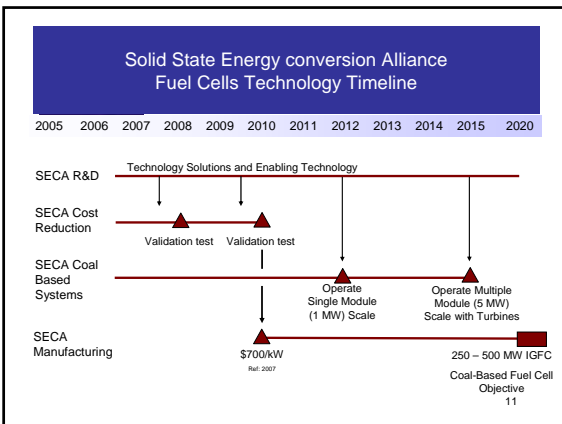
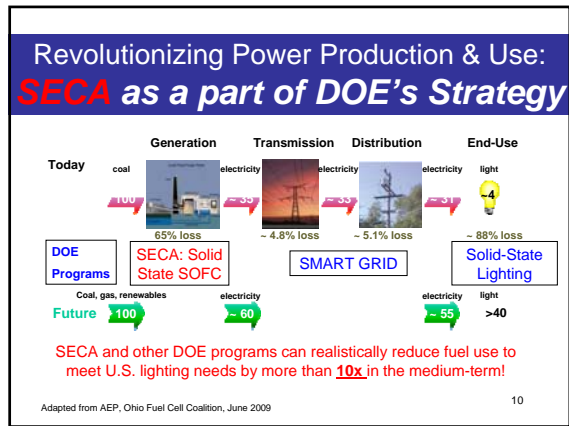
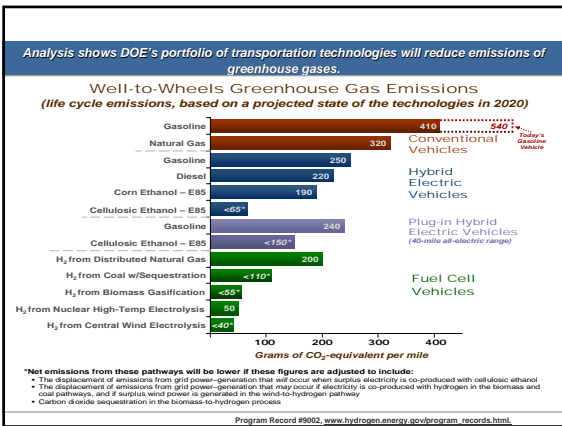
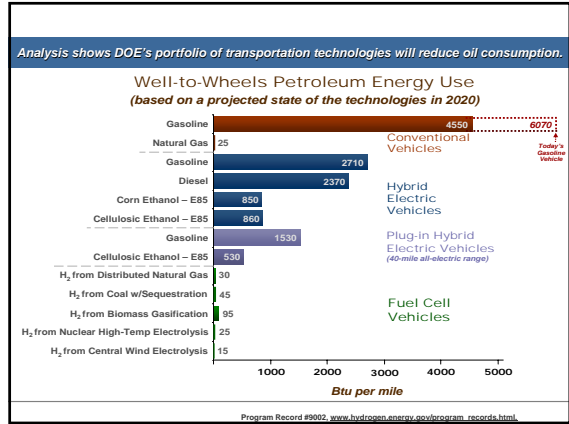
6

Annex Participation

Participation in the current annexes

	Annex XVI	Annex XVII	Annex XVIII	Annex XIX	Annex XX	Annex XXI
Australia	X		X	X		
Austria	X			X	X	X
Belgium	X			X		
Canada	X		X		X	X
Denmark	X		X	X	X	X
Finland	X		X	X	X	X
France	X	X	X	X	X	X
Germany	X	X	X	X	X	X
Italy	X	X	X	X	X	X
Japan	X	X	X	X	X	X
Korea	X	X	X	X	X	X
Mexico	X					
Netherlands	X		X	X	X	
Norway	X		X	X	X	
Sweden	X		X	X	X	
Switzerland	X	X	X	X		
Turkey	X	X	X			
UK	X		X	X	X	
USA	X	X	X	X	X	


7



Technical Achievements 2004-2008

- Technology annexes:
 - Materials & process development
 - Stack development & testing
 - System modelling
- Applications annexes:
 - Learning from demonstration projects
 - Market studies
 - Well to wheel studies


12



Annex Accomplishments

- **Annex XX: Fuel Cells for Transportation**
 - Information has been shared on targets, status and projections for automotive fuel cell systems, including results from a study of the cost breakdown of components of a PEMFC stack. A review has been undertaken of hydrogen storage options and their status, characteristics and challenges. Information has been exchanged on the progress and future plans of fuel cell vehicle development programmes in participant countries.
- **Annex XXI: Fuel Cells for Portable Applications**
 - Two expert meetings were held in 2005 and 2006, at which information was exchanged on system analysis, system, stack and cell development, and materials innovation.


13



Annex Accomplishments

- **Annex XIX: Fuel Cells for Stationary Applications**
 - A study has been completed on the market prospects for fuel cells in different countries based on the latest available information regarding the development of and the market conditions for stationary fuel cell systems. One of the important outcomes from this market study is that the different conditions in different countries and regions like energy prices, grid stability, demand pattern for heating and cooling domestic energy sources etc are very important for the introduction of fuel cells. The conditions are not at all the same and this is especially valid for the small stationary fuel cells. For the larger fuel cells it is not so sensitive as they operate for longer periods with base load characteristics and can ideally use locally produced fuels. In that case is the investment costs not that important but the high efficiency and reliability of the fuel cells plant are major advantages. The environmental advantages are also one of the major factors for the decision to invest in a stationary fuel cells plant.

14



Annex Accomplishments

- **Annex XVI: Polymer Electrolyte Fuel Cells**
 - Technical achievements in Annex XVI have included sharing of information on:
 - new methods for making lower-cost, higher durability platinum electrodes,
 - development of an ammonia-fuelled PEFC,
 - development of an 80kW system for fuel cell locomotives,
 - understanding of the degradation mechanisms involved when cells are started up and shut down, and when they are exposed to sub zero temperatures,
 - development of a PEFC stack simulator for system studies,
 - studies on the effect of air impurities on the performance of cell components, and
 - performance modelling of high temperature PEFCs.
- **Annex XVII: Molten Carbonate Fuel Cells**
 - The latest R&D data on MCFC stack and system performance have been presented and discussed at annual workshops. Discussions have centred on reducing stack degradation rates and costs through better design and improved materials.
- **Annex XVIII: Solid Oxide Fuel Cells**
 - Annex XIII has held a series of successful annual workshops to exchange information on SOFC cells, stacks and systems. Workshops held to date have addressed low cost manufacture and design; low temperature operation; systems, and; modelling of cell and stack operation and electrode processes. They have also provided an opportunity to share information on national programmes and industry activities.

15




USA Benefits

Information exchange

“One of best forums for understanding world R&D status of fuel cell technology – pace and direction; discussion of difficulties and obstacles in fuel cell commercialization; Identification of markets for USA products.”

16



Wider Benefits 2004-2008

- Open discussion of technical issues
- Information exchange
- National programmes
- Further collaboration


“Being a multi-disciplinary research area, fuel cells need to be cross-fertilized by people from different laboratories around the world.” “The level of openness and personal contact is superior to bigger conferences”

“The primary benefit is that you get a true international network within fuel cells. There are no other forums where you can cooperate with Japan, USA, Canada etc.”

“The IEA work has enabled us to shape the hydrogen and fuel cell program in the Netherlands”

“Participation enabled POSCO (a Korean steel maker) to start new fuel cell business with FCE of USA”

17



Strategy for the period 2009-2013

Further strengthen cooperation through activities that:

- Continue and expand the informational network
- Perform market assessment and monitoring
- Identify and lower barriers to implementation
- Develop technical and economically viable stacks and systems
- Stimulate tools for, and knowledge of, balance of plant
- Increase the value of demonstration programmes by evaluating test data
- Contribute to feasibility studies of deployment of FC technologies

In this way the Implementing Agreement (IA) can make a major contribution to addressing the barriers to FC commercialisation and improve the efficiency and effectiveness of other national and international FC activities.

18



Annexes - Future

- Annex 22: Polymer Electrolyte Fuel Cells
- Annex 23: Molten Carbonate Fuel Cells
- Annex 24: Solid Oxide Fuel Cells
- Annex 25: Fuel Cells for Stationary Applications
- Annex 26: Fuel Cells for Transportation
- Annex 27: Fuel Cells for Portable Applications

19



Thank you for your attention

For further information about today's briefing
please contact:

Ms. Mary-Rose de Valladares
IEA HIA Secretariat

+1 301 634 7423

mvalladares@ieahia.org

20



Our thanks go to:

Mrs Heather Haydock
Secretary, IEA Advanced Fuel Cells
Executive Committee

heather.haydock@aeat.co.uk

Or see the IEA AFC website at
www.ieafuelcell.com

21