IEA HIA:
Positioning Hydrogen for a Global Marketplace through R,D&D, Analysis and Outreach

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Fuel Cell Seminar
San Antonio, Texas, USA October 21, 2010
IEA HIA Presentation

- Introduction
- The IEA HIA Strategic Plan and Portfolio
- The Roles of Analysis and Outreach
- Member Activities
Autonomous body within the Organization of Economic Cooperation and Development (OECD), founded in 1974 to carry out energy cooperation among member countries.
Hydrogen Implementing Agreement (HIA)

A collaborative research and development (R&D) program
Created in 1977 on a task-shared, “bottom-up” basis

Strategic Framework

Vision
A hydrogen future based on a clean sustainable energy supply of global proportions that plays a key role in all sectors of the economy

Mission
To accelerate hydrogen implementation and widespread utilization to optimize environmental protection, improve energy security and promote economic development internationally while establishing the HIA as a premier global resource for expertise in hydrogen

Strategy
To facilitate, coordinate and maintain innovative research, development and demonstration (RD&D) activities through international cooperation and information exchange

Fuel Cell Seminar 2010 San Antonio
IEA HIA Tasks Since 1977

1. Thermochemical Production
2. High-Temperature Reactors
3. Potential Future Markets
4. Electrolytic Production
5. Solid Oxide Water Electrolysis
6. Photocatalytic Water Electrolysis
7. Storage, Conversion and Safety
8. Techno-Economic Assessment
9. Hydrogen Production
10. Photoproduction of Hydrogen
11. Integrated Systems
12. Metal-Hydride for H₂ Storage
14. Photoelectrolytic Production
15. Photobiological Production
16. H₂ from Carbon-containing mat.
17. Solid & Liquid Storage Materials
18. Integrated Systems – II
19. Hydrogen Safety - II
20. Hydrogen from Waterphotolysis
22. Fundamental & Applied H₂ Storage Materials Development
23. Small-Scale Reformers for On-Site H₂ Supply (SSR for H₂)
24. Wind Energy and H₂ Integration
25. High Temperature Processes for H₂ Production
26. Advanced Materials for H₂ from Waterphotolysis
27. Near-Market Routes to H₂ by co-utilization of biomass with fossil fuel
28. Large Scale Hydrogen Delivery Infrastructure
29. Distributed and Community H₂ (DISCO H₂)
30. Global Hydrogen Systems Analysis
2009 – 2015 Themes

Collaborative R, D & D
that advances hydrogen Science and Technology
- Hydrogen Production
- Hydrogen Storage
- Integrated Hydrogen Systems
- Hydrogen integration in existing infrastructure

Analysis that Positions Hydrogen for
- Technical progress and optimization
- Market preparation and deployment
- Support in political decision-making

Hydrogen Understanding, Awareness and Acceptance
that foster technology diffusion and commercialization
- Information Dissemination
- Safety
- Outreach
Theme: Collaborative R,D&D

Portfolio: HYDROGEN PRODUCTION
Task 21: BioHydrogen
May 1999-May 2013 (recently extended)
OA: Dr. Michael Seibert

Task 22: Small-Scale Reformers for On-Site H2 Supply
December 2006 - December 2011 (recently extended)
OA: Dr. Ingrid Schjølberg of Sintef

Task 23: Advanced Materials for Waterphotolysis of H2
May 2008 - May 2011
OA: Dr. Eric Miller of U.S. DOE Washington, D.C. USA

Task 24: Wind Energy and H2 Integration
December 2006-December 2010
OAs: Dr. Luis Correas - Ismael Aso (Hidrógeno Aragón)

Task 25: High Temperature Processes for H2 Production
May 2007 - May 2011
OA: Dr. François Le Naour of CEA

Task 26: Near-Market Routes to H2 by Co-Utilization of Biomass as a Renewable Energy Source with Fossil Fuel
2008 - 2011
OAs: Dr. Jan-Erik Hanssen and Ms. Elif Caglayan

Task 27: High Temperature Processes for H2 Production
May 2007 - May 2011
OA: Dr. Francois Le Naour of CEA

Task 28: Advanced Materials for Waterphotolysis of H2
May 2008 - May 2011
OA: Dr. Eric Miller of U.S. DOE Washington, D.C. USA

Task 29: Small-Scale Reformers for On-Site H2 Supply
December 2006 - December 2011 (recently extended)
OA: Dr. Ingrid Schjølberg of Sintef

Task 30: Wind Energy and H2 Integration
December 2006-December 2010
OAs: Dr. Luis Correas - Ismael Aso (Hidrógeno Aragón)
Theme:
Collaborative R,D&D

Portfolio:
HYDROGEN STORAGE

HYDROGEN IMPLEMENTING AGREEMENT
Task 22: Fundamental and Applied Hydrogen Storage Materials Development

December 2006-November 2012 (recently extended)

3 Targets:
- Reversible or regenerative storage media
- Fundamental & engineering understanding
- Storage materials for stationary apps.

20 HIA countries, 53 projects: World’s largest collaboration on H2 storage

- Project types: experimental, engineering, theoretical, safety
- Classes of Materials: Reversible metal hydrides, Regenerative hydrogen storage materials, Chemical hydrides, Nanoporous materials, Rechargeable organic liquids and solids
- Gordon Conference style meetings ultimate forum for expert cooperation; 450+ publications/articles; 450+ presentations up to December 2008
- 17 patents from predecessor Task 17 (June 2001-May 2006)

OA: Dr. Bjørn C. Hauback of IFE
Theme: Collaborative R,D&D

Portfolio: INTEGRATED H₂ SYSTEMS
Task 23: Small-Scale Reformers for On-Site H2 Supply
December 2006 - December 2011 (recently extended)
OA: Dr. Ingrid Schjølberg of Sintef

Task 18: Integrated Systems Evaluation
January 2004 - December 2009 (recently completed)
OA: Dr. Susan Schoenung (Longitude 122 West, Inc., USA)

Task 29: Distributed and Community Hydrogen
December 2010 - December 2013 (preliminary approval)
OA: Dr. Federico Villatico

Task 2: Integrated Systems Evaluation
January 2004 - December 2009 (recently completed)
OA: Dr. Susan Schoenung (Longitude 122 West, Inc., USA)
Theme: Collaborative R,D&D

Portfolio: H₂ INTEGRATION IN EXISTING INFRASTRUCTURE
Theme:
Analysis that Positions Hydrogen

Portfolios:
TECHNICAL, MARKET, AND SUPPORT FOR POLITICAL DECISION-MAKING
Past Technical Analysis

Near Term

Medium Term

Long Term

R&D Priorities and Gaps in H₂ Production and Storage

Available for downloading at http://www.ieahia.org/iea_publications.html
Analysis and Influence

1. Analysis
2. Budget Development
3. Support R&D, Private Investment
4. Results and Outcomes
5. Policy Making
6. Policy Decisions
7. Information and Conclusions
Task 30: Global Analysis of Hydrogen Systems

May 2010-June 2013

Goal:
- Preparation of authoritative and balanced analysis that informs policymakers and stakeholders

3 Subtasks:
- Subtask A: reports
- Subtask B: database development and update of Prospects for Hydrogen and Fuel Cells
- Subtask C: coordination with IEA analysts

Co-OAs: Mr. Jochen Linssen and Dr. Susan Schoenung
Theme:
Hydrogen Awareness, Understanding and Acceptance

Portfolio:
SAFETY
Task 19: Safety

October 2004 – December 2010

OA: William Hoagland (W. Hoagland & Associates, USA)

Three subtasks laying foundation for codes & standards:

A. Survey of Quantitative Risk Assessment (QRA) methodologies and testing methodologies

B. Testing and Experimental Program: will evaluate the effects of equipment, product and/or system failures under a range of real-life scenarios, environments or mitigation measures

C. Targeted information packages for stakeholder groups such as: permitting officials, insurance providers, system developers, manufacturers, early adopters.

Bonfire test, Grenade test, Hydraulic burst test, Gunfire test, Drop test
Theme:
Hydrogen Awareness, Understanding and Acceptance

Portfolio:
INFORMATION DISSEMINATION
Theme:
Hydrogen Awareness, Understanding and Acceptance

Portfolio:
OUTREACH
Outreach 2004 - 2009

Conference/Meeting/Event Strategy
- 12 internal IEA presentations
- 40 external ExCo presentations
- 8 Conference Exhibits
- >1,015 task presentations
- >1,153 task publications
- 33 patents

Public Relations
- Creation and inaugural award of HIA Individual Prize for technical excellence in H2 R&D and harmony in international cooperation; Project Prize in 2010

Media Engagement
- Released 25th Anniversary Report at National Press Club in Washington, D.C.
IEA HIA Project Prize

Fundamental Safety Testing and Analysis of H2 Storage Materials and Systems (H-25), a project of Task 22, Fundamental and Applied H2 Storage Materials Development

- 4 country (Canada, Germany, Japan, USA) collaboration
- Project Leader: Dr. Don Anton

ITHER (Infraestructura Tecnológica del Hidrógeno y Energías Renovables)

“Green Hydrogen from Wind and Solar Mobile Applications, a project of Task 24, Wind Energy and Hydrogen Integration

- Developed by Fundación para el Desarrollo de Nuevas Tecnologías del Hidrógeno en Aragón

Fuel Cell Seminar 2010 San Antonio
Highlights

OTHER IEA HIA MEMBER PROGRAMS AND INITIATIVES
JAPAN and GERMANY sign Memorandum of Understanding (MOU) on future collaboration
Highlights - Japan

**JHFC Registered Vehicles:** Total 60 units (FY 2007)
- TOYOTA FCV
- NISSAN X-TRAIL FCV
- HONDA FCX
- MAZDA RX-8 hydrogen
- Hydrogen FCVs 12 units
- FCV 43 units
- GM HydroGen3
- DANIER A-Class F-Cell
- SUZUKI MRwagon FCV
- BMW Hydrogen 7
- TOWA FC-BoS

**JHFC Hydrogen Stations:** Total 12 stations (FY 2007)

*Map of hydrogen stations in Japan*

[Map image]

- Osaka
- Centrair Airport
- Kansai region 2 stations
- Chubu region 1 station

[Website link]

http://www.jhfc.jp/e/data/pdf/brochures_stake.pdf

Fuel cell residential cogeneration system - Ballard Power
HOT Topic #2
- At September UN Summit on Climate Change, Japan announced it will aim to reduce emissions by 25% compared to 1990 levels.
- Japan & US agree to cooperate on Clean Energy Century Plan for clean energy technologies.

HOT Topic #3
- Long-Distance (1,100 km - 637 miles) 3 vehicle Demo Drive
- 2 refuelings; total H2 - 28.8 kg;
  average fuel efficiency 118.4 km/kg

HOT Topic #4
- ~1000 unit demo stationary fuel cells for residential use launched in 2009

Targets, Policies, Funding
- FCV - commercialization starts in 2015
- Stationary FC - 20-100MW (2010); 2,500 MW (2030)
- 2010 budget ~18 billion Yen for H2, Fuel cells, demo, codes & standards, subsidy

Focus on Strategy & Innovation
Highlights - Germany

NIP (National Innovation Program) 2007-2016

- Government, industry, science
- **1.4B € budget** (50% industry; 30% Ministries of Transport, Bldg & Urban Affairs – focus on demonstration; 20% Ministry of Economics – focus on R&D)

**Initiatives**

- Lighthouse projects & clusters
- Clean Energy Partnership II Berlin
- New H2 station in Hurth provides final link in 600 mile hydrogen highway (Munich to Amsterdam)
Highlights - Germany

NOW GmbH (National Organization of H2 and Fuel Cells)

H2 Mobility - Industrial Alliance of several auto manufacturers and energy industry partners leads to MOU on build-up; two phase plan begins 2010

- Phase 1: standardization and planning
- Phase 2: roll out with serial production starting in 2015

MOU between NOW and NEDO
- H2 and Fuel Cell commercialization (May 2010)

- Info exchange, applications (stationary and transport) and infrastructure
- Commercialization planning, project management, Policy and technology “trends”

Focus on Strategy & Innovation
Focus on Proven Pioneers

**Denmark**
- the nation that ignited the world’s modern wind turbine industry
- now set to compete in fuel cells for export
- Hydrogen and electric vehicles exempt from taxation
- Hosted COP15 in 2009

**Korea**
- now major automotive manufacturer, soon to include fuel cell vehicles
- residential demo program - 1000 units
- FCV - commercialization strategy
- Fleet program
Focus on Strategy and Innovation

Canada

- largest per capita OECD H2 producer - 3 million tons annually
- program targets: H2 production, storage, fuel cells; safety, codes & standards
- Chair of ISO Technical Committee 197
- 20 fuel cell buses at Winter Olympics
- Ontario H2 Village in Toronto & remote sites

France

- 7 year R&D investment; 200M €; 20 partners
- R&D focus on nuclear hydrogen
- Voilà! EDF is promoting fuel cells in the press!
Focus on Strategy: Innovation & Targets

US

- Major milestones and critical path technology goals:
  - H2 produced from domestic resources for $2-3.00 per gallon gasoline equivalent
  - On-board H2 systems for light-duty vehicles with 300 mile range
  - PEM fuel cell technology: $30/kW; durability 5,000 hours of service = 150,000 ml/240,000 km
  - Stationary - 40,000 hours at $750/kW
- 11 patents in 2009; 21 others in progress
- 1000 fuel cell systems - mixture of uses
- FY10 Budget - $174M + $40M fuel cell deployment by 2012
- Tax regime: more favorable tax credits or grants in lieu of credit; manufacturing credit

Congratulations to DOE on 2010 AMR!
Focus on Economics and Climate: the European Engine of Change

Commission of the European Union

- **FCH Joint Technology Initiative (JTI)** established October 2008 as a public-private partnership to produce “fit-for-use” hydrogen energy and fuel cell technologies
- **Lisbon Treaty** comes into force – energy now a shared competence among 27 member states
- **European Research and Innovative Action plan** now in preparation

Congratulations to 27 Member States on upcoming General Assembly in Brussels!
Focus on Strategy: Policy Priorities and R&D

Lithuania
- 2006 creation of Lithuanian H2 & Fuel Cell Technology Platform
- Focus on Storage and Education

Turkey
- Renewable H2 an important alternative fuel
- Clean coal, catalysis and biomass
- Robust R&D regime
- Home base - UNIDO ICHET
Focus on Strategy, Innovation & Demonstration

**Switzerland**

- **Innovation in research** - SFOE (photoelectrochemical [PEC] watersplitting)
- **Innovation in products** - Swiss Innovation Promotion Agency (CTI)
  - Minibars on Swiss Railway trains (SBB) powered by PEM fuel cells with solid state metal hydride storage
  - 1st H2 street-cleaner - demo in Basel

**Finland**

- Moving toward demo - FinnHy
- National program at Tekes targets industry opportunities to create breakthrough fuel cell products
Focus on Strategy, Innovation & Demonstration

**Spain**
- Spanish Technology Platform for H2 and FC - 2005 launch
- Aggressive 2008-2012 Action Plan for energy efficiency
- Big player in wind energy
- Strong regional H2 investment

**Italy**
- 5 year national plan includes H2 & fuel cells
- Regional focus on Demos
- Industry 2015 - H2 and Fuel cell projects in sustainable mobility
Focus on Strategy, Innovation & Demonstration

Sweden

- One of world’s best addresses for BioHydrogen
- Fuel Cell & H2 – Joint Technology Initiative launched 2008

The Netherlands

- DutchHy launched 2009
- Emphasis on infrastructure

Iceland

- SMARTH-2, SMARTH2 Boat (Sustainable Marine & Road Transport)
Focus on Strategy, Innovation & Demonstration

Greece
- Renewables and remote site projects for sustainability

Norway
- Storting to pursue long-term climate policy
- HyNor - multiple stations (route extends into Denmark and Sweden) and large vehicle fleet (H2 Prius, Think H2, Mazda)
Focus on Clean and Sustainable Energy

Australia

- Emissions plan: 5-25% reduction by 2020
- Clean Energy funding: $A652 M RE future fund; will expand to $A5.1B clean energy initiative

New Zealand

- HOT NEWS: pushing ahead with ETS (emissions trading scheme), which comes into effect July 1 with carbon price of NZ$12.50 CO2e (equivalent CO₂) per tonne

United Kingdom

- Named for commitment: Department of Energy and Climate Change
Focus on Connection with the Developing World

UNIDO

- Represented by its project, UNIDO ICHET, whose mission is to demonstrate viable implementation of hydrogen energy technologies and facilitate their widespread use in developing countries
- UNIDO-IChET located in Istanbul, Turkey
- Funding Instruments: pre-feasibility, pilot, R&D
- Demonstration activities:
  - H2 3-wheelers, New Delhi, India
  - Bozca Hydrogen island, Turkey
  - Aitutaki, Cook Islands
  - FC-based UPS, Turkey
  - Fuel cell fork-lift, Turkey
  - Hydrogen FC boat, Turkey
- R&D - Test labs; Education; Conferences
International Energy Agency
Hydrogen Implementing Agreement . . .

. . . A premier global resource for technical expertise in \( \text{H}_2 \) RD&D

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Thank you very much!