

The IEA HIA: R,D&D to Supply Hydrogen Energy For a Changing World

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IEA HIA Presentation

- ❑ IEA HIA Fundamentals
- ❑ Overview of IEA HIA Portfolio
 - ❑ Science and Technology
 - ❑ Market Environment
 - ❑ Outreach Program
- ❑ IEA HIA Value Proposition

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

Strategy

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

Annex / Task

Basic unit of organization; Next level is sub-task;
Operating Agent manages Annex; Experts do work



IEA HIA Members



Canada
Mr Nick Beck (Chairman)



European Commission
Dr Stathis Peteves



Japan
Dr Yoshiteru Sato



Italy
Mr Agostino Iacobazzi



Iceland
Dr Agusta Loftsdottir



Lithuania
Dr Jurgis Vilemas



The Netherlands
Mr Frank Denys



France
Dr Paul Lucchese



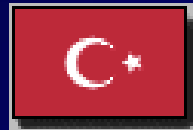
Australia
Dr John Wright



Germany
Mr J.-F. Hake



Greece
Dr Eli Varkaraki



Turkey
Dr Alper Sarioglan



Korea Mr Kijune Kim



New Zealand Dr Steven Pearce

IEA HIA June 2008

Norway

Ms Line Amlund Hagen



Spain

Dr Antonio Garcia-Condé



Sweden

Dr Lars Vallander



Switzerland

Dr Andreas Gut



United Kingdom

Dr Ray Eaton



United States

Dr Carole Read



Denmark

Mr Jan Jensen



Finland

Dr Heikki Kotila



IEA HIA Goals

Science & Technology Goal

Advancement of Science via Pre-Commercial Collaborative RD&D

- Hydrogen Production
- Hydrogen Storage
- Hydrogen Systems

Market Environment Goal

Assessment of Market Environment,
including Non-Energy Sector

- Non-Energy and Industrial Processes
- Foundation for Codes & Standard
- Infrastructure

Outreach Program Goal

Increasing Knowledge and
Comfort with Hydrogen

- Membership and Participation
- Information Dissemination
- Synchronization worldwide

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
 13. Design and Optimization of Integrated Systems
 14. Photoelectrolytic Production
 15. Photobiological Production
 16. H₂ from Carbon-Containing Materials
 17. Solid & Liquid State Storage Materials
- Current Portfolio**
18. Integrated Systems - II
 19. Hydrogen Safety
 20. Hydrogen from Waterphotolysis
 21. BioHydrogen
 22. Fundamental and 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

Current Tasks by Focus Area

Science and Technology

Production

- 20. Hydrogen from Waterphotolysis
- 21. BioHydrogen
- 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

Storage

- 22. Fundamental and Applied H₂ Storage Materials Development

Market Environment

Analysis, Safety and Economics

- 18. Integrated Systems Evaluation
- 19. Safety

Science and Technology HYDROGEN PRODUCTION

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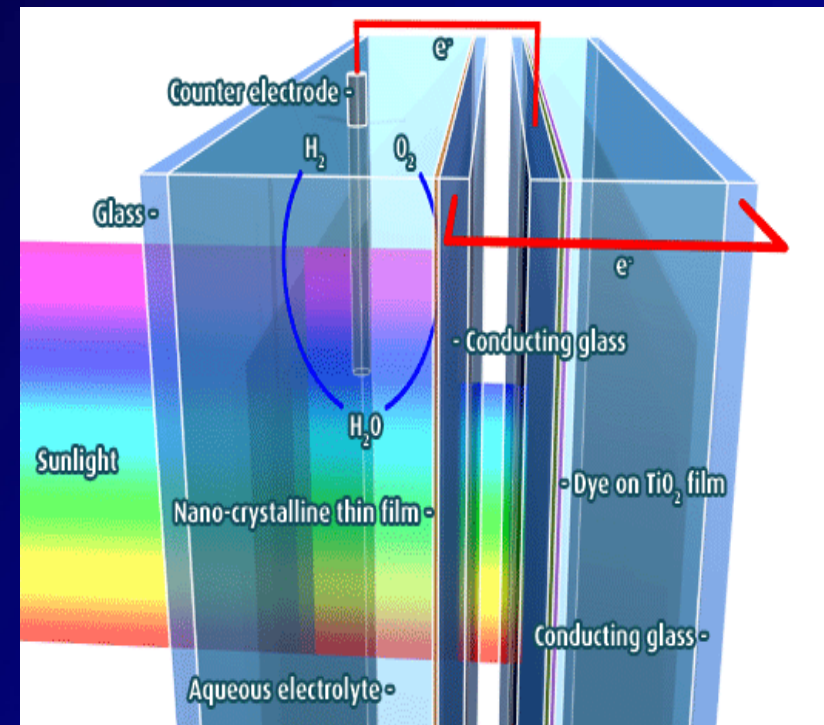
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Task 20: Hydrogen from Waterphotolysis

October 2004 – June 2008 (closing)

- ❑ Continuation and expansion of Task-14 (up to 14 countries and 37 research groups)
- ❑ Aim: Net solar-to-hydrogen conversion efficiency of 10%
- ❑ Objectives: Intensification of international collaboration, advancement of PEC materials science, development of engineering solutions, demonstration of leading concepts, promotion of photolysis of water



OA: Dr Andreas Luzzi (University of Applied Sciences Rapperswil, Switzerland)

Task 21: BioHydrogen

October 2005-October 2008

- ❑ Evolved from Task 15
- ❑ Includes four areas of investigation:
 - ❑ Hydrogen dark fermentations
 - ❑ Photobiological hydrogen production systems
 - ❑ Bio-inspired systems
 - ❑ Overall analysis



OA: Dr. Jun Miyake

Task 23: Small-Scale Reformers for On-Site H2 Supply

December 2006-December 2009

- ❑ Development of reformer technologies and distributed on-site reformer based H2 supply systems
- ❑ Three Subtasks:
 - 1) Harmonized Industrialization
 - 2) Sustainability and Renewable Sources
 - 3) Market Studies



OA: Dr. Ingrid Schjøberg of Sintef

Task 24: Wind Energy and H2 Integration

December 2006-December 2009

- ❑ **Mid-term R&D for entire wind to hydrogen production chain**
- ❑ **Subtask A** – State of the Art
- ❑ **Subtask B** – Needed Improvements and System Integration
- ❑ **Subtask C** - Business Concept Development
- ❑ **Subtask D** - Applications with Emphasis on wind energy management



OAs: Dr. Luis Correias and Mr. Fernando Carpintero

Task 25: High Temperature Processes for H2 Production

May 2007

- ❑ Will Support production of massive quantities of zero-emission H₂ through use of high temperature processes ($> 500\text{ }^{\circ}\text{C}$) coupled with nuclear and solar heat sources
- ❑ **Three process families:** thermochemical cycles: steam electrolysis: and innovative water splitting
- ❑ **Four Subtasks:**
 - ❑ **Subtask A** – State of the Art
 - ❑ **Subtask B** – Methodology approach of HTPs
 - ❑ **Subtask C** – HTP R&D and future industrial development
 - ❑ **Subtask D** – Information Dissemination



OA: Mr. Gilles Rodriguez of CEA

Science and Technology HYDROGEN STORAGE

WHEC 2008

Brisbane, Australia



Task 22: Fundamental and Applied Hydrogen Storage Materials Development

December 2006-December 2009

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

- **17 HIA countries, 50 projects**
- **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



OA: Dr. Bjørn C. Hauback

Market Environment

ANALYSIS, SAFETY AND ECONOMICS



Task 18: Integrated Systems Evaluation

January 2004 – January 2009



- ❑ **Subtask A - Comprehensive information datasets and summary compilation of integrated hydrogen demonstration systems and development plans** - www.port-h2.com/IEA-Annex-18/
- ❑ **Subtask B - Modeling and existing analysis tools used to evaluate hydrogen demonstration projects.**
- ❑ **Case Studies** (http://www.ieahia.org/case_studies.html)

Phase 1 had two Subtasks, A and B. Phase 2 will include:

- ❑ **Subtask C – Synthesis and Learning** to bridge Subtask A and B experience and provide lessons learned, benchmark assessments and trend analysis

OA: Dr Susan Schoenung (Longitude 122 West, Inc, USA)

Task 19: Safety

October 2004 – January 2008 recently extended



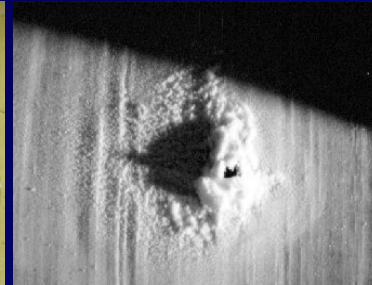
Bonfire test



Grenade test



Hydraulic burst test



Gunfire test



Drop test

- ❑ Survey of Quantitative Risk Assessment (**QRA**) methodologies and testing methodologies
- ❑ **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
- ❑ **Targeted information packages for stakeholder groups such as:** permitting officials, insurance providers, system developers, manufacturers, early adoptors

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

Tasks in Definition

Science and Technology Goal Related : **PRODUCTION**

- ❑ Near Term Market Routes to Hydrogen by Co Utilization of Biomass as a Renewable Source with Fossil Fuels
- ❑ Advanced Materials for Waterphotolysis (successor to Task 20)

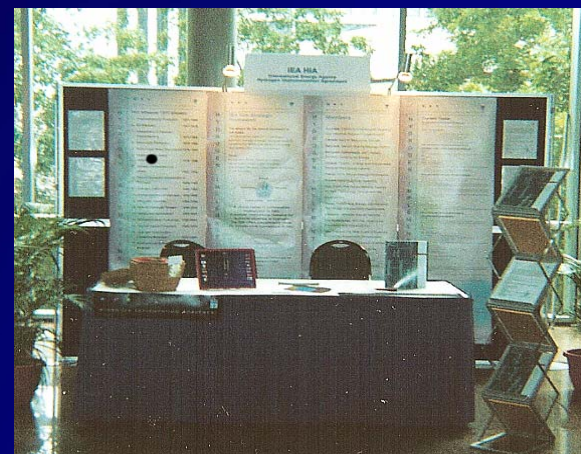
Both Science & Technology and Market Analysis Goals
Related : **STORAGE AND ANALYSIS**

- ❑ Large Scale Hydrogen Infrastructure and Mass Storage

Outreach and Collaboration

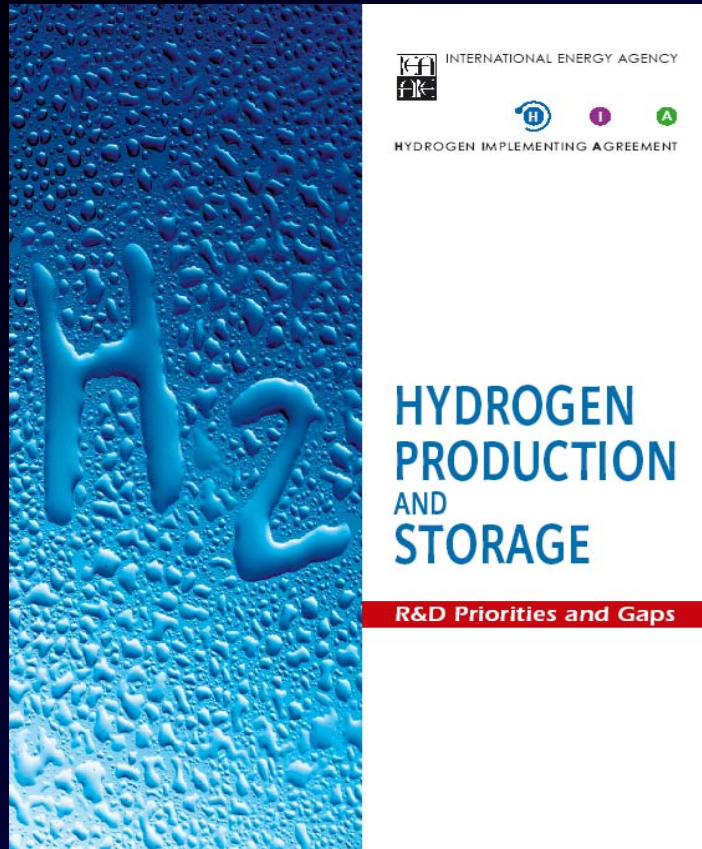
Objectives

- 1) Increasing Membership and Participation
- 2) Information Dissemination
- 3) Synchronization Worldwide



Collaboration: Means and End

Analysis Related to Market Environment and Outreach Goals



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

Information Dissemination:

Download free at www.ieahia.org



25th Anniversary Report: In Pursuit of the Future

Luzzi / Bonadio / McCann
Released at the National Press Club,
Washington DC, 7-Sep-04



2006 Annual Report



Task 14 Final Report Photoelectrolytic Production of Hydrogen

WHEC 2008

Brisbane, Australia



IEA HIA Value: a Sustainable Proposition

Provides a neutral international profile

- ❑ Knowledgeable, reliable, unbiased
- ❑ Access to technical experts
- ❑ Global reach (government, academia, industry)

Leverages resources

- ❑ Focus includes science & technology, market analyses and outreach
- ❑ Portfolio includes shorter term and long-term, pre-competitive activities
- ❑ Careful intellectual property (IP) treatment
- ❑ Established network of researchers

Offers assurance based on track record

- ❑ Collaborative research tasks completed over 30 years
- ❑ Growing Membership

*International Energy Agency Hydrogen
Implementing Agreement . . .*

www.ieahia.org

*. . . An R,D&D Collaboration pursuing
hydrogen sustainability*

