

IEA HIA Production and Other Activities: Current and Prospective 2009-2014

*Mr. Antonio G. García-Conde (ExCo. Chair),
Mr. Jan Jensen, Dr. Steven Pearce (ExCo. Vice Chairs)
Ms. Mary-Rose de Valladares (ExCo. Secretariat Manager)*

National Hydrogen Association
Conference & Expo

May 4, 2010

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International Energy Agency



Germany



Australia



Austria



Belgium



Canada



Korea



Denmark



Spain



United States



EC



Finland



France



Greece



Neherland



Hungary



Ireland



Italy



Japan



Luxembourg



Norway



New Zealand



Portugal



United Kingdom



Czechk Republic



Sweden



Switzerland



Turkey

Autonomous body within the Organization of Economic Cooperation and Development (OECD), founded in **1974** to carry out **energy cooperation** among member countries.

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Hydrogen Implementing Agreement (HIA)

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

Strategic Framework

2009 - 2014

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

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Hydrogen Implementing Agreement (HIA)

Collaborative R&D

- Annex / Task:** Basic unit of organization in HIA. Several members collaborate on each task.
- Operating Agent:** Manages Annex – **Experts** do work
- Tasks-Shared:** Member countries fund their expert researchers directly according to the level of person hours agreed upon in each task.

23 Members – Contracting Parties



Australia

Dr Roy Chamberlain



Canada

Mr Nick Beck



Denmark

Mr Jan Jensen

Co Vice-Chair



European Commission

Dr Marc Steen



Finland

Dr Heikki Kotila



France

Mr Paul Lucchese



Germany

Mr J.-F. Hake



Greece

Dr Elli Varkaraki



Iceland

Dr Augusta Loftsdottir



Italy

Mr Agostino Iacobazzi



Japan

Dr Yoshiteru Sato



Korea

Mr Kijune Kim



Lithuania

Dr Rolandas Urbonas



New Zealand

Dr Steven Pearce

Co Vice-Chair



Norway

Dr Stian Nygaard



Spain

Mr Antonio Garcia-Con

Chair



Sweden

Mr Gustav Krantz



Switzerland

Dr Stefan Oberholzer



The Netherlands

Mr Frank Denys



Turkey

Dr Alper Sarioglan



United States

Dr Carole Read



UNIDO

Dr N Lymberopoulos



United Kingdom

Mr Ray Eaton

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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 & Optimization Integ. Systems
14. Photoelectrolytic Production
15. Photobiological Production
16. H₂ from Carbon-containing mat.
17. Solid & Liquid Storage Materials
18. Integrated Systems – II

20. Hydrogen from Waterphotolysis

Current Portfolio

19. Hydrogen Safety -II
21. BioHydrogen - II
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 Temp. 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

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Strategic Framework 2009 - 2014



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2009 – 2014 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

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Current Tasks by Theme and Portfolio

Collaborative R,D&D

Production

- 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
- 26. Advanced Materials for Waterphotolysis of Hydrogen
- 27. Near Term Market Routes to Hydrogen by Co Utilization of Biomass as a Renewable Source with Fossil Fuels

Storage

- 22. Fundamental and Applied H₂ Storage Materials Development

Integrated H₂ Systems

- 18. Integrated Systems Evaluation
- 23. Small-Scale Reformers for On-Site H₂ Supply (SSR for H₂)
- 2X. Distributed and Community Hydrogen (in definition)

H₂ Integration in the Existing Infrastructure

- 23. Small-Scale Reformers for On-Site H₂ Supply (SSR for H₂)
- 28. Large Scale Hydrogen Infrastructure and Mass Storage

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Current Tasks by Theme and Portfolio

Analysis that Positions Hydrogen

Technical, Market and Support for Political Decision-making:

3X. New Analysis Task (in definition).

Hydrogen Awareness, Understanding and Acceptance

Safety:

19. Safety

**Information Dissemination
Outreach**

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HYDROGEN IMPLEMENTING AGREEMENT

Theme:

Collaborative R,D&D

Portfolio:

HYDROGEN PRODUCTION

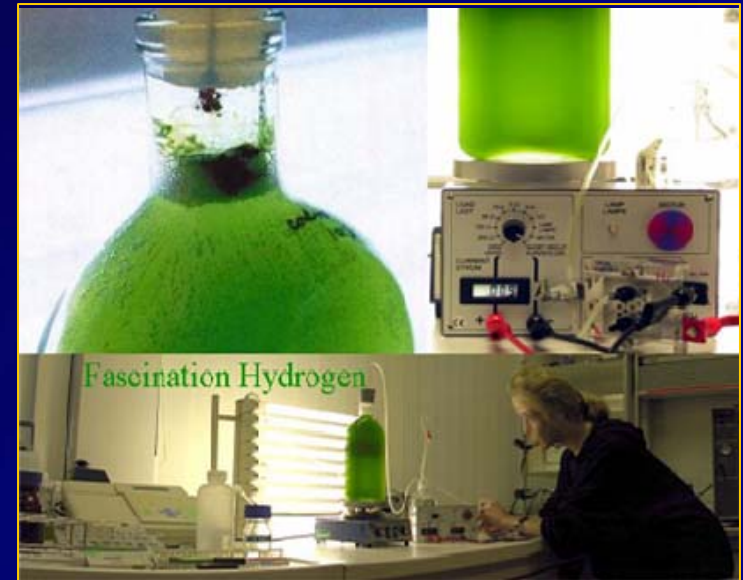
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Task 21: BioHydrogen

*October 2005-May 2009
(Successor task proposed)*

- ❑ Evolved from Task 15
May 1999-July 2005 (completed)
**R&D Progress toward development
of H₂ production by microalgae**
- ❑ Includes four areas of investigation:
 - ❑ Hydrogen dark fermentations
 - ❑ Photobiological hydrogen production systems
 - ❑ Bio-inspired systems
 - ❑ Overall analysis



Achieved better genomic understanding of H₂ producing strict anaerobes

OA: Dr. Jun Miyake

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

*December 2006 - December 2011
(recently extended)*

- ❑ Development of reformer technologies and distributed on-site reformer based H₂ supply systems
- ❑ **Contributing to norms & fast-tracking deployment**
- ❑ **Three Subtasks:**
 - 1) Harmonized Industrialization
 - 2) Sustainability and Renewable Sources
 - 3) Market Studies



OA: Dr. Ingrid Schjølberg of Sintef

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Task 24: Wind Energy and H₂ Integration

December 2006-December 2009

- ❑ Mid-term R&D for entire wind to hydrogen production chain
- ❑ Four Subtasks:
 - 1) Subtask A – State of the Art
 - 2) Subtask B – Improvements and System Integration
 - 3) Subtask C – Business Concept Dev.
 - 4) Subtask D – Applications with Emphasis on wind energy management
- ❑ **Setting the stage for large-scale use of renewable wind energy for H₂ production**
- ❑ **Aims for full wind and H₂ integration via storage and electrical conversion**



OAs: Dr. Luis Correias – Ismael Aso (Hidrógeno Aragón)

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Task 25: High Temperature Processes for H₂ Production

May 2007 – May 2010

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



OA: Ms. Sabine Poitou of CEA

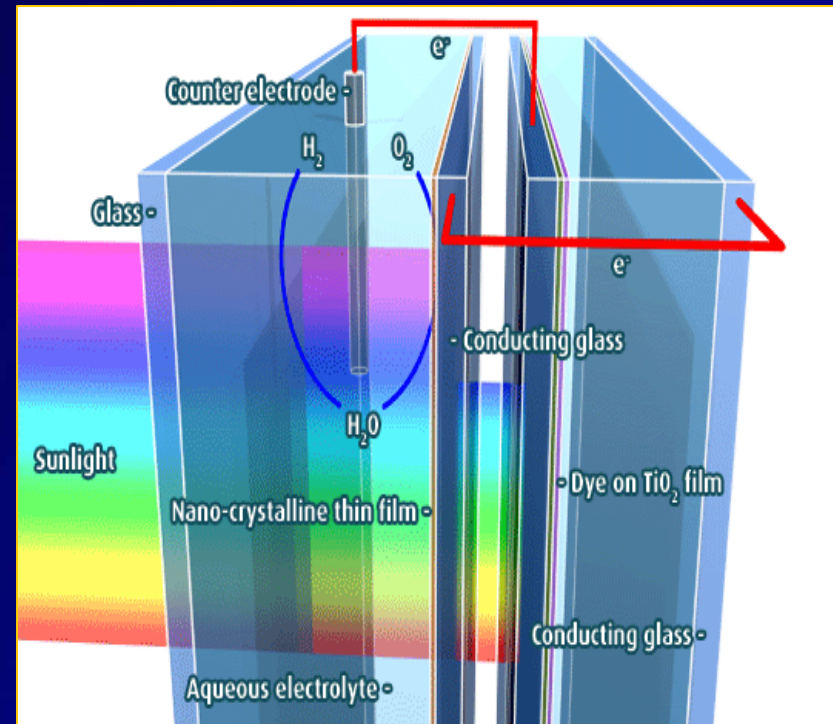
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Task 26: Advanced Materials for Waterphotolysis of H₂

May 2008 – May 2011

- ❑ Continuation and expansion of Task 20, Hydrogen from Waterphotolysis – Final Report available May 2009.
- ❑ **Aim:** Photoelectrochemical (PEC) materials that enable net solar-to-hydrogen conversion efficiency of 10% in PEC water-splitting
- ❑ 4 Subtasks:
 - 1) Materials “Theory” R&D
 - 2) Materials “Synthesis” R&D
 - 3) Materials “Characterization” R&D
 - 4) “Information Coordination/ Database” Development



OA: Dr Eric Miller of Hawaii Natural Energy Institute, University of Hawaii, Manoa

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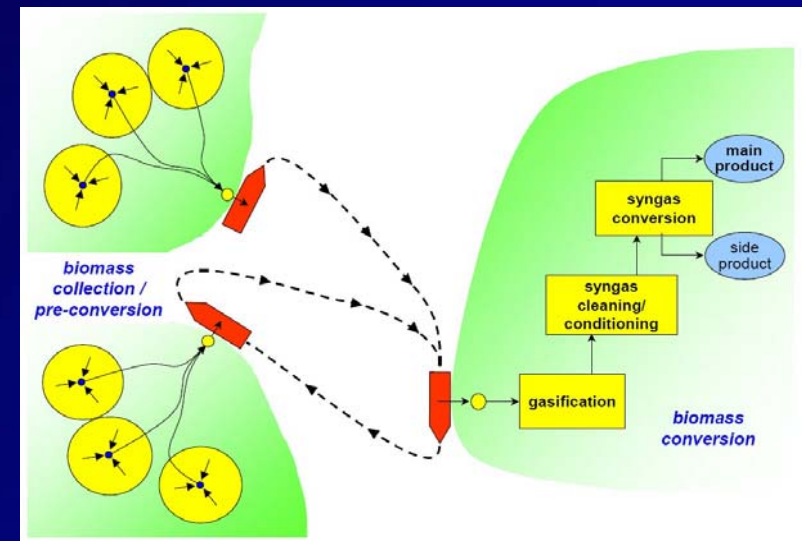
Task 27: Near-Market Routes to H₂ by Co-Utilization of Biomass as a Renewable Energy Source with Fossil Fuel

2008 – 2011

Objective: To advance the development of H₂ production based on renewable sources (biomass) – Focusing market

□ 4 Subtasks:

- A. Co-gasification of biomass with fossil fuels
- B. Hydrogen market facilitation based on distributed processing of biomass to new **tradable intermediates**
- C. Near term stand-alone biomass gasification
- D. **Roadmap** – development and verification



Source: Shell

OAs: Dr Jan-Erik Hanssen and Ms. Elif Caglayan

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HYDROGEN IMPLEMENTING AGREEMENT

Theme:

Collaborative R,D&D

Portfolio:

HYDROGEN STORAGE

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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
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Theme:

Collaborative R,D&D

Portfolio:

INTEGRATED H₂ SYSTEMS



Task 18: Integrated Systems Evaluation

January 2004 – December 2009
(recently completed)



- ❑ Phase 1 – Subtasks A and B.
Phase 2 includes Subtask C.
- ❑ Subtask A Phase 1 - **World's best address for information and analysis on H₂ and integrated systems:** <http://iea-hia-annex18.sharedpointsite.net/Public/default.aspx>
- ❑ Subtask B Phase 1 - Modeling & existing analysis tools to evaluate H₂ projects. **H₂ Demonstration Projects Development** covers state of the art
- ❑ Case Studies <http://www.ieahia.org/page.php?s=d&p=casestudies>
- ❑ Subtask C Phase 2 – 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)

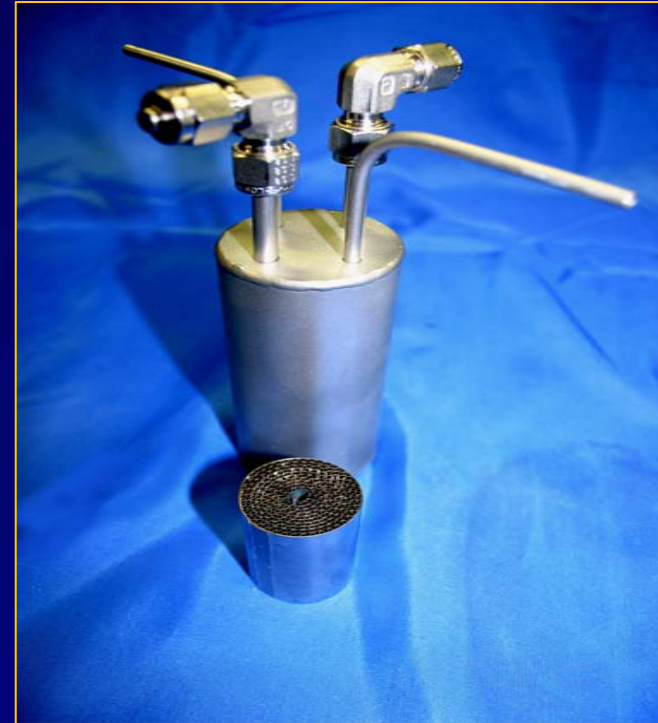
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Task 23: Small-Scale Reformers for On-Site H₂ Supply

*December 2006 - December 2011
(recently extended)*

- ❑ Development of reformer technologies and distributed on-site reformer based H₂ supply systems
- ❑ **Contributing to norms & fast-tracking deployment**
- ❑ **Three Subtasks:**
 - 1) Harmonized Industrialization
 - 2) Sustainability and Renewable Sources
 - 3) Market Studies



OA: Dr. Ingrid Schjølberg of Sintef

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Task in Definition

Distributed and Community Hydrogen

Coming soon!

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Theme:

Collaborative R,D&D

Portfolio:

**H₂ INTEGRATION
IN EXISTING INFRASTRUCTURE**



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

*December 2006 - December 2011
(recently extended)*

- ❑ Development of reformer technologies and distributed on-site reformer based H₂ supply systems
- ❑ **Contributing to norms & fast-tracking deployment**
- ❑ **Three Subtasks:**
 - 1) Harmonized Industrialization
 - 2) Sustainability and Renewable Sources
 - 3) Market Studies



OA: Dr. Ingrid Schjølberg of Sintef

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Task 28: Large Scale H2 Delivery Infrastructure

May 2010 – April 2013
(pending final approval in May)

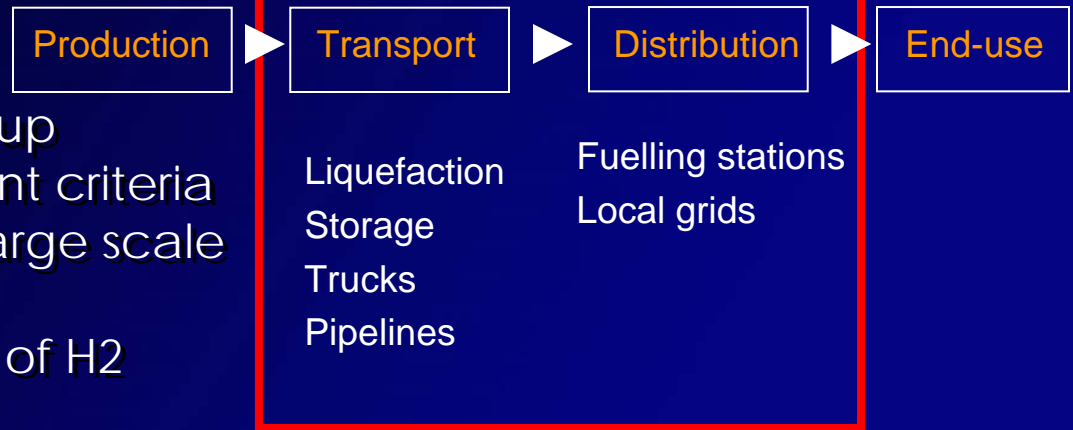
Four objectives:

- 1) International expert group
- 2) Development assessment criteria for application to various large scale infrastructure concepts
- 3) Improve understanding of H2 infrastructure
- 4) Support IEA ETP

Seven Subtasks:

- 1) Coordination
- 2) Definition
- 3) Tools for design and analysis

Large Scale Hydrogen Delivery Infrastructure



- 4) Boundary Cond. & Key Attributes
- 5) H2 Delivery Routes
- 6) Knowledge Management
- 7) Dissemination

OA: Mr. Marcel Weeda

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Theme:

Analysis that Positions Hydrogen

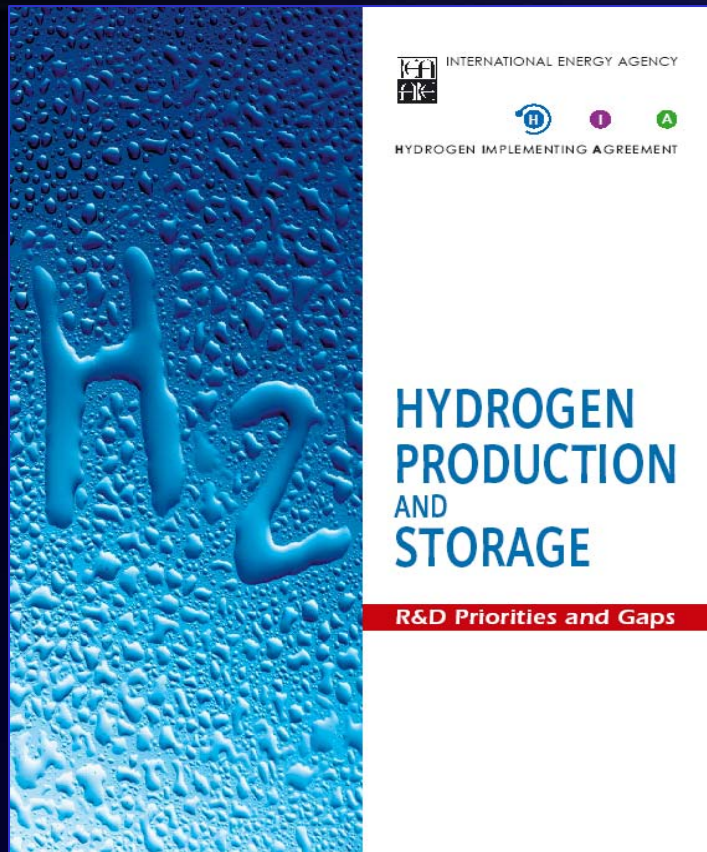
Portfolio:

TECHNICAL, MARKET AND SUPPORT FOR POLITICAL DECISION-MAKING

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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*

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Task in Definition

Analysis that Positions Hydrogen

Coming soon!

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Theme:

Hydrogen Awareness, Understanding and Acceptance

Portfolio:

SAFETY



Task 19: Safety

October 2004 – December 2009



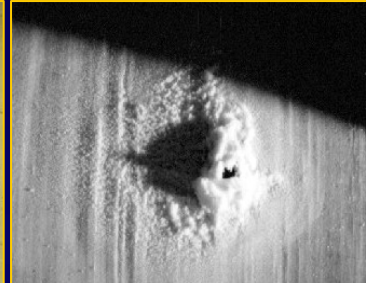
Bonfire test



Grenade test



Hydraulic burst test



Gunfire test



Drop test

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

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Theme:

Hydrogen Awareness, Understanding and Acceptance

Portfolio:

INFORMATION DISSEMINATION

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Information Dissemination

Download free at www.ieahia.org



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THE IEA HIA TODAY

In June the International Energy Agency Hydrogen Implementing Agreement (IEA HIA) celebrated an important milestone as the anniversary of the original IEA HIA Substantial Progress Dr. Gary Sandrock. Dr. Tapan Bhowmik also passed away in January 2008, leaving a commemorative prize for lifetime achievement. (See page 1 for the full story)

The month of June also marked another first with presentation of an all IEA HIA track at the World Hydrogen Energy Conference (WHEC) also known as a legacy talk on energy, "The International Hydrogen Energy - Status and Challenge" addressed by Dr. Ryszard Hrabak and co-chaired by Dr. Sandrock. The IEA HIA track also included the following presentations:

Task and Promoters	Presentation Theme
IEA HIA Mile Year Book	IEA HIA 10 Years in Review: Progress for a Changing World
Task 14 - Integrated System Operation	An Evolution of Integrated Hydrogen Systems: Overview of IEA HIA
Dr. Ryszard Hrabak	Task 14 - IEA HIA Achievement in Detail: Task 14 - Integrated System Operation
Task 21 - IEA HIA Achievement in Detail: Task 21 - Hydrogen Safety	Hydrogen Safety: Status in Changing Global Risk Assessment Context
Dr. Ryszard Hrabak	Task 21 - Hydrogen Safety
Task 22 - IEA HIA Achievement in Detail: Task 22 - Hydrogen Storage and Utilization	Task 22 - Overview of IEA Hydrogen Implementing Agreement
Dr. Ryszard Hrabak	Task 22 - Hydrogen Storage and Utilization
Task 23 - High Temperature Production of Hydrogen	A High Temperature Hydrogen: Status in Changing Global Risk Assessment Context
Task 23 - High Temperature Production of Hydrogen	Task 23 - High Temperature Production of Hydrogen
Task 24 - Integrated System Operation	Task 24 - Integrated System Operation
Task 24 - Integrated System Operation	Task 24 - Integrated System Operation

The IEA HIA held its 10th Executive Committee meeting in Berlin immediately following WHEC. An important milestone occurred at this meeting with election of Mr. Antonio G. Garcia-Combe as Chairman. An International Council of Experts for a Green Hydrogen Economy (ICGE) was also established. Mr. Garcia-Combe is currently Director of ITC's Hydrogen Laboratory from 1990-1998. Mr. Jan Jansen of Denmark and Dr. Steven Pearce of New Zealand were elected to Vice Chairs.

25th Anniversary Report: In Pursuit of the Future

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

End-Of-Term Report 2004-2009 & Strategic Plan 2009-2014

2007 Annual Report
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Theme:

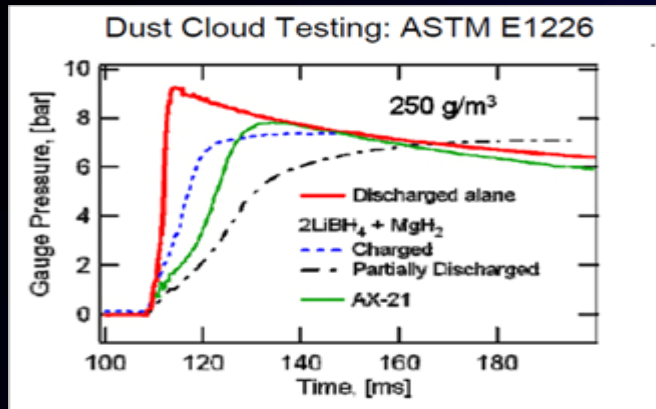
Hydrogen Awareness, Understanding and Acceptance

Portfolio:

OUTREACH



IEA HIA Project Prize



Fundamental
Research

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



Technology
Demonstration

IHER (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

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International Energy Agency Hydrogen Implementing Agreement . . .

. . . A premier global resource for technical expertise in H₂ RD&D

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Thank you very much !

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