

H Y D R O G E N I M P L E M E N T I N G A G R E E M E N T

The IEA HIA: Cooperation in the Field of Hydrogen Energy

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

Fuel Cells & Hydrogen Joint Undertaking Stakeholders General Assembly
26-27 October 2009

Brussels

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AN IMPLEMENTING AGREEMENT OF THE INTERNATIONAL ENERGY AGENCY

International Energy Agency



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Australia



Austria



Belgium



Canada



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Denmark



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United States



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Greece



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Italy



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Neherland



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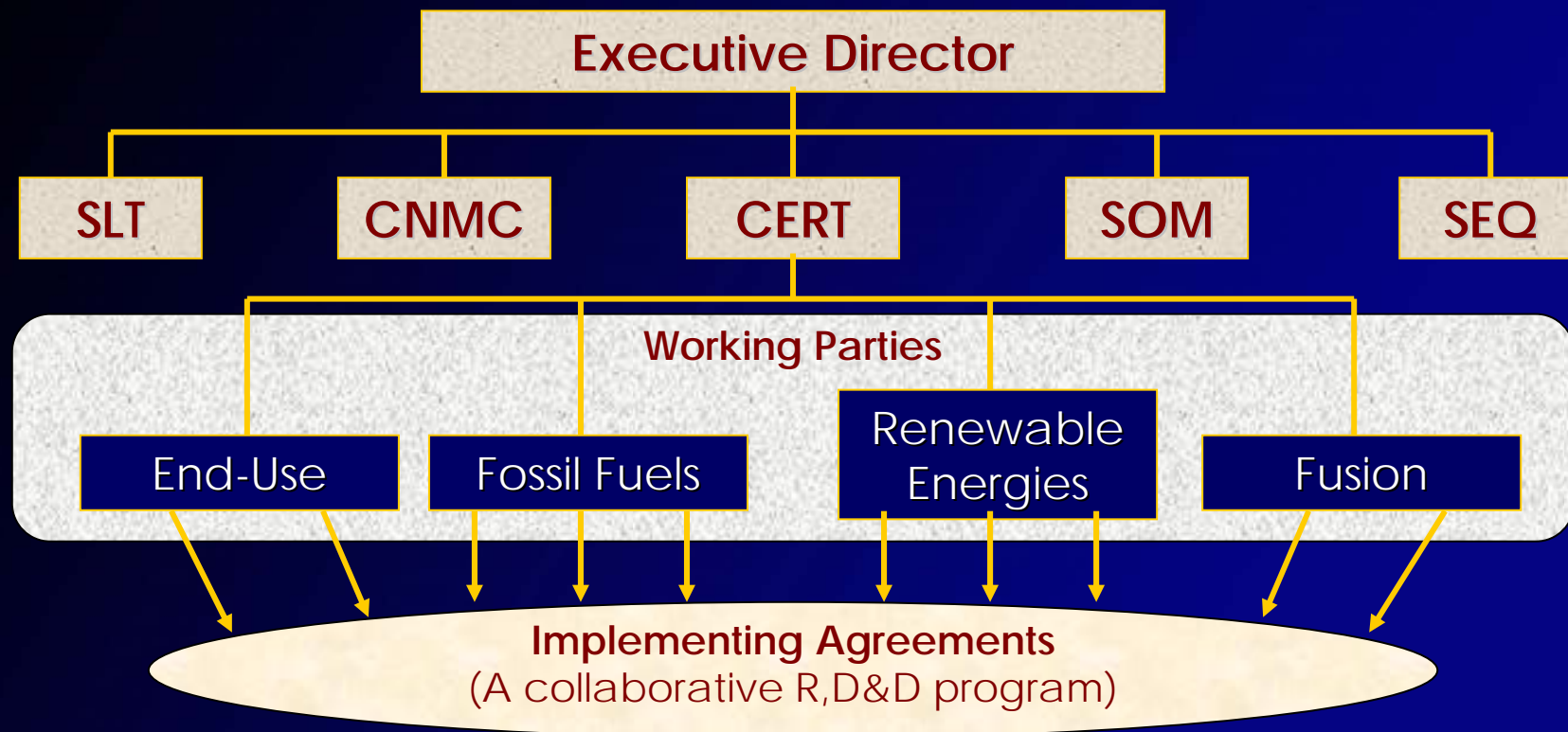
Japan

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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IEA Organization



CERT: Committee on Energy Research and Technology

SLT: Standing group on Long-Term co-operation

SOM: Standing group on Oil Market

CNMC: Committee on Non-Member Countries

SEQ: Standing group on Emergency Questions

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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
Taks-Shared:	Member countries fund their expert researchers directly according to the level of person hours agreed upon in each task.

IEA HIA Members Executive Committee (October 2009)

Europe



European Commission
Dr Marc Steen



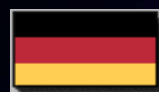
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Germany
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Dr Elli Varkaraki



Iceland
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United Kingdom
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North America



Canada
Mr Nick Beck



United States
Dr Carole Read

Asia - Pacific



Japan
Dr T. Itomi



Korea
Mr Kijune Kim

Oceania



Australia
Dr J. Wright



New Zealand
Dr S. Pearce
Co Vice-Chair



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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
 20. Hydrogen from Waterphotolysis
- Current Portfolio**
18. Integrated Systems - II
 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 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



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



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)

H₂ Integration in the existing infrastructure

- 23. Small-Scale Reformers for On-Site H₂ Supply (SSR for H₂)
- 2X. Large Scale Hydrogen Infrastructure and Mass Storage (in definition).

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Current Tasks by Theme and Portfolio

Analysis that Positions Hydrogen

Technical, market and support for political decision-making:

2X. New Analysis Task (in definition).

Hydrogen Awareness, Understanding and Acceptance

Safety:

19. Safety

**Information dissemination
Outreach**



H Y D R O G E N I M P L E M E N T I N G A G R E E M E N T

Theme:

Collaborative R,D&D

Portfolio:

HYDROGEN PRODUCTION

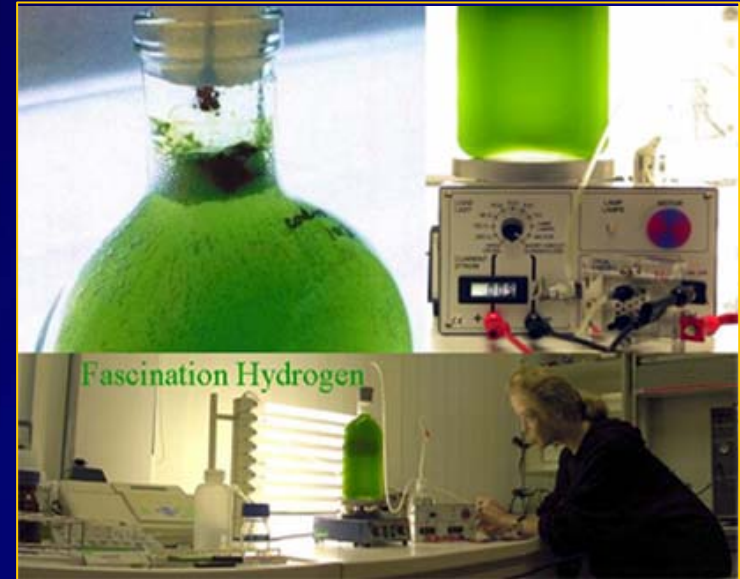
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Task 21: BioHydrogen

October 2005-October 2010

- ❑ 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

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

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)

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

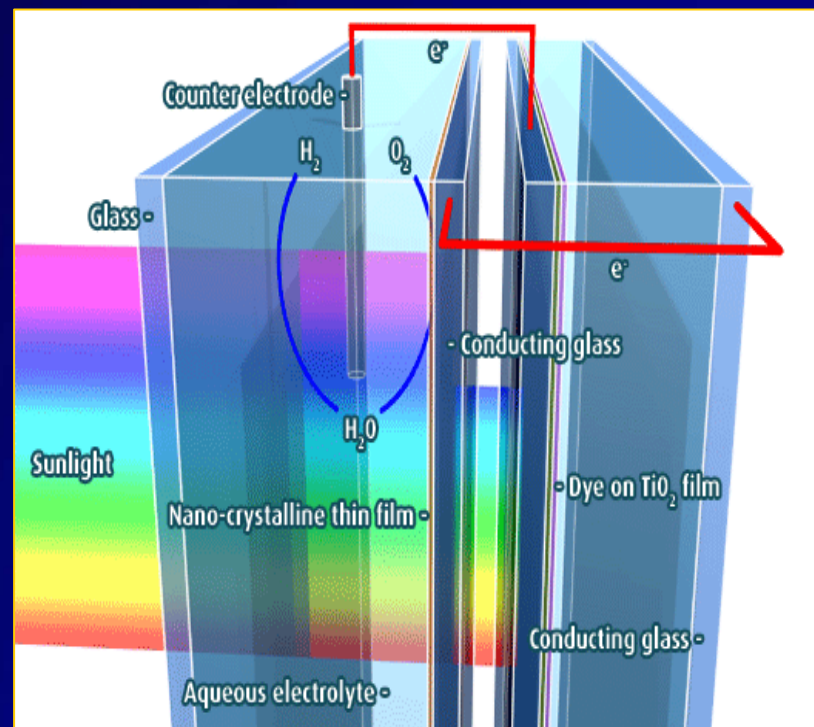


OA: Ms. Sabine Poitou of CEA

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

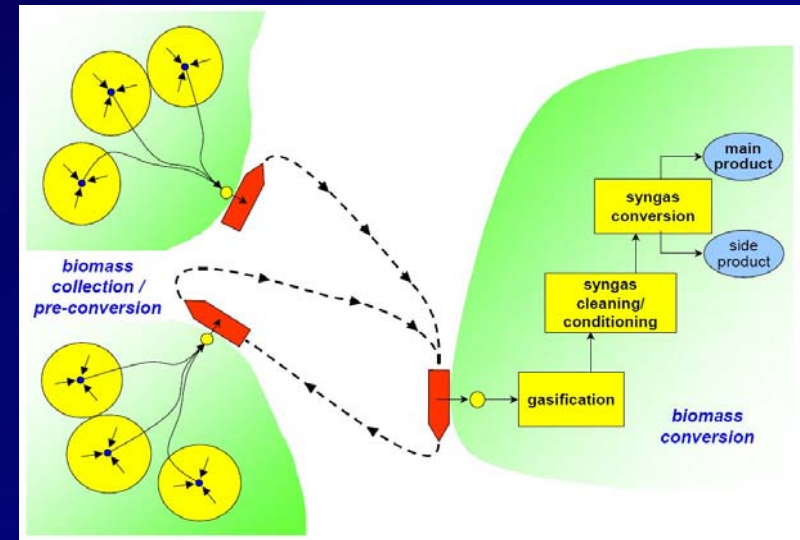


OA: Dr Eric Miller of Hawaii Natural Energy Institute, University of Hawaii, Manoa

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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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 IET

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H Y D R O G E N I M P L E M E N T I N G A G R E E M E N T

Theme:

Collaborative R,D&D

Portfolio:

INTEGRATED H₂ SYSTEMS

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Task 18: Integrated Systems Evaluation

January 2004 – December 2009



- ❑ 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)

HYDROGEN IMPLEMENTING AGREEMENT

Theme:

Collaborative R,D&D

Portfolio:

**H₂ INTEGRATION
IN EXISTING INFRASTRUCTURE**

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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
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 - 1) Harmonized Industrialization
 - 2) Sustainability and Renewable Sources
 - 3) Market Studies



OA: Dr. Ingrid Schjølberg of Sintef

Task in Definition

Large Scale Hydrogen Infrastructure and Mass Storage

Coming soon!



Theme:

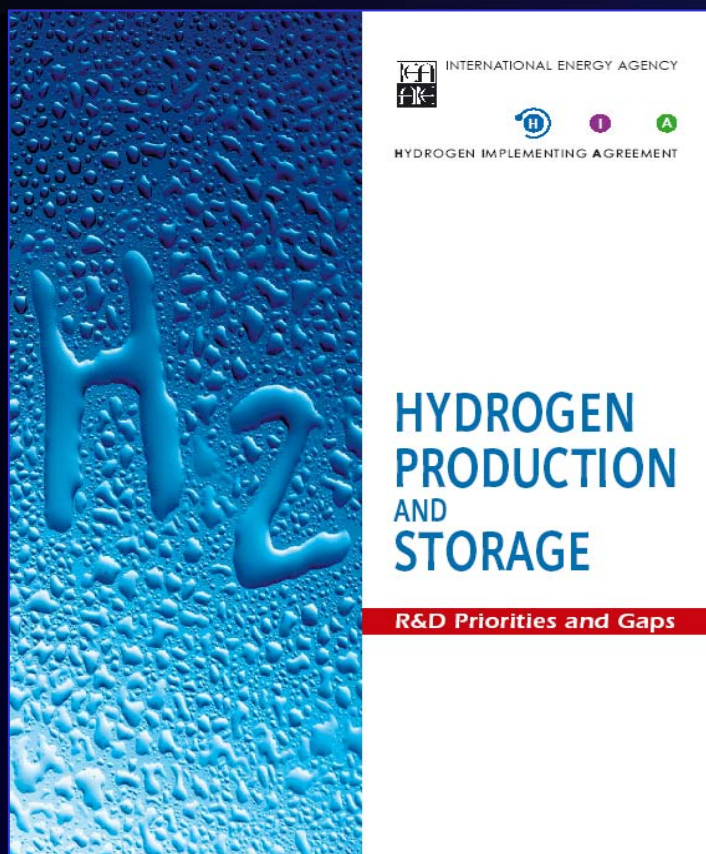
Analysis that Positions Hydrogen

Portfolio:

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**

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Task in Definition

NEW ANALYSIS TASK

First definition meeting

Will come soon!



Theme:

Hydrogen Awareness, Understanding and Acceptance

Portfolio:

SAFETY



Task 19: Safety

October 2004 – December 2009



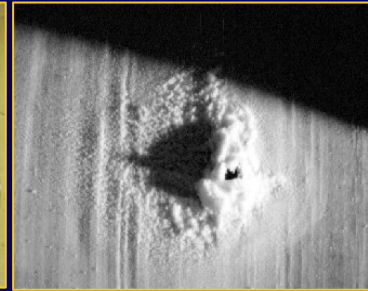
Bonfire test



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



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

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

2007 Annual Report

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International Energy Agency Hydrogen Implementing Agreement . . .

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

For more information contact:

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Thank you very much !

