



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

# IEA Hydrogen Implementing Agreement (HIA)

## Building the Hydrogen Economy Through R,D&D Cooperation

Nick Beck, Yoshiteru Sato, Antonio García-Conde, Ray Eaton  
Mary-Rose de Valladares

IEA/IPHE Workshop on Infrastructure Development - Europe  
July 10-12, 2007

AN IMPLEMENTING AGREEMENT OF THE INTERNATIONAL ENERGY AGENCY



# 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

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# IEA HIA Members



**Canada**  
Mr Nick Beck (Chairman)



**European Commission**  
Dr Stathis Peteves



**Japan**  
Dr Yoshiteru Sato



**Italy**  
Dr Agostino Iacobazzi



**Iceland**  
Dr Augusta Loftsdottir



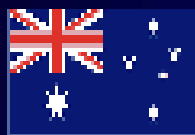
**Lithuania**  
Dr Jurgis Vilemas



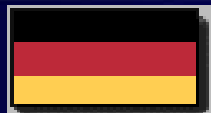
**The Netherlands**  
Mr Frank Denys



**France**  
Dr Paul Lucchese



**Australia**  
Dr John Wright



**Germany**  
Mr J.-F. Hake



**Greece**  
Dr Eli Varkaraki



**Turkey**  
Dr Alper Sarioglan



**Korea** Dr Young-Sam Kim



**New Zealand** Dr Steven Pearce

# IEA HIA July 2007

**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

# HIA Annexes 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 H<sub>2</sub> Storage
  13. Design and Optimization of Integrated Systems
  14. Photoelectrolytic Production
  15. Photobiological Production
  16. H<sub>2</sub> 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 H<sub>2</sub> Storage Materials Development
  23. Small-Scale Reformers for On-Site H<sub>2</sub> Supply (SSR for H<sub>2</sub>)
  24. Wind Energy and H<sub>2</sub> Integration
  25. High Temperature Processes for H<sub>2</sub> Production

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# Task 18: Integrated Systems Evaluation

January 2004 – January 2009 **recently extended**



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

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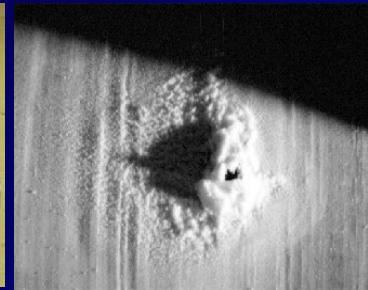


# Task 18 Demonstration Sites – Phase 1 and 2

CANADA	Pacific Spirit Station (H2 filling station)
DENMARK	Island Power
FRANCE	Review lessons learned from fuel cell evaluation (EPACOP)
GERMANY	Hydrogen Filling Station
GREECE	RES2H2
ICELAND	Hydrogen bus/refueling project (ECTOS)
ITALY	BEAM project: System efficiency; Control strategy
JAPAN	Regenerative PEM FC-power system (grid)
NEW ZEALAND	Renewable hydrogen at remote site
SPAIN	The Fuel Cell Innovative Remote Systems for Telecommunications (FIRST) project
SWEDEN	Malmö filling station and hythane-fueled buses
UK	Hydrogen and Renewables Integration (HARI) Project
USA	Las Vegas Energy Station
USA	Hydrogen Power Park

# Task 19: Safety

October 2004 – January 2008



Bonfire test

Grenade test

Hydraulic burst test

Gunfire test

Drop test

- ❑ Survey of Quantitative Risk Assessment (QRA) methodologies and testing methodologies (**public report October 2007**)
- ❑ **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)

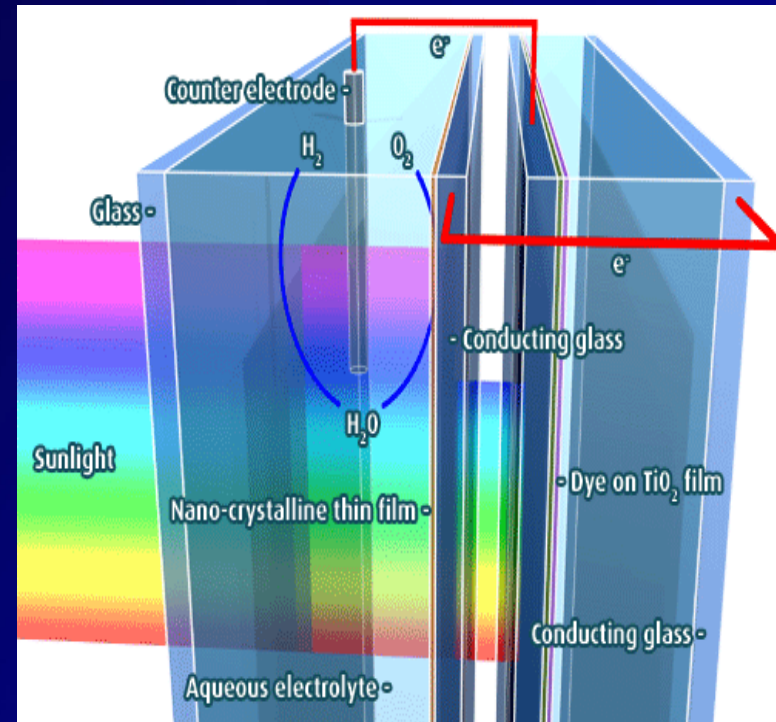
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# Task 20: Hydrogen from Waterphotolysis

October 2004 – October 2007

- ❑ 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

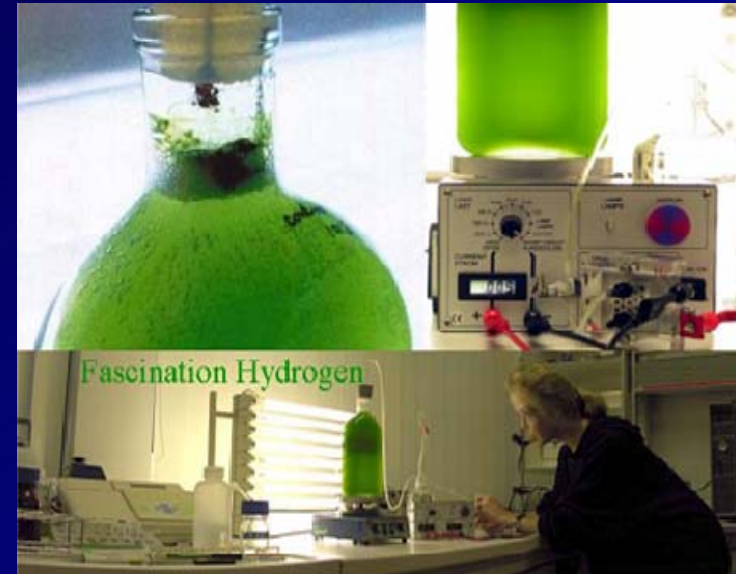


OA: Dr Andreas Luzzi (University of Applied Sciences Rapperswil, Switzerland)

# 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 of AIST

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# 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

## ❑ 15 HIA countries, 43 experts, 39 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

# Task 23: Small-Scale Reformers for On-Site H<sub>2</sub> Supply

December 2006-December 2009 **NEW!**

- ❑ Development of reformer technologies and distributed on-site reformer based H<sub>2</sub> 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 **NEW!**

- ❑ 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 Tamaya-Madurga

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# Task 25: High Temperature Processes for H2 Production

May 2007

NEW!

- ❑ Will Support production of massive quantities of zero-emission H<sub>2</sub> 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:**
  - ❑ **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



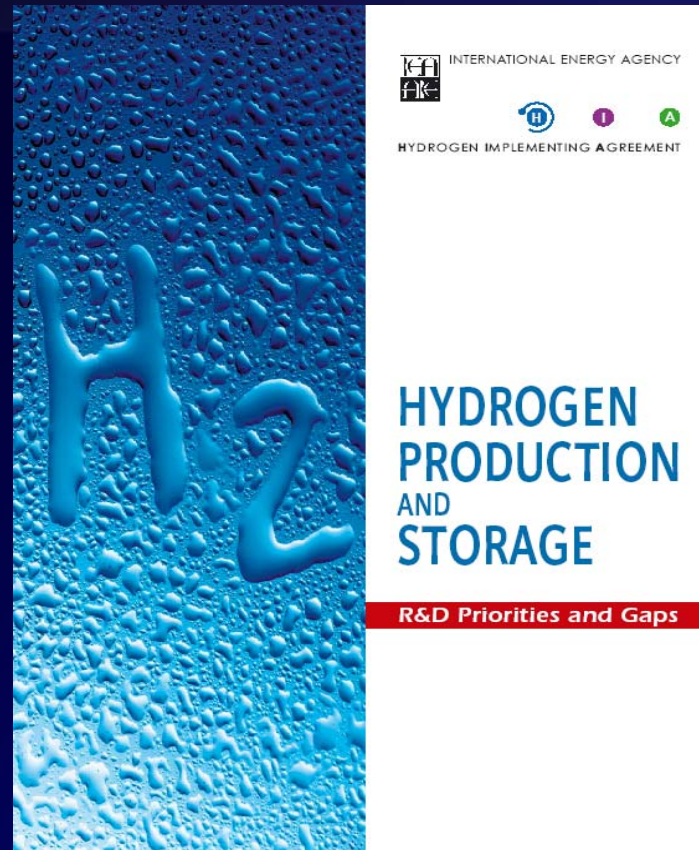
OA: Mr. Gilles Rodriguez of CEA

# Other Tasks: Now in Definition or Proposed

- ❑ Near Term Market Routes to Hydrogen by Co-Utilization of Biomass as a Renewable Source with Fossil Fuels
- ❑ Hydrogen Distribution Infrastructure and Mass Storage



# *R&D Priorities and Gaps in H2 Production and Storage*



*Available for downloading at  
[http://www.ieahia.org/iea\\_publications.html](http://www.ieahia.org/iea_publications.html)*

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# IEA HIA R,D&D Cooperation

## 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 25 years
- ❑ Growing Membership

*International Energy Agency Hydrogen  
Implementing Agreement . . .*

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