



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 Secretariat

Management Support for Sustainable International Cooperation

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M.R.S. Enterprises, LLC
April 22, 2005

This presentation does not contain any proprietary or confidential information

Project SAP2

Overview

IEA HIA Secretariat Function

Timeline

- ❑ US **commitment** long-standing
- ❑ Support **ongoing**
- ❑ M.R.S. engaged FY04

Budget

- ❑ FY04 - \$103,000
- ❑ FY05 - \$107,000
- ❑ Voluntary Contractor Cost-Share- \$57,000/yr

Other Funding

R&D **costs of 200 experts, 175 FTEs, "task-shared"** by member countries.

Overview - Barriers

IEA HIA Secretariat Function

DOE Hydrogen
Program
Management
and
Operations
6.1

- ❑ Cites **value** to US in **cooperative partnerships** and coordinated international hydrogen activities
- ❑ Acknowledges **DOE's leadership** role in **collaborative international** activities via the IEA HIA
- ❑ Builds on **sustainable HIA model** with Secretarial initiative for an “International Partnership for a Hydrogen Economy”

Overview - Barriers

IEA HIA Secretariat and HIA R&D

- HIA's collaborative R&D, analysis and outreach portfolio contributes to removing full range of technical barriers in hydrogen
 - Production
 - Storage
 - Safety
 - System Analysis and Integration

- Secretariat management function essential to continued barrier reduction via HIA R&D



Overview- Barriers and Targets

Examples

DOE Program Plan Areas and HIA Tasks

Task 15 Photobiological

Task 16 H₂ from Carbon
Containing Materials

Task 17 Storage

Task 18 Integrated Systems
Analysis

Task 19 Safety

Task 20 H₂ Waterphotolysis

Example Technical Barriers and/or Technical Targets

- ❑ 50% molar yield of carbon conversion to H₂
- ❑ \$1.50/gge total H₂ distributed H₂ production
- ❑ Reversible H₂ storage medium recoverable with 5wt% H₂ at @ 80°C
- ❑ Conflicts bet. domestic and int. codes & standards; lack of consistent modeling approaches; info and experience gap in tech validation
- ❑ Limited historical database; Proprietary data; Validation of historical data;
- ❑ Net solar to H₂ conversion efficiency of 10%





Canada
Mr Nick Beck



European Commission
Dr Stathis Peteves



Japan
Dr Koji Nakui



Italy
Dr Agostino Iacobazzi



Iceland
Mr Agust Vatfells



Lithuania
Dr Jurgis Vilemas



The Netherlands
Dr Henk Barten



France
Dr Paul Lucchese



Australia
Dr John Wright

HIA Member Countries Partners

Norway
Mr Trygve Riis (Chairman)



Spain
Dr Antonio Garcia-Conde



Sweden
Dr Lars Vallander



Switzerland
Dr Gerhard Schriber



United Kingdom
Dr Ray Eaton



United States
Mr Patrick Davis



Denmark
Mr Jan Jensen



Finland
Dr Seppo Hannus



IEA HIA Fundamentals

International Energy Agency (IEA)

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

IEA Implementing Agreement (IA)

A **collaborative** research and development (**R&D**) program

Annex / Task

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

Hydrogen Implementing Agreement (HIA)

Created in **1977** on **task-shared**, “**bottom-up**” basis; **US** a **founding** member
US **supports** HIA Secretariat and **participates** in all tasks



HIA Annexes Since 1977

Past Tasks

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

1. Design and Optimization of Integrated Systems
2. Photoelectrolytic Production

Present Tasks

15. **Photobiological** Production
16. H₂ from **Carbon-Containing Materials**
17. Solid & Liquid State Storage Materials
18. Integrated Systems - II
19. **Safety**
20. Hydrogen from **Waterphotolysis**

Objectives

- ❑ **Manage** orderly and efficient conduct of HIA to **support** realization of **HIA mission** and **DOE Hydrogen Program** to advance hydrogen economy
- ❑ Support appropriate and effective expansion of the HIA R&D, analysis and outreach program
- ❑ Promote **growth** in HIA **membership** and industry participation
- ❑ **Cooperate** with other **international** hydrogen R,D&D **ventures**, notably the **IPHE**
- ❑ Enhance HIA **leadership** position in international hydrogen RD&D ventures
- ❑ Foster HIA's standing as a **premier global resource** for technical **expertise** in hydrogen R&D



Approach

In support of HIA mission & DOE Hydrogen Program Objectives and under direction of HIA Executive Committee

Manage HIA Operations

- Strategic planning for R&D, analysis and outreach portfolio
- Finance and accounting
- Administration
- Conferences, meetings and event planning

Manage HIA Personnel

- Employees and consultants, both professional and administrative

Manage Communication and Outreach program

- Internal HIA communications and IEA liaison
- External communications and cooperation (www.ieahia.org)
- Media Engagement
- Representation to relevant organizations and groups



HIA Secretariat

Accomplishments-Progress-Results

Operations

- ❑ **Membership recruiting** - Current total 17 members:
 - ❑ 4 new members
 - ❑ 1 returning member
 - ❑ 8 potential country members in pipeline to join HIA
- ❑ **Formal IEA approval for new five year term of operation 2004-2009 and Strategic Plan**
 - ❑ Features plans for HIA **growth** and **expanded** collaboration
- ❑ **Two Executive Committee meetings per year**
- ❑ **HIA R&D, Analysis and Outreach Portfolio and Work plan**
 - ❑ 3 new tasks (18, 19, 20) approved
 - ❑ approval of 4th task imminent
 - ❑ 2 tasks in project definition phase and others in decision pipeline



HIA Secretariat

Accomplishments-Progress-Results

Outreach and Communications

- ❑ Press conference held at the National Press Club in Washington, D.C. to launch the 25th Anniversary Report *In Pursuit of the Future: 25 years of IEA Research towards the realisation of Hydrogen Energy Systems*
- ❑ HIA featured speaker at 10 major international conferences
- ❑ 12 media articles on HIA
- ❑ 4 major presentations and 2 posters now planned
- ❑ New corporate identity (logo, etc) developed
- ❑ HIA website www.ieahia.org now under reconstruction
- ❑ Published HIA Annual Report

Personnel

- ❑ Managed Secretariat's administrative and professional resources

HIA's **success** acknowledged as a **sustainable** vehicle for collaborative R&D that offers a **global** model for international **cooperation**

HIA 25th Anniversary Report “In Pursuit of the Future”

Luzzi / Bonadio / McCann



released at the National Press Club, Washington DC, 7-Sep-04

- 1) provides an introduction to the complex, interconnected issues associated with the development of a hydrogen infrastructure and the adoption of hydrogen as the “future fuel”
- 2) conveys the attractive fundamentals of the hydrogen energy proposition
- 3) highlights important HIA contributions to the advancement of hydrogen science and technology

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

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

DOE Program Review 2005



Task-15: Photobiological Hydrogen Production

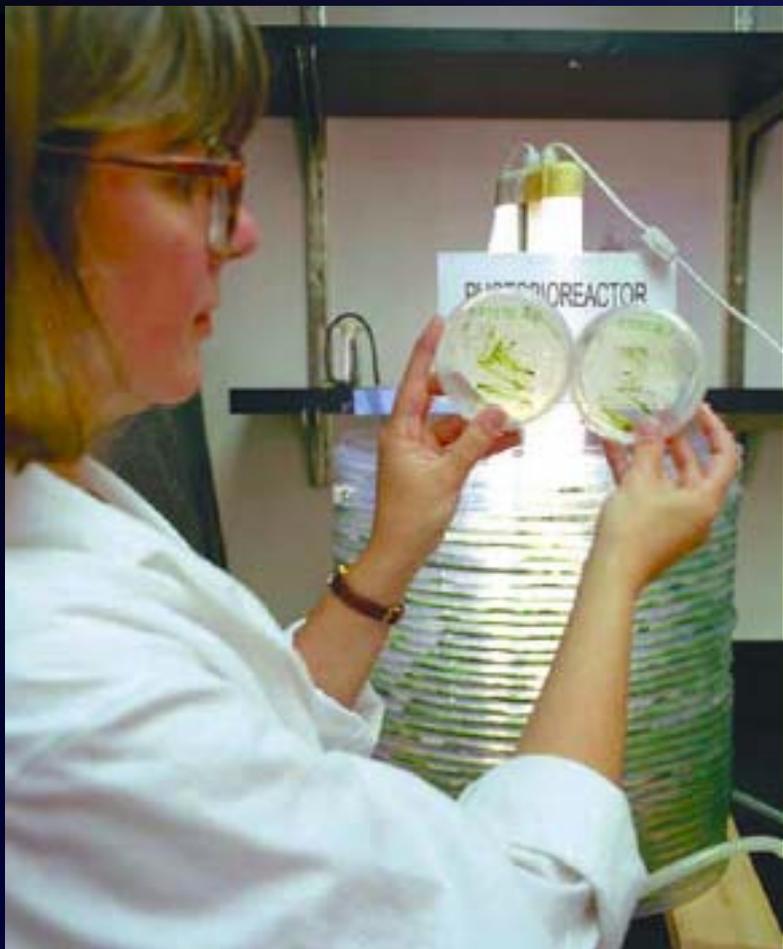
Technical Accomplishments-Progress-Results

May 1999 – June 2004

- ❑ Completed – will evolve into Task-21
- ❑ Various process-development-scale **photo-bioreactor systems** being tested
- ❑ Comprehensive **global database** established on hydrogen-producing **microorganisms**
- ❑ Hydrogen production from a **green algae demonstrated**
- ❑ **Two breakthroughs**
 - ❑ Accessory genes for photoproduction of H₂ in *Chlamydomonas Reinhardtii* identified
 - ❑ STA7 and starch metabolism play important roles in this process



Gen-Mutated Algae Cultures for Hydrogen Production



NREL

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

DOE Program Review 2005



Task-16: H₂ from Carbon-Containing Materials

Technical Accomplishments-Progress-Results

April 2002 – December 2005

- ❑ Completed concept study of **large-scale integrated hydrogen production project** for power production with decarbonization
- ❑ Comprehensive status and R&D challenges report on **hydrogen production from biomass** complete; Resource, technology and market analysis for biomass feedstock underway
- ❑ Review of **small-scale stationary reformers** for hydrogen production from fossil fuels with CUTE update
- ❑ Three subtasks:
 - ❑ Osaka Gas won engineering excellence award from ENAA for reformer work under Subtask C



“Small-scale” Natural Gas Reformer



Mahler

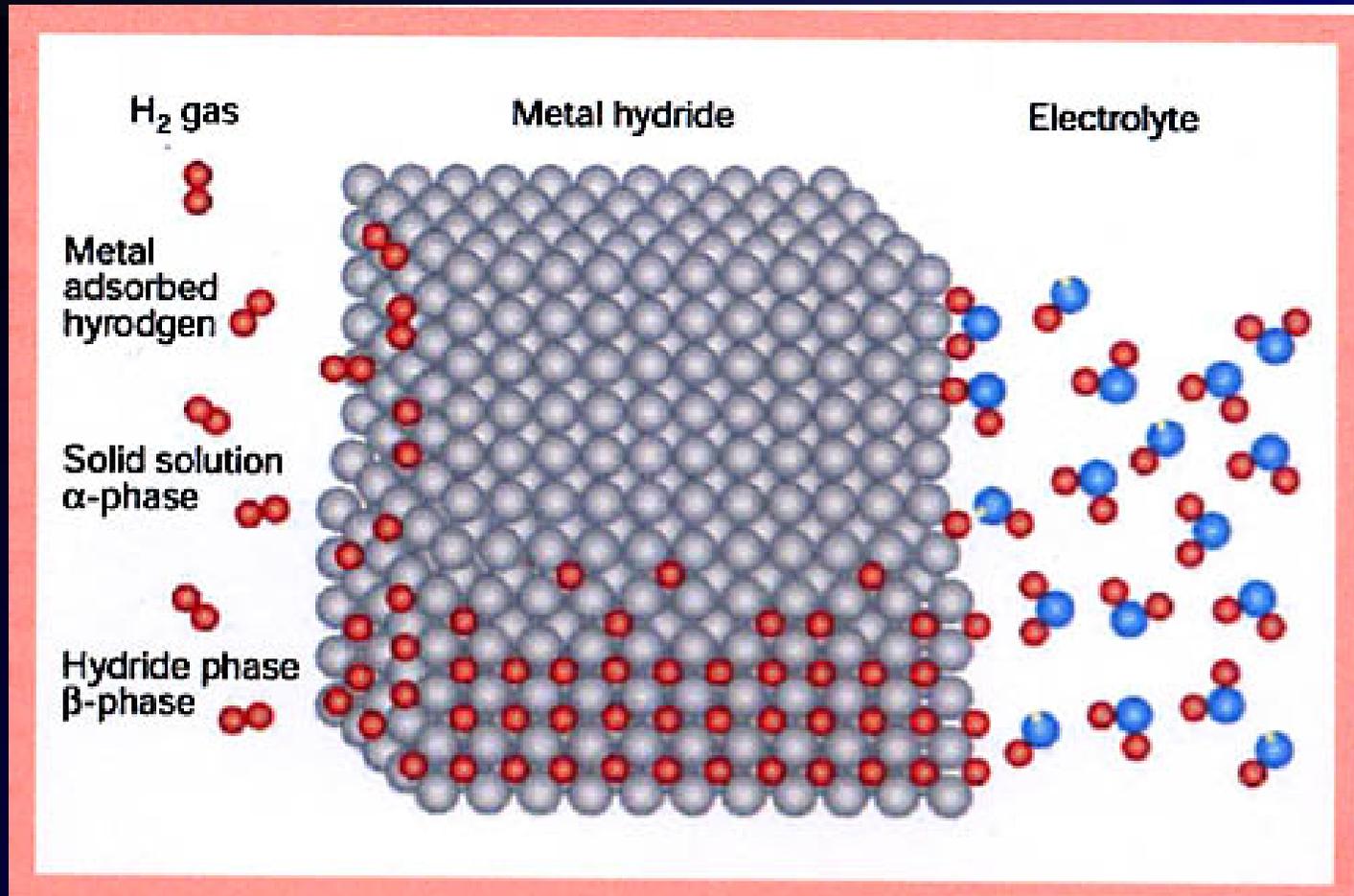
Task-17: Liquid & Solid Hydrogen Storage

Technical Accomplishments-Progress-Results

June 2001 – May 2006

- ❑ **Global database** created <http://hydpark/ca.sandia.gov>
- ❑ R&D on catalyzed sodium aluminum hydrides led to identification of hydride capable of **4 wt% reversible hydrogen @ 120°C**
- ❑ Metal hydride storage material with **5 wt% @ 150°C** confirmed
- ❑ Joint R&D on **14 metal hydride**, **12 combined hydride/carbon** and **6 carbon projects**

Hydriding Mechanisms



L. Schlapbach

Task-18: Integrated Hydrogen Systems

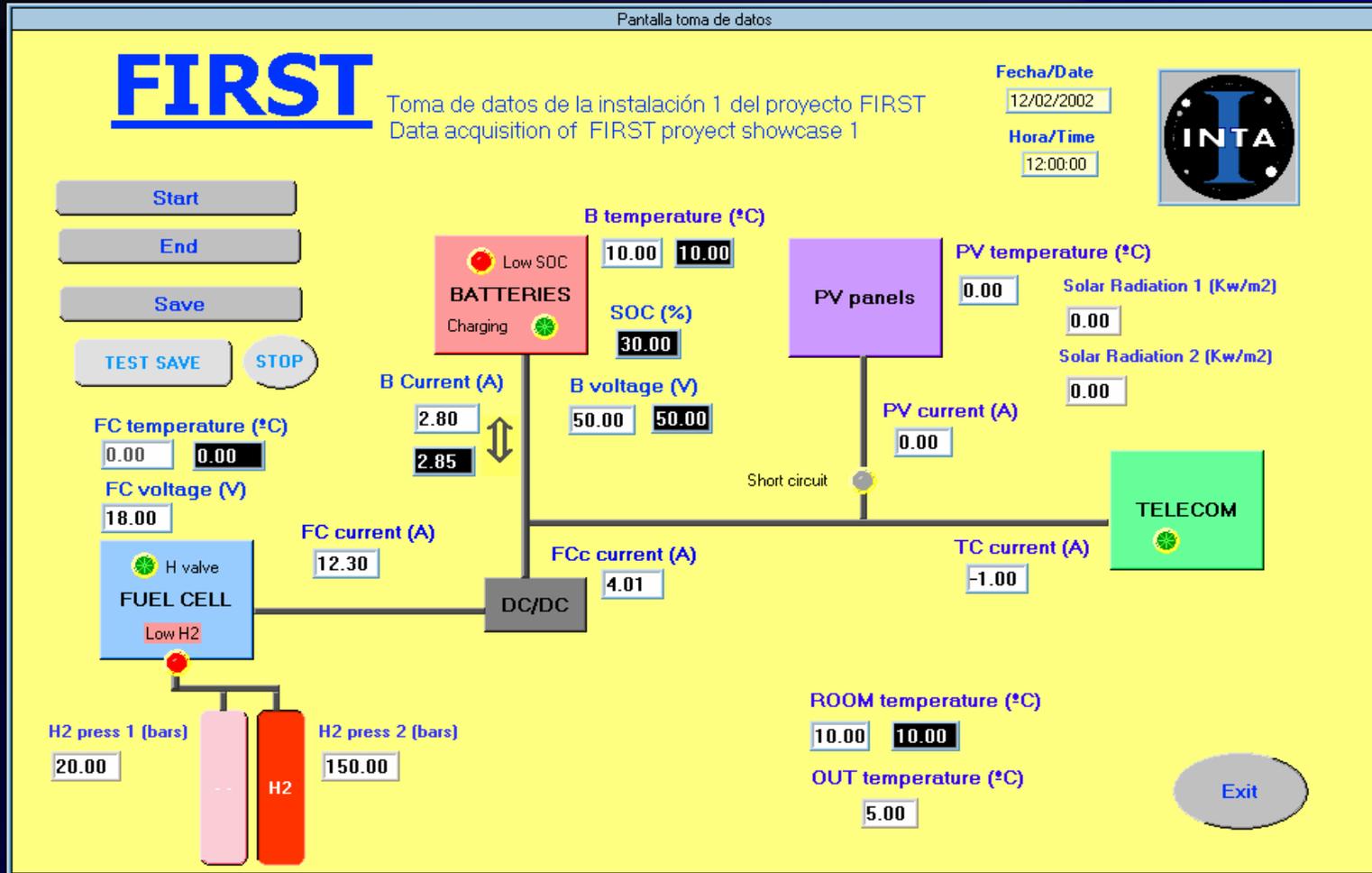
Technical Accomplishments-Progress-Results

January 2004 – January 2009

- ❑ Anticipates development of comprehensive information datasets and summary compilation of **integrated hydrogen demonstration systems** and development plans
- ❑ Utilizes **Modeling** and use of previously developed **analysis tools** to evaluate hydrogen demonstration projects
- ❑ Project selection and assessment: 8 demonstration projects selected; 2 evaluations complete; 6 underway
- ❑ “**Hydrogen Resources Study**” underway with broad participation
- ❑ **New case study approach** for other demonstration projects



Fuel Cell Innovative Remote System For Telecommunication



INTA

Task-19: Safety

Technical Accomplishments-Progress-Results

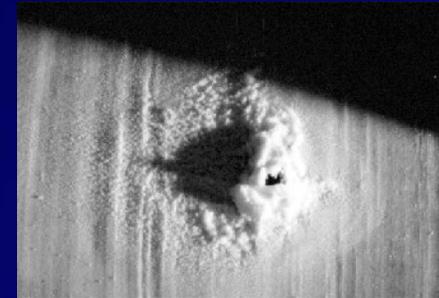
October 2004 – October 2009

- ❑ Approved October 2004
- ❑ **Subtask 1:** Survey of **Quantitative Risk Assessment (QRA)** methodologies and testing methodologies **underway**
- ❑ **Subtask 2:** Establishment of **testing equipment** to evaluate the effects of equipment, product and/or system **failures** under a range of **real-life scenarios**, environments or mitigation measures
- ❑ **Subtask 3:** Development of **targeted information packages** for stakeholder groups

E.g.: High-Pressure Hydrogen Gas Tank Testing



Bonfire test



Gunfire test



Grenade test



Drop test



Hydraulic burst test

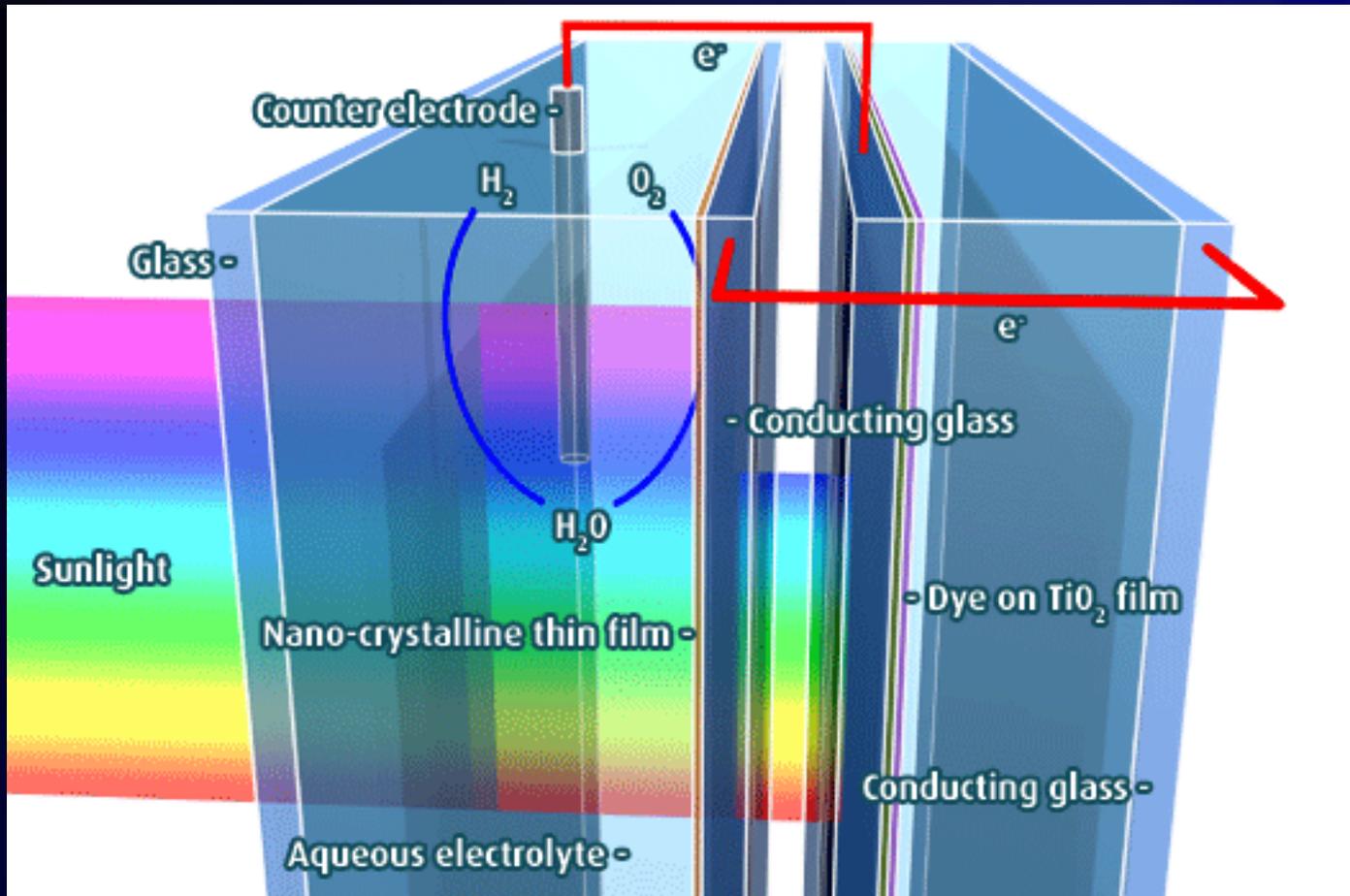
Task-20: Hydrogen from Waterphotolysis

Technical Accomplishments-Progress-Results

October 2004 – June 2008

- ❑ Launched October 2004: countries, 35 research groups, experts
- ❑ Continuation and **expansion of Task-14** (up to 14 countries and 35 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

Photoelectrochemical (PEC) Tandem Cell



Hydrogen
Solar LLC (UK)

The Future: HIA 5-Year Plan (2004 - 2009)



The Future

HIA Goals 2004-2009

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

Future Plans for Annexes & Activities

- ❑ Internal IEA **cooperation** – e.g. with Advanced Fuel Cells IA
- ❑ External **collaboration** – e.g. with IPHE
- ❑ **High-temperature processes**: Electrolysis, thermochemistry
- ❑ **Low-temperature processes**: Including electrolysis and wind
- ❑ **Compressed gas** assessment
- ❑ Hydrogen **storage** (focus on liquid & advanced solid state storage concepts)
- ❑ **Industrial uses** of hydrogen with **non-energy focus**
- ❑ **Infrastructure** for stationary applications
- ❑ Hydrogen **economics**
- ❑ Expanded **outreach** with **newsletter** on revamped **website**



Publications and Presentations

Secretariat Supported and/or Delivered

Presentations

Publications

- ❑ **25th Anniversary Report: *In Pursuit of the Future***
- ❑ **End of Term Report and Five-Year Plan**
- ❑ **HIA Annual Reports**
- ❑ **Final management Report Task 14**
- ❑ **200 expert publications**
- ❑ **Opportunities Assessment Report: Gaps & Priorities in Hydrogen R&D**
- ❑ **Papers for inclusion in conference proceedings**
- ❑ **Press releases on HIA news**
- ❑ **Member only publications – Semi-Annual Reports and presentations**
- ❑ **Secretariat and media articles**

FY2004

- ❑ German Hydrogen Energy Conference
- ❑ U.S. National Hydrogen Association Conference
- ❑ Windsor Workshop Panel Discussion
- ❑ World Hydrogen Energy Conference 15 – Presentation and poster
- ❑ Task 16 Subtask C presentation
- ❑ World Renewable Energy Conference (WREC)

FY2005

- ❑ Fuel Cell Seminar
- ❑ Gaps and Priorities in Hydrogen R&D to IEA Hydrogen Coordinating Group
- ❑ Renewable Hydrogen at IEA REWP Meeting
- ❑ IPHE Storage Conference (Co-sponsor)
- ❑ International Hydrogen Energy Congress & Exhibition
- ❑ World Hydrogen Technologies Conference
- ❑ European Hydrogen Energy Conference/Exhibition



HIA Secretariat:

Enhances HIA Investment Value for DOE

Provides a neutral international profile

- ❑ Knowledgeable, reliable, unbiased
- ❑ **Global reach** (government, academia, industry)

Leverages resources through task-sharing

- ❑ **Focus** includes **science & technology**, market analyses and **outreach**
- ❑ **Portfolio** includes shorter term and long-term, **pre-competitive activities**

Offers sustainable model for management of international R&D cooperation