THE IEA HIA TODAY

New Members

Early in 2013, the IEA HIA was very pleased to welcome Israel as a Contracting Party to our Agreement. In March, after careful consideration and in an effort to enhance our capacity to achieve the IEA HIA mission and vision for hydrogen, the Executive Committee adopted a policy framework that allows “Sponsor Members” from industry, public-private partnerships, associations and consortia. We are happy to announce that the International Association, for Hydrogen Safety (IA HySafe) has officially become the IEA HIA’s first Sponsor Member.

Strategy Matters

• The International Energy Agency’s (IEA) flagship publication, Energy Technology Perspectives 2012 (ETP 2012) - Pathways to a Clean Energy System, has for the first time dedicated a chapter to a far-reaching examination of hydrogen use in the future global energy mix, concluding that hydrogen could play an important role in a low-carbon energy system.
• IEA HIA Roadmap On July 10th & 11th, the IEA undertook development of a Hydrogen Roadmap (H2RM), the last in the IEA’s Technology Roadmap series. The H2RM is expected to have an intersectoral scope that encompasses transport, buildings, and industry, as well as infrastructure. There will be a special focus on use of hydrogen for large-scale energy storage and its linkages to the integration of variable renewable energies.

ExCo Meetings

In June 2012, the IEA HIA held its 66th Executive Committee (ExCo) Meeting in June in Toronto, Canada. There, the ExCo agreed to schedule in-person meetings at eight-month intervals. Since the ExCo must officially meet biannually, this means that even years will now have one “webinar” ExCo meeting and one in-person ExCo meeting. Accordingly, the second 2012 IEA HIA ExCo Meeting (67th ExCo Meeting) took place via global webinar in November 2012. • The IEA HIA was delighted to welcome IEA Deputy Executive Director, Ambassador Richard Jones, to speak at our 68th ExCo Meeting held during March 2013 in Paris, France.

IEA HIA Portfolio

Final Reports for Task 23 - Small-Scale Reformers for On-Site Hydrogen Supply, and Task 24 – Wind Energy and Hydrogen Integration have been approved and posted on the IEA HIA website. The Task 23 Final Report is featured in the Publication Alert section. • Two new tasks have been approved: Task 32 – Hydrogen-Based Energy Storage and Task 33 – Local Hydrogen Supply for Energy Applications.
Key findings and outcomes include:

- Progress toward development of uniform standards intended to facilitate codification and safety certification that enhances prospects for mass-production and resulting cost reductions.
- A state of the art review of commercially available small-scale hydrogen production technologies — including a cost curve that illustrates reformer cost relative to capacity — focused on reforming hydrocarbon feedstock to hydrogen.
- A comprehensive discussion of material challenges and possible technological alternatives for hydrogen reforming such as catalytic heat-exchange, membrane, sorbent-enhanced, and plasma reforming.
- A thorough review of renewable sources of hydrogen production featuring a well-to-tank analysis of various carbon footprint reduction opportunities from sources like biogas and renewable electricity.
- Examination of how on-site generation of hydrogen can ease integration of carbon capture technologies that reduce the carbon footprint of hydrogen from fossil fuel reformation, a priority for market penetration.
- Market Studies on production capacities, existing infrastructure, and cost estimates as well as national and sub-state level policies for U.S., Norway, Italy, France, Germany, Turkey, Japan, Sweden, and the Netherlands.

A new task, Task 33, will succeed Task 23 and feature an exclusive network of suppliers and end users of electrolysers, as well as reformers. Building on the experience and results of its predecessor, Task 33 is expected to foster the cooperation crucial for infrastructure deployment with on-site generation.

The Task 23 Final Report was approved for release at the 68th Executive Committee meeting in Paris, France March 13–14, 2013. It is available for viewing at www.ieahia.org/new.htm. Citing the report, Jan K. Jensen, IEA HIA Chairman and Executive Vice-President of the Danish Gas Center, emphasized that "Hydrogen production by on-site reforming is an important and competitive stepping stone in the development of a hydrogen re-fuelling infrastructure for the transport sector.

### THE HYDROGEN FUEL CELL MARKET SPACE

From April 2009 - March 2013 Japan’s Ene-Farm, the subsidized Combined Heat and Power (CHP) project, installed 49,813 commercial systems. The Ene-Farm project is a topic of study as a replicable model in Task 29 — Distributed and Community Hydrogen (DISCO H2). In April 2013, Hyundai delivered 15 hydrogen fueled cars to the City of Copenhagen. It appears that Hyundai might be the first car to be introduced on a commercial basis in Norway beginning in 2014. Given its attractive incentives for hydrogen fuel cells, Norway could be an interesting early market for introduction of hydrogen fuel cell vehicles, as it has already been for electric vehicles. Also in Norway, NEL Hydrogen has recently introduced a new electrolyzer, which can operate over a large range of production capacity down to 10%. The new electrolyzer also has a much shorter response time to changes in production levels, so is more suitable for intermittent electricity sources such as wind and photovoltaics. The Clean Energy Patent Index (http://cepi.typepad.com/cepi/index.html) reports that 950 U.S. fuel cell patents were issued in 2011, nearly double the ~540 figure for solar, the run-up category. The California Energy Commission (CEC)’s updated 2013-2014 investment plan includes $20 million to fund construction of 17 hydrogen fueling stations in California. The French Industrial Gas Company Air Liquide invested €5 million (66.5 million USD) in Plug Power, the US fuel cell developer. Navigant Research reports a 62% increase in North American systems shipped in the last year and a 48% increase in global MWs shipped.
The International Energy Agency’s (IEA) flagship publication, *Energy Technology Perspectives 2012* (*ETP 2012*) – *Pathways to a Clean Energy System*, for the first time dedicates a chapter to a far-reaching examination of hydrogen (H₂) use in the future global energy mix, concluding that hydrogen could play an important role in a low-carbon energy system. The transportation sector is pivotal to realizing this outcome: deployment of hydrogen powered Fuel Cell Electric Vehicles (FCEVs) at the ETP 2012 2°C Scenario analysis levels could reduce CO₂ emissions significantly, helping to limit average global temperature increase to 2°C, the agreed UN target. An increasing role for hydrogen could help avoid over-reliance on other uncertain low-carbon energy sources, particularly bio-energy. Policy-wise, ETP 2012 makes the case for sharp increases in funding of R,D&D (Research, Development, Demonstration and Deployment) for hydrogen and FCEVs. ETP 2012 argues that if the cost of a full hydrogen/FCEV-system could be cut by a few percent through stronger R,D&D programs, this investment would yield high returns in a sustainable energy future, paying for itself many times over. Without hydrogen, concludes ETP 2012, it may not be possible to eliminate fossil fuel in transport and industry in the longer term, post 2050. “The inclusion of a hydrogen chapter in ETP 2012 is a real milestone for hydrogen and FCEVs,” the IEA HIA acknowledges that there’s more work to do on hydrogen and the IEA HIA agrees. The IEA analysts faced the challenge of integrating the use of hydrogen as both a fuel and feedstock. The IEA Technology Network. This approach enabled the IEA HIA contribution to the Hydrogen Chapter. More precisely, the IEA HIA contribution came from ExEa Members and our tasks, especially Task 30 – Analysis of Hydrogen Resources, and Task 28 – Large Scale Hydrogen Infrastructure and Mass Storage. The IEA analysts faced the challenge of integrating and balancing the research, findings and conclusions on this important new ETP topic. We thank them for including hydrogen as an integral part of the ETP system analysis. In particular, we would like to acknowledge Dr. Lew Fulton and Dr. Markus Wråke their support was key to launching the first-ever ETP chapter on hydrogen.

The IEA HIA looks to future editions of the ETP (and the World Energy Outlook [WEO]) that feature the important role of hydrogen and the IEA HIA agrees. Citing the significance of the H₂ Mobility‘S planned 2015 commercialisation launch, ETP 2012 stresses that continued coordinated action is needed to develop hydrogen infrastructure. ETP 2012 also encourages more early-stage hydrogen development projects to enhance real-world experience that will facilitate a major hydrogen systems roll-out. Moreover, large scale hydrogen storage in the gas grid (P2G) warrants serious investigation, since hydrogen can be converted from and back to electricity. ETP 2012 recommends in-depth regional level analysis of the interaction between large-scale variable energy integration, energy storage and the use of hydrogen as both a fuel and feedstock.

**Technology Spotlight**

**IEA HIA NEWS**

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IEAHIA NEWS

Summer 2013

VOLUME 7, NUMBER 1

IEA HIA Portfolio

Hydrogen Production & Integrated Hydrogen Systems

PAST

Task 1 1977-1988
Thermochemical Production
Task 2 1977-1979
High Temperature Reactors
Task 3 1977-1980
Assessment of Potential Future Markets
Task 4 1979-1988
Electrolytic Production
Task 5 1979-1983
Solid Oxide Water Electrolysis
Task 6 1979-1988
Photocatalytic Water Electrolysis
Task 7 1983-1992
Storage, Conversion, and Safety

Task 8 1986-1990
Technical and Economic Assessment of Hydrogen

Task 9 1988-1992
Hydrogen Production

Task 10 1995-1998
Photoelectrolytic Production

Task 11 1995-1998
Integrated Systems

Task 12 1995-2000
Metal Hydrides for Hydrogen Storage

Task 13 1999-2001
Design and Optimization

Task 14 1999-2004
Photobiological Production

Task 15 1999-2004
Photoproduction of Hydrogen

Task 16 2002-2005
Hydrogen from Carbon Containing Materials

TASK INK

Hydrogen Production & Integrated Hydrogen Systems

Current Acts

Task 21 Biophotolysis
Operating Agent: Dr. Michael Seibert, immediate past OA
Dr. Jun Miyake, former and current acting OA
- The Fall 2012 meeting was held December 3-5 in Bethesda. Task 21 experts then went to Capitol Hill to brief U.S. Senate Energy and Natural Resources Committee staffs about biophotolysis.
- When funding issues resultied in the departure of Operating Agent (OA) Dr. Michael Seibert, former OA Dr. Jun Miyake stepped forward to fill the gap. Task 21 is expected to present a proposal for a successor task at the December 2013 ExCo Meeting.

Opening Act
Task 33 Local Hydrogen Supply for Energy Applications
Operating Agent: Dr. Øystein Uleberg
This task succeeds Task 23 – SSR for Hydrogen. It will evaluate and harmonize on-site production technologies – including electrolyzers – for cost reduction, improved efficiencies and mass production

Hydrogen Storage

Closing Act
Task 22 Fundamental and Applied Hydrogen Storage Materials Development
Operating Agent: Dr. Bjorn Hauback
- The final Task 22 meeting was held October 26-27 in Japan. The Final Report is in preparation and will be presented for ExCo approval at the 69th IEA HIA ExCo Meeting in December 2013.
- Recognized as the “gold standard” for global research in hydrogen storage, the ~50 Task 22 projects produced >2500 publications and presentations as well as >50 patent applications

Opening Act
Hydrogen Storage
Task 32 Hydrogen-based Energy Storage
Operating Agent: Dr. Michael Hirscher
- This task succeeds Task 22 – Hydrogen Storage. The kickoff meeting was held end of April in Crete, Greece. Task 32 will have strong representation from experts who participated in Task 22.
- Task 32 will have a broader focus than its predecessor with increased emphasis on applied research and other energy storage technology applications.

Hydrogen Integration in the Existing Infrastructure

Current Acts
Task 28 Large-Scale Hydrogen Delivery Infrastructure
Operating Agent: Dr. Marcel Weeda
- A fourth subtask entitled “Supporting large-scale deployment of variable renewable energy sources” was presented by OA Marcel Weeda on behalf of the IEA HIA at the 2012 Energy Storage Conference, making the case for large scale storage of H2 for variable renewable energies and the greening of natural gas
- The other three tasks are: Subtask A Scenarios; Subtask B Assessment of HRS concepts; Subtask C – Analysis of Hydrogen Delivery Pathways
- Work on the Final Report is well underway. Emphasis has been placed on development of messages.
Task 29 Distributed and Community Hydrogen (DISCO-H2)
Operating Agent: Dr. Federico Villatico, Immediate Past OA
Dr. Hiroshi Ito, Acting OA

- Completed identification and selection of projects in urban, rural/industrial and industrial categories. Finalising in-depth SWOT analysis of projects that will serve as a reference for development of DISCO-H2 models, one model per category.
- Experts from Task 29 provided input to the IEA-RETD publication on “Renewable Energies for remote areas and islands.”
- Task 29 presented a poster at the 2012 Fuel Cell Seminar and Exposition held November 5-8 in Connecticut, USA.

Analysis
Operating Agents: Dr. Susan Schoenung; Mr. Jochen Linsen

Task 30 Global Hydrogen Systems Analysis
Subtask A: “An international model for resource analysis” is now fully functional, providing a dynamic modeling tool for “what if” sensitivity analyses of global hydrogen resource flows; the final report for this subtask is expected by year-end 2013.

Subtask B: the Database structure is complete for 27 technologies. The draft handbook structure is complete.

Subtask C: held a successful March workshop with IEA Analysts and ExCo in Paris.

Created a new Subtask D: “Hydrogen storage enabling renewable energies.”

Hydrogen Understanding, Awareness and Acceptance
Task 31 Hydrogen Safety
Operating Agent: Mr. William Hoagland

- Hydrogen Safety Stakeholders Workshop (October 2-3) was a success, and End of Term Workshop for Task 19 (that also highlighted current Task 31) brought together approximately 50 leaders in the hydrogen safety arena.
- It is anticipated that a second Hydrogen Safety Stakeholders Workshop will be held in Europe, likely in Berlin, to mark the completion of Task 31.
- Planning for the Task 31 successor is now underway.

Task 32 Hydrogen-based Energy Storage
Task 33 Local Hydrogen Supply (SSR for H₂)

Task 34 2007-2010
Wind Energy and Hydrogen Integration

Task 25 2007-2011
High Temperature Production of Hydrogen

In March 2012, a new Energy Agreement was reached in Denmark. The Agreement contains a wide range of ambitious initiatives, bringing Denmark a solid step closer to the target of 100% renewable energy in the energy and transport sectors by 2050. In the first phase (by 2020), use of natural gas and fuel oil in household heating systems is set to be phased out. New regulations will prohibit use of heating systems based on natural gas or fuel oil in new buildings. By year-end 2012, wind power comprised 30% of Denmark’s electricity supply. Meanwhile, state funding for Danish energy research and demonstration programs on fuel cells and hydrogen has increased from about 100 million Danish kroner per year to more than 350 million Danish kroner annually.

TEKES is supporting a new type of Finnish research funding dubbed “strategic research opening.” This new funding mechanism addresses the new knowledge and competencies that will be needed by businesses in the future. Funded projects include a study on the production of hydrogen using solar power in a modern integrated bioeconomy. Since 2012, the TEKES Fuel Cell Programme has funded several hydrogen based projects including: a Roadmap to hydrogen society; the Safety of fuel cell applications and hydrogen infrastructure (related to the major demonstration project Demo2013); and the Safe processing of hydrogen originating from new open cycle (related to the Outostone Open cycle process reported under HIA Task 25).
AFHyPAC, the French Association created in June 2011 from the merger of AFH2 and the French platform HYPAC (H2ydrogène et les Piles à Combustible), hosted the April 2013 meeting of Task 28 – Infrastructure at its Paris office. “H2 mobility France” on MobHyF is working on a National implementation plan for hydrogen mobility that highlights the specific important role of fleets in kick-starting the market. MobHyF, a consortium of some 20 companies, is taking part in the European program HIT: Hydrogen Infrastructure for Transport.

There are 6 H2 filling stations in Norway, 2 connected with EU projects, and 3 operated by the company HVOE that took over from StatOil. A new Directive from EU, the Directive for Clean Transport in Europe, is indicating the number of Hydrogen filling stations in different countries necessary to establish a minimum infrastructure for early use of Hydrogen in transport sector. For Norway, the target number of filling stations is 20.

In Europe, H2 Mobility is expanding its reach. Inspired by the example of H2 Mobility Germany, H2 Mobility UK formally charted its course. A recent feasibility analysis serves as the background and rationale for creation of H2 Mobility Switzerland.

Spain is making plans to celebrate the 10th anniversary of the Fundacion para el Desarrollo de Nuevas Tecnologias del Hydrogen en Aragon sometime in the first half of 2014.

In the United Kingdom, Scotland is moving forward on its ambitious plan of meeting the equivalent of 100% of Scotland’s electricity demand from renewables by 2025.

In the U.S., the launch of H2USA, a public-private partnership, was officially announced at the 2013 Department of Energy (DOE) Annual Merit Review (AMR). H2USA will pursue the deployment of hydrogen infrastructure in the U.S.

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MESSAGE FROM THE CHAIR

The release late last year of the ETP 2012 and its first-ever chapter on hydrogen was the culmination of a multi-year effort on the part of the IEA HIA to encourage the IEA to include hydrogen as part of its ETP system analysis. The development of the hydrogen chapter was a test of both the Implementing Agreement’s ability to react to the ETP’s strict publication schedule and the IEAs capacity to integrate our input. Our hope and expectation is that future editions will build on this foundation to deepen and expand hydrogen coverage.

The IEAs announcement of the imminent development of a Hydrogen Roadmap (H2RM) was long anticipated and very welcome. The H2RM will complete the IEAs Technology Roadmap series. IEA Roadmaps are a crucial industry and public policy tool that broadly signals technology value. The IEA HIA is committed to participating – start to finish – in the three geographic workshops planned by our IEA colleagues for the development of the hydrogen roadmap. In addition, at the behest of the IEA, the IEA HIA has actively cultivated targeted industry participation in the roadmap development process. The first workshop took place in early July in Paris. It finalized the overall roadmap scope and also focused on the European situation. The hydrogen roadmap will also address the critical issue of storage: its findings and recommendations will serve as a reference for the IEA Storage Roadmap, which will not address hydrogen.

Internally, the IEA HIA’s decision to invite Sponsor Members to join the Agreement is yet another milestone. Our affirmation of a “participation principle” that levies essentially equal Common Fund dues on all Sponsor Members irrespective of category (i.e., public/private partnership, industry, association, consortia) reflects the value the ExCo places on having Sponsors present and active “at the table as ExCo participants.” And, of course, we are delighted to welcome the International Association of Hydrogen Safety (HySafe). HySafe’s accession to the IEA HIA is a boon to our hydrogen safety activities and a global step forward for hydrogen safety.

Our two 2012 End of Task Workshops are an important component of IEA HIA Information Dissemination and Outreach strategies, allowing us to share the results of our work and communicate the advances in hydrogen.

With the approval of successor tasks for Task 22 - Storage, and Task 23 – SSR for Hydrogen, (which became Task 32 – Hydrogen-based energy storage, and Task 33 – Local Hydrogen Supply), our portfolio continues to evolve.

Dr. Ingend Schöpfl, former Operating Agent (OA) for Task 23, has been named Project Director at the Norwegian University of Science and Technology (NTNU) Centre for Autonomous Marine Operations and Systems. Sintef’s loss is NTNU’s gain. Sincere congratulations are in order! The IEA HIA looks forward to working with Dr. Schöpfl again soon in her new maritime capacity.
At this time I would like to acknowledge and thank some of the outgoing representatives on the Executive Committee. There are some new faces on the Executive Committee as well. Mr. Tadashi Ito of Japan is returning to his home company Chiyoda Corporation from his assignment at NEDO. In his place we welcome Mr. Hiroyuki Kanesaka and Mr. Kenji Horiuchi as the Japanese Representatives. For Korea, Dr. Shul Yong Gun from Yonsei University replaces Dr. Yongsuk Tak from Inha University. Dr. Elli Varkarai, ExCo Member from Greece, has been recruited to work at Belenos Clean Power Holding Ltd. in Switzerland. Dr. Nikos Lymberopoulos, ExCo Member from UNIDO, has transitioned to the FCH JU in Brussels. The IEA HIA is fortunate indeed to have and to have had such high caliber representation.

I must also comment on other year-end 2012 changes. We are sad to announce that both Dr. Michael Seibert, Operating Agent for Task 21 – BioHydrogen and Emeritus – the U.S. National Renewable Energy and Laboratory (NREL); and Dr. Federico Villatico: Operating Agent for Task 29 – Distributed and Community Hydrogen (DISCO–H2) have transitioned out of their task leadership roles due to funding related issues. Their departures represent a genuine loss to their respective tasks as well as the Agreement, but we are grateful for their service and continued friendship.

In closing, the IEA HIA extends its sincere thanks to all outgoing ExCo Representatives and Operating Agents, our old friends. We welcome and look forward to working with all incoming Representatives and OAs, our new friends.

Sincerely,

Jan K. Jensen
Jan K. Jensen, Chairman