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IEA HIA Research & Analysis that Enable H2 Energy Solutions

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Abstract

The International Energy Agency Hydrogen Implementing Agreement (IEA HIA) is the world's largest and longest-lived cooperative organization in hydrogen research. It offers researchers an established, global network and acts as a catalyst and framework for collaboration. The IEA HIA's core business is hydrogen R,D&D. Our vision is a hydrogen future based on a clean sustainable energy supply of global proportions that plays a key role in all sectors of the economy. This paper provides an overview of the IEA HIA collaboration and our eleven (11) current/closing tasks, emphasizing the role of research and analysis that enables hydrogen energy solutions.

International Energy Agency Hydrogen Implementing Agreement; IEA HIA; collaboration; tasks

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1.0 Introduction

The International Energy Agency Hydrogen Implementing Agreement (IEA HIA) is the world's largest and longest-lived collaborative organization in hydrogen research. It includes 21 countries, the European Commission (EU), and the UN Industrial Development Organization (UNIDO). The IEA HIA's core business is hydrogen R,D&D. The Agreement offers researchers an established, global network and acts as a catalyst and framework for collaboration.

Our vision is one of a hydrogen future based on a clean sustainable energy supply of global proportions that plays a key role in all sectors of the economy. Our mission is to accelerate hydrogen implementation and widespread utilization to optimize environmental protection, improve energy security and promote economic development internationally while establishing the IEA HIA as a premier global resource for expertise in hydrogen. The IEA HIA believes that if the question concerns sustainability, the answer involves hydrogen.

During its 30+-year history of international cooperation, the International Energy Agency Hydrogen Implementing Agreement (IEA HIA) (www.ieahia.org) tasks and activities have achieved much technical progress in hydrogen (H_2) production, storage, conversion, safety, integrated systems and infrastructure. With the *Strategic Plan for 2009–2015*, the IEA HIA expanded its commitment to analysis and outreach to advance introduction and commercialization of H_2 energy technology. [1] This paper examines the purpose, approach and significant recent progress of the 11 current (including six closing) tasks, using the 2009-2015 strategic framework of themes and portfolios, as well as task milestones and the newest Annual Reports. In particular, it emphasizes the role of research and analysis that enables hydrogen energy solutions. [2]

2.0 The IEA HIA Framework

2.1 Strategic Plan 2009–2015

The 2009-2015 IEA HIA strategic framework has three themes that stem from its vision and mission. Each theme has several associated portfolios.

- **Collaborative R,D&D** that advances hydrogen science and technology
  The four Collaborative R,D&D portfolios are:
  - Hydrogen Production
  - Hydrogen Storage
  - Integrated Hydrogen Systems
  - Hydrogen Integration in Existing Infrastructure
- **Analysis that Positions Hydrogen** for technical progress and optimization for market preparation and deployment for support in political decision-making
  The three Analysis portfolios are:
  - Technical
  - Market
  - Support for Political Decision-Making
- **Hydrogen Awareness, Understanding and Acceptance** that fosters technology diffusion and commercialization
  The three Hydrogen Awareness, Understanding, and Acceptance portfolios are:
  - Safety
  - Information Dissemination
  - Outreach – inform and engage critical subset of HIA stakeholders and decision makers

While long-term, precompetitive IEA HIA efforts in fundamental R,D&D are ongoing, there is an increasing emphasis on applied R,D&D.

2.2 IEA HIA Members

The IEA now has 23 members, comprising 21 countries, the Commission of the European Union, and the UN Industrial Development Organization (UNIDO). The member countries are Australia, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Italy, Japan, Korea, Lithuania, The Netherlands, New Zealand, Norway, Spain, Sweden, Switzerland, Turkey, the United Kingdom, and the U.S. In the near future, the IEA HIA hopes to inaugurate a "sponsor" membership category that will include industry.

2.3 Funding and Management

IEA HIA members contribute to a Common Fund for management and promotion. All members are eligible to participate in any/every task at no additional cost on a "task-shared" basis. A typical task-shared labor commitment ranges from 0.25–0.5-person years/year. This system is lean and efficient: no money changes hands for labor at the Secretariat level. Members compensate their experts directly. The IEA HIA Secretariat is managed by Mary-Rose de Valladares, MBA, M.A., of M.R.S. Enterprises.

3.0 The IEA HIA Tasks [3]

All IEA HIA tasks are initiated and developed on a democratic "bottom-up" basis by members. Each task is managed by an Operating Agent (OA); subtasks typically have Leaders (STL). Of the 31 tasks created by the IEA HIA, 20 have been completed. Eleven (11) tasks are currently in place. Pending completion of their final reports, six of these tasks will officially close. Two successor tasks will follow immediately, assuring continuity in those subject areas. The current task list appears below with notations for closing tasks whose final reports are outstanding (FR) and those that plan successor tasks (ST):

Task 21 - BioHydrogen
Task 22 - Fundamental and Applied Hydrogen (H_2) Storage Materials Development (FR) (ST)
Task 23 - Small-Scale Reformers for Hydrogen (H_2) Production (FR) (ST)
Task 24 - Wind Energy & Hydrogen Integration (H_2) (FR)
Task 25 - High Temperature Processes (HTP) for Hydrogen Production (FR)
Task 26 - Advanced Materials for Hydrogen (H_2) WaterPhotolysis (FR)
Task 27 - Near-Term Market Routes to H_2 by Co-Utilization of Biomass with Fossil Fuel (FR)
Task 28 - Large-Scale Hydrogen (H_2) Delivery Infrastructure
Task 29 - Distributed and Community Hydrogen (DISCO H_2)
Task 30 - Global Hydrogen System Analysis
Task 31 - Hydrogen (H_2) Safety

To carry out their work programs, all but one task meet for 2-3 days on a semi-annual basis at rotating locations determined by task members, sometimes in conjunction with related conferences. The lone exception, Task 22, now meets at nine-month intervals because its meetings are 4-5 days long.

3.1 Collaborative R,D&D Theme

The IEA HIA's core competence, and the main focus of the majority of our tasks, is R&D. IEA HIA R&D is typically long-term, pre-competitive research. However, there is an increasing amount of applied R&D. There are four R,D&D portfolios within the Collaborative R,D&D theme.

3.1.1 R,D&D Production Portfolio

Of the 20 completed IEA HIA tasks, over half were production related. Today, six (6) of the 11 current tasks are production related. All six (6) deal with renewable H_2, exclusively or in part.

3.1.1.1 Production: Task 21 – BioHydrogen (2010-2013)

Task 21 (OA Dr. Michael Seibert) is concerned with the production of H_2 by microorganisms. This is the "grow your own" approach to renewable H_2 production. Its activities include bacterial dark fermentation (which uses biomass materials and other organic wastewaters), photosynthetic microbes, and in vitro and bio-inspired systems. The task is also interested in BioHydrogen from economic and sociological perspectives. BioHydrogen is a relatively new but ambitious research topic with great potential. An earlier phase of Task 21 began in 2005 and ended in 2010. The current task was also conceived with a five-year framework: a three-year period followed by an optional two years if deemed necessary by members. Twelve (12) members comprise Task 21: Canada, Finland, France, Germany, Italy, Japan, Korea, The Netherlands, Norway, Sweden, Turkey, and the U.S. In 2011, Task 21 experts reported 127 peer-reviewed publications, nine of which were in high impact journals, as well as six patents. During this period five (5) Ph.D. dissertations were completed and two M.S. degrees were conferred. The EU 6^{th} Framework Project produced 25 Ph.D. dissertations over the five years of the IEA HIA Task 21 effort. The five subtasks are:

Subtask A – Bio-inspired Systems (STL Dr. P. Lindblad) looks to increase H_2 production from substrates above currently achievable yields (i.e., 3 to 4 moles H_2/mole glucose). 2011 witnessed a couple important milestones as four (4) U.S. groups synthesized functional water-oxidizing catalysts and three (3) other groups synthesized water-reducing (H_2 production) catalysts that do not contain noble metals. The U.S. also identified a molybdenum-oxo complex that can generate gaseous H_2 either from water at neutral pH or from seawater.

Subtask B – Dark BioHydrogen Fermentation Systems (STL Dr. P. Hallenbeck) seeks to demonstrate potentially practical processes for the conversion of water or organic substrates to H_2 using solar energy. One Canadian group found that under optimal conditions, fermentation of waste glycerol produced 1 mol H_2/mol glycerol; another Canadian group found that waste thin stillage from bioethanol plants is an effective substrate for H_2 production. Japan and the Netherlands developed and optimized integrated systems incorporating a sequential, dark, anerobic and photofermentation process to enhance H_2 production efficiency from biomass waste. Japan field tested a two stage fermenter at the Takaki bakery using bakery waste. At its April 2011 meeting, Task 21 experts visited the Sapporo Brewery pilot plant in Sao Paulo, the milestone-meeting scale-up of an H_2 fermentation process at an industrial facility.

Subtask C – Basic Studies of Light-Driven BioHydrogen Production (STL Dr. M. Rousset) identifies promising applications of enzymes and biologically inspired processes for H_2 production and fuel cells. U.S. researchers found that H_2 photoproduction activity in algal cultures can be improved by a factor of 2 by increasing the gas-phase to liquid-phase volume ration of the photobioreactor (PhBR).

Subtask D – Biological Electrochemical Systems
(STL Dr. A. Guwy) identifies and develops promising applications of microbial/enzymatic electrochemical cells for H_2 production processes. A UK report summarizing the current status of microbial electrochemical cells meets the milestone for a technological survey of available methods.

Subtask E – Overall Analysis (STL Dr. J. Miyake) This subtask investigates how to introduce and integrate Bio-inspired H_2 and BioHydrogen processes in society. Australia is modelling the global fuel supply, identifying key constraints to the microalgal industry to guide scale-up and design of production systems and carrying out economic modeling of microalgal biofuel production systems.

3.1.1.2 Production: Task 24 – Wind Energy and Hydrogen (H_2) Integration (2006-2011)

Task 24 (OAs Dr. Luis Correas and Mr. Ismael Aso) aimed: (1) to explore in detail all possible uses (technical, economic, social, environmental, market and legal) related to H_2 production via electrolysis with wind energy; and (2) to explore all possible applications for H_2 produced by electrolysis using wind energy. This is an applied R&D task, as wind energy and electrolysis technologies are commercially available today. The integrated wind/H_2 system is considered an attractive storage option for both grid-connected and stand-alone because it addresses the issue of intermittent availability of wind power. It also provides load balancing for grid-connected applications. Task 24 members are Canada, Denmark, Germany, Greece, Japan, Norway, Spain, Switzerland, the United Kingdom and the USA. Task 24 has four subtasks, which are described below. Its final report is slated for completion in late 2012.

Subtask A – State of the Art (STL Dr. A. Hoskins) conducted an in-depth review of the current state of the art in wind turbines, electrolyzers and the power electronics that allow for system integration.
Subtask B – Necessary Improvements & System Integration; Technology Development on Equipment and System Integration Concepts (STL Dr. K. Harrison) focused on two main components for H_2 production–the wind turbine and the electrolyzers. One very interesting lesson learned involves system efficiency and hardware for system controls. Maximum Powerpoint Tracking (MPT) Testing indicates a relationship between incidence of solar radiation and energy transfer from photovoltaic array (PV) to electrolyzer stack. At or below 500 watts/m^2, direct coupling of the PV array to the electrolyzer stack is more efficient; over 500 watts/m^2 performance is improved through use of a power converter.
Subtask C – Business Concept Development (STL Dr. K. Stolzenburg) categorized wind-H_2 systems relative to their main purpose (e.g., electricity or fuel production), and addresses regulations on electricity and fuels. One conclusion is that the support mechanisms for renewable energy are becoming subject to adjustment based on grid stability implications of renewable resource fluctuation. For Task 24 member countries, this finding contributes to the medium-long term appeal of energy storage in the form of H_2.
Subtask D – Applications Emphasis on Wind Energy Management (STL Dr. R. Garde) addressed near term applications for wind produced H_2 with a special emphasis on fully integrated wind and H_2 systems, and use of H_2 for energy storage.

The Task 24 ITHER, or "Green Hydrogen from Wind and Solar Mobile Applications" Project, won the 2010 IEA HIA Project Prize in the demonstration category. ITHER showcases H_2 and renewable energies in an integrated wind energy and H_2 demonstration at the Foundation for the Development of New Hydrogen Technologies in Aragon, Spain.

3.1.1.3 Production: Task 25 – High Temperature H_2 Production Processes (2007-2011)

Task 25 (OA Dr. François Le Naour) investigated production of massive amounts of H_2 via nuclear and/or solar high temperature (>500º C) processes (HTP) with no CO_2 emission. A "white paper" is in preparation as the final Task 25 report.

Subtask A – Scientific, Technological Review and Analysis of Temperature Processes and the State of the Art (STL C. Sattler) performed a technical review of different processes utilizing the results of

different processes to create a database of Innovative High Temperature Routes for H_2 Production (INNOHYP) projects that maps HTP process studies and development worldwide.
Subtask B – Benchmarking of Calculation and Methodology (STL A. Giaconia) defined the main criteria for integration of HTP into the H_2 chain. It benchmarked the investment level for four simple scenarios using a multi-criteria Analysis methodology. In a notable finding, France and the U.S. advocate use of solar and nuclear High Temperature Steam Electrolysis (HTSE), given that HTSE produced H_2 HTSE could be cheaper alkaline electrolysis produced H_2 if the electrolyzer life cycle is sufficiently long.
Subtask C – Establishment of Benchmarks, Recommendations for HTP R&D and Future Industry Deployment The strategy for this subtask evolved substantially in view of industry conditions.
Subtask D – Communication Actions: Coordination and Links with Other International Organizations plus Information Dissemination (F. Le Naour) developed 12 process description and two general brochures, which may be found at http://ieahia.org/page.php?s=d&p =documents&t=task&id=25. For more information on Task 25, see the June 2011 IEA HIA NEWS at http://ieahia.org/pdfs/HIANewsJune2011.pdf.

3.1.1.4 Production: Task 26 – Advanced Materials for Waterphotolysis (2008-2012)

Task 26 (OA Dr. Eric L. Miller) seeks to develop new semiconductor materials for stable and efficient photoelectrochemical (PEC) hydrogen-production system. The objective is a low-temperature, low-tech, direct water-splitting process powered by sunlight, the renewable source. In addition to administration, Task 26 has six subtasks built around Theory, Synthesis, and Analysis techniques to develop the most promising materials classes to meet the PEC challenges in efficiency, stability and cost. Task 26 received a one-year extension to complete its final report in 2012 and also prepare a proposal for a follow-up task.

In the recent past Task 26 has made significant strides towards its goals and objectives. New benchmark performance levels in III-V materials multi-junction photoelectrodes were achieved at NREL as a result of the US PEC Working Group efforts. Work continued on the refinement of the “Standardized Methodologies for PEC Measurements and Reporting” effort. The international peer review process is still underway: Task-26 Experts and associated research groups have published more than 50 PEC articles per year in scientific journals and conference proceedings.

3.1.1.5 Production: Task 27 – Near Term Market Routes to Hydrogen (H_2) Via Co-Gasification Using Biomass as a Renewable Resource (2008-2011)

Task 27 (Co-OAs Dr. Jan Erik Hanssen and Ms. Berrin Bay Engin) looks to advance the development of H_2 production based on renewable sources—primarily biomass—and their co-utilization with fossil fuels for industrial applications. Task 27 has eight (8) members: Finland, Italy, The Netherlands, New Zealand, Norway, Spain, Turkey, and the United States. Final reports for Subtasks A, B, and C are being finalized and reviewed. Subtask D is completing its final product, a roadmap. The Task 27 Final Report is expected before the fourth quarter 2012.

Subtask A – Co-Gasification of Biomass with Fossil Fuels (STL Dr. A. Bardi) investigates flexible co-processing. It contemplates: key parameters for all biomass classes; ash fusion issues (critical for EF gasification); quantification of large-scale co-gasification of in existing industrial plant; methodologies for techno-economic process analysis; pre-engineering of 10 MW scale demo plant (5t/h co-gasification); co-gasification tests at Puertollano 30 MW full scale IGCC; and economic and social barriers. The Subtask A final report highlights the need for feedstock consistency to guarantee reliable economics of scale. The main technical challenges continue to be feedstock prehandling and gas reforming. H_2 can be usefully produced by co-gasification with coal at 20-30 wt% biomass in conventional gasifiers. The most promising technological option is to use entrained flow gasifiers able to produce H_2 rich, low tar content syngas. Milling biomass to 0.3 mm particle size can cost up to 1/10 of energy input, while torrefication reduces milling power need by ~80% and prevents potential problems in co-feeding. The Task 27 associated Elcogas Pilot Plant for CO_2 Capture and H_2 Production in Puertollano, Spain, was awarded the 2012 IEA HIA Project Prize for excellence in R,D&D and harmony in international cooperation that contributes to the advancement of basic and applied hydrogen science.

Subtask B – Hydrogen Market Facilitation Based on Distributed Processing of Biomass (STL Dr. B. Beld) examines the value of bio-energy carriers in securing the consistency of feedstock across time and time This subtask compares processes for H_2 production from biomass-derived intermediates (liquids, slurries, pellets, torrefied materials; reviews and analyzes all gasification processes for H_2 production (entrained flow). It maps industrial gasifiers; reviews the experience on entrained flow gasification of intermediates, mostly for liquids; and estimates transport costs for intermediates (BTG pyrolysis liquids) by land and sea from Malaysia to Europe. Worldwide, there are nine H_2 producing plants whose collective production capacity is 15.6 million Nm^3/day. Industrial gas facilities are found in major markets across Europe and in high demand growth zones where there is an excellent match with availability of agricultural residues. BTG/BTL is constructing a 10 MW_{th} plant in the eastern Netherlands to process fast pyrolysis liquids at 5 tons/hour. This plant represents a potential market-enabling breakthrough for industrial use of pyro liquids.

Subtask C – Near-term Stand-alone Biomass (STL Dr. C. Kurkela) has reviewed all technologies and pilot plants/projects for dedicated biomass conversion, analyzing techno-economic issues.

Subtask D – Roadmap Development and Verification (STL Dr. J.E. Hanssen) is developing a scenario for mainstreaming renewable H_2 using tradable bio-energy carries and co-gasification.

3.1.2 R,D&D Storage Portfolio

Storage is considered one of the great H_2 research challenges, as well as one of the most promising near term applications for renewable energy.

3.1.2.1 Task 22: Fundamental and Applied H2 Storage Materials Development (2006-2012)

Task 22 (OA Bjorn Hauback) has three targets: reversible or regenerative H_2 storage; fundamental and engineering understanding of qualified H_2 storage media; mobile, stationary, and other applications. Task 22 counts 53 experts from 17 countries: Australia, Canada, Denmark, the European Commission, France, Germany, Greece, Iceland, Italy, Japan, Korea, the Netherlands, Norway, Switzerland, Sweden, UK, and USA. Its 47 projects encompass experimental, engineering, theoretical and modelling research, as well as safety aspects of H_2 storage materials. The following classes of materials are included: reversible metal hydrides (31 projects); regenerative H_2 storage materials; nanoporous materials (13 projects); and rechargeable organic liquids and solids. There are three applied R&D storage projects.

There have been significant achievements in Task 22. Highlights in the nanoporous area include the development of new compounds and improved understanding of phenomena such as spillover. Many new metal hydride compounds were developed based on Task 22 collaboration as well. There have also been important substitution, nanoconfinement, and catalyst activities related to modification of known compounds. International collaboration has been vital to Task 22 progress. Although the collaboration has not yet found “the” H-storage material for vehicles, it has made advances for other applications.

Dr. Hauback participated in the February 2011 IEA workshop on *Energy Storage Issues and Opportunities.* The Task 22 successor, Hydrogen-based Energy Storage, received final Executive Committee approval in June 2012 as Task 32 and will launch officially in 2013.

3.1.3 R,D&D: Integrated H_2 Systems Portfolio and/or H_2 Integration in Existing Infrastructure Portfolio

These two portfolios are separate but closely related. *Integrated H_2 Systems* theme is system specific, while *H_2 Integration in the Existing Infrastructure* refers to incorporation of H_2 systems in the broader environment. The following tasks fall under both portfolios.

3.1.3.1 Integrated H_2 Systems and H_2 Integration in Existing Infrastructure: Task 23 – Small-Scale Reformers for On-site H_2 Supply (SSR for H_2) (2007-2011)

Task 23 (OA Dr. Ingrid Schjølberg) sought to provide a basis for harmonization of reformer technology for on-site production of H_2 from hydrocarbons – fossil and renewable. Task 23 has ten member countries: Denmark, France, Germany, Italy, Japan, The Netherlands, Norway, Sweden, Turkey and the U.S. This task brings together suppliers, gas companies and research institutes. The strong industry participation is evidence of commercial potential: industry can supply H_2 from small scale reformers at a reasonable price now. Moreover, on-site H_2 production is an important stepping stone in early development of the refueling infrastructure. The Task 23 Final Report will be completed by fourth quarter 2012. Task 23 held the first IEA HIA "End of Task Workshop" entitled On- Site H2 Supply—Reforming vs. other Options on 24 April at GDF Suez in Paris, France. A successor task —working title "Local Hydrogen Supply"—will hold its Task Definition Meeting 25-26 September in Oslo, Norway.

Subtask 1 – Harmonized Industrialization (STL Dr. E. Ochoa) is harmonizing the approach to reformer capacities to facilitate industrialization and reduce costs. Its report will provide up-to-date lists of suppliers for reformer technology, together with set of standards of each system component.
Subtask 2 – Sustainability and Renewable Sources (STL Dr. C. Nelsson) has analyzed fuel paths and conducted a sensitivity analysis, and a survey of carbon capture and sequestration technology.
Subtask 3 – Market Studies (STL Dr. I. Yasuda) performed an average cost comparison of reformer units in three sizes (50 Nm^3/hr, 100Nm^3/hr, and 500Nm^3/hr) for three market segments (Japan, California, Germany). Results include cost curves.

3.1.3.2 Hydrogen Integration in Existing Infrastructure: Task 28 – Large-scale Hydrogen (H_2) Delivery Infrastructure (2010 -2013)

Task 28 (OA Dr. Marcel Weeda) is investigating transport and distribution aspects of large-scale H_2 delivery infrastructure through modelling and analysis. There are seven members (Australia, Denmark, France, Germany, Japan, the Netherlands and U.S.) and significant industry participation in the task.

Subtask A – Scenarios (STL Dr. A. Pigneri) aims to determine the number and size distribution of H_2 refueling station (HRS) using a market analysis approach, including a ramp-up curve for the evolution of number of H2 HRS via a simple innovation diffusion model. Subtask A results feed into Subtask C.
Subtask B – H_2 HRS (STL M. Weeda) compares central and on-site production based systems to identify general requirements and key parameters.
Subtask C – Analysis of H_2 Delivery Routes (STL Dr. A. Elgowainy) aims to develop performance and cost databases. He recently presented the U.S. methodology to determine cost targets for H_2 production and delivery, including delivery components.
Subtask D - H_2 for Storage of Renewable Energy and Mixing of H2 into the Natural Gas Grid (STL TBD) will explore the integration of intermittent energy sources in future low carbon energy systems.

3.1.3.3 Integrated H_2 Systems: Task 29 – Distributed and Community H_2 (DISCO H_2) (2010-2013)

Task 29 (OA Dr. Federico Villatico) aims to progress the optimization and replication of “green” hydrogen produced at the local level within distributed and community systems. Seven countries (Canada, France, Greece, Japan, New Zealand, the UK and the USA) as well as the United Nation participate in this task. Participants include six private companies and HyER (Hydrogen Fuel Cells and Electro-Mobility in European Regions), an association of 30 European communities. With five subtasks (including management and outreach) the scope of DISCO H_2 encompasses: 1) Urban Communities; 2) Rural and Island; and 3) Industrial Distributed H_2 Applications.

Subtask 2 – Analysis and Selection (STL CRES) has assembled a list of projects for assessment. The report for this subject has been completed and the results were presented at WHTC 2011.
Subtask 3 – Models Concept Development From a short list of 18 projects, six (6) were selected— two (2) per category— for analysis and use as the basis for model concept development. In the Urban Community category, the US Octagon House and the Japanese CHP were selected. Chosen in the Rural and Island category were: the U.S. OCTAGON and the Japanese CHP; the EU MYRTE and Lolland Projects. The EU HyLog was selected as the industrial distributed H_2 application. A SWOT analysis will examine economic, environmental/technical, social and regulatory aspects of these projects.
Subtask 4 – Replicability (STL IRL) will develop replicable distributed and community models.
Subtask 5 – Dissemination Task 29 plans an aggressive outreach effort that will likely include cooperation with EU Initiatives CONCERTO and SMART Cities and Communities in October 2012.

3.2 Analysis that Positions H_2 Theme

This theme bespeaks an “analytic imperative” to provide balanced H_2 analysis for technical, market, and policy-related purposes. While analysis is a key feature of all of our tasks, Task 30 is a dedicated analysis task that grew from ad-hoc ExCo activities into a task that can perform significant analyses and support the IEA Analysts in Paris in their analytic efforts. The IEA HIA and its Task 30 were featured participants in the early 2012 IEA ETP Workshop on Systems Analysis.

The IEA HIA marked a major milestone in its analytic efforts with the inclusion of a hydrogen chapter in the IEA Energy Technology Perspectives (ETP) 2012. Chief among the findings, the ETP concludes that without hydrogen, it may simply not be possible to eliminate fossil fuels in transport and industry over the long term.

3.2.1 Task 30 – Global Hydrogen Systems Analysis (2010-2013)

Task 30 (OAs Mr. Jochen Linssen and Dr. Susan Schoenung) is performing comprehensive technical and market analysis of H_2 technologies and resources, supply and demand related to the projected use of H_2 in a low-carbon world with sustainable (including intermittent) energy sources. Task members are Canada, France, Germany, Greece, Italy, Japan, Norway, Spain, Sweden, and the United States. Of the three Subtasks, A and B are described below. These subtasks aim to produce reports and databases. In contrast, Subtask C was designed as a liaison function with IEA headquarters analytics to optimise value added for both the Agreement and IEA headquarters hydrogen related efforts.

Subtask A – Detailed Analysis: Global H_2 Resources (STL S. Schoenung**)** is assessing H_2 resources worldwide based on projections/potential of primary energy sources for different regions from 2010 to 2050 subdivided by sector, including trading and projected costs of H_2. Report expected in mid-2012.

Subtask B – Building a Harmonized H_2 Technology Database (STL J. Linssen) is developing a database structure for all hydrogen technologies that is unique for production, distribution and use, and for performing data checks for IEA headquarter analytic models.
Subtask C - Collaboration with IEA Analytics
STL K. Espegren) Cooperation with IEA Analytics has been greatly facilitated by this function.

3.3 H_2 Awareness, Understanding & Acceptance Theme

3.3.1 Task 31 – Hydrogen Safety falls into this theme under the safety portfolio.

Task 31 (OA William Hoagland) seeks to provide a technically sound and credible basis for risk informed codes and standards for stationary and transportation systems. The four subtasks and their scopes of activity appear below:

Subtask A – Physical Phenomena (S.T. Leader P. Bernard) covers gaseous and liquid phase properties of outflow and dispersion, consequences and ignition, and quantitative tools.
Subtask B – Storage Systems and Materials Safety Issues (ST Leader J. Khalil) addresses solid storage issues; liquid and cryo-compression materials issues related to pressurized and low temperature storage; and sensors/leak detection.
Subtask C – Early Markets (STL A. Tchouvelev) focuses on hazard analysis and risk characterization for early markets.
Subtask D – Knowledge Analysis, Dissemination and Global Relevance: Safety Knowledge Tools (STL Steven Weiner) is enhancing Task 19 databases and websites, helping to shape Task 31 products, and developing collaborations and tools.

A hydrogen safety workshop will be held in 2012 to disseminate the findings and lessons learned from the predecessor task, Task 19, learning to date from Task 31.

3.3.2 Information Dissemination and 3.3.3 Outreach Portfolios

Information Dissemination and Outreach, the other two portfolios under this theme, is the domain of the IEA HIA Executive Committee, Operating Agents and Secretariat. While information dissemination is an important activity for every task, it is a vital function for the Secretariat, which produces an Annual Report, newsletters, and brochures while maintaining the website and coordinating conference participation and other outreach activities. Webinars will be initiated soon. Beyond simply informing, the Outreach portfolio looks to engage and influence stakeholders and decision makers, expand membership and foster mission appropriate growth. In the future, end-of-task workshops are expected to be regular activities that celebrate and disseminate the findings, conclusions and products of each task.

4.0 Acknowledgments

The authors gratefully acknowledge the efforts of Executive Committee Members and Operating Agents.

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