PURPOSE OF TASK

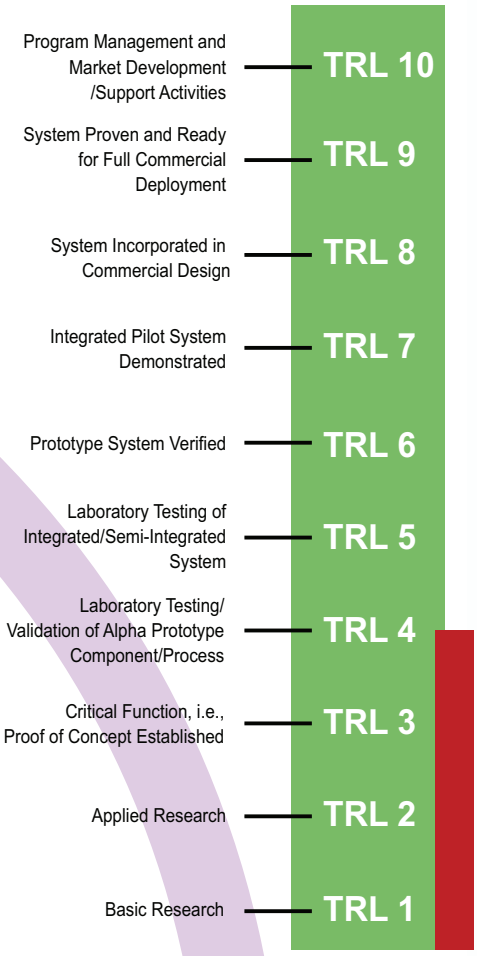
The goal of the IEA HIA Task 36 – Life Cycle Sustainability Assessment of Hydrogen Energy Systems is to facilitate decision-making in the hydrogen energy sector by providing a robust and comprehensive methodological framework for the sustainability assessment of hydrogen energy systems. The specific objectives of Task 36 are:

- To carry out a review of LCA (Life Cycle Assessment) studies on hydrogen energy
- To address the issue of direct and indirect land use change in LCA of biohydrogen energy systems
- To compare capital and production costs of different hydrogen production pathways, identifying opportunities to improve economic efficiencies and optimal pathways in different national contexts
- To develop an LCC (Life Cycle Costing) framework for evaluating the economic performance of hydrogen energy systems
- To provide a robust set of social indicators for SLCA (Social Life Cycle Assessment) of hydrogen energy systems
- To integrate sustainability indicators into a common methodological LCSA (Life Cycle Sustainability Assessment) framework for evaluating hydrogen energy systems
- To apply the methodological framework to key hydrogen case studies
- To collaborate with IEA Headquarters (HQ) analysts and support the HIA Executive Committee in the liaison with IEA HQ

STATUS OF THE METHODOLOGY

TECHNICAL READINESS LEVEL

Attempts to provide a general methodological framework for sustainability assessment have been based on widening the frame of discussion from the concept of environmental LCA to the LCSA approach. A difficulty that arises is that there is not a simple, general solution to the complex problem of assessing sustainability. In particular, the singularities of a given system usually require tailor-made methodological frameworks and assumptions. Hence, concentrating efforts on the development of methodological solutions for LCSA at lower scales (e.g., at the sectoral level) is considered to be preferable. Task 36 constitutes the first attempt to provide a harmonized LCSA methodological framework for hydrogen systems.



TASK 36

LIFE CYCLE SUSTAINABILITY ASSESSMENT OF HYDROGEN ENERGY SYSTEMS

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VITAL STATISTICS

Term
2015–2017

Members
Spain
Germany
Japan
Norway
Italy

Expert Participants
6

2014 Meetings
13 November
Avenue de la Toison d´Or 55,
1060 Brussels, Belgium

ADVANCES WITHIN THE TASK 36 FRAMEWORK

Task 36 was approved in 2014 and a preliminary meeting between experts of Spain and Germany was held in Brussels on 13 November 2014. The official kick-off meeting of Task 36 took place in Madrid on 27 January 2015, with experts from Spain, Germany, Norway, Japan, and Italy. Given the early stage of the Task, key advances in the development of the target methodological framework are limited to the consensual scope of the Task and, in particular, of the methodological framework, as well as of the key case studies to be addressed. Further advances are expected for the next experts meeting to be held in Toledo, Spain, in September 2015.

FRAMEWORK SUMMARY OF TASK

SUBTASK A: ADDRESSING ENVIRONMENTAL CHALLENGES IN LCA OF HYDROGEN ENERGY SYSTEMS

Subtask A is led by Dr. Paolo Masoni (ENEA, Italy). Subtask A is designed to address specific LCA challenges that have arisen in the environmental evaluation of hydrogen energy systems. In particular, methodological concerns with direct and indirect land use, and change in biohydrogen energy systems are explored in order to propose a solid framework that deals with these aspects. Emphasis is also laid on the "goal and scope definition" stage of the assessment, providing recommendations not only on the choice of functional unit and impact assessment method, but also on the suitability of attributional and consequential life-cycle approaches for the environmental assessment of hydrogen energy systems. The main sources of uncertainty are identified and discussed (e.g., data availability and quality, system's boundaries, capital goods, assumptions, etc.).

SUBTASK B: ECONOMIC ANALYSIS OF HYDROGEN ENERGY SYSTEMS

Subtask B is led by Dr. Petra Zapp (FZ Jülich, Germany). Subtask B includes a techno-economic analysis to compare capital and production costs of different hydrogen production pathways, identifying opportunities to improve economic efficiencies and optimal pathways in different national contexts. This subtask is conceived as a follow-up to Subtasks A and B of former HIA Task 30. It includes energy-economic modelling of hydrogen energy systems and the expansion and refinement of the database of hydrogen technologies. These data improvements support increasingly robust analyses via process simulation, LCA and LCC. Furthermore, the development of an LCC framework for evaluating the economic performance of hydrogen energy systems from a life-cycle perspective is expected.

SUBTASK C: SOCIAL INDICATORS FOR THE ASSESSMENT OF HYDROGEN ENERGY SYSTEMS AND INTEGRATIVE APPROACHES FOR LCSA

Subtask C is led by Dr. Diego Iribarren (IMDEA Energy, Spain). Subtask C involves a detailed review of social indicators for SLCA in order to test their suitability for the evaluation of hydrogen energy systems. Hence, a robust set of social indicators for SLCA of hydrogen energy systems is intended. Moreover, as a combination of the efforts undertaken in Subtasks A, B and C, this Subtask also addresses the integration of sustainability indicators into a common methodological LCSA framework for evaluating hydrogen energy systems.

SUBTASK D: COLLABORATION WITH IEA HQ ANALYSTS

Subtask D is led by Kari A. Espegren (IFE, Norway). Subtask D is conceived as a follow-up to Subtask C of former HIA Task 30. This subtask facilitates an effective collaboration between HIA Task 36 experts and IEA HQ analysts.

MEMBERS

TASK #36		1	2	3	4	5	6
Cont. Party or Sponsor		INTA/IMDEA Energy - Spain	INTA/IMDEA Energy - Spain	FZ Jülich - Germany	NEDO - Japan	Forskningsrådet - Norway	ENEA - Italy
EXPERT NAME (indicate if subtask leader)		Javier Dufour (Operating Agent)	Diego Iribarren (Sub-Task C leader)	Petra Zapp (Sub-Task B leader)	Yuki Ishimoto	Kari A. Espegren (Sub-Task D leader)	Paolo Masoni (Sub-Task A leader)
EXPERT'S INSTITUTION NAME		IMDEA Energy	IMDEA Energy	FZ Jülich	IAE	IFE	ENEA
Subtask if applic.		A, B, C, D	A, B, C, D	A, B, C, D	A, B, C, D	A, B, C, D	A, B, C, D
PY	2009	-	-	-	-	-	-
PY	2010	-	-	-	-	-	-
PY	2011	-	-	-	-	-	-
PY	2012	-	-	-	-	-	-
PY	2013	-	-	-	-	-	-
PY	2014 (Q4 - Task preparation)	0.125	0.125	0.125	-	-	-
PY	Q1 '15 (Task launch)	0.125	0.125	0.125	0.125	0.125	0.125
Gov (yes-1, no-0)		0	0	0	0	0	1
Industry (yes-1, no-0)		0	0	0	0	0	0
Research Inst. (yes-1, no-0)		1	1	1	1	1	0
Other (yes-1, no-0)		0	0	0	0	0	0
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WEB SITE		www.energy.imdea.org	www.energy.imdea.org	www.fz-juelich.de	www.iae.or.jp	www.ife.no	www.enea.it

Task Member and Expert Table

COMMENTS ON GROWTH/CHANGES IN MEMBER AND/OR EXPERT PARTICIPANT COMPOSITION

As discussed in the previous section, a robust group of experts from five different countries have already started to work within the framework of Task 36. Nevertheless, new experts are expected to be welcome in the near future (e.g., experts from Aragon Hydrogen Foundation [Spain]).

ACTIVITIES AND RESULTS IN 2014

PROGRESS AND ACCOMPLISHMENTS

Task 36 research activities officially started in 2015 with the kick-off meeting held in Madrid on 27 January. During this kick-off meeting, experts discussed the scope of the Task with respect to the target methodological framework and the key case studies to be addressed in Subtasks A, B, and C. Previously, the main actions carried out in 2014 focused on the preparation and presentation of the Task proposal and the definition of the Task Work Plan, which included a preliminary meeting in Brussels on 13 November 2014.

Regarding the collaboration with IEA HQ, Task 36 experts contributed to the revision of the role of hydrogen in the following documents: "ETP 2015" (revisions made in November–December 2014 as well as in January 2015) and "Technology Roadmap – Hydrogen and Fuel Cells" (revisions made in March 2015).

MILESTONES AND THEIR STATUS

Overall Task 36 accomplishments in 2014 included Task approval and readiness for starting Task activities in January 2015. Task milestones include Work Plan definition along with task approval and readiness for commencing activities.

OUTREACH AND COMMUNICATION

No outreach and communication activities were reported in 2014 due to the fact that Task activities started in January 2015. Task website was not active in 2014.

FUTURE WORK

ACTIVITIES AND/OR TARGETS FOR 2015

Several activities are planned to be carried out in 2015 within the different subtasks. In Subtask A, the review of LCA studies on hydrogen energy will be completed and recommendations on the "goal and scope definition" stage of the LCA framework for the evaluation of hydrogen energy systems will be given. Regarding Subtask B, the literature review of LCC and techno-economic studies dealing with hydrogen energy will be completed and the current economic database developed in Task 30 will be progressively improved. This will result in recommendations on the economic approach for the life-cycle evaluation of hydrogen energy systems. Subtask C will focus on the completion of the review of social indicators and databases, as well as on the screening of social indicators for hydrogen energy systems. Subtask D will continue to provide IEA HQ analysts with scientific feedback on hydrogen energy systems from Task 36 experts, with emphasis on the revision of key documents on energy trends. Finally, a new Task 36 experts meeting will be held in Toledo, Spain, in September 2015.

ACTIVITIES AND/OR TARGETS BEYOND 2015

The duration of Task 36 is 36 months, running from 1 January 2015 to 31 December 2017. Subtask A activities are expected to provide a robust LCA framework for hydrogen energy systems in December 2016, while Subtask B activities should provide a robust LCC framework along with an enhanced economic database for hydrogen energy systems in June 2017. Subtask C activities will result not only in a robust SLCA framework for hydrogen energy systems (around month 30), but also in a harmonized LCSA methodological framework for this type of systems. It should be noted that this LCSA framework requires significant input from Subtask A and B activities. The LCSA framework is a key outcome from Task 36 and it is expected to be available in December 2017. Subtask D activities beyond 2015 will be similar to those in previous years, facilitating the collaboration between Task 36 experts and IEA HQ analysts.

R&D CHALLENGES

Key R&D challenges are faced in Subtasks A, B and C. The development of a tailor-made LCSA framework for hydrogen energy systems is a novel and challenging research topic. On the one hand, a general challenge is the integration of LCA, LCC and SLCA frameworks into a consistent life-cycle sustainability framework. On the other hand, specific challenges include the consideration of attribution/consequential approaches for the evaluation of the life-cycle performance of hydrogen energy systems, the inclusion of land use change aspects, and the comprehensive implementation of social/socio-economic indicators.

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SELECTED KEY PUBLICATIONS

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- Susmozas, A., Iribarren, D., Dufour, J., 2013. “Life-cycle performance of indirect biomass gasification as a green alternative to steam methane reforming for hydrogen production”. Int. J. Hydrogen Energy 38, 9961-9972.
- Zucaro, A., Fiorentino, G., Zamagni, A., Bargigli, S., Masoni, P., Moreno, A., Ulgiati, S., 2013. “How can life cycle assessment foster environmentally sound fuel cell production and use?”. Int. J. Hydrogen Energy 38, 453-468.

RECOMMENDED READING

- Guinée, J.B., Heijungs, R., Huppes, G., Zamagni, A., Masoni, P., Buonamici, R., Ekvall, T., Rydberg, T., 2011. “Life cycle assessment: Past, present, and future”. Environ. Sci. Technol. 45, 90-96.
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