Power-to-Hydrogen and Hydrogen-to-X System Analysis of the techno-economic, legal and regulatory conditions: a new task of the IEA Hydrogen Implementing Agreement

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A new task of the IEA Hydrogen Implementing Agreement

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Energy systems are changing around the world due to a variety of factors:

- Increasing demand for energy in the world due to globalization and emerging countries;
- Increasing renewable share in the energy mix, especially in the electricity mix;
- Greenhouse gas constraints and CO_2 reduction in the energy sector;
- Local pollution constraints;
- Deregulation in the energy system, allowing new challengers to enter the market;
- Energy security constraints, reliable systems needed;
- Needs for decentralisation systems, and local production.

The balancing of the electricity grid is increasingly challenging as the installed renewable energy capacity is increasing. Solutions like transmission super grid, smart grid and demand management, or back-up capacity implementation could help overcoming this issue; but new measures that go beyond increasing transmission capacity and flexible generation or consumption will have to be introduced to manage the grid as the level of renewable energy sources is increased. Energy storage technologies, including hydrogen-electrolyser-fuel cell combinations will be a key factor in this perspective.

"Power-to-hydrogen" concept means that once hydrogen is produced from electricity from the grid, a large portfolio of uses are possible. It opens the door to new and diversified applications in diverse sectors, as depicted in Figure 1:

- transport (hydrogen for fuel cells, biofuels, synthetic methane for transport …),
- natural gas grid (by mixing hydrogen directly with natural gas or synthetize methane and inject in the natural gas grid),
- re-electrification through hydrogen turbines or fuel cells,
- general business of merchant hydrogen for energy or industry, especially refinery, steel industry, ammonia, etc.,
- ancillary services or grid services for the electricity grid, transport or distribution grid. Hydrogen provides a flexible energy storage and carrier option which could defer the need for new lines and would alleviate the transmission difficulties.

There is a huge number of demonstration projects started or in progress in this field, covering different applications and in different local/regional situations. A lot of studies have been published also including some economic aspects. However, business models are not always clearly defined and reliable, and are very dependent on the local geographic, economic and energy landscape. There is a lack of global perspective on business models in this domain and there exists no global overview on the macro-economic and systemic impacts of the role of hydrogen in the energy system.

What is more, the legal and regulatory framework will play a key role in the development of new markets linked to hydrogen. The legal framework nowadays is rather unclear or not adapted in terms of regulations, incentives etc. to promote these new usages. Comprehensive analyses are required to evaluate the economic feasibility of hydrogen systems and to go beyond demonstration projects or specific economic case studies.

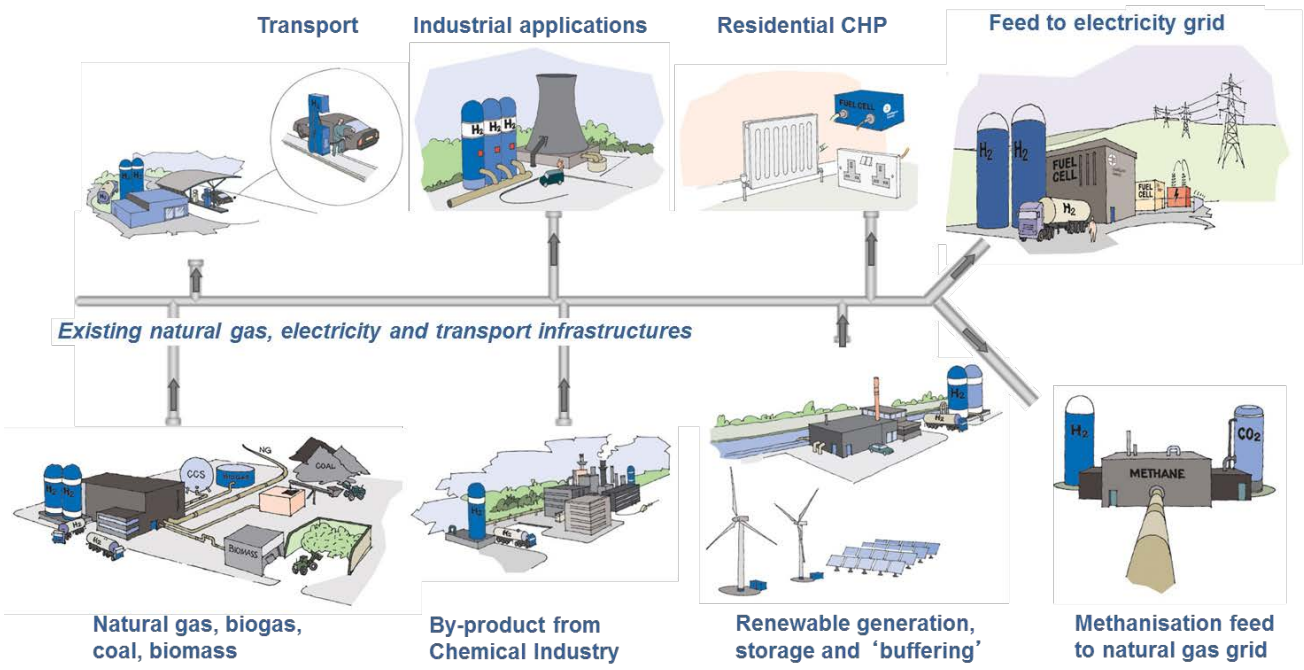

Figure 1. Power-to-Hydrogen and Hydrogen-to-X concept

In such a context, a new task of the Hydrogen Implementing Agreement of the International Energy Agency was proposed and approved by the Executive Committee as "Task #38". It is entitled: "Power-to-Hydrogen and Hydrogen-to-X: System Analysis of the techno-economic, legal and regulatory conditions".

The general objective of the task is to provide a comprehensive understanding of the various economic pathways for power-to-hydrogen applications according to the local situations, and a comprehensive assessment of existing legal framework. Identifying the local key parameters combined with a various portfolio of different business cases will be a key aspect in this new task. The task will include both the business model evaluation and analysis of the benefits in terms of macro-economic impacts through a systemic approach.

A specific objective will be to deliver some general guidelines and recommendations to both business developers and policy makers to enhance hydrogen system deployment in energy markets.

Last but not least one objective will be to develop hydrogen visibility as a key energy carrier for a sustainable and smart energy system.