Hydrogen – A zero-carbon energy vector for a change of energy systems management paradigm

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Abstract

Most regions in the world – cities, territories, countries - are currently engaged in a transition towards more efficient and environmentally friendly energy systems, the so-called energy transition. Structural changes are on-going in all sectors: energy production, transmission, distribution, and energy consumption, in all its forms. Other important issues may be at stake, depending on regions: access-to-energy, energy security and affordability.

As a zero-carbon energy vector, hydrogen can play a key role in the evolution of current energy systems towards new forms. Hydrogen technologies help optimize the use of local energy resources and maximize the value of production assets, while lowering the carbon intensity of a local economy. Deployment of these technologies also contribute to foster a local "green" economic growth, through associated activities in R&D, manufacturing, maintenance of assets...

Indeed, hydrogen can be placed at the cornerstone of an energy system – local, regional or national - due to its multiple applications: hydrogen (1) is a mean to store energy storage; (2) has many possible end-uses: mobility, production of heat and electricity (cogeneration); and (3) is a raw material that can be used to produce synthetic fuel or chemicals through hydrogenation of CO_2, bringing value to CO_2 Capture.

Furthermore, hydrogen can serve as a bridge between the different energy networks (electricity, gas, heat), through different technological routes that involve electrolysers, fuel cells, methanation units, paving the way for a change in the energy management paradigm towards a global optimization of all systems simultaneously, for optimum techno-economic and environmental performance.

This presentation reviews the state-of-the-art of hydrogen technologies (production, conditioning and transport, usages), their different positionings and possible contributions to the global energy system and the transport sector. The latest European demonstration and deployment activities are discussed to illustrate not only benefits obtained but also the remaining economic, social and legal issues yet to solve. First attempts to aggregate these technologies in local energy ecosystems (e.g. French hydrogen territories; European cities / areas…) are also presented, to illustrate how capitalizing on complementarities and synergies between hydrogen technologies allows increasing the overall performance of the ecosystem in line with the concept of "hydrogen economy". These deployments also benefit from the

increasing availability and use of ICT in the energy sector through the concept of “smart energy networks”.

Finally, some thoughts on the potential of hydrogen to help decarbonize the energy system of Hong Kong will be presented.