« Green » Hydrogen … let us be serious!

A call to the European Commission

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As engineers and scientists, former officials of the Commission now retired, we believe that the Commission risks losing credibility with its proposed "Hydrogen Strategy", promoting the use of this gas (difficult and expensive to produce) as an energy vector to cope with the intermittency of wind and solar energy. Especially if the real goal is to deeply decarbonise the economy, and to reduce drastically the use of fossil fuels.

The Commission has a long track record on the subject of hydrogen. Beginning in 1969 at Ispra, the Joint Research Centre studied the production and use of hydrogen. The Directorate General for Research followed up with a full research programme. The laws of physics and chemistry being what they are, researchers and engineers concluded, after numerous analyses, tests and demonstrations, that the low efficiency and high economic costs limited, at that time, the scope for industrial deployment of hydrogen as an energy vector. It would be useful to go back to these previous research results before contemplating the future!

Later in time, to address the oil crises, and then in support of the implementation of the Kyoto Protocol, the topic came back on the agenda. It resulted, at the beginning of the millennium, in the establishment of a high-level transatlantic cooperation between the Commission and the USA, without however resulting in more industrial deployment.

We now see the Commission, without having carried out a full impact assessment, relaunching the hydrogen theme under the Green Deal, in particular as a key element for the large deployment of intermittent renewable energies, even foreseeing the possibility of producing "green" hydrogen in Africa for its use in Europe… Africa, where more than half the population does not have access to electricity.

The case of Germany shows us the limitations of such a large deployment of intermittent renewable energy sources. The EnergieWende, which is costly – 25 billion euros annually in subsidies over 20 years, equivalent to about 1000 euros per family per year – has had practically zero impact in terms of decarbonisation, wind power and solar panels only producing 4,3% of its primary energy! Indeed, a massive recourse to these energies results most of the time in either an excess or a lack of electricity production compared to the demand. In the case of a lack, which happens most of the time, Germany, proceeding with its nuclear phase-out, relies on fossil fuels, brown or black coal, or Russian imported gas, which explains the low decarbonisation impact of the strategy. Ideally, one would then like, in the case of excess production, to have the means to massively store the "green" renewable electricity to use it later. But to store the electricity produced by wind power and solar panels during the limited time they operate[1], there are only three ways: batteries, pumping stations, or the use of an intermediate energy vector such as hydrogen. Massive storage in batteries being a dream, and pumping stations requiring large investment and suitable sites, the mythical hydrogen solution is coming back.

[1] Load factors (energy effectively produced per year divided by the energy which would be produced if the installation would operate all time at full capacity): 12% for solar panels, 20 to 35% for onshore/offshore wind (mean values for Europe)

The problem is that producing electricity from hydrogen coming from wind power or solar panels only has an efficiency of 28%, corresponding to a loss of energy of 70%. In addition, because of the intermittency of wind and solar, the fleet of large electrolysers needed in such a case would also operate intermittently, meaning the equivalent of 20% of the time at their full capacity. And that would not be economically viable.

Using the hydrogen vector for the massive production of decarbonised electricity for the grid makes no economic sense. More so since, if associated with the green holy grail of 100% renewable electricity, it would mean multiplying the wind and solar power installed capacities by a factor of more than ten[2] (depending on the load factors and efficiencies). It makes much more sense to use nuclear energy, the only fully decarbonised primary energy able to massively produce dispatchable electricity, and to optimise the deployment of intermittent renewable sources based on an economic evaluation considering all the costs of the global electricity system. Instead of targeting a minimum figure for the deployment of intermittent renewable sources, it would then be more logical to target a maximum, above which the consumer would be losing economically and the system would not be reliable.

When it comes to the production of hydrogen for other uses, as feed for industrial processes or, possibly, as a fuel for mobility, the intermittent operation of electrolysers fed by wind or solar power would have the same economic viability problem.

This being said, the demand for hydrogen will grow worldwide, inter alia for the production of ammonia, a key component for the fabrication of fertilizers to meet the growing needs of an increasing population. Today, the industrial hydrogen production is almost entirely based on fossil fuels. For such applications, apart from using electrolysis, the energy required for the dissociation of water could be provided by using direct heat produced in a fully decarbonised way by high temperature nuclear reactors. Research and demonstration of such reactors is ongoing in China, Japan and the USA. The European Commission should not only look closely to the topic, but above all invest, if it wants to avoid geopolitical sidelining from other regions where such developments are the order of the day. The post-covid Recovery Plan offers an opportunity. We hope the European Union will not miss it.

In conclusion, we strongly encourage the Commission to review its "Hydrogen Strategy", without the influence of lobbies looking for subsidies, recognising that the massive production of hydrogen from intermittent renewable sources is an illusion, and to analyse the potential of nuclear energy as a promising route for the production of fully decarbonised hydrogen.

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[2] With an average load factor (wind and solar combined) of 20% and an efficiency of 28% for the conversion electricity-hydrogen-electricity (P2P), one has to multiply the wind and solar installed capacity by 15 if the goal is to produce electricity solely using the intermittent renewable sources, combined with hydrogen storage.