Hydrogen: The Missing Piece of the Zero Carbon Puzzle

An IHS Markit study considering the potential role of hydrogen in a net-zero carbon Europe

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2. Practicality

Practical issues surround the rollout of any new technology or fuel into the energy mix. For hydrogen these issues include questions of the suitability of existing gas distribution for injection of hydrogen or conversion to pure hydrogen; the need for hydrogen storage and suitability of various solutions; safety aspects of hydrogen use in different circumstances; the conversion of equipment and consumer appliances to use hydrogen; and, for transport uses, the requirements of the refuelling network.

Appropriate regulatory frameworks will be needed to encourage development of hydrogen. There will be strong competition for hydrogen in some sectors from other ways of reaching low-carbon outcomes – notably from battery electric vehicles in the mobility sector, and heat pumps for space heating. These issues – regulation and market competition in the innovation space – will also form part of the practical constraints around developing future use.

3. Tipping Points

The report will identify what IHS Markit sees as 'tipping points' that can trigger a take-off of hydrogen from niche fuel into a more significant part of a zero- or ultra-low carbon future, as costs fall with increasing volume. These will differ sector by sector. The report will propose tipping points for potential significant applications:

- HGV transport for fleet vehicles (buses, versus diesel use, for example)
- Blending of hydrogen into existing gas infrastructure
- Conversion of methane grids to pure hydrogen
- Industrial use in refineries and ammonia production
- Management of curtailment
- Provision of long term or high volumes storage.

Other key 'tipping points' may emerge as the study proceeds.

The analysis for the tipping points will include costs of the relevant hydrogen-use technologies and their ancillary equipment, compared with the costs of a credible alternative solution to hydrogen. The cost of carbon avoided will also be calculated.

4. Business Models for Integrating Hydrogen

The potential diversity of the future use of hydrogen implies that companies in many different sectors will take an interest in its commercial possibilities. Choice of an appropriate business model will depend both on the anticipated uses, and on the existing business model of the company concerned.

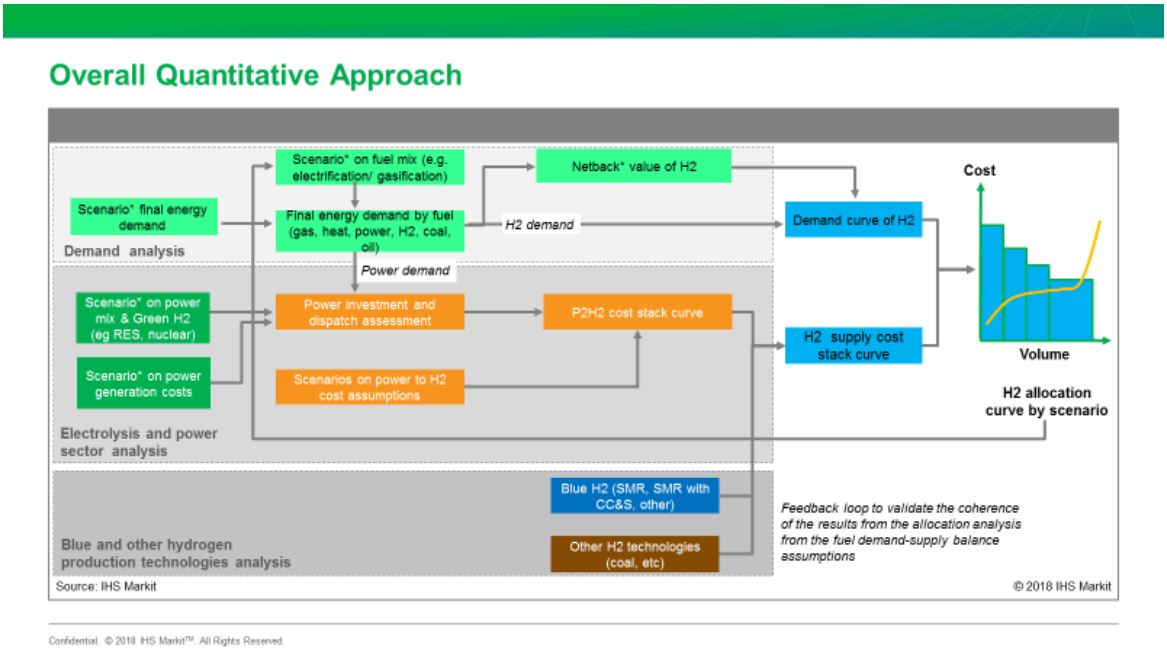
This section will review existing structures by which companies are integrating hydrogen into their businesses. It will also suggest models that may be adapted by utilities, gas supply and infrastructure companies, integrated energy companies, and new entrants to the fuel supply business. Key questions will include:

- For ‘green hydrogen’, in the electricity sector, whether to accept curtailment, or pursue a curtailment-based strategy or a dedicated facility approach for hydrogen
- For infrastructure owner-operators, whether to pursue a geographic pure hydrogen strategy or a strategy of carbon-reduction by blending – or to combine both
- What scale of production to aim for, over what time frame – the answers are likely to be different for ‘blue hydrogen’ and ‘green hydrogen’
- Some companies may have an interest in development of very large-scale operations – this could this have a significant effect on the competitive environment
- Some companies may be constrained, for commercial or regulatory reasons, to a specific sector focus; others may prefer a broader approach, incorporating for example mobility, industrial uses, and supply/distribution to heating markets

Quantitative Analysis

The quantitative analysis will assess potential scale and volume of hydrogen for 2030, 2040 and 2050. The hydrogen outlook will be consistent with IHS Markit energy scenarios.

- For the power sector we will ensure consistency with existing outlooks for renewable deployment, interconnection and alternative forms of storage. Sensitivity cases based on approach to net-zero carbon emissions will be developed.
- For the residential/commercial, industrial and transport sectors, an assessment of the scope of hydrogen will be presented along with a discussion of infrastructure needs.



Sample of a workshop agenda

09:00-10:00 Context—Scene Setting – A Case for Hydrogen
10:00-11:00 Technology – Supply Cost Comparisons
11:00-11:15 Break
11:30-11:45 Discussion on Other Decarbonization Options (e.g. Biomethane)
11:45-12:30 Practicalities/Identifying Limits to Pace of Adoption
12:30-13:15 Lunch
13:15-14:00 Tipping Points
14:00-14:45 Quantitative Approach
14:45-15:00 Next Steps

List of topics

Section	Topics	Target
Scene setting for MCS	EU energy targets	EU roadmap to 2050. Climate and renewables targets. Progress so far. Mobility (LDVs, HDVs, other mobility) and heat sector lagging.
Scene setting for MCS	EU environmental targets	Other environmental drivers e.g. air quality. Links with chemicals, agriculture.
Scene setting for MCS	Hydrogen as a potential solution	Overview of potential pros and cons of hydrogen vs other decarbonization options e.g. all electric. Existing gas infrastructure.
Scene setting for MCS	Explore potential scale	Global breakdown of hydrogen now vs potential scale (extreme and moderate case for heating and mobility)
Technology status	Green hydrogen technology	Electrolyze technology costs, efficiencies, learning rates, projections.
Technology status	Green hydrogen production costs	Levelized costs of green hydrogen: capex, O&M, cost of electricity, load factor. Discount rate.
Technology status	Blue hydrogen technology	SMR (ATR) + CCS, Coal gasification + CCS. Process options. capex, O&M, cost of electricity, load factor.
Technology status	Blue hydrogen production costs	Levelized costs of blue hydrogen: capex, O&M, gas price, degree of CO2 capture, carbon price
Technology status	CCUS	Available sites/opportunities for CCS/CCU.
Technology status	Costs of compression	Costs for delivering hydrogen for various end uses
Technology status	Costs of hydrogen storage	Costs of tanks and cylinders etc.
Technology status	Align costs	Create comparable cost structure for green and blue hydrogen
Practicalities	Suitability of existing gas pipes	Suitability for H2/NG mix, % H2, pure H2.
Practicalities	Hydrogen storage	Suitability for H2/NG mix, % H2, pure H2.
Practicalities	End use equipment	Suitability for H2/NG mix, % H2, pure H2.

Practicalities	Mobility infrastructure	Requirements for refueling stations, hubs, density of stations
Practicalities	Safety	Absolute and relative to existing fuels
Tipping Points	Mobility case outline	Buses (or fleets) vs diesel or battery. What drivers, infrastructure, cost improvements (qualitative), needed vs diesel, BEV?
Tipping Points	Curtailment case outline	Spill vs electrolysis. Cost of wind/solar. Load factor. Duration of storage. Battery storage.
Tipping Points	Gas grid injection outline	Heating options with gas or electricity. Seasonality. Need for deep refurbishment, power grid investment. Decarbonization path
Tipping Points	Gas grid conversion to hydrogen outline	Heating options with gas or electricity. Seasonality. Need for deep refurbishment, power grid investment. Decarbonization path
Tipping Points	Long-term storage case outline	Need for weeks, months storage. Batteries, PSH, biomass, thermal, P2L, ammonia alternative. Import of solar energy.
Tipping Points	Ammonia case outline	Direct CCS vs carbon price. NH3 vs urea?
Tipping Points	Refinery case outline	Direct CCS vs carbon price. Reducing demand for refining?
Tipping Points	Other case requests	Get input from workshop

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