Hydrogen in the Golden State

An IHS Markit study considering the potential role of hydrogen in a low-carbon economy

October 2018

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Introduction

Hydrogen can be both a zero-carbon energy carrier and storable/dispatchable. In principle therefore, it offers significant advantages in energy systems where other sources of energy tend to be one, or the other, but not both.

However, before hydrogen can be considered as a significant contributor to the future fuel mix a series of practical issues need to be addressed, and businesses and investors will need to develop business models that offer the prospect of acceptable returns.

The study will focus on California opportunities in the context of California's economy-wide low-carbon energy ambitions. This study will look first at the technology options for the manufacture and supply of low-carbon hydrogen. Second, it will review the practical issues around rollout of the fuel into various sectors of the energy economy. It will then identify possible 'tipping points' which could bring hydrogen into serious contention as an energy source in net zero carbon world. Next, it will review existing policy structures by which many countries are supporting the development and integration of hydrogen into their long-term carbon goals and suggest policy models that may be suitable for adoption by California, other US states or the total United States. Finally, it will assess the maximum potential scale and volume of hydrogen for 2030, 2040 and 2050, assuming favourable costs and policy support.

1.Technology Status

This section will describe the various technologies for the manufacture of hydrogen, comparing the capital expenditure requirements, operating and maintenance costs, and efficiency.

The focus will be on comparison of manufacture by electrolysis using zero-carbon renewable electricity ('green hydrogen') and by steam-reforming of methane ('blue hydrogen') with carbon capture and storage. Other technologies will be reviewed in less detail.

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:

- Management of renewable energy generation curtailment
- Management of seasonal renewable energy generation
- HDV 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

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.

4. Global Policies Supporting Hydrogen

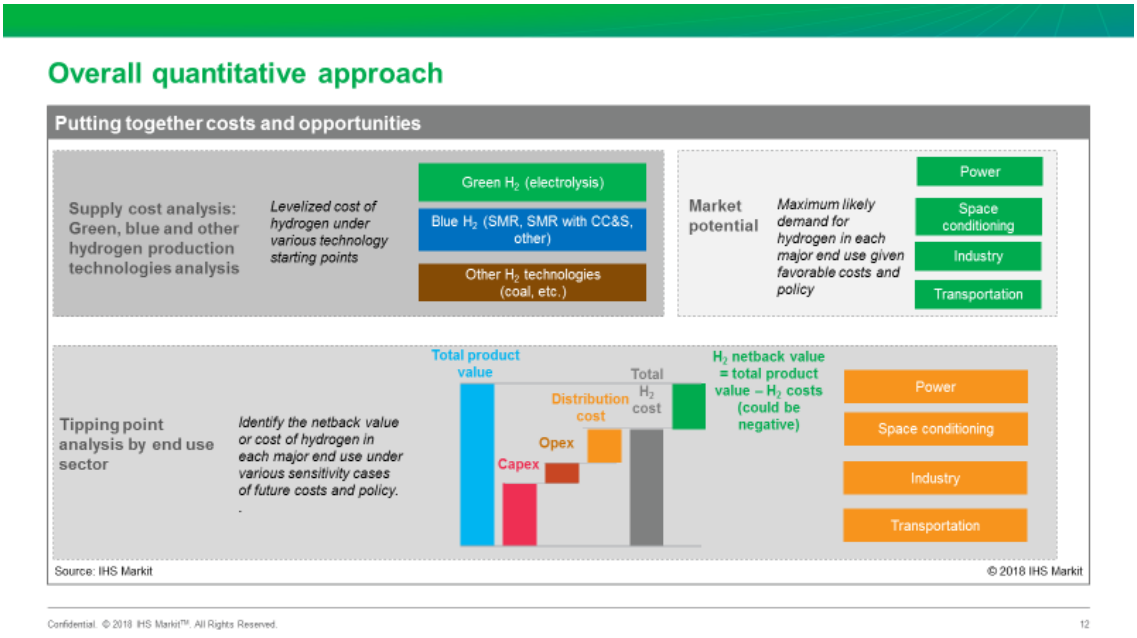
This section will review existing policy structures by which many countries are supporting the development and integration of hydrogen into their long-term carbon goals. It will also suggest policy models that may be suitable for adoption by California, other US states or the total United States. Key policy components will likely include:

- For 'green hydrogen', in the electricity sector, approaches to the issue of accepting curtailment versus pursuit of a dedicated facility approach for hydrogen.
- 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'.
- A specific sector focus versus a broader approach, incorporating for example mobility, industrial uses, and supply/distribution to heating markets.

5. Quantitative Analysis

The quantitative analysis will assess the maximum potential scale and volume of hydrogen for 2030, 2040 and 2050, assuming favourable costs and policy support.

- For the power sector we will ensure consistency with California's current goals for renewable deployment, greenhouse gas reduction and alternative forms of storage, and recognizing California's interconnection to the balance of the western North American power grid.
- 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.



Shankari Srinivasan
Vice President Global Gas
Shankari.Srinivasan@ihsmarkit.com

Mark Griffith
Senior Research Director, North American Scenarios
Mark.Griffith@ihsmarkit.com

Deborah Mann
Director, European Power, Gas, Renewables
Deborah.Mann@ihsmarkit.com

Cristian Muresan
Commercial Director
Cristian.Muresan@ihsmarkit.com