2020-IP06: The Hydrogen Economy Outlook released by BloombergNEF

BloombergNEF released on the 30Th March 2020 the key messages of their "Hydrogen Economy Outlook" (https://data.bloomberglp.com/professional/sites/24/BNEF-Hydrogen-Economy-Outlook-Key-Messages-30-Mar-2020.pdf), aiming to summarize the current hydrogen scenario and the key actions to scale-up the hydrogen production and distribution. The main objective is to identify the factors to put in place to cut down costs and catalyse the use of hydrogen in the industrial and energy sectors as one of the main decarbonising strategies.

During the last months, IEAGHG has focused efforts to follow up the evolution of the techno-economics of hydrogen in different regions and its impact on energy intensive industries and power production. As part of this work, a workshop was held in Paris (November, 2019), led by CSLF and IEAGHG, together with IEA-Hydrogen TCP and Equinor. A summary of this report can be found in: (http://documents.ieaghg.org/index.php/s/YKm6B7zikUpPgGA?path=%2F2020%2FTechnical%20Reviews)

In this summary, key actions and main points from the technical sessions were identified, aiming to spot required short, medium, and long-term needs on the hydrogen sector. In this Information Paper, common points in both reports, the IEAGHG summary and the BloombergNEF "Hydrogen Economy Outlook" summary, are discussed, and the differences and additional cost information which BloombergNEF is providing are identified.

IEAGHG summary: key points	**BloombergNEF summary**
1. Hydrogen is essential for the decarbonisation of the industrial sector (production and consumption), and may play a significant role for the power sector (pure and blended with natural gas) as well as in transport, buildings, portables and appliances. The use of hydrogen for energy storage is expected to play an important role in the future integrated energy system 2. The market and business models should be seen as main objectives in the following years 3. Compared to green hydrogen (hydrogen produced from renewable sources), blue hydrogen (hydrogen from fossil fuels with CCS) has the additional challenge of public acceptance of CCS 4. Collaboration is key for the implementation of new infrastructure and clusters. Those topics must be studied from a technical and policies perspective 5. Harmonisation of safety standards could be key for the further H_2 deployment	1. Due to the characteristics of the molecule of hydrogen, it can play an important role as a fuel for transport and power sectors, heat for industry and buildings, and as a feedstock for chemicals and other industrial products. Transporting and storing hydrogen still needs a significant investment. 2. BloomergNEF has released several cost estimations for different regions and production pathways 3. In the BloomergNEF summary there is not further information on hydrogen production through fossil fuels with CCS, although it is mentioned as one significant route for some regions and as a current competitive option 4. Clusters are included in this summary, but specifying that these not only will share a common infrastructure, but will include a portfolio of wind and solar-power electrolysers and a large geological storage facility 5. Standards are identified as the second step on the scale-up of the hydrogen supply chain, following clear targets and legislations to achieve net-zero emissions and before the investment mechanisms are put in place

IEAGHG summary: key points	BloombergNEF summary
6. Sequential scale up is key to de-risk the H_2 supply chain deployment 7. Parallel demonstration projects are essential to increase the range of available production pathways, promote the knowledge transfer, and catalyse the learning by doing	6. Seven steps on the hydrogen scale up are identified, covering policies, standards and technical challenges. 7. Demonstration initiatives are not mentioned specifically on the summary, although policy and technical effort are recognised as key factors

IEAGHG summary: key points	BloombergNEF summary
8. There is plenty of experience on hydrogen production with CCS, mainly on SMR 9. There is a wide range of decarbonised hydrogen production pathways. Emerging technologies could be key to decrease hydrogen production costs in the near future 10. The rapid decline in renewables costs, such as in photovoltaic and some wind technologies, have decreased the green hydrogen production cost in some areas 11. Current hydrogen production technologies focus on maximizing H_2 production and venting/ capturing the CO_2 after. Emerging technologies focus not only on H_2 production but also CO_2 capturing during the process phase, increasing its efficiency	8. It is recognised that 99% of the hydrogen is produced from fossil fuels 9. BloombergNEF predicts that renewables will be key on cutting down costs on hydrogen production 10. It is predicted that the cost of electrolyzers will decrease. BloobmergNEF calculations suggests that green hydrogen (hydrogen from renewables) will have a cost of 0.8-1.6 $/MMBtu in most regions by 2050, becoming cheaper than blue hydrogen and competitive with natural gas prices in Brazil, China, India, Germany, and Scandinavia 11. The BloombergNEF summary mentions the coal and natural gas based production with CCS as competitive routes in the early stages of hydrogen production

IEAGHG summary: key points	BloombergNEF summary
12. Cooperation between countries to implement the entire hydrogen supply chain, and between industries and academia, and those with international organisations, is key to accelerate the deployment and market penetration 13. Research and development to enhance current and emerging technologies are still needed. However, it should not inhibit the deployment process 14. Policies are still needed to provide economic support, de-risk deployment projects, and implement standards for hydrogen production and greener products. In summary, those will be key to create the hydrogen market	12. The profiles of different countries are analysed from an investment perspective, identifying key events to determine if the hydrogen economy is emerging in such region (Table 2) 13. Gas turbines and other equipment are identified as a key technology on the hydrogen supply chain 14. Policy is critical. Current programs are poorly funded and industrial scale up requires comprehensive policy across government. With policy in place, 34% of the greenhouse gas emissions from fossil fuels and industry could be reduced by the use of hydrogen. Policies will enable the supply of 187 MMT of hydrogen by 2050, meaning the 7% of the energy needs in the 1.5C scenario. An investment of 11 trillion $ is required to implement the production, storage and transport infrastructure.

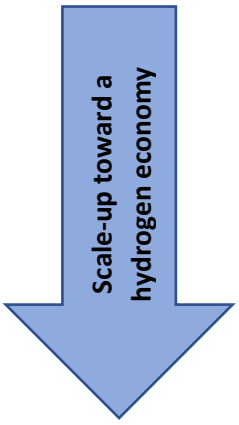
The BloomergNEF summary is a good reference for estimations of hydrogen costs over the time and identifies policies and incentives as essential measures on the hydrogen economy (Table 2). The workshop held in November also considered cooperation as a strong action, while specific research needs on hydrogen production, transport and storage were also identified (Table 1). Speakers discussed technical details of hydrogen production routes and explained current and future large projects.

Table 1 Key actions identified in the IEAGHG summary

<u>Immediate actions:</u> Cooperation between countries, different industries, and between industry and academia; Regulatory framework as a driver of the research, development, and innovation, which will catalyse the blue hydrogen deployment
<u>Medium-term actions</u>: Application and deployment of hydrogen to niche opportunities for industry
<u>Long-term actions:</u> Implementation of a complex infrastructure for hydrogen and CCS. Experience on long testing campaigns (e.g. safety, materials) and large-scale deployment

Table 2 Signpost of scale-up toward a hydrogen economy identified in the BloombergNEF summary

Actions BloombergNEF summary
Net-zero climate targets are legislated
Standards governing hydrogen use are harmonized and regulatory barriers removed
Targets with investment mechanisms are introduced
Stringent heavy transport emissions standards are set
Mandates and markets for low-emission products are formed
Industrial decarbonization policies and incentives are put in place
Hydrogen-ready equipment becomes commonplace



IEAGHG will continue monitoring technical and economic aspects of the current hydrogen framework and the scale-up. We are collaborating with several organisations and we are looking forward to seeing the next steps taken by different regions, research groups, and industries toward the hydrogen economy.

References

2020-TR01 IEAGHG Summary Hydrogen Workshop. January 2020 (http://documents.ieaghg.org/index.php/s/YKm6B7zikUpPgGA?path=%2F2020%2FTechnical%20Reviews)

Hydrogen Economy Outlook- Key Messages. March 2020 (https://data.bloomberglp.com/professional/sites/24/BNEF-Hydrogen-Economy-Outlook-Key-Messages-30-Mar-2020.pdf)

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