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Heavy industries plan to leverage low-carbon hydrogen to achieve their sustainability targets

By 2030, 64% of Energy and Utilities organizations plan to invest in low-carbon hydrogen

Paris, April 6, 2023 - Low-carbon hydrogen[1] is emerging as one of the most promising routes to accelerating decarbonization of high-emission sectors and a crucial facilitator in achieving a greener future. A new report from the Capgemini Research Institute "*Low-Carbon Hydrogen - A Path to a Greener Future*" finds that 62% of heavy industry companies across sectors[2] are looking at low-carbon hydrogen to replace carbon-intensive systems. On average, Energy and Utilities (E&U) companies expect low-carbon hydrogen to meet 18% of total energy consumption by 2050. They are unlocking investment across the hydrogen value chain, notably to develop hydrogen infrastructure, cost-effective electrolyzers and fuel cells.

The report finds that most organizations believe low-carbon hydrogen will be a long-term contributor to achieving emissions and sustainability goals. 63% of E&U organizations view low-carbon hydrogen as critical for decarbonizing economies, and 62% believe it can help nations reduce dependence on fossil fuels and promote energy independence. According to those surveyed, low-carbon hydrogen could meet up to 55% of hydrogen mix totals by 2050. On average, 0.4% of total annual revenue is earmarked for low-carbon hydrogen by E&U organizations by 2030, in particular for hydrogen energy transport and distribution (53%), production (52%) and R&D (45%).

Florent Andrillon, Group ClimateTech Lead at Capgemini, comments: *"Low-carbon hydrogen is crucial in the clean energy mix for decarbonizing priority high-emission sectors such as industry and transportation, and thus combating global warming. Scaling the initiatives we see today will require significant investment in R&D, collaboration across the value chain, clear partnership strategies, and tailored business-case assessments. Organizations must establish the right collaboration throughout the value chain, secure their offtake, develop hydrogen-competence centers, and harness technologies like simulations, digital twins and traceability solutions to scale their low-carbon hydrogen initiatives successfully. While achieving measurable success won't be easy, we have the opportunity to create a decarbonized future."*

Demand and investment are growing for low-carbon hydrogen across sectors

Across industries and geographies demand for hydrogen has increased by more than 10% in the past three years. This demand is expected to continue to grow, particularly in traditional hydrogen applications such as petroleum refining, chemicals, and fertilizers: 94% of petroleum refining organizations anticipate a

[1] For hydrogen production to be considered low-carbon, it must come under the EU's proposed emissions threshold of 3.38 kg CO_2-equivalent per kg of hydrogen, which is 70% lower than that of the predefined fossil fuel comparator, including transport and other non-production emissions. In the US, the corresponding carbon intensity value to qualify for hydrogen production tax credits under the IRA is 4.0 kg CO_2e/kgH_2. Although low-carbon hydrogen can include biomass pyrolysis as well, in this research, the main focus includes renewable or nuclear-energy-powered electrolysis-produced hydrogen emitting no or marginal carbon – also called respectively "Green Hydrogen" and "Pink Hydrogen".

[2] End-user sectors including heavy transportation, aviation, maritime transport, steel, chemicals, and refining

significant impact on their industry by 2030; similarly, 83% of chemicals and fertilizer companies expect a comparable effect.

New applications like heavy-duty transportation, aviation, and maritime are predicted to increase demand for hydrogen. Although these applications may take longer to mature, the report found that organizations in these sectors are optimistic about their potential and are exploring innovative business models and cost-reduction strategies to help scale. Yet, the real potential lies in those sectors where electrification is not an option, and the use cases can be realized in the short term given localized volumes. For instance, nearly three-quarters (71%) of E&U organizations believe that low-carbon hydrogen is a viable solution of energy storage from intermittent renewable sources, acting as a battery and making renewable energy such as solar and wind available to even more applications.

Production, engineering and infrastructure challenges remain

Although the demand for low-carbon hydrogen is increasing across sectors, challenges with hydrogen production are well known, with current methods being neither cost-effective nor environmentally friendly. The scale of the investments required and the need to simultaneously grow supply and demand will require partnerships, ecosystems, and increased collaboration between the historical hydrogen players and new entrants, along with the development of transparent and open markets.

While the production of low-carbon hydrogen faces challenges with sourcing low-carbon electricity and high costs of electrolyzers, E&U organizations are showing confidence in low-carbon hydrogen with almost half (49%) of organizations expecting its cost to steadily decrease by 2040.

In addition, most organizations are still at the proof-of-concept or pilot stage with hydrogen. Only 11% of E&U organizations and 7% of end-user organizations have fully embedded low-carbon hydrogen projects in their market. To achieve large-scale commercialization and deployment of low-carbon hydrogen, critical engineering and infrastructure challenges need to be addressed in addition to cost and energy concerns.

The report also found that organizations in different sectors face sector-specific pain points. For instance, 65% of organizations in heavy transport cite scaling up production of hydrogen fuel cells as their biggest infrastructure and engineering challenge. In aviation, 58% of respondents cite the need for modification in aircraft design to use low-carbon hydrogen as fuel. Meanwhile, 72% of respondents in the steel industry say that a significant infrastructure upgrade is required for large-scale hydrogen-based steel production.

In addition to cost, infrastructure, and engineering issues, a lack of skills and expertise is also a top challenge to scaling hydrogen, according to 60% of organizations. The skills shortage is particularly pronounced for end-user organizations in Spain (70%) and for E&U organizations in Japan (65%), France and Australia (63% for each).

Read the full report **here**.

Methodology

To understand how energy and utilities (E&U) organizations could capitalize on low-carbon hydrogen's potential, the Capgemini Research Institute conducted a global survey across 13 countries. Responses were collected from 500 executives from E&U firms with more than $500 million in annual revenue, and 360 executives from end-user sectors with more than $1 billion in annual revenue, including heavy transportation, aviation, maritime transport, steel, chemicals, and refining[3]. Interviewees are involved in the planning and development of low-carbon-hydrogen initiatives and work across functional areas such as strategy, product/service development, innovation and engineering, operations (supply chain – procurement, transportation, etc. / production), business units specifically dealing with hydrogen,

[3] Note: Selected end-user sectors included in the survey based on hydrogen usage potential.

renewables, new energies, decarbonization, the environment, sustainability, energy transition, end usage (hydrogen used for fuel cells / engines), etc.
To complement the quantitative insights, the Institute also conducted more than 21 in-depth interviews with supply- and demand-side organizations, startups, venture capital organizations, academics, researchers, and regulators.

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