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Evaluating cost competitiveness of hydrogen production in India

Part -1 (Hydrogen cost benchmarks, demand built-up, transport infra & market size evaluation for India)

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Evaluating cost competitiveness of hydrogen production in India

Hydrogen is accelerating globally and is likely to catch up the trend in India as well

Policy and economic forces are converging to create unprecedented momentum in the hydrogen sector, paving the way for rapid deployment of and investment in hydrogen technologies. A growing number of societal actors – from youth activists to scientists to concerned consumers – are pushing for stronger policy action to more drastically limit carbon emissions. Climate change requires urgent attention: if we continue to emit CO_2 at current levels, we have only ten years remaining in the global carbon budget before we breach the 1.5-degree Celsius threshold, emphasizing the need for immediate action. Governments are responding with increasingly ambitious decarbonization targets. At the time of the 2019 UN Climate Summit, 66 countries had announced their intent to meet net-zero carbon emissions targets by 2050. In the EU, regulation includes potential fines for failure to meet targets, and a Green Deal was recently announced to support the net-zero emissions target. In the US, 25 states formed the bipartisan United States Climate Alliance with a collective commitment to reduce greenhouse gas (GHG) emissions by at least 26 to 28 per cent below 2005 levels by 2025. China has made considerable progress towards its climate policy goals of reaching peak emissions by 2030 and meeting its target of 20 per cent of primary energy demand from non-fossil fuel sources with continued investment in sustainable technologies.

Unlike previous eras in hydrogen's development, the renewed attention on hydrogen is strengthened by a realization that the use of hydrogen will be critical if we are to meet the climate objectives. Governments are recognizing hydrogen's ability to decarbonize sectors that are otherwise impossible or difficult to abate – such as logistics, industrial heating and industry feedstock – and its role in energy security. Meanwhile, industry leaders across the automotive, chemicals, oil and gas and heating sectors look to low-carbon and renewable hydrogen as a serious alternative to reach their increasingly robust sustainability objectives.

This renewed attention also comes as the key cost drivers of clean hydrogen have seen a sharp improvement. For instance, electrolysis fed with renewable electricity – the most common production method to produce 'renewable hydrogen' – has become 60 per cent more affordable as low-carbon and renewable electricity prices have dropped, and electrolysis capex has fallen. The cost of solar and wind power, the largest driver of renewable hydrogen production costs, has seen an 80 per cent decrease over the past decade. India has already drafted a comprehensive hydrogen policy which could be published formally on or before January 2022 and serve as a guide for hydrogen market development in the country

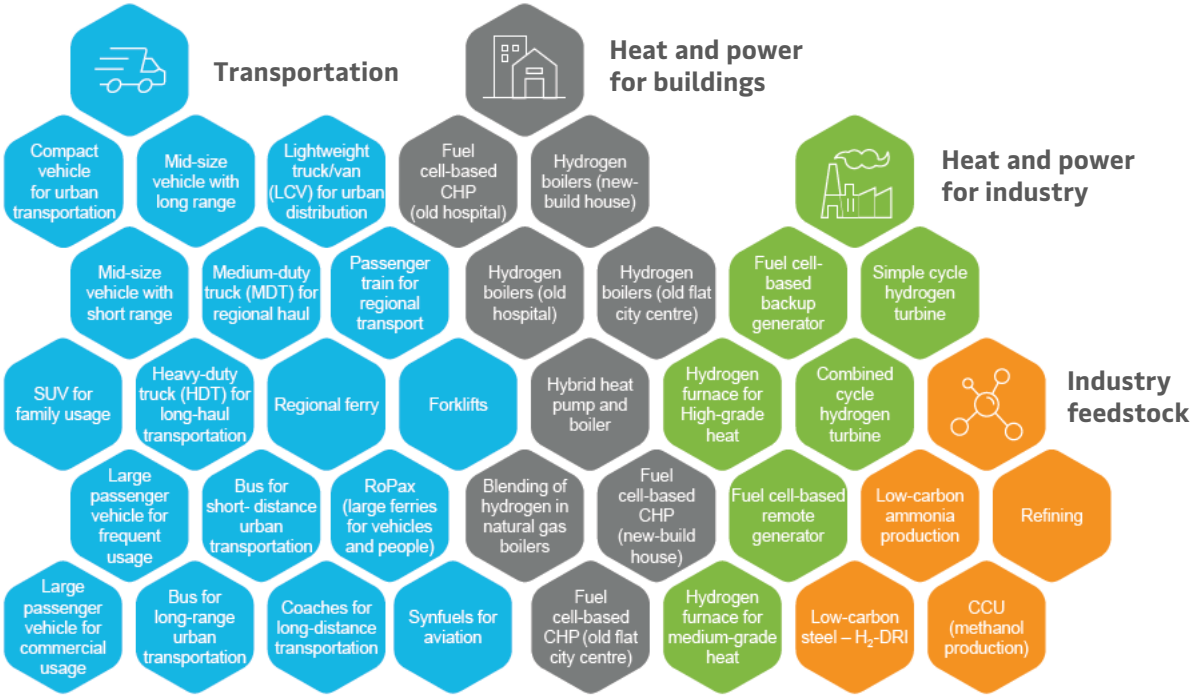
Cost perspective of hydrogen: Hydrogen is competitive as a low-carbon alternative

Overview of cost-competitiveness by application

While studying the hydrogen market and contriving the report we concluded that a hydrogen supply and distribution system at scale will unlock hydrogen's competitiveness in many applications sooner than previously anticipated. We have covered more than 35 possible application of hydrogen based upon global case studies and over buildings, industry heat, and industry feedstock as depicted in the Exhibit. It includes both new and existing applications currently responsible for 60 per cent of the world's energy- and process-related emissions

Overview of hydrogen application in India – growth & maturity factored

CO_2 global emissions
100% =37Gt



Source : eninrac research & analysis, McKinsey & MOEF, India

Cost perspective of hydrogen: Hydrogen is competitive as a low-carbon alternative (contd.)

Total cost of ownership (TCO) wise low-carbon hydrogen solution for India

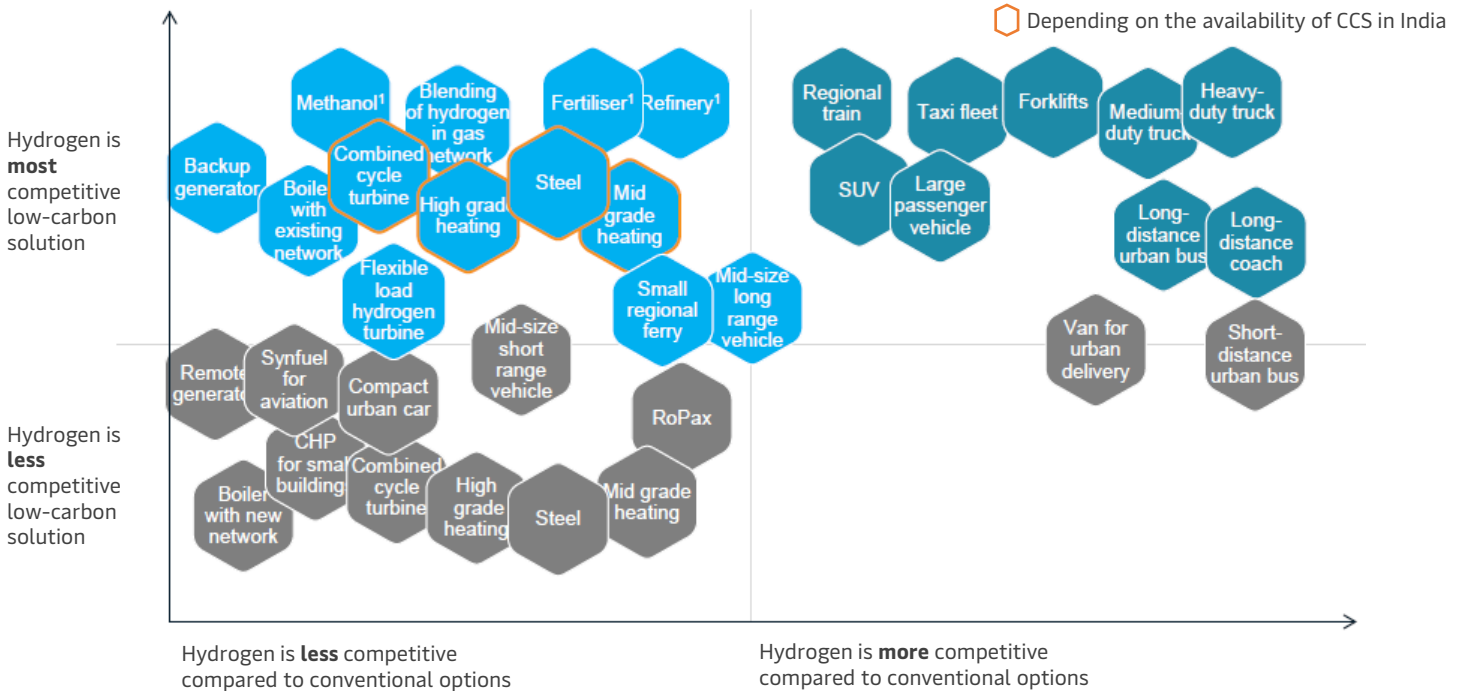
For each application, we assessed the TCO for a low-carbon hydrogen solution from 2020 to 2050 for India. For most applications, we then compared these costs with other low-carbon solutions (e.g., battery vehicles, heat pumps) and conventional technologies (e.g., diesel-powered vehicles, gas boilers). In some applications, hydrogen is practically the only low-carbon solution – for example, in feedstock applications such **as ammonia production and hydrocracking in refining, low-carbon and renewable hydrogen competes with 'grey' hydrogen produced from unabated fossil resources. In such cases, we only compared to conventional alternatives and between different hydrogen sources**.

On lines with our analysis, we found 22 applications where hydrogen can become a cost-competitive low-carbon solution before 2030 under the right conditions and assumed scale-up cited before. Examples of these include long-distance transport applications and regional trains, which are highly competitive with low-carbon alternatives, as indicated by their position high on the Y-axis of the following exhibit. In four of the reviewed applications, the competitiveness of hydrogen depends on the availability of CCS. If CCS resources for those applications are not available, hydrogen offers the only way to decarbonize the application. Examples include combined cycle turbines, steel production, high-grade heating for cement and medium-grade heating for plastics production.

Compared with conventional alternatives, we find several applications to be highly competitive at scale to both low-carbon and conventional alternatives, requiring zero- or low-carbon prices for hydrogen to break even, as indicated by their position at the right of the X-axis. This is true for nine applications, including trucks, trains, long-range passenger vehicles, and long-distance buses. Conversely, for several other applications, including use in turbines, industry feedstock, or synthetic fuel for aviation, a carbon tax of at least US$ 100 per ton of carbon dioxide equivalent (CO_2e) would be required to make hydrogen competitive with conventional fuels.

Cost perspective of hydrogen: Hydrogen is competitive as a low-carbon alternative (contd.)

Competitiveness of hydrogen applications vs. low-carbon conventional alternatives



[1] Hydrogen is the only alternative and low-carbon/renewable hydrogen competing with grey (optimal renewable or low-carbon shown)

Source : eninrac research & analysis, McKinsey & MOEF, India

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