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Blue Paper

What would be the key drivers of cost competitiveness in India?

Part -2 (Hydrogen cost benchmarks, demand built-up, transport infra & market size evaluation for India)

RACeninrac

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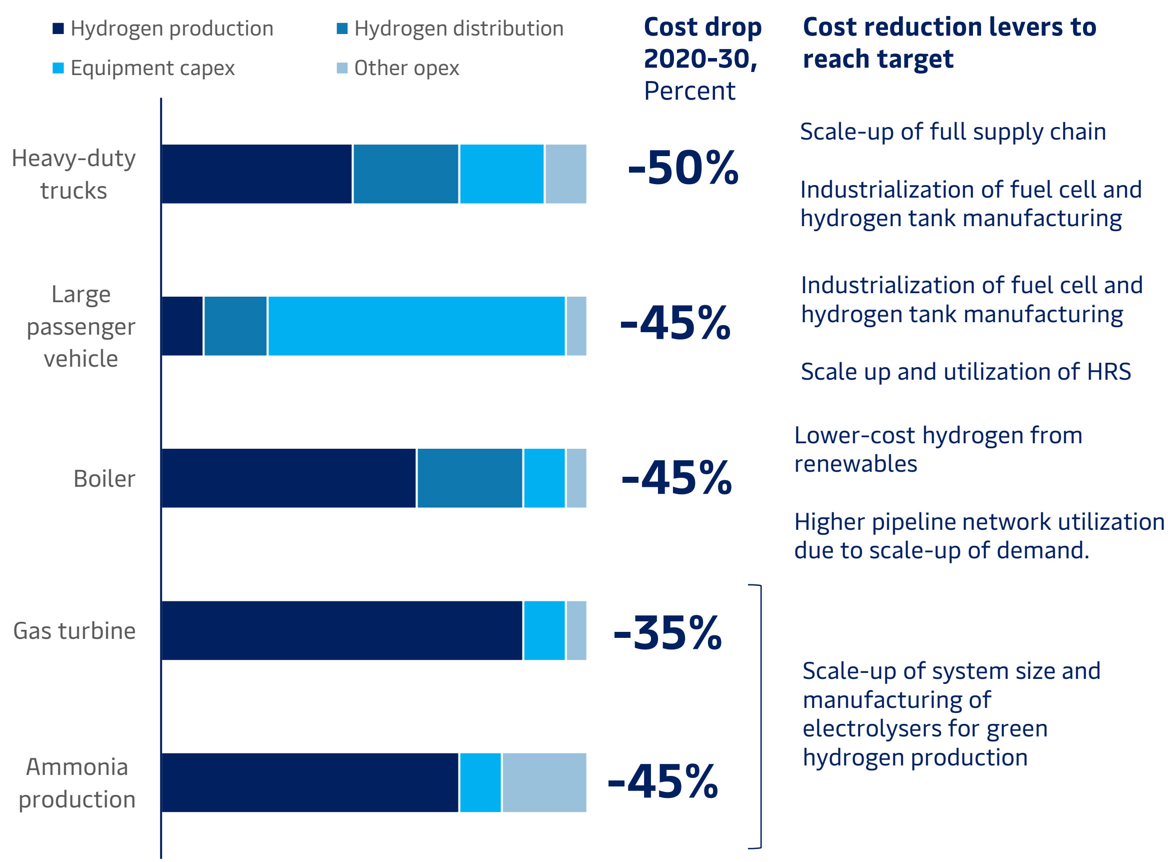
Drivers of cost competitiveness of hydrogen in India

TCO is driven by hydrogen production and distribution

Application TCOs typically comprise hydrogen production, distribution and end-use equipment costs. The degree to which each of these elements impact the TCO of an applications differs by application. For non-transport applications, more than 80 percent of the TCO is driven by hydrogen production and distribution. In contrast, end use equipment costs may comprise up to 70 per cent of transport application TCOs, depending on the usage profile.

We first consider the importance and implications of production scale on equipment capex. We then explore the impact of consumption volume on the utilization of distribution infrastructure. Finally, we showcase the importance of scale in reducing hydrogen production costs.

Driver's of low-cost hydrogen and its competitiveness as per applications in India



Source : eninrac research & analysis, channel checks & McKinsey

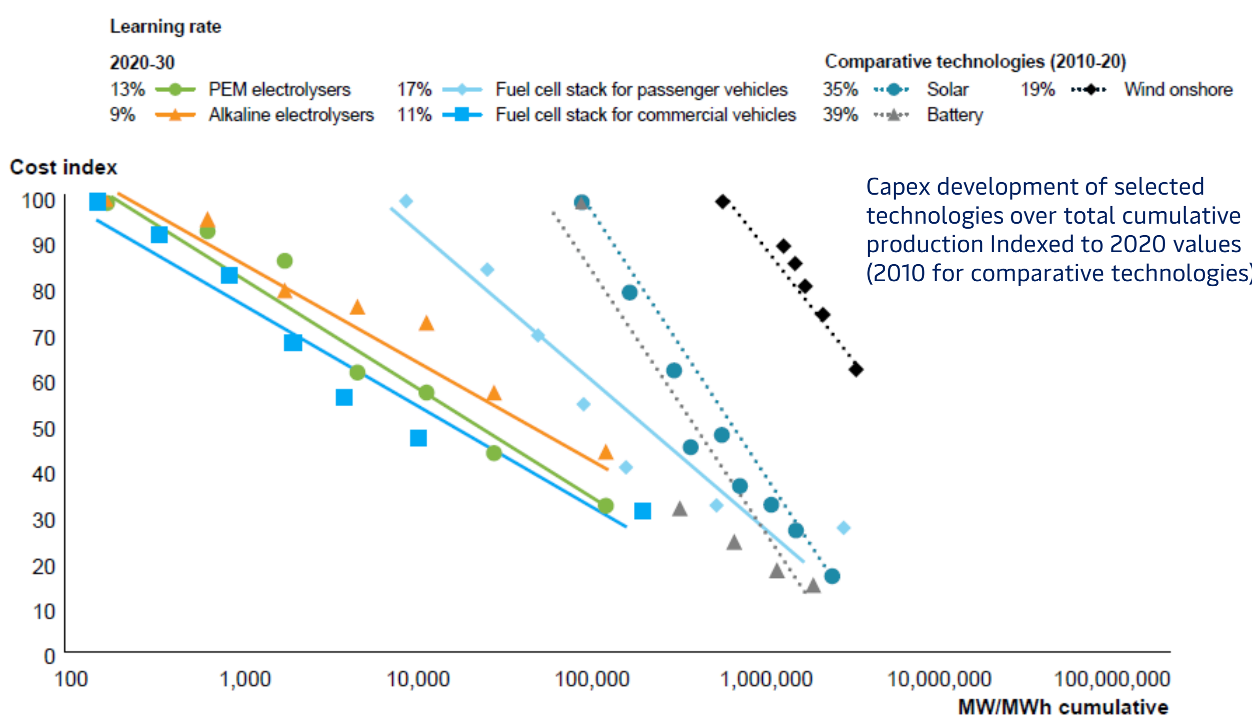
Drivers of cost competitiveness of hydrogen in India (contd.)

Implications of scale and size on equipment costs in India

Scale will reduce equipment costs significantly across the hydrogen value chain. Hydrogen technologies currently have niche status, and there is significant potential for both achieving economies of scale in the manufacturing process and improving the technology further. In solar and wind power, for example, each doubling of cumulative production in the past led to cost reductions of 19 to 35 per cent. Exhibit below shows the estimated learning rates for electrolysers and fuel cells compared to solar, onshore wind and batteries. We estimate that fuel cell stacks for passenger vehicles will exhibit learning rates of about 17 per cent soon. The learning rates for commercial vehicles are lower, at roughly 11 per cent, primarily due to the lower volume of vehicles, but will still benefit from scale-up in other segments. Electrolyzer learning rates are about 9 per cent and 13 per cent, respectively, for alkaline and PEM technology.

Learning rate estimates for PEM are slightly higher, as this technology is less mature and therefore has higher cost-reduction potential. All these estimates are independent of synergies between the technologies, which could further drive up the learning rates. For instance, the PEM electrolyzer manufacturing may benefit from improvements in the PEM fuel cell production. These cost reductions may seem aggressive at first, and uncertainties exist in both scale of deployment and technology. However, when comparing the cost trajectories with other 'new' technologies such as solar panels and lithium-ion batteries, both with historical learning rates above 30 per cent, they appear conservative, and we may in fact expect further upside.

Exhibit 6.4: Learning rates of hydrogen applications in India and Global benchmarks



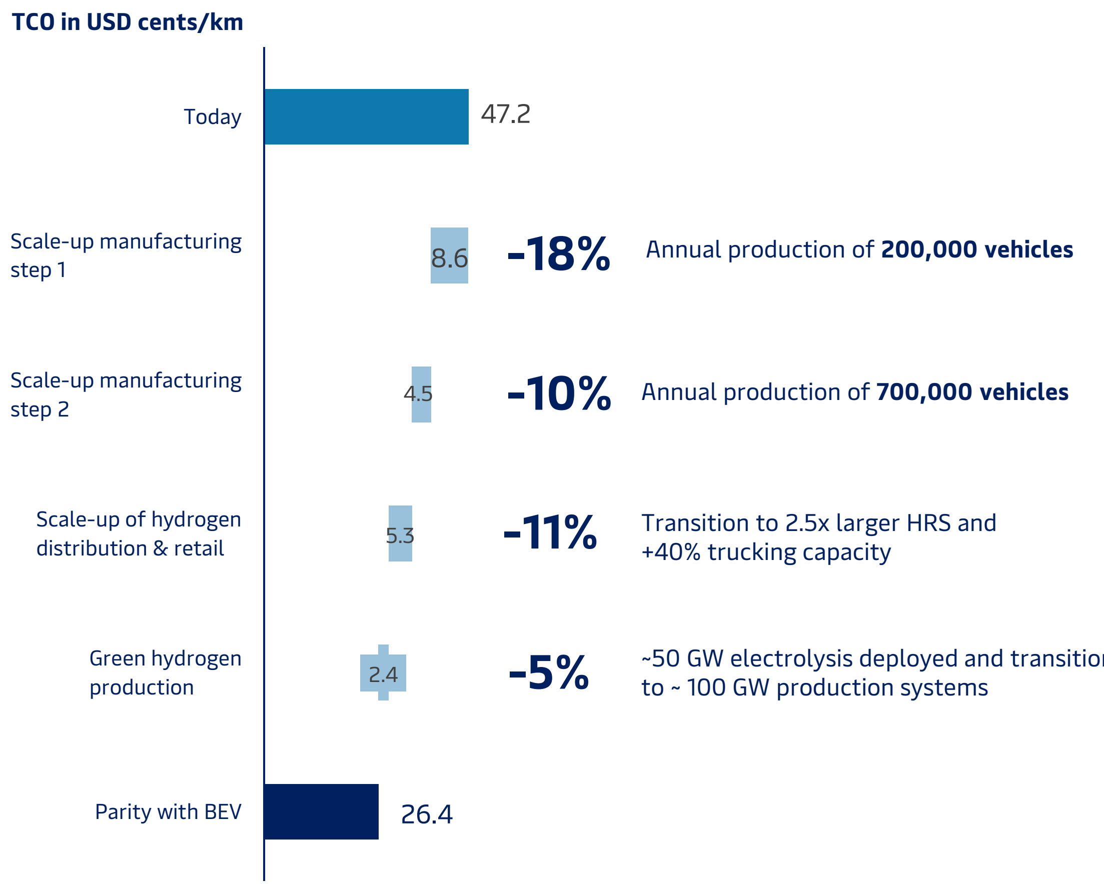
Source : eninrac research & analysis, channel checks & McKinsey

Implications of scale on utilization and distribution costs

Beyond reductions in equipment costs, a scale-up in hydrogen usage will also lead to improved utilization of capex. This point can be illustrated with reference to passenger car TCO. Achieving cost reductions for fuel cell vehicles requires the scale-up of both manufacturing of components as discussed above (e.g., fuel cells and hydrogen tanks) and the total hydrogen supply chain.

The TCO for large passenger vehicles could decline by about 45 per cent by 2030 driven by three main factors: lower-cost vehicle capex, lower-cost distribution and retail of hydrogen, and lower-cost hydrogen production. These cost reductions are vital for reaching cost parity with BEVs.

Cost reduction map for larger passenger vehicles – global status



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