

Economic analysis of hydrogen energy towards 2050 in China



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Overview of hydrogen energy cost in 2020

Hydrogen energy is a major energy source in the industry and an important secondary energy to support green energy transition. Hydrogen is easy to store and has broad application in areas, and it can be converted across different energy networks. Nevertheless, it also faces practical challenges such as technological maturity, lack applicable industries and security issues. With higher penetration of renewable energy and cost reduction of fuel cells in the future, hydrogen energy-based applications will become more competitive. Particularly, hydrogen is expected to be technically feasible and cost-effective in the heavy-duty transportation industry, as well as to be a valuable energy source in a renewable energy dominated power sector.

The cost of hydrogen energy covers production, transportation, storage and fueling sections. The cost of different types of hydrogen production vary greatly.



Electrolysis of water

RMB 20-40/kg
(electricity price RMB 0.3-0.8/kWh)



Curtailed RE power

the lowest RMB 10/kg
(electricity price RMB 0.1/kWh)



Fossil fuel

Coal for RMB 10/kg
Natural gas for RMB 25-30/kg



Industrial by-products

RMB 8-14/kg



Transportation and storage

A 20MPa tube trailer per 100km costs RMB 7/kg, it is currently a cost-effective short-distance transport method adopted in China. Liquid hydrogen trailers and hydrogen pipelines are still immature and lack standards. With expansion of the market, they will become more cost-effective.



Fueling

Over RMB 15/kg for 500kg/day of fueling capacity. The cost mainly depends on the scale of fueling stations. The cost will drop significantly provided the the fueling capacity reaches over one tonne or two tonnes per day.



The purchase price of hydrogen for vehicles is over RMB 40/kg assuming the use of industrial by-product hydrogen, 200 km of high-pressure transportation and storage, and 500kg/day fueling mode.

2050 outlook of RE-produced hydrogen energy

The transport sector will be the major RE-produced hydrogen consumption sector. By 2030, fuel cell vehicles are expected to consume 1.5 million tonnes of RE-produced hydrogen; by 2050, road and marine transport would jointly consume over 30 million tonnes of RE-produced hydrogen, nearly 80% of annual RE-produced hydrogen production.

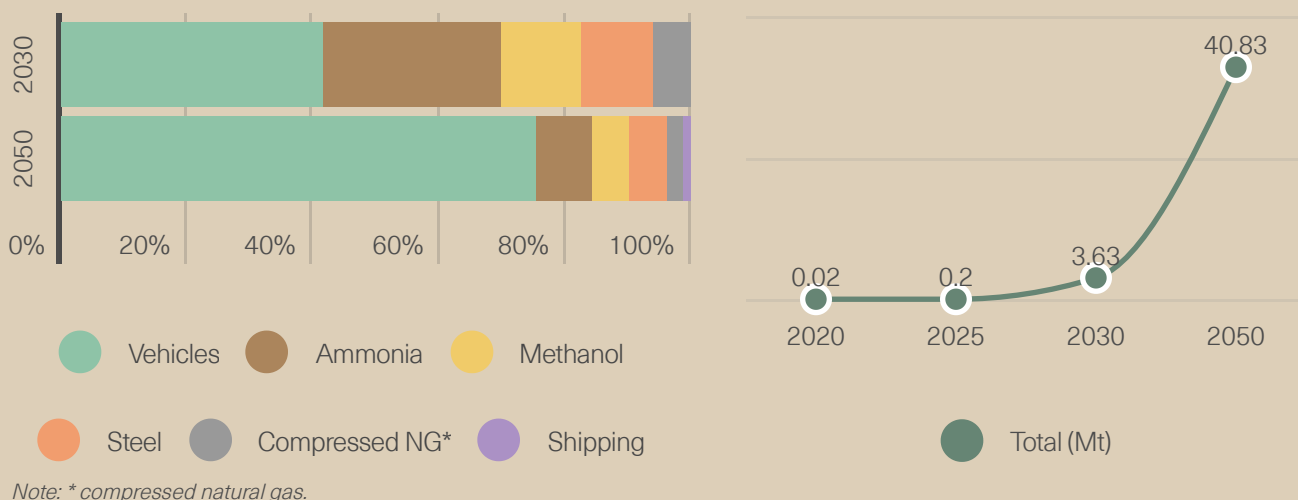


In non-transport sectors, the highest accepted terminal hydrogen price in 2030 is expected to be RMB 6-15/kg. Utilization of hydrogen will be cost-effective in specific fields that have requirements of short-distance and centralized transport of hydrogen regardless of the way of production. An increasing share of renewable power, RE-produced hydrogen is expected to replace fossil fuel from economic perspective in steel, ammonia and methanol production by 2050.



In the transport sector, the highest acceptable terminal hydrogen price in 2030 is expected to be close to RMB 40/kg, making fuel cell vehicles to be almost competitive with EV. While large-scale fuel cell buses are expected to achieve price parity prior 2050.

2050 RE-produced hydrogen consumption



POLICY SUGGESTIONS

Improve top-layer policy design

To define the energy and chemical properties of hydrogen from a legislative level in order to establish a good foundation for formulation of policies and standards in the future.



Enhance R&D of key technologies, carry out demonstrations

To support independent R&D of large-scale and cost-effective RE-produced hydrogen, hydrogen transportation and storage, and fuel cell technologies from incentive and project approval perspectives.



Encourage infrastructure construction

To explore new business models such as natural gas and hydrogen joint fueling stations and provide subsidies for hydrogen fueling.