Energy Transition Pathway: Key Facts

The global energy landscape is reshaping and gravitating towards carbon-neutral energy options to address the climate risk. Energy and Resource companies are showing some commitment to participate in the climate action journey to mitigate potential risks to business sustainability and growth. Investments by energy companies in blue hydrogen developments supplemented by the Carbon Capture and Storage option are the reflection of this transition. Currently, blue and green hydrogens are identified as the main pillars to support the energy transition pathway towards carbon neutrality.

Replacement of fossil fuels and grey hydrogen industrial demand by carbon neutral hydrogen is projected to avoid approximately 6Bt/y CO_2 emission by 2050. The current industrial hydrogen demand of 120 million tons/year is projected to grow to 530 million tons/year by 2050. Considering the massive scale of development to meet the carbon-neutral hydrogen demand outlook, a gradual progression from blue to green hydrogen has been identified as a viable transition pathway. This viewpoint is further strengthened by the fact that a combined share of two mega green hydrogen projects, i.e. 0.24 million tons/year at Neom by 2025 and 1.75 million tons/year Asian Renewable Energy Hub (AREH) in Australia by 2028, will contribute only fraction of the total projected demand. In summary, the following outlines the transition pathway.

- Blue and green hydrogen will complement each other for the next 20 years and jointly grow carbon-neutral energy footprints.
- Organizations having hydrocarbon endowments and low-cost CO_2 sinks are likely to dominate the blue hydrogen market share.
- Green hydrogen is likely to compete on price with blue hydrogen when the development possesses the right mix of solar and winds to offer a high capacity factor (CF), low-cost land and water. [1]NEOM and AREH are the current examples of such developments.
- Substantial R&D investments are cascading in the green hydrogen value chain to bring the production cost down.
- Likewise, CCS cost optimization is at the centre stage of blue hydrogen developments to make the investment viable without any government fiscal and financial support.

A high-level comparison between optimal blue hydrogen and high-efficiency green hydrogen developments is summarised below.

	Unit	Blue Hydrogen	Green Hydrogen
Feedstock for H_2 Production		Natural Gas	Renewables Energy
Production Cost (excludes CCS)	$/kg	1.26 @ $3/million BTU gas 1.96 @ $9/million BTU gas	2.3 @ power cost 2c/kwh 6.6 @ power cost 10c/kwh
CO2 emission	Kg CO_2/kg H_2	9	0
CCS cost loading	$/kg H_2	$0.28 @ CCS cost of $40/ton	0
Production Cost (includes CCS)	$/kg	1.54 @ $3/million BTU gas price and CCS cost of $40/ton	1.5 (NEOM projection)
Power demand for H_2 production	kwh/kg of H_2	1.9	55
Water demand	kg/kg of H_2	6	9
Land requirement: 1.76 million tons/year H2 plant capacity	Km2	14 (2 for H2 Plant + 2 for CCS + 10 for Pipeline corridor)	5,750

[1]*AREH project of 23 MW capacity and NEOM 4 MW capacity*