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# India's Energy Transition Towards A Green Hydrogen Economy

WHITE PAPER ON BUILDING A GREEN HYDROGEN ECONOMY AND POLICY ROADMAP FOR INDIA



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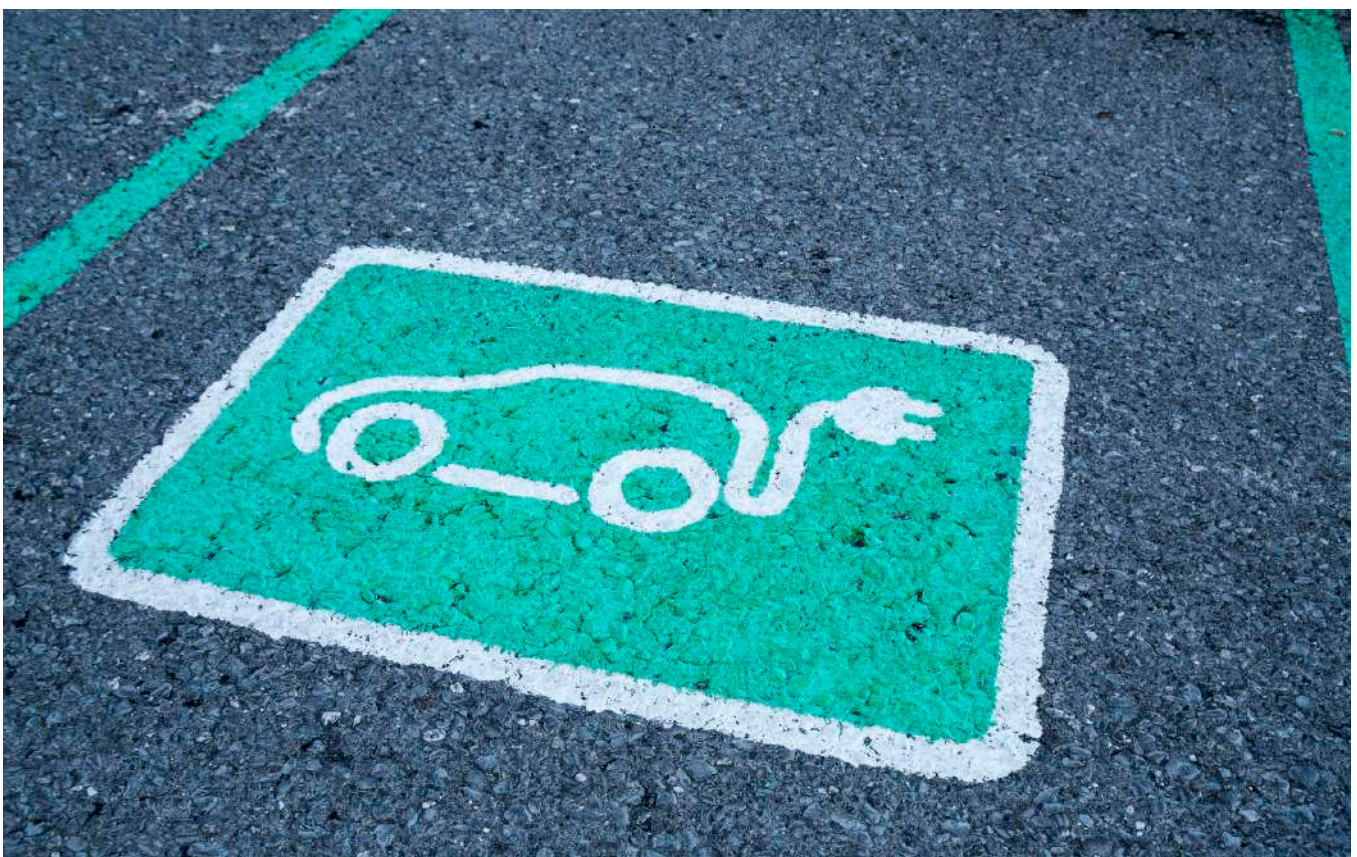
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## Executive Summary

India is motivated towards stronger energy transition actions beyond its current climate change initiatives, aggressive renewable energy, electric vehicle (EV) Infrastructure build-out; and energy diplomacy initiatives. The imperative to decarbonise the Indian economy is drawn from the poor air quality in Indian cities, high fossil fuel import bill and concerns about India's energy security. Despite national efforts with climate change actions, India's fossil fuel consumption, of both oil and gas, as well as that of coal, is expected to continue to rise to meet the economy's voracious appetite for energy in any form. Electric vehicles, battery technology and renewable energy growth seemed to offer the only hope to de-carbonise the economy with unanswered questions of energy storage and critical supplies of battery components, including rare earths and metals, creating only a tentative path for energy transition and a zero-carbon future.

The growth of green hydrogen production technologies (hydrogen produced by splitting water molecules with electrolysis using renewable energy sources), falling costs of electrolyzers and fuel-cell stacks, and increasingly concerted policy actions to encourage green hydrogen projects in different parts of the world, are coming together to create a paradigm shift for energy transition. With blue or grey hydrogen technologies (produced using natural gas, with or without Carbon Capture Sequestration) as an interim step, stakeholders see green hydrogen become economically viable within a decade in some parts of the world, working closely with battery-tech, EVs and a higher renewable energy generation scenarios, offering scalable zero-carbon scenarios.



## Rationale for a Green Hydrogen Ecosystem

Despite an early start (India's first Hydrogen and Fuel Cell Roadmap was announced in 2006 followed by R&D funding), India has lagged other parts of the world in moving towards large-scale demonstration hydrogen projects. Europe and US lead on electrolyser and FCEV technologies, Japan and Korea are investing heavily to become global hydrogen-use champions, while Australia and Chile are building global green hydrogen production hubs to export liquified or pressurised hydrogen. Each of them is building green hydrogen ecosystems for hydrogen's potential as a fossil-fuel replacement and its storage potential, marrying it with renewable energy and battery technologies.

As the global green hydrogen ecosystem matures, cost of hydrogen production is expected to come down and become comparable with fossil-fuels. With hydrogen production and demand increasing globally, there will be green hydrogen winners and losers, placing hydrogen importing economies next to low-cost ones (those who leverage national renewable energy and local manufacturing to make green hydrogen affordable).

India remains one of the large economies that have yet to re-articulate a national green hydrogen policy and it should do so before India assumes the G20 Presidency in 2023. Hydrogen reports published by the Ministry of New and Renewable Energy (MNRE), stated ambition by the Office of the Principal Scientific Advisor (PSA) and early pilots by IOCL (and the significant R&D efforts by Indian institutions) indicate a desire for a strong play in the emerging global green hydrogen economy. India can choose to wait till the global green hydrogen ecosystem matures or take a proactive role in developing local manufacturing capabilities to create a local supply chain. The dilemma is one of timing, scope, and economics; and framed by key four questions:

1. If 2030 is the year when green hydrogen is expected to expand globally, what should India do in the preceding five years (from 2025-30), and what should it do in the preceding five years (from 2020-2025) to prepare for this change?
2. What can India do to leverage its position as a large consumption economy and global demand centre, to attract hydrogen investments and build a local manufacturing base?
3. What does India need to do to 'leap-frog' on the adoption curve and earn a seat at the global green

hydrogen table? Will it take more R&D investments or large-scale development projects?

4. What are the enabling factors? How much public-private partnership is required? How much funding is required in next five years, and the following five? How will this be raised and utilised?

The white paper has attempted to answer these questions by undertaking a benchmarking of global green hydrogen policies, evaluating three hypothetical adoption pathways and draws inspiration from measures taken in other economies to creating India-specific set of stakeholder and policy interventions.

## Methodology

The India Green Hydrogen Roadmap white paper has been prepared as a voluntary initiative, bringing together global developments with inputs from multi-stakeholders. It focusses on policy and partnership approaches with energy industry members, government stakeholders and energy experts that will help create a green hydrogen economy in India over the next two decades. The paper does not make technical comparisons between different hydrogen-based technologies. A global benchmarking of green hydrogen policies and published reports was undertaken followed by a multi-stakeholder consultation on Nov 10 2020. More than 50 stakeholders participated at the consultation and this was followed by direct engagement with individual stakeholders. Stakeholders who have been engaged as part of the preparation of this white paper, include:

- Government of India: NITI Aayog, Ministry of New and Renewable Energy, Ministry of Heavy Industries, Ministry of Road and Highways
- Energy Industry: global and domestic energy companies. The stakeholder e-consultation witnessed participation from 14 global organisations and seven major Indian organisations.
- Energy experts and multi-lateral organisations: think tanks, academics and energy commentators

The industry consultation discussed three possible adoption pathways, focusing on the question of timing and enabling role of policy for the green hydrogen ecosystem to grow.

- First pathway assumes proactive policy role in creating incentives that would encourage the private sector to co-invest (with the government) in building the green