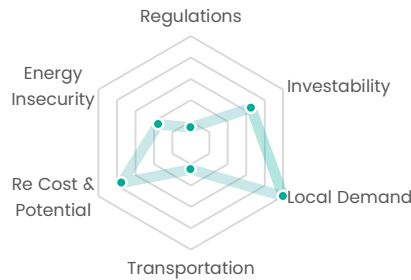
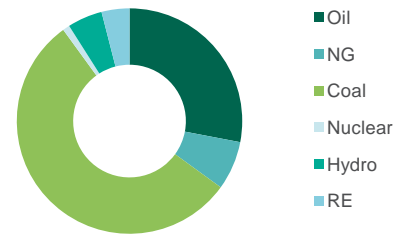


| | |
|------------------------------------------------|--------------|
| GDP - USD (tn): | 2.62 |
| GDP per capita - USD: | 1,901 |
| Land area ('000 km2): | 2,973 |
| Population density (per km ²): | 456 |
| Grid emissions factor (gCO ₂ /kWh): | 743 |

Hydrogen Drivers Matrix



Primary Energy Mix



0.7 Regulatory commitment

- No net zero target or carbon pricing
- Exporters to EU may need to decarbonize to stay competitive

1.2 Transportation

- Extensive ammonia transport infrastructure in place
- Country looking to transition from coal/biomass to gas-based energy

3.3 "Investability"

- Rated BBB- by S&P
- 63rd in WB Ease of Doing Business
- Strong DFI support and domestic investor appetite in power

3.8 RE cost and potential

- Third largest wind and solar market globally
- Low-cost renewables, although not among the very lowest

5.0 Local demand potential

- 2nd largest steel manufacturing
- 4th largest oil refiner
- 3rd largest ammonia producer and by far world's largest importer

1.8 Energy insecurity

- 34% net energy importer
- Hydrogen likely only attractive as energy diversification at lower cost than alternative

Hydrogen for energy independence; funding required to overcome price sensitivity

Green hydrogen is being touted by Prime Minister Modi as the key to India's energy independence by 2047. In August 2021, Modi unveiled a USD1.35 trillion infrastructure plan, a cornerstone of which is the National Hydrogen Mission, a high-level four-year strategy and ten-year outlook that sees India as a global hub for not only hydrogen production but also electrolyser manufacturing and fuel cell technologies. The government targets reaching 12mtpa of hydrogen consumption by 2030 but the proposed budget over the next three years is however only a modest Rs 800 crores (c.USD100m).

India's grey hydrogen demand today stands at 6.9mtpa, 53% from refineries and 44% from ammonia plants. India is the world's third largest ammonia producer and by far the world's largest importer of ammonia; the second largest producer of steel and cement; the fourth-largest oil refiner and second largest oil importer—all of which points to a very large, but also very price sensitive market. Energy import costs are some USD185bn per year. With no domestic carbon pricing, it remains to be seen how far the hydrogen agenda can be pushed in the absence of targeted support schemes. India has reasonably cheap renewables, ranks of low-cost EPCs, as well as vast renewable potential.

Reliance USD10bn H2 supply chain

India's biggest private sector oil firm Reliance Industries plans to invest USD10bn in the construction of four renewable manufacturing gigafactories

in the next three years, including an electrolyser and a fuel cell plant, but to date it is not clear who will be the technology partner.

New H2 Alliance

There is a strong private sector push for hydrogen in India, amongst which U.S.' Chart Industries and India's Reliance Industries have formed an industry coalition with the intention of working with government in shaping the national hydrogen roadmap, creating a PPP task force, identifying large national demonstration projects and establishing a national hydrogen fund.

International partnerships

In 2021, the Indian government established a number of international task forces including with the US Department of Energy (DOE) and Abu Dhabi National Oil Company (ADNOC). Local conglomerate Adani also signed a MoU with Italian oil & gas and chemical engineering group Maire Tecnimont and with Italy's Snam to investigate a hydrogen value chain in India and internationally.

Brazil-Germany Alliance

State-owned Indian Oil Corporation, which controls 1/3 of India's refining capacity, is planning a small 1 ton/day wind-powered hydrogen plant and is looking into hydrogen-spiked compressed natural gas (H-CNG) for buses. NTPC, the country's largest electricity company, has announced plans to set up India's first green refueling station and is looking into blending hydrogen into the city gas distribution grid.