TATA

TATA CONSULTING ENGINEERS LIMITED

ENGINEERING A BETTER TOMORROW SINCE 1962

HYDROGEN

Engineering to Deliver the Future of Fuels Today

INTRODUCTION

Satisfying energy demands forms an integral part of the development of the world. Growing concerns over climate change, especially finding an alternate means of energy sources to the present fossil fuels, has increased interest in Hydrogen.

Hydrogen is a flexible and alternative energy carrier with potential applications across all energy sectors. It is considered a clean energy source and a viable alternative to fossil fuels to control emissions as it can be produced from renewable sources. Hydrogen has the potential to transform the energy sector by contributing to a sustainable energy future. Global climate change and emission concerns can be addressed at both ends of the value chain, i.e., hydrogen production and hydrogen use.

Hydrogen has a wide application range. It has created interest amongst stakeholders of several industry sectors such as renewable electricity, industrial gas, automobiles, oil and gas, steel, carbon capture, etc. It is not only hydrogen producers but also includes those who use or could use, Hydrogen as a feedstock for various industrial applications.

Hydrogen can be helpful in various ways to achieve energy security. It can be integrated into the electricity infrastructure by converting electrical energy (supplied by renewable sources) to produce Hydrogen and then reconvert it back to electrical energy. Fossil fuel-based hydrogen-producing processes can be amended to employ carbon capture technologies to produce clean Hydrogen.

ABOUT US

Established in 1962, Tata Consulting Engineers Limited (TCE) is India's Leading Integrated Engineering Consultant providing Concept to Commissioning services. With 10,000+ projects delivered in more than 55 countries, the company has a double digit five-year CAGR.

TCE offers its customers invaluable expertise – a by-product of more than five decades of premier service as an integrated engineering service provider. Our specialised, in-house talent pool and the ability to provide holistic solutions under one-roof, makes us an invaluable partner.

TCE, amongst top 2 consultants in its core sectors

1. Power
2. Resources - Mining & Metals
3. Resources - Hydrocarbons & Chemicals

TCE serves domestic as well as international markets and is known for several first-of-its-kind projects offering the following services:

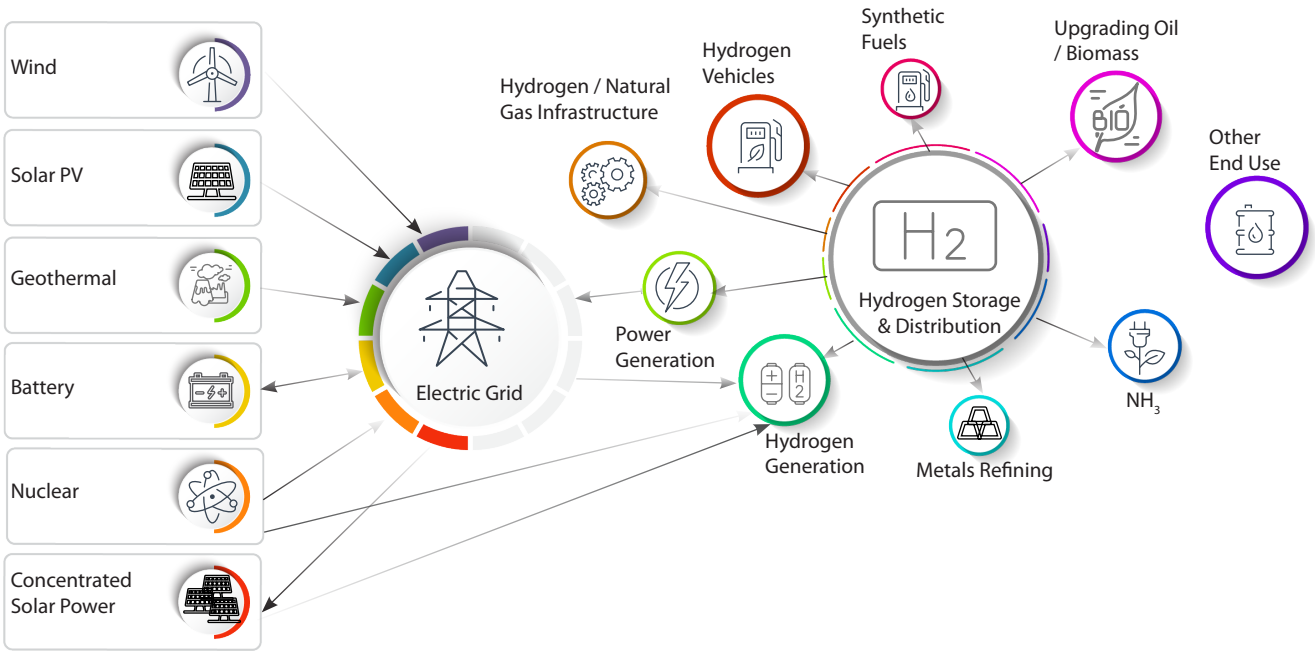
1. Design & Engineering
2. Project Management & Safety
3. Procurement Management
4. Digital & Advanced Technologies

THE HYDROGEN STORY

Hydrogen as the energy storage and carrier for the future has a wide range of applications in power, CHP, steel, non-Ferrous (Al, Zn, Cu), ammonia, fertilisers, methanol and petroleum refining other than mobility (road transport, hydrail, ships, submarines, aviation and space travel).

Hydrogen is expected to play a vital role in slashing emissions in several highly polluting industries that now face strict climate targets.

Renewable energy from solar /wind can be stored efficiently by converting it into hydrogen using electrolysis and used for mobility purposes and energy needs in metals, chemicals and other industries and captive power generation for such plants.



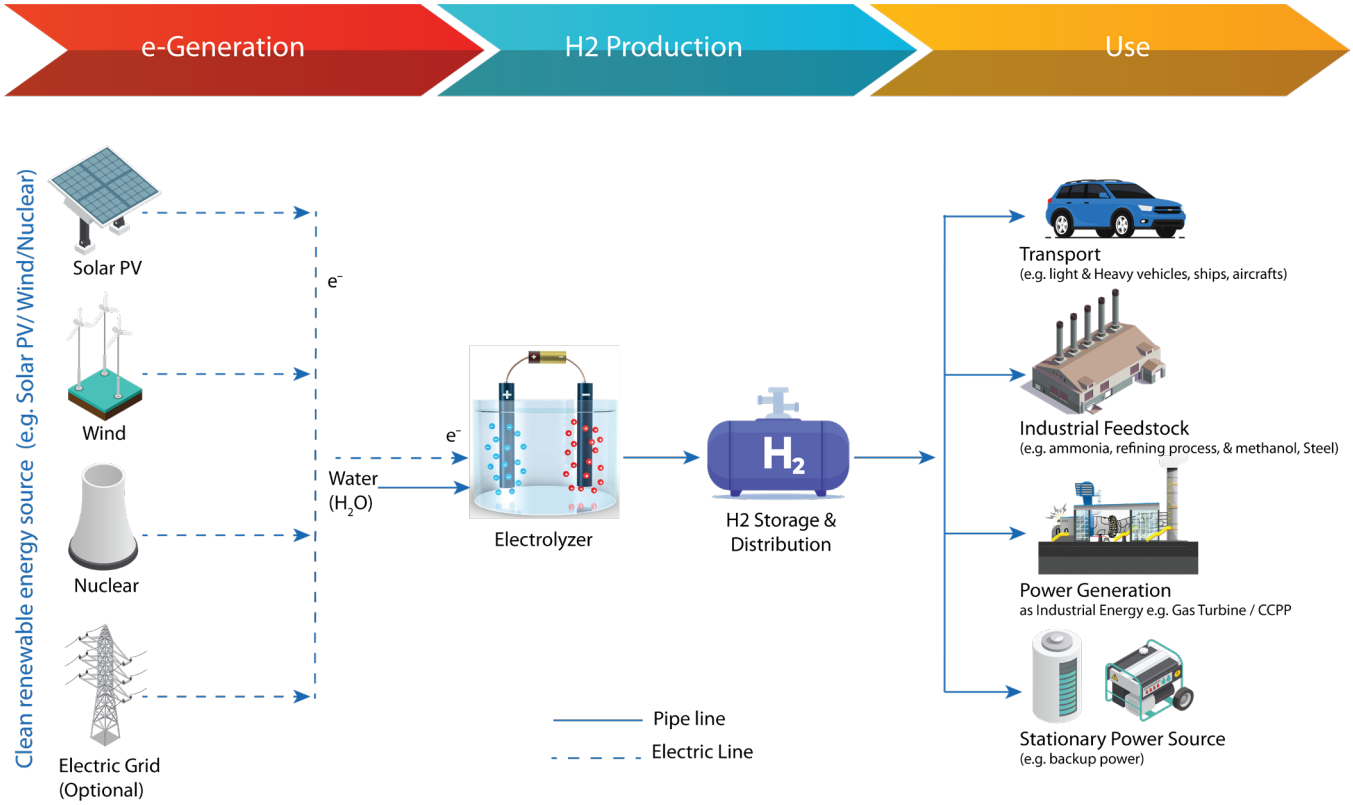
HYDROGEN IN ENERGY TRANSITION

HYDROGEN COLOR PALETTE

	GREY	BLUE	GREEN
Feedstock	Steam reforming of natural gas (or coal) into hydrogen and CO_2	Steam reforming of natural gas (or coal) into hydrogen and CO_2	Splitting of water into hydrogen and O_2 powered by electricity from renewable sources
CO_2 Emissions	CO_2 emitted in the atmosphere (with coal emitting 20x more than steam methane reforming)	CO_2 stored with CCS or reused	No CO_2 emissions

COMPETITIVE PATHWAY FOR GREEN HYDROGEN

According to the International Renewable Energy Agency (IRENA) study and predictions, the cost of electrolysers is expected to halve from USD 840 to USD 420 by 2040. When coupled with a fall in renewable generation cost, the pathway for green hydrogen could become the cheapest energy source in not so distant future. Green hydrogen will also address the integration challenges of variability in renewable generation.



THE INDIA STORY

Announcement of National Hydrogen Mission.

IOCL is putting up a pilot plant for electrolysers, operating fuel station and developing H2 storage cylinders.

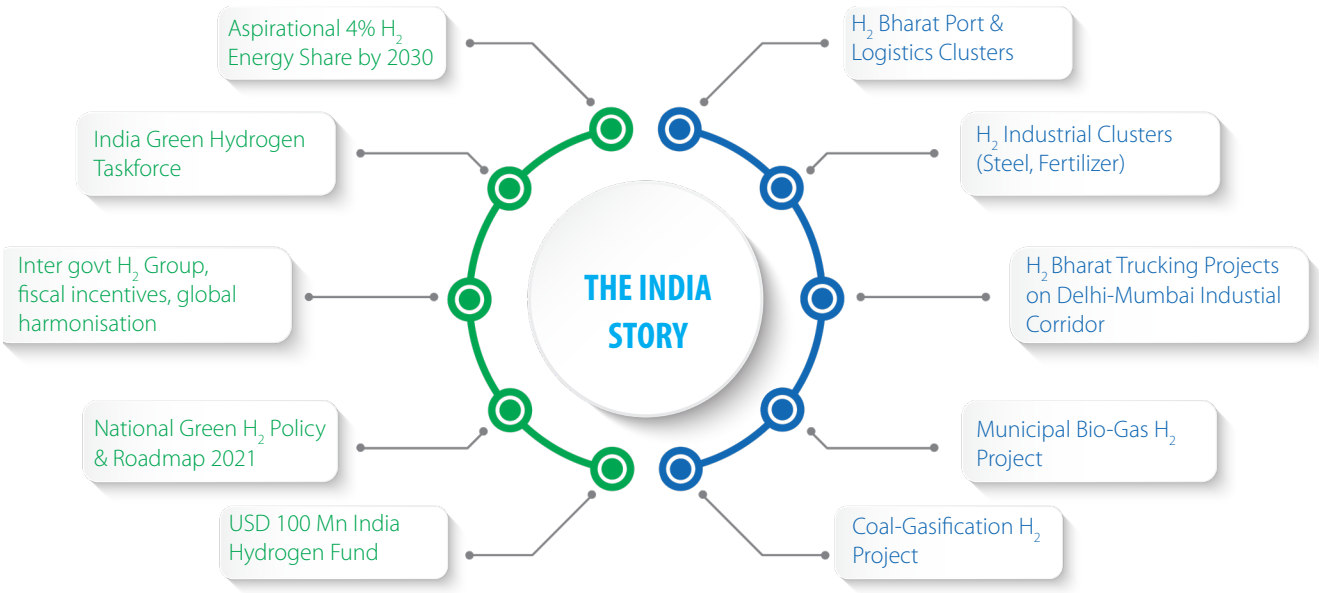
TERI predicts the cost of H2 from renewables to outcompete fossil fuels by 2030 and reach 80% generation from renewables by 2050.

Green H2 partnerships:

- Fusion Fuel Green PLC, EU and BGR Energy System
- Indian Oil and Greenstar, Norway to develop Centre of Excellence for Hydrogen in India
- Acme Solar Holdings Ltd, with Lhyfe Labs SAS, France.

POLICY INTERVENTIONS

NATIONAL DEMONSTRATION PROJECTS (Proposed)



DESIRED OUTCOMES BY 2030

1 India in Global H2 Supply Chain
Domestic Manufacturing of Electrolysers, Fuel-Cell stacks, components. Partnerships and H2 India Consortium

2 10 National H2 Projects
Large, demonstration-stage, different use cases

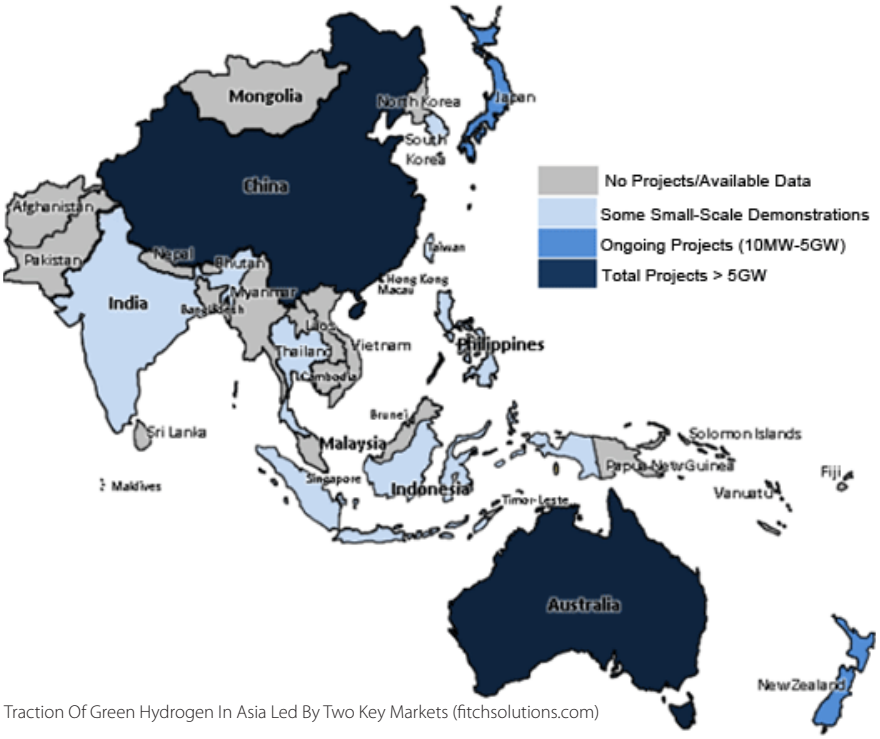
3 USD 500 Mn
Expanded Hydrogen Find by 2030

4 75000
New Hydrogen Economy jobs potential

5 GW - Scale
Electrolyser capacity in India

THE ASIAN STORY

The rapid growth of renewables in Asia with a steep fall in costs will become a driver for adopting green hydrogen technology. Reduction of electrolyser costs and the option of storing excess energy from renewable generation makes hydrogen an alternate competitive energy source. Hydrogen can also be integrated into existing gas networks and ship storage.



Traction Of Green Hydrogen In Asia Led By Two Key Markets (fitchsolutions.com)

THE TRANSPORT SECTOR

The transport sector in ASEAN countries is primarily dependent on imported oil (40% of 4.5MBD consumption). Biofuel blending up to 20% has been proposed as an aggressive plan. Electrification of road transport using BEV has inherent problems of battery manufacture and life and cause more emissions over a lifetime than ICEV with electricity generation from fossil fuels (Figure 1 and 2).

FCEV option offers many advantages with hydrogen generation from clean sources and flexible storage options. ERIA report estimates 80GW of Solar Power, 229GW of Wind Energy, 158 GW of Hydropower (including small hydro), 61 GW of biomass, and 200 GW of Geothermal. The technology gaps for vehicles is narrowing rapidly, and by 2030, the TCO of FCEV will match that of ICEV. Proper policy support of pricing GHG emissions, charges on fossil fuels power and vehicles can accelerate hydrogen economy.

Figure 1: Average Vehicle Total Cost of Ownership ($/km) in ASEAN Today

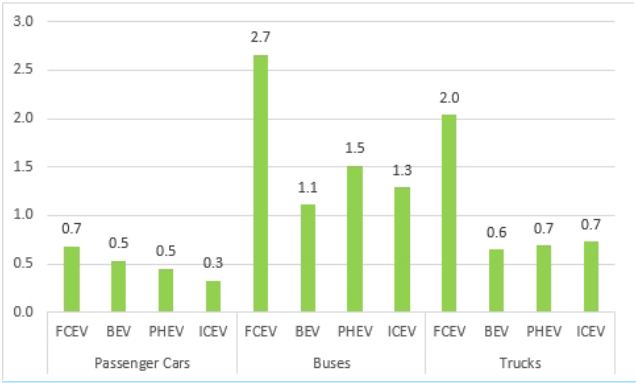
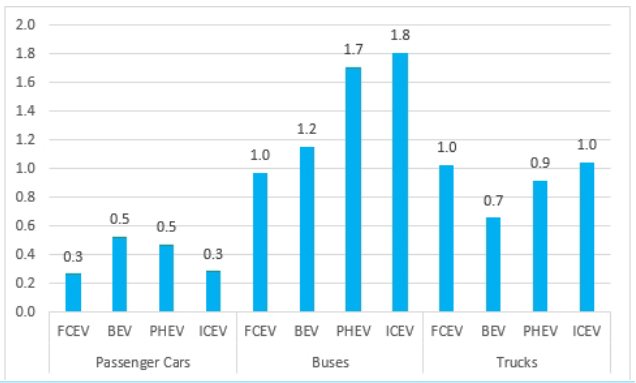


Figure 2: Average Vehicle Total Cost of Ownership ($/km) in ASEAN by 2030



VISION

To be an internationally respected engineering consultant offering comprehensive solutions

MISSION

Provide technically excellent and innovative solutions, for adding value for all stakeholders, and operate globally as professional consulting engineers

CORE VALUES

- Customer Satisfaction and Loyalty
- Technical excellence with professional ethics
- Responsibility to society
- Employee dignity and self-respect
- Organisational and individual growth

TATA

TATA CONSULTING ENGINEERS LIMITED

Engineering A Better Tomorrow

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