



International Conference on Green Hydrogen 2023

Hydrogen in Mobility



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Long Waves of Innovation

KEY BREAKTHROUGHS

FIRST WAVE

During the Industrial Revolution, the first factory emerged—a cotton mill in Britain.



SECOND WAVE

As railways proliferated, their networks strongly influenced urban growth.



THIRD WAVE

Henry Ford's Model T introduced the assembly line, revolutionizing the automotive industry.



FOURTH WAVE

Aviation gains mass adoption on a global scale, providing a lever



FIFTH WAVE

In 1990, 2.3M used the internet—by 2016 this reached 3.4B.

Source: World Bank



SIXTH WAVE

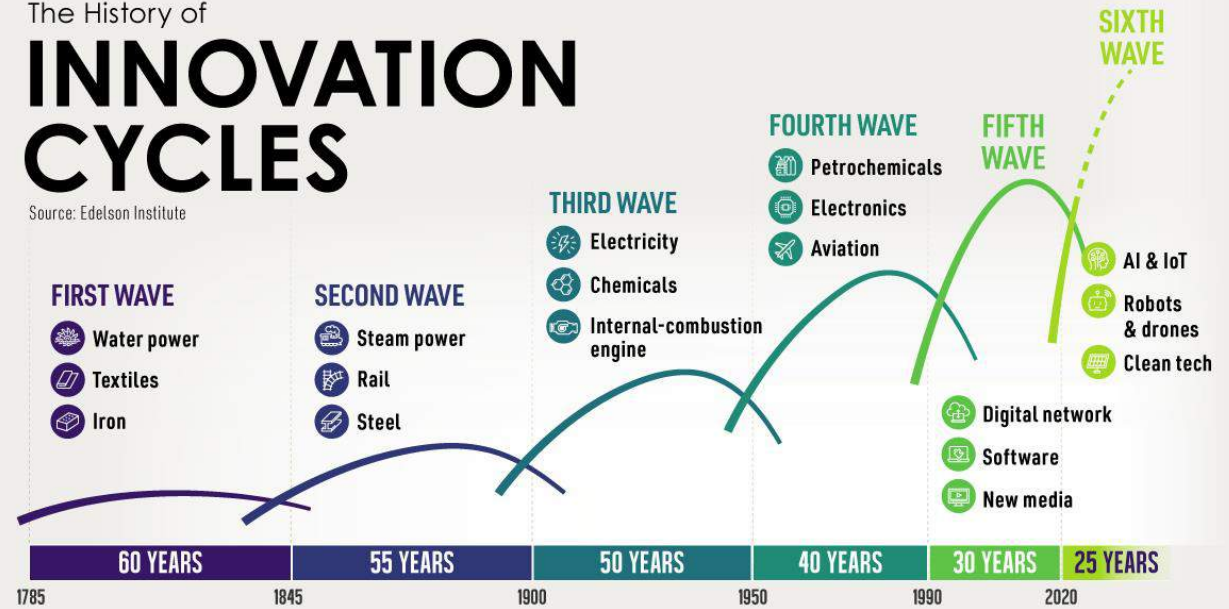
As climate challenges intensify, clean tech may reshape business



The History of

INNOVATION CYCLES

Source: Edelson Institute



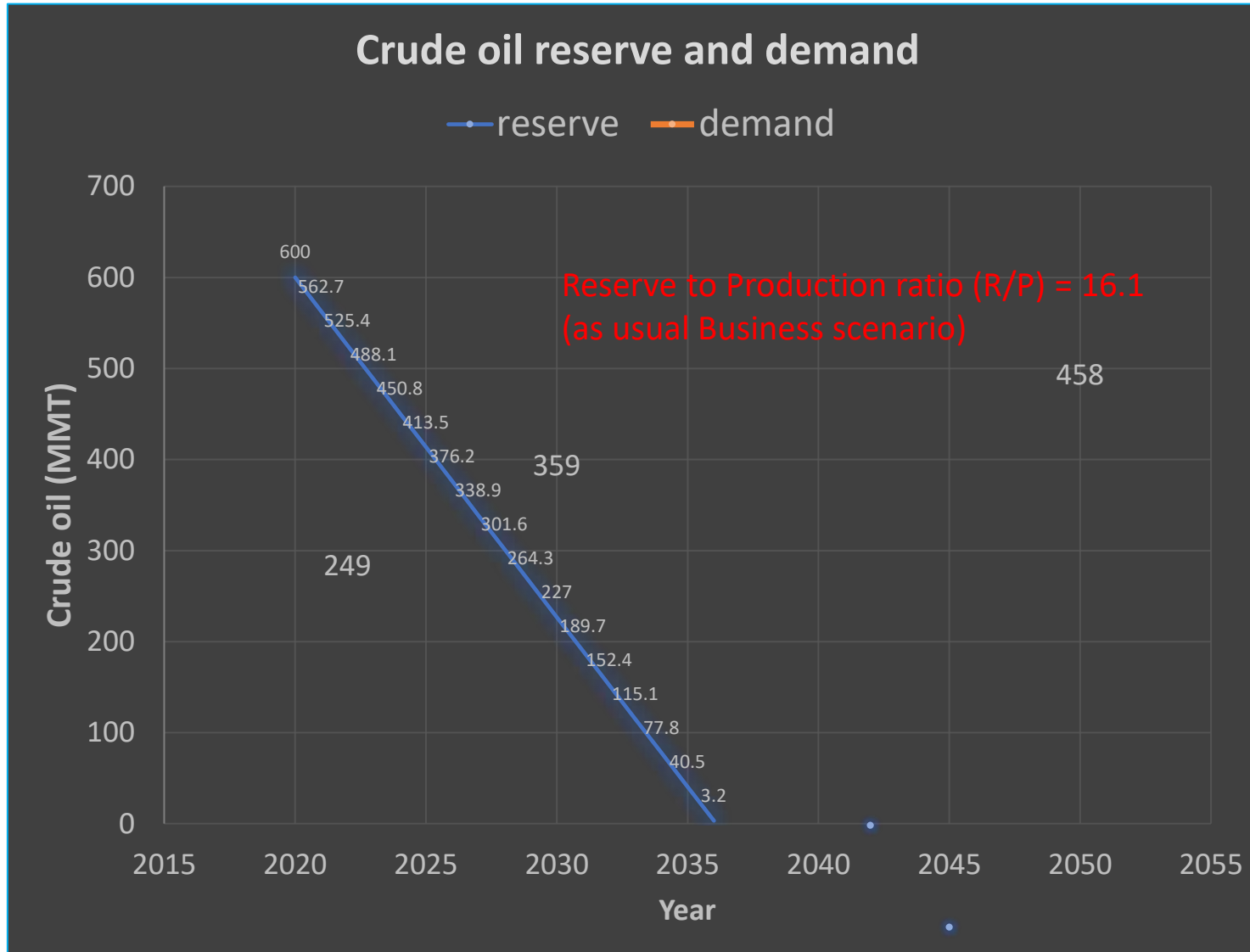
Energy Independence

Our honorable Prime Minister speech during the Independence Day 2022:

- To make India *aatmanirbhar* (self-reliant) in the energy sector is one of the key elements of the country's sustainable growth agenda.
- India's journey towards energy independence and its decarbonisation drive for significant economic opportunity.
- The decarbonisation is imperative in order to:
 - achieve climate action goals,
 - substantially reduce the import bill,
 - freeing up resources for other sectors.



Crude oil reserve and demand in India

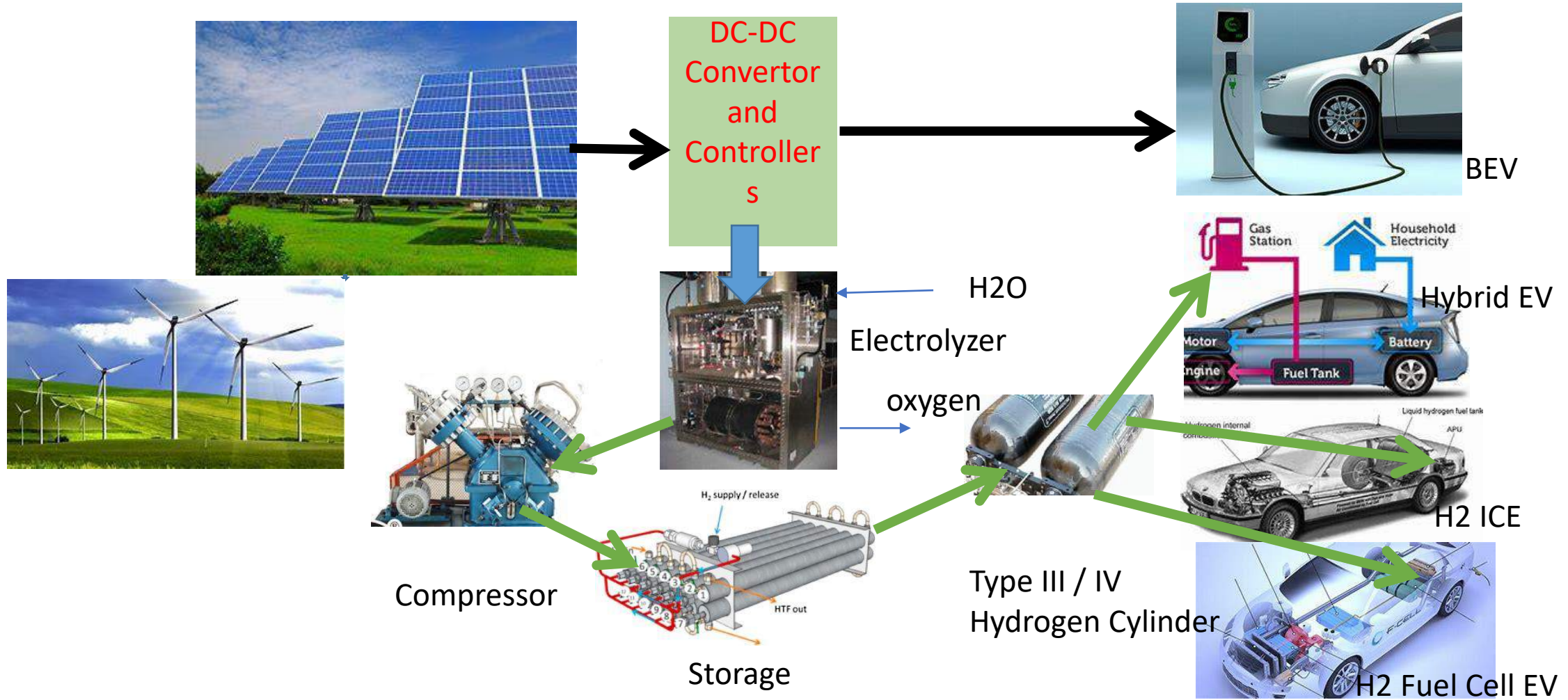


Year		Oil demand (million bpd)	MMTPA
2019	=	4.8	239.04
2022	=	5	249
2030	=	7.2	358.56
2050	=	9.2	458.16

Less or no crude reserve will be available in India beyond 2036

Source: International Energy Agency (IEA), World Energy Outlook 2021, BP Statistical Review of World Energy 2021

Electricity / Hydrogen Use in Automotive Vehicles



Battery Electric Vehicles

- BEVs are vital for enabling fast decarbonization of transport

Hydrogen Internal Combustion Engine / Fuel Cell Electric Vehicles

- Regions with constrained renewables or grid capacity in the mid to long term
- Vehicle segments with high power and energy demands
- Long-range capability
- Fast refuelling

A Scenario for Projection of Fuels / Energy for Sustainable Road Transportation towards Net Zero Emissions

- Electricity
- Biofuels
- Hydrogen

Electric two/three-wheeler



Electric / biofuel Car



Hydrogen Vehicle



Sustainable Fuels for Road Transportation for meeting Net Zero Targets

Fuel	2022	2027 I (33%)			2037 II(67%)			2047 III (100%)	
		2025	2030	2035	2040	2045	2050		
<u>Fossil (short-term)</u>									
Gasoline Y	Y	Y	Y	Y	Y	N	N		
CNG	Y	Y	Y	Y	Y	Y	N		N
DIESEL	Y	Y	Y	Y	Y	Y	N		N
<u>Ethanol blend (Medium-term)</u>									
E10	Y	N	N	N	N	N	N		N
E20	-	Y	Y	Y	Y	Y	N		N
ED5	-	Y	Y	N	N	N	N		N
ED15	-	-	Y	Y	Y	Y	N		N
DME-Diesel	-	-	Y	Y	Y	Y	N		N
<u>Renewable (Long-term)</u>									
Biofuel/E100	-	-	Y	Y	Y	Y	Y		Y
Hydrogen	-	-	Y	Y	Y	Y	Y		Y
Electric	Y	Y	Y	Y	Y	Y	Y		Y

Energy Independence or 100% Energy Security for Transportation Sectors in 2047

How to achieve smooth transition from hydrocarbon fuels to Hydrogen for Mobility Sectors

- Environment
- Energy Security
- Efficiency
- Economy
- Infrastructure developments
- Safety
- challenges for automotive industries to adopt hydrogen
- Way forward

Views of the expert members and discussions



- Hub of hydrogen vehicles manufacturing
- Employment
- Export
- Equity