



India's First Indigenously Developed HFC Bus

For Prelims: National Hydrogen Mission, Green Hydrogen, Hydrogen Fuel Cell, Climate Change Goals, Green Hydrogen/Green Ammonia Policy, FAME India, EV30@30 campaign, Ethanol Blending

For Mains: Hydrogen fuel cell - India's innovations, National Hydrogen Energy Mission, Climate Change and Green Fuel Transition

Why in News?

Recently, the Union Minister of State of Science & Technology launched **India's first Hydrogen Fuel Cell (HFC) Bus**.

- **Bisphenol-A pilot plant in CSIR**- National Chemical Laboratory (NCL), an **important feedstock for the production of epoxy resins**, polycarbonate and other engineering plastics was also inaugurated.

What are Hydrogen Fuel Cells (HFC)?

- **About:**
 - A hydrogen fuel cell is an **electrochemical device** that converts hydrogen into electrical energy.
 - Fuel cells work in a similar manner to conventional batteries found in electric vehicles, but they do not run out of charge and don't need to be recharged with electricity.
 - They continue to produce electricity as long as there is a supply of hydrogen.
 - One of the most successful **fuel cells uses the reaction of hydrogen with oxygen to form water**.
- **Advantages of HFC Powered Vehicles:**
 - They produce **no tailpipe emissions** (emission of gaseous and particulate pollutants) and **only emit water vapour and warm air**.
 - They are **more efficient than internal combustion engine vehicles**.
 - Hydrogen FCEVs have an advantage over battery powered EVs in terms of refuelling time, **hydrogen can be refilled in a fuel cell vehicle in a matter of minutes**, nearly as fast as an internal combustion engine can be refilled with fossil fuels.

What are the Key Highlights of this Innovation?

- The HFC bus has been developed by the **Council of Scientific & Industrial Research (CSIR)** and **KPIT**, an Indian Multinational Corporation.
- The launch of this **India's first truly indigenously developed HFC Bus** is in tune with the **National Hydrogen Energy Mission**.
- The fuel cell utilizes Hydrogen and Air to generate electricity to power the bus and the **only**

effluent from the bus is water. Thus, making it **possibly the most environmentally friendly mode of transportation.**

- The high efficiency of fuel cell vehicles ensures lower operational costs per kilometre than diesel powered vehicles and can **bring freight revolution in India.**

What is the National Hydrogen Energy Mission?

- The [Union Budget for 2021-22](#) announced a National Hydrogen Energy Mission (NHM) to draw up a **road map for using hydrogen as an energy source.**
 - It will **capitalise on one of the most abundant elements on earth (Hydrogen)** for a cleaner alternative fuel option.
 - The initiative has the potential of transforming transportation.
- It will:
 - Focus on generation of hydrogen from green power resources.
 - Link India's growing renewable capacity with the **hydrogen economy.**
- The usage of hydrogen will not only help India in achieving its emission goals under the [Paris Agreement](#), but will also **reduce import dependency on fossil fuels.**

Why is this Innovation Significant?

- This innovation is a **part of Prime Minister's Hydrogen Vision** which will ensure **self-reliant means of affordable and accessible clean energy**, meeting [climate change goals](#), and **creating new entrepreneurs and jobs.**
- [Green hydrogen](#) is an excellent clean energy vector that **enables deep decarbonization of difficult-to-abate emissions** from the heavy commercial transportation sector among others.
- A single diesel bus plying on long distance routes typically emits 100 tons of CO₂ annually and there are over a million such buses in India. About 12-14% CO₂ emissions and particulate emissions come from diesel powered heavy commercial vehicles (which are decentralised emissions and hence difficult to capture).
 - **Fuel Cell vehicles give zero green-house gas emissions.** Moreover, their **operational cost in rupees per kilometre is lower** than diesel powered vehicles.
- By the means of such innovations, India can **transition from being a net importer of fossil energy to becoming a net exporter of clean hydrogen energy.**
 - It will **provide India a global leadership in hydrogen space** by becoming a large green hydrogen producer and supplier of equipment for green hydrogen.

What is Green Hydrogen?

- **About:**
 - It is **produced by splitting water into hydrogen and oxygen** using an electrolyzer powered by renewable energy sources such as wind and solar.
 - The fuel is **considered a game-changer for the energy security of India**, which imports 85% of its oil and 53% of gas requirements.
 - In February 2022, the [Ministry of Power has notified Green Hydrogen/Green Ammonia Policy](#) for production of Green Hydrogen or Green Ammonia using renewable sources of energy.
- **Significance:**
 - Green hydrogen energy is vital for India to meet its [Nationally Determined Contribution \(INDC\) Targets](#) and ensure regional and national energy security, access and availability.
 - Green Hydrogen can **act as an energy storage option**, which would be essential to meet intermittencies (of renewable energy) in the future.
 - In terms of mobility, for long distance mobilisations for either urban freight movement within cities and states or for passengers, **Green Hydrogen can be used in railways, large ships, buses or trucks, etc.**
 - Hydrogen has the potential to be the **key renewable target in supporting infrastructure as well.**

In What Other Ways is the Government of India Promoting Clean Fuel Transition?

- [NTPC's project for hydrogen Fuel Cell Electric Vehicles \(FCEV\)](#)
- [FAME India Scheme](#)
 - [Faster Adoption and Manufacturing of Electric Vehicles \(FAME II\)](#) scheme.
- [Green Hydrogen Fuel Cell Electric Vehicle \(FCEV\) Toyota Mirai](#)
- [EV30@30 campaign](#)
- [Roadmap for Ethanol Blending in India by 2025](#)
- [Amendments to the National Policy on Biofuels, 2018](#)

UPSC Civil Services Examination, Previous Years Questions (PYQs)

Prelims

Q. According to India's National Policy on Biofuels, which of the following can be used as raw materials for the production of biofuels? (2020)

1. Cassava
2. Damaged wheat grains
3. Groundnut seeds
4. Horse gram
5. Rotten potatoes
6. Sugar beet

Select the correct answer using the code given below:

- (a) 1, 2, 5 and 6 only
(b) 1, 3, 4 and 6 only
(c) 2, 3, 4 and 5 only
(d) 1, 2, 3, 4, 5 and 6

Ans: (a)

Q. With reference to 'fuel cells' in which hydrogen-rich fuel and oxygen are used to generate electricity, consider the following statements: (2015)

1. If pure hydrogen is used as a fuel, the fuel cell emits heat and water as by-products.
2. Fuel cells can be used for powering buildings and not for small devices like laptop computers.
3. Fuel cells produce electricity in the form of Alternating Current (AC).

Which of the statements given above is/are correct?

- (a) 1 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans: (a)

Source: PIB

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