# 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 $CO_2$ annually and there are over a million such buses in India. About 12-14% $CO_2$ 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)**

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**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**