First Green Hydrogen Fuel Cell Bus

For Prelims: Green Hydrogen, Fuel Cell

For Mains: Significance of the Green Hydrogen Fuel Cell for a greener and sustainable future, Government policies and initiatives for green hydrogen

Source: PIB

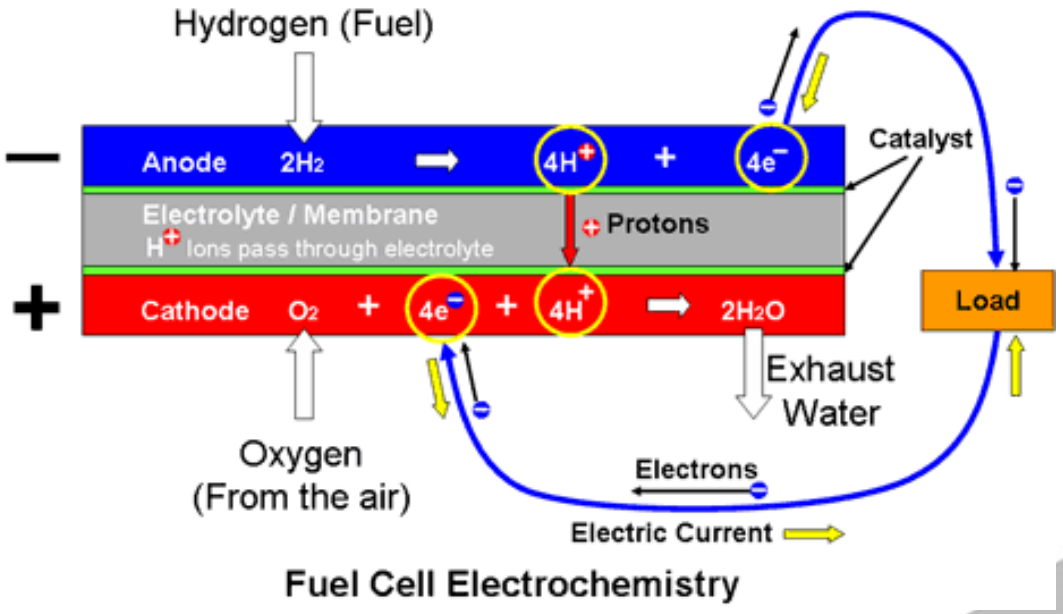
Why in News?

Recently, the Union Minister of Petroleum & Natural Gas flagged off the **country's first** Green Hydrogen Fuel Cell Bus **in New Delhi**, marking a revolutionary step in the transition to clean energy.

What is a Green Hydrogen Fuel Cell?

- **About:**
  - Green Hydrogen Fuel Cells are a clean, reliable, quiet, and efficient source of high-quality electric power.
  - They use Green Hydrogen as a fuel to drive an **electrochemical process** that produces electricity, with water and heat as the only by-products.
- **Green Hydrogen:**
  - Green hydrogen is a type of hydrogen produced through a process called **electrolysis,** using **renewable energy** sources like wind **or** solar power.
    - It involves splitting water (H_2O) into its constituent elements, hydrogen (H_2) and oxygen (O_2), with **zero** greenhouse gas emissions.
- **Fuel Cell:**
  - A fuel cell is an electrochemical device that **converts chemical energy (in this case, hydrogen) into electrical energy.**
    - It consists of two electrodes **(anode and cathode)** separated by an electrolyte.
- **The Process of Generating Electricity:**
  - Green hydrogen is supplied to the anode side of the fuel cell.
  - At the anode, hydrogen molecules release electrons and become positively charged hydrogen ions (protons).
    - Electrons flow from the anode to the cathode through an external circuit, generating an electric current.
  - Oxygen from the air is supplied to the cathode.
  - At the cathode, oxygen molecules combine with electrons and protons to **produce water vapor (H_2O) as a byproduct.**

//



Fuel Cell Electrochemistry

- **Advantages:**
  - The only byproduct of green hydrogen fuel cells is **water,** making them a **zero-emission energy source.**
  - Hydrogen fuel cell vehicles can be refueled in a matter of minutes, similar to traditional vehicles.
- **Challenges:**
  - Currently, the production of green hydrogen can be **expensive, but ongoing research aims to reduce costs.**
  - The development of a hydrogen infrastructure, including production, storage, and distribution, is essential for widespread adoption.

What is the Significance of the Green Hydrogen Fuel Cell Bus?

- The bus uses hydrogen and air to generate electricity, emitting only water as a by-product, making it an **eco-friendly mode of transportation.**
  - Hydrogen **boasts three times the energy density of conventional fuels and zero harmful emissions,** making it a cleaner and more efficient choice.
- **Further Plans:**
  - IndianOil plans to introduce 15 more hydrogen fuel cell buses in Delhi NCR by the end of 2023.
    - These buses will help gather performance data under Indian operating conditions, assessing efficiency and sustainability.

How Does Green Hydrogen Transform India's Energy Landscape?

- Hydrogen and biofuels will account for **25% of global incremental energy demand growth over the next two decades.**
- India aims to become a global champion in the production and export of hydrogen and emerge as a **hub for green hydrogen.**
- The success of the **Green Hydrogen Mission** can shoot India from being a net importer of fossil energy to becoming a **net exporter of clean hydrogen energy.**
- Hydrogen is poised to be a game changer in India's ambitious quest to achieve **Net-Zero emissions** by the year 2070.

What are India's Initiatives to Promote Green Energy?

- **Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles (FAME)**
- **International Solar Alliance (ISA)**

- **National Green Hydrogen Mission**

UPSC Civil Services Examination Previous Year Question (PYQ)

Q. Consider the following heavy industries: (2023)

1. Fertilizer plants
2. Oil refineries
3. Steel plants

Green hydrogen is expected to play a significant role in decarbonizing how many of the above industries?

(a) Only one
(b) Only two
(c) All three
(d) None

Ans: C

Q. With reference to green hydrogen, consider the following statements : (2023)

1. It can be used directly as a fuel for internal combustion.
2. It can be blended with natural gas and used as fuel for heat or power generation.
3. It can be used in the hydrogen fuel cell to run vehicles.

How many of the above statements are correct?

(a) Only one
(b) Only two
(c) All three
(d) None

Ans: (c)

Q. Hydrogen fuel cell vehicles produce one of the following as “exhaust” (2010)

(a) NH_3
(b) CH_4
(c) H_2O
(d) H_2O_2

Ans: (c)