

## **2. Hydrogen Fuel**

**Prelims Syllabus:** Scientific Exploration

**Mains Syllabus:** GS-III Science and Technology - developments and their applications and effects in everyday life Achievements of Indians in science & technology; indigenization of technology and developing New Technology.

### **Context:**

- Recently, the NTPC Ltd and a central PSU under Ministry of Power, has invited Global Expression of Interest (EoI) to provide 10 Hydrogen Fuel Cell (FC) based electric buses and an equal number of Hydrogen Fuel Cell based electric cars in Leh and Delhi.

### **About Hydrogen:**

- Hydrogen is the lightest and first element on the periodic table. Since the weight of hydrogen is less than air, it rises in the atmosphere and is therefore rarely found in its pure form, H<sub>2</sub>.
- At standard temperature and pressure, hydrogen is a nontoxic, nonmetallic, odorless, tasteless, colorless, and highly combustible diatomic gas.
- It is the most abundant element in the universe. The sun and other stars are composed largely of hydrogen.
- It is estimated that 90% of the atoms in the universe are hydrogen atoms. Hydrogen is a component of more compounds than any other element.
- Water is the most abundant compound of hydrogen found on earth.
- Molecular hydrogen is not available on Earth in convenient natural reservoirs.
- Most hydrogen on Earth is bonded to oxygen in water and to carbon in live or dead and/or fossilized biomass. It can be created by splitting water into hydrogen and oxygen.

### **About Hydrogen Fuel:**

- It is a zero-emission fuel burned with Oxygen.
- It can be used in fuel cells or Internal Combustion Engines.
- It is also used as a fuel for Spacecraft Propulsion.

### **Storage of Hydrogen:**

- It can be stored physically as either a gas (typically requires high-pressure tanks) or a liquid (cryogenic temperatures because the boiling point of hydrogen at one atmosphere pressure is  $-252.8^{\circ}\text{C}$ ).

- It can also be stored on the surfaces of solids (by adsorption) or within solids (by absorption).

### **Potential of Clean Hydrogen:**

- Hydrogen as a fuel has long been touted as an almost magical solution to air pollution crisis.
- The only by-product or emission that results from the usage of hydrogen fuel is water — making the fuel 100 per cent clean.
- It is considered an alternative fuel. It is due to its ability to power fuel cells in zero-emission electric vehicles, its potential for domestic production, and the fuel cell's potential for high efficiency.
- It can also serve as fuel for internal combustion engines. The energy in 2.2 pounds (1 kilogram) of hydrogen gas contains about the same as the energy in 1 gallon (6.2 pounds, 2.8 kilograms) of Gasoline.

### **Significance of Hydrogen:**

- It doesn't produce harmful emissions. It is readily available.
- It is environmentally friendly and is a non-toxic substance. It can be used as fuel in rockets. It is three times as powerful as gasoline and other fossil fuels. This means that it can accomplish more with less.
- It is fuel efficient. Compared to diesel or gas, it is much more fuel efficient as it can produce more energy per pound of fuel.
- It is renewable. It can be produced again and again, unlike other non-renewable sources of Energy.

### **Limitations of Hydrogen:**

- It does not occur in deposits or reserves like fossil fuel. It needs to be actually produced using Chemical Reactions.
- It is far more expensive to produce. And hydrogen-fueled vehicles are also more expensive than even battery-electric ones.
- It is highly flammable. It is difficult to store. The clean hydrogen industry is small and costs are high. There is a big potential for costs to fall, but the use of hydrogen needs to be scaled up and a network of supply infrastructure created.