

National Hydrogen Energy Mission

The National Hydrogen Energy Mission was announced in the Union Budget 2021 by the Finance Minister, who said it will be launched in 2021-22. India has set ambitious targets in the renewable energy sector and the push for hydrogen energy will help steer the country in the right direction in this respect. In this article, you can read all about the newly-launched National Hydrogen Energy Mission (NHME) for UPSC and other [government exams](#).

This topic forms a part of the polity, and environment & ecology sections of the [UPSC syllabus](#).

What is the National Hydrogen Energy Mission?

Along with announcing the launch of the NHEM, the government also announced that it would be holding Green Hydrogen auctions. The budget allocates Rs.1500 crore for renewable energy development including hydrogen.

The government will, pursuant to the mission, draw a roadmap for using hydrogen as an energy source. This has the potential to transform the transport sector, as well as, other industries.

Hydrogen is the most abundant element on earth and this mission will capitalise on this. It is also a much cleaner fuel.

- This mission will emphasise hydrogen from clean sources.
- It also envisages linking the country's growing renewable energy capacity with the hydrogen economy.
- India's target for 2022 for renewable energy generation is 175 GW and this mission is expected to bolster the process.
 - The renewable energy target for 2030 is 450 GW.
 - The country has set to decarbonise by 2050.
- Using hydrogen will serve the twin purposes of achieving India's emission commitments under the [Paris Agreement](#) and reducing the import dependence on fossil fuels.
- The end-users of hydrogen energy are the transportation sector, chemical industry and steel sector.
 - These sectors contribute to 1/3rd of all greenhouse gas emissions because of their using fossil fuels.
 - Replacing fossil fuels with hydrogen in these sectors will help reduce [GHGs](#) in a big way.

National Hydrogen Energy Mission - Need for the Mission

There are a number of reasons why hydrogen is being promoted and the government is betting on it.

- Electricity generation in India is heavily dependent on fossil fuels (coal). If hydrogen can replace it, there will be reduced pollution (because of not burning fossil fuels). Additionally, the import of coal can be reduced.
- Hydrogen is the most abundant element on the planet and has other advantages such as being lighter, more energy-dense and energy-efficient (2 - 3 times more than petrol).
- The transportation, iron and steel, and chemical industries will be benefitted.

Hydrogen as a Fuel

Hydrogen is a clean source of alternate fuel. When used in a [fuel cell](#) that produces electrical energy through a chemical reaction, the by-product is only water. This makes it extremely attractive as a renewable energy source.

Hydrogen can be produced from a variety of sources such as biomass, natural gas, nuclear power, and other renewable energy sources like wind and solar energy. Hence, hydrogen is a good option as fuel for electricity generation and transportation applications.

Types of Hydrogen

While producing electricity from hydrogen does not produce pollution since the by-product is just heat and water, the process of producing hydrogen itself can cause pollution. (Despite this, fuel cell vehicles can reduce greenhouse gas emissions by more than 30% compared to petrol engine vehicles.)

Based on the source of production, hydrogen can be classified into three types, as explained below.

1. **Grey Hydrogen:** Hydrogen from hydrocarbons (natural gas, fossil fuels) is called grey hydrogen. This is the most common method of production of hydrogen today. It produces carbon dioxide as a by-product.
2. **Black/Brown Hydrogen:** This is the oldest method of producing hydrogen and involves transforming coal into gas. The hydrogen produced is called brown if lignite coal is used and black if bituminous coal is used for the process. It is a highly polluting process as both carbon dioxide and carbon monoxide are released into the atmosphere which cannot be reused.
3. **Blue Hydrogen:** This is the name given to the hydrogen produced from hydrocarbons where the emissions generated from the process are captured and stored. They are stored underground by industrial carbon capture and storage (CSS). Hence, it is considered a better alternative than grey hydrogen where the emissions are released. However, even in this process, about 10-20% of the carbon dioxide generated cannot be captured.
4. **Green Hydrogen:** In this case, hydrogen is generated from renewable sources of energy like solar and wind. In this process, electricity splits water into hydrogen and oxygen. This is the cleanest form of hydrogen generation since the by-products are just water and water vapour. Only 1% of the hydrogen generated is via this process.

Advantages of Hydrogen Fuel

Hydrogen offers many advantages compared to traditional fossil fuels. Some of the advantages are discussed below:

- It is a renewable source of energy and found in abundance.
- It is a clean energy source as burning hydrogen does not produce any harmful by-products. It has a near-zero carbon footprint.
- It is not a toxic source for human health unlike nuclear energy or energy from natural gas.
- It is very dense in energy and hence highly efficient. It is three times more powerful than most fossil fuels.
- For automobiles, hydrogen can be stored in tanks and used.
- It is lighter than [lithium-ion batteries](#) making it ideal for long-haul trucks and commercial vehicles.
- It also refuels very fast.

Disadvantages of Hydrogen Fuel

There are some disadvantages of using hydrogen energy and hydrogen as a fuel for transportation. Some of the disadvantages are mentioned below.

- Hydrogen is volatile and is a highly flammable substance due to its high energy content. Also, hydrogen is an odourless gas which makes sensors necessary to detect leaks. This makes it a risky and dangerous fuel.
- The methods of generation of hydrogen are rather expensive. Also, the production methods involve fossil fuels which lead to pollution. Because of the complicated nature of the methods of production, hydrogen energy is expensive compared to traditional sources of energy and fuel, which makes its adoption a slow process.
- Being a lighter substance, hydrogen is difficult to store and transport. To store hydrogen, it has to be converted into liquid form and stored at a very low temperature or as a gas at high pressures. This makes its transport especially in large quantities a difficult proposition.
- Even though hydrogen fuel cells are more energy-efficient than internal combustion engines, they are still less efficient than lithium-ion batteries.

Hydrogen Fuel Cell Cars

Unlike conventional vehicles which run on gasoline or diesel, fuel cell cars and trucks combine hydrogen and oxygen to produce electricity, which runs a motor. Since they are powered entirely by electricity, fuel cell vehicles are considered [electric vehicles \(“EVs”\)](#) - but unlike other EVs, their range and refuelling processes are comparable to conventional cars and trucks.

Converting hydrogen gas into electricity produces only water and heat as a by-product, meaning fuel cell vehicles don't create tailpipe pollution when they're driven.

Differences between fuel cell cars and other EVs:

- Electric vehicles use energy stored in a battery, whereas fuel cell vehicles have stored fuel that reacts to produce energy.
 - Whereas conventional vehicles burn fuel in an internal combustion engine, battery-powered electric vehicles don't have an engine. Instead, they use energy stored in batteries to power one or more electric motors.
 - Fuel cell vehicles are also driven by an electric motor, but instead of being powered by a battery, they create the electricity in an onboard fuel cell, usually using oxygen from the air and stored hydrogen.
 - Fuel cells use a catalyst to combine two reactants, which generates a flow of electrons (i.e. electricity).
 - Fuel cells can be of many types, but the common one is which uses hydrogen to produce electricity.
 - When oxygen and hydrogen react, they produce only water and heat, making them “zero-emissions” vehicles (like battery-powered electric vehicles).
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