GREEN HYDROGEN - GS III MAINS

Q. Enumerate the need for India to transform into the green hydrogen-based energy economy along with the measures taken by the government. (15 marks, 250 words)

News: *Why green hydrogen presents both major opportunities and significant challenges*

What's in the news?

- The Ministry of New and Renewable Energy (MNRE) has announced a Rs-496-crore (until 2025-26) scheme to support pilot projects that either test the viability of green hydrogen as a vehicle fuel or develop secure supporting infrastructure such as refuelling stations.

Key takeaways:

- The Govt has announced a scheme to support efforts to test the viability of green hydrogen as a fuel for cars and heavy vehicles.
- Green hydrogen presents both a big opportunity and some major challenges.

Accelerating Green Hydrogen Adoption - A Strategic Roadmap for India's Energy Transiion:

- The report recommends public-private interventions in expediting the adoption of green hydrogen in India.
- It provides pathways for establishing green hydrogen as a viable energy source in India.

Current Status of Hydrogen Production:

- Currently, India produces 6.5 million metric tonnes per annum (MMTPA) of hydrogen, predominantly for use in crude oil refineries and fertilizer production.
- Most of the country's current hydrogen supply is grey hydrogen, produced using fossil fuels in a process that creates CO2 gas emissions.

Green Hydrogen:

- The Ministry of New and Renewable Energy (MNRE) has defined green hydrogen as hydrogen produced to **emit no more than 2 kg of carbon dioxide per kg of such hydrogen.**
- Currently, producing 1 kg of 'grey hydrogen,' as it is known, emits 9 kg of carbon dioxide.
- While Green hydrogen is produced by electrolysis splitting water molecules into hydrogen and oxygen through an electrolyzer using renewable energy, grey hydrogen requires carbon combustion.

Applications of Green Hydrogen:

- It is a key input in fertilizers and refineries, feedstock in the chemical industry to carry out various processes like ammonia production, transport, energy storage, power generation, etc.

Need for Green Hydrogen Transformation:

1. Increasing Energy Demand:

- India is currently the third-largest economy in the world in terms of energy needs, and the country's demand for energy is set to surge further.
- As per the report, the demand is estimated to grow 35% by 2030.

2. Reducing Energy Import Cost:

- India's Energy Import Bill in 2022 was around $185 billion, which is likely to increase if the country continues to supply its growing energy demand through traditional methods.
- According to the MNRE, National Green Hydrogen Mission, India can reduce fossil fuel imports worth Rs 1 lakh crore by 2030.

3. Climate Goals and Emission Reduction:

- India commits to achieve net zero by 2070 at the United Nations Climate Change Conference in Glasgow (COP26), held in 2021.
- Green Hydrogen Green hydrogen can abate at least 50 MMTPA of greenhouse gases by 2030.

4. Enhancing Energy Security:

- Green hydrogen is critical to help meet India's energy security needs while reducing emissions in hard-to-abate sectors on the path to net zero.
- India has the potential to produce 210 Mtpa (598 Mtoe) of hydrogen from solar and wind and meet 32% of Asia-Pacific's (APAC's) hydrogen demand.

5. Forex Earnings:

- According to the International Energy Agency, there could be a global demand for about 180 million tons of hydrogen by 2030.
- India may utilize this opportunity to transform itself from an energy importer to an energy provider and exporter.

6. Growing Global Significance:

- The growing importance of Hydrogen in the energy space is expected to influence the technological and geo-political trends worldwide.

7. Renewable Energy Advantage:

- Countries with access to abundant low-cost renewable energy could become producers/exporters of green hydrogen.
- This can be witnessed from the signing of MoUs on hydrogen and its derivatives trade. Ex-Japan has signed a cooperation agreement with UAE for production, supply, and trade of green or blue H2/NH3.

8. Global Strategies:

- Many countries/regions around the world like the European Union, Singapore, South Korea, and Japan among others have announced their new strategies to import Green/Clean Hydrogen and its derivatives, thereby providing an opportunity for Indian producers.

Challenges of Green Hydrogen in India:

1. Utilisation of Grey Hydrogen:

- Most of the hydrogen capacity in India is mainly produced using natural gas within refineries and fertiliser industries.

2. Huge Production Cost:

- The production costs of green hydrogen amount to roughly $4-5 per kilogram, equivalent to approximately double the price of grey hydrogen.
- The green hydrogen production costs is dependent upon the
    - Round-the-clock renewable energy electricity costs, which account for approximately 50–70% of green hydrogen costs.
    - Electrolyser costs constitute 30–50% of total green hydrogen production costs.

3. Water Intensive Nature of Electrolysers:

- Water consumption by electrolyzers is another issue that needs to be discussed. Electrolyzers consume about 9 liters of water to produce 1 kg of hydrogen.
- Thus, seawater electrolysis may be helpful, it requires further development and research work.

4. Lack of Harmonised Standards and Codes:

- Since the industry is in a nascent stage in India, standards and codes for manufacture and safety for the entire chain of green hydrogen is required to be put in place.
- India's standards allow the use of biomass which also results in carbon emissions for the production of green hydrogen.
- Moreover, diverting scarce renewable energy capacity towards the production of green hydrogen means inadequate clean electricity being made available for consumers.

5. Inadequate Hydrogen Infrastructure:

- The existing hydrogen infrastructure is insufficient to promote the larger acceptance of fuel cell vehicles.
- Currently, India has only two established hydrogen refueling stations at the Indian Oil R&D Center, Faridabad, and the National Institute of Solar Energy, Gurugram.

Way Forward:

1. Renewable Energy Capacity Addition:

- India's renewable energy potential can support its goals for green hydrogen growth but needs rapid capacity addition.
- The country's solar energy potential is estimated at 748 gigawatts (GW) at full capacity.

- However, currently, the total installed solar capacity in India stands at 72.31 GW as of November 2023, or 9% of its total potential.

2. Reducing the Cost of Producing Green Hydrogen:

- Renewable energy incentives and tariffs: For example, the Solar Energy Corporation of India (SECI) recently achieved a cost of INR 2.6 /kWh through standalone solar and wind tender tariffs while tenders for RTC renewable energy stand at INR 4–4.5 /kWh.
- Scale and Innovation in Electrolysers: This can be done by increasing direct subsidies for early adopters.
    - For example, the USA has announced, under the Inflation Reduction Act (IRA), a tax credit of up to $3/kg of hydrogen.
- Supporting long capital investment cycles for technologies with long-term clarity on policies and incentives
- Encouraging the development and testing of indigenous electrolyser technology.

3. Disincentivize Carbon-Intensive Alternatives:

- Local, regional and national governments in India might consider diverting their current spending on fossil-fuel subsidies to projects supporting green hydrogen production and infrastructure-building.
- For example, Europe has included green hydrogen under the Emissions Trading System.
- Reduce or eliminate costs related to green hydrogen conversion, storage, and transport:

4. Energy Conversion:

In the short to medium term, allow/encourage companies to form clusters and bid for PLIs/other incentive schemes.

- **Transports:** Investing in long-term infrastructure construction, including pipelines for transporting green hydrogen throughout the country.
    - For example, the European Union's European Hydrogen Backbone program aims to develop a pipeline network in the EU.
- **Storage:** Storage accounts for roughly 30–40% of total RTC renewable energy costs. This can be reduced by interventions for energy storage systems throughout the country. .
- **Developing Harmonised Standards:** Work with other countries/global organizations to develop harmonized global standards (and/or the ability to certify green hydrogen made in India according to importers' norms).