Sambhav-2024

Day 97: Discuss the role of green hydrogen in India's energy transition strategy, considering both opportunities and concerns. (250 Words)

11 Mar 2024 | GS Paper 3 | Science & Technology

Approach / Explaination / Answer

- Write a brief introduction to India’s ambitious energy transition plan.
- Mention the role of green hydrogen in India's energy transition strategy.
- Highlights the opportunities and concerns.
- Write a way forward.

Introduction

As India endeavors to decarbonize its economy and meet ambitious renewable energy targets, green hydrogen emerges as a key player in achieving a sustainable and low-carbon future.

Green hydrogen holds significant potential in India’s energy transition strategy. It is seen as a key element in achieving the country’s ambitious climate targets, including reaching ‘net zero’ by 2070 as committed at the Glasgow COP26.

Body

The Role of Green Hydrogen:

- **Energy Security:** India depends significantly on fossil fuel imports. Green hydrogen production using abundant renewable resources can enhance energy independence.
    - According to a study by the International Energy Agency, “India's annual import bill for fossil fuels is projected to triple by 2040 as the country is set to experience the largest energy demand increase in the world over the next two decades,
- **Grid Stability and Balancing:** Green hydrogen production can act as a flexible load, absorbing excess electricity during times of surplus generation and releasing it back to the grid when demand is high. This can help stabilize the grid and facilitate the integration of higher shares of renewable energy.
- **Sustainable Mobility**: Green hydrogen is a clean fuel ideal for heavy-duty vehicles, shipping, and aviation where electrification isn't practical. Fuel cell electric vehicles (FCEVs) running on hydrogen offer longer range and quicker refueling than battery electric vehicles (BEVs), making them viable for long-haul transport. Building hydrogen refueling infrastructure can boost FCEV adoption and cut emissions in transportation.

- **Decarbonization of Industry**: Green hydrogen can replace fossil fuels in industries like steel, ammonia production, and chemical manufacturing, cutting down carbon emissions in India and aiding its climate objectives.
    - Replacing coal-fired power plants with hydrogen-powered ones. This shift would dramatically improve air quality in Indian cities.
- **Job Creation and Economic Growth**: The development of a green hydrogen economy can generate jobs in the manufacturing, installation, operation, and maintenance of renewable energy infrastructure and hydrogen technologies. It also spurs investment and innovation in clean energy, driving economic growth and competitiveness.

India's Green Hydrogen Opportunity:

- **Renewable Energy Powerhouse**: India's growing solar and wind power capacity provides a strong foundation for cost-effective green hydrogen production through electrolysis.
- **Manufacturing Hub**: India can become a global leader in manufacturing electrolyzers, fuel cells, and other critical components for the hydrogen economy.
- **Mission and Incentives**: The government launched the National Green Hydrogen Mission in 2022 with a dedicated budget to:
    - **Become a Global Leader:** The mission aims to establish India as a major producer and exporter of green hydrogen and its derivatives.
    - **Production Incentives**: The Strategic Interventions for Green Hydrogen Transition (SIGHT) program provides financial support for manufacturing electrolyzers and green hydrogen production.
- **Export Potential:** India's green hydrogen can be exported to meet the growing global demand, creating new economic opportunities.

Concerns and Challenges:

- **High Production Costs:** Current electrolyzer technology is not yet cost-effective. High upfront capital expenditure for these systems makes green hydrogen production expensive compared to traditional methods
- **Storage and Transportation**: Hydrogen has low energy density by volume, making storage and transportation challenging. Developing a dedicated infrastructure network for pipelines or specialized storage vessels is needed, adding to the cost.
- **Integration with Existing Grid**: Effectively integrating green hydrogen production with the existing energy grid infrastructure requires significant investment and planning.
- **Limited Domestic Demand:** Currently, there's limited domestic demand for green hydrogen in India. This means there's a risk of producing hydrogen without a ready market to absorb it.

Way Forward

- **Financial Incentives:** The government's National Green Hydrogen Mission and initiatives like SIGHT are a good start. Continued support through subsidies, tax breaks, and viability gap funding can encourage large-scale production.
- **Public-Private Partnerships:** Collaboration between the government, private sector, and research institutions can accelerate technological advancements and infrastructure development.
- **Infrastructure Development**: Investment in pipelines for long-distance transportation. Setting up strategically located hydrogen fueling stations, especially along major transportation corridors. Development of efficient hydrogen storage facilities.
- **Demand Creation:** Public procurement policies that mandate the use of green hydrogen in specific sectors like government vehicles and power plants. Funding pilot projects across various industries to showcase the viability of green hydrogen technologies. Collaborating with private companies to create a robust hydrogen market.
- **Skill Development and Capacity Building**: Develop training programs for engineers, technicians, and other professionals involved in the hydrogen value chain. Partner with educational institutions to create specialized courses in green hydrogen technologies.