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TODAY'S IMPORTANT CURRENT AFFAIRS

UPSC MAINS

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RENEWABLE ENERGY- HYDROGEN

Source: The post is based on the article published in **"The Hindu"** on **16.04.2025**.

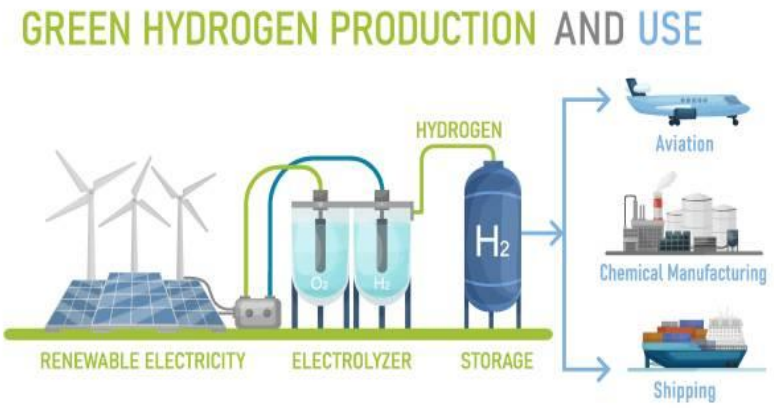
In News:Rising Power Demand in India and the Hydrogen Factor

India is experiencing a rapid increase in **power demand,** driven by industrial growth, urbanization, and the electrification of various sectors. Meeting this demand sustainably is a central challenge as the nation pursues **its low-carbon goals and net-zero commitments.**

Syllabus: ***Mains – GS III (SCIENCE AND TECHNOLOGY -RENEWABLE ENERGY)***

India's Low-Carbon Goals

- India's long-term low-carbon development strategy includes:
- Meeting **50% of its cumulative electric power** installed capacity from **non-fossil** sources by 2030.
- **Reducing the emission** intensity of its GDP by 45% below 2005 levels by 2030.



- **Expanding renewables**, strengthening the grid, and supporting R&D into future technologies like green hydrogen and fuel cells.
- Promoting **energy efficiency** and rationalizing the use of fossil fuels.

Low-Carbon Technologies: Meaning and Types

Low-carbon technologies refer to methods, systems, or devices that **emit little or no greenhouse gases**. Key types include:

- Renewable energy (solar, wind, hydro, biomass)
- Nuclear power
- Carbon capture, utilization, and storage (CCUS)
- Green hydrogen production and fuel cells.

Types of Hydrogen Based on Production

Type	Production Method	Carbon Emissions
Green Hydrogen	**Electrolysis using renewable energy**	**Zero**
Blue Hydrogen	Steam methane reforming + carbon capture/storage	Low (with CCS)
Grey Hydrogen	Steam methane reforming (no carbon capture	High
Pink Hydrogen	Electrolysis using Nuclear power	Very low

Green Hydrogen Production:

Green hydrogen is hydrogen produced by the **electrolysis of wate**r using renewable electricity (solar, wind, hydropower). This process **emits zero carbon dioxide**, making it a sustainable, low-carbon alternative to traditional hydrogen production

Green hydrogen is the most sustainable, but other low-carbon variants (like pink hydrogen from nuclear) are increasingly recognized in policy.

Uses and Significance of Hydrogen

In the Power Sector

- **Grid Balancing & Storage**: Hydrogen can store surplus renewable electricity (from solar/wind) via electrolysis and release it when needed, helping balance the grid and reduce reliance on batteries.

- **Base Load Power Integration**: Electrolysers can absorb excess electricity from nuclear plants during off-peak hours, converting it to hydrogen and avoiding the technical challenges of ramping nuclear plants up and down.

In Industry

- **Steel Production:** Hydrogen can replace coal as a reducing agent, enabling low-emission steel manufacturing (e.g., hydrogen-based Direct Reduced Iron processes).
- **Fertilizer Production:** Green hydrogen can replace natural gas-derived hydrogen in ammonia production, reducing emissions from fertilizer manufacturing.
- **Cement and Chemicals**: Provides high-temperature heat and energy where direct electrification is not feasible.

Other Sectors

- **Transport**: Hydrogen fuel cells power vehicles, especially in heavy-duty, long-haul, and shipping sectors where batteries are less practical.
- **Backup Power and Microgrids:** Green hydrogen can provide electricity in remote areas, enhancing energy independence.
- **Heating Systems**: Can be used for residential and industrial heating, further reducing fossil fuel dependence.

Significance for India

- **Decarbonization**: Hydrogen, especially green hydrogen, is crucial to decarbonize hard-to-abate sectors like steel, cement, and fertilizers.
- **Energy Security**: Reduces dependence on imported fossil fuels and supports indigenous energy production.
- **Economic Efficiency**: Enables continuous operation of renewable and nuclear plants, maximizing their economic and environmental benefits.
- **Sustainable Growth:** Supports India's ambition to become a global leader in green technologies and meet its climate commitments.

Conclusion

Hydrogen, particularly green hydrogen, is central to India's strategy for **meeting rising power demand while achieving low-carbon growth**. Its versatility across sectors—power, industry, transport—makes it a key enabler for a **sustainable, net-zero future**. Policy support, infrastructure development, and technological innovation will be crucial for scaling up hydrogen adoption in India.