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India, rising power demand and the 'hydrogen factor'

India's Roadmap to Net-Zero: Electrification and Hydrogen Integration

1. **Net-Zero Transition: The Energy Paradigm Shift**
    - India aims to achieve **net-zero emissions by 2070**.
    - This requires **massive electrification** across all sectors — industry, transportation, buildings, and agriculture.
    - Simultaneously, India must scale up the use of **low-carbon energy sources** like **solar, wind, hydro, nuclear, and hydrogen**.
2. **Fossil Fuel Dependence Beyond Electricity**
    - Fossil fuels are not just used for power generation; they are also:
        - **Source of process heat** in industries.
        - **Providers of essential molecules**, e.g.,:
            - Carbon from coal is used in **steelmaking**.
            - Hydrogen from natural gas is used in **ammonia production** for fertilizers.
3. **Hydrogen as an Industrial Decarbonization Tool**
    - Hydrogen can **replace coal in the steel sector**, enabling:
        - **Cleaner steel production**.
        - A major step towards **industrial decarbonization**.
    - Thus, **hydrogen adoption in key industries** is essential for India's net-zero goal.

Rising Power Demand and Nuclear Energy Expansion

4. **Future Electricity Demand**
    - As India progresses toward becoming a **developed, net-zero nation**, electricity demand will:

    - **Rise exponentially** due to electrification in transport, industry, and households.

- Intermittent renewables (solar/wind) alone **cannot meet this growing demand**.

5. **Role of Nuclear Energy**

    - Nuclear power is critical as a **reliable, low-carbon, base-load energy source**.
    - India plans to reach **100 GW of nuclear capacity by 2047**.

6. **Ongoing and Planned Nuclear Projects**

    - India is currently building and operating **700 MW Pressurized Heavy Water Reactors (PHWRs)**.
    - A total of **26 PHWRs** of this capacity are planned across different states.
    - **Bharat Small Reactors (BSRs)** of **220 MW** are also proposed for **captive use by PSUs**, to decentralize nuclear energy usage.

Strategic Role of Low-Carbon Electricity

7. **Diverse Low-Carbon Sources**

    - India's future energy mix will rely more on:
        - **Hydropower**
        - **Solar and wind (intermittent)**
        - **Nuclear (base-load)**
    - Coal, although still dominant, will be phased down gradually.

8. **Challenge of Flexing Power Plants**

    - Currently, coal plants are **flexed (ramped up/down)** to balance solar power availability.
    - Flexing **reduces emissions**, but:
        - It is **technically and economically unfeasible** for nuclear plants due to:
            - **High capital investment**
            - **Technical rigidity**

Hydrogen Production: A Smarter Use of Surplus Electricity

9. **Electrolysers as a Flexible Solution**
    - Instead of flexing plants, **surplus electricity from solar, wind, or nuclear** can be used to:
        - Run **electrolysers** that split water into hydrogen and oxygen.
    - Electrolysers:
        - Are **low-cost and modular**.
        - Can operate flexibly based on **available electricity supply**.
10. **Hydrogen Use in Industries**

- The hydrogen produced is **not used to generate electricity again**.
- Instead, it is:
    - Supplied to **steel, fertilizer, refining, and chemical industries**.
    - This ensures **energy is not wasted**, and **emission reduction** is achieved.

Reclassifying Hydrogen: From Green to Low-Carbon

11. **Current Incentive Scheme**

- India currently promotes **"green hydrogen"**, defined as:
    - Produced using **solar/wind electricity**.
    - Emission limit: **less than 2 kg CO_2 per kg of hydrogen**.

12. **Need for Reclassification**

- Hydrogen produced using **nuclear electricity** has **similar life-cycle emissions**.
- Proposal: Rename "green hydrogen" to **"low-carbon hydrogen"**, allowing:
    - Inclusion of **nuclear-based hydrogen**.
    - Broader adoption and **policy flexibility**.

Need for Integrated Energy Systems

13. **Siloed Systems: A Missed Opportunity**

- Currently, **hydrogen production** and **electricity storage (batteries)** are treated as **separate solutions**.
- This limits:
    - **Economic efficiency**
    - **System optimization**

14. **Integrated Approach Benefits**

- Case studies show that combining:
    - **Battery storage** with
    - **Electrolyser-driven hydrogen production**
    - Can **lower overall system cost**.
- Hydrogen acts as a **long-term storage medium**, while batteries provide **short-term balancing**.

Policy Recommendations for India's Net-Zero Transition

15. **Expand Hydrogen Definitions**

- Officially redefine "green hydrogen" as **"low-carbon hydrogen"** based on **emission intensity**, not just energy source.
- Include **nuclear energy** under hydrogen certification to:
    - Broaden applicability.
    - Drive investments.

16. **Promote System Integration**

- Encourage **policy-level and project-level integration** of:
    - Battery energy storage.
    - Electrolyser systems.
    - Renewable and nuclear power sources.

17. **Encourage Industrial Adoption**

- Provide **targeted incentives and subsidies** to industries for:

- Transitioning to **hydrogen-based processes**.
- Setting up **captive renewable-nuclear-hydrogen hybrid plants**.

Conclusion: Building a Clean and Resilient Energy Future

18. **Key Takeaways**

- Electrification and hydrogen are **two pillars** of India's net-zero strategy.
- Nuclear energy plays a crucial **base-load and hydrogen-producing** role.
- A policy shift toward **low-carbon classification** and **integration of energy systems** will:
  - **Enhance efficiency**
  - **Reduce emissions**
  - **Ensure economic competitiveness**.

Source: https://www.thehindu.com/opinion/op-ed/india-rising-power-demand-and-the-hydrogen-factor/article69453753.ece