Balancing Energy Transition & Security

For Prelims: **Economic Survey 2024-25**, **Union Budget 2025-26**, **Energy security**, **Coal**, **Natural Gas**, **UNFCCC COP 29**, **Renewable Energy**, **Critical Minerals**, **European Union**, **REPowerEU Plan**, **National Critical Minerals Mission**, **Nuclear Energy Mission**, **Small Modular Reactors (SMRs)**, **Bharat Small Reactors (BSR)**, **Bharat Small Modular Reactors (BSMR)**, **Pressurised Heavy Water Reactors (PHWR)**.

For Mains: Role of coal in ensuring energy security, Balancing coal and renewable energy in energy transition.

Source: IE

Why in News?

The **Economic Survey 2024-25** highlights **coal's continued importance** as a **reliable and affordable** energy source for India's **energy security and economic development**.

- In another development, the **Union Budget 2025-26** announced some initiatives in the renewable energy sector.

What is Energy Security?

- **About: Energy security** refers to the ability to maintain a **reliable, sustainable, and affordable energy** system that can meet the needs of **individuals, industries, and governments.**
- **Components:**
  - **Availability**: Reliable energy supply from **diverse sources** to meet demand.
  - **Accessibility**: Infrastructure to deliver **energy to all, including remote areas**.
  - **Affordability**: Stable, **cost-effective** energy prices for consumers and industries.
  - **Sustainability**: **Clean, efficient energy** use for long-term environmental balance.
- **Importance:** It is essential for meeting daily **energy demands** and supporting key sectors like agriculture and manufacturing.
  - **Economic Growth**: Fuels industrial growth and productivity.
  - **Political Stability**: Prevents unrest from energy shortages.
  - **Sustainable Development**: Ensures clean energy for the future.
  - **Food Security**: Essential for agriculture, impacting food production, distribution, and prices.
- **Factors Affecting Energy Security:**
  - **Physical Factors**: Fossil-rich regions have better energy security, others face scarcity challenges.
  - **Costs**: Depletion of non-renewable resources raises extraction costs and energy prices.
  - **Technology**: Advances make renewable energy viable, but environmental impacts must be considered.
  - **Political Factors**: Geopolitical tensions and conflicts can disrupt energy supply.

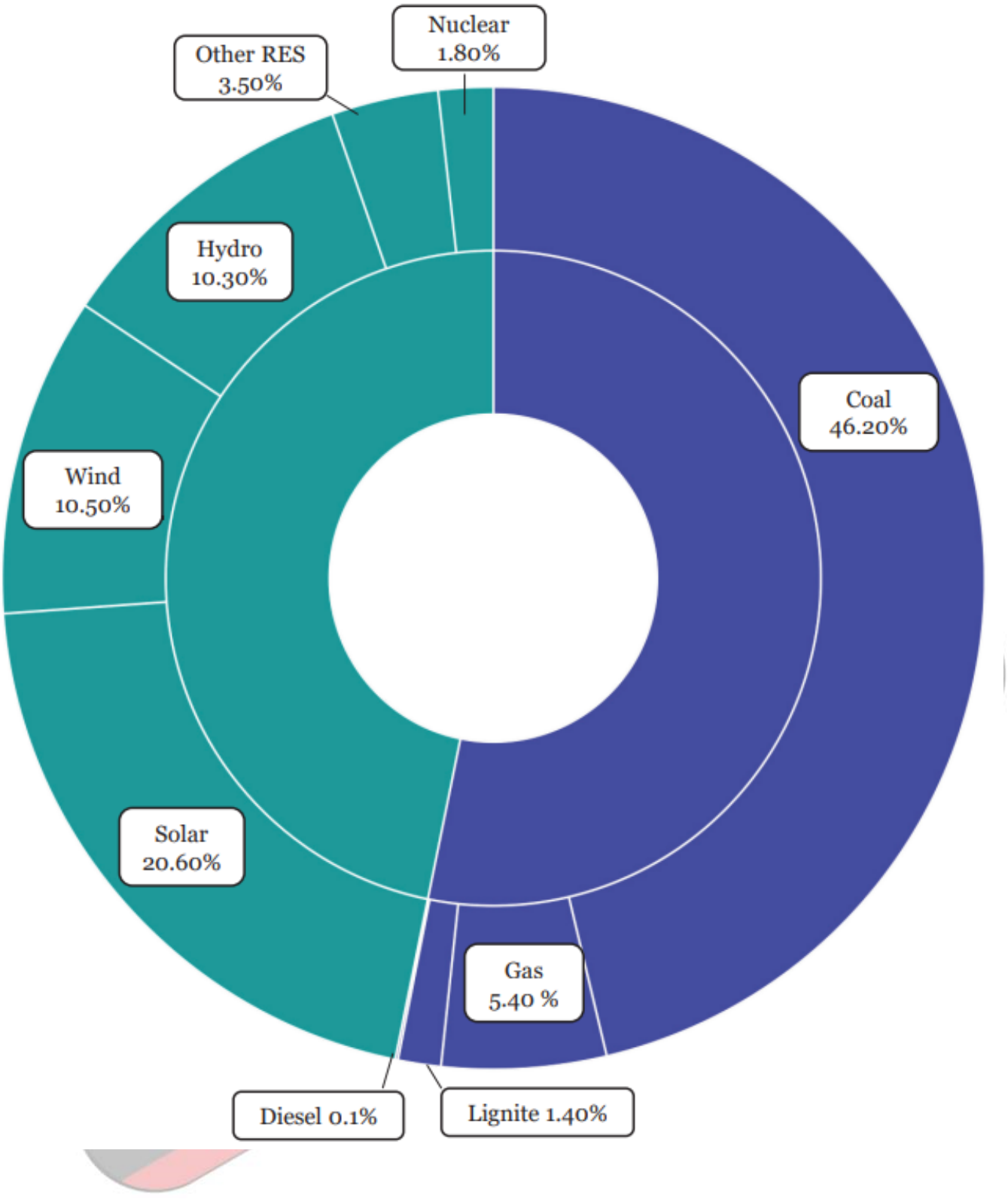
Why Coal is Important for India's Energy Security?

- **Large Coal Reserves**: India holds **10% of the world's coal reserves but only 0.7% of its natural gas reserves**, making coal the most reliable and affordable energy source in the country.
- **Economic Viability**: **Coal-based power plants** have seen **significant investments**, especially since the **2010s**, and shutting them down prematurely would leave these investments **stranded and underutilized**.
- **Climate Financing:** At **UNFCCC COP 29 in Baku, Azerbaijan**, developed countries promised only **USD 300 billio**n in annual climate finance, falling short of the required **USD 1 trillion.**
    - This may force India to **continue its dependence on coal** and may require it to adjust its climate targets.
- **Challenges with Renewable Energy**: **Renewable energy** sources like solar and wind face significant challenges such as:
    - **High investments for grid integration**.
    - Issues with **battery storage** to manage intermittency.
    - **Limited land availability** in densely populated areas for renewable installations.
    - The need for **critical minerals** required in renewable technology, which India does not have in abundance.
- **Geopolitical Vulnerabilities**: Renewable energy technologies often rely on **imported materials and technologies**, increasing India's vulnerability to external geopolitical risks, boosting **energy independence and national security.**
- **Lessons from Developed Nations**: Energy transitions in the past were driven by **commercial interests**, **not** by a desire to **limit emissions** from advanced economies.
    - **France** expanded its nuclear power in the **1970s due to oil embargos,** while in 2022, the **European Union** launched the **REPowerEU plan** to reduce reliance on **Russian gas supplies.**
    - In 2023, the US approved its **largest oil-drilling project in Alaska**, highlighting that even developed countries **continue to rely on fossil fuels.**
- **Congestion Costs:** The transition to renewable energy introduces **congestion costs** and has led to **increased electricity prices** in many countries.
    - Congestion cost refers to the **extra costs** arising from **limited transmission or distribution capacity**, making electricity delivery inefficient.

Status of India's Renewable Energy

- **Installed Capacity**: As of November 2024, India has **213,701 MW** from non-fossil fuel sources, making up **46.8%** of total electricity capacity.
    - India aims for **50%** of its electricity generation from **non-fossil fuels by 2030.**
- **Progress**: In 2022-23, **420.8 thousand GWh** came from non-fossil fuels, contributing **22.8%** to total generation.
    - **Large Hydro** contributes **8.81%**, **Nuclear** accounts for **2.49%**, and **Solar, Wind, Biomass make up 11.52%**.

//



What are Union Budget Announcements in the Renewable Energy Sector?

- **Customs Duty Exemption: Cobalt powder, lithium-ion battery scraps, lead, zinc**, and 12 other critical minerals have been **exempted from basic customs duty.**
    - In July 2024, **25 critical minerals not available domestically were exempted from customs duties.**
- **National Critical Minerals Mission (NCMM): Rs 410 crore** allocated for **2025-26** to the **NCMM for technology development**, skilled workforce creation, and **financing**

mechanisms for clean energy.
    - NCMM under the **Ministry of Mines** aims to **enhance domestic production**, **recycle critical minerals**, and **acquire global mineral assets**.
- **Nuclear Energy Mission**: A budget of **Rs 20,000 crore** has been allocated for the **Nuclear Energy Mission**, aimed at developing **indigenous Small Modular Reactors (SMRs)**.
    - The goal is to operationalize **at least five SMRs reactors by 2033**.
    - The **private sector** will be involved in the development of **Bharat Small Reactors (BSR)** and **Bharat Small Modular Reactors (BSMR)**.
        - **BSR** refers to incrementally **modified forms** of India's existing **Pressurised Heavy Water Reactors (PHWR)** whereas **BSMR** is a **nascent technology** being researched globally.

What are the Initiatives Shaping India's Energy Transition?

- **Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles (FAME)**
- **Pradhan Mantri Sahaj Bijli Har Ghar Yojana (SAUBHAGYA)**
- **Green Energy Corridor (GEC)**
- **National Solar Mission (NSM)**
- **National Biofuels Policy and SATAT**
- **International Solar Alliance (ISA)**

Conclusion

India's energy transition must be **gradual and strategic**, balancing **renewable adoption with energy security.** While coal remains **crucial**, investments in renewables, nuclear energy, and critical minerals are **essential**. Learning from global experiences, India must ensure energy **affordability, stability, and self-reliance** while progressing toward its net-zero goal by 2070.

Drishti Mains Question:

Discuss the challenges and opportunities in India's shift towards a low-carbon energy future.

UPSC Civil Services Examination, Previous Year Questions (PYQ)

Prelims

Q. According to India's National Policy on Biofuels, which of the following can be used as raw materials for the production of biofuels? (2020)

1. Cassava
2. Damaged wheat grains
3. Groundnut seeds
4. Horse gram
5. Rotten potatoes
6. Sugar beet

Select the correct answer using the code given below:

(a) 1, 2, 5 and 6 only

(b) 1, 3, 4 and 6 only

(c) 2, 3, 4 and 5 only

(d) 1, 2, 3, 4, 5 and 6

Ans: (a)

Q. In India, the steel production industry requires the import of (2015)

(a) saltpetre

(b) rock phosphate

(c) coking coal

(d) All of the above

Ans: (c)

Mains

Q. Describe the benefits of deriving electric energy from sunlight in contrast to conventional energy generation. What are the initiatives offered by our government for this purpose? (2020)

Q. “In spite of adverse environmental impact, coal mining is still inevitable for development”. Discuss. (2017).