



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?

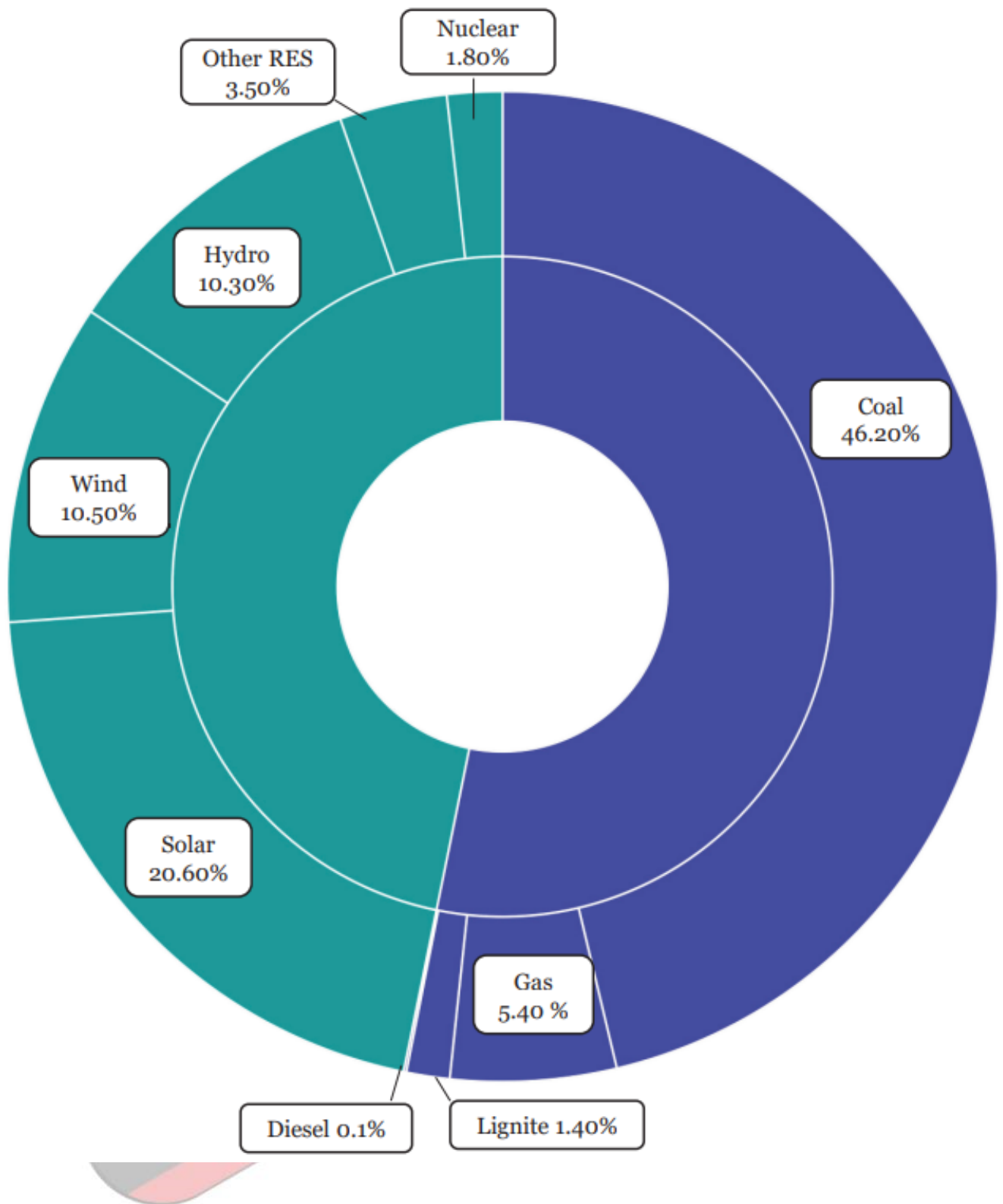
- **About:** [Energy security](#) refers to the ability to maintain a **reliable, sustainable, and affordable energy** system that can meet the needs of **individuals, industries, and governments**.
- **Components:**
 - **Availability:** Reliable energy supply from **diverse sources** to meet demand.
 - **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 billion** in annual climate finance, falling short of the required **USD 1 trillion**.
 - This may force India to **continue dependence on coal** and may India may need 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).

Gyan Bharatam Mission and NMM

Source: TH

The [Union Budget 2025-26](#) has introduced the 'Gyan Bharatam Mission', aimed at **surveying, documenting, and conserving India's vast manuscript heritage.**

- **Objective:** The initiative seeks to conserve over **one crore manuscripts** housed in academic institutions, museums, libraries, and private collections.
- **Budget Allocation:** To accommodate this new initiative, the budget allocation for the [National Manuscripts Mission \(NMM\)](#), has been increased from **Rs 3.5 crore to Rs 60 crore.**

National Manuscripts Mission (NMM):

- [NMM](#) was **launched by the Ministry of Culture in 2003** under the **Indira Gandhi National Centre for Arts (IGNCA).**
- It aims to **preserve and make accessible India's vast manuscript heritage.**
 - [IGNCA](#) was established in **1987** as an **autonomous institution for research, academic pursuit, and dissemination in the arts.**

Manuscript:

- A manuscript is a **handwritten composition** created on materials such as **paper, bark, cloth, metal, or palm leaf**, and it must be **at least 75 years old.**
- India holds an estimated **5 million manuscripts**, probably the largest collection in the world.

Read More: [Revival of National Mission for Manuscripts \(NMM\)](#), [National Mission for Manuscripts and National Culture Fund](#)

CSIR-IICT's Breakthrough in Clean Energy

[Source: TH](#)

Researchers at the [Council of Scientific & Industrial Research \(CSIR\)](#) - Indian Institute of Chemical Technology (IICT) have produced [biohydrogen \(bioH₂\)](#) from [food waste](#).

- **BioH₂ Production:** Food waste undergoes microbial fermentation in an **upflow reactor** with a **self-regulating buffering system**, optimizing **bioH₂** yield and **minimizing methane** and [Carbon dioxide \(CO₂\)](#) emissions compared to traditional **biogas methods**.
 - Fermentation is the **anaerobic (absence of oxygen) breakdown** of compounds by **microorganisms (such as bacteria or yeast)**, releasing energy.
 - The study addresses both **waste management and clean energy needs**, supporting [net-zero targets](#).
- Another study led by the chief scientist at IICT demonstrated an efficient method to convert **CO₂** into [ethanol](#) and [acetic acid](#), reducing [greenhouse gas emissions](#).
- **CO₂ Conversion: Traditionally, H₂ is needed for CO₂** conversion into products like methane, ethanol, or acetic acid.
 - The study used **high-pressure gas fermentation (HPGF) reactor**, eliminating the need for **H₂**, making the process more sustainable, energy-efficient, and cost-effective, yielding **higher ethanol and acetic acid**.
- **CSIR-IICT:** Established in 1944, **CSIR-IICT** in Hyderabad is one of the oldest **National Laboratories** recognized for its expertise in **chemical technology, applied research, and commercialization**.

Read more: [Biofuels](#)

SC/ST Act to Include Intellectual Property

[Source: IE](#)

In the *Principal Secretary Government of Maharashtra v. Kshipra Kamlesh Uke Case, 2024*, the [Supreme Court](#) upholds the [Bombay High Court](#)'s ruling, expanding the definition of "property" in the [Scheduled Castes and Scheduled Tribes \(Prevention of Atrocities\) Act, 1989](#) to include [intellectual property](#).

- The aggrieved sought compensation for the theft of their **research data, laptops, and intellectual property** under the provisions of the **SC/ST Act, 1989**.
- The **Bombay High Court** ruled that the term "property" should be interpreted broadly to include **intellectual property** such as **data, electronic material, and intellectual rights**, whether **tangible or intangible**.
- [Patents, copyrights](#), and [designs](#), are property, even though they lack physical existence, and are capable of being valued for **compensation under the SC/ST Act, 1989**.
- The SC/ST Act, 1989 defines **specific offenses** against SC/ST members, including **physical violence, harassment, and social discrimination**.
 - The SC/ST Act, 1989, **does not allow anticipatory bail**, unless a **prima facie case** is made against the accused.
 - It mandates **special courts for swift trials** and **SC/ST Protection Cells** at the state level, led by **senior police officers**, to oversee its implementation.

INTELLECTUAL PROPERTY RIGHTS (IPRs)

IP refers to intangible assets owned/legally protected by an individual/company from outside use or implementation without consent.



NEED FOR IPR

- ↳ Encourages Innovation
- ↳ Economic growth
- ↳ Safeguard rights of creators
- ↳ Enhances ease of doing business



RELATED CONVENTIONS/TREATIES (INDIA SIGNATORY TO ALL)

- ↳ WIPO Administered (first recognised IPR under):
 - ↳ Paris Convention for the Protection of Industrial Property 1883 (Patents, Industrial Designs)
 - ↳ Berne Convention for the Protection of Literary and Artistic Works 1886 (Copyrights)
- ↳ WTO - TRIPS Agreement:
 - ↳ Ensures adequate standard of protection
 - ↳ Argues for incentives for technology transfer to developing countries
- ↳ Budapest Treaty 1977:
 - ↳ International recognition of the deposit of micro-organisms for the purposes of patent procedure
- ↳ Marrakesh VIP Treaty 2016:
 - ↳ Facilitate access to published works by visually impaired persons and persons with print disabilities
- ↳ IPR also outlined in Article 27 (Universal Declaration of Human Rights)



INDIA AND IPRS - INITIATIVES

- ↳ National IPR Policy 2016:
 - ↳ Motto: "Creative India; Innovative India"
 - ↳ Compliant with TRIPS Agreement
 - ↳ Brings all IPRs to single platform
 - ↳ Nodal Dept - Department of Industrial Policy & Promotion (Ministry of Commerce)
- ↳ National (IP) Awareness Mission (NIPAM)
- ↳ Kalam Program for Intellectual Property Literacy and Awareness Campaign (KAPILA)

World Intellectual Property Day: 26th April

Intellectual Property	Protection	Law in India	Duration
Copyright	Expression of Ideas	Copyright Act 1957	Variable
Patent	Inventions- New Processes, Machines, etc.	Indian Patent Act 1970	20 years Generally
Trademarks	Sign to distinguish business goods or services	Trade Marks Act 1999	Can last Indefinitely
Trade Secrets	Confidential Business Information	Protected without Registration	Unlimited time
Geographical Indication (GI)	Sign used on specific geographical origin and possess qualities due to site of origin	Geographical Indications of Goods (R & P) Act, 1999	10 years (Renewable)
Industrial Design	Ornamental or aesthetic aspect of an article	Design Act, 2000	10 years

