



Balancing Sustainable Energy Goals with Coal Realities

For Prelims: [Coal](#), [Sustainable Development](#), [Renewable energy](#), [Paris Agreement](#), [Thermal Power Plants](#)

For Mains: India's Reliance on coal in its Energy Portfolio and its Impact, India's renewable energy

Source: [TH](#)

Why in News?

In the evolving landscape of [renewable energy](#), the clash between traditional and eco-friendly practices is evident.

- **Coal**, a widely used yet highly polluting energy source, stands as a major hurdle for global sustainability goals.
- Despite efforts to embrace cleaner alternatives, **coal remains a significant challenge** for achieving [sustainable development](#) worldwide.

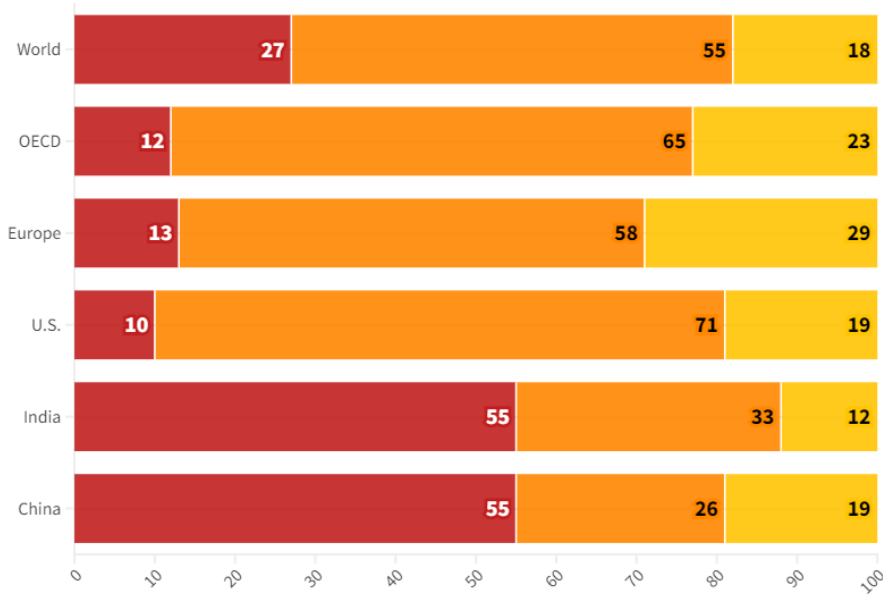
What is the Role of Coal in the Energy Mix?

- **Coal in Global Energy Mix:**
 - In 2022, **oil, coal, and gas accounted for 30%, 27%, and 23%** of the world's total energy, while **solar and wind energy sources together contributed only 2.4%**.
 - Coal supplies just over a **third of global electricity generation** even though it is the most carbon-intensive fossil fuel.
- **Coal in India's Energy Context:**
 - Only **10.4% of India's primary energy consumption** is from **renewables**; coal and oil gas dominate at 55.1% and 33.3% in 2022.
 - Coal-fired thermal power plants (TPPs) generated **74.3% of India's electricity during FY 2022-2023**, and generation by TPPs continues to grow to meet demand.
 - 96% of the coal used by TPPs in India comes from **domestic mines** and is key to why electricity is so affordable in India.
 - India's National Electricity Plan projects that TPP capacity in India will **reach 259-262 GW by FY32**, from 212 GW in FY23.
 - India's per capita energy supply stands at 37% of the global average, highlighting a **growing energy demand** that aligns with the [Human Development Index](#).
 - To balance this with India's long-term goal of reaching [net zero by 2070](#), the country must continue to implement **clean coal technologies** to reduce the power sector's emissions.
 - The efficient operation of [TPPs \(thermal power plants\)](#) is crucial for India to ensure continuous and affordable supply to meet peak and off-peak demands.
 - India's cumulative emissions from fossil fuels and industry between the start of the **industrial revolution** in 1750 and the end of 2021 are only **3.3% of the global total**, far behind those of Europe (31%), the U.S. (24.3%), and China (14.4%).

Primary energy consumption in 2022

Made with Flourish

■ Share of coal (%) ■ Share of oil/gas (%) ■ Rest (%)



What are the Environmental and Social Impacts of Coal?

■ Coal Quality and Transportation:

- Indian coal contains **high levels of fly ash** compared to coal from other major coal-mining countries.
- Burning coal with more ash leads to **erosion** and failure of boiler tubes, **affecting plant availability, efficiency, and performance leading to an increase in emissions.**
- Transporting **unwashed raw coal** to power plants located over 500 km away congests transportation systems and results in **carbon dioxide emissions** and environmental pollution.

■ Sulphur Dioxide Emissions:

- Indian coal other than that from Assam and Meghalaya has **lower sulphur content** compared to coal used in Chinese power plants.
 - Tall stacks and favourable weather conditions in India allow **sulphur dioxide emissions to disperse far and wide.**
- According to the **United Nations Intergovernmental Panel on Climate Change**, historical **sulphur dioxide emissions have created a cooling effect**, masking global temperature rise.

■ Flue Gas Desulphurisers (FGDs):

- Retrofitting existing power plants with FGDs increases specific coal consumption, lowers energy efficiency, and leads to higher emission intensity and temporary plant shutdowns.
 - FGD is a process that removes sulfur dioxide (SO₂) from exhaust gases.
- Retrofitting FGDs has been delayed in India due to the **inability to shut down** operating power plants.

■ Employment and Industry:

- The coal sector plays a vital role in industries like power, steel, cement, and aluminium, employing millions.
 - Transition to cleaner energy could result in an **imbalance in the preservation of jobs and economic stability.**

■ Energy Access and Affordability:

- Coal contributes significantly to electricity generation, ensuring access and affordability for a large population.
 - Transitioning to renewables must consider **maintaining affordable and reliable energy access.**

What are the Strategies to Reduce Coal's Impact on Sustainable Development?

- **Efficiency Enhancement in Thermal Power Plants (TPPs):**
 - Invest in research and development to increase the efficiency of existing coal-fired TPPs.
 - Implement advanced technologies and operational improvements to **reduce emissions** per unit of electricity generated.
- **Promotion of Clean Coal Technologies:**
 - Allocate resources and incentives for the development and implementation of **clean coal technologies**.
 - Prioritize technologies that significantly reduce carbon emissions and improve overall environmental performance.
- **Diversification of Energy Sources:**
 - Accelerate the deployment of **renewable energy sources**, such as solar and wind, to decrease dependence on coal.
 - Develop policies that encourage a **diverse energy mix**, ensuring a gradual transition towards cleaner alternatives.
- **Global Cooperation for Critical Minerals:**
 - Collaborate with international partners to secure a stable and diversified supply chain for **critical minerals** required for battery storage.
 - Most of the critical materials required for grid-scale battery storage are controlled by the top three producers - especially China.
 - Explore diplomatic avenues to mitigate risks associated with import dependencies on countries like China.
 - **Batteries might only become cost-effective after 2030**, necessitating a focus on other strategies in the interim.
- **Nuclear Energy Expansion:**
 - Increase investment and support for **nuclear energy** as a low-carbon alternative to coal.
 - Encourage research and development for small modular nuclear reactors for enhanced efficiency and safety.
- **Pumped Storage Projects and Grid Integration:**
 - Enhance pumped storage projects to efficiently integrate intermittent renewable energy sources like solar and wind into the power grid.
 - Develop **smart grid technologies** for better management of variable energy inputs.
- **Washed Coal Mandate:**
 - Enforce regulations mandating the use of **washed coal** in TPPs located more than 500 km from mines to **reduce environmental impact**.
 - Integrate coal-washing charges into the tariff determination process to ensure economic feasibility.
 - This reduces carbon dioxide emissions and environmental pollution.
- **Incentivizing Low-Carbon Technologies:**
 - Approximately 30% of current power plant capacity in India is based on **supercritical or ultra-supercritical technologies**.
 - **Advanced ultra-supercritical technology (AUSC) reduces carbon dioxide emissions by 15%** compared to supercritical technology.
 - Integrated gasification combined cycle (IGCC) power plants have efficiencies of 46-48% and can capture carbon dioxide.
 - Incentivize projects to prove IGCC or AUSC technologies at scale before 2030.
 - Encourage NTPC to repurpose some power plant sites for small modular nuclear reactors for zero-carbon electricity generation.
 - Low-carbon development is **not a choice but a necessity for India**, as reflected in its '**Long-term Low-Emissions Development Strategy**' submitted to the **United Nations Framework Convention on Climate Change and Paris Agreement**.
 - Encourage research initiatives to explore and develop **carbon capture technologies for existing TPPs**.
 - Transitioning to renewables must consider maintaining **affordable and reliable** energy access.
- **Particulate Emission Reduction:**
 - Implement a '**graded priority**' approach for power plant pollutants, prioritizing the reduction of **particulate matter**.

- Deploy cost-effective electrostatic precipitators to achieve a 99.97% reduction in particulate emissions.

UPSC Civil Services Examination, Previous Year Question (PYQ)

Prelims

Q1. Consider the following statements: (2020)

1. Coal ash contains arsenic, lead and mercury.
2. Coal-fired power plants release sulphur dioxide and oxides of nitrogen into the environment.
3. High ash content is observed in Indian coal.

Which of the statements given above is/are correct?

- (a) 1 only
- (b) 2 and 3 only
- (c) 3 only
- (d) 1, 2 and 3

Ans: (d)

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