Coal and Thermal Power Plants in India

For Prelims: NITI Aayog's energy dashboard, India's coal-fired thermal capacity, solar capacity , Wind power, sulfur dioxide (SO2), Co-burning biomass (organic matter), Central Electricity Authority (CEA)

For Mains: Current Status of the India's Power Sector,Grade of Indian Coal,Technologies to Reduce Emissions from Thermal Power Plant,Existing Challenges and Government Initiatives in Thermal Power Sector

Source: IE

Why in News?

Recently, According to the data on **NITI Aayog's energy dashboard**, India's **coal-fired thermal capacity** grew to 218 GW in FY24 from 205 GW in FY20, a 6% growth.

- A recent report alleges that in 2014, the a company **misrepresented low-grade Indonesian coal** as high-quality, and sold it to a public power generation company in Tamil Nadu.

What is the Current Status of India's Power Sector?

- **Background: The power market is experiencing a growing demand-supply mismatch due to a slowdown in new coal-fired power plant capacity and a lack of effective storage options for** renewable energy.
    - This has put pressure on the country's grid managers, especially with increasing power demand during **soaring temperatures**.
- **Thermal Power Plants: The share of coal-fired power generation has risen to 75% in FY2023-24 from 71% in FY2019-20.**
    - Generation by coal-fired thermal plants also increased by 34% from 960 billion units (BU) to 1,290 BU, and the average plant load factor (PLF) rose from 53% to 68%.
    - In the past five years**, thermal capacity addition** has fallen short of the government's targets by an average of 54% annually with the **private sector** only contributing 7% of new capacity.
        - The private sector has contributed **only 1.7 GW**, or **7% of the total thermal capacity** added in the **last five years**.
    - **There has been a push for investments in new thermal power projects, including from the private sector, with a target of adding 80 GW of new thermal power capacity by 2032.**

- **Renewable Energy:** India's solar capacity has seen a significant surge, **doubling to 81 GW.** Wind power capacity has also witnessed impressive growth, **increasing by 22% to reach 46 GW.**

- Setting up a new **coal plant (Rs 8.34 crore per MW)** is considerably **more expensive** compared to setting up a **solar power plant (per MW cost much lower)**.

INDIA'S POWER MIX

Power source	Share in power generation		Capacity utilisation	
	FY20	FY24	FY20	FY24
Coal-fired	71%	75%	53%	68%
Solar	4%	7%	17%	16%
Wind	5%	5%	20%	21%
Hydro	12%	8%	39%	33%
Others	8%	5%	-	-

What Grade of Coal does India Produce?

- **High Grade' vs 'Low Grade' Coal: The Gross Calorific Value (GCV) determines the gradation of coal based on the amount of heat or energy that can be generated from burning it.**
  - Coal is a **mixture** of **carbon, ash, moisture, and other impurities**. The higher the available carbon in a unit of coal, the better its quality or 'grade.'
  - The most important **uses of coal** are in thermal power plants and in powering blast furnaces for **steel production,** each requiring different kinds of coal.
    - **Coking coal** is needed for **producing coke**, an essential component of steel making, and **requires minimal ash content**.
    - **Non-coking coal** can still be used to generate useful **heat for running boilers and turbines** despite its ash content.
- **Characteristics of Indian coal: Indian coal historically has high ash content and low calorific value compared to imported coal.**
  - Domestic thermal coal has an average GCV of **3,500-4,000 kcal/kg**, while imported thermal coals have over **6,000 kcal/kg**.
  - Also, Indian coals also have **over 40% ash content**, while imported coal has **less than 10%**.
    - **Burning high-ash coal** results in higher particulate matter, nitrogen, and sulphur dioxide.
    - The **Central Electricity Authority (CEA)** recommended in 2012 that about **10-15% blending of imported coal can be safely used** in Indian power boilers designed for low-quality Indian coal.
- **Clean Coal: Clean coal is achieved by increasing the carbon content and reducing ash content.**
  - This can be done through **washing plants** on coal plant sites, which use blowers or a 'bath' to remove ash.
  - Another method is **coal gasification**, which converts coal into gas using steam and hot pressurised air or oxygen.
    - The **resulting syngas** are then cleaned and burned in a gas turbine to generate

electricity, increasing the efficiency of coal used.

- **Future of Coal in India: In 2023-24, India produced 997 million tonnes of coal, showing an 11% increase from the previous year. Most of the production came from the state-owned Coal India Ltd and its subsidiaries.**
    - Despite commitments to move away from fossil fuels, coal remains the main source of energy in India.

What are the Technologies to Reduce Emissions from Thermal Power Plants?

- **Flue Gas Desulfurization (FGD): FGD systems scrub flue gas (exhaust gas) with methods like wet or dry scrubbing process that absorbs SO_2, removing it from the emissions before they are released into the atmosphere.**
    - This technology targets **sulfur dioxide (SO_2),** a major air pollutant linked to respiratory problems.
- **Selective Catalytic Reduction (SCR): SCR systems tackle nitrogen oxides (NOx), another group of pollutants contributing to smog and acid rain.**
    - During the SCR process, hot flue gas passes through a catalyst coated with precious metals like **platinum**. This triggers a chemical reaction that converts harmful NOx into **harmless nitrogen gas and water vapor**.
- **Electrostatic Precipitators (ESPs): It targets** particulate matter (PM)**, tiny particles linked to respiratory illnesses.**
    - ESPs use **high voltage electricity** to charge particles in the flue gas. These charged particles then stick to collector plates, which are periodically cleaned.
- **Fabric Filters (Baghouses): Similar to ESPs, baghouses capture particulate matter. They may be used in conjunction with ESPs or as a standalone technology.**
    - Flue gas passes through a **fabric filter bag**, trapping PM on the fabric's surface. The bags are periodically shaken to release the collected particles.
- **Coal Washing: This pre-combustion technology aims to reduce emissions by improving coal quality.**
    - Coal is washed with water to **remove impurities like** ash and sulfur, which can contribute to air pollution when burned.
- **Co-firing with Biomass:** This approach involves co-burning biomass (organic matter) along with coal.
    - The revised **Biomass Policy of 2023,** mandates **5% biomass co-firing** in thermal power plants from FY 2024-25.

What are the Existing Challenges and Government Initiatives in Thermal Power Sector?

- **Challenges:**
    - **Demand-Supply Mismatch:** Rising electricity demand is outpacing the addition of new **capacity of thermal power plant**, particularly from renewable sources due to their unreliable nature.
    - **Reliance on Coal:** Coal remains the **dominant source** of power generation, despite its environmental impact and rising costs.
    - **Limited Private Sector Participation:** The **private sector is hesitant to invest** in new coal plants due to financial and environmental concerns.
    - **High-Ash Indian Coal:** Domestic coal has **lower calorific value** and higher ash content compared to imported coal, leading to higher emissions.
    - **Technological Limitations:** Large-scale battery storage solutions are still under developed which are crucial for integrating renewables into the grid.
- **Government Initiatives:**

- UDAY (Ujwal Discom Assurance Yojana)
- PM-KUSUM
- Green Energy Corridor (GEC)
- National Smart Grid Mission (NSGM) and Smart Meter National Programme
- International Solar Alliance (ISA)
- Sovereign Green Bonds for Solar Sector

Way Forward

- Accelerating the **growth of solar and wind** power, with a focus on grid integration solutions like large-scale battery storage.
- Implementation of technologies like **Flue Gas Desulfurization (FGD)** and **Selective Catalytic Reduction (SCR)** to reduce emissions from existing coal plants.
- Offering **financial and regulatory incentives** for private companies to invest in cleaner and more efficient power generation technologies.
- Promoting **energy efficiency** measures to reduce overall demand and lessen the pressure on the grid.
- Modernising the **grid infrastructure** to handle the integration of variable renewable energy sources and improve overall efficiency.
- Exploring alternative sources like clean **coal gasification, gravity battery, harnessing ocean energy** and **nuclear power** (with strict safety protocols) to meet energy needs.

Conclusion

India's power sector transformation requires a well-defined roadmap that balances immediate energy needs with long-term sustainability goals. By focusing on renewables, clean coal technologies, and energy efficiency, India can ensure a reliable and sustainable power supply for its growing economy.

Drishti Mains Question:

Q. Highlighting the current status of India’s power sector, discuss the existing challenges and Government Initiatives in the thermal power sector.

UPSC Civil Services Examination, Previous Year Questions (PYQs)

Prelims

Q1. Consider the following statements: (2022)

1. “The Climate Group” is an international non-profit organization that drives climate action by building large networks and runs them.
2. The International Energy Agency in partnership with the Climate Group launched a global initiative “EP100”.
3. EP100 brings together leading companies committed to driving innovation in energy efficiency and increasing competitiveness while delivering on emission reduction goals.
4. Some Indian companies are members of EP100.
5. The International Energy Agency is the Secretariat to the ‘Under2 Coalition’.

Which of the statements given above are correct?

(a) 1, 2, 4 and 5

(b) 1, 3 and 4 only

(c) 2, 3 and 5 only

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

Ans: (b)

Q2. Consider the following statements: (2019)

1. Coal sector was nationalised by the Government of India under Indira Gandhi.
2. Now, coal blocks are allocated on lottery basis.
3. Till recently, India imported coal to meet the shortages of domestic supply, but now India is self-sufficient in coal production.

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: (a)

Q3. Which of the following is/are the characteristic/characteristics of Indian coal? (2013)

1. High ash content
2. Low sulphur content
3. Low ash fusion temperature

Select the correct answer using the codes given below:

(a) 1 and 2 only

(b) 2 only

(c) 1 and 3 only

(d) 1, 2 and 3

Ans: (a)

Mains

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

PDF Refernece URL: https://www.drishtiias.com/printpdf/coal-and-thermal-power-plants-in-india