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GS Paper II: Current Affairs

1. Coal Gasification: India's Push for Cleaner Coal Utilisation

a. Introduction

The Union Government has approved a ₹37,500-crore incentive package to promote surface coal gasification, with the objective of reducing imports of chemicals, fertilisers and fuels worth an estimated ₹3 lakh crore. The initiative builds upon the ₹8,500-crore financial support package announced in 2024, reflecting India's growing emphasis on value addition from domestic coal resources.

Although India is rapidly expanding renewable energy, coal continues to remain the backbone of its energy system. Consequently, improving the efficiency and value derived from coal has become an important component of India's broader energy transition strategy.

COAL COMBUSTION vs COAL GASIFICATION

 COAL COMBUSTION	VS	COAL GASIFICATION 
 Coal Burned Directly	PROCESS	Coal Converted into Syngas 
 Produces Heat	OUTPUT	Produces CO + H ₂ 
 Mainly Electricity	APPLICATIONS	Multiple Industrial Products 
 Lower Value Addition	VALUE ADDITION	High Value Addition 
 More Polluting	ENVIRONMENTAL IMPACT	Cleaner & More Efficient 
 Limited Applications	SCOPE	Fuels, Chemicals, Fertilisers, Hydrogen 

b. Background Context

Coal accounts for the largest share of India's commercial energy consumption and electricity generation. Despite possessing the fifth-largest coal reserves in the world, India continues to import substantial quantities of natural gas, methanol, ammonia and several industrial chemicals, as domestic production remains insufficient to meet industrial demand.

Traditionally, coal has been used primarily for electricity generation through direct combustion. However, advances in technology now make it possible to convert coal into a range of high-value industrial feedstocks and cleaner fuels. Consequently, coal gasification is increasingly being viewed not merely as an alternative method of coal utilisation but as a strategic tool for enhancing energy security, promoting industrial diversification and reducing import dependence.

Understanding the significance of this policy initiative requires an appreciation of the coal gasification process and its industrial applications.

c. What is Coal Gasification?

Coal gasification is a process in which coal is converted into synthetic gas (syngas) by reacting it with oxygen and steam under high temperature and pressure in a controlled environment. Unlike conventional combustion, which burns coal directly to generate heat, gasification converts coal into a gaseous fuel that can subsequently be used for multiple industrial purposes.

Syngas primarily consists of carbon monoxide (CO) and hydrogen (H₂). It serves as an important feedstock for the production of:

- Methanol
- Ammonia
- Fertilisers
- Synthetic Natural Gas (SNG)
- Hydrogen
- Chemicals and petrochemicals
- Electricity

By converting coal into multiple value-added products instead of simply generating electricity, coal gasification substantially enhances the economic value of domestic coal resources.

India's abundant coal reserves make gasification particularly attractive as a strategy for strengthening long-term energy and industrial security.

d. Why is India Promoting Coal Gasification?

India's vast coal reserves provide a significant opportunity to reduce dependence on imported fuels and industrial feedstocks while simultaneously creating higher-value products within the country.

- **Strengthening Energy Security:** Coal gasification reduces dependence on imported natural gas, methanol, ammonia and other chemical feedstocks, thereby improving long-term energy security.
- **Supporting Atmanirbhar Bharat:** The technology promotes domestic production of fertilisers, chemicals, fuels and industrial raw materials, reducing vulnerability to external supply disruptions.
- **Promoting Industrial Diversification:** Instead of being used solely for electricity generation, coal can serve as the foundation for a wide range of downstream chemical and petrochemical industries, thereby increasing domestic value addition.
- **Enabling the Hydrogen Economy:** Coal gasification also offers an additional pathway for producing hydrogen, which is expected to play an increasingly important role in India's future clean-energy and industrial decarbonisation strategy.

While the economic rationale for coal gasification is compelling, India faces a unique technological challenge arising from the characteristics of its domestic coal.

e. The Challenge of High-Ash Indian Coal

The principal constraint to large-scale coal gasification in India lies in the quality of domestic coal.

Indian coal generally contains 30–45% ash, significantly higher than the coal used in many commercially successful gasification plants across the world. High ash content adversely affects gasification by:

- Reducing conversion efficiency.
- Creating slagging and operational difficulties.
- Accelerating equipment wear and tear.
- Increasing maintenance requirements.
- Raising overall production costs.

Consequently, technologies developed for low-ash imported coal cannot simply be replicated under Indian conditions. This necessitates the development of indigenous gasification technologies specifically designed for India's coal characteristics.

Recognising these technological constraints, the Government has adopted a policy framework combining financial incentives with research and commercial deployment.

f. India's Current Status

The Government has announced substantial financial incentives to encourage commercial-scale coal gasification projects across the country.

Coal India Limited (CIL) and other public sector enterprises are developing coal-to-chemicals and coal-to-syngas projects, while research institutions are working to develop technologies specifically suited to India's high-ash coal.

Coal gasification has consequently emerged as an important pillar of India's strategy to strengthen energy security, reduce import dependence, promote domestic manufacturing and improve the efficiency of coal utilisation.

While coal gasification offers significant strategic and economic advantages, it is not without environmental and commercial challenges.

g. Challenges

- **High Capital Requirement:** Coal gasification projects require substantial capital investment and involve high operating costs, making commercial viability dependent upon sustained policy support.
- **High-Ash Coal:** The quality of Indian coal continues to reduce gasification efficiency and increase operational costs.
- **Carbon Emissions:** Although cleaner than direct combustion in several respects, coal gasification remains a carbon-intensive process unless integrated with Carbon Capture, Utilisation and Storage (CCUS) technologies.
- **Water Intensity:** The process consumes significant quantities of water, posing sustainability concerns in water-stressed regions.
- **Technology Dependence:** Many commercially proven gasification technologies have been designed for low-ash coal, highlighting the need for indigenous technological innovation.

Realising the full potential of coal gasification will therefore require simultaneous technological advancement, environmental safeguards and institutional support.

h. Way Forward

- **Develop Indigenous Technologies:** India should accelerate research and development of indigenous gasification technologies capable of efficiently processing high-ash domestic coal.
- **Integrate CCUS:** Future coal gasification projects should increasingly incorporate Carbon Capture, Utilisation and Storage (CCUS) to reduce greenhouse gas emissions and align coal utilisation with India's climate commitments.
- **Promote Public-Private Collaboration:** Greater collaboration between Government, public sector enterprises, research institutions and private industry will be essential to improve technology, reduce costs and facilitate commercial-scale deployment.
- **Improve Water Efficiency:** Advanced water recycling systems, wastewater reuse and efficient water-management practices should become integral components of future gasification projects.
- **Adopt a Strategic Long-Term Approach:** Coal gasification should be viewed not merely as an import-substitution initiative but as an important component of India's broader strategy to

achieve energy security, industrial competitiveness, technological self-reliance and a gradual transition towards a cleaner and more diversified energy economy.

Conclusion

Coal gasification represents an important strategic pathway for enhancing India's energy security, reducing import dependence and creating greater value from its abundant coal reserves. However, its long-term success will depend on developing indigenous technologies for high-ash coal, integrating cleaner production methods such as CCUS, and balancing economic objectives with environmental sustainability as part of India's broader energy transition.

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While every effort has been made to balance depth with brevity, please keep the following in mind:

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However, the PrepAlpine team is simultaneously developing a dedicated Prelims-focused Current Affairs Series, designed for:

- factual coverage
- data recall
- Prelims-style MCQs
- objective pattern analysis

This Prelims Edition will be released separately as a standalone publication.

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