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CENTRE FOR A People-centric Energy Transition

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COAL GASIFICATION IN INDIA

Role, Demand Outlook, and Policy Pathways

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Policy Brief

COAL GASIFICATION IN INDIA

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1. Importance Of Coal In India's Energy and Development Trajectory

Coal has historically played a central role in India's economic and energy development and continues to be a cornerstone of the country's energy system. As of 2023-24, coal accounts for over 70% of electricity generation[1] and remains a critical input for key industrial sectors such as steel, cement, aluminium, and chemicals. Beyond electricity, coal underpins industrial growth, employment, and fiscal revenues for coal-producing states, making it deeply embedded in India's development architecture.

India is a coal-abundant country with more than 90% of the total coal consumed in India sourced domestically[2]. A major sector built around the coal industry in India is contributing to its economic growth. This sector alone accounts for close to 13 million direct and indirect jobs[3] and, at the same time, helps ensure energy security by reducing India's import dependence. This is unlike other energy sources, where, in the case of crude oil and natural gas, 82% and 45% of the requirements are met through imports[4], respectively, and China has been the main source for importing renewable energy equipment like solar cells and storage systems.

India's developmental ambitions, particularly the goal of becoming a *Viksit Bharat* (developed nation) by 2047, are closely tied to sustained high economic growth, which needs rapid industrialisation and infrastructural development. These processes are inherently energy-intensive and would lead to a significant increase in India's electricity demand. However, the world is trying to move away from coal towards clean energy, for which, considerable work is underway to explore a viable energy mix that can significantly reduce coal dependence. Despite the noteworthy growth in renewable energy capacity, coal continues to provide the scale, reliability, and affordability required to support baseload power and industrial heat demand in India especially for the hard-to-abate sectors.

India has committed to achieving net-zero emissions by 2070. This creates a complex policy landscape where coal must gradually transition from being a dominant energy source to a more limited, cleaner, and strategically deployed input. Rather than an abrupt phase-out, India's coal pathway must be framed predominantly around transition management: improving efficiency, reducing emissions intensity, and exploring cleaner coal technologies such as coal gasification and ultra super critical technology.

In this regard, Chintan Research Foundation (CRF) and Ashoka Centre for a People-centric Energy Transition (ACPET) attempted to undertake a policy study to explore the potential of coal gasification in India. The study was also informed by a Roundtable discussion, organised by CRF and ACPET, that was attended by stakeholders from the industry, government, academia and think tanks with the aim to discuss the gaps and challenges in coal gasification industry expansion and the probable solutions to them. This study comes at a critical juncture as India seeks to balance energy security, industrial growth, employment generation, and climate responsibility under its long-term development vision, while charting a pragmatic and sustainable way forward.

1.1 What is Coal Gasification?

Coal gasification technology involves the process of converting coal to synthetic gas (syngas), which is a mixture of carbon monoxide (CO), hydrogen (H2), carbon dioxide (CO_2) and other minor constituents like methane (CH_4) and water vapour. This is done by partial oxidation of coal at high temperatures and pressures to produce syngas[5]. This process is often integrated with carbon capture, utilisation and storage (CCUS) technology to reduce CO_2 emissions. The syngas is useful for hydrogen production, power generation, chemicals, and fuels, and is being positioned as a bridge technology in India's coal transition pathway. The products derived from the process and their potential is further discussed in section 2.3.

Coal gasification can allow continued utilisation of domestic coal resources while providing two major benefits. Firstly, it involves a significant amount of

reduction in greenhouse gas (GHG) emissions by avoiding traditional combustion of coal, making it a cleaner source for energy production. The gasification process is done at high temperatures, which also allows for easier removal of other pollutants such as sulphur and nitrous oxide.

Secondly, coal gasification helps reduce reliance on imports. The syngas can be used to produce Dimethyl Ether (DME), which is valued for its potential of being a sustainable synthetic fuel. This DME can be easily blended with LPG in significant proportions, which could help India reduce its import dependence for LPG. Beyond syngas, coal gasification produces by-products such as slag, tar, phenols, ammonia, and sulphur. With appropriate processing and market linkages, these can supply inputs to domestic industries, including fertilisers and chemicals, and may help reduce select import dependencies. This value addition strengthens the economic case for gasification while improving overall resource efficiency.

2. Coal Demand Projections & Coal Gasification: Outlook to 2047

A considerable body of global, regional, and national literature has attempted to link energy consumption patterns with a country's economic output. In later decades, as derived energy like electricity became important, it emerged as a major proxy for energy use in research. The background study conducted by ACPET – which modelled India's coal demand using a causal regression model with GDP growth and electricity demand as explanatory variables, underpins this policy brief.

The said study examines four energy-mix outcomes across three manufacturing-growth scenarios. The share of manufacturing in the GDP increases to 27%, 30%, and 34.5% by 2047, forming low, medium, and high growth scenarios, along with four renewable energy scenarios representing different levels of Renewable Energy Sources (RES). This comprehensive matrix projects how economic shifts and energy transitions jointly influence electricity demand and capacity requirements until 2047.

2.1 Thermal Coal Demand Trajectory

The study reports that coal demand is expected to rise until 2047 across scenarios, largely driven by generation requirements from coal-based thermal power plants. Even under a scenario where the share of coal-based generation declines significantly, from the current 74%[6] in 2024 to 35% by 2047 the estimated coal demand for power generation remains at 1,758 million tonnes (Figure 1). This is close to double the current coal demand.

The following are the key highlights of the study, and these results present a critical trend in India's coal demand which state:

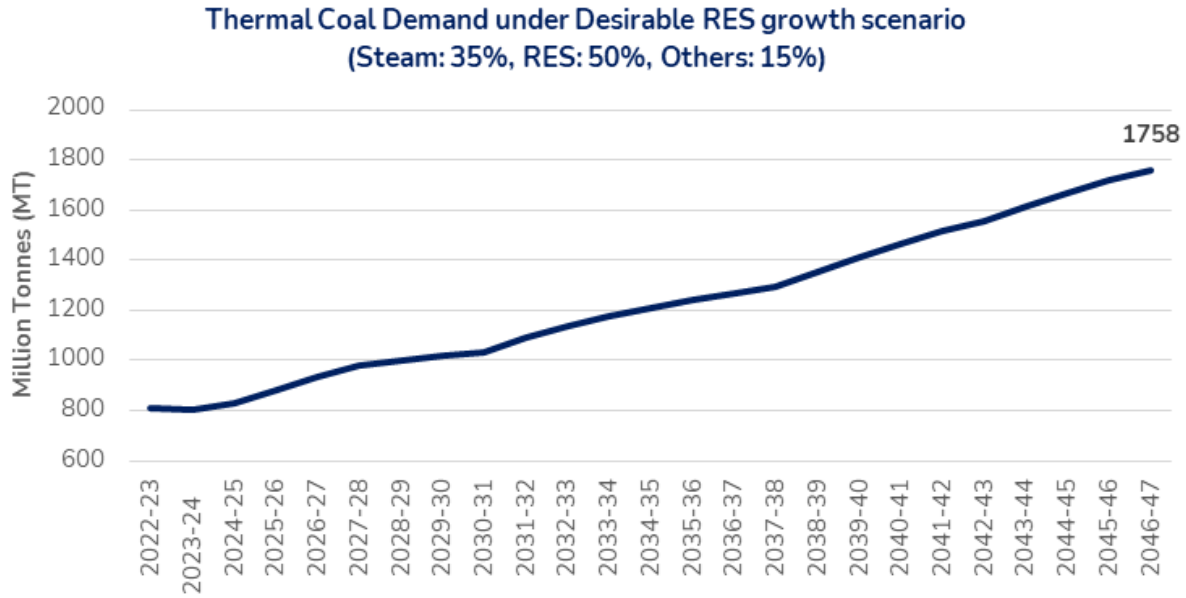
- Between 2022 and 2047, thermal coal demand will not peak; in fact, the trend shows a plausible rise driven primarily by rising electricity demand.

Table 1: Energy Mix Pathways

Source-wise Share of Sources in Electricity Generation				
Year	Scenarios	Steam	RES	Others
2022-23	Actual (as of 2024)	74%	12%	14%
2046-47	Low-RES growth	70%	15%	15%
2046-47	Conservative-RES growth	65%	20%	15%
2046-47	Desirable -RES growth	35%	50%	15%
2046-47	Optimistic -RES growth	25%	60%	15%

#Steam includes coal-fired plants; RES includes Solar, Wind, Small hydro and Biomass; Others include Nuclear, Hydro, Diesel and Gas.

Figure 1: Thermal Coal Demand Projections (ACPET, 2025)



- In 2022, India consumed 1.6 trillion units (kWh) of electricity[7], which is projected to rise to 7.1 trillion units in 2047[8]. This growth trajectory aligns with India's ambition to become a high-income country by 2047.
- In 2024, India's per capita electricity consumption stood at 1,395 kWh[9], significantly below the world average of 3,474 kWh[10]. China, comparable in population and size to India's, consumed close to 10 trillion units of electricity in 2023[11], and its demand is still on the rise.

Given these trends, India's electricity consumption is growing at an accelerating pace, driven not only by expanding economic activity but also by increasing need for electrification, like the rapid growth of electric vehicles, rising data centre demand, and other emerging electricity-intensive sectors.

A recent NITI Aayog report under the Scenarios towards *Viksit Bharat* and *Net Zero*[12] projects India's electricity demand to rise sharply to around 6.5-8.1 trillion units by 2050 from the current level of 1.7 trillion units. Under its Net Zero scenarios, the study assumes that RES will account for nearly 80% of electricity generation by 2050, significantly higher than background study model's assumption of 60%. Notably, even under this high-RES penetration scenario, the projected coal demand remains substantially higher than current levels, reaching about 1795 MT by 2050. These projections are broadly consistent with the findings of the ACPET study and reinforce the continued role of coal alongside rapid renewable expansion in meeting India's long-term electricity demand.

2.2 Implications of Rising Coal Demand and Linkages with Coal Gasification

ACPET's background study and the NITI Aayog Report, both confirm that coal's use will continue till 2050. The consistent rise in coal demand indicates that the coal story for India is far from over. With the world moving towards cleaner energy, India too has aligned its long-term energy goals with cleaner, more sustainable sources. However, in the short to medium term, India's energy transition cannot rely on an abrupt shift away from coal. Instead, it requires a more nuanced and pragmatic approach to the energy mix that reflects domestic resource availability, energy security concerns, and development priorities.

From an energy security perspective, coal reduces exposure to volatile international fuel markets and dependence on imports, particularly compared to oil

and natural gas. Considering the current scenario of the energy security issue created due to the ongoing war in the Gulf Region, the syngas produced by coal gasification can be used as a substitute to LNG. Carbon Capture, Storage and Utilisation (CCUS) integration with coal gasification would also help in producing hydrogen for blending with natural gas and other independent use. This could reduce India's dependence on imported natural gas from West Asia. Therefore, coal gas should be looked forward as a resource not only for decarbonisation but also a tool which could help increase the energy security and reduce supply chain vulnerability.

In this context, coal can be viewed as a "bridge fuel" that can support economic growth while the scale-up of renewable energy, storage technologies, and grid flexibility mechanisms are still underway. One proposed pathway to reconcile coal use with environmental objectives is coal gasification. When combined with pollution control technologies and carbon capture, coal gasification is positioned as a transitional technology that could reduce local air pollutants and enhance resource efficiency.

2.3 Coal Gasification Products and Potential

Gasification is a process that converts carbonaceous materials, such as coal, petroleum coke, or biomass, into carbon monoxide, hydrogen and other trace constituents like CO_2, CH_4 and water vapour. Coal gasification as a power-generation technology is gaining popularity in many countries due to the ready global availability of the raw material. Beyond syngas, coal gasification also produces various byproducts. Some of the important applications of coal gasification, other than power generation, are

- **Hydrogen production:** Hydrogen is increasingly gaining prominence as a clean fuel Syngas derived from gasification processes contains a significant amount of hydrogen (H_2), which can be further increased through water-gas shift (WGS)[13] and readily separated into a pure H_2 product meeting industry product quality standards.
- **Chemicals and Petrochemicals:** The coal-to-liquid industry can help produce various chemicals and petrochemicals that are currently derived from natural gas and crude oil. India is heavily dependent on imports of natural gas and crude oil, and this shift can help protect the chemical and petrochemical industries from marketvolatility. Coal can be used to make the following products:
  - Methanol
  - Ethanol
  - Olefins – (Primarily – Ethylene and Propylene)
  - DME, Acetic Acid and Formaldehyde
- **Fertilisers and NH_3 based products:** Hydrogen present in syngas can be utilized to produce ammonia (NH_3), which serves as a key feedstock for fertilisers such as urea and ammonium nitrate, in addition to having several other industrial applications.
- **Steel Making:** The steel industry consumes both coking coal and non-coking coal. Coke primarily used in the blast furnace route does not have a substitute as of now. In contrast, non-coking coal is used as a reducing agent in the DRI (Direct Reduced Iron) process, which has a close and better substitute in the form of syngas. Syngas, produced through coal gasification, a combination of CO and H_2, can be utilised as a reducing agent. This alternative is environmentally friendly due to its lower emission intensity.
- **Pharmaceutical Sector:** India is highly import-dependent for APIs (Active Pharmaceutical Ingredients)[10]. API is the biologically active component and the core chemical compound that treats or prevents disease. Methanol production is essential for API production, and the domestic supply chain can be a gamechanger for the Indian pharmaceutical sector.

The adoption of coal gasification can help multiple sectors reduce import dependence by generating valuable by-products such as syngas, methanol, and ammonia. Thus, the projected persistence of coal demand raises a crucial question: *how can domestic coal be allocated and utilised more strategically and sustainably across sectors?*

3. Coal Gasification Technologies

Coal gasification can be done underground or on the surface. The underground coal gasification

process requires 75% of the CAPEX compared to surface gasification[14], but it isn't preferred due to environmental concerns such as groundwater contamination and geological subsidence. Surface gasification processes are broadly categorised based on the type of gasifier used. These include:

- Moving Bed or Fixed bed Dry bottom (FBDB)
- Fluidised Bed (back mix reactors)
- Entrained Bed (plug flow reactors)

The entrained bed currently dominates the global market primarily due to their proven scalability and relatively lower capital expenditure for coal with favourable characteristics, but it is the least suitable for Indian coal due to its high ash content[15].

4. Coal Gasification in India

Global efforts on coal gasification are concentrated in India, the US and China. Among these countries, China has emerged as a global leader in coal gasification due to its large-scale coal-to-chemicals industry. India first began its efforts to gasify coal in 1968 with a fertiliser plant at Sindri (now closed) that used gasified coal for fertiliser production and since then, multiple attempts have been made to set up a coal gasification plant. Jindal Steel and Power Limited (JSPL) in its Angul plant had also tried mixing imported coal with domestic coal for the gasification process which is currently inoperative or running sub-optimally. Further, the government of India announced a coal gasification-based fertiliser plant at Talcher in 2018, with commissioning expected in 2023-24, which is now being pushed to the end of 2027. Many key industry players have been trying to work on coal gasification plants ever since. Bharat Heavy Electricals Limited (BHEL) had set up a pilot plant in Trichi, producing 6.2 MW of power, but faced issues with handling high-ash coal. Thermax Limited installed a pilot plant for coal-to-methanol production, with funding support from Department of Science and Technology, under the aegis of NITI Aayog in Pune and L&T is in the business of erection and commissioning of gasifiers and has commissioned many gasifiers in China.

In May 2020, Coal India Limited (CIL) announced 3 coal gasification projects for coal-to-methanol production[16]. This was followed by the Indian Prime Minister's impetus towards clean coal gasification and the formation of a steering committee under NITI Aayog to examine coal gasification. India identified coal gasification as a strategic priority in 2018 across multiple policy initiatives. Considering the importance of coal in the sustained and low-carbon economic growth, the Government of India launched the National Coal Gasification Mission in 2020 with the target of achieving 100 MT of coal gasification by 2030[17]. Towards this, in 2024, the Union Cabinet approved the scheme for promotion of Coal Gasification Projects of Indian Public Sector Enterprises and Private Sector with an outlay of ₹8,500 crore towards incentive for coal gasification projects, which was divided in the following ways:

- Financial assistance to tune of ₹3850 crores was allocated for the private sector to establish the

coal gasification plants with ₹1000 crores or 15% of capex, whichever is lower, as a grant per project.
- A 50% rebate in the revenue share for coal used in gasification was introduced in commercial coal block auctions, provided that at least 10% of the total coal production is used for gasification purposes.

However, as of late 2025, progress in the coal gasification capacity is very slow due to various technological, financial, and infrastructural gaps, with most projects in the planning and early implementation stages.[18] The Rajya Sabha proceeding report on Coal Gasification Projects, published by the Ministry of Coal in November 2025, has listed only eight pilot projects on their way to making the establishment and smooth running of large-scale commercial projects in the future.

Private sector participation is also actively encouraged in the development of the coal gasification projects, and the following steps have been taken to encourage private sector participation.

- Financial support is extended to both private and government companies under Category II and Category III of the Financial Incentive Scheme launched by the Ministry of Coal.
- A new sub-sector, "Production of Syngas leading to coal gasification," has been created under the Non-Regulated Sector (NRS) linkage auctions policy to support the coal gasification initiative.
- The Government has allowed coal supply to gasification projects under the NRS auction with a floor price at the Notified Price of the regulated sector, for the projects commissioning within the next seven years.
- 50% rebate in the revenue share for coal used in gasification has been introduced in commercial coal block auctions, provided that at least 10% of the total coal production is used for gasification purposes.
- A framework has been established for granting waivers from registration for Transfer of Technology (ToT) from land-border-sharing countries on a case-by-case basis.

Policy deliberations to date have emphasised the need for technological adaptation to high-ash coal, financial viability assessment, and environmental safeguards, while recognising that large-scale commercial deployment remains at an early stage.

With this background, a high-level policy deliberation was organised by CRF and ACPET, in the form of a Roundtable Discussion on February 20, 2026, in New Delhi.

The next sections attempt to discuss the key gaps identified through the literature and highlighted in the Roundtable, followed by the policy recommendations suggested by the expert stakeholders.

5. Key Challenges

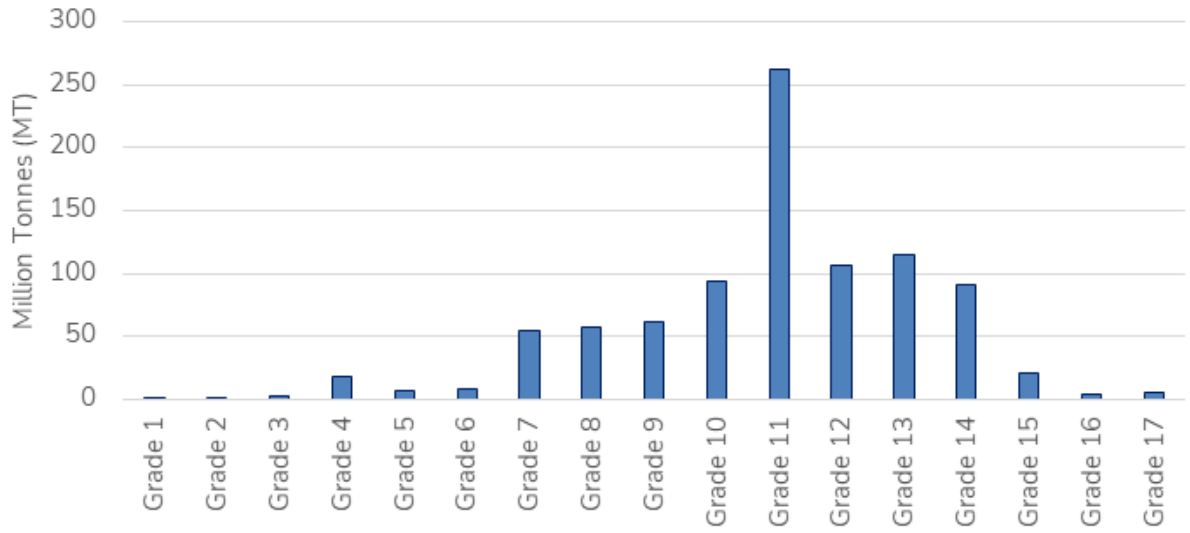
Major coal-producing countries such as India and China are increasingly showing interest in coal gasification, as reflected in their growing policy support for this pathway. While coal gasification offers a relatively cleaner means of utilising coal reserves - particularly in coal-abundant economies - it faces several critical bottlenecks that hinder its large-scale deployment. These challenges span technological, regulatory, policy, financial, and socio-economic dimensions. Addressing these constraints will be essential for enabling the successful development of the coal gasification industry in India. Key challenges identified through the literature review and roundtable discussions include, among others:

5.1 Technological Gaps

Availability of efficient and suitable technology plays a key role in the success of an industry-based project. These are projects which involve heavy machinery and equipment that are necessary to deliver the outputs. Coal gasification is a similar high capital expenditure industry, which requires high-tech machinery to deliver suitable outputs. Some key challenges faced by the technology in India includes:

- **High and variable ash content:** Indian coal possesses distinct characteristics, notably high ash content and significant variability in quality. According to the Ministry of Coal, most

Figure 2: Grade-wise Despatch of Non-coking Coal (2023-24)



Source: Ministry of Coal (Coal Directory 2023-24)

domestically mined coal falls within grades 7 to 15 (Figure 2), with a calorific value ranging from 3100 to 5200 kcal/kg and ash content between 30% and 45%. This ash content is considerably higher than that of coal available globally. While India's abundant coal reserves present a significant opportunity for expanding coal gasification, the high ash content necessitates additional processing to produce clean coal suitable for such applications. Gasification plants require beneficiated coal, with a raw-to-clean coal ratio of approximately 3.5:1. In practical terms, this implies that producing one tonne of usable clean coal requires around 3.5 to 4 tonnes of raw coal. This poses a major constraint for large-scale projects. Although entrained-flow gasifiers dominate the global market – owing to their proven scalability and relatively lower capital costs for coal with favourable properties – they are less suited to Indian conditions due to the high ash content of domestic coal.

- **CCUS Integration:** While coal gasification can reduce local air pollutants such as SO_2, NO_2, and particulate matter, it does not inherently address CO_2 emissions. In the absence of CCUS, coal gasification systems remain carbon intensive. Although many coal gasification plants have incorporated carbon capture technologies, significant gaps persist in the development and deployment of CCUS infrastructure.
- **Importing Technology:** Coal gasification is not a new technology and has been in use commercially in several countries. China currently hosts the largest number of large-scale coal-to-chemicals plants based on coal gasification. In contrast, India's experience at the commercial scale remains limited, with many projects still at the pilot or early development stages. Indigenous coal gasification technologies are largely confined to pilot-scale applications, and as a result, commercial-scale deployment continues to depend significantly on imported technologies.

5.2 Policy and Regulatory Gaps

Policies and regulations highly support scaling up of an industry. A smarter and integrated planning is required for the overall development of the coal gasification industry. Below are some of the existing policy and regulatory gaps plaguing the sector:

- **Inefficient utilisation of resources:** The over-reliance on liquefied natural gas (LNG) has constrained the development of more affordable, domestically sourced gas alternatives. India imports around 25 million tonnes of LNG annually, even as its regasification infrastructure remains significantly underutilised. Despite this, LNG infrastructure continues to expand, locking

in capital and creating long-term dependencies on a supply chain that is vulnerable to global disruptions. In contrast, greater investment in coal gasification could enable the production of domestically sourced syngas, thereby enhancing energy security and reducing import dependence.

- **Cluster-based Development Model:** There is a need to promote the clustering of coal gasification plants in India; however, an enabling ecosystem for such cluster-based development is currently lacking. An integrated ecosystem approach – encompassing access to inputs and raw materials, skilled labour, and targeted capacity building – has enabled countries such as China to scale up their gasification industries rapidly and efficiently. Developing similar cluster-based ecosystems could play a critical role in accelerating the growth of India's coal gasification sector.
- **Supply-side policy:** The coal gasification industry faces significant challenges due to high upfront capital costs. Government interventions such as Viability Gap Funding (VGF) can help bridge financial shortfalls by providing concessional support until projects become commercially viable, while also encouraging private sector investment. However, high import and customs duties on critical plant inputs continue to constrain domestic value addition and increase project costs. At the same time, the economic potential of downstream products such as urea remains underutilised. Creating stronger market linkages for such products could improve project economics and enhance revenue streams for producers.
- **Coal linkage Policy:** The coal linkage policy offered by the government has merely stayed on paper due to its limitations like narrow eligibility and need for high-quality coal. The application of this policy is limited to the projects commissioned after 2022, and there have been almost no large-scale projects that have started post-2022. This has created a huge disadvantage for large scale successful projects like the JSPL Raigarh plant, which started in 2014. The policy also requires premium non-coking grade coal, which is very limited in India.

5.3 Financial Viability Gaps

One of the most prominent gaps identified in the literature review and discussed in the Roundtable was financing the coal gasification projects. The following are the reasons why the coal gasification plants are not considered economically viable:

- **High capital costs and long gestation periods:** Coal gasification projects have very high CAPEX costs driven by complex technologies, ash-handling capabilities, and environmental compliance. Recent techno-economic assessments of circulating fluidised bed gasifiers (CFBG) in the Indian context indicate that capital costs constitute

the largest share of syngas production costs, accounting for nearly 30% of the total production costs. Financial viability remains highly sensitive to weighted average cost of capital, syngas yield, and selling price assumptions. For instance, a 65 MWth CFBG evaluated in a recent study reported an internal rate of return of approximately 9.5% with a payback period of over eight years, under specific cost and price assumptions[19]. Given these high capital requirements, international participation could play a crucial role in improving access to finance and enhancing overall project viability. Additionally, coal gasification projects are characterised by long construction timelines, with gestation periods of 5 to 7 years, further escalating overall project costs and financial risks.

- **Infrastructure Status and Risk Mitigation Structures:** Coal gasification projects require substantial upfront investment, making instruments such as Viability Gap Funding (VGF) essential to bridge financial shortfalls. At present, however, coal gasification does not have infrastructure status, which can delay access to financing, often until a project has demonstrated operational performance. The successful entry of the private sector into this space will depend critically on effective risk reduction. Establishing robust risk mitigation frameworks will be key to scaling pilot projects to the commercial level. Granting infrastructure status to coal gasification could significantly improve access to finance and enhance project bankability, particularly by enabling alignment with existing government frameworks such as the National Infrastructure Pipeline and the Infrastructure Finance Secretariat.[20] These mechanisms are designed to attract private investment, improve project efficiencies, and systematically address policy and regulatory bottlenecks, thereby supporting the development of de-risked infrastructure projects.
- **Demand-side Policy:** Demand side incentives such as offtake assurance could play a big role in making coal gasification projects economically viable. Companies are not willing to invest unless the buyer promises to buy their gas and chemical products. The byproducts of gasification should also be covered under the assured off-take mechanism to nudge investments.

5.4 Gaps with Socio-economic Implications

- **Water concerns:** Coal gasification is a water-intensive process, especially when paired with CCUS technology. This becomes a critical concern, especially for coal-abundant areas with water scarcity. Though underground coal gasification (UCG) requires 75% of CAPEX as compared to surface gasification, the threat of underground water contamination is higher in UCG[21]. Coal gasification also generates a huge amount of wastewater annually, which would need treatment, increasing CAPEX cost further.
- **Production of Coal Gasification Slag:** Coal Gasification Slag is a solid waste generated during the coal gasification process. China, a global leader in coal gasification, produces 33 million tons of slag annually; 90% of this is sent to open-air landfills, posing an environmental threat[22]. If India has to expand its coal gasification capacity, it becomes essential to develop efficient and reasonable methods for utilising coal gasification slag to minimise environmental pollution.
- **Cost-benefit analysis:** Most of the current projects have not been supported by comprehensive assessments of their environmental, economic, and social impacts. A holistic cost-benefit analysis, covering the entire ecosystem, is essential to accurately evaluate the net benefits of coal gasification plants at the regional level.

5.5 Lack of a Robust Business Model

NITI Aayog has noted that the progress on India's coal gasification remains limited due to the lack of robust business models.[23] Consulting studies conducted by Deloitte[24] have also highlighted the same with ambiguity of a robust business case as a key barrier in the success of coal gasification. As per these studies, some of the measures that could help businesses focus on achieving the 100 MT target by 2030 are:

- **Lack of Tailored Tech-Feedstock Matching:**

Companies overlook blending high-ash Indian coal with pet coke or lignite, which can reduce the ash content by 25-30% making it feasible for the existing technology.

- **Lack of Flexible Revenue Diversification:** Failing to modularly integrate by-products (e.g., methanol, urea, SNG) to boost Internal Rate of Return (IRR).
- **Insufficient Risk-Sharing Partnerships:** Not aggressively forming Joint Ventures (JVs) with Public-sector Undertakings (PSUs) like CIL, BHEL, for capex dilution, expertise transfer, and feedstock access, resulting in ambiguity in business cases.
- **Ignoring Resource Planning:** Neglecting high water needs (8-12 gal/MMBtu syngas), CCUS integration, and pithead land acquisition, amplifying economic hurdles.
- **Underutilizing Incentives:** Limited bidding on RFPs for ₹85,000 crore incentives, VGF, 50% revenue rebates, and carbon credits, due to capacity building gaps and operational expertise shortages.

CASE STUDY – TALAIPALLI COAL MINING PROJECT

Techno-economic sensitivity analysis shared by NTPC Limited

The observations of this analysis that may further help refine policy design are:

1. Policy focus on reducing cost of capital

The sensitivity analysis indicated that project IRR is most sensitive to the cost of capital. A change of ±1% in WACC results in approximately ±1.2% change in IRR, making it the single most influential parameter affecting project viability. This suggests that policy instruments aimed specifically at lowering financing costs, such as concessional lending windows, sovereign backed credit lines or eligibility for low-interest transition finance could have a disproportionately large impact on project bankability.

2. Exchange-rate risk due to imported equipment

The analysis also showed significant sensitivity to Euro vs Rupee exchange rate variations because many critical gasification components are currently imported. Even a ₹1 change in exchange rate results in noticeable variation in project IRR. This highlights the importance of encouraging domestic manufacturing of gasification equipment and key balance of plant components to reduce currency exposure and improve long term economic stability of projects.

3. Role of depreciation policy in improving early project cash flows

The sensitivity analysis indicated that depreciation rate has a measurable influence on project IRR. This suggests that accelerated depreciation provisions for gasification assets could meaningfully improve early-stage project cash flows, which is particularly relevant for highly capital-intensive projects with long payback periods.

4. Working capital financing support

Another factor emerging from the analysis is the sensitivity of IRR to working capital requirements. Dedicated working capital credit facilities for coal-to-chemical projects possibly through development finance institutions could help reduce liquidity risks during early years of operation.

5. Technology and efficiency improvements

Operational parameters such as syngas yield also show meaningful influence on project returns. Continued support for R&D, pilot projects, and technology optimization aimed at improving gasification efficiency could therefore have a measurable impact on project economics.

These observations suggest that aligning policy instruments with the parameters that most strongly influence project IRR particularly financing costs, exchange rate exposure, and early-stage cash flow structures may significantly improve investment attractiveness of coal gasification projects.

6. Recommendations

Based on the discussion at the Roundtable, we propose the following recommendations to address the above-mentioned challenges and scaling up coal gasification in India. The recommendations made below include reforms, which should be focused upon by the government, the technology designers and developers and the businesses to help boost the overall ecosystem of coal gasification projects.

Government/Policy Makers

- Providing infrastructure status to coal gasification projects and building risk mitigation structures
- Composite gas policy for effective resource distribution, reducing competition with LPG and Natural Gas thereby enhancing India's energy security and reducing supply chain vulnerability
- Supply-side policy push with increased percentage of VIF and expanding parameters of the linkage policy for guaranteed long-term supply contracts at fixed notified prices via auctions
- Demand-side measures like offtake assurance to buy gas and chemical products along with the byproducts
- State government support for projects such as single window clearance for land, environmental clearances etc. Support coal gasification manufacturing in India through ecosystem approach

Businesses

- Focusing on Cluster-based Development Models and investing in JVs with public sector enterprises to improve efficiency and create integrated value chain.
- Optimising the high-ash coal using pet coke to reduce ash percentage in input fuel.
- Implement pilot projects to draw lessons & develop commercial models for scaling up
- Work with technology designers and developers- encouraging collaborations between academia and technological experts for comprehensive research and development.
- Over all focus on designing an ecosystem which is well-suited to the needs of Indian coal and industry.

Technology designers and developers

- Focus on research and development of technology favourable for high-ash coal of India
- Work towards reducing carbon intensity with CCUS integration
- Research on the treatment of waste water and slag generated in the coal gasification process for effective dumping

7. Conclusion

India's coal consumption remains structurally embedded in its development trajectory. In this context, coal gasification has emerged as a key policy instrument at the intersection of energy security, industrial strategy, and emissions management. Beyond enabling cleaner coal utilisation, it produces valuable by-products such as methanol, ammonia, and DME-blended LPG, which can reduce import dependence. However, the sector remains limited to a few pilot projects due to persistent technological and economic constraints. India's high-ash coal requires more suitable gasification technologies, along with CCUS integration to further reduce emissions. Private sector participation has been constrained by inadequate supply- and demand-side incentives, including limited access to VGF and the absence of assured offtake – both critical for capital-intensive projects with long gestation periods. Additionally, socio-economic concerns, particularly related to water use for coal beneficiation, need careful consideration. More broadly, India lacks a robust business model that supports a complete

coal gasification ecosystem. Greater industry participation in project implementation is essential to better identify gaps and calibrate targeted government support.

The government should prioritise a more efficient allocation of resources, which are currently concentrated on LPG. Given the potential of coal gasification to produce DME-blended LPG, resources could be more productively redirected to support this pathway. Alongside policies such as the linkage policy, composite gas policy, and other demand–supply interventions, state governments will play a critical role in the success of gasification projects by fast-tracking pre-construction processes, particularly approvals and clearances. Businesses should consider forming joint ventures to diversify risks and foster collaboration in research and development. At the same time, technology developers must undertake comprehensive assessments that evaluate the suitability of technologies for India's coal, their emission reduction potential, cost–benefit dynamics, and implementation strategies.

In sum, India's coal future lies increasingly in gasification rather than combustion – enabling the production of gases, chemicals, and cleaner fuels that can reduce emissions while strengthening supply chain resilience and enhancing energy security amid geopolitical uncertainties. •

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