Chintan Research Foundation

CENTRE FOR A People-centric Energy Transition
ASHOKA UNIVERSITY

COAL GASIFICATION

Pathways, Policies, Perspectives

A compilation of opinion pieces and expert insights on coal gasification

ABOUT CRF

Chintan Research Foundation is an independent think tank committed to shaping policy through rigourous research and thought leadership. With a strong focus on fostering collaboration between policymakers and industry, CRF aims to incorporate to practical insights into its research and advocacy efforts. It conducts comprehensive research to support informed decision-making and engages with stakeholders through discussions, events, and workshops.By publishing research papers, articles, and op-eds, CRF seeks to address key challenges in India and the Global South, fostering diverse perspectives and contributing to impactful policy advocacy.

For more details: www.crfindia.org

ABOUT ACPET

The Ashoka Centre for a People-centric Energy Transition (ACPET) supports the transition towards a net-zero economy by addressing critical knowledge gaps for India and the Global South. The Centre develops people-centric, context-responsive frameworks and solutions that strengthen the economic, social, and governance pillars of sustainable growth. Working with industry leaders, government institutions, and community champions, ACPET designs and tests practical interventions to create scalable and adaptable solutions. It also promotes collaboration, knowledge-sharing, and capacity-building through reports, policy briefs, publications, and discussions that contribute to informed policymaking and a more inclusive and sustainable energy transition.

For more details: www.*acpet.ashoka.edu.in*

A compilation of critical perspectives

COAL GASIFICATION

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FOREWORD

Chintan Research Foundation (CRF) was established to shape public policy through rigorous research, thought leadership, and sustained engagement with policymakers, industry, and civil society. Over time, CRF has deepened its interdisciplinary research, broadened its reach, and created platforms for informed debate on the questions shaping India's development trajectory. Aligned with that mission, CRF has joined hands with the Ashoka Centre for People-centric Energy Transition (ACPET) to examine critical issues at the intersection of energy security, climate resilience, and just, equitable transitions.

The first event in this series, a Roundtable held in February 2026 — focused on the continuing role of coal and the potential of coal gasification. That discussion brought into sharper relief the strategic, economic, and regional dimensions of using coal as a feedstock rather than solely as a combustion fuel. Researchers from both institutions compiled the roundtable's insights into a policy brief and produced the pieces gathered in this volume.

For India, coal remains a foundational domestic resource tied to energy security, industrial capacity, and millions of livelihoods in coal-bearing regions. The question before policymakers is not merely whether coal will persist, but how its use can be reoriented toward higher-value, lower-emission pathways that align with national development priorities. Coal gasification is one such pathway: by converting coal into syngas and intermediary feedstocks, it can enable domestic hydrogen and chemical production, reduce import dependence, support regional manufacturing, and broaden economic opportunities in mining areas. This compilation assembles a curated selection of articles by researchers from CRF and ACPET, published across different platforms. The contributions approach coal gasification from multiple vantage points — hydrogen, chemicals, power, regional development, and national security — and combine policy analysis with practical considerations for implementation. Collected ahead of broader public attention to import vulnerabilities, these pieces aim to provide a balanced, evidence-driven foundation for debate.

We hope this booklet serves as both a record of collaborative inquiry and a practical resource for policymakers, researchers, industry stakeholders, and civil society. Our intent is to inform decisions that make India's energy transition both strategically prudent and development-oriented, while ensuring the wellbeing of communities that depend on coal.

Warm regards,
Shishir Priyadarshi
President, Chintan Research Foundation

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THE GREEN COAL TRANSITION

India's Green Industrial Revolution needs Coal Gasification

By Shishir Priyadarshi
President, CRF

CLEAN COAL PATHWAY

India's green industrial revolution hinges on coal gasification — a pragmatic bridge between dependence and clean energy that can succeed only through government–industry collaboration

India's march towards energy self-reliance and sustainable industrial growth faces a pivotal test. As global energy regimes pivot from fossil fuels to renewables, the role of coal - still India's most abundant indigenous energy source - is under increasing scrutiny. Yet dismissing coal as merely an obstacle to climate ambitions would be a strategic error. Through advanced coal gasification technology, India has a rare opportunity to reconcile its economic, strategic, and environmental objectives. But realising this potential demands policies that move beyond declarations, unleashing private sector dynamism with strong, targeted incentives.

The Strategic Case for Coal Gasification

India's energy and manufacturing ambitions are vast. By 2047, as the country approaches its centenary, it aspires to be a high-income, global manufacturing powerhouse. Achieving this will require a secure, affordable base of high-value feedstocks. Today, coal is mostly burnt in power plants, emitting vast quantities of CO_2 and particulate pollution. However, when coal is gasified—converted into syngas and then processed into chemicals and fuels—it becomes a versatile, low-emission platform for producing methanol, ammonia, synthetic natural gas, fertilisers, and even clean hydrogen.

This technology, already proven in countries like China, South Africa, and the United States, can transform coal from a cause of environmental distress into a lever for economic renewal. Coal gasification offers far cleaner utilisation than combustion, eliminating the uncontrolled release of many pollutants that bedevil old-style coal use. By exploiting this pathway, India can future-proof a legacy resource and help create the backbone of a green manufacturing ecosystem.

Most critically, gasification is a natural partner for carbon capture, utilisation, and storage (CCUS). Because CO_2 emerges in a concentrated stream—before dilution in exhaust—it is cost-effective to trap and store, or reuse, the resulting carbon. This makes coal gasification arguably the only path to continued coal utilisation that is compatible with achieving net zero emissions by 2070. It is the bridge between "black gold" and green growth.

Economic, Strategic, and Industrial Benefits

India's heavy reliance on chemical, fertiliser, and synthetic fuel imports drains foreign exchange and leaves the country vulnerable to global supply shocks. Methanol, for example, is a versatile chemical used in fuels, plastics, and pharmaceuticals, but nearly all Indian demand is met by imports. The same is true for synthetic ammonia and many petroleum-derived olefins.

By converting even a portion of its vast coal reserves into domestic chemical feedstock, India can embark on a new era of value addition and import substitution. Entire industries—fertilisers, petrochemicals,

synthetic fuels, advanced plastics—could shift from input insecurity to competitive advantage. But the scale and complexity of the coal-to-chemicals revolution cannot be achieved through public funding alone. Creation of gigawatt-scale gasification complexes, deployment of cutting-edge CO_2 capture, and process innovation across the value chain all demand the capital, project management, and technical excellence that only private enterprise can deliver at speed.

Yet, private participation in coal gasification faces hurdles: regulatory uncertainty, large upfront costs, long payback periods, and technology risk. Here, the government must act as both enabler and risk-mitigator—creating a climate where investment is not just viable but attractive.

Incentivising the Transition

For India to unlock the full economic and environmental promise of coal gasification, bold government action is not optional—it is essential. Given the long development timelines of gasification plants, the private sector will only enter at scale if the risk-reward equation is fundamentally reshaped by clear, sustained, and ambitious policy signals. There are several reasons why providing strong incentives for coal gasification projects is imperative.

First, coal gasification projects demand far higher initial capital expenditure than traditional uses of coal. The technology is newer, the operational complexity greater, and the learning curve steeper. Returns are often back-loaded, and unlike conventional businesses, regulatory uncertainty or project delays can quickly erode commercial viability. Without targeted incentives, most private players—especially first movers—will simply deploy capital in less risky sectors or internationally competitive locations.

Moreover, the social and environmental gains from coal gasification—lower emissions, secure supply chains, high-quality job creation—are classic examples of positive externalities that markets alone cannot price in or reward in the early years. Only smart state support can “crowd in” private capital, accelerate the demonstrati

Need of the Hour

To spur private investment in coal gasification, the government must consider a mix of robust fiscal and revenue incentives. Lowering or waiving government revenue shares on coal designated specifically for gasification; upfront capital subsidies and production-linked incentives (PLIs); and offering multi-year tax holidays would be especially effective in offsetting high initial risks and catalysing early investment.. Facilitating concessional, long-tenor green financing through public sector banks and multilateral institutions, while leveraging India’s global climate partnerships, can lower capital costs substantially. Complementing this with targeted credit guarantees or viability gap funding would give institutional investors the needed confidence to commit capital.

The government can develop an exclusive, transparent mechanism for streamlined allocation and expedited environmental clearance of coal blocks dedicated to gasification, prioritising those with optimal quality and

cost. Furthermore, reserving a fixed portion of future coal auctions specifically for downstream chemical conversion—rather than just power generation—will ensure that private players have dependable access to the coal necessary for diverse industrial applications.

On the demand side, the state can play a catalytic role in anchoring offtake and reducing market risk. Public sector undertakings should serve as long-term buyers by issuing indexed purchase tenders for key gasification outputs like methanol, ammonia, and hydrogen. Introducing "green procurement" requirements into infrastructure, fertiliser, and chemical purchase agreements would provide producers with stable demand and price floors, further mitigating the commercial uncertainties that often stall industrial innovation.

Finally, long-term regulatory clarity is essential for unlocking sustained investment. The government should commit to a transparent, predictable policy roadmap for coal gasification, CCUS, and synthetic chemicals, reducing the regulatory risk that deters private entrants. Simpler, harmonised standards for environmental clearances and carbon accounting must be developed so firms can comply with global best practices efficiently, ensuring both industrial competitiveness and rigorous environmental protection.

Conclusion

Climate commitments are rightly at the heart of India's industrial strategy. But rather than seeing coal as an immovable obstacle, policymakers should recognise coal gasification as a crucial tool for local manufacturing, green job creation, and decarbonization. No other technology offers such a practical bridge from present energy realities to a low-emission future. India can show the world a new model: harnessing legacy resources with front-line technology to meet the dual imperatives of development and decarbonization. Coal gasification is not a halfway house—it is a catalyst for economic renewal, environmental protection, and industrial self-reliance, if government and business work in tandem.

Every rupee spent to incentivise coal gasification triggers a multiplier effect—reducing petrochemical import bills, generating rural and urban employment, stimulating R&D, and building resilient industrial clusters. Incentives can be designed to sunset as the sector matures, using declining subsidies to nudge companies towards competitiveness. Crucially, these policy moves signal to global and domestic investors that India is serious about a just, green industrial transition—one in which the private sector is a core partner, not a bystander.

With bold incentives and an enabling regulatory framework, India can unleash private investment, scale innovation, and make coal a driver of its next green industrial revolution—turning "black gold" into an engine for sustainable, inclusive growth. •

Views expressed are personal.
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02

ESTIMATING COAL DEMAND IN INDIA

Why Realism Matters For India's Energy Transition

By Anvesha Adhikari, Navya, Anjali Goyal, Anandajit Goswami and Rakesh Kacker

All 5 authors are affiliated with Ashoka Centre for a People-centric Energy Transition (ACPET)

COAL FOR BASELOAD POWER

India is at a transition point of reaching Viksit Bharat by 2047 and the Net Zero Goal by 2070. Viksit Bharat can be achieved only if India's agriculture, industry, and services sectors grow at a steady rate. Achieving net zero emissions by 2070 demands maintaining a steady-state path of declining emission intensity. The growth of the sectors will both depend on and drive up electricity demand, which is expected to increase about 15 times by 2070, while GDP might grow about 17 times during the same period.

Such a rise in electricity demand would require continued use of coal in the generation mix, particularly in the absence of storage facilities and the concomitant infrastructure to support a renewable-led sectoral growth of the Indian Economy.

Coal is the dominant fuel in India for power generation as well as for several industrial uses, such as the production of steel, cement, and aluminium. The objective of India's Energy Transition is to reduce this dominance, given the environmental consequences of coal use. These consequences are both local and global. A realistic assessment of coal demand is crucial to understand how far the present policies and business practices are conducive to a rapid energy transition. This will also help us understand how to manage coal in India in the interim period, until coal consumption comes down to acceptable levels. For that, the first premise is to know what India's demand for thermal coal (used for power generation) and non-thermal coal (used for non-power generation purposes) will be by 2047 and 2070, two distinct time points that are essential for India's trajectory of development and to be a global voice.

Hence, ACPET has developed a framework that estimates India's thermal coal demand until 2070 based on the causal relationships between GDP growth, sectoral electricity demand, and the resultant demand for coal. Further, within the framework, efficiency assumptions and auxiliary consumption losses are embedded to arrive at a final demand estimate for thermal coal through 2070.

A scenario-specific approach is overlaid on this framework. Details of the assumptions are highlighted in Table 1 below -

Key assumptions behind the estimation of the thermal coal demand

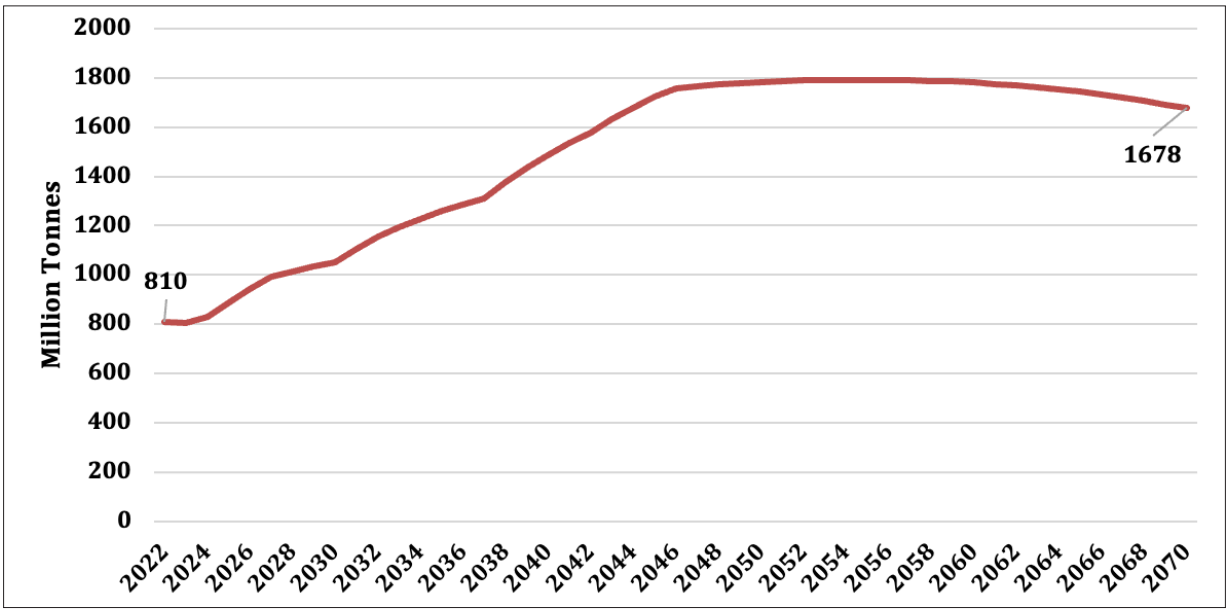
Parameter	2047	2070
Auxiliary Consumption	5.8 – 5.0% (2023-2046)	5- 4.5% (2046 -2070)
T&D Loss	15.8- 10%	10.0 to 6.0%
Efficiency	1.1% to 5%	10% or 15% (2 scenarios)
RES share in the generation mix	15%-60% 4 scenarios	63%-77% 3 scenarios
Share of others# in the generation mix	15%	12%
Electricity to Coal conversion factor	0.6 kgs of coal per kwh	0.6 kgs of coal per kwh
GDP Average growth rate	7% (2022-2046)	5% (2047-2070)

#Others include Nuclear, Large Hydro, Diesel and Gas.

Based on the above framework and assumptions, it can be observed that thermal coal demand peaks at about 1680 MT only around 2060, even with very ambitious assumptions about the progress of the renewable energy sector. Thereafter, the thermal coal demand drops to about 1678 MT by 2070 (Fig 1).

The recently issued draft National Electricity Policy estimates that by 2047, non-fossil fuel sources will account for 66% of electricity generation. This is lower than the optimistic scenario we used, according to which this number is 75% in 2047. If we go with the GOI number, coal demand will be even higher than that shown in Figure 1.

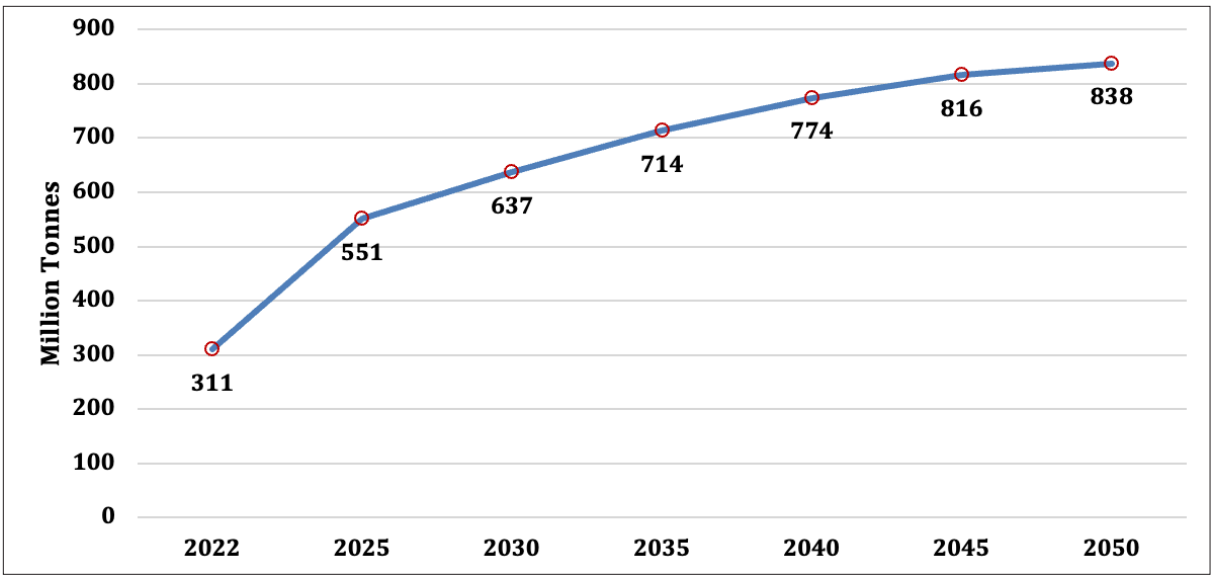
Figure 1: Thermal Coal Demand in Million Tonnes when the share of steam in generation by 2070 is 11% and RES is 77%, and efficiency goes up to 15% by 2070



We now turn to non-thermal demand. Non-thermal coal demand is estimated using an industry-level energy demand framework, where coal consumption is derived from sectoral output projections and process-specific energy requirements across major coal-using industries. The model embeds assumptions about energy-efficiency improvements across two scenarios and yields total non-thermal coal demand projections through 2050. The BAU scenario assumes no improvements in energy efficiency over time. In contrast, the Ambitious scenario incorporates efficiency gains, under which industrial energy demand in 2050 is assumed to be approximately 20% lower than the BAU level at a given output level. These efficiency improvements are represented in the model through specific LEAP demand-side levers, which disaggregate energy use across individual industrial processes.

On this basis, the demand for non-thermal coal is shown in the graph below under the Ambitious Scenario. This shows no peaking and will continue to rise until 2050. By this date, the demand for non-thermal coal will reach 838 million Tonnes (Fig 2).

Figure 2: Non-thermal Coal Demand in Million Tonnes under the Ambitious Scenario



It is also essential to validate the framework-based findings with other estimates coming from CEA, IEA, and NITI Aayog before proceeding towards any conclusive policy direction.

The Central Electricity Authority (CEA) has estimated coal demand in two documents. The first is the National Electricity Plan (NEP) for 2022-2032. The second is the cost minimization report (CMR) which covers the period 2023-30. Both show no peak in coal demand for thermal power plants during this period. Total coal demand for thermal generation is expected to rise steadily from 723 Mts in 2021-22 to 1054 MT in2031-32 as per the NEP. The CMR has not estimated coal demand but shows that coal plus Lignite installed capacity is expected to rise from 215 GW in 2021-22 to 267 GW in 2029-30. In one IEA scenario, coal demand increases from 901 MTOE in 2035 to 977 MTOE in 2050, whereas in the other scenario it drops from 840 MTOE in 2035 to 706 MTOE in 2050. NITI Aayog's IESS scenario shows that coal demand is expected to steadily increase from 146 Mtoe in 2020 to 415 Mtoe in 2047, with no peaking in demand until 2047.

From the above findings, it can be inferred that different organizations have reached the same conclusion: there is no near-term peaking in coal demand. This finding implies that, in the short and medium term, coal demand in India will remain high as we move along the Viksit Bharat @2047 path. Hence, to attain

the net-zero goal by 2070, while coal demand remains strong in the short and medium term, India has to develop cleaner coal transition pathways, such as coal gasification, carbon capture, and higher-efficiency coal technologies, for example, towards ultra-supercritical boilers. Therefore, we have to adapt growing coal use towards lower emissions. If this storyline has to be changed, a much greater effort than hitherto employed is required. Cost to consumers will need to be minimized and local environmental concerns will have to be more strenuously addressed. Looking beyond 2047, our own study shows that coal demand will peak by about 2060 and then start declining, only if RES (Solar, Wind, Small hydel & Biomass) come to scale in capacity and generation. While our model does not calculate required storage and grid integration, there is no doubt that both are essential to achieving higher non-fossil fuel penetration. If this scenario materializes, it will bring a new set of challenges that require early planning. These will include repurposing coal mines as they begin to close, managing the retirement of thermal power assets, and addressing the effects on sectors such as railways that are heavily dependent on coal revenues. These problems need to be anticipated, and solutions designed early on to ensure a just, people-centric energy transition away from coal. •

Views expressed are personal.

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QUOTED & NOTED

ETChemicals.in
From The Economic Times

Industry & Market • 5 Min Read

India's coal gasification push: A strategic lever for chemical industry self-reliance and energy security

India is turning to coal gasification as a strategic tool to drive self-reliance in the chemical sector, cut import dependence, and boost regional development. The government and industry are working to overcome hurdles and unlock the full potential of this technology.

ETChemicals
Published On May 05, 2026 at 05:35 PM IST

Policy roadmap and implementation hurdles

Experts at Chintan Research Foundation and NITI Aayog suggest that granting infrastructure status to coal gasification projects could unlock long term coal linkages, improve transparency in coal auctions, and attract affordable financing. Additional policy levers, such as custom duty waivers and viability gap funding for early adopters, will be necessary to ensure bankability and scale.

03

COAL GASIFICATION

Powering Viksit Bharat Without Derailing Net Zero

By Dr Anandajit Goswami
Research Lead and Senior Fellow, ACPET
and Dr Debajit Palit
Centre Head, Centre for Climate Change and Energy Transition, CRF

ENERGY SECURITY

With coal set to anchor India's growth for decades, gasification can reconcile energy security, industrial ambition, and 2070 climate commitment

Despite the global push for clean energy and India's own ambitious climate goals, the story of coal in the country is far from over. The Viksit Bharat 2047 pathway projects India's electricity demand increasing nearly fivefold, reaching approximately 8,515 billion units by 2047. Along with renewable energy sources, India's energy transition pathway calls for technologies such as coal gasification and Carbon Capture, Utilisation and Storage (CCUS) to help reduce emissions from coal.

With NITI Aayog acknowledging the need for coal in its recently released reports on 'Scenarios Towards Viksit Bharat 2047' and 'Net Zero 2070', high-level deliberations are needed to address a pressing question: Can coal gasification be a bridge technology in the energy transition roadmap to support India's long-term energy security?

NITI Aayog reports affirm coal's two-to-three-decade role in India's growth to net-zero by 2070, with coal gasification key via coal-to-chemicals, CCUS, and the national 100 MT target by 2030. Coal can be a bridge for India's energy security amid vast reserves and a fivefold increase in energy needs by 2047. The need of the hour is a stronger private-sector engagement that will help overcome barriers such as capital and regulation. This would then pave the way for a scaling up of coal gasification projects in the country.

Government backing is propelling efficient coal utilization amid declining domestic gas production, with coal gasification emerging as the hero, producing vital syngas (synthesis gas). What is required are demand-side policies that would help pivot steelmaking from blast furnaces to the syngas-hungry Direct Reduced Iron (DRI) process.

Coal gasification has several benefits: seamless CCUS integration, especially underground plants for superior environmental gains, and its potential for power, methanol, ammonia, and other chemicals production. Several factors can facilitate the responsible, indigenous and commercially viable deployment of coal gasification in India. Successful models in Odisha and Maharashtra underscore the importance of incentives for state-level policies, such as subsidies on power tariffs, land allocation, and round-the-clock water access for industrial projects.

At the national level, projects must be granted infrastructure status, long-term offtake assurances must be provided for downstream products such as methanol and ammonia, production-linked incentive (PLI) support should be given for coal-to-chemical value chains, custom duty waivers given to early adopters, and a composite gas policy must mandate blending targets, such as 10% of LPG to be blended as dimethyl ether (DME), a synthetically produced alternative fuel.

Policies must encourage inter-ministerial coordination for coal linkages, technology partnerships that blend 'Make in India' with imports, and comprehensive cost-benefit analyses incorporating environmental externalities to reflect long-term economic and environmental considerations. Demand-side measures include providing incentives to shift industries, such as steel, toward DRI processes, positioning gasification to meet the 100 MT target by 2030 while aligning with Viksit Bharat 2047 and Net Zero 2070 goals. India needs to prioritize fluidized bed systems (which convert coal to syngas) that are suited to India's high-ash coal, integrating CCUS to reduce emissions, and develop industrial clusters focused on coal-to-chemicals, methanol, ammonia, and green hydrogen production to enable economies of scale and value-chain optimization.

The country must also develop indigenous capability, create clearer frameworks and greater incentives for private-sector participation. Because of high capital intensity and technological access constraints, the industry today requires enhanced viability gap funding (VGF), streamlined disbursement processes, innovative risk-sharing mechanisms between governments and private players, and risk-mitigated financing models inspired by past thermal power reforms.

All these gaps and challenges were discussed in the High-level Policy Roundtable on Coal Gasification organized recently by Chintan Research Foundation (CRF) and Ashoka Centre for People-centric energy transition (ACPET). The Roundtable involved inputs from prominent leaders like Dr Anil Jain, Chairperson, Petroleum and Natural Gas Regulatory Board (PNGRB), Dr AK Balyan, Secretary General, Coal Gasifiers Association, Shri Shaswattam, Executive Director, NETRA (NTPC Limited) and Dr Peeyush Kumar, Managing Director, Coal India Limited. The insights shared by the key speakers were followed by a moderated discussion representing Indian industry experts from New Era Cleantech, JSPL, Adani Power and Grant Thorton LLP. Industry leaders from Chinese companies like Chindustry (Shanghai) Technology Co. Limited which is working extensively on coal gasification technologies in China also took part in the discussion.

This conversation 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. India's challenge is not whether to use coal, but how to use it more intelligently, efficiently, and responsibly in the decades ahead. •

Views expressed are personal.
The article was originally published by The Hans India on April 17, 2026.

QUOTED & NOTED

Debajit Palit, who heads the Chintan Research Foundation (CRF), points out that India continued to use the gasification route to power and heat generation, but not for chemicals and liquid fuels. “We never thought of a crisis in supply of LNG and LPG,” he adds.

04

FROM COAL TO CHEMICALS

Unlocking State-Level Gains through Coal Gasification

By Dr Debajit Palit
Centre Head, Centre for Climate Change and Energy Transition, CRF
and Shagun Mamgain
Research Consultant, CRF

ELEVATING THE COAL STATES

The West Asia conflict has disrupted energy flows exposing India's structural dependence on imported fossil fuels. The implications have been immediate and material, as India imports a large part of its total oil and gas requirement. Amidst the geopolitical turbulence, the Indian Cabinet recently approved the next round of climate commitments, maintaining its track record of carefully balancing developmental imperatives with environmental responsibility.

Despite the international pressure to move away from fossil fuel, India's dependence on coal is likely to remain in the short- to medium-term. Beyond the coal based thermal power generation, new areas such as coal gasification for producing coal-to-gas, chemicals, and liquid-fuels are being explored to improve India's its energy security and supply chain resilience. In addition, these projects can help boost the regional economic development of the coal bearing states, which otherwise is facing uncertainty because of likely closure of coal mines.

What is Coal Gasification?

Coal gasification involves the process of converting coal to synthetic gas (syngas), which is a mixture of carbon monoxide, hydrogen, carbon dioxide and other minor constituents like methane and water vapour. The gas is produced by partial oxidation of coal at high temperature and pressure. This syngas is useful for production of various chemicals, hydrogen as well as for power generation.

Despite renewable expansion, direct use of coal remains central to India's baseload power due to intermittency and storage constraints, underscoring its continued strategic importance. Studies by NITI Aayog and others indicate that coal will continue to provide base load power at least till 2050s, beyond which its use may decline. Thus, alternative use of coal is essential to ensure India's energy security and derive value from a commodity, which is in abundance in India.

Use of Syngas

The syngas produced through coal gasification can support methanol production and other chemicals, which India currently imports in large quantity. Methanol is a relatively cleaner fuel that can substitute fossil oil in transport, with significantly lower emissions. Growing global demand, particularly in shipping, further strengthens its relevance. Domestic methanol production would also support India's pharmaceutical sector by supplying key inputs for Active Pharmaceutical Ingredients, reducing import reliance. Additionally, syngas can be used to produce Dimethyl Ether (DME) that can be blended with LPG. With over 60% of LPG demand met through imports, DME blending offers a viable pathway to enhance domestic energy security.

Coal gasification also produces hydrogen, commonly called grey hydrogen due to associated greenhouse gas (GHG) emissions. When coupled with carbon capture, utilisation and storage (CCUS), it is termed as blue hydrogen, suitable for power generation, heating, and integration into transport systems to reduce

emissions. Recent budgetary support for a CCUS mission creates an enabling framework for linking syngas production with carbon management. The hydrogen can also be used to decarbonise the hard-to-abate sector such as steel, fertilizer, aluminium etc. thus addressing the environment goals in trade, particularly addressing Carbon Border Adjustment Mechanism (CBAM) penalty, further attracting investments.

Hydrogen from coal gasification can be combined with nitrogen to produce ammonia - a proven and scalable pathway. This is evident in China, where a significant share of ammonia production relies on coal gasification. Expanding domestic ammonia production would reduce India's import dependence - much of which is sourced directly or indirectly (via LNG) from West Asia. Given geopolitical uncertainties, this dependence poses risks to both energy and food security.

Benefits for Coal-States

A strategically scaled coal gasification capacity can attract significant private sector investment in core infrastructure and processing facilities in the coal bearing states. The construction and commissioning of integrated coal gasification complexes are labour-intensive, generating substantial employment opportunities during project development phases. Once operational, these projects create significant direct employment across operations and maintenance, along with a much larger pool of indirect jobs across logistics, MSMEs, services, and ancillary industries. For instance, the Adani Group and New Era Clean Tech's projects in Odisha and Vidarbha are expected to create more than 46,000 jobs. Furthermore, coal mine lands can be repurposed to build infrastructure, supporting the coal gasification processes.

This momentum can further catalyze the development of downstream industries such as petrochemicals, fertilizers, and specialty chemicals, leading to the creation of integrated industrial clusters and regional economic hubs. Considering the potential, a collective investment of more than Rs. 200,000 crores have been committed by Coal India subsidiaries and leading private sector players in some of the coal bearing states such as Odisha, Jharkhand, Chhattisgarh, Maharashtra and West Bengal. These states have the potential to become a hub for energy industries driving regional economic development and creating jobs. However, the success of these projects depends on the enabling policies by the central and the state governments.

Need for Strategic Policy Interventions

The Government of India launched the National Coal Gasification Mission in FY 2020-2021 aiming to gasify 100 million tonnes of coal by 2030 to maximise the value and utility of coal in a relatively cleaner way. Despite the Mission, the sector has seen limited progress, constrained by technological and economic challenges. India's high-ash coal necessitates customised gasification technologies, alongside integration with CCUS to mitigate emissions. These projects are capital-intensive, involving high upfront investments, complex ash-handling requirements, and stringent environmental compliance. Long gestation periods - typically 5 to 7 years - further elevate financial risks and deter private sector participation.

A key barrier has been the absence of strong demand- and supply-side incentives. Access to viability gap funding (VGF) and, more importantly, assured offtake mechanisms are critical for improving investor confidence. For capital-intensive projects, bankability hinges on predictable revenue streams, making offtake policies essential to unlock investments.

While a comprehensive business model for a coal gasification ecosystem is still evolving, stakeholder consultations by the authors point to clear priorities. At the central level, recognising these projects as core infrastructure can enable access to affordable coal through transparent auctions, streamline approvals, and affordable capital.

State governments have a pivotal role in facilitating cluster-based development while expediting pre-construction processes such as land acquisition, clearances, and compliance approvals including environmental clearances. Preferential land aggregation and allocation, stamp duty exemptions and flexibility for sub-leasing to downstream units can further enable industrial clustering and reduce project cost. Fast tracking these stages can significantly reduce project construction timelines.

Furthermore, targeted incentives such as reduced power tariff, electricity duty exemptions, and reliable grid connectivity can substantially improve project bankability. Ensuring long-term coal linkages, water availability with recycling measures, multiple rights of way for pipelines, conveyors, transmission lines etc. and robust single-window clearance systems will be crucial to scale up coal gasification.

Coal creates local pollution as well as GHG emissions, but it should not be seen as a binary choice between coal versus clean energy. India's people-centric energy transition will be a symbiotic co-existence of coal, used in better way like coal gasification, and clean energy, placing people at the core by addressing inequality, local industrialisation, and economic development. Coal will evolve during such a transition, generating value added products, substituting imports and ensuring energy security. •

Views expressed are personal.
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05

COAL GASIFICATION

Catalysing India's Chemical Industry Growth and Achieving Aatmanirbharta

By Shagun Mamgain
Research Consultant, CRF
and Dr Debajit Palit
Centre Head, Centre for Climate Change and Energy Transition, CRF

CHEMICAL INDUSTRY GROWTH

India has a growing chemical industry that contributes to around 7% of the country's GDP. The industry's growth is heavily fuelled by the increasing domestic demand. With the industry producing more than 80,000 chemical products, it significantly contributes to agriculture, pharmaceuticals, textiles, packaging, and construction. Despite being one of the highest global consumers, India's chemicals trade deficit at more than US$ 30 billion, underscores the high dependence on imported feedstock and specialty chemicals, particularly from China. The West Asia geopolitical crisis has further aggravated the situation, calling for India to rethink its strategy.

Coal has traditionally been used for power generation with coal contributing almost 70% of India's electricity generation despite aggressive renewable expansion. Studies by NITI Aayog, Chintan Research Foundation and others indicate that coal will continue to provide base load power at least till 2050s, beyond which coal's use may decline. Use of coal is essential to ensure India's energy security and derive value from a commodity, which is in abundance in India, estimating at nearly 400 billion tonnes, among the largest globally.

Coal could be gasified to produce gas for power generation, hydrogen, and chemicals like methanol, olefins, dimethyl ether (DME), and ammonia, among others, to reduce India's import vulnerability as well as secure the raw materials used to make these products.

What is Coal Gasification?

Coal gasification technology involves the process of converting coal to syngas, which is a mixture of carbon monoxide, hydrogen, carbon dioxide and other minor constituents like methane and water vapour. This is done by partial oxidation of coal at high temperature and pressure.

Driving supply-chain resilience: Reducing import dependence

The success of coal to chemicals in China shows that coal can be used for both gasification and liquefaction to produce chemicals. China started focusing on modern gasification technology in the 2000s, using its locally available coal, to produce methanol, urea, DME, among others. Methanol to Olefins (MTO) technology was at the centre of this transition. Olefins, particularly ethylene, propylene, and butadiene, are the building blocks for the petrochemical industry. Not only was China's import dependence reduced, but coal's use also increased its domestic demand.

Methanol plays a critical role in the production of Active Pharmaceutical Ingredients (APIs), compounds essential for producing medicines. With India importing 70% of its APIs, methanol production using local coal could help India strengthen its supply chain resilience for APIs to support generic medicine production, the largest in the world.

The DME obtained through coal gasification can be blended with LPG, thus reducing India's import dependence.

Hydrogen produced from syngas, integrated with carbon capture, can be combined with nitrogen to produce ammonia and urea - a proven pathway being used in China - to reduce our imports.

Syngas can also be used in gas-based plants to produce electricity, thereby enhancing grid stability by addressing the variability of renewable energy and managing peak load.

What it brings for India's regional development?

Coal gasification projects could be implemented in the coal-belt states. With construction and operation of integrated coal gasification complexes being labour-intensive, it will generate substantial direct jobs along with a much larger pool of indirect jobs across logistics, MSMEs, services, and ancillary industries. This will help boost the local economy and address the issue of job losses due to the shift away from coal used for thermal generation. In sum, coal gasification can facilitate a just transition for the mining communities affected by mine closures.

Pathway for India

Understanding the potential, the Indian Government launched the National Coal Gasification Mission in 2020 with the target of achieving 100 MT of coal gasification by 2030. Despite the potential, coal gasification in India has seen limited progress, constrained by technological and economic challenges. The time is ripe now for the central government to renew its focus by providing infrastructure status to the sector, which can enable long-term coal linkages through transparent auctions, streamline approvals, and attract affordable capital. Furthermore, custom duty waivers and viability gap funding for early adopters will help in ensuring project viability. The state governments can facilitate the speeding up of land acquisition, water allocation and recycling, environmental clearances, compliance approvals, and specialised electricity tariffs for the integrated coal gasification and chemicals clusters, to enable economies of scale and value-chain optimization.

The transition to coal gasification should be considered a strategic necessity for India and not an economic burden, as this would help reduce India's vulnerability, strengthening supply chain resilience and achieving Aatmanirbharta. The coal to chemical industry sector can be established in a phased manner, not by a binary of replacing oil and gas, but in a complementary fashion to produce chemicals. Over time, the phased shift can make coal gasification the major source for generating chemical products. •

Views expressed are personal.
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THE KEN

MAKE INDIA COMPETITIVE AGAIN

EDITION #57 • 18 MAY 2026 • 8 MIN READ

India's Rs 37,500 crore coal bet against oil shocks has one big lesson: be more like Jindal

Coal gasification promises energy security, fertiliser resilience, and industrial self-reliance. So why does India have only one convincing success story?

by Inderpal Singh

"[Syngas] is being positioned as a bridge technology in India's coal transition pathway," said Debajit Palit, head of the Centre for Climate Change and Energy Transition at the Chintan Research Foundation, and former director at TERI.

06

FROM ONE MOLECULE TO MANY

Unlocking the Potential of Coal Gasification

By Dr Debajit Palit
Centre Head, Centre for Climate Change and Energy Transition, CRF
and Shagun Mamgain
Research Consultant, CRF

LPG, HYDROGEN AND CHEMICALS

The article "Reframing India's Energy Transition Paradigm" in the Enersider April 2026 issue by the first author, highlighted that the discourse on achieving India's climate targets must move beyond the binary of fossil and non-fossil to electrons and molecules for an effective and systemic energy transition. Coal - a versatile molecule that can be converted into both electrons and a range of value-added molecules - fits well within this framework, aligning with India's development-led climate agenda and its pursuit of energy security.

The West Asia conflict has disrupted energy flows exposing India's structural dependence on imported molecules like LPG and crude oil. The implications have been immediate and material, as India imports a large part of its total oil and gas requirement. To enhance India's energy security and reduce the foreign exchange outflow, these molecules should be replaced with domestically produced molecules. With the country having large reserves of coal, the gasification of coal can provide the solution.

What is Coal Gasification?

Coal gasification involves the process of converting coal to synthetic gas (syngas), which is a mixture of carbon monoxide, hydrogen, carbon dioxide and other minor constituents like methane and water vapour. The gas is produced by partial oxidation of coal at high temperature and pressure. This syngas can be used to produce electrons as well as range of value-added molecules for use in the production of speciality chemicals, fertilisers and hydrogen.

Enhancing Energy Security and Achieving Sovereignty

The syngas produced through coal gasification can support methanol production and other speciality chemicals, which India currently imports in large quantity. Methanol is a relatively cleaner fuel that can substitute fossil oil in transport, including shipping, as well as support India's pharmaceutical industry by meeting solvent requirement for producing Active Pharmaceutical Ingredients (APIs), reducing import reliance. This would help increase the supply chain resilience of the India's pharmaceutical sector, which is the largest producer of generic medicines globally but depends on imported APIs. Additionally, syngas can be used to produce Dimethyl Ether (DME) that can be blended with LPG in significant proportions. With over 60% of LPG demand met through imports, DME blending offers a viable pathway to enhance domestic energy security.

Coal gasification produces hydrogen, commonly called grey hydrogen due to associated greenhouse gas emissions. When coupled with carbon capture, it is termed as blue hydrogen, suitable for power generation, heating, and integration into transport systems to reduce emissions. The hydrogen can also be used to decarbonise the hard-to-abate sector such as steel, fertilizer, aluminium etc. thus also addressing the environment goals in trade, particularly addressing Carbon Border Adjustment Mechanism (CBAM) penalty, further attracting investments.

Hydrogen from coal gasification can be combined with nitrogen to produce ammonia - a proven and scalable pathway. This is evident in China, where a significant share of ammonia and urea production relies on coal gasification. Expanding domestic ammonia production to produce urea would reduce India's import dependence - much of which is sourced directly or indirectly (via LNG) from West Asia.

Despite the renewable expansion, direct use of coal remains central to India's baseload power due to intermittency and storage constraints, underscoring its continued strategic importance. Studies by NITI Aayog, Chintan Research Foundation (CRF) and others indicate that coal will continue to provide base load power at least till 2050s, beyond which its use may decline. India usually relies on gas-based power plants to meet the peak demand in summers. However, these plants mostly use imported gas, vulnerable to uncertainties and price shocks. Syngas can help meet peak power demand, balancing variable renewable energy (VRE) and maintain grid stability. The carbon intensity of using coal to produce electricity through direct combustion is 820 grams CO_2eq. per kWh, which can be reduced to less than half if an integrated coal gasification plant coupled with carbon capture, utilisation and storage (CCUS) is used.

Benefits for Coal-States

A strategically scaled coal gasification capacity can attract significant private sector investment in core infrastructure and processing facilities in the coal belt states such as Odisha, Jharkhand, Chhattisgarh and Maharashtra. The construction and commissioning of integrated coal gasification complexes are labour-intensive, generating substantial employment opportunities during project development phases. Once operational, these projects create significant direct employment across operations and maintenance, along with a much larger pool of indirect jobs across logistics, MSMEs, services, and ancillary industries. Furthermore, coal mine lands can be repurposed to build infrastructure, supporting the coal gasification processes.

These states have the potential to become a hub for energy industries driving regional economic development and creating jobs. The success of these projects, however, depends on the enabling policies by the central and the state governments.

Central and State level Strategic Policy Interventions

The Indian Government launched the National Coal Gasification Mission in 2020 aiming to gasify 100 million tonnes of coal by 2030. Despite this, the sector has rarely progressed, constrained by technological and economic challenges. India's high-ash coal necessitates customised gasification technologies, alongside integration with CCUS to mitigate emissions. The projects are capital-intensive, have long gestation periods, require complex ash-handling requirements, and stringent environmental compliances. All these increase the financial risks and deter private sector participation.

A key barrier has been the absence of strong demand- and supply-side incentives. Access to viability gap funding (VGF) and, more importantly, assured offtake mechanisms are critical for improving investor

confidence. For capital-intensive projects, bankability hinges on predictable revenue streams, making offtake policies essential to unlock investments.

While a bankable business model for the coal gasification sector is still evolving, stakeholder consultations, as part of CRF research, point to clear priorities. At the central level, recognising the coal gasification projects as core infrastructure can enable access to secured supply of coal through transparent auctions, streamline approvals, and low-cost finance.

State governments have a critical role in facilitating cluster-based development while expediting pre-construction processes such as land acquisition, clearances, and different compliance approvals including environmental clearances. Preferential land aggregation and allocation, stamp duty exemptions and flexibility for sub-leasing to downstream units can further enable industrial clustering and reduce project cost. Fast tracking of different aspects of project approvals can significantly reduce project construction timelines.

Furthermore, targeted incentives such as reduced power tariff, electricity duty exemptions, and reliable grid connectivity will substantially improve project bankability. Ensuring long-term coal linkages, water availability with recycling measures, multiple rights of way for pipelines, transmission lines, among others, will be crucial to scale up coal gasification.

India's dependence on the "buried sunshine", as coal is often called, is likely to remain. The transition to coal gasification should be considered a strategic necessity and not an economic burden, as this would help reduce India's energy vulnerability, strengthening energy molecules supply chain resilience and achieving Aatmanirbharta. India's will need a symbiotic co-existence of coal, used in better ways like coal gasification, and clean and renewable energy to ensure energy security, energy availability and energy sovereignty. •

Views expressed are personal.
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07

FUELLING THE NATION FROM WITHIN

Addressing Imports through Domestic Coal Gasification

By Dr Debajit Palit
Centre Head, Centre for Climate Change and Energy Transition, CRF
and Shagun Mamgain
Research Consultant, CRF

SYNGAS FOR POWER GENERATION

Amid a volatile global energy landscape, the coming summer might be challenging for India with high expected electricity demand. The West Asia conflict has tightened gas supplies and pushed prices upwards, threatening the viability of gas-based generation, used to meet peak demand. Beyond this crisis, gas-based plants, mostly reliant on imported gas, will continue to exacerbate vulnerabilities to geopolitical risks and market fluctuations not just for power generation but also for imported commodities like ammonia, urea, and methanol. Coal gasification can emerge as a strategic solution by leveraging India's abundant coal reserves to cut imports, bolster domestic electricity generation and enable a cleaner utilization of coal, thus unlocking value from the nation's key resource.

What is Coal Gasification?

Coal gasification technology involves the process of converting coal to synthetic gas or syngas (SNG), which is a mixture of carbon monoxide (CO), hydrogen (H2), carbon dioxide (CO_2) and other minor constituents like methane and water vapour. This is done by partial oxidation of coal at high temperature and pressure to produce SNG. This syngas is useful for hydrogen production, various chemicals, as well as a fuel for gas turbine combined cycles for power generation. The SNG can thus be positioned as a bridge technology in India's coal transition pathway towards NetZero by 2070.

Driving Power Generation

The government usually relies on gas-based power plants (GBPs) to meet the peak demand in summers. However, these GBPs mostly use imported gas, vulnerable to uncertainties and price shocks. Coal gasification could help India produce SNG, which can help meet peak power demand, balancing variable renewable energy (VRE) and maintain grid stability.

Currently, the Ministry of Power provides minimum off-take guarantee tenders to procure energy from GBPs for peak demand hours. During the summer crunch periods of 2023, 2024, and 2025, energy procured from the selected GBPs was 317 MU, 482 MU and 1,477 MU respectively. The average PLF of GBPs fluctuated between 12% and 25% from 2019 to 2024, largely influenced by imported LNG price trends. The total installed capacity of GBPs in India is around 24 GW. With lower utilisation and higher gas prices, electricity prices usually range between Rs 10 – Rs 15 per kWh, much higher than coal or renewable based electricity supply. Prolonged periods of high prices have also forced some GBPs into extended inactivity, rendering several of them no longer technically viable for operation. With India producing only 50% of its annual gas consumption and domestic gas being primarily allocated for transport and household consumption, GBPs will continue to face vulnerability from high import price, though their importance in providing flexibility and managing peak demand and grid stability will increase in coming years with more VRE integrated to the grid. Gasification, on the other hand, if tapped properly, can provide the SNG at a relatively cheaper rate to help improve the grid stability as well as making peak load power more affordable. Study by NTPC indicate that coal gasification can help reduce the price of peak demand power generation below Rs. 10 per kWh.

Producing Hydrogen

Coal Gasification can also help in producing hydrogen. The hydrogen derived from coal is called grey hydrogen due to emission of greenhouse gases (GHG). However, if this is coupled with carbon capture, utilisation and storage (CCUS) systems, the gas is called blue hydrogen, which can be utilised for power generation and heating purposes. Hydrogen also has the potential to be integrated in existing transportation infrastructure helping to reduce GHG emissions. With the recent budgetary announcement of the CCUS mission, the framework and necessary funding for coupling SNG production with CCUS are already in place.

The hydrogen produced though coal gasification can be mixed with nitrogen, which is then purified to produce ammonia. This represents a proven, economically and environmentally viable pathway, as evidenced by China - the world's largest producer of ammonia - where roughly 78% of production in 2024 was from coal-based process, predominantly using gasification technologies.

Locally produced ammonia would also reduce the dependence on imported urea. Urea is essential for agricultural productivity and India is highly dependent on West Asia. With around 20% of direct urea and much of the LNG used to produce domestic urea sourced from West Asia, geopolitical instability could have a direct impact on India's food security.

Reducing Import Dependence

Globally, India is among the largest importers of methanol mainly sourcing from countries such as Saudi Arabia, Qatar, Oman and Bahrain. Given the current geopolitical tension and conflicts, this heavy dependence places significant pressure on India's energy security and supply stability. The government has been working on initiatives to boost the local methanol production as a part of a broader strategy to enhance India's energy security and sustainability.

The SNG produced by coal gasification can help in methanol production. SNG undergoes a water-gas shift reaction to achieve the optimal H2/CO ratio ideal for a methanol synthesis. Methanol is a relatively cleaner fuel and can replace fossil oil in transportation and LPG and kerosene in cooking fuel. It burns efficiently in all internal combustion engines, produces almost no particulate matter, no soot, almost nil SOX and NOX emissions.

The demand for methanol has also been on the rise for the shipping industry, which is looking out for alternative fuel options to reduce emissions. Domestic production of methanol would also help in meeting solvent requirement for producing Active Pharmaceutical Ingredients (APIs). This would help increase the supply chain resilience of the Indian Pharmaceutical Sector, which produces the largest provider of generic medicines in the world but depends on imported APIs.

Around 62–65% of India's demand for LPG is met through imports. India imported about 23.3 million tonnes of LPG in 2025, up 8.4 per cent from 2024. The SNG derived from coal gasification can also be used to produce Dimethyl Ether (DME) that can be blended with LPG in significant proportions, thus reducing India's import dependence.

Status of Gasification in India

The concept of using coal gasification to meet some of India's fuel needs first emerged in mid-1950s when then Director of the Regional Research Laboratory Hyderabad (now the CSIR-Indian Institute of Chemical Technology) had proposed to the government to allow the institute to produce and supply coal syngas through pipelines for domestic and industrial use. The proposal did not find takers in the government as the policy focus at that time was on finding petroleum reserves. Thereafter, during the mid-2000s, biomass gasifiers were promoted under the Ministry of New and Renewable Energy's Village Energy Security Programme, as well as under the biomass-for-thermal-use scheme for applications such as rubber drying, institutional cooking, and dyeing, among others. Support was also provided through the UNDP-supported Biomass Energy for Rural India project. However, technology management in remote rural sites posed challenges, and the easy availability of natural gas reduced the use of thermal gasifiers. For instance, in Morbi (Gujarat) ceramic cluster, coal gasifiers were being used in almost all the tile manufacturing units. However, the National Green Tribunal ordered the banning of coal gasifiers in 2019 and advised the units to switch to PNG to control the air and water pollution in the Morbi-Wankaner region. Furthermore, with the growth of National Solar Mission, the gasifier programme lost importance with the policy makers.

However, considering the importance of coal in India's sustained economic growth, the Government of India launched National Coal Gasification Mission in 2020 with the target of achieving 100 MT of coal gasification by 2030. Many key industry players have since then joined the sector. BHEL had set up a pilot plant in Trichi in 2020, producing 6.2 MW of power. However, they faced some issues with handling high-ash coal. Thermax Limited installed a pilot plant for coal-to-methanol production in Pune. In May 2020, Coal India also announced 3 coal gasification projects for coal-to-methanol production. In 2024, the Union Cabinet further approved the scheme for promotion of Coal Gasification Projects of Indian Public Sector Enterprises and Private Sector with an outlay of Rs. 8,500 crores. Yet, there have been persistent gaps in the successful commissioning of these projects.

The current energy crisis has put gasification again at the centre stage. The Rajya Sabha proceeding on Coal Gasification Projects on March 23, 2026 listed seven coal gasification projects planned across Maharashtra, Odisha and West Bengal with an investment of Rs. 64,000 crores. Among them, the Talcher plant in Odisha - a joint venture between GAIL, CIL, RCF, and FCIL - is expected to be commissioned in 2027–28 and is planned with a capacity of 2,200 MTD of ammonia and 3,850 MTPD of urea production. Other companies, such as New Era Cleantech and the Adani Group, have also begun work on coal-to-chemicals projects in the Vidarbha region of Maharashtra.

Challenges in Scaling

Despite the numerous benefits that can be derived from coal gasification, the sector remains limited to a few pilot projects. India's high-ash coal requires customised gasification technologies, along with CCUS integration to reduce emissions. Coal gasification projects have high CAPEX, require ash-handling capabilities, and environmental compliance. Additionally, they are characterised by long construction timelines of 5 to 7 years that further escalates project costs and financial risks.

Private sector participation has been constrained by inadequate supply and demand-side incentives. Access to Viability Gap Funding (VGF) and assured offtakes, both are critical for any capital-intensive, long gestation projects. Industries' willingness to invest will improve if buyers promise to buy their gas and chemical products. Offtake policies are thus critical including for the byproducts to nudge investments.

Furthermore, India currently lacks a robust business model that supports a complete coal gasification ecosystem. Not aggressively forming Joint Ventures (JVs) with Public-sector Undertakings (PSUs) like CIL, BHEL for capex dilution, de-risking investments, expertise transfer, and feedstock access, adds to challenges. Furthermore, reduced resource planning and lack of tailored feedstock matching (blending coal with pet coke to reduce ash content) is also hindering in expansion of these projects. Greater industry participation is essential to identify gaps and calibrate targeted government support.

Strategic Policy Directions

Stakeholder consultations with industry representatives suggest a set of practical steps to accelerate coal gasification in India. Policymakers should consider classifying these projects as core infrastructure, enabling access to long-term, affordable coal through transparent auction mechanisms, providing offtake assurances, and expediting approvals with active support from state governments - thereby reducing import dependence on fuels such as natural gas.

Industry players should explore cluster-based approaches and partnerships with public sector enterprises, optimise feedstock through by blending, initiate pilot-scale projects to develop bankable business models and de-risking investments, and collaborate with research institutions to develop customised technologies for India. Technology providers and research institutions, in turn, should focus on developing solutions tailored to the characteristics of Indian coal, integrating CCUS technologies to mitigate emissions, and establishing environmentally sound systems for managing by-products such as wastewater and slag. It is time to recognise that coal is a versatile fuel. The fuel is not the enemy - the carbon emissions are. The emissions can be captured and used as a resource for producing other products. Coal can strengthen India's supply chain resilience and enhance energy security amid geopolitical uncertainties if planned and used properly. •

Views expressed are personal.
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Business Standard

Home / Industry / News / Why India must ramp up coal gasification as part of its energy strategy

Why India must ramp up coal gasification as part of its energy strategy

India's abundant coal reserves and rising energy demand make coal gasification a key strategy to reduce import dependence, boost industrial fuel supply, and strengthen long-term energy security

Representative image from file.

Policy Support

"Coal can be a bridge for India's energy security amid vast reserves and a fivefold increase in energy needs by 2047. The need of the hour is stronger private-sector engagement that will help overcome barriers such as capital and regulation. This would then pave the way for scaling up coal gasification projects in the country," said Debajit Palit, who heads the Centre for Climate Change and Energy Transition, Chintan Research Foundation (CRF).

08

FUELLING AATMANIRBHARTA

The Strategic Role of Coal in North East India

By Shagun Mamgain
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UNTAPPED NORTH EASTERN COAL

Contributing to over 13% of the nation's crude oil output and 16% of the natural gas output, the Northeastern Region (NER) of India has been a traditional hub for the oil and gas industry since the time of British India. One can trace the roots of India's petroleum industry to 1867 when the first oil well was drilled at Digboi in Assam. The discovery marked the inception of the India's oil exploration and production activities.

The NER is also home to abundant coal reserves, which are considered crucial for energy security, particularly in the light of the conflict in West Asia. In fact, the mining of coal was first started, around the same time of oil exploration in Upper Assam, in 1882 by the erstwhile Assam Railways and Trading Company at Makum Coalfields in Upper Assam. Though the NER region accounts for less than 1% of the total national coal reserves, however, its relatively lower ash percentage makes it crucial to be explored. Among the NER states, Meghalaya holds the highest amount of coal accounting to 583 million tonnes, followed by Assam and Nagaland - both with approximately 510 million tonnes respectively. The Coal India Limited (CIL), through their subsidiary North Eastern Coalfields, plays a crucial role in mining of coal in the NER states. However, coal production in NER is going down, with the state-owned coal producer suspending mining operations in many mines due to a combination of environmental, topographical, and geological factors. Similarly, there has also been decline of coal production in Meghalaya due to a 2014 ban on rat-hole coal mining imposed by the National Green Tribunal.

With recent focus on energy security, this versatile commodity possessed by the region could act as a complimentary add on to the current energy production from existing oil and gas energy hub in the region, if used in a better way than the conventional methods. Exploring the potential of the available coal for liquefaction and gasification could help the country drive its clean coal pathway and contribute to the economic development of the NER.

What is Coal Gasification

Coal gasification involves the process of converting coal to synthetic gas (syngas), which is a mixture of carbon monoxide, hydrogen, carbon dioxide and other minor constituents like methane and water vapour. The gas is produced by partial oxidation of coal at high temperature and pressure. This syngas can be used to produce various speciality chemicals, hydrogen as well as for power generation. Gasification helps in not only producing the thermal energy but also capturing the chemical value of coal.

Northeastern Coal: A Strategic Solution

The coal found in the NER has one of the most suitable chemical compositions for gasification. In Meghalaya, coal found in the Garo and Khasi hills district is relatively cleaner with low ash content as compared to the coal found in other regions of India. A petrochemical evaluation of the NER coal states that the low-ash coal is highly suitable for coal gasification and liquefaction technologies. The chemical composition of this coal keeps it non-banded in nature. This means that the coal is fine-grained, and rich

in hydrogen and volatile matter. Being rich in vitrinite, this coal has high industrial value as it has low ignition and burnout temperatures making it easy to gasify or liquefy. The gasification process can also help facilitate the production of hydrogen, and liquefaction can produce other chemicals like ethanol and methanol. China has very successfully used coal gasification and liquefaction technologies to utilise their vast coal reserves for producing value added chemicals and fertilizers.

Coal gasification occurs at high temperatures with extensive cleaning needed to remove contaminants from the syngas produced. The coal found in Meghalaya is vitric in type making it high in volatile matter, therefore, rich in hydrocarbons, combustible gases and tar. This coal is sub-bituminous in rank, which means that it has the capacity of driving faster conversions during the gasification process, helping in stabilising the reactions. This type of coal is highly suitable for fluidised-bed gasifiers as it usually uses low ash content coal.

Coal gasification technologies could also be extended to other parts of the NER particularly Assam. The Makum Coal Field is one of the largest coal fields in Assam with approximately 305 million tonnes of proved coal reserve. Its chemical composition includes 2-9% moisture, least among the other coal reserves in the state with an average of 10% moisture content and 38-51% of volatile matter thus having high industrial value.

However, coal mining carries environmental risks. Given the terrain and forest areas in the NER region, it is equally important to maintain an equilibrium between energy development, environmental protection, technology availability and viability of the projects.

Challenges in Scaling and Incentives Needed

Despite having high quality coal most suited for coal gasification, there are barriers to scaling up coal gasification in the NER. Unlike the coal-belts in other Eastern states, the coal fields in Meghalaya are fragmented in small areas with complex land ownership rights. Individuals own different mining lands, which makes it difficult for a sustainable controlled mining. Aggregation of these decentralised coalfields is needed to extract coal in a structured manner without impacting the environment.

Another crucial challenge that is faced while mining in the NER is that of terrain. These coalfields often occur in complex and remote areas making it difficult to drive investments. Therefore, to overcome these barriers, a NER focused incentive mechanism will be needed under the National Coal Gasification Mission, which was launched in 2020. The recent sanction of Rs. 37,500 crores by the Government of India to promote coal gasification could also play a key role in scaling projects in the NER, if some dedicated fund is allocated for development of coal gasification projects in NER.

While the Government of India has recognised the importance of coal gasification, there are challenges that continue to persist. A key barrier has been the absence of strong demand- and supply-side incentives.

Beyond the recent viability gap funding support announced, assured offtake mechanisms are crucial for improving investor confidence. For capital-intensive projects, bankability hinges on predictable revenue streams, making offtake policies essential to unlock investments for which infrastructure status would play a major role.

State governments have a pivotal role in facilitating the pre-construction processes such as land acquisition, clearances, and compliance approvals including environmental clearances. Preferential land aggregation and allocation, stamp duty exemptions among others. Flexibility for sub-leasing to downstream units can further enable industrial clustering and reduce project cost. Fast tracking these stages can significantly reduce project construction timelines.

The coal gasification industry in India also faces a lack of a structured business ecosystem. There is thus a need to promote a cluster-based development model encompassing access to raw materials, inputs, skilled labour and targeted capacity building to scale up gasification projects. Utilising the resources efficiently, the NER can bridge this gap by providing a complete ecosystem.

Developing Energy Hub

A strategically scaled coal gasification capacity can attract significant private sector investment in core infrastructure and processing facilities in the coal bearing states of the NER, particularly Assam and Meghalaya. The construction and commissioning of integrated coal gasification complexes are labour-intensive, thus generating substantial employment opportunities during project development phases. Once operational, these projects can create significant direct employment across operations and maintenance, along with a much larger pool of indirect jobs across logistics, MSMEs, services, and ancillary industries. This momentum can further catalyse the development of downstream industries such as petrochemicals, fertilisers, and specialty chemicals, leading to the creation of integrated industrial clusters and economic hubs in the region. The development of the coal gasification industry will further strengthen India's energy security, a domain in which the NER has been a pioneer since the discovery of oil and coal in the region.

Views expressed are personal.
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09

BLACK ROCK, CLEAN MOLECULE

The case for coal to hydrogen

By Akanksha Jain
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Research Consulatant, CRF

BLUE HYDROGEN

The Union Cabinet's ₹37,500 crore incentive scheme to promote surface coal and lignite gasification into syngas and downstream products is one of the most significant policies of our times. This is even more consequential for India's hydrogen ecosystem. Be it urea or ammonia used in fertilisers or a refinery for transport fuel, all of it runs on a molecule called hydrogen. India consumes roughly 6 million metric tonnes (MMT) of this workhorse molecule every year, a number expected to double to 12 MMTPA by 2030 as the economy expands. But the real challenge is where this hydrogen comes from, its planetary cost, and India's import dependence. The answer increasingly points to coal.

Globally, 96% of hydrogen is produced by steam methane reforming of natural gas, emitting 9–12 kg of CO_2/kg of hydrogen produced. This is "grey hydrogen." What is less discussed, and more relevant to India, is "brown hydrogen" produced from coal gasification, a thermochemical process in which coal or lignite reacts with steam and oxygen, undergoing partial oxidation to produce synthesis gas (syngas), a mixture of hydrogen and carbon monoxide.

While coal gasification emits CO_2 at levels comparable to those of natural gas reforming, it produces a high-purity, high-pressure CO_2 stream well-suited for Carbon Capture, Utilisation and Storage (CCUS) technologies. With CCUS, this pathway can produce "blue hydrogen" with over 90% lower emissions than the unabated baseline. This is where Budget 2026-27's ₹20,000 crore CCUS outlay matters as much as the gasification scheme itself. Together, they represent a ₹57,500 crore bet on a blue hydrogen industrial strategy.

Yet India's official hydrogen policy has not caught up with this logic. The National Green Hydrogen Mission (NGHM), with an outlay of ₹19,744 crore over seven years, is India's flagship hydrogen programme, aiming to achieve 5 MMT per annum of green hydrogen production capacity by 2030, supported by 125 GW of dedicated renewable energy. Alongside the NGHM, the Green Hydrogen Certification Scheme of India (GHCI), launched by the Bureau of Energy Efficiency in April 2025, sets a lifecycle emissions threshold of 2 kg CO_2/kg hydrogen, one of the most demanding green hydrogen standards in the world. Eligible production pathways under the GHCI are currently limited to electrolysis powered by renewable energy and biomass-based conversion. Coal gasification with CCUS, regardless of its actual lifecycle carbon intensity, falls entirely outside the certification tent.

In effect, a hydrogen produced from Indian coal via gasification and carbon capture, with a lifecycle intensity below 2 kg CO_2/kg hydrogen, fails India's green certification, while a molecule with identical emissions from an electrolyser with imported critical minerals and high water requirements would pass. That is not rational climate policy but sheer hex-code obsession. India's hydrogen mission obsesses over the colour agenda rather than focusing on the molecule itself, its footprint across the full lifecycle, and, most critically, where it comes from and who controls its supply chain. The solution is simple: include coal gasification with CCUS under the GHCI, using the same emissions threshold as electrolysis. Allow projects to combine gasification and CCUS incentives, and shift the NGHM target from "green" to "clean" hydrogen, including blue hydrogen. Beyond certifications and targets, the strongest case for coal-to-hydrogen is energy sovereignty.

In the financial year 2025-26 alone, India's import bill was ₹2.77 lakh crore, which, along with energy security threats, raises geopolitical and sovereignty vulnerabilities. And it has a domestic solution sitting right beneath the ground— coal. India's 401 billion tonnes of coal reserves are domestic, sovereign, and domestically priced; its supply chain is onshore, and the workforce is Indian. The FOREX stays in the country. A coal-based blue hydrogen economy is not merely cheaper than its alternatives in the Indian context but is also more secure. The self-reliance quotient of a molecule produced from Indian coal, captured with Indian CCUS, is categorically higher than that of green hydrogen dependent on imported electrolyser supply chains and scarce freshwater, or grey hydrogen dependent on imported LNG.

Therefore, India should seriously explore coal gasification for hydrogen. While technological and economic challenges persist, hampering investment and growth in the coal gasification industry, and should be addressed by the new incentive scheme. While the scheme aims to address financial incentives of up to 20% of plant and machinery costs, there is still a lack of clear guidance on offtake assurances and on providing infrastructure status to further strengthen economic viability.

But beyond clean energy, energy security means supply control. Coal offers that, gasification provides the pathway, and CCUS adds climate credibility. Policy certification now needs to align with this reality.

Views expressed are personal.
The article was originally published in Indian Chemical News on June 02, 2026.

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CRF-ACPET ON COAL GASIFICATION IN MEDIA

Perspective and Presence in the Media Landscape

ONE MOLECULE TO MANY

CRF-ACPET's OPINION IN MEDIA

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The Green Coal Transition

India's green industrial revolution hinges on coal gasification — a pragmatic bridge between dependence and clean energy that can succeed only through government–industry collaboration

BY Shishir Priyadarshi 9 Oct 2025 11:21 PM

Shishir Priyadarshi 9 Oct 2025 11:21 PM

India's march towards energy self-reliance and sustainable industrial growth faces a pivotal test. As global energy regimes pivot from fossil fuels to renewables, the role of coal - still India's most abundant indigenous energy source - is under increasing scrutiny. Yet dismissing coal as merely an obstacle to climate ambitions would be a strategic error. Through advanced coal gasification technology, India has a rare opportunity to reconcile its economic, strategic, and environmental objectives. But realising this potential demands policies that move beyond declarations, unleashing private sector dynamism with strong, targeted incentives.

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By Dr Anandajit Goswami & Dr Debajit Palit

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With coal set to anchor India's growth for decades, gasification can reconcile energy security, industrial ambition, and the 2070 climate commitment

Despite the global push for clean energy and India's own ambitious climate goals, the story of coal in the country is far from over. The Viksit Bharat 2047 pathway projects India's electricity demand increasing nearly fivefold, reaching approximately 8,515 billion units by 2047. Along with renewable energy sources, India's energy transition pathway calls for technologies such as coal gasification and Carbon Capture, Utilisation and Storage (CCUS) to help reduce emissions from coal.

With NITI Aayog acknowledging the need for coal in its recently released reports on 'Scenarios Towards Viksit Bharat 2047' and 'Net Zero 2070', high-level deliberations are needed to address a pressing question: Can coal gasification be a bridge technology in the energy transition roadmap to support India's long-term energy security?

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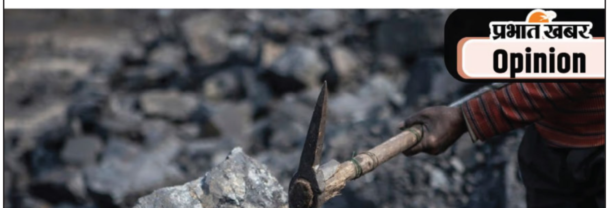

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कोयले पर देश की निर्भरता बनी रहने वाली है. ऐसे में, कोयला आधारित बिजली उत्पादन के अलावा ऊर्जा सुरक्षा और आपूर्ति श्रृंखला की मजबूती बढ़ाने के लिए कोयला गैसीकरण जैसे नये क्षेत्र-जैसे कोयले से गैस, रसायन और तरल ईंधन उत्पादन-की खोज की जा रही है. ये परियोजनाएं कोलफील्ड्स के आर्थिक विकास को भी बढ़ावा दे सकती हैं.

पश्चिम एशिया का संघर्ष ऊर्जा आपूर्ति को बाधित कर रहा है, जिससे आयातित जीवाश्म ईंधनों पर भारत की निर्भरता उजागर हो रही है. इसका असर बड़ा है, क्योंकि भारत अपनी कुल तेल और गैस जरूरतों का बड़ा हिस्सा आयात करता है. भू-राजनीतिक उथल-पुथल के बीच केंद्रीय मंत्रिमंडल ने हाल ही में जलवायु प्रतिबद्धताओं के अगले चरण को मंजूरी देकर विकास जरूरतों और पर्यावरणीय जिम्मेदारी के बीच संतुलन बनाने की परंपरा कायम रखी है. जीवाश्म ईंधनों से दूर जाने की बात की जा रही है, पर अल्प और मध्यम अवधि में कोयले पर देश की निर्भरता बनी रहने की संभावना है. कोयला आधारित बिजली उत्पादन के अलावा ऊर्जा सुरक्षा और आपूर्ति शृंखला की मजबूती बढ़ाने के लिए कोयला गैसीकरण जैसे नये क्षेत्र-जैसे कोयले से गैस, रसायन और तरल ईंधन उत्पादन-की खोज की जा रही है. ये परियोजनाएं कोलफील्ड्स के आर्थिक विकास को भी बढ़ावा दे सकती हैं.

कोयला गैसीकरण के तहत कोयले को संश्लेषित गैस (सिनगैस) में बदला जाता है. यह गैस कार्बन मोनोऑक्साइड, हाइड्रोजन, कार्बन डाइऑक्साइड और मीथेन व जलवाष्प जैसे घटकों का मिश्रण होती है. इसका उपयोग विभिन्न रसायनों तथा हाइड्रोजन व बिजली उत्पादन के लिए किया जा सकता है. नवीकरणीय ऊर्जा के विस्तार के बावजूद अस्थिरता और भंडारण की सीमाओं के कारण कोयले का प्रत्यक्ष उपयोग भारत की बेसलोड बिजली आपूर्ति में केंद्रीय बना हुआ है. नीति आयोग, चिंतन रिसर्च फाउंडेशन और अन्य संस्थाओं के अध्ययन बताते हैं कि 2050 के दशक तक कोयला बेसलोड बिजली प्रदान करता रहेगा. देश की ऊर्जा सुरक्षा सुनिश्चित करने के लिए कोयले के वैकल्पिक उपयोग जरूरी हैं. कोयला गैसीकरण से उत्पन्न सिनगैस मेथनॉल और अन्य रसायनों के उत्पादन में सहायक हो सकती है. मेथनॉल अपेक्षाकृत स्वच्छ ईंधन है, जो परिवहन क्षेत्र में जीवाश्म ईंधन का विकल्प बन सकता है. खासकर शिपिंग में बढ़ती वैश्विक मांग इसकी प्रासंगिकता को मजबूत करती है. मेथनॉल उत्पादन फार्मास्युटिकल क्षेत्र को भी सहारा देगा, क्योंकि यह सक्रिय औषधीय अवयवों (एपीआइ) के लिए जरूरी इनपुट प्रदान करेगा, जिससे आयात पर निर्भरता कम होगी. सिनगैस का उपयोग डाइमिथाइल ईथर उत्पादन में भी किया जा सकता है, जिसे एलपीजी के साथ मिलाया जा सकता है. इससे आयात में कमी आयेगी और घरेलू ऊर्जा सुरक्षा बढ़ेगी.

कोयला गैसीकरण से हाइड्रोजन भी उत्पन्न होती है, जिसे आमतौर पर ग्रीनहाउस गैस उत्सर्जन के कारण 'ग्रे हाइड्रोजन' कहा जाता है. कार्बन कैप्चर तकनीक के साथ जोड़े जाने पर इसे 'ब्लू हाइड्रोजन' कहा जाता है, जिसका उपयोग बिजली उत्पादन, औद्योगिक ताप और परिवहन प्रणालियों में उत्सर्जन कम करने के लिए किया जा सकता है. कार्बन कैप्चर मिशन के लिए बजटीय आवंटन ने सिनगैस उत्पादन को कार्बन प्रबंधन से जोड़ने के लिए एक सक्षम ढांचा प्रदान किया है. स्टील, उर्वरक और एल्यूमिनियम के डीकार्बोनाइजेशन में भी हाइड्रोजन उपयोगी हो सकती है, जिससे पर्यावरणीय लक्ष्य हासिल करने में मदद मिलेगी. कोयला गैसीकरण से प्राप्त हाइड्रोजन को नाइट्रोजन के साथ मिलाकर अमोनिया बनाया जा सकता है. घरेलू अमोनिया और यूरिया उत्पादन के विस्तार से भारत की आयात निर्भरता कम होगी. रणनीतिक रूप से विकसित कोयला गैसीकरण क्षमता बुनियादी ढांचे और प्रसंस्करण सुविधाओं में बड़े निजी निवेश को आकर्षित कर सकती है. एकीकृत कोयला गैसीकरण परिसर श्रम प्रधान होता है, जिससे रोजगार के अवसर पैदा होते हैं. संचालन शुरू होने के बाद ये परियोजनाएं संचालन और रख-रखाव में प्रत्यक्ष रोजगार के साथ लॉजिस्टिक्स, सेवाओं और सहायक उद्योगों में बड़े पैमाने पर अप्रत्यक्ष रोजगार उत्पन्न करती हैं. कोयला खदानों की भूमि का पुनः उपयोग कर गैसीकरण अवसंरचना विकसित की जा सकती है. यह आगे चलकर पेट्रोकेमिकल्स, उर्वरक और विशेष रसायनों जैसे उद्योगों के विकास को भी बढ़ावा दे सकती है, जिससे एकीकृत औद्योगिक क्लस्टर और क्षेत्रीय आर्थिक केंद्र बन सकते हैं. इन संभावनाओं को देखते हुए ओडिशा, झारखंड, छत्तीसगढ़ और महाराष्ट्र जैसे कोयला समृद्ध राज्यों में कोल इंडिया की सहायक कंपनियों और प्रमुख निजी कंपनियों द्वारा दो लाख करोड़ रुपये से अधिक के निवेश की प्रतिबद्धता जतायी गयी है, जो क्षेत्रीय आर्थिक विकास और स्थानीय रोजगार सृजन को बढ़ावा देगी. केंद्र सरकार ने वित्त वर्ष 2020-21 में राष्ट्रीय कोयला गैसीकरण मिशन शुरू किया, जिसका लक्ष्य 2030 तक 10 करोड़ टन कोयले का गैसीकरण करना है, ताकि कोयले के दाम और इसकी उपयोगिता को अधिकतम किया जा सके. हालांकि इस क्षेत्र में प्रगति सीमित रही है. भारतीय कोयले चूंकि उच्च राख वाले हैं, इसलिए विशेष गैसीकरण तकनीकों की जरूरत होती है, साथ ही, उत्सर्जन कम करने के लिए कार्बन कैप्चर के साथ एकीकरण जरूरी है. ये परियोजनाएं पूंजी-गहन होती हैं, जिनमें उच्च प्रारंभिक निवेश, जटिल राख प्रबंधन और पर्यावरणीय अनुपालन शामिल हैं.

कोयला गैसीकरण के लिए व्यवसाय मॉडल विकसित हो रहा है. केंद्र स्तर पर इन परियोजनाओं को कोर इंफ्रास्ट्रक्चर के रूप में मान्यता देने पर पारदर्शी नीलामी से दीर्घकालिक कोयला उपलब्धता सुनिश्चित हो सकती है, अनुमोदन प्रक्रिया सरल हो सकती है और सस्ती पूंजी आकर्षित की जा सकती है. राज्य सरकारों की भूमिका क्लस्टर आधारित विकास को बढ़ावा देने और भूमि अधिग्रहण, पर्यावरणीय स्वीकृति व अनुपालन प्रक्रियाओं को तेज करने में महत्वपूर्ण है. कम बिजली दर, बिजली शुल्क में छूट और विश्वसनीय ग्रिड कनेक्टिविटी जैसे प्रोत्साहन परियोजनाओं की व्यवहार्यता बढ़ा सकते हैं. जल की उपलब्धता, पाइपलाइन, कन्वेयर और ट्रांसमिशन लाइनों के लिए मार्ग अधिकार, तथा सिंगल-विंडो क्लीयरेंस प्रणाली भी कोयला गैसीकरण के विस्तार के लिए जरूरी होंगे. हालांकि कोयला जलाना प्रदूषण और कार्बन उत्सर्जन का कारण बनता है, पर देश का जन-केंद्रित ऊर्जा रूपांतरण एक संतुलित सह-अस्तित्व की मांग करता है, जहां कोयला गैसीकरण जैसे स्वच्छ विकल्पों के साथ नवीकरणीय ऊर्जा का तेज विस्तार हो, साथ ही, औद्योगिक विकास, आर्थिक प्रगति, आपूर्ति शृंखला की मजबूती और ऊर्जा सुरक्षा को बनाये रखा जा सके.

(ये लेखकद्वय के निजी विचार हैं.)

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APRIL 30, 2026 / 16:53 IST

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Coal is the dominant fuel in India for power generation and several industrial uses

By Anvesha Adhikari, Navya, Anjali Goyal, Anandajit Goswami and Rakesh Kacker

CRF's OPINION IN MEDIA

From One Molecule To Many: Unlocking The Potential Of Coal Gasification

By Dr. Debajit Palit & Shagun Mamgain, CRF

An earlier article in the Enersider April 2026 issue - Reframing India's Energy Transition Paradigm - it was highlighted that the discourse on achieving India's climate targets must move beyond the binary of fossil and non-fossil to electrons and molecules for an effective and systemic energy transition.

Coal - a versatile molecule that can be converted into both electrons and a range of value-added molecules - fits well within this framework, aligning with India's development-led climate agenda and its pursuit of energy security.

The West Asia conflict has disrupted energy flows exposing India's structural dependence on imported molecules like LPG and crude oil. The implications have been immediate and material, as India imports a large part of its total oil and gas requirement.

To enhance India's energy security and reduce the foreign exchange outflow, these molecules should be replaced with domestically produced molecules. With the country having large reserves of coal, the gasification of coal can provide the solution.

What is Coal Gasification?

Coal gasification involves the process of converting coal to synthetic gas (syngas), which is a mixture of carbon monoxide, hydrogen, carbon dioxide and other minor constituents like methane and water vapour. The gas is produced by partial oxidation of coal at high temperature and pressure.

This syngas can be used to produce electrons as well as range of value-added molecules for use in the production of speciality chemicals, fertilisers and hydrogen.

Enhancing Energy Security and Achieving Sovereignty

The syngas produced through coal gasification can support methanol production and other speciality chemicals, which India currently imports in large quantity.

Methanol is a relatively cleaner fuel that can substitute fossil oil in transport, including shipping, as well as support India's pharmaceutical industry by meeting solvent requirement for producing Active Pharmaceutical Ingredients (APIs), reducing import reliance.

This would help increase the supply chain resilience of the India's pharmaceutical sector, which is the largest producer of generic medicines globally but depends on imported APIs.

Additionally, syngas can be used to produce Dimethyl Ether (DME) that can be blended with LPG in significant proportions. With over 60% of LPG demand met through imports, DME blending offers a viable pathway to enhance domestic energy security.

Coal gasification produces hydrogen, commonly called grey hydrogen due to associated greenhouse gas emissions. When coupled with carbon capture, it is termed as blue hydrogen, suitable for power generation, heating, and integration into transport systems to reduce emissions.

The hydrogen can also be used to decarbonise the hard-to-abate sectors such as steel, fertiliser, aluminium etc. thus also addressing the environment goals in trade, particularly addressing Carbon Border Adjustment Mechanism (CBAM) penalty, further attracting investments.

Hydrogen from coal gasification can be combined with nitrogen to produce ammonia - a proven and scalable pathway. This is evident in China, where a significant share of ammonia and urea production relies on coal gasification. Expanding domestic ammonia production to produce urea would reduce India's import dependence - much of which is sourced directly or indirectly (via LNG) from West Asia.

Despite the renewable expansion, direct use of coal remains central to India's baseload power due to intermittency and storage constraints, underscoring its continued strategic importance. Studies by NITI Aayog, Chintan Research Foundation (CRF) and others indicate that coal will continue to provide base load power at least till 2050s, beyond which its use may decline.

India usually relies on gas-based power plants to meet the peak demand in summers. However, these plants mostly use imported gas, vulnerable to uncertainties and price shocks. Syngas can help meet peak power demand, balancing variable renewable energy (VRE) and maintain grid stability.

The carbon intensity of using coal to produce electricity through direct combustion is 820 grams CO_2eq. per kWh, which can be reduced to less than half if an integrated coal gasification plant coupled with carbon capture, utilisation and storage (CCUS) is used.

Benefits for Coal-States

A strategically scaled coal gasification capacity can attract significant private sector investment in core infrastructure and processing facilities in the coal belt states such as Odisha, Jharkhand, Chhattisgarh and Maharashtra.

The construction and commissioning of integrated coal gasification complexes are labour-intensive, generating substantial employment opportunities during project development phases.

Once operational, these projects create significant direct employment across operations and maintenance, along with a much larger pool of indirect jobs across logistics, MSMEs, services, and ancillary industries. Furthermore, coal mine lands can be repurposed to build infrastructure, supporting the coal gasification processes.

These states have the potential to become a hub for energy industries driving regional economic development and creating jobs. The success of these projects, however, depends on the enabling policies by the central and the state governments.

Central and State level Strategic Policy Interventions

The Indian Government launched the National Coal Gasification Mission in 2020 aiming to gasify 100 million tonnes of coal by 2030. Despite this, the sector has rarely progressed, constrained by technological and economic challenges. India's high-ash coal necessitates customised gasification technologies, alongside integration with CCUS to mitigate emissions.

The projects are capital-intensive, have long gestation periods, require complex ash-handling requirements, and stringent environmental compliances. All these increase the financial risks and deter private sector participation.

A key barrier has been the absence of strong demand- and supply-side incentives. Access to viability gap funding (VGF) and, more importantly, assured offtake mechanisms are critical for improving investor confidence. For capital-intensive projects, bankability hinges on predictable revenue streams, making offtake policies essential to unlock investments.

While a bankable business model for the coal gasification sector is still evolving, stakeholder consultations, as part of CRF research, point to clear priorities. At the central level, recognising the coal gasification projects as core infrastructure can enable access to secured supply of coal through transparent auctions, streamline approvals, and low-cost finance.

State governments have a critical role in facilitating cluster-based development while expediting pre-construction processes such as land acquisition, clearances, and different compliance approvals including environmental clearances.

Preferential land aggregation and allocation, stamp duty exemptions and flexibility for sub-leasing to downstream units can further enable industrial clustering and reduce project cost. Fast tracking of different aspects of project approvals can significantly reduce project construction timelines.

Furthermore, targeted incentives such as reduced power tariff, electricity duty exemptions, and reliable grid connectivity will substantially improve project bankability. Ensuring long-term coal linkages, water availability with recycling measures, multiple rights-of-way for pipelines, transmission lines, among others, will be crucial to scale up coal gasification.

India's dependence on the "buried sunshine", as coal is often called, is likely to remain. The transition to coal gasification should be considered a strategic necessity and not an economic burden, as this would help reduce India's energy vulnerability, strengthening energy molecules supply chain resilience and achieving Aatmanirbharta. India's will need a symbiotic co-existence of coal, used in better ways like coal gasification, and clean and renewable energy to ensure energy security, energy availability and energy sovereignty.

The views expressed are personal.

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Fuelling the Nation from Within: Addressing imports through domestic coal gasification

May 12, 2026

By Debajit Palit, Centre Head, and Shagun Mamgain, Consultant, Centre for Climate Change and Energy Transition, Chintan Research Foundation

Amid a volatile global energy landscape, the coming summer might be challenging for India with high expected electricity demand. The West Asia conflict has tightened gas supplies and pushed prices upwards, threatening the viability of gas-based generation, used to meet peak demand. Beyond this crisis, gas-based plants, mostly reliant on imported gas, will continue to exacerbate vulnerabilities to geopolitical risks and market fluctuations, not just for power generation but also for imported commodities such as ammonia, urea and methanol. Coal gasification can emerge as a strategic solution by leveraging India's abundant coal reserves to cut imports and bolster domestic electricity generation.

What is coal gasification?

Coal gasification is the process of converting coal to synthetic gas or syngas (SNG), which is a mixture of carbon monoxide (CO), hydrogen (H_2), carbon dioxide (CO_2) and other minor constituents such as methane and water vapour. This is done by partial oxidation of coal at high temperature and pressure to produce SNG. SNG is useful for production of hydrogen and various chemicals, as well as a fuel for gas turbine combined cycles for power generation. SNG can thus be positioned as a bridge technology in India's coal transition pathway towards Net Zero by 2070.

Driving power generation

The government usually relies on gas-based power plants (GBPs) to meet peak demand in summers. However, these GBPs mostly use imported gas, vulnerable to uncertainties and price shocks. Coal gasification could help India produce SNG, which can help meet peak power demand, balance variable renewable energy (VRE) and maintain grid stability.

Currently, the Ministry of Power provides minimum off-take guarantee tenders to procure energy from GBPs for peak demand hours. During the summer crunch periods of 2023, 2024 and 2025, energy procured from the selected GBPs was 317 MU, 482 MU and 1,477 MU, respectively. The average plant load factor of GBPs fluctuated between 12 per cent and 25 per cent during 2019-2024, largely influenced by imported LNG price trends. The total installed capacity of GBPs in India is around 24 GW. With lower utilisation and higher gas prices, electricity prices usually range between Rs 10-Rs 15 per kWh, much higher than coal or renewable-based electricity supply. Prolonged periods of high prices have also forced some GBPs into extended inactivity, rendering several of them no longer technically viable for operation. With India producing only 50 per cent of its annual gas consumption, and domestic gas being primarily allocated for transport and household consumption, GBPs will continue to face vulnerability due to high import price, though their importance in providing flexibility and managing peak demand and grid stability will increase in the coming years with more VRE being integrated with the grid.

Producing hydrogen

Coal gasification can also help in producing hydrogen. The hydrogen derived from coal is called grey hydrogen due to emission of greenhouse gases (GHG). However, if this process is coupled with carbon capture, utilisation and storage (CCUS) systems, the gas is called blue hydrogen, which can be utilised for power generation and heating purposes. Hydrogen also has the potential to be integrated in existing transportation infrastructure, helping reduce GHG emissions. With the recent budgetary announcement of the CCUS mission, the framework and necessary funding for coupling SNG production with CCUS are already in place.

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Black Rock, Clean Molecule: The case for coal to hydrogen

While technological and economic challenges persist, hampering investment and growth in the coal gasification industry, should be addressed by the new incentive scheme

By Dr. Akanksha Jain and Ms. Shagun Mamgain, Research Consultants, Centre for Climate Change and Energy Transition | June 02, 2026

The Union Cabinet's Rs. 37,500 crore incentive scheme to promote surface coal and lignite gasification into syngas and downstream products is one of the most significant policies of our times. This is even more consequential for India's hydrogen ecosystem. Be it urea or ammonia used in fertilisers or a refinery for transport fuel, all of it runs on a molecule called hydrogen. India consumes roughly 6 million metric tonnes (MMT) of this workhorse molecule every year, a number expected to double to 12 MMTPA by 2030 as the economy expands. But the real challenge is where this hydrogen comes from, its planetary cost, and India's import dependence. The answer increasingly points to coal.

Globally, 96% of hydrogen is produced by steam methane reforming of natural gas, emitting 9–12 kg of CO_2/kg of hydrogen produced. This is "grey hydrogen." What is less discussed, and more relevant to India, is "brown hydrogen" produced from coal gasification, a thermochemical process in which coal or lignite reacts with steam and oxygen, undergoing partial oxidation to produce synthesis gas (syngas), a mixture of hydrogen and carbon monoxide.

While coal gasification emits CO_2 at levels comparable to those of natural gas reforming, it produces a high-purity, high-pressure CO_2 stream well-suited for Carbon Capture, Utilisation and Storage (CCUS) technologies. With CCUS, this pathway can produce "blue hydrogen" with over 90% lower emissions than the unabated baseline. This is where 2026-27's Rs. 20,000 crore CCUS outlay matters Budget as much as the gasification scheme itself. Together, they represent a Rs. 57,500 crore bet on a blue hydrogen industrial strategy.

Yet India's official hydrogen policy has not caught up with this logic. The National Green Hydrogen Mission (NGHM), with an outlay of Rs. 19,744 crore over seven years, is India's flagship hydrogen programme, aiming to achieve 5 MMT per annum of green hydrogen production capacity by 2030, supported by 125 GW of dedicated renewable energy. Alongside the NGHM, the Green Hydrogen Certification Scheme of India (GHCI), launched by the Bureau of Energy Efficiency in April 2025, sets a lifecycle emissions threshold of 2 kg CO_2/kg hydrogen, one of the most demanding green hydrogen standards in the world. Eligible production pathways under the GHCI are currently limited to electrolysis powered by renewable energy and biomass-based conversion. Coal gasification with CCUS, regardless of its actual lifecycle carbon intensity, falls entirely outside the certification tent.

In effect, a hydrogen produced from Indian coal via gasification and carbon capture, with a lifecycle intensity below 2 kg CO_2/kg hydrogen, fails India's green certification, while a molecule with identical emissions from an electrolyser with imported critical minerals and high water requirements would pass. That is not rational climate policy but sheer hex-code obsession. India's hydrogen mission obsesses over the colour agenda rather than focusing on the molecule itself, its footprint across the full lifecycle, and, most critically, where it comes from and who controls its supply chain. The solution is simple: include coal gasification with CCUS under the GHCI, using the same emissions threshold as electrolysis. Allow projects to combine gasification and CCUS incentives, and shift the NGHM target from "green" to "clean" hydrogen, including blue hydrogen. Beyond certifications and targets, the strongest case for coal-to-

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