

World Petrocoal Congress International Conference

Coal Gasification & Coal-to- Liquid Conversion

**N.N.Gautam,
Advisor ACB(India) Ltd.
Former Advisor Min. of Coal & UNDP**

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➤ Coal, a carbon-intensive energy source, is at the centre of debate on energy and climate policy. In a growing number of countries, the elimination of coal-fired generation is a key climate policy goal after the signing of Paris Agreement under COP21. In others, especially in Asia Pacific Region, coal remains the preferred source of electricity and is seen as abundant and affordable.

➤ As the World is trying hard to find viable alternative energy sources, coal continues to maintain its sheen in India, China and the Asia Pacific region and shall continue to dominate the energy scene for at least next two-three decades positively.

➤ Coal has been named by the environmentalists as a dirty fuel as its use contributes to environmental degradation and climate change. Coal is the most versatile and used energy source that nature has provided to mankind. It is not a dirty energy source, but the manner of combustion makes it dirty. Use of Clean Coal Technology with CCS is a green and clean use of coal.

➤ **India's extractable coal reserves will last at least over 40-50 years. Coal-fired plants generate 72% of India's electricity. This, combined with the growth of coal-consuming industrial sectors like steel, is why the solid fuel source will continue to be integral to India's economy in the next couple of decades. India's coal requirement is expected to go up to 1123 million tonnes (mt) by 2023 from the present levels of around 700 mt.**

➤ **India's increasingly ambitious renewable targets and the government's announcement of a moratorium on new coal plant approvals until 2027 may mark the most significant turning point yet for coal. Even Coal India Limited has announced that it would invest ₹5600 Crores by March 2024 to develop 14 solar power projects to help power its mining operations.**

• Under its NDC, India will aim to increase the share of non-fossil fuel based capacity in the electricity mix to over 40 per cent by 2030. In January 2019, the Secretary of the Ministry of New and Renewable Energy announced plans to lift installed renewable energy capacity (excluding large-scale hydro) to 500 GW in 2028. Solar is expected to drive the bulk of the expansion in renewable capacity. The target is divided into 350 GW of solar, 140 GW of wind and 10 GW of other technologies, and excludes large-scale hydro.

➤ However, with the possible reduction of use of coal for power generation due to massive programme of increase from RE sources, the other uses of coal hitherto not being done in India must get the important & expected proper boost in near future. However, lot of R&D work is required towards this end and need to be heavily supported by the Govt.

Need for Coal Gasification

- With such huge coal reserves, India need to exploit its coal energy resources to be more “Energy Secure” and ensuring a sustainable energy future.
- **Repositioning Coal from “Energy Product” to “Chemical Feedstock”**
- Aimed at “Import Substitution” for lessening burden on foreign exchequer
- **Aligned to “Make in India”**
- Coal Gasification shall play a major & key role in becoming “AtmaNirbhar Bharat” in the field of energy security.
- **Hon'ble Prime Minister, Shri Narendra Modi's vision to gasify 100 MMTPA of coal by 2030.**

Meeting challenges through Gasification

- Monetization of abundant coal reserves equivalent to >130 years of current consumption
- As emission norms becoming more stringent - timely exploitation of country's coal resources through environment friendly gasification technology
- Creating Energy security through effective utilization of gasification industry – resulting in reduction of crude, chemical & Petchem imports
- Gasification offers cleanest way of utilizing Coal - SO_x and NO_x emissions are minimal compared to any other coal usage
- Proven technology with hundreds of reference plants.

Gasification Plants

Jindal Power and Steel Ltd. is producing Steel from state-of-the-art and the World's First DRI Plant (1.80 Million Tonne/ Annum capacity) based on "Coal Gasification technology" located at Angul, Odisha which being operated using Indian high ash non-coking coal available in Odisha.

India is aiming to convert 100mn t of thermal coal into synthetic natural gas and chemical products in the coming decade, as part of its broader push to promote cleaner sources of energy. Hon'ble PM has announced Rs. 20,000 crs to be spent for Gasification Projects by 2030.

Coal India floated open global tender for setting up a first-of- its-kind coal-to-methanol (C2M) plant in India through surface coal gasification on build-own-operate (BOO) model at investment of Rs 6,000 crore at CIL's Dankuni Coal Complex (DCC) . Will produce 6.76 lakh tonne/ann. Of methanol for blending with petrol up to 15%. CIL is in talks with will have tie with Indian Oil (IOC) etc. marketing of methanol. Low-ash, high-calorific coal of Ranigunj coalfields will be supplied

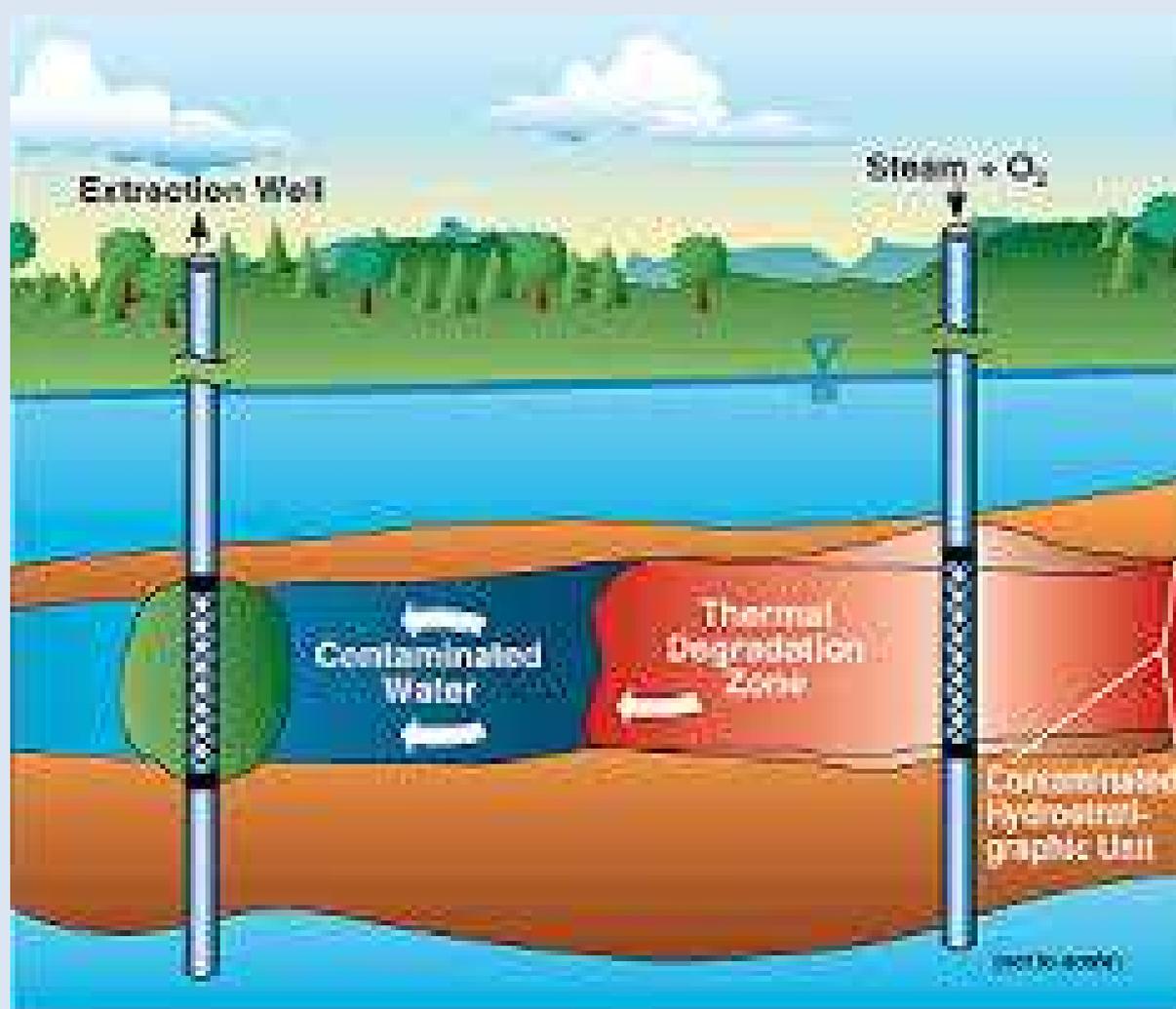
Ammonia and Urea Plant at Talcher - Talcher Fertilizer Ltd.

Talcher Fertilizers—a joint venture between CIL, GAIL, Rashtriya Chemicals and Fertilizers Ltd and Fertilizer Corporation of India Ltd—is also building a 2.5 MT coal gasification unit with an investment of Rs 13,277 crore. The project was to be complete by September, 2023, but will get delayed due to Covid disruptions.

**Share: CIL 30%, Gail 30%, RCF 30%, FCIL 10%, Capacity Ammonia 2200 TDP , Urea 3850 TDP, Coal requirement 250 TPH around 2 mill.T PA
Pet coke 38.5 TPH, Project cost in 2017 7887 crs now 11600 crs
Construction likely to complete in 2021.**

Between 2022 and 2026, CIL is planning to invest another Rs 25,000 crore to build six other coal gasification projects with cum. capacity of 6 MT. Since imports from Gulf countries are likely to pose price challenges for these products, some Govt. support needed for these projects .

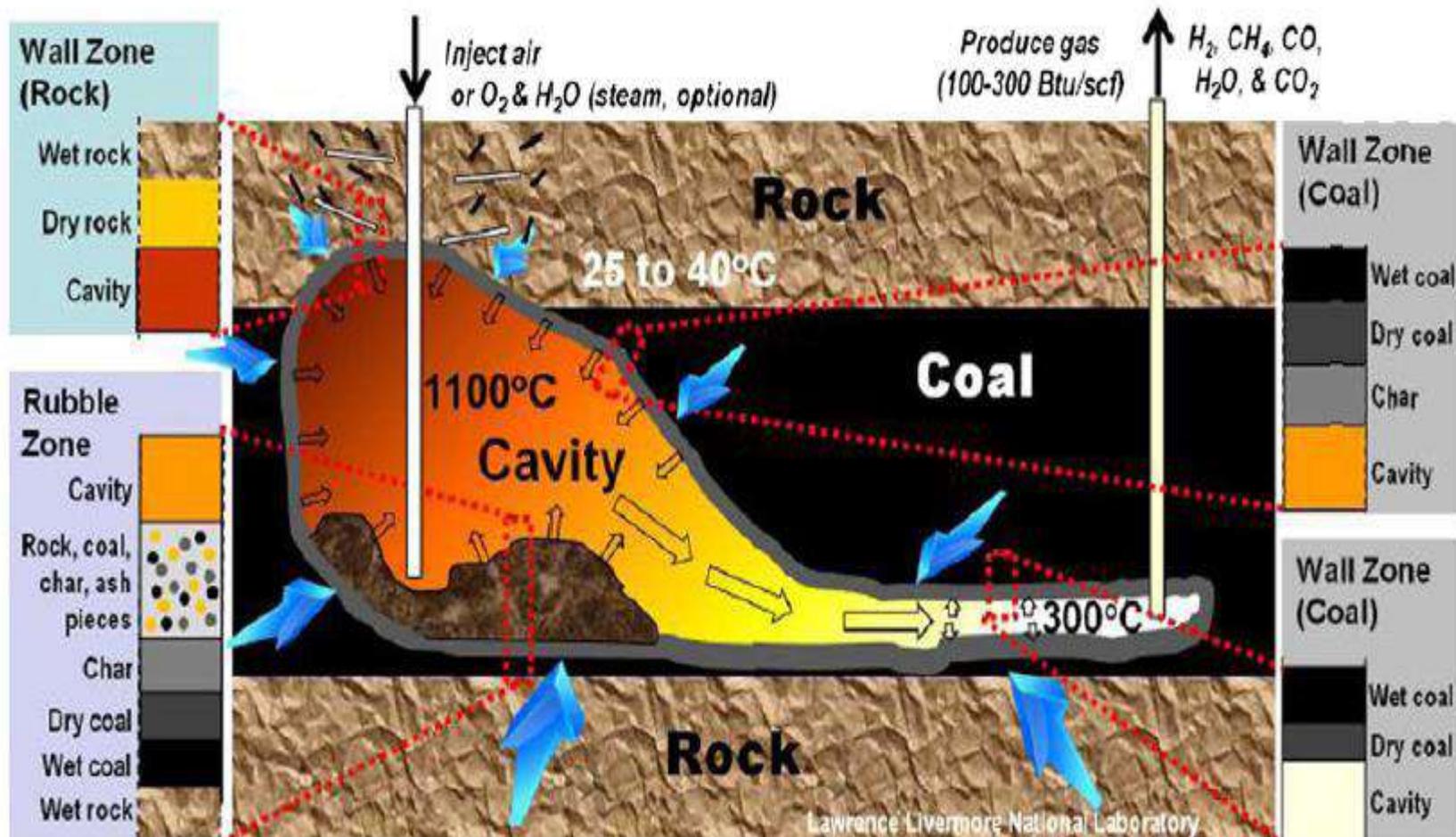
UCG



HFC uses steam and oxygen to drive DNAPLs out of the soil to a recovery well.

- **Partial Oxidation of a coal seam in-situ**
- **Pairs of wells are drilled and a connection made between them**
- **Oxidant (air/O₂ + steam) pumped down one well**
- **Coal is ignited and produced synthetic gas (called 'syn-gas')**
- **'Syn-gas' flows up the second hole**
- **Liquid & char generated remained underground**

Typical cavity configuration and coal gasification reaction zones



Composition of Syn. gas

- **Mixture of CO and H₂**
- **Subsidiary CO₂, H₂O, CH₄**
- **Plus N₂ if the oxidant is air**
- **Typical Syn Gas Composition:- CO :30 to 60%,
Hydrogen: 25 to 30%, CO₂: 5 to 15 % , CH₄ : 0
to 5%.**

**Rough estimate, will vary as per technology
selection & use of air or Oxygen etc.**
- **CV varies from around 35% of natural
gas if oxygen blown and 10% if air-blown**

Environmental Issues

- **Contaminants introduced into the ground water during , at termination and after termination of UCG process.**
- **Simultaneous diffusion and penetration of contaminants generated with the gas escape to the surrounding underground table above .**
- **Contaminants may affect water quality making sources unfit for use of human and wildlife**
- **Subsidence may cause all round disturbance at surface and groundwater movement**

Environmental Benefits

- **Underground coal gasification has some environmental benefits relative to mining.**
- **No discharge of tailings, reduced sulphur emissions and reduced discharge of ash, mercury and tar**
- **Additional benefit of Carbon dioxide sequestration**

India has to start making use of coal for producing chemicals which can save very large amount of Forex as India is importing lot of Chemicals and fertilizers.

India is importing large quantities of chemicals like acetic acid, MEG, methanol, PVC, Poly olefins, DME, SNG etc.

India can save Forex out go of 21 billion rupees.

Exploitation of coal for Indian Chemical demand

Key Chemicals	Demand gap by 2025 (MMTPA)	Coal required (MMTPA)
Acetic acid	1.1	7
Methanol*	6.6	32
MEG	1.4	8
PVC	3.7	11
Poly-Olefins	7.0	87
DME*	2.3	4.8
Total	22.1	150

Carbon Capture and Storage (CCS),

carbon sequestration, is a means of separating out carbon dioxide when burning fossil fuels, collecting it and subsequently “dumping” it underground or in the sea. CCS is an integrated concept consisting of three distinct components: CO₂ capture, transport and storage (including measurement, monitoring and verification).

A small-scale CCS plant is already operational in India. A plant at the industrial port of Thoothukudi is capturing CO₂ from its own coal-powered boiler and using it to make baking soda. It will lock up 60,000 tonnes of CO₂ a year.

Utilization of CO₂ produced during Coal Gasification :

1) For Enhanced Oil Recovery

e.g. : Ninety percent of the CO₂ produced in "Hydrogen Energy California Project" is captured and transported to Elk Hills Oil Field for EOR, enabling recovery of 5 million additional barrels of domestic oil per year. This project is IGCC project based on Gasification.

2) For production of Urea

Example : At TFL, 50% of produced CO₂ is being utilized for the production of Urea and rest is vented out.

3) Boudouard Reaction :

CO₂ may be converted into CO by this reaction and can be utilized.

4) CO₂ may also be used for production of SNG and Dimethyl Ether.

Attachments area

Conclusions

- Energy Security - India's growing dependence on energy imports increases uncertainty regarding availability of energy at affordable prices.
- **For a developing country like ours, in absence of other major fossil fuels, considering overall energy options in India; utilizing coal for energy, remains quintessential.**
- Environmentally responsible gasification technologies are helping to unlock the India's coal reserves with increasing efficiency.
- **UCG can potentially access coal resources that are not mineable conventionally or not-economical to extract**
 - **Potential to more than double recoverable coal resources**
 - **UCG is an in-country energy solution, independent of exchange rate and oil price**
- Economics, government policies and geo-political, global energy scenario are the key decisive factors and remain as a key issues.

THANK YOU