13th World Petroleum Congress

COAL GASSIFICATION & COAL TO LIQUID CONVERSION

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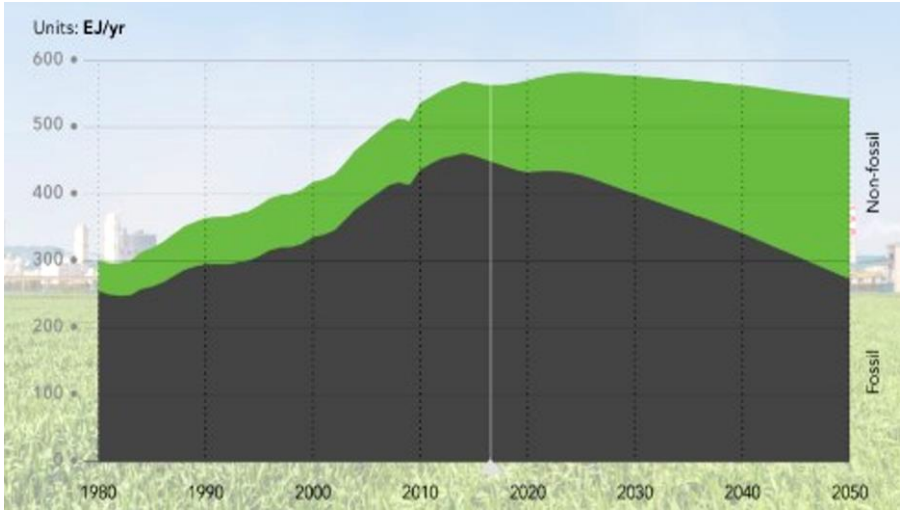
CONVENTION CENTRE NDCC, NEW DELHI

cgai
Coal Gasifiers
Association of India

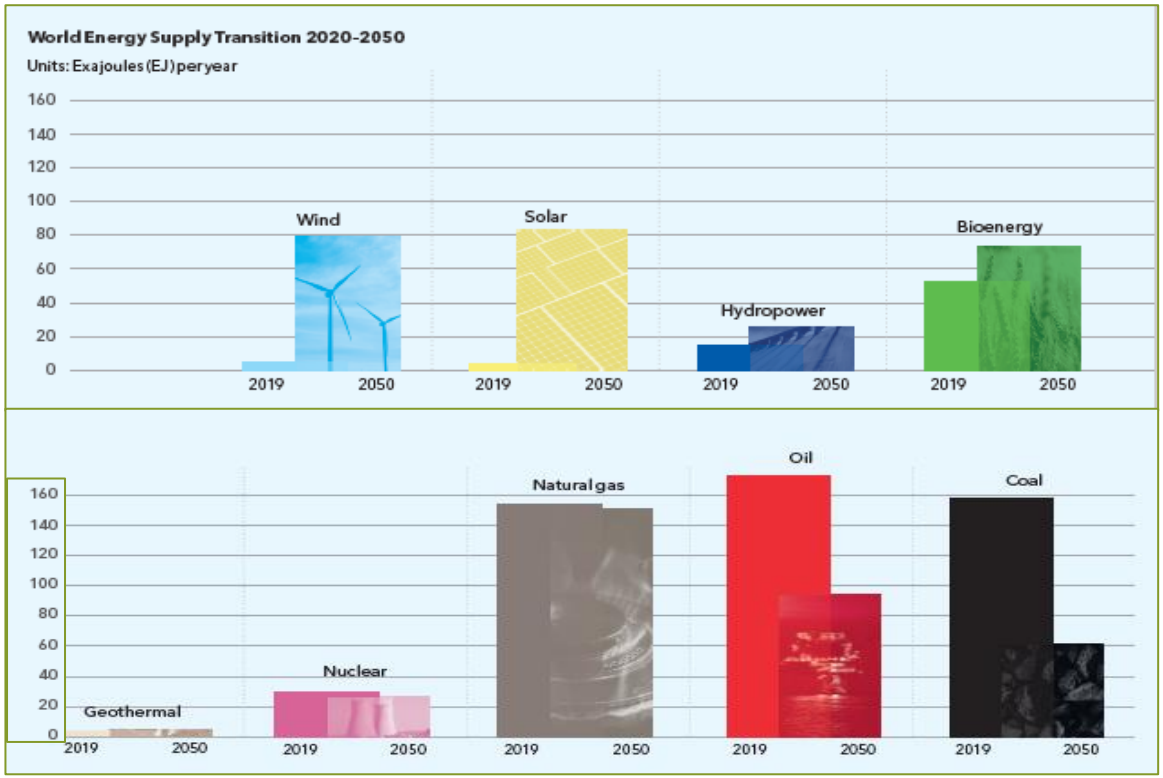
Contents

Primary Energy Forecast



1 Exajoule = 948 Tbtu, 23.88 Mtoe
source : DNV projections

World Energy Supply Transition Projection



Source : DNV study

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World Energy Segments – Asia-Pacific

INDIAN SUBCONTINENT

- 500 million more people and GDP growing fourfold will see rising energy demand in this region
- Despite the rapid growth of renewables, fossil-energy sources will also grow and represent 62% of the energy mix in 2050
- The region's enormous two- and three-wheeler vehicle fleet will transition almost entirely to electricity before 2040

GREATER CHINA

- Powerhouse for renewables growth and the energy transition, both for domestic use and abroad
- The share of electricity in final energy demand will grow from 23% in 2018 to 52% in 2050 -highest of all regions, over 90% from renewable sources
- Coal will reduce its dominant share in the power mix (currently 60%) to 12% over the forecast period

SOUTH EAST ASIA

- Energy demand, especially from space-cooling and appliances, grows significantly but levels off towards the end of the forecast period
- Increasing use of natural gas and renewables to supply domestic demand for electrification, will result in lower importance of coal and oil
- Manufactured goods production more than doubles until 2050, driving demand for natural gas and transforming this region into a net-importer of LNG

OECD PACIFIC

- Falling population and improved efficiencies will almost halve energy use over the forecast period. 2050 electricity mix is dominated by wind, and at 50% of final energy demand, is the second-most electrified region in 2050 after China
- Hydrogen will gain a foothold (9% of energy use), sourced initially from Australia through SMR processes, but later mainly via renewably powered electrolysis

Source : DNV Study

Future of Coal

1. Coal faces two main issues globally:
   - Local pollution, greenhouse gas emissions with global consequences
   - Belief that India has renewable energy now so does not need much coal which is risky and expensive option
2. India produced 777 MT in 2022 with over 8% YoY increase. Although Coal is growing, India is on track to meet its commitments of Paris agreement.
3. Abundance of coal reserves is an opportunity for India. Focus is on Clean Coal Technologies to reduce green house gases as also non green house gases (SOx, NOx, particulate matter) emissions
4. Decarbonization – slow progress
5. As per Gasification & Syngas Technologies Council:
   - 272 operating plants with 686 gasifiers
   - 74 plants under construction with 238 gasifiers

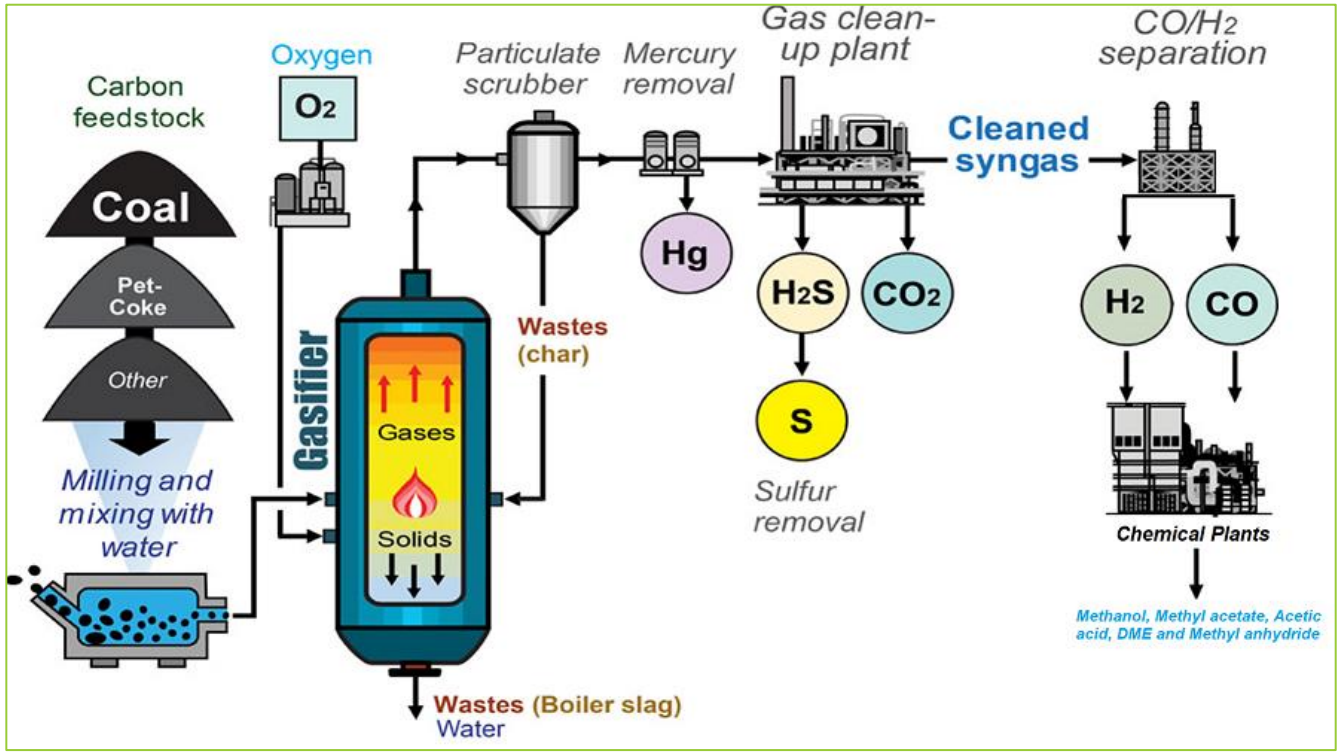
Surface Coal Gasification

- Coal gasification is considered internationally as most effective cleaner option as compared to direct burning of coal and utilizes the chemical properties of coal.
- Clean coal technologies offer higher efficiencies with lesser environmental impact
- Syn Gas produced from Coal gasification can be utilized in producing Synthetic Natural Gas (SNG), energy fuel (methanol & ethanol), production of urea for fertilizers and production of Chemicals such as Acetic Acid, Methyl Acetate, Acetic Anhydride, DME, Ethylene and Propylene, Oxo chemicals and Poly Olefins.
- Definition Issue:
  - Gasification is a thermo-chemical process in which carbon rich feedstock such as biomass, coal, lignite or pet coke when heated at high temperature and pressure in limited presence of oxygen/air and catalyst is converted into a gaseous mixture consisting of CO, CO2, H2, CH4 and traces of others gases. This gaseous mixture is called Syngas/ Synthesis gas/ **Producer gas.**

$$CH_4\,(g) + H_2O\,(g) \xrightarrow[Ni]{1270\ K} CO\,(g) + 3H_2\,(g)$$

Coal Gasification

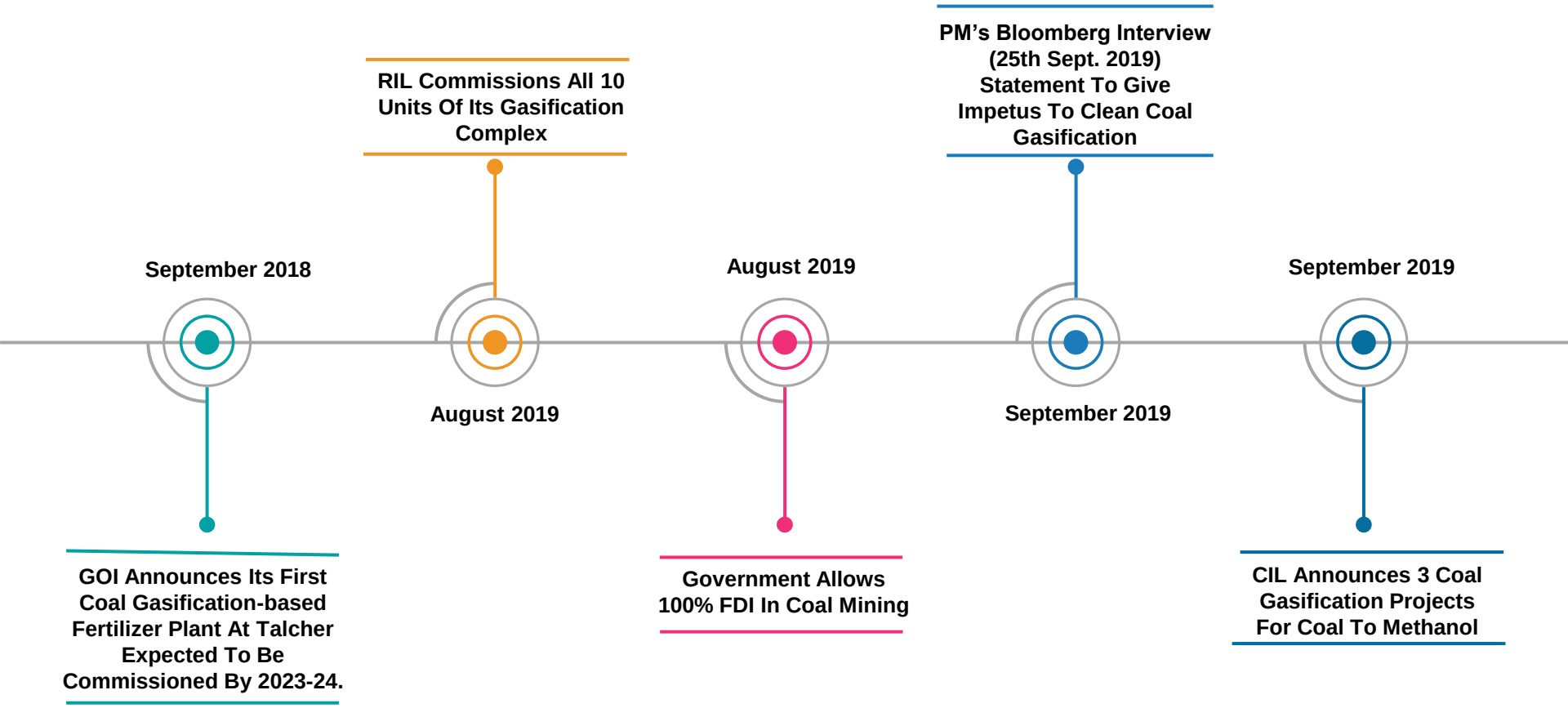
- Coal Gasification is considered as cleaner option compared to direct burning of coal.
- Offers opportunity to produce several value – added products via Syngas/producer gas viz methanol, ethanol, ammonia for fertilizers, petrochemicals etc.



Advantages of Coal Gasification Technology

- **Promotes alternative usage of domestic coal in an eco-friendly manner:** This process is around 17 to 20% more efficient than conventional coal-burning to produce electricity. Hence, it reduces the dependency on coal mining for energy generating power plants.
- **Hydrogen Economy:** It can be used in hydrogen fuel cell production because gasification of coal is one method that can produce power liquid fuel chemical and hydrogen.
- **Reduce Fiscal Deficit:** Use of more domestic Coal for energy uses will reduce imports of coal, urea, crude oil, and gas, reducing the fiscal deficit.
- **Decrease Transportation Cost:** Transporting gas is a lot cheaper than transporting coal.
- **Greater Efficiency than Conventional Coal-Burning:** It can effectively use the gases twice: the coal gases are first cleansed of impurities and fired in a turbine to generate electricity. Then, the exhaust heat from the gas turbine can be captured and used to generate steam for a steam turbine-generator.

Coal Gasification: Important Milestones



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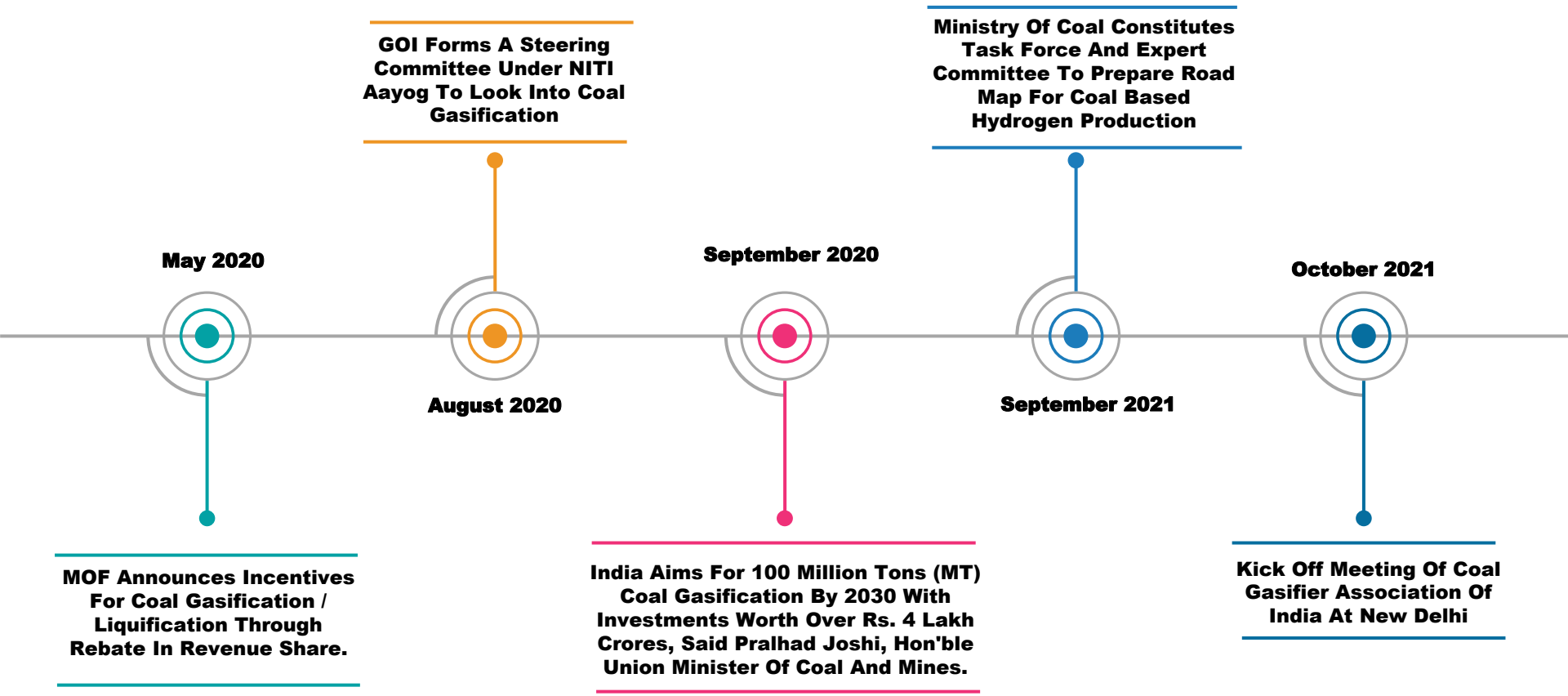
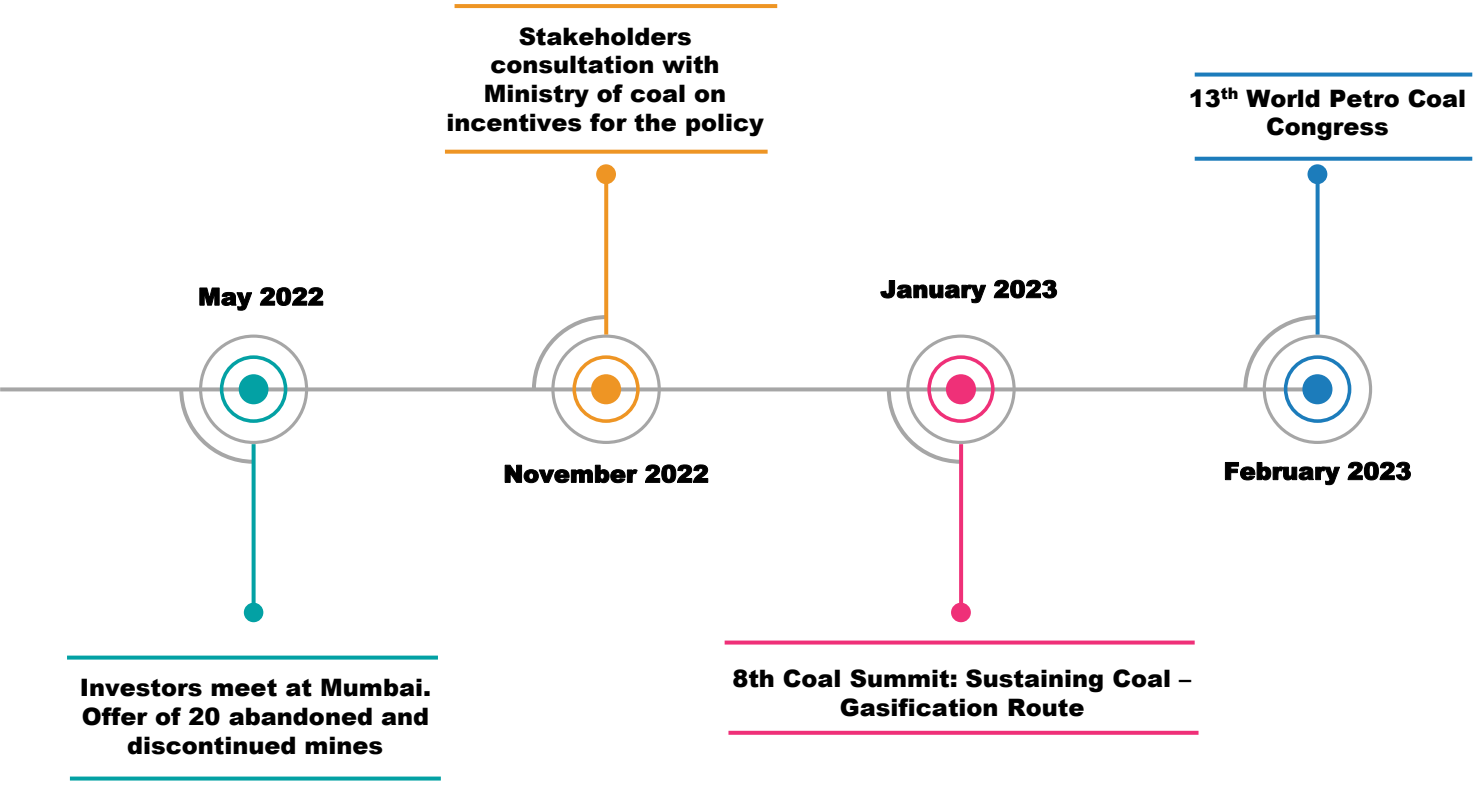


Coal Gasification: Important Milestones



Recent Developments & Project Initiatives

1. Integrated Coal Gasification Combined Cycle (IGCC) and Integrated Coal Gasification Fuel Cell Combined Cycle Power Generation Technology (IGFC) – Higher efficiencies of these technologies offset the increased cost due to CO2 capture process.

2. Advanced Coal Gasification technologies developed in Japan:
   a) HYCOL – Coal to hydrogen
   b) EAGLE – Multipurpose technology for coal Energy Application for Gas, Liquids & Electricity

3. Development Focus on:
   a) Replacing the cryogenic process currently used to separate oxygen from air when oxygen is used in the gasifier with new membrane technology.
   b) Developing new membrane technologies to better separate and purify hydrogen from the gas stream
   c) Intensifying the process (combining steps into fewer operations).
   d) Development of swing adsorption mechanism for simultaneous H2S and CO2 removal

Recent Developments & Project Initiatives

4. Catalytic hydrothermal high pressure gasification in aqueous state developed by Paul Scherrer Institute (PSI).
   a) Simpler, cheaper and quicker process. 60% biomass disposed off in few minutes
   b) About 0.25 Kg methane produced from 1 Kg of organic dry matter

5. Indonesia plans to build a new National Coal Gasification Industry converting coal reserves into methane and DME.
   a) Feasibility study is done by Powerindo Cipta Energy and China National Chemical Engineering Corporation for coal to develop methanol plant at an estimated cost of $ 560
   b) Air Products announced $ 13 – 15 billion investment in several coal gasification plants

Recent Developments & Project Initiatives in India

1. Talcher Fertilizers Limited (A joint venture of CIL, GAIL, RCF & FCI):
   a) India's first coal gasification-based fertilizer plant at Talcher.
   b) The state-of-the-art complex consists of a coal gasification unit, an ammonia as well as urea plant.
   c) TFL currently building a 2.5 MT coal gasification unit with an estimated investment of Rs 13,277 crore. The project is expected to be completed by September, 2023.

2. New Era Greentech Solution:
   a) 5 mmtpa coal gasification project for value added products I Chandrapur, Maharashtra at an estimated investment of $ 2.5 billion
   b) It is a joint venture led by Subhalaxmi Polyesters , Shri Bala Saheb Darade (entrepreneur) and Shri Gopi Latpate (Investor) besides other investors

3. New Indigenous Coal Gasification Technology
   a) Reliance Industries has developed a gasification technology working over the years
   b) Thermax has developed gasification technology suitable for Indian coals
   c) BHEL has developed expertise to successfully design, construct an operate a pilot gasification plant
   d) CSIR - CIFMR , Dhanbad has developed design of fluidized bed coal gasifier suitable for Indian coals

Recent Developments & Project Initiatives in India

Company	Coal India	Neyveli Lignite	Jindal Steel & Power	BPCL	ECL	CCL	WCL	SECL
Location	Dankuni	Neyveli Gasification Project	Raigarh	Kochi Pet Coke Gasification	Sonepur Bazari	Khalari Mine, North Karanpura	Chandrapur	Mahamaya Mines
Target Product	Methanol 0.676 mmtpa	Methanol	2nd Gasification Plant	Value added products – Hydrogen, Acetic Acid, Ethanol etc	Methanol 0.66 mmtpa	Ammonium Nitrate	Ammonium Nitrate 0.66 mmtpa	Ammonia 0.72 mmtpa
Status	Target Completion 2025	Feasibility done. EIL as PMC	Prefeasibility study	-	Approved	Approved	Approved	Approved

Operating Gasification Plants

1. Pet coke Gasification Plant of Reliance Industries at Jamnagar
2. Coal Gasification Plant of Jindal Steel & Power Ltd (JSPL) at Angul
3. Coal Gasification to Methanol pilot plant of BHEL. 10000 hrs. of operation registered

Government of India Initiatives

1. 'UTTAM' – Unlocking Transparency by Third party Assessment Mechanism
2. 'SHAKTI' - Policy for award of coal linkages on long term through auction
3. All coal companies to assign a nodal officer and formulate a plan to gasifying at least 105 of their coal production
4. 'Coal Gasification Mission' – a comprehensive document on way forward for coal gasification in the country. Guiding principle for the policy framework on coal gasification. 100 MT coal to be allocated for coal gasification by 2030.
5. Road show for award of 20 abandoned & discontinued mines for coal gasification through open bidding process on 6th May 2022.
6. Stakeholders consultation for finalizing the policy to incentivize coal gasification on 25th Nov 2022.

Suggestions Given by Coal Gasifiers Association of India (CGAI) to Ministry of coal

1. These projects require high investment /capex. There should be some subsidy. The coal pricing should be specific to the project. There should be no royalty or revenue sharing.
2. Indigenous technology need to be promoted and focus should be on carbon capture & utilization (CCUS) application in the project.
3. Projects should be extended at least 20% viability gap funding.
4. Ministry should share a long-term road map for coal gasification
5. CGAI suggested that potential investors would be the Producer Gas Producers in the country. They have gained experience over the decade and would be willing to expand /invest.
    a. Govt may consider implementation on PPP model.
    b. Coal pricing should be attractive & specific to project similar to the power sector
    c. The government should make all approvals for coal, project implementation and land for the plant upfront as part of offer.
    d. Viability gap funding would be necessary in view of the developmental nature of the project and large capex.
    e. Government to consider buy back arrangement for the targeted end product of coal gasification for long term (5 to 10 years) for sustainability of project

Sl. No.	Plant/ Organization		Location	Gasifier No's
1	Aadhunik Steel	Odisha	Rourkela	4
2	ANJANI STEELS LTD	Uttar Pradesh	Allahabad	3
3	Ankit Metal & Power Limited	West Bengal	Bankura (WB)	4
4	Ardent Steel Limited	Odisha	Odisha.	2
5	Baba Steel	West Bengal	Raniganj (WB)	2
6	BALLARPUR INDUSTRIES LTD	Maharastra	Ballarpur	2
7	BALLARPUR INDUSTRIES LTD	Haryana	SGU, YAMUNANAGAR, HR	2
8	BESCO LTD	West Bengal	Kolkata, WB	1
9	BHILAI REFRACTORIES (Sail)	Chhattisgarh	BHILAI, CG	1
10	BMM ISPAT LIMITED	Karnataka	Bellary, Karnataka	12
11	CENTURY PULP & PAPER MILL	New Delhi	New Delhi	3
12	CG Ispat & Pvt. Ltd.	Chhattisgarh	Raipur	2
13	Chandi Steel Industries Limited	West Bengal	Howrah	2
14	DCW	Maharastra	Mumbai, MH	3
15	Fortune Mettalics Limited	Chhattisgarh	Raipur	1*
16	GOURIKA INDIA LTD , A/c HIMADRI CHEMICALS & INDUSTRIES LTD	West Bengal	Kolkata, WB	2
17	Hira Group, Godwari Power & Ispat Ltd	Chhattisgarh	Raipur	20
18	IFFECO	Jharkhand	RAMGARH, JH	1
19	ITC Limited - Paperboards & Specialty Papers Division		BHADRACHALAM, AP	8
20	ITC LTD	Andra Pradesh	Bhadrachalam, AP	8
21	JANKI CORP LIMITED	Karnataka	Bellary, Karnataka	3
22	Jindal Saw ltd	Maharastra	Sinnar Nashik	5
23	Jindal Steel & Power Ltd	Chhattisgarh Jharkhand	Raigar & Patratu (25 - RGH & 10 - Pat)	35
24	JK PAPER LTD, CENTRAL PULP MILL	Gujrat	FORT SONGARH, GJ	2
25	JK PAPER LTD, JK PAPER MILL	Odisha	RAYAGADA, OR	3
26	Katni Minerals Private Limited	Madhya Pradesh	KATNI, MP	1
27	KUANTUM PAPERS LTD, (FORMERLY ABC PAPER LTD)	Punjab	Hoshiarpur Punjab	1
28	MAITHAN CERAMIC LTD	Jharkhand	CHIRKUNDA, JH	3
29	MSP Sponge Iron Ltd	Odisha	Keonjhar	3
30	MSP Steel & Power Ltd	Chhattisgarh	Jamgaon	13
31	Nalwa Steel & Power Limited	Chhattisgarh	Nalwa	4
32	NECO CERAMICS	Maharastra	NAGPUR, MH	1
33	Nutan Ispat & Power Limited	Chhattisgarh	Raipur	2
34	OCL (Dalmia Group)	Odisha	Rajgangpur – Odhisa	12
35	ORIENT PAPER MILL	West Bengal	Kolkata, WB	1
36	Prakash Industries Limited	Chhattisgarh	Raipur	3
37	Prakash Industries Limited	Chhattisgarh	Raipur	6
38	Prime Ispat Private Limited	Chhattisgarh	Raipur	2
39	Rashi Steel and Power Ltd	Chhattisgarh	Bilaspur, Chhattisgarh	2
40	Rashmi Metaliks	West Bengal	Khargpur (WB)	16
41	Real Ispat & Private Ltd.	Chhattisgarh	Raipur	1
42	S K S Ispat & Power Limited	Chhattisgarh	Raipur	5
43	S K Samanta & Company (P) Limited	Chhattisgarh	Bilaspur	1*
44	Sarda Energy and Minerals Ltd	Chhattisgarh	Raipur	10
45	Seshasayee Paper and Boards Limited	Tamil Nadu	Tamilnadu (Tirunelveli & Erode)	2

46	SHAKAMBHARI-BRAVO SPONGE IRON PRIVATE LIMITED (BSPL) Bravo Sponge Iron Pvt Ltd (Bhalotia Group) Shakambhari Group of Industries	West Bengal	KOLKATA, West Bengal	2
47	Shree Bajrang alloy Limited	Chhattisgarh	Raipur	2
48	Shree Bajrang alloy Limited	Chhattisgarh	Raipur	1*
49	Shree Bajrang Power & Ispat Limited	Chhattisgarh	Raipur	2
50	Shri Bajarang Power & Ispat Ltd	Maharastra	Mumbai, MH	4
51	Shri Mahavir Ferro Alloys Pvt Ltd	Odisha	Sundergarh Odhisa	6
52	Shyam Steel Industries Ltd.	Odisha	Jharsuguda	15
53	Shyam Steel Industries Ltd.	West Bengal	Durgapur	12
54	SIRPUR PAPER MILLS	Andra Pradesh	SIRPUR, KAGAZNAGAR, AP	2
55	Sree Metaliks	Odisha	Odhisa	4
56	SRI KANAKA DURGA CHROMATES (P) LTD	Andra Pradesh	Vijaywada, AP	1
57	Super Smelters Limited	West Bengal	Ranigang(WB)	10
58	Trl Krosaki Refractories Limited	Odisha	Belpahar	10
59	USHA MARTIN LIMITED	West Bengal	Kolkata, WB	5
60	Vandana Ispat Limited	Chhattisgarh	Raipur	4
61	Vardhaman Steel and Power ltd	Maharastra	Maharashtra	3
62	Visa Steel	West Bengal	Kolkata, WB	5
TOTAL				**305**

Suggestions Given by Coal Gasifiers Association of India (CGAI)to Ministry of coal

6. Coal pricing should be on the lines of regulated power sector and same priority may be given to these project as in case of power sector for both rail & road transport. The existing operators including PGP players be given some eligibility preference.

7. It was requested that a long-term demand projection for products like methanol and other chemicals may be shared.

8. The subsidy grant may be increased to Rs 1000 crores from Rs 600 crores in view of complexity of projects. This may give more confidence to banks to disburse loans

9. Govt may consider permitting sale of syngas on merchant basis.

Coal Gasifiers Association of India (CGAI)

THE PURPOSE

- To create a platform for promoting & advancing the National Agenda with respect to coal gasification in the country
- Make collective efforts to promote communication, knowledge sharing & exchange of ideas among the members of the association to achieve the goal.
- To promote R&D, Publications, Seminars, Workshops to further the advancement of coal gasification technology
- To be a common voice for the policy advocacy on coal gasification.
- To create a platform for data and knowledge repository on coal gasification.

Coal Gasifiers Association of India (CGAI)

MAIN OBJECTIVE

- To promote, support and protect, by legitimate and constitutional means, the interests of the members of the association, who are investing in clean & green technology, specific to coal gasification technology.
- To protect the interest of companies, working on coal gasification technology or planning to collaborate & invest in clean & green technology, specific to coal gasification technology.
- To liaison with government to provide support in developing the policy framework for "Coal Gasification" and incentivize coal gasification projects such as allocation of dedicated resource of requisite quality, fast track approvals, technology collaboration and to promote the adaptation of clean & green technology.
- To promote initiatives for sustainable, gainful & maximum utilization of national coal reserves.
- To harness value added products through coal gasification for reducing import dependency

Thank You for your attention
Coal Gasifiers Association of India (CGAI)

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