

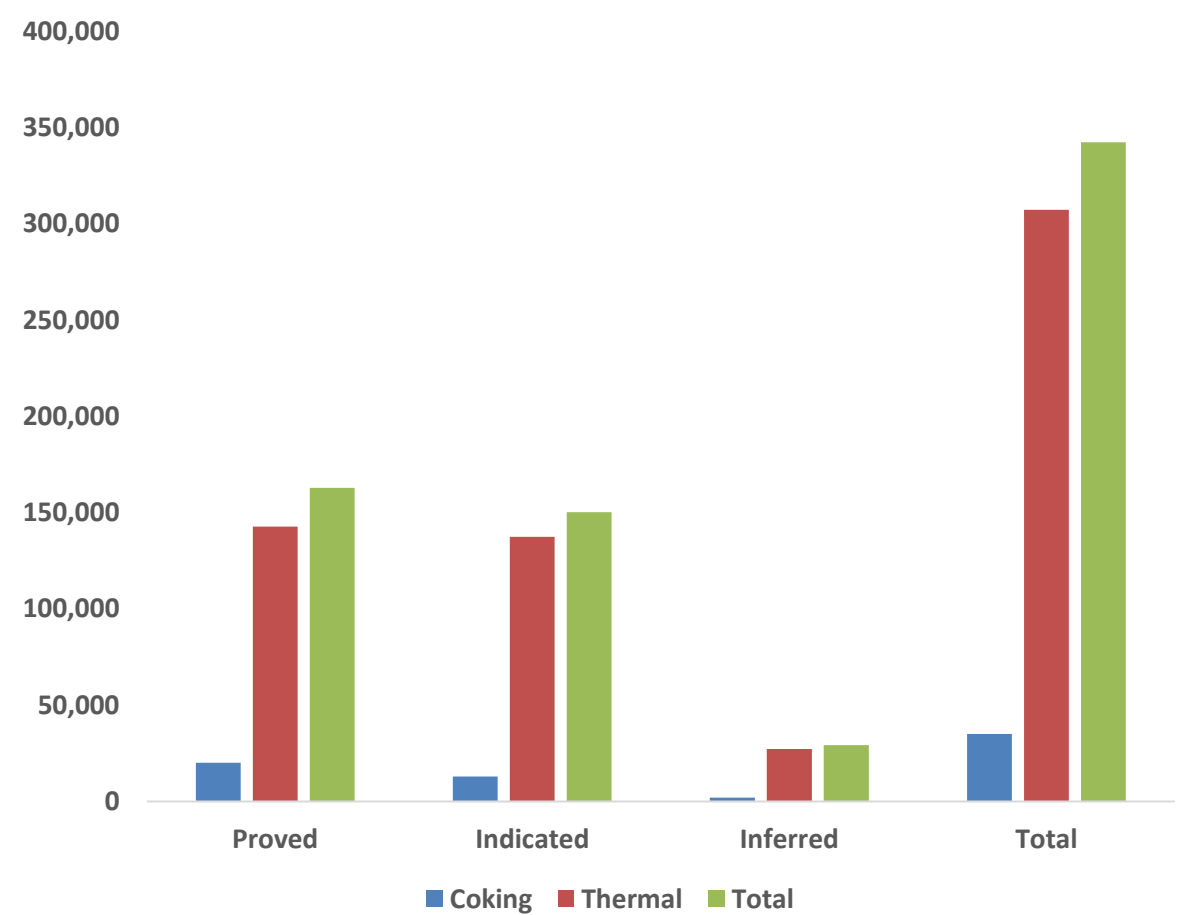


Coal Gasification- Overview

Need for Coal Gasification: Abundant indigenous Coal Source

India can monetize abundantly available coal reserves through gasification to cater the growing energy and chemicals needs of the country

Coal Resources in India (Million tons)



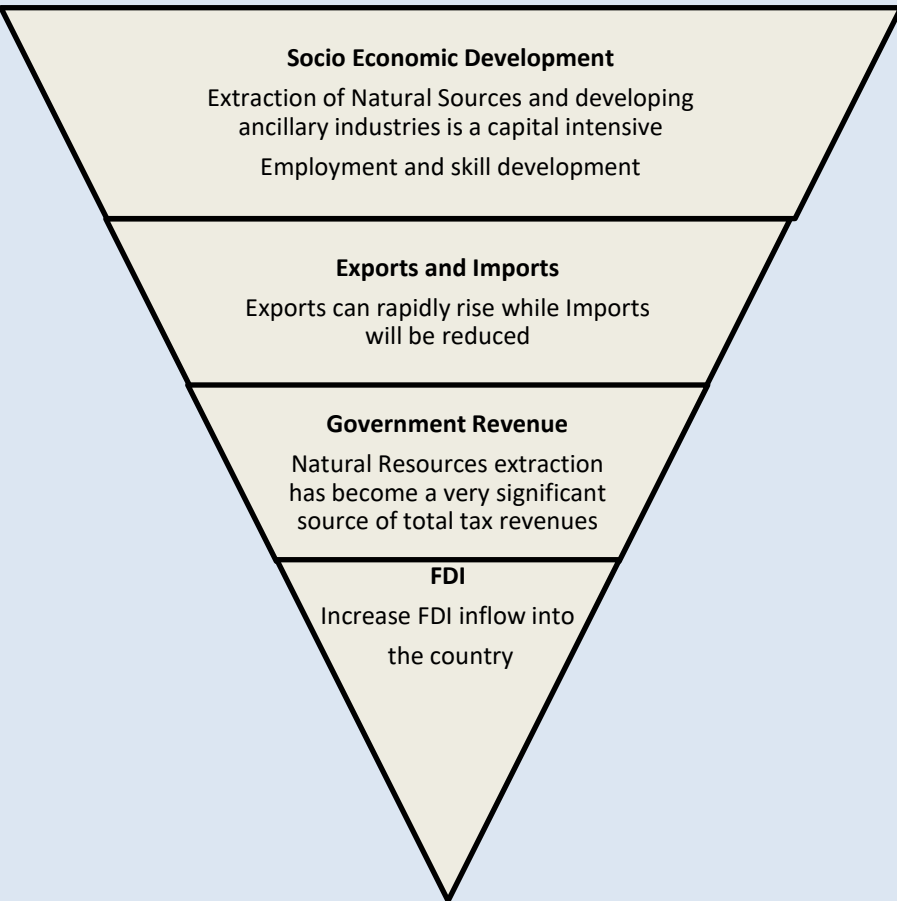
Key Takeaways

- It is evident that India has huge reserves of coal, it would be beneficial for India if it finds a sustainable way of using these reserves as the world including India is gradually transitioning away from coal toward cleaner fuels in the wake of climate change
- The use of domestic coal reserves becomes even more important, especially when India does not have other sources of fuel – crude oil and natural gas, 82% and 45% of the requirement of those fuels is met through imports. This exposes India to the vagaries of price volatility and supply insecurity.
- India will continue to depend on coal for its future energy needs at least till 2050 as per several reports.
- Since coal has to be used for coming 2 to 3 decades, there is an urgent need to make use of coal as green as possible

Source: GSI Coal Inventory 2020

Need for Coal Gasification: Optimal utilization of indigenous natural resources is critical for long term economic growth and competitive advantages

Natural resources hold significant potential to contribute to development of an economy

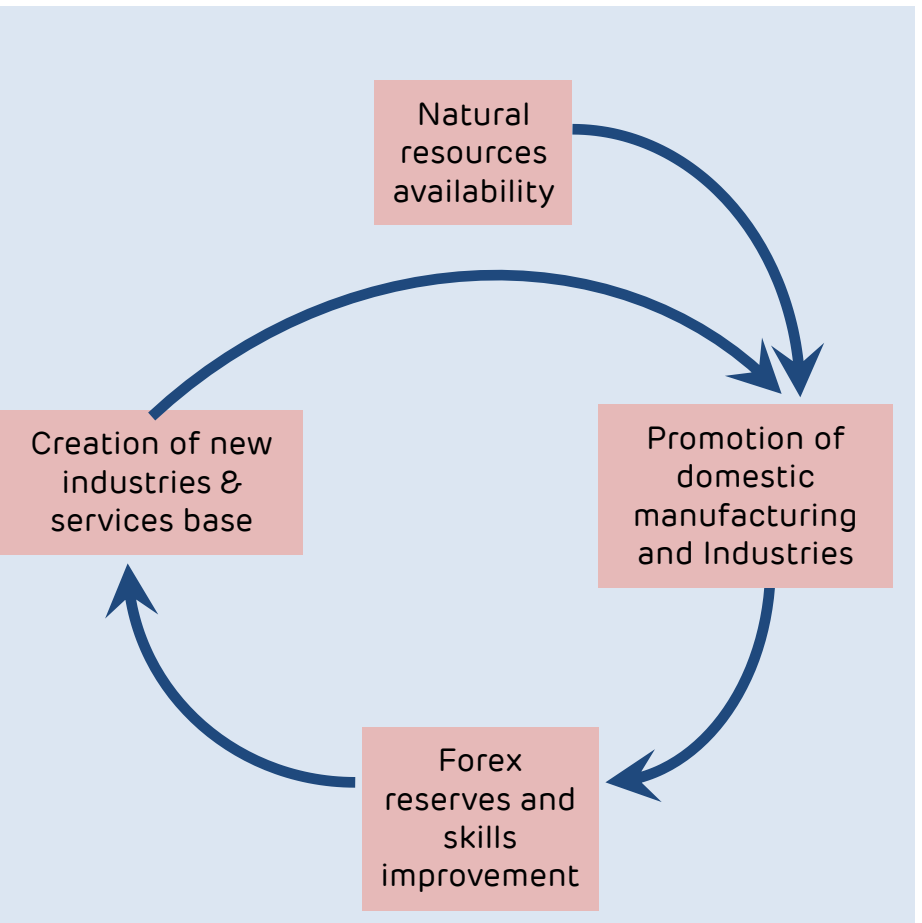


Timely exploitation of Natural resources have helped countries in creating long term economic drivers

E.g.

- Shale gas revolution in US
- **Coal to Chemicals in China**

Optimal utilization of resources can result in long term economic growth



China is monetising Indigenous coal resources to meet Energy, Chemical and Petrochemical demands

Methanol

- Role of Coal Gasification in Methanol: China has become by far the largest producing country in the world, representing 54% of world methanol capacity (~80 MTPA) and 48% of world methanol production in 2018
- China is the incremental methanol supplier to the world. Around 70% of China methanol is produced from coal
- China has significantly Increased Methanol Blending in fuels over the last few years which now stands at **21 MMTPA**.
 - ✓ Methanol direct blending with Gasoline (**8.5 MMTPA**)
- Direct blending now stands at 8.5 MMTPA or 9% of transport fuel demand
- While M15(Methanol-15%, Gasoline 85%) is the main methanol blend available in major cities and provinces. Other blends like M25, M30, M85 and M100 are also being used

Coal to Chemicals China

- China produces more than 90% of its ammonia through coal gasification
- Higher self-reliance in energy supply and lower risk of oil and gas supply from abroad are the major drivers of coal gasification related industries
- China has been pushing for coal gasification in a major way by adopting proven western-developed gasifiers to gain operational experience
- It is the only country in the world, where large-scale coal gasification related industries play a significant role in economic development
- Role of Coal Gasification in Ammonia/Urea: NH₃ capacity is approx. 70 MTPA (~30% of the world) and urea capacity is approx. 80 MTPA (~40% of the world).
- Role of Coal Gasification in Ethylene Glycol (EG): Capacity of coal-based EG is approx. 2.5 MTPA (~30% of China total).
- Role of Coal Gasification in Methanol to Olefin (MTO): Capacity of coal-based Olefin is approx. 13mt/a (~25% of China's total).

Coal Gasification- Advantages



Reduce dependence on Imports

- Strategic importance due to abundant availability of indigenous coal resource
- Reduce dependence on imported energy sources, chemicals and feedstock for a variety of products



Self Reliance- Atmanirbhar Bharat

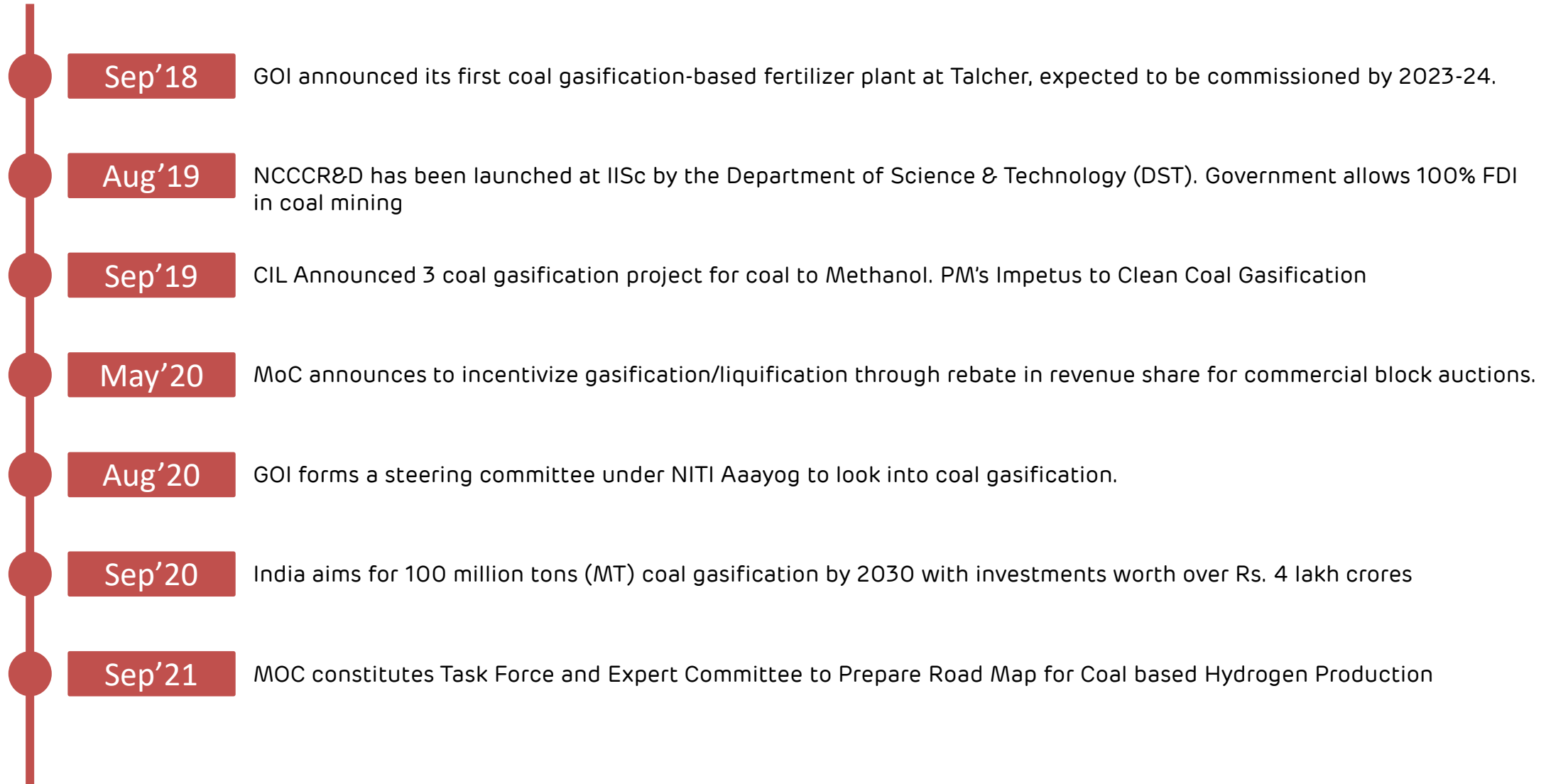
- Widespread implementation & promotion of technology can make India "Atmanirbhar" in several value-added products
- Mega coal to chemicals plant complexes at coal pit-heads can bring in regional economic prosperity as well as help meeting the gaps in interior states of the country



Low Carbon Emissions

- To promote initiatives for sustainable, gainful & maximum utilization of national coal reserves
- CO2 and other polluting gases can be separated, captured in cheaper way and utilized for other industrial uses

Recently, coal gasification has gained momentum with series of key events and govt. initiatives



100 MT Coal Gasification Target by 2030

- Indian government aims for 100 million ton (MT) coal gasification by 2030, with investments worth over Rs. 4 trillion.
- In order to encourage the use of clean sources of fuel, the government has provided a concession of 20% on revenue share under commercial coal block auctions.
- A Steering Committee has been constituted regarding Surface Coal Gasification under the chairmanship of Dr. V.K. Saraswat and members from the Ministry of Coal.
- CIL has also planned to set up at least 3 gasification plants (besides Dankuni) on BOO basis through global tendering and has signed an MoU with GAIL for marketing synthetic natural gas.

Other factors and challenges slowing investments- To be addressed by Govt. and Industries

Key Challenges

Coal Related

- Low Grade, high ash coal
- Large Quantity of fines due to improper mining
- Monetisation of Coal fines
- Variation in quality due to unavailability of dedicated source
- Inadequate coal beneficaiton facilities

Environment Related

- Huge quantity of waste, black water generation
- Costly waste treatment for ZLD
- Costly systems for CO₂, H₂S removal
- Ash storage and disposal

Technology Related

- Availability of proven gasification technology suitable for Indian poor-quality Coal
- Costly & Complex coal feed preparation technology
- High technology cost affects Syngas & downstream products costs & Project viability
- Costly large capacity Cryogenic ASU plants required for Oxygen gas supply
- Lack of experienced EPC / LSTK and O&M Manpower contractor
- Due to demand / price fluctuations, only poly-generation route configuration is viable

Reduce dependence on Imports

- Coal gasification is yet to get recognition as “New Business Opportunity”
- Recognition of coal gasification as Infrastructure sector
- Modification in ‘Coal Distribution Policy’ to accommodate Coal Gasification including Producer Gas Plants using coal
- Declaration of a separate Sector for facilitate allocation of coal
- Earmarking coal sources/blocks to supply right quality of coal
- Fixation of Norms by a scientific institute for coal allocation to accommodate support units and considering type of gasifier, washability characteristics of coal, coal specifications & grade

'Dedicated, closeby Coal Mines' to be earmarked for Coal Gasification Projects (to be awarded through Auction Linkage) for better Coal Quality consistency , sustained Supply & closer Mining & Transportation Cost control.

Viability gap funding, Infrastructure status

Financial Incentives from Govt to support very high Capex of Gasification Projects needed to improve Viability of 'Energy Security' (Clean) Projects.

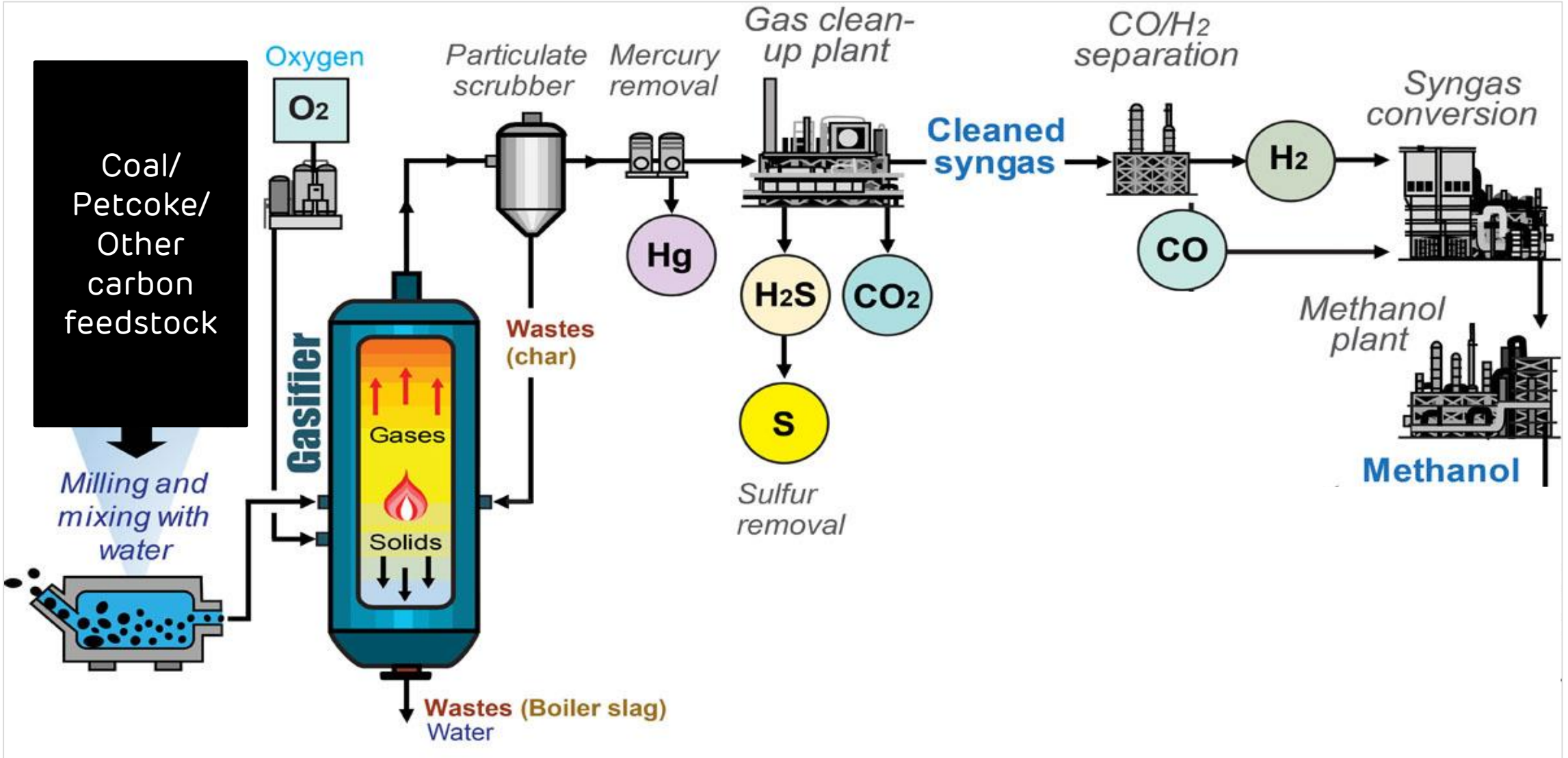
Level playing field

Exemption from currently applicable Cess / Duties on Coal Feedstock prices to be provided for Environment - friendly Coal Gasification Projects due to its Clean Technology adaptation

'National Policy on Coal Gasification & Liquefaction' should be urgently formulated and promulgated for faster and smooth implementation of Coal Gasification based Projects.

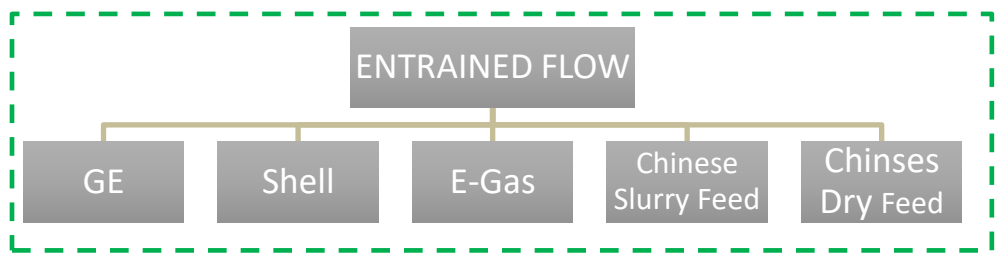
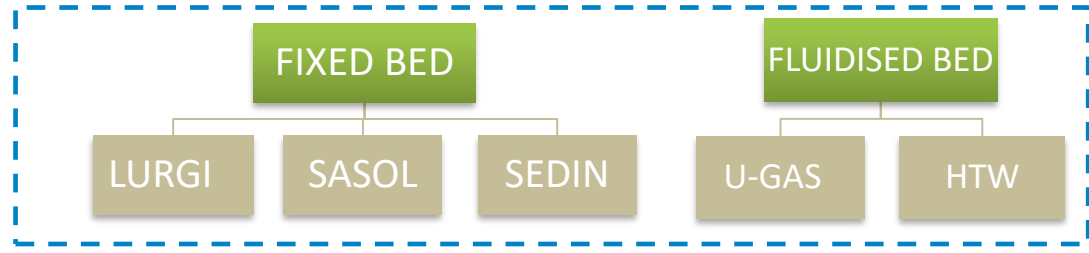
Schemes for **'Blending Methanol, DME with Gasoline & LPG'** respectively to be implemented at the earliest. Policy framework for all by products of coal gasification.

Coal Gasification- Process Unit

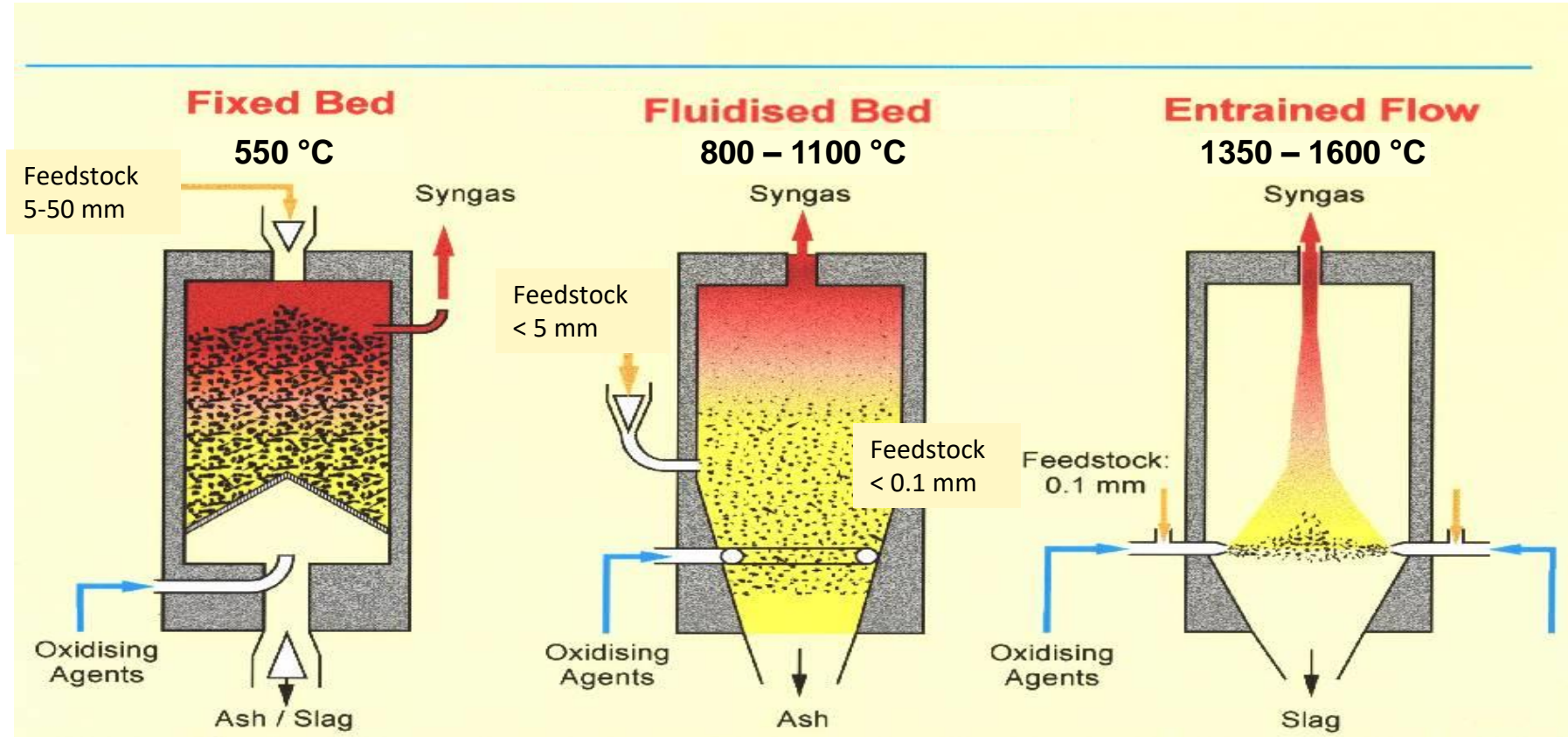


Suitability of Gasification Technologies to Indian coal

Suitable for high ash Indian coals (>35% Ash)



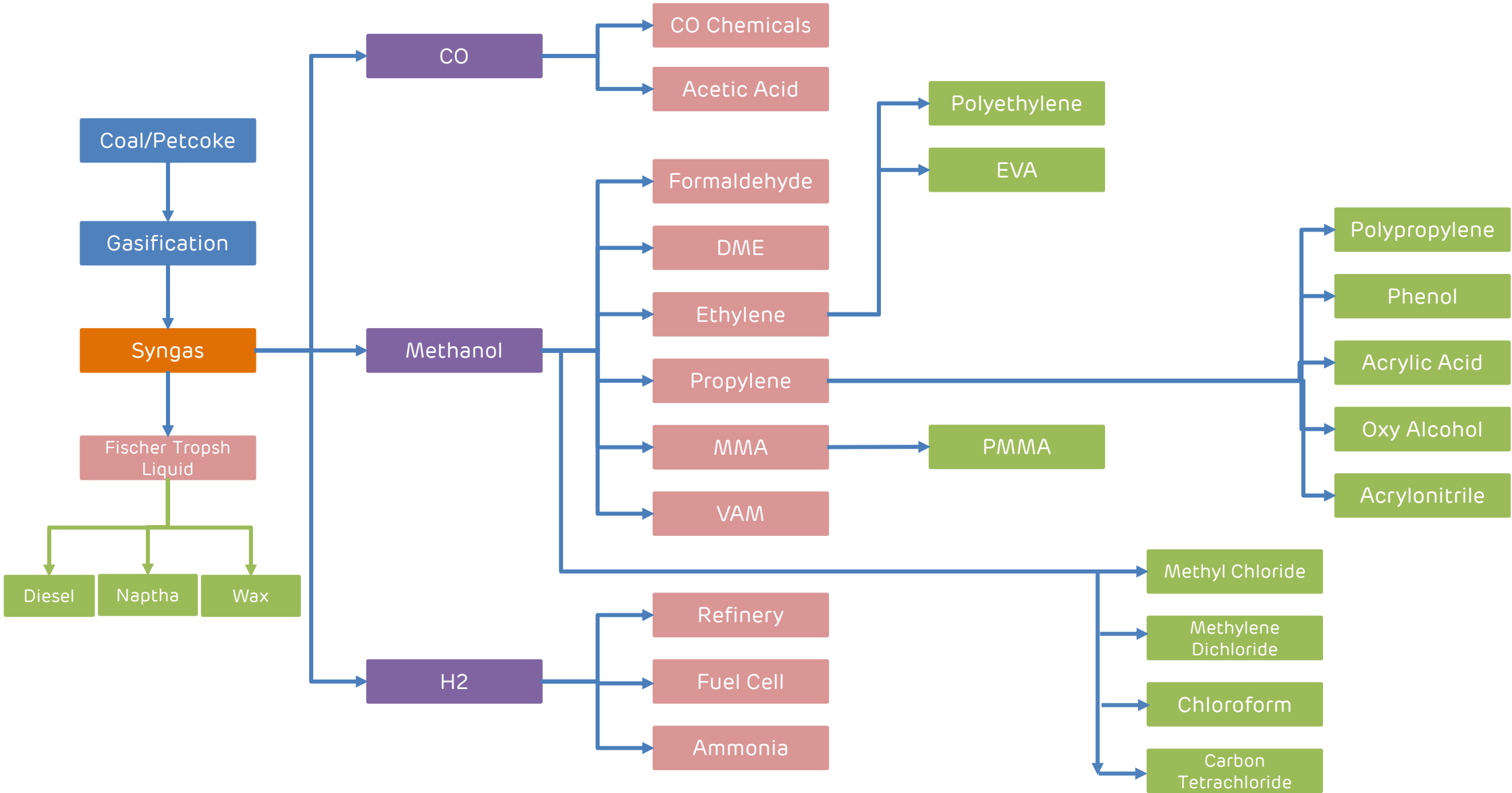
Best Suitable for Petcoke/Coal blends Or Coal (<30% Ash)



Specifications of available technologies

Parameter	Lurgi	GE	SHELL
Gasification type	Fixed Bed	Entrained flow	Entrained flow
Type of feed	Coal	100% Coal, 100% Petcoke, Petcoke & coal blend	100% Coal, 100% Petcoke, Petcoke & coal blend
Type of syngas cooling	Syngas cooler	Syngas cooler, bottom quench	Syngas cooler, bottom quench
Feed type	Dry feed	Slurry	Dry feed
Wall	Jacketed	Refractory	Membrane Wall
Pressure(bar)	30	65, 85	40-45
Outlet syngas Temp	~550 °C	~1500 °C (SG)/ ~240 °C (quench)	~1600 °C (SG)/ ~210 °C (quench)
Feed size suitability	5-50 mm	<100 µm	<100 µm
Ash range	25% to 35%	<30%	<30%
Minimum Ash/Flux required	-	2-3 %	8 %
H ₂ /CO ratio	~1.6	~0.6	~0.5
No. of gasifiers	114	>100	>23
No. of burners	no burners	single	multi burner

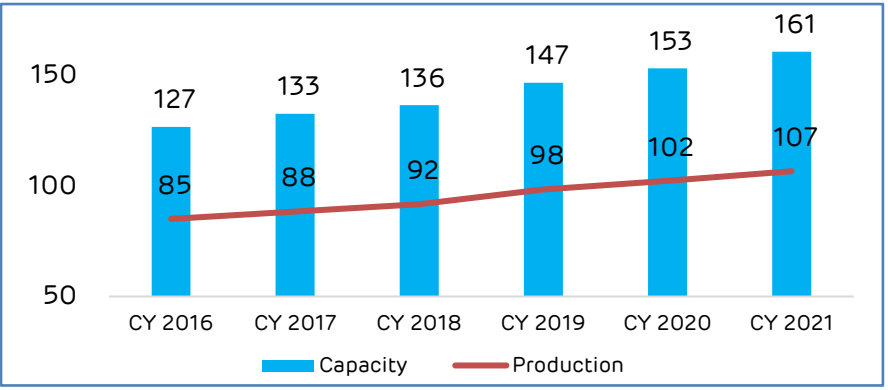
Gasification Products



Methanol Market Overview

Market Overview

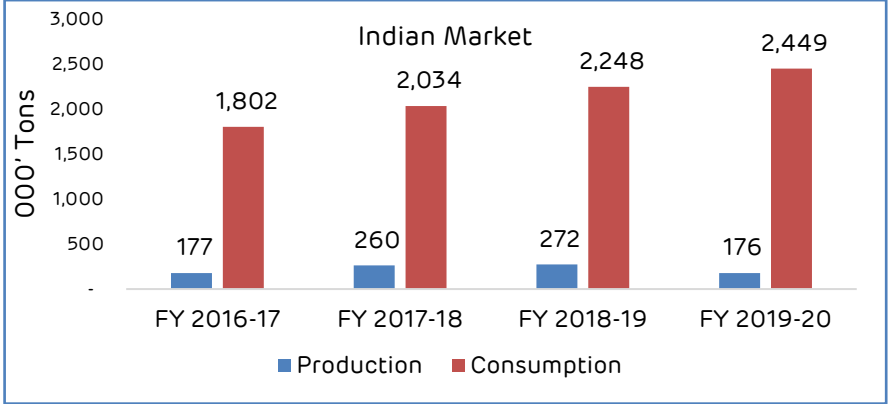
- Global Capacity (2021): 161 MMTPA.
- Expected CAGR: 4.5 -5%
- Production level is at 67% of the capacity.
- Asia and China are the major supplier as well as consumer of Methanol.



Top Producer of Methanol In India		
Company	Location	Capacity (MTPA)
GNFC	Bharuch, GJ	160000
Deepak Fertilizers	Taloja, MH	10000
Rama Petrochemicals	Patalganga, MH	60000
RCF	Trombay, MH	49500
Assam Petrochemicals	Namrup, AS	40000
National Fertilizers	Nangal, AP	19500
Total		429000

Indian Market

- Indian demand is mainly met through import. Total demand is approx. 2.5 million tons, out of which around 90% is being import.
- Installed Capacity: 4.74 Lakh tons
- Major Import are from Middle East countries – Qatar and UAE



Benefits of meeting the needs of Fuels, Chemicals through Methanol & Downstream value chain of Coal Gasification

220 Bn
\$

of Foreign exchange saved by Indigenous production over the project life of 20 years

>15000
0

Direct and In-direct Employment Generation



Supply security for Enhanced Energy , Fertilizer & Chemicals



Revenue to the Govt. over the project life as Taxes, Duties, Coal Royalty etc.



- ✓ Clean Technology: 99% Recovery of Sulphur in coal as saleable Sulphur; CO2 in ready to capture form
- ✓ Methanol 15 (M15) in petrol will reduce pollution by 33% and diesel replacement by methanol will reduce by more than 80 %.

NITI Aayog's Methanol Economy Program

- NITI Aayog's '**Methanol Economy**' programme is aimed at reducing India's oil import bill, greenhouse gas (GHG) emissions, and converting coal reserves and municipal solid waste into methanol.
- Blending of **15% methanol** in gasoline can result in at least **1-5% reduction** in the import of gasoline/crude oil, which will bring down GHG emissions by 20%, thereby improving the urban air quality.
- Creation of **5 million** jobs through methanol production/application and distribution services.
- Rs 6000 crore can be saved annually by blending **20% DME** (Di-methyl Ether, a derivative of methanol) in LPG. This will help the consumer in saving between **INR 50-100 per cylinder**.
- Under R&D, work is in progress to set up coal-to-methanol plants in the country using indigenous technology, which is being developed by **BHEL** (Hyderabad and Trichy), **Thermax**, and **IIT Delhi**.
- An R&D project has also been sanctioned by the Department of Biotechnology to **IISc Bengaluru** and **Praj Industries** Pune to produce methanol from biomass. Phase-I of the production of syngas from biomass was demonstrated in January 2019.



Growth
with
Goodness

