Energy For Sustainable Growth

Breakout Session 3: Coal Gasification

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India – Fuel Carbon Imports

(2018 data, approx.)

Commodity	Import, MMT/yr	% C	Imported C, MMT/yr
Crude Oil	220	85%	190
Coal	200	75%	150
Natural Gas	15	77%	11.6

Demand Side Response

- Reduce energy requirement (enhance efficiency)
- Reduce carbon requirement (non-carbon energy e.g. solar, wind, geothermal)

Supply Side Response

Find about 350 MMT of domestic carbon (on current basis) to replace our fuel / plastics carbon imports

*Need **carbon** security solutions within our control*

Indian Coal
Realizing Possibilities

- ~319 billion MT coal reserves down to 1.2 km depth (of which 149 BMT proven/measured)
- Mostly high ash, ~ 26% C, i.e. 38 billion MT C atoms (~100 years)
- Less suited to thermal power plants, but adaptable to gasification
- IGCC plants (gasification, gas turbine and waste heat steam turbine) can reduce GHG while raising power generation efficiency

- Coal utilization is associated with high GHG emissions – CCUS likely to be necessary for low-carbon commitments
- Domestic expertise exists in limited pockets but not end-to-end, and not at high TRL
- Parallel efforts worthwhile for assimilating international tech and building domestic capability
- Coupling high-ash-coal IGCC with syngas-to-methanol or syngas-to-chemicals may be a unique model for India

Coal Gasification solutions should be customized to national needs – not necessarily replicate Western models

Overview

- Objectives: Purity, Cost, Scale and Sustainability of Coal-to-Hydrogen via Gasification
- Constituent Modules: Coal preparation, Gasification, syngas clean-up and conditioning, hydrogen generation and purification, CCUS (and also ash utilization / disposal)

Success Metrics and Imperatives

- Syngas Purity: Specifications depend on application
  - Impurity profile depends on manufacturing process
  - Impurities determine cost of syngas clean-up
  - Domestic Technology available at low TRL – to scale up quickly
- Cost: Production, storage, transport
  - Blue hydrogen must ideally compete with NG-based H2
  - Value maximization for balance of Syngas
- Scale: Time bound scale up required with simultaneous alignment of Supply-side, capex, opex and demand-side considerations
- Sustainability: Coal based hydrogen requires energy integration and CCUS to offset Net GHG headwinds
- Ash disposal and other environmental impact must be factored into technology selection / project development

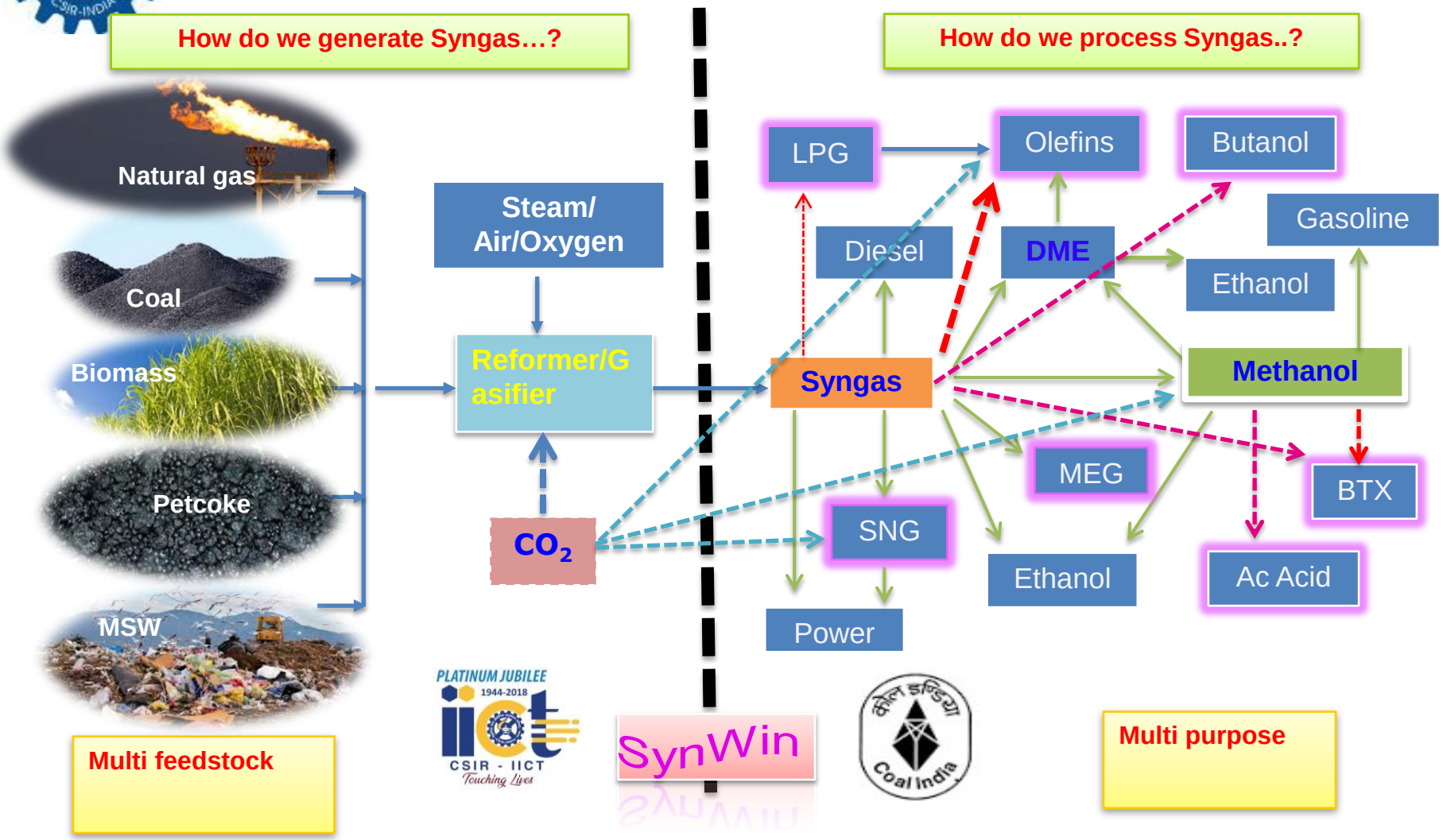
GASIFICATION POTENTIAL MAPPING

- NITI Aayog entrusted *CSIR-CIMFR & CMPDIL* **"Gasification Potential Mapping of Indian Coal"** (Notification: 17/05/2018)
- Completed mapping for **MCL** (13 mines, Ash: 20-46%), **CCL** (6 mines, Ash: 29-53%) and **ECL** (5 mines, Ash: 18-38%). Report submitted to **NITI Aayog** on 24th Dec, 2019
- Developed Coal characterization matrix for Physico-chemical properties of coal/Ash essential for gasification.
- Suggested ***Matching gasification technology*** vis-à-vis ***Utilization pattern*** & ***gasification strategy*** for gainful utilization of Indian coal resource.

OUTCOME: Utilization Pattern & Gasification Strategy

- Inputs for selection of matching Gasifier according to coal properties.
- High ash coal washing or blending with Petcoke to reduce ash content suitable for Entrained flow Gasifier (Shell) or Moving Bed gasifier (Lurgi FBDB) Gasifier.

Syngas Value Addition



Multi-Feed Gasification Adaptability with Multi-Product Downstream Slate Should be the Long-Term Vision

LCA and CCUS

- All projects must be rigorously assessed for effective carbon utilization, energy efficiency, carbon capture rate, CO2 emissions and environmental performance
- Any investments in demonstration units must be based on generation of sufficient real-time data at pilot scales on high-ash Indian coal
- Gasification, syngas clean-up and conditioning, hydrogen generation, CCUS and ash disposal modules should be evaluated both as independent and as integrated offerings

Thank You

Questions?