

# Coal Gasification Opportunities and Challenges for India

Kalpana Jain  
Gasification India: 2016



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# Need for clean coal

- **Coal – prime fossil fuel in India**

- Abundant reserves
- Vital for Energy Security

- Mostly available in low quality, high ash
- Environmental issues

## Clean Coal Technologies

### **Beneficiation (pre combustion)**

- *Practical challenges in achieving desired levels*
- *Disposal issues*

### **Coal Conversion**

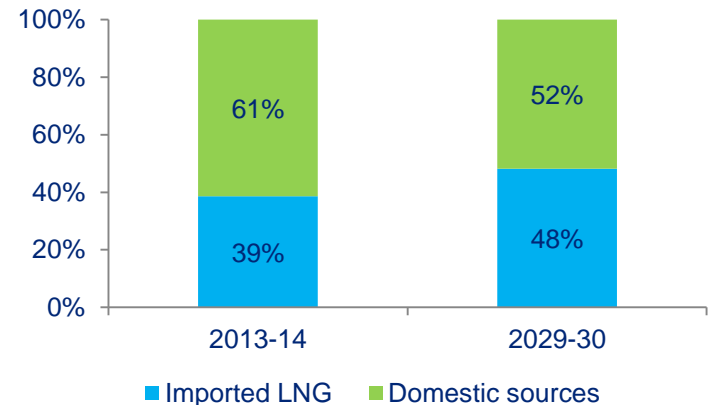
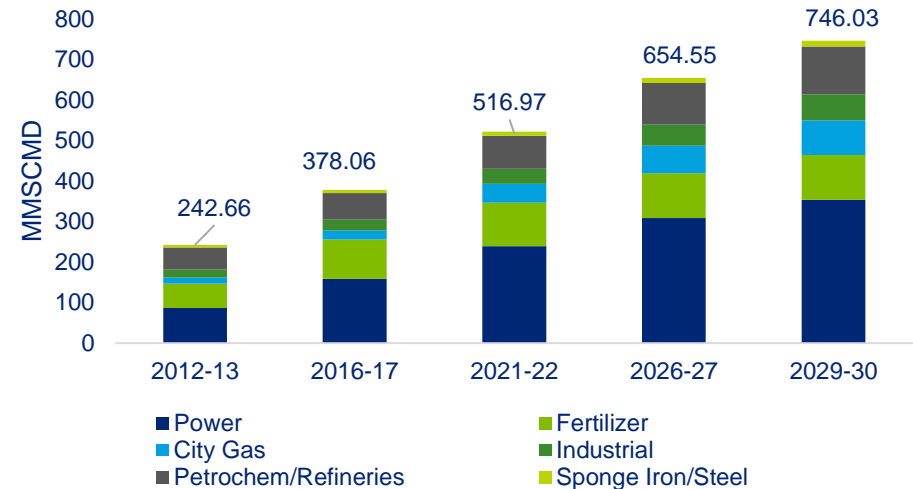
- *Coal Gasification*
- *Coal to Liquid*

# Why gasification?

**In order to overcome uncertain natural gas supply, unlocking domestic coal gas potential a need**

- Increasing demand for natural gas in India; driven by growing economy – resurging industrial production & infrastructure development
- Current natural gas shortage estimated at 14.1 million tons; increasing dependence on imports; price volatility
- Urea shortage estimated at around 7-8 million tons

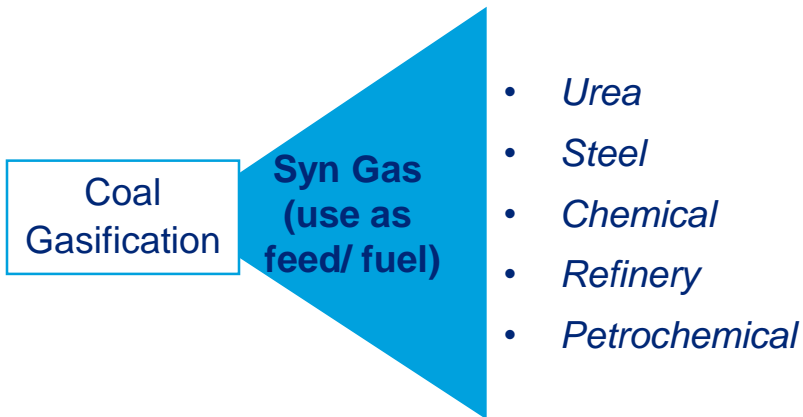
Natural Gas Demand in India



Source: Vision 2030" Natural Gas Infrastructure in India, Report by Industry Group For Petroleum & Natural Gas Regulatory Board

# Importance for India

## Potential areas for utilization



## Recent examples

Company	End Use	Status
JSPL	DRI	Operating
GAIL, RCF, CIL, FCIL	Urea	JV formed, initial studies underway
Adani	Urea, Methanol, SNG	MoU signed with State Governments

## Government Benefits

- Savings in foreign exchange
- Revenue generation – taxes, duties, royalty, etc.
- Employment generation

# Importance for India

## Optimization of coal reserve

*All quantities in billion tons*

<b>Reserves (as on 1 April 2014)</b>	<b>Proved</b>	<b>Indicated</b>	<b>Inferred</b>	<b>Total</b>
0-300 m	96.3	69.5	10.5	176.3
300-600 m	13.6	58.7	16.5	88.8
0-600 m*	13.8	0.4	0.0	14.2
600 – 1200 m	2.2	13.9	6.1	22.2
<b>Total</b>	<b>125.9</b>	<b>142.5</b>	<b>33.1</b>	<b>301.5</b>

*\* Jharia coal field*

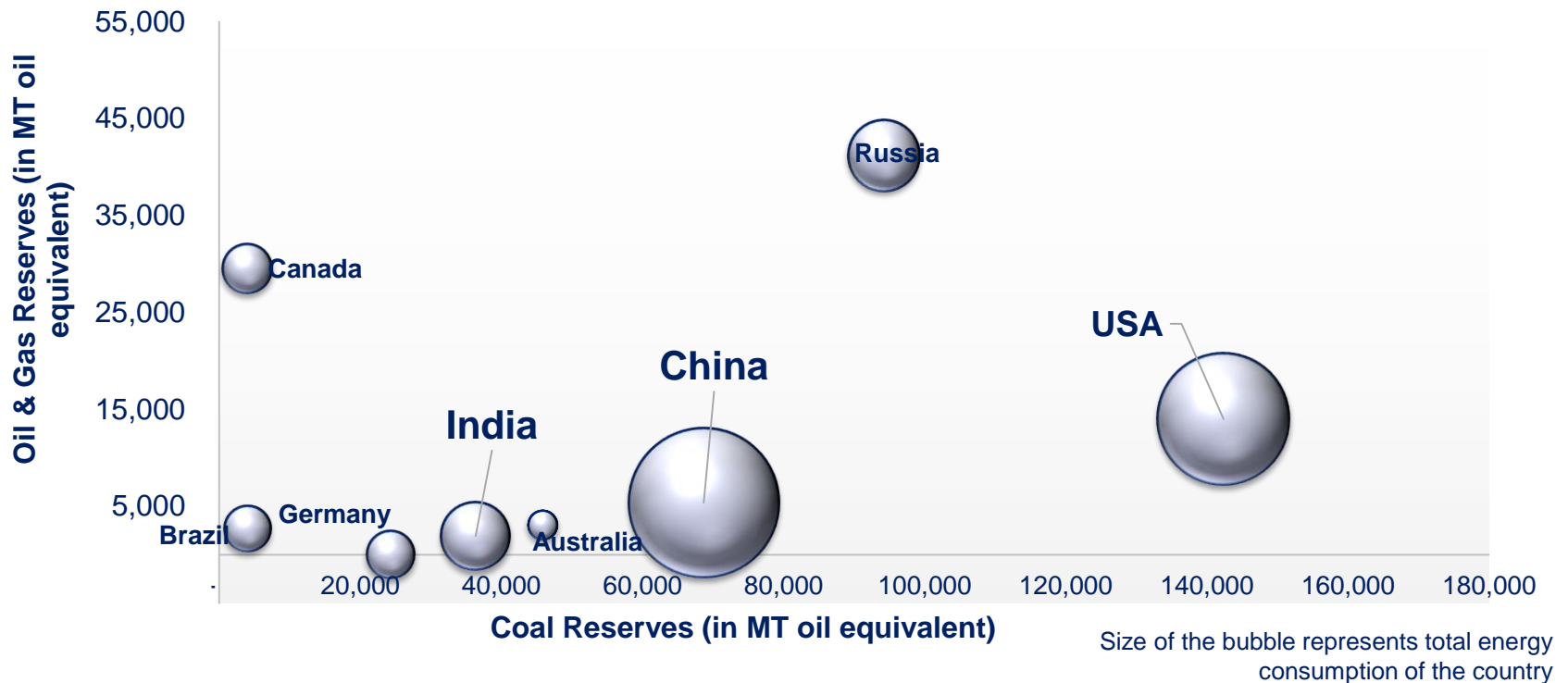
- Abundant reserves
- Ranked 3<sup>rd</sup> in non coking coal and lignite ore deposits
- Potential to generate ~ 2500 m<sup>3</sup> of syn gas per ton of coal

### Technical Advantages

- *Low emissions*
- *Low ash disposal*
- *Low water consumption*
- *Improved efficiency*
- *No land degradation, landscape changes*
- *No R&R issues*
- *Increased safety*
- *Saleable by-products*

# Importance for India

## Captive energy resources – select economies



- Largest energy consuming economies - China, USA and India
- Both China and India have limited oil & gas reserves and large coal reserves for exploitation
- While China has invested significantly in coal gasification with more than 100 operating plants, India is under exploratory phase – only one operating plant of JSPL

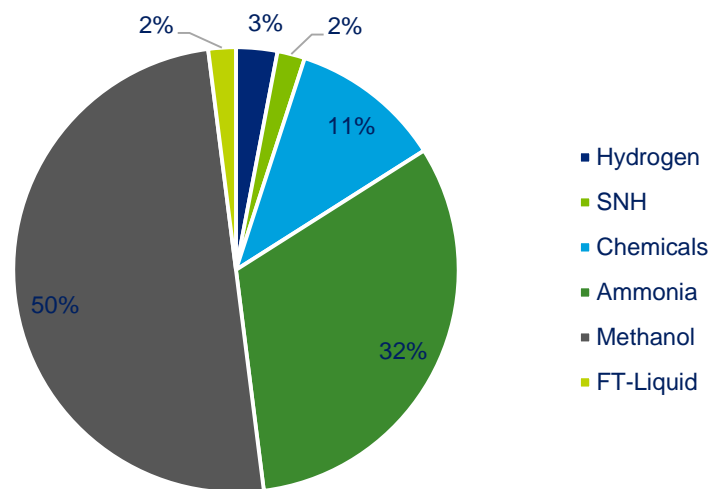
# China story

- Volume of coal gasified: ~ 250,000 tons per day
- More than 107 plants operating and about 40 plants to be commissioned between 2015-19 (coal consumption of 600,000 tons per day)

## Coal gas based production (million tons)

Product	2015	2020
Methanol	96.3	66
LPG	13.6	5
DME	13.8	20
Olefin	2.2	15
Ethylene Glycol	1.7	NA
Oil products	2.4	30
Urea	60	NA

## Product wise distribution of coal based plants (no. of plants)





# Opportunity areas

**Limited technical capabilities  
present domestically**

## **Global pioneers for technology collaborations**

- Technology Suppliers
- Equipment Providers
- Project Management Consultants

## **Project Developers/ Investors**

- Collaboration/partnership for bidding jointly/ in consortium for coal blocks
- Independent bidding for coal blocks

# Key challenges

Risk Areas	Challenges	Possible Mitigation
<b>Technology</b>	<ul style="list-style-type: none"> <li>• Indian coal quality – high ash</li> <li>• Lack of proven expertise</li> <li>• Plant configuration challenge</li> <li>• By products</li> <li>• CO2 emissions</li> <li>• Larger requirement of water &amp; land</li> </ul>	<ul style="list-style-type: none"> <li>• Investment in R&amp;D</li> <li>• Use of CO2 - Manufacture products which can consume CO2 e.g. Urea. Possibility of use for EOR of nearby O&amp;G fields</li> <li>• Sale of by products</li> </ul>
<b>Financing</b>	<ul style="list-style-type: none"> <li>• Relatively higher capital costs as compared to natural gas based projects</li> <li>• Long gestation period and development concerns</li> <li>• Economic viability concerns</li> </ul>	<ul style="list-style-type: none"> <li>• Government support</li> <li>• Ownership of block with plant located at proximity</li> <li>• Economies of scale</li> </ul>
<b>Regulatory</b>	<ul style="list-style-type: none"> <li>• Resistance to coal use</li> <li>• Coal blocks bidding not allowed for coal gasification</li> </ul>	<ul style="list-style-type: none"> <li>• Close participation of Government and Private sector required</li> <li>• Need for a separate regulatory framework</li> </ul>

Though need of self reliance on energy supply is critical, price competitiveness will play a major role

# Economics – key driver for coal gas developments

## Indicative price gap (natural gas – coal)\* (USD/ mmbtu)

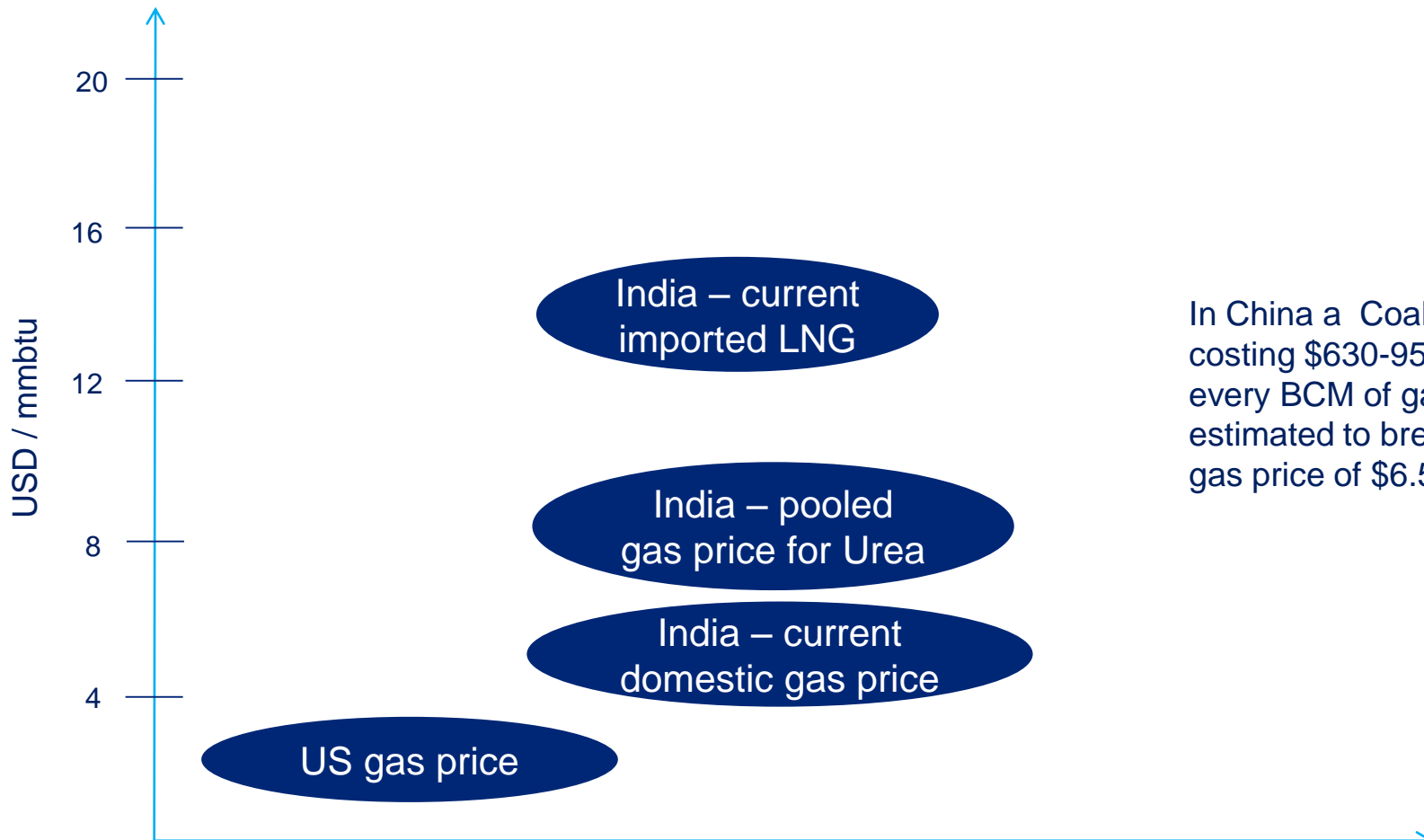


- Price gap between gas and coal is higher in Asia as compared to US
- For India, which is dependent on imported LNG, the gap may be able to cover conversion cost of gasification

*\* Coal prices in USD/ MT converted into equivalent prices in USD/ mmbtu.  
Doesn't include conversion cost of coal gasification  
Prices are illustrative*

*\*\* Japan reference price*

# Economics – key driver for coal gas developments

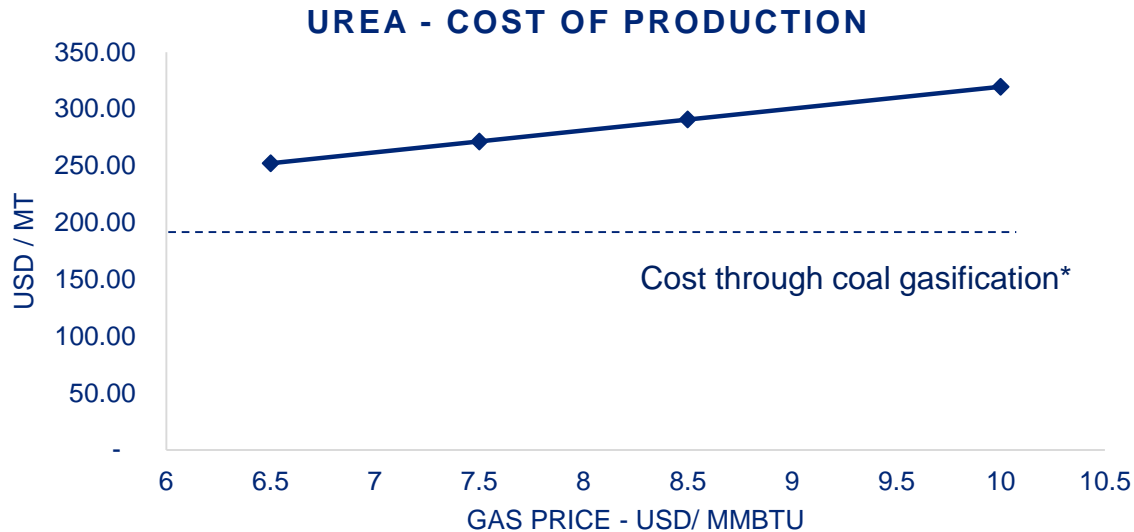


In China a Coal To Gas plant costing \$630-950 million for every BCM of gas capacity estimated to breakeven at a gas price of \$6.5-8 per mmbtu

*Note: Price estimates are indicative in nature and subject to change based on contract terms, market and regulatory changes.*

# Economics – An illustration: Production of Urea

- Preliminary studies suggest cost of syn gas production from coal could be cheaper by upto 30% compared to natural gas
- Indicative cost of production (fixed plus variable) of Urea:



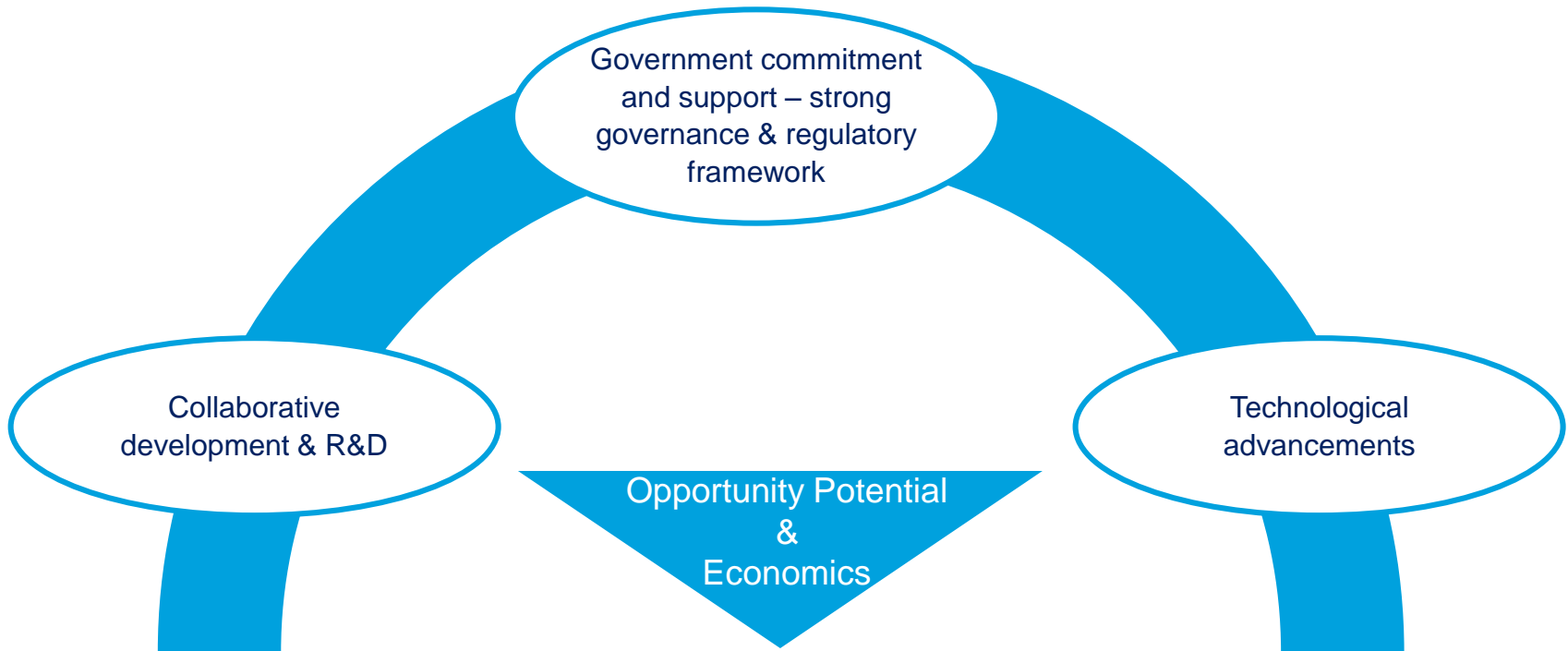
\* Delivered washed coal cost @ ~ INR 2,000 / MT

Indicative Capital Cost (1.3 MMTPA) Urea Plant

- Natural gas based:  
USD 0.9 – 1 billion
- Coal gas based:  
USD 1.2 – 1.4 billion

# Way forward...

*“In countries like India, there are vast opportunities for those wishing to invest in clean coal technology, since our dependence will not reduce very soon.” – Narendra Modi, Hon’ble Prime Minister of India*



**Given the infrastructure development needs and significant coal reserves, investment in coal gasification needs to grow in coming years ....**



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