

# Coals to Chemicals: Syngas to Ethanol & the Path to Decarbonization...

**12<sup>th</sup> World Petro-Coal Congress: International Conference on Petroleum-Coal-Gas**  
(Keynote Session VI: Coal Gasification and Coal-to-Liquid Conversion)



# True North Venture Partners: Introduction & Overview



- Long term commitments to our businesses via a perpetual holding company: **Capitalized in Excess of USD 700 million.**
- Invests in and Develops **Interconnected and Symbiotic Set** of Innovative Technologies and Businesses that could
- Reshape Core Industries and help the World Transition to a **Clean & Sustainable Future.**
- A 20-year History, to the founding and scale up of **First Solar, a Global Leader in Photovoltaics.**

## Strategy: Long-Term Value Creation



Invest early and solely in the development of promising technologies



Execute “fast fail” programs



Commercialization using core engineering methodologies and strong entry markets



Scale rapidly to drive economies of scale and efficient learning cycles



Migrate from entry markets toward disruptive long-term opportunities

## Core Capabilities



Technology assessment and development



Robust Engineering



Organizational Excellence and Development



Strategic Marketing

## Our Businesses: Solutions for India's Market



Novel fermentation technology to process syngas from multiple sources into high value products



Novel electrolysis platform technology to cost effectively produce industrial grade hydrogen and oxygen with renewable energy



Chemistries and cell design to produce maintenance-free, 20-year stationary energy storage



Ceramic membrane technologies to filter surface and ground water, wastewater and seawater for potable and non-potable uses



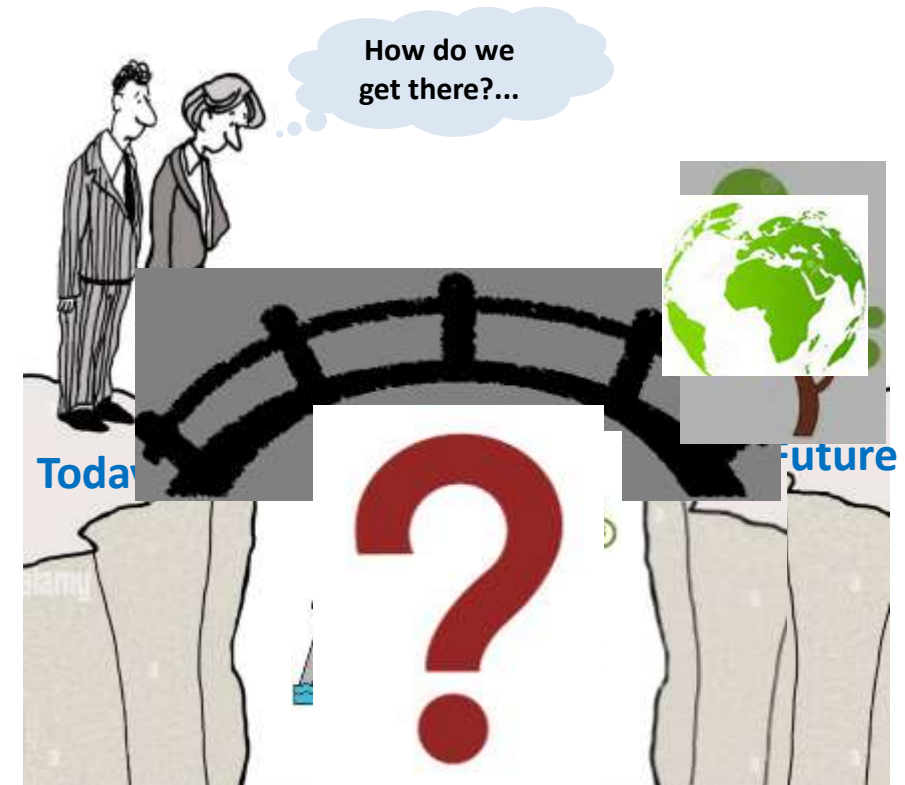
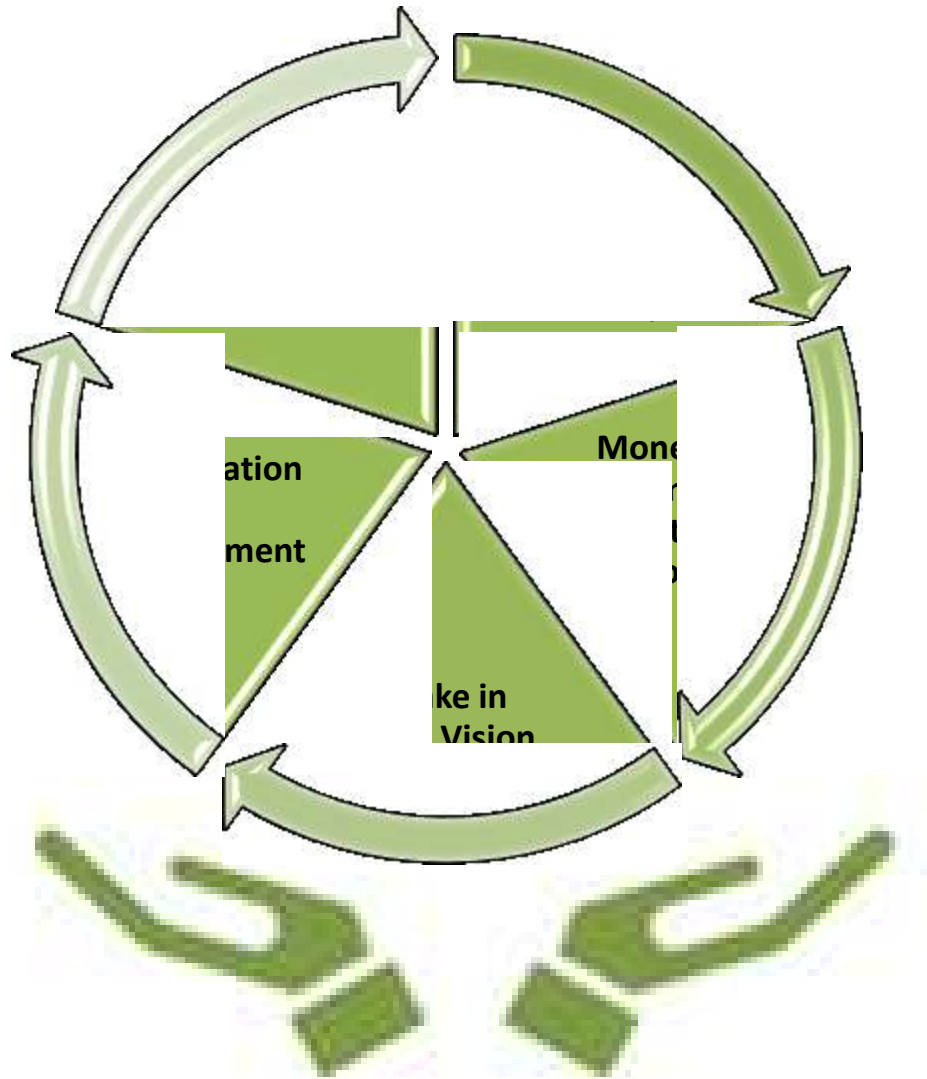
Novel catalytic process to convert methane into chemicals at low pressure and temperature



Technology diverting waste streams from landfills and process them into energy and other products

# India is Aiming for Exciting Solutions for some Challenging Questions

However, the road from the energy intensive present to the green & sustainable future isn't easy...



What are the resource(s) that can help us build this bridge?...

# India's Natural Resources: What can we use?

## Solar



- ❑ Fast developing industry with **cumulative installed capacity of ~48 GW** as of November 2021
- ❑ **Lowest capital cost per MW** globally to install the solar power plants
- ❑ **Promoted by Policies, Support & Incentives** for enabling acceleration
- ❑ However, **downstream technology to use P2X platforms are still in nascency**

## Biomass



- ❑ Promising feedstock with **abundant availability**
- ❑ **Substantial research and development** towards biomass conversion technology
- ❑ **Alternative usage required** to solve the traditional disposal methods and make Swachh Bharat a reality
- ❑ But **conversion technologies still at desktop stage and are considered unscalable and uneconomical**

## Coal



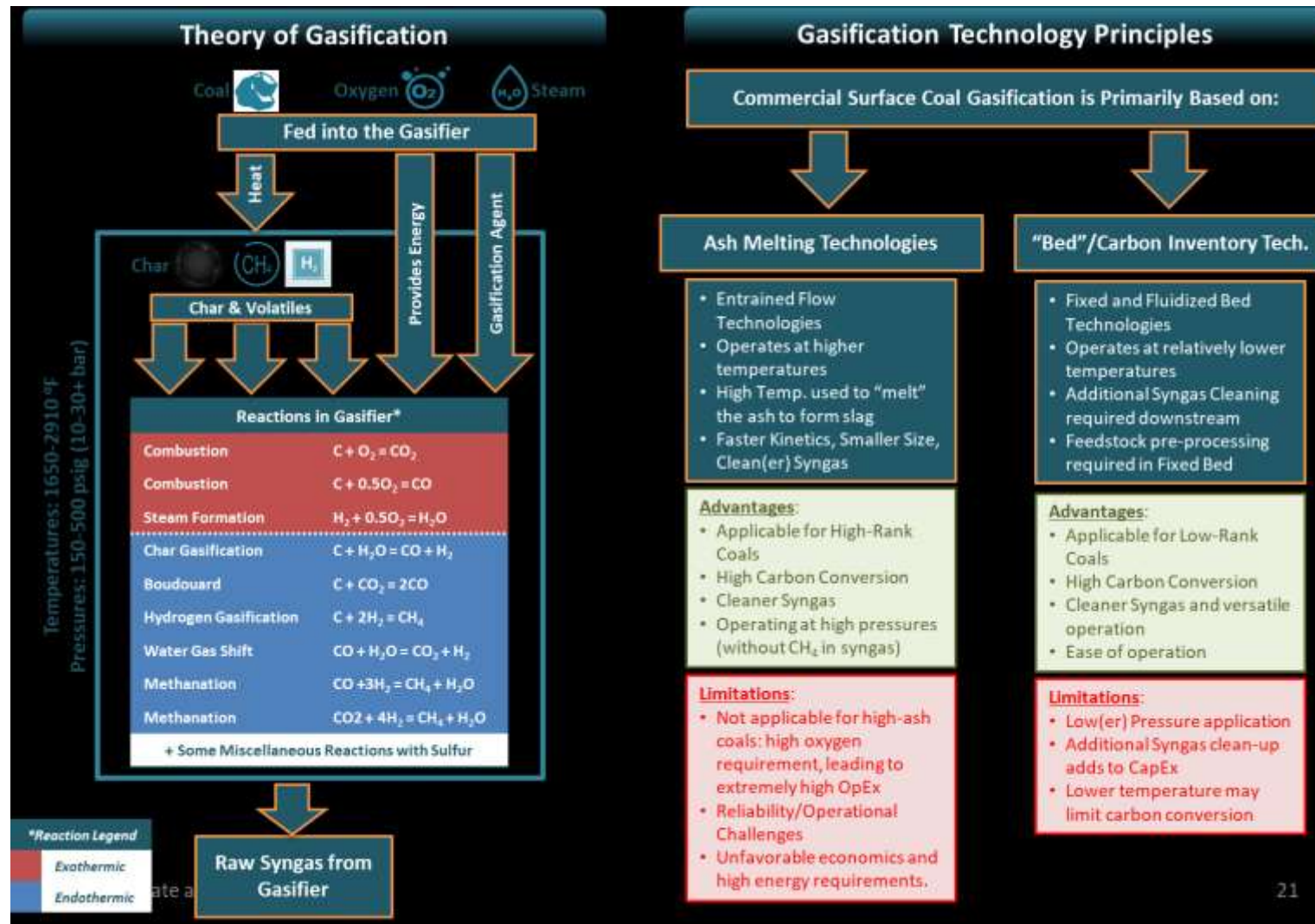
- ❑ **Abundant availability** and provides the most promising variable margin
- ❑ *"...World's third largest coal reserves are in India. For a country like India, we cannot ignore it but find a solution for it", PM Modi at a Global Business Forum (Sept. 2019)*
- ❑ Major application for power, but NTPC has announced **that no new power plants after 2024. Alternative uses of coal CRITICAL to maintain revenue!!**
- ❑ **Bad reputation environmentally.** However, **"clean" coal conversion technologies (gasification) are commercial and globally employed**
- ❑ **Policy support required for coal to achieve its full potential!!!**

Leveraging the widely commercial and proven 'coal gasification' platform using an efficient and economical syngas conversion technology, can help convert...

**BLACK**  to **GREEN** (   )



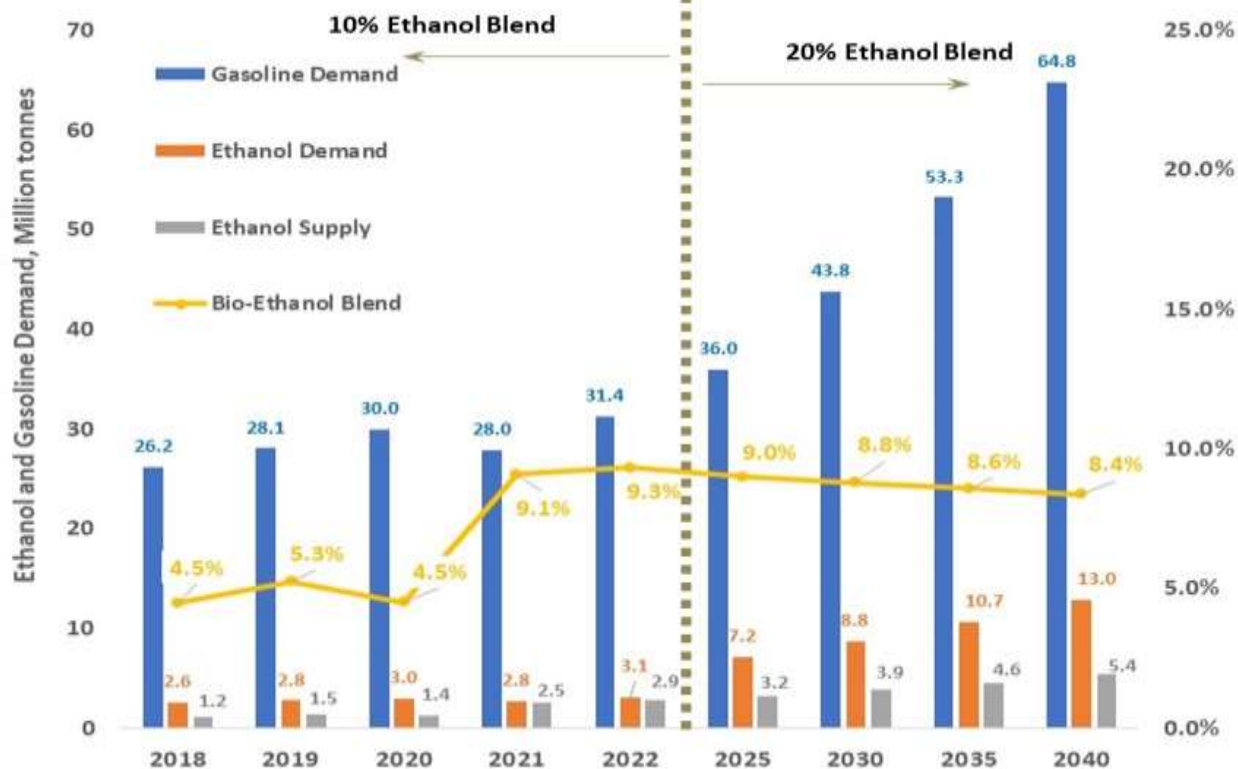
# Challenge for High-Ash Coal: Choice of Gasification Technology



**Selection of Gasification Technology based on Coal Type is EXTREMELY CRUCIAL!!!...**

# Synata Bio's Transformative Coal-to-Ethanol Technology: A scalable & economic solution for India's vision of E20 beyond 2025

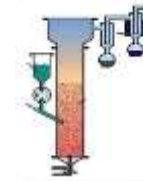
## India's Vision for Energy Independence and Reduction of Imports via Ethanol Blending into Gasoline



### Hurdles and Challenges for EBP to become Reality:

- ❑ **Excessive dependence** of sugar-cane (a water guzzling crop) **and unscalable biomass-based technologies**
- ❑ **Substantial demand-supply gap** for Ethanol to meet the 20% target
- ❑ **Huge capital investments** for 2G-ethanol plants: ~INR 700-850 crores for one plant producing ~28 kmtpa (~3.7 cr. lit/yr.)
  - Solving the gap (only till) 2030 will need about **180 additional projects at a total capital investment of ~INR 1.5 lakh crores (~USD 20 Billion)**

## Synata's Disruptive and Novel Coal (Syngas) to Ethanol Technology Offers ...



A single-step, scalable and highly efficient syngas conversion technology, which has



Compelling and Disruptive Economics: of Ethanol Production, and is



Feedstock flexible, thus providing an alternative utilization option for Indian coal,



Resulting in domestically produced low-cost ethanol fuel, thereby fulfilling

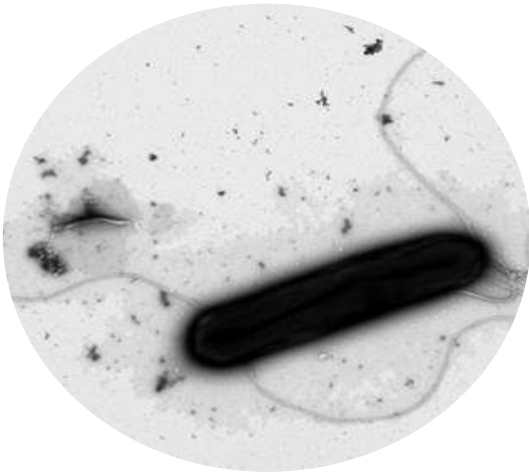


India's objective of achieving E20 blends in gasoline, thus reducing crude imports

# Synata Bio: What are our Core Technology Differentiations

A highly scalable technology with the potential of one plant producing ~40 cr. liter per year at moderate capital investments (~INR 125 per kg (per yr.) EtOH) compared to (~INR 250-300 per kg EtOH from 2G-plants)

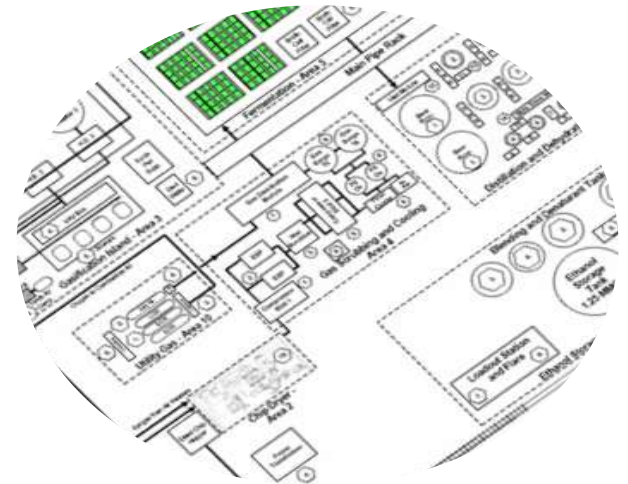
## Unique Microorganisms



## Advanced Bioreactors

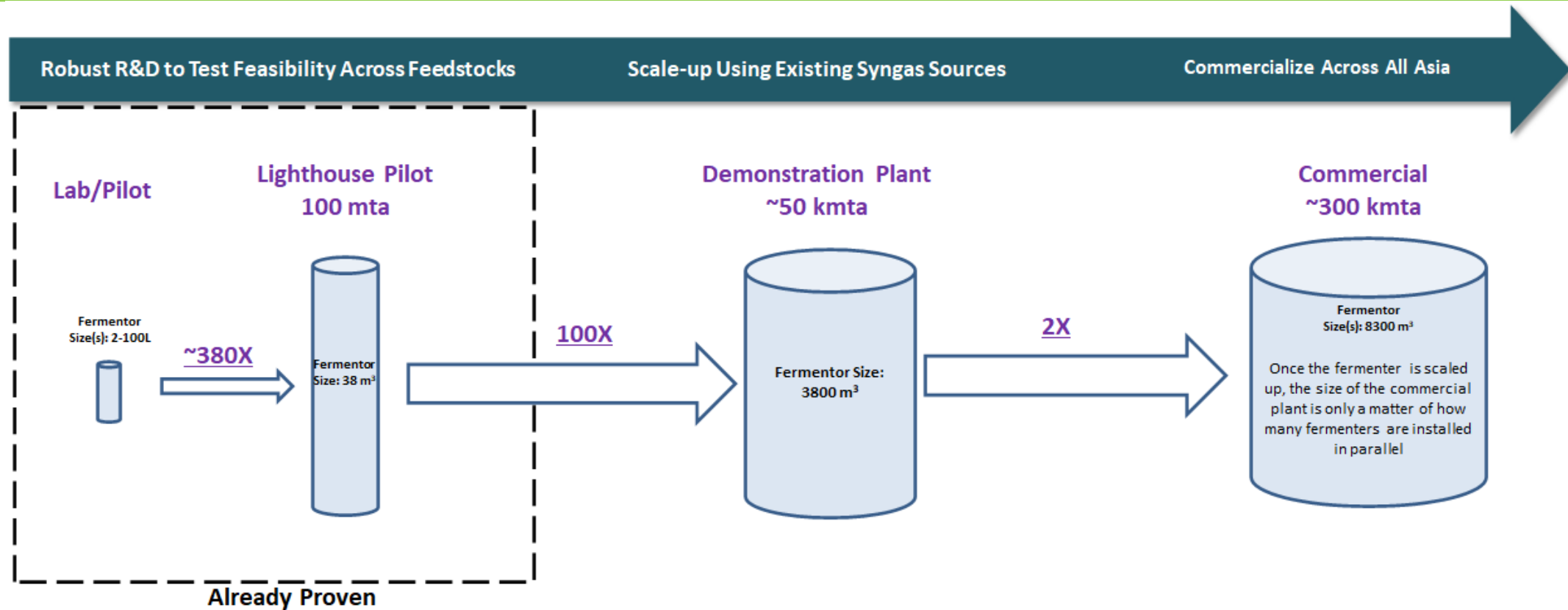


## Fully Integrated Plant



The Above along-with a **‘One-Step Direct Syngas to Ethanol Conversion’, ‘High Syngas Conversion Efficiency’, and ‘High Ethanol Selectivity’** Provides Extremely Compelling Process Economics

# Synata Bio: What is our Commercial Feasibility?



- Target Demand-Supply gap of Ethanol for E20 program can be achieved by **building about 14 Synata Plants**
- Potential to **kick-start and accelerate investments** in coal-gasification sector.
  - ✓ The above plants will need a total of **~15,000 MM Nm³/yr. syngas**
  - ✓ Syngas required is a **typical ~2:1 H<sub>2</sub>/CO syngas ... like a coal-to-methanol process!!**



# Synata Economics: Syngas-to Ethanol Production Cost

Synata Ethanol offers **CHEAPEST ROUTE TO ETHANOL PRODUCTION** from Indian coal compared to existing ethanol prices, and refined gasoline prices at moderate crude oil levels\*\*

## Techno-Economics of Synata Process

### Nameplate/Design Metrics for Synata Ethanol Plant

Nameplate Ethanol Capacity, kmt/yr.	299
Annual Syngas Requirement, MMNm <sup>3</sup> /yr.	1,060
Estimated Synata Capital Investment	USD 240 – 260 MM
Estimated Synata Capital Investment	INR 1,700 – 1800 Cr.

### Production Cost of Syn-Ethanol, INR/lit

Total Production Cost of Synata Ethanol*	INR 40 – 45 per lit.
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### Existing Ethanol Prices in India

Ethanol Price from <u>Sugarcane</u>	INR 63.45 per lit
Ethanol Price from <u>B-Heavy Molasses</u>	INR 59.08 per lit
Ethanol Price from <u>C-Heavy Molasses</u>	INR 46.66 per lit
Ethanol Price from <u>Rice</u>	INR 56.87 per lit
Ethanol Price from <u>Maize</u>	INR 51.55 per lit

## Layout and Capital for Solving the Ethanol Demand-Supply Gap till 2040!

Year	Ethanol Requirement, MM mt	No. of Plants <sup>1</sup>	Total CapEx <sup>2</sup> (\$ Bn)	Total Coal <sup>3</sup> , (mtpd)
2025	4.0	14	~\$ 3.5	18,900
2030	1.0	4	~\$ 1.0	5,400
2035	1.2	4	~\$ 1.0	5,400
2040	1.4	5	~\$ 1.3	6,750
<b>Total</b>	<b>7.5</b>	<b>27</b>	<b>~\$ 6.8</b>	

<sup>1</sup> Capacity of one plant: 300 kmtpa

<sup>2</sup> Capital Investment of one plant : ~USD 250MM

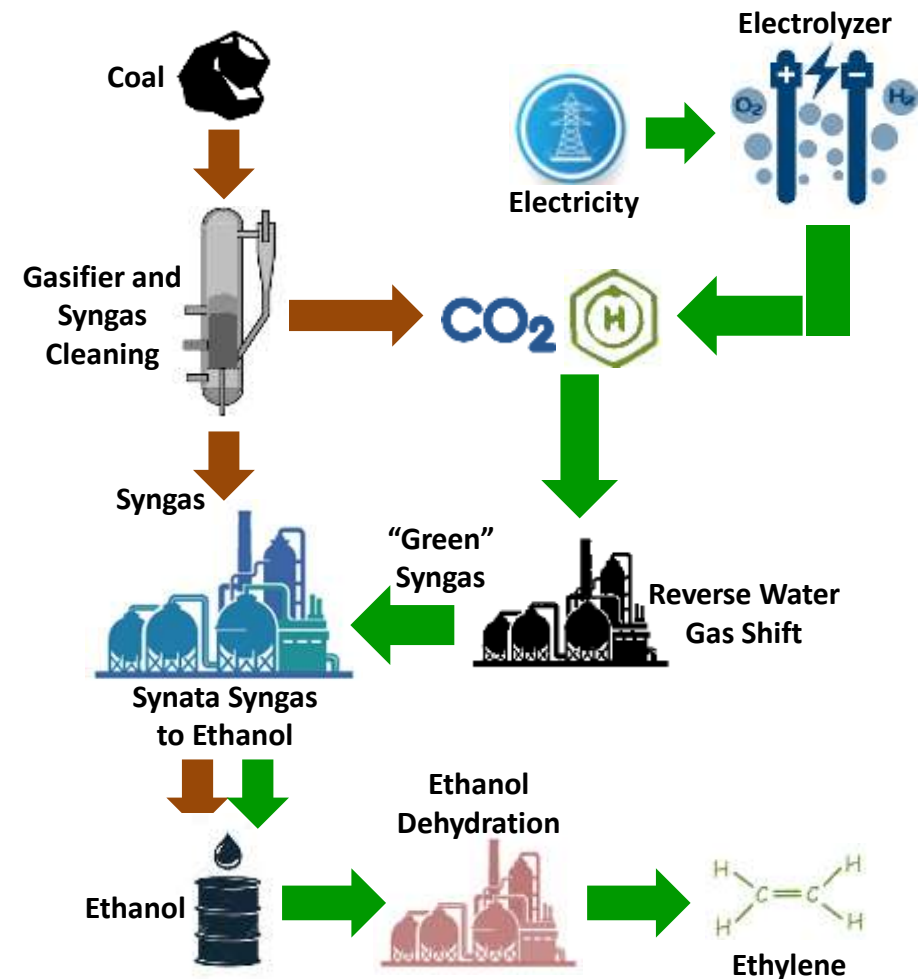
<sup>3</sup> Coal Requirement per plant: 1,350 mtpd

\* Syngas Price Range of \$11-\$13 per MMBtu

\*\* Gasoline Gate Price from Crude at \$80/bbl: ~ INR 47 per lit

# Synata Bio: Commercial Status

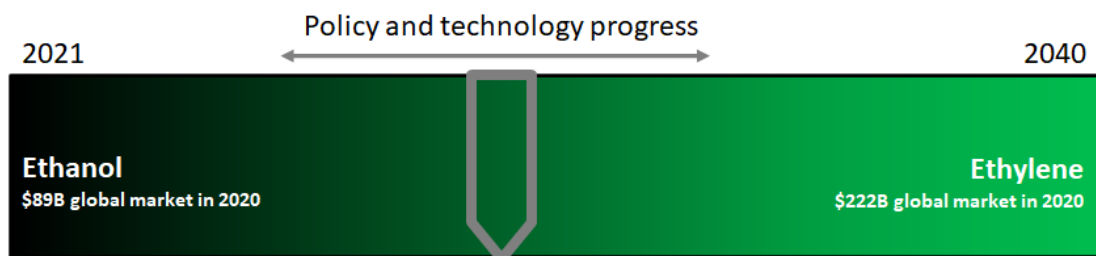
- ❑ Partnership discussions aggressively pursued in China and India.
- ❑ JV framework and Partnership Agreement with HOTO, Henan Longyu and Ruibai signed by all parties (China)
  - First Phase will consist of building **50 ktpa “Demonstration Plant”** using “On-Purpose Coal-Derived Syngas”
  - Assuming success of first phase, second phase will expand capacity to **500 ktpa using Waste Gas/Biomass-Derived Syngas/Green H<sub>2</sub>+Recovery CO<sub>2</sub>**, putting Synata on a path to be largest Syngas to Ethanol Technology Provider in the World in the next few years...
- ❑ Talks and Discussions also in progress with Thermax and investors in India for setting up **20 ktpa coal to ethanol plant** at Sonepur-Bazari coal complex, in West Bengal
  - Tremendous support from the Ministry of Coal and NITI Aayog for accelerating the execution of the project
- ❑ Discussions towards further policy support are ongoing.



Synata’s India Demonstration can serve as the test vehicle of the future to demonstrate and prove the potential of “green” hydrogen and CCU and provide a solution for decarbonization...

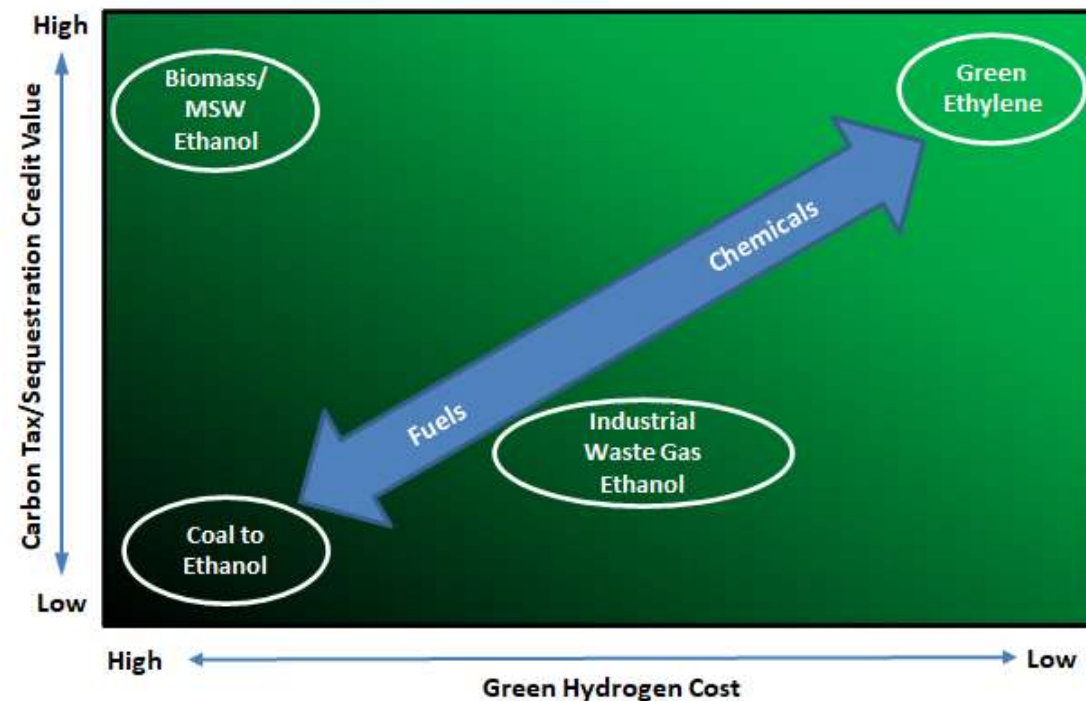
# Synata Ethanol Can be a Building Block to Replace Fossil-based Carbon in the Chemicals Value Chain...

## Two Potential Backbones of Demand...

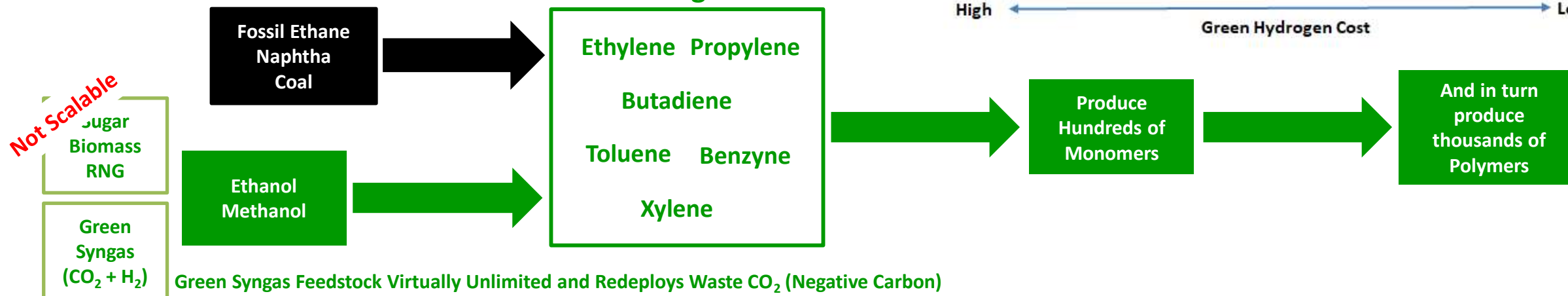


- Slower transitions to a low carbon economy extend the life and expand the scope of our market opportunity in coal-based ethanol
- More progressive policy and more rapid advancement of green H<sub>2</sub> technology catalyzes our opportunity in green ethylene
- We are effectively neutral on the pace of this transition

## Outcome of De-coupling Policy and Technology



## 6 Building Blocks



# What is Needed to help Synata Bio Fulfill India's Long-Term Energy Vision

## What is the Technology Capable of?

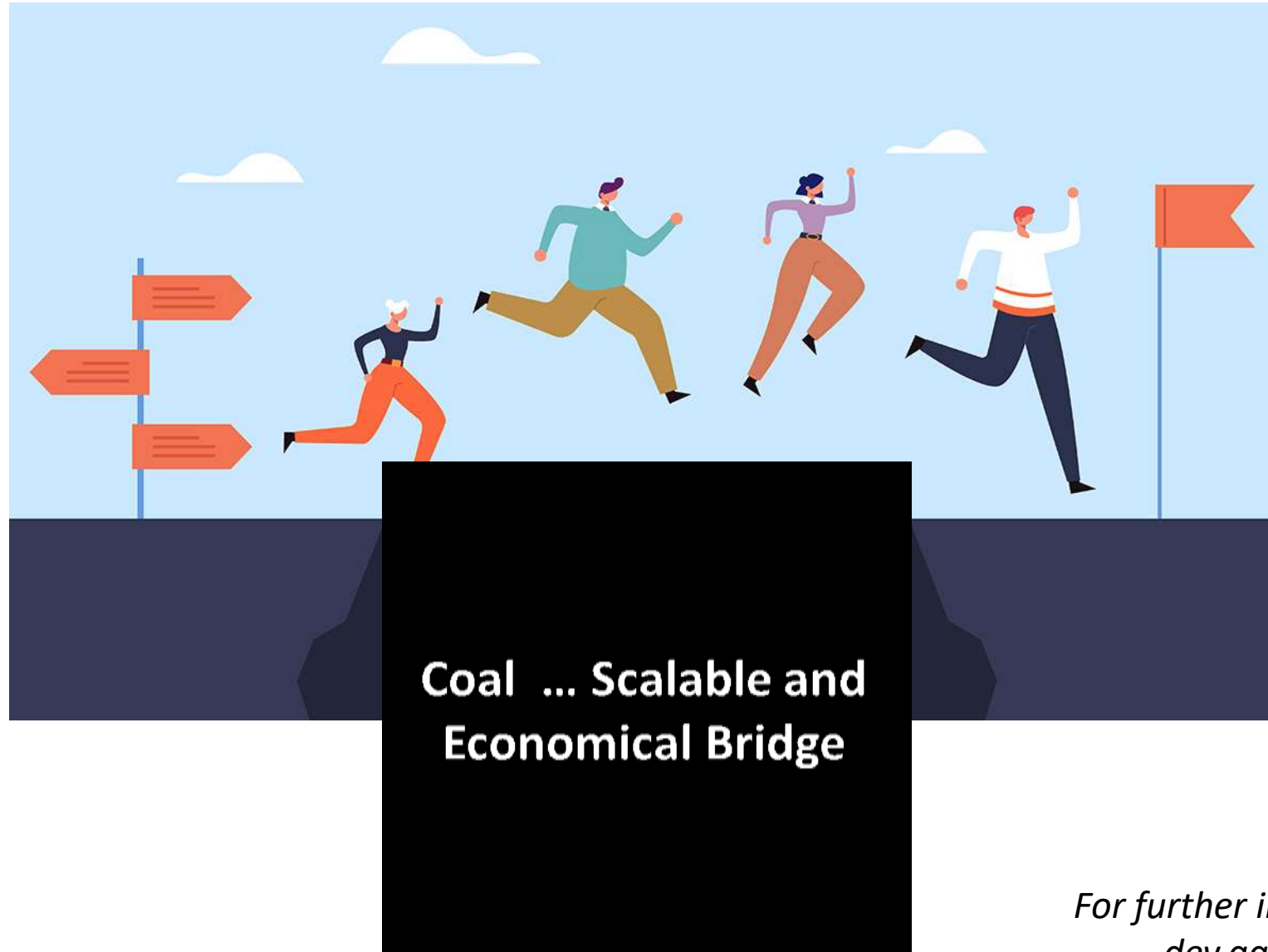
- ❑ Cheapest & completely indigenous route to ethanol production
- ❑ Providing a Platform for Accelerating Coal-Gasification Technology in India using Domestic Coal
  - Deployment of Synata plants can **accelerate commercialization and learning cycles of indigenously developed gasification technologies suitable for Indian coal (without blending with expensive or imported feedstocks)**, thereby helping:
    - ✓ **Make in India** Initiative
    - ✓ Recently launched **Atma-Nirbhar India Abhiyan**
    - ✓ **Vocal for Local** Vision
- ❑ An Effective Lever to Kick-Start India's '100 MT Coal Gasification Program' & 'Coal Monetization' Initiatives, due to...
  - Already existing 'Ethanol Blending Program' providing guaranteed ethanol off-take
  - Scalability and simplicity of the technology allowing for potential of large-scale and co-located 'coal-to-chemical' projects

## What are we looking for?

- ❑ Inclusion of Synthetic Ethanol from Coal as an acceptable blend in the 'Ethanol Blending Program'
  - Synthetic Fuel Ethanol Pricing Guidelines that will further incentivize development of coal to ethanol projects
- ❑ A coal linkage policy for coal gasification projects has already been announced
- ❑ Opportunities to develop a gasification economy in India with leading 'Coal Gasification' Technology Providers
  - Synata is an ideal platform for developing an indigenous gasification technology – for the high ash Indian coal – by efficiently converting the syngas to a valuable product
- ❑ We are open to partnerships and investors to work with us, for the first phase of this technology commercialization and finally making the transition to the 'green' planet a reality!!!



# Together We Can!!!.....



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