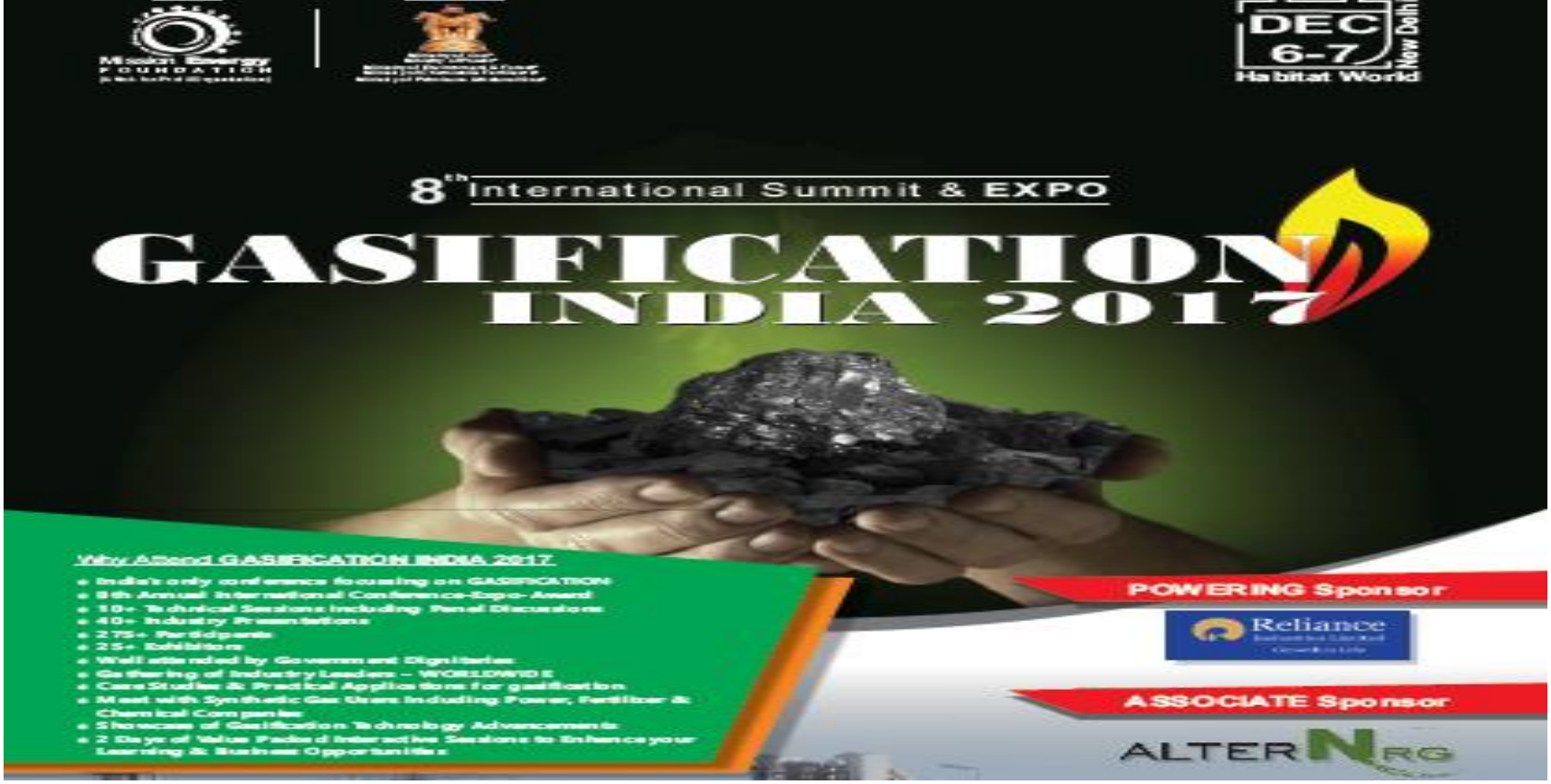

UPDATE OF PETCOKE GASIFICATION PROJECT AT JAMNAGAR, INDIA

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Reliance Industries Ltd

6th December 2017 **New Delhi**

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- Reliance & Jamnagar refinery
- Petcoke gasification
- Base syngas utilization
- Project details and Status
- Technology Challenges & Operational Preparedeness
- Future syngas utilization
- Conclusion

Reliance – An Introduction

Growth Journey

- 1958: Reliance Commercial Corporation – Trading House
- 1966: Naroda Textile Units – Vimal Fabric
- 1977: Reliance goes Public – Reliance IPO
- 1982-88: Patalganga Complex – POY/ PSF/ PTA/ LAB/ PX
- 1991-92: Hazira Phase I – MEG/ PVC/ VCM/
- 1997-97: Hazira Phase II- PTA 1,2/ PFY/ PSF/ PET/ PP/ Naphtha Cracker
- 1999-00: Jamnagar DTA Refinery (J1)
- 2000-01: Reliance Info-comm
- 2005-06: Reliance Retail
- 2008-09: Jamnagar SEZ Refinery (J2)/ KGD6 Gas Production
- **2016-17: J3 Project Implementation: Gasification Project & Jio 4G**

Reliance: An Introduction

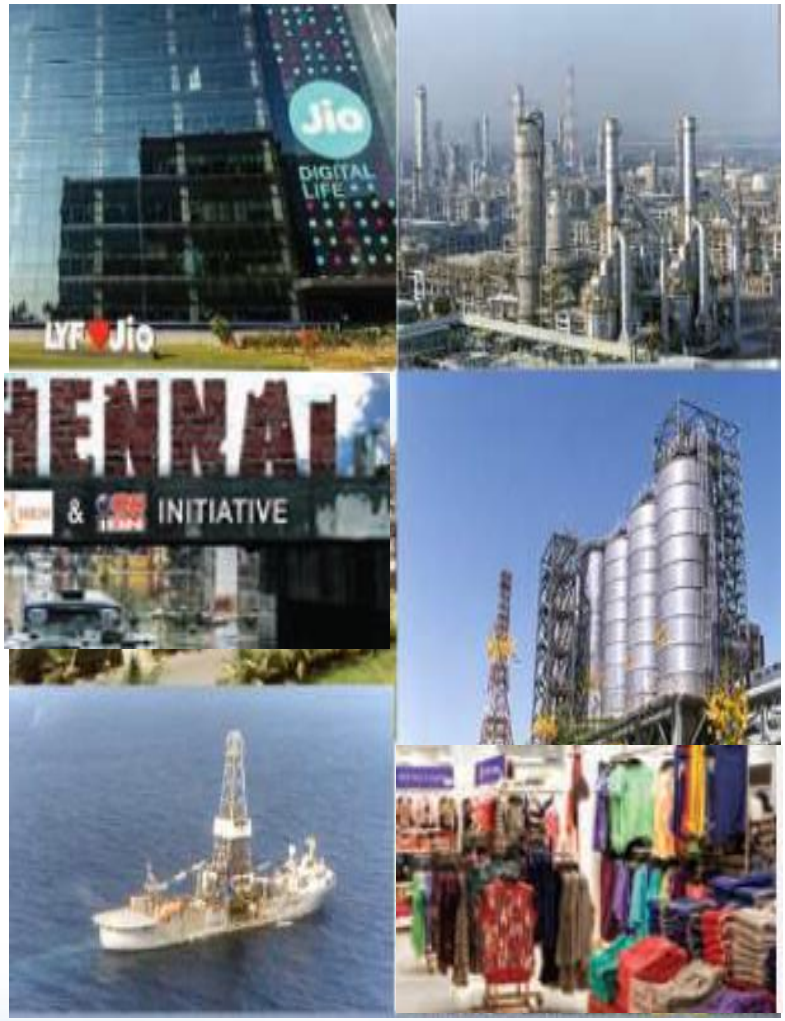
Reliance Industries Ltd, India

- **#1 company in India,** in private sector
- **Global rankings,** (Fortune 2017)

  #203 in revenues;#110 in profits

Performance, FY ’17	**$bn**
Revenue	50.9
Earnings, EBDIT	8.6
Market capitalization	90
Net worth	44.5
Growth, CAGR [1]	**%**
Earnings	26.7
Market capitalization	31.5
Net worth(NW)	13.9
Returns (adjusted) [2]	**%**
ROCE	25.4
RONW	16.8

Note: (1)CAGR =compounded annual growth rate since IPO in 1977
(2) Adjusted for work in progress



⇒ Indian company, with a global footprint

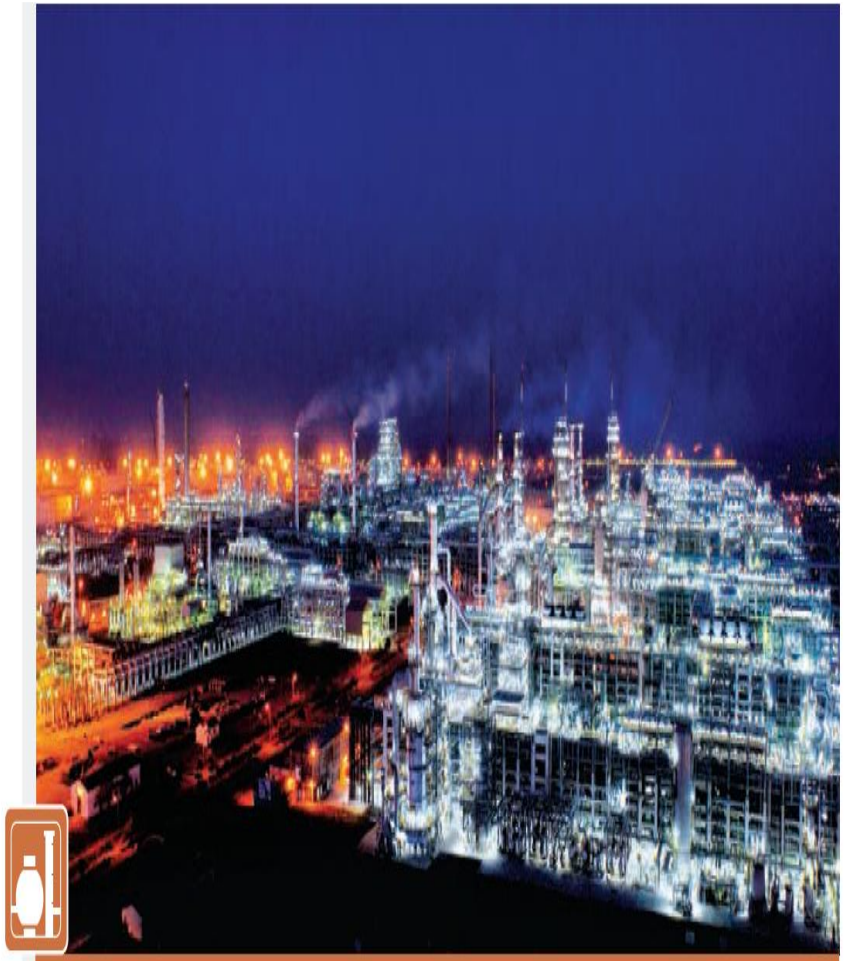
Jamnagar Refinery : A profile

Jamnagar refinery

- **Largest refinery**
  - Crude processed, kb/d — 1380
  - World rank,# — 1
- **Superlative performance**
  - Complexity Index — 12.7
  - Energy Intensity Index — 64
  - Availability,% — ~97
- **Integrated complex**
  - Petrochemicals, %of crude — 14.5
  - Utilities & power, % captive — 100
  - Ports & terminal — 5 SPM + 5 berth jetty
- **Global exports**
  - By revenues,% — 51
  - By volume, % — 56
- **Margins**

GRM,FY'17	**$/bbl**
Jamnagar	11.0
USGC/WTI	8.7
Singapore/Dubai	5.8
Rotterdam/Brent	5.3

Note: GRM = Gross refining margin

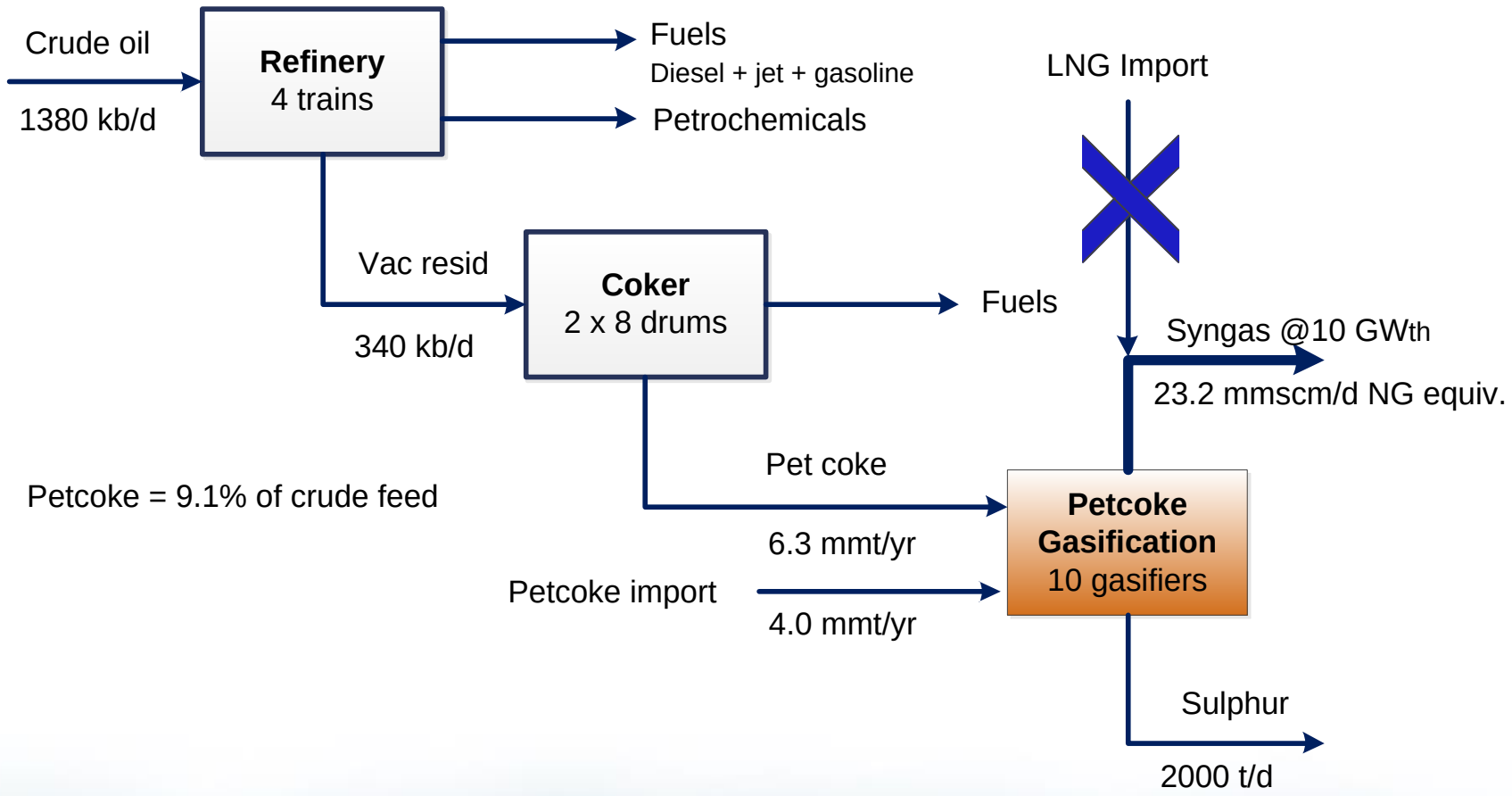


Panoramic view of Jamnagar Refinery

⇒ **Arguably the best refinery in the world**

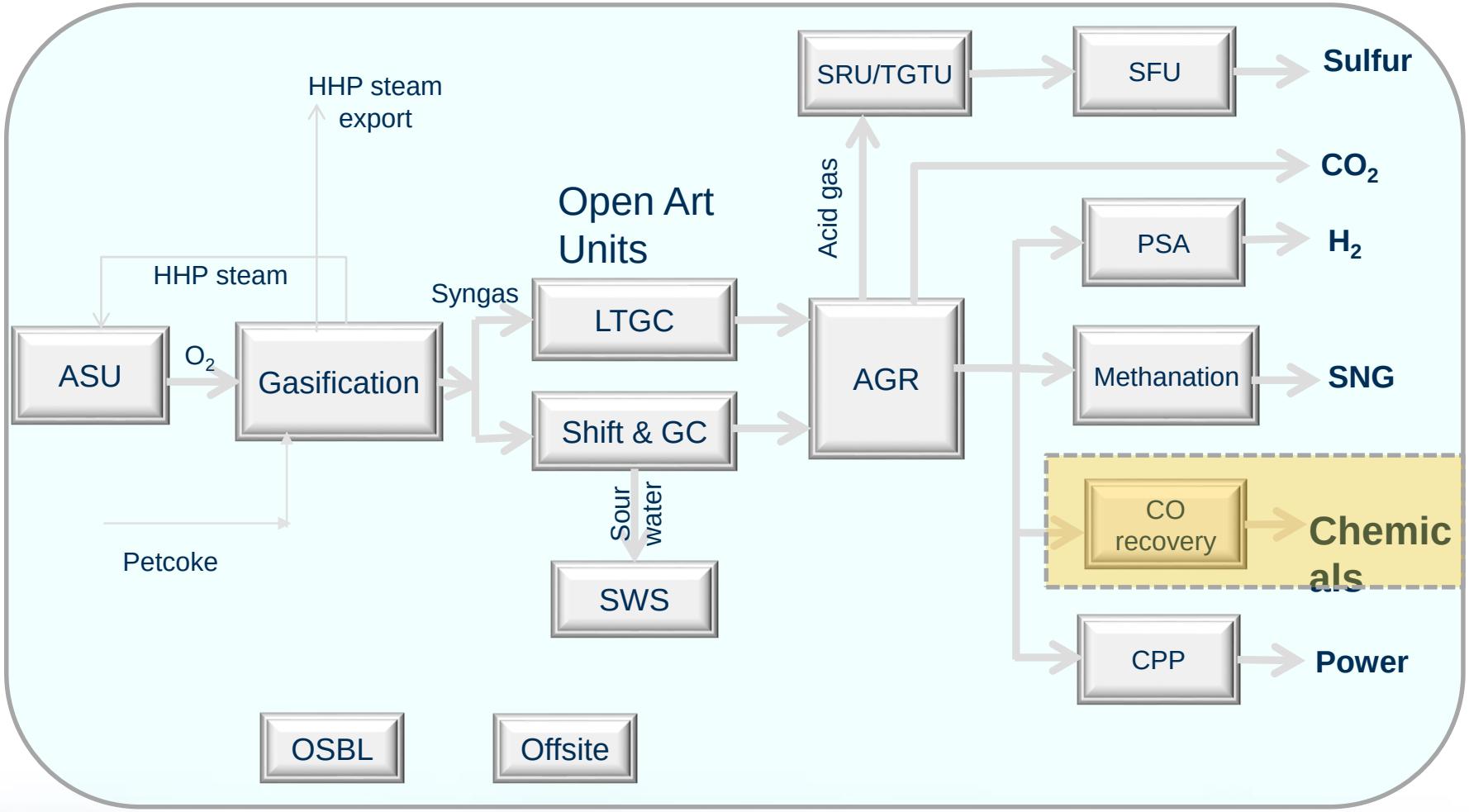
Jamnagar Gasification

Scope :



⇒ Gasify petcoke to syngas, for 100% Jamnagar consumption

SCOPE: Gasification Configuration: BFD



Dotted line indicates future vistas

Gasification Configuration:

Config

- 10 Gasifiers
- 4 in DTA refinery; 6 in SEZ refinery
- Modular design, 2 gasifiers /modules

Feed

- 1,150 MWth gasifier largest in the world
- 100% petcoke feed, ~2,900 tpd per gasifier
- 65% petcoke + 35% coal feed blend flexibility

ASU

- 5 ASU, 1 ASU/ gasifier module
- 5,250 t/d 99% O_2

Product

- 2.3 mmscmd NG equiv / gasifier (272 kNm3/hr)
- Repower 1,300 MW CPP with syngas and 1,700 tph of steam
- 1,160 t/d H2, 2-4 mmscmd SNG (balancing product)

Project : Scope

Engineering:	**#**
PFD	115
P & ID	1700
Equipment:	**#**
Equipment	2920
Piping isometrics	44,000
Materials:	**Quantity**
Concrete, million cum	1.1
Structural steel, kt	210
Piping, million in m	14
Electrical cable, km	3900
Instrumentation cable, km	6500
Construction:	**#**
Construction workers, peak	>1,00,000
Cranes, peak	>1700

Gasifier-Cooling Tower

⇒ **Flagship gasification project of the world**

CURRENT STATUS

- World's largest ASU 1 unit commissioned successfully and operational
- First Gasifier unit refractory drying and alkali boil out completed
- All utilities are operational
- AGR unit commissioning under progress

⇒ **No compromise on safety**

CURRENT STATUS

⇒ **No compromise on safety**

CURRENT STATUS

⇒ **No compromise on safety**

CURRENT STATUS

CURRENT STATUS

⇒ **No compromise on safety**

Technology Challenges

Operational Challenges: Successful Gasifier operation depends on

- Consistent quality of feed-stock
- Proper blend of fluxant
- Slurry properties like stability, strength, and viscosity (Flowability / Pumpability)
- Life of slurry mixer (burner)
- Gasifier design to provide right volume and temperature
- Slag flow characteristics
- Refractory Life

⇒ **No compromise on safety**

Technology Challenges

Process Safety

- Handling of Toxic chemicals - Hydrogen Sulphide (TLV 1ppm), Syngas- Carbon Monoxide (TLV – 25 ppm)
- Handling of Flammable & Explosion Hazards- H2, pure Oxygen, methanol,
- Handling of solids - Dust explosion Hazards- Petcoke, coal,
  - ✓ Conservative designs – compliance to international standards (AIGA/ EIGA)
  - ✓ Developed standards for handling toxic chemicals
  - ✓ Detail Consequence Analysis studies of complete complex and action plan

⇒ **No compromise on safety**

Operational Preparedness

Operational Preparedness:

- Study on effect of fluxant to feed ratio on ash viscosity with temperature – Optimized fluxant to feed ratio

↓

- Study on slurry preparation using optimized fluxant to feed ratio – Optimized slurry stability, strength, and viscosity

↓

- Study using optimized slurry for understanding the reaction kinetics using equipment in entrained flow environment

↓

- Validating scaled up Gasifier design using kinetics and CFD modeling
- A detail work plan prepared. Various teams comprising members from different areas prepared to handle each concerned area.

⇒ **Flawless and smooth Start-up**

Operational Preparedness

Operational Preparedness:

Tie up with renowned research institutes / Universities:

- Working with Penn State Universities, Micro beam Technology, USA. Planning to collaborate with NETL, Frieberg University, Germany.
- Generate the property data for actual feed stocks and develop correlations for predicting properties
- Generate kinetic data for development of model
- Develop CFD models

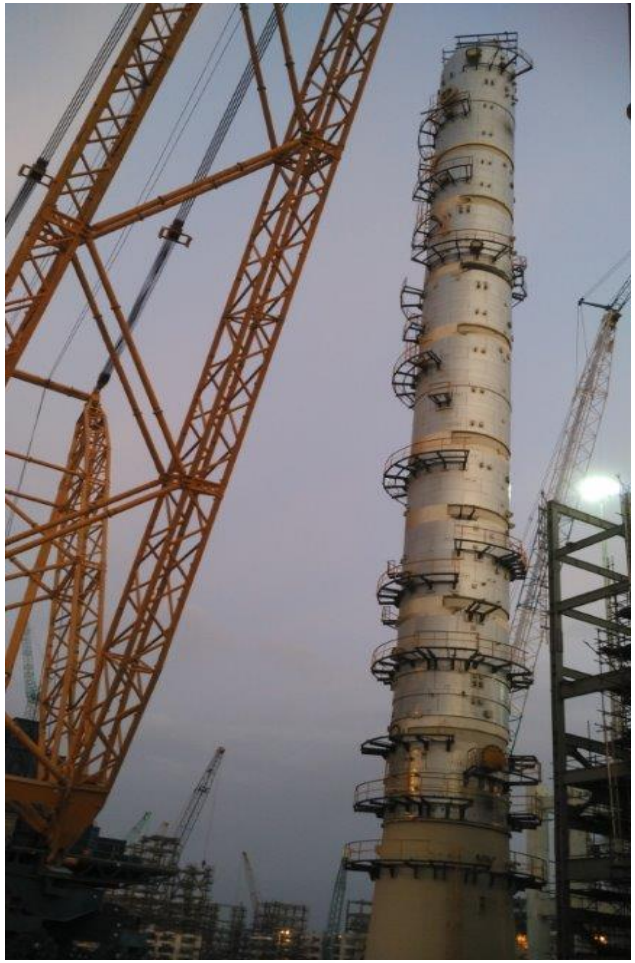
Extensive Dynamic simulation study of:

- Gasification module to validate control philosophy provided by licensor
- Control system for all units in Gasification complex individually and integrated way
- Control system of Gasification complex with rest of the Jamnagar complex
- Extensive use of OTS for operational training

⇒ Flawless and smooth Start-up

Gasification: Future Enhancements

NH_3	Recover NH3 @ 140 kt/yr from sour water
	43% from gasification + 57% from refinery
	Convert N, a crude contaminant, into an opportunity
	Substitute imports, into India
Urea	Exploit pure CO_2 from gasification shift
	Add CO2 to NH3, recovered + imports
	Boost fertilizer supply + food security of India
V	Recover vanadium(V) @ 9.5 kt/yr from gasification slag
	Recover Ni @ 2.0 kt/yr as co product
	Convert V, a crude contaminant into a metals opportunity
	Global #1 in V, a micro alloy for high strength steel
Ethanol	Exploit syngas for synthetic ethanol
	Use biochemical reaction kinetics
	Blend ethanol into crude derived gasoline
	Stretch gasoline without crude increase
APC + RTO	Develop integrated gasification model
	Model scope = 10 gasifiers + syngas headers
	APC = Advance process control
	RTO = Real time optimization using ROMeo software
	Enhance gasification performance

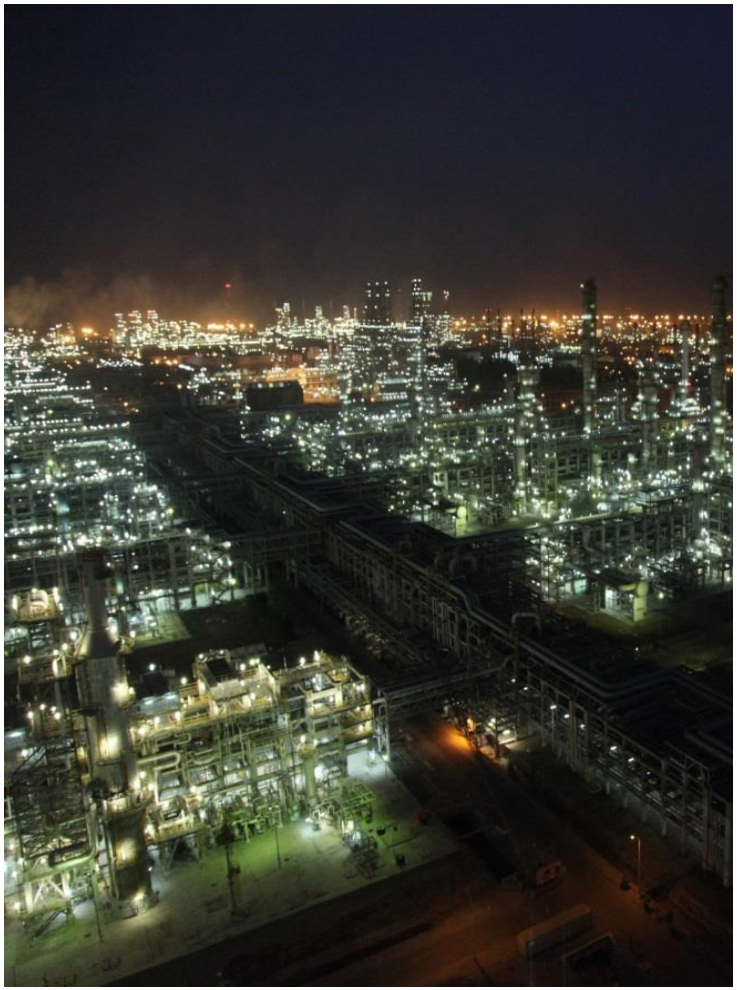


AGR – Methanol Wash column

⇒ Enhance gasification economics

Future Syngas Utilization

Gasification	Syngas quality @ $H_2/CO = 0.62$
	Syngas price @ 40% discount to LNG derived syngas
	Base syngas utilization = H2 + plant fuel
	Future syngas utilization = Oxygenated chemicals
CO	Recover CO from low H2/CO syngas
	Exploit low cost CO feed for acetic acid + ethylene glycol
	Derive acetyl chemicals from acetic acid
	Acetates + VAM + VAE + PVacetate + PValcohol
	Ethylene glycol, via unconv.process from CO
	Acrylic acid ,via unconv. process from CO, in future
Syngas	Target chemicals, requiring low H2/CO syngas as feed
	Oxo–alcohols + DME + MMA/ PMMA
	Blend DME into crude derived LPG
	Methanol and its derivatives
CO_2	CO2 capture ready plant
	Identify technology for CO2 utilization/sequestration



⇒ Maximize value addition with syngas to chemicals

Global landmark in Gasification

Path-breaker for Indian Energy Sector

Thank You