

# Exploration & Production Business

**INDIA'S LARGEST  
UNCONVENTIONAL  
E&P PLAYER**

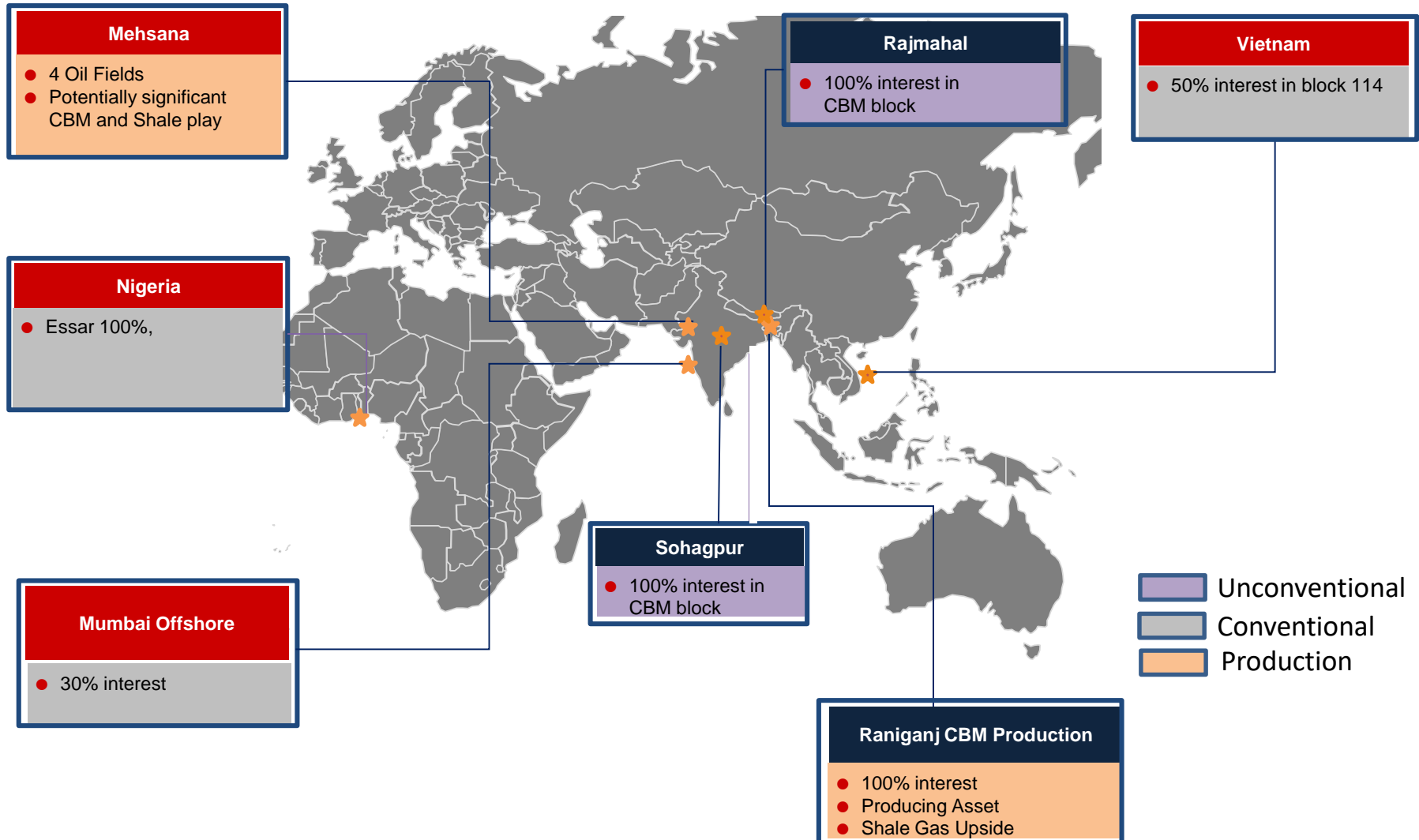
*April, 2019*

*Ranchi*

*[www.essar.com](http://www.essar.com)*

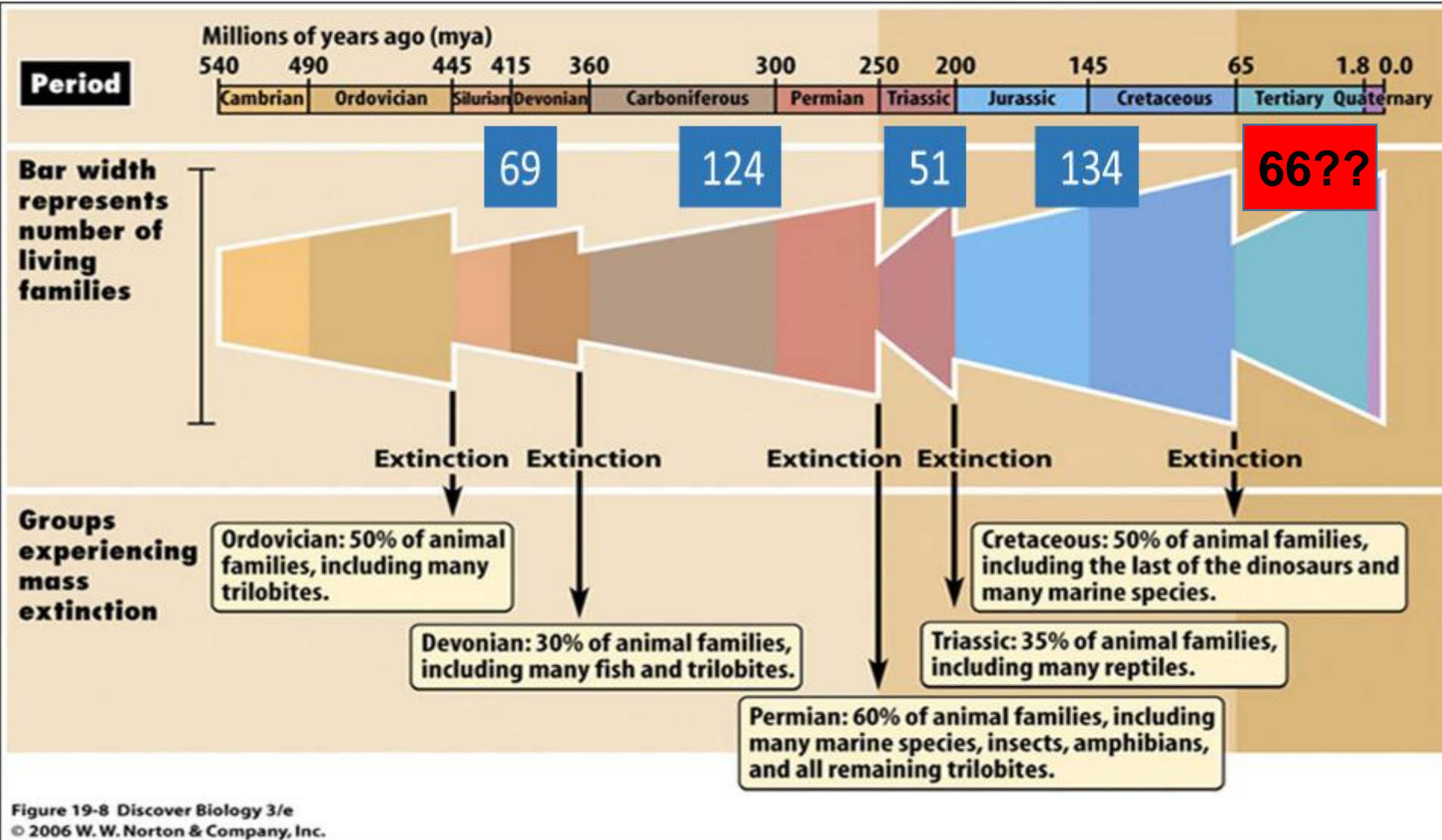


# Global Portfolio



**Unconventional Gas In Place of 18.5 TCF & Conventional resource of ~700 mmboe  
Equity investment of ~ US\$ 1 Bn**

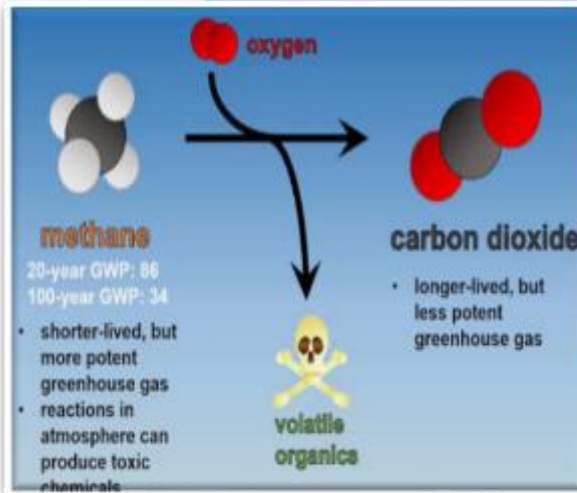
# Earth Mass Extinction Cycle



# Moving towards Sustainable Energy

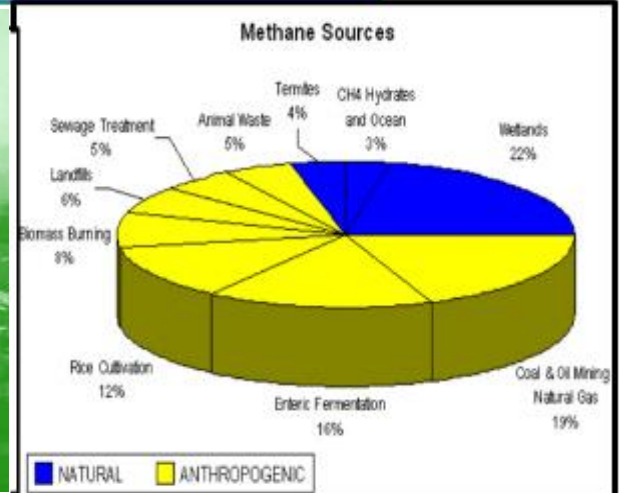


Gas: A transitional fuel to bridge the gap

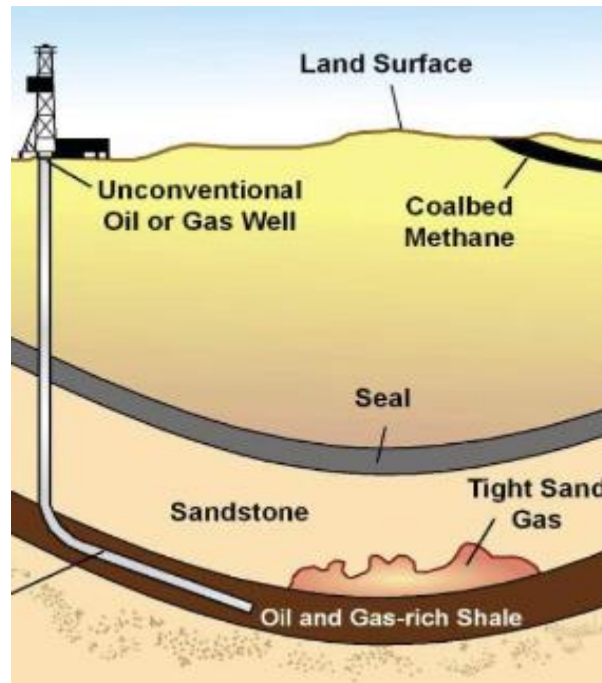
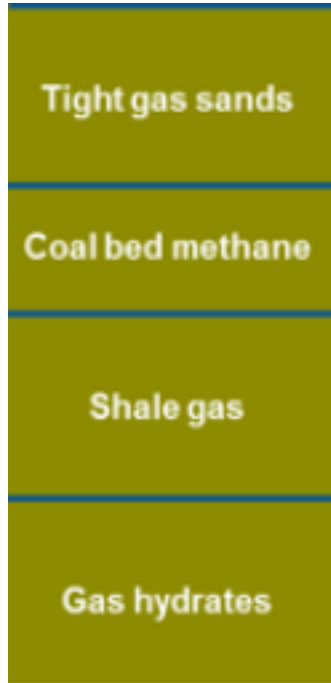


SINCE 1990, GLOBAL EMISSIONS OF CO2 HAVE INCREASED BY MORE THAN **46%**

gettyimages THE GLOBAL GOALS



# Unconventional Gas Resources



**Renewable Natural Gas ('RNG')** is an ultra-clean and ultra low-carbon natural gas alternative.

**SOURCES OF RNG**

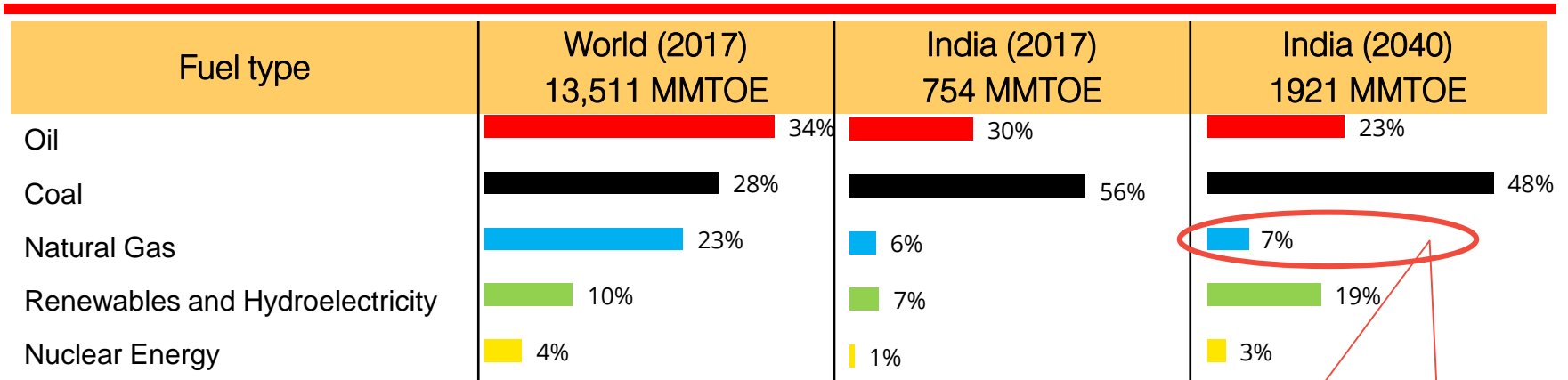
 <p><b>AGRICULTURAL WASTE</b> 8,000 Land Farms and Dairies</p>	 <p><b>WASTE WATER</b> 17,000 Facilities</p>
 <p><b>LANDFILL GAS</b> 1,750 Landfills</p>	 <p><b>FOOD WASTE</b> 66.5 Million Tons / YEAR</p>

\*Equivalent 60 Billion Gallons of Untapped Resources

Source: The Coalition for Renewable Natural Gas



# India Energy Sector Overview



Source: BP Statistical Review of World Energy June 2016, BP Energy Outlook 2018

**Government target for increasing gas share to 15%**

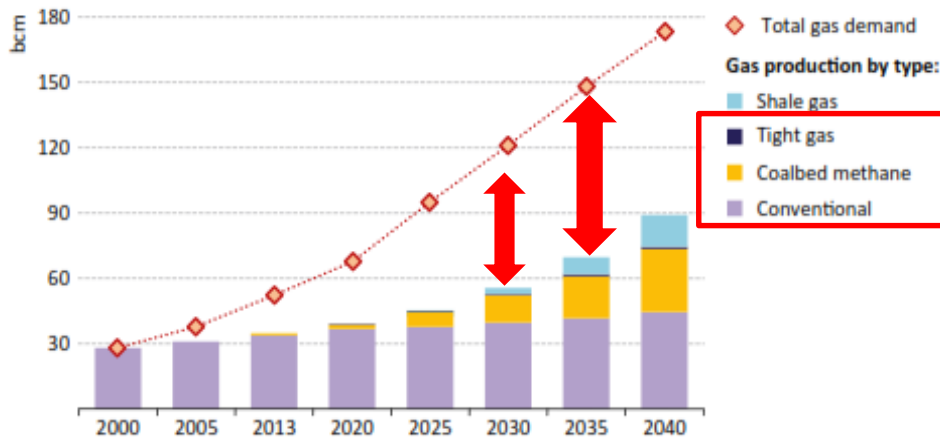
- ❖ India's energy consumption expected to grow by ~4.2% p.a and gas consumption by ~5% till 2040 – to account for 11% world's energy consumption
- ❖ Target to increase share of gas to 15% by 2030 by creating a “Gas Based Economy” – challenging but achievable

**Increase in gas consumption can potentially further reduce the share of coal and oil in India's energy mix...**

# India Moving towards Gas Based Economy

## Why Natural Gas

- Environment Friendly
  - Cheaper than liquids
  - Enabler for commitments on COP21
  - Policy initiatives
- India is targeting to increase share of gas from 6.2 % to 15% to transform to a 'Gas Based Economy'




**Promoting Gas Based & Clean Fuel Economy in New India**  
Pradhan Mantri Urja Ganga

**2650 km long**  
To promote Gas based economy and development of eastern India, 2650 km long (Kolkata - Haldia & Bokaro - Dhamra) Natural Gas Pipeline Project, popularly known as **Pradhan Mantri Urja Ganga**, is being executed at an investment of around ₹5000 Cr., which includes 40% capital grant from the Government of India. This is the first time ever that Government of India has extended capital grant to a Natural Gas Pipeline Project.

**Covering 40 Districts**  
Urja Ganga will cater to energy requirements of five states, namely Uttar Pradesh, Bihar, Jharkhand, Odisha and West Bengal, covering 40 Districts.

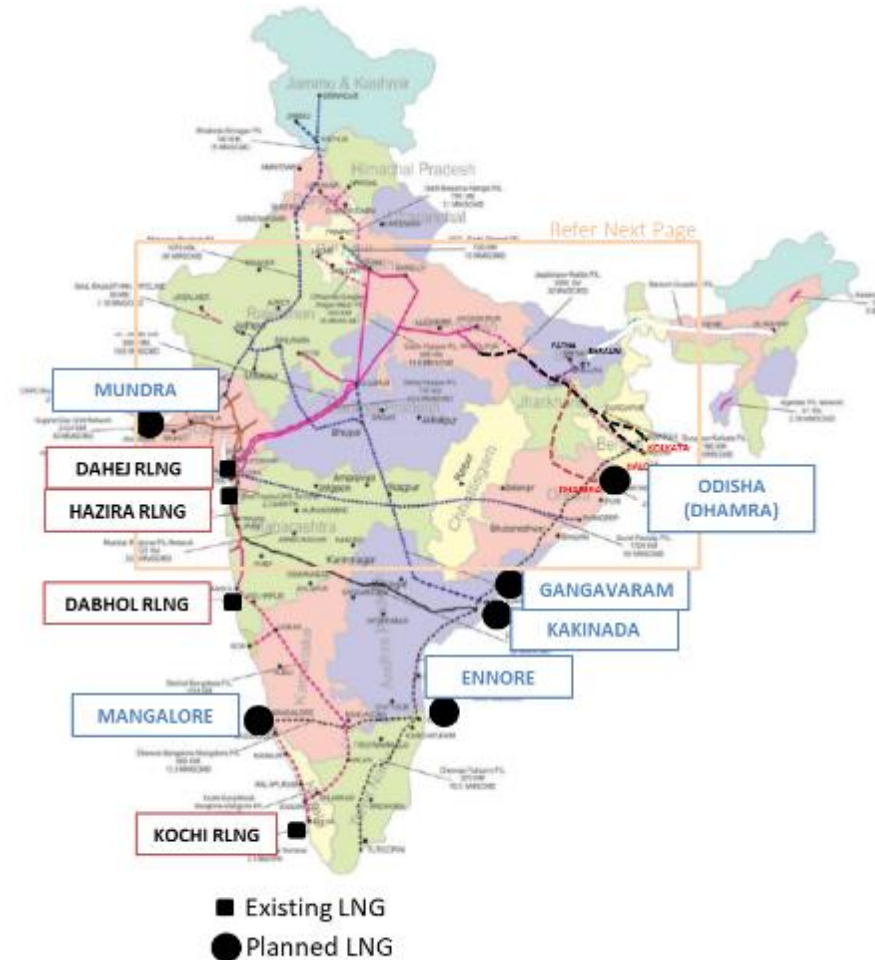
**Covering CGD Project in 7 Cities**  
Foundation stones were laid for CGD projects at Kolkata on 24.10.2016 and for Imbajunihar and Cuttack CGD projects on 18.3.2017.

**Revival of 3 large fertilizer units**  
This project will also lead to the revival of three large fertilizer units, Gopalpur, U.P., Sindri, Jharkhand and Barakati, Bihar in the eastern region and industrialization of more than 20 cities and City Gas Network (CGN) development in 7 cities of eastern India.

55 / ENERGISING NEW INDIA

# Positive Triggers – Unconventional Gas Development

- ❖ Expected Gas market of 15.0 mmscmd to be connected to the Urja-Ganga (JHBDPL) pipeline grid
- ❖ City Gas Distribution (CGD) 9th Bid Round completed in May, 2018 (Access to Gas in 86 geographical areas across 174 districts in 22 states (24% of National area and 29% population).
- ❖ 10<sup>th</sup> CGD Round also launched.
- ❖ Marketing and pricing freedom to CBM contractors
- ❖ SIMEX – Simultaneous Unconventional Exploration & Exploitation Policy (August 2018)
- ❖ GAIL National Natural Gas Pipeline Grid (Urja Ganga) connection (upto Durgapur by Jul., 2019)
- ❖ CIL also to extract CBM from its Coal MLs.
- ❖ Policy Reforms to incentivize E&P



Source – PNGRB



# Gasification - Benefits

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## Environmental Impact of Gasification

- a. Use of natural gas is clean
- b. Natural gas is 40% less polluting than coal and 25 % less polluting than Oil
- c. Methane is 28 time more potent than CO<sub>2</sub>- use of CBM is beneficial
- d. COP21 environment commitments

## Financial Impact of Gasification

India imports close to 5 million Barrels per day

- 1\$ increase in crude oil price impacts import bill by Rs. 13000 Crore annually
- 8.5 mmscmd of Gas expected from 5/6 CBM development blocks

**Cumulative – Saves \$ 250 million annually on imports (1% reduction in Imports)**

**1% import reduction possible from CBM**

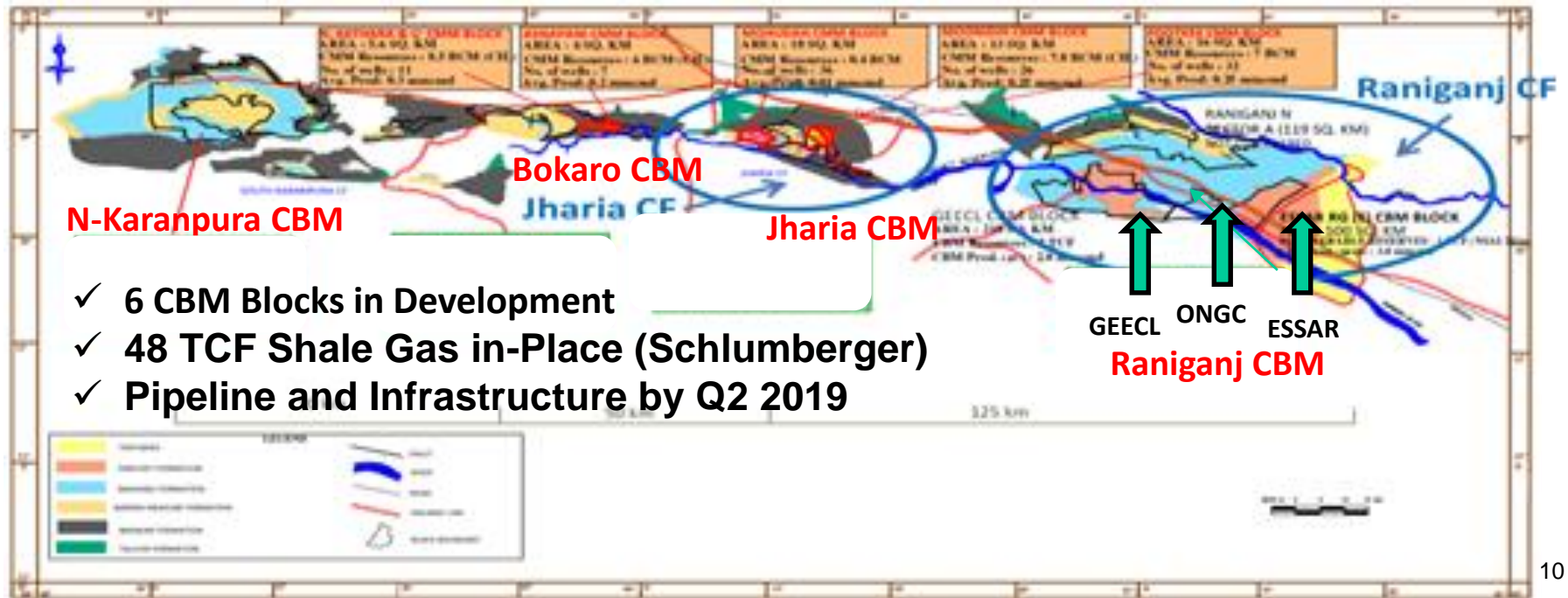
**There are potential of further upside in reduction of imports from Shale development**

## Social Impact

- a. Rural gasification would lead to replacement of firewood
  - b. Reduction in ailments likes cataract, Respiratory Ailments
  - c. Rural Gasification would impact women
    - i. Reduce cooking time from 3 hrs to 90 mins
    - ii. Increased time would be invented in Family welfare/ secondary income
-

# Damodar Valley Basin – Prolific CBM and Shale Area **ESSAR**

- The Damodar Valley Basin of Eastern India has been nationally and internationally accepted as one of the most prolific Coal bearing master-basin
- EOGEPPL discovered prices with GAIL will encourage and fast-track the activities in the region
- Six CBM blocks in development Raniganj East (Essar) and Raniganj South (GEECL) in Raniganj Coalfield are actually in commercial production,
- ONGC gearing up for CBM fray (4 blocks)
- Coal India Ltd. also in the lookout
- Excellent demand and evacuation infrastructure to tap each molecule of gas.



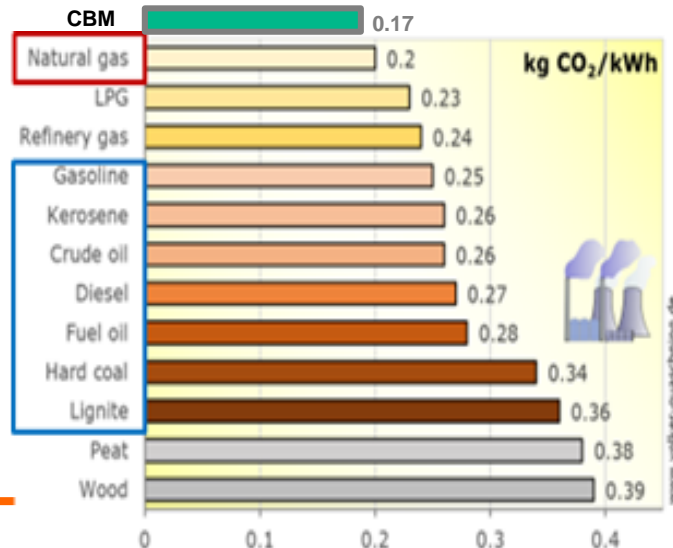
# Clean Development – Crucial for India

- Every cubic meter of CBM will result in
- ❖ Rs. 8.00 subsidy saving to the Fertilizer sector
  - ❖ Rs. 1.6 of Royalty to State Govt.
  - ❖ Rs. 22 of FOREX saving (considering LNG landed and transported price)
  - ❖ 30 Tons of equivalent CO<sub>2</sub> emission (CG4 is ~25 times potent GHG than CO<sub>2</sub>)
  - ❖ Direct Investment in excess of Rs, 10,000 Crs
  - ❖ Indirect Investment of approx.. Rs. 18-20,000 Crs.
  - ❖ In addition there will be direct socio-economic benefits to the local population



## Benefits of CBM

- ❖ Highly clean fuel
- ❖ Wide Sector usage
- ❖ Exhausts
  - No H<sub>2</sub>S
  - No SO<sub>x</sub>
  - No NO<sub>x</sub>
  - Less CO<sub>2</sub>



## CBM - Usage



FUEL to INDUSTRIES - Steel, Others



FEED to INDUSTRIES - Power, Fertilizer



CNG - Automobiles



COMMERCIAL - Hotels, Hospitals, Restaurants



DOMESTIC - Households

# EOGEPL - Focus on Unconventional Hydrocarbons

## Pioneers of CBM in India

First CBM wells drilled and tested in early 90's (Gujarat-Mehsana lignites)

## Prolific Blocks/Assets

- ❖ One Production Asset (CBM Raniganj East)
- ❖ **Upside in Shale Potential**
- ❖ Three Exploratory acreages
- ❖ Total un-conventional gas resource of ~18.5 TCF
- ❖ Estimated recoverable resources of ~5 TCF

## Strategic Location

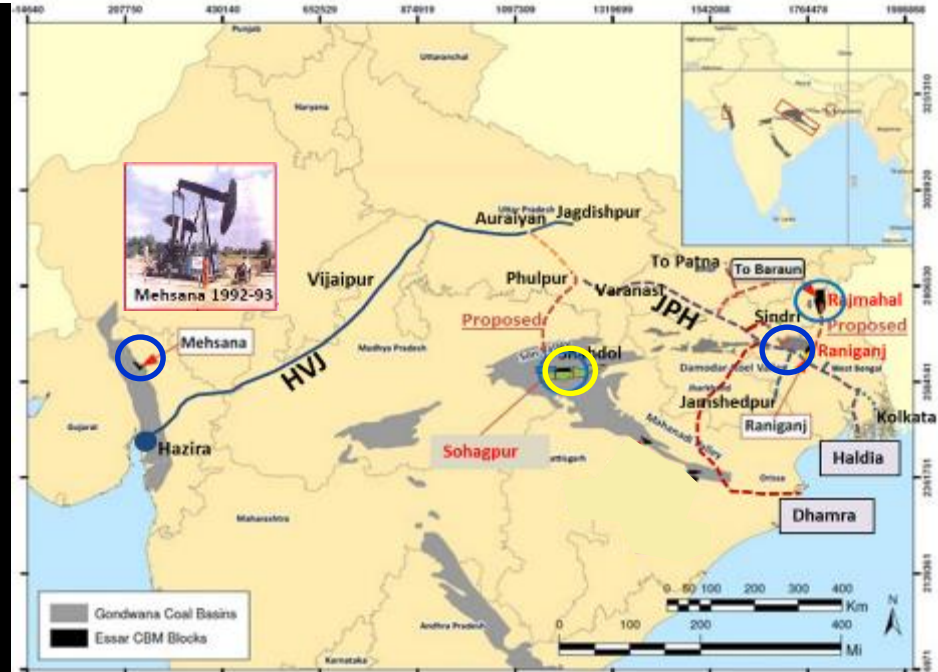
- ❖ Proved coal basins
- ❖ Gas Evacuation Infrastructure in place

## Expertise in CBM

CBM learning curve in place

## Development benefits

- ❖ 2017 CBM early monetization policy
- ❖ **2018 SIMEX Policy**



### Internal Enablers

- CBM Learning Curve
- Experienced Manpower
- Services / Contracts
- Operation Hub Proximity
- Regional/Local Influence



### External Enablers

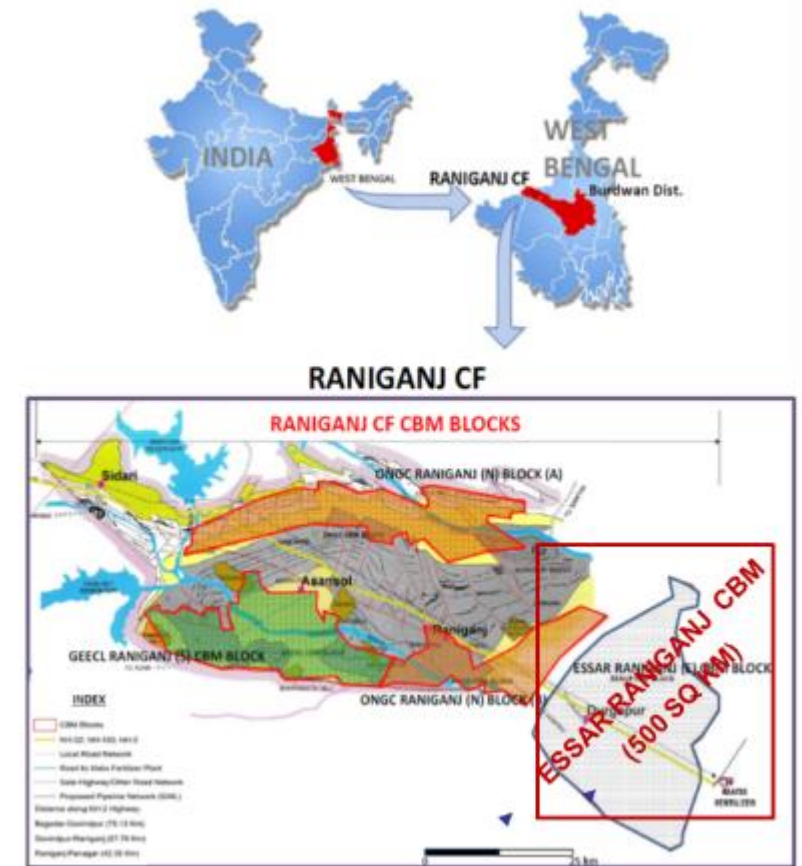
- a. **Highly remunerative Gas Price (New Policy, 2017)**
- b. Urja Ganga pipeline
- c. Strong Gas demand
- d. **SIMEX Policy (July, 18)**

# Raniganj East project – A Pioneer in CBM

- ❖ Located in and around Durgapur, WB.
- ❖ Project commissioned with **348 wells** and related facilities as on April 1, 2018
- ❖ Gas Compression facilities for 2.2 mmscmd & 3 mmscmd MCS in place
- ❖ 300 KM of pipeline network
- ❖ Production of **1.0 mmscmd** achieved  
*(First in any CBM Block in India)*
- ❖ Long term GSPA with GAIL (India)



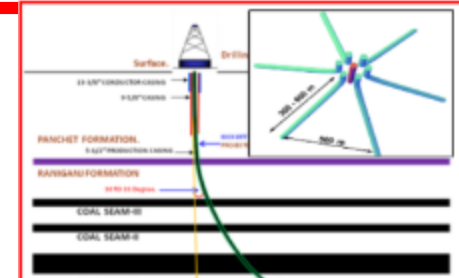
## Block Location Map





# Raniganj Asset – KPIs

- ❖ Incorporated good practices in well drilling like Pad Drilling, Optimized well and fluid design etc.
- ❖ Drilling time optimization from **30 to 12.8 days**.
- ❖ Optimized Well completion system and Well site facility development such as
  - ❖ Optimized Pump size & Completion string
  - ❖ Skid based design for well site facility
  - ❖ VFD controlled dewatering pumps
  - ❖ Water tank facility for efficient water transportation as against conventional water pits
- ❖ Developed in-house monitoring system like IPDMA for close monitoring of wells and SCADA for online monitoring
- ❖ Optimally designed compression facilities having higher efficiency and less methane emission
- ❖ Has achieved cost optimization from well drilling to facility development
- ❖ Robust surface facilities, concept to commissioning done in-house



# Essar's Resilience

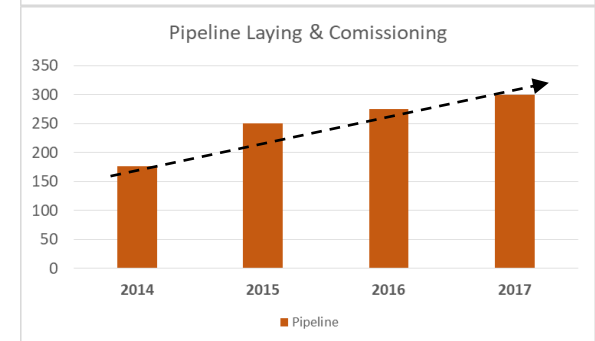
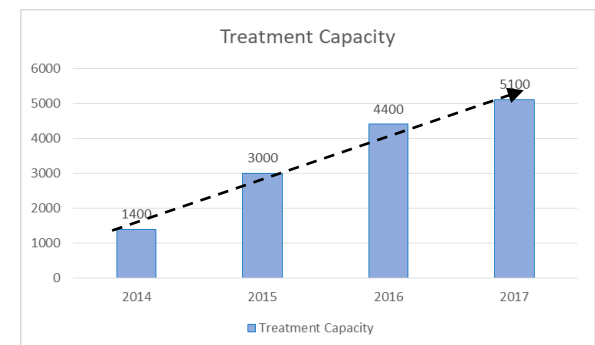
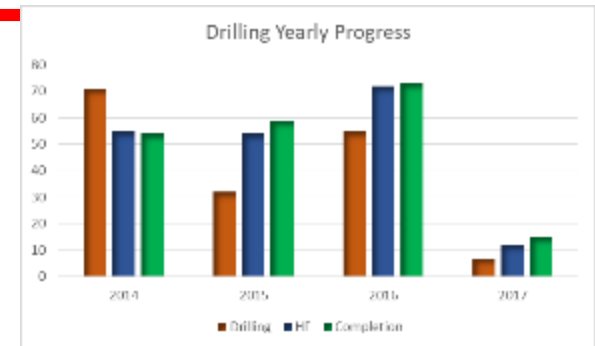


## Investments during Industry Downturn

2014-2017 (In last 03 Yrs. ~200 Million USD invested)

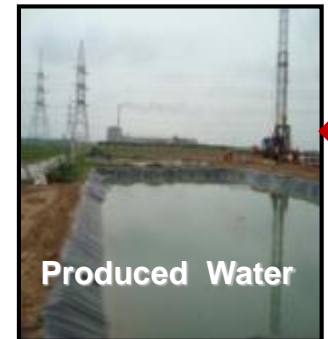
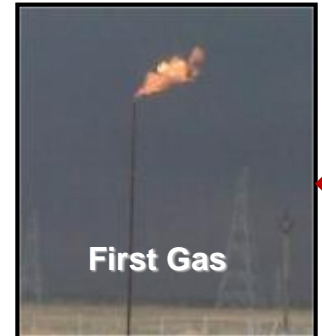
### Key Milestones

- ❖ 165 wells drilled
- ❖ 193 wells hydro-fractured
- ❖ 201 wells were put on production
- ❖ 123 Kms pipeline laid and commissioned
- ❖ Low Pressure Compression capacity augmented from 0.9 to 2.1 MMscmd
- ❖ 1.5 MMscmd booster compression at MCS commissioned in 2017, increased to 3.0 MMscmd
- ❖ Water treatment capacity augmentation from 700 cmd to 5100 cmd





# Raniganj East - Well head to Market



# Upside Potential

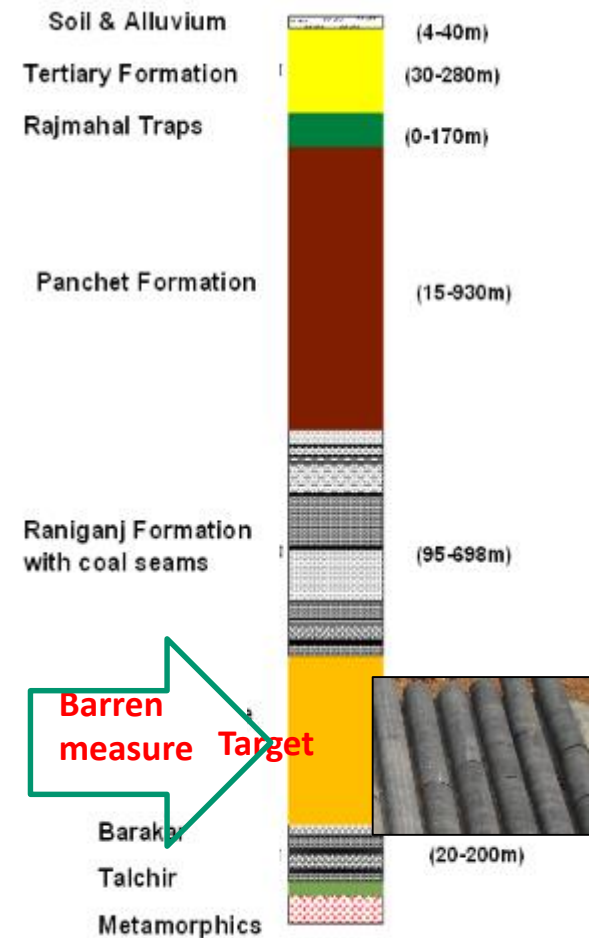
## A. Shale Gas in Raniganj CBM Asset



## Shale Gas Upside - Raniganj CBM Block

- ❖ Simultaneous Exploration & Production Policy provides exploitation for all hydrocarbons.
- ❖ Thick extensive shales in Raniganj (Barren Measures)
- ❖ TOCs measured in the range of 5%.
- ❖ **Potential Gas in Place of ~8 Tcf (Recoverable 1.6 TCF @ 20%) (ARI-Invenire, 2015)**
- ❖ EOGEP L has already commissioned a reputed international consultant firm for a through exploration program design towards assessment of shale potentiality.
- ❖ Plans in place to drill 4-5 exploratory wells and expand to 20 pilot wells to understand actual potentiality
- ❖ Environment Clearance for above 20 wells is already in place (14<sup>th</sup> Feb., 2019).
- ❖ EOGEP L envisages an initial cost of upto US\$ 60 mm for the initial 20 wells
- ❖ A full field development will involve a CAPEX expenditure in excess of US\$ 1 Bn.

Thick Barren Measures in Gondwana CBM blocks



Raniganj Coalfield section - schematic

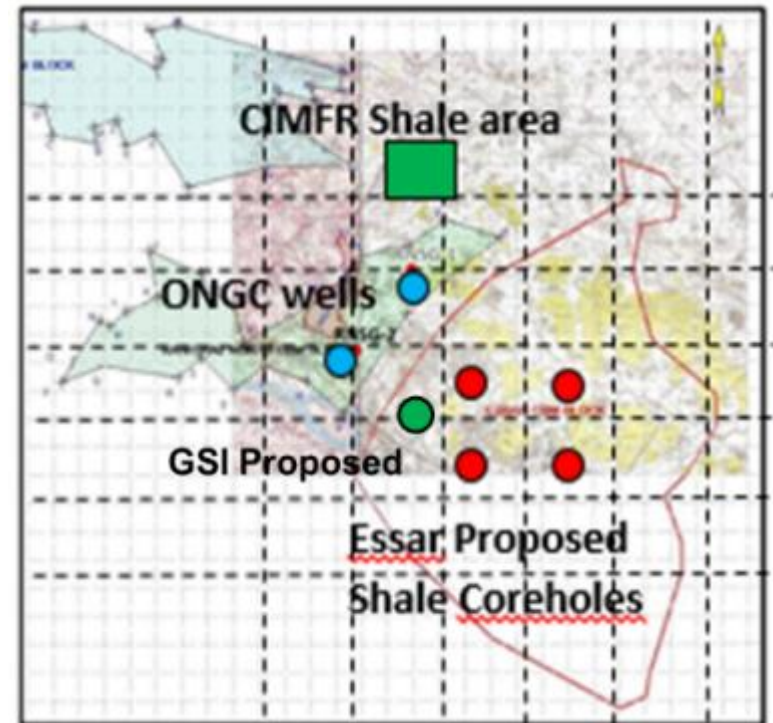
## Synergy for shale E&P in Raniganj Coalfield

- ❖ 3 CBM operators Essar, GEECL & ONGC
- ❖ Central Institute of Mining and Fuel Research (CIMFR)
- ❖ Geological Survey of India (GSI)
- ❖ The DG, DGH has advised to constitute a Joint Group amongst these operators as a platform of exchange to expedite shale development (Synergy)

### Summary of parameters Barren Measure Shales

(Dr. VA Mendhe\*)

- ❖ High in TOC max-18% (+4% considered favorable)
- ❖ High in maturity
- ❖ Good gas storage capacity
- ❖ In pyrolysis  $S1 > 1$  (good amount of free gas)
- ❖ Most of the pores are meso pores (good for gas storage)



### Key Information

- ❑ In a meeting by the various CBM operators convened by DGH Essar, Essar based on extensive review of database and studies so far suggested
  - a. Flagging of Raniganj Coalfield as the most prospective area for shale
  - b. A fast track establishing of potential can be achieved by synergy between the above operators.
- ❑ It is a welcome news that the DGH has endorsed both the above factors and has issued a letter for focusing on Raniganj and coming together of all the companies/agencies as a synergic venture for shale.

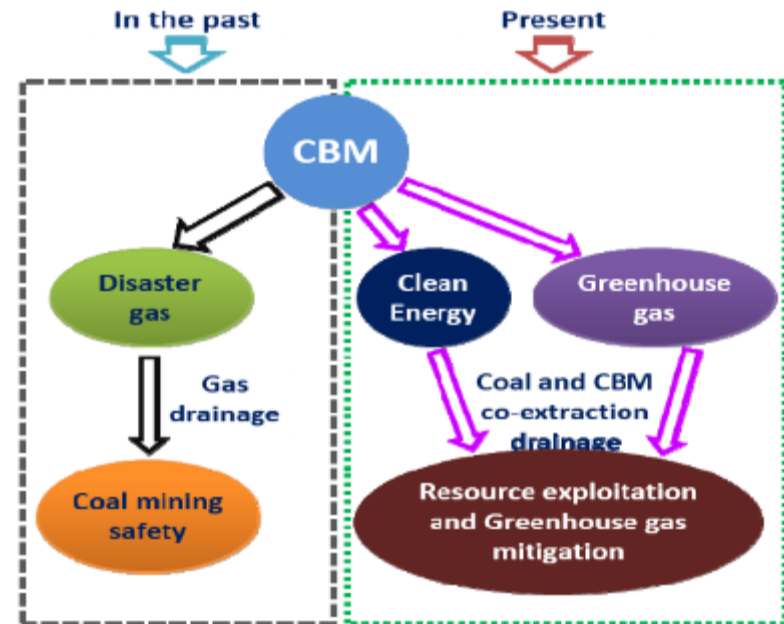
# CIL & CBM - Safe Mining & Lower Emissions

- ❖ Lower emissions and environmental pollution from mining.
- ❖ Degasification would reduce the mining risks and possible fire hazards in these mines, as and when they are mined.
- ❖ The mining activity would be cost effective due to lesser CAPEX & OPEX on ventilation and safety systems
- ❖ Access to additional resources in regional catchment.
- ❖ Fast-track development possible with partnership of CBM and Coal Mining companies with mutual expertise.
- ❖ Benefits at Federal and State levels from additional fiscal flows.
- ❖ Such projects will also be showcase to the country's hydrocarbon securitization initiative

INDIA'S CMM EMISSIONS (MILLION CUBIC METRES)

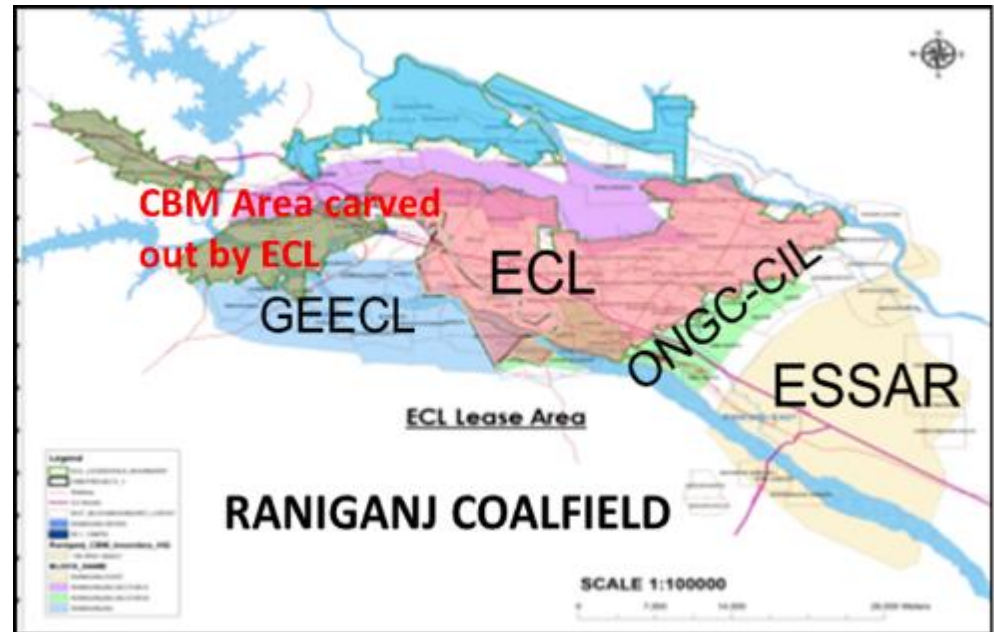
USEPA

Year	1990	1994	1995	2000	2005
CMM Emissions (no utilization)	763*	957.3	959*	1106*	1363 *



# CBM Development in CIL leasehold

- ❖ It is a welcome move that the CIL is also keen to start CBM development and has rightly identified the Damodar Valley Basin, particularly focused on Raniganj Coalfield.
- ❖ This is pursuant to the CBM Exploitation rights accorded by the GoI in its November, 2015 Policy.
- ❖ In April, 2018 there was a cabinet approval granting with amendment giving CIL freedom for engaging CBM developer is a welcome news.
- ❖ Coal India has initiated action for exploitation of CBM from some of mining leasehold areas of Eastern Coalfield Limited.
- ❖ ECL area is Raniganj Coalfield is the primary target (a total around 650 sq km is under ECL leasehold).
- ❖ For CBM development, initial exercise has identified certain areas in the southern part of the Raniganj Coalfield with higher gassiness (Saha, CIL).



**Essar is keen to engage with CIL in successful CBM development and exploitation.**






# Essar Benefits

- ❖ Unique leadership position in unconventional hydrocarbon space in India with a CBM learning curve in place.
- ❖ We would like to leverage this learning for efficient and effective development of future Unconventional pursuits and partnering with other investors in the region for fast track CBM development.

*This is keeping in view our commitments towards import dependency reduction goal set by our Hon. Prime Minister.*

## KPIs

- ❖ Pioneers in CBM E&P in India.
- ❖ Our First successful CBM wells way back 1992/93 in North Gujarat.
- ❖ Foot-print across all key CBM prospective basins.
- ❖ Presently, among the largest CBM acreage (2800 sq. km) & resource holders (>10 TCF) in the country
- ❖ Successful CBM Anchor Asset at Raniganj East currently producing in excess of 1.0 mmscmd of gas.

Factors	
CBM Learning Curve	
Experienced Manpower	
Services / Contracts	
Operation Hub Proximity	
Regional/Local Influence	

## Truly Sustainable Development – “Beyond Domain”





# Corporate Social Responsibility

CSR addresses the needs of the people and not the demands. However, CSR plays a vital role in keeping the action area of Essar, operation-friendly and in mitigating issues by identifying and addressing such needs of the stakeholders that are philanthropic in nature and are abiding the norms Schedule VII, Companies Act 2013.

**The thematic areas of execution are –**

**Health**

**Livelihood**

**Education**

**Women Empowerment**

**Sports & Culture**

**Infrastructure development**

## CSR Support for Road Safety

**FOUR** road divider-barriers were handed over to **Molandighi PS.**

*(The dividers not only carries the Company logo & name but also messages on road safety practices. These barriers will be placed at different accident prone points on Muchipara-Shibpur road.)*



## Mobile Medical Unit

**52 OPD camps in February 2018 reaching out to 607 beneficiaries**



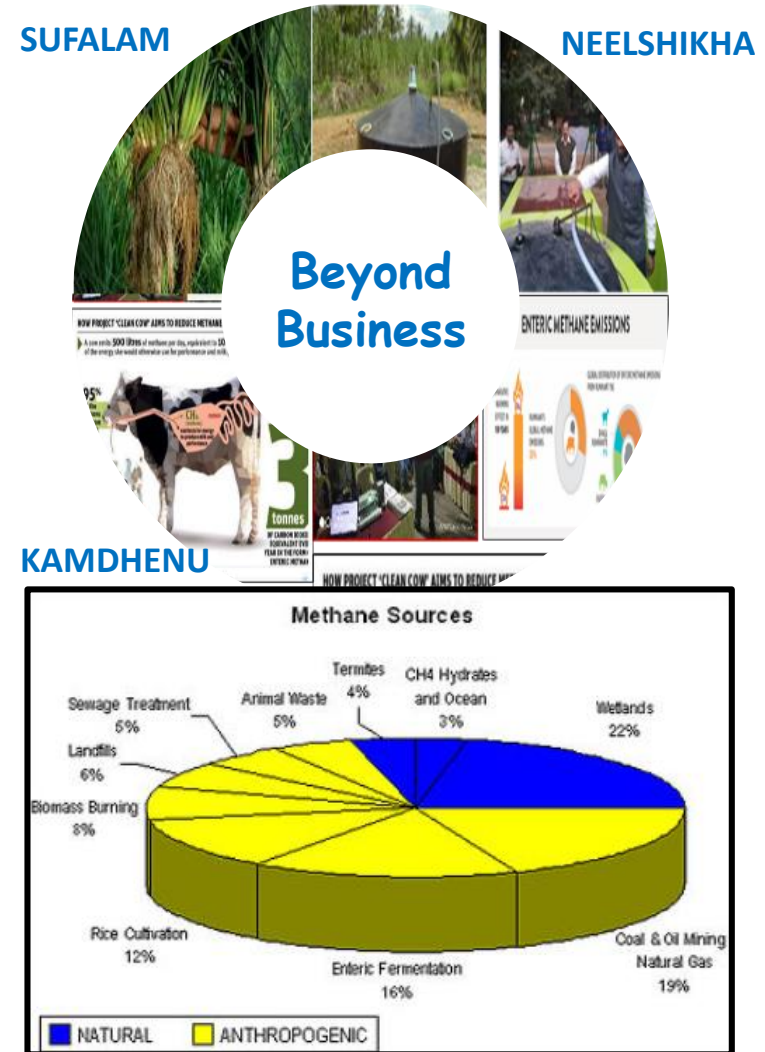
## Other Highlights

- ✓ **Anganwari base awareness programme on adolescent issues**
- ✓ **ANC (Ante Natal Care) and PNC (Post Natal Care) follow up**
- ✓ **Support and Convergence With Localities and Govt. Representatives**

## Beyond Domain – Areas for better future

Essar's efforts beyond project domain to make a difference Initiatives include:

- ❖ Reducing methane emissions
- ❖ Flagship Projects
- ❖ Deploying a system of rice intensification in nearby communities to help (SUFALAM):
  - Increase yield while reducing costs
  - Significantly reduce use of fertilisers and agrochemicals
  - Reduce use of irrigation water
- ❖ Enteric Fermentation support (KAMDHENU)
- ❖ Installing **bio-gas plants** (NEELSHIKHA)
- ❖ Spreading **awareness on biomass burning**
- ❖ Supporting local administration in **controlling forest fires**
- ❖ Creating **vermicompost** using animal waste



## CH<sub>4</sub> Emission Reduction – SUFALAM (SRI Rice Farming)

### Benefits of Systematic Rice Intensification (SRI) over Conventional Methods

- Reduction of
  - a. Use of fertilizers and agrochemicals
  - b. Irrigation water
  - c. Overall cost of cultivation
- Increase in CROP YIELD by 40-45%
- Reduction in Methane emission

### Implementation of SRI in Raniganj Block

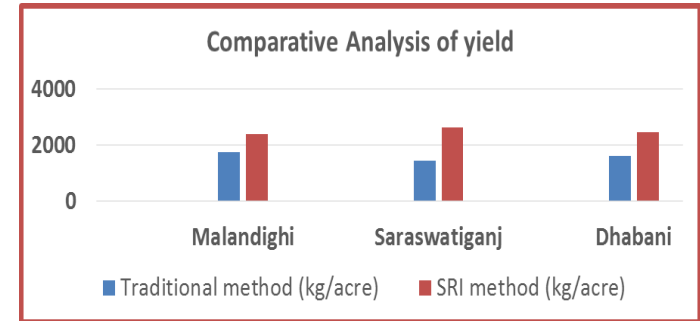
Coverage - 37 demo plots of ONE BIGHA each (**Total 5 Hectares**)

Training – 150 farmers trained

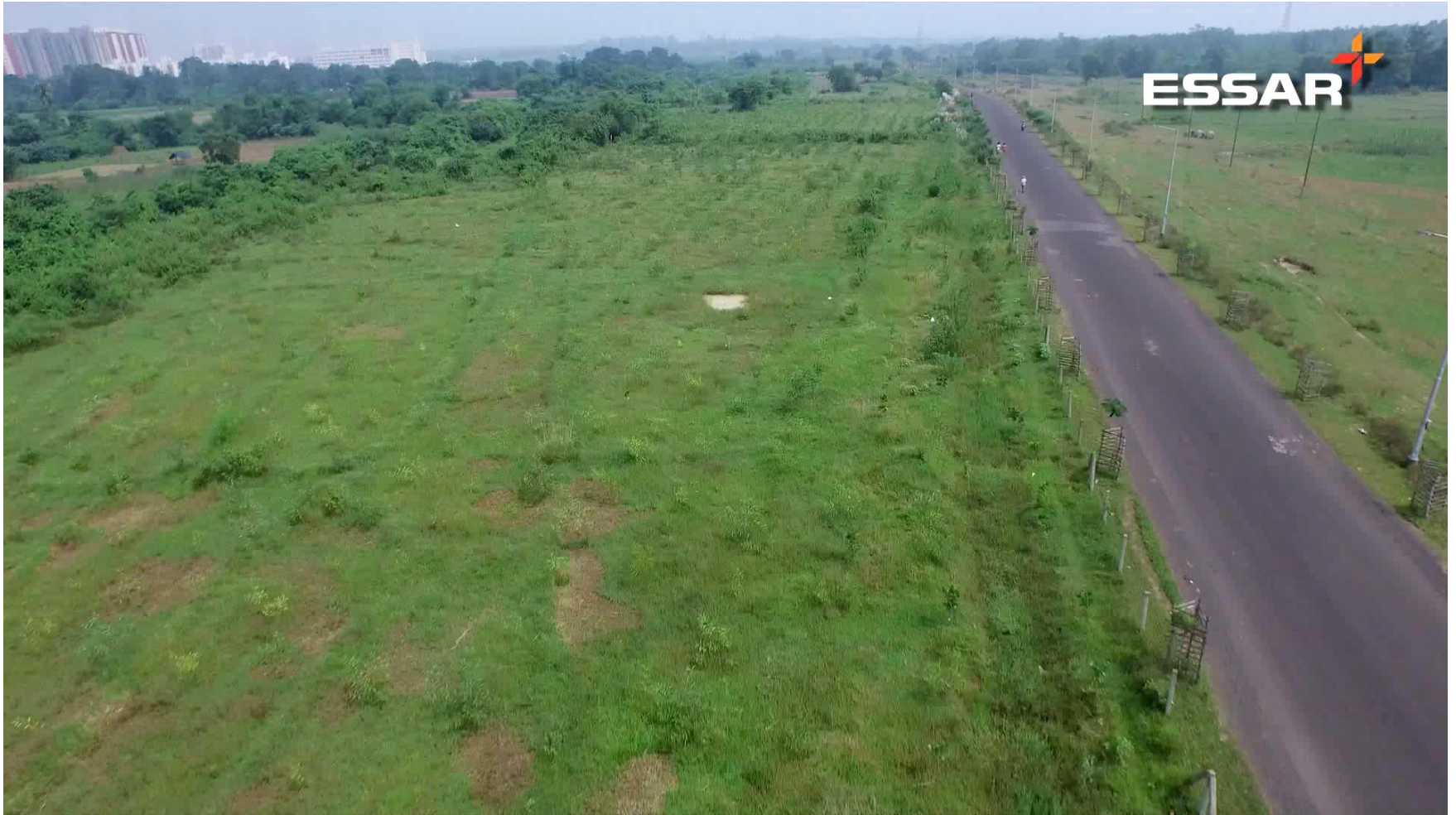
### Statement

- ✓ EOGEP has helped to methane emission

### Collaboration with Indian Grameen Services



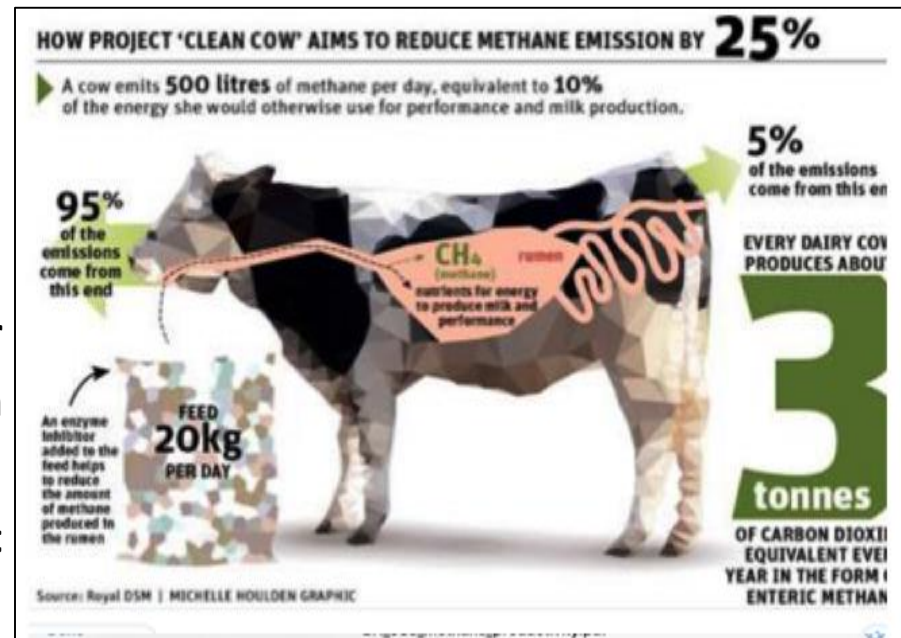
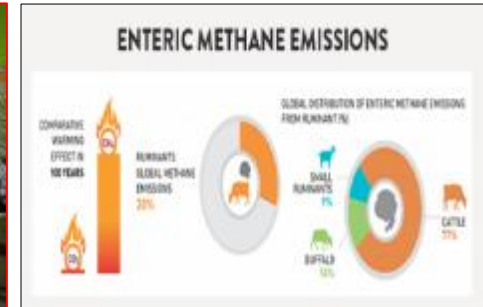
*Prashant Mondal, Molandighi –  
Practising SRI on 14 bigha land*



## CH<sub>4</sub> Emission Reduction - KAMDHENU (Enteric Fermentation)

“Feed Management is a effective tool for reducing Methane emission & Increasing the Milk Yield

- ❑ National Dairy Development Board (NDDB) launched a Mobile App on 7<sup>th</sup> July, 2015 called “**PASHU POSHAN**”
- ❑ Aim was to boost farmer’s income by
  - (a) Raising Milk Yield and
  - (b) Cutting feed cost
- ❑ The App recommends balanced diet for cows and buffaloes spanning 2.4 million heads of Indian Cattle.
- ❑ This is aimed to increase milk output and reduce methane emission.



# Project NEELSIKHA : Biogas Plant - The Blue Flame Revolution



- ❖ Biogas plant of approx. 50 kg capacity has been installed.
- ❖ Feed of Biogas plant: Kitchen waste & night soil of the Company's guesthouse, produces an avg. of 7-8 m<sup>3</sup> of biogas/Day:
- ❖ Replicate with small biogas in villages- 2 m<sup>3</sup> of biogas/ day
- ❖ Substantial Socio-economic benefits.

*Potential in Block Area: 100 biogas can be setup  
(study undertaken)*



# Global Clean Energy Award 2018 'Truly Sustainable Project'



- ❖ In Nov., 2018, EOGEPL honoured with "Global Clean Energy Award 2018" for developing Raniganj Asset as a showcase of 'Truly Sustainable Project' at the Gasification India 2018 conference in New Delhi.

## Accolades

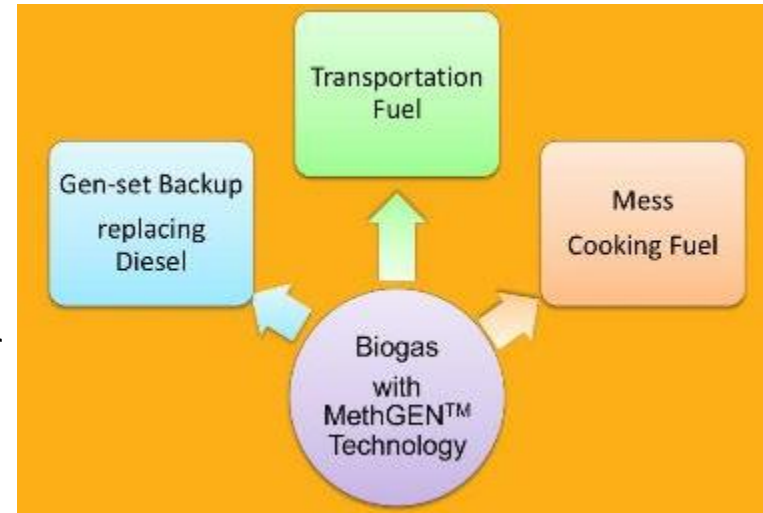
- ❑ *Direct Environment, Economical and Social benefits.*
- ❑ *Essar is actively contributing to Gasification drive by enhancing CBM production now and planning to begin Shale exploration as well*
- ❑ *Key Note address has been made by our MD & CEO and*
- ❑ *Head- production & highlighted the CBM activities and its development.*



# Other Plans - Bio CNG

Purified Biogas is called Bio CNG

- ❖ Bio CNG is **renewable Natural Gas**
- ❖ Bio CNG is exactly similar to Natural gas in composition and properties
- ❖ It is a direct replacement of Natural Gas and for applications of LPG



Parameters	Biogas	Bio-CNG
Methane (v/v)	55-65%	92-98%
CO <sub>2</sub> (v/v)	35-45%	2-8%
H <sub>2</sub> S (ppm)	500 – 30,000	<20 ppm
Moisture (deg C dew point)	Saturated	< -40 deg
Other Impurities (e.g. Siloxanes)	Present	Not present
Calorific Value (LCV)	~ 19500 kJ/kg	~ 52000 kJ/kg





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