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JUPITER OXYGEN CORPORATION

**A Low-Carbon Growth Strategy for India
Synergies from Oxy-Combustion, Carbon Capture, and ECBM**

Mumbai, September 30 2016

PRESENTATION OVERVIEW

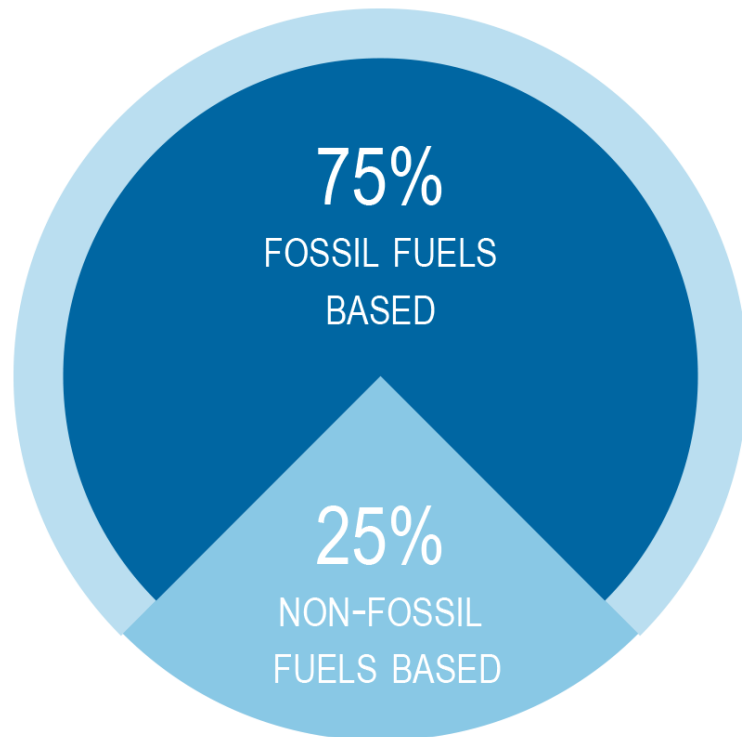
1. **Vision: Clean technology development & low-carbon growth (Video)**
2. **CO₂ Utilization: Key for self supporting carbon capture demonstration**
3. **Jupiter Oxygen Corporation: Cost effective carbon capture technology**
4. **Business Opportunity India: Enhanced coal bed methane recovery**
5. **CCUS Demonstration: Importance of site selection & project synergies**
6. **Industry Engagement: Getting the utility, oil, gas & coal industry involved**

THE VISION: CLEAN TECHNOLOGY & SUSTAINABLE DEVELOPMENT

KEY FOR SUSTAINABLE DEVELOPMENT CLEAN ENERGY TECHNOLOGY SOLUTIONS



THE CHALLENGE TO LOW-CARBON GROWTH



PROJECTED GLOBAL ENERGY USE IN 2040

*SOURCE: IEA WEO 2015
INTERNATIONAL ENERGY AGENCY
WORLD ENERGY OUTLOOK 2015
EXECUTIVE SUMMARY
CENTRAL SCENARIO*

THE SOLUTION: TURNING CARBON INTO A COMMODITY

- ▶ *Carbon Capture, and Storage and Utilization (CCUS) technologies offer an essential solution to clean up the existing coal power plant fleet, as well as new build plants.*
- ▶ *CCS/CCUS is also the only viable mitigation option to decarbonize the production of commodities such as iron, steel and cement.*
- ▶ **Bioenergy carbon capture and storage (BECCS) appears to be the only currently available technology capable of delivering large-scale negative CO₂ emissions.**

THE SOLUTION: TURNING CARBON INTO A COMMODITY

CO₂ UTILIZATION OPTIONS:

- ▶ ***ENHANCED OIL RECOVERY (EOR): 40 YEARS+ EXPERIENCE IN USA***
- ▶ ***ENHANCED COAL BED METHANE RECOVERY (ECBM):
PILOTS IN CANADA, USA, CHINA***
- ▶ ***ALGAE PRODUCTION FROM CO₂ / ALGAL BIOMASS/FUEL INDUSTRY***
- ▶ ***"FROZEN METHANE": SUBMARINE GASHYDRATES
INDIA AND CHINA HAVE IDENTIFIED HUGE RESERVOIRS OFFSHORE***

CO₂ UTILIZATION OPPORTUNITIES EXIST WORLDWIDE

- “ In India, Advanced Resources International (ARI, 2009) estimated 70 to 90 trillion cubic feet of Coal Bed Methane in place, of which 20 trillion cubic feet are recoverable with CBM, and another 15 to 18 trillion cubic feet of the gases in place are potentially recoverable with ECBM, storing billions of tons of CO₂*
- “ Reviewing the ECBM potential for CBM sites currently in operation or being developed in India, ARI estimated an ECBM potential of 2 trillion cubic feet, potentially utilizing close to 1 billion tons of CO₂*

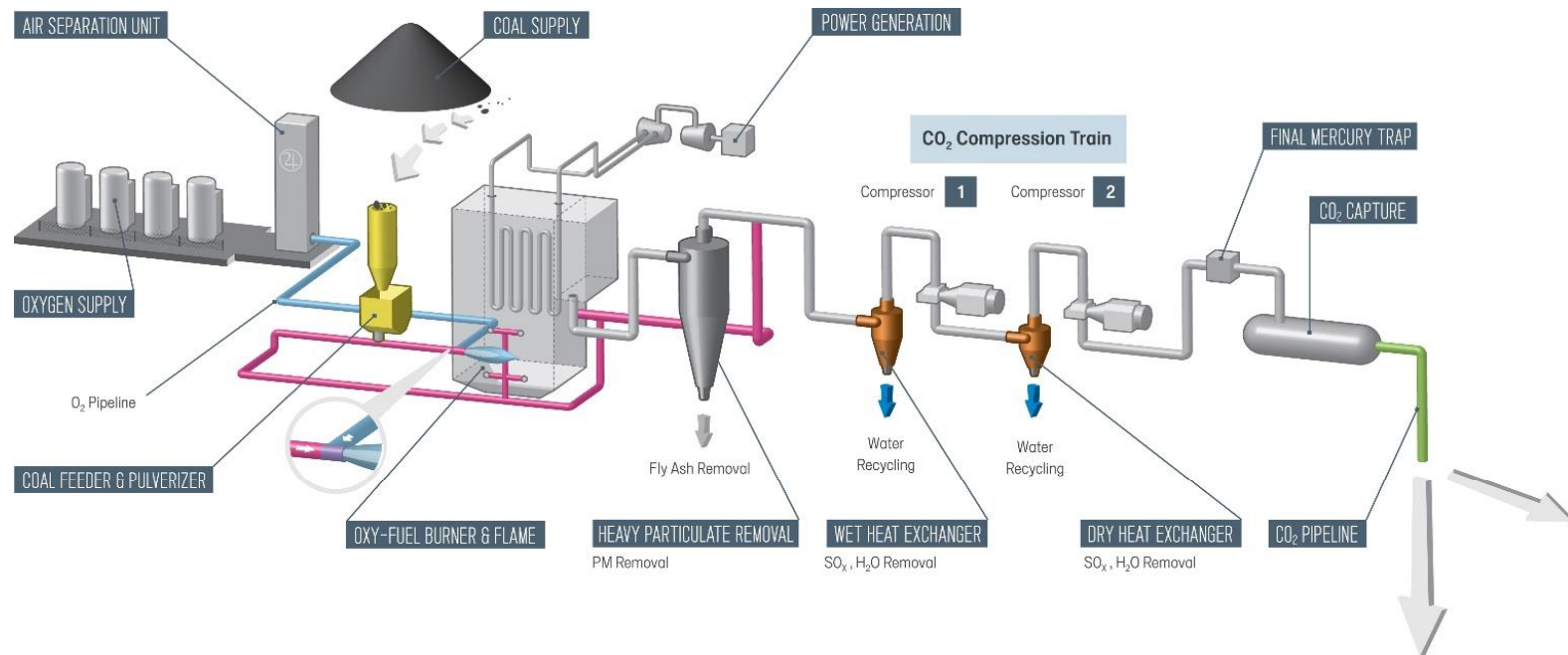
CO₂ UTILIZATION OPPORTUNITIES EXIST WORLDWIDE

Those unconventional energy resources from EOR / ECBM will increase energy independence for countries engaging in CO₂ utilization strategies.

▶ Main costs associated with CCUS technologies are related to carbon capture process from fossil fuel power plants and industrial sources

***JUPITER OXYGEN CORPORATION (JOC) OFFERS
A COST EFFECTIVE CARBON CAPTURE PROCESS***

A COST EFFECTIVE CLEAN-COAL PATHWAY: JOC OXY-COMBUSTION CARBON CAPTURE



CO₂ Underground Storage and Use

- Specific Geological Formations
- Enhanced Oil / Natural Gas Recovery
- Enhanced Coal Bed Methane (ECBM) Recovery
- Algal Biomass Industry
- Submarine Extraction of Methane from Hydrate

- ▶ ***Pathway for Clean Coal Power Generation***
 - É ***Demonstrated 95%+ carbon capture from flue gas***
 - É ***Ultra low emissions from coal power plants [NO_x, SO_x, PM, mercury]***
 - É ***Multiple fuel usage***
 - É ***Efficiency gains in boiler***
 - É ***Reuse of condensed water***

JUPITER OXYGEN: COST EFFECTIVE CARBON CAPTURE TECHNOLOGY

JOC OXY-COMBUSTION CARBON CAPTURE SYSTEM

- ***Test results indicate a 20% energy penalty
(from air separation unit & carbon capture system)***
- ***Technology Readiness Level 6 [TRL 6]***
- ***Results can be used for scale up of technology***

JUPITER OXYGEN CARBON CAPTURE TECHNOLOGY: SUMMARY

- ▶ **Oxy-fuel represents a cost effective approach for CO₂ capture through concentrated CO₂ in greatly reduced exit gas volume.**
- ▶ **Efficiency gains in boiler from high flame temperature oxy-combustion technology application can ‘offset’ in part parasitic power losses that come along with oxygen production and CO₂ capture.**

BUSINESS OPPORTUNITY ECBM IN INDIA

ADVANCED RESOURCES (ARI): EOR & ECBM SCREENING STUDY

Scope of Work

Review past experience of coalbed methane (CBM), ECBM, and CO₂-EOR projects in India.

Estimate ECBM and CO₂-EOR potential and associated CO₂ requirements in areas where their application appears feasible.

Match areas appearing to be amenable to ECBM and/or CO₂-EOR with areas of high levels of CO₂ emissions from power plants to identify possible early “win-win” opportunities.

Identify and characterize possible project partners for a demonstration project in India.

ECBM Experience in India

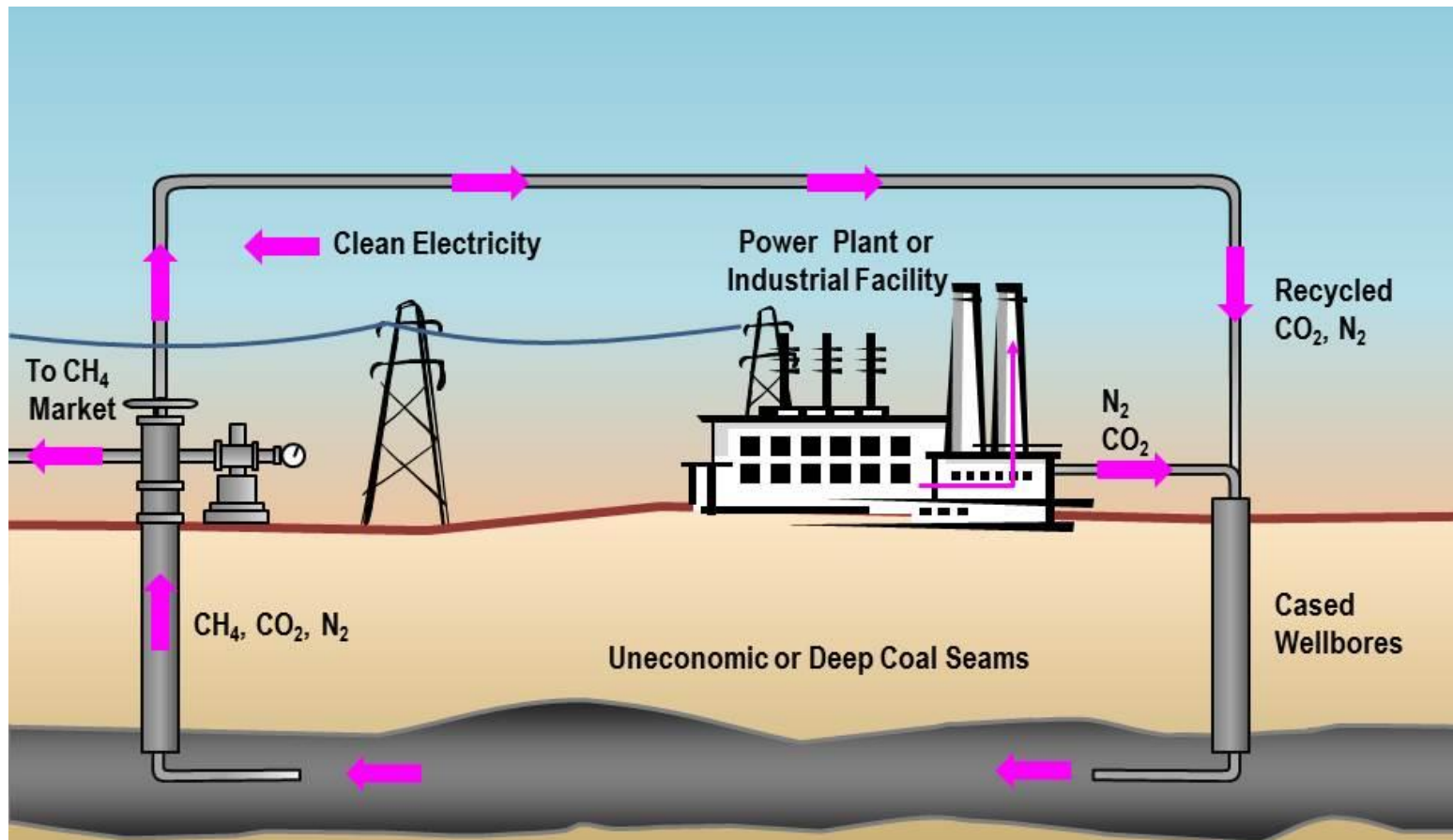
Reportedly, Coal India Ltd. (CIL) is investigating and assessing the potential of ECBM at some of its coal mines

It has been reported that India's Directorate General of Hydrocarbons (DGH) has planned to initiate a CO₂-ECBM pilot in some selected Gondwana coal fields.

Some research work is also underway.

However, while little ECBM activity has taken place, production of traditional CBM is relatively well established.

What is Enhanced Coalbed Methane (ECBM)?



Process

- CO_2 adsorption into coal
- CO_2 displaces clean burning methane (ratio varies by coal)
- Flow of CO_2 controlled by permeability of coal seam

“Win-Win” Opportunities For CCS and ECBM

Possible “win-win” opportunities were identified by assessing the following factors, in relative importance:

- . The availability of existing infrastructure to be utilized to allow cost-effective ECBM and/or CO₂-EOR.
- . Proximity to existing CO₂ emissions sources
- . Willingness, need, and/or ability of existing producers to pursue an ECBM or CO₂-EOR pilot
- . Characteristics for viable ECBM or CO₂-EOR, including areas amenable to CO₂ mixed with N₂ for ECBM.

Opportunities For CCS and ECBM

The existing producing areas in the Raniganj South and East blocks are potentially the most attractive, as they have existing CBM infrastructure in place that could be used for ECBM

These areas are near many potential industrial facilities that would be good sources of CO₂ for a CO₂ storage-ECBM project.

CCUS DEMONSTATION:

Importance of site selection and project synergies

- “ **First-of-its-kind CCUS project sites have to be carefully selected:**
- “ **Identify early opportunities for large-scale, economically viable utilization of CO₂ for ECBM / EOR**
- “ **Locate CO₂ source in proximity to potential CO₂ utilization sites**
- “ **Provide carbon capture solutions for coal fired power plants and other industrial CO₂ sources / address CO₂ capture and air pollutant control**

CCUS - ECBM DEMONSTATION: Importance of site selection and project synergies

- “ Establish clean technology alliance between carbon capture technology provider, EOR/ECBM experts and local energy company**
- “ Define EOR / ECBM potential and expert strategy**
- “ Involve at an early project stage local, regional, and national authorities**
- “ Assess ‘clean tech’ funding options from Multilateral Development Banks**

BEYOND TALK, ACTION

WORLD'S FIRST COMMERCIAL SCALE PROJECT

▶ WESTERN CHINA

**Retrofit of coal-fired power plants
with Jupiter's oxy-combustion
and CO₂ - capture technologies**

**With CO₂ Utilization for Enhanced
Coalbed Methane (ECBM) Recovery**



- ▶ **First commercial full-scale ECBM project in the world**
- ▶ **Next: India!**

CCUS DEMONSTRATION: Importance of site selection and project synergies

February 3, 2015: Exploring ECBM Business Opportunities in India

ESSAR Oil Limited, Advanced Resources International, and Jupiter Oxygen Corporation signed a Letter of Intent to explore opportunities for relatively green fossil energy projects, through enhanced coal bed methane (ECBM) using CO₂

GETTING THE UTILITY, OIL, GAS & COAL INDUSTRY INVOLVED

- ▶ **India has significant CO₂ ECBM utilization potential**
- ▶ **Many CO₂ sources [utility size- / industrial boilers] are in proximity to potential CO₂ ECBM sites**
- ▶ **The oil and gas industry is well prepared to provide the necessary infrastructure for CO₂ ECBM operations**
- ▶ **The domestic utility, coal , oil and gas industry can play a leading role for tapping into unconventional cleaner fossil energy resources**
- ▶ **Carbon capture with CO₂ ECBM provides an advanced energy strategy and significant business opportunity for India**

MORE INFORMATION AT WWW.JUPITEROXYGEN.COM

U.S. based clean energy technology company offers:

- ▶ **High flame temperature oxy-combustion process Know-How**
- ▶ **Patents and Licensing**
- ▶ **Consulting Services**

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