

**TRANSITION TOWARD A LOW-CARBON SOCIETY IN ASIA:
OXY-COMBUSTION CARBON CAPTURE & CO₂ UTILIZATION**

ADB - ASIA CLEAN ENERGY FORUM 2016

**JUNE 6 to 10, 2016
MANILA, PHILIPPINES**

THE CHALLENGE



THE CHALLENGE.....

- **COAL CONTINUES TO BE A VITAL ENERGY RESOURCE IN ASIA**
- **PROVIDING INCREASED ELECTRICITY IS NECESSARY**
 - **TO ADDRESS POVERTY**
 - **INCREASE ECONOMIC OUTPUT**
- **CHINA, INDIA, INDONESIA, AND OTHERS: INCREASING COAL USAGE**
- **BUT CLIMATE CHANGE REQUIRES THAT THE COAL FIRED POWER PLANT EMISSIONS BE CAPTURED**
- **ECBM (ENHANCED COAL BED METHANE) RESULTS IN"... AN OVERALL REDUCTION IN GREENHOUSE GAS EMISSIONS IS ACHIEVED..." IEA CLEAN COAL CENTRE 2015 " POTENTIAL FOR ENHANCED COAL BED METHANE RECOVERY"**
- **AND REDUCED AIR POLLUTION**



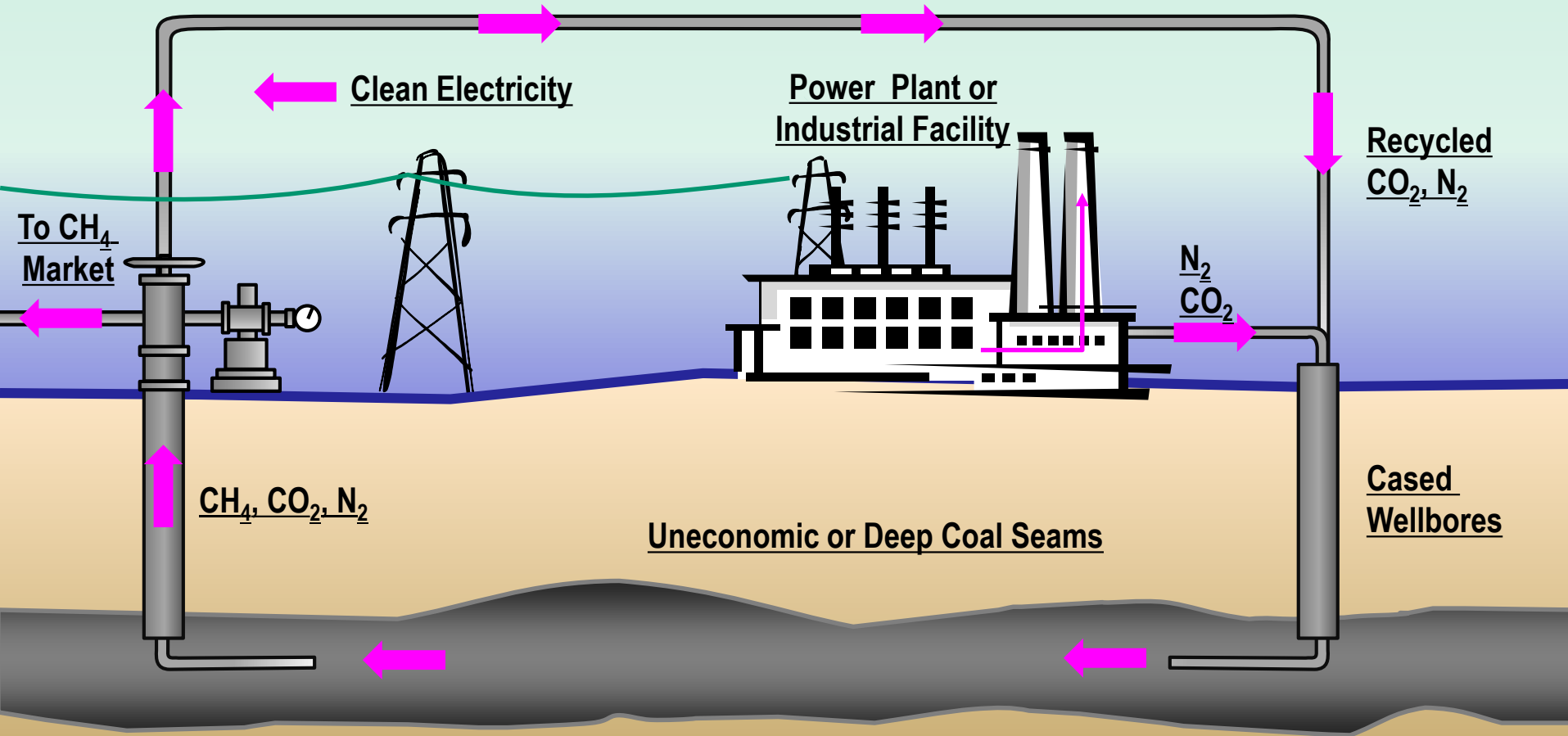
ECBM

ECBM IS ENHANCED COAL BED METHANE RECOVERY WHICH USES CO₂ THAT THEN IS STORED

- **CCUS ECBM OXY-COMBUSTION CAN ALLOW COAL FIRED POWER PLANTS**
 - **WITHOUT CO₂ EMISSIONS WHERE CONDITIONS ARE RIGHT FOR ECBM**
 - **IEA CLEAN COAL CENTRE HAS IDENTIFIED**
 - **CHINA, INDIA, AUSTRALIA, JAPAN**
 - **INDONESIA ALSO HAS BEEN IDENTIFIED**
 - **COMMERCIAL VIABILITY WHERE ECBM CAN BE PROFITABLE**
 - **A NEW ECBM APPROACH ENHANCES PRODUCTIVITY AND PROFITABILITY**
- **THE RECOVERED METHANE IS AN ENERGY SUBSTITUTE FOR**
 - **COAL AND OIL**
 - **POWER, HOME HEATING, AND TRANSPORTATION SECTOR**
- **METHANE EMITS FAR LESS CO₂ THAN COAL**



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

CCUS NEEDS SUPPORT

CCUS DEMONSTRATION PROJECTS SHOULD BE SUPPORTED

- **PART OF THE ANSWER TO DECREASED CO₂ EMISSIONS**
 - **POTENTIAL STORAGE OF BILLIONS OF TONS OF CO₂ IN ASIA**
- **ACCELERATE CCS/CCUS TECHNOLOGY**
 - **DEVELOPMENT AND DEPLOYMENT**

INITIAL DEMONSTRATION PROJECTS NEED FINANCIAL SUPPORT:

- **FIRST OF KIND/EARLY MOVER – RISK ISSUES**
- **GREEN CLIMATE FUND**
- **CCS TRUST FUND**
- **OTHER**



ABOUT JUPITER OXYGEN CORPORATION

- **DEVELOPED AND PATENTED A HIGH FLAME TEMPERATURE OXY-COMBUSTION PROCESS FOR HEAT TRANSFER**
- **TECHNOLOGY DEVELOPMENT**
- **PATENTS AND LICENSING**
- **CONSULTING SERVICES**



WHAT IS OXY-COMBUSTION?

REPLACE INPUT GAS FROM AIR TO OXYGEN FORCES CONSIDERABLE CHANGES INCLUDING:

- **BOILERS**
 - AN IMPROVED RADIANT HEAT TRANSFER PROCESS
 - EXCELLENT FOR RETROFITS OF EXISTING COAL BOILERS TO INCLUDE CO₂ CAPTURE
 - EFFICIENT HEAT TRANSFER
- **FLUE GASES**
 - CO₂-WATER VAPOR INSTEAD OF NITROGEN- CO₂-WATER VAPOR
 - EASY TO PURIFY CO₂
 - JOC OXY-COMBUSTION ECONOMICS EXCELLENT FOR CCUS ECBM



FLAME TEMPERATURE MATTERS – MULTIPLE BENEFITS

JUPITER'S PATENTED HIGH FLAME TEMPERATURE OXY-COMBUSTION OFFERS

- **HIGHER FLAME TEMPERATURE – 2760 C RANGE**
- **CONTROLLED HEAT TRANSFER**
- **PROCESS TEMPERATURES (NO CHANGE – SAME AS AIR FIRING)**
- **MATERIAL TEMPERATURES (NO CHANGE – SAME AS AIR FIRING)**
- **GREATER RADIANT HEAT TRANSFER**
- **SAVES FUEL**

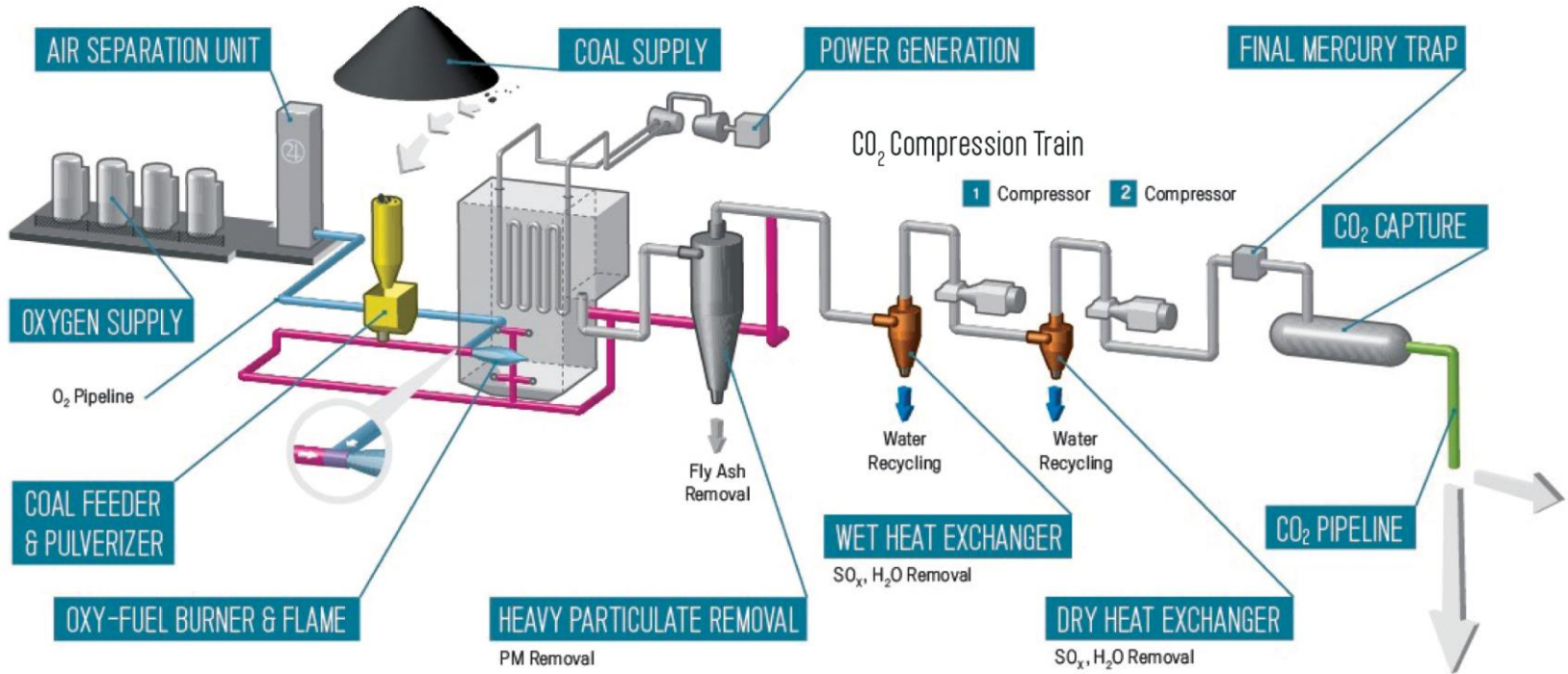


LOWER CAPITAL AND OPERATING COSTS

- **JUPITER'S PROCESS - BENEFITS**
 - **Lower fuel costs**
 - **Less gas (oxygen) needed**
 - **Less CO_2 created**
 - **Purer carbon dioxide at the boiler exit**
 - **Lowers carbon capture costs**
 - **Captures water going out with the flue gases**



JOC OXY-COMBUSTION & CARBON CAPTURE SYSTEM



● Flue Gas Recirculation
 ● Latent Heat Recovery
 ● O₂ Pipeline
 ● Water Recycling
 ● CO₂ Pipeline

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



JUPITER OXYGEN CORPORATION

JOC CO₂ CAPTURE SYSTEM

- **BAG FILTER**
 - Removes almost all the particulate matter
- **MULTI- STAGE COMPRESSION SYSTEM**
 - Alters flue gas temperature
 - Pressurizes co₂
- **HEAT EXCHANGERS**
 - Removes water and s0x
- **SPECIAL FILTERS**
 - Removes mercury
- **NOX AND SOX ALSO CAPTURED AS NEEDED**
- **OUTCOME**
 - 95-100% co₂ capture
 - Transport ready carbon capture
 - Jupiter's technologies enable combined technologies to be:
 - Economical
 - Efficient



JOC CO₂ CAPTURE SYSTEM Vs TRADITIONAL SYSTEMS

- **JOC CO₂ CAPTURE SYSTEM DOES AWAY WITH THE NEED TO HAVE MANY BOILER AUXILIARIES**
 - **FD,**
 - **ID,**
 - **SCR,**
 - **ESP,**
 - **FGD**
 - **CHIMNEY**
- **WATER RECOVERY**
 - **EXCEEDS BOILER FEED WATER REQUIREMENTS**



JUPITER OXYGEN CCUS ECBM DEVELOPMENTS - CHINA AND INDIA

IN THE SLIDES TO FOLLOW:

- **TWO LIKELY PROJECTS**
 - **FIRST OF A KIND CCUS ECBM PROJECT IN CHINA**
 - **ENGAGEMENT IN CCUS ECBM DEVELOPMENTAL WORK IN INDIA**



CCUS: ENHANCED COAL BED METHANE RECOVERY

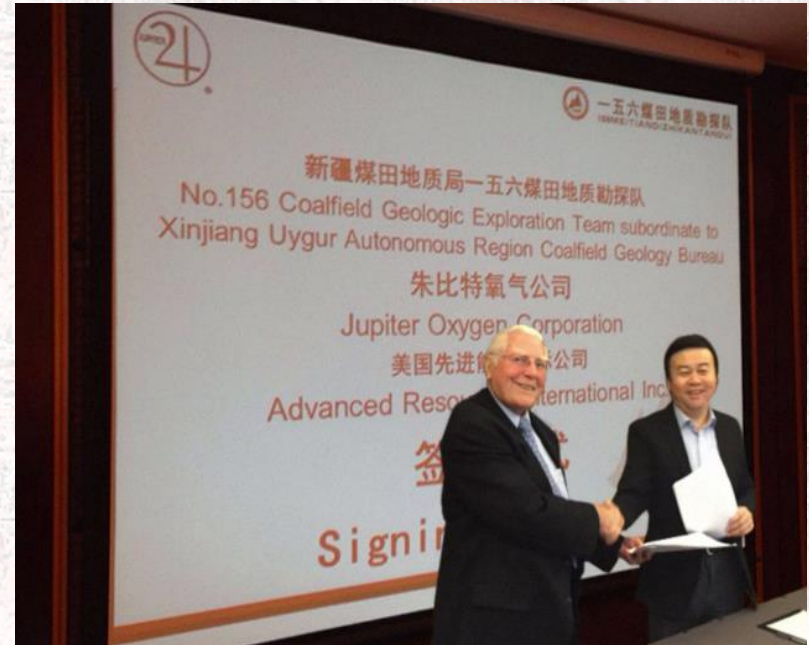
- COAL BED METHANE (CBM) UTILIZATION IS IMPORTANT TO SOLVE THE LACK OF SUFFICIENT METHANE RECOVERY. CHINA IS THE BIGGEST COAL PRODUCTION AND CONSUMPTION COUNTRY.
- CBM IS A NEW CLEAN ENERGY FOR CHINA.
- CO₂ AND NITROGEN USED FOR ECBM



XINJIANG CCUS – ECBM COMMERCIAL SCALE PROJECT

BEIJING: NOVEMBER, 18 2015

**AGREEMENT SIGNED FOR COMMERCIAL
SCALE CCUS – ECBM PROJECT
IN WESTERN CHINA**



**INCLUDES RETROFITTING COAL POWER PLANTS WITH JOC'S HIGH FLAME
TEMPERATURE OXY-COMBUSTION AND CO₂ CAPTURE TECHNOLOGIES**



JUPITER OXYGEN CORPORATION

NO. 156 TEAM

NO. 156 TEAM OF XINJIANG PROVINCE COAL GEOLOGY BUREAU IS A STATE OWNED ENTERPRISE WHICH IS LEADING THE COMMERCIAL DEVELOPMENT OF ECBM, AND HEADQUARTERED IN URMQI, CHINA.



ADVANCED RESOURCES INTERNATIONAL

ADVANCED RESOURCES INTERNATIONAL IS A LEADING INTERNATIONAL CONSULTING FIRM WITH EXPERTISE IN THE TECHNOLOGIES, MARKETS, ENVIRONMENTAL AND REGULATORY ISSUES, AND ECONOMICS OF ENHANCED COAL BED METHANE RECOVERY, THE GEOLOGIC SEQUESTRATION OF CO₂, AND CO₂ ENHANCED OIL RECOVERY (CO₂-EOR), WITH ITS HEADQUARTERS IN VIRGINIA, USA.



CCUS-ECBM PROJECT IN XINJIANG

NO. 156 COALFIELD GEOLOGIC EXPLORATION TEAM SUBORDINATE TO XINJIANG UYGUR AUTONOMOUS REGION COALFIELD GEOLOGY BUREAU (CHINA), JUPITER OXYGEN CORPORATION (USA), AND ADVANCED RESOURCES INTERNATIONAL (USA) ARE PLEASED TO ANNOUNCE THE SIGNING ON NOVEMBER 18, 2015 IN BEIJING OF A CONTRACT FOR A LARGE SCALE ENHANCED COAL BED METHANE RECOVERY PROJECT (ECBM) IN CHINA WHICH ALSO WILL STORE CO₂ FROM COAL FIRED POWER PLANTS. THIS IS A KEY CLIMATE CHANGE PROJECT FOR CHINA, THE US, AND THE WORLD BECAUSE IT WILL DEMONSTRATE:

- THE COMMERCIAL VIABILITY OF CARBON CAPTURE, UTILIZATION AND STORAGE (CCUS) ECBM;**
- THE FEASIBILITY OF COMMERCIAL SCALE HIGH FLAME TEMPERATURE OXY-COMBUSTION WITH CARBON CAPTURE FOR CCUS AND CARBON CAPTURE SEQUESTRATION (CCS) TECHNOLOGY DEPLOYMENT.**



CCUS-ECBM IN XINJIANG

IMPROVING COALBED METHANE DEVELOPMENT, WHILE ACHIEVING ENVIRONMENTAL GOALS USING ECBM ADVANCED TECHNOLOGY WILL SIGNIFICANTLY REDUCE CARBON DIOXIDE AND NITROGEN EMISSIONS. USING THE WASTE GAS TURNS WASTE INTO AN ECONOMIC BUSINESS MODEL. THE WORLD OF THE 21ST CENTURY NEEDS SUSTAINABLE BUSINESS STRATEGIES THAT PROVIDE AN INCREASING ENERGY SUPPLY WHILE SUPPORTING CLIMATE PROTECTION AND SOCIAL DEVELOPMENT GOALS. TRANSFORMATIONAL TECHNOLOGIES, SUCH AS CARBON CAPTURE, UTILIZATION, AND STORAGE (CCUS) WILL PLAY A KEY ROLE TO MANAGE THESE CHALLENGING TASKS, AS LONG AS FOSSIL FUELS DOMINATE THE ENERGY MIX WORLDWIDE. CLIMATE CHANGE INITIATIVE PROGRAM (CCUS) IS THE GOAL THAT AMERICAN AND CHINESE GOVERNMENTS HAVE BEEN WORKING TOGETHER TO ACHIEVE.



CCUS-ECBM IN CHINA

- THE PROJECT WILL PROVIDE METHANE FOR CHINA'S RESIDENTIAL AND VEHICLE NEEDS.
- THE PROJECT REFLECTS CLIMATE CHANGE COOPERATIVE EFFORTS BETWEEN THE US AND CHINA. THE PARTIES DEEPLY APPRECIATE THE ASSISTANCE RECEIVED FROM THE US DEPARTMENT OF ENERGY AND US DEPARTMENT OF COMMERCE IN CHINA, AND THE US DEPARTMENT OF ENERGY NATIONAL ENERGY TECHNOLOGY LABORATORY WITH TECHNOLOGY DEVELOPMENT.



JUPITER OXYGEN CORPORATION - INDIA

- JOC-ARI STUDY SHOWED A VERY LARGE ECBM POTENTIAL IN THE STATES OF WEST BENGAL, JHARKHAND AND MP/ CHATTISGARH
- ENGAGED IN DEMONSTRATION PROJECT DISCUSSIONS WITH VARIOUS POWER UTILITIES.



ECBM/CO₂ STORAGE POTENTIAL IN INDIA

Coalfield	Operator	Area		Resource		Wells (as of 2012)		Coal Rank	Est. Primary CBM	Est. ECBM	CO ₂ :CH ₄ Ratio	Est. CO ₂ Storage	
		m ²	km ²	Tcf	Bcm	Drilled	Producing	%Ro	Bcf	Bcf		Bcf	MM tonnes
Raniganj South	Great Eastern Energy Corporation Limited (GEECL)	81.1	210	2.4	67.96	153	102	0.74	950	480	4.12	5,896	312
Raniganj East	Essar Oil Limited (EOL)	193.1	500	2.2	60.88	135	57	0.60	850	430	5.72	7,328	388
Sohagpur (East)	Reliance Industries Ltd (RIL)	218.9	567	2.0	56.63	31	10-15	2.38	300	400	0.66	464	25
Sohagpur (West)	Reliance Industries Ltd (RIL)	223.2	578	1.5	42.48			1.32	225	300	1.67	875	46
Parbatpur Area, Jharia Coalfield	Oil and Natural Gas Corporation (ONGC)	7.7	20	0.9	25	~50	~30	1.50	132	177	1.36	421	22
East Bokaro	Oil and Natural Gas Corporation (ONGC)	24.7	64	0.7	20.10	~10	~10	1.06	107	142	2.35	585	31
				9.6	273.1				2,564	1,929		15,568	824



ECBM FITS INDIA

- **INDIA HAS SIGNIFICANT CO₂ ECBM UTILIZATION POTENTIAL**
- **MANY CO₂ SOURCES 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**



NEXT STEPS FOR INDIA

- **FINALIZE PARTICIPATING INDIAN ORGANIZATIONS**
- **FUNDING JUPITER OXYGEN OXY-COMBUSTION CCUS ECBM STUDY**
- **CONDUCT INITIAL STUDY**
- **DEVELOP MODEL FOR CCUS ECBM IMPLEMENTATION**
- **START DEMONSTRATION PROJECT**



CHALLENGE BEFORE INDIA - THERMAL TO DOMINATE

POWER SCENARIO 2015-16* GENERATION CAPACITY

298,059.97 MW - TOTAL

210,675.04 MW – THERMAL (70.68%)

1,107.385 BU– TOTAL IN 15-16

943.407 (85.19%) – THERMAL

*CEA GEN REPORT MAR2016

EXP. SCENARIO IN 2031-32** GENERATION CAPACITY

700,703 MW – TOTAL

444,149 MW – THERMAL (63.39%)

3085.15 BU TOTAL IN 31-32

2240.64 BU (72.63%) THERMAL

**INTEGRATED ENERGY POLICY REPORT ,
GOI 2006



MORE INFORMATION AT WWW.JUPITEROXYGEN.COM

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