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JUPITER OXYGEN CORPORATION

POWER PLANT SUMMIT

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Overview

- Why we are here
- Jupiter Oxygen and Jupiter Aluminum
- Oxy-Fuel Technology Development
- Integrated Pollutant Removal System
- Hammond Burner Test Facility
- Economics of JOC Technology
- Sustainable Technology Solutions

Jupiter Oxygen why we are here

- We are here with a technology for the beneficial use of coal or other fossil fuels
- Our process uses oxygen instead of air
  - Efficient process
  - Enabling near zero pollution
- Our process can be used for power plants and other industrial furnaces, our process is patented (India)
- Seeking projects where funding from development banks can improve the economics of a carbon reduction project, working with our customers for competitive advantages

Jupiter Oxygen and Jupiter Aluminum

Development through Research & Cooperation

Scientific Approach & Practical Experience

- Extensive experiments with the use of oxygen in industrial melting furnaces were applied in day-to-day operations
- Knowledge from these experiments led to a patented process for advanced combustion and burner systems:
- Private-Public R&D Program in Cooperation with U.S. DOE over 15 million (US) dollar investment

To Develop, Establish and Promote Jupiter's Technology

- Patenting technology worldwide
- Cooperative Research And Development Agreement (CRADA) with U.S. Department of Energy, National Energy Technology Laboratory

Jupiter's Network: International Cooperation

- IEA, International Oxy-fuel Network, United Kingdom
- United Nations Framework Convention on Climate Change, UNFCCC
- Asia-Pacific Partnership on Clean Development and Climate, AP6
- Business Council for Sustainable Energy, Washington DC
- Carbon Sequestration Leadership Forum (CSLF)
- PEW Center for Global Climate Change, Washington DC

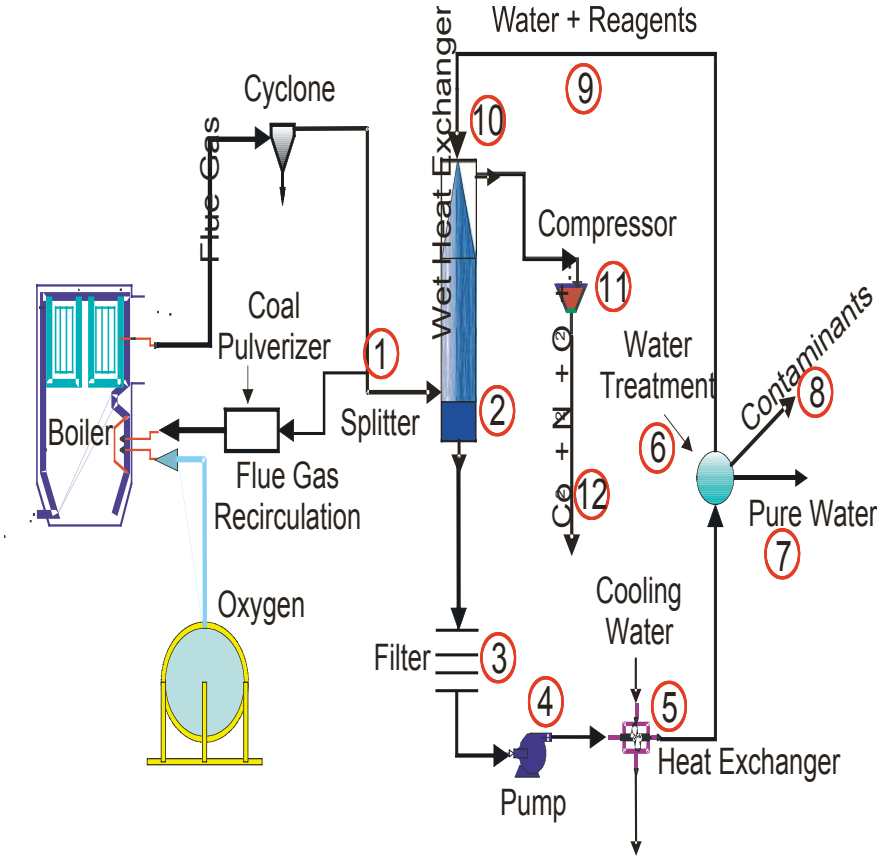
Jupiter Oxy-fuel Technology Development

Oxy-Fuel

- Using Oxygen (95% purity or higher) instead of air for combustion
- Thermodynamic advantages
- Viewed as a capture technology
- Viable emissions benefits for NO_X, SO_X and Mercury reductions

Oxy-fuel is new to

- Power industry
- Equipment suppliers



Jupiter Oxy-fuel Technology Development

Jupiter Oxygen

- High Flame temperature
- Radiant heat transfer
- Industrial development
- Stoichiometric Combustion
- Low-NO_X oxy-fuel combustion can be a viable alternative to conventional controls for NO_X or other pollutants from coal-fired power generation

IPR (Integrated Pollutant Removal)

- Multi-pollutant approach (Sulfur, Mercury, CO_2, Particulate Matter)
- Heat Recovery

Jupiter Oxygen's Solution

Traditional Combustion

- Air fuel fired 21% oxygen, 79% nitrogen
- 3 to 5% excess air

Oxy-fuel Misconceptions

- Flame temperature is too high
- Economics not obtainable
- New materials are needed

Higher thermal efficiency – lower fuel input

- Increased radiant heat transfer

Concentrated CO_2 — reduces capture cost — enabling technology with versatile application

Stack exhaust 25% by volume — pollution control is suddenly less expensive

- Smaller SO_2 scrubber, and other traditional emissions clean-up technologies
- Smaller ESP, for particulate removal
- Easier to capture mercury
- Enables new capture method, IPR (described later)

Ultra low NO_x — No Air — No Nitrogen

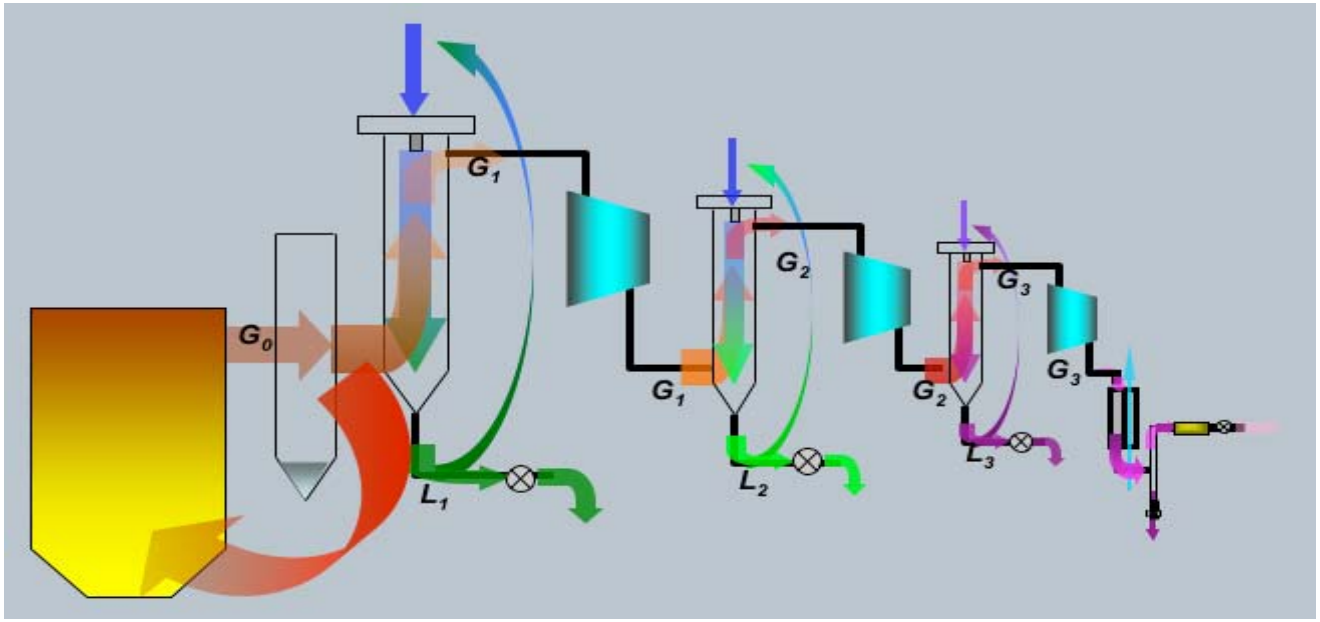
Low excess oxygen

Jupiter Oxygen's Solution

- Cost effective approach through concentrated CO_2 in greatly reduced flue gas volumes that enables effective CO_2 capture
- Reducing parasitic power losses associated with carbon capture
- Creates a practical approach for retrofits
- Represents a truly CO_2 capture ready strategy
- Lowers cost of emission reduction
- Efficiency increase for the boiler on the order of 5 to 12%, even on retrofit applications
- Decrease in fuel usage up to 16%
- Nitrous Oxides production of 0.088 lbs/mmbtu, without the need for back end technology, expectation for below 0.05
- Across the board reduction of all pollutants due to fuel reduction
- Lower cost and higher efficiency of running current back end equipment

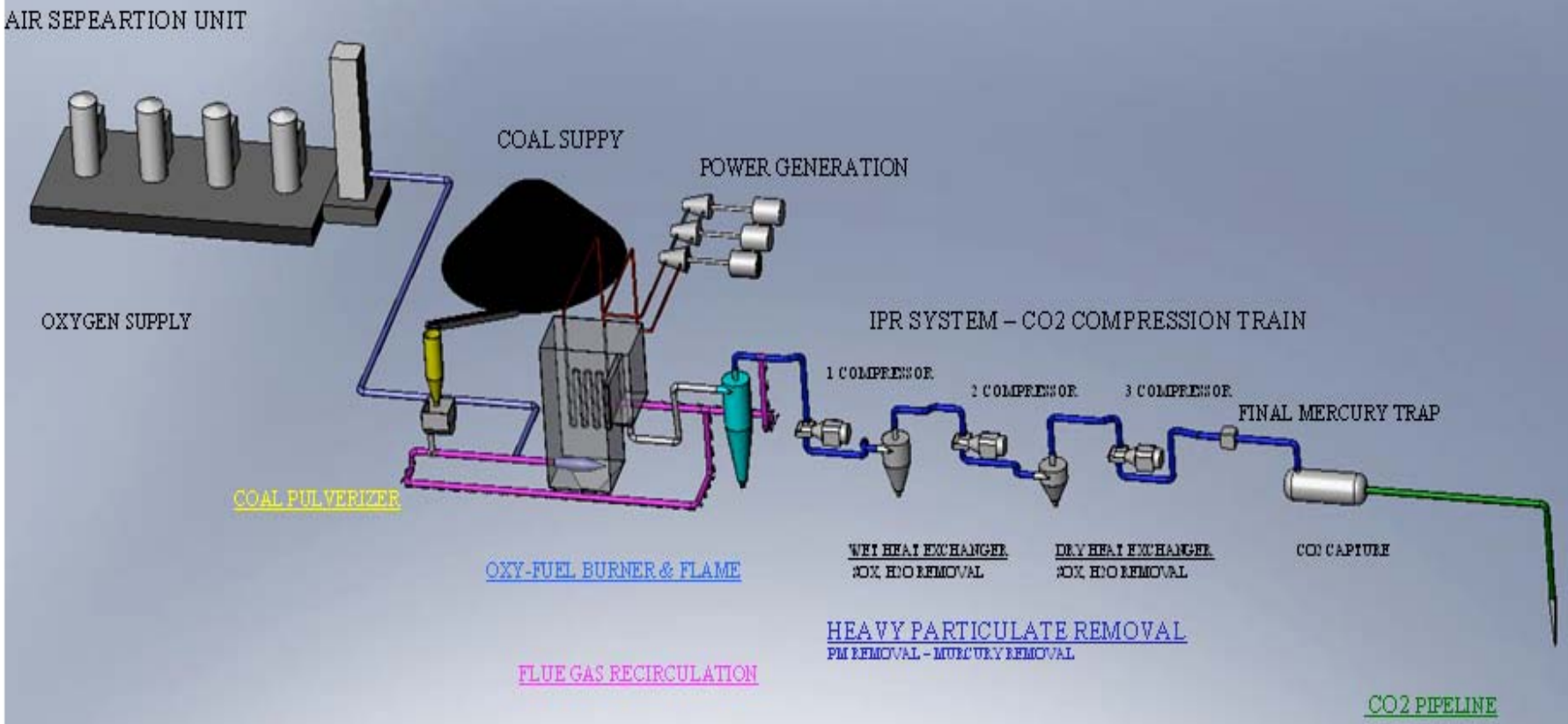
Integrated Pollutant Removal

- No need for NOx control technology
- Capture of more then 80% of the CO_2, at a pressure which shows at least 95% can be captured
- 60 to 90% mercury capture (range due to test measurement limitations)
- 99% sulfur removal
- 99% removal all particulates, with 80% removal of the small particles (PM 2.5)



JOC OXY-FUEL IPR* CLEAN COAL POWER GENERATION

*Integrated Pollutant Removal (IPR) System, NETL US DOE



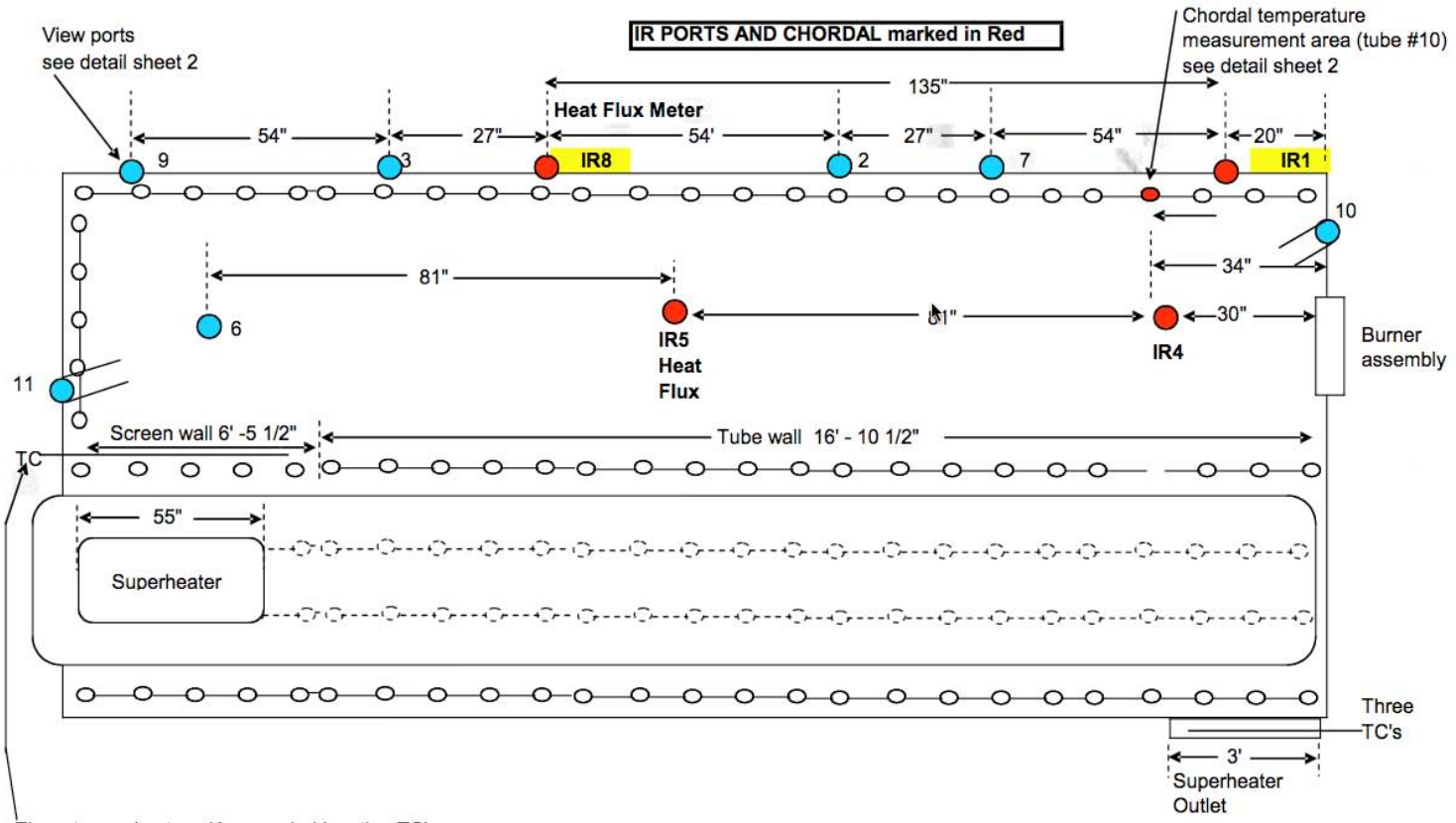
CO2 – UNDERGROUND STORAGE AND USE

- SPECIFIC GEOLOGICAL FORMATIONS
- ENHANCED OIL/NATURAL GAS RECOVERY

JUPITER OXYGEN CORPORATION

15 MWth Test Facility

15 MWth Boiler Plan View



Boiler Plan View

Economics

- **Potential fuel savings with Jupiter's process technology**
  - Means less oxygen
  - Means less fuel is needed
  - Less carbon dioxide created
    - Lower Operating and Capital Costs

- **Lower Excess Oxygen**
  - Again less production of oxygen
    - Less Cost
  - More pure carbon dioxide at the back end
    - Lowering cost

1. "Jupiter Oxygen Combustion Technology of Coal and Other Fossil Fuels In Boilers and Furnaces" by Gross, Schoenfield, Simmons and Patrick (2003)
2. "Integrated Pollutant Removal And Coal Oxy-Fuel Combustion: A Proven Path For Removal Of All Pollutants And CO2 In Power Generation" by Ochs, Oryshchyn, Summers, Gerdemann & Patrick (2006)

Pulverized Coal [new design] - Supercritical

Efficiency

- Efficiency [LHV in %]: 40
- Efficiency loss due to capture [LVH]: 7
- Capture efficiency [%]: 95

Electricity costs ($2005/MWh):

- Capture Plant: 41 to 52
- Reference Plant: 37 to 47

Investment costs (in $2005/kW):

- With capture: 1,400 to 1,950
- Without capture: 1,300 to 1,800

CO2 avoidance costs ($2005/t CO2): 6 to 22

CO2 emissions (kg/kWh)

- Capture plant: 0.042
- Reference plant: 0.708

Natural Gas [new design]

Efficiency

- Efficiency [LHV in %]: 48
- Efficiency loss due to capture [LVH]: 7
- Capture efficiency [%]: 95

Electricity costs ($2005/MWh):

- Capture Plant: 65 to 77
- Reference Plant: 57 to 70

Investment costs (in $2005/kW):

- With capture: 1,150 to 1,260
- Without capture: 560 to 690

CO2 avoidance costs ($2005/t CO2): 22 to 57

CO2 emissions (kg/kWh)

- Capture plant: 0.021
- Reference plant: 0.370

Pulverized Coal [retrofit]

Efficiency

- Efficiency [LHV in %]: 40
- Efficiency loss due to capture [LVH]: 7
- Capture efficiency [%]: 95

Electricity costs ($2005/MWh):

- Capture Plant: 52
- Reference Plant: 52

Investment costs (in $2005/kW):

- With capture: 1,600 to 2,100
- Without capture: 1,300 to 1,800

CO2 avoidance costs ($2005/t CO2): 0

CO2 emissions (kg/kWh)

- Capture plant: 0.036
- Reference plant: 0.715

Natural Gas [retrofit]

Efficiency

- Efficiency [LHV in %]: 40
- Efficiency loss due to capture [LVH]: 7
- Capture efficiency [%]: 95

Electricity costs ($2005/MWh):

- Capture Plant: 65
- Reference Plant: 57

Investment costs (in $2005/kW):

- With capture: 1,125
- Without capture: 560 to 690

CO2 avoidance costs ($2005/t CO2): 22 to 57

CO2 emissions (kg/kWh)

- Capture plant: 0.021
- Reference plant: 0.370

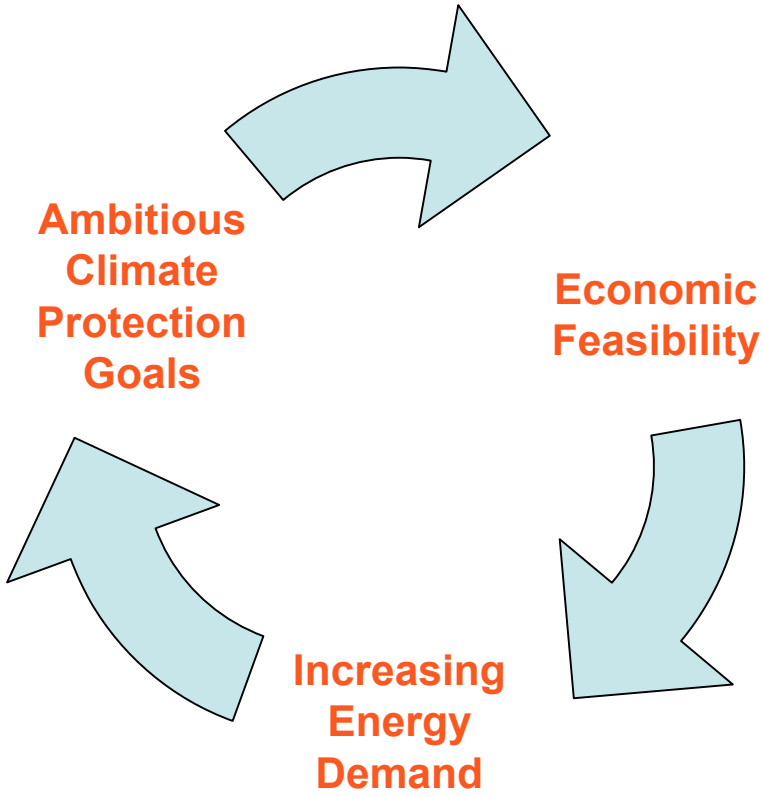
Conclusion and Outlook – Power Plants

- Technology transfer of oxy-fuel combustion to boilers for power plants and other steam applications have shown significant results for environmental improvements and open up pathways for ultra-low emission energy generating

- Jupiter's oxy-fuel combustion technology combined with the IPR-system are proven pathways to efficient CO_2 - capture and elimination of all key pollutants from the flue gas of fossil-fuel fired power plants

- The Asia-Pacific Partnership on Clean Development and Climate is analyzing and selecting industry's best practices, such as oxy-fuel combustion technology

Sustainable Technology Solutions



Sustainable Technology Solutions with a significant impact on greenhouse gas mitigation are needed specifically in fast emerging economies with high energy demands and the absence of carbon constrains.

Carbon Capture and Sequestration allows the use of fossil fuel with ultra low emissions

Jupiter Oxygen's Retrofit Technology enables effective carbon capture from existing power plants at reasonable costs

Keys for Carbon Capture Technology

Key for successful carbon capture technology development:

- Reduce parasitic power losses associated with carbon capture
- Use cost effective technology for carbon capture
- Create a practical approach for retrofits
- Design a truly CO_2 capture ready concept
- Create a market and an infrastructure for CO_2

India Opportunity: Oxy-fuel based Flagship Project

Showcase Pathway for Clean Fossil Power Generation in India

- **Demonstrate ultra low emissions from coal power plant sources**
- **Save significant amounts of water through reuse of condensed water from IPR system**
- **Improve local and regional environment and health**
- **Apply for CCS – Clean Development Mechanism Project**
- **Participate in World Bank's Carbon Partnership Facility**
- **Apply for innovative Climate Investment Fund**
- **Create options for commercial use of carbon captured, like**
    - Enhanced Coal Bed Methane Recovery
    - Enhanced Oil Recovery
    - Dry Ice Market

Financing Strategies for Clean Technology

There is a strong interest from The World Bank Group and other financing institutes to participate in break-through clean technology concepts and to support sustainable industry solutions!

Visionary Innovation ♦ Scientific Approach♦ Operational Experience

Jupiter Oxygen Corporation:

"Create Practical Technology Solutions That Are Result Orientated, i.e., Achieving Significant Net Reductions of CO_2 Emissions at Reasonable Costs"

Contact Information

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