JUPITER OXYGEN CORPORATION

Energy Efficiency Conference: Reducing Costs and Increasing Competitiveness Through Industrial Energy Efficiency

"Jupiter Oxygen's Best Practice Technology for Efficient Industrial Process Heating"

Thomas Weber, Executive Vice President

Istanbul, Turkey on June 4, 2010

Overview

I. Support Climate Protection Goals Through Energy Efficient Technology

II. Jupiter Oxygen Corporation: Integrated Clean Technology Solutions

III. High Flame Temperature Oxy-Combustion: Development & Achievements

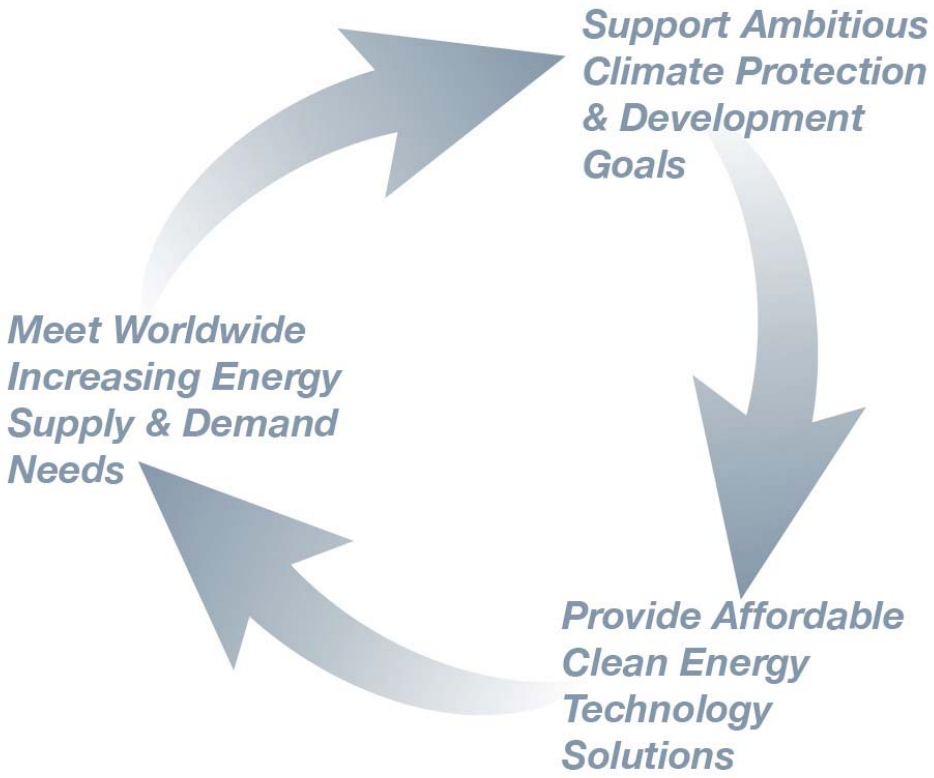
IV. Making it Pay: Economics from a U.S. Application / Deployment Barriers

V. Clean Technology Implementation and Deployment: Tax Incentives, Carbon Markets, Environmental Funds

VI. Sustainable Strategy: Carbon Capture & CO_2 Utilization from Power Plants

VII. Conclusion & Outlook

I. Support Climate Protection Goals:
Through Energy Efficient Technology



Support Climate Protection Goals (cont.):
Through Energy Efficient Technology

By revolutionizing combustion of fossil fuels based on Jupiter's unique oxy-combustion process, heat transfer effectiveness is maximized and energy efficiency is improved!

<u>The impressive results are two fold:</u>

(1) Significant energy efficiency gains and emission reductions in industrial furnaces for aluminum and steel production.

(2) An effective pathway to clean up major CO_2 emissions and key pollutants from existing and future fossil fuel power plants.

II.Jupiter Oxygen Corporation:
Integrated Clean Technology Solutions

- **U.S. based clean energy technology company**
- **Patented high flame temperature oxy-combustion process**
- **Oxy-combustion technology solutions**
- **Consulting services**
- **Licensing agreements**

Jupiter Oxygen Corporation (cont.):
Awards, Alliances, International Network

▶ **Innovative Star of Energy Efficiency Award 2008**

from the Alliance to Save Energy in Washington DC

▶ **Strategic Alliance India: JUPITER – ENCON ALLIANCE**

with ENCON Thermal Engineers, Faridabad near New Delhi

▶ **International Network and Engagement**

- Aluminum Association North America
- Asia Pacific Partnership on Clean Development and Climate
- Electric Power Research Institute [EPRI member since 2010]
- U.S. Business Council for Sustainable Energy [BCSE member since 2005]
- International Energy Agency, GHG R&D Programme [Oxy-fuel]
- United Nations Framework Convention on Climate Change UNFCCC

III. High Flame Temperature Oxy-Combustion:
Development & Achievements: Aluminum Re-melting

Dr. Subodh Das (SECAT, 2004):

… process heating and burners offer major energy saving opportunities (60% – 80%) in secondary aluminum industry plants…

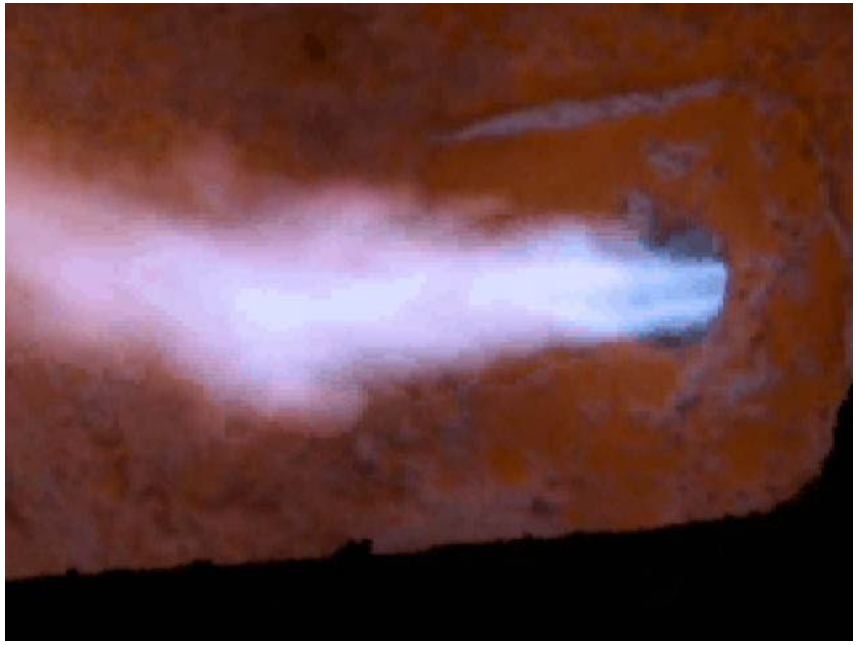
….in aluminum re-melting 925 Btu per pound are projected achievable versus 2,200 Btu per pound of U.S. average

… process heating consumes more than 70% to 85% of the total energy used for the secondary aluminum industry

High Flame Temperature Oxy-Combustion (cont.):
Development & Achievements: Aluminum Re-melting

Jupiter's technology is a…

- **patented process for the combustion of fossil fuels with nearly pure oxygen**
- **using a high flame temperature, but keeping the same process temperatures**
- **existing furnace materials can mostly be used and the same melting temperatures are maintained**



High Flame Temperature Oxy-Combustion (cont.):
Conventional air fired combustion vs oxy-combustion

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

- **Relatively low flame temperature [1,800 Degrees C]**

- **Readily available nitrogen to create NO_X**

- **Nitrogen increases the combustion volumes**

- **78% potent heat escapes through stack.**

High Flame Temperature Oxy-Combustion (cont.):
Development and Characteristics

1. **Higher Flame temperature; temperature exceeds 2,750 degrees C**
2. **Precision combustion & combustion control**
3. **Maximizing heat transfer effectiveness**
4. **Reduced fuel consumption**
5. **Even heat distribution**
6. **Exit gas volume reduction to one forth**
7. **CO_2 tenfold concentrated for efficient carbon capture**

High Flame Temperature Oxy-Combustion (cont.):
Conventional air fired combustion vs oxy-combustion

Concerns in the Aluminum Industry:

<u>Oxy-combustion will cause:</u>

- **Oxidation of metal**
- **Destruction of refractory material from high flame temperature**
- **Higher costs**

High Flame Temperature Oxy-Combustion (cont.):
Key findings in aluminum re-melt furnace applications

Key findings:

- **No change in furnace design and materials**
- **Fuel flexible**
- **Does not affect inclusions and impurities in re-melted aluminum**
- **No change in dross generation**

  - *For details see Technical Paper as presented at the Aluminum India 2010 conference in Mumbai, February 2010, see news / archives at www.jupiteroxygen.com*

High Flame Temperature Oxy-Combustion (cont.):
Achievements & Results: Aluminum Remelting

▶ Improved Energy Efficiency

- 750 to 900 Btu per pound
  [417 – 500 Kcal / Kg] for continuous runs
- Elimination of airborne nitrogen
- More radiant heat transfer
- Longer gas residence time

▶ Lower Fuel Costs

- Natural gas fuel reduction up to 73%
- Oil fuel usage reduction up to 68%

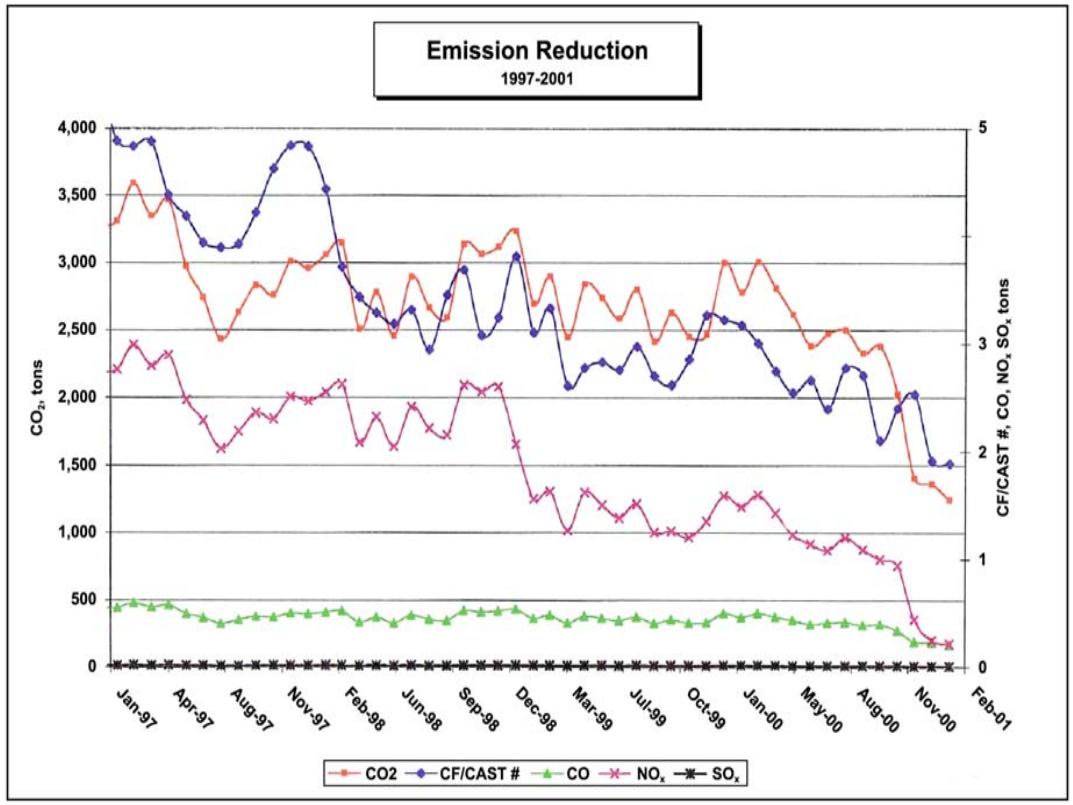
▶ Improved Production

- Increased melt rate

High Flame Temperature Oxy-Combustion (cont.):
Achievements & Results: Aluminum Remelting

Oxy-combustion technology implementation at US licensee

1997: 0%
1998: 27%
1999: 46%
2000: 54%
2001: 100%



Graph:
Documentation of results from furnace by furnace oxy-combustion technology implementation at U.S. licensee concerning reduction of fuel consumption [blue], CO_2 emissions [red] and NOx [purple]

High flame Temperature Oxy-combustion (cont.):
Further Applications

1. **Secondary Aluminum**

2. **Re-melting & Holding furnaces**

3. **Dross Recovery**

4. **Co Production**
   - Nitrogen
   - Argon

5. **Alumina Calcinations Processing**

6. **Steel Billet Reheating Furnaces**

7. **Power Generation**

IV. Making it Pay:
Favorable Economics from a U.S. Application

<u>Retrofit Industrial User 110,000 tons/a</u>

- **40MMBtu per hour fuel usage**
- **Capital investment US$ 5,000,000**
  - Cryogenic Plant [used] $3,500,000
  - Combustion System $1,500,000

- **320,000 MMBtu annual energy savings [$2,400,000*]**
- **$1,740,000 net**operational savings per year**
- **15,000 tons net CO_2 avoidance from fuel savings per year*****
- **Other revenue streams possible from using the nitrogen**
- **Payback time for investment two years based on fuel savings and other revenue streams**

*Natural gas S$7.50/MMBtu

**$660,000 electricity costs for O_2 production

***Based on SECAT paper

Making it Pay (cont.):
Barriers for Deployment

- **Moderate to low fossil fuel price**
- **Conservative industries to deal with**
- **Organizing oxygen supply, operating Air Separation Unit on-site**
- **Lack of incentives for energy efficient technology implementation**

V. Support: Clean Tech. Implementation and Deployment:
Through tax credits, carbon markets and environmental funds

Domestic Support:

- **Tax credits for energy efficient technology implementation**

International Support :

- **Streamline Joint Implementation and CDM processes**
- **Global Environment Facility funding for initial projects & capacity building**
- **Clean Technology Fund, including funding opportunities for innovation and first-of-its-kind technologies to set precedence cases**

VI. Sustain. Strat. - CO_2 Capture from Power Plants:
Through Energy Efficiency Gains in Boiler and CO_2 Utilization

▶ **Results from Jupiter Oxygen's test boiler at our US research center indicate 5% to 15% fuel efficiency gains in natural gas or coal fired boilers with high flame temperature oxy-combustion firing.**

▶ **Those efficiency gains in part 'offset' power losses that are associated with carbon capture from power plants.**

Sustain. Strat. - CO_2 Capture from Power Plants (cont.):
Through Energy Efficiency Gains in Boiler and CO_2 Utilization

- **Oxy-fuel represents a cost effective approach for CO_2 capture through concentrated CO_2 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 CO_2 capture.**

- **Our technology * is a practical approach for retrofits, applicable to the existing fossil fuel power plant fleet worldwide**

** In Cooperation with U.S. Department of Energy, National Energy Technology Laboratory ["Integrated Pollutant Removal system"]*

Sustain. Strat. - CO_2 Capture from Power Plants (cont.):
Through Energy Efficiency Gains in Boiler and CO_2 Utilization

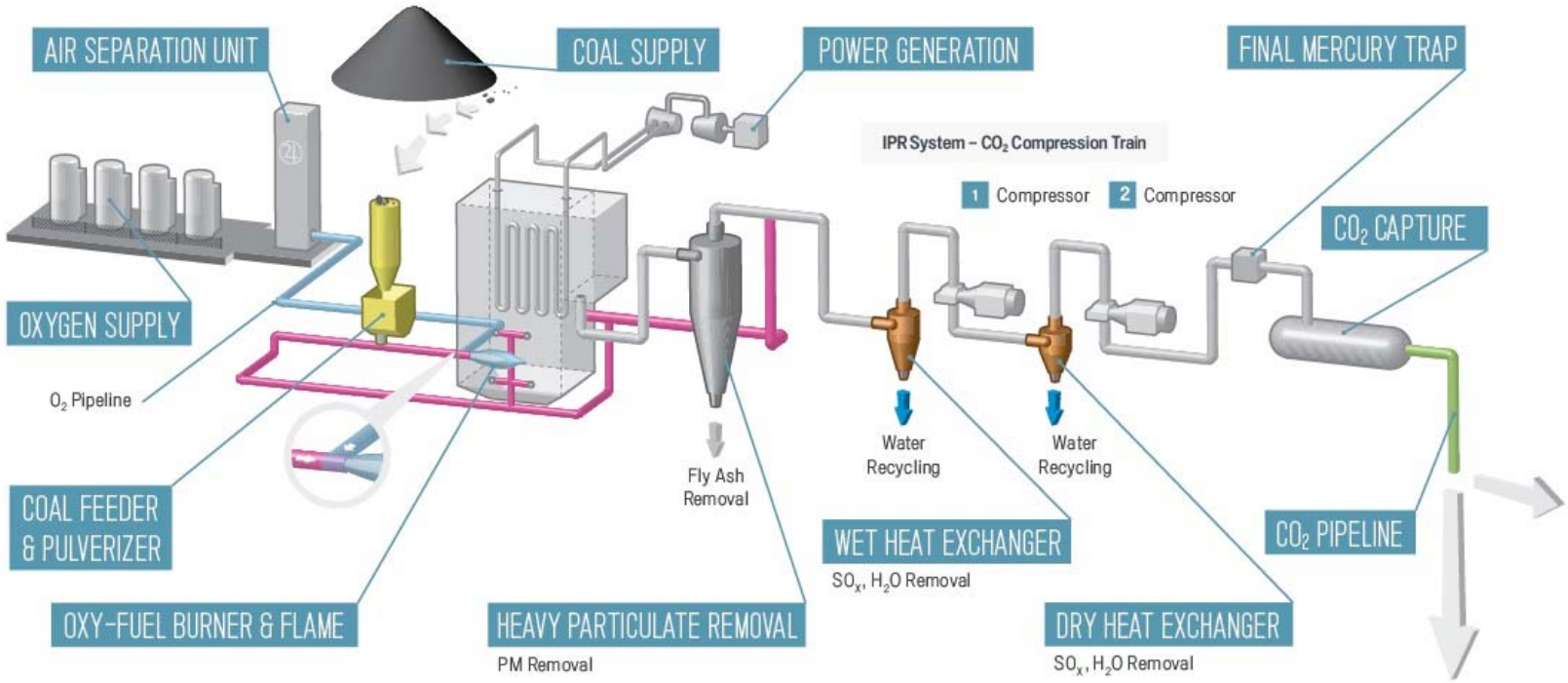
Jupiter Oxygen in cooperation the U.S. Department of Energy's National Energy Technology Laboratory developed an integrated system based on high flame temperature oxy-combustion process, with a carbon capture train and integrated pollutant removal system. Results are:

- 95%+ carbon capture, low NOx, elimination of SOx, PM and mercury
- Significant amounts of water saved through reuse of condensed water
- Heat recovery implemented in Integrated Pollutant Removal system

Create options for commercial use of carbon captured, like

- Enhanced Oil Recovery [EOR], Enhanced Coal Bed Methane Recovery [ECBM]
- Algae production & Bio fuels, Submarine Extraction of Methane from Hydrate
- Food grade quality [CO_2 for beverages]

Energy Efficiency Gains in Boilers:
Key to Affordable Carbon Capture from Power Plants



CO_2 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

VII. Conclusion and Outlook:
Industrial Furnaces

- **High flame temperature oxy-combustion technology has a proven record of fuel efficiency, CO_2 emission reduction, and low NOx.**
- **High potential for multiple applications in industrial process heating**
- **Cost savings from efficiency gains, increased melt rate and multiple use of the air separation unit can realize a favorable pay back on investment**
- **Technology is relevant for Joint Implementation / CDM projects and for environmental funds**
- **Capacity building is needed for energy efficient technology implementation in Economies in Transition and Developing Nations**

Conclusion and Outlook (cont.):
Power Plants

- **Jupiter Oxygen technology, when applied to coal or natural gas fired power plants, provides efficiency gains in the boiler and is the pathway for cost effective carbon capture and CO_2 utilization**

- **Our sustainable strategy to retrofit coal fired power plants is addressing energy efficiency, CO_2 capture, key pollutant control, heat recovery and water reuse in an integrated system economically**

- **Clean Technology Funds should support Carbon Capture and CO_2 Utilization projects in Developing Nations and Economies in Transition**

- **The UNFCCC should acknowledge and support efforts concerning industrial carbon capture and CO_2 utilization project developments**

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