

# CEFCO

## GLOBAL CLEAN ENERGY, LLC

Presentation at: Utility MACT Webinar 2010

Robert Tang

September 2010



# About CEFCO

## The CEFCO Process:

- integrates established and patented technologies
- accomplishes *virtually complete capture of flue gas emission pollutants, including CO<sub>2</sub>*

The CEFCO Process will enable MACT compliance by fossil-fueled emissions sources:

- new and retrofitting existing coal-fired power plants
- petroleum refineries
- petro-chemical plants
- cement and lime plants
- industrial and municipal incineration facilities
- pulp and paper and other industrial applications

# Key Issues to be Addressed

1. If the CEFCO Technology is so good, then why haven't we heard about it before now?
2. Why does the CEFCO Technology consume so little "energy penalty" or "parasitic load"?
3. How does the Technology work? What are its major advantages?
4. Where can I obtain a user license for the CEFCO Process?

# Power Engineering Article 1:

## “Supersonic Emissions Control”

January 2009 issue



**POWER Engineering** Previous Page | Contents | Zoom in | Zoom out | First Page | Search Issue | Next Page |

### Braden Systems for Gas Turbines

For over 40 years, Braden has designed, engineered and manufactured hundreds of GT auxiliary systems as the preferred supplier for leading OEMs.

**Comprehensive Retrofit Solutions**  
Braden's full range of engine (structural, mechanical, electrical and mechanical) services every aspect of your retrofit design. Braden also provides complete intake and exhaust systems.

- Air Filtration
- Water Cooling/Heating
- Lubrication
- Exhaust & Inlet
- Detachment
- Flexible Dampers
- Expansion Joints
- Dynamic Brakes
- Diffusers and Flanges
- Insulation
- Inspection and Repair Services

**BRADEN MANUFACTURING, LLC**  
A Division of Emerson Industrial Automation  
500 N. 10th St. • Suite 200 • Waukegan, IL 60087 USA  
Tel: 815.251.1000 • Fax: 815.251.0004  
Email: sales@braden.com  
www.braden.com | emerson.com/braden  
For info: [US] 800.222.5638 | [UK] 01243 822111

**Supersonic Emissions Control**  
A synthesis of chemistry and physics might revolutionize emissions from coal-fired and natural gas-fired (CCNG) power plants, efficiently reducing their carbon output while producing cleaner energy for the power generation of tomorrow. The technology has evolved from an experimental curiosity and engineering challenge to a commercial reality that the world has been eagerly awaiting for some time.

The group of physicists and engineers with backgrounds in aerospace science and aerodynamics has leveraged the modeling technology they possess to create a reactor designed to match their own patterns with other engines that their chemical engineering colleagues have developed. The process remains virtually pollution-free and requires minimal down cost when tested. The conversion between the process and other pollution-reducing technologies is a matter of engineering, meaning the process can become a profit center instead of a cost center.

Problems that can be ignored in high concentrations include factors, reactions, diffusion, reaction, absorption, precipitation, evaporation, condensation, and so on. In the process, the primary concern is to remove solid combustion emissions of SO<sub>2</sub>, SO<sub>3</sub>, and moisture at levels above 99 percent. Development includes the process engineering, chemical design, high performance materials, flow control, and cost-effective operation and maintenance.

Key to the process is atomization, physics, which enables and accelerates the chemical reaction. The process uses a flow of steam or nitrogen within a jet velocity flow entering the gas. Accelerating the steam allows rapid droplet sizes that they merge into a supersonic shock wave system. When the droplets contact the supersonic shock wave, they shatter into extremely small droplets and evaporate before being compressed molecules in the jet gas they contain. After reflecting into spherical shapes, they are then

**POWER Engineering** Previous Page | Contents | Zoom in | Zoom out | First Page | Search Issue | Next Page |

**POWER Engineering** Previous Page | Contents | Zoom in | Zoom out | First Page | Search Issue | Next Page |

### Inc. RACE BY BITS

operating systems  
security  
or  
range of hardware  
networks  
in the  
USA  
search.com

commented by the shock wave at high speed so as to flow radially inward forming a vortex ring that forces the combustion gas and the fuel liquid droplets to pass through the atomic nozzle.

Further conditions within the nozzle are air filter droplets containing the sub-micron particulates and oxides to give rigidity. This is because these molecules cause multiple collisions, impurities, reactions, evaporation and further condensation. Such a condition of rapid droplet pressure and temperature increases an "expansion" reaction, which allows extremely slow contact and mixing of the molecules with each other and promotes the reaction that breaks down liquid molecules. The droplets quickly grow large enough to be easily separated from the effluent gas stream. Separation of the product-containing liquid from the remainder of the flow is performed by an atomization process in the system.

**CEFCO - Solution for Clean Energy Goals** - How do you reduce carbon dioxide emissions from the process?

"Clean technologies for carbon capture and sequestration (CCS) and air quality control systems (AQCS) are demanded by international chemistry and (de)carbonization," said Dagling. "The mission statement of CEFCO is to reduce CO<sub>2</sub> emissions from power plants. Current technology requires high cost energy input and the use of chemical processes are slow to use or more costly than processes. And they often require large amounts to make one or more chemical reactions produce specific results."

"By reducing the high performance chemical production reactions that companies are involved in," said Dagling. "The mission statement of CEFCO is to reduce CO<sub>2</sub> emissions from power plants. Current technology requires high cost energy input and the use of chemical processes are slow to use or more costly than processes. And they often require large amounts to make one or more chemical reactions produce specific results."

While developers of the CEFCO process emphasize its ability to efficiently remove pollutants in power generation, CO<sub>2</sub> and nitrogen are not the main focus. Dagling said the same technology can be used to remove other emissions. It is also used for CO<sub>2</sub>. "The only difference is a small number of steps before the process and the exact chemical agents used," he said. Conventional systems would not be used. Furthermore, the speed and flexibility of the system would be a function of current conventional design, because all of the high performance chemical reactions "break down" which designed to be less than 100 percent in the level of the gas turbine the chemical processes in the Reactor.

A process engineer's independent evaluation is to be before the CEFCO process could make many products that are not only using and cheap. The process engineer plans to make the system design to use the gas emissions source from up to 300 MW. The technology will allow combining units in multiple parallel systems to remove existing gas or from new power plants of up to 300 MW. This plant of 300 MW or 300 MW could be located in the United States.

The main challenge is to combine several known technologies into a fully integrated system for high performance engineering and carbon capture. A small-scale pilot unit facility capable of processing 100 or 200 tonnes of the gas to use would be a demonstration practical application - from

**Business Briefs**  
Braden also signed a contract with the Swiss Club registered in Zurich. Claims to build machines, which are not only used in the United States but in Zurich.

**Business Briefs**  
Business Briefs Management and Fleet Corp. will invest directly and use the process to improve engineering and reduction of capital costs. It is a Black professional services and related supplier, located

**POWER Engineering** Previous Page | Contents | Zoom in | Zoom out | First Page | Search Issue | Next Page |

# Power Engineering Article 2:

Power Engineering - Patent rights will soon be available for novel emission control process... <http://pe.articles.printthis.com/pe/action-epkbbide-Powe...>



[Click to Print](#) [SAVE THIS](#) [EMAIL THIS](#) [Close](#)

**August 11, 2009**

**Patent rights will soon be available for novel emission control process**

By Steve Blankinship, Associated Editor, Power Engineering magazine

Patent rights are expected to be available soon for an emission control process that developers believe could deliver a scientific breakthrough in the selective capture of flue gas pollutants, including pure CO<sub>2</sub>, as a captured and saleable product, and the subsequent conversion of sequestered pollutants into high-grade saleable end-products. Developers, including CEFCO Chairman Don DeGing, believe that when commercialized, it could become a game-changer in the current climate change debate.

CEFCO, the technology's developer, expects the patent to be eligible for issue any time between 2011 and 2013. As detailed in the January 2009 Issue of Power Engineering, the CEFCO Process combines the best of two proven technologies from non-related fields of use.

One portion of the technology, the patented Cooper Process, removes and recovers nitrogen and sulfur oxides from power plant combustion gases and chemically converts them into sulfates and nitrates that can be used as fertilizers. It also removes CO<sub>2</sub> in a bicarbonate-carbonate solution from which pure CO<sub>2</sub> is released that can be made into a range of valuable products, such as bio-diesel fuel feedstock, ethylene dichloride, and PVC plastic. It can also be sequestered or used for enhanced oil recovery.

The steam propelled Free Jet Systems (also referred to as the "HGS" or "Free Jet Collision" scrubber in U.S. Department of Energy and Environmental Protection Agency literature) have been recognized by the EPA for many years and have become a standard component of Maximum Achievable Control Technology (MACT). Their reliability, effectiveness and performance are proven and this aerodynamic technology is the enabling technology for the CEFCO process. The Twin MACT technology comprises a series of issued patents in which fine particulate is captured by encapsulating or entraining the particulate in small droplets and thereafter causing the droplets to grow in size until they can readily be separated from the flue gas in accordance with aerodynamic collecting, flow detachment and separation principles.

The Twin aerodynamic gas cleaning technology has been in continuous use by the DOE for more than 25 years at all Nuclear Regulatory Commission (NRC) facilities for handling and treating the incineration of radioactive wastes, acidic, toxic and hazardous off-gases. At the NRC, its applications have been used by specialized technology contractors: Westinghouse, DuPont, Union Carbide, General Electric, Lockheed Martin, URS, Washington Group, Sactral and Battelle.

The two predecessor technologies have been independently patented, developed, and available for industrial application for years. Their respective earlier separate inventors have joined CEFCO as co-inventors and shareholders. CEFCO has successfully combined and integrated the best features of both technologies and has applied for patent under new invention procedures. CEFCO has received the Preliminary International Report on Patentability issued by the EPO/PCT patent examining authorities in July 2009.

Find this article at:  
<http://pe.articles.printthis.com/action-epkbbide-Powe...>

[Click to Print](#) [SAVE THIS](#) [EMAIL THIS](#) [Close](#)

Check the box to include the list of links referenced in the article.



Copyright © Power Engineering

*“Patent Rights Will Soon be Available for Novel Emission Control Process”*

11 August 2009

# CEFCO Co-Founders and Co-Inventors



*“We use **physics** first...then **chemistry!**”*

**Thomas K. Ewan (1918 – 2009)**  
***Aerophysics Technology Advisor  
and Co-Inventor***

Tom Ewan had served as a Technology Advisor to the Company until his passing, at age 91, in June 2009. Ewan, a Physicist, retired as Chief of Operations and Administration of the National Ordnance Aerophysics Laboratory of the DOD (Combined USAF, USN, USA, NASA: Aerodynamic Designs for Missiles, Air Frames, NASA Shuttles, etc.), and headed the Executive Committee of the Guided Missile Program of the National Research Laboratory, DOD. Ewan received a B.S. in Physics from the College of William & Mary. He co-authored and published “The Glossary of Guided Missile Terms” that was used by the Department of Defense. Ewan held several issued and deployed patents, including that for the “Free Jet” collision scrubbers, which have been in continuous use at Nuclear Regulatory Commission facilities for the handling and treatment of radioactive incineration off-gases, and toxic and acidic gases emissions. His technology has been recognized by the EPA as a standard component of the Hazardous Waste Combustors (“HWC”) Maximum Achievable Control Technology (“MACT”) for air emissions elimination.

# CEFCO Co-Founders and Co-Inventors



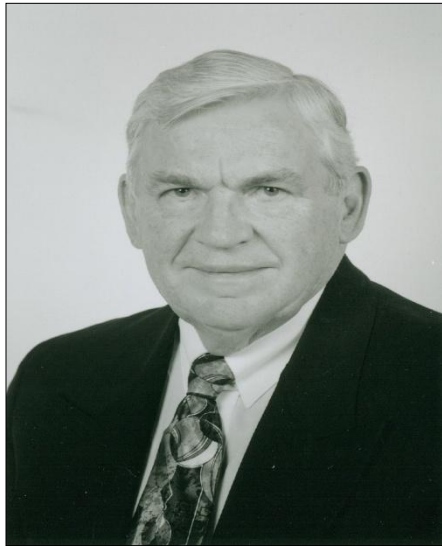
*"A pollutant is only a misplaced but very **recoverable** and **valuable** resource."*

**Hal B.H. Cooper**  
***Chemical Engineering Advisor***  
***and Co-Inventor***

Hal Cooper serves as the Chief Chemical Science Officer of the Company and is a co-inventor. Cooper was a Professor of Civil Engineering and Environmental Engineering for eight years at the University of Texas at Austin and for two years at Texas A&M University. He taught courses on gaseous and particulate emission control, air quality chemistry and meteorology as well as on energy technologies and systems. He was active in various programs related to air pollution and air emissions control for the power industry and in the study of alternative energy technologies. Cooper received his Ph. D. in Civil Engineering in Environmental Engineering from the University of Washington in 1972, his M.S. in Civil Engineering in Environmental Engineering in 1966 from the University of Washington, and his B.S. in Chemical Engineering in 1963 from the University of California at Berkeley. He is a registered professional engineer. Cooper also worked as Sr. Consulting Engineer at Brown & Caldwell, ICF-Kaiser and Stone & Webster prior to co-founding the Company in 2006. He is an inventor with several issued patents. His motto is: "A pollutant is nothing but a misplaced, very valuable and recoverable resource".



# CEFCO Co-Founders and Co-Inventors



**Donald E. Degling**  
***Chairman and Co-Inventor***

Don Degling serves as Chairman and is a co-inventor. Degling has collaborated with Tom Ewan for over forty years in the development of the Ewan aerodynamic processes and his nozzle technology and had filed and prosecuted numerous patents for Tom Ewan. Degling is a retired Intellectual Property Attorney and Senior Partner in the law firm of Fish & Neave (now Ropes & Gray). He received a B.S. in Mechanical Engineering from Cornell University in 1949 and a LL.B/J.D. also from Cornell University in 1952. Degling is an expert in the area of patent, trademark and copyright application, prosecution and litigation throughout the steel, mineral processing, chemical, oil and gas industry, equipment and aircraft engines industries. Degling is the trustee of the Ewan I.P. Estate.



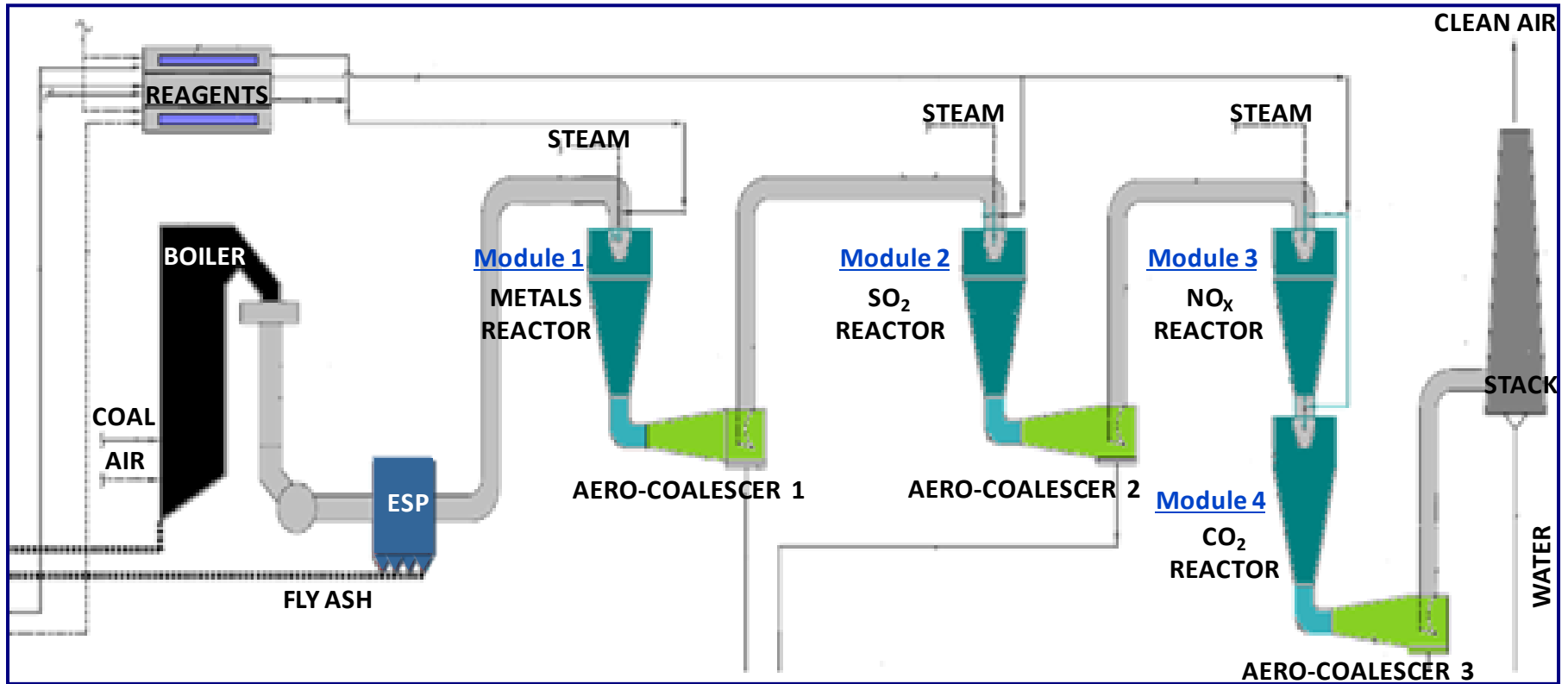
# CEFCO Co-Founders and Co-Inventors



**Robert E. Tang**  
***President and CEO and Co-Inventor***

Robert Tang is currently the Chief Executive Officer of CEFCO Global Clean Energy, LLC and is a co-inventor. He also serves on the Board of Directors of two major specialty engineering and construction companies, one of which has great emphasis and experience in the utility power industry and air pollution control (AQCS) industry, and the other is in the petro-chemical and refining industry. Tang received his B.A. from Columbia University in 1971 and two additional graduate degrees from Oxford University in England in 1973 and 1979. In late-2006, Tang invited the Ewan group of inventors to team with Hal Cooper to create the subject patent-pending CEFCO Technology, and led all the co-inventors altogether to co-found the Company by uniting the patented Ewan technology with the patented Cooper Process into an integrated system under new patenting procedure.

# CEFCO Process Modules

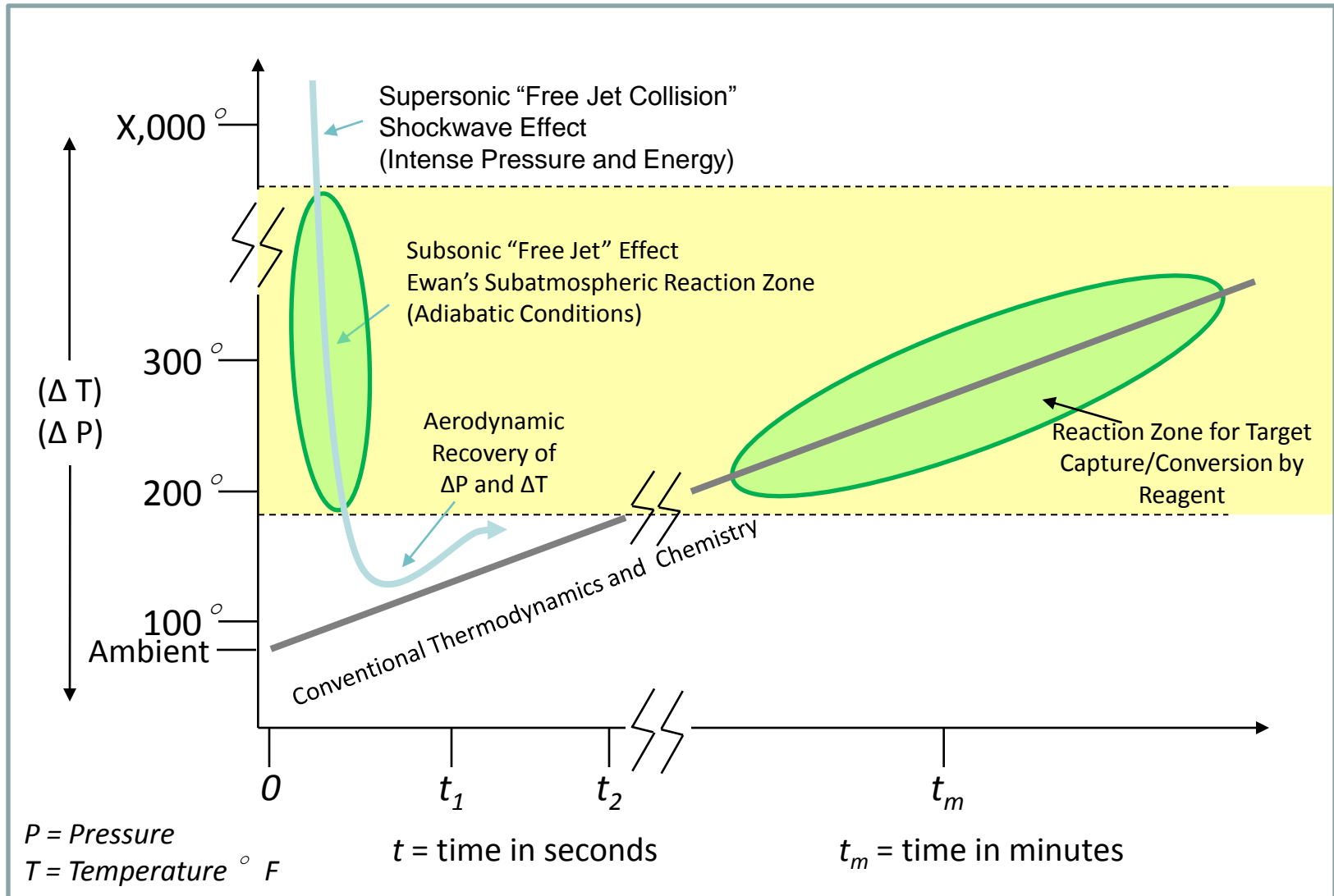


CEFCO uses a comprehensive re-circulating and re-generating system that optimizes the conservation of water, energy and all required inputs.

Recovered Metals

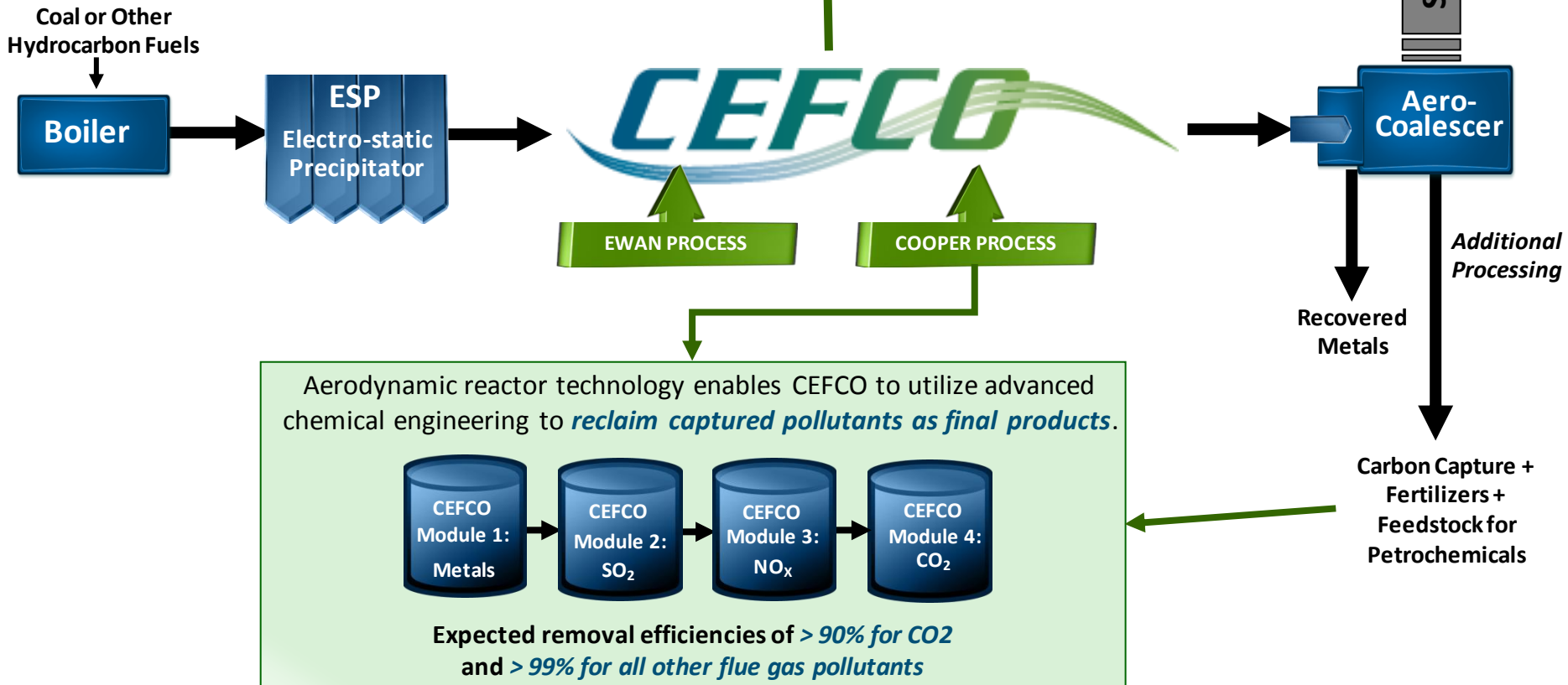
CO<sub>2</sub> + Fertilizers & Petrochemicals

# Comparison of Parasitic Load and Energy Penalty




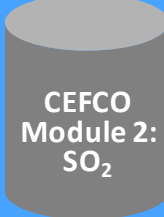
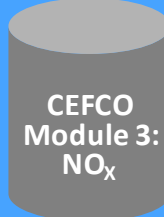
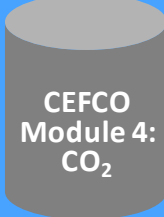
# The CEFCO Process

The *key distinguishing value* of The CEFCO Process is the *integration of two proven, patented technologies*, the Ewan and Cooper Processes, to produce a sequenced, selective and virtually complete removal of pollutants, including metals, SO<sub>2</sub>, NO<sub>x</sub>, and CO<sub>2</sub>.



# Recovery and End-Products

Sequenced modules selectively capture pure products from pollutants.

				
<b>Final Products</b>	<p><b>Metal Compounds (Mercury + Trace Metals)</b></p> <p><b>Fine Particulates (&lt; 2.0 Microns)</b></p>	<p><b>Potassium Sulfate (Fertilizer)</b></p>	<p><b>Potassium Nitrate (Fertilizer)</b></p>	<p><b>Pure CO<sub>2</sub></b></p>
<b>Potential Revenue Streams</b>	<ul style="list-style-type: none"> <li>• Metals Market</li> <li>• Alloy-Steel Users</li> <li>• Industrial Market</li> <li>• Trace Metals for Hi-Tech Electronics Users</li> <li>• Catalysts and Additives for Refining &amp; Petrochemical Markets</li> </ul>	<ul style="list-style-type: none"> <li>• Fertilizers &amp; Agricultural Applications</li> <li>• Industrial Market</li> <li>• Feedstock for Petrochemical Market</li> </ul>	<ul style="list-style-type: none"> <li>• Fertilizers &amp; Agricultural Applications</li> <li>• Industrial Market</li> <li>• Feedstock for Petrochemical Market</li> </ul>	<ul style="list-style-type: none"> <li>• Enhanced Oil Recovery</li> <li>• Sequestration Market</li> <li>• Carbon Credit</li> <li>• Methanol, Ethanol &amp; Diesel Fuels</li> </ul>

# The CEFCO Advantage: Faster and Cheaper

CEFCO technology is more compact, more efficient, and results in significantly lower costs:

COST CONSIDERATIONS FOR A TYPICAL 1,000 MW PLANT FOR ALL POLLUTANTS AND CO <sub>2</sub> CAPTURE MODULES		
	Current AQCS Technology*	CEFCO
<b>Capital Cost</b>	<ul style="list-style-type: none"> <li>Multiple pollutant-specific technologies required</li> <li>Est. CAPEX ~\$1.5 to \$2.0B;</li> <li>Equipment size equivalent to 5+ basketball stadiums</li> </ul>	<ul style="list-style-type: none"> <li>Single integrated technology to treat all pollutants and CO<sub>2</sub></li> <li>50% less CAPEX</li> <li>75% less space (~150ft in length), stackable / modular configurations</li> </ul>
<b>Operating Cost</b>	<ul style="list-style-type: none"> <li>Significant energy required for pollutant capture &amp; recovery</li> <li>Total system shutdown required for periodic maintenance and repair</li> </ul>	<ul style="list-style-type: none"> <li>Utilizes spent steam and re-circulating reagents for increased efficiency and cost-savings</li> <li>No downtime for maintenance with parallel modules</li> </ul>
<b>Parasitic Load</b>	<ul style="list-style-type: none"> <li>30%-60%</li> <li>Efficiency degrades over operational use and time</li> </ul>	<ul style="list-style-type: none"> <li>&lt; 10%</li> <li>Maintains high efficiency throughout</li> </ul>

\*Current AQCS Technology refers to all technologies in the marketplace from many sources

# The CEFCO Advantage: Safer

CEFCO removes CO<sub>2</sub> and all toxins from flue gas to create a cleaner and healthier environment, as well as products that are safe and free from contamination:

<b>BYPRODUCTS FROM AIR POLLUTANTS</b>		
	<b>Current AQCS Technology*</b>	<b>CEFCO</b>
<b>Metals &amp; Mercury</b>	Contaminated Sludge	Stable metals for mineral refining and metal processing
<b>Fine Particulates (&lt; 2.0 microns)</b>	Cannot capture	Captures
<b>SO<sub>2</sub> &amp; NO<sub>x</sub></b>	Low-valued Gypsum, hazardous Ammonium Fertilizers	Valuable and desirable Potassium-based Fertilizers
<b>CO<sub>2</sub></b>	CO <sub>2</sub> in hazardous Ammonium Solution	Pure CO <sub>2</sub> gas (sellable), Fuel & Petrochemical Feedstock, Algae production, Sequestration, EOR

*\*Current AQCS Technology refers to all technologies in the marketplace from many sources*



# Upcoming Market Segments

CEFCO is looking for experienced and qualified engineering product or service providers to become authorized distributors in the following market segments (or distribution channels) for Clients who are subject to:

- Utility MACT Compliance
- Boiler MACT Compliance
- Cement MACT Compliance
- HWC MACT Compliance

**CECO has already appointed licensed distributorship for the Cement and Lime Industries in USA, Canada, and Mexico.**

Please visit our Website at: [www.cefcoglobal.com](http://www.cefcoglobal.com)

Email: [robert.tang@cefcoglobal.com](mailto:robert.tang@cefcoglobal.com)