

# Advanced Clean Energy Laboratory



## Developing combustion solutions for tomorrow

Our world demands better use of energy resources. For industries striving toward energy efficiency and environmental stewardship, advanced combustion technologies and alternative fuels offer unique possibilities for cost reduction, productivity and sustainability.

Air Products understands these challenges. For over 50 years, we have been developing innovative oxygen-based combustion technologies to help customers improve productivity, reduce energy consumption, reduce emissions and increase the use of alternative fuels.

Our patented and/or proprietary burners and combustion technologies have been successfully customized to fit the needs of customers in diverse industrial operations such as glass melting, iron and steel production, smelting furnaces, cement and lime kilns, and power boilers.

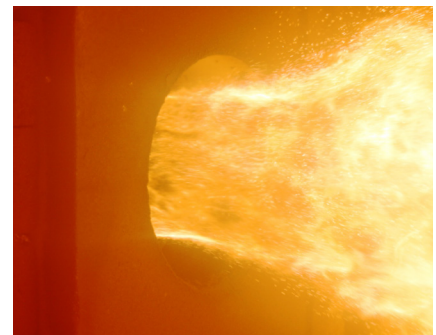
Our time-tested approach to success is simple: Unite top talents, including combustion technologists, industry experts and modeling specialists, and provide them with state-of-the-art resources to encourage and enable innovation.

There is of course one more ingredient to Air Products' success in oxy-fuel combustion: Our people never stop striving to improve. And this is why, after operating some of the most advanced oxy-fuel combustion laboratories in the world, we are so proud to tell you about our newest, largest and most advanced energy conversion facility.

## A world-class demonstration facility

Commissioned in 2010 at Air Products' headquarters in Allentown, Pa., the Clean Energy Laboratory is a state-of-the-art, multi-fuel, 20 MM Btu/hr combustion and gasification pilot-scale facility.

The facility can accommodate a full spectrum of gaseous, liquid and solid fuels of commercial interest (see Table 1) using oxidizers ranging from air to 100% oxygen. The lab facilitates development and full-scale testing of actual combustion and gasification systems using fuels from customers. It also enables direct demonstration of the advantages of oxygen-enhanced combustion over conventional air-fuel combustion in high-temperature processes. Moreover, our comprehensive line of combustion analyzers allows for precise measurements of emissions



Real-time tests can be viewed through remote video cameras and the Internet.



State-of-the-art instrumentation and process control capabilities enable you to test your application to its full potential.

such as NO<sub>x</sub>, SO<sub>x</sub>, CO, CO<sub>2</sub>, and particulates. Also, in-flame spectral analyzers can simultaneously assess critical flame properties needed to adapt our technology to a wide variety of industrial furnaces.

## Virtual participation from around the globe

You need to make sure new products and technologies will work for your application prior to making an investment. The Clean Energy Laboratory features a powerful remote video imaging system. In nearly all locations around the world, you will be able to participate in live, virtual demonstrations and data sharing over the Internet.

Moreover, with testing conditions representative of your own process, you can quickly assess the performance of your combustion application in a controlled environment. And we'll be able to better meet your process needs.

## Combustion modeling and process control

To provide you with a deeper insight into your application, we continuously develop advanced computational fluid dynamics (CFD) models for our combustion and gasification technologies. Once validated in the Clean Energy Lab, they provide you with a vision into the process which surpasses that from measurements alone.

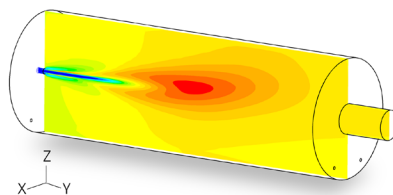
Moreover, our dynamically optimized oxy-fuel control systems allow us to consistently achieve the highest performance from our technologies while safely integrating them into your processes.

## Our emphasis on safety

At Air Products, nothing is more important than safety — not sales, not production, not profits. It is a commitment we all share and one that we share with our customers. The pilot facility, located in the heart of our corporate headquarters, offers proof that we believe in and stand behind the safety of our combustion technologies, which we design and operate to the highest safety standards on a worldwide scale. Furthermore, we are consistently among the leaders in industrial gas safety performance and top performers of the Chemical Manufacturers Association's Responsible Care® program.

## About Air Products

Air Products serves customers worldwide with a unique portfolio of atmospheric gases, process and specialty gases, performance materials, and equipment and services. Founded in 1940, we are recognized for our innovative culture, operational excellence and commitment to safety and the environment.



Our advanced computational models can let you see inside your combustion application.

Table 1

### Facility parameters

Furnace Size: 8 ft in diameter (2.4 m), 30 ft in length (9.1 m)
Oxygen Enrichment: air-fuel to full oxy-fuel
Firing Range: 0–20 MM Btu/hr (5.9 MW)
Process Temperature: up to 3,000 °F (1,600 °C)
Gaseous Fuels: natural gas, hydrogen, synthesis gas
Liquid Fuels: light to heavy fuel oils, bio-liquids
Solid Fuels: coal, petroleum coke, biomass, solid wastes

### Features

Air preheating to 1,000 °F (500 °C)
Automated controls
Thermal and process gas measurements
Remote video imaging

### Benefits

Industrial scale testing
Multi-fuel firing capability
Air-fuel to full oxy-fuel combustion and gasification
Advanced data acquisition
Live, remote participation in testing via online video and data sharing

For more information, please contact us at:

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