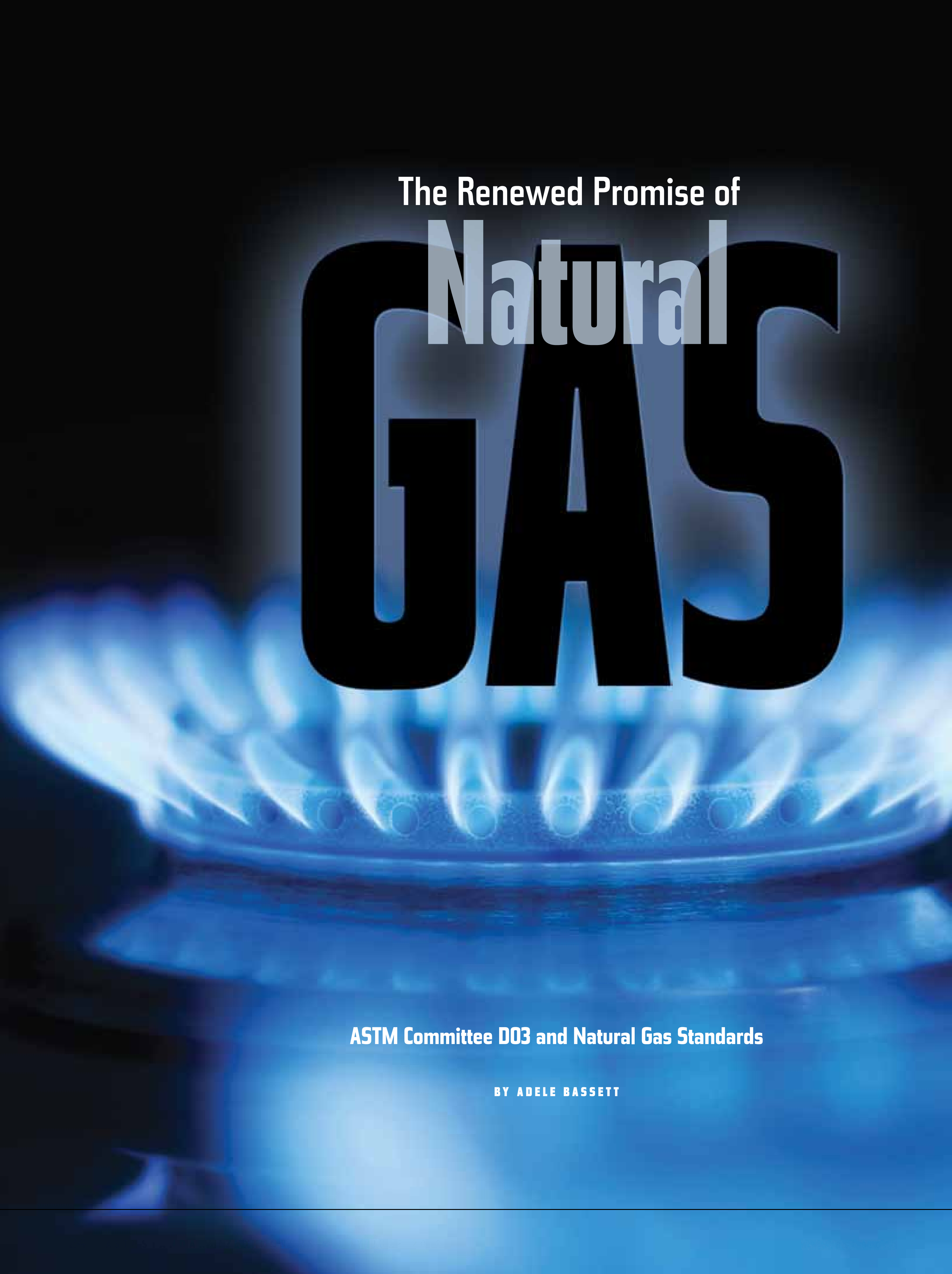
The Renewed Promise of Natural GAS



ASTM Committee D03 and Natural Gas Standards

BY ADELE BASSETT

An increased interest in natural gas in the United States and its potential as a domestic energy source that burns more cleanly than other fuels could lead to new standards work in an ASTM International committee.

When the ancient Greeks saw flames escaping from the earth, they considered them of divine origin and built a temple on the site for the Oracle of Delphi. Ironically, the combustible fuel we now recognize as natural gas is reclaiming some of its heaven-sent reputation, but for different reasons.

Natural gas is primarily methane, or CH_4, a colorless, odorless gas formed from organic particles covered and compressed by layers of sediment and debris, and combined with high temperatures deep within the earth. Natural gas can also be formed as biogenic methane — such as landfill gas — when tiny microorganisms, found near the surface of the earth and in the intestines of animals, break down organic matter.

Partly due to its abundance, plus new exploration and recovery techniques, natural gas is being hailed as a plentiful U.S. energy source, a solution to national energy security concerns, a potential remedy for climate change, a renewable biogas, a valuable feedstock for electrical power generation and a bridge to future energy sources.

For the past 75 years, ASTM International Committee D03 on Gaseous Fuels has tracked the evolution of the natural gas industry, developing collection and analysis standards to meet the changing demands of production, transportation and utilization. Now, says Kenneth Hall, professor of chemical engineering at Texas A&M and a veteran ASTM member, “With greater amounts of production and enormous amounts of product changing hands, standards for natural gas will become increasingly important."

A DOMESTIC FUEL FOR DOMESTIC NEEDS

First, the key factor driving renewed interest in natural gas is its domestic availability.

In June 2009, the combined findings of the U.S. Department of Energy and the Potential Gas Committee calculated U.S. natural gas reserves at 2,074 trillion cubic feet (59 trillion cubic meters).[1,2] Nearly one-third of U.S. natural gas reserves is locked in some 30 shale rock formations. The largest, the Marcellus, stretches from West Virginia through Pennsylvania and into New York.

Energy from natural gas presently accounts for 24 percent of total U.S. energy use.[3] According to Tony Hayward, CEO of BP Oil, the United States has enough natural gas to fuel its needs for the next century at current rates of consumption.[4] Not having to import energy supplies from other countries could help protect the United States from political instability elsewhere and reduce energy price swings.

Second, "natural gas is a clean-burning fuel that harnesses energy and combustion in a way that's not as harmful as oil or coal," says Tom Daniels, a Denver, Colo.-based product manager with Agilent Technologies.

Natural gas does contain some heavy hydrocarbons like ethane, propane, butane and pentane, which are byproducts of processing, plus carbon dioxide, nitrogen, helium and hydrogen sulfide. But unlike coal and oil, natural gas releases no ash or particulate matter when burned and only small amounts of sulfur dioxide and nitrogen oxides. As methane, it's also considered a greenhouse gas contributing to global warming. But, natural gas emits almost 30 percent less carbon dioxide than oil and 45 percent less carbon dioxide than coal for an equivalent amount of heat,[5] an increasingly important factor.

"Regulations on carbon dioxide emissions are coming, whether or not anyone believes in man-made global warming," says Jeff Werner, chief operating officer of DCG Partnership 1 Ltd., Pearland, Texas, and an ASTM member since 1998.

Third, "the rapid expansion in developing renewable electricity production from wind and solar sources, where the input source is not constant, has highlighted the need for generation backup. The best-fit technology currently available is natural gas fired-generation," explains Ron Goodman, market development manager for Southern California Gas Co.

Biogenic methane, or landfill gas, has the potential to make power generation even greener. Cleaned to meet pipeline standards, biogenic methane can be blended with and substituted for natural gas. Daniels cites the Fresh Kills Landfill on Staten Island, N.Y., which produces 5 million standard cubic feet (.14 million standard cubic meters) of high heat content gas every day,[6] powering generators that provide electricity to borough residents. "We're going to continue to produce waste, and we have the technology to recover energy from it," says Daniels.

Natural gas is also a major feedstock for producing ammonia to make fertilizer; it's used in manufacturing fabrics, glass, steel, plastics, paint and other products. And when used in compressed form to power motor vehicles, natural gas has the energy efficiency of a gasoline-powered engine but emits 90 to 97 percent less carbon monoxide and 25 percent less carbon dioxide.[7] Plus, natural gas can be cooled to liquid form, known as liquefied natural gas, having about one six-hundredth the volume of its gaseous form[8] and making it easier to transport. Perhaps even more important, natural gas can be used to produce hydrogen for the potential fuel cells that may power our future.

Given the promise of natural gas, it's not surprising that multinational energy companies have been acquiring new resources. For example, in December 2009, ExxonMobil bought Fort Worth, Texas-based XTO Energy for $31 billion, presumably to get access to XTO's shale deposits in the Rocky Mountains, Great Plains, Texas and Appalachia regions and to hedge its bet that the U.S. Congress will eventually put a price on carbon emissions.[9]

STANDARDS FOR NEW APPLICATIONS AND TECHNOLOGIES

Despite what appears to be a bright future, natural gas is not without issues, especially as the industry taps more challenging sources like shale formations.

"How much fuel value natural gas has can determine how it's used. And the fuel value — or the purity of the methane — depends on where it's found and how it was created," says Werner.

When ASTM Committee D03 on Gaseous Fuels was formed in 1935, it developed standards for the steel industry to ensure that the natural gas fueling blast furnaces contained the appropriate heating value.

As with home gas stoves, if the heat output is too high, natural gas will erode the holes in the burners. In fact, any equipment running on natural gas requires the proper mixture of gas or its operation can be compromised.

"Standards like ASTM D1945, Test Method for Analysis of Natural Gas by Gas Chromatography, have been around for a long time," notes Werner.

Likewise, laboratory-based ASTM standard D5504, Test Method for Determination of Sulfur Compounds in Natural Gas and Gaseous Fuels by Gas Chromatography and Chemiluminescence, became the primary method for determining the sulfur content of gas. Natural gas laced with hydrogen sulfide, also known as sour gas, can compromise quality and damage equipment and catalysts for processing and utilization. However, odoriferous sulfur gases are also deliberately added to alert users and the public of leaks in pipelines and appliances.

"At some point, the natural gas industry realized it needed to get a firmer grasp on custody transfer transactions," says Hall, ensuring that natural gas providers, distributors and public utility commissions had standard test methods for measuring the properties of gas all along the pipeline. Among other standards, custody transfer concerns led to a new online sulfur measurement method, ASTM D7493, Test Method for Online Measurement of Sulfur Compounds in Natural Gas and Gaseous Fuels by Gas Chromatograph and Electrochemical Detection.

While many of the current proposed committee standards address new technologies for verifying gas quality and meeting custody transfer contracts, one applies to landfill gas. WK24875, Practice for On-Line Determination of Siloxanes in Biogas and Other Gaseous Fuels by FTIR, provides landfill gas and sewage digestion plant personnel with a standard method of measuring the silicon-containing substances in landfill gases used to power local gas turbine engines. Over time, those substances convert to an abrasive silicone dioxide coating that reduces the lifetime of equipment.

Another proposed standard could apply to shale gas. Because it is recovered by hydraulic fracturing, a process that pumps significant amounts of water and chemicals into shale formations, shale gas is likely to be wet gas containing water vapor. "Water can trap other impurities in the methane, such as sulfur compounds, so you may not get a true picture of what you're pulling out of the ground," says Werner. WK24874, Test Method for Determination of Moisture Vapor Concentration in Natural Gas and by Tunable Diode Laser Spectroscopy (TDLAS), offers a standard for measuring moisture in natural gas in its raw form, in processing plants, pipelines, and in storage and distribution facilities.

Currently, much of the focus of D03 is on developing standards for hydrogen. For example, D7265, Specification for Hydrogen Thermophysical Property Tables, was created as a reference for engineers designing equipment, particularly hydrogen fuel cells, to generate, transport, store and deliver hydrogen to vehicles and appliances.

"Companies in California have come to the committee wanting to know how to analyze compressed gas fuels, like hydrogen, to meet strict state regulations for test methods," explains Werner. He adds that hydrogen-fueled equipment has a low tolerance for impurities, a fact that is pushing the limits of analytical technologies.

As of now, Committee D03 has not developed standards specific to shale gas. If the vast reserves of shale gas in the U.S. do become a critical source of fuel, D03 may expand and adapt existing standards to accommodate a brand-new facet of the natural gas industry.

Committee D03 will celebrate its 75th anniversary during its Dec. 6-8 meetings in Jacksonville, Fla. For more information about the anniversary, to help sponsor an anniversary event or to learn more about the committee's standards developing activities, please contact Brynn Murphy, ASTM (phone: 610-832-9640; bmurphy@astm.org).

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