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Overcoming Hurdles to Natural Gas Technology Implementation

Natural gas is a key resource that has many uses, from serving as a feedstock for producing useful chemicals to generating heat and electricity to fueling vehicles. Consumption of natural gas is increasing globally as new uses are discovered and technologies to process and employ natural gas are improved. The AIChE Center for Energy Initiatives (CEI) divides the uses of natural gas into three broad categories: chemical product synthesis, stationary power generation, and transportation.

Natural gas is used as a raw material in the synthesis of several chemical products and intermediates, such as ammonia and methanol. Ammonia is produced by reforming natural gas to create synthesis gas (syngas), which is processed further to produce ammonia. (For more information, see “Introduction to Ammonia Production,” *CEP*, Sept. 2016, pp. 69–75.) Ammonia can be used to produce urea and other fertilizers, fibers, and resins, as well as used in applications in the refrigeration and pulp and paper industries. Methanol can be used to produce chemicals such as formaldehyde and acetic acid, or as a fuel or fuel additive.

In residential and commercial applications, natural gas is used to heat buildings and water as well as for cooking, while in industry, it can be employed to heat reactors. Natural gas is used to produce electric power, often via gas turbine generators. It can be used to cogenerate heat alongside electricity in combined heat and power (CHP) applications for efficient use of energy.

Liquefied natural gas (LNG) and compressed natural gas (CNG) are used as fuels in transportation vehicles. LNG powers vehicles in many countries, including Japan, South Korea, China, the U.K., and Spain. LNG is produced by liquefying natural gas that has been cooled using a refrigerant gas; the LNG can then be stored and shipped in special containment tanks. Liquefaction is energy-intensive and costly, and steps will need to be taken to reduce the cost of production and transportation for LNG to be competitive with other fuels.

CNG production is simpler than liquefaction, and involves compression, cooling, dehydration, transportation/receiving, and storage. However, CNG has not been widely adopted because of concerns associated with gas containment, safety, and control systems.

Consumption of natural gas is increasing globally. The U.S. Energy Information Administration (EIA) predicts

that residential natural gas consumption from Oct. 2016 to March 2017 will be 10% higher than consumption over the same period from 2015 to 2016. The International Energy Agency (IEA) states that the share of natural gas production in countries that do not belong to the Organisation for Economic Co-operation and Development (OECD) or OECD Europe/Eurasia has increased from 20.3% to 40% since 1994. The share of production in OECD countries (which includes the U.S.) has not increased as rapidly, increasing by 2.7% in 2015 over the previous year. In 2015, the average capacity of natural gas combined-cycle plants increased above the average capacity of coal steam plants.

As demand for natural gas continues to increase, companies will look to increase throughput and reduce production costs by implementing new technologies. Ceramic membranes that convert natural gas to benzene could be used in oil wells that typically flare natural gas because it is too expensive to transport. The membranes could be employed to convert the gas to a liquid that is easier to transport, reducing waste and generating another income source. The membrane project is a collaboration between researchers at the Univ. of California at Berkeley and Ceramtec, with the support of a \$1.3 million grant from the U.S. Advanced Research Projects Agency for Energy (ARPA-E).

Black & Veatch and Emerging Fuels Technology, Inc., have combined efforts to offer an alternative to flaring. The FLARE BUSTER reduces the amount of natural gas lost to flaring. It is a compact and portable skid-mounted plant that can be installed at oil and gas facilities to collect and store natural gas that otherwise would have been flared.

AIChE’s CEI is addressing the obstacles that face natural gas technology implementation by hosting a series of natural gas utilization workshops. The first workshop took place in 2014, and in 2016, with the support of West Virginia Univ. (WVU) and Siluria Technologies, CEI hosted the Natural Gas Utilization Workshop: Overcoming Hurdles of Technology Implementation, Nov. 1–3, in Morgantown, WV. The workshop focused on the development and commercialization of natural gas technologies, including alternatives to flaring. Additional workshops will be held in the future to continue these discussions. Contact energy@aiche.org to join the conversation. 