

Coal gasification: unlocking the potential of low-quality coal reserves

For countries with large, even low-quality, coal reserves, gasification technology can enhance energy security while reducing energy costs, writes Harriet Crawley*

THE COAL-gasification sector is set to bounce back following a slowdown in 2009 – except in China, which saw a steady acceleration in development led by GE, Shell, Siemens and SES.

There are around 70 operational coal-gasification plants in the world, including 30 in China and three in the US, but none in Russia or the Ukraine, which together have 21% of the world's coal reserves, most of it brown coal and lignite, not worth mining and transporting (see Figure 1).

This “near-worthless resource” is ideal for gasification, says Alexander Gordienko, director of strategic development for coke and chemical production at Ukraine's Donetsk steel plant. “Ukrainian coal is high in sulphur and ash, and the only way to profit from it is to gasify it.”

Ukraine would benefit from the technology's widespread use politically as well as commercially, given its high degree of dependence on Russia for natural gas supplies. “Large-scale coal gasification would give Ukraine energy independence and security, and cut its gas costs by 50%,” says Denis Smyslov, chief executive of US-based Red Mountain Energy.

Lacking government support

However, government support is essential, but as yet not forthcoming. Gordienko has devised a coal-gasification business plan for his company, but, with Ukraine still deep in recession, there are still no tax breaks for coal-gasification investments.

Talks between industry and Ukraine's coal ministry aimed at establishing a regulatory environment that would be more conducive to investment have been put on hold until after the presidential elections. However, Smyslov says the economic case is overwhelming: Ukraine imports over two-thirds of its gas from Russia (71% of the gas it consumed in 2008, according to Cedigaz), at an average price of \$250/000 cubic metres (cm).

The production costs of coal-to-substitute/synthetic natural gas (SNG) are about \$113/000 cm – less than half. A gasification plant with a capacity to process 1.3m tonnes a year (t/y) of coal will

produce 0.5bn-0.7bn cm/y of SNG, according to Smyslov (production depends on the quality of the coal).

In addition, valuable by-products make it possible to recoup a significant part of the high capital expenditure (capex): argon is used for welding and nitrogen is widely used in chemicals plants and as an inert medium in industrial applications.

Meanwhile, Russia, with 19% of the world's coal reserves, has no coal-gasification facilities, but this may be about to change. In November, President Dmitry Medvedev spoke of the need for “rapid modernisation” in the country's energy industry and appealed for “high-tech investments”. Although Russia has over 157bn tonnes of coal, over two-thirds of it is poor-quality brown coal and lignite.

Says Smyslov: “Coal gasification could bring down the price of gasoline. Today's cost of gasoline is \$800 a tonne, whereas gasoline produced using coal gasification would cost \$210/t. Although the cost of a coal-to-gasoline plant is higher than a coal-to-SNG facility, the economic benefit is striking.”

So far Russian coal companies have shied away from gasification projects, deterred by lack of experience and the high capex: a two-train, coal-to-gasoline gasification plant costs about \$1bn. In addition, the country's abundant supply of natural gas has resulted in limited interest in coal gasification, despite efforts by Shell and ExxonMobil to develop the sector.



A 1.3m t/y coal-gasification plant can produce 0.5bn-0.7bn cm/y of SNG

Another hurdle is the volatility of oil prices. Anna Belova, deputy director general of strategy and corporate development at SUEK, Russia's biggest coal company, says a stable, minimum oil price of \$80 a barrel is required before coal gasification is viable. The gasification of low-quality coal “offers the most promising way forward” to produce a large variety of “value-added products” from an otherwise wasted resource, she says.

Underground coal gasification (UCG) is a technology suitable for coal seams that cannot be mined and was pioneered in the Soviet Union. In Russia, the first UCG project for decades has been launched by CBM Partners, a subsidiary of Red Mountain Energy, in the Kemerovo region. Initially, SNG from UCG will be used to generate power for a local town.

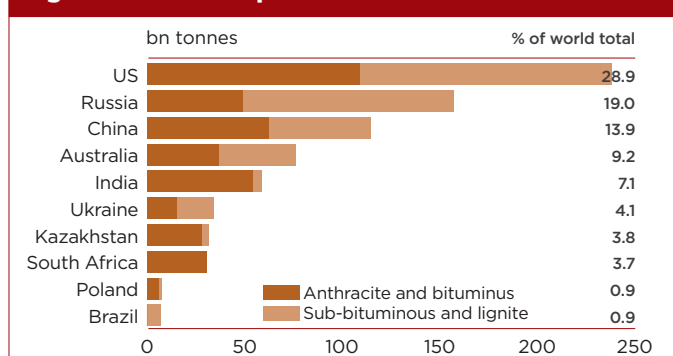
While the chemicals and fertilisers industries drive the bulk of gasification projects, especially in China, in North America, the new driver is the economic value of producing SNG – which can be fed into the existing gas-pipeline grid. In Decatur, Illinois, Secure Energy is building a \$0.8bn coal-to-SNG plant, the first to be built in the US for two decades, to convert 1.4m t/y of coal into 0.6bn cm/y of SNG

Others may follow, pending legislation before the Senate to mandate controls on carbon dioxide (CO₂) emissions. A 1.4m t/y coal-gasification plant would emit 2.5m t/y of CO₂, considerably less than the 3m t/y from a coal-fired power plant processing the same volume of coal.

Environmental groups argue that coal gasification is unacceptable, because of the high volumes of CO₂ it produces. But this may change if coal-gasification plants are combined with the new generation of integrated-gasification combined-cycle (IGCC) power plants and with carbon capture and storage (CCS) technology, claim its proponents.

In addition, say IGCC developers, because the SNG is cleaned before combustion, gasification plants produce significantly lower quantities of air pollutants, such as nitrogen oxides and sulphur dioxide, than coal-combustion plants. ●

Figure 1: World's top-10 coal reserves holders



Source: BP Statistical Review of World Energy

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