

EPA Coalbed Methane Outreach Program Technical Options Series
***CONVERSION OF COAL MINE METHANE
INTO SYNTHETIC FUELS***



Commercial scale gas-to-liquids plant in Pueblo, Colorado fueled by landfill methane gas (1992)
(Photo courtesy of Rentech, Inc.)

COAL MINE METHANE USE IN SYNFUEL PRODUCTION...

- ◆ Use of coal mine methane as a feedstock gas can improve synfuel economics
- ◆ Produces high-quality liquid fuels that can be easily transported
- ◆ Ideal for methane recovered from coal mines without pipeline access
- ◆ Use of coal mine methane reduces greenhouse gas emissions
- ◆ Can operate on medium-quality gob gas

Coal mine methane may be a low-cost alternative to conventional natural gas for small gas-to-liquids plants

Synthetic fuels are environmentally superior to conventional petroleum products

The market for high-quality diesel is increasing worldwide

Why Consider Coal Mine Methane for Synfuel Production?

For safety reasons, many gassy underground coal mines drain methane from their coal seams. Most coal mines vent this methane to the atmosphere, which not only represents the loss of a valuable fuel source, but also contributes to global warming, as methane is a potent greenhouse gas. While an increasing number of coal mines recover methane for pipeline injection, mines producing medium quality gas (typically less than 80% methane), or those not located near pipelines, look to other gas-use options. Recently, there has been a renewed interest in the conversion of methane into liquid hydrocarbon fuels such as diesel, kerosene, and naphtha. Because liquids can be transported more efficiently than gas, energy producers are developing methane-to-liquid fuel technologies in areas where pipeline facilities may not be economically justified. As a result, locating a synfuel plant near a coal mine could enhance the economic viability of both methane recovery and synfuel production.

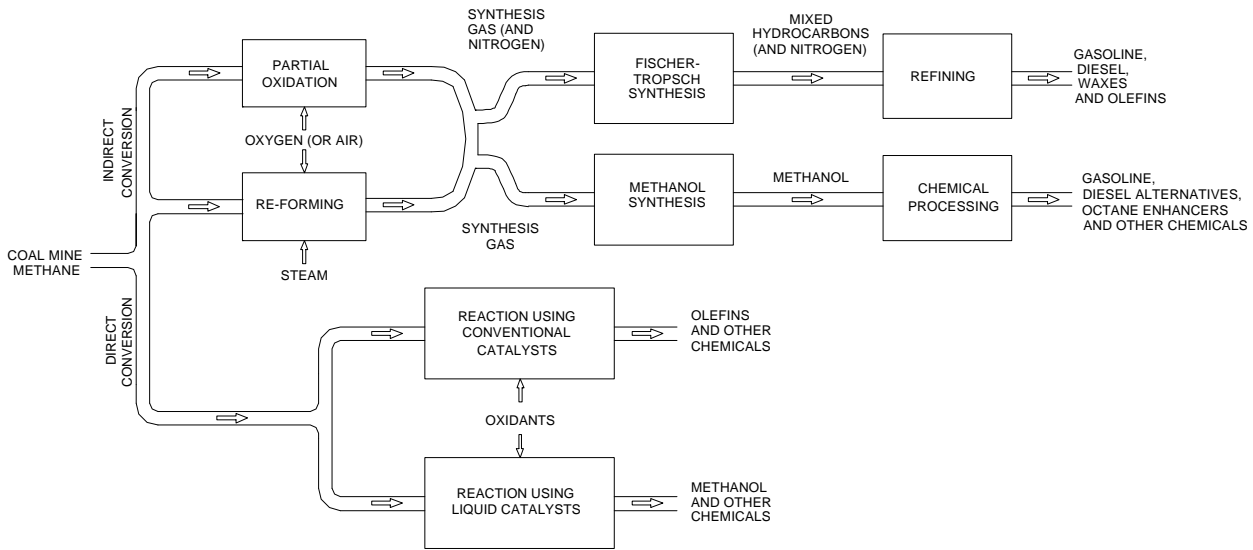
Although gas-to-liquids technologies have existed since the 1920s, the capital cost of conversion plants has hindered the economic feasibility of synfuels production. The most successful conversion of methane to liquid fuels to date is through Fischer-Tropsch Synthesis technology. The discovery of advanced catalysts during the past decade has greatly reduced the costs of the technology, thus making methane conversion plants smaller than 5,000 barrels per day economically possible. Currently, Syntroleum Corporation refines the Fischer-Tropsch chemistry using a proprietary catalyst that allows up to 30% N₂ and CO₂ in the feedstock gas. Using an iron-based catalyst, Rentech, Inc. successfully converts gas with methane concentrations as low as 40%. In addition, the Department of Energy is working with Air Products and Chemicals, Inc. to develop a novel ceramic membrane that could reduce the cost of converting natural gas to transportation-grade liquid fuels by 50%.

The products produced from these conversion processes are environmentally superior to many fuels because they are free of aromatics, nitrogen, and sulfur, and have a high centane number (clean burning properties). The quality of synthetic diesel fuel produced by the Fischer-Tropsch process is excellent, and therefore would be of special interest to underground coal mines operating or considering operating diesel equipment. In fact, these properties make synthetic diesel suitable as a blending component for upgrading conventional diesel fuels to meet stringent mining specifications.

SOME FACTS ABOUT SYNFUEL PRODUCTION...

- ◆ Ten thousand cubic feet (10 mcf) of methane will produce approximately one barrel of liquid products
- ◆ Plant sizes typically range from 2,000 to 20,000 barrels/day, but smaller plants may be feasible if low cost gas is available
- ◆ At \$0.50–1.00/mcf of methane, feedstock gas costs are \$5-10/barrel, while estimated operating and maintenance costs (at 5,000 barrels/day) are \$5-6/barrel
- ◆ Typical 1998 synthetic diesel prices are about \$US 27 to \$32 per barrel (typically \$8/barrel more than conventional diesel prices)

SYNTHESIS FUEL FLOW CHART



In an era of increasing environmental concerns, high-quality, sulfur-free diesel is readily sold on worldwide markets. For example, Royal Dutch/Shell Group produced synthetic diesel at its 12,500 b/d plant in Malaysia and sold it in California, because it met the stringent emission standards imposed by the California Air Resources Board. Moreover, the Mine Safety and Health Administration (MSHA) proposed a rule in April 1998 to reduce diesel particulate matter in underground coal mines. As a result, diesel engines used in these mines may require particulate filters in the future. Synthetic diesel use can reduce particulate emissions by up to 30%. In addition, synthetic diesel can reduce NO_x emissions (which represent a major problem for diesel engine exhaust) by 10%. U.S. EPA is proposing new diesel engine emission standards in 1999 for a wide range of highway and off-road applications. Coal mine methane-produced synthetic fuels could help reduce emissions that cause ground-level ozone (primarily NO_x and particulate matter).

The success of coal mine methane recovery and use requires a reliable market for the gas, and synfuel plants seek ample (five million standard cubic feet per day or more) methane sources. A coal mine or a group of coal mines located close together could supply low-cost methane feedstock to gas-to-liquid plants. In return, the mines would have access to high-quality diesel and other fuels to meet the fuel needs of their mining equipment. The recovery of coal mine methane for use as a synfuel feedstock reduces emissions of this greenhouse gas into the atmosphere.

PROPERTIES OF HIGH-QUALITY SYNTHETIC DIESEL

FUEL PROPERTIES	MSHA RECOMMENDATIONS	CONVENTIONAL DIESEL	SYNTHETIC DIESEL
Centane Number*	> 48	40-57	> 65
Aromatic Content	< 20%	<35%	< 1%
Sulfur Content	< 0.05%	<0.25%	< 0.0001%

* The centane number refers to the volatility of a fuel. Higher numbers indicate lower hydrocarbon emissions.

For More Information...

The continued development and refinement of gas-to-liquid technologies offers opportunities for coal mine operators and synfuel producers. Synfuel production provides a market opportunity for gassy coal mines without ready access to pipelines, while producers of liquid synthetic fuels may find the opportunity to purchase low-cost coal mine methane attractive.

To obtain more information about gas-to-liquids technologies, contact:

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Or contact EPA's Coalbed Methane Outreach Program for information about this and other profitable uses for coal mine methane:

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