COMMITTEE ON SCIENCE AND TECHNOLOGY
Subcommittee on Energy and Environment
U.S. House of Representatives

The Benefits and Challenges of Producing Liquid Fuel from Coal: The Role for Federal Research

Wednesday, September 5, 2007
10:00 a.m.
2318 Rayburn House Office Building

PURPOSE

On Wednesday, September 5, 2007 the Subcommittee on Energy and Environment of the Committee on Science and Technology will hold a hearing to receive testimony on the use of coal to produce liquid fuel, the status of coal-to-liquid (CTL) technologies and what additional research, development and demonstration programs should be undertaken at the Department of Energy or other agencies to better understand the benefits and barriers to converting coal into transportation fuels.

The Subcommittee will hear testimony from six witnesses who will speak to a range of policies that warrant consideration before moving forward with the advancement of the production of synthetic transportation fuels from coal. Policies for consideration include carbon dioxide management, infrastructure improvements, water usage, energy security, energy balance of CTL technologies (energy used and produced), exhaust emissions, options for using coal with organically derived feedstocks to produce liquid fuels, coal production requirements, potential outcomes for consumers, and the appropriate level of federal investment in CTL technologies. They also will discuss the technical and economical challenges with meeting any desired policy objectives as well as the benefits and drawbacks of investing federal resources in CTL technologies.

WITNESSES

Dr. Robert L. Freerks, Director of Product Development Rentech Corp., Denver, CO. He will speak to the state of development of CTL technologies using the Fischer-Tropsch process. He will highlight the benefits of the commercialization of the FT process and discuss some of the challenges.

Mr. John Ward VP, Marketing and Governmental Affairs Headwaters, Inc. South Jordan, Utah. He will discuss the growing global demand for oil and the need to explore alternative liquid fuel options using the nation's abundant coal reserves. He will review the local and global economic benefits as well as the national security and environmental benefits.

Dr. James Bartis, Sr. Policy Researcher RAND Corp., Arlington, VA . He will address economic and national security benefits of CTL technology as well as the technical challenges for addressing the carbon dioxide emissions resulting from the CTL process. He will also provide suggestions for federal activities needed to address the uncertainties surrounding CTL technology.

Mr. David G. Hawkins, **Director, Climate Center at Natural Resources Defense Council, Washington, DC.** He will speak to the environmental concerns associated with the adoption of CTL technologies – in particular, the "well-to-wheel" emissions of these new fuels and the impact on global climate change. He will also address other energy strategies which still rely on coal, but help to reduce our nation's carbon dioxide footprint at the same time.

Dr. Richard D. Boardman, **The Secure Energy Initiative Head, Idaho National Laboratory, Idaho Falls, ID**. He will discuss water resource management related to the production of liquid fuels from coal. He will also address the potential for producing liquid transportation fuels using coal with organically derived feedstocks.

Dr. Joseph Romm, Center for Energy & Climate Solutions; Center for American Progress; former Acting Asst. Sec at Department of Energy during the Clinton Administration, Washington, DC. He will address the environmental policy considerations related to advancing CTL technology. He will focus on the role of CTL technology in a world with greenhouse gas constraints.

BACKGROUND

The coal-to-liquids (CTL) process was discovered by German scientists and used to make fuels during World War II. Since that time, there has been varying intensity of interest in this technology. As the price of petroleum and natural gas stays high, there will be an increasing interest in developing the commercial potential of producing synthetic liquid fuels from coal.

There are a number of proposed CTL projects in the United States and overseas, and SASOL in South Africa has a long history with CTL. According to the 2007 Massachusetts Institute of Technology (MIT) Report "*The Future of Coal,"* SASOL has been producing 195,000 barrels per day of liquid fuel using Fischer-Tropsch technology for several decades. In addition, jet fuel from a gas-to-liquids pilot plant has already been certified for use by the United States Air Force.

There are two mainstream processes for producing liquid fuels for transportation applications: direct and indirect. It is generally the indirect route for liquid fuel production that is discussed in the United States. A good explanation for the focus on the indirect process is the fact that SASOL in South Africa has commercialized that technology increasing the confidence in the indirect approach to liquefaction. In addition, the MIT Report explains that converting coal directly to liquid products requires reactions at high temperatures and high hydrogen pressure. This liquefaction route is

very costly due to the type of equipment needed to operate at these conditions. The MIT report also states that in general, the direct liquefaction route "produces low-quality liquid products that are expensive to upgrade and do not easily fit current product quality constraints."

INDIRECT LIQUEFACTION PROCESS:

As described by the MIT Report the initial step in the production of methane, chemicals, or liquids from coal is the gasification of coal to produce a syngas – this is the same process carried out in Integrated Gasification Combined Cycle (IJCC) for electricity generation. The synthesis gas, or syngas, (predominantly carbon monoxide and hydrogen) is cleaned of impurities and a water gas shift reaction increases the hydrogen to carbon monoxide ratio. Then, a Fischer-Tropsch reaction converts a mixture of hydrogen and carbon monoxide to liquid fuels. The hydrogen and carbon monoxide can be derived from coal, methane or biomass.

CHALLENGES WITH CTL

The MIT report states that "Without CCS (carbon dioxide capture and storage), Fischer-Tropsch synthesis of liquid fuels emits about 150% more CO_2 as compared with the use of crude oil derived products." Requiring these facilities to capture and sequester the carbon dioxide will make the synfuels more expensive. However, the MIT report also points out that carbon capture and storage would not require major changes to the synfuels process or significant energy penalties because the CO_2 is byproduct in an almost pure stream and easier to capture and manage.

In addition, questions have been raised about the ability to guarantee a dependable and sustained market for coal-to-liquid fuels which could deter private-sector investment. Specifically, industry has expressed concern that the uncertainty of world oil prices coupled with the technical risks associated with the operation of the initial commercial plants and the implementation of carbon dioxide management options will make private investment difficult to obtain.

CTL plant costs will vary based on location, capacity, construction climate, product slate and coal type. The Fishcer-Tropsch synthesis using coal has been criticized as inefficient and thus costly. The MIT report concludes, "Today, the U.S. consumes about 13 million barrels per day of liquid transportation fuels. To replace 10% of this fuels consumption with liquids from coal would require over $70 billion in capital investment and about 250 million tons of coal per year. This would effectively require a 25% increase in our current coal production which would come with its own set of challenges."

BENEFITS FROM CTL

Production of domestic liquid fuel would help secure energy supplies by displacing imports of diesel or jet fuel. Refiners cannot meet U.S. demand for these fuels so diesel or jet fuel production from CTL facilities would offset imports.

"Unlike conventional transportation fuels, CTL fuels, made using an indirect liquefaction process, produce tailpipe emissions that are almost completely free of sulfur." *(Coal International – January/February 2007)*

"Carbon dioxide emissions, over the full fuel cycle, can be reduced by as much as 20%, compared to conventional oil products, through the use of carbon capture and storage." *(Williams & Larson 2003, Princeton University, "A comparison of direct and indirect liquefaction technologies for making fluid fuels from coal," Energy for Sustainable development, Volume VII No. 4 December 2003)*

Table 1. Comparative Merits and Drawbacks of Fishcer-Tropsch (CRS RL34133)

Abundant coal reserves available as feedstock.	↔	Competition for coal in electric Power generation.
Coal-to-liquids generates significant CO_2	↔	CO_2 separation during synthesis gas production makes capture feasible.
Produces ultra-low sulfur, high cetane diesel.	↔	Produces low-octane gasoline
Low efficiency in converting coal to liquid.	↔	waste heat available for electricity co-generation.
May have lower operating expenses than direct coal liquefaction	↔	Conceptually more complex than direct liquefaction approach and higher in capital investment cost.
Deep geologic sequestration offers solution for CO_2 emissions.	↔	CO_2 sequestration not yet demonstrated on a large industrial scale.
Gas-to-liquids offers reduced CO_2 generation.	↔	Competition with domestic natural gas use.
Biomass-to-liquids offers zero carbon footprint.	↔	Competition with biomass for cellulosic ethanol production.

If you have questions or need additional information, please do not hesitate to contact Michelle Dallafior with the Science and Technology Subcommittee on Energy and Environment at 226-2179.