

## Coal-Based Methanol for Fuel Cell Vehicles Study Summary

The University of Florida recently completed a study for Georgetown University, titled "An Investigation of the Feasibility of Coal-Based Methanol for Application in Transportation Fuel Cell Systems." The summary below is based on the final version of the report, issued in April 2004.

The main purpose of this study was to analyze the future overall costs of various fuel options for fuel cell vehicles. Recognizing that future fuel cell fuels would likely be alternative (i.e. not petroleum-based) fuels, the researchers concentrated on natural gas and coal as feedstocks. Specifically, the key fuel options investigated were: hydrogen from natural gas, hydrogen from coal, and methanol from coal.

A number of factors were examined in order to reasonably project the cost of fuels for fuel cell vehicles for the year 2020. First, the total energy demand for fuel cell vehicles in the U.S. was predicted, based on recent energy trends and expected future energy demand. As a baseline this study assumed that fuel cell vehicles will be gradually introduced into the U.S. fleet, reaching 50% of new car sales in the year 2020. Second, the demand, supply, and cost of the two studied feedstocks (natural gas and coal) were analyzed. Finally, the study thoroughly examined costs of the various fuel production methods, transportation, storage, and taxes.

The following table summarizes the key results of the hydrogen fuel cost analysis. This table compares the projected costs per gasoline-equivalent gallon in the year 2020 for the different sources of hydrogen for fuel cell vehicles (costs include taxes and are given in 1996 dollars).

Hydrogen (H <sub>2</sub> ) Feedstock	H <sub>2</sub> from Natural Gas Off-board reforming	H <sub>2</sub> from Coal Gasification	H <sub>2</sub> from Methanol from Coal On-board reforming
\$/gallon in 2020 (gasoline equivalent)	\$3.44 - \$4.32	\$3.18	\$1.77

The following is a synopsis of the key conclusions of the study:

- The amount of petroleum imported into the United States is greater than during the energy crisis of the 1970s and is increasing. Reducing this dependency on foreign petroleum is in the best long-term interests of the U.S.
- Natural gas and coal are the only energy sources currently available in quantities comparable to petroleum for transportation.
- The cost of natural gas is likely to increase if demand increases as expected. Also, more natural gas will have to be imported into the U.S. to meet this increased demand. Thus natural gas may not be an appropriate feedstock for future alternative fuels if the goal is to reduce dependence on foreign energy sources.
- Recoverable reserves of coal will last at least five times as long as technically recoverable natural gas or petroleum in the U.S.
- Methanol is the most desirable liquid hydrocarbon fuel for fuel cells and can be effectively utilized in internal combustion engines using existing technologies.
- While all alternative fuels are expected to be more expensive to the consumer than present-day gasoline, methanol produced from coal is likely to be the least expensive of the fuels considered, if natural gas prices increase as projected.

In order for fuel cell vehicles to gain widespread acceptance in the future, fuel cell compatible fuels must be available to the general public at prices competitive with conventional fuels. The feedstock, production, transportation, storage, taxes, and infrastructure requirements are major components of alternative fuel costs, and the feedstocks used can have major impacts on U.S. energy independence. This study emphasizes the possible role methanol could have in the future automotive sector, especially if it is produced from domestic coal and used in fuel cell vehicles.