

Appendix C

Conversion of Biogas to Biomethanol

Interest in neat methanol as a vehicular fuel has been steady for many years; the “Methanol Institute” promotes this chemical and major energy (oil, gas) companies also have some interest in this fuel. There are claims that methanol-using internal combustion engines reduce air pollution. Methanol is now also being considered as a storage fuel for hydrogen fuel cell cars. Nevertheless, during the past 20 years, no significant market has developed for methanol as fuel, although it is often used as an additive and can be blended with biodiesel to enhance cold weather properties. Methanol has only half the energy content of gasoline; it has a lower vapor pressure than gasoline; it can attack fuel and engine components; and it is toxic. Although these obstacles could be overcome, together with the lack of a methanol vehicle fueling infrastructure, they have limited the potential of this fuel.

Past Unrealized Projects

One company (TerraMeth Industries, Inc. of Walnut Creek, California) proposed building a landfill-gas-to-methanol plant in West Covina, Southern California during the 1990s. Despite legislation that supported the project and several years of trying to find financing, this project did not come to fruition. Another proposed project in Washington State was also abandoned. With the phase-out of MTBE, interest in methanol production waned.

The process for converting dairy manure biogas to biomethanol is challenging, primarily because it would need to be carried out at a scale several orders of magnitude smaller than current processes. For example, the unrealized TerraMeth landfill-gas-to-methanol project would have cost just under \$10 million (capital costs) for a facility that produced about 6 million gallons of methanol per year (and this cost is judged optimistic by many who have examined this conversion). An equivalently sized dairy facility would need over 50,000 cows to produce this much gas, which, by industrial standards is actually a very small plant.

The Smithfield Foods Utah Project: From Hog Manure to Biodiesel

A recent example of an animal-manure-to-methanol project is one proposed by Smithfield Foods in Utah. A subsidiary firm, Best Fuels LLC, announced an ambitious \$20-million project that would convert the manure from 23 hog farms (with a total of 257,000 finisher pigs) first to biogas and then to methanol for biodiesel production (Figure C-1). The farms were all within a 5-mile radius and the impetus for the project was the difficulty of marketing electricity from biogas produced from the animal manure.

As shown in Figure C-1, manure (about 40,000 tons dry matter/year) collected from swine houses is pumped to a central location, thickened by gravity to about 4.5% solids and digested in inground, heated (95 °F), floating cover digesters. The facility would produce about 1.2 million ft³/day of biogas.

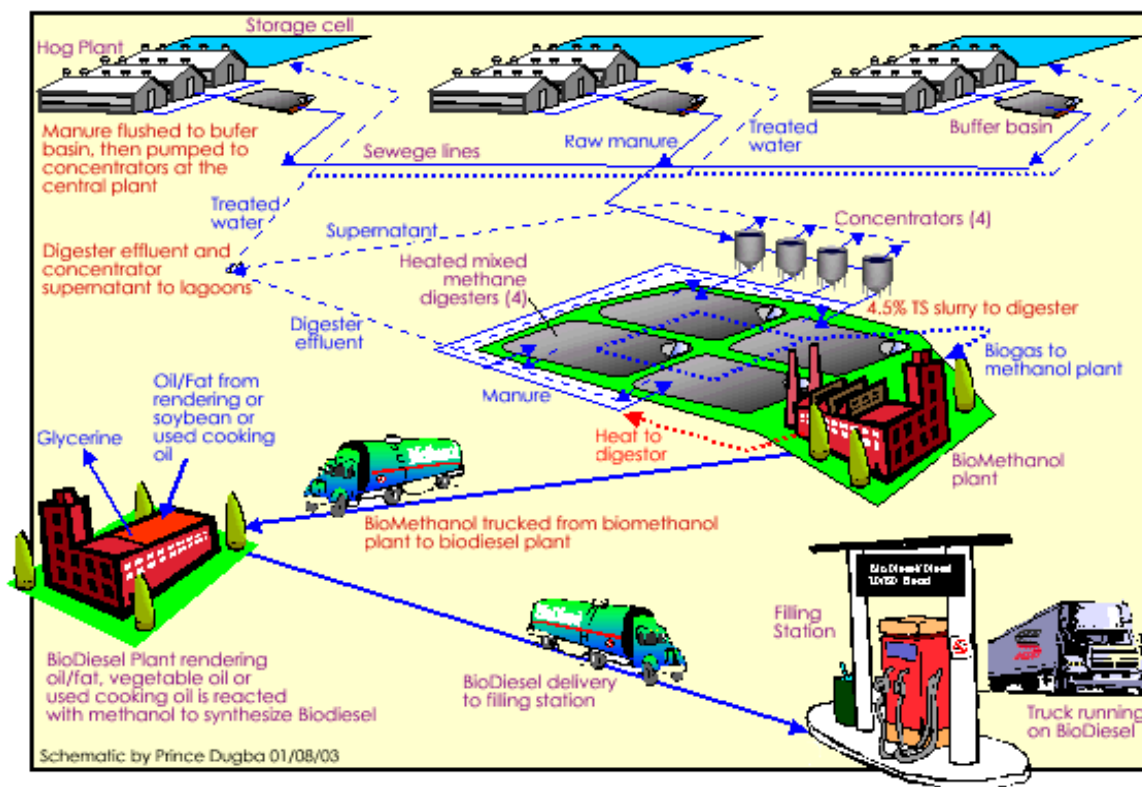
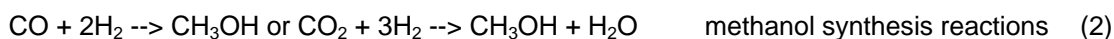
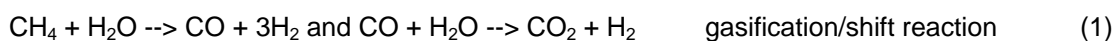


Figure C-1 Project of Best Fuels LLC/Smithfield Foods for Converting Hog Manure to Methanol

The biogas is next pumped to a central plant, where H_2S is removed with sodium hydroxide (NaOH). The gas is converted to methanol in a conventional steam-reforming/water-gas shift reaction followed by high-pressure catalytic methanol synthesis:



The process at the Smithfield site is expected to yield 7,000 gallons of methanol per day. The methanol is used off-site for biodiesel production, expected to yield 40,000 gallons of biodiesel per day. The project literature states, “These processes should be considered industrial-scale processes, thus requiring a highly trained staff and high-tech equipment.”

However, after the initial much publicized announcement of the project no further information has become available. It is the opinion of the authors that if such an approach were even modestly economically attractive, it would have already been implemented under the much more favorable (from an engineering standpoint) opportunities made possible at stranded high- CO_2 natural gas wells. There the quality, quantity, pressure of the gas would much better justify their upgrading and conversion to methanol. It remains to be seen if this project actually moves forward.