Methanol

WHY METHANOL?

- Methanol has been called the ideal liquid 'hydrogen source' for fuel cells because it is easier to produce hydrogen from methanol – a one carbon molecule - than other more complex hydrocarbon molecules (see: www.methanex.com; www.methanol.org).

- Methanol produced from biomass represents a more broadly applicable and environmentally clean approach to generating power because its conversion is carbon neutral (Biomethanol fuel reduced total fuel chain GHG emissions by 65% and 82% for conventional family cars and greater emissions reductions occurred from using hybrid vehicles (74-87%) such as fuel cell vehicles (Ohlström et al. 2001)

Total GHG emissions of fuel cell vehicles using methanol produced from biomass and from natural gas for a family car (5 seats) (Ohlström et al. 2001. New concepts for biofuels in transportation. Biomass-based methanol production and reduced emissions in advanced vehicles. VTT Research Notes 2074)

Process	g CO_2 (eq)/km
Methanol produced from natural gas	**117**
Methanol produced from biomass	**6**
Reformulated gasoline including MTBE from biomass	**185**
Reformulated diesel from crude oil	**111**
Hybrid vehicles – 85% methanol from biomass blended with 15% gasoline	**117**
Hybrid vehicles – 85% methanol from natural gas blended with 15% gasoline	**145**

- Wood is a higher quality starting material to transform to methanol compared to other agricultural crops because of its more consistent chemical composition that results in a high efficiency of conversion to by-products such as methanol. The efficiency of chemical conversion and the resulting products will vary based on the process (e.g. gasification, pyrolysis, fast pyrolysis), the mix of tree species used, and what is included in the raw material (bark, needles, cones, etc.). Efficiencies as high as 45-55% have been recorded for forest residue conversion to methanol and 65-75% for liquid bio-fuels

Starting Material	Efficiency/Conversion to Methanol	Reference
Pulp Mill Black liquor	**65**	Ekbom et al. 2003
Biomass feedstock	**1 ton can produce 186 gallons of methanol**	NREL/SP-420-5570-Rev.2
Biomass	**60**	Specht and Bandi
Forest residues	**55**	Mäkinen and Sipilä 2003
Wood residues	**43.5 – 50.8**	DOE 1990
Forest residues	**65 - 75** (liquid bio-fuels)	Oasmaa et al. 2003
Soybean-cake	**43** (to bio-oil)	Pütün et al. 2002

- Methanol production costs from biomass can be higher or equivalent to its production from other materials (a). Direct costs with methanol use are lower when all the externalities associated with the generation of power are included except for coal (b), and using methanol as the fuel to drive cars has a slightly higher unit cost per km compared to gasoline but cheaper than diesel or liquefied petroleum gas (c).

(a) Estimated fuel production costs (Ohlström et al. 2001. VTT Research Notes 2074)

FUEL	EUR/GJ (Estimated production cost 2001)
Gasoline (RFG, 10% MTBE)	**9.8**
MeOH from natural gas	**4.7**
MeOH from biomass, Finland	**16.4**
MeOH from biomass, Far East	**9.6**
Electricity, Finland average	**7.0**

(b) **Production costs of power generation technologies**. Production costs (Euro'90/KWh) for power plant operating at 7000 hours, without subsidies/excise taxes (Capros et al. 2000).

Unit	Imported Coal	Monovalent Fuel Oil	Monovalent Biomass-Wastes	Wind Turbines	Solar Photo-voltaic	Nuclear
Euro'90/KWh	**0.034**	**0.059**	**0.040**	**0.046**	**0.494**	**0.048**

Countries -Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, The Netherlands, Portugal, Spain, Sweden, United Kingdom

(c) Unit cost per km driven for average annual mileage of a gasoline car. Transport cost (Euro'90/km or mi driven) for private cars (annual mileage 13000 km per year), without excise tax. (Capros et al. 2000)

Units	Diesel	Gasoline	Liquified Petroleum Gas	Methanol*
Euro'90/km driven	**0.343**	**0.313**	**0.371**	**0.327**
Euo'90/mi driven	**0.549**	**0.501**	**0.594**	**0.523**

Countries -Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, The Netherlands, Portugal, Spain, Sweden, United Kingdom

*methanol extracted from natural gas with assumed efficiency of 70%

METHANOL SOURCES (Ohlström et al. 2001)

- In 1997, 86% of methanol was produced from natural gas; 33% of produced methanol was used in the gasoline/fuel sector, 67% by the chemical industry
- Methanol production from wood was estimated using the best technology to yield 55 wt% of dry wood (Elam et al. 1994) and yields of 48-58 wt% of dry wood depending on gasification technology used (Williams et al. 1995)

References

Capros P, N Kouvaritakis, L. Mantzos, V Panos, EL Vouyoukas. Athens, Novermber 2000. ANNEXES. Commission of the European Communities. Green paper. Towards a European Strategy for Energy Supply Security)

Ohlström N, T Mäkinen, J Laurikko, R Pipatti. 2001. New concepts for biofuels in transportation. Biomass-based methanol production and reduced emissions in advanced vehicles. VTT Research Notes 2074

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Kristiina Vogt, Professor, co-Program Coordinator of Forest Systems and Bioenergy, CFR, UW (kvogt@u.washington.edu); Michael Andreu, Research Associate, co-Program Coordinator of Forest Systems and Bioenergy, CFR, UW (andreu@u.washington.edu); Kevin Hodgson, Professor, CFR, UW (hodgson@u.washington.edu); Daniel Vogt, Assoc. Professor, CFR, UW (dvogt@u.washington.edu); Ragnhildur Sigurdardottir, President CAPEIntl Iceland (raga@capeintl.org); Robert Edmonds, Professor, CFR, UW (bobe@u.washington.edu)

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