Program in Forest Systems and Bioenergy, CFR, University of Washington

Hydrogen Fuel Cells

OUR FUTURE IN A HYDROGEN BASED ECONOMY SUPPLIED BY METHANOL

- It has been suggested that the future will be a 'hydrogen based economy' and billions of dollars of funding are being made available globally to reach this goal. Major car makers have already spent over $2 billion developing H cars (Rifkin 2003).
- Linking biomass generation of methanol to H generation has the potential to reduce greenhouse gas (GHG) emissions by 80-90% because of reduced GHG emissions from cars or power plants no longer being fueled by fossil fuels.
- Currently Methanol is produced from natural gas - a non-renewable resource. Due to new technologies, methanol can be produced efficiently using a renewable resource (wood).

FUEL SOURCES FOR HYDROGEN FUEL CELLS

- Many different hydrocarbon fuels (e.g. ethanol, ethylene glycol, natural gas, liquefied petroleum gas, white gas, kerosene, diesel, "biodiesel", methanol) can be used as a source of hydrogen to power fuel cells.
- Methanol (CH_3OH) is uniquely structured to be an efficient source of hydrogen to be used in fuel cells and is driving the rapid developments in fuel cell technology. The preferred fuel source for fuel cells is methanol since its chemical bonds are easier to break to release H than other fuels such as ethanol (CH_3CH_20H) or hydrocarbon fuels (i.e. diesel, gasoline).
- All fuel cells use hydrogen gas (H_2) as a starting material to produce an electric current. (Fuel cells have been used for years in spacecraft as a means of producing both electricity and a source of water).
- Infrastructure for transporting, storing, and dispensing H_2 gas in not generally available in the US.
- Recently, fuel cells able to use methanol as opposed to H_2 gas as a starting material have become *commercially* available. This development has created new opportunities for powering fuel cells which do not require a hydrogen gas distribution system.

FUEL CELL SYSTEMS AND RURAL AREAS

- Small, "turn-key" fuel cells that can utilize a variety of fuels (e.g. methanol, ethanol, diesel) as a source of hydrogen are now commercially available (www.idatech.com). These fuel cells are ideally suited for remote sites/rural areas because: (1) As they can use methanol, there is no need to develop storage containers for the highly volatile H, (2) their small size, and (3) they are safe to use inside buildings means that can satisfy the electrical needs at a specific location (e.g. small building, house, room).

Additional Fuel cells Facts (Azar et al. undated)

- Presently, fuel cells are expensive to use in cars. Electricity from fuel cells costs ~ US$3000 kW (Lloyd 1999), but this price is rapidly decreasing.
- Expected costs of fuel cells is currently highly variable – Chrysler (Ogden et al. 1998) estimated US $200/kW with current manufacturing technologies; Directed Technologies suggest will be as low as 20 US$/kW (Lomax 1998). (NOTE: natural gas fired power plants cost US$600/kW which is 30 times more expensive which would revolutionize electricity generating industry if costs of fuel cells reach the $200/kW range)
- Efficiency of H production from methanol by IdaTech fuel cells = 99.8%

References
Azar C, K Lindgren, BA Andersson. EC website. Undated. Hydrogen or methanol in the transportation sector?
Rifkin 2003. Dawn of the hydrogen economy. European Union Hydrogen Conference. Brazil. 16-17 June 2003.

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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