Biomass

Biomass Feedstocks

- Residues
  - Forest
  - Mill
  - Agricultural
- Urban wood wastes
- Dedicated energy crops
- Landfill gas

- Industrial residues
  - Black liquor
  - Animal manures
- Municipal solid waste
- Tires
- Railroad ties
- Utility poles

General Characteristics of Biomass

- Lower heating value than coal or oil
  - 15-19 GJ/tonne vs. 20-30 for coal, 42-45 for oil
- High moisture content
  - Air dried to 15-20% (Utah coal-5%, Wyo-28%)
- High oxygen content
  - (Cellulose, Hemicellulose & Lignin) – better ignition
- Low bulk density
  - ~100-150 kg/m³ vs. 700-850 kg/m³ for coal
  - Makes transportation uneconomical
- Low ash (but perhaps high alkali) (0.5 to 5%)
- Low sulfur (<0.1%)
Why Is Biomass Considered CO₂ Neutral?

- Releases CO₂ when burned
- Grows by taking CO₂ from atmosphere
- No net increase or decrease in amount of biomass on earth

Chemical Structures

Terminology

- Sugar platform
  - Cellulose
  - Hemicellulose
  - Sugars
  - Alcohol
  - Other chemicals
  - Biodiesel
  - Lignin
  - Fuel for power (or chemicals)

- Thermochemical platform
  - Biomass
  - Fuel for power (or gasification)

Potential Improvements in Black Liquor Recovery

Requirements:
- Recover Na
- Recover energy

Research Ideas:
- Use recovery gasifier instead of boiler
- Output is CO & H₂
- Fischer-Tropsch Catalysis
- Product is liquid fuel (diesel or gasoline)

Driving Force:
- Large quantities of black liquor already being recovered!
What Changed?

- % Nuclear went down
- Total amount of nuclear still increased

U.S. Energy Forecast (cumulative)

U.S. Energy Forecast (non-cummulative)

2004 Out of 169 quads

2005 Out of 136 quads

What Will E10 Do To My Car?

- Lower emissions
  - NOx
  - CO
- Less knock (higher octane rating)
- Lower gas mileage
  - As much as 30%
- May clog fuel filter with continued use

Bottom line: Huge corn subsidy is not going away

Biofuels

- B20
  - Diesel with 20% bio-derived fuel
- E85
  - 85% ethanol, 15% gasoline
  - Special engines needed
- E10
  - 10% ethanol, 90% gasoline
  - Any engine