

Ethanol Plant Energy Strategies

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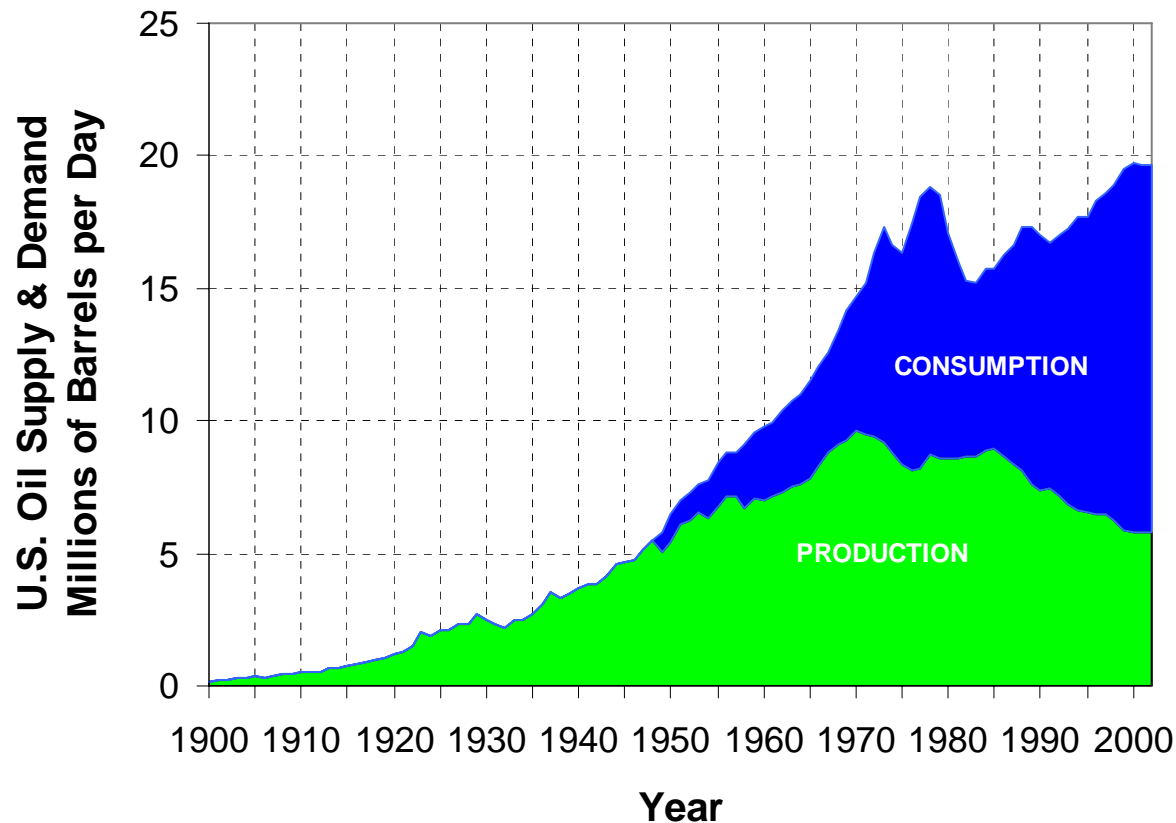
Georgia Tech Strategic Energy Institute

Tifton, Georgia

August 3, 2006

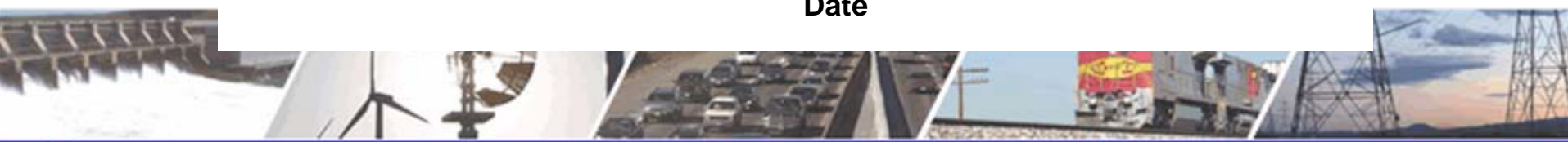
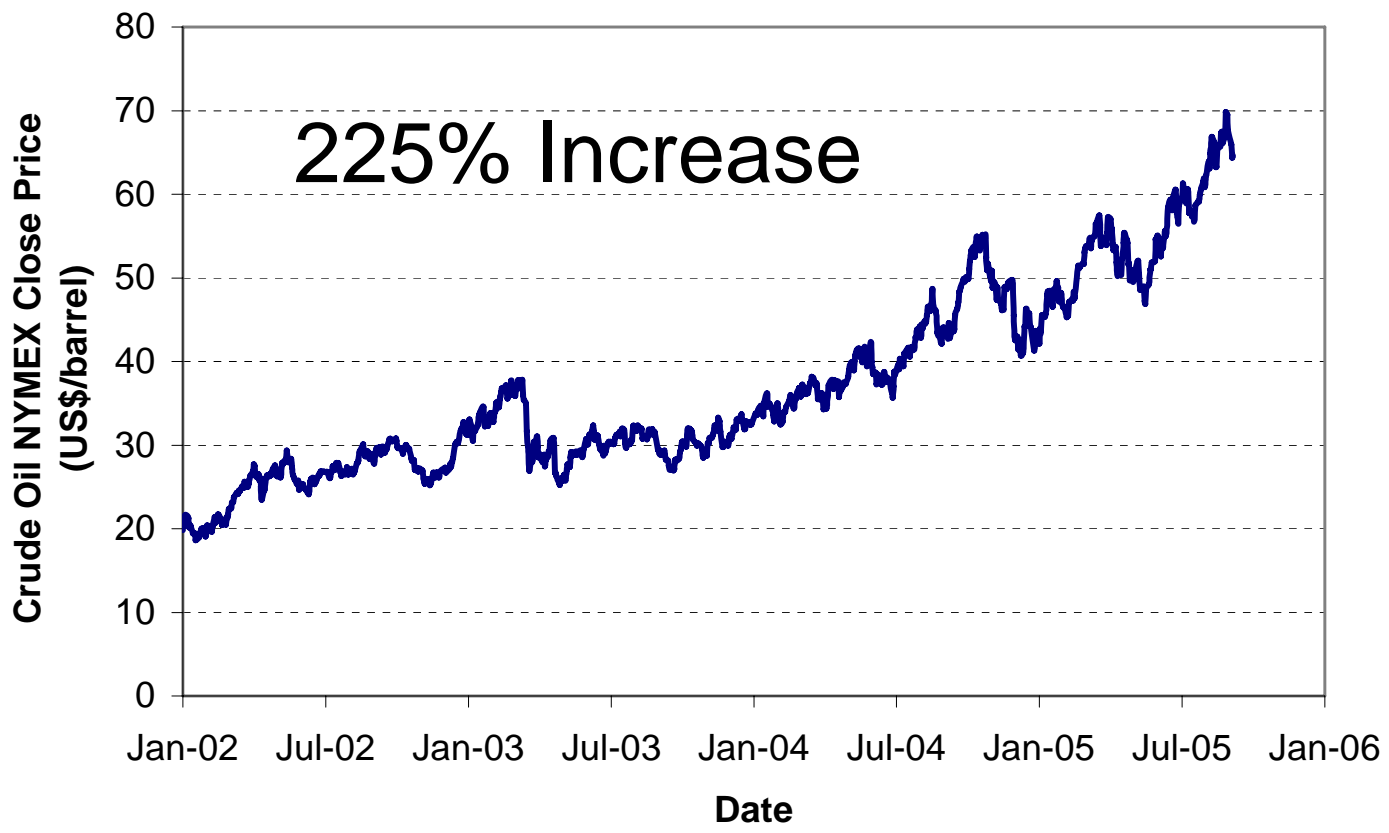


Fossil Fuel Production Constraints



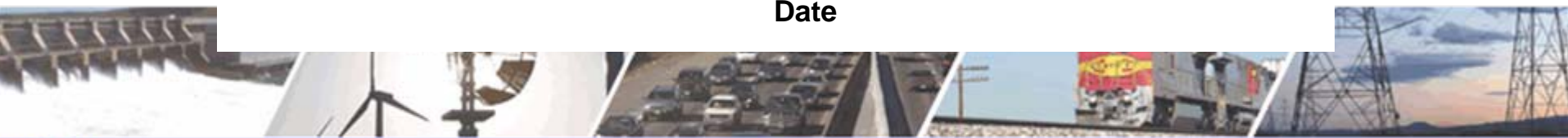
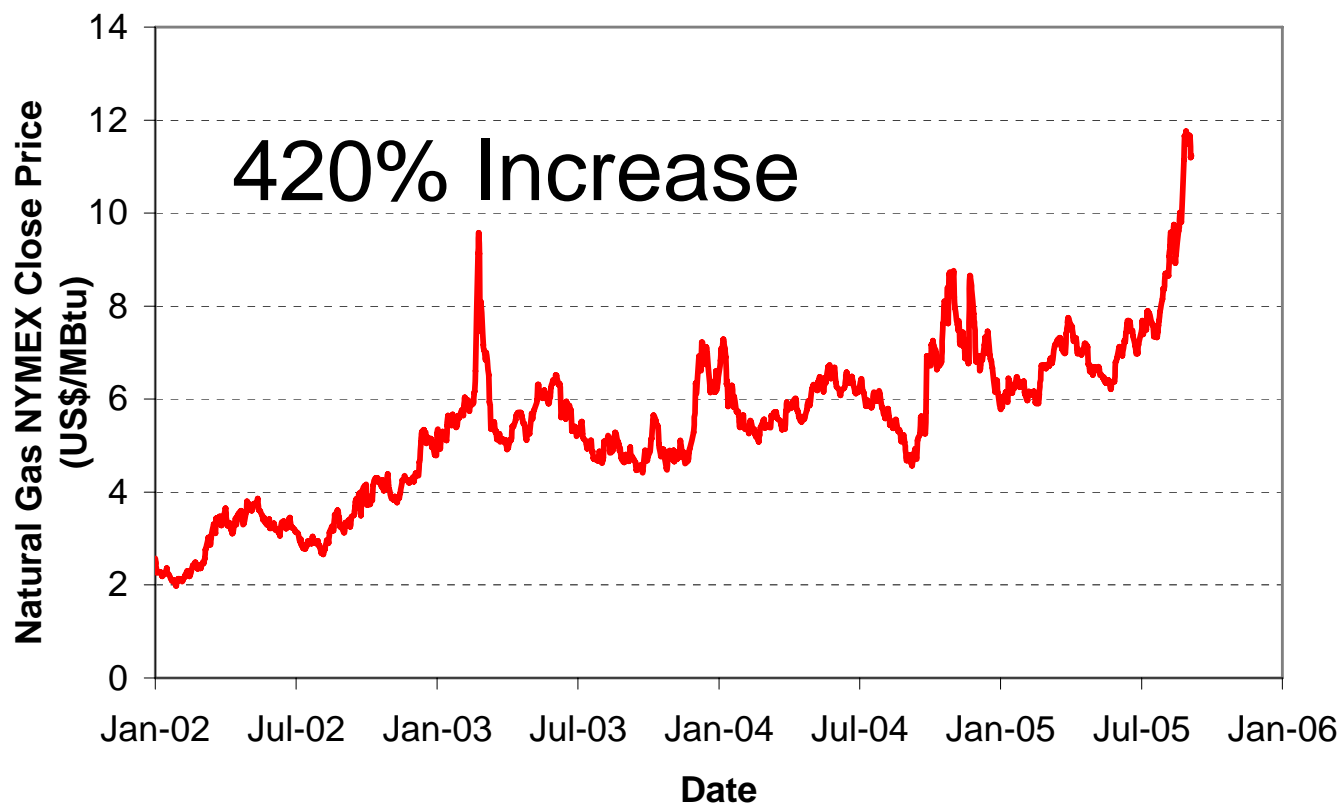
Cost of Crude Oil

2002-Present



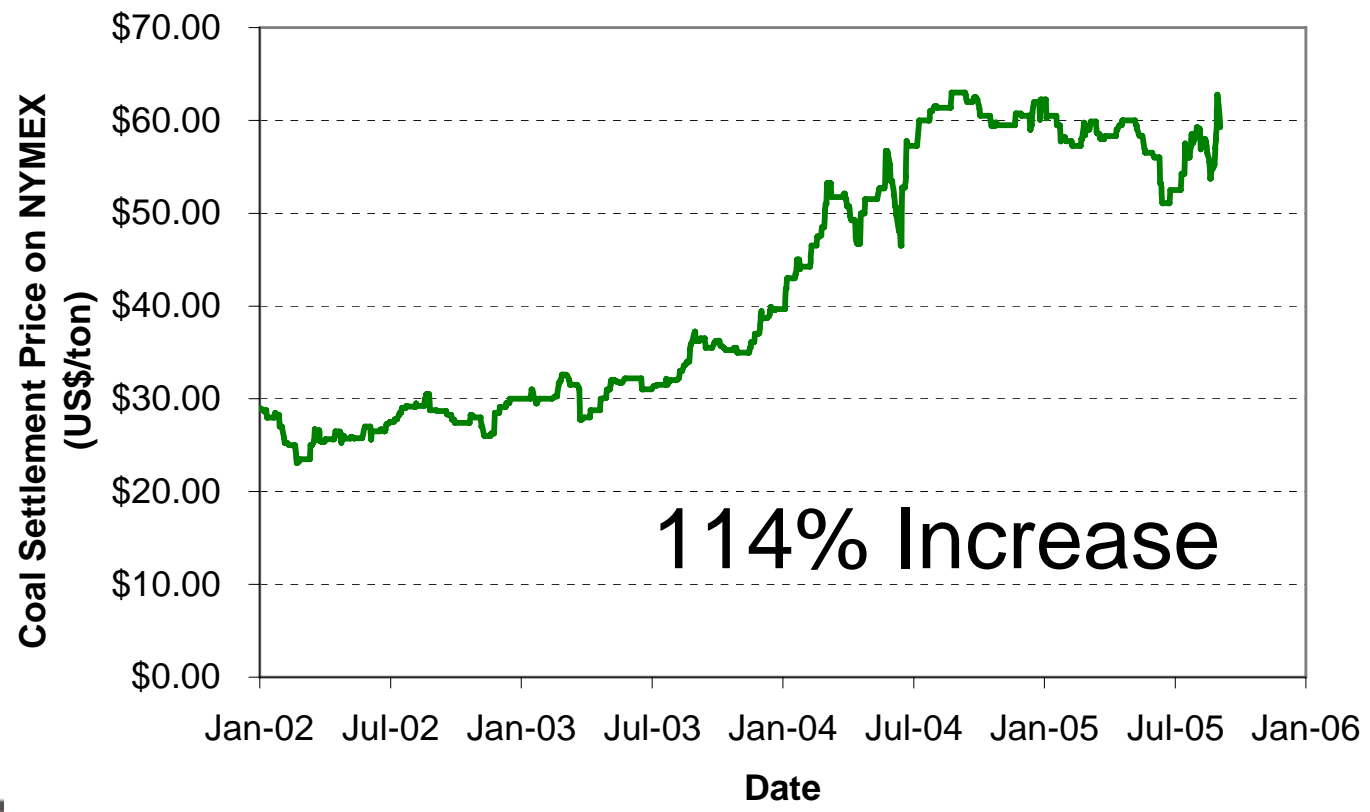
Cost of Natural Gas

2002-Present



Cost of Coal

2002-Present



Present Energy Costs

- Natural Gas – Henry Hub - \$8.93/MMBtu
- Central Appalachian Coal - \$64.25/ton - \$2.57/MMBtu + Transportation
- PRB – \$12.25/ton - \$0.70/MMBtu + Transportation
- Wood Waste – \$10/ton - \$1.25/MMBtu



Ethanol Plant Energy Requirements (50 Million Gallons/Yr.)

- Corn Plant: Steam – 220 MMBtu/hr heat input, 6.5 MW electricity input
- Cellulosic Plant: Steam – 299 MMBtu/hr heat input, 4.5 MW electricity input



Biomass Plant Opportunities

- Direct Combustion – Power/Steam
- Gasification – Replacement Fuel
- Landfill Gas
- Anerobic Digestion



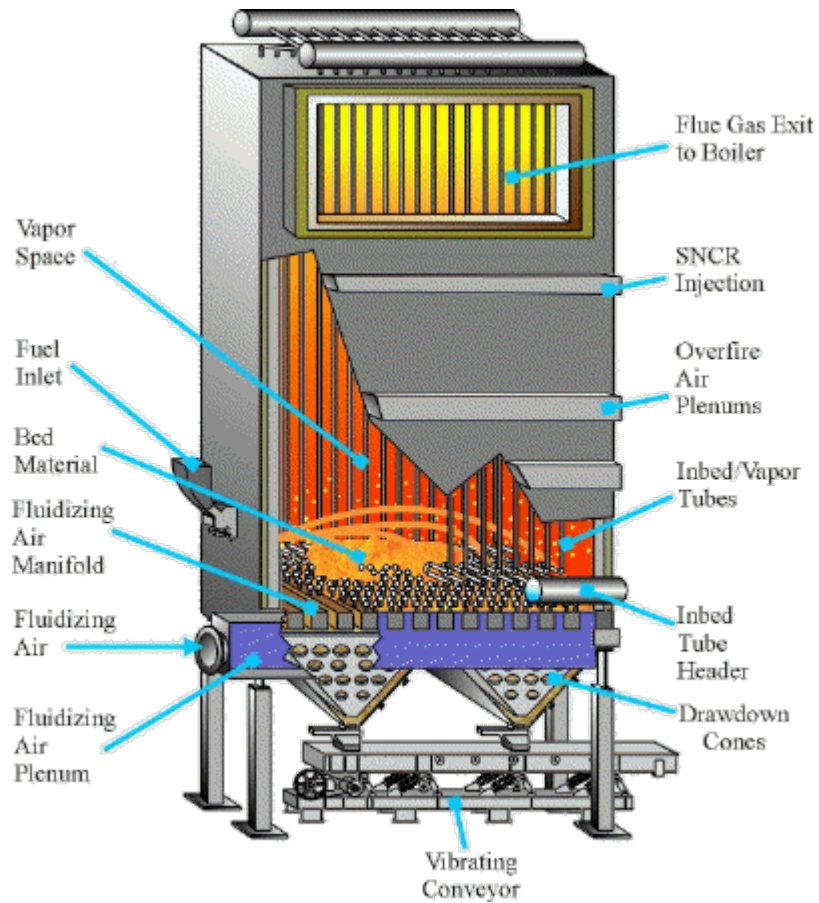
McNeil Generation Plant

(Burlington, VT – Biomass Boiler)



Fluidized Bed – Coal/Solid Fuels

(Source – EPI)

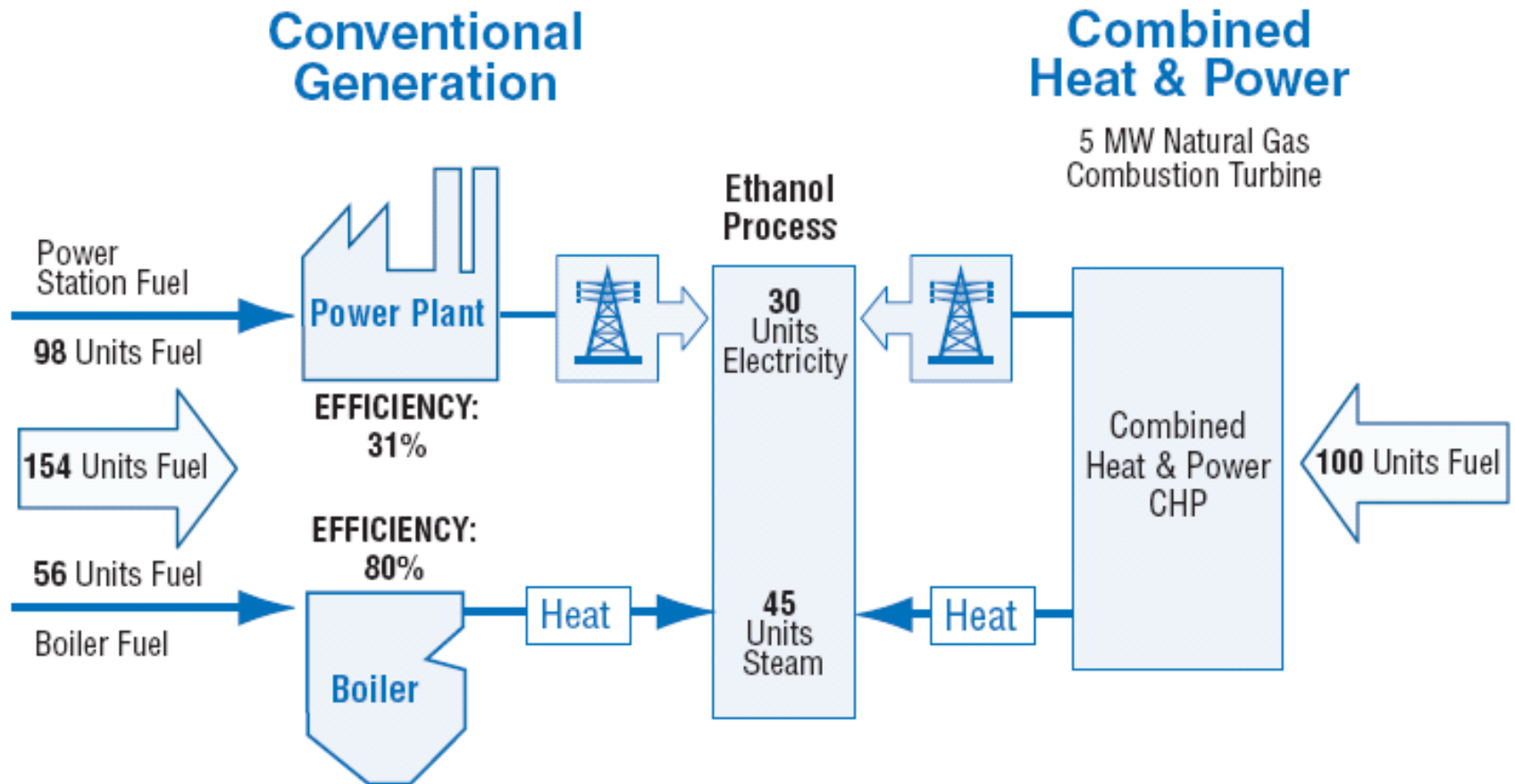


Combined Heat & Power – Ethanol Plants

- Adkins Energy, LLC; Lena, Illinois; 5 MW gas turbine
- U.S. Energy Partners, LLC; Russell, Kansas; two 7.5 MW gas turbines
- Northeast Missouri Grain, LLC; Macon, Missouri; 10 MW gas turbine
- Otter Creek Ethanol; Ashton, Iowa; 7 MW gas turbine
- East Kansas Agri Ethanol; Garnett, Kansas; 1 MW recuperative thermal oxidizer/steam turbine



Combined Heat & Power Illustration



49% OVERALL EFFICIENCY

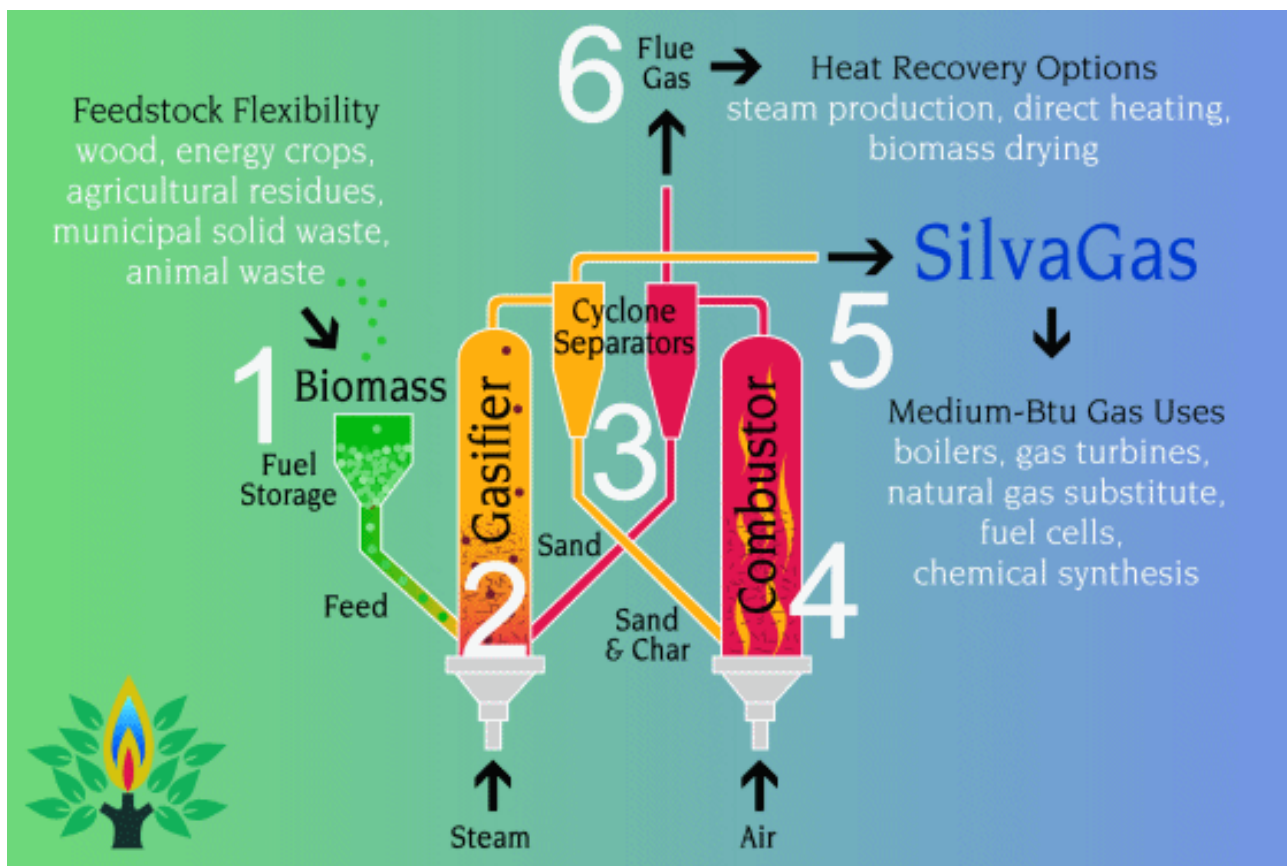
75% OVERALL EFFICIENCY

Tests - CHP

- Do you use more than 20,000 pounds per hour of steam?
- Do you pay more than 6 cents per kWh for electricity?
- Is reliable high-quality power important?
- Is it important to reduce energy costs and increase the overall energy efficiency of your ethanol process?
- Are biomass or alternative fuels readily available near your site?
- Do you want to increase your plant's environmental performance?



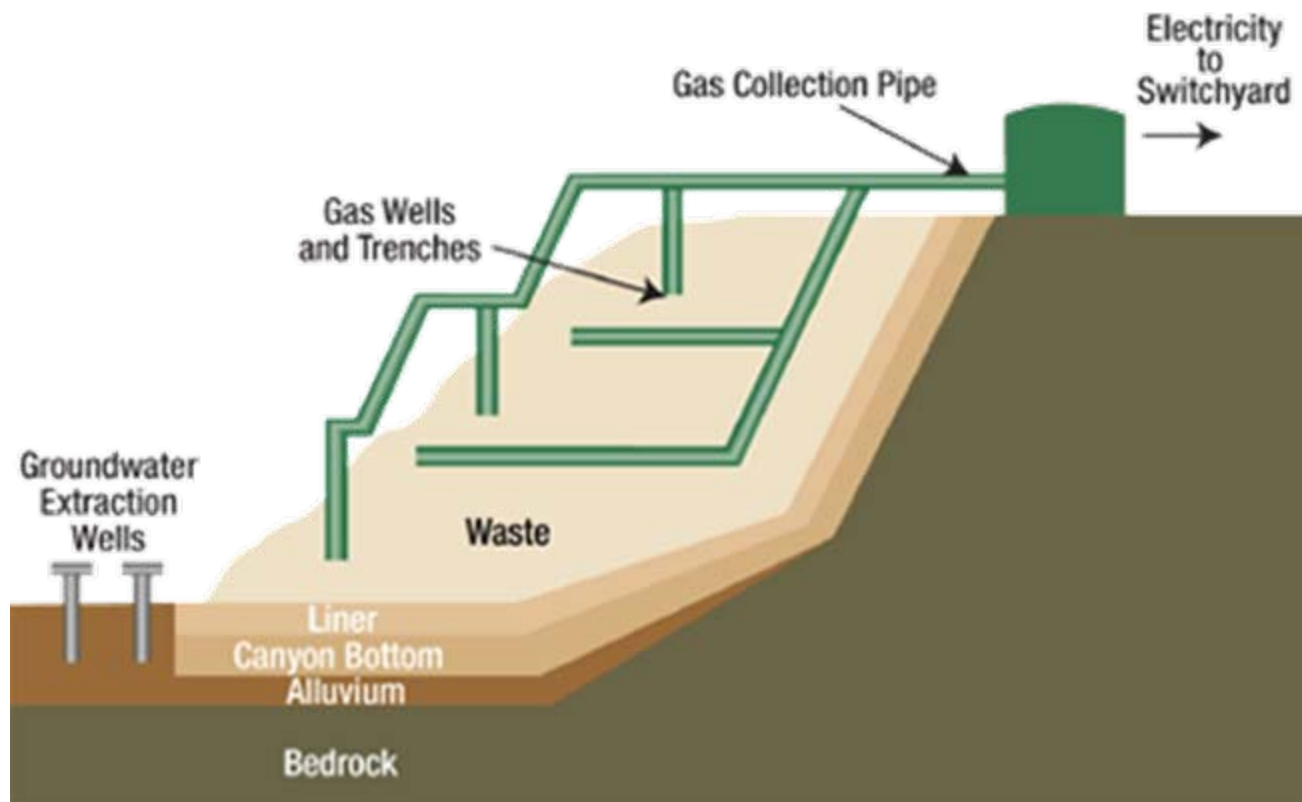
SilvaGas™ Process



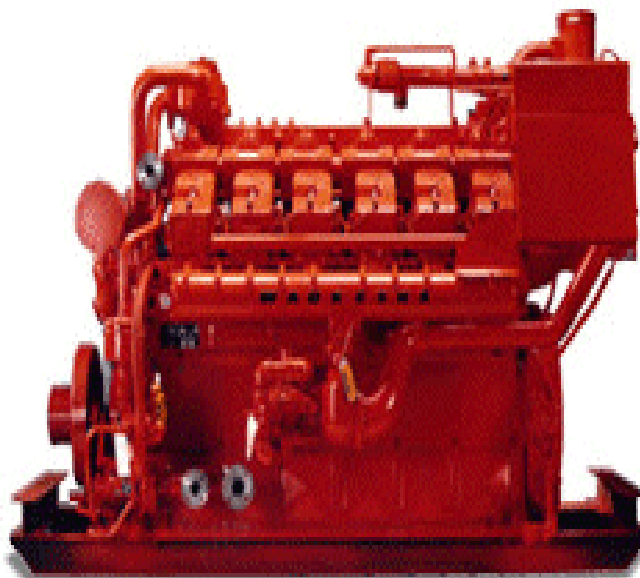
SEI Gasifier Plant Quincy, Florida



Landfill Gas – Engine Fuel



Waukesha Landfill Gas Engine



Source: Dresser Inc.



Anaerobic Digester Brazil Ethanol Plant

(Source: NREL)



SI Engine – Digester System

(Source: NREL)



Conclusions – Ethanol Plant Energy Input

- Gas/Oil Fuel – Low First Cost (Boiler) – High Fuel Price Volatility
- Coal Fuel – More Expensive Energy Plant – More Predictable Fuel Cost
- Coal – Harder to Permit, Rail Access Needed
- Alternative/Residue Fuels – Should be considered
- Cogeneration/CHP – Should be considered

