COAL TO LIQUID

WHAT WE KNOW

AND

WHAT WE DON’T KNOW

CARBON

- COAL IS CARBON INTENSIVE
- LIFE CYCLE – CTL W/O CCS PRODUCES 2X THE GHG AS PETROLEUM
  - MIT FUTURE OF COAL REPORT: “WITHOUT CCS, F-T SYNTHESIS OF LIQUID FUELS EMITS ABOUT 150% MORE CO2 AS COMPARED WITH THE USE OF CRUDE OIL DERIVED PRODUCTS”
- LIFE CYCLE – CTL W/CCS PRODUCES A SIMILAR AMOUNT OF GHG AS PETROLEUM
- - ARGONNE NATIONAL LAB: WITH 85% CCS, CTL 20% GREATER GHG EMISSIONS THAN PETROLEUM DIESEL

CLIMATE CHANGE CONCERNS

- CRITICAL QUESTION:

  IS CTL DEVELOPMENT COMPATIABLE WITH NECESSARY GHG REDUCTIONS IN ORDER TO STAVE OFF CATASTROPHIC CLIMATE CHANGE?

NEEDED REDUCTIONS IN GHG

- 50% REDUCTION IN GLOBAL GHG EMISSIONS BY 2050
- 80% REDUCTION IN INDUSTRIALIZED COUNTRIES' GHG EMISSIONS BY 2050
- REDUCTIONS IN ALL SECTORS BUT ESPECIALLY POWER AND TRANSPORT

CARBON

- COAL REQUIREMENTS

- 1 TON COAL → 1 BARREL CTL FUEL
- 1 TON COAL → 2 BARRELS CTL FUEL

- 50,000 B/D PLANT → 42,500 B/D (x .85)
  42,500 TONS PER DAY OF COAL OR
  15.51 MILLION TONS OF COAL PER YEAR

- 2005 MT PRODUCTION – 40.4 MILLION TONS

CTL PLANT REQUIREMENTS

- INFRASTRUCTURE

1. 500 TO 1000 ACRES
2. COAL SUPPLY
3. RAIL TRANSPORT (LIKELY)
4. WATER SUPPLY
5. PIPELINE FOR PRODUCT AND CO2
6. TRANSMISSION LINE

COST/CARBON ISSUE

- PLANTS EXPENSIVE
- LIKELIHOOD OF FUTURE CARBON REGULATION
- VERY DIFFICULT TO FINANCE PROJECTS

IS THERE ENOUGH COAL?

- Present estimates of coal reserves are based upon methods that have not been reviewed or revised since their inception in 1974, and much of the input data were compiled in the early 1970s. Recent programs to assess reserves in limited areas using updated methods indicate that only a small fraction of previously estimated reserves are actually mineable reserves. Such findings emphasize the need for a reinvigorated coal reserve assessment program using modern methods and technologies to provide a sound basis for informed decision-making.

  National Research Council, "*Coal: Research and Development to Support National Energy Policy*," Washington, DC, 2007

ENOUGH COAL?

- A RECENT RESURVEY OF WESTERN COAL MINES BY USGS INDICATES THAT ESTIMATES MAY BE OFF CONSIDERABLY (AS LOW AS 0.3 TIMES OR AS HIGH AS 1.6 TIMES).
- MONTANA HAS ESTIMATED RECOVERABLE RESERVES OF ABOUT 70 BILLION TONS.

ENOUGH COAL?

- "The fact that if prospective supplies turn out to be at the low end of this uncertain range there would be essentially no room for new coal uses such as CTL …."

R. Williams, Western Governors Association, "Coal to Liquids" (November 2007) (Draft)

IS THERE ENOUGH PORE SPACE?

- CCS
- “Worldwide, it is virtually certain that there is 200 Gt CO2 of geologic storage capacity and likely that there is at least 2000 Gt CO2 of geologic storage capacity.”

  IPCC, SPECIAL REPORT ON CCS (2005).
- LOWER NUMBER MAY PRECLUDE THE DEVELOPMENT OF A SIGNIFICANT CTL INDUSTRY.

IS THERE ENOUGH WATER

- WESTERN WATER CONSTRAINTS:

1. LIMITED EXISTING SUPPLIES
2. CONTINUED PRESSURE ON SUPPLIES FROM POPULATION GROWTH AND ECONOMIC ACTIVITY
3. CLIMATE CHANGE WILL LIKELY RESULT IN DIMINSHED PRECIPITATION IN THE WEST

CONCERNS ABOUT WATER

- "The withdrawal and consumption of water in regions where water is not abundant for coal mining, CTL production, and oil shale development necessitates competition with other industries and public consumption."

NETL "Emerging Issues for Fossil Energy and Water" June 2006

CONCERNS ABOUT WATER

- “The environmental impacts associated with certain types of coal mining and water usage requirements, especially in the West, may limit the number of locations at which F-T coal-to-liquid plants can be operated.”

  James Bartis, Rand Corporation, testimony Senate Energy and Natural Resources Committee (2007)

NEED FOR WATER

- PROCESS WATER
- BOILER FEED/BLOWDOWN
- COOLING

WATER DETERMINANTS

- CLIMATE (TEMPERATURE AND ARIDITY)
- COAL MOISTURE CONTENT
- PLANT EQUIPMENT (TYPE OF GASIFIER)
- PLANT DESIGN

WATER ESTIMATES

- 5 TO 1 (Bechtel 1998)
- 4.9 TO 1 (Parsons 2005)
- 14.5 TO 1 (BITUMINOUS) (INL 2007)
- 12 TO 1 (SUB-BITUMINOUS) (INL 2007)
- 1.5 TO 1 (Rand 2007)
- 1 TO 1 (Rentech, STATE OF WY 2005)

WATER SAVING MEASURES

- AIR COOLING
- HIGH EFFICIENCY REVERSE OSMOSIS
- CLOSED LOOP SYSTEMS

- TECHNOLOGICAL FRONTIER
- COSTLY
- HOW COSTLY IS UNCLEAR

WATER USE COMPARISONS

- 5 TO 1 WATER TO PRODUCT RATIO

  20,000 BPD – 3.6 MMGal/day
  50,000 BPD – 8.9 MMGal/day

  CITY OF HELENA (27,000) – 5.2 MMGal/day

  CITY OF BILLINGS (102,000) – 20.5 MMGal/day

CAPTURE RATE

- DOE NETL – >85% OF CARBON PRODUCED AT THE PLANT
- INDUSTRY – 50% TO 65% CAPTURE RATE

ARE THERE BETTER OPTIONS?

- MUCH BETTER VEHICLE EFFICIENCY

  THE AVERAGE NEW VEHICLE TODAY GETS WORSE MILEAGE THAN IN HENRY FORD'S DAY
- PLUG-IN HYBRIDS
- SMART GROWTH
- BIOFUELS