Forum on the Environment: Emerging Energy Technology

Brent Sheets
Arctic Energy Office, Fairbanks, AK

Feb 10, 2010
National Energy Technology Laboratory
Where Energy Challenges Converge and Energy Solutions Emerge

- Only government owned, government operated DOE national lab
- One lab, three research sites
- >1,200 Federal and support-contractor employees
- Research spans fundamental science to technology demonstrations

Oregon

Pennsylvania

West Virginia
NETL Locations

- Pittsburgh, PA
- Morgantown, WV
- Houston, TX
- Fairbanks, AK
- Albany, OR
Arctic Energy Office Mission
(Public Law 106-398)

• Fossil Energy:
  – Promote research, development and deployment of oil recovery, gas-to-liquids and natural gas production & transportation

• Remote Power:
  – Promote research, development and deployment of electric power in arctic climates, including fossil, wind, geothermal, fuel cells, and small hydroelectric facilities
Work funded by the U.S. Department of Energy, National Energy Technology Laboratory's Arctic Energy Office, Fairbanks, AK
## Summary of Alaska Projects

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Summary of Alaska Projects

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- Bristol Bay oil potential
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A Few Drivers for Technology Development

- Demand for more energy
- Economics
  - Lower costs
  - Scalability
- Environmental issues and regulations
Alaska’s Energy Consumption by Fuel Type

- Gas (62%)
- Hydro Power (19%)
- Oil (10%)
- Coal (9%)

Fossil Energy Will Continue to Dominate

Energy Demand Today

- 101 QBtu / Year
  - 85% Fossil Energy
  - United States: 101 QBtu / Year, 85% Fossil Energy
  - 453 QBtu / Year
    - 81% Fossil Energy
    - World: 453 QBtu / Year, 81% Fossil Energy

Energy Demand 2030

- 118 QBtu / Year
  - 82% Fossil Energy
  - United States: 118 QBtu / Year, 82% Fossil Energy
  - 703 QBtu / Year
    - 82% Fossil Energy
    - World: 703 QBtu / Year, 82% Fossil Energy

U.S. Endowment of Solid, Liquid, and Gaseous Fuels Resources

98.6% of energy potential requires advanced technology and additional exploration

Total U.S. technically and economically recoverable
+ 400 coal
+ 226 “SSEB coal survey”
+ 22 petroleum
+ 32 natural gas
680 billion b.o.e. (1.4% of total)

Methane Hydrates

Oil Shale

Alaskan Undiscovered Coal
Undiscovered Coal 1974
Inferred Coal sub-economic

Remaining Light Oil
Remaining Heavy Oil
Oil Reserve Growth, Undiscovered, Transition
Oil (Tar) Sands

51 trillion barrels of oil equivalent
Alaska’s Energy Resources
Comparing Equivalent Energies

- Oil (6%) Discovered and Undiscovered
- Gas (3%) Discovered and Undiscovered Resources
- Coal (91%) Identified Resources
  171 Billion Tons

Oil & Gas Data Source: Alaska DNR/DOG, 3/20/01
Coal Data Source: Alaska DNR/DGGS Special Report #37, 1986
View of Potential U.S. Coal Resources

- **Estimated Recoverable Reserves**: adds 133 years to 236 years = 369 years @1.13 billion st/yr
- **770**
- Adds 125 billion tons (+55%) to non-economic DRB
- **1,993**
- **2,237**
- **1,223**
- **151**
- **267**

**Inferred**

- **7,602**
- Adds 5,365 billion tons (+240%) to Total Undiscovered (Alaska hypothetical)
- **Total 9,595 (+143%)**
- Billion short tons

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USGS Estimate

- Demonstrated Reserve Base (DRB)
- Undiscovered
- Total Estimated Reserve

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Alaska Fossil-Based Opportunities

- Affordable resource assessment technologies
  - Aerial/Satellite imagery
  - Seismic
  - Small coring/drilling rigs
- Propane/CNG for villages
- Conventional & Unconventional Natural Gas
- Transmission Lines
- Gas to Liq. & Coal to Liq.
- Small-scale technology for coal (& biomass) utilization
Technology for Resource Assessment
Propane or CNG

Alaska Natural Gas Development Authority (ANGDA) is Pursuing a project to provide propane to villages

- Home heating & cooking
- Transportation
- Power generation
Conventional & Unconventional Natural Gas

DGGS seismic shoot at Fort Yukon, 2001.

*Photo’s courtesy Jim Clough, DGGS*
Gas-to-Liquids or Coal-to-Liquids

Building Blocks for Chemical Industry

Clean Electricity

Transportation Fuels (FT-diesel or Hydrogen)
Gasification Products

Feed → Gasification Facility → Syngas → Combined Cycle

- Argon, Nitrogen, & Oxygen
- Carbon Dioxide
- Sulfur / Sulfuric Acid
- Steam
- Hot Water
- Electricity
- Hydrogen
- Carbon Monoxide
- Ammonia-based Fertilizer
- Synthetic Natural Gas
- Industrial Chemicals
- Methanol / Ethanol
- Naphtha
- High Cetane Diesel
- Jet Fuel
- Wax

Slag for Construction Materials → Fischer Tropsch Synthesis
Transmission Lines
PFBC Elevation View-Broadside
(300 MWe/Bituminous Coal/Barge)

Max Height: 240 ft above main deck
Nome Region Energy Assessment
Typical Site for Barge-Based PFBC Power Unit (140 MWe Unit Shown)

Landside facilities required: coal pile, switchyard, etc.
Nome Electrical Energy Averages
Mid-Case Escalation (in 2007 $$)

In Constant 2007 Dollars (no inflation – just price escalation) with mid diesel escalation

Diesel -Mid
Diesel - High
Coal $63/ton
Coal $78/ton
Wind
Geothermal
Natural Gas

In Constant 2007 Dollars (no inflation – just price escalation) with mid diesel escalation
Nome Electrical Energy Averages
High-Case Escalation (in 2007 $$)

In Constant 2007 Dollars (no inflation – just price escalation) with high diesel escalation
Technology Alone
Will Not Result in Development

• The following must be a part of any plan to successfully implement new energy technology:
  – Policy
  – Human Resources
  – Impacts on People
  – Impacts on Environment
  – Infrastructure, including distribution
  – Economics
Visit Our Websites

Office of Fossil Energy
www.fe.doe.gov

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www.netl.doe.gov