SLIDES: U.S. Shale Gas: Resources, Reserves and $$$

John B. Curtis
U.S. Shale Gas

Resources, Reserves and $$$

John B. Curtis
Potential Gas Agency
Colorado School of Mines
Oil Shale Gas Hydrates

Tight Gas Sands; CBM; Gas Shales

Tight Oil; Heavy Oil; Bituminous Sands

Oil Shale

Gas Hydrates

Conventional Reservoirs: Small Volumes, Easy to Develop

Unconventional Reservoirs: Large Volumes, Hard to Develop

Huge Volumes, Difficult to Develop

Increasing Product Price

Improving Technology

Province Resource Size

(S. Sonnenberg, CSM)
Shale Gas Annual Production and Energy Information Administration (EIA) Forecast

Annual Production, Bcf

EIA Projection

CUM

EnCana
Targeted Research – $150 Million
Acquisitions – >$50 Billion

Source: Trollart.com – Ray Troll
Resource Development – >$15 Billion
Hydrocarbons From Shale – Never Say Die

Growth in Barnett Shale - Ft. Worth Basin

- Gas Production
- Well Count

Annual Production, Bcf

- 1980
- 1982
- 1984
- 1986
- 1988
- 1990
- 1992
- 1994
- 1996
- 1998
- 2000
- 2002
- 2004

Producing Wells

- 0
- 500
- 1,000
- 1,500
- 2,000
- 2,500
- 3,000
- 3,500
- 4,000
- 4,500
- 5,000
Schematic geology of natural gas resources

- Conventional non-associated gas
- Land surface
- Coalbed methane
- Conventional associated gas
- Seal
- Sandstone
- Tight sand gas
- Gas-rich shale
- Oil

U.S. Energy Information Administration
Shale Gas Reservoir Mechanisms

Stage 1: Desorption From Internal Surfaces
Stage 2: Flow Through the Matrix
Stage 3: Flow in the Natural Fracture Network

Natural Fracture Network
Exploration Considerations

- Natural fractures - Friend or Foe?
- Facies changes - greater permeability
- Kerogen type - I, II, IIS, III
- Microbial or thermogenic gas?
- Thermal maturation history
- MWD - especially w/ gas isotopes
Some Elements of a Successful Shale Gas Play

- Organic Richness
- Maturation
- Thickness
- Gas-In-Place
- Mineralogy
- Permeability
- Brittleness
- Pore Pressure

Productivity
Potential Supply of Natural Gas in the United States

Report of the Potential Gas Committee
(December 31, 2008)
Regional Resource Assessment

Data source: Potential Gas Committee (2009)

- Traditional: 1,673.4 Tcf
- Coalbed: 163.0 Tcf
- Total U.S.: 1,836.4 Tcf

Map of the United States showing regional gas resources:
- Rocky Mountain: 374.4 Tcf (51.9%)
- Pacific: 51.3 Tcf (2.6%)
- North Central: 24.0 Tcf (16.6%)
- Atlantic: 353.5 Tcf (17.3%)
- Mid-Continent: 274.9 Tcf (51.9%)
- Gulf Coast: 455.2 Tcf (3.4%)
- Alaska: 193.8 Tcf (57.0%)
PGC Resource Assessments, 1990-2008

Total Potential Gas Resources (mean values)

Data source: Potential Gas Committee (2009)

- Coalbed gas resources
- Traditional gas resources

shale gas (615.9 Tcf)
Possible Constraints on Future Gas Supply

- Sufficient Supply to Meet Demand
- Resource Base
- Environmental Concerns
- Skilled Workforce
- Technology
- Gas Price
- Pipeline Capacity
- Regulatory & Land Issues
- Rig Availability
Potential Gas Agency