Tight Gas in Western Canada:
An Important and Continuing Component of
Overall Supply


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Agenda

• Introduction
• WCSB Gas Supply Challenge
• Unconventional Gas
• CBM/Shale
• WCSB Tight Gas
  – Shallow
  – Jean Marie
  – Deep Basin
• Summary
Tight Gas in Western Canada

Forward Energy Group Inc

Planning
Investments

GOALS

STRATEGIES

TACTICS

Portfolio

Plays

Properties

Prospects

Projects

Discovery

Recovery

Better information for strategic decisions

Geographic Regions

- SW Saskatchewan (137)
- NW Saskatchewan (254)
- BC Plains (545)
- NW Alberta (699)
- NE Alberta (512)
- Central Alberta (733)
- EC Alberta (349)
- SE Alberta (744)
- Deep Basin (578)
- Foothills (227)

Geographic Regions modified from Petroleum Services Association of Canada

Natural Gas Supply Trends 1990 - 2002

Large and complex basin
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WCSB Production

- WCSB Production:
  - Recent peak at 16.9 Bcfd in 2001
  - Decreased to 16.5 Bcfd in 2003
  - Rebound to 16.7 Bcfd in 2004
- Alberta: dominant provincial source
- BC: only region with growth trend

- WCSB ultimate potential for ‘conventional’ natural gas: 290 Tcf (NEB/EUB)
- Unconventional resource potential: 300 – 1000s Tcf

Will production grow again, sustain or decline?
Supply Challenge: Sustain Production

- Total WCSB production flat at 16.7 Bcfd ± 0.2 Bcfd
- Decline in production from connected wells
- Rate additions from new wells onstream provide growth
- Wells onstream since 1989 produce 80% of gas

WCSB supplies 25% of consumption in US and Canada

How has industry responded?

- Connection activity reached record levels, above 14,000 connections, by the end of 2004
- Activity, and rate additions, responded to prices, cash flow, acquisition and capital markets, export capacity, etc.
Tight Gas in Western Canada

How big is the annual challenge?

- Supply additions were 1.7 Bcfd in 1990, peaking at 3.9 Bcfd in 2001; 3.7 Bcfd in 2004
- Shallow declines in early years; first year decline has increased from less than 30% to 40%
- Rate additions for all wells onstream in year is the peak monthly rate

Higher production rates require higher production replacement

WCSB Supply Additions

WCSB: Very large area, many producing plays, very active
More, but lower productivity, opportunities at the economic margin

- Rate added by new connections declined to 250 Mcfd per zone (2004)
- Threshold size of an economic well decreased as gas price and netback increased
- Expanded opportunity set: smaller, higher cost, lower quality, higher risk or more remote prospects

Supply Measures

Extrapolated recovery

Deliverability

Rate added
- the primary measure
- allocated by load factor-adjusted first 12 month rate

Discounted production
Plant gate marketable

Supply measures calculated from decline functions
What is Unconventional Gas?

To provide a comparison to the US production, we have adopted the US Energy Information Administration (EIA) definition of unconventional gas:

"Natural gas extracted from coalbeds (coalbed methane) and from low permeability sandstone and shale formations (tight sands and gas shales) is commonly referred to as unconventional gas. Most of these resources must be subjected to a significant degree of stimulation (e.g., hydraulic fracturing) or other "unconventional" production techniques to attain sufficiently economic levels of production."
Identification Issues

- U.S. agencies currently report natural gas production in the Lower 48 states from conventional and "unconventional" sources

- Canadian agencies do not (yet) distinguish production from tight sand or shale reservoirs from conventional gas production

- The Alberta EUB only recently began to identify production from coalbed methane wells separately

- Confidentiality provisions delay some information release, thus potentially obscuring more recent trends
Lower 48 gas production flat at 50-52 Bcfd; WCSB plateau at 16-17 Bcfd
CBM and shale gas in WCSB not yet on radar
3 major plays for Tight* gas in WCSB
Tight gas in lower 48 at 20% of total 2004 production vs 28% contribution in WCSB
Conventional* gas in decline

WCSB Unconventional Gas
2004 gas rates
- Shale: nil
- CBM: 60 MMcfd
- Tight*: 5.0 Bcfd
- Conventional*: 11.6 Bcfd

Tight* gas: Selected three plays as examples where tight gas dominates
With decline in conventional, tight gas becoming greater share of the mix

Tight gas – currently 30% of WCSB output
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Coalbed Methane in WCSB

• Resource potential: 300-400 Tcf gas in place; 10-20 Tcf recoverable (various sources)

• Recent startup – WCSB production at 170 MMcfd

• Only commercial production to date from the Horseshoe Canyon coals, in Alberta

• Experimental pilots operating in BC and in Alberta – production levels not yet material
CBM plays in Alberta

- Horseshoe Canyon and Belly River coals
  - Upper Cretaceous
  - Typically dry gas production
  - Focus of most of current activity

- Ardley (Scollard)
  - Upper Cretaceous
  - Limited activity to date

- Mannville Group
  - Lower Cretaceous
  - Often with associated water
  - Experimental pilots, results often confidential

Coalbed Methane Production

- Production rate increasing dramatically
  - 60 MMcfd annual average in 2004
  - 110 MMcfd exit rate – Dec04
  - 170 MMcfd est. rate – Jun05

- CBM now contributing 1% of total WCSB

- Recent start; high growth rates
- 3000+ wells drilled to date; 1000 wells onstream by end Dec04 (EUB designation)
Coalbed Methane Opportunities and Challenges

- Significant resource potential

- Value drivers increasing with strengthening of commodity prices and technology improvements

- Due to their location, CBM properties often have the benefit of existing infrastructure and stakeholder familiarity

- Surface land and land user impacts

- Major challenges
  - sufficient resources of permeability-thickness
  - (the cost of) water handling

Shale Gas in WCSB

- No current recognized gas production from shale zones

- Values for resource estimates $\rightarrow$ large numbers

- Experimental work being undertaken – results are confidential

- Some production occurring as commingled production with sand stringers, whether inadvertent or planned
What is Tight Gas?

- In the US, “tight gas reservoirs generally are defined as gas-bearing rocks with an in-situ permeability to gas of less than 0.1 md” (Spencer, 1989)

- Since in-situ permeability data is not publicly reported for gas zones in the WCSB, we have estimated tight gas production on the basis of a number of criteria, including stratigraphic group, geographic region, the occurrence of fracture stimulation or horizontal drilling and depth
For the purpose of this analysis, we illustrate three types of tight gas plays, as examples:
- Shallow (SE Alberta/SW Sask.)
- Jean Marie
- Deep Basin

The key uncertainty is the proportion of tight gas production from fracture-stimulated Mesozoic zones deeper than 6000 feet

Three tight gas plays – all on growth trends

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Shallow: SE Alberta/SW Saskatchewan

- Shallow fracture-stimulated, low-permeability Upper Cretaceous reservoirs in the Sweetgrass Arch area of southeast Alberta and southwest Saskatchewan
- Well depth: 2000-2500 ft, predominantly vertical
- 2004 production: 1.7 Bcfd in 2004, 10% of WCSB production
- 95% of the over 33,000+ events connected since 1990 have been fracture stimulated
Shallow Tight Production

- Intense activity: 1.8 Bcfd from 66,000+ wells onstream (to Apr05)
- Average well rate: 33 Mcfd
- Steady production to 2000, 9%/year growth rate since

Shallow Tight Gas Rate Additions

- 5000+ new wells connected each year
- Supply additions increasing to 350 MMcfd/year, above the annual loss due to decline (~150 MMcfd)

Resource play: continuous activity to keep production rate going
Shallow: Operators

- EnCana largest operator, by far; 1.0 Bcfd (42% of total play)
- EOG second largest, but only 8% of volume
- Nearly 200 other operators share the activity
- Variance in average rate per well reflects internal play diversity

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Jean Marie

- Gas-charged, under-pressured shelf carbonates of the Devonian Jean Marie Formation in NE British Columbia, typically drained by horizontal wells

- Well depth: 4000-4500 ft – TVD:
- Horizontal leg length: average 2900 ft, up to 5000 ft

- Jean Marie sources produced about 0.5 Bcfd, 3% of 2004 WCSB production
Jean Marie Production

- 2004: 480 MMcfd from ~1000 wells onstream; average well rate: 480 Mcfd
- Very little base production; recent growth from application of technology

Jean Marie Rate Additions

- 250 new wells connected each year
- Supply additions nearly 200 MMcfd, above the loss due to decline
- Average initial rate decreasing – to 750 Mcfd/well in ‘04
Jean Marie: Horizontal Drilling

- Full scale deployment of horizontal, under balanced drilling technology, commencing in 1999, enhanced play development
- Over 95% of recent wells in Jean Marie play are horizontal
- Productivity of horizontal wells 20-100% better than vertical wells

Horizontal technology made this play

Jean Marie: Operators

- Jean Marie play characterized by few operators
- EnCana is the largest; nearly 450 MMcf/d, or 60% of the total
- CNRL and Devon operated 24% and 7%, respectively

EnCana dominates the Jean Marie play
Deep Basin

- Definition of the Deep Basin characteristics:
  - Gas charged area in west-central Alberta (and parts of BC), just east of the Foothills disturbed belt
  - Located in recent to Jurassic stratigraphic groups
  - Deeper than 6000 ft

- A large portion of these reservoir rocks are low permeability, or ‘tight’

- Well depth: 7000-11,000 ft; average 8400 ft; predominantly vertical

- The Deep Basin play produced about 2.6 Bcfd, 15% of 2004 WCSB production
Deep Basin Production

• Increasing activity: 2.9 Bcf/d from 7600+ wells onstream (to Apr05)
• Average well rate: 400 Mcfd
• Steady production growth from 1990, 7%/year compound annualized growth rate

Deep Basin tight gas: significant and growing
Deep Basin Fracture Stimulation

- A majority of the wells in this Deep Basin play are fracture stimulated
- 80-85% of these rate adds from fractured wells

Connection Activity by Deliverability Class

Extraordinary growth in the number of low rate (<0.5 MMcfd and 1-2 MMcfd) connections since 1995; number of connections in the higher rate classes has remained relatively constant

Rate Added by Deliverability Class

Rate additions from lower deliverability wells (<2.0 MMcfd) increased from 30% to 65% of annual rate additions

Pushing the marginal economic limit has lead to growth in overall rate additions from lower deliverability wells
Deep Basin: Operators

- Approximately 200 operators share the activity; no single operator dominates.
- Burlington largest operator; 1.0 Bcf/d (23% of total play).
- BP and CNRL second largest, but only 9% of volume each.

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Where To From Here?

- Outstanding issues:
  - No clear working definition of tight gas
  - Lack of accepted characterization of plays and resources
  - Size and scope of resource potential/opportunity is not agreed
  - Focus on enabling technologies not as well understood

- Resolution: Forward Energy is embarking on a tight gas characterization project
  - Multi-client
  - Wide support: industry, government, agency
  - Multi-year

Key Messages

- The WCSB is a large, diverse and dynamic basin; many opportunities available to all types and sizes of operators

- Unconventional gas is one of the few components of the WCSB with sustainable growth potential

- CBM is in relative infancy in Canada; tight gas is a continuing program

- Tight gas, developed through the resource play mechanism, is a major focus for selected operators

- Technology developments have been, and will continue to be a major factor in resource development
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