Deep Basin Tight Gas:
Resource Characterization, Assessment and Future Supply

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CSUG Canadian Society for Unconventional Gas

Forward ENERGY GROUP INC.

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Western Canada Tight Gas Resource Characterization Project

Natural Resources Canada - GSC

Devon Canada Corporation
Husky Oil Operations Ltd.
Imperial Oil Limited
Petrel Robertson Consulting Ltd.
Talisman Energy Inc.
TransCanada Pipelines Limited

NEB, CGPC, BCMEMPR, EUB, Sask IR, ARI, USGS, EIA

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Resource Models Differ

CONVENTIONAL	UNCONVENTIONAL
1. Discrete gas pools in ocean of water	1. Pervasive gas saturated accumulations
2. Only high quality reservoir accumulates gas in place	2. Very large gas in place in reservoir of all qualities
3. Discovery is uncertain, recovery is certain	3. Discovery is certain, recovery is uncertain
4. Discovery process is efficient	4. Recovery is inefficient but improves with technology
5. R&D to increase success	5. R&D to improve recovery and characterization
6. Remaining resource, in small undiscovered pools, is small	6. Remaining resource in lower quality reservoirs is large
7. Official view of WCSB remaining resources	7. US and industry view of WCSB remaining resources
"Glass is mostly empty"	*"Glass is mostly full"*

Test unconventional view of Deep Basin plays

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Outline

- Deep Basin plays
- Characterization
- Resource Estimates
- Supply Modelling
- Conclusions

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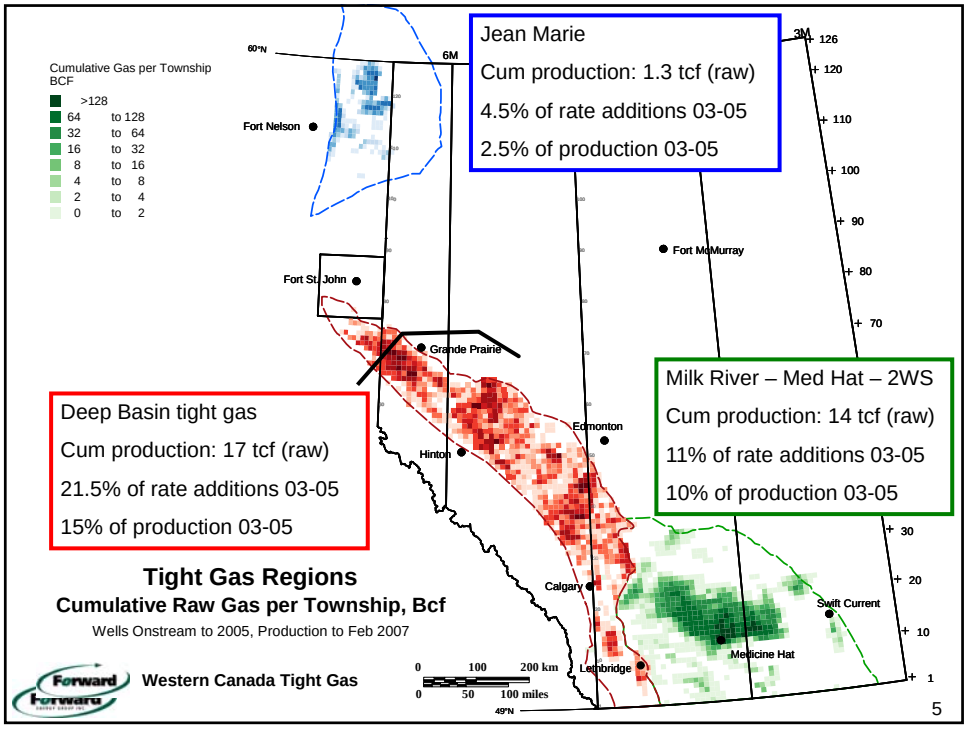
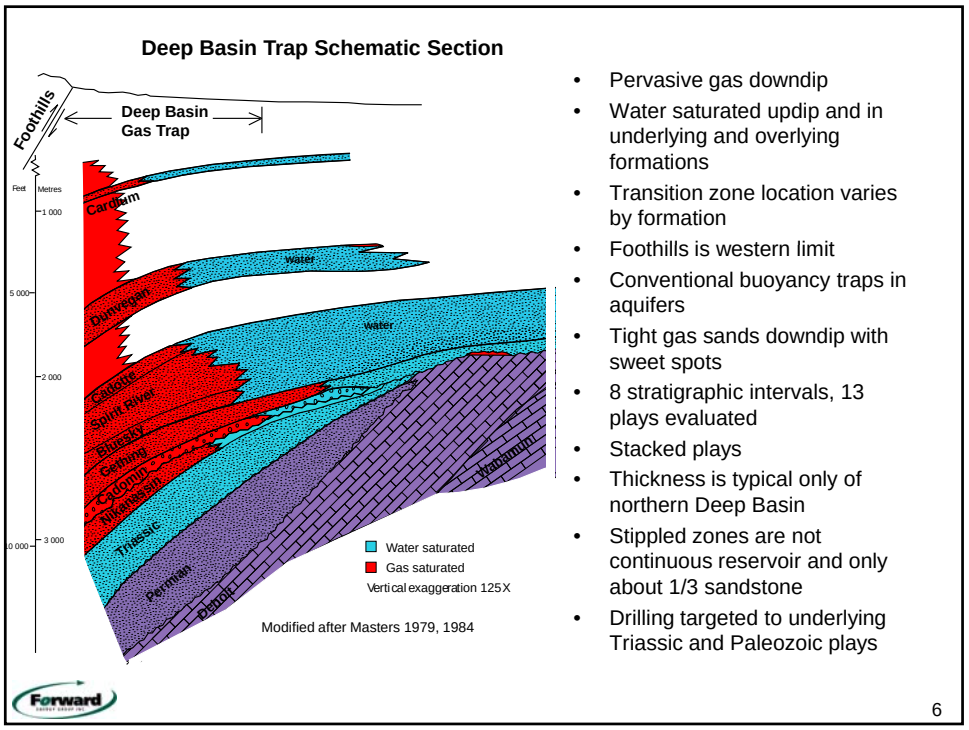
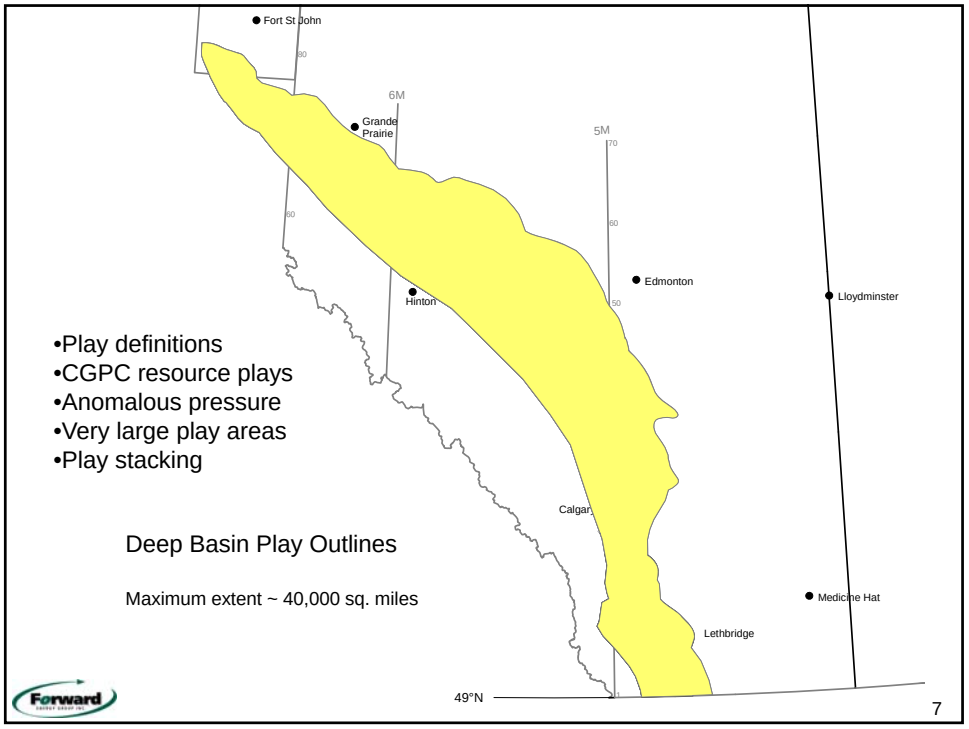
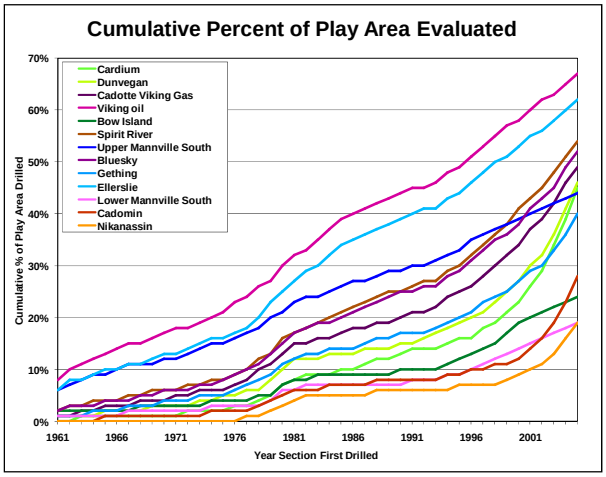




- Pervasive gas downdip
- Water saturated updip and in underlying and overlying formations
- Transition zone location varies by formation
- Foothills is western limit
- Conventional buoyancy traps in aquifers
- Tight gas sands downdip with sweet spots
- 8 stratigraphic intervals, 13 plays evaluated
- Stacked plays
- Thickness is typical only of northern Deep Basin
- Stippled zones are not continuous reservoir and only about 1/3 sandstone
- Drilling targeted to underlying Triassic and Paleozoic plays



Maturity Varies by Play



- Evaluated area varies from 18% to 67%
- Uncertainty increases for less mature plays
- Most wells have modern log suites
- Many wells drilled since the Deep Basin trap concept was described in 1970s

- Accelerating activity, particularly in northern plays, since 1992
- Drilled area of Cadomin play has tripled in last 10 years

Increasing activity targeted to Deep Basin tight gas

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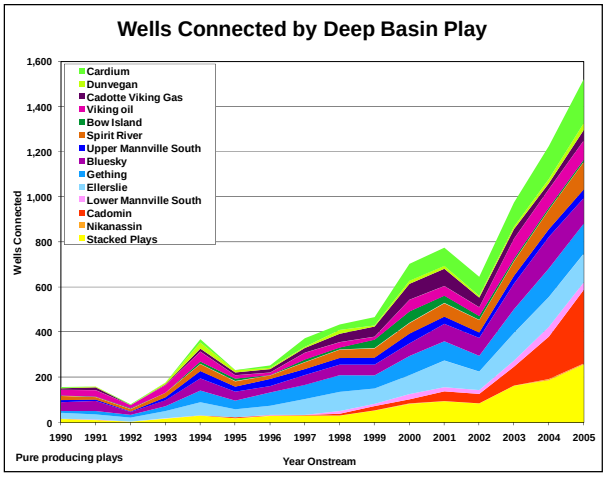
Gas Well Connections



- Total annual connections growing rapidly
- 28% growth rate from 2002 to 2006
- Cadomin, stacked plays and Cardium plays lead connection growth
- Declining connections in some plays: Cadotte and Bow Island

- Stacked play wells : segregated production from different plays or commingled production from two or more plays
- Stacked play wells average 13% of total connections

63% of all Deep Basin connections since 1998

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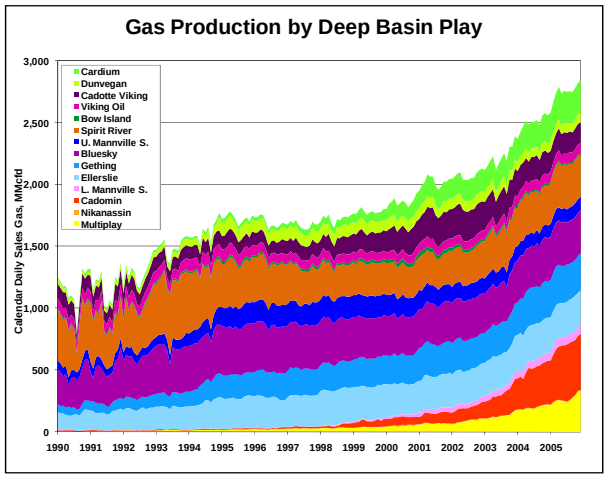
Gas Production



- Total production grew by over 1 Bcf/d since 1998
- 6% growth rate from 1998 to 2006
- Cadomin, Multiplay and Cardium plays lead production growth
- Declining production in some plays: Cadotte, Upper Mannville South and Bow Island

- Multiplay: commingled production from two or more plays where the primary producing zone cannot be distinguished
- Commingling regulations will result in far more Multiplay producers in future

2005 Deep Basin production: 1 Tcf per year

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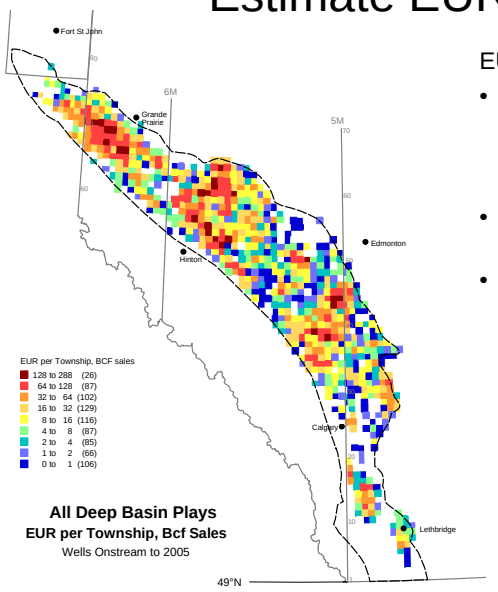
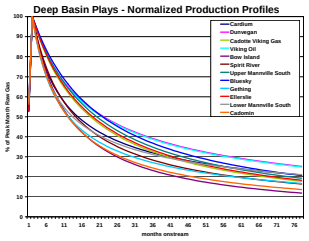
Estimate EUR per Well



EUR : Estimated Ultimate Recovery

- Calculate EUR using normalized production profile by play, current rate, producing time and cumulative production
- Normalized production profiles vary in shape between plays
- All profiles are hyperbolic with high initial decline rates



Almost 22 Tcf connected by 2005 in Deep Basin plays

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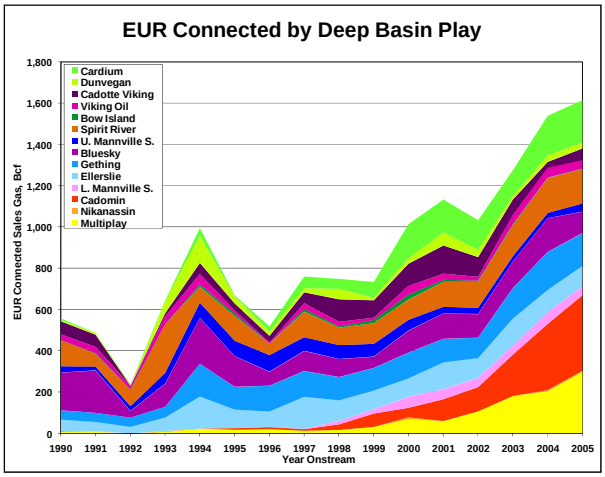
EUR Connected



- EUR connected growing
- Growth rate not as rapid as wells connected
- Cadomin, Multiplay and Cardium plays lead EUR connected growth
- Declining EUR connected in some plays: Cadotte, Upper Mannville South and Bow Island

- Multiplay: commingled production from two or more plays where the primary producing zone cannot be distinguished with publically available data
- Commingling regulations will result in far more Multiplay producers in future

Deep Basin EUR connected exceeds production

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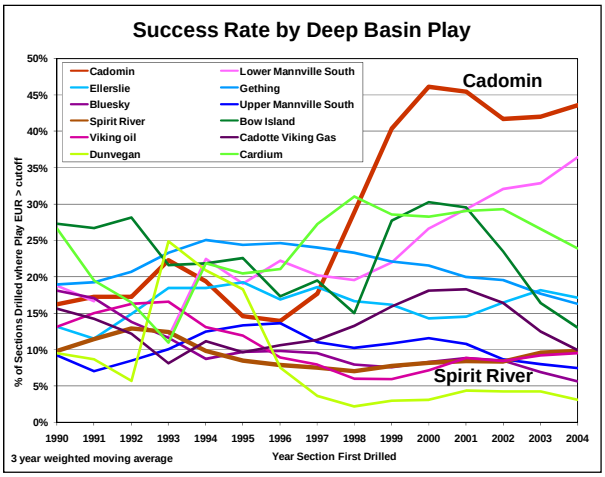
Success Rate



- Historical total success rates for individual plays are low relative to US tight gas plays
- Annual success rates have been fairly consistent through time
- Recent trend in the Cadomin is exception
- Success in any Deep Basin play: 35%

- Success: Section where at least one well drilled to the play has an EUR greater than a minimum EUR (commonly 0.25 Bcf)
- Multiplay success sections have been allocated to pure plays

Low success rates: discovery is uncertain!

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Resource Estimation Methods

- Discovery process models: “Law of diminishing returns”
  - Discrete pools in play where discovery history exists - CGPC
- GIP: “Dream the Big Dream”
  - Subsurface volumetric study from petrophysics and mapping
  - John Master’s 1984 estimate of 1500 Tcf GIP for Mannville in the Deep Basin trap!
- Cellular methods:
  - Extrapolate resources to undrilled areas based on well recovery, success rate and well spacing from drilled and evaluated areas
  - US EIA resource estimates for unconventional gas from USGS and Advanced Resources International (ARI)

Resources = (Area * Success / Spacing) * EUR/well

Area:	Undeveloped area
Success :	% of Undeveloped area EUR > cutoff
Spacing:	Average drainage area of wells
EUR/well:	Average EUR for successful well

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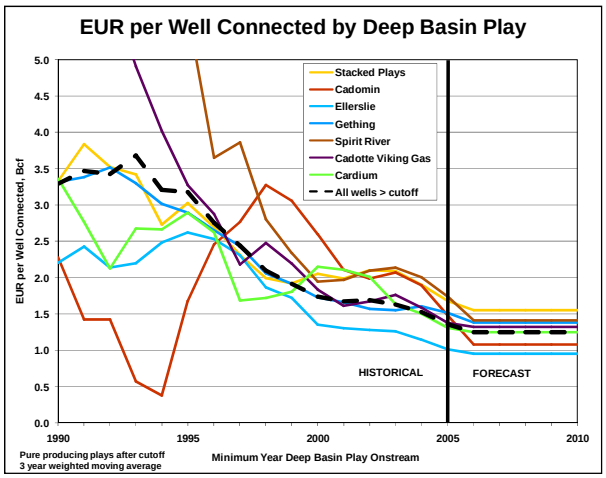
EUR per Well



- EUR per well decreased rapidly – from few high EUR wells to many lower EUR wells connected recently
- Decrease since 2000 has been relatively low – we believe improved technology is offsetting the decline trend
- Stacked play wells have slightly higher EUR per well than average

- EUR per well used in forecast is estimated from recently-connected wells
- Assume technology will maintain future average EUR per well constant

Trend driven by price and pursuit of marginal EUR

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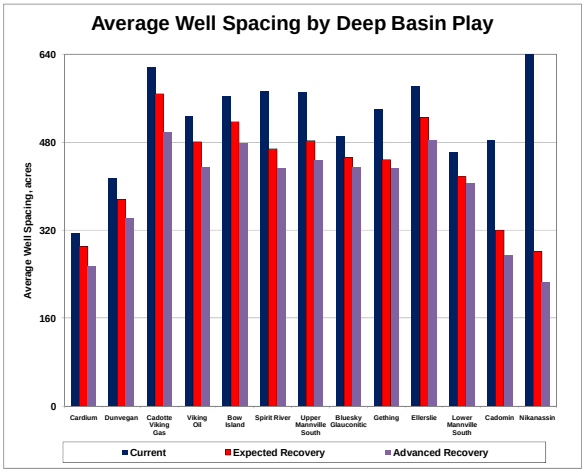
Well Spacing



- Most plays are currently drilled at 640 acres with minor downspacing
- Exceptions are Cardium, Dunvegan, Lower Mannville South and Cadomin
- Expected Recovery and Advanced Recovery scenarios envision incremental decreases in well spacing

- Contrasts with US tight gas plays where well spacing is 26 to 160 acres
- Are Deep Basin operators satisfied with current recovery of GIP?

Scenarios assume incremental downspacing

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Resource Estimation Scenarios

- Continuing Trends scenario
  - Undeveloped area will experience the historical success rate and well spacing but a lower mean EUR than recent drills
- Expected Recovery scenario
  - Incremental improvements: success rate is higher and well spacing is reduced resulting in more successful wells
- Advanced Recovery scenario
  - Significant improvements: success rate is higher, particularly for immature plays, and the trend to downspacing is extended
- EUR per well remains constant in all scenarios
  - Technology identifies and recovers same EUR from progressively lower quality reservoir
- Success rate increases and drainage area decreases
  - Lower quality reservoir will be recognized and completed as successfully productive
  - Reservoir characterization identifies downspacing opportunities

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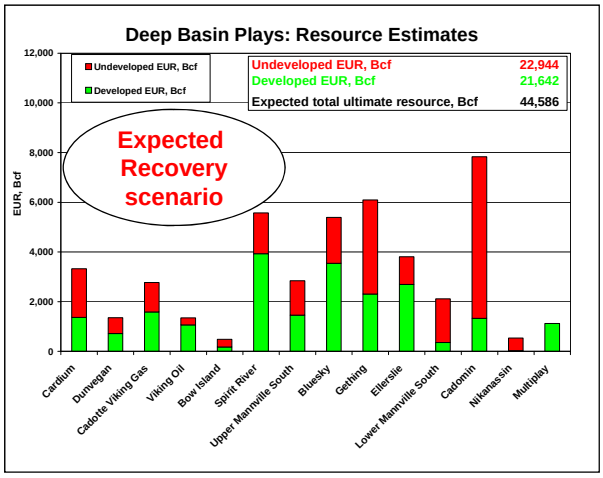
Deep Basin Resource Estimates



- 22 Tcf resource developed to 2005
- Under the Expected Recovery scenario: 23 Tcf undeveloped resource, to be connected from 2006
- Cadomin (6.5 Tcf) and Gething (3.8 Tcf) largest portions of undeveloped resource

- Continuing Trends scenario estimate: 16 Tcf
- Advanced Recovery scenario estimate: 30 Tcf

45 Tcf ultimate resource

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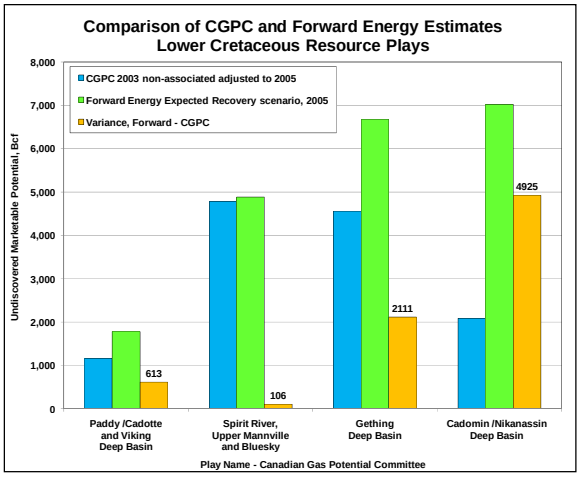
Comparison to CGPC



- Forward Energy Expected Recovery estimate is 20.3 Tcf vs 12.6 Tcf for CGPC
- Cadomin and Gething >90% of increase
- Most Cadomin reserves reporting post-dates the year-end 2003 reserves CGPC

- CGPC estimate based on 2003 year end reserves was factored to non-associated gas and adjusted by EUR connected 2004 to 2005

>60% increase in undeveloped resource

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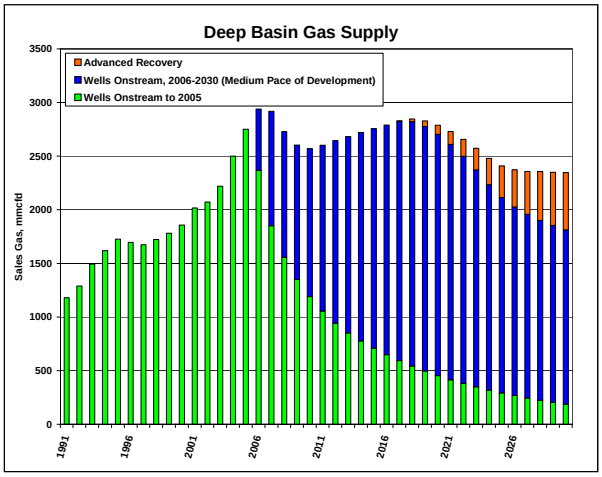
Gas Supply



- 10,000 wells onstream produced 14 Tcf to 2005; remaining EUR of 7 Tcf produced by 2030
- At a medium development pace, Deep Basin peak output (2.9 Bcfd) reached in 2006; long term rate stabilizes near 2.8 Bcfd
- Rate of supply constrained by finite volume of undeveloped resource (23 Tcf)

- With Advanced Recovery, technological advances improve success rates, increase down spacing and maintain EUR/well metrics over the longer term
- Most Advanced Recovery volume (7 Tcf) developed and produced after 2030

Expected Recovery will not sustain Deep Basin rates

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Tight Gas Play Comparison
Deep Basin and US Rocky Mountain region

	Deep Basin	US Rockies Tight Gas
Plays	13	13
Production, 2005	2.7 Bcfd	5.6 Bcfd
Play areas	Very large 3,500-21,500 sq miles	Small 1,000-6,500 sq miles
Play success rate	Low 5%-25%	High 73% to 96%
Well Spacing, future	220 - 500 acres	26 -160 acres
EUR per section, Bcf	Modest 0.5 to 3.4 Bcf	Large 2.2 – 50 Bcf
Undeveloped Resources	22.9 Tcf	67.1 Tcf
Reservoir interval	10's of feet	100's of feet
Play area % drilled	Higher %	Lower %
Sand/shale ratio	Low	High

Sources: Forward Energy, EIA AEO2007 supply model inputs

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Conclusions

Deep Basin plays differ from Unconventional model

- Low success rates, singly or stacked
  - Discovery remains uncertain and requires management
- EUR per well has been decreasing
  - Rather than recovery per well increasing with advancing technology, recent high prices made lower reserve prospects economic
- Low frequency of downspacing
  - Operators appear satisfied current spacing will drain GIP
- Cadomin, Cardium and Lower Mannville South plays appear more similar to Unconventional model

Undeveloped Resources

- Resource estimates range from 16 Tcf to 30 Tcf

Future Supply

- Expected Recovery of 23 Tcf will be connected, reach peak rate before 2020 and will be mostly consumed by 2030
- Increased supply from an Advanced Recovery scenario will require focused industry and government-supported R&D into technology to reduce risk and increase recovery

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