Security of Supply: Operational Margins at the Wellhead and Natural Gas Reserve Maturation*

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Abstract

The early success in the development of unconventional natural gas plays pioneered in the US and Canada has many eager followers worldwide keen to enhance their natural gas resource base. Security of reserves is a cornerstone of every national energy policy. Essentially, the maturation of unconventional prospective resources into economic proved reserves is a task that must be executed by oil and gas companies. This study first reviews the critical steps and key issues that must be addressed when companies enter into emergent unconventional gas plays. The exploration process is no gamble--but a cost-conscious program with many decision stages aimed at identifying resources that may generate a profit when reserves are eventually developed. The resource inventory is classified according to strict rules mandated by the SEC and supported by SPE and UN resource classification schedules. Reserves inventory is a key asset of oil and gas companies and affects their balance sheets. Progressive investment in data acquisition and subsequent professional appraisal and modeling leads to reserve maturation. Changes in reserve inventory may positively affect the credit ratings of oil and gas companies, but any downgrading of reserves could increase their cost of capital. The risk of fluctuation in the asset inventory made up by gas reserves is much higher for unconventional operators than for conventional gas operators. The underlying causes: geological factors, technology issues, environmental concerns and economic constraints are analyzed, categorized and benchmarked in a sensitivity analysis. The model accounts for regional volatility in wellhead and wholesale prices and uses cost-effective well productivity data from three decades of accelerated US and Canadian unconventional gas development. For investors, it is crucial to understand sensitivities in the reserve maturation process, to better judge the risk involved in the unconventional gas sector. For operators, it is essential for rapidly building positive free cash flow in a highly competitive market. For governments, accelerated reserve growth with a low volatility is important for security of supply. Recommendations are formulated for optimum resource development, with a focus on seizing opportunities while mitigating the risks associated with uncertainty in the development of unconventional natural gas reserves.

Reference

Security of Supply: 
Operational Margins at the Wellhead and Natural Gas Reserve Maturation

Three decades of accelerated 
US Unconventional Gas Development: 
Lessons for reserve maturation in Europe

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NL natural gas production separated into reservoir type

- Historic
- Projection

- Saudi Field Projects Geoarabia
- Scaling Salt Tectonics BEG/USA
- TU Delft MPBE/NL
- PhD Mantle Convection Sweden
- MS Spain Fieldwork Betics
- Start BS Geology Study
- Start UGRI

Groningen Field

- Offshore Small Fields
- Onshore Small Fields

Window of Opportunity for Unconventional Gas

BCMA: 3,531 bcfa

Productions separated into reservoir type: Offshore Small Fields, Onshore Small Fields.
US natural gas production separated into reservoir type

- Net Imports
  - Historic
  - Projection
- Shale gas
- Tight gas
- CBM
- Conventional gas (non-associated onshore)
- Conventional gas (non-associated offshore)
- Associated Gas (on & offshore)
- Alaskan gas

Historic:
- 11% Net Imports
- 14% Shale gas
- 28% Tight gas
- 8% CBM
- 20% Conventional gas (non-associated onshore)
- 9% Conventional gas (non-associated offshore)
- 2% Associated Gas (on & offshore)
- 9% Alaskan gas

Projection:
- 0.28 Tcm for Shale gas
- 0.85 Tcm for Total
Proved natural gas reserves for the US

Based on DOE/EIA, 2011 data
Volume of economically producible proved reserves shifts with gas price.

- **Optimization of Technology & Geoscience**
- **Upward move increases economic production volumes**
- **Downward move decreases economic production volumes**
- **Critical Cost Curve**
- **Volume already produced**
- **Volume left for economic production**
  - 4 $/Mcf
  - 6 $/Mcf
  - 8 $/Mcf

Long term wellhead price economic cut off.

Volume sub-economic at current long-term wellhead price.

Volume for economic at current long-term wellhead price.

(*) scalable by success in reserve maturation process.

Percentage of natural gas prices:
- P90
- P50
- P10

Natural Gas Price:
- 0
- 10
- 20
- 30
- 40
- 50
- 60
- 70
- 80
- 90
- 100
- 110
- 120

$/Mcf:
- 4
- 6
- 8
- 10
- 12
- 14
- 16
- 18
- 20
- 22
- 24
- 26
- 28
- 30
- 32
- 34
- 36
- 38
- 40

Tcf of gas:
- 0
- 500
- 1,000
- 1,500
- 2,000
- 2,500
- 3,000

Source: MIT
Companies report Reserves Inventory to SEC (K-10; F-20; F-40) & to National Governments on annual basis.

- Addition of reserves
- Impairment of reserves
- Balance sheets show current Assets

National reserve inventories are based on the annual filings.

Company Reserves Aggregated

In the US DOE receives the tally of companies SEC filings

Most other countries have a similar process

National Reserves Updated

Annual review reveals Cumulative Production & EUR based on company reporting
Interpretation of SEC’s New resource classification system (2009-onward)
Net oil & gas properties valuations

Do fundamentals support this?

Steep rise in ‘Acreage Collateral’
**Unconventional Gas**

- **Proved Developed Reserves**
  - EOG
  - Devon
  - Petrohawk
  - Chesapeake

- **Proved Undeveloped Reserves**
  - Introduction of new SEC rules

- **Proved Total Reserves**

**Conventional Gas**

- **Proved Developed Reserves**
  - BP
  - Shell
  - Chevron
  - Exxon

- **Proved Undeveloped Reserves**

- **Proved Total Reserves**

Weijermars & Watson (2011a,b)
Retained Earnings

Billion USD

'Conventional' Exxon

'Unconventional' Chesapeake

Performance Gap
• Pre-Tax margins of US Independents are marginal or negative for Unconventional gas

• If Art Berman is right – who is wrong? “Unconventional Gas Companies are in a dead spiral” (Karl Miller, analyst)

• The world needs a prolonged success of Tight Gas, CBM, Shale Gas.

• US gas Independents need a financial lift -> Gas price must go up (EU vs US).

• More transparency about performance needed.

• Volatile changes in reserves (up & down) must be avoided.

• Real-time economic models (cock-pit dials) need to be taken seriously
Better NPV Models Needed

Gas Production Curve

EUR is 0.37 Tcf

Pay-back is after 18 years for 0% discount rate

Wells of 0.2 bcfa

Cumulative Cash Flow

- Retained Earnings
- Royalties @ 12%
- Taxes @ 25%
- OPEX
- CAPEX wells @ 5 million USD each

Gas price of 5 USD/Mcf
Conclusions - Recommendations

1. **Operational Performance**: Improve the Unconventional Reservoir Model, real-time monitoring of the impact of gas price volatility, technology cost gains, and well productivity’s connect to EUR – let’s get real smart about unconventional oil & gas wells.

2. **Corporate Governance**: improve transparency and better accountability on performance – stop disinformation.

3. **Reserves Reporting Compliance** - with more than 430 billion dollars of combined market capitalization, any concurrent concerns about the business fundamentals of US shale gas operators need to be mitigated swiftly and decisively – a call for action on SEC leadership.

Once investors get burned on gas investments, shale gas exploration and production companies now emerging around the world will have a hard time to find venture capital - the reputation of the upstream gas business with the global investor community is at stake.