PETRONAS and the Unconventionals

DUG Australia 2014

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UNCONVENTIONAL HYDROCARBONS: WHAT IS IT?

The key difference between “conventional” and “unconventional” hydrocarbons is the manner, ease and cost associated with extracting the resource.

- **Oil**: Conventional Reservoirs: Small Volumes, Easy to Develop
- **Gas**: Unconventional Reservoirs: Large Volumes, Hard to Develop
- **Oil Shale**: Huge Volumes, Difficult to Develop

**Conventional Oil and Gas**
- Continuous deposition
- Low permeability
- Both traditional & “basin-center” settings
- Self-sourcing reservoir
- Gas absorbed in coal requires depressurizing & usually dewatering
- Requires pervasive natural or created fracture network
- Majority of bitumen is trapped at very shallow depths
- Immobile at undisturbed reservoir conditions
- Extremely high viscosities, 8.5-15 deg API, 60,000-400,000 cP
- Requires heat to mobilize the fluid
- Shales rich in bituminous material and yield petroleum upon distillation.
- Extracted via mining and retortion or in situ process.

**Unconventional Gas Resources**
- TIGHT GAS
  - Continuous deposition
  - Low permeability
  - Both traditional & “basin-center” settings
- COALBED METHANE
  - Self-sourcing reservoir
  - Gas absorbed in coal requires depressurizing & usually dewatering
- SHALE GAS
  - Self-sourcing plus traditional porosity reservoirs gas absorbed in organic matter
  - Requires pervasive natural or created fracture network
- SHALE OIL
  - Requires heat to mobilize the fluid
- OIL SANDS

The technology and cost of extracting unconventional resources increase as the resources go deeper.

Source: Adapted from WoodMac and Canadian Association of Petroleum Producers, not drawn to scale. Chart is for illustrative purposes only.
Unconventional resource additions have dwarfed conventional exploration over past five years.

Contributing Factors
- Large volumes in place
- Often penetrated by existing conventional wells

The Result
- Perception that world is “awash” with hydrocarbons
- Reduced price pressure

Source: Goldman Sachs Global Investment Research.
May '08: PETRONAS acquires 27.5% in GLNG

December 2010: PETRONAS EXCO approves Unconventional strategy

2013: Creation of Unconventional Energy Division Development of Unconventional Capability Framework

December 2012: PETRONAS Acquires Progress Energy

August 2011: Acquires 50% of North Montney Joint Venture

2014: Creation of PUNCH, Entry into China

Purchase of Talisman Montney Assets

2020: A Leading Unconventional Resource Player

THE PETRONAS UNCONVENTIONAL ENERGY JOURNEY
KEY ROLES FOR PETRONAS UNCONVENTIONAL ENERGY

- Development and Operations - Delivering 250,000 boe/d by 2020
  - Canada - North Montney Shale Gas
  - Canada - Progress Sasol Montney Partnership
  - Canada - Deep Basin Tight Oil
  - Australia - Coal Seam Gas

- Evaluate and Acquire Additional Assets for Growth

- Expanding and Developing Unconventional Capability
  - PETRONAS Unconventional Hydrocarbon Center
  - Secondment to Front Line Operations
  - Experienced Mentoring

- Optimizing Value
  - Seamless integration with LNG
  - Cost focused culture
**PETRONAS’ UNCONVENTIONAL ASSETS**

**North Montney Joint Venture**
- Location: British Columbia
- Operator: Progress Energy
- Play Type: Shale Gas
- Equity: 62%
- Production: 400 mcm/d
- 2P Reserve: 10.5 Tcf/118 MMbbl
- 2C Resource: 24.1 Tcf/316 MMbbl
- 2014 Capital: USD 2.3 billion
- 2014 Drills: 170 wells

**Alberta Deep Basin Tight Oil**
- Location: Alberta
- Operator: Progress Energy
- Play Type: Tight Oil/Tight gas
- Equity: 100%
- Production: 12,000 boepd
- 2P Reserve: 0.9 Tcf/3.5 MMbbl
- 2C Resource: 10 MMbbl/0.04 Tcf
- 2014 Capital: USD 130 million
- 2014 Drills: 24 wells

**Progress Sasol Montney Partnership**
- Location: British Columbia
- Operator: Progress Energy
- Play Type: Shale Gas
- Equity: 50%
- Production: 130 mcm/d
- 2P Reserve: 0.9 Tcf/3.5 MMbbl
- 2C Resource: 10.3 Tcf
- 2014 Capital: USD 400 million
- 2014 Drills: 21 wells

**Gladstone Coal Seam Gas**
- Location: Queensland
- Operator: Santos
- Play Type: Coal Seam Gas
- Equity: 27.5%
- Production: 120 mcm/d
- 2P Reserve: 5.4 Tcf
- 2014 Drills: 114 wells

**China Exploration**
- Location: Santaghu
- Operator: HESS
- Play Type: Shale Oil/Shale Gas
- Equity: 30%
- Production: Exploration Stage
- 2P Reserve: -
- 2014 Capital: Estimated $30 Million
- 2014 Drills: 1 Vertical and 1 side track
**POSITIVE OUTLOOK FOR EMERGING BASINS**

**China:**
More diverse group of companies are being allowed to bid on shale acreage. Issues with population density and water shortage remain.

**India:**
The country relies heavily on LNG imports. The Cambay Basin lies within one of India's main industrial centres.

**Argentina:**
World class reservoirs identified, recognized but challenges remain with fiscal regime, price controls and labor costs.

**Australia:**
Strong gas demand from domestic growth and export projects offset by service sector and infrastructure limitations.

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Source: Wood Mackenzie
MONTNEY – A WORLD CLASS RESOURCE

MONTNEY PLAY

- Located in northern Canada on the Alberta/British Columbia border
- First multistage horizontal wells in 2006
- Over 2500 horizontal wells drilled
- Daily production over 4 Bcf
- National Energy Board estimated potential recoverable resource 450 Tcf

Source: RBC Capital Markets
North Montney Area

- Located in thickest portion of Montney fairway
- Most active drilling area for past two years
- Combination of liquids rich gas and dry gas
- Most favourable royalty structure
- Remote area, limited residents nearby

Petronas holds dominate land position with over 600,000 acres

Source: RBC Capital Markets
UP TO FOUR LAYERS OF DEVELOPMENT

PECL CARIBOU
C-58-J/94-6-2

PECL TOWN SOUTH
C-50-J/94-B-16

LOWER MONTNEY
UPPER MONTNEY
MIDDLE MONTNEY

75m THICK
225m THICK
Detailed study of 150 wells completed by global expert DeGolyer McNaughton

Total Estimate Gas in Place - Over 200 Tcf

Similar numbers confirmed by GLJ, Government, other operators

13,000 well locations provides estimated Prospective Resources - Over 50 Tcf

Estimated Recovery Factor - 25-30%

- Jedney/Bubbles 150 bcf/section
- Lily / Caribou / Kahta 240 bcf/section
- Town 175 bcf/section
WELL SPACING OPTIMIZATION

- Microseismic and reservoir modelling used to optimize spacing

- Frac envelope typically 100m high and 400m wide

- Stagger pattern allows for up to 16 wells per section

Four Layer Example

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PETRONAS
As of February 28, 2014:

- 280 wells rig released
- 179 wells on production
- 37 completed and awaiting tie-in
- 64 waiting on completion
80 Producing Horizontals
Variety of Areas
Very Consistent Results

Average is on trend with more mature areas
NORTH MONTNEY DEVELOPMENT STRATEGY

Appraisal Phase
2012-2015
Maximizing Reserve Growth
Operational Ramp up to 25 Rigs
Stepout Drilling
Target: 15 TCF Reserves by 2014
FID

Development Phase
2015-2018
Maximizing Production Growth
Continue Adding Reserves
Pad Drilling
Target: 2 Bcf/d by 2018 1st
LNG Export

Final Investment Decision 2014
First LNG Volumes 2018
APPRAISAL PHASE - Delineating 15TCF

- Well pads spaced 5km apart to maximize reserves bookings
- Three wells drilled on each pad (Upper, Middle and Lower)
- Wells tied into system and put on long term production:
  - Validates type curve profile
  - Early cashflow (25% self funded in 2014)
- Reserves evaluated 100% externally
Key Upstream Elements for FID Coming into Place

**Gas Supply**
Robust third party report and existing production provides confidence
Large additional resource already identified
Backstopped by 12bcf/d Canadian market

**Operational Capability**
Successfully operated at ~70% of maximum capacity
Supported by large Canadian service sector

**Infrastructure**
NGTL provides dedicated access with very capable operator
Liquids transportation and processing in place

**Cost Control**
Testing of cost reduction technology completed
Framework for governance and key service contracts
Implementation in 2015

**Technical Capability**
Staff count increased by 100% to handle future requirements
HRM and compensation plans in place for long term retention
POISSONS RATIO USED TO OPTIMIZE PERFORMANCE

FRACABILITY
- Using PR as an indicator of rock properties to help pick Hz location
- Optimizing frac repeatability
- Reduces water required to complete frac

RESULTS
- Better frac placement with less fluid
- Reduced costs due to less power requirements
- Well performance improvements
SEISMIC INTEGRATION EXAMPLE

Monitor Well

North Well – 5.6 mmcf/d

South Well – 4.0 mmcf/d
EFFICIENT WATER HANDLING SYSTEM

Each Area to Have:

- 20,000 - 30,000 m³ double contained recycled water storage
- 50,000 - 200,000 m³ fresh water storage
- Innovative water recycle system
- 8” pipeline connection to each pad

Typical Operation:

- Combination of fresh and produced water continuously pumped to C-rings at wellsite during fracturing
- Water heated during winter using specialized natural gas portable system
UNCONVENTIONAL DEVELOPMENT PROCESS

Area Type Curve

Review Results

Execute Program

Master Well Spacing Layout

Detailed Design/Licensing

Drilling and Production Schedule

Infrastructure Requirements

Capex/Opex Forecast

Reserves

Feedback

Management Review

Final Plan
For Approval
CONCLUSIONS

- Unconventional hydrocarbon sources are revolutionizing the energy industry

- PETRONAS is positioning itself to be leading player in this sector

- The North Montney is a world class resource with a promising future

- Technological and logistical innovation will lead to cost and productivity breakthroughs