Worldwide Shale Developments: What makes them work and is there a sweet spot in Europe?

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Who are RISC?

RISC London has the same capability in UK and Europe.

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<tr>
<th>Year</th>
<th>Target / Asset</th>
<th>Bidder</th>
<th>Value (AUD'MM)</th>
<th>Independent Expert</th>
<th>Technical Specialist</th>
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<td>Focus (post-Horizon)</td>
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Completed deals with due diligence supplied or managed by RISC Advisory’s London Office:

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<tr>
<th>Year</th>
<th>Acquirer</th>
<th>Seller &amp; Asset/Company</th>
<th>Value (USD$)</th>
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<td>2019</td>
<td>BlackRock</td>
<td>ADNOC oil pipelines</td>
<td>$4 Billion</td>
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<td>2018</td>
<td>Vitol, Delonex, Africa Oil Corp</td>
<td>Petrobras Nigeria</td>
<td>$1.5 Billion</td>
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<td>2018</td>
<td>Ophir</td>
<td>Santos SE Asia assets</td>
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<td>2015</td>
<td>Premier Oil</td>
<td>E.On UK</td>
<td>$120 million</td>
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<td>2015</td>
<td>First Reserve</td>
<td>EMAS Offshore Lewek FPSO</td>
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<td>2013</td>
<td>Qatar Petroleum</td>
<td>Total E&amp;P Congo assets</td>
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<td>2012</td>
<td>Premier Oil</td>
<td>Rockhopper Falklands assets</td>
<td>$1 Billion</td>
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<td>2009</td>
<td>Centrica plc</td>
<td>Venture Production plc</td>
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<tr>
<td>2009</td>
<td>Premier Oil</td>
<td>Oilexco</td>
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Where it all started: Growth of the Eagle Ford

Eagle Ford 2007

Eagle Ford 2019
Growth in US natural gas production

“North America emerges as a major importer of LNG” (EIA, IEEJ & others)

“Natural Gas prices will remain high in the US for the foreseeable future” (EIA)

US dry shale gas production

Source: EIA
History repeating itself on Australia’s east coast

US dry shale gas production

“The US is destined to become a key LNG import market” (BG)

“North America emerges as a major importer of LNG” (EIA, IEEJ & others)

“Natural Gas prices will remain high in the US for the foreseeable future” (EIA)

Australia's east coast needs to urgently start importing LNG: EnergyQuest

Sydney — Australia’s gas-strapped east coast needs to urgently start importing LNG in order to mitigate a range of risk factors stretching from supply issues to regulatory uncertainties, energy consultancy EnergyQuest said Wednesday.

When insanity makes sense: Australia's best option is LNG imports

Australia has painted itself into a corner with its natural gas industry and faces the stark reality that there are no easy choices to alleviate the dual problem of a looming supply crunch and the associated higher prices.

FROM ABC ILLAWARRA

- Why Tania Daykin is putting old chickens before the eggs
- Art and alcohol bringing not creative flair in expanding entertainment landscape
- Liberal candidate angry over re-election back to where you came from

LNG import terminal approval — an Australian first — a sign of hope for NSW manufacturing

ABC Illawarra By Kelly Fuller and Glenn Cooke

Source: EIA
Major North American unconventional plays

- Discrete zones of higher porosity / higher resistivity
- Plays are laterally heterogeneous
- Over-pressure. Rate more important than in-place
- Finding the balance in GOR. Rate versus product
- Areas of very mature conventional production – data / infrastructure / tolerant community stakeholders

*Logs presented at same scale. Source PXD*
Heterogeneity in unconventional plays

Source: Consensus view from public domain information
Break-even oil prices for new wells in North American plays

**KEY PLAYS**

- MONTNEY (CANADA)
- WOLFCAMP MIDLAND
- WOLFCAMP DELAWARE
- EAGLE FORD
- CRETACEOUS (CANADA)
- BAKKEN
- BONE SPRING
- NIOBRARA
- SCOOP/STACK
- DUVERNAY (CANADA)
- THREE FORKS

**RANGE OF BREAK-EVEN IN THE NORTH AMERICAN UNCONVENTIONAL PLAYS ($/BBL)**

- **SWEET-SPOTS**
- **FRINGE**

*Source: Consensus view from public domain information*
Unconventional play systems

THERE ARE NO HARD LINES BETWEEN CONVENTIONAL AND UNCONVENTIONAL RESOURCES

UNCONVENTIONAL RESERVOIRS SHARE A LOT OF SIMILAR CHARACTERISTICS TO CONVENTIONAL RESERVOIRS

- Zones of higher porosity / permeability
- Zones of higher resistivity
- Zones of higher pressure
- Regional structures or structural highs

UNDERSTANDING HETEROGENEITY IS KEY - ITS NOT JUST A GAME OF FINDING A SHALE AND FRACCING THE BEJEEZUS OUT OF IT
Common recovery segment mapping

Common recovery segment map (Sweet Spot Map)

Recovery potential is the combined effect of multiple attributes

- Reservoir thickness
- Hydrocarbon generation
- Reservoir quality
- Structure
- Depth/Pressure

Example from the Murteree shale, Cooper basin
Break-even gas price mapping

- **Common Recovery Segment Map**
  - **EUR per Layer**
  - **Number of Potential Layers**
  - **Distance to Pipeline**
  - **Drill Depth**
  - **EUR per Cell**
  - **EUR per Layer**

**Example from the Murteree shale, Cooper basin**

**Break-even gas price mapping**

**Production test from vertical frac**

**Type curve range**

- Calibration Murteree type curve EUR (Bscf)
- High Case: 7.6
- Mid Case: 3.4
- Low Case: 1.2

**Rate**

**Time**

- 5 wells per 2km x 2km cell

- WELL PAD

- 400m

- 2000m
Eagle Ford break-even analysis

Source: Consensus view from public domain information

Break-even oil price
- $80
- $70
- $60
- $50
- $40

100% of Eagle Ford break-even at $70> Oil (8,000,000 acres)
Break-even price development of the Murteree play

MURTEREE ESTIMATED ULTIMATE RECOVERY POTENTIAL

Mid-case total EUR = 23.2 Tcf

Estimated resource: 16.4 Tcf *

* Mid-case type curve EUR with full development (Well count: 5363)

Break-even analysis assuming NPV10 well head price at 2019 development costs
Break-even price development of the Murteree play

Depending upon gas price:

- 5 Tcf → 16 Tcf
- 900 km² → 4,300
- 1,000 wells → 5,400

Murteree is one of 6 shale plays in Cooper Basin

Break-even analysis assuming NPV10 well head price at 2019 development costs
Cooper basin resource totals (all prospective units) at $8/GJ break-even

Total resource estimates for Cooper unconventional plays at $8/GJ

Low estimate: 106 Tcf
Mid estimate: 288 Tcf
High estimate: 548 Tcf

-10% for inert gas and assuming 40% of maximum development

33 Tcf
99 Tcf
192 Tcf
Cooper basin resource totals (all prospective units) at $12/GJ break-even

Low estimate | Mid estimate | High estimate
---|---|---
158 Tcf | 427 Tcf | 829 Tcf

Total resource estimates for Cooper unconventional plays at $12/GJ

-10% for inert gas and assuming 40% of maximum development

52 Tcf | 149 Tcf | 294 Tcf
Some closing thoughts

• Proven unconventional systems are typically extensions of conventional petroleum systems

• Heterogeneity is key. Resource potential is tied to wells drilled – which is tied to demand and pricing. The ‘unconventional accordion’

• Rising gas prices in the Eastern Australian gas market are driving speculation about LNG import requirements for the market. The same speculation occurred in the US in the mid 2000’s. The US responded by developing unconventional resources

• We need to quantify and understand unconventional potential to determine in what gas price environment it make sense to develop our unconventional resources
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<thead>
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<th>Location</th>
<th>Address</th>
<th>Contact Details</th>
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