Unconventional and Conventional Petroleum Activity in South Australia

Look – it is possible to herd cats

Nirvana Outcomes

Barry Goldstein, Executive Director – Energy Resources
South Australian State Government

www.petroleum.dmitre.sa.gov.au
VISION: The unconventional gas revolution will deliver decades of safe, secure, competitive gas

To reach the vision

• Potential risks to social, natural and economic environments are reduced to as low as reasonably practical (ALARP); and meet community expectations for net outcomes BEFORE IT IS PERSONAL – before approval sought for land access;

• Affected people and enterprises get timely information describing risks and rewards to enable informed opinions;

• Convene roundtables to deliver roadmaps for unconventional petroleum projects to inform: the PUBLIC, GOVERNMENTS, INVESTORS, AND REGULATORS and in doing so – enable welcomed unconventional petroleum projects.

• South Australia’s Roadmap published Dec. 2012
Technically Recoverable Shale Resource Estimates

<table>
<thead>
<tr>
<th></th>
<th>Gas (TCF)</th>
<th>Oil (Billion Bbls)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>USA</td>
<td>1,161</td>
</tr>
<tr>
<td>2</td>
<td>China</td>
<td>1,115</td>
</tr>
<tr>
<td>3</td>
<td>Argentina</td>
<td>802</td>
</tr>
<tr>
<td>4</td>
<td>Algeria</td>
<td>707</td>
</tr>
<tr>
<td>5</td>
<td>Canada</td>
<td>573</td>
</tr>
<tr>
<td>6</td>
<td>Mexico</td>
<td>545</td>
</tr>
<tr>
<td>7</td>
<td>Australia</td>
<td>437</td>
</tr>
<tr>
<td>8</td>
<td>South Africa</td>
<td>390</td>
</tr>
<tr>
<td>9</td>
<td>Russia</td>
<td>285</td>
</tr>
<tr>
<td>10</td>
<td>Brazil</td>
<td>245</td>
</tr>
<tr>
<td>11</td>
<td>Others</td>
<td>1,535</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>7,795</td>
</tr>
</tbody>
</table>

Fast follower criteria outside North America

- The right rocks (liquids rich better)
- Markets
- Supportive investment frameworks
- Trusted regulatory frameworks
- Pre-existing infrastructure
- Capacity to move down cost curve
Australia:

Shale gas - technically recoverable potential:
- 437 tcf in 6 basins (avg 21% RF), EIA 2013
- > 1000 tcf in all prospective basins, Cook, 2013

Shallow CSG, Queensland & New South Wales
- 235 TCF est. tech. recov. resource (Santos ‘13)
- 42.8 tcf 2P reserves, YE ’12 (Core Energy, 2013)

Shale oil plays
- 17.5 BBO in 6 basins (avg 4% RF), EIA 2013
- In South Australia - prospects targeted in the onshore Otway and Arckaringa basins

Tight gas - technically recoverable potential:
- Still to be assessed nationally. Estimated 300+ tcf gas-in-place resource target in just PEL 218, South Australian Cooper Basin (Beach Energy)

Deep coals - technically recoverable potential:
- Still to be assessed nationally. Considerable gas resource targets. 9+ tcf targeted in just PEL 96, South Australian Cooper Basin (Strike Energy)
- First commercial gas discovered in 1963.
- Has produced over 5 tcf of gas
- >1,800 O&G wells
- Large unconventional gas resource targets.
- Existing infrastructure
- Sales gas netbacks from LNG exports reported to be AUS$9/GJ. Impacts domestic gas prices;
- Some Cooper gas already committed to export from Gladstone
Cooper Basin Composite and Deep Coal Plays

Gas saturated composite play

Patchawarra Formation

Regional Seal

Murteree Shale

Regional Seal

Roseneath Shale

Regional Seal

Nappamerrri Group

PRIMARY SOURCE INTERVAL
Cooper Basin, South Australia

Patchawarra Fm. Pressure Gradient

Composite Play below ~2,900m

Base Patchawarra depth structure map showing unconventional gas wells
CO₂ and Gas Wetness, South Australian Cooper Basin
(Epsilon, Patchawarra, Tirrawarra, and Merrimelia Formations)

% CO₂

Bbls Propane + Butane per MMcf Gas

Bbls Condensate per MMcf Gas

Patchawarra Absent
DEEP GAS IN THE COOPER BASIN

EIA (2013): 93 TCF sales gas in Cooper shales

Beach Energy: PEL 218: Potential 300 TCF gas in place in just PEL 218 (Nappamerri Trough, SA) ~100 TCF in shales and >200 TCF in sands. Chevron now PEL 218 partner

Santos: High-side 200+ TCF recoverable raw gas. Moomba 191 (vertical well): 2.6 MMscf/d from unconventional reservoirs at line pressure flowing to market. Santos – Beach – Origin JV have domestic and export markets.

Senex Petroleum: Est. 75-110 TCF gas in place in tight sandstone, shales & coals.

Strike Energy: Est. 9 TCF gas resource in deep coal in PEL 96 and has attracted a major gas customer (Orica) to back its appraisal program versus terms for 142 bcf
Conclusions for the Cooper Basin

1. Huge unconventional resource play in the deep troughs of the Cooper Basin.


3. Initial unconventional resource estimates for the Cooper Basin are high:
   - Company 2C contingent unconventional gas resources: ~5 TCF
   - EIA potential sales gas from shales: 85 TCF
   - Rough estimate of sales gas in Composite Play: ~ 175 TCF

4. Exploration and appraisal ramping up with several E&Ps and gas customers now funding exploration.
Priorities to foster sustainable, profitable projects roundtable and roadmap for unconventional gas

- **Outcome:**
  Attain the vision

- **Strategy:**
  Cooperate to compete

- **Roundtable:**
  List what to do by priority (125 recommendations)

- **Working Groups:**
  Implement priority recommendations.

www.petroleum.dmitre.sa.gov.au
Top priorities to build trust:

- Legal frameworks provide certainty and simultaneously meet community and investor expectations for outcomes
- Trustworthy, people implement and regulate projects
- Environmental sustainability
- Manage supply-chain risks (people and facilities)
- Bolster understanding of risks, risk management and rewards

www.petroleum.dmitre.sa.gov.au
To download the Roadmap for Unconventional Gas Projects in South Australia - go to:


or Google DMITRE & Unconventional Gas
or hand me you business card
Case Study – Petroleum Retention Leases for Oil

Oil exploration wells (2000-13), western Cooper – Eromanga
- 56% located with 3D were discoveries (and find-size ↑)
- 30% located with 2D were discoveries

Proven Cooper-Eromanga oil play

Petroleum Licence Holders
- Ambassador Exploration Pty Ltd
- Beach Energy Ltd
- Bridgeport Energy Ltd
- Discovery Energy SA Ltd
- Drillsearch (513) Pty Ltd
- Holloman Petroleum Pty Ltd
- Linc Energy Ltd
- Santos Ltd
- Senex Energy Ltd
- Strike Energy Ltd

Legend:
- Oil well
- Gas well
- Western Flank proven oil play
- Gas pipeline
- Gas and liquids pipeline
- Liquids pipeline
- Coongie Lakes control zone – no access
Case Study – Petroleum Retention Leases for Oil

Winner’s Curse?

Know your market!

Average for High Bids: $4,435 per sq km per year

$4,500 / km² pa

$ y = 16418e^{-1.03x}
R² = 0.6809

Square Km Area of PEL
Go to Australia

 DRILL A WELL

 BINGO

 SORTED

I can't help feeling you may have over simplified our objectives somewhat...
Composite Resource Play, Cooper Basin

Roseneath, Epsilon and Murteree (REM) Shales

Gidgealpa Group Composite Play
Deep Cooper Basin (Gidgealpa Coals): Enormous Generation Capacity

Senex’s Paning 2 (May 2013):
Single 63,000 pound proppant fracture stim. in Toolachee coal (~2900m). Up to 90,000 scf/d, over 4 days.

Santos, Beach, Origin JV
Supply-chain goal posts:
2,800 wells @ 3Pj / well over 15 yrs to attain 8,422 Pj (~10% of 93 TCF EIA estimate for gas from shales)

<table>
<thead>
<tr>
<th></th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017-2028 (12 years)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Drilling rigs</strong></td>
<td>3</td>
<td>5</td>
<td>9</td>
<td>15</td>
</tr>
<tr>
<td><strong>Type of wells</strong></td>
<td>Vertical</td>
<td>Horizontal</td>
<td>Vertical</td>
<td>Horizontal</td>
</tr>
<tr>
<td><strong>Rig Years @ 50% vertical vs horizontal</strong></td>
<td>1.5</td>
<td>1.5</td>
<td>2.5</td>
<td>2.5</td>
</tr>
<tr>
<td><strong>Wells/yr/rig</strong></td>
<td>17.5</td>
<td>11</td>
<td>17.5</td>
<td>11</td>
</tr>
<tr>
<td><strong>Wells Tally</strong></td>
<td>26.25</td>
<td>16.5</td>
<td>43.75</td>
<td>27.5</td>
</tr>
</tbody>
</table>

**Work for government-industry:**
- Discover competence possibly without capacity to supply rigs, pipe, roads, rail, materials, services, people, etc, etc.
- Foster pre-qualification for tenders; and
- Enable clusters and IPOs for budding multi-nationals
Field Size Distribution – Proven Productive Oil Play in the Cooper-Eromanga Basins

Swanson’s Mean = 2.53 million barrels per new field discovery
Key Matters Considered in Decision-Making for the Regulation of PRLs

• The highest priority defined by the Roundtable for Unconventional Gas is the appropriate recognition of the life-cycle for finding, appraising, developing and producing resources. Fit-for-purpose licenses terms are the most direct way to recognize this life cycle. This is equally relevant to all mineral and energy resource sectors. The Subject Area Arrangement:

  ▪ Avoids 18 -24 months delay in exploration/discoveries after: intermittent relinquishments; call for bids; bids; negotiation of land access agreements; and grant of successively smaller PELs;
  ▪ Accelerates investment at contestable levels through renewal terms in ways not achieved with PELs;
  ▪ Delivers investment, jobs, production and royalties, sooner - clearly in the interest of the People of South Australia;
  ▪ Industry as a whole has greater investment efficiency;
  ▪ Attains very competitive levels of investment without the perverse outcome of ‘winner’s curse’ bidding;
The Subject Area Arrangement (continued):

- Based on DMITRE’s mapping of the proven oil play trend - 21 companies in JVs under 10 Operators may opt into Subject Area Agreements (e.g. cross-section of industry will benefit, including service companies who will get more extensive contracts);
- Nurtures small enterprises to become medium to large in size enterprises;
- Overcome a looming issue: Ever-smaller licences attracting circa $20 million bids (400 sq km 3D + 4 exploration wells) stretch the financial competence of ASX IPOs – and financial competence is a requirement for compliant licence-holders;
- Seeks secure investment at a time the State needs stronger investment;
- Farm-outs and sales are expected to further accelerate investment than is likely to be attracted through success, intermittent work program bids;
- A company approached Government with a proprietary request to progress applications for PRLs;
- Undertook targeted consultation with a cross-section of key Operators, at least one non-Operator and service companies active in the Cooper-Eromanga basins;
- The clear majority of enterprises considered the concept of PRLs for oil as a significant (even visionary) step worth taking;
- With regret, there little chance that all regulatory decision will please all stakeholders, always;