Santos Cooper Basin Unconventional Program

Carl Greenstreet, Manager - Unconventional Resources & Exploration
Unconventional Roundtable - 2 December 2013
The race is on!

Can North America’s success...

- Australia is highly prospective for unconventional resources
  - #6 in world in Prospective Resource
  - #2 in Potential when non-geological factors also considered

- Unconventional acreage positions have been taken across Australia

- Cooper Basin is well positioned to become a leader in Australian unconventional production

... be repeated Internationally?
Santos unconventional footprint

Portfolio of multiple play types spread across eastern Australia

McArthur Basin
- Liquids-rich shale play

Amadeus Basin
- Conventional oil and gas
- Evaluating unconventional potential

Today’s focus
- Cooper Basin
  - Conventional
  - Tight gas
  - Shale
  - Deep coal

- Surat/Bowen Basin
  - Coal seam gas

- Gunnedah Basin
  - Coal seam gas
The Cooper Basin provides the most prospective unconventional reservoir opportunity in Australia

The Cooper Basin is a world scale unconventional resource

Moomba field

- **BCG Tight Sands**
  - Regionally extensive over-pressured gas system
  - Heterogeneous stacked tight fluvial sands

- **Shale**
  - Over-pressured gas system
  - Tight formations requiring fracture stimulation

- **Deep Coal**
  - Porous coals, over-saturated with free gas
  - Thick and regionally extensive

- **Tight sands & mixed Lithology**

- **Cooper Multi-Tcf**

- **Shale**

- **Deep coal**

**Cooper Basin**

CONVENTIONAL GAS PLAY
- 2 TCF EUR
- Gross Gas Thickness: 1,600 FEET

SHALE GAS PLAY
- 20 TCF OGIP

DEEP COAL GAS PLAY
- 30 TCF OGIP

TIGHT GAS PLAY
- 7 TCF OGIP

BASEMENT GAS PLAY
- < 5 TCF OGIP
Building on extensive Cooper Basin unconventional knowledge & expertise

Santos has 50+ years of E&P experience in the Cooper Basin and...

...has been actively progressing an unconventional reservoirs program for the last decade

* Contingent resource booking for shale, deep coal and mixed lithology
We understand the rocks

Significant understanding of resource continuity and thickness trends...

- Extensive subsurface data set from 50+ years of operation
- Over 940km$^2$ of 3D seismic coverage
- 106 wells drilled through the REM (289 in total)
- >4,000 feet of core acquired
- >300 fracture stimulated wells
- Diagnostic fracture data used to develop field wide understanding of frac gradients, geo-mechanical properties, and over pressure

...provides confidence in resource assessment, well and fracture design
## Program On Track

<table>
<thead>
<tr>
<th>Play</th>
<th>Milestone</th>
<th>Progress</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basin Centred Gas</td>
<td>Drill Gaschnitz-1</td>
<td>✔️</td>
</tr>
<tr>
<td></td>
<td>Drill Van der Waals-1</td>
<td>✔️</td>
</tr>
<tr>
<td></td>
<td>Drill Langmuir-1</td>
<td>✔️</td>
</tr>
<tr>
<td></td>
<td>Multi-frac Gaschnitz-1</td>
<td>✔️</td>
</tr>
<tr>
<td></td>
<td>Multi-frac Van der Waals-1</td>
<td>On track</td>
</tr>
<tr>
<td></td>
<td>Multi-frac Langmuir-1</td>
<td>On track</td>
</tr>
<tr>
<td></td>
<td>Gaschnitz 3D</td>
<td>✔️</td>
</tr>
<tr>
<td>Deep Coal</td>
<td>Moomba-77 testing</td>
<td>✔️</td>
</tr>
<tr>
<td></td>
<td>Drill &amp; frac Roswell-1</td>
<td>✔️</td>
</tr>
<tr>
<td></td>
<td>In-wellbore projects (5)</td>
<td>On track</td>
</tr>
<tr>
<td>Shale</td>
<td>Drill &amp; multi-frac Moomba-192</td>
<td>✔️</td>
</tr>
<tr>
<td></td>
<td>Drill Moomba-194</td>
<td>✔️</td>
</tr>
<tr>
<td></td>
<td>Multi-frac Moomba-194</td>
<td>On track</td>
</tr>
<tr>
<td></td>
<td>Drill &amp; multi-frac Roswell-2H</td>
<td>On track</td>
</tr>
<tr>
<td></td>
<td>Drill &amp; multi-frac Moomba-193H</td>
<td>On track</td>
</tr>
<tr>
<td></td>
<td>In-wellbore projects (1)</td>
<td>On track</td>
</tr>
</tbody>
</table>

**Map**: Santos Exploration Permit, Santos Production Licence, Basin Centred Gas Wells, Shale Gas Wells, Deep Coal Wells, Gas Field

**Broad program targeting multiple plays**
Cooper unconventional program highlights

**Basin Centred Gas play**
- Play and resource proven
- Large resource with over-pressured ~1,000m gas saturated section
- Gaschnitz area encouraging

**Shale play**
- Murteree and Epsilon flow potential demonstrated (Moomba 191)
- Further coring and reservoir characterisation completed
- Horizontal and vertical shale tests underway
Proving up the Nappamerri Trough

Subject to realising commercial flow rates from exploration and pilot wells, Santos positioned to quickly commence development of its unconventional plays.

**BCG Exploration 2013**
- Prove Sustained Commercial Flows
  - Exploration (3 wells)
  - Stimulation / flow testing
  - Acquire Gaschnitz pilot 3D seismic survey
  - Early pilot engineering, design and materials procurement

**BCG Production Pilot 2014-2015**
- Prove Dynamic Performance
  - Drill ~2 deep appraisal wells and ~4 development pilot wells
  - Progressively ramp production rate
  - 8” Trunkline to Correa (~8 km) contingent on flow rate results

**BCG Accelerated Development 2016+**
- Progressive Development
  - Fast-track development and areal appraisal
  - Acquire large regional 3D survey
  - Facilities & infrastructure upgrades

---

**Gaschnitz Appraisal Pilot Concept**

Subject to realising commercial flow rates from exploration and pilot wells, Santos positioned to quickly commence development of its unconventional plays.
Gaschnitz Pilot 3D Seismic Survey

- Fast tracked pilot 3D Survey
  - 120 km²
  - Long Offset / Fully azimuthal
  - Tie into adjacent 3D surveys
- Acquisition completed in July 2013, currently processing
- Objectives
  - Develop and refine best practice geophysical workflows
    - Rock property cubes / geomechanical input
    - Simultaneous inversion
    - Multi-attribute analysis, etc.
  - Increase geological value-add input into commercialisation and development activities
  - Optimise acquisition and processing parameters for likely future much larger NTUZ 3D survey
Cooper Basin well positioned for success

Unprecedented demand signal
- Rising gas prices $5 -> $9/GJ
- Operators highly incentivised
- Supply response in progress

EA markets access
- Ability to supply gas to EA or export markets
- Comprehensive midstream / downstream infrastructure

Established well construction services
- Service industry well represented in basin
- Industry experience & know-how from decades of operations

Early technical successes
- M191 REM shale
- Nappamerri Trough Basin Centred Gas Play
- Encouraging Deep Coal results
Challenges & Opportunities – a Fine Balance

"Crack the Code"

High Costs
Infrastructure
Limited Services
“Crack the Code”
Environ. Impacts
Social Licence

Regulatory Stability
Competition
Technology
Demand / rising prices!
Early Technical Success
Market Access
CB Infrastructure

"Discovery consists of seeing what everybody has seen and thinking what nobody has thought"

Albert Szent-Gyorgyi
Acknowledgements

Thanks to the South Australian Cooper Basin (SACB) Joint Venture for supporting this program

South Australia Cooper Basin JV Partners