ARROW ENERGY
EXPLORATION DEPARTMENT

➢ Tony Knight, Vice President Exploration
TODAY’S AGENDA

- Introduce Arrow Energy
- Provide information on Coal Seam Gas (CSG) and exploration activities
- Future plans for CSG to Liquefied Natural Gas (LNG)
- Listen, understand and respond to questions and concerns about the CSG Industry and Arrow’s projects
ARROW ENERGY
A QUEENSLAND SUCCESS STORY

- Queensland-based company - Started in 2000, first gas sales in 2004
- Currently provides >20% of gas consumed in Queensland
- Portfolio includes:
  - Domestic gas supply
  - Gas transmission pipelines
  - Electricity generation
- Future projects – potential for expansion - both domestic and export supply of gas (LNG technology has opened up an extensive overseas market)
- 50/50 Shell and Petrochina – 2 stable owners committed to safety, environment and long term relationships with stakeholders
- 500 staff in Moranbah, Dalby & Brisbane
COAL SEAM GAS (CSG)

- Natural gas – methane
- Commonly used for electricity generation and industrial uses (e.g. refining)
- Coal seams contain both gas and water. The gas is kept in place by water pressure and ground pressure
- Gas is produced from coal seams by drilling wells, pumping water from coal seams, which allows the gas to be released
- CSG is very different from Underground Coal Gasification (UCG)
## CSG vs UCG
### THE KEY DIFFERENCES

<table>
<thead>
<tr>
<th>CSG</th>
<th>UCG</th>
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<tbody>
<tr>
<td>1. CSG – naturally occurring gas</td>
<td>1. UCG – synthetic gas</td>
</tr>
<tr>
<td>2. 95-98% methane, trace amounts of Nitrogen and Carbon Dioxide</td>
<td>2. Composed of (in decreasing order) Hydrogen, Carbon Dioxide, Carbon Monoxide, Methane and possibly Nitrogen</td>
</tr>
<tr>
<td>4. Water and gas pumped from the well</td>
<td>4. Oxidants pumped into well to sustain insitu combustion</td>
</tr>
<tr>
<td>5. CSG has been commercially produced in Qld for 15 years</td>
<td>5. Under trial to determine viability</td>
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COAL SEAM GAS
EXPLORATION

Right to Explore

- Right to explore provided by “Authority to Prospect” (ATP)
- Granted under the *Petroleum and Gas (Production and Safety) Act, 2004*
- Administered by Department of Employment, Economic Development and Innovation (DEEDI)
ARROW ENERGY
WHERE DO WE EXPLORE?

65,000km2 of acreage

Queensland
- Bowen Basin
- Surat Basin
- Nagoorin Graben Basin
- Capricorn Basin
- Styx Basin
- Hillsborough Basin
- Galilee Basin

Queensland and NSW
- Clarence Moreton Basin
CAPRICORN BASIN

- Available data indicates low quality coals and/or oil shales

- Very early stage exploration work

- Exploration is seeking to identify “sweet spots” – with initial targets shown

- Exploration work would comprise drilling wells at wide spacings (10km – 20km apart) in early stages

- Progression to further works will depend on results

- If good results are found, then more focus would be put into assessing potential development – e.g EIS
WHAT DOES EXPLORATION MEAN?
THREE STEP FOCUS

Identify and assess the potential of coal seam gas resources in an area to determine:

1. The presence, depth and extent of coal seams

2. Whether the coal seams contain gas

3. Whether the gas can be ‘produced’ (ie brought to the surface)

Exploration is one key part of deciding if a CSG resource can be developed into a project – also need to obtain environmental, Government and commercial approvals
EXPLORATION STEP 1: SEISMIC OPTION
DETERMINING THE PRESENCE, DEPTH AND EXTENT OF COAL SEAMS

Low impact
Alternative to drilling
Located along main roads where possible
2D reflection seismic recorded using straight lines of receivers crossing the ground –
creates images of geological changes in the subsurface – helps select drilling targets
EXPLORATION STEP 1: DRILLING OPTION
DETERMINING THE PRESENCE, DEPTH AND EXTENT OF COAL SEAMS
EXPLORATION STEPS 1 & 2: DRILLING

1. Determine the presence, depth and extent of coal seams
2. Determine whether the coal seams contain gas

- Landholder consultation
- Flexible Approach
- Site inspection/survey (eg environment/vegetation/cultural heritage)
- Site preparation (60m by 60m)
- Drilling and Logging
- Testing (some cases)
- Cementing of well
- Drilling and testing timeframe – approx one month
- Rehabilitation of site
EXPLORATION STEPS 1 & 2: DRILLING
WHAT TO EXPECT

- Visit individual landholder at least 3 months ahead of planned drilling
- Locate site in consultation with landholder avoiding sensitive areas/seasons, crops, livestock etc
- Determine access conditions: tracks, no-go areas, working hours, washdown procedures
- Conduct activities in approval with access conditions
- Cement and seal hole, rehabilitate site to former condition
EXPLORATION STEPS 1 & 2: DRILLING

BASICS OF DRILLING

- Hole diameter is about 120mm (5 inches)
- Hole depth depends on geology – but generally less than 700m
- Multiple strings of casing – isolation of well from surrounding
- Water flushed down the drill string to the face of the bit, to allow cuttings to be flushed back to surface
- Cuttings at surface are captured in a small ground pit
- All strings cemented in place to isolate any aquifers
- Qualified drilling personnel
- Strong safety focus – lifesavings rules
- Site rehabilitated after drilling (unless groundwater monitoring is required)
# WELL CONSTRUCTION

**EXPLORATION WELL – CORE HOLE**

<table>
<thead>
<tr>
<th>Section</th>
<th>Depth</th>
<th>Hole Size</th>
<th>Casing Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conductor</td>
<td>+/- 6 m</td>
<td>7 7/8”</td>
<td>6 5/8”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tricone</td>
<td>SFJ</td>
</tr>
<tr>
<td>Surface</td>
<td>60 m</td>
<td>5 1/2”</td>
<td>4 1/2”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hammer</td>
<td>SFJ</td>
</tr>
<tr>
<td>Drill</td>
<td>200 m</td>
<td>4”</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>PDC</td>
<td></td>
</tr>
<tr>
<td>Core</td>
<td>600 m</td>
<td>4”</td>
<td></td>
</tr>
</tbody>
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HQ3 Diamond
EXPLORATION STEP 3: PILOT TESTING
WHETHER GAS CAN BE PRODUCED? (BROUGHT TO THE SURFACE)

- Drilling up to 5 individual wells
- Wells in close proximity (between 100m – 500m apart)
- Water and gas brought to surface – water stored in small purpose-built dam
- Pilot testing may last up to 18 – 24 months
HYDRAULIC FRACTURING – ‘FRACCING’

Fracxing may be considered during pilot testing in areas where permeability of the reservoir is low

99.5% water and sand
0.5% chemical additives – such as acetic acid (vinegar), sodium hypo chlorite (pool chlorine)

Arrow does not use BTEX chemicals – Benzene, Toluene, Ethylbenzene, Xylene

BTEX chemicals are commonly used for, or derived from, various industrial purposes & can be naturally occurring

A detailed information sheet on ‘fracxing’ is available
GROUNDWATER

Aquifers
- Shallow
- Coal seam

Well integrity
- Casing and cementing
- Plugging and abandon

Drilling fluids
- Chemicals
- Handling

Produced water
ARROW LNG PROJECT

The Arrow LNG Project will meet the growing world demand for cleaner burning fuels through conversion of CSG to liquefied natural gas (LNG)

The proposed project includes:

➢ The Arrow LNG Plant on Curtis Island (off Gladstone) – liquefaction facility to produce 16 million tonnes per annum (mtpa) of LNG

➢ The Surat Gas Project and the Bowen Gas Project – development of CSG from reserves in the Surat Basin and the Bowen Basin

➢ The Arrow Surat Pipeline and the Arrow Bowen Pipelines – transmitting gas to Gladstone
BEYOND EXPLORATION

If exploration is successful we recognise there are key issues that we must address.

Community consultation will occur on:

- Produced water management – monitoring, storage, use and/or disposal
- Salt management – containment & disposal
- Groundwater management (including local supply)
- Field development – location of wells & infrastructure
- Working with landholders & others to minimise impacts
- Social and economic impacts and benefits
- Fair terms and process for access and development
- Opportunities for improvement
CONTINUED ENGAGEMENT

Arrow intends to update the community on exploration activities through similar information sessions annually.

The project team can be contacted at any stage on:

Freecall 1800 038 856
Email info@arrowenergy.com.au
Web www.arrowenergy.com.au
QUESTIONS AND ANSWERS