Many in the community are asking questions about unconventional gas mining management and practice. In this series of fact sheets we answer those questions most relevant to the dairy industry, enabling farmers to better prepare should unconventional gas mining be investigated in their local area.

Some dairy regions in Australia have coexisted with unconventional gas mining industries for more than ten years and have a wealth of knowledge on which to draw. These fact sheets incorporate this experience.

This FAQ publication introduces the key concepts and definitions. The accompanying fact sheets provide further detail on issues that may require further investigation or action should you need to consider coexistence on your farm.

**What does unconventional gas mining mean?**

Conventional gas moves to the surface through gas wells without the need to intervene. Unconventional gas, also known as onshore gas, is generally produced from complex geological systems that prevent or significantly limit the movement of gas and therefore require the use of extraction technologies.

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**Unfracked well**
- Coal warm permeable enough to allow sufficient gas flow

**Fracked well**
- Coal warm not permeable enough and requires fracking (hydraulic fracturing) to produce sufficient gas flow

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Source: Science Media Centre.
Unconventional gas comes in three main forms, defined by their underground geological source. The most commonly known, explored and now produced for market in Australia is coal seam gas (CSG).

The lesser known others are shale and tight gas. Shale and tight gas refer to natural gas trapped in low-fracture, low permeability formations that is generally unable to flow without intervention. These formations are usually located below 2,000 metres, much deeper than CSG sources.

Directional drilling and hydraulic fracturing (fracking) are the specialised technologies usually associated with mining shale and tight gas reservoirs. The development of shale and tight gas is largely in its infancy in Australia because of the difficulties and costs involved in extraction.

CSG mainly consists of methane held in water-pressurised coal seams between 300 to 1,000 metres below ground. It is accessed by drilling wells into the coal seams, to reduce the pressure, allowing water and gas to flow to the surface through a fully encased well. Water from the coal seam is called ‘produced water’. At the surface, it is separated from the gas and piped elsewhere for use or further treatment.

**Where might the dairy industry have to consider co-existence with unconventional gas mining?**

The dairy regions of eastern Australia have been broadly mapped in more detailed reports against potential CSG, shale and tight gas reservoirs, and current exploration and development licences.

The primary gas production target areas in NSW, Queensland and South Australia are associated with specific parts of the Great Artesian Basin (GAB), eastern Australia’s largest groundwater basin underlying 1.7 million square kilometres. This basin overlies older geological basins such as the Bowen Basin, and underlies younger basins such as the Murray-Darling Basin (CSIRO, 2012a).

Current CSG activities in Queensland have had little effect on the sub-tropical dairy industry to date. In NSW, existing and potential gas mining activity is in the Far North Coast (Lismore/Casino), Hunter (including Gloucester), Greater Sydney and Central tablelands. About 407 dairy farms are in these regions.

### Key Comparisons between CSG, Shale and Tight gas

<table>
<thead>
<tr>
<th></th>
<th>Coal seam gas</th>
<th>Shale gas</th>
<th>Tight gas</th>
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</thead>
<tbody>
<tr>
<td><strong>Location</strong></td>
<td>Qld, NSW and potentially Victoria</td>
<td>Remote locations in WA, Qld, NT and SA. Potential also in the Sydney Basin and Bowen Basin</td>
<td>Onshore WA, SA and Victoria. Largest known resources are in the Perth (WA), Cooper (SA) and Gippsland (Vic) Basins</td>
</tr>
<tr>
<td><strong>Commercial Production</strong></td>
<td>Significant exploration and known resources. Production began in 1996 and now accounts for 80% of Qld’s gas production</td>
<td>Currently resources are poorly understood and quantified. Only well known to produce commercial gas began in 2012, in SA’s Cooper Basin</td>
<td>Currently no known commercial production. Known tight gas reserves existing within conventional reservoirs will be primary targets for production</td>
</tr>
<tr>
<td><strong>Source rock (Organic material origin)</strong></td>
<td>Coal (Peat)</td>
<td>Low permeability fine grained sedimentary rocks (Silt mudstones &amp; shale mudstones) (Algae, plant, and animal derived organic debris deposited as muds in estuaries and in deep basins)</td>
<td>Various source rocks have generated gas that has migrated into low permeability sandstone and limestone reservoirs</td>
</tr>
<tr>
<td><strong>Depth (m)</strong></td>
<td>300-1000</td>
<td>1000-2000+</td>
<td>&gt; 1000</td>
</tr>
<tr>
<td><strong>Gas occurrence</strong></td>
<td>Adsorbed on coal organic matter including pores of coal</td>
<td>Stored within pores and fractures but may also be adsorbed on organic matter</td>
<td>Within pores and fractures</td>
</tr>
<tr>
<td><strong>Gas composition</strong></td>
<td>Usually &gt; 95% methane. Small amounts of CO2 and other gases may be present</td>
<td>Mostly methane but may also contain significant higher quantities of higher hydrocarbons (condensate)</td>
<td>Mostly methane</td>
</tr>
<tr>
<td><strong>Extraction technology</strong></td>
<td>Vertical or directional wells; hydraulic fracturing is sometimes required</td>
<td>Hydraulic fracturing and horizontal wells are usually necessary</td>
<td>Large hydraulic fracturing treatments and/or horizontal drilling are required</td>
</tr>
<tr>
<td><strong>Water usage</strong></td>
<td>Water must be pumped from seams to reduce reservoir pressure and allow gas to flow. If hydraulic fracturing is necessary, water is required for the fracturing process</td>
<td>Very little produced water is generated because of the geology of the rock formations. Water is required for hydraulic fracturing in much larger volumes than CSG</td>
<td>Water is required for hydraulic fracturing</td>
</tr>
<tr>
<td><strong>Extraction challenges</strong></td>
<td>Removal of seam water and its subsequent disposal</td>
<td>Overcoming low permeability</td>
<td>Reducing infrastructure footprint</td>
</tr>
</tbody>
</table>

In Victoria, the highest potential for unconventional gas mining is in the Gippsland and Otway basins. According to Local Government Area (LGA) statistics, about 1430 dairy farms in Gippsland and 600 in Western Victoria are in potential gas-bearing areas.

The unconventional gas production potential associated with Victoria’s brown coal deposits is less well-known than NSW and Queensland’s black coal deposits. The deeper location and low permeability of Victoria’s reservoirs mean extraction may be more difficult and thereby more costly.

Tasmania has potential for unconventional gas resources to be discovered within the Tasmania Basin extending from the north coast to south of Hobart. Only three licences currently allow for petroleum products exploration. Only one of those licences was granted with an aim of exploring the potential for unconventional oil and gas in the southern midlands (DPI, Parks, Water & Environment, 2014).

In South Australia, shale gas potential traditionally has been explored in the southeast of South Australia, around the Penola region (DMITRE, 2012).

What are the physical outcomes of drilling on my property? Are there potential layout and management effects that I may have to tackle?

Drilling a well to extract gas involves various surface infrastructural and management requirements that may affect farm layout and operation, including:

- The well pad footprint may be anywhere between 5m² & 100m² during a 3 to 4 week construction period. It shrinks to a more moderate footprint of between 5m² to 30m² during the gas production period lasting 15 to 25 years.

- Contractors will need to access the well pad using existing or newly built laneways. During construction, traffic may include large earthmoving and drilling equipment. During production, traffic is greatly reduced to vehicles associated with periodic maintenance and monitoring.

- Gas and water pipeline gathering systems will be buried at least 1m underground to transport gas and water to processing and treatment facilities. The surface will be rehabilitated back to its original condition.

In the CSG production phase, hundreds of wells can be partnered into “well sets” which are progressively commissioned and decommissioned within the project area during the project’s estimated life, usually between 15 to 25 years. The progressive nature of well development, operation, decommissioning and rehabilitation means the location of well pads will change over time.

See Fact Sheet: Unconventional Gas Mining – Planning and managing in a coexistence scenario for more information on potential farm adaptations.

If unconventional gas mining activity has any effects on the layout or management of your farm, these should all be addressed in the Landholder Access Agreements and/or Compensation Agreements that you negotiate with mining companies.

See Fact Sheet: Unconventional Gas Mining: Land access and farmers’ rights for more information.

What is fracking and will it jeopardise the quality of the milk I produce?

Safeguarding against risk factors has been a major focus of governments, research agencies and gas companies. Many risks can be reliably controlled through ongoing technical advancements in engineering design and preventative management.

Uncontrolled risks are associated in the main with human operational error. Recent increased scrutiny in engaging suitably qualified and experienced drilling contractors has improved stakeholder confidence in the industry to prevent the likelihood or consequence of uncontrolled incidents.

Hydraulic Fracturing

Hydraulic fracturing (or “fracking”) is the process of injecting fluids containing sand or small ceramic grains (called “proppant”) under pressure to fracture a rock and improve the ability for water and gas to flow back to the well. The proppant holds open the fracture to allow gas to drain more completely and quickly.

Depressurising the seam creates a gradient towards the well. This means that water held in the immediate cleats and fractures flows towards the well and up to the surface along with the water used in the fracking process, carrying most of the fracturing fluid. This water is called flowback water. Flowback water takes an average two days to surface.

Water alone is not always adequate for fracturing certain coal seams because its low viscosity limits its ability to transport proppant evenly through fracture lines. Chemicals are added to the fluid to improve the effectiveness of the fracturing; these constitute between 1-2% of the fracturing fluid.

According to the CSIRO (2012b), commonly used chemical additives in fracturing fluids include:

- Guar gum (a food thickening agent used in ice-cream) Purpose: used to create a gel that transports sand through the fracture.
- Sodium hypochlorite (used in pool chlorine) and sodium hydroxide (used to make soap). Purpose: to prevent bacterial growth that contaminates gas and restricts gas flow.
- Ammonium persulphate (used in hair bleach). Purpose: to dissolve hydraulic fracturing gels so they can transport water and gas.
- Surfactants such as ethanol and the cleaning agent orange oil (used in toothpastes). Purpose: to increase fluid recovery from the fracture.
- Acetic acid (vinegar) and sodium carbonate (washing soda). Purpose: to control the acid balance of the hydraulic fracturing fluid.

Some additives above are used in the dairy industry to clean and sanitise pipes, tanks and heat exchangers, often with surfactants and wetting agents added to enhance effectiveness.

While there is no definitive composition or concentration of fracturing fluids, mandatory codes of practice in NSW and Queensland place clear legal requirements on chemical use and require full disclosure of all chemicals to be used in project Fracturing Stimulation Management Plans.
The use of additives containing BTEX compounds is banned in all Australian States. To date, less than 5% of wells in Australia have required fracking as the unconventional gas mining industry has been largely associated with relatively permeable CSG extraction. Shale gas wells require greater intervention through fracking and higher volumes of fracking fluid than CSG.

See Fact Sheet Unconventional Gas Mining – Water Quality and Quantity for more information.

Managing flowback water above the ground

When flowback water (produced water & fracking fluid) is brought to the surface, it is not suitable for stock watering or pasture application. If used for agriculture without treatment, it is likely to lead to soil salinisation and degradation. Recent studies suggest that treatment by an integrated process of using microfiltration, ion exchange and reverse osmosis can make flowback water suitable for re-use.

Gas Well Integrity

Well integrity is the key to managing potential risks. When the desired depth is reached, the well shaft is cased with steel and the gap between steel and the rock is pressure cemented from the coal seam to the ground surface. This ensures that all formations and aquifers overlaying the coal seam are isolated from fluid and gas flowing inside the gas well.

Mandatory codes of practice in Queensland and NSW place clear legal requirements on the construction and abandonment of wells and bores. These codes are important in the regulated safeguarding frameworks established in these States.

See Fact Sheet Unconventional Gas Mining – Overview of regulatory safeguards and research for more information.

Further Information

Fact sheets have been prepared on the following topics:
- Land access and farmers’ rights.
- Planning and managing in a coexistence scenario.
- Impacts and opportunities for dairy.
- Water quality and quantity.
- Overview of regulatory safeguards and research.

The full set of fact sheets and a comprehensive contact list for each State is at www.dairyaustralia.com.au.

What about food safety requirements for milk?

In producing milk, the Australian dairy industry, including farmers, is subject to Standard 4.2.4 of the Australian and New Zealand Food Safety Code (ANZFSC).

Food safety programs must include control measures to prevent, eliminate or reduce the introduction of chemicals and microbiological hazards that can be indirectly introduced into milk through animal feeds or water.

As such, dairy farmers need to work with dairy processors to identify any changes needed in food safety programs as a result of any unconventional gas mining activity in dairy regions. This includes notifications, testing and documentation, and costs associated with managing additional requirements.

In cases where fracking is to occur, Fracture Stimulation Management Plans will be a key information source on any additives brought onto dairy farms to check against food safety standards.

References

Commonwealth Scientific and Industrial Research Organisation [CSIRO] (2012b) Factsheet: What is hydraulic fracturing?

Dairy Australia Limited ABN 60 105 227 987
Level 5, IBM Centre
60 City Road, Southbank VIC 3006 Australia
T + 61 3 9694 3777 F + 61 3 9694 3701
E enquiries@dairyaustralia.com.au
dairyaustralia.com.au

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