

Health Effects of Coal Seam Gas



Keith Adam – RACP Congress May 2016

What's in a name?

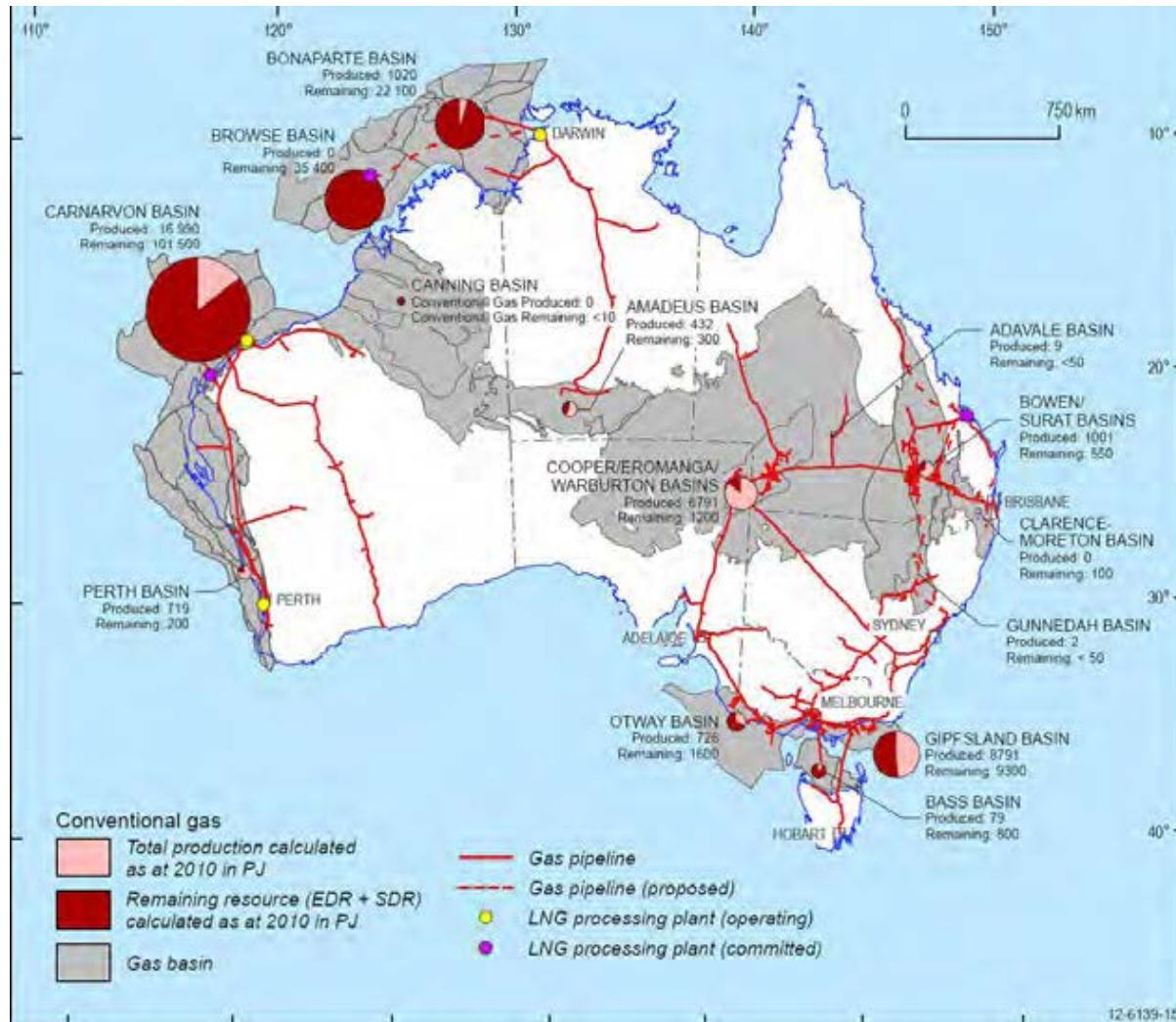
Conventional Gas

Unconventional Gas

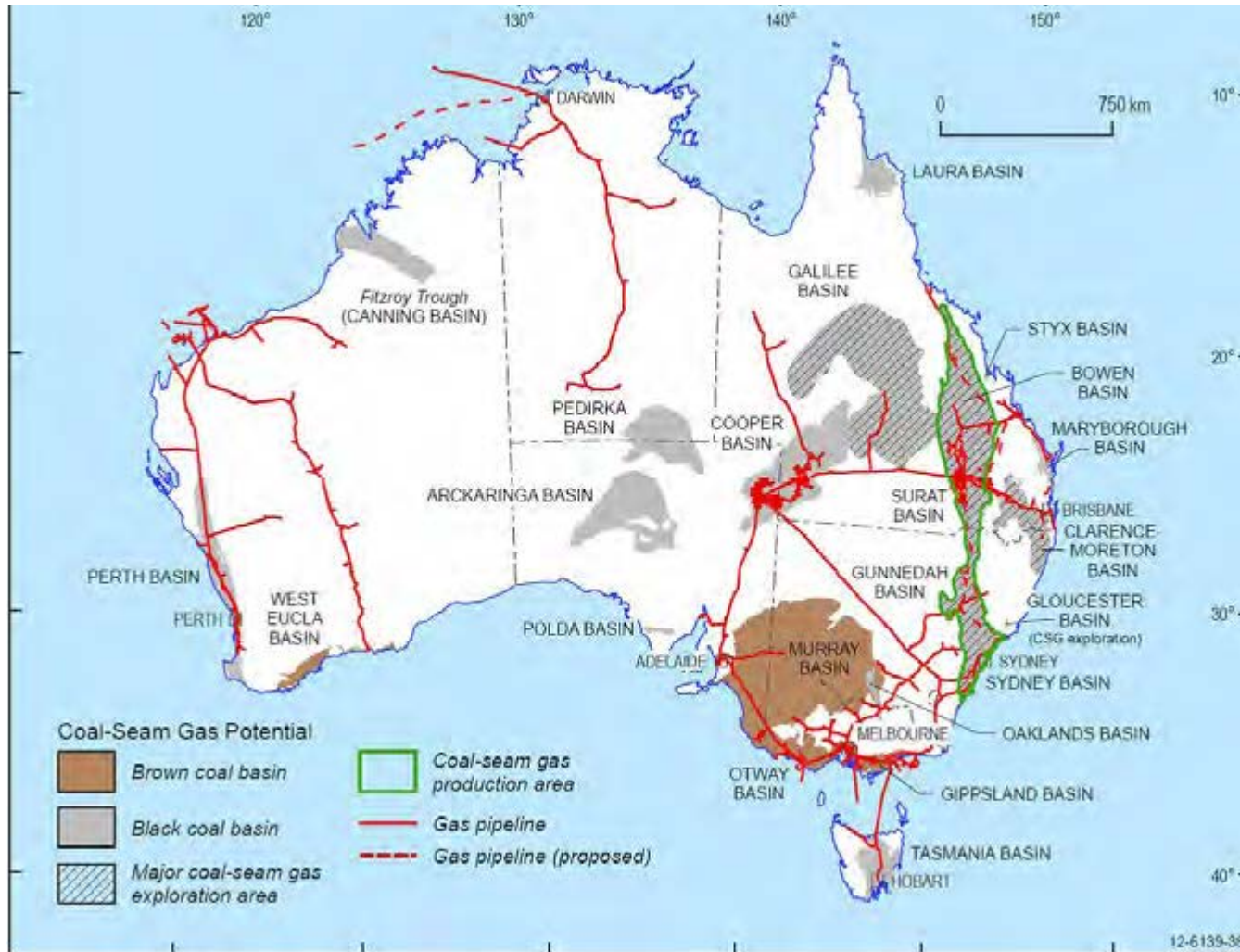
- **coal seam gas**
- shale gas, and
- tight gas.

Underground coal gasification

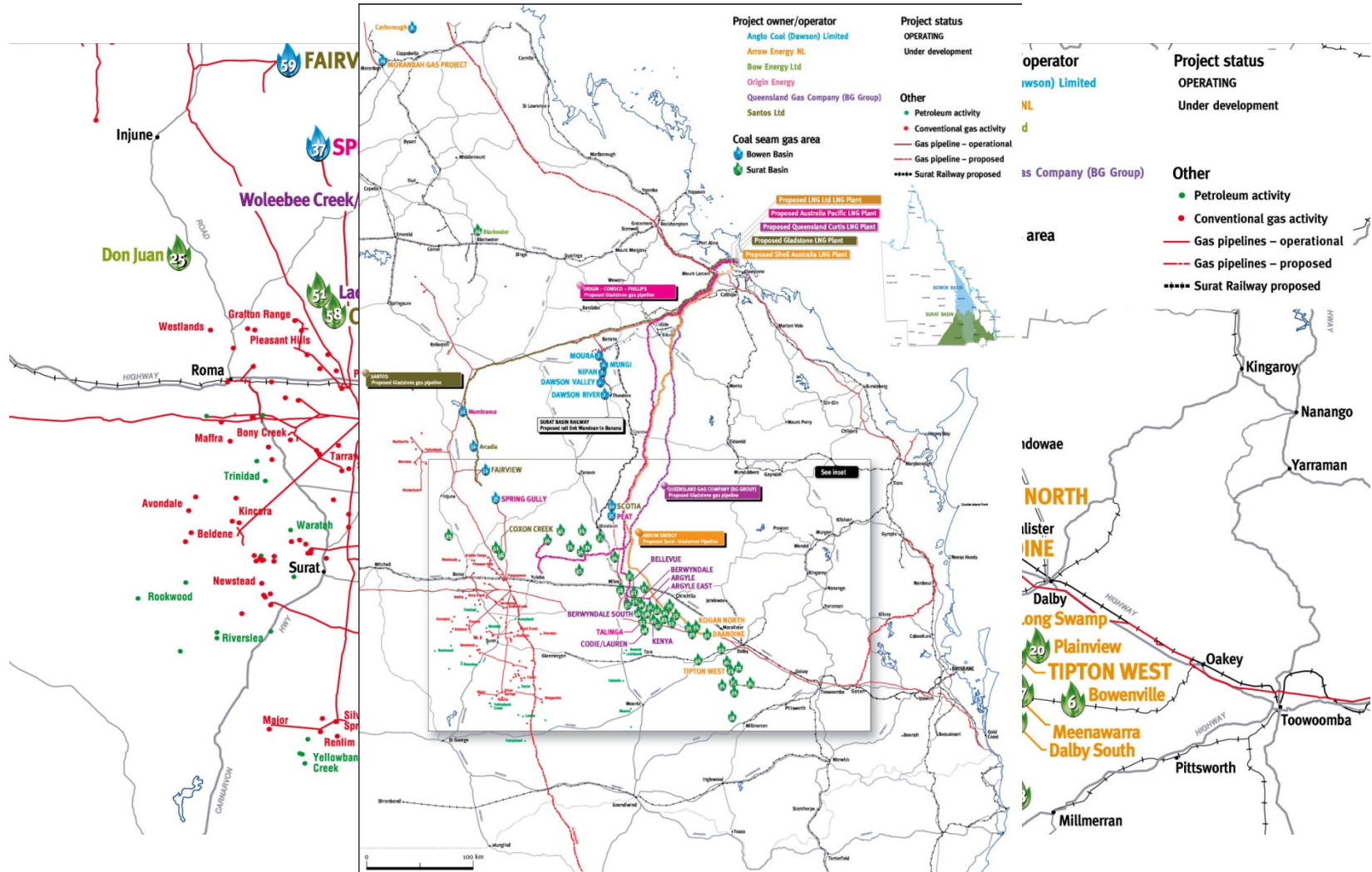
Conventional Gas



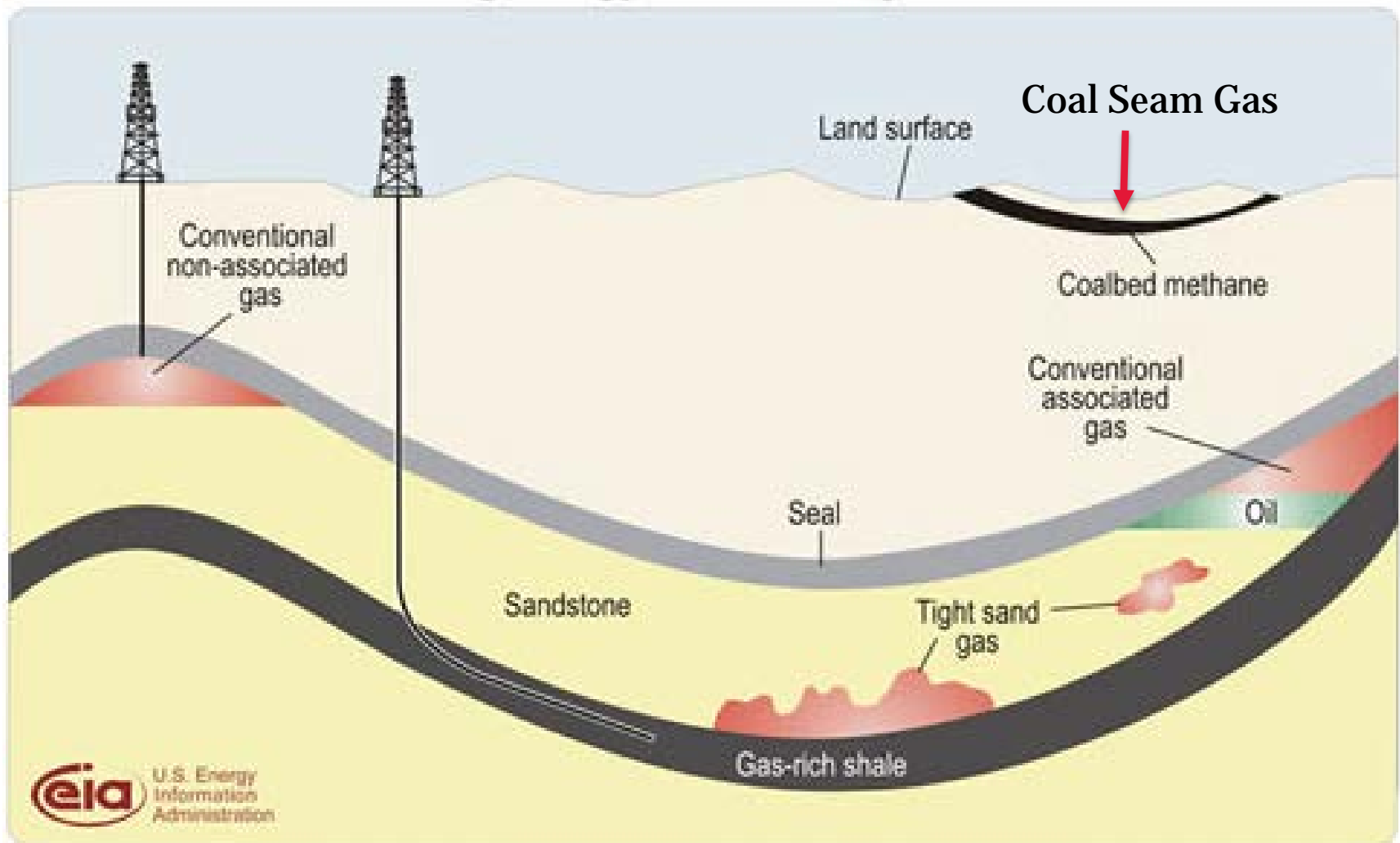
Where Do We Extract CSG



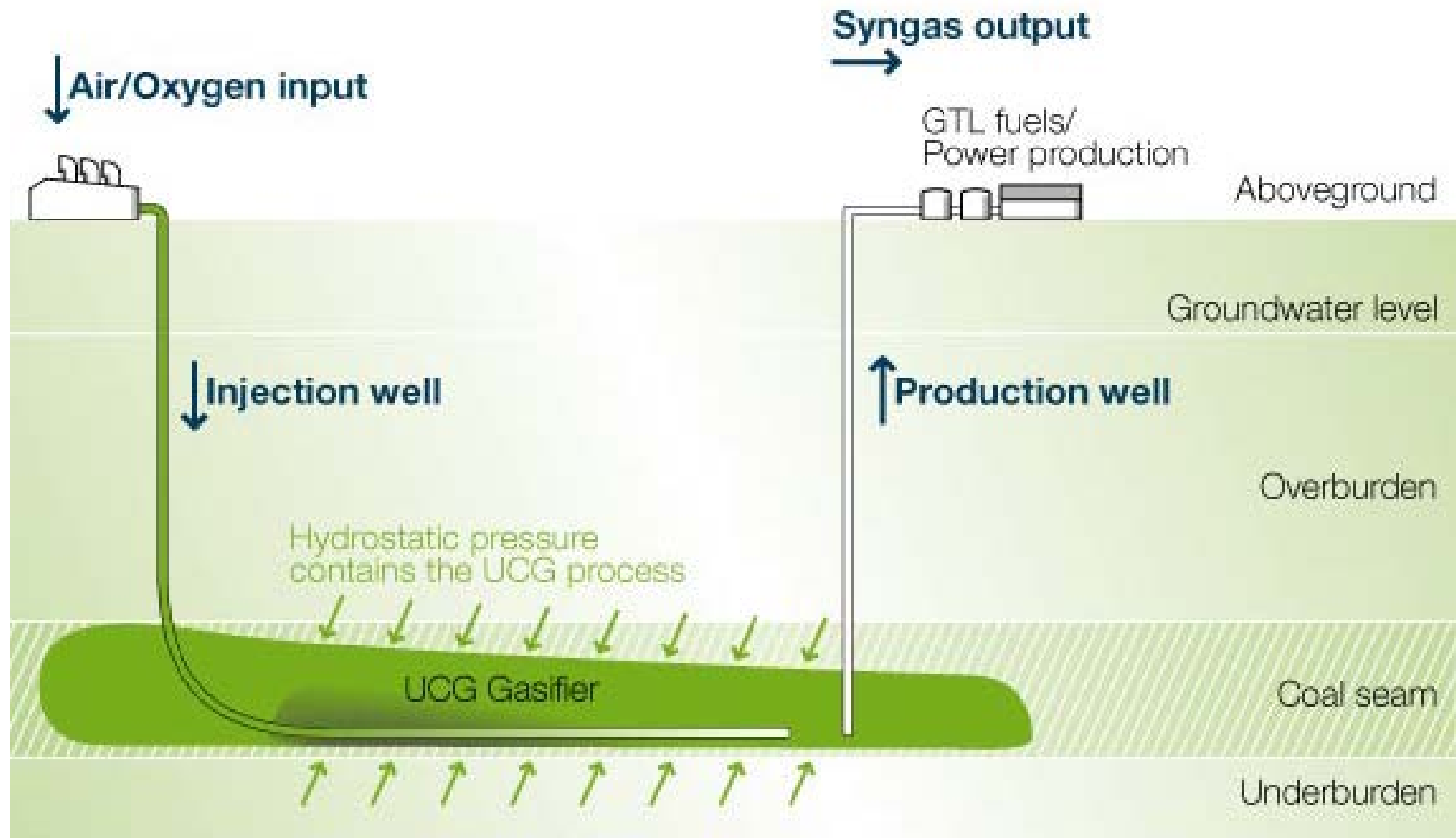
Where Do We Extract CSG



Geology of Gas Resources



Underground Coal Gasification (UCG)



Underground Coal Gasification (UCG)

Coal is combusted and transformed underground under controlled conditions to produce a synthesis gas (syngas)

- Carbon monoxide,
- sulphur oxides (SO_x)
- mono-nitrogen oxides (NO_x)
- hydrogen sulphide (H_2S)
- Gaseous hydrocarbons including
 - benzene, toluene, ethylbenzene and xylenes (BTEX)
 - polycyclic aromatic hydrocarbons (PAH)

Utilised for power generation or as feedstock in the production of liquid fuels, fertilisers, or other chemical products

Composition of Gases

Natural Gas	Coal Seam Gas ¹	Syn Gas
Methane (CH ₄) CO ₂ Ethane Propane Butane Condensates	CH ₄ 95-97% Only small quantities of N ₂ and other hydrocarbons	CO ₂ , H ₂ , CO, CH ₄ , N ₂ , H ₂ O gaseous hydrocarbons (BTEX, PAH) small quantities of SO _x , NO _x , and H ₂ S.

¹ Average of Codie Wells (QGC) – CH₄ 98.3%, N₂ 1.5%, CO₂ 0.2%

The Psycho-Socio-Political Climate



Land freehold vs Exploration and mining rights

- “Lock the Gate”

Land use – mining vs agricultural use

W:

A large yellow triangle pointing downwards, partially overlapping the text 'Lock the Gate Alliance'.

Lock the Gate Alliance

- Contamination of aquifers

Global warming and greenhouse gases

Health Effects

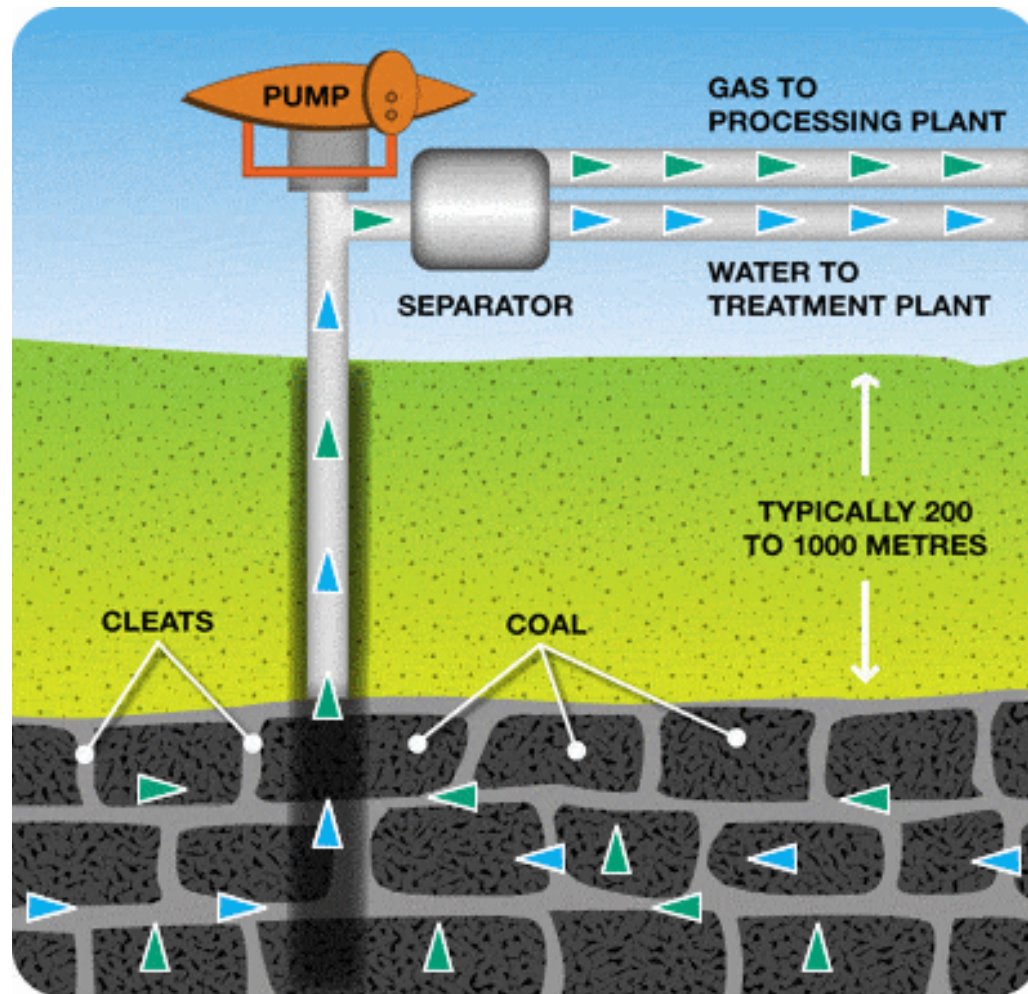
Coal Seam Gas



CSG Well



Coal Seam Gas

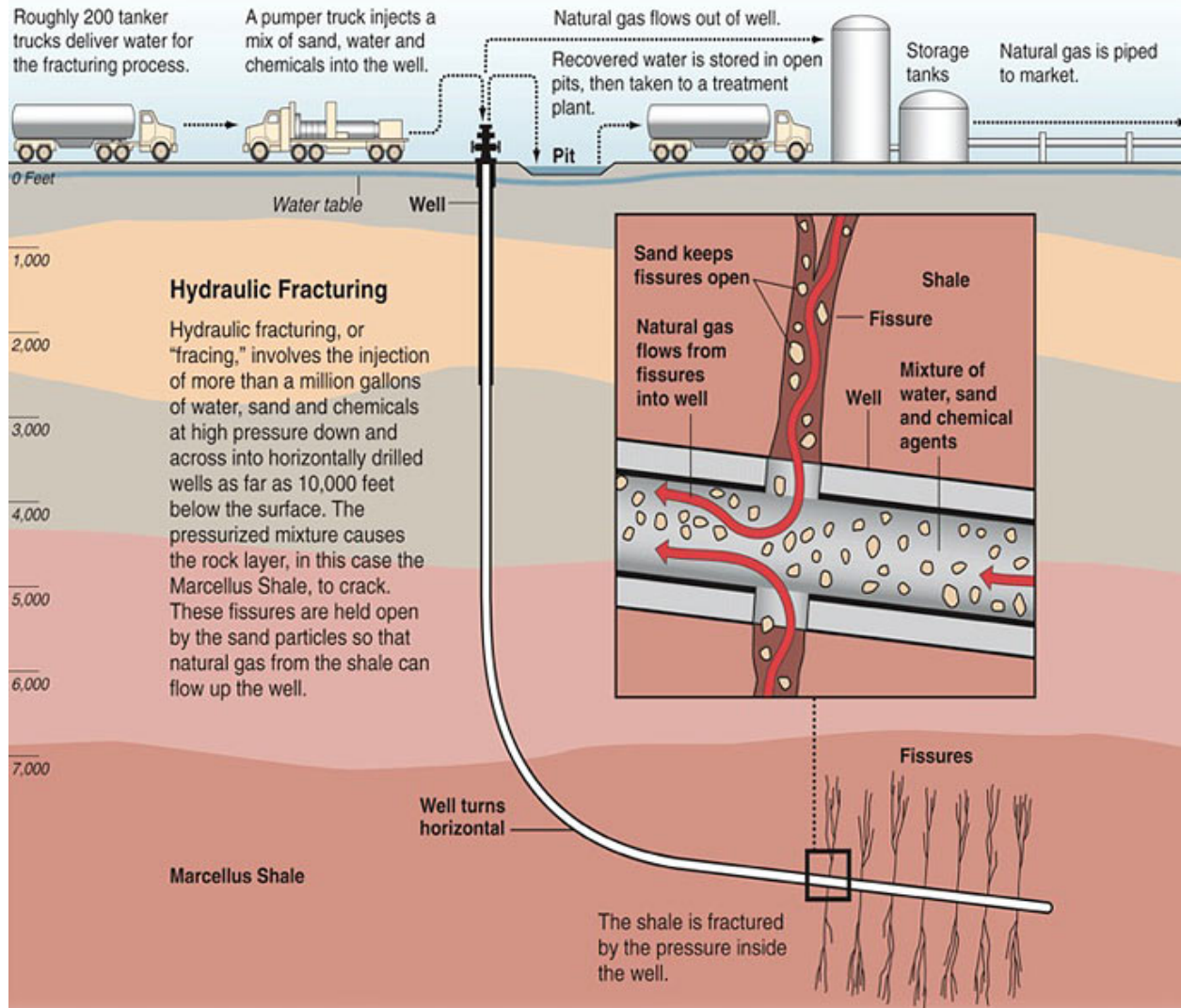


Coal Seam Gas

Coal Seam Gas (CSG) is natural gas found in coal deposits, sometimes called coal seam methane

- mostly (95-97%) methane
- held in place by hydraulic pressure
- Large volume of water removed from seam to release CSG from coal – “produced water”
- contains dissolved salts; high levels of sodium and bicarbonate as well as other geogenic substances originating from the coal seam.
- Varies with local geology

Hydraulic Fracturing “Fracking”



Hydraulic Fracturing or “Fracking”

- increases the rate and total amount of oil and gas extracted from reservoirs.
- injecting fluid made up of water, sand and chemical additives under high pressure into the cased well
- creates a fracture in the coal seam
- might extend to a distance of 200 to 300 metres from the well
- The sand in the hydraulic fracturing fluid acts to keep the fracture open after injection stops
- most of the hydraulic fracturing fluid is, over time, brought back to the surface and treated before being used again or disposed of.
- Currently estimated 6% of wells, may rise to 40%

Fracturing or “Fracking”

What does hydraulic fracturing fluid contain?

- Water (84 to 96 per cent)
- proppant (3 to 15 per cent), such as sand,
- Added chemicals make up about 1 per cent of the hydraulic fracturing fluid.

Fracking Chemicals

Additive Type	Main Compound(s)	Purpose
Diluted Acid	Hydrochloric Acid, muriatic acid	Dissolves minerals
Biocides	Glutaraldehyde, Tetrakis, hydroxymethyl phosphonium sulfate	Eliminates bacteria in water that produce corrosive products
Breaker	Ammonium persulfate/ sodium persulfate	Delayed break gel polymer
Corrosion Inhibitor	n,n-dimethyl formamide, methanol, naphthalene, naphtha, nonyl phenol, acetaldehyde	Prevents corrosion of pipes
Friction Reducer	Mineral oil, polyacrylamide	Reduces friction of fluid
Gel	Guar gum	Thickens water
Iron Control	Citric acid, thioglycolic acid	Prevent metal oxides
KCl	Potassium chloride	Brine solution
pH Adjusting Agent	Sodium or potassium carbonate	Maintains pH
Scale Inhibitor	Ethylene glycol	Prevents scale deposits in pipe
Surfactants	Isopropanol, 2-Butoxyethanol	Affects viscosity of fluid
Crosslinker	Ethylene glycol	Affects viscosity of fracking fluid

Worker Exposure



Silica

Moving, transporting and refilling thousands of pounds of sand onto and through sand movers, along transfer belts, and into blenders generates considerable dust, including respirable crystalline silica

- Silicosis
- COPD
- Group 1 carcinogen

Silica exposure



Silica Monitoring

NIOSH collected 116 full-shift personal-breathing-zone (PBZ) air samples at 11 different hydraulic fracturing sites

- exposures to respirable silica consistently exceeded relevant occupational health criteria
- 54 (47%) exceeded OSHA PELs
- 92 (79%) exceeded NIOSH REL & ACGIH TLV
- 36 (31%) exceeded NIOSH REL by a factor of 10 or more

Benzene Exposure

Flowback - process fluids that return from the well bore after hydraulic fracturing.

Returning process fluids can contain hydrocarbons including benzene, depending on geology



Exposure Monitoring

- short-term and full-shift PBZ and area air sampling for exposures to benzene and other hydrocarbons
- Real-time, direct reading instruments for peak and short-term
 - VOCs, benzene (C_6H_6), CO, H₂S, and flammable/explosive atmospheres.
- biological monitoring pre- and post-shift urine samples to evaluate exposure to benzene.

Exposure Monitoring

Gauging tanks

- average TWA PBZ benzene exposure was 0.25 ± 0.16 ppm.
- 15/17 samples exceeded NIOSH REL of 0.1 ppm
- 6/17 samples met or exceeded the ACGIH TLV adjusted value of 0.25 ppm
- peak benzene concentrations at open hatches exceeding 200 ppm

Exposure Monitoring

Not gauging tanks

- average TWA PBZ benzene exposure was 0.04 ± 0.03 ppm
- 17/18 samples below NIOSH REL of 0.1 ppm

Biological monitoring

- No samples were found to exceed the ACGIH BEI for s-phenyl mercapturic acid (benzene)

Exposure Monitoring

Overall

- 0/35 samples exceeded the OSHA permissible exposure limit for benzene of 1 ppm for general industry
- Exposures to other hydrocarbons (toluene, ethyl benzene, and xylenes) did not exceed any established occupational exposure limits.

Resident Exposure Tara Review



Tara and the “blockies”

Tara, 80 km west of Dalby, has a population of around 800 people.

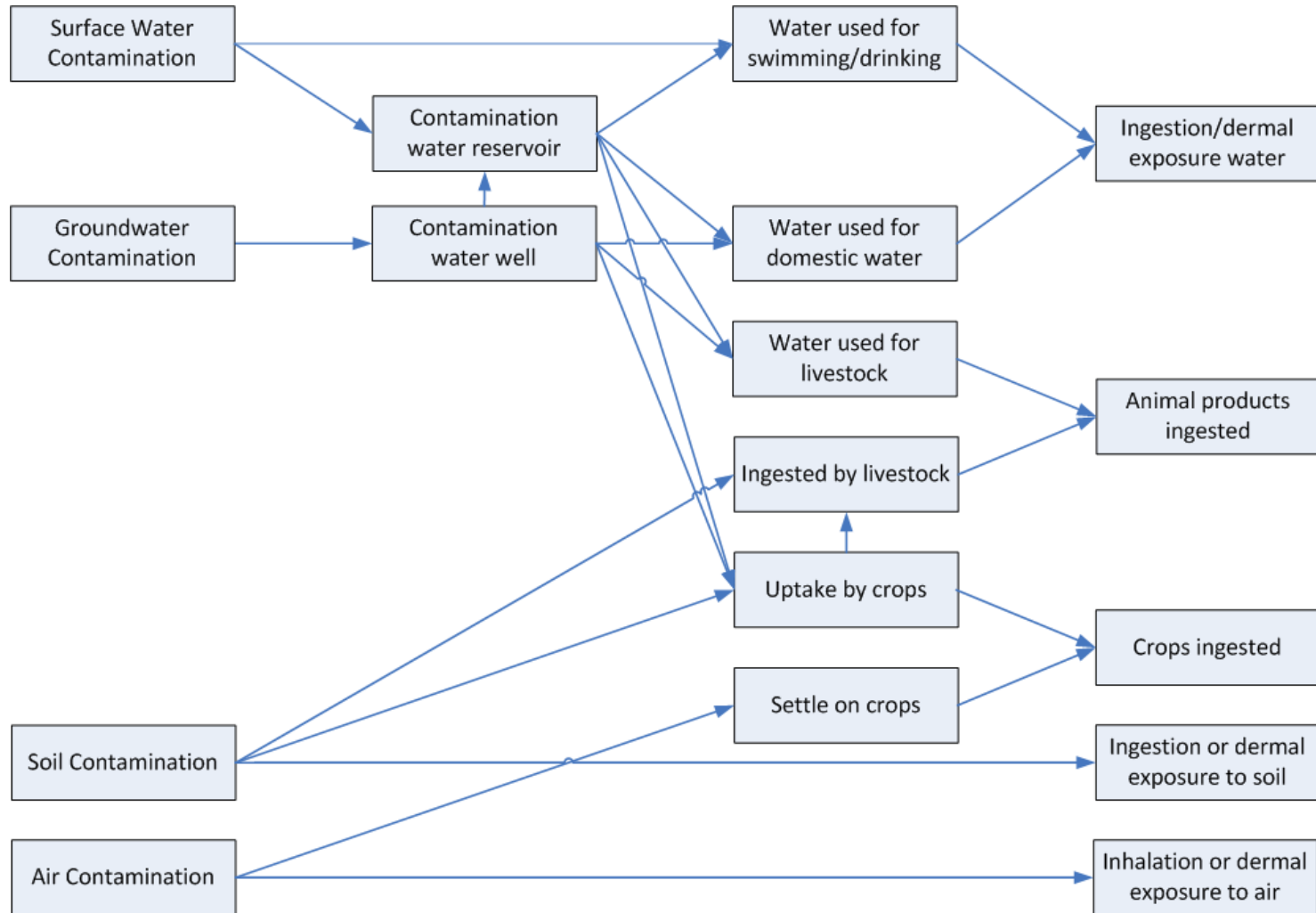
Surrounding area - more than 2100 rural subdivision blocks called ‘lifestyle rural blocks’, comprising of 13 to 40 hectare properties

The current population of ‘blockies’, is more than the town itself.

Numerous CSG wells in close proximity to some blocks

Concern about health effects

Potential Exposure Pathways



Environmental Health Assessment Report

Tara Complaint Investigation Report

Environmental Resources Management Australia Jan 2013

A review of soil, air and water samples from 9 blocks in Wieambilla adjacent to QGC wells 11, 12, 13, 16, 17, 18 and 19 July 2012

- 37 soil samples, 15 water samples, 13 air samples

14 air and 14 water measurements available from local wells

Environmental Health Assessment Report

Water

5 samples had E. coli – unrelated to CSG

2 samples showed Cd, 1 showed Pb– unrelated to CSG

Soil

No constituents above thresholds

Air

One overnight sample contained benzene above health risk criteria; but the average of the 2 samples was below NEPM 2004.[Benzene not detected in local wells]

SIMTARS Odour Report

9 short-term (30–60 seconds) air samples were collected in evacuated Summa vacuum canisters between 3 July to 6 December 2012.

Allows collection when odour was worst

- Four residents collected six samples
- DEHP field staff collected two samples in the CSG fields
- control sample from Barakula State Forest
- 3–7 VOC were detected in all 9 samples.
- none exceeded short-term (1-hr) criteria

SIMTARS Odour Report

Passive sampling to determine long-term average air concentrations of VOC was conducted at four locations in the Wieambilla Estate and a control location in Chinchilla.

Over 3 weeks 26 September to 16 October 2012.

- all results, with one exception were well within relevant reference criteria
- 1 sample benzene 0.6ppb - meets Queensland and Texas reference values, but exceeds Ontario reference value.

Queensland Health

I visited Tara on 11 and 12 October at request of Queensland Health, to undertake a review of individuals who believe their health has been adversely affected as a result of coal seam gas exploration being undertaken in the region.

- 14 individuals, including 2 families
 - 4 children at school/work
- 3 telephone interviews

Queensland Health

Symptoms

- headache
- nausea and vomiting
- nosebleeds - irritation of nose, throat and eyes
- Various rashes and sores
- one child has developed asthma, aggravation with a sulphur smell ? associated with drilling.
- One report of a child with pins and needles in hands and feet, and a complaint that it hurts to walk.

Examination

- several cases, nasal mucosa appeared a little inflamed
- 1 infant papular rash, unable to identify.

Other reports

Symptomatology of a gas: field An independent health survey in the Tara rural residential estates and environs. Dr Geralyn McCarron April 2013

- Questionnaire – 113 individuals, 38 households
- Critique of QH report

“Harms unknown: health uncertainties cast doubt on the role of unconventional gas in Australia’s energy future.” MJA 2014

Conclusions

One agency to “own”, co-ordinate

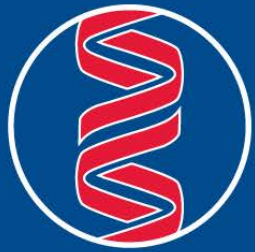
- Collate various sources of information
- resolve apparent anomalies, contradictions
- comprehensive communication strategy

Potential hazards to workers identified

No health hazards to residents clearly identified

Picture confounded by psycho-social factors

Most information was anecdotal or speculative



Sonic
HealthPlus

Questions?