Why is So Much Hot Air Bubbling to the Surface: CSG Impacts vs No Impacts?

SEng Society Seminar, 9th May 2013

eng.monash.edu.au/enveng
Ad Busters !!!!

• http://www.youtube.com/watch?v=p8s4BB0en8Y&feature=endscreen&NR=1
There must be a source of energy down there.
Presentation Overview

• Australia’s Energy Resources …
• What is Coal Seam Gas (brief !)
• Common Environmental Concerns
• Groundwater Risks and Impacts
• Need for Thorough Research & Evidence of ‘NO HARM’
Energy Everywhere … even in Oz
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- Australia has substantial and varied energy resources:
  - solar thermal & PV, wind, tidal, coal, conventional gas, coal seam gas, shale gas, uranium …
  - But we are running out of conventional oil …
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- Yet we continue to simply dig or drill ...
Energy ... Oz Style

Energy in Australia 2012

BREE for RET

Saturday, 11 May 13
Energy ... Oz Style

Energy in Australia 2012
BREE for RET

Saturday, 11 May 13
What is Coal Seam Gas?

- Coal can often contain significant amounts of methane – also called ‘natural gas’ – hence the name ‘coal seam gas’ (CSG)
- CSG is a major problem for coal mining – especially underground (CSG is the principal cause of coal mine accidents, & historically simply simply vented to the air)
- You can extract CSG before coal mining, or even separately through bores & pipes
Coal Seam

- Butt Cleats
- Face Cleats
- Bedding planes

Conventional

- Sand Grain
- Gas filled porosity

Graphs:

- Dewatering, Stable production, Decline
- Methane, Water
- Time, Pressure reduced by water production, gas desorbs

- Methane, Water
- Time, Pressure drives out gas, water influx kills well.
CSG vs Geology vs Groundwater ...

APLNG, Origin-Conoco Philips

Saturday, 11 May 13
CSG Exploration or ‘Appraisal’ Well

Gladstone EIS, Santos, 2009

Saturday, 11 May 13
CSG Production Well

Gladstone EIS, Santos, 2009
Common Environmental Concerns

- Major environmental issues with CSG include:
  - compatibility of land use (eg. farming v CSG)
  - surface water impacts (toxics, erosion, floods, ...)
  - groundwater impacts – quantity & quality
  - toxic pollutants released – accidents or ongoing operations

- The extent of scientific research documenting these risks is MINIMAL …
CSG & Water Issues

• Water WATER WATER
Aerial view of a CSG Water Pond
Groundwater Concerns v CSG
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  2. Poor quality of CSG formation waters
  3. Potential for explosive buildup of methane gas
  4. Dependence of rural communities & industries on groundwater
4.6 GROUNDWATER POLLUTION

A previous technical assessment of the groundwater regime found that as the entire casing of each well is cemented from top to bottom, connection between the Illawarra coal measures and overlying aquifers is not possible. The potential for cross contamination between aquifers during the production life of a well is therefore extremely unlikely.

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Given the limited volumes of groundwater generated during well construction and the nature of the containment within the coal measures as well as overlying formations, surface aquifer depletion or subsidence are not considered to be significant issues.
Previous technical assessment of the groundwater regime has noted that the potential for contamination or depletion of shallow sandstone aquifers of the area, or cross-contamination between aquifers during the production life of a well, is extremely unlikely given the use and construction of gas production wells. As the entire casing of each well is cemented from top to bottom, connection between the Illawarra coal measures and overlying Hawkesbury Sandstone aquifers is not possible and the potential for cross contamination between aquifers during the production life of a well is therefore extremely unlikely. Given the limited volumes of groundwater generated during well construction and operation, the nature of the containment within the coal measures as well as overlying formations, shallow sandstone aquifer depletion has not been considered an issue.

To further assess the groundwater situation within the project area AGL has developed a groundwater investigation and monitoring program in conjunction with Parsons Brinckerhoff (PB), a specialist environmental and engineering consultancy.

AGL, 2010-11 Annual Environmental Performance Report, pp 34
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"NO DATA = NO PROBLEM"
Case Study: Condamine Alluvium, Qld

Courtesy: A. Brown
Methane contamination of drinking water accompanying gas-well drilling and hydraulic fracturing

Stephen G. Osborn\textsuperscript{a}, Avner Vengosh\textsuperscript{b}, Nathaniel R. Warner\textsuperscript{b}, and Robert B. Jackson\textsuperscript{a,b,c,1}

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Edited\textsuperscript{*} by William H. Schlesinger, Cary Institute of Ecosystem Studies, Millbrook, NY, and approved April 14, 2011 (received for review January 13, 2011)

Directional drilling and hydraulic-fracturing technologies are dramatically increasing natural-gas extraction. In aquifers overlying the Marcellus and Utica shale formations of northeastern Pennsylvania and upstate New York, we document systematic evidence for methane contamination of drinking water associated with shale-gas extraction. In active gas-extraction areas (one or more gas wells within 1 km), average and maximum methane concentrations in drinking-water wells increased with proximity to the nearest gas well and were 19.2 and 64 mg CH\textsubscript{4} L\textsuperscript{-1} (n = 26), a potential explosion hazard; in contrast, dissolved methane samples in neighboring nonextraction sites (no gas wells within 1 km) within similar geologic formations and hydrogeologic regimes averaged only 1.1 mg L\textsuperscript{-1} (P < 0.05; n = 34). Average $\delta^{13}$C-CH\textsubscript{4} values of dissolved methane in shallow groundwater were significantly less negative for active than for nonactive sites ($-37 \pm 7\%$o and $-54 \pm 11\%$o, respectively; $P < 0.0001$). These $\delta^{13}$C-CH\textsubscript{4} data, coupled with the ratios of methane to higher chain hydrocarbons and $\delta^{13}$CH\textsubscript{4} values...

Study of CH$_4$ in groundwaters of shale gas extraction and background (non-gas) areas

- for shale gas areas, showed that CH$_4$ concentrations in groundwater are significantly higher than background norms
- isotope fingerprinting clearly showed shale CH$_4$ as the source
Duke Uni. – GW, Shale Gas & CH$_4$
The graph shows the methane concentration (mg CH₄/L) plotted against the distance to the nearest gas well (m). The data points are categorized into two groups: active extraction areas (represented by circles) and non-active extraction areas (represented by triangles). The shaded area indicates the action level for hazard mitigation, as defined by the US Department of Interior.
‘Bubbly’ Condamine Style …

- In mid-2012, several kilometres of the Condamine River near Dalby-Chinchilla were found to be bubbling away …
- Bubbles quickly proven to be strong CH$_4$ …
- Within 1 hour of the video going on YouTube, CSG & QG ‘denied’ it could be related to CSG impacts … then they announced an ‘investigation’ (Sir HA style!)

https://www.youtube.com/watch?v=jKjTfXeTV8o
Modified from Fig. 4-4, pp 29 (QWC, 2012)
But Wait … MORE !!!

- Enter my old friend RADON
- Ground-breaking research by SCU folks has shown significantly elevated CH$_4$ and RADON in the Qld CSG fields near Tara …
But Wait ... MORE !!!

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Methane & Radon v CSG

(a) $r^2 = 0.81$
   $p = 0.04$

(b) $r^2 = 0.87$
   $p = 0.02$

(c) $r^2 = 0.72$
   $p = 0.07$

(d) $r^2 = 0.56$
   $p = 0.14$

Tait et al (2013)
Need for **MUCH** Better Monitoring …

- CSG industry in Australia is rapidly expanding – fracking expected to increase (albeit still minority of wells)
- Yet we still do not understand the full extent of groundwater risks – in space & time
- Both industry & government have been too lax in simply believing minimal impacts
- Need much greater monitoring & transparency
- Track record is poor on both fronts …
Summary & Choices ...

- CSG is a technically viable way to produce gas, often very profitable **BUT**
- CSG has major issues around water
  - Often poor quality water extracted with CSG
  - Can be major impacts on groundwater resources – still major uncertainty with spatial & temporal extent
- **Industry/government claim no impacts**
- Many communities assert severe impacts ...
- Whether CSG should muscle out renewable energy is yet to be seen
Acknowledgements

• John Polglase (some photo’s!)
• Andrew Brown (GW graphs!)
• Many community groups in NSW and Qld working on CSG issues

• Any questions, please contact me:
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We have to get the balance right.

Top layer belongs to farmers

Next layer belongs to miners

Impervious Sedimentary rock

Bottom layer belongs to religion (50% to God 50% to pollsters)

What's your underlying concern?

Keep your fracking coal seam gas rig OFF MY LAND!

Those farmers use very scientific language these days...

How far down's the coal?

There's a few layers of overburden to remove

Xenophobia
anti-mining ideology
parochialism
ecological fundamentalism