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CSIRO

AUSTRALIA PACIFIC LNG

Coal seam gas: opportunities, methods & impacts

Peter Stone, GISERA Director

Why are we talking about gas?

- Australia's & the world's energy use continues to rise
- Australia is seeking to cost-effectively transition to a lower carbon economy
- Australia has large quantities of CSG
- Global demand for LNG is rising

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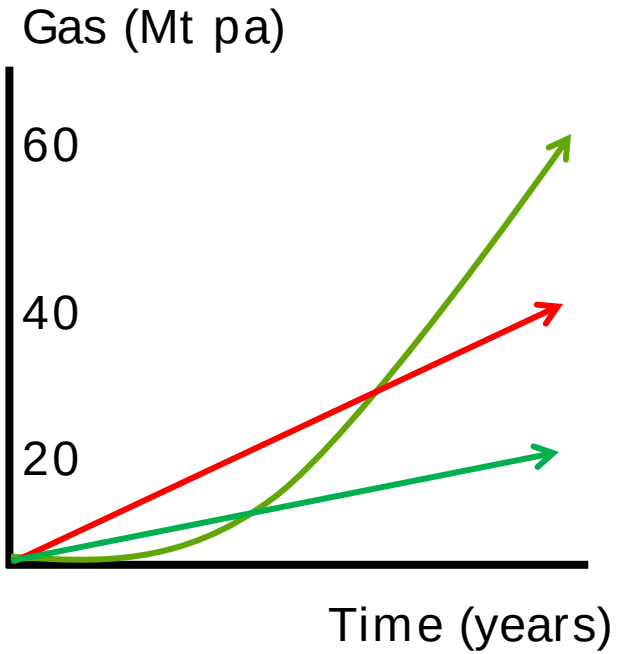
Are we agreed on the scale of the issues?



- Variable rate & scale of development
- Variable rate & scale of impacts & opportunities
  - how many wells?
  - how much water?
  - how much farmland?
  - how many jobs?
  - what financial benefit?

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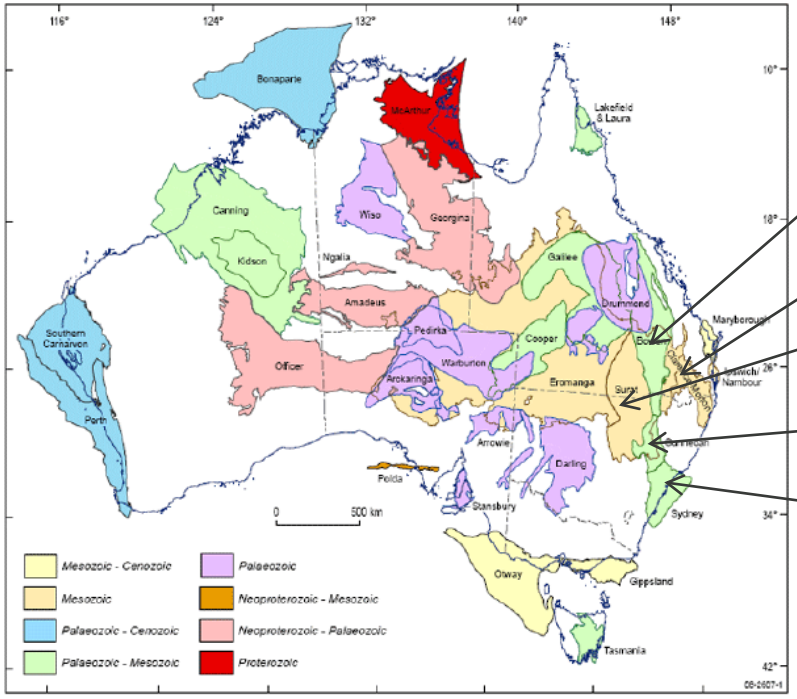
Proven and probable reserves of CSG



Bowen 27%

Clarence- Moreton 2%

Surat 61%

Gunnedah 7%

Sydney & Gloucester 3%

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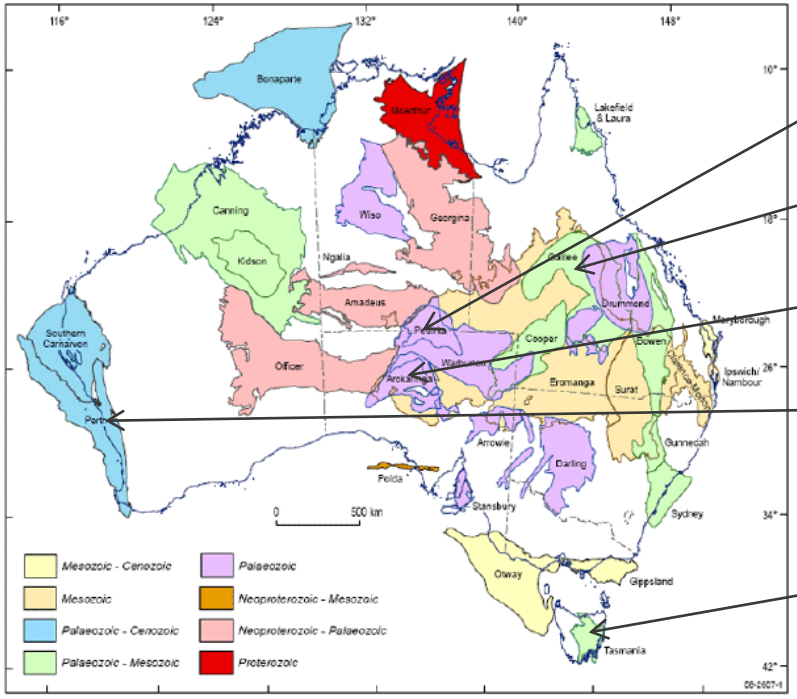
Continuing exploration for CSG



Pedirka

Galilee

Arckaringa

Perth

Fingal- Dalmayne

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Coal seam gas miscellany

- Coal seam gas was formed when coal was being made 200-280 mya
- The gas has been trapped underground at 200 to 1000 m depth, largely by water pressure
- > 95% pure methane
- Queensland has 90-95% of Australia's 2P CSG
- CSG ≠ shale ≠ UCG

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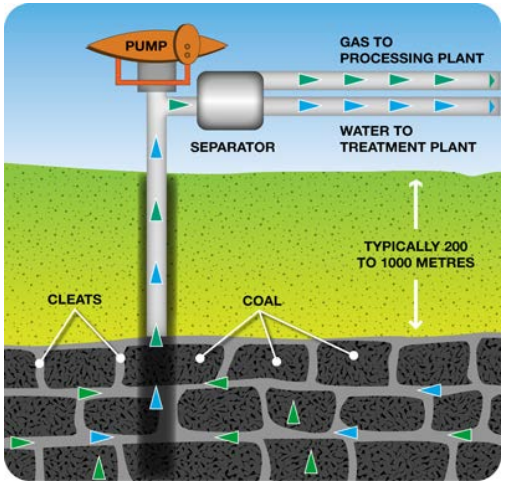
CSG extraction



0.3 x 1000 m

- Wells are inserted to a depth of 400-1000 m
- Water must be pumped from the coal seam to allow egress of gas
- Water and gas are separated and processed away from the well site
- Water & gas production peak in years 1+ & 2+

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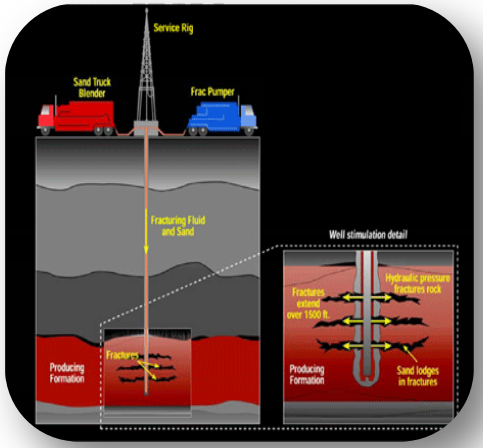
Hydraulic fracturing – 'fraccing'



- Fraccing increases rate & volume of gas extraction
- Fraccing currently applied to 8% of wells, increasing to 10-40% over time
- Fraccing uses mainly water (ca 90%) and sand (ca 9%), with ca 1-3% additives
- In Australia, 'fraccing' additives believed to present low risk via:
  - dilution, removal, degradation & separation

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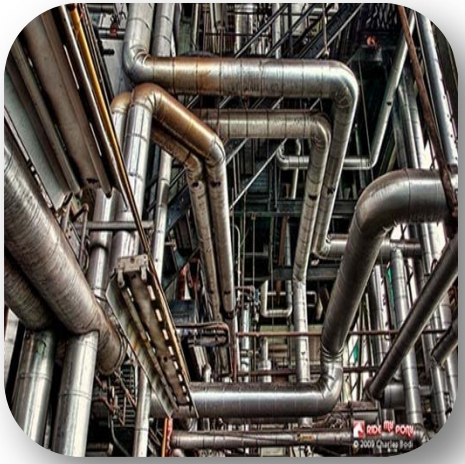
The gas network



- Wells may be spaced on a 750 m grid, and may total ca 12-40,000 wells
- Regional compressors feed power stations (domestic) or LNG trains (export)
- Pipeline network will be extensive, largely underground
- 26%(and rising) of Qld's electricity is generated using CSG

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Gas processing

- CSG will be converted to LNG by cleaning, cooling (-161℃) & compressing in LNG trains at Curtis Island
- ca 80%of CSG will be exported, following conversion to LNG
- Annual exports may total 50 mmt pa
- LNG transport have proven safe
- LNG creation is GHG intensive, ca 4.5 t CO2-e per 10 t LNG (est.)
- Export requires dredging & marine infrastructure
- Increase in shipping traffic (10%above projected rise

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Gas use

- Most CSG will be burned from LNG to generate electricity, domestically or abroad
- CSG is more thermally efficient than coal (+5 - 10%)
- Electricity from CSG is usually more GHG efficient than coal (15 - 50%, est.)
- CSG = 0.44 t CO_2-e per MWh (est.), whole of lifecycle
- Estimates need to be confirmed using measures on specific assets

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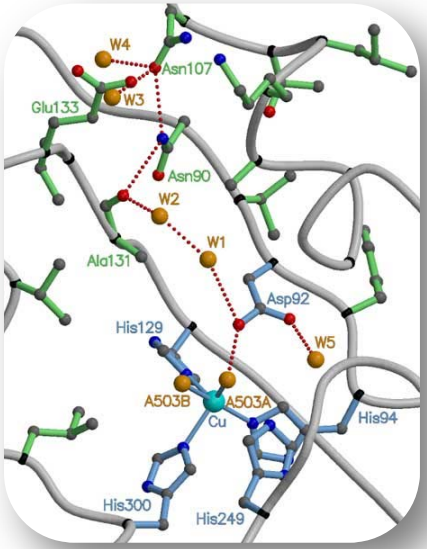
The CSG water network



- Water is a by-product of gas production
- Water production per well in Qld has averaged ca 4 olympic pools per year
- The CSG industry likely to produce ca 95 GL water/yr (30%that initially predicted)
- Water contains avg. 6 g/L salts (range 0.2 - 10)
- Peak salt production likely ca 0.6 mmt
- Multiple options exist for disposal of water & salt

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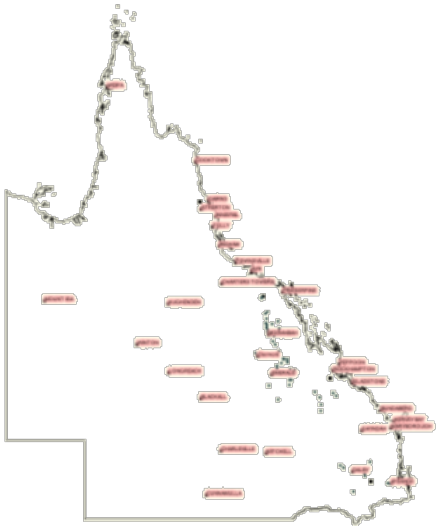
Consequences
Just Ahead

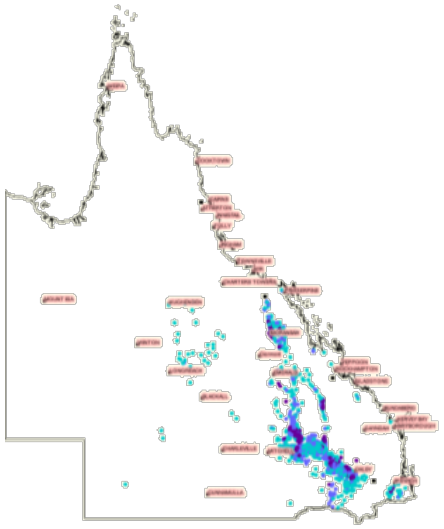
Coal seam gas introduces new neighbours



Current coal

75,000 ha

Small number of large assets
= **few neighbours**



Potential coal seam gas

< 75,000 ha

Large number of small assets
= **many neighbours**

Impacts - social

- Significant internal migration
  - social infrastructure demands
  - competition for labour
- Community function & well-being
- Uncertainty
- Autonomy
- Capacity to engage & respond

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Potential impacts on agricultural land

- Alienation
- Fragmentation
- Degradation
- Self-determination
- Amenity

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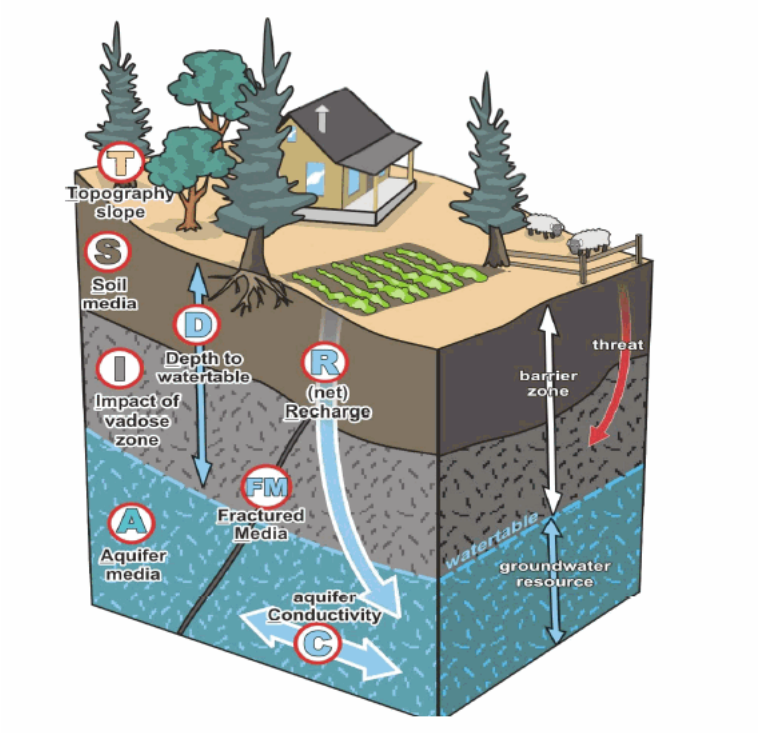
Potential impacts on water resources



- Drawdown
- Depressurisation
- Contamination
- Subsidence
- Salt
- ‘New’ water resources
- Potential to offset existing withdrawals

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What is CSG's GHG footprint?

- CSG is likely to reduce GHG intensity of electricity production cf. coal
- All available figures for operational GHG intensity are 'best available' & based on analogues & estimates:
  - power stations fired with CSG can reduce ghg by 15-50%cf. black coal and 70%cf. brown coal
  - ca 4.5 t CO_2-e per 10t LNG (est.)
- Little data on fugitive emissions
- GHG intensity sensitive to variation in fugitive emissions

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Biodiversity

- Terrestrial habitat & biodiversity under added pressure
- Habitats and species differ in their:
  - current ‘health’ status
  - sensitivity to change
- Benefit from better understanding
  - levels of current & future pressure
  - cumulative impacts of human activity

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Impacts – marine environment

- Marine impacts will arise largely through dredging, marine infrastructure & increased shipping traffic
- Dredging impacts directly via digging & indirectly via altered sediment transport
  - Can reduce food supply, increase hunting & therefore boat strike
- Marine infrastructure can provide habitat, if designed appropriately
- Increased shipping traffic during construction & operation may increase turtle & dugong strikes, general disturbance
- Curtis Island is at the southern end of the GBR

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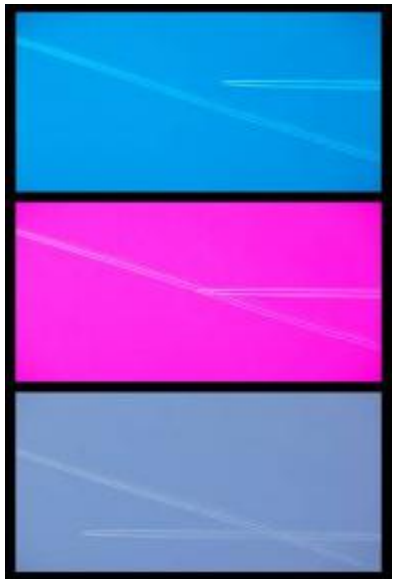
Heterogeneous distribution of impacts & opportunities



CSG development is of a type & scale that generates opportunities & challenges at every stage of project life

Challenges & opportunities are not distributed evenly in space or time, or amongst stakeholders

This understandably fosters tension & uncertainty

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Scale dependent certainty

The certainty with which impacts & outcomes can be predicted declines with the scale at which they are considered

- Resource developments are approved at a regional scale, for which there is a reasonable degree of certainty
- Resource development impacts are experienced by people mainly at a local scale, for which there is less certainty

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GISERA independence

GISERA purpose-built to ensure that:

- identification of research priorities
- selection…
- conduct…
- reporting of research projects

is independent of gas interests

- Only the Research Advisory Committee (2/9 industry members) can develop, approve or stop projects
- All reports publicly available following CSIRO peer-review
- All 'internal' documentation publicly available at www.gisera.org.au

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Thank you

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