

NSW Gas Future 2020: Big Changes Ahead?

A Driller's Perspective

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Synopsis

- **NSW & Qld awash with methane molecules**
- **Methane is trapped in coal, tight sands, shale, & made by burning coal underground**
- **Economic release of this methane will be an industrial boom eg cheap gas for industry, for power generation, for LNG export, for chemical feedstock, for synthetic liquids manufacture.**
- **Advanced drilling technology needed to release this methane**
- **Significant resistance from Not-In-My-Backyard**
- **Drilling techniques to protect aquifers**
- **Techniques to utilise & dispose of produced water**
- **Determination needed to not squander the opportunities.**

AJ Lucas Group and Gas

- **Diversified mining services, infrastructure and construction**
- **Sector focus: energy, water, public infrastructure, coal**
- **Australia's leading Coal Drilling company**
- **Integrated full services for Coal Seam Gas industry**
- **Upstream: drilling, gathering systems and field infrastructure**
- **Midstream: high pressure cross country trunklines**
- **Downstream: mechanical and civil engineering**
- **Investor in shale gas and coal seam gas acreage**

Gas is the “Transition Fuel”

- **Future is nuclear? Solar? Tidal? geothermal? Hydrogen?**
- **Until then, Gas is the “transition” fuel.**
- **“Gas” means methane**
- **Eastern Australia is awash with methane molecules.**
- **Abundant and cheap resource leads to development.**

Definitions

Conventional v. Unconventional Gas

Conventional Gas

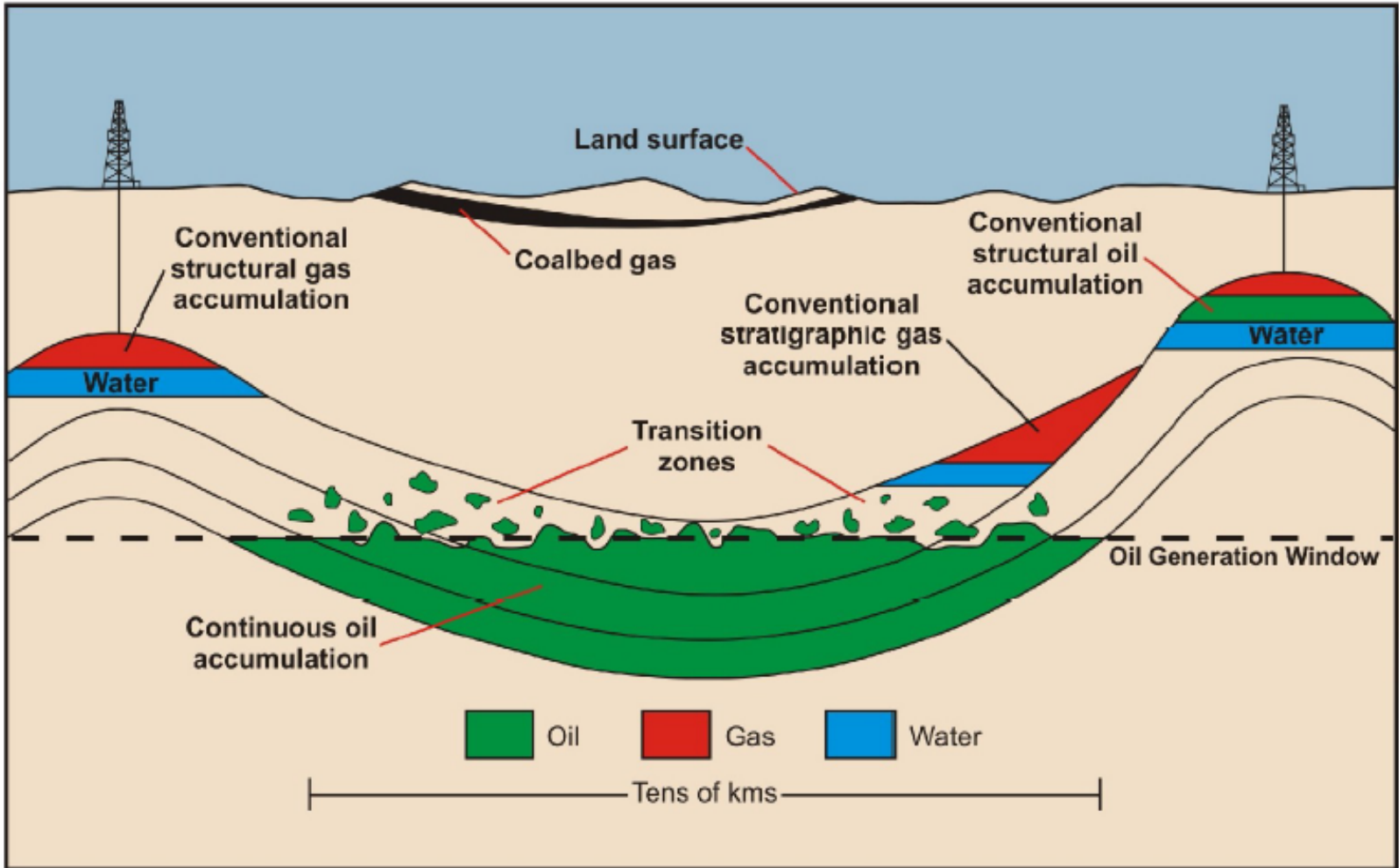
- **gas trapped in anticlines and other geology.**
- **Conventional gas not created in these reservoirs**
- **Gas flows to reservoir and is trapped there**

Unconventional Gas

- **gas from the source rocks**
- **rocks which have created the methane**
- **Source rocks are Coal, Shale, Underground coal gasification**

Conventional vs Continuous Resources

Continuous Shale Accumulations

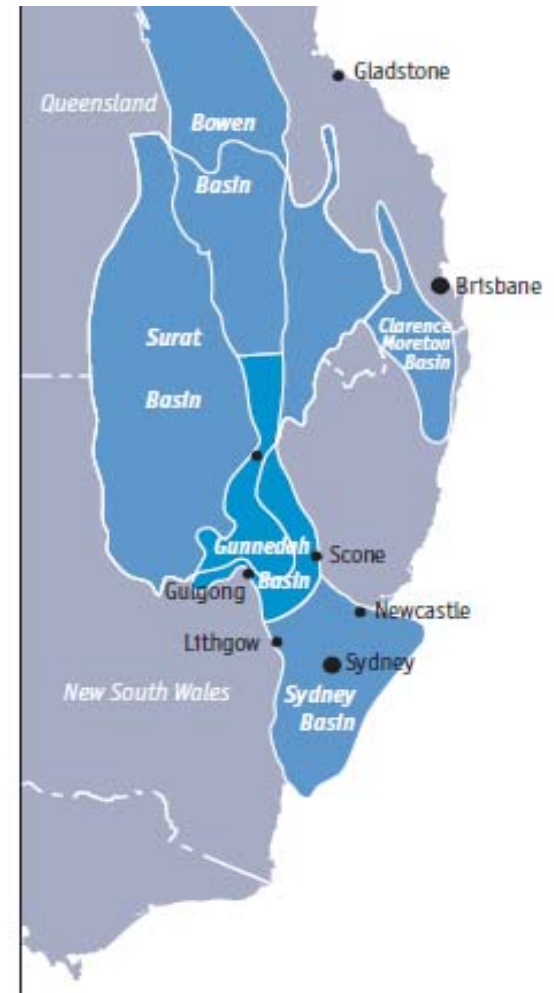


Conventional Gas in NSW

- **Little gas found so far in easy-to-exploit reservoirs**
- **There is gas in tight sands reservoirs**
- **Tight sands reservoirs little explored in NSW**
- **Gas offshore Newcastle? Maybe**

Awash with Unconventional Gas

- **Sydney Region uses 150 PJ / year**
- **>100,000 PJ of coal seam gas?**
- **>10,000 PJ in Hunter Valley**
- **>17,000 PJ in Gunnedah Basin**
- **>300,000 PJ from gasification?**
- **Shale gas in western NSW, SA**



NSW Awash with Gas Molecules Could Mean...

- **Don't import gas from other states**
- **LNG export potential**
- **Continue cheap power production using gas**
- **Chemical industry feedstock**
- **Synthetic liquid fuel production?**

It all hinges on effective drilling technology

The Questions are...

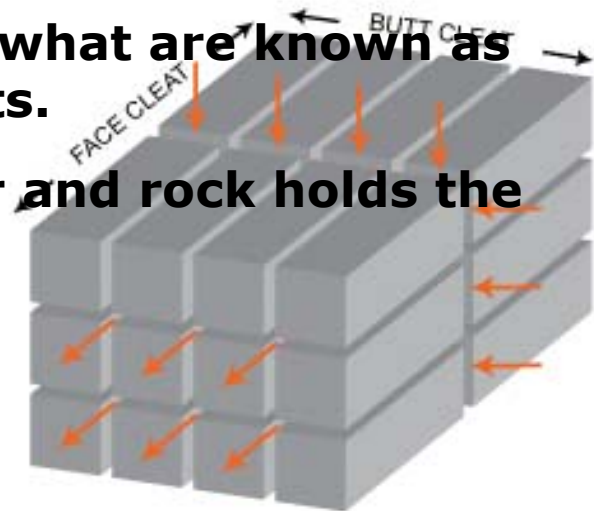
- **Best drilling techniques to release CSM from coal.**
- **Effective drilling of tight gas reservoirs.**
- **Protecting aquifers during drilling & production.**
- **Overcoming NIMBY reluctance & resistance.**
- **Political will to benefit NSW from these resources?**
- **Increasing prices: Moomba shale gas affordable?**
- **Will LNG export pricing make gas too expensive?**
- **Opportunities for CO2 sequestration in coal.**

Techniques for Producing Gas from Unconventional Resources

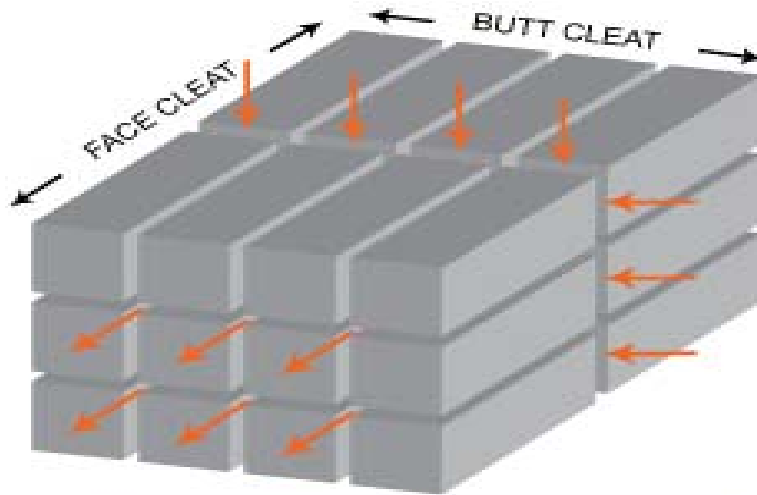
- **For Methane trapped in coal**
 - **Vertical drilling – free flow**
 - **Vertical drilling with stimulation (fracturing)**
 - **Horizontal drilling**
- **For Methane trapped in shale**
 - **Shales “ain’t” shales – brittle shales only**
 - **Horizontal drilling and fracturing**
- **To manufacture methane – burn coal underground**

Why Methane is in Coal

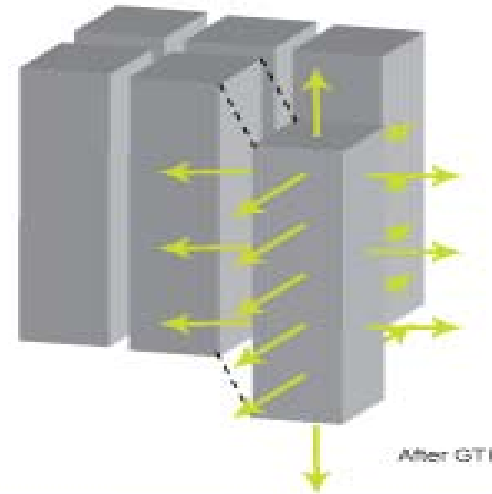
- The formation of coal over time from the gradual breakdown of organic materials often creates methane.
- The methane is trapped under increasing depths of burial.
- The methane is not held in a void of space, but instead clings on to the micropore surface of the coal – it is adsorbed to the surface
- The jagged coal surface is made up of what are known as "cleats" – gas moves along these cleats.
- The pressure of the surrounding water and rock holds the gas in place.



Releasing the Methane from Coal



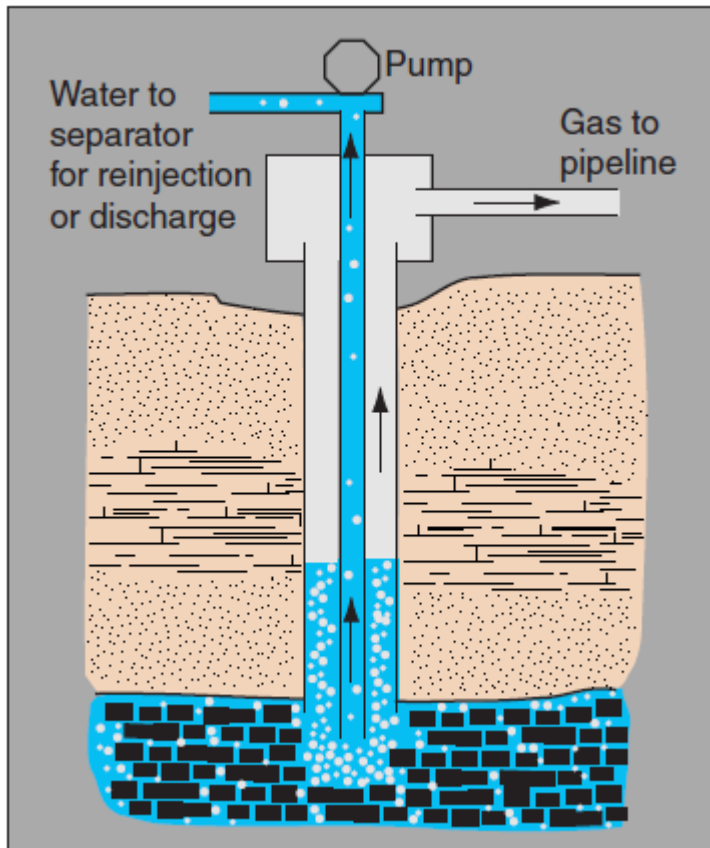
Production Through Natural Fractures



Gas Desorption and Diffusion

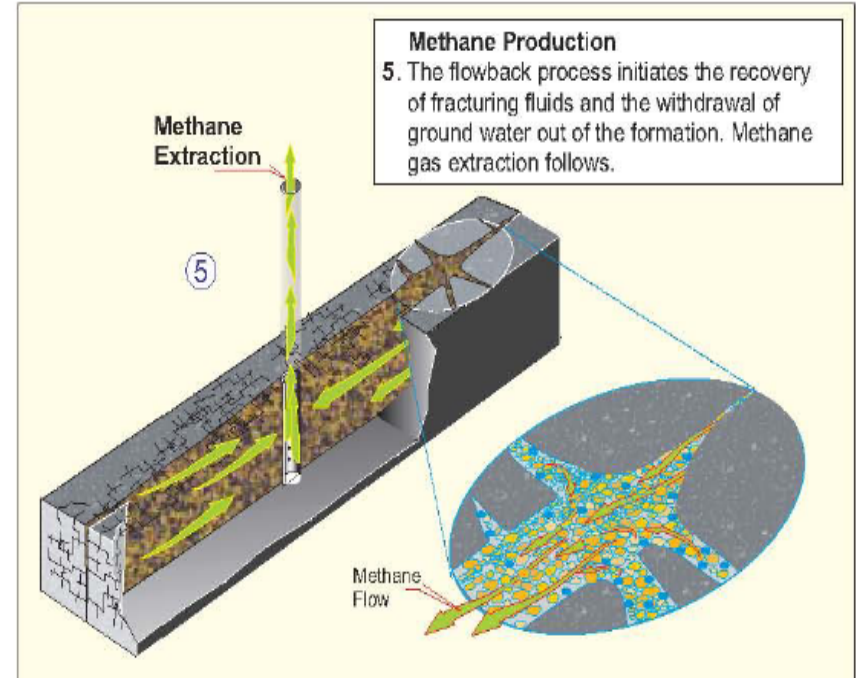
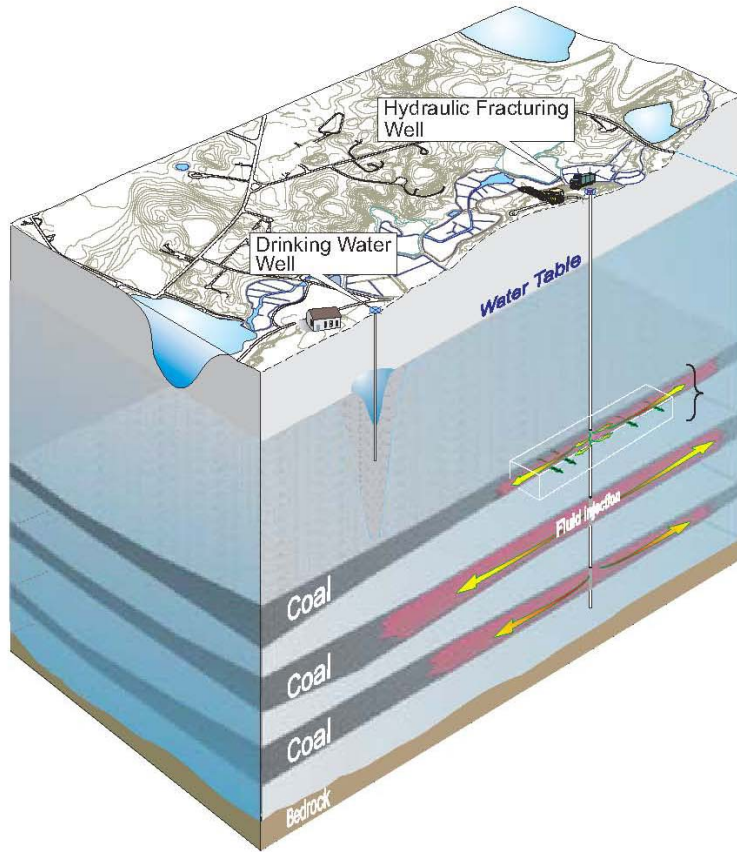
- Pump off hydrostatic water head and gas flows to a hole
- Productivity of gas flows depends on open cleats.
- If cleats not open, gas does not flow (low permeability)
- Drilling technique needs to open cleats and keep them open
- Coal eating bugs can open cleats and create more methane.

Vertical Wells



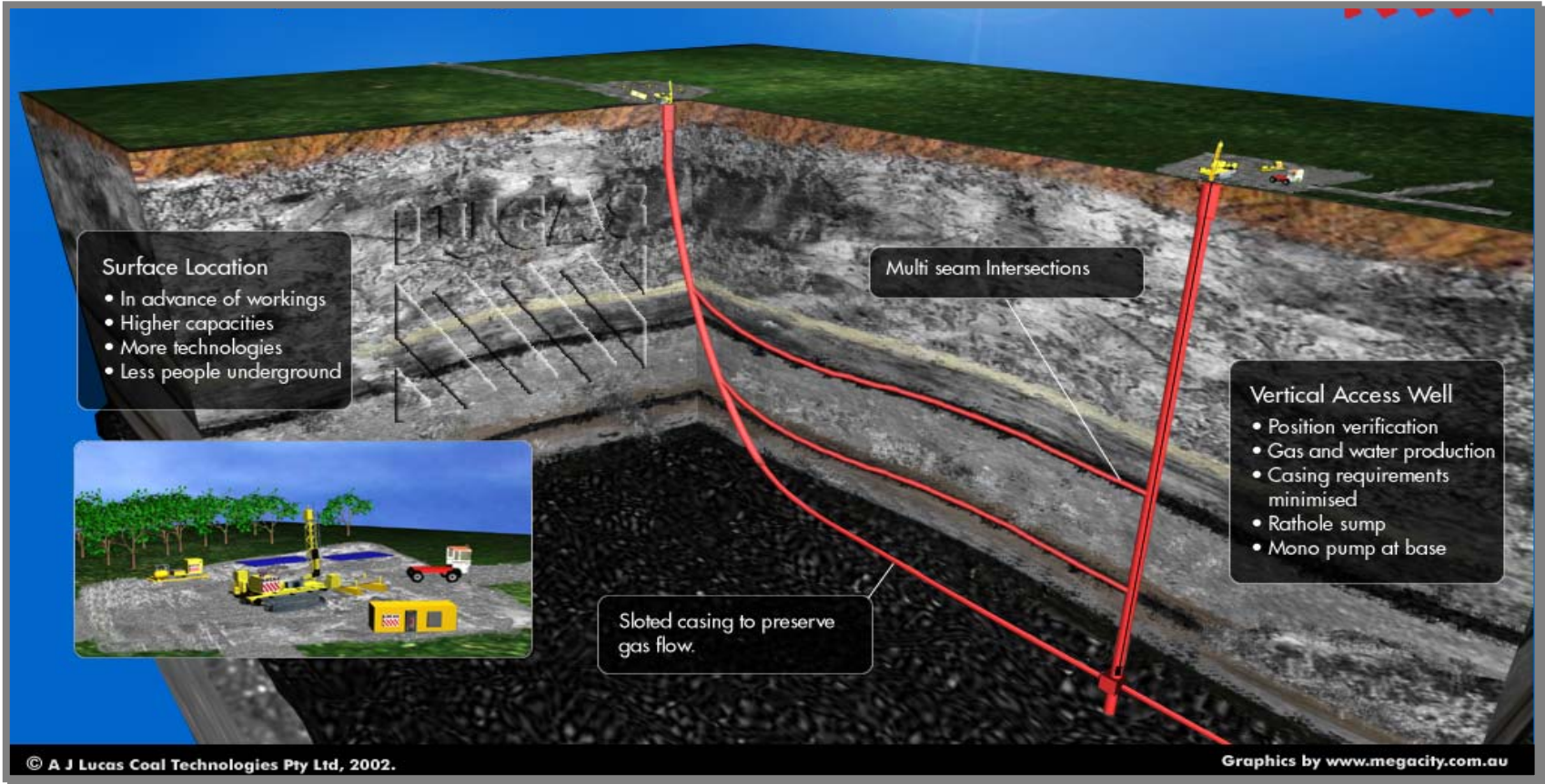
- **water needs to be pumped off coal to release gas from coal**
- **down hole water pumps used**
- **aquifers above coal needs to be protected**
- **production enhanced by cavity completions or hydraulic fracturing**

Producing CSM by Hydraulic Fracturing

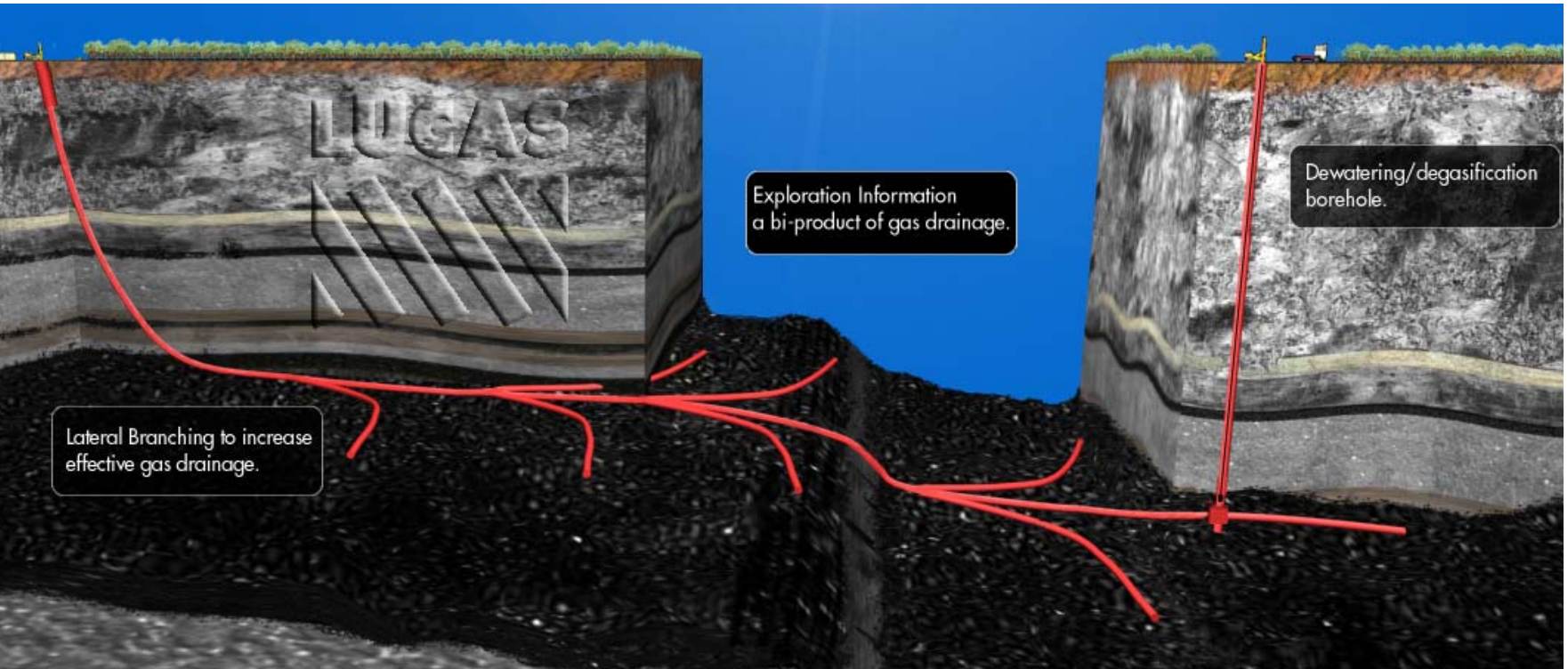


Water and additives pumped at high pressure high volume cause coal to fracture and open cleats

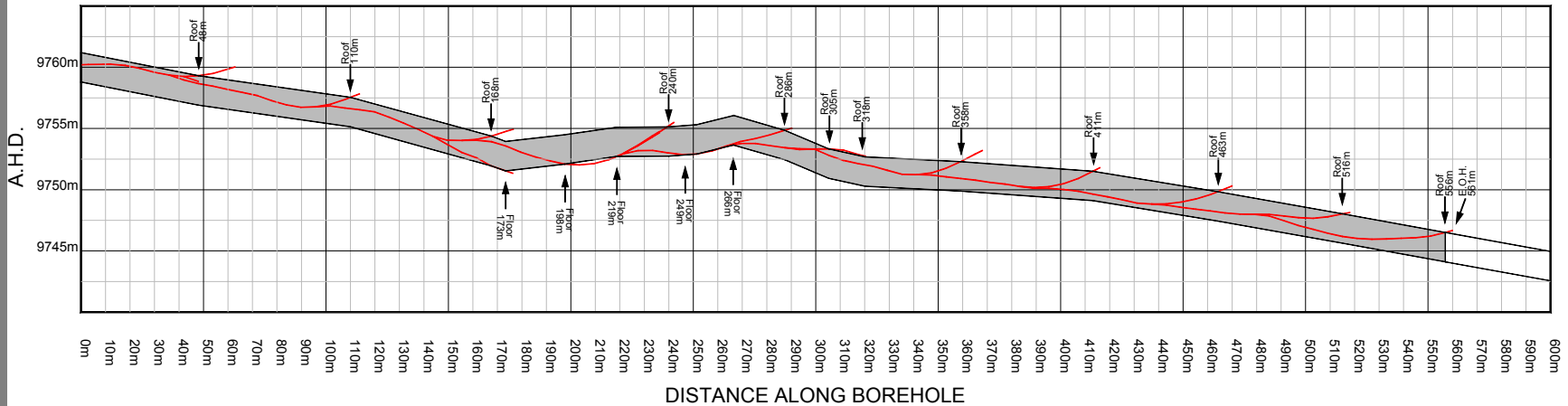
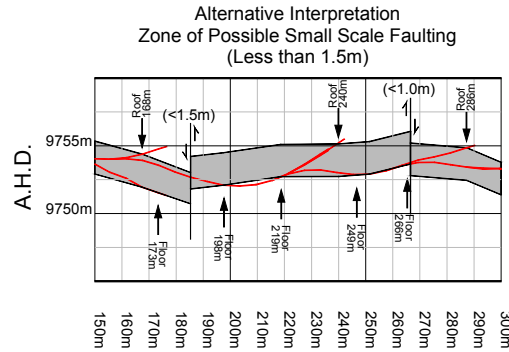
Producing Methane from Coal By Horizontal Drilling



Producing Methane from Coal By Horizontal Drilling

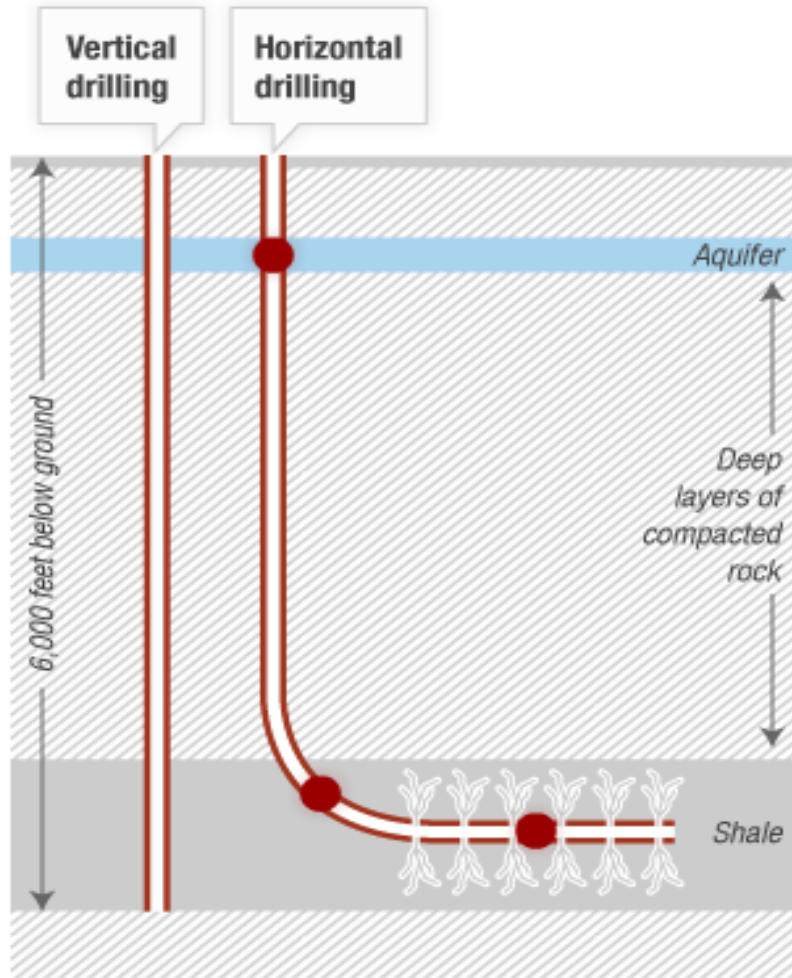


Multi-branching in Coal Seam to form Flow Paths for Gas



Producing gas from shale

- **Shale is the source rock – the gas / oil “kitchen”**
- **Shale tends to be very thick with huge gas quantities**
- **Permeability of shale is low – needs to be fractured**
- **Shale needs to be brittle to fracture**
- **Gas released by fracturing from horizontal holes**
- **Need to ensure that fracture does not extend through reservoir seal to connect to aquifers.**
- **Technology is in drilling and fracturing**
- **Shale gas underlies Moomba – if field gas price gets to \$4.50/ GJ, this gas might flood NSW?**



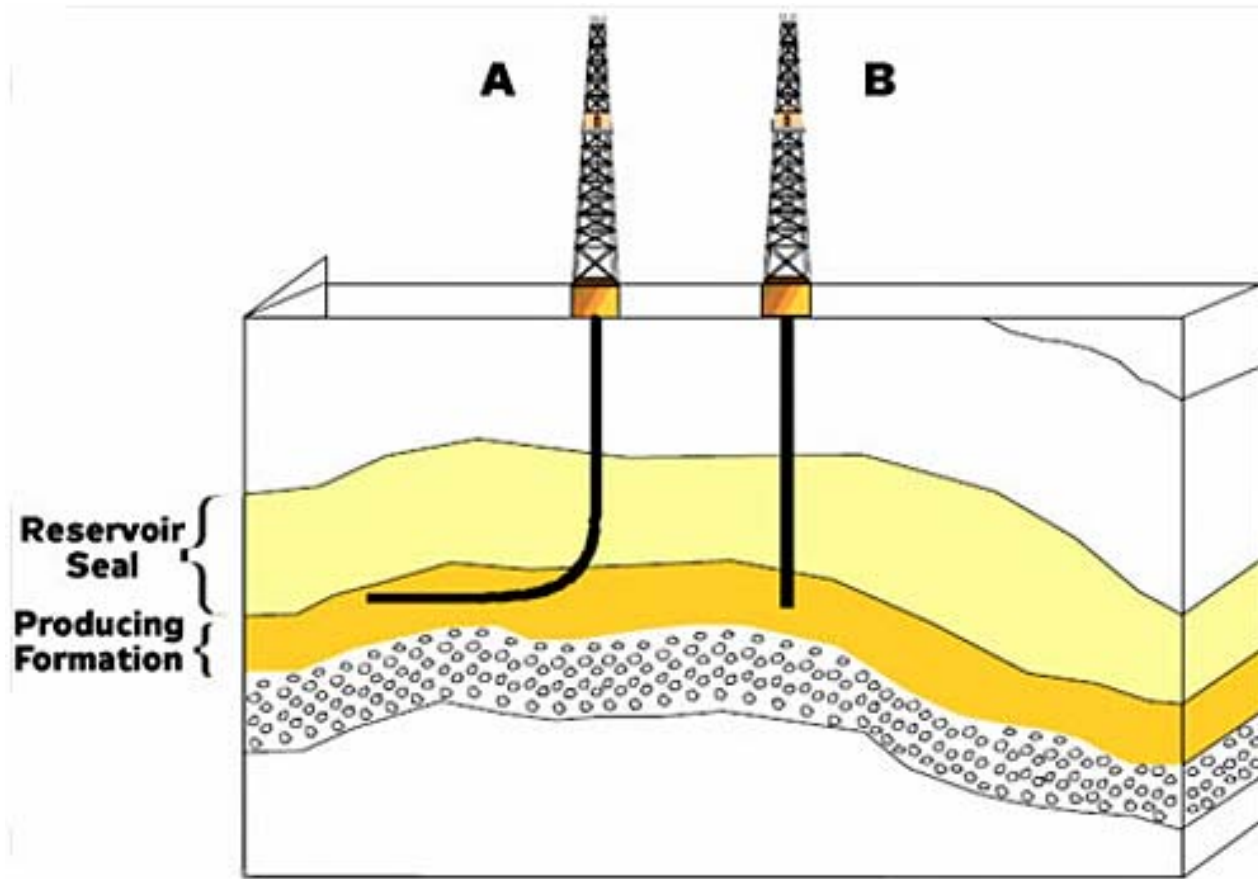
Credit: Tom Gjelten, Alyson Hurt and Avie Schneider/NPR

Horizontal Fracturing of Shale from Horizontal Wells

Need deep layer separating shale from aquifer so that aquifer not connected to well by old or new fractures

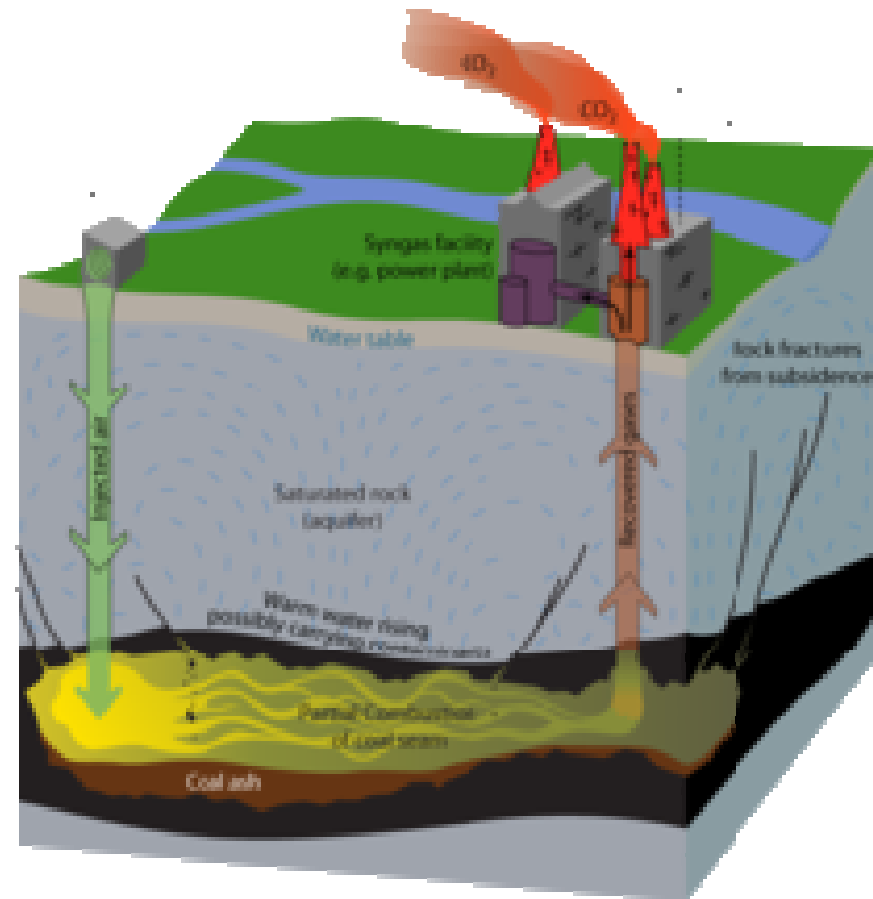
Problems in USA in locations where aquifers too close to fracture zones

Reservoir Seal Needed to Protect Aquifers



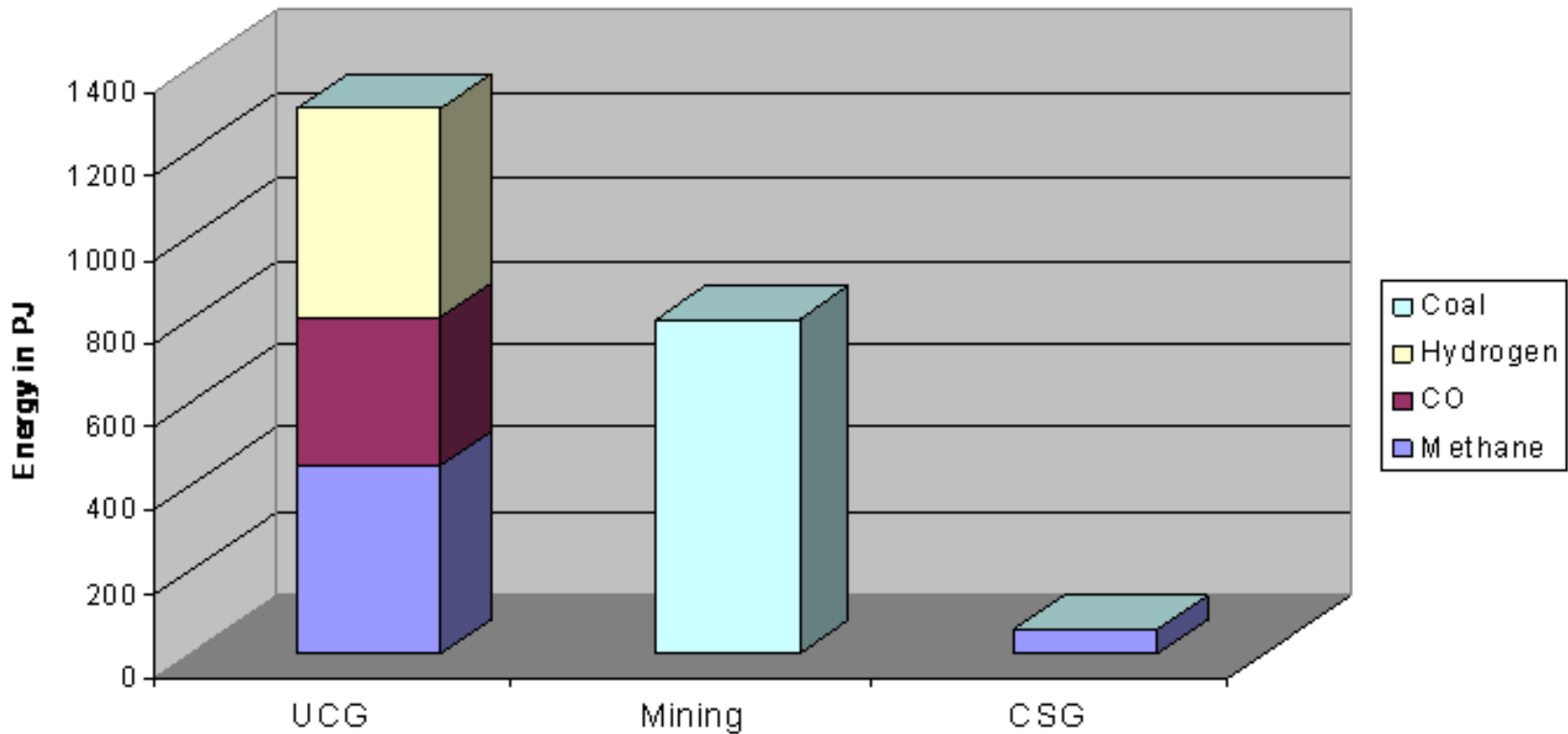
Underground Gasification

- **30 times the energy from cubic metre of coal compare with coal seam gas**
- **Burn coal in controlled environment to manufacture gas**
- **The gas is not trapped in the coal but manufactured**
- **Manufactures methane, hydrogen, carbon monoxide (all energy & chemical sources) and CO₂**

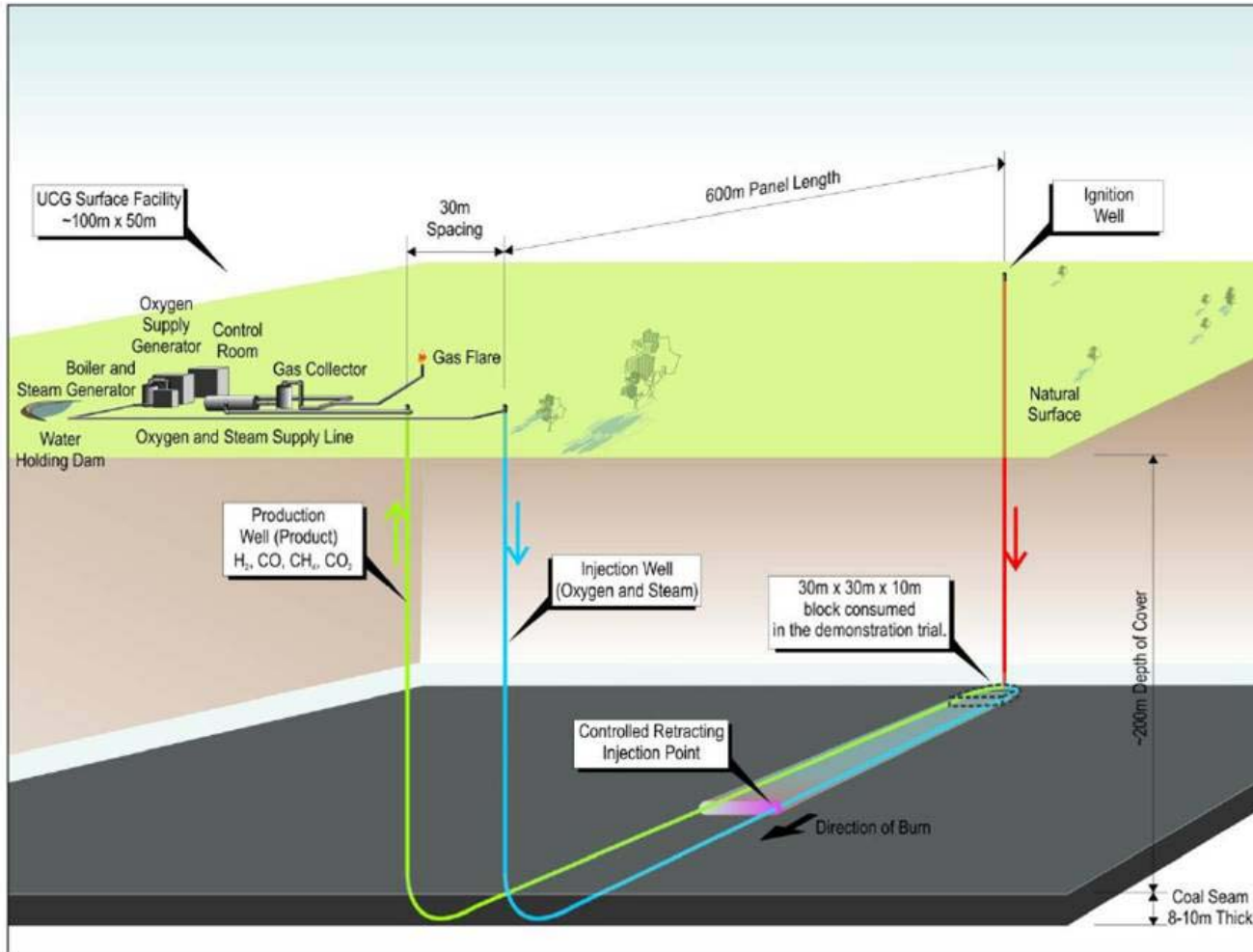


Underground Gasification is Very Dense Energy Producer

Energy Extraction by Method for Typical 12 km² Deposit



Horizontal Drilling is Key for Underground Gasification



Environmental Issues

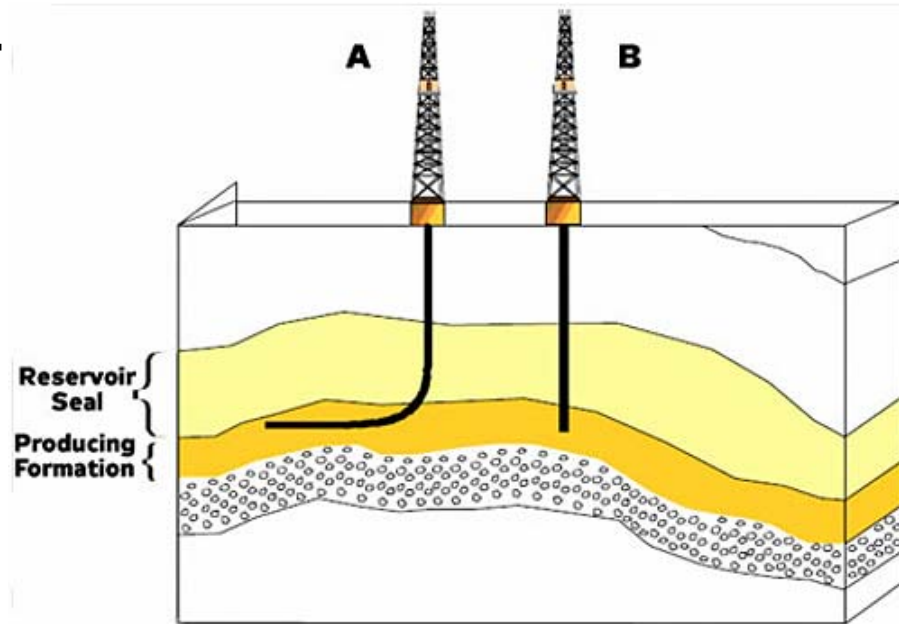
- **How much change to the landscape is acceptable?**
- **Protection of aquifers**
- **Minimise project foot print – fewer wells with more horizontal reach**
- **Disposal of water released from coal**
- **Disposal of water and additives used in shale fracking**
- **Containment of chemical residues from underground gasification**
- **Potential for carbon sequestration in coal**
- **How much money should land owner get?**

Minimising Changes to Landscape

- **Spread out wells – vertical wells at 800 metre spacing replaced by horizontal wells at 4000 metre spacing**
- **This means fewer well heads, fewer access roads**
- **Bury all pipelines**
- **Disguise or bury well head facilities**
- **Completion techniques which minimise workovers and minimise need to visit well heads**

Protecting the Aquifers

- Demonstrate that coal or shale seams are not connected to potable water aquifers above.
- Demonstrate that fracking will not connect the coal or shale to those aquifers.
- Grout / cement casing of the well through and past the aquifers
- Recharging the aquifers with treated water



Disposal of Coal Seam Water

- **Water needs to be pumped from coal seams to release the methane held on the micro surfaces of the coal by water head pressure.**
- **Coal seam water is saline, typically 8,000 ppm. Sea water is 24,000 ppm.**
- **Evaporation of this saline water from storage ponds is not constructive use of that water.**
- **Saline water can be desalinated in reverse osmosis or ion exchange plants or pumped into suitable saline aquifers.**
- **Desalinated water used for agriculture or industry or pumped underground to recharge aquifers.**
- **Brine can be further evaporated, used by industry, or piped to coast for sea disposal.**

Vertical v. Horizontal wells

Many of these vertical well sites might be eliminated by using horizontal directional drilling of long holes instead



Significant Potential for Sequestration of CO₂ in Coal

- **Besides methane, coal also adsorbs CO₂ to micro surfaces**
- **Coal adsorbs CO₂ in preference to methane**
- **CO₂ will displace methane for the coal surface**
- **Potentially this enhances the production of methane.**
- **Problem is that CO₂ molecule is large and blocks pathways**
- **CO₂ capture is expensive as is CO₂ deployment**
- **Potential is there but more drilling technology needed**

Conclusions by this driller/ producer

- **Yes – opportunity for big changes ahead for NSW gas.**
- **Changes driven by unconventional gas resources.**
- **Eastern Australia awash with unconventional gas.**
- **Effective application of drilling technology is the key.**
- **Poor drilling and production concepts have given rise to environmental concerns.**
- **Overcome environmental concerns by clever drilling.**
- **Not-in-my-back-yard solutions through clever drilling.**
- **Determination needed to not squander the opportunity**

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