

**Submission
No 6**

INQUIRY INTO COAL SEAM GAS

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Submission to NSW Parliamentary Inquiry into Coal Seam Gas

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Summary:

- 0.0. Discussion of Coal Seam Gas development is invariably framed in terms of a model developed by Haliburton for shale gas in the United States. That model, notoriously displayed in the film “Gaslands” and now all too familiar to Australian farming communities, features a network of surface installations connected by roads, pipelines and foul water containments. This is a development model that leaks methane and foul water, contaminates aquifers and interferes grossly with existing land uses such as agriculture, biodiversity conservation and catchment management. **This is not the only way to produce coal seam gas, nor by any measure “best practice”.**
- 0.1. The thrust of this submission is to point out an alternative model for coal seam gas production based on existing gas drainage operations in gassy underground coal mines, exemplified by BHP-Billiton's Appin-Tower Power project. Extension of that technique to extract commercial quantities of gas using boreholes drilled horizontally from the periphery of underground mine workings offers an alternative to the disruption of land use and aquifers that plague the “Gaslands” model. Other potential advantages of underground gas extraction and a sample of the technical questions that affect its viability are presented below. This inquiry represents an opportunity to clarify such questions with mining engineers and economists.
- 0.2. Meanwhile, longwall subsidence and open cut impacts, plus recognition of greenhouse gas pollution impacts from fugitive gas and the combustion of coal, point to inevitable future decline of coal mining. Redeployment of mine infrastructure and skilled workforce for underground gas production could facilitate the necessary economic and social transition to more sustainable industries. Growth projections for coal indicate that the industry itself and its political cheer squad have no plans for such orderly transition, other than to privatise the boom while it lasts and socialise the inevitable bust, leaving water catchments, farms, abandoned collieries, coalfield communities and Australia's economy in tatters.
- 0.3. The proposed conversion of existing collieries to underground gas mines may not solve all the land use conflicts involving either coal or gas. It is inspired by the special case of the Southern Coalfield, particularly the Woronora catchment and reservoir where current and expected approvals for orthodox coal and gas production are together destroying the most reliably watered catchment in the Sydney Water system. An economic alternative here would have immediate and lasting community benefits and provide a benchmark for environmental best practice in evaluating future projects. If successful in reducing external costs and impacts, conversion of additional collieries to mine gas should take priority for approval over surface Gaslands development eg. in the Pilliga.

Underground Production of Coal Mine Gas

A Potential alternative to longwall coal and surface coalseam gas mining, offering a genuinely transitional resource.

1. Overview:

- 1.1. Coal mine gas (CMG) drainage has long been employed to reduce the hazards of outburst and explosion in gassy underground mines. Horizontal boreholes are drilled ahead of the advancing coal face and gas is collected in underground pipelines, to be disposed of usually by flaring to reduce the greenhouse impact of its methane content, or simply venting to the atmosphere. Borehole leakage and gas seeping from previously mined areas is swept up in ventilation airflows. Too dilute to burn, this significant flow of fugitive greenhouse gas emissions is usually vented to the atmosphere.
- 1.2. In some mines, notably BHP's Appin-Tower complex in the Southern Coalfield of NSW, the collected gas is used in large piston engines to generate electric power, in that case up to 90MW [1] . As well as the valuable concentrated gas pumped directly from the coal seam, these engines draw in ventilation air, usefully consuming dilute methane otherwise vented to the atmosphere.
- 1.3. A technical assessment of gas drainage technology is required to explore the feasibility of extending it to convert damaging longwall mines to gas mines, extracting fuel gas from surrounding and underlying coal seams, using some for local power generation and marketing the surplus. The concept entails horizontal boreholes and collection pipelines in underground drives at the periphery of existing mine workings. It is anticipated that such underground gas extraction technologies could replace longwall operations, stop subsidence and avoid the damaging surface impacts of conventional (Gaslands) coalseam gas (CSG) operations.
- 1.4. The viability of this proposal rests on the resolution of technical and economic issues as follows. The subsequent non-technical discussion attempts to illustrate potential benefits from the perspective of climate action, agriculture, nature conservation, water catchment and aquifer protection, mining communities and the mining industry.

2. Some of the technical questions to be resolved.

- 2.1. What is the practical limit in range for horizontal drilling of gas production boreholes, ie. the radius around an existing underground working from which gas could be extracted?
- 2.2. How does that radius compare with the spacing of boreholes in conventional surface-drilled gas production?
- 2.3. To contain and usefully consume the dilute gas in mine ventilation air for local electricity generation, a corresponding volume of concentrated fuel gas is required. What size gas field would typically yield sufficient gas to provide a saleable surplus for other uses?
- 2.4. It is understood that gas production from a coal seam involves dewatering the coal between adjacent boreholes. In an underground operation comprising gas production boreholes extending radially from the mine perimeter, would it be practical to sequentially inject the water produced in dewatering one section of the seam into another part of the same or underlying seams?
- 2.5. In an underground gas mine as described above, could a system of sequential dewatering be designed to contain all foul water underground within the coal seams from which it came?
- 2.6. In seams requiring hydraulic fracturing and dewatering to release gas, what percentage dilatation and contraction of the seam is involved and how would the resulting disturbance of overlying strata compare with that from longwall mining the same seams?

- 2.7. If water was pumped from one seam or area of a seam to another, how would the hydrological impact on overlying aquifers compare with that of longwall mining?
- 2.8. What is the range of expected production lifetimes for coalseam gasfields?
- 2.9. At what threshold price for CO₂ equivalent emissions would the tax or permit cost of fugitive gas pollution alone justify converting a typical gassy mine from coal to gas production?
- 2.10. How would the economics of that conversion change if additional (discounted) tax credit was given for the avoided greenhouse burden of previously approved coal production forgone?

Perspectives for evaluating underground coal mine gas extraction.

3. For the farmer, water catchment or conservation land manager :

- 3.1. CMG is the same stuff as that extracted in CSG operations but the deployment of drilling and pumping machinery, access roads and collection pipelines completely underground avoids a large part of the environmental damage associated with the “Gaslands” paradigm of CSG extraction. The annexation of land, the network of roads, pipelines, pumping facilities and continued maintenance traffic notoriously disrupts agricultural land management. And despite assurances of reliability, the proliferation of gas bores also elevates the overall risk of gas and water leakage around boreholes, causing contamination of aquifers and gas fire hazard.
- 3.2. For farmers and managers of conservation areas and water catchments, a surface Gaslands-style road and pipeline network creates additional problems of erosion, stream siltation, weed and pathogen infestation. Despite stringent wash-down procedures, repeated access by vehicles and workers over the life of the gasfield multiplies an allegedly low risk of infestation from vehicles, tools, boots and clothing to near certainty. The difficulty and cost of clearing infestations of weeds or phytophthora fungus from existing roadsides and disturbed areas underlines the economic penalty for such intrusion. The 2010 discovery of Myrtle rust fungus infestation in eastern Australia adds further urgency to controlling access to conservation and water catchment areas.
- 3.3. Any benefits of the proposed underground coalseam gas production in avoiding surface disturbance are critically dependant on whether foul water drained from or injected into a coalseam can be managed underground in a way that does not pollute water supply aquifers or surface streams. By avoiding boreholes drilled through overlying aquifers and isolating strata, horizontal drilling within the coal seam promises to avoid much of the risk of aquifer contamination.
- 3.4. Subject to confirmation by mining engineers on these and other questions listed, horizontal drilling technologies appear to afford access to gas resources extending several kilometers around existing collieries. If so for example, the Helensburgh Metropolitan mine in the Southern Coalfield might be adapted to extract gas from under the Woronora catchment, on which invasive surface CSG operations are currently planned by APEX Energy. This is in a Special Catchment Area, for setting foot in which a person can be fined \$11,000. By providing an income and employment alternative to continued longwall mining, underground gas extraction could also avoid the planned undermining of the Woronora reservoir.

4. For climate activists and greenhouse gas regulation agencies:

- 4.1. According to industry and Government growth projections, coalseam gas fuel is not viewed as a “transition” to a low-carbon future but an additional source of hydrocarbon fuel, further exacerbating global greenhouse gas accumulation. Even while pleading “insignificant Australia” (producing 5.8% of world coal consumption) as an excuse for climate inaction, coal companies have been clamoring for government investment in port and rail infrastructure and promising ever-increasing shareholder returns for projected growth in production per Fig 15 and 16 of [2]. Leaving aside oil and gas consumption, just burning the available coal worldwide would itself greatly exceed the global capacity to absorb CO₂ within the Cancun target limit of 2° temperature rise [3]. If widespread use of CSG under the “transitional” figleaf delays the uptake of renewable technologies it will further increase the future cost of climate mitigation and adaptation.
- 4.2. As its pollution cost is progressively recognised through carbon pricing schemes to exceed the cost of alternatives, burning coal can no longer be considered an economic energy resource. Quite apart from climate effects, longwall and open cut coal mines are amongst the most destructive of industries to landscapes, agriculture, water supplies and community health. They must inescapably close down over the 21st century as Indian and Chinese industries mature and existing contracts, capital and workforce retire. Continued recruitment of workers into this unsustainable industry is callously irresponsible but unless transitional employment opportunities are demonstrated, the votes of coalfield communities will block the necessary changes. Underground gas mining connects several important incentives to clear that blockage.
- 4.3. A frustration for climate activists is that while coal companies report and to some extent reduce the emission of fugitive greenhouse gasses, they disown responsibility for the far greater greenhouse burden of the product, coal. That is Somebody Else's Problem, either here or overseas. Australia's carbon tax/trading will to some extent influence local coal consumption but a price signal on exports awaits an international carbon trading system. When coal mines are exhausted or abandoned, who takes responsibility for paying for, or preventing, their continued fugitive gas emissions? Conversion to economic operation as gas mines is proposed as one possible step toward addressing the technological, economic and social problems entailed.
- 4.4. A recent Cornell study [7] pointed to higher greenhouse emissions from shale gas than coal for given end-use energy. It identified several contributing factors that would also apply to surface-drilled coal seam gas boreholes but may be minimised by horizontally drilled underground bores. Emissions due to flow-back fluids, drill-out and liquid unloading for example can be contained in an underground gas mine because the bore-heads are centrally located, so collecting pipelines can be economically installed before drilling, with shared gas/liquid separator equipment.
- 4.5. In promoting conversion of coal mines to gas production, one must recognise investments already made by companies in preparation for Government-approved future coal production. While needing careful oversight to avoid scams, restructuring of the industry to abandon myopically approved coal production would be greatly assisted by compensation for revenue forgone in the form of emission tax credits or permits, discounted for changes in market outlook. By thus imposing a potential liability on Governments for approving coal mines, such compensation would also force politicians to reconcile development and greenhouse gas reduction policies that are now blatantly incompatible.

4.6. Conventionally burned gas is not a long term energy solution but efficient gas-fuelled co-generation technologies offer significant medium term greenhouse gas abatement. Further benefits are possible if dilute fugitive gas can also be consumed in the process, which requires opportunities for heat utilisation close to the emission source. Gas and other sources of carbon, including waste plastic, can also potentially replace coking coal for smelting steel [4] [5]. In the longer term, hydrocarbon gas can be converted by solar thermal pyrolysis into pollution-free hydrogen fuel and solid carbon structural materials such as carbon nanotubes or fibres or a range of intermediate organic compounds useful for structural resins, process chemicals or pharmaceuticals etc. Gas production however can only qualify as a transitional technology if it replaces, rather than augments, the production of coal or oil, and significantly reduces the greenhouse gas burden for a given end-use benefit.

5. For Mining companies and coalfield communities.

5.1. With the advent of emissions tax / trading in Australia, fugitive gas emissions from coal and gas mining operations must be accounted and paid for, reportedly in some cases threatening the economic viability of collieries [6]. Simply abandoning gassy mines however does not solve the pollution problem, as once enclosing strata are dewatered and/or cracked by longwall operations, gas will continue to leak indefinitely from goaf and exposed coal faces through disused shafts and rock fissures, as demonstrated by burning bubbles in the Nepean and Cataract Rivers in the Rivers SOS video “Rivers of Shame”.

5.2. Much of the capital and workforce skills invested in gassy mines might be salvaged by continuing to operate such mines for underground gas production along the lines of BHP-Billiton's Appin-Tower Power project but augmented by extensive drilling into surrounding and underlying seams. Conversion to underground gas production for current or abandoned gassy mines in sensitive agricultural and water catchment areas, eg. in the Southern Coalfield, the Hunter Valley or even under the Sydney CBD, could similarly prevent further impacts of surface CSG operations and/or longwall subsidence, while potentially fulfilling the hitherto false promise of coalseam gas as a transitional fuel: transitional for companies, mining communities, technology and the Australian economy.

5.3. It is not suggested that underground gas mining would create the same income, profits or growth as boom-time coal or CSG extraction but it would maintain mine operation with reduced carbon tax imposts, contain fugitive gas responsibly, afford continued employment for coalfield communities and provide investors an orderly transition to other projects. Boom-and-bust mine closures in an unsustainably growing coal industry will not. That was conceded by BHP-Billiton CEO Marius Kloppers in stating that "Australia will need to look beyond just coal towards the full spectrum of available energy solutions" [8] . He might have added that “we should look to a future for fossil fuels beyond burning for energy”, recognising that before being displaced by oil and gas in the 20th century, coal was the mainstay of the chemical industry. With improved, cleaner chemical technologies, hopefully in conjunction with solar thermal energy, coal may again assume that role as oil and gas prices rise. It will hopefully never again be consumed at the present rate.

References:

- [1] Section 2.1.2 and 2.5.5
<http://www.bhpbilliton.com/home/aboutus/regulatory/Documents/bulliSeamSection2ProjectDescription.pdf>
- [2] http://www.abare.gov.au/publications_html/energy/energy_06/coal_exports.pdf
- [3] <http://www.pik-potsdam.de/news/press-releases/archive/2009/on-the-way-to-phasing-out-emissions-more-than-50-reductions-needed-by-2050-to-respect-2b0c-climate-target>
- [4] <http://www.asiapacificpartnership.org/pdf/Projects/Steel/SOACT-Handbook-2nd-Edition.pdf>
- [5] <http://www.science.unsw.edu.au/vsahajwalla-research>
- [6] http://www.australiancoal.com.au/resources.ashx/Announcements/56/DocumentFile/ABC9A4EF07C0D09A302F121340D5D2A1/ACA_Report_10_06_11.pdf
- [7] Climatic Change (2011) 106:679–690
<http://www.springerlink.com/content/e384226wr4160653/fulltext.pdf>
- [8] <http://www.smh.com.au/business/bhp-boss-dumps-on-future-of-coal-20100915-15cpk.html>

Prior circulation of related documents:

The Parliament's website advises that “You should not distribute copies of your submission without the committee’s permission”. Please note that this submission is based on a paper already circulated in successive drafts to conservation activists and mining consultants for comment. The present inquiry is a welcome but unexpected interruption of that process. Earlier versions were submitted to NSW Coal and Gas Strategy Inquiry April 2011 and EPBC Referrals on APEX Exploration within Wollongong LPA Feb 2011. These documents may be downloaded from <http://users.tpg.com.au/mjscott/Contents.html>

Addressing the Terms of Reference

1. The environmental and health impact of CSG activities including the:
 - a. Effect on ground and surface water systems,
Sections 2.3, 2.4, 2.6, 3.1, 3.2, 3.3, 3.4, 5.1
 - c. Effects related to hydraulic fracturing,
Sections 2.5,
 - d. Effect on Crown Lands including travelling stock routes and State forests,
Sections 2.5, 3.2, 3.3, 3.4, 5.2,
 - e. Nature and effectiveness of remediation required under the Act,
Sections 3.2, 4.2, 4.3, 5.1, 5.2,
 - f. Effect on greenhouse gas and other emissions,
Sections 1.1, 1.2, 1.3, 2.3, 2.9, 2.10, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6
 - g. Relative air quality and environmental impacts compared to alternative fossil fuels.
Sections 4.4, 4.6,
2. The economic and social implications of CSG activities including those which affect:
 - a. Legal rights of property owners and property values,
Sections 2.10, 3.1, 3.2, 4.2, 4.5, 5.2
 - b. Food security and agricultural activity,
Sections 3.1,
 - c. Regional development, investment and employment, and State competitiveness,
Sections 0.2, 5.1, 5.2, 5.3,
 - d. Royalties payable to the State,
Sections 2.9, 2.10, 3.4,
 - e. Local Government including provision of local/regional infrastructure and local planning control mechanisms.
Sections 3.1, 3.2, 4.3,
3. The role of CSG in meeting the future energy needs of NSW including the:
 - a. Nature and extent of CSG demand and supply,
Sections 2.8, 2.9, 5.3,
 - b. Relative whole-of-lifecycle emission intensity of CSG versus other energy sources,
Sections 4.4,
 - c. Dependence of industry on CSG for non-energy needs (eg. chemical manufacture),
Sections 4.6, 5.3
 - d. Installed and availability costs of CSG versus other stationary energy sources,
Sections 4.2
 - f. Contribution of CSG to energy security and as a transport fuel
Sections 4.6.
4. The interaction of the Act with other legislation and regulations, including the Land Acquisition (Just Terms Compensation) Act 1991.
Sections 4.5
5. The impact similar industries have had in other jurisdictions.
Sections 0.0, 4.4