Supplementary comment to the Infrastructure, Planning and Natural Resources Committee on proposal to ban Underground Coal Gasification in Queensland. Dr Cliff Mallett

## With respect to contamination at UCG sites as a basis for banning UCG

In my original submission I maintained that no environmental harm had yet been demonstrated as a result of underground coal gasification, and hence banning UCG at this stage was premature at best, and unjustified; as existing procedures can ban any project that cannot establish it can be operated in a safe and environmentally acceptable manner via an EIS.

Last week during the period of public hearings on the proposed legislation there were headlined press articles in newspapers and TV on much more extensive contamination being discovered around Hopeland than previously thought, with respect to the measurement of hydrogen in soil gases. In my submission I questioned the validity of the hydrogen measurements which are the basis of an excavation ban in the Hopeland area, and the source of so much negative press with respect to UCG. I would like to provide further detail on my reasons for questioning the significance of the hydrogen results, in case the Committee is being influenced by the press articles.

**Hydrogen - The case**

A consultant firm Gilbert and Sutherland have been carrying out soil gas surveys in the Surat Basin around and remote from UCG sites for the Queensland government. They have reported gas samples from shallow boreholes with significant levels of hydrogen, which could represent a risk of explosion in an excavation at comparable depths to the samples. An excavation ban was imposed in 2016 over a large area and the area was recently expanded further. Some local residents are seriously concerned and report impacts on their health and livelihood from these impacts. The government has stressed that there are no risks to health as any gas present rapidly and safely diffuses into the atmosphere. No impact on pastoral or agricultural use of the land has been indicated to residents.

***Sampling methods***

Four gas sampling methods have been employed. Three involving drilling a shallow borehole and sampling gas from the bottom of the borehole immediately after it is drilled. This method of soil gas sampling is non-standard and the consultants say it is only a preliminary screen to see if the area has anomalous soil gas composition. The consultants apparently had no experience in soil gas monitoring prior to undertaking the work for the government. An independent expert report by one of Australia's leading soil contamination experts that I have seen indicated that this sampling method ***cannot provide any reliable measure*** of soil gas conditions. Nevertheless these results seem to be the basis of the ban.

The three drilling methods involve different levels of soil disturbance and in some data provided to me by DEHP, the analyses consistently show that hydrogen levels are directly proportional to the amount of disturbance of soil by the steel probe or auger. Reports in the scientific literature describe cases where iron (steel) crushing soils with certain mineral composition and moisture levels yield hydrogen from these reactions. This is consistent with the Surat Basin soil gas investigations, where greater crushing of the sample always produces higher concentrations of hydrogen at the

same locality. At the very least this implies that significantly more scientific investigation is required before implementing bans that worry local residents needlessly, and reflect unjustifiably on the reputation of UCG.

*Standard soil gas testing*

The fourth set of gas results come from long term installations that allow soil gas in a lined borehole to equilibrate with surrounding soil gas, where the sample represents the composition of the soil gas actually present in the soil. This method approximates standard soil gas measurement processes. In data I have seen, this method reports negligible levels of hydrogen in soil gas samples at the same locations that higher levels are detected with non-standard sampling methods.

**Hydrogen detection and distribution**

*Pattern of distribution*

It is contended by government consultants that hydrogen has dispersed away from a point source, and despite travelling quickly to the surface through almost 200m of impermeable rock, it then stops its upward migration and accumulates in soils at a few metres depth. A theory lacking any justification of a scientific mechanism.

The hydrogen concentrations discovered are irregular in distribution. If they come from a single localised source one would expect some concentric distribution of results around the point source. This is explained by consultants as a result of trapping hydrogen under some localised impermeable cap. No explanation of hydrogen migration principles are advanced to verify such a process. I contend that the variations in hydrogen produced during sampling is more likely to reflect variations in soil composition and moisture which affects its capacity to generate hydrogen when crushed by steel. Mapping and logging of soil layers during sampling would resolve this issue.

*Area of distribution*

The area of hydrogen impact now implied has a radius of 25km in recent press statements. The UCG pilots in Queensland were all of quite limited scale. The coal consumed by gasification and the gas produced are carefully monitored and mass balance analyses are used to compare the two to determine gasification conditions and if any gas is being lost. Global experience is that around 10% of UCG syngas gas made is not in the surface product. This is of commercial significance (lost product), but not environmentally, as the components of syngas are already present through all underground rock, (although not in the same proportions as in syngas). For air fed UCG, as most of the Queensland UCG pilots were, this indicates that fugitive hydrogen would be no more than 1% of the volume of syngas actually produced. There is not enough fugitive hydrogen from a UCG site to generate a plume large enough to affect an area with a radius of 25km (circle with diameter of 50km). The greater the area of hydrogen anomaly identified, the less likely that it is related to fugitive gas from a point source. Extension of sampling areas is not demonstrating a greater impact of a source, but actually proving that a single point source is not possible and an alternative explanation is required.

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**Summary**

- Non-standard 'screening' soil gas sampling for hydrogen has no validity and reflects hydrogen generation by steel augers and pipes in certain soil types.
- Standard soil gas sampling methods indicates no significant hydrogen is present
- There is no concentric distribution of hydrogen results that would indicate a point source
- The area of the hydrogen plume and distribution alleged exceeds possible fugitive sources from a small UCG pilot

## Comments on Volatile Organic Compound contaminants

I have claimed that no UCG pilot site has been demonstrated to have levels of organic compounds which reduce the environmental value of groundwater or cause environmental harm. There is no doubt that chemicals produced during UCG production are dangerous, mainly from a group called BTEX chemicals of which benzene is by far the highest concentration species. These chemicals are found in the immediate vicinity of UCG gasifier cavities, a halo only a few tens of metres thick and in quite low concentrations. These occurrences are of no long term environmental concern as they

- Are at depth in a coal seam and cannot easily be accessed
- At low levels that will naturally degrade in a few decades
- At levels that do not prevent use as stock water in an emergency
- Are in slow moving groundwater systems so chemicals will have degraded before they could migrate any significant distance.
- Do not change the environmental value of groundwater which is naturally poor quality

Most of the chemicals involved are in common use in the community and in mining and chemical industries, and are safely handled at much higher concentrations than found in UCG. There is no reason to suggest that their presence in UCG poses any greater risk than it does in other industries.

## No justification for a ban on UCG

- UCG has no greater environmental impact than other industries using or producing volatile organic compounds
- The government already has adequate powers to prevent any project proceeding that cannot prove that it is environmentally safe
- Although mistakes have occurred during the UCG pilots, they have allowed the criteria for safe operation of UCG to be determined
- One of the UCG Pilots was acknowledged by the Chief Scientist of the Queensland government as having satisfactorily completed all the requirements of the Independent Scientific Panel appointed by the government to review the UCG pilots. If even just one of the sites shows that with appropriate controls UCG can be safely done, surely the government has the capability to ensure these appropriate measures are used by all UCG projects
- The value of a UCG industry to Queensland in extracting and value adding to our natural resources, and creating a new rural based industry and employment does not seem to have been considered.