

Demystifying science—communication of complex science to reduce community fear of industry

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Abstract

There are many claims made by those in opposition to the coal seam gas that the science behind this industry is not yet known, despite the fact that comprehensive Environmental Impact Statements have been prepared and approved by both the State and Federal governments, for three of the four major Queensland CSG-LNG projects.

Those in opposition to the coal seam gas industry, whether individuals or organised groups (the anti-CSG lobby) use self-generated online, newsprint and TV media to promote highly emotive messages to gain the broader community support for their desire to stop the development of the CSG industry.

Many of the claims made by the anti-CSG lobby are based on anecdotal evidence, untested hypothesis and incomplete scientific analysis and are more specifically designed to evoke fear of the industry. Seldom to the anti-CSG have groups provided a true and balanced view of the likelihood of the risk as to allow critical thinking or true debate on their claims.

This paper describes the impact of the “conformational bias”, whereby anti-CSG groups have created their own interpretation of the science associated with CSG extraction. This interpretation of the science has been built into to the communities understanding of the industry. The major issue with confirmatory bias is the more evidence that the government and industry provides the community on the safety of the industry, the more the defiant the anti-CSG groups becomes. This is referred to in the document as the “backfire effect”.

Finally the paper looks at the methods used by the anti-CSG lobby to convey the risk associated with the industry and makes the recommendation that to counteract the deliberately exaggerated consequences of the risks presented, that the industry needs to respond with the balanced argument based on the risks likelihood, demonstrating through simple scientific language, that in most cases the community should have a no rational reason to fear this growth and economically rewarding industry.

Introduction

In the digital age there are a number of sources of information critical to understanding complex scientific matters.

In recent years, the news media have contained a lot of hype and misinformation about CSG issues. Online, on-air reporting and even print reporting is plagued with incorrect/inconsistent use of terms energy units, misleading charts and a

general lack of critical thinking. An easy example is the misuse of the term “Coal Seam Gas Mining” rather than “Coal Seam Gas Extraction”. The inference that the process is mining is incorrect, yet this terminology has been widely used in the media as the descriptor for the process.

The use of the internet and social media has been a driving factor in the distribution of information on project such as the CSG-LNG development in Queensland, and is now spreading to Northern New South Wales. However there is considerable inaccuracy in the interpretation and reporting of scientific fact, associated with the development of these projects, and many of the sources of this information are significantly biased against the CSG industry. This is demonstrated in the way that they present the risks and consequences of an action but fail the public by neglecting to present the necessary balance in their argument. And this balance includes the crucial premise which is to the likelihood that the risk will eventuate.

There are many examples where the industry and the government have provided robust scientific fact to support the industry, only to have the anti-CSG lobby claim that the information is somehow incorrect, falsified or that the government is part of some nefarious conspiracy to hide the facts from the community. The key therefore to demystifying the science associated with this growing industry will be to acknowledge the risks and consequences as presented by the anti-CSG lobby, and in simple terms, provide the public with the evidence of likelihood that the risk will occur.

The Perception of CSG Science

One of the common criticisms of the CSG industry has been allowed to proceed on the basis of an unknown science. The Green's, in particular Senator Waters, believes “there's so much about this new fossil fuel that we do not know” (Waters,L.2013)

Now that is simply not true.

A great deal of work has been undertaken by many companies (not just the CSG to LNG majors) on developing the processes for the extraction (not mining) of coal seam gas in Queensland and New South Wales. Three major Environmental Impact Statements (EIS) have been prepared to describe both the surface and subsurface existing environments within the companies CSG exploration and production tenures. Complex, internationally recognised computer models, predicting the extent of any potential impacts that may occur as a result of the CSG production activities have been prepared, peer reviewed and crosschecked, and the companies have formulated mitigation measures to minimise environmental harm that may be caused as a part of the process.

Further, companies have also prepared comprehensive Social Impact Management Plans (SIMP's), which in the same way as the EIS's do, review the social fabric of the communities in which their projects operate. Again these plans

predict possible social impacts and propose a program of social benefits that are applied to the communities to both mitigate the impact of their presence in the community and for the long-term betterment of the region in which they operate.

It is important to note that these EIS's are not simply the products of the respective CSG companies. The EIS's are the input into a formal legislated process of both the State and Federal Governments. Prior to commencing the preparation of the EIS, the company must first provide the regulator an Initial Advice Statement (IAS) which in itself is the high level description of the project that the company intends to undertake. The Government reviews this IAS and then sets the Terms of Reference (ToR) on which the EIS is formed.

In the preparation of the EIS, the CSG companies, who are not equipped internally with all the expertise to prepare the document, will hire consulting firms to prepare the scientific studies required to quantify, analyse and recommend processes that are required to qualify, and mitigate (to the extent practical) the possible environmental impacts of the project, in line with the ToR.

The scientific reports that are prepared to support the chapters of the EIS are peer reviewed as a part of both the consultants and the CSG companies Quality Assurance (QA) processes, most of which will be approved under the International Standards Organisation ISO:90001 process. Further the scientific studies in the EIS are reviewed by the peak scientific bodies of both state and federal government as a part of the EIS approval process. These scientific bodies include the State departments (using Queensland as an example), such as the Department of Environment and Heritage Protection (formerly the Department of Environment and Resource Management - DERM), Department of Primary Industries (DPI), Queensland Health, Treasury, Department of Transport and Main Roads (TMR), Department of Mines and Energy (DME) and other independent bodies, such as the Queensland Water Commission and The CSG Technical Sciences Committee.

On the Federal review list are the Department of Sustainability, Environment, Water, Population and Community (SEWPaC), Commonwealth Scientific and Industrial Research Organisation (CSIRO), and Geosciences Australia (GA).

When deciding on whether to approve a CSG project under national environmental law, the Minister for the Environment considers the likely significant impacts on matters protected under national environmental law, as well as economic and social matters and the principals of ecologically sustainable development. (Australian Government, SEWPAC 2013)

Finally, the broader community are given the chance to read, review and make submissions to the government regulators on their concerns with the predicted environmental impacts and the mitigation measures that are proposed by the companies. During this period, the communities scientific interpretation of the projects and the resource could be submitted to the government for review. In this instance the community groups individual have the ability to read, review and bring forward concerns on the content of the completeness of the science that underpin the EIS.

The state and federal governments and the responsible ministers, have used their national scientific network through the standard EIS review process, as well as the community reviewers at large, to make a sound and informed

decision on the potential impacts of the CSG industry. In doing so governments both state and national, using the principles of ecologically sustainable development, on behalf of the communities at large:

- believe the mitigated impacts are not environmentally significant on a state and national scale,
- have approved the mitigation measures that have been proposed by the companies in the event they may occur to ameliorate any potential impact; and
- have imposed an expansive set of conditions relating to the monitoring of scientific predictions as to the extent of the possible impacts.

The question therefore is – with the level of rigour that has gone into the preparation of the scientific studies to support the current CSG project, and the fact that this information has continued to be publically available in regards to the projects, – what is it about this fossil fuel that Senator Waters and the Greens still need to know?

Community Perception and Conformational Bias

Despite the availability of the background scientific studies that were used to baseline, predict and report any measureable environmental impacts from the CSG-LNG industry, anti-CSG groups have created their own interpretation of the science associated with CSG extraction. In some cases the materials produced by the anti-CSG lobby contain significant inaccuracies and misinterpretations of the supporting scientific fact, and their claims may sometimes be based on untested hypothesis or interpretation of possible effects that have been inferred to have experienced in extremes cases from other countries.

Anti-CSG groups in Queensland and New South Wales have, on many occasions, have demonstrated what is known as “Confirmatory Bias” (also known as Confirmation Bias or Myside Bias)¹ in the development of their counter arguments of the CSG industry. They demonstrate this conformation bias through the single sided arguments and information that they present to the media and their followers and the general public.

On one hand the anti-CSG community claims that the science associated with large scale CSG is not yet known, however the majority of the information that has been gathered by the CSG-LNG companies and made public, is instantly discounted as corrupt, insufficient or somehow falsified to meet the companies or the governments agenda.

In addition, the anti-CSG groups are willing to rely on anecdotal evidence, untested hypothesis and incomplete scientific analysis as their basis for their condemnation of the CSG industry. This has been demonstrated in the recent hype surrounding the University of Southern Queensland’s (USQ) research on the potential increase of fugitive methane from within Tara gas fields. (Lock the Gate, 2012)

¹ Wikipedia - **Confirmation bias** (also called **confirmatory bias** or **myside bias**) is a tendency of people to favor information that confirms their beliefs or hypotheses. People display this bias when they gather or remember information selectively, or when they interpret it in a biased way. The effect is stronger for emotionally charged issues and for deeply entrenched beliefs.

At the public presentation of the initial findings of the research project, the principal researcher, Dr Isaac Santos stated “we do not have a final answer on any of the questions, we only have preliminary data, but we do believe that those preliminary observations are going to push the debate forwards”. (Santos, I. Dr. 2012)

Despite Dr. Santos clearly and deliberately disclaiming that the information presented was based on “preliminary data”, “observations” and indicating the research that he was presenting did not present answers, the anti-CSG groups were quick to acknowledge the work as “significant science” against the CSG industry calling for the federal government to intervene and empower a moratorium on LNG exports until the until the research is definitively completed and verified.

Recent community opposition to AGL’s drilling in the Sydney Basin and the incomplete USQ research has already become the basis of the fear campaign, driving criticism at the NSW government’s decision to allow AGL to drill the wells horizontally under urban areas.

In an article in the Sydney Morning Herald, The Greens MP - Jeremy Buckingham, a prominent anti-CSG politician demonstrates the traits of conformational bias, by indicating that he has not only accepted the USQ research, but is willing to espouse it as fact to the public , noting in the article that “*extracting coal seam gas from underneath built-up areas was completely inappropriate*”, *claiming evidence from Queensland's industry that gas escapes to the surface, posing an environmental risk*”. (Aston,H. and Han,E 2012).

Giving Science to the Community and the Backfire Effect

It is fair to say that the level of scientific information that is available to the general community is not readily comprehensible to the majority of the populations and often requires a ‘broad’ understanding of regional geology, hydrology or chemistry. The technical language that is used to describe the science by the anti-CSG lobby is often precluded with the emotional element of impending doom or “great risk” to the population.

Ensuring environmental and technical considerations are properly considered going forward, Environment Minister Tony Burke has announced a new Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development. The committee will play an important role in reviewing existing and future coal seam gas proposals, focusing in particular on their potential impact on water resources.

“The work of this committee will give communities reason to be confident that future decisions about coal seam gas and large coal mining development are informed by the best possible science,” Burke said. (Beyond Zero Emissions, 2012)

However the major challenge that the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development and the CSG industry will need to consider, is how the information will be disseminated, in a way that the general public will comprehend and trust.

In line with concept of Confirmatory Bias, there is also the term the “Backfire Effect” to describe how some individuals when confronted with evidence that conflicts with their beliefs come to hold their original position even more strongly. (Nyhan.,B. and Reifler.J. 2010)

In the book *Unnatural Acts: Critical Thinking, Scepticism and Science Exposed!* The author Robert T Carroll discussed the concepts of both natural thinking and unnatural thinking, and the way that these two cognitive processes effect our beliefs.

Carroll explains that natural thinking is instinctive, intuitive, quick and dirty – and works the majority of the time. It is the information that we most commonly receive about a certain topic or issue and forms the basis for our general understanding. Natural thinking describes the beliefs that we hold, which without challenge or the presentation of a counter belief, commonly will perceive as the truth.

Carroll describes that without pursuing critical thinking the counter information, or drawing fact on an issue (Carroll is of the belief that not all people critically think and therefore for an individual to critically analyse a concept is not a natural or instinctive act, aka Carroll coins this as- unnatural thinking). Carroll believes that we can deceive ourselves into believing what’s not true, even if the information is against our own self-interest, and notes that manipulators who understand the concept of natural thinking can hoodwink people into believing information on concepts that are not true.

Examples of natural thinking can be found in those conscripted into the anti-CSG debate. The anti-CSG groups are exploiting the intuitive, quick and simple thinking by presenting risk-without-likelihood style information, e.g. risk: benzene has been found in isolated CSG water samples; consequence: benzene causes health effects, therefore the CSG industry must be responsible if you are sick, and live near the project. Those people who support the anti-CSG movement are more likely to more likely to believe the information that supports their position i.e. confirmatory bias, and less likely to critically think about or investigate the likely link between the source of the benzene and the levels required to cause the health effects.

When these arguments are countered by industry with evidence, the anti-CSG groups claim that the companies are lying, falsifying or concealing the real data that does not agree with their own. Further, when the information is presented by Government, the anti-CSG groups will point to conspiracy or corruption between the companies and government.

An example of the backfire effect, as it relates to the current interaction between the scientists and the anti-CSG community groups, is demonstrated through the reaction of the Lock the Gate organisation, to the Queensland Governments media release relating to the natural leaking of methane into the Condamine River.

On the 21st January the Queensland Government announced that:

“Government agencies have already undertaken comprehensive investigations and testing along the Condamine River independent of the investigation being conducted by coal seam gas company, Origin.”

Further the media release noted that:

“Queensland Government report has confirmed that bubbles in the Condamine River pose no risk to the environment or to human and animal health.”

Minster Cripps also stated that the tests would be independently verified by Queensland Chief Scientist:

“An independent scientific review will be completed by Queensland’s Chief Scientist, Dr Geoff Garrett, to ensure that Origin’s investigation and verification actions by government agencies, achieve a high scientific standard and integrity.” (Cripps.A.MP 2013)

Despite the fact that the government has indicated that the studies were both complete and independently verified by the Queensland Chief Scientist, Lock the Gate Alliance rejected the validity of a State Government investigation. Lock the Gate Secretary Sarah Moles reported to the Australian Broadcasting Corporation (ABC) that in her opinion *“the Government has a vested interest in the CSG industry and cannot be trusted... She says the report’s findings are flawed.”*

Moles stated in the interview:

“Affected landholders and people in the vicinity have very little or no confidence in the independence of the Government’s testing and the community should be involved in selecting a truly independent company or scientific organisation to undertake those tests so that everybody is confident,” (Rego,F. 2013)

Although Lock the Gate Alliance has chosen to make comment to the media on the findings, they have not posted an official media release on the Queensland Government study and have not presented any alternative scientific findings to back their claims that the research or the findings were flawed. It was simply their belief verses the evidence.

As the results of the study do not present the findings in favour of the anti-CSG group’s belief that the natural seepage of gas is a cause of environmental and human health harm, they have chosen to deny its validity, in favour of their existing belief, which is backed by emotional believe and not by scientifically justified rebuttal.

A Case Study – Conditional Bias in Media Reporting against CSG

The case study presents publicly available from submissions to the Senate Inquiry on CSG and other digital literature prepared by community interest groups, principally representatives of Doctors for the Environment. The case study intends to illustrate how conditional bias affects the way that information is presented with the intent of over emphasising a risk, action or outcome, in a way to arouse fear in the readers, therefore gaining emotional support for the author’s position against the industry.

In February 2012, Viewpoint Magazine published the article *Coal Seam Gas: future bonanza or toxic legacy?* by Dr. Marian Carey. Dr. Carey is a highly credentialed public heath physician and a member of the national executive of

Doctors for the Environment. Doctors for the Environment's vision statement is that it is a "*voluntary organisation of medical doctors in all states and territories*". (DEA, 2013)

The article was prepared to discuss the growth of the coal seam gas industry and to highlight, in the authors opinion, the health and environmental risks associated with the development of the industry. However, Dr. Carey highlights the risks and the consequences – but not the likelihood that the risk may eventuate as a result of the CSG industry. This is a common way that the anti-CSG lobby presents their information to foster emotional support over logical reasoning.

Understanding standard risk analysis is important in understanding the modus operandi of the anti-CSG lobby's in convincing their supporters that the CSG industry should be stopped.

When we analyse risk, we look at the risk itself, and then weight that risk against the consequence that may result from the risk against the likelihood that the risk it may eventuate. A risk event may have a significant consequence if it did occur, resulting in a catastrophic outcome, however if the probability that the risk event will occur is exceptionally unlikely, then we categorise the event as being low risk. If a person wishes to bias an issue, with the intent to cause fear, they will highlight the risk and the consequence of an issue – and not inform the audience if the "likelihood" that the risk will occur.

Examples in Dr Carey's article demonstrate how the portrayal of a risk and consequence can be used to bias the argument against the CSG industry. Two examples of conditional bias are evident in Dr Carey's article, specifically the risks associated with the use the Ethylene glycol in hydraulic fracking operations and the presence of Benzene in the environment.

In relation the potential consequence of ethylene glycol to Dr Carey states that there is a risk that a person could ingest the substance leading to poor health outcomes.

"Ethylene glycol, for example, is used to make anti-freeze. When it breaks down in the body, it forms chemicals that crystallize and collect in the kidneys and can affect kidney function. It can also form acidic chemicals in the body, affecting the nervous system, lungs and heart" (Carey,M.Dr. 2012)

The source of this information is a fact sheet on the most frequently asked questions relating to the toxicological effects of Ethylene glycol. The fact sheet has been prepared by the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Environmental Medicine, Atlanta, USA.

While the above statement, according to it source is true, Dr Carey only highlights the risks and the consequences of ingestion of ethylene glycol. When read as a statement, in isolation of the factsheet and any knowledge of the likelihood that ingestion could occur, this will almost certainly draw alarm and fear in the reader.

However it is noted in the factsheet on ethylene glycol the likelihood statements are made on the chemicals exposure potential and its relative toxicity. (ATSDR, 2007)

On the source of ethylene glycol in everyday life the fact sheet notes:

- *Ethylene glycol is used to make antifreeze and de-icing solutions for cars, airplanes, and boats. It is also used in hydraulic brake fluids and inks used in stamp pads, ballpoint pens, and print shops. (ATSDR, 2007)*

On the likely cause of health impacts:

- *Your health is not likely to be seriously affected by the very small amounts of ethylene glycol that could be tasted or otherwise accidentally eaten (for example, by putting your fingers in your mouth after getting them wet with antifreeze). Accidental or intentional ingestion of larger amounts of ethylene glycol can cause serious illness or death. (ATSDR, 2007)*
- *Treatment after early diagnosis has been very successful in people **drinking** large amounts of ethylene glycol. (ATSDR, 2007)*

On effect of exposure, and levels of risk:

- *The EPA has determined that exposure to ethylene glycol in drinking water at concentrations of 20 ppm for 1 day or 6 ppm for 10 days is not expected to cause any adverse effects in a child. A **lifetime** exposure to 14 ppm ethylene glycol is not expected to cause any adverse effects. (ATSDR, 2007)*
- *Exposure to ethylene glycol in air, drinking water, or soil is not expected as ethylene glycol in air will break down in about 10 days, in water and in soil will breakdown within several days to a few weeks. (ATSDR, 2007)*

As far as the likelihood that ethylene glycol entering into the drinking water system, QGC, APLNG have committed that it does not use ethylene glycol in its hydraulic fracturing fluid in the Surat Basin. Arrow Energy has documented the chemicals that they use in hydraulic fracturing – of which ethylene glycol is excluded from the list. Santos have completed a hydraulic fracturing risk assessment, and concluded that ethylene glycol is considered a low environmental risk. (QGC, 2013; APLNG, 2011; Arrow, 2013; Santos, 2010)

In relation the potential risks consequence of Benzene, to Dr Carey paints an alarming portrait of the risks of bone marrow loss leading to anaemia and the potential of leukaemia.

In the article, Dr Carey states:

“Long-term exposure to benzene can affect the bone marrow, causing anaemia, and increasing the risk of leukaemia. BTEX chemicals have been used as fracking fluids, even though this practice is now banned in Queensland and NSW. However, the fracking process itself may release BTEX from sediments into surrounding air or water” (Carey, M.Dr. 2012)

The statement itself relating to the consequences of prolonged exposure to Benzene may be true, however the levels of exposure are not presented, nor the duration of exposure required for these health impacts to present. In reading the

above statement, an uninformed reader may also infer that BTEX chemicals are still being used in Fracking fluids despite their ban in Queensland. Perhaps this is just poorly written.

The source of the information is again a fact sheet has been prepared by the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Environmental Medicine. The fact sheet notes that benzene is an extremely common chemical in modern society and the exposure to it could come from a vast number of sources in daily life:

“Benzene is widely used in the United States; it ranks in the top 20 chemicals for production volume. Some industries use benzene to make other chemicals which are used to make plastics, resins, and nylon and other synthetic fibers. Benzene is also used to make some types of rubbers, lubricants, dyes, detergents, drugs, and pesticides. Natural sources of benzene include emissions from volcanoes and forest fires. Benzene is also a natural part of crude oil, gasoline, and cigarette smoke.” (ATSDR, 2007)

Conclusion - Demystifying the Science for the Community

When the statement is made that "there is so much that we do not know about the science associated with CSG", it is evident that the millions of dollars that have been spent on the in-depth science studies undertaken to support the State and Federal approval have not been used by those who are against the CSG industry to educate themselves on the process and science of the industry.

Further, the anti-CSG lobby's' thirst for more evidence to support their bias, leads to a demonstration of significant hypocrisy, through their ready acceptance and use of incomplete science to gain support for their position, while making claim that the industry generated science is incomplete or unknown.

It is an interesting observation to be made, that that the anti-CSG groups who decry the science surrounding CSG, are invariably part of a movement which demands we must accept 100% the science supporting climate change.

Conformational bias will lead these groups to automatically reject any science, evidence or proof presented by the CSG industry that moves beyond their core belief.

We find that the more we provide robust and conclusive science on a particular issue that debunks their claims, the anti-CSG lobby rejects the facts and claim that the studies are by government and the industry are not independent and infer corruption or falsification the data for the betterment of the industry. Their rejection of the industries and government science and evidence, demonstrates the "backfire effect".

After all, as the 19th century French political thinker Alexis de Tocqueville once said, *“it is easier for the world to accept a simple lie than a complex truth”*.

So, as it appears that there is limited gain in the government or the company's continuing to present the robust evidence based science in the traditional manner of research and reporting. We should not stop the scientific research – as it is invaluable in the ongoing process of environmental innovation and improvement; however we stop publishing our complex findings and adopt the methods that have been successful for the promoters of the anti-CSG messaging so far, through the exploitation of the general public's instinctive process of “natural thinking”.

Perhaps the answer to demystifying the science of CSG, we need to use our expert environmental and social scientists, and the volume of scientific research that we have collated over the last decade to address the “risk and consequence” claims made by the anti-CSG groups. When presenting our scientific knowledge, we need to address the likelihood of the risks and consequences, in a way that is simple and logical, and therefore easily accepted by the “natural thinkers”.

We cannot assume that the general public will ever critically think the science of CSG or take the time to read and educate themselves on the industry, and therefore we need to do this for them. We need to be more proactive in the simplification of the science, accept that there are risks associated with the industry and demonstrate that government knows the risk, the industry have management measures in place to prevent or mitigate the consequences and demonstrate that the likelihood of the anti-CSG's apocalyptic portrayal of the industry exceptionally unlikely to eventuate.

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