HOME TRUTHS

The Home Truths of Santos' Narrabri Gas Project from the Community of North West NSW

June 2019

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Why Santos Should Abandon the Narrabri Gas Project

The Narrabri Gas Project has been plagued by a downgrade of the Gunnedah Basin reserves, the financial write-off of the project, further demands for more accurate information from a number of NSW Government Departments and organisations, and strong community opposition.

This is reports outlines why Santos and its partners should abandon the Narrabri Gas Project.

Home Truths has been produced by the volunteer members of People for the Plains Inc, a group of Narrabri Shire residents who have sought to gain a comprehensive understanding of the processes surrounding coal and coal seam gas developments, and the impacts of those processes. Its charter is to educate and advocate on these issues affecting North Western New South Wales.

Contact: Sally Hunter
Secretary – People For The Plains
Email: People4theplains@gmail.com

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Executive Summary

There is too much concern within the community, based on observation and scientific evidence, to allow the Narrabri Gas Project (NGP) to proceed. The Narrabri Gas Project has no social licence and should be abandoned due to the following reasons:

1. The NGP is not required to fulfil Australia's gas needs, as the country is awash with gas. However, most of it is now exported, allowing Santos to drive up the price of gas for domestic consumers. The NGP would be a high cost producer and would not result in lower gas prices.
2. There is no community acceptance of the NGP. This is proven by a range of community surveys and almost 23,000 submissions objecting to Santos' Development Application and supporting Environment Impact Statement (EIS).
3. This will be a stranded asset as landholder after landholder in every direction surrounding the Pilliga is determined to block access for pipelines.
4. Well integrity is questionable, with all wells failing at some stage, including beyond the active life of the project.
5. According to Santos, the project will impact the surface and groundwater of the Gunnedah-Oxley Basin, upon which many farming families are dependent.
6. Santos' gasfield poses direct and indirect threats to existing long term sustainable industries, particularly agriculture and to a lesser extent, Siding Spring Observatory.
7. Santos leaves itself exposed to a raft of future litigation both domestically and internationally due to contaminated agricultural products entering the food chain.
8. The NGP risks the Great Artesian Basin (GAB), a critical resource for landholders and communities across 23% of Australia's landmass. The community is not willing to risk this iconic asset for coal seam gas (CSG) production.
9. Santos has denied the existence of sulphate reducing bacteria (SRB) in the gas strata, which "eat" concrete and steel. SRB attack and destroy wells from the time they are drilled until long after they are sealed off and abandoned.
10. A lack of proper assessment of the potential mental and physical health risks demonstrates a lack of moral responsibility by the company to its staff and communities.
11. A poor track record of already more than 20 known spills and leaks in the Pilliga Forest is of considerable concern to the community. Local whistleblowers have shown that Santos will not admit to spills and leaks until forced to. Responsible corporate citizens would take responsibility and act in the best interests of the community.
12. Prior remediation work has been woefully inadequate and continues to dog Santos' assertions that remediation is possible. This is concerning to the community, considering future development and necessary ongoing remediation.
13. The development of the Leewood water treatment facility brings with it multiple risks and a salts disposal problem that Santos has no answers for.
14. Time is against Santos, with the approval process already having been delayed more than four years. The longer time goes by, the more people will realise there is not a shortage of gas production in Australia and that they have been misled.
15. Significant light pollution would affect the neighbouring Siding Spring Observatory and the Warrumbungle Dark Sky Park, compromising their importance for astronomy and tourism.
16. The risk from this project and infrastructure igniting and/or further inflaming bush fires is too great.
17. Methane is one of the most potent greenhouse gases and is unavoidably lost to the atmosphere as fugitive emissions when coal seams are disturbed by gas extraction.
18. Fossil fuels need to stay in the ground; warnings from scientists across the world are that we are fast running out of time to limit warming to 1.5 degrees and avoid catastrophic climate outcomes. Fossil fuels such as methane are key contributors to climate change.

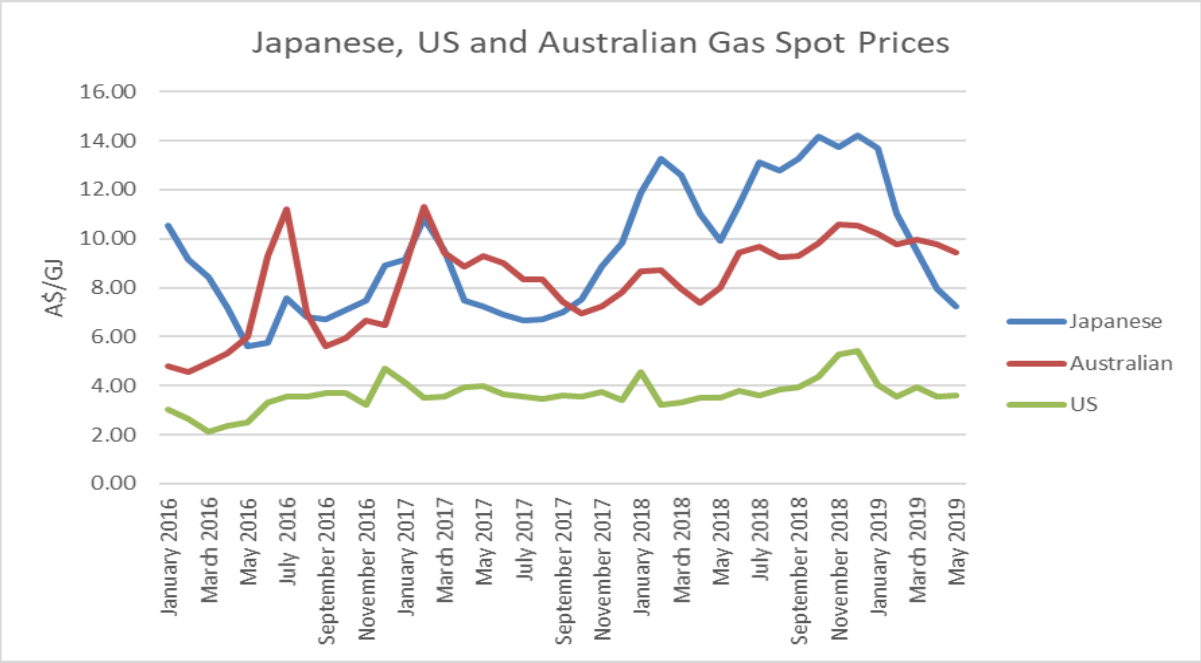
Chapter 1: Gas Crisis – What Gas Crisis?

In 2014, Santos announced to investors that its strategy was to link the price that Australians pay for gas to the (higher) world parity price, by exporting to the world market. This link was made possible by the development of the gas liquefaction process, using giant refrigerators to shrink the volume of gas by around 600 times, thereby making it more economic to transport in ships. If Australian gas users wanted access to Australian gas, they would now have to pay at least as much as Santos could achieve on the export market.

Santos subsequently built a large liquefaction plant and export facility at Curtis Island, off Gladstone. This facility was to be supported by the burgeoning supply of CSG from Queensland.

As a result, gas production in Australia tripled (since 2010) and in late 2018 Australia surpassed Qatar as the world's largest exporter of gas. And Santos was able to achieve its aim, with the price of gas increasing from $4/GJ to over $10/GJ. In March 2017, many commercial and industrial gas users were being offered gas at $20/GJ. Prices now stand at between $8 and $12/GJ according to the Australian Competition and Consumer Commission (ACCC).

So Australia's much-touted 'gas crisis' is not about the lack of gas, it is about the price of gas. Australia has enough gas to meet its requirements many times over. However, the more we produce, the more will be sent offshore to allow Santos to meet its export commitments. Consumers and domestic industry in eastern Australia now pay more for gas than Australia's customers in South East Asia. This is illustrated in the adjacent graph, where Australian gas prices are now higher than those in Japan and significantly higher than in the US.



Source: US Energy Information Administration, Ministry of Economy, Trade and Industry, Australian Energy Market Operator, Reserve Bank of Australia

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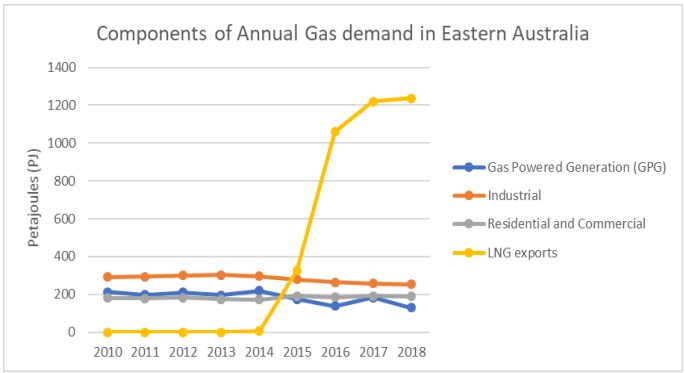
The Narrabri Gas Project (NGP) is part of the east coast onshore gas province. This is globally high cost gas. The NGP is the highest cost producer in a high cost province[i]. Narrabri gas is $7.25/GJ at the wellhead. This compares to the Asian (delivered, after liquefaction and shipping) spot price of $7.71/GJ. By comparison, last year the average gas price in the US was A$4.00/GJ[ii].

Bringing the NGP into production will therefore do nothing to bring down gas prices. We have now reached the position where Australia, the world's largest gas exporter, is looking to import gas, as it is cheaper than the artificially inflated cost of local gas. As a result, various consortia are planning on building up to five gas import facilities to satisfy east coast demand.[iii]

We could have the absurd situation of gas tankers passing each other in the middle of the Indian Ocean, carrying gas in opposite directions. If Australia imports its domestic gas needs, it will be embedding in the domestic price three services it does not need: the cost of liquefaction; the cost of shipping; and the cost of re-gasification, so prices will stay high.

As a result of the now high domestic price for gas, due to exports, demand in Australia is falling (see graph adjacent). Gas-dependent industry is closing. Remapak, Dow Chemicals and Claypave have recently shut their doors in part due to high gas prices[iv]. Domestic consumers are switching fuel sources and gas is being used less for electricity production. In October 2016, Incitec Pivot opened a $1 billion ammonia plant in Louisiana, providing several thousand jobs. The plant was originally scheduled for Newcastle, but relocated due to the high Australian gas prices [Ref: The Australian, 7-8 October 2017 .



Source: AEMO

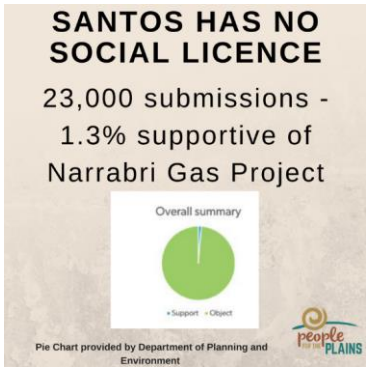
In the meantime, Santos has downgraded its reserves at the Pilliga gas project from 2P to 2C i.e. from "proven and probable" to "contingent" resources[v], ensuring that this is not a bankable development project. In early 2016 Santos wrote off $1.4 billion on the NGP, to a then current value of $0.00 i.e. it was considered not worth a red cent. Santos was unsuccessful in trying to sell the project, so has now re-instated the NGP as a "core asset" on the back of these higher gas prices.

What does this mean?

The development of the NGP will do nothing to bring down gas prices to help Australian industry and energy prices. As a high cost producer, the NGP could be left stranded with no market, should lower cost gas be imported as proposed.

Chapter 2: The Community does not accept the NGP

The Narrabri Gas Project and its proposed pipeline has been comprehensively rejected by the North West (NW) NSW residents and has no social licence.



Nearly 23,000 submissions were received responding to Santos' EIS, smashing all previous records for development projects in NSW. Of the submissions, only 300 (1.3 per cent) supported the project, with 98.7 per cent opposed. Even in the local area (Narrabri, Wee Waa and Boggabri postcodes), 319 opposed the project, versus 180 supportive.

People from a range of diverse backgrounds, including farmers, have gone to, and will continue to go to, whatever lengths necessary to protect the region from CSG and halt Santos' NGP and pipeline.

There is wide-scale community rejection of the CSG industry in NW NSW, and the NGP in particular. Comprehensive community-run door-to-door surveys have been undertaken in the north west, spanning an area of over 3.5 million hectares to date. These communities have unilaterally declared their districts Gasfield Free with an average of 96% wanting to remain gasfield free, making it clear that Santos has no social licence to operate here.[vi]

A door to door survey of more than 800 homes in the township of Narrabri at the end of 2018 revealed only 28% support the Narrabri Gas Project and 54% are opposed to it. Many people chose to abstain and are tired of the division that the industry is creating.

ReachTEL polling, commissioned for the Independent candidate in the March 2015 State election, showed 87% of people across the broad NW NSW region encompassing Santos PEL areas are concerned about CSG mining; 63% "very concerned" and 24% "concerned".

Local communities are resolute in their opposition to Santos' plans to turn our region into a gasfield.[vii]

Claims of "working together with host communities" are completely rejected. Santos has "bought" the support of some community organisations through sponsorship. Its coercion of a locally sponsored club, which was to provide the venue for a meeting involving Senator Glenn Lazarus, provoked outrage from many in the community and beyond.

What does this mean?

It is unacceptable that community opposition is ignored by Santos and its partners. Public companies have legal and moral obligations to listen to the concerns of the community and to act appropriately.

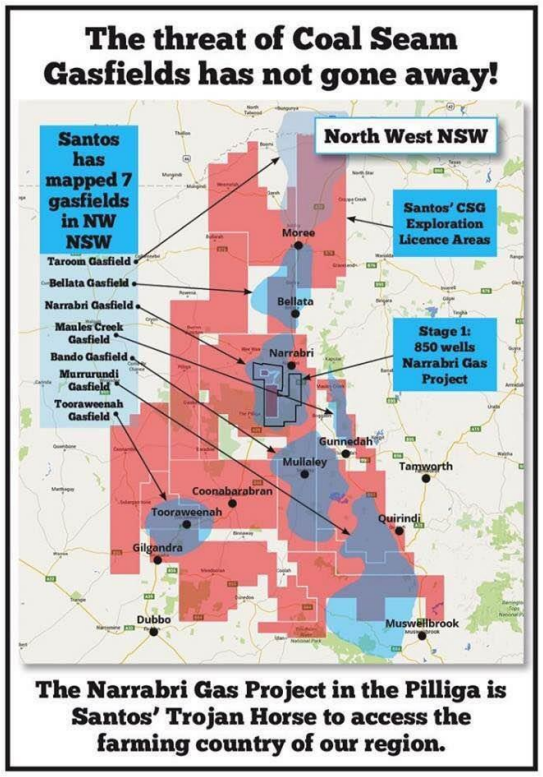
Chapter 3: Narrabri Gas Project is a Stranded Asset

Santos' reporting makes it clear that it does not have its sights set only on the Pilliga and the vital southern recharge area of the Great Artesian Basin.

While Santos is telling the local community that it is only focused on its Narrabri Gas Project it is, at the same time, mapping to its investors seven prospective gasfields across productive agricultural land in NW NSW, making it very clear the long term intention for this region is gasfield expansion and interconnecting pipelines.

APA has begun its heavy-handed approaches to the landholders of the Western Slopes Pipeline route and has already been met with community opposition. Signs are being erected on front gates at a rapid rate and farmers are banding together to work out how they can convey their non-negotiable stance.

Whole communities have voiced their opposition to the project, from Moree Plains Shire in the north to Gilgandra Shire to the south of the NGP, from the west across the cotton belt, to the east across the Liverpool Plains and beyond.



Santos' chances of extending the pipeline network into these areas will be severely diminished by the fierce opposition it will meet on all fronts.

The NGP will be a stranded asset, at risk of isolation from markets as the pipeline will need to pass through large tracts of privately owned, highly productive and valuable agricultural land. Opposition has been marshalling since announcement of the pipeline route.

What does this mean? The risk of the Narrabri Gas Project becoming a stranded asset is a key factor in the demise of the project.

Chapter 4: All Wells Fail at Some Stage

Corroding Well Infrastructure

There is substantial evidence that well integrity can be compromised at any stage of a well's existence.

Using figures supplied by industry in the USA, Professor Tony Ingraffea found that 7% of wells leak immediately, 30% leak within 20 years, and 50% within 30 years.[viii] Concrete deterioration cannot be prevented: a gas well is an engineered structure, which will crumble and corrode with age.

Where the deterioration causes farmers' bores to fail, the community is concerned that it will be impossible to compensate farmers adequately. Even if Santos could afford to replace lost groundwater with "make good" water, experience elsewhere shows this to be entirely inadequate to serve farmers' purposes.

In the Surat Basin, the Queensland Government has predicted 574 bores will be impacted in the long term with 127 already impacted as of March 2019.[ix]

Professor Ingraffea (who heads the Cornell Fracture Group and who has undertaken numerous research and development projects for both public and private institutions, including Schlumberger and the Gas Research Institute) asserts that "Cementing and completion practices in the basins are the main risks to the downhole environment. Many mechanisms are present to cause the cement to deteriorate. As a result, sufficient zonal isolation cannot be guaranteed for any amount of time. The major risk associated with cement failure is cement carbonation."[x] Without ongoing treatment with biocides into the distant future, which is impractical, many of these wells will eventually corrode to create connections between aquifers and coal seams.

Brian Bender's bore bubbling with gases

Associate Professor Bryce Kelly from the University of NSW says "Results from coal bed and shale gas production regions in the US show that if a gas production well is poorly constructed then there is a risk of groundwater contamination at a local scale".[xi]

Hydrogeologist Andrea Broughton has warned that well integrity is one of the greatest threats to our clean aquifers. She has also warned that depressurisation of the coal seams may have flow on effects to water pressure in the GAB and individual aquifers.[xii]

Following the EIS process, government departments, community and stakeholders provided submissions and then Santos provided its Response to Submissions (RTS). The RTS failed to address a range of issues raised including refusing the request of Narrabri Council to provide a security deposit to cover the true cost of rehabilitation and a fund to cover any off-site remediation and rehabilitation caused by the project.

What does this mean? Groundwater contamination of the Great Artesian Basin is a major risk for Santos and its partners, and for those who rely on aquifers for their water supplies.

Chapter 5: Drilling through aquifers is a risk!

The people living in the North West are highly reliant on groundwater and surface water: they drink, bathe, water stock and irrigate with it. More than 20 years of policy reform, utilising the precautionary principle, has improved our understanding of the importance of recharge and what is required to ensure sustainability. Presently the community views the system as sustainable and are highly protective of allocations.

Any change to the equilibrium due to abstraction in the deeper systems will result in the resource changing and finding a new state of equilibrium. How much that impacts on other groundwater users and those living in the region depends on the degree of connectedness of the many geological layers between the coal seams, where the groundwater is being pumped from, and the ground/surface water connection.

The immediate impact of the NGP is the abstraction of groundwater which is under a very high pressure head, high enough to absorb the coal seam gas into the coal cleats. Long-standing water licence holders also extract groundwater in the Gunnedah-Oxley Basin at different depths to the coal seams.

Original pressure of GAB in Blackall

Santos, in its Referral of Proposed Action to the federal Department of Environment stated that the depressurisation of coal seams for dewatering **will impact** the groundwater and surface water of the Gunnedah-Oxley Basin.[xiii]

Indeed, in its recent 2017 review of the NGP EIS, the Independent Expert Scientific Committee (IESC) identifies groundwater depressurisation and drawdown of aquifers as a key risk of the project and noted the impact on, amongst others, other groundwater users and changes to water flow and quality as a result of discharges to Bohena Creek.[xiv]

Santos does not have the information to say categorically it will not affect other groundwater systems or contaminate surface water systems. Furthermore, it is unable to provide concrete assurances the impact can be confined to the deeper systems as the current interconnectedness between the GAB and the deeper coal seams is unknown.

The location of the Santos NGP and its connection with Bohena Creek also poses a surface water risk. Bohena Creek connects directly with the Namoi River both above and below ground. The proximity of the intersecting Bohena Creek and Namoi River to the starting point of the Lower Namoi groundwater paleochannel means that any surface water contamination of Bohena Creek could contaminate one of the Namoi Valley's most extensive irrigation resources.

What does this mean? Santos is risking irreversible damage to the water resources of the Namoi Valley and the GAB and shall be held liable for any damage that occurs.

Chapter 6: Impact on Existing Sustainable Industries

Santos' Narrabri Gas Project poses direct and indirect threats to agriculture, the main industry that has sustained this part of NSW since white settlement. The local agricultural industry also supports a multitude of diverse secondary industries such as research stations, cotton ginning, oil seed crushing, grain handling, livestock selling, freight, machinery dealers, and many other rural supply and service businesses, which together employ 21% (1,124 jobs) of all the jobs in Narrabri Shire. The next highest employer is retail trade with 10% and health care with 9%. Furthermore, 45% of all businesses within the shire are farming, fishing or forestry related[xv]. The Total Gross Farmgate Value of agriculture in Narrabri Shire was $394.6 million (2010/2011) with cotton the largest contributor, at $223.5 million. Agriculture is by far the single largest contributor to Narrabri Shire revenues and stands to be the biggest loser from the CSG industry.

Local wheat production is a long term beneficial industry

Much of the region's agriculture is highly reliant on stock water from aquifers and/or irrigation water from surface or bore supplies. Based on the work of the Independent Expert Scientific Committee[xvi] (IESC) and many other experienced and professional scientists, the NGP represents a long term threat to both the quantity and quality of agricultural and domestic water supplies in the NSW section of the Surat Basin and elsewhere.

This threat sits squarely on the shoulders of Santos and APA, but it is the farmers who will suffer.

CSG exploration and production is incompatible with many types of agricultural production, particularly irrigated cropping. Centre pivot and travelling laterals are not able to manoeuvre over or around fences or wellheads. Dissecting fields with CSG infrastructure is totally incompatible with precision laser graded surface irrigated fields and disruptive of dryland cropping patterns. CSG and viticulture do not mix. All of these agricultural enterprises are common in the Namoi Valley and other areas surrounding the NGP.

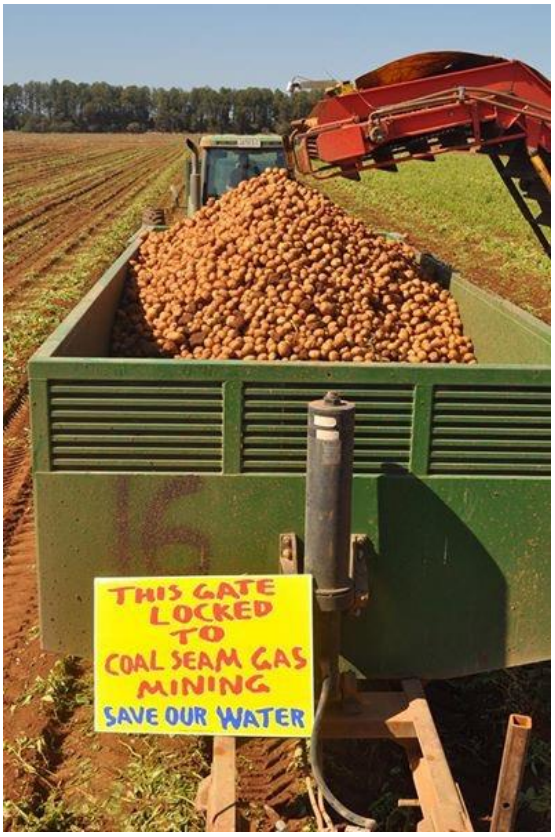
The Productivity Commission Report[xvii] acknowledged that one area where landholders will be impacted by the CSG industry is the reduction in land values, and there is no mechanism for setting compensation for this. A reduction in property values has also been acknowledged by the Queensland State Valuation Services which applies a reduction of up to 20% in valuations for grazing lands with CSG wells located on them.

Landholders may also experience difficulties in borrowing and securing insurance. Rabobank, a major rural lender, is opposed to CSG because of the potential to adversely affect rural property values, reducing farm equity and hence the ability of farmers to borrow.

What does this mean? Santos should not be allowed to undertake the systematic dismantling of existing sustainable industries that represents core Australian values.

Chapter 7: Santos Exposed to a Raft of Litigation

Landholders have been advised by their insurers that their farm businesses, the associated water resources and/or farm produce are considered "uninsurable" against CSG contamination. Therefore both the likelihood of the risk manifesting, and the severity of the risk, are unacceptably high for an insurer to cover. The insurers are suggesting that a significant adverse impact as a result of CSG operations in the region is considered almost inevitable.



CSG extraction risks existing agricultural production

Furthermore, Meat and Livestock Australia states that "the landholder may still have primary liability in the event of contamination of the soil, pasture or groundwater, neighbouring properties, as well as livestock which, if then processed and consumed, could breach Australian food standards or importing country requirements for meat."[xviii] This is particularly pertinent for landholders who sign a National Vendor Declaration or similar document for their produce. Signing such a document provides the buyer with a guarantee of the food safety status of the animals or crops they are purchasing and puts responsibility of any potential contamination in the hands of the landowner.

Being unable to obtain insurance leaves landholders at grave risk, questioning what consequences there may be for food products sold into the future, and whether they may ultimately incur a legal or financial liability. This is precisely why landholders have sought to insure against such an eventuality, and for which cover is not available. Neither Santos, nor its insurance company, nor a NSW Government Bank Guarantee (to an undisclosed amount), can provide certainty of cover for, or remedy, the inability to obtain insurance privately. This will ultimately expose Santos to future claims and legal action on a scale possibly not seen before in this country.

Santos' Response To Submission also failed to address the Narrabri Council's request for the company to hold "pollution legal liability insurance that covers pollution and natural resource damage both on-site and off-site including groundwater contamination and for the benefit of the insured, third parties and contractors".

What does this mean?

Insurers consider the CSG industry uninsurable, suggesting contamination is virtually unavoidable. The result will be unwanted distraction and cost of litigation between agricultural producers and Santos. The NGP should not be approved unless these guarantees are given.

Chapter 8: NGP Will Impact the Great Artesian Basin

Today, water from the Great Artesian Basin (GAB) sustains the lives of more than 180,000 people and 7600 enterprises.[xix] It is a vital resource for a significant portion of Australia (23% of the landmass). If these lives and businesses are negatively impacted by contamination and/or drawdown of the GAB, Australia will see its greatest environmental disaster in its history and Santos will be responsible.

Having reviewed the "Bibblewindi EIS (July 2013)" and the "Water Resources Assessment" (June 2013), both prepared for Santos, Senior Petroleum Geologist Peter Lane[xx] concludes that "no basic hydrogeological or geological data has been provided and therefore it is not possible for any expert in these fields to make any meaningful comment as to whether the conclusions reached in the above mentioned reports are justifiable or not". The Independent Expert Scientific Committee, in its review of the NGP EIS, in fact recommended more monitoring.

The Great Artesian Basin covers an extensive area of Australia

We are concerned that Santos is relying on reports of convenience rather than those of substance which ultimately prevents the company from undertaking appropriate risk assessment and mitigation strategies.

CSG mining in the Pilliga State Forest has the potential to impact the groundwater quality and quantity within the GAB Pilliga Sandstone aquifers and the Quaternary (recent) unconsolidated alluvial aquifers. Connectivity has already been established between the GAB and many of its underlying petrochemical rich basins[xxi] confirming the likelihood of both contamination and drawdown from CSG produced water removal.

The project is located above the Pilliga Sandstone recharge beds to the GAB. Santos' own Referral of Proposed Action to the Federal Department of Sustainability, Environment, Water Population and Communities in 2014 states "that the duration and wider geographic extent of depressurisation of groundwater head within the coal seams and adjacent strata WILL cause a significant impact to the groundwater resources of the Gunnedah-Oxley"[xxii]. This excessive drawdown of pressure heads in the recharge zone of the GAB associated with gas extraction has the potential to reduce pressure heads in artesian waters across a large part of the GAB, and may completely stop the free flow of water to the surface at springs and bores[xxiii]. The IESC identified impacts on groundwater dependent ecosystems (GDE), including at Hardys and Eather Springs, as a key risk of the project and recommended that more work be carried out to identify further GDEs at risk.

UNSW Professor Bryce Kelly stated that in Queensland "gas production from the Walloon Coal Measures will eventually result in hundreds of thousands of megalitres of groundwater being extracted each year; depressurising the groundwater systems in the Walloon Coal Measures and adjacent geological formations. The full extent of the impacts due to this volume of groundwater extraction will take multiple decades to be transmitted throughout the aquifers of the Great Artesian Basin and the Condamine Alluvium."[xxiv]

The GAB is a national icon, a vital lifeblood and part of an intricate and critical underground water network that sustains life, agriculture and communities that rely on it. Contamination of GAB water by produced water through well failures, unpredicted geological anomalies, or through surface water migration will cause devastation on a national scale.

The CSIRO has rejected the claim made in an APPEA television commercial aired in 2012 that 'CSIRO (and government studies) have shown that groundwater is safe with coal seam gas'. They reiterated on 4 September 2015 "At no time has CSIRO made such a statement, and nor do the results of CSIRO research support such a statement."[xxv]

What does this mean?

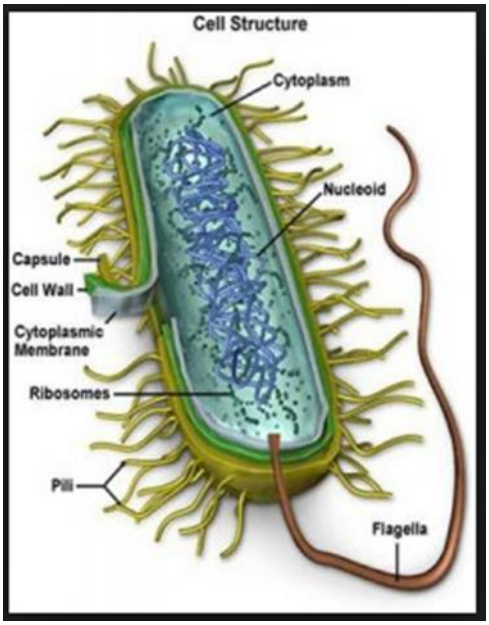
The community has little confidence that the Narrabri Gas Project can proceed without endangering the Great Artesian Basin, on which so many farms and communities rely.

xxvi

Great Artesian Basin bore used to grow food and fibre

Chapter 9. Sulphate Reducing Bacteria – the driller's nemesis

Sulphate Reducing Bacteria (SRB) are one of the oldest and most widespread bacteria on the planet. SRB inhabit nearly every conceivable location where there is no oxygen (anaerobic conditions), including the depths of the ocean, the human stomach, moist soil, hot water services, and sewage pipeworks. They also inhabit aquifer systems, coal seams, gas well drill rigs and associated infrastructure, including drill strings and mud tanks.



In most cases the population of naturally occuring SRB is controlled by the restricted availablity of a food source. However, if a food source is introduced via drilling fluids and concrete casings, for example, the SRB population increases and with it problems for gas wells.

SRB can work fast or slowly and are non-selective with regards to the source of their "food", creating problems well into the future for gas well infrasture and any other non-related underground infrastructure, such as town water bores and pipelines. The issue is therefore not confined to gas companies and government approving bodies, but extends to anyone with underground infrastructure, such as Councils and the farming community.

Well drillers have long known of the damage caused by SRB. These anaerobic bacteria grow on organic compounds found in water contaminated with hydrocarbons and organic material. They convert sulphate into hydrogen sulphide (rotten egg gas). The presence of hydrogen sulphide not only reduces the commercial value of natural gas, but also rapidly corrodes pipes, tanks and other iron and steel structures.[xxvii] Hydrogen sulphide from SRB also plays a role in the biogenic sulphide corrosion of concrete.

While SRB can be controlled to some extent in the produced water from the coal seams by the use of biocides[xxviii], they cannot be controlled in the natural aquifer system. Once in the aquifer, SRB become a very real threat to the longevity of the outer concrete casing of a gas well, as the SRB convert sulphides in the cement to food. The effectiveness of the concrete outer casing to prevent cross contamination of groundwater is thereby severely compromised. That is, low quality water from one aquifer could contaminate high quality water in another. The loss of this concrete seal can also result in the residual gas from the coal seam escaping to the surface.

When a gas well is drilled there is a certain amount of aquifer/drilling fluid (mud) interchange, as mentioned in all of the Eastern Star Gas Reviews of Environmental Factors and in the earlier Santos REFs for PEL 238. (Santos bought out Eastern Star Gas and its NGP in 2011). As the drilling fluid pressure is always greater than the pressure in the aquifer, drilling fluid is lost to the aquifer. The

organic lignite, lignin, tannins, cellulose, starches, and fatty acids found in many mud systems are carbon food sources for SRB. These muds can also harbour SRB.

Biocides are almost ineffectual in controlling SRB in aquifers because the water/biocide dilution rate is too high. By introducing drilling muds to the aquifers, the gas industry is in fact actively encouraging SRB. While this is well known in drilling circles, it is an issue which the CSG industry and government regulators never mention, as it one reason why rehabilitated well integrity can never be guaranteed.

In August 2018, new technology was introduced into Queensland to patch severe and localised external corrosion in well casings. According the company Saltel "it is suspected that this is caused by bacteria growth…. And that it is systemic in the region". [xxix]

What does this mean? Santos aims to seal wells at the end of their productive life by pumping full of concrete. However, the outer concrete casing will always be subject to attack by sulphate reducing bacteria, allowing cross-contamination of aquifers and possible escape of residual methane to the atmosphere.

Chapter 10: Health Impacts Have Not Been Properly Considered

We believe Santos has a corporate responsibility towards the health of its staff and the communities in which it operates. As the number of CSG wells under the operation of Santos increases exponentially, the health impacts from these wells and associated infrastructure begin to mount up.

Particularly concerning are impacts to the environment and people from fugitive methane emissions. Santos uses a CSIRO report[xxx] on just 43 wells to declare that methane emissions are much lower than in the USA, but ignores the facts that: the wells were hand-picked by the company for testing, they were only tested at the well head, they were all new and no account was taken of the aging of wells and equipment, and that fugitive emissions escape from many other places between the wells and point of use.

A peer reviewed study by Southern Cross University showed that emissions in the Tara gasfields are much higher than expected and that methane is also seeping through the soil.[xxxi]

It is imperative that the company uses the best possible information, not the most convenient to the outcome it desires.

Along with CO_2, methane levels are now at their highest atmospheric concentrations in about 800,000 years, with their increase about 2.5-fold since pre-industrial times. Atmospheric methane is generally considered to be non-toxic unless in concentrations dense enough to displace oxygen and cause asphyxiation, which is unlikely except in enclosed spaces. However, when exposed to sunlight, atmospheric methane can form formaldehyde. Any methane only partially burnt in flares or motors can also result in formaldehyde emissions.[xxxii]

The severity of symptoms from formaldehyde exposure depends upon the concentration (how much) and duration (how long) and the individual sensitivity, but even short term exposure may result in immediate symptoms. These symptoms are the same as those experienced by people in the Tara and Chinchilla gasfields and those evacuated from the Porter Ranch natural gas leak in California in 2015.[xxxiii]

Professor Mary O'Kane outlined health impacts as missing from the debate

While there is a lot of anecdotal evidence from people living and working near these industries, there are still no comprehensive studies on the long term health effects of CSG as recommended in the NSW Chief Scientist's Report.[xxxiv] Santos has not taken a proactive position on these concerns and is failing its moral responsibility in its concern for impacted people.

[xxxv]

Brisbane GP Dr Geralyn McCarron has been studying the health effects of CSG on people in Queensland gasfields and has documented evidence of dozens of side effects.[xxxvi] American studies have shown that the rates of childhood diseases increase when living within a 10km radius of natural gas wells.[xxxvii] Studies of chemicals used in and produced (brought to the surface) as a result of CSG have identified many health risks that will likely increase with time, well numbers and exposure.[xxxviii]

A community-based exploratory study found increased levels of volatile compounds in and around gasfields, individual wells and associated infrastructure at a number of locations in the USA. These included levels that exceeded American federal guidelines for eight volatile compounds, most commonly benzene, formaldehyde and hydrogen sulphide.[xxxix]

Many residents anywhere near CSG facilities are inevitably stressed by the consequences of the development on their family, community and business, and the strain of dealing with CSG companies.

The public record shows at least two incidents in Queensland over the last couple of years where farmers have taken their own lives due to the stresses CSG places on their families and enterprises. Similar stresses have already been witnessed in the local Narrabri community.

What does this mean?

Health impacts of CSG have been poorly addressed to date, causing growing community concern and scepticism, further eroding the acceptability of the NGP. People living along the pipeline route have particular concerns about the future impacts on their health.

Chapter 11: Spills and Leaks are Inevitable, but Not Acceptable

The NGP has been responsible for a succession of spills, leaks and unapproved releases of produced water from sources which include water treatment plants, drill rigs, well sites, cuttings ponds, storage reservoirs, tankers, poor operating practices and poor container cleanout practices by contractors. Santos' internal records show that many have not been reported as required by the Conditions of Operating and many of these events have been recorded and communicated to the regulators only by community members.

The spill at Bibblewindi created a 2 ha kill site

Santos is not being proactive in its monitoring and/or not being honest in its reporting of incidents. Either way this is a poor way for a reputable company to operate.

More than 20 occurrences of spills, leakages and failures are known to date, some of which happened long after Santos purchased the field from Eastern Star Gas (ESG).

In late 2011 a member of the public discovered a large spill which had not been reported to the regulator. The spill allegedly occurred in mid-2011 and allegedly consisted of produced water from the Bibblewindi water treatment facility. The spill occurred over a five hour period and decimated approximately two hectares of vegetation. Santos declared that "the spill was only 10,000 litres of water, some of which was recovered", which would equate to only two cups of water per square metre. Obviously far more water than this was spilt as most of the vegetation on the two hectare site was killed and significant soil pH changes were measured (and reported by Santos' consultants CH2M Hill and Golder Associates) 277 metres from the spill site, to the depth of measurement (pH 10.0, 8.5 and 8.2 at depths of 0-50, 50-150 and 500-600 mm respectively, compared to a background level of 5.6).

This response by Santos destroyed its credibility in the eyes of the community. All vegetation in the area has died or remained severely retarded for the past 7 years, resulting in further ridicule of Santos' response.

In 2012, the NSW Environment Protection Authority (EPA) issued Santos with fines for two separate discharges into a local waterway of polluted waste water from CSG activities at Bibblewindi by ESG over the period 2010-11-12. Then, despite being formally warned by the EPA for a water discharge incident in 2011, in 2013 Santos itself was fined for a pollution incident which involved a leak from a CSG waste water storage pond.

Santos has also been fined more than $50,000 by the NSW Land and Environment Court for four separate breaches of the conditions of its petroleum title.

HOME TRUTHS

Why Santos Should Abandon the Narrabri Gas Project

In 2014, Santos was fined for contaminating an aquifer at the Bibblewindi water storage site, the first proven case of its type in Australia. A suite of heavy metals was found, including uranium at levels 20 times higher than safe drinking water guidelines. A run-off incident at Leewood in early 2016 prompted the EPA to investigate the adequacy of Santos' erosion controls on site.

Santos employees and contractors appear derelict in their duties. Santos has been issued with warning letters for storing environmentally damaging material at the Narrabri Operations Centre, while a long-term contractor was issued with warning letters and penalty notices for breaches of the Protection of the Environment Operations Act.

In spite of these notices, Santos has continued with sub-standard practices. In March 2016, an employee was observed and filmed leaving a high point vent and its security cage open while he left the site. This is a clear breach of the Conditions of Operation for all water/gas line vents, imposed by the EPA in 2015 after an automatic vent failed and released water and gas into the environment.

While it was clear that the infrastructure Santos acquired with its $924m takeover of ESG was poorly constructed, it is also clear that it is now poorly operated.

It is highly embarrassing that the community is usually the one to identify, document and communicate first about these spills and leaks. It is also disheartening that Santos doesn't seem to be able to prevent these types of incidences from happening time and again.

What does this mean?

The community cannot trust Santos to operate in a manner which protects the environment and the community.

Chapter 12: Remediation

To date Santos has spent over $17 million on attempted rehabilitation, with limited success. The areas of forest decimated by spills of produced water are still virtual dead zones devoid of almost any new self-regenerated native vegetation. Of the predominant Pilliga species, the cypress pine is dead, bull-oak is heavily impacted and both are yet to re-establish naturally. Wattles are growing but most of the sennas would appear to have been introduced with the mulch and wood chips.

Unsuccessful remediation works can still be easily seen

The Bibblewindi Water and Gas Gathering Facility is an environmental fiasco, where after three years of intensive rehabilitation work, including soil removal and replacement, and amendment with gypsum and sulphur, very few native species have regenerated. The area within the facility has since been refilled and gravelled over. The bulk of the "kill zone", however, is outside the fence and has finally reached a semi-rehabilitated state only because Santos is now planting tree species in an attempt to speed up the rehabilitation process.

There are seven such major spill areas in the project area. However, the current lead regulator was not aware of all the approval requirements around rehabilitation. It was left to members of the community to make the regulator aware of these requirements as per the original approval documents and State Forest leasing agreements. Santos has started rehabilitating many of the legacy sites with mixed success, with some of the older sites now removed from the Santos lease.

What does this mean?

Santos has demonstrated a poor track record of sustaining world's environmental best practice in CSG and is poorly prepared to sustain a large-scale gasfield across some of Australia's most important water catchment areas.

Chapter 13: Water Treatment and Salts Disposal

There is no plan for the safe disposal of the chemical salts that are bought to the surface during dewatering of the coals seams, which is necessary to allow the CSG to flow. During peak production the NGP will pull up more than 115 tonnes of toxic salts each day. From the time Santos took over from ESG, the method of salts disposal has been questioned. The answer has changed successively as each option proposed by Santos has been shown to be flawed. In the EIS Santos said salts would disposed of "In a Government-approved waste disposal facility". This was highly questioned by the chief environmental regulator, the EPA. In its Response to Submissions, Santos continues its refusal to identify how and where this massive load of toxic salts will be disposed of safely.

The Leewood Produced Water Treatment plant has caused deep concern within the community. In 2018 Santos was fined for irrigating a lucerne crop without the appropriate licence. Not only are there concerns about disposal of the salts once they are removed via reverse osmosis plant, but also about the amount of salts remaining in the irrigation water.

Reverse osmosis can never remove all the toxins, heavy metals and chemicals, nor can it change the chemical balance.[xl] Hydrogeologist and geochemist John Polglase has commented on an informal water test result of produced water in one evaporation pond in the Pilliga. "The major element ratios in this water are completely unlike freshwater," according to Mr Polglase. "This water cannot be remediated to agricultural or human consumption without intense treatment followed by further element supplementation to produce a more natural balance of elements. For instance, the potassium concentration and the sodium concentration are so high and the calcium concentration and magnesium concentration are so low, that a process like desalination cannot rectify this major element imbalance".

In addition, information supplied by Santos about the use of the treated water for irrigation has caused considerable concern. Based on the proposed salt concentration, the treated water would deposit 2.2 tonnes of salts per hectare per year on the unsuitable duplex soils Santos proposes to irrigate, which would amount to 11,400 tonnes over the life of the project[xli]. If the production stage were approved, this extra treated water is proposed to be sold to local farmers for irrigation use, adding even larger quantities of salts to the area. Again, these soils are in the southern recharge area of the GAB. Water from this area also contributes to the recharge of the Lower Namoi Alluvium Aquifer, which currently provides high quality water for irrigators.

What does this mean?

The poor track record of Santos in controlling and managing toxic components extracted from coal seams during the exploration phase of the Narrabri Gas Project is a portent for how a fully-developed Santos gasfield would place the community and environment at risk.

Chapter 14: Delays … Delays … Delays

The Narrabri Gas Project has been plagued by multiple delays. A Memorandum of Understanding with Santos was signed in February 2014, where the NSW government promised to fast track consideration of the EIS for the project, with a decision to be provided by January 2015. Now, nearly five years later, the company is struggling to respond to the nearly 23,000 submissions to the EIS and is a long way short of approval.

The EPA have made it clear that they rely on the community to uphold their conditions and, whilst this is not a role the community appears to take on gladly, it seems to be a role that many feel a moral obligation to undertake. The community will no doubt continue to observe closely all aspects of the NGP and take decisive, well informed and calculated action when inappropriate acts are undertaken. The opposition is well informed, well connected and aware of the legislation in order to call out these tactics. They will not accept the use of approval creep or the use of inappropriate approvals for developments.

In addition to large numbers of the local community, there are many from outside the region that are more than happy, it would appear, to stall this project for however long it takes. This would include litigation if necessary. A well organised and motivated group of outside activists established a large camp in the vicinity of the NGP during the period of construction activity. Many locals supported the camp with the provision of food and supplies, and moral support.

Activists, both local and from further afield, have chosen to disrupt the NGP on numerous occasions, principally by “locking on”. In spite of recent changes to NSW law with respect to protests, there would appear little chance of the local landholders and activists retreating, presenting ongoing challenges for Santos and the construction of a pipeline to take gas away from the project.

What does this mean? Every delay on the Narrabri Gas Project is proving costly for the company and its partners, and has allowed the general public time to become more educated about the risks inherent in the NGP.

Chapter 15: Light Pollution will Ruin Siding Spring Observatory

Siding Spring Observatory is a unique scientific research facility neighboring the Pilliga Forest. This historic site has been working for over 50 years, and houses currently more than 50 telescopes which conduct both national and international research in astronomy and astrophysics.

This is Australia's premier research facility of this type and is located in the Warrumbungles expressly to take advantage of the requisite dark skies, but with proximity to infrastructure like electricity, engineering and general services. The surrounding area is one of only 55 internationally recognised certified Dark Sky Parks in the world. These parks have "exceptional or distinguished quality of starry nights and a nocturnal environment that is specifically protected"[xlii]. It is also one of the three observatories in the southern hemisphere which together provide the required 24 hour night sky coverage.

The Australian National University co-ordinates work at the facility, alongside other universities, government industries and private enterprise from around the world. More than $100 million worth of research equipment is located at the observatory, with extra funds allocated annually to maintain and upgrade facilities to keep abreast of innovations in science and research.

Siding Spring Mountain hosts the world class Siding Spring Observatory

This research hub is Coonabarabran's second largest employer (after the shire council), with about 35 people employed onsite and a further 150 supported in Canberra and Sydney. The facility is credited with discovering the oldest known star and is currently undertaking the largest survey of dark matter ever attempted[xliii], maintaining Australia's reputation as a leading astrophysics player. [xliv] [xlv]

The observatory also gives Coonabarabran its identity and provides core tourism opportunities, with 30,000 visitors annually.

Why Santos Should Abandon the Narrabri Gas Project

The Bibblewindi and Leewood exploratory flares, which are 90 kilometres away, will be in direct line of sight from these telescopes and when active will impact on the NE sky as seen from the Observatory.

[xlvi]Light pollution and light spills will impact on the effectiveness of this unique Australian asset. Every little bit of unshielded light makes it harder to conduct cutting edge research. Even light pollution from Sydney, over 400 kilometers away, can have an impact. The Federal Government highlighted the protection of the observatory as one of the key areas it was ~~be~~ looking at in the EIS for the NGP, because of its importance to the regional economy and the national astronomy sector.

Santos' future gasfield expansions include Coonabarabran itself, Tooraweenah, Gilgandra, Gunnedah, Mullaley, Dubbo and more. Some of these gasfields would be much closer to Siding Spring and there would be increased flaring, causing an even greater impact on the observatory than the NGP. One outcome would be a downsizing of Siding Spring Observatory and the withdrawal of some of the major projects.

The effects on Sidings Spring could result in the removal of Australia from the global astrophysics landscape. It is unlikely that this site would be rebuilt to the same scale anywhere in Australia again. No further developments or discoveries would be made in Australia and Coonabarabran would be stripped of its key employer, its major tourist attraction, and its identity.

Santos could shield some lights on new building facilities but not all the light pollution from 850 gas wells, including emergency flare stacks 10 times higher than currently in use, being 50 metres high with flames up to 30 metres higher. These emergency flares will have some consequences for the brightness of the NE sky from Siding Spring. Santos have suggested, but not made any written commitment, to shielding such flares should they be a problem for the Observatory. This shielding should be a commitment from the outset, not a retrofit. However, the Santos measurements of existing sky brightness are discrepant from independent measures. They cannot be trusted to accept data that contradicts their claims that there will be no effect on the Observatoy's operations.

Siding Spring boasts a 4 metre telescope

What does this mean?

Whilst this may not have been considered when Santos purchased this asset, it is now apparent that the impact to Siding Spring Observatory is one aspect that cannot be ~~overcome~~ ignored and we do not accept its downgrading on our watch. The community does not accept the damage that the project will cause to this internationally renowned facility and calls on Santos to stop the NGP.

Chapter 16. Bushfire Risks are Too Great

The Pilliga Forest is well known for its low humidity, high fuel load and hot summers creating catastrophic fire conditions. Massive bushfires break out every few years, often started by lightning strikes.

On January 24th 2018, a massive fire burnt out 58,000 hectares and came perilously close to some homes[xlvii]. Rural Fire Service (RFS) resources involved 10 bomber planes, 4 helicopters, more than 40 trucks, up to 150 personnel per shift for ten days, and an estimated 7,200 volunteer hours[xlviii]. These fires not only put the lives of firefighting personnel at risk, they damage the forest, animals and can risk homes and livelihoods.

This fire was about 30km south of Santos' proposed Narrabri coal seam gasfield.

During this disastrous fire week in 2018 Tamworth Country Music Festival goers were not allowed to use their gas BBQs for cooking, yet in the Pilliga Forest, Santos was permitted to continue to burn at least three open flares for their exploration wells.[xlix]

Santos' EIS Appendix S determined there was a "medium risk" and "major consequence" of bushfire from the operation and construction of the gasfield, confirming that Santos would not be able to mitigate the consequences of a runaway bushfire, which could be deadly[l].

Location of 2018 bushfire compared to gaswells

In its scathing response to the EIS, the RFS noted that "the EIS is considered to be short on detail." The RFS went on to request that Santos not use open flaring in their operations due to the high fire danger.

In Santos' Response to Submissions, they continue to refuse to rule out operating live flares in the NGP.

Santos' Operations Bushfire Management Plan states "Santos personnel and contractors are advised that leaving an area early is the safest option in the event of an active bushfire in proximity to operational areas."[li] This leaves RFS staff and volunteers dangerously exposed to highly unsafe conditions.

Open flares are used to burn off excess gas. Stray leaves or grasses, blown through by willy-willies (dust devils) or thunderstorm induced microbursts or tornadoes, could be ignited and blown off into surrounding forest with devastating outcomes.

What does this mean?

A gasfield, along with its associated infrastructure including pipelines, will exacerbate the risks of bushfires in the region. Open flares in a tinder dry environment drastically increase the chances of igniting a fire. These risks are far too great for our community.

Chapter 17. They wouldn't waste the gas, would they?

Fugitive emissions in the gas industry comprise the gas lost from:

- Field production, from valves, flanges and other connections, and also from around the well casing
- Processing, from leaks from many items of equipment such as seals in compressors and the valves, flanges and associated pipework. Gas is also lost through deliberate venting and flaring, and equipment malfunction or failures. Some pneumatic equipment is operated with compressed gas rather than air, another source of loss
- Transmission and storage, from booster compression stations, and from
- Distribution, with losses from the low pressure distribution network, accidents, and the initial gas losses when lighting appliances.[lii]

Some of these losses are difficult to measure while some, such as venting and flaring, are more straightforward. In the U.S., new technologies including satellite and aircraft-based systems have been used to detect methane emissions and quantify emission rates. Some of these technologies are currently being deployed in Australia but Santos has chosen to ignore them.

Instead, Santos claims in its EIS that "Fugitive emissions (excluding venting and flaring) are minor losses of gas that are **assumed to occur** (emphasis added) from equipment and infrastructure. They are **measured by applying legislative emission factors**" (emphasis added). In other words, Santos has used industry estimates for all of its figures on gas losses from the production, transport and processing system of the NGP.

Fugitive emissions are NOT "assumed to occur" – they are known to occur. They are NOT a "minor loss", but a significant portion of the produced gas and a major contributor to greenhouse gases, as borne out in recent observations in the United States. Where measured, emissions from unconventional gas developments in the United States range from 2 to 17% of production, with 6% being a typical figure across some gas fields.[liii]

High point vent in Narrabri Gas Project flow line

For example, high point vents (HPVs) are located on all of the water collection flow lines wherever the pipes pass over a rise in the ground. Accumulated gas that comes out of solution needs to be released from the vents periodically, otherwise it forms a gas pocket which blocks the flow.

Gas releases from HPVs in the Pilliga have been observed and photographed by community members. Given that the gas must be released at regular intervals as it accumulates at the HPVs, and given that the gas comprises mostly methane and carbon dioxide, this could represent a major emissions source, but it was completely ignored in the Santos EIS.

As a result of observations, the United States Environment Protection Authority recently (2016) increased its estimates of emissions emanating from gas field production and gathering systems by 134 per cent. These estimates have not been increased in Australia.

The largest coal seam gas (as opposed to shale gas) producing area in the United States is the San Juan Basin, in Colorado and New Mexico. Satellite data shows that this area now sits under a methane emissions "hot-spot", a 6500km^2 cloud of methane pooling above the natural gas fields, where methane has escaped from infrastructure.[liv] These emissions are 1.8 times greater than reported emissions for the region.

Residents of the farms, towns and villages in and around the Pilliga Forest would prefer not to sit within a methane "hot-spot", with its health and global warming impacts.

The NGP will also release carbon dioxide directly to the atmosphere, as some is inevitably mixed with the methane in the coal seams. Again, however, "The assumed carbon dioxide content of gas was based on industry experience" and "The estimates were based on the extracted gas containing 10 mol% carbon dioxide", which is equivalent to the volume percentage[lv]. That is, the extracted gas is assumed to contain 10 per cent carbon dioxide by volume.

There is absolutely no reason to **assume** the carbon dioxide content of the Pilliga gas, as it has been measured during the exploration phase. Data from GeoGas Pty Ltd show CO_2 levels ranging from 17 per cent in the Upper Maules Creek seam to 78 per cent in the Hoskissons seam, with an average across the four seams being accessed approaching 50 percent. However, most of the CSG is proposed to be accessed from the Maules Creek seam, which averages 18 per cent CO_2, well in excess of the assumed 10 per cent.

This $C0_2$ would be released directly to the atmosphere after separating from the methane.

And finally there is no requirement to pay royalties until the gas is sold. Any leakage costs will not be borne by the proponent.

What does this mean?

Far from being "clean and green", methane is a particularly potent greenhouse gas which inevitably finds its way into the atmosphere when coal seams are disturbed.

Chapter 18: Fossil Fuels Must Stay in the Ground

The days of denying anthropogenic climate change are over, with 2014, 2015 and 2016 being the hottest years on record globally. Temperature records are being smashed monthly; with 10,883 out of 10,885 peer-reviewed climate articles agreeing with the International Panel on Climate Change report of 2013 that "It is *extremely likely* that human influence has been the dominant cause of the observed warming since the mid-20th century"[lvi]; and with all of the world's scientific societies (such as the National Academy of Sciences, American Geophysical Union, the Royal Society, etc) agreeing with them. How long is it going to take Santos to realise that fossil fuel production and world climate stability are incompatible?

The majority of greenhouse gases come from burning fossil fuels to produce energy[lvii]. While natural gas emits 50 to 60 percent less CO_2 when combusted in a new, efficient natural gas power plant and emits 15 to 20 percent less heat-trapping gases than petrol when burned in today's typical vehicle[lviii]; we know that when fugitive emissions are factored in, CSG is no more "greenhouse friendly" than coal[lix].

This is because methane is such a powerful greenhouse gas, 86 times more powerful than carbon dioxide when its atmospheric impacts are considered over a 20 year period, and 34 times more powerful over a 100 year period[lx]. [ref IPCC] Consequently, a loss of only a few per cent of methane from the system easily overcomes the advantage of methane over coal (e.g. 2% x say 35 times the potency = 70% + 50% from combustion = 120% compared to coal). It is therefore unlikely that CSG will ever be better placed to limit global warming. As shown in Chapter 16, emissions are likely to be much more than 2 per cent, so replacing coal with gas makes no sense in limiting global warming.

Many astute business leaders are acutely aware of the problems we face due to global warming. As former National Australia Bank CEO Cameron Clyne said "… climate change is real, human beings are causing it, and the threat is existential…" He adds "… we know from history what happens when a business or government sets its face against a change that is coming anyway."[lxi] AGL past-CEO Andrew Vesey recognised this and started rapidly transitioning his company to a renewable energy company[lxii], to take advantage of "the change that is coming anyway". Fire chiefs, wineries, banks, insurance companies, etc are factoring climate change into their forward planning. It would appear that Santos chooses to put its head in the sand.

The Paris Summit affirmed that to avert catastrophic global warming, we need to keep nearly all the world's known reserves of fossil fuels in the ground[lxiii].

As outlined by a number of Australia's leading CEOs on the Santos website (until it was removed): "Climate change is affecting our businesses and the communities in which we operate…. The longer we wait, the harder it will be and the more it will cost us… We are also vulnerable to climate impacts and we have a strategic interest in managing climate change"[lxiv].

What does this mean?

For Santos to continue to deny the role that fossil fuels (including CSG) play in climate change is morally reprehensible. Santos has the opportunity to follow the leadership provided by AGL.

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