Expert Review
Narrabri Gas Project
Prepared for the NSW Independent Planning Commission

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About the Author

I achieved a Bachelor of Science in Chemical Engineering at Lehigh University, USA.
I worked:

- 15 years with Exxon Mobil
- 15 years with BHP's oil and gas division as Sr Advisor Facilities and Operations
- with Jemena as Commercial Manager for the Queensland Coal Seam Gas Pipeline
- with the Australian Energy Market Operator (AEMO) as Gas Planning Principal
- as an energy systems researcher with the University of Melbourne.

I was briefed to provide this advice by the Environmental Defenders Office acting on behalf of the North West Alliance. I present this submission as an independent expert. Opinions expressed are my own. I have reviewed Part 31 Division 2 of the *Uniform Civil Procedure Rules 2005* (NSW) and the Expert Witness Code of Conduct which govern the use of expert evidence in NSW Courts, and I agree to be bound by their terms.
This submission is based on my research at the University of Melbourne and on my career professional experience in the oil and gas industry. This submission expands on my 23 July 2020 Zoom presentation to the Independent Planning Commission (IPC).

Key Submission Topics

The submission focuses on the following:

- the Narrabri Gas Project's release of carbon dioxide (a greenhouse gas) extracted from the coal seams
- the Narrabri Gas Project's release of methane (a greenhouse gas)
- false claims of gas shortages
- falling demand for gas in eastern Australia
- economic alternatives to burning fossil gas.

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Greenhouse gas emissions from the Narrabri Gas Project

1. The Narrabri Gas Project will cause a significant volume of greenhouse gas to be released into our atmosphere. There are a number of ways that this will happen; however, this submission discusses only two ways in which the proposed project will emit greenhouse gases:
   - release of carbon dioxide extracted from the raw gas
   - release of methane.

Carbon dioxide extracted from raw Narrabri gas - and released

2. The gas in the coals of the Narrabri region primarily consists of flammable methane. However, the coals also contain high concentrations of naturally-occurring carbon dioxide (from volcanic sources). (1) Both carbon dioxide and methane are greenhouse gases.

3. The presence of carbon dioxide in the coal seams is not a favourable thing for the proposed project. Since carbon dioxide cannot be burnt, it cannot be used for heat. The amount of carbon dioxide in these particular coals exceeds what can be put into any gas distribution pipeline. Therefore, a large sum of money must be spent on a large carbon dioxide removal plant. As an example, Exxon and BHP recently spent over two billion dollars for such equipment in Gippsland. (2) The Narrabri Gas Project will also face high ongoing costs to run the carbon dioxide removal equipment.

4. And then, what will be done with the carbon dioxide once it has been separated from the gas? The gas industry is allowed to vent this greenhouse gas straight up into the air. Further, a significant amount of methane will also be released with the waste carbon dioxide – because in the separation process methane cannot be perfectly separated from the carbon dioxide.

5. The high concentration of carbon dioxide in the Narrabri coals means that the gas produced at Narrabri will be even more climate damaging and more expensive than might otherwise be expected. The project Environmental Impact Statement (EIS) describes ~0.5 million tonnes of emissions from this source alone.

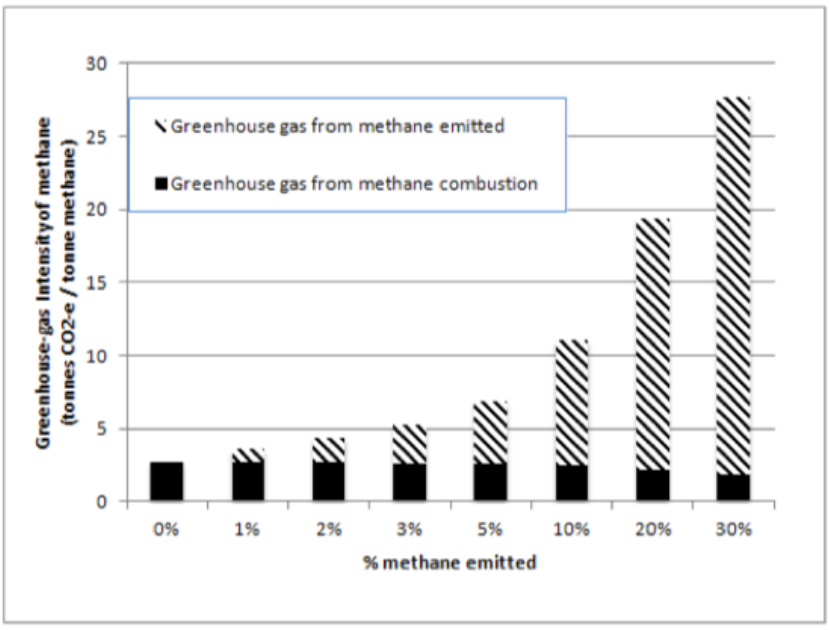
6. To the extent that the concentration of carbon dioxide in the Narrabri coals is even larger than the project proponent expects – as may be revealed with future well appraisal drilling – then the amount of greenhouse gas from this source will exceed the figures provided in the Narrabri Gas Project EIS.

Release of methane from the Narrabri Gas Project

7. Methane is a powerful greenhouse gas. When contemplating climate impacts that will occur over the critical next twenty years, methane is 86 times more powerful than carbon dioxide (on a per tonne basis). (3)

The importance of focusing on methane emissions

8. The following chart illustrates why we must focus on methane emissions. Fossil gas negatively impacts our climate through the burning of methane and the conversion of methane to carbon dioxide, a greenhouse gas. But because methane itself is a powerful greenhouse gas far more damaging than carbon dioxide, if only a few percent of the original methane is released before it even gets burnt, this is very bad for our climate.



Greenhouse gas impact of releasing methane vs burning methane (3)

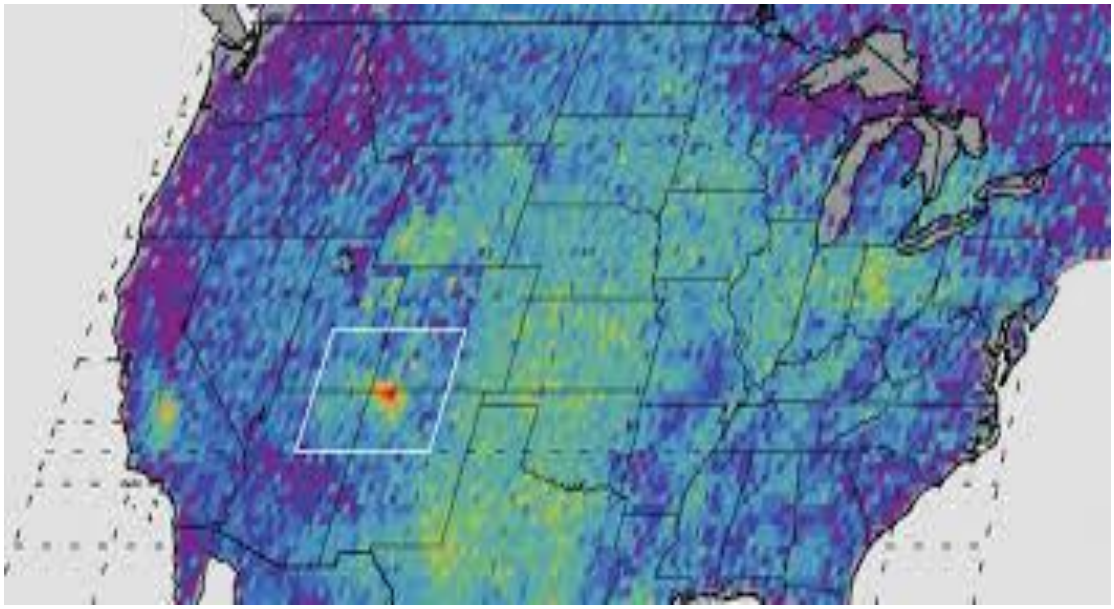
9. The chart shows how if only 1% of the methane is released, the impact is large even when compared to burning the other 99%. Releasing 3% of the methane will have the same climate impact as burning the other *97%*, doubling the emissions impact.

10. The impacts are even more severe if even more than 3% of the methane is released, as happens in many gas fields around the world. (3) The gas industry describes fossil gas as being a cleaner energy source than coal when comparing these fuels for electricity generation. However, given the strong impact of methane emissions, it is unlikely that fossil gas is in fact "cleaner than coal".

11. Importantly, the climate impact of fossil gas should be compared not only with a dirty energy source such as coal, but also versus renewable energy options (including renewable-heat harvesting heat pumps as described later in this submission).

Gas industry methane emissions are so large they can be seen from space with satellites

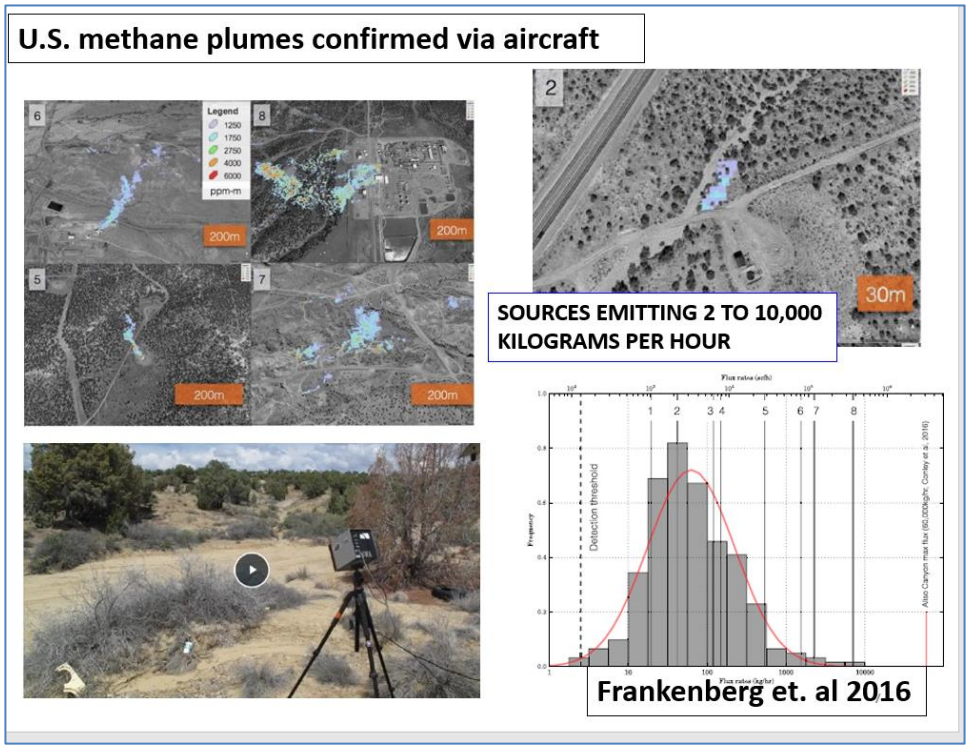
12. The following satellite image shows a large release of methane coming from the "Four Corners" region (New Mexico, Colorado) of the United States. (4) This region happens to be one of the largest coal seam gas producing regions in the world. Emanating from there, methane can be seen from space with a satellite.



Methane hot spot seen from space (4)

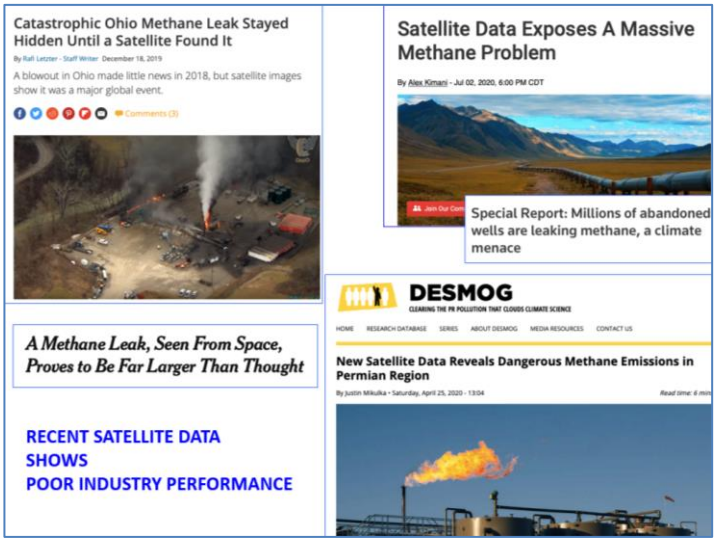
13. Upon observing this Four Corners hot spot, researchers flew an aircraft overhead, instrumented with infrared detectors, and found over 250 emission sources releasing anywhere from two kilograms per hour up to 10,000 kilograms per hour of methane. The largest sources were given the name: "super-emitters".

14. Going down to the ground, the researchers found the causes of some of these emissions: equipment failures such as corroded pipelines, but also large emissions that were business-as-usual methane venting and depressuring operations in the gas field. (4)



Images from Frankenberg et al. (4)

15. As shown in the recent news items below, data from satellites is showing, globally, what a poor job the industry does with methane emissions. The concern is that a project like the Narrabri Gas Project with hundreds of wells and other gas-production infrastructure may perform similarly poorly to overseas experience.



Methane satellite data in the news highlights poor industry performance

Gas industry claims don't match measured performance

16. Some commentators say that greenhouse gas emissions in the US are down thanks to gas replacing coal. However, those figures are all based on simple (and low) fixed mathematical methane emission rates put forward decades ago by the industry, before gas production from coal seams or shales had reached significant scale.

17. These simple, low, and incorrect factors are then used by governments, including in the United States and in Australia for reporting emissions. (3,5)

18. Gas companies aren't required to actually measure emissions arising from their operations. Nor are they required to report actual emissions.

19. However, with new satellite data showing significant release of methane, there is mounting pressure on the gas industry globally to reduce methane emissions.

20. The following table illustrates the difference between what the gas companies do (based on the investigations of researchers) versus what the gas companies claim they will do (reported, estimated, factor-based emissions).

MEASURED	
US Pennsylvania shale	**3 to 17%**
US Wyoming coal seam gas	**30%**
Denver gas fields	**2 to 8%**

ESTIMATED / FACTOR BASED	
US EPA	**1.4%**
Aus Gov	**0.5%**
QLD CSG Industry	**0.1%**
Narrabri	**0.02%**

Measured methane emissions (upper box black font) vs reported emissions (lower box red font). (3)

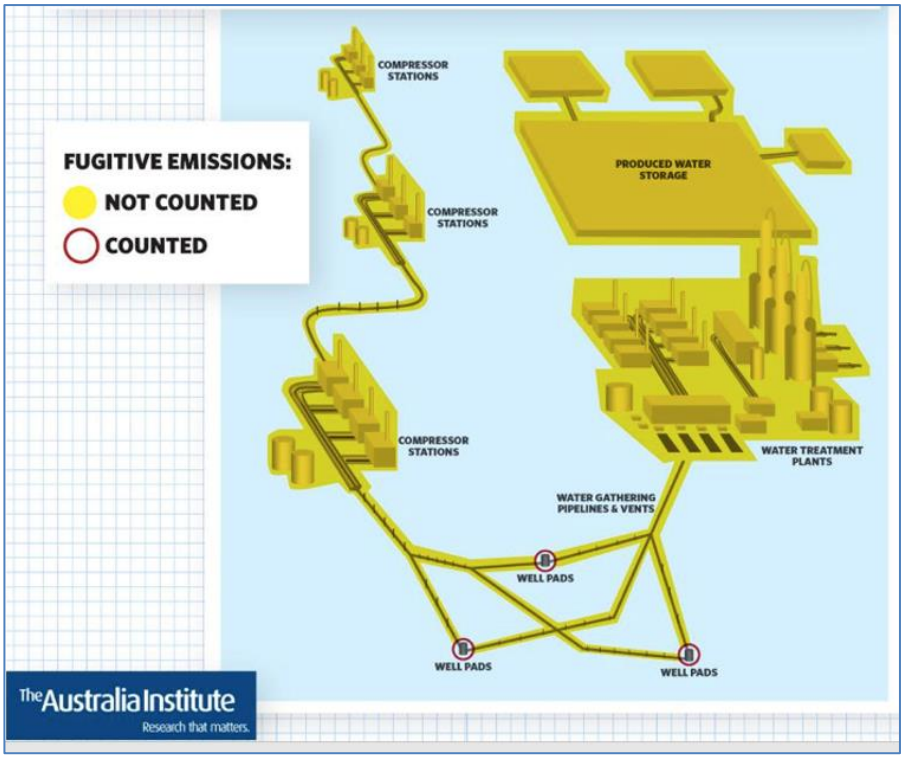
21. From a Pennsylvania shale gas fieldin the United States, researchers found 3 to 17% of the methane that came up out of the ground was being released into our atmosphere. In a US Wyoming coal seam gas field, 30% of the methane that came out of the ground ended up in our atmosphere. In the Denver area, emissions of 2 to 8% were recorded from a variety of fossil gas sources.

22. The US EPA claims that emissions from the industry are only 1.4% of the methane that is extracted from the ground. However, in recent years when the US EPA has looked at this issue, they have increased this figure. (3) With the new satellite data coming in, and perhaps if a new administration is in place in Washington in 2021, this figure will likely need to be adjusted upwards yet again.

23. The Australian government claims that the oil and gas industry emits into our atmosphere only 0.5% of the methane that is extracted from the ground. Again, this estimate is based on outdated factors from the US. Unfortunately, what the CSIRO stated in 2012 remains still true in 2020:

> "... it is clear that a comprehensive data set relating to the true scale of fugitive emissions from the CSG Industry does not yet exist." CSIRO (3)

24. My previous co-authored desktop research found that “no systematic measurements have been made of emissions” from the extensive network of gas gathering lines, compressors, and pumps which connect producing gas wells to the transmission pipeline tie-in points and that “in both individual company reports and in the national emissions inventory”, emissions from these sources are **“set to zero”,** as illustrated below. (3)



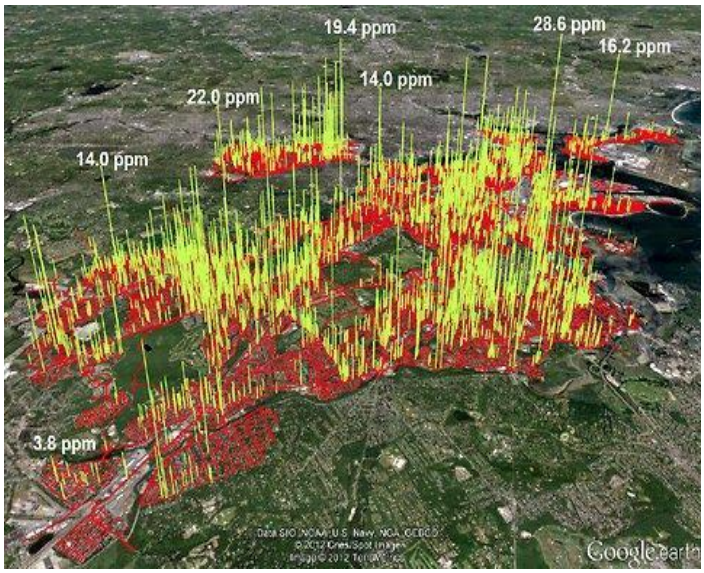
25. The Queensland coal seam gas industry claimed that they would keep methane emissions at 0.1% of production. But there is no evidence that an emission level near this figure has been achieved.

26. In the Narrabri Gas Project EIS, the claim is made that emissions of methane will be held to 0.02% of what comes out of the ground. This estimate is not credible.
The Narrabri Gas Project EIS does not provide credible information about methane emissions.

27. The Narrabri Gas Project proponent SANTOS produces coal seam gas in Queensland. Therefore, SANTOS could transparently present actual measured Queensland gas field performance as the basis for the methane emission figures presented in the EIS, rather than presenting not-credible estimates.

28. Downstream of the gas fields, methane is also released from pipelines and gas distribution systems too, as shown in the image below for the city of Boston. Thousands of methane releases were found using infrared technology. The gas industry, including the Narrabri Gas Project proponent, claim that their product is a clean source of energy. However, methane-emissions investigations using infrared

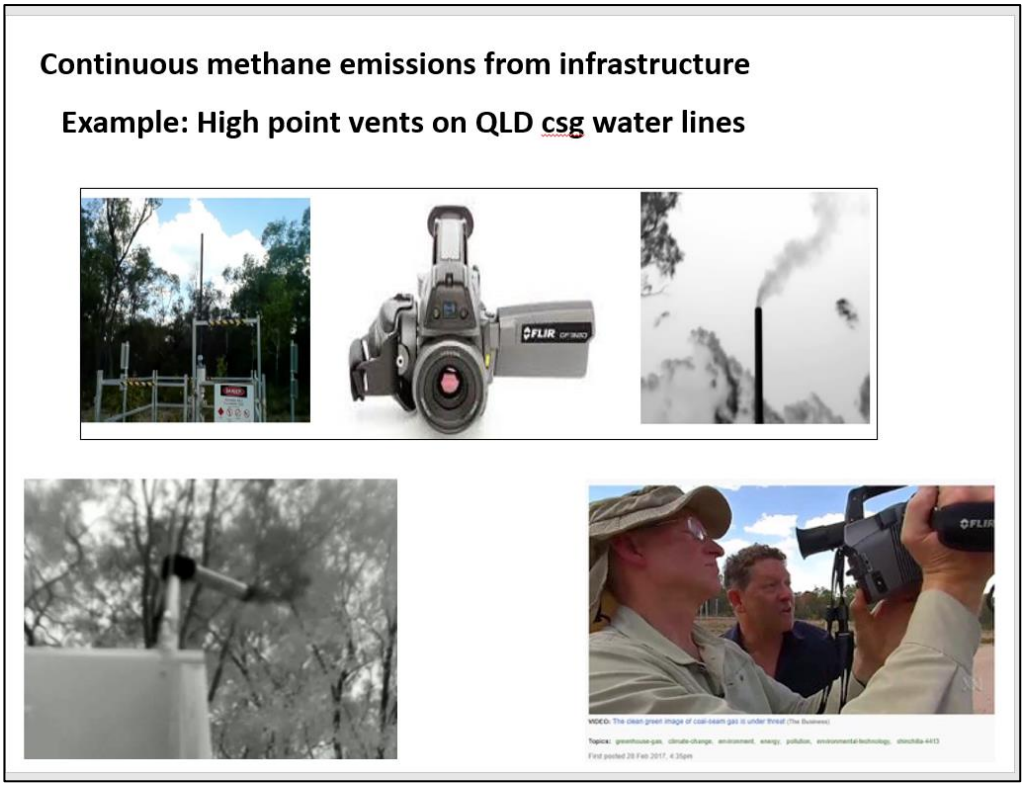
technology all along the system from gas-production to pipelining to end-use, show this claim is false.



Methane emissions from the gas distribution system in the City of Boston

Infrared camera investigations in the Queensland coal seam gas fields

29. In February 2017 I travelled to the Queensland coal seam gas fields with a special methane-detecting infrared camera and found methane being emitted continuously from high-point vent stacks. (6,7) Methane is invisible to the naked eye, but with this camera and in the images below, methane appears as a black plume.



30. When Queensland government regulators visited 58 coal seam gas wells in 2010, they found gas being released at 26 of them. (3)

31. People ask "doesn't this wasted gas have a value? Why are the gas companies so wasteful"? Sometimes, methane is released because of a one-off event, but often the methane is released by design, continuously, as seen above. With methane emissions from the gas industry being a designed-in feature of the operation (see the image above), terms like "leakage" and "fugitive emissions" can mislead. Designed-in on-purpose emissions aren't "leaks" nor "fugitives" that somehow managed to escape. Rather, on-purpose emissions are normal business-as-usual operations in the gas field.

32. But again one can ask: "Why is the gas industry so wasteful with this resource?". The answer is, that with no carbon price and with regulators requiring no measurements and setting no firm requirements, what we see is the industry's self-declared "best practice". The industry has no financial or regulatory reason to do a better job of containing methane gas.

33. The industry could do better. However, “doing better” comes at a cost. Already we know that Narrabri gas will be expensive to produce. The project proponent would wish to avoid additional regulatory burden and the costs that compliance might involve.

34. In the NSW Government’s recommended approval conditions for this project, words are used - regarding steps that the project proponent should take to in order to control methane emissions – such as:

“reasonable and feasible measures”.

35. This non-specific wording leaves the industry free to interpret these words as the industry sees fit. These conditions are unlikely to result in the project proponent doing anything beyond what they were planning to do anyway.

False claims of gas shortages - exposed by our analysis

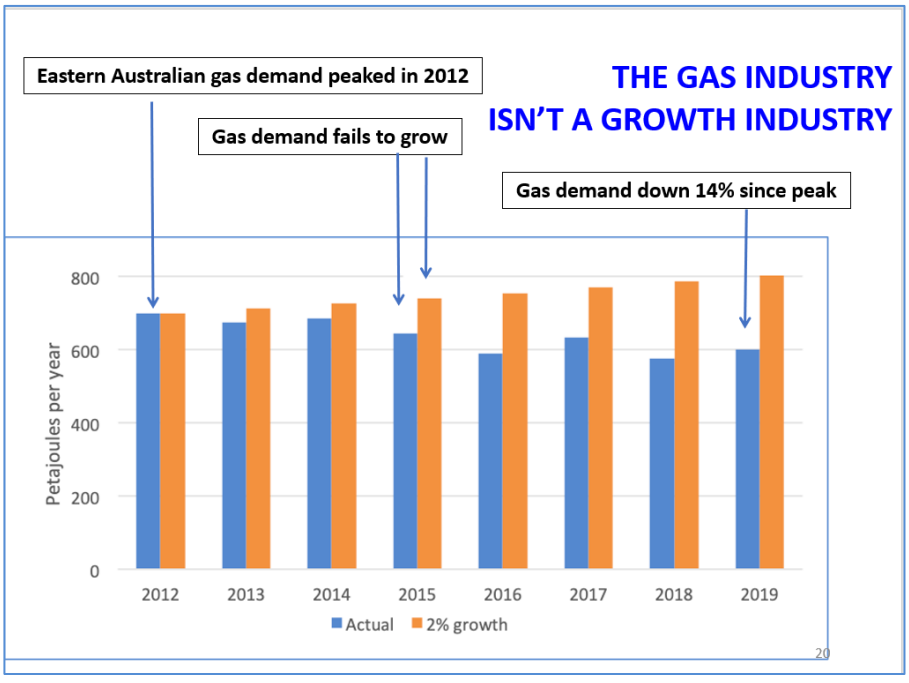
36. My previous co-authored research on gas supply and demand analysis exposed false claims about any urgent need for Narrabri gas. The gas industry, the Australian Energy Market Operator (AEMO), and others claimed that gas fields such as Narrabri needed to be urgently developed, otherwise New South Wales would experience acute shortages of gas supply. These shortages were to have occurred in 2018 and following years. Our research, published in these reports in 2015 and 2017

    - "A dash from gas: Could demand in New South Wales fall to half" (8)
    - "A short-lived gas shortfall: A review of AEMO's warning of gas-supply shortfalls" (9)

    showed that there was no threat of imminent gas shortages. On both occasions, in subsequent publications, AEMO retracted their claims of imminent gas-supply shortfalls.

Gas demand in eastern Australia down 14% from 2012 peak

37. The following chart illustrates that gas demand in eastern Australia peaked in 2012 and has declined 14% since. Less gas is being burned in all sectors of the eastern Australian economy. (10,11) Gas demand is not keeping pace with Australian population or GDP growth.



Declining gas consumption, compared with a 2% GDP growth trendline.

38. One reason that less gas is being burned in all sectors of the eastern Australian economy is the availability of economic alternatives to burning gas, as described next.

Economic alternatives to fossil gas

39. Because of the coal seam gas industry and the export of gas from the east coast of Australia, there has been a dramatic increase in the price of gas. Fortunately, today there are less costly and cleaner alternatives to fossil gas for homes and other buildings, in industry, and in electricity generation. (12)

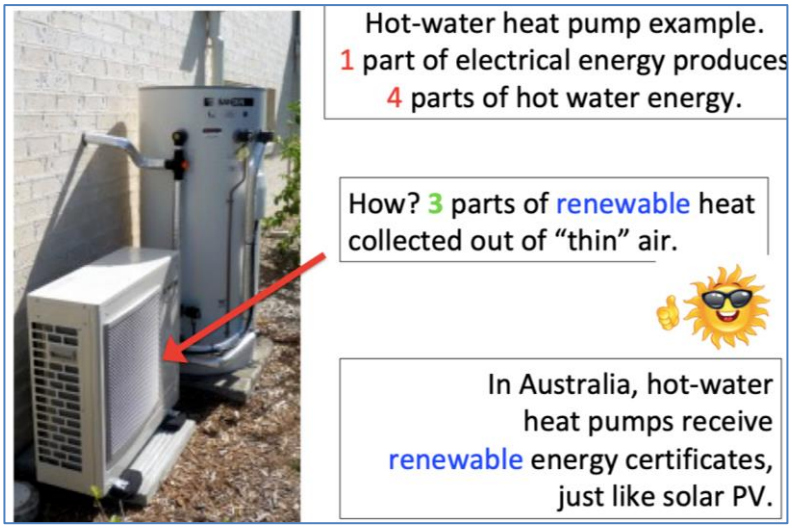
Getting off gas at home and in other buildings

40. As I write from Melbourne in COVID lockdown, some folks in Melbourne are freezing, while running up big gas bills. But some Victorians like myself, aren't freezing, nor are we running up big gas bills. How can this be?

41. Because the basics in our homes - draught proofing, insulation, window coverings - have been attended to. This is called energy efficiency.

42. Furthermore, some Victorians aren't using any gas in their homes at all. So how do we stay warm? We know a secret. We've found the heat button on our reverse cycle air conditioners (aka heat pumps) and we've worked out, that as we reported at the University of Melbourne (10), and as have others since (13) that heat pumps can be a far cheaper way to heat than burning expensive fossil gas.

43. With the alternatives available for space heating, water heating and cooking, there is no longer any economic reason for any new home or suburb to be connected to the gas grid. Entire suburbs are being planned and built without any connection to a gas grid, because this is an economic thing to do.



Heat pumps harvest free renewable heat from the air outside your house

44. In my home, we heat with reverse-cycle air cons for one-third the cost of ducted gas. (14) At Melbourne Uni we calculated that Victorians, and others across Australia, could save hundreds of millions of dollars each winter simply by pushing the heat button on their air con. (10, 15)

45. And since the publication of that research, more and more Australians are becoming aware of this money-saving opportunity. There are now have more than 17,000 current members at the Facebook group "My Efficient Electric Home". People are switching off gas and having their gas meters removed from their properties.

Home disconnected from gas grid and gas meter removed from property

46. Even the gas and electricity supplier AGL are now telling their customers they'd be better off having no gas in their homes.

AGL website: https://discover.agl.com.au/your-home/setting-new-home-benefits-electricity-gas/

Getting off gas in industry

47. Industry also can save money by burning less gas. Industry needs to recognise, regardless of whether the Narrabri Gas Project is built, that gas at the cheap prices of past decades isn't coming back. (2) Industry needs to deploy energy efficiency measures and fuel-switching measures, such as investing in electrically-powered industrial-scale heat pumps. (16,17)

Getting off gas for electricity generation

48. My co-authored 2017 report (9) marked the point where solar and wind went beyond gas as an economic choice for electricity. Since then, wind and solar have become cheaper still. For example, in their Draft 2020 Integrated System Plan (ISP), AEMO sees no role for gas in electricity generation unless gas prices "materially reduce". For electricity, the future is wind, solar, and energy storage.

Governments should assist businesses and individuals to get off gas

49. My previous reports have described and recommended how governments should be helping people and businesses to get off gas. In eastern Australia versus more economic alternatives, gas is now too expensive to burn.

50. A recent study done by Northmore Gordon for Victoria alone

"Victorian Gas Market – demand side measures to avoid forecast supply shortfall" (18)

showed how demand-side measures can reduce gas demand by around 100 petajoules per year (a volume larger than what would be produced by the Narrabri Gas Project), thereby obviating the need for supplying expensive gas to Victoria via gas import terminals or expanding pipelines to transport coal seam gas from Queensland.

51. A study similar to the above should be done also for New South Wales in order to update my co-authored work done in 2015. (8) There are valid and available alternatives to the expansion of the gas industry in Australia and to the Narrabri Gas Project in particular.

Conclusion: Rejection of Narrabri Gas Project

52. The Commission should reject the proposed Narrabri Gas Project.

53. We are in the midst of a Climate Emergency. The proposed Narrabri Gas Project will cause a significant amount of greenhouse gas to be emitted into our atmosphere, driving accelerated breakdown of our climate.

54. Fortunately, we have economic alternatives to producing and burning expensive and damaging fossil gas that the Narrabri project would produce. Governments should be assisting individuals and businesses to implement economic alternatives to burning gas.

55. Elsewhere, such as where I live in Victoria, law-makers listened to the concerns of Victorians and legislated that coal seam gas will not be produced in Victoria.

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