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Dr Alan Finkel
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Dear Dr Finkel,

I was enjoying your ABC Big Ideas podcast (Tuesday 19 September 2017) in which you encouraged scientists to read more science-fiction until you shocked me with your use of false claims to denigrate citizens who are concerned about the impacts of unconventional gas mining.

You said:

‘In terms of other examples of wiki net area where science is perhaps not being taken on board and recognised, concerns about unconventional gas extraction, whether its concerns of seismic activity or the unexpected release of methane that’s called fugitive emissions or contamination of aquifers, are rampant through many communities but there’s actually no data to support those concerns. There is no easy way to address those concerns because they’ve got the status of urban lore, but that’s a clear case where the evidence and beliefs are out of sync.’

You are wrong that there is no data to support concerns about seismic activity, fugitive emissions, and aquifer contamination associated with unconventional gas fields. You are incorrect that there is ‘no easy way to address those concerns’. And you are mistaken to suggest that concerned citizens are unscientific, prone to ‘wiki net’ thinking, and under the influence of ‘urban lore’.

A recasting of your statement to reflect appropriate risk management and a truly evidence-based approach could have read:

‘In terms of other examples of wiki net area where science is not being taken on board, the unconventional gas industry maintains that its operations are safe, even though they have no data to support such claims. Community concerns about the impacts of the industry are based on limited, but nonetheless solid, scientific evidence. These concerns could readily be addressed if regulatory authorities and the industry carried out evidence-based procedures for evaluating the safety of products and processes that expose communities or the environment to risk. There’s no easy way to address the industry’s avoidance of science-based risk management because they are focussed on making profit.’

Risk management is usually understood to be a process of thinking systematically about all possible risks before they occur, and setting up procedures to prevent problems or mitigate

impacts. Cost/benefit analysis is the reasoned consideration of all the potential costs and benefits of a proposed development. 'Duty holders' are legally obliged to exercise due diligence and to consider all risks, not just those for which regulations exist, but even hazards that are unknown at the time. A lack of knowledge of an impact does not indicate that there is no risk worth considering.

I think that managing the risks of operating unconventional gas fields in populated areas should be about protecting people and the environment from harm. Cost/benefit analyses need to consider costs as well as benefits. I believe that politicians and company executives have a duty of care to protect citizens and be receptive to, and actively seek out, information about possible risks.

In contrast, your statement reflects a very different form of risk management that is promulgated by the unconventional gas industry. In this approach there is no systematic thinking about possible risks because unconventional gas fields are assumed to be safe despite the lack of any evidence that they are. Benefits for gas field industrialisation are claimed, with no analysis of costs. The risk being managed is not that gas mining might harm people and the environment. Rather, the aim is to protect company profits and government revenue. The danger the industry fears is that they might lose their social license to operate. They extend their duty of care only to themselves and their shareholders. And they misapply the 'burden of proof'.

Your statement implies that, like a defendant in a criminal trial, the unconventional gas industry is entitled to the 'assumption of innocence'. Your comments suggest that gas fields can be assumed to be safe unless the community, acting like a prosecutor in a criminal trial, produces data to prove an adverse effect 'beyond a reasonable doubt'. That's not a proper application of the burden of proof in regulatory contexts where a company or a person seeks to profit from doing something that exposes the public to potential risk. For instance, when a pharmaceutical company wants to sell a new medication, it's not assumed that the product is safe. Rather, in accord with evidence-based science, they have to demonstrate the safety and efficacy of their product by comparing health data taken before and after people use the new drug.

There can be no doubt that industrialising previously rural landscapes with vast unconventional gas fields has significant impacts on human, water, air, and soil systems. For this industry, an evidence-based demonstration of safety would once have been a straight-forward process. Companies and regulatory authorities had only to collect baseline health and environmental data before drilling began, and compare this to data obtained after the gas fields were operating. And even if they failed to collect baseline measures, they could have obtained data from subsequent years to use for comparison and to correlate with the growth of the gas field. But they never did this. Consequently, they have no evidence that their operations are safe.

I will briefly address your claim that there is no data to support concerns about adverse impacts of the unconventional gas industry.

I'll leave it to you to research the association between the unconventional gas mining and seismic activity - the issue is mostly of interest to citizens in the USA and New Zealand - but the following references will get you started:

- Kuchment, A. (2016). Drilling for Earthquakes. *Scientific American*, July, pages 42 - 49.
- Weingarten, M., et. al. (2015). High-Rate injection is associated with the increase in US mid-continent seismicity. *Science*, V 348, June, pages 1336-1340.

The research on aquifer contamination is well-known and readily accessible, so it was very surprising that you are unaware of some widely-publicised incidents that have occurred in Australia.

Do you not know about the NSW Environmental Protection Agency's (EPA) finding that a faulty Santos holding pond in the Pilliga area contaminated an aquifer? In this incident, coal seam gas (CSG) waste water leaked through a torn plastic pond liner to contaminate an aquifer kilometres away with high levels of lead, aluminium, arsenic, barium, boron and nickel, and uranium levels 20 times higher than safe drinking limits.

Are you also unaware of the January 2015 report that monoethanolamine borate, a fracking chemical, was found in water samples near Australian Gas Light's (AGL) pilot CSG gas field at Gloucester? AGL decided to abandon CSG mining after this finding became public and the NSW EPA stopped their trial of using filtered CSG wastewater on agricultural land due to the build up of heavy metals in the soil.

Vast amounts of CSG waste water are stored in ponds and thousands of wells are drilled near and through underground water systems while there is scant monitoring of water quality going on. The above incidents indicate that aquifer contamination is a significant risk to our country and its citizens.

In this age of accelerating climate destabilisation, the potentially catastrophic effects of fugitive emissions from unconventional gas fields are of even greater concern. The scientific evidence warrants the most serious attention, and should not be dismissed out of hand, especially by Australia's Chief Scientist.

I'll give you some background.

Unlike conventional gas, in unconventional gas mining, injected and naturally-present water from gas bearing strata is brought to the surface. As intended, this frees up previously bound gases so they can be pumped up the well. This has consequences. Fracturing and removing the water from gas-bearing seams creates an unknowable network of new and previously existing cracks and faults that can act as conduits for the liberated gas to vent into the atmosphere. As gas comes up fissures and cracks, water goes down. The most obvious effect of this geologic turmoil is lowered water tables and depleted farm bores; the gas mining company Santos predicted that by 2028 the level of groundwater in the Bowen Basin gas fields would drop by up to 65 metres.

Gas companies and regulatory authorities do not systematically measure methane and other fugitive emissions above gas fields: they only estimate emissions with formulae that calculate likely leakage from valves and seals and such. To my knowledge, there has been no collection of baseline data that samples the atmosphere above gas fields.

The following peer-reviewed papers by Australian scientists are essential reading on fugitive emissions from unconventional gas fields:

- Maher, D., Santos, I., & Tait, D. 2014. Mapping methane and carbon dioxide concentrations and d13C values in the atmosphere of two Australian coal seam gas fields. *Water, Air, & Soil Pollution*, 225, 2216. (See attached abstract and references.)
- Tait, D., Santos, I., Maher, D., Cyronak, T., and Davis, R. 2013. Enrichment of Radon and Carbon Dioxide in the Open Atmosphere of an Australian Coal Seam Gas Field, *Environmental Science and Technology*, 47, 3099–3104. (See attached paper.)

In 2012 Dr Isaac Santos and Dr Damien Maher recorded atmospheric methane concentrations as they drove the 500 kilometres from Lismore’s Southern Cross University to the Tara gas fields in Queensland’s Darling Downs. Their instruments showed concentrations close to the current global average of 1.8 parts per million until they approached Tara, where methane and radon readings increased threefold. They reported that Australia set a new world record with methane levels of 6.89 parts per million, exceeding the previous highest reading from a Siberian gas field. The methane to CO₂ isotope ratio indicated that these emissions were coal seam gases; as were the bubbles that have turned sections of the Condamine River into a spa.

These scientists discovered that a blanket of methane of unknown thickness extends for kilometres around Tara. Why is there a landscape-scale venting of coal seam gases into Tara’s air? According to the researchers, ‘In natural conditions, methane is contained within the coal seam by water pressure... (in CSG mining) we get lowering of the water table, horizontal drilling, fracturing, infrastructure leakage, but our evidence suggests that we also have leaks through the soil as well, and these leaks through the soil are not counted in any fugitive estimates’.

Methane is colourless and odourless; you can see it venting in the Condamine River because it bubbles through water. In 2016 NSW Greens MP Jeremy Buckingham clicked a stove lighter over the side of a boat and set the Condamine River on fire. The Condamine River has been bubbling methane since 2012, and according to CSIRO’s Professor Damian Barrett the rate of gas flow had increased over the 12 months prior to Mr Buckingham’s boat trip.

The following peer reviewed paper from US researchers is also essential reading on fugitive emissions:

- Turner, A., Jacob, D., Benmergui, J., Wofsy, S., Maasackers, J., Butz, A., Hasekamp, O., & Biraud, S. 2016. A large increase in U.S. methane emissions over the past decade inferred from satellite data and surface observations. *Geophys. Res. Lett.*, 43, 2218–2224.

In 2016 these US scientists reported that the ‘global burden of atmospheric methane has been increasing over the past decade’. When they examined measurements of methane in the air above the United States, they discovered that from 2002 to 2014 - the period corresponding to America’s shale oil and gas boom - methane emissions had increased by more than 30%. The scientists concluded that this increase in methane emissions accounted for ‘30 to 60 percent of the global growth of atmospheric methane in the past decade’.

The paucity of scientific findings regarding the impacts of unconventional gas mining does not indicate that there is no significant risk worth considering. Rather, the lack of data reflects

a systematic failure of regulatory authorities and gas mining companies to properly manage risks and undertake evidence-based research.

I urge you to contact Dr Isaac Santos and his colleagues at Southern Cross University to discuss how their research program has been effected by political and industry pressure. The attacks on independent scientists who work in this area have been demeaning and personal. When in 2012 Dr Isaac Santos and Dr Damien Maher made public their findings of landscape-scale methane emissions in Queensland gas fields, then Federal MP Martin Ferguson, who later took up an executive position with the Australian Petroleum Production and Exploration Association, accused them of ‘a cynical attempt to grab headlines’ and ‘trying to score political points without proper consideration of the best interests of the broader community’.

The following article from *The Conversation* (see attached document) penned by Prof. Isaac Santos, Dr Maher, and Mr Tait highlight the disturbing state of scientific research on an issue that has potentially profound global implications.

- Santos, I., Maher, D, & Tait, D. 2014. Science and coal seam gas – a case of the tortoise and the hare? *The Conversation*. 8 December.
<https://theconversation.com/science-and-coal-seam-gas-a-case-of-the-tortoise-and-the-hare-35100> 1/3

I want to do what I can to counter the damaging effects of both your claim as Australia’s Chief Scientist that there is no data to support concerns about the adverse impacts of unconventional gas mining, and your portrayal of decent, concerned citizens as irrational and unscientific.

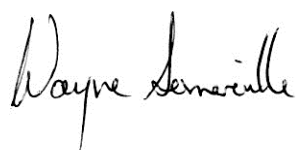
To this end, and to facilitate a much-needed public discussion of these matters, I will be sending this email/letter to: Australia’s state-based Chief Scientists; politicians; Paul Barclay, the host of ABC’s Big Ideas program; organisations; and groups of concerned citizens, amongst others. If you reply to my comments within a month from the date on this letter/e-mail, I will attach your response.

I respectfully ask that you educate yourself about these issues. Please do what you can to protect and promote evidence-based research and the efforts of scientists who are acting in the best interests of our nation and its people.

Please do not hesitate to contact me if you wish to discuss this letter.

Thanking you for your time and consideration.

Yours faithfully,



Dr Wayne Somerville
Clinical Psychologist

Addendum

10 February 2018

I sent Dr Finkel e-mail and hard copy versions of my letter and the accompanying references. His office acknowledged receipt of the e-mail and wrote that their policy was to respond to all e-mails within a month. At the time of writing, neither Dr Finkel nor his office has replied. If he does, I will forward his comments to you separately.

Since I wrote to Dr Finkel, I have learned of new studies that further heighten concerns about the unconventional gas industry's fugitive methane emissions.

In the USA, Purdue University Researchers used an aircraft-based mass balance technique to measure methane concentrations above three natural gas-fired power plants and three oil refineries. They found that average methane emission rates for the gas-fired power plants were 21-120 times larger than facility-based estimates that are reported to the EPA. For oil refineries, methane emissions were 11-90 times larger than estimates.

- Reference: Lavoie, T., Shepson, P., Gore, C., Stirm, B., Kaeser, R., Wulle, B., Lyon, D. and Rudek, J. 2017. Assessing the Methane Emissions from Natural Gas-Fired Power Plants and Oil Refineries. *Environ. Sci. Technol.*, 51, 3373–3381.

In the other study, a team led by scientists at NASA's Jet Propulsion Laboratory provided an explanation for the ~8 p.p.b. (parts per billion) per year increase in atmospheric methane since 2006. Their analysis of satellite measurements of atmospheric methane from the 2001-2007 and the 2008-2014 time periods showed that the majority of the worldwide increase in methane was due to emissions from the oil and gas industries.

- Reference: Worden, J., Bloom, A., Pandey, S., Jiang, Z., Worden, H., Walker, T., Houweling, S., Röckmann, T. 2017. Reduced biomass burning emissions reconcile conflicting estimates of the post-2006 atmospheric methane budget. *Nature Communications*, 8: 2227.

And since I wrote to Dr Finkel, new research has added further evidence of the deleterious impacts of unconventional gas mining on the environment and human health and well-being. But that's for another time.
