CLIMATE CHANGE IMPACTS OF PROPOSED SHALE GAS DEVELOPMENT IN THE NORTHERN TERRITORY

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The author of 20 books and more than 1000 other publications, Professor Lowe's contributions to environmental science have won him a Centenary Medal, the Eureka Prize for promotion of science, the Prime Minister's Environment Award for Outstanding Individual Achievement, the Queensland Premier's Millennium Award for Excellence in Science, the University of NSW Alumni Award for achievement in science and the Konrad Lorenz Gold Medal, awarded biennially by the International Academy of Sciences, Health and Ecology for contributions to sustainable futures. He was made an Officer of the Order of Australia in 2001 for services to science and technology and for contributing to public understanding of environmental issues.

INTRODUCTION

As the Australian Academy of Science said five years ago, to have a 50 per cent chance of keeping the increase in average global temperature below two degrees, the less ambitious Paris target, global emissions need to peak by 2020 and then go steeply down. That means it is criminally irresponsible to be proposing new fossil fuel projects, whether they are coal, oil or gas. This report refers to the potential impacts of the proposed shale gas development in the Northern Territory, a particularly dangerous contribution to accelerating climate change, but similar conclusions apply to other fossil fuel developments. Shale gas is especially inappropriate because its extraction inevitably involves fugitive emissions of methane, which has a much greater capacity to increase global warming than carbon dioxide in the short term.

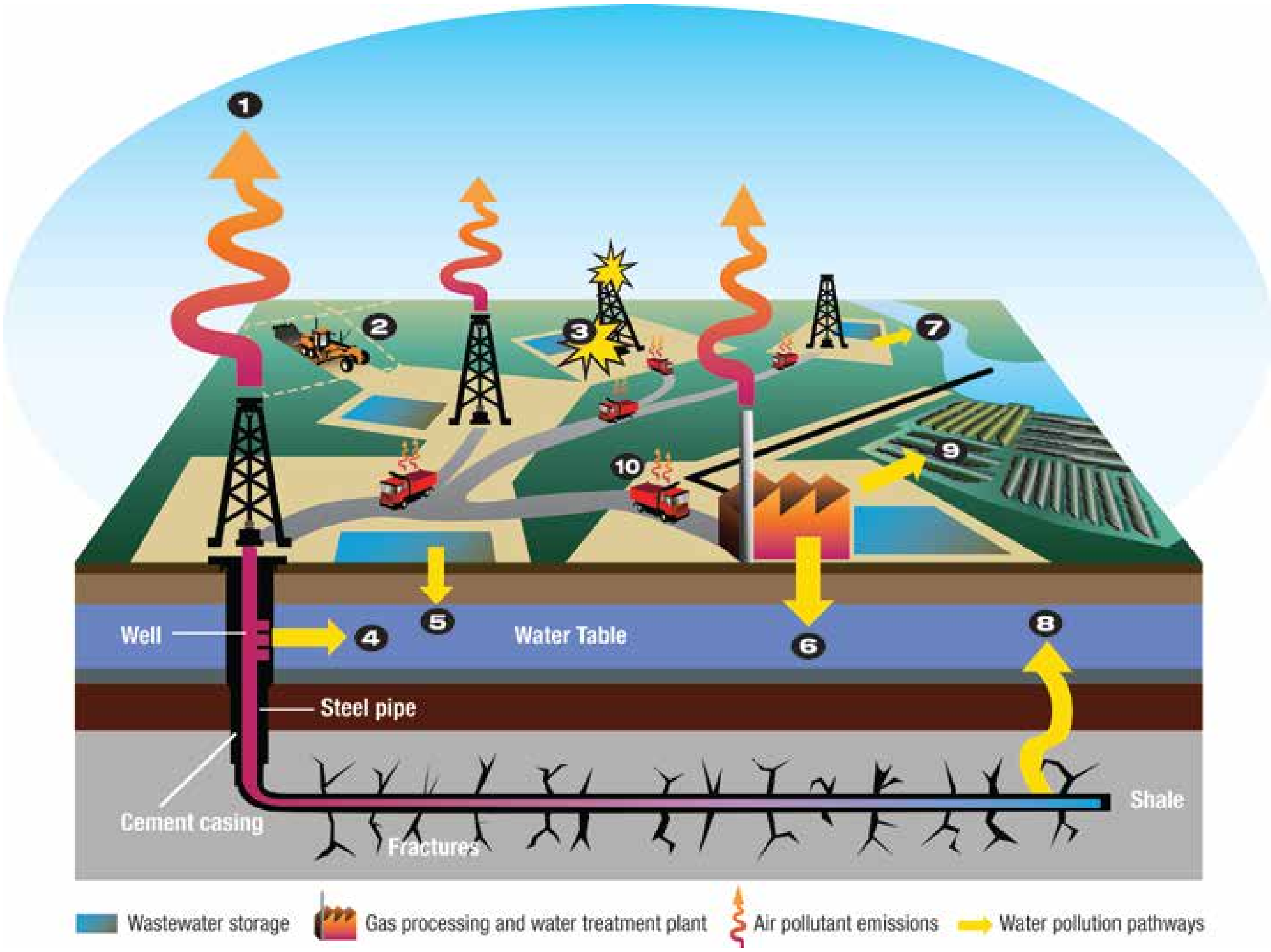


FIGURE 1: Potential emissions and pollution pathways in unconventional gas operations
(Adapted from UNEP, 2012)

THE POTENTIAL SCALE OF DEVELOPMENT

The Memorandum of Understanding between the Australian government and the government of the Northern Territory states that exploration wells indicate a P50 gas-in-place resource of "at least 500 trillion cubic feet", in the old Imperial measures, in just one of the prospective layers in the Beetaloo Sub-basin. It has also been claimed that the sub-basin is "geologically analogous to the giant Marcellus Shale in the USA which delivers over 11 trillion cubic feet of gas to market per year". That rate is about ten times total Australian gas consumption, but the scale of the claimed resource is so large that it would allow gas to flow at that rate for about fifty years if its development were to be approved. The sub-basin is only a part of the larger McArthur Basin, in which other resources have been identified. It is clear that approving development of these resources would have a catastrophic impact on Australia's efforts to slow climate change, totally incompatible with our obligations under the Paris agreement.

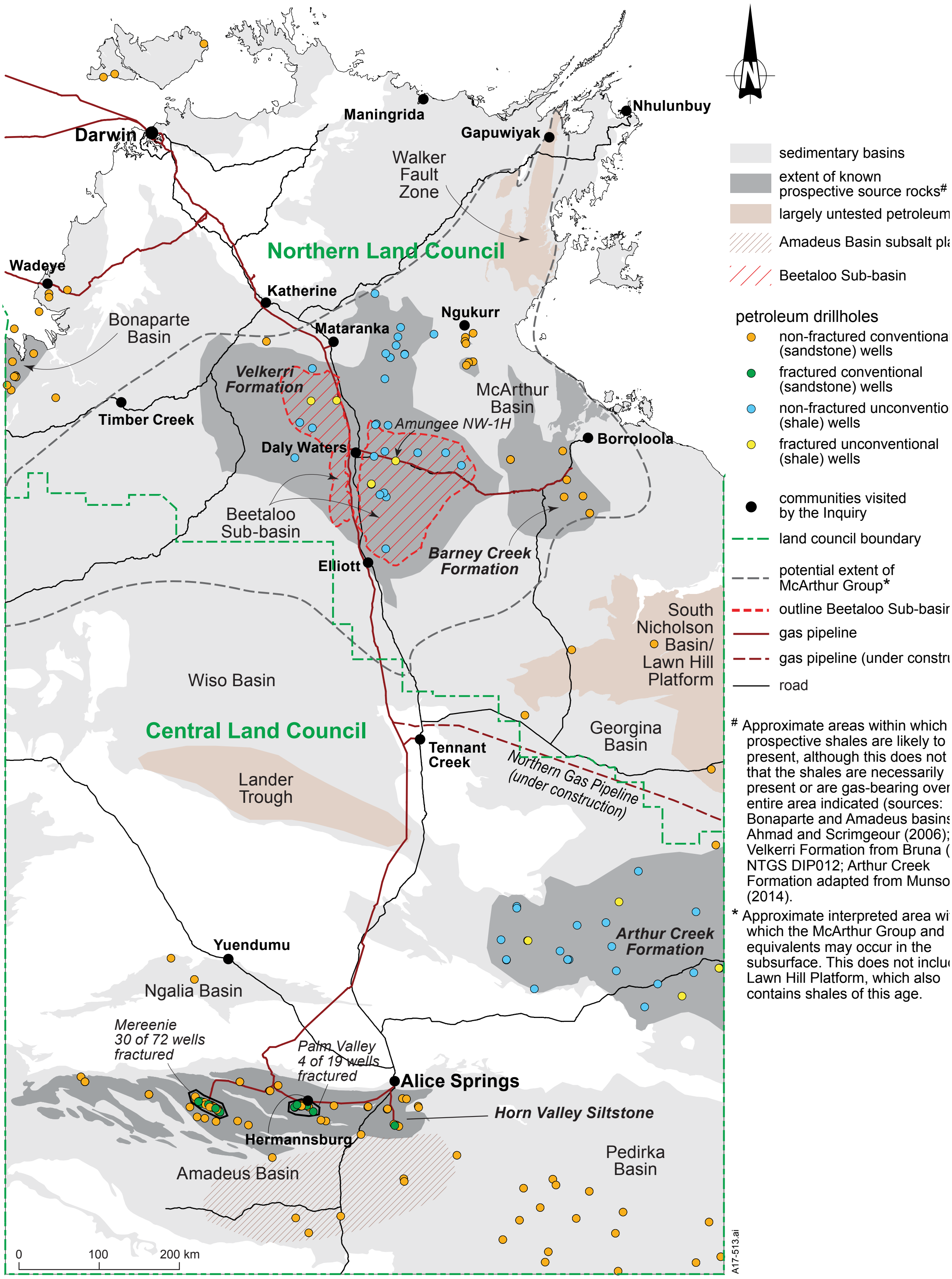


FIGURE 2: MAP OF BEETALOO BASIN

Petroleum wells in the Northern Territory showing the extent of known prospective source rocks. Source: DPIR.

The grey areas show the extent of known prospective shale gas source rocks, that is, rocks that are considered to have the necessary prerequisites for shale gas occurrence and commercial development. The taupe areas are those that are considered to have the potential prerequisites for shale gas to occur but that have not been tested through drilling. (Extract from Pepper et al, (2018))

SPECIFIC CALCULATIONS

The contributions of proposed developments have been calculated using the most recent edition of the Australian government's guidelines for greenhouse gas emissions, published by the Department of Environment and Energy. This gives values for the direct emissions from various forms of natural gas. The problematic issue in calculating the total impact is estimating the scale of fugitive emissions and deciding what multiplier to use to calculate the Global Warming Potential [GWP] of the leaked methane. In the scientific literature, there are various estimates of life-cycle methane emissions from shale gas. A comparative analysis recently observed that most of these values are based on sparse and poorly documented data (Howarth et al, 2012). The exception is a paper based on measurements from an actual US shale gas field over a year (Petron et al, 2012) which found leakage rates varying between 2.3 and 7.7 per cent, concluding that the best estimate for current practice is 4 per cent. This is significant because the NT Fracking Inquiry was urged to accept that best practice could reduce the overall rate of fugitive emissions to as low as 1.7 per cent. While that seems extremely optimistic, for the purpose of this study three calculations were undertaken: the optimistic assumption of only 1.7 per cent leakage, an intermediate figure of 5 per cent based on Forcey's observations in Queensland, (Forcey, 2018) and a worst-case of 7.7 per cent based on the US measurements.

The IPCC have used a GWP of 25 to calculate the impacts over a 100-year time frame, but "more recent research that better accounts for the interaction of methane with other radiatively active materials in the atmosphere suggests a mean value for the global warming potential of 33 for the 100-year integrated time frame" (Shindell et al, 2009). The same summary suggested that it might be more appropriate to compute the impact of methane over a twenty-year time frame, given that the Paris agreement is based on 2030 emissions. The choice is significant because the relevant figure for the GWP of methane on the shorter time frame is 105. For the purpose of this study, the 100-year time frame with a GWP of 33 and the 20-year time frame with a GWP of 105 were calculated for the three selected scales of fugitive emissions.

RESULTS OF CALCULATIONS

As a boundary case, this study computed the scale of emissions if it were possible to utilise the finding that the Beetaloo sub-basin is geologically analogous to the Marcellus Shale deposit in the USA and extract gas at a rate of "11 trillion cubic feet" per year. That would be equivalent to 0.31 trillion cubic metres per year**.** Using the Australian government's figures for the energy content of extracted gas (0.037 Gigajoules per cubic metre) and the emission factor of 51.4 kg CO2-e per Gigajoule, **that scale of production would contribute about 600 million tonnes of carbon dioxide equivalent per year. To put that figure in context, Australia's total emissions for the most recent year – the highest ever recorded – were 560 million tonnes.** So just extracting and burning gas at the rate projected, without taking into account the extra contribution from fugitive emissions, would do more to accelerate climate change than Australia's entire current activity. That would clearly be totally unacceptable.

The following graphs consider two possible scales of gas production, 365 PJ/year and 1240 PJ/year. These figures were chosen because they were the production estimates provided by the industry to the NT Fracking Inquiry. The initial submission assumed a potential shale gas field would produce 800-1100 TJ/day, a nominal 365 PJ/yr, while a further submission provided a best estimate for a later development scenario that equate to 3,400 TJ/day, or 1240 PJ/yr. For each of those cases, the graph gives the base emissions from extracting and burning the gas, then a range of calculations for different levels of fugitive emissions and two time-scales, 100 years and 20 years. All figures are in millions of tonnes per year of carbon dioxide equivalent.

FIGURE 3:

Emissions from 365 PJ/year production

100-year timescale with a methane global warming potential of 33

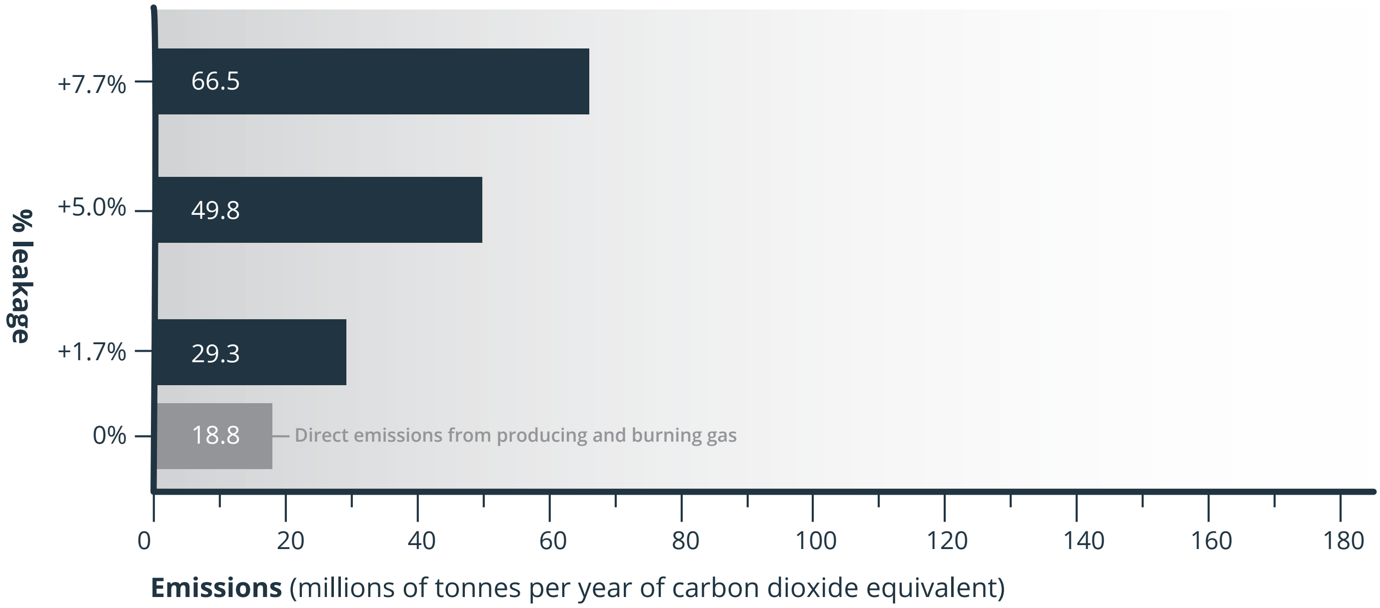
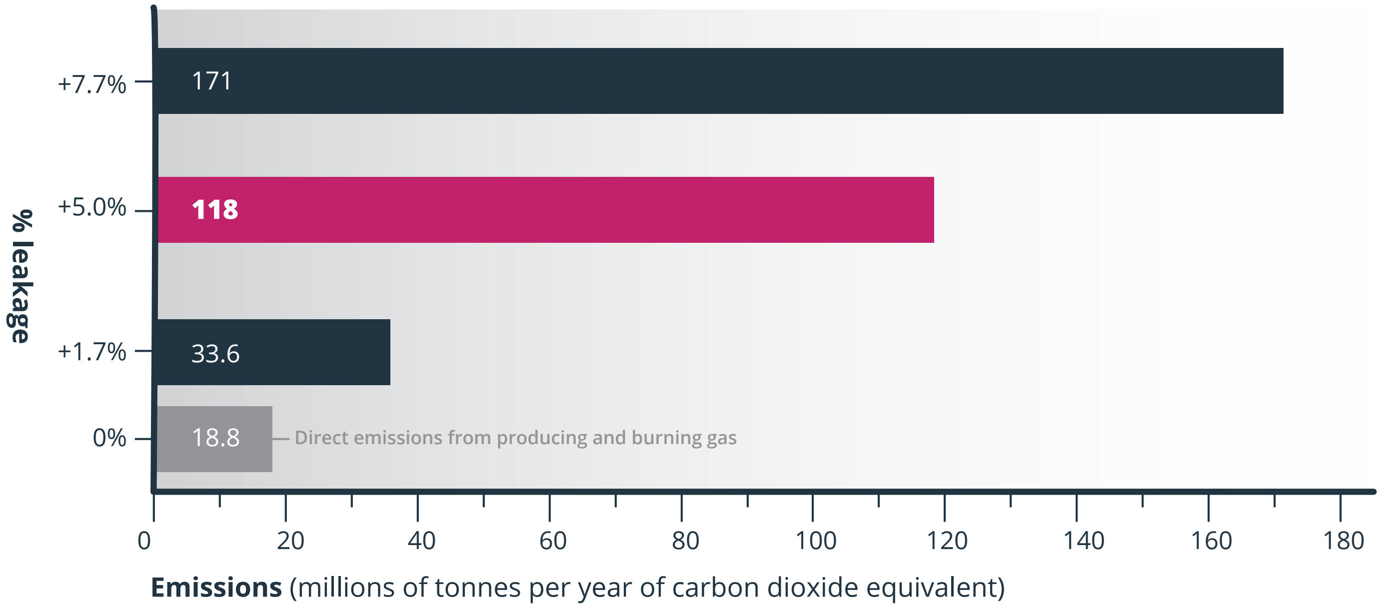


FIGURE 4:

Emissions from 365 PJ/year production

20-year timescale with a methane global warming potential of 105



In the above graphs, the row highlighted in pink is probably the most appropriate case to consider: fugitive emissions about 5 per cent of production and the impact of the released methane considered on a twenty-year timescale.

FIGURE 5:
Emissions from 1240 PJ/year production
100-year timescale with a methane global warming potential of 33

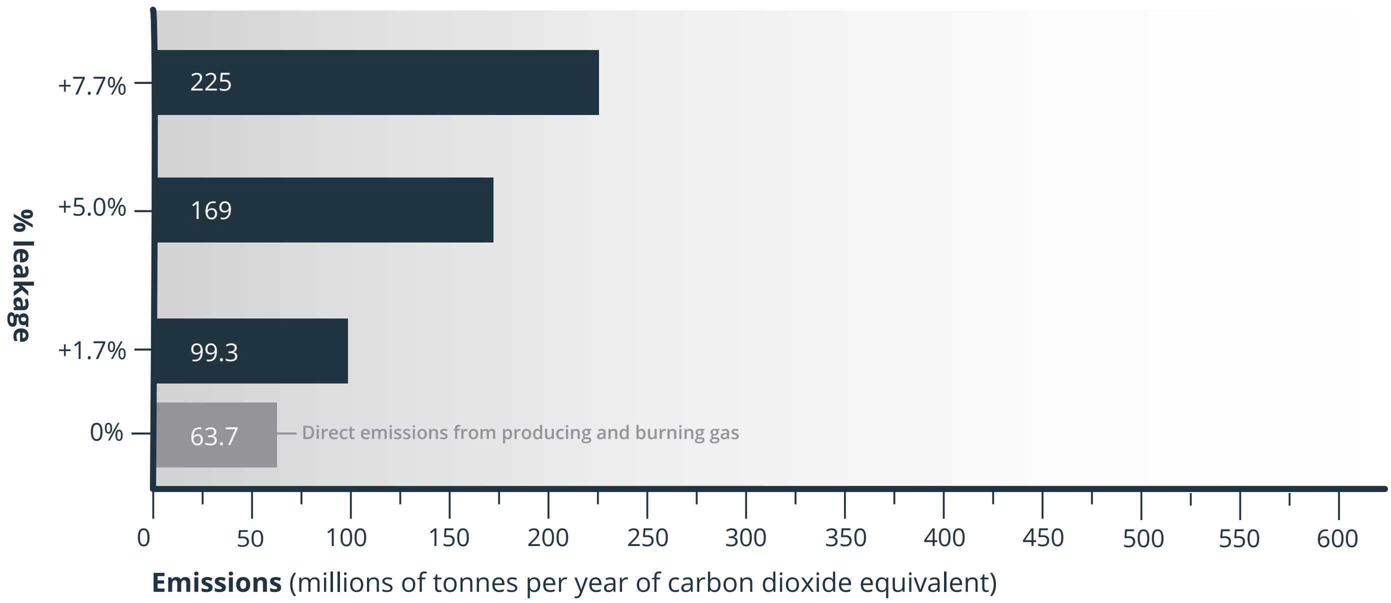
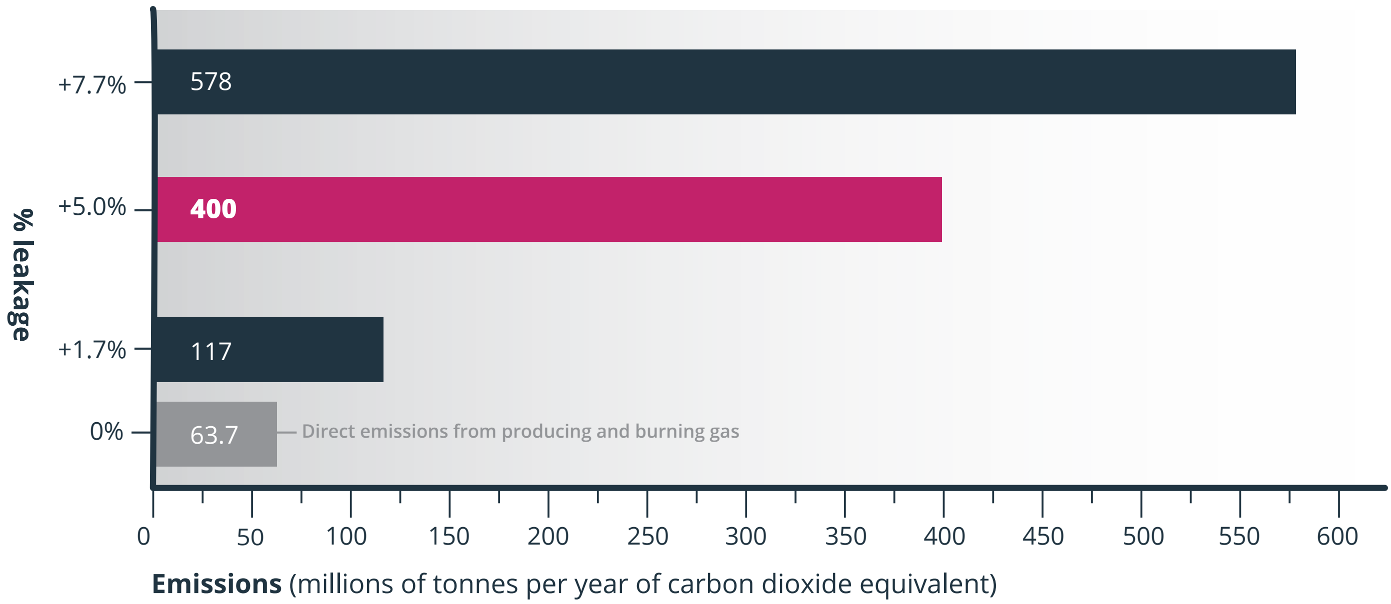


FIGURE 6:
Emissions from 1240 PJ/year production
20-year timescale with a methane global warming potential of 105



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In the graphs, the row highlighted in pink is probably the most appropriate case to consider: fugitive emissions about 5 per cent of production and the impact of the released methane considered on a twenty-year timescale. The calculation shows that even the lower rate of production, 365 PJ/year, would add about 20 per cent to Australia's total national emissions, while the higher rate of production (1240 PJ/year) would add nearly 75 per cent to our total. That higher production rate with a higher level of leakage would more than double Australia's emissions. **Even on the heroic assumption that leakage could be constrained to 1.7 per cent, the proposed development would add very significantly to our national emissions.**

DISCUSSION

These results are consistent with other studies. For example, Schanell et al (2019) estimated the whole-of-life greenhouse gas emissions from coal seam gas operations in the Surat Basin. They concluded that producing 576 PJ per year of coal seam gas would result in emissions of 4-6 Mt CO2-e per year in Australia plus about 39 Mt/yr on combustion overseas, adding up to total impacts of 43-45 Mt/yr, assuming fugitive emissions could be held to 2 per cent of production and using the 100-year time-scale to compute the impacts of methane. Scaling that calculation would give about 28 Mt/yr for 365 PJ of production and about 95 Mt/yr for 1240 PJ, very similar to the results in the graphs for 1.7 per cent leakage on a 100-year timescale.

The question of whether using gas could slow climate change is hotly disputed. It has been stated, for example, that "natural gas from the Northern Territory could play an important role in helping to reduce the world's reliance on high emissions coal in countries such as China and India" (Origin Energy, 2019). This claim actually has no foundation. Schanell et al note "a general consensus" in the literature that "climate benefits of natural gas replacing coal are lost where fugitive emissions from all upstream operations are greater than 3% of total production". The same study cited US estimates of fugitive emissions ranging from 2.3 to 2.85 per cent, a range in which any benefits are marginal. Given that estimates based on actual production are in the range from 4 to 5 per cent, as noted above, it is totally invalid to claim that gas production reduces the overall greenhouse gas impact of electricity generation, even when it directly replaces coal-fired generation. Of course, there is also no evidence that Australian production of gas replaces burning of coal; in many cases, it produces extra energy. **Schanell et al conceded that it is impossible to calculate whether LNG exports reduce greenhouse gas emissions "because we do not know the proportion of gas used to displace what would have been produced from coal". So it is just dishonest to claim that producing more gas from Australian deposits will slow climate change.**

CONCLUSION

Approving the proposed development of shale gas from the Beetaloo Sub-Basin or McArthur Basin would add very significantly to Australia's greenhouse gas emissions in the critical period before 2030, when we are required by the Paris agreement to achieve significant reductions. **While the NT Fracking Inquiry suggested that emissions from gas production could be offset by savings in other areas, the scale of reductions that would be needed for even the lower level of production is totally impractical.** For example, offsetting the lower rate of production computed in this study for 5 per cent leakage would require reducing emissions in other areas by more than the entire transport sector. **Even the heroic assumption that fugitive emissions could be constrained to 1.7 per cent – a lower figure than any measured for any shale gas development – would still require offsets comparable to the emissions from all industrial processes.** At the higher production rate for which emissions have been calculated, even assuming unprecedented success in reducing leakage and using the 100-year timescale instead of 20 years, the scale of offsets required would be about the same as all emissions from the entire transport sector. There is no conceivable way of achieving reductions on that scale before the 2030 deadline for us to meet our Paris obligations.

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