Fact Sheet – Shale and Tight Gas Extraction

What is the difference between conventional and unconventional gas?

The difference between conventional and unconventional gas is the geology of the reservoirs from which they are extracted and which therefore require different extraction techniques to obtain commercial quantities of gas. Conventional gas is usually found in relatively large permeable rock reservoirs. In a conventional gas deposit, once drilled, the gas can usually be extracted relatively easily via vertical wells. Conventional gas has been extracted in Australia for many decades.

Unconventional natural gas is found in less permeable deposits or spread more diffusely throughout the rock substrates, not in discrete pockets or reservoirs. This gas is more difficult to extract and therefore requires more specialized (i.e. 'unconventional') extraction techniques and processes. The methods required for the extraction of unconventional gas include hydraulic fracturing (fracking), horizontal drilling, multiple drilling, and acidation.

In addition to extra processes such as fracking, unconventional gasfields also involve the industrialisation of entire landscapes (covering considerably larger areas than conventional gasfields). They generally require thousands of wells, vast networks of roads and pipelines, compressor stations, processing plants, wastewater holding dams and treatment plants. The three main types of unconventional gas are coal seam gas (CSG), shale gas and tight gas. CSG is found in coal seams, shale gas is found in shale rocks, whilst tight gas is found in low permeability sandstone rocks.

A categorical assessment[1] of peer-reviewed literature published in April 2016 found that out of 685 published papers on the impacts of unconventional gas development, '84% of public health studies indicate risks to public health, 69% of water studies show actual or potential water contamination and 87% of air quality studies indicate elevated air pollution'.

Shale and tight gas mining processes require vast amounts of water

- Extraction of shale and tight gas requires high volume, 'slick-water' hydraulic fracturing and usually involves horizontal drilling. This newer type of fracking is far more risky than older fracking techniques previously used in the gas industry.
- Fracking for shale and tight gas is an extremely water-intensive practice. Each well may require up to ten fracks[2] over its production life. The Australian gas industry provides a figure of 11 million litres per shale or tight gas frack[3]. Other sources suggest that water use is often much higher[4]. According to one UN report, a single frack operation on a shale gas well will use between 11 and 34 million litres of water, roughly 360 – 1100 truckloads[5]. Drilling a shale or tight gas well also requires around 1 million litres per well[6].

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[1] Toward an Understanding of the Environmental and Public Health Impacts of Unconventional Natural Gas Development: A Categorical Assessment of the Peer-Reviewed Scientific Literature, 2009-2015: http://journals.plos.org/plosone/article?id=10.1371%2Fjournal.pone.0154164

2 European Parliament, Economic & Scientific Policy Dept, Impacts of shale gas and shale oil extraction on the environment and on human health.

3 APPEA: The Natural Gas Revolution- Natural gas from shale and tight rocks.

4 Kargbo D, William R & Campbell D, (2010) Natural Gas Plays in the Marcellus Shale: Challenges and Potential Opportunities, Vol. 44, No. 15 *Environmental Science & Technology;* CIWEM UK, 2012 Policy Position Statement 'Hydraulic Fracturing (Fracking) of Shale in the UK';

[5] UNEP Global Environmental Alert Service: Gas Fracking: Can we safely squeeze the rocks?

6 WA Govt: Natural gas from shale & gas fact sheet: water use & management.

- In the US, towns and pastoral properties that must compete with fracking operators for scarce water supplies have been seriously affected. In Texas, extraction of water for fracking has contributed to serious problems of ground and surface water depletion during drought conditions[7].

Shale and tight gas mining uses large amounts of chemicals in each fracking operation

- The gas industry is at pains to point out that chemical additives make up only a very small proportion of fracking fluids- 'approximately' .5%[8]. In reality, the amounts used range from .5 to 2%[9], and while this is a small proportion relative to the large volumes of water used, it translates to very large quantities of chemicals. A typical 15 million litre fracturing operation would use 80 - 330 tons of chemicals[10].
- Industry also maintains that 'most' of these chemicals are found in household products[11] but this does not mean they are safe. Fracking compounds used in Australia have also been shown to include many hazardous substances, including carcinogens, neurotoxins, irritants/sensitisers, reproductive toxins and endocrine disruptors[12]. Many of the chemicals used in fracking have never been assessed for their long-term impacts on the environment and human health.

Shale and tight gas mining places water resources at risk

- The gas industry claims that because shale and tight gas extraction involves deeper rock layers, they are safer than gas extraction from shallow coal seams. But according to a European Commission Report[13] there is an overall high risk of ground and surface water contamination resulting from fracking.
- US studies have implicated shale gas in the contamination of groundwater with heavy metals, salts and gas[14]. Contamination can occur from well casing failure due to corrosion, faulty construction or repeated fracturing. Data from one US state shows that 6-7% of new shale gas wells were faulty and leaking gas[15]. After 20 years this failure rate may increase to 50%, as wells corrode and cement casings degrade[16].
- Groundwater contamination can also occur if gas and toxic flowback fluids migrate from gas wells into aquifers through natural underground faults or fractures created during fracking operations.Recent research from the USA found higher levels of arsenic and other heavy metals, plus higher salinity, in water bores which were less than 3km from shale gas wells[17]. Other research has found increased methane concentrations in water bores closer to shale gas wells, creating an explosion hazard[18].

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7 *Frackers guzzle water as Texas goes thirsty*: http://nation.time.com/2013/09/29/frackers-guzzle-water-as-texas-goes-thirsty/; Western Organization of Resource Councils: *Watered Down: Oil & gas production & oversight in the west.*

8 APPEA: The Natural Gas Revolution- Natural gas from shale and tight rocks.

9 Hazen and Sawyer, December 22, 2009. Impact Assessment of Natural Gas Production in the New York City Water Supply Watershed.

10 Ibid

11 APPEA: The Natural Gas Revolution- Natural gas from shale and tight rocks.

12 National Toxics Network: *Toxic Chemicals in the Exploration and Production of Gas from Unconventional Sources.*

13 Broomfield Mark, Support to the identification of potential risks for the environment and human health arising from hydrocarbons operations involving hydraulic fracturing in Europe. AEA Technology, 2012.

14 Fracking: The evidence, https://docs.google.com/file/d/0B1cEvov1OlyHdzRBRjk4dElfbVE/edit?pli=1

15 Ibid

16 *Marcellus Shale Exposed,* Antony Ingraffea, http://www.youtube.com/watch?v=7DK3fODCZ3w; ANTHONY R. INGRAFFEA , PH.D., P.E., *FLUID MIGRATION MECHANISMS DUE TO FAULTY WELL DESIGN AND/OR CONSTRUCTION.*

17 Fontenot et al 2013, An Evaluation of Water Quality in Private Drinking Water Wells near Natural Gas Extraction Sites in the Barnett Shale Formation. *Environ. Sci. Technol. 2013. 47 (17) pp 10032-10040*

18 Osborn et al 2013. Methane contamination of drinking water accompanying gas-well drilling and hydraulic fracturing. PNAS, May 17 2011.

- Surface water pollution can occur when there are accidental spills of fluids or solids at the surface, when well blow outs occur, and through discharge of insufficiently treated waste water into waterways. Studies from Duke University in the US have found high levels of radioactivity in a creek used for disposal of wastewater [19].
- There is ever-increasing evidence from across the US of significant depletion and contamination of water resources and waste management issues from unconventional gas operations[20].

Disposal of wastewater from shale and tight gas operations is a serious problem

- According to industry sources, around 30% of the fracking fluid flows back to the surface[21]. However, as little as 6 to 8% may be recovered[22].
- Underground water in the drilling area can also come to the surface during gas production. For a typical shale gas well, daily 'produced' water volumes range from 300 – 4,500 litres[23].
- In addition to drilling and fracking chemicals, 'flowback' and 'produced' water can contain a range of naturally occurring contaminants from the rocks. These include, heavy metals, naturally occurring radioactive materials (NORMs), volatile and semi volatile organic compounds (VOC's) and high concentrations of salts[24].
- The large volumes of waste water produced from shale and tight gas mining are likely to be reinjected into aquifer formations, partially 'treated' and reused or released into waterways, or trucked to holding ponds for storage and 'evaporation'[25].

Shale and tight gas operations can have serious consequences for human and animal health

Whilst the gas industry maintains that unconventional gas extraction is safe and 'clean', there is a rapidly growing body of research from overseas that highlights the impacts of shale and tight gas operations on land, water and human health. Communities living near gasfields in the US have reported serious health effects following the commencement of unconventional gas operations[26]. Some of the public health effects of unconventional gas development that US researchers have documented, as outlined in *The Compendium of Fracking Risks*[27] include:

- Increased rates of hospitalization for cardiological complaints, cancer, skin conditions, and urological problems.

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19 Warner et al, *Impacts of Shale Gas Wastewater Disposal on Water Quality in Western Pennsylvania*, Environ. Sci. Technol., **2013**, 47 (20), pp 11849–11857

20 Western Organization of Resource Councils: *Watered Down: Oil & gas production & oversight in the wes; Fracking: the evidence,* https://docs.google.com/file/d/0B1cEvov1OlyHdzRBRjk4dElfbVE/edit?pli=1*;* Hansen, Mulvaney & Betcher, *Water resources reporting and water footprint from Marcellus Shale development in West Virginia & Pennsylvania.*

21 APPEA: The Natural Gas Revolution- Natural gas from shale and tight rocks.

22 Hansen, Mulvaney & Betcher, Water resources reporting and water footprint from Marcellus Shale development in West Virginia & Pennsylvania

23 Bill Chameides, *"Natural Gas, Hydrofracking and Safety: The Three Faces of Fracking Water,"* National Geographic, September 20, 2011.

24 Ibid

25 National Toxics Network: Toxic Chemicals in the Exploration and Production of Gas from Unconventional Sources.

26 Centre for Environmental Health: Toxic and Dirty Secrets: The Truth about Fracking and Your Family's Health.

27 http://concernedhealthny.org/compendium/

- Increase in frequency of health symptoms reported by residents as distance between households and gas wells decreased; with rashes and upper respiratory problems more prevalent among persons living less than one kilometre from drilling and fracking operations.
- Increase in infant deaths to six times the normal rate over three years.
- Congenital heart defects, and possibly neural tube defects in newborns, associated with the density and proximity of natural gas wells within a 10-mile radius of mothers' residences.
- Reductions in average birthweight and length of pregnancy as well as increased risk for low birthweight and premature birth associated with proximity to fracking operations.
- Residents living adjacent to coal seam gas operations around Chinchilla Queensland also report a range of health symptoms, including serious respiratory ailments, nose throat and eye irritations and neurological illnesses.
- A 2012 case study in the US also found serious evidence of harm to domestic stock from shale gas drilling waste contamination, including cattle deaths, stillbirths and reproductive problems[28].

Economic/Employment Impacts of Unconventional Gas Extraction[29]

- While gas companies continually spruik the promise of more jobs for local communities as a justification for unconventional gas development, in actual fact the oil and gas industry is one of the smallest employers in Australia, employing less than 0.2% of the Australian workforce.
- The majority of gas industry jobs are required for the short construction phase only, they are not ongoing, as modern gas fields are highly mechanized and need very few people to operate them. Local employment opportunities are minimal with the majority of skilled workers being brought in from elsewhere with fly-in-fly-out workforces.
- Those employed locally are usually skilled workers poached from local industries that have spent years training them, often leaving these industries short of labour and unable to compete with gas industry wage rates.
- Recent large scale coal seam gas developments in Queensland have failed to deliver on the promised economic benefits, with many existing businesses and entire industries badly affected by loss of skilled staff to the gas industry and increased costs of labour, rent, transport and goods and services.
- With the 4 year construction phase of the CSG production gasfields in Queensland now coming to an end, the gas 'boom-towns' of Dalby, Roma and Chinchilla has seen a crippling economic down turn with associated job losses and loss of revenue for local businesses who had initially benefitted from the boom.

Further Reading

Further detailed information collated from peer reviewed research into the environmental and health risks from fracking and unconventional gas operations can be found in these reports:

-*Compendium of Scientific, Medical, and Media Findings Demonstrating Risks and Harms of Fracking*
-*New York State Public health review of Hydraulic Fracturing for Shale Gas Development*

28 MICHELLE BAMBERGER, ROBERT E. OSWALD, *IMPACTS OF GAS DRILLING ON HUMAN AND ANIMAL HEALTH.*

[29] The Australia Institute: Be Careful what you Wish For: http://www.tai.org.au/content/be-careful-what-you-wish