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GHG emissions from shale greater than conventional gas, coal or oil

Over a 20-year time period, the greenhouse gas (GHG) footprint of shale gas is greater than that of coal, oil or conventional gas, according to a recent study. Methane emissions make up most of this footprint. This suggests that substituting conventional fossil fuels with shale gas may not have the desired effect to mitigate climate warming in the short-term.

Global reserves of natural gas extracted from reservoirs (conventional gas) are being depleted. Technological development has allowed unconventional sources of natural gas to be exploited, including natural gas trapped in the tiny pores of shale formations (underground, sedimentary rock).

This study estimated the GHG footprint of shale gas in the United States using the latest information on emissions for the oil and gas industry from the US Environmental Protection Agency. The GHG footprint includes all GHG emissions from well completion, extracting, developing, transporting and using the gas, expressed in terms of carbon dioxide equivalents, for every unit of energy produced.

Methane is the major constituent of natural gas (about 85 to 95 per cent) and is a powerful GHG, with a greater global warming potential than that of carbon dioxide. Most of the GHG footprint for shale (and conventional) gas comes from direct carbon dioxide emissions from burning the gas during consumption and, especially for shale gas, from fugitive methane emissions that are not collected and piped away.

Shale gas is extracted by the fracking process, where water under high pressure is repeatedly pumped into the shale to fracture the rock and release the gas. Life-time losses of methane occur during development of the wells, the extraction processes, leaks from equipment, during removal of impurities prior to piping the gas, and from the transport, storage and distribution of the gas.

Overall, the life cycle estimated losses of methane emissions from a typical shale gas well amount to 3.6 to 7.9 per cent of the total amount of gas produced by the well. This compares with methane losses of 1.7 to 6 per cent of total gas production from conventional wells.

Methane remains in the atmosphere for around a decade, compared with a residence time of about 100 years for carbon dioxide. Over 20 years horizon, the GHG footprint of shale gas is primarily influenced by methane and is 22 to 43 per cent higher than for conventional gas, at least 20 per cent to twice as high as the GHG footprint for coal and at least 50 per cent to 2.5 times higher than for oil.

Over 100 years horizon, as methane emissions diminish, the GHG footprint for shale gas is still 14 to 19 per cent higher than for conventional gas, is similar to that of coal and about the same or up to 35 per cent higher than for oil.

Given that burning natural gas produces less carbon dioxide than the equivalent quantity of coal required to produce the same amount of energy, many see the increased use of natural gas in place of coal or oil as a way to reduce GHG emissions whilst society develops a low carbon society. However, the impact of methane emissions over a 20 year period suggests the use of gas, and shale gas in particular, might not be an effective way to reduce global warming in the short-term. The article notes that better regulation and the use of “green” technologies in the gas industry could help to reduce life cycle methane emissions for shale gas and suggests that carbon markets would value methane emissions more correctly if a 20 year horizon was used instead of a 100 year period, and emission values were updated.

The study concludes by highlighting the need for further study on fugitive methane emissions of shale gas, given the wide uncertainty in their magnitude at present.

Source: Howarth, R.W., Santoro, R., Ingraffea, A. (2011) Methane and the greenhouse-gas footprint of natural gas from shale formations. *Climatic Change.* DOI 10.1007/s10584-011-0061-5.
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