Environmental Science & Technology

Viewpoint

pubs.acs.org/est

Fracking Cannot Be Reconciled with Climate Change Mitigation Policies

Philip L. Staddon*[,†,‡] and Michael H. Depledge[‡]

[†]Department of Environmental Science, Xi'an Jiaotong-Liverpool University, Suzhou 215123, China

[‡]European Centre for Environment and Human Health, University of Exeter Medical School, Exeter EX1 2LU, U.K.

Addressing climate change and meeting our energy needs are two of the greatest challenges that societies face. Many obstacles hinder progress. The search for inexpensive and plentiful energy supplies appears to be at odds with climate change mitigation commitments. The desire for short-term (next 30 years) energy security has reinvigorated investment in fossil fuel technologies and led to a North American boom in hydraulic fracturing for shale gas (fracking). However, fracking contributes both directly and indirectly to greenhouse gas emissions, further driving anthropogenic climate change. Here we consider the implications and conclude that the expansion of fracking is incompatible with climate change mitigation.

The evidence is overwhelming that recent climate change arises primarily from human activities that release greenhouse gases, including carbon dioxide (CO_2), and methane (CH_4), into the atmosphere. Resulting damage to ecosystems and threats to human health and wellbeing has emerged over the past few decades.[1] All sectors of the economy and society are affected by the disruption of infrastructure, food production (agriculture and fisheries), business activity, ecosystem services, and health services. Climate change is causing the loss of millions of disability adjusted life years globally. Coal, oil and gas consumption account for over 80% of the CO_2 emissions worldwide.[2] Despite a myriad of international agreements (e.g., COP20 in Peru), and promises by numerous governments, CO_2 emissions from fossil fuel combustion have continued to rise from 19 gigatonnes (Gt) CO_2 yr^{-1} in 1980 to 30 Gt CO_2 yr^{-1} in 2010. The rate of increase in emissions has accelerated from 1.5% per year between 1980 and 2000 to 3% per year between 2000 and 2012.[2]

New and improved technologies have radically increased the amount of fossil fuel that is economically recoverable, especially via the exploitation of oil sands and shale gas. Unconventional gas could soon represent 40% of recoverable gas resource globally, with shale gas accounting for 27%.[3] If all unconventional gas resources were to be mobilized, the impact on climate change would be enormous (see Figure 1). Gas demand is increasing rapidly, which led Hansen et al.[2] to remark that "...despite the clarity and imminence of the danger of continued high fossil fuel emissions, governments continue to allow and even encourage pursuit of ever more fossil fuels." The shale gas GHG footprint is much larger than is widely recognized. Up to 8% of the methane produced at shale-gas wells escapes to the atmosphere,[4] which is roughly double conventional gas production losses. The shale gas carbon footprint is in fact very similar to that of coal when compared over 100 years.[4] Evidence contradicts the view that shale gas is a "clean" or "environmentally friendly" energy source. Furthermore, increasing amounts of North American shale gas are now exported as liquefied natural gas (LNG), which has life-cycle

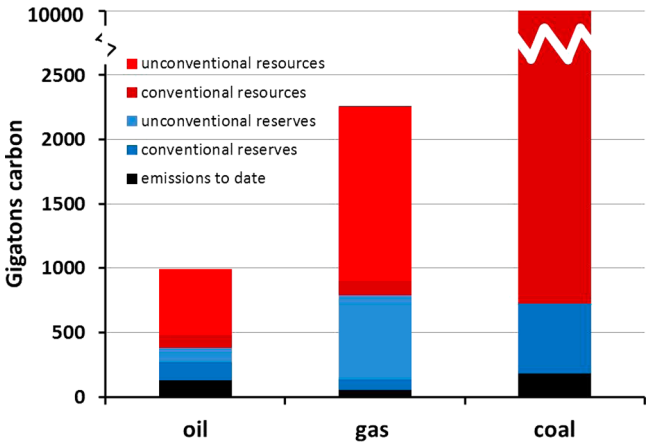

Figure 1. Global fossil fuel carbon emissions to date and carbon content of reserves and resources for oil, gas and coal. Reserves are exploitable now with current technologies and at current energy prices; resources are potentially exploitable with technological advances and/or at higher energy prices. Redrawn from Hansen et al. 2013.[2]

Received: May 18, 2015
Published: July 2, 2015

DOI: 10.1021/acs.est.5b02441
Environ. Sci. Technol. 2015, 49, 8269−8270

GHG emissions ca. 20% higher than domestically consumed gas.[5]

From facts presented here and elsewhere, it is difficult to avoid the conclusion that expansion of shale gas fracking is inconsistent with climate change mitigation. "The large GHG footprint of shale gas undercuts the logic of its use as a bridging fuel over coming decades, if the goal is to reduce global warming".[4] Lowering GHG emissions requires reduced dependence on fossil fuels, rendering the government-sponsored search for new sources of oil and gas particularly perverse. Expanding fossil fuel extraction capabilities sends the message that rapid climate change mitigation is neither urgent nor essential. The IPCC has calculated that to not exceed a 2 °C rise, human activities must release no more than 3670 gigatonnes of CO_2. Having already emitted ca. 2900 gigatonnes of CO_2 equivalent GHGs, we must now emit less than 1000 gigatonnes of CO_2 to achieve our critical goal. The questions then become: How do we spend the remaining 1000 gigatonnes and what do we do with the vast, unusable reservoirs of oil and gas?

Shale gas is dubiously portrayed as an "environmentally friendly" transition fuel to a CO_2 emission-free future, by the oil and gas industry, as well as many governments. The dangers posed by "greenwashing" shale gas as a route to climate change mitigation, are well documented.[5] It is unimaginable that oil and coal reserves will be left in the ground, therefore shale gas represents an *additional* source of GHG emissions. This will add to overall GHG emissions and delay the transition to a low carbon future. Another detrimental consequence of maintaining reliance on fossil fuels is that investment in renewable energy and low or zero-carbon alternative energy sources diminishes. Nonrenewable energy is seen as a high return, low risk investment, which is delaying the switch away from fossil fuels. Damage from climate change will intensify as climate forcing progresses, affecting hundreds of millions of people. Governments have agreed in principle to limit GHG emissions, yet fracking for shale gas will extend the fossil fuel age, increase the costs of mitigation and drive up the cost of adaptation required to support human societies in a less hospitable climate. The negative financial impacts on economies and to human health will be externalised and borne by those often poorer societies most affected by climate change.

The evidence presented here leads unrelentingly to the view that fracking for shale gas is incompatible with climate change mitigation. Expanding the volumes of extractable fossil fuels reserves, in whatever form, is irreconcilable with commitments to reducing anthropogenic greenhouse gas emissions. Carbon-neutral and low carbon energy alternatives are available and must be further developed to limit the "need" for fossil fuels in a sustainable future. What is at stake is the health and wellbeing of millions of people worldwide and the sustainability of the Earth's ecosystems. At some point, it is inevitable that humans will be forced to apply increasingly robust controls and deploy new technologies to tackle rapid anthropogenic climate change. We may then reflect on how many people have lost their lives or had a miserable existence because we did not act sooner.

AUTHOR INFORMATION

Corresponding Author

*Phone: +86 (0) 512 8188 4892; e-mail: Phil.Staddon@xjtlu.edu.cn.

Notes

The authors declare no competing financial interest.

REFERENCES

(1) IPCC. *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Working Group II Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*; Cambridge University Press: Cambridge, U.K., 2014.

(2) Hansen, J.; Kharecha, P.; Sato, M.; Masson-Delmonte, V.; Ackerman, F.; Beerling, D. J.; Hearty, P. J.; Hoegh-Guldberg, O.; Hsu, S.-L.; Parmesan, C.; Rockstorm, J.; Rohling, E. J.; Sachs, J.; Smith, P.; Steffen, K.; van Susteren, L.; von Schuckmann, K.; Zachos, J. C. Assessing "dangerous climate change": required reduction of carbon emissions to protect young people, future generations and nature. *PLoS One* **2013**, *8*, e81648.

(3) McGlade, C.; Speirs, J.; Sorrell, S. Unconventional gas—A review of regional and global resource estimates. *Energy* **2013**, *55*, 571−584.

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

(5) Stephenson, E.; Doukas, A.; Shaw, K. Greenhouse gas: Might a 'transition fuel' label legitimize carbon-intensive natural gas development. *Energy Policy* **2012**, *46*, 452−459.

DOI: 10.1021/acs.est.5b02441
Environ. Sci. Technol. 2015, 49, 8269−8270