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CLIMATE CHANGE

# A crack in the natural-gas bridge

**Integrated assessment models show that, without new climate policies, abundant supplies of natural gas will have little impact on greenhouse-gas emissions and climate change.**

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Burning fossil fuels such as coal, gas and oil produces more than 80% of the world's energy and more than 90% of global carbon dioxide emissions. Slowing and ultimately stopping climate change depends on decarbonization — the transformation of the global energy system into one that does not dump $CO_2$ into the atmosphere. Because gas-fired power plants emit roughly half as much $CO_2$ per unit of energy produced as coal-fired plants, the greatly expanded gas supplies promised by new hydraulic fracturing (fracking) methods have been celebrated as a means of cutting emissions[1]. Progressive substitution of gas for coal and oil can thus decarbonize the energy sector[2] and serve as a 'bridge' to a more distant future when carbon-free, renewable-energy technologies are more affordable and reliable than they are now[3]. In a paper published on *Nature*'s website today, however, McJeon *et al.*[4] uncover a serious crack in the gas bridge: in the absence of new climate policies, increased supplies of natural gas may have little effect on $CO_2$ emissions and could actually delay decarbonization of the global energy system.

McJeon and colleagues' findings reveal two effects. First, abundant gas makes energy cheaper, thereby encouraging higher energy consumption and discouraging investment in energy efficiency. Second, natural gas competes for market share not only with coal, but also with very-low-carbon energy sources such as renewables and nuclear.

Previous studies have questioned the climate benefits of natural gas relative to coal owing to the potential for the gas (mostly methane, a greenhouse gas) to leak into the atmosphere during its extraction, processing and transport[5]. More recently, researchers have begun to consider the effects of abundant natural gas on $CO_2$ emissions in the broader context of the energy marketplace[6–9]. McJeon and co-workers' paper is the first peer-reviewed study to do so on a global scale. It uses five independent energy-economic models to simulate the effects of gas supplies on the global energy system and on emissions of $CO_2$, methane, nitrous oxide and aerosols such as sulphur dioxide and black carbon. Their study compares a 'conventional' gas supply with an 'abundant' case in which natural-gas prices are halved, and evaluates the net influence of emissions on the climate system in the two scenarios.

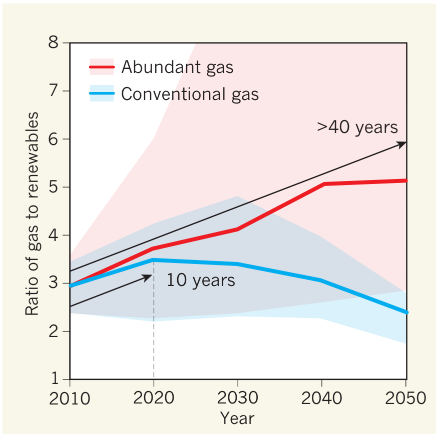


**Figure 1 | Relative growth of gas and renewable electricity.** The ratio of natural gas to renewables used to generate electricity is sensitive to how much inexpensive gas is available. The red and blue lines show the median of this ratio across five energy-economic models used by McJeon *et al.*[4] for scenarios of abundant and conventional gas supplies, respectively, whereas the shaded areas show the full range spanned by the individual models. For cases in which less gas is available (that is, in the conventional scenario), renewables as an electricity source begin to grow faster than gas 10 years into the 40-year modelling period. But when gas is abundant, its use grows faster than that of renewables throughout the period modelled and probably beyond it.

In all five models used by the authors, $CO_2$ emissions and their effect on climate (climate forcing) scarcely differed between the conventional and abundant scenarios. At most, abundant gas reduced cumulative $CO_2$ emissions between 2010 and 2050 by 2%, and reduced climate forcing over the same period by 0.3%. In several of the models, emissions and forcing actually increased under the abundant-gas scenario. But the exact numbers, although revealing, are less important than the overall insight: whether the goal is avoiding $CO_2$ emissions or hastening the transition to an emissions-free energy system, a global gas boom is not a replacement for energy and climate policies.

Indeed, by replotting some of McJeon and colleagues' results, it is possible to observe the extent to which the availability of abundant gas delays the transition to low-carbon, renewable energy sources such as solar and wind. Figure 1 shows the ratio of the amount of gas to renewables used to generate electricity in the authors' models between 2010 and 2050. In the race between fossil fuels and low-carbon energy, the lines in the figure (which reflect the median of all five models) indicate which energy source is gaining ground. In the abundant-gas scenario, the ratio never decreases: gas-fired power pulls further and further ahead of renewable power throughout the 40-year period. But in the conventional-gas scenario, the ratio begins to decrease from 2020: renewables start catching up.

McJeon and co-workers' study assumes that there will be no policies intended to reduce greenhouse-gas emissions or to support low-carbon energy other than those already in place. Future work must carefully assess the effectiveness of various policies in reducing greenhouse-gas emissions and decarbonizing the global energy system. Similarly, the authors' results are probably sensitive to assumptions about the cost of low-carbon energy technologies over time, and systematic analyses of such sensitivity could inform energy funding and policies. Finally, further studies may be needed to evaluate the extent to which natural gas could be used strategically to complement and support variable renewable-energy technologies by providing flexible back-up power that can ramp up quickly[10]. Such applications could have very different implications for decarbonization and cumulative $CO_2$ emissions. Rather than simply building vast fleets of gas-fired power plants that lock in another generation of "committed emissions"[11], if we get the technologies and the policies right, natural gas might help us to cut emissions by working with renewable energy sources, rather than against them.

The integrated analysis of McJeon *et al.* makes it clear that emissions per unit of energy is a poor measure of prospective energy sources. Differences in emissions between energy sources, considered in isolation, may be irrelevant given the complex feedbacks of the energy markets. Specifically, the authors' study is the most robust evidence yet that expanding supplies of natural gas will not help us to avoid climate change and manage the transition to renewable energy sources in the absence of an effective climate policy. ■

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