Is the future of natural gas leaking away?

By Laszlo Varro
Head of Gas, Coal and Power Markets Division, IEA

In the autumn of 2013, the Intergovernmental Panel on Climate Change (IPCC) dropped a quiet bombshell. Reflecting the evolving scientific understanding on the underlying physics of climate change, the IPCC raised the assessment on the medium-term (20 years) greenhouse gas impact of methane from 72 to 86 times than that of CO_2. This means that one ton of methane emitted today will have the same impact on climate 20 years from now as 86 tons of CO_2 emitted today. The lower figure itself was also the result of an upward revision made in 2007 from a previous estimate of 62. Consequently there has been a decade of bad news for the climate impact of methane. The longer-term, 100-year warming potential of methane was also revised up from a lower base, but that matters less: while we are all dead in the long run, the battle to tackle climate change will be lost or won in the next couple of decades. Strangely, this series of bad news has made very little impact on the discussion on the future role of natural gas in either energy policy or corporate strategies. This is a mistake. While the optimism is justified that gas has an important and positive role to play in the transition to a low-carbon system, methane leakage has the potential to completely undermine the case for gas and make it part of the problem rather than part of the solution.

Let's illustrate the scale of the challenge[1]: a major GW-sized modern coal plant replaced by an equally modern combined cycle gas turbine (CCGT) running in mid merit saves around 2 million tons of CO_2 emissions, which is equivalent to taking 1.2 million cars off the road. Indeed, natural gas is one of the few options that can lead to large-scale rapid reduction of CO_2 emissions based on existing technologies without the complete rebuilding the energy infrastructure. However, under a conservative assumption of 1 per cent leakage rates across the gas value chain, around 7,000 tons of methane will leak before reaching the gas turbine. These 7,000 tons of methane has the greenhouse gas impact of 600,000 tons of CO_2, eliminating one third of the advantage of switching from coal to gas. This makes a difference, since in large parts of the world gas is much more expensive than coal, consequently the environmental advantages need to be large to make the expensive shift worthwhile.

If we still want to achieve 2 million tons of CO_2 emissions reduction, compensating for the greenhouse gas impact of the 7,000 tons of methane with the old 62 methane impact estimate, that is equivalent to building 270 windmills next to the CCGT to reduce the operations of the gas turbine, while using the turbine to turn wind into a baseload resource. The revision to the estimate of 86 means that we need to build an additional 100 windmills next to the CCGT to have the same climate benefit. As the scientific understanding has improved about how damaging the emissions impact of methane really is, gas has had to run faster and faster just to stand still. In fact, given that in good winds, the 370 windmills would provide 0.6 GW next to the 1 GW gas plant, one could reach the conclusion that we should replace coal with renewables and use gas only to the extent that it is necessary to compensate for volatility and guarantee supply security. Of course, gas does remain extremely important for keeping the lights on, but in terms of volumes, demand will be greatly constrained by the deployment of low-carbon sources and given the abundance of resources a substantial proportion of them will stay underground for centuries.

Response from industry required

Given the importance of the problem for the strategic future of gas and its role in a decarbonising system, there is a need for a comprehensive management response from the industry. Currently, in the overwhelming majority of upstream projects and midstream infrastructure, methane leakage is not properly monitored, measured and reported. According to IEA data methane emissions from the oil and gas industry have been rising at roughly the same rate as global oil and gas production; consequently, the situation is not improving. Nevertheless, these data are not measurements, they are estimates from energy flows. There are also a host of academic studies with different measurement methodologies and broadly diverging results generating controversy, but not much disclosure from the industry.

So far, the message of the gas industry to society has often been to reassure without providing the necessary transparency and hard data to be reassuring. The social and environmental concerns leading to demonstrations and protests against shale gas development are usually not focused on methane leakage, and of course, methane leakage is by no means unique to shale gas. Nevertheless methane leakage concerns are often woven into a broad set of concerns about local environmental and water use impacts. Parallel concerns exist about the local sustainability and the global desirability of gas. Therefore this is not a desirable strategic position for gas.

In a sense, however, the water-related concerns about fracking and the climate-related concerns about methane leakage are analogous, because the proper responses are similar. Both have the potential to undermine social acceptance of gas and thus stop what we at the IEA have called a "Golden Age of Gas" in its tracks – but they do not have to if these legitimate concerns are addressed at both the corporate and the policy level. Whether the issue is the proper handling of fracking liquids or methane leakage, the most likely cause for an environmental and safety problem is not a natural or technical accident but inadequate project management. The gas industry has all the technologies and capabilities to keep methane leakage to a minimum level and enable gas to remain firmly as a part of the solution. These skills are usually not very high tech either, but good old-fashioned maintenance, well completion and operational excellence. These issues are being addressed in a comprehensive fashion by the IEA Unconventional Gas Forum which as a follow up to our publication of *Golden Rules for the Golden Age of Gas*, brings together governments, energy companies as well as academic institutions to discuss and develop best practices in the environmental management of shale gas projects and thus ensure broad social support. Some of the lessons from the Golden Rules are applicable to conventional gas operations as well.

The very first Golden Rule is "Measure, disclose and engage". This should be applicable to both water quality as well as to methane. Measurement is a first step towards management control and transparency is the foundation of social trust. Progress is being made, but the journey is not nearly over. We have a Golden Rule on "Isolate wells and prevent leaks". This sounds self-evident, and indeed it should be, but we cannot emphasise enough the importance of operational excellence in maintaining environmental integrity. Specifically for methane, the green well completion techniques that were originally developed to tackle volatile organic compounds luckily also all but eliminate methane emissions as well. They should be universally applied on every fracked well. It would be better if this happened through a voluntary industry standard and we could avoid the industry being forced to comply through formal regulation. The same applies to midstream operations – valves, bearings and compressors can be made to minimise leaking, but there needs to be a robust management framework that ensures this.

Keeping gas on the right side

One of the most important Golden Rules is "Eliminate venting, minimise flaring". There should be a clear consensus that gas flaring is not acceptable. Wasting a valuable natural resource that causes environmental destruction should be one of the bad dreams of the 20th century that we left behind. Except that we have not. Moreover, due to imperfect burning, a degree of methane leakage is almost inevitable when gas is flared. There is a long history of anti-flaring measures, but we need to do better. One elegant solution to turn the tables for pipeline leakage as well as flaring, is to apply a generic carbon price on the leaked methane based on its greenhouse impact. A modest US$20 a ton carbon price applied with an 86 greenhouse gas factor would create a value for avoided methane leaks of around US$37 per million BTU, or over five times current US market prices. There is no doubt that this would unleash the technical creativity and management prowess of the gas industry on this low cost – high value greenhouse gas abatement option.

Gas can have, and should have a bright future. The Golden Age of Gas that we at the IEA have outlined is a safer, cleaner and economically more efficient energy system than most of its alternatives. But its attractiveness crucially depends on gas being an ally for environmental objectives. The advantage of gas over coal is obvious in view of the particulate and SO_2 emissions that blight the megacities of the coal-dependent nations of Asia, but it is not enough. Addressing methane leakage is less visible and has a longer-term impact, but it is equally important to keep gas on the right side of environmental concerns. ■

1. I assumed 1 GW of supercritical coal with 5000 hours load factor replaced by CCGT. A windmill is assumed to be 2MW with 2000 hours average load factor and operating between 10-80 per cent depending on wind speed.