Written evidence from Professor Grant Allen (MET0013)

Author Biography

Prof Grant Allen is Chair of Atmospheric Physics in the Department for Earth and Environmental Science, University of Manchester. He has over 20 years' experience in atmospheric research and greenhouse gas emissions quantification at scales from global to point source, using satellites, research aircraft and unmanned aerial vehicles. Prof Allen leads a research group on GHG emissions quantification and holds NERC funding to quantify methane sources onshore in the UK. He has also worked on projects with the UN Environment Programme to study offshore oil and gas emissions, as well as other NERC projects to reconcile the global methane budget.

Summary

The UK must quantify and report its methane emissions to the UNFCCC under existing climate agreements. As the second-most potent greenhouse gas (GHG) after carbon dioxide, methane emission reductions offer important global potential for climate quick-wins due to its short atmospheric lifetime (around 10 years) compared to carbon dioxide (more than 100 years). Concerted action on methane now can reduce the rate of climate warming relatively quickly, in parallel CO_2 (and other GHG) reduction strategies.

The Global Methane Pledge commits the UK to emissions reductions of at least 30% by 2030 (compared with 2020 levels). This is a short but achievable timeframe if policy and regulation can align with scaled alternative energy supplies, industrial practices and technological solutions.

Accurate knowledge of the UK's methane emissions is integral to measuring our success in meeting the Global Methane Pledge and Net Zero goals.

Terms of Reference

What role could methane emissions reduction play in meeting the UK's domestic and international climate change targets? What is your assessment of the Global Methane Pledge: is the UK on track to meet it? If not, how could this be accelerated?

Through the Global Methane Pledge, the UK is committed to emissions reductions of 30% by 2030 (compared to 2020 levels). The UK is also committed to achieving Net Zero emissions by 2050, which would mean that any remaining carbon-dioxide-equivalent emissions need to be balanced by sinks or active removal (such as carbon capture and storage). The Global Methane Pledge therefore represents an important milestone on the path to Net Zero, and an important test of our progress by that date. Now just 6 years away from this 2030 target we have seen very little change (see Figure 1) in the UK's nationally reported emissions (black bars in Figure 1) between 2016 and 2021 (the latest available estimate). To achieve the Global Methane Pledge, we would need to reduce the UK's annual methane emissions to around 40 Tg (CO_2-equivalent).

Given this recent trend, we are not on track to meet the Global Methane Pledge.

To accelerate progress, there is a need to move away from the use of fossil methane as an energy source, to capture and utilise more biogenic methane generated from industries such as landfill, wastewater treatment, and agriculture, and to reduce methane generated from human-influenced biogenic sources generally. Nisbet et al., 2020, discussed methods to reduce such emissions and the practicality of achieving this for different sectors, identifying landfill waste and oil and gas infrastructure as areas that have received much attention and technological advance recently. There is also a need to address harder-to-mitigate sectors such as agriculture and biomass burning, as well as exploring the potential to reduce the prevalence of fugitive emissions (leaks and venting). To the best of my knowledge, there are currently no emissions targets specific to individual emitters at the site scale (with the exception of flaring), nor enforcement action or regulation to limit GHG emissions to defined thresholds. This is partly because the accurate measurement-led quantification of emissions is technically challenging, making enforceable regulation difficult. However, many new technologies exist to assist with this.

For meaningful emissions reduction, policy, regulation, technology and industry need to align with incentives to reduce, mitigate, or replace methane emissions. Alignment between regulation and policy may be best coordinated by the Department for Energy Security and Net Zero as it holds responsibility for implementation of Net Zero policy. There is a need for coordination between DESNEZ and DEFRA given DEFRA's activity in reporting the UK's UNFCCC-reportable emissions inventory. The UK's commercial readiness to respond to monitoring requirements needs to be assessed and nurtured, and there is a role for academics to advise on technologies and accounting challenges.

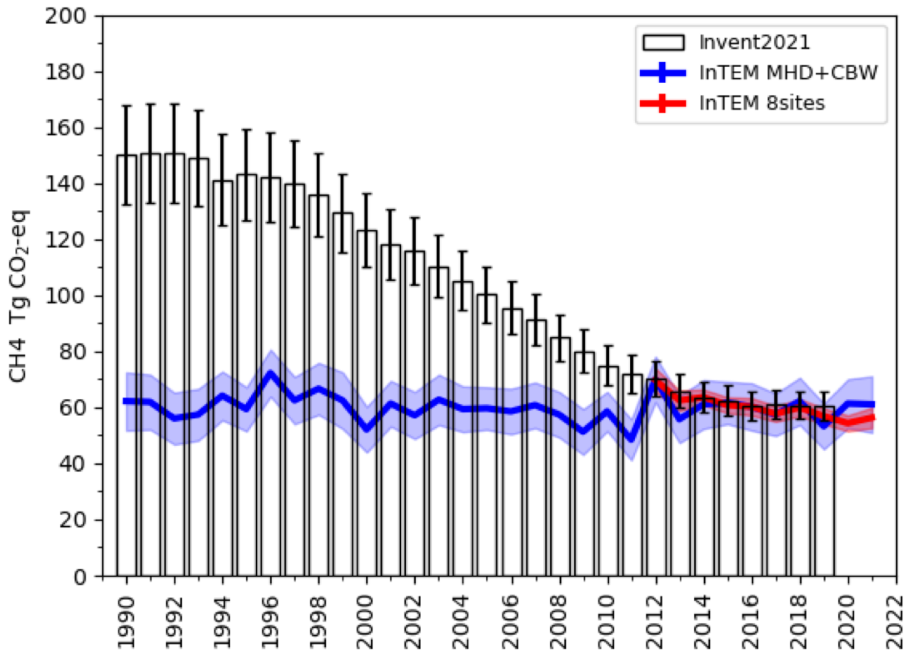

Figure 1. UK methane emissions from 1990 to 2021 estimated from the UK's official inventory (black bars, with corresponding error bar), and from inversion of measurements from the DECC tall tower network (blue and red). Figure

recreated here is from Fig 14a of the annual public report on Long-term Atmospheric Measurement and Interpretation of Radiatively Active Trace Gases.

How significant are UK methane emissions when compared to global emissions? What impact could UK efforts on reducing methane emissions have on total emissions?

The global anthropogenic methane emissions total was historically projected to be 9390 Mt for 2020 (carbon-dioxide-equivalent) according to the US Environmental Protection Agency. However, the precise fraction of anthropogenic emissions compared to total 2020 emissions (~570 Mt CH_4, according to the International Energy Agency) from all sources (natural and anthropogenic) is the subject of significant academic debate. The UK's emissions (Figure 1) were just over 60 Mt (in CO_2-equivalent units). Clearly, the UK's estimated methane emissions are a very small fraction of the global total (<1%), and unlikely to have a very large impact on climate warming on their own. However, climate warming has global impact and requires global solutions. Each country must do its part and the UK (as a G8 nation) should lead by example. If every country assumes that their contribution to warming is minimal, the sum of all parts will continue to drive dangerous levels of climate change. The UK's impact must therefore be seen in the context of doing its part and leading others by example.

What lessons could the UK learn from abroad?

Perhaps the most important lesson is the UK's lack of methane emissions regulation. The European Union and USA are both adopting regulation, which will require emitters to measure and report their emissions and take action to mitigate emissions. EU regulation (adopted in November 2023) goes further and includes strict limits on methane emissions from coal mines and requires the fossil fuel industry to create inventories of legacy assets and take action to mitigate their emissions.

The new EU and USA regulations will require regular measurement surveys of assets. This is a technical and logistical challenge as the infrastructure and knowledge to measure and quantify emissions with high precision at site-specific scales is the subject of ongoing academic endeavour. A thriving commercial sector is rising to meet this survey challenge and there are environmental survey companies in the UK that stand ready to meet this challenge, which are working alongside academics. Standardised and highly transparent approaches to emissions quantification are needed if data are to be reliable and trusted by regulators and the UNFCCC. There is much to do to ensure openness and standardisation of such measurement approaches at present (both domestic and international), with some commercial enterprises seeking to protect proprietary methods and therefore obscuring transparency. To counter this, and build trust and accuracy, regulation and international standards (e.g. ISOs) need to be developed. UK academia and the UK's National Physical Laboratory could have a leading role to play to facilitate this.

The UK urgently needs to develop domestic methane emissions regulation, perhaps using EU regulation as an appropriate template. This is especially important post-Brexit and the machinery for creating new UK regulation must keep pace if we are to meet the Global Methane Pledge and Net Zero.

What progress is being made on methane monitoring and data collection in the UK using technologies such as satellite data and drones?

The University of Manchester has done significant work (e.g. Shaw et al., 2021, Yong et al., 2024, Allen et al., 2019) to develop, validate, and standardize methane emissions quantification methods using UAVs (i.e. drones) since 2014. Much of our early work to develop UAVs as a methane quantification tool was funded by the UK Environment Agency with a view to developing regulation for its use. The University of Manchester has worked with companies such as FlyLogix, SurveyAR, and Mirico in the UK to help develop capability for UAV emissions quantification, but the market in the UK is currently limited as there is no regulatory driver or requirement on emitters to directly measure and report their emissions. Such a requirement would be of great benefit to Ricardo Plc (as the UK's current inventory compiler) and would provide direct metrics of success in meeting emissions reduction targets by sector. However, methane monitoring at scale will need to become a commercial activity to meet the needs of regulation similar to that in the USA and EU. There is a continuing need for academic input to the commercial sector to ensure that measurements are as accurate as possible.

Satellites such as TROPOMI, GHGSat, and the recently launched MethaneSat, can all offer additional data (for the largest emitters). TROPOMI can be useful for national-scale accounting (but not for individual emitters). GHGSat and MethaneSat are "point and stare" satellites – they need to be tasked to observe individual emitters and so rely on prior knowledge, or expectations. Even then, satellites are only suitable for the largest of emission sources (e.g. for large leaks, or national emergencies such as the Elgin blowout disaster in 2012). As an example, the point source limit of detection of GHGSat is around 100 kg per hour (under ideal conditions), which is very large by comparison to emitters such as UK landfill etc.

In summary, there is no single technology or measurement that can capture all methane emission sources at all scales, all of the time. Instead, a menu of technologies is needed, suited to their respective strengths at different scales and for different sectors. For example, UAVs are well suited to site-specific monitoring in a prescribed framework (perhaps defined by regulation), whereas satellites and national capability aircraft such as the UK's FAAM facility, offer taskable solutions for known (or suspected) super-emitters.

Are there sources that could be mitigated quickly and easily in the short term, and which would take longer or be more complex?

As efforts to diversify the UK's energy mix continue, identifying and reducing fugitive emissions from the natural gas sector is an immediate win-win for climate, energy security and consumers. Methane lost to leaks is not only climate-warming, but lost profit, and a burden on consumers. Legal incentives (through regulation that defines emissions limits) and infrastructure investment to avoid, detect, and rapidly mitigate fugitive emissions may help with this. There is also scope for better capture of methane at active and historic landfill and legacy oil and gas assets, some of which are currently unknown and/or not adopted.

Longer term, agriculture and wastewater treatment represent less immediately tangible targets. However, efforts such as methane capture at source (over slurry at farms for example), or methane avoidance (by alternative feedstocks), offer potential. Energy policy to replace and wind down natural gas use (and pursue carbon capture and storage) is essential to achieving Net Zero by 2050.

To what extent is there existing regulation in each emitting sector to mitigate methane emissions, and how well is this working? Given the regulations already in place for methane reduction in the waste sector, why are emissions from the waste sector static over recent years? Are existing regulations monitored and enforced?

Current regulation is evidently not working to drive emissions down further and progress on emissions reduction has stalled since 2014 (Figure 1). Where it exists, current regulation is designed to ensure best industrial practice (in only some sectors such as oil and gas and waste), not to limit emissions directly. For example, landfill regulation considers waste capping and methane capture, but it does not define any specific emissions limit (or percentage of waste mass). Methane-specific regulation for wastewater and agriculture does not exist to the best of my knowledge. If we are to incentivize meaningful methane emissions reduction, dynamic limits on emissions suited to each sector are needed. The UK's recent stagnation in emissions reduction is testament to this. As discussed earlier, there are excellent EU policy analogues that could inform UK policy.

To what extent will improved methane captured at landfill sites, remain necessary to reduce methane emissions after March 2026?

It will remain necessary. It may also need to be improved, especially for historic landfills that were abandoned prior to modern regulation that mandated capping and methane capture.

Are there further methane reductions that could be made in the UK fossil fuels sector (e.g., oil, gas or other fossil fuels), or at a faster pace? What impact would bringing forward the ban on flaring and venting have on both emissions and the industry?

Flaring of methane (especially in offshore oil and gas and onshore refineries) is a reducible source. The North Sea Transition Authority (NSTA) regulates flaring and venting under the Energy Act 1976 (as amended by the Energy Act 2016) and the Petroleum Act 1998. The 2021 NSTA strategy expects that there will be zero routine flaring and venting by 2030 and that all new developments should be planned and developed based on zero routine flaring and venting.

Our work in 2019 quantified emissions from controlled venting (attempted flaring) associated with the UK's first exploratory hydraulic fracturing well using UAVs. In this case, methane was emitted during a well unloading event from an onshore flare without flare ignition, resulting in an estimated emission of 4.2 Tonnes of methane over the course of several days in 2019. This was a breach of an Environment Agency site permit and was reported to the regulator by the operator directly. It is believed that the flare could not be ignited as the concentration of methane was too low to be ignited. Events such as this are not compatible with the 2021 NSTA strategy and care needs to be taken that fugitive emissions such as this are avoided entirely. Monitoring will be required to ensure compliance with this regulatory requirement.

How can we ensure that reducing methane emissions in the oil and gas sector are not at the expense of reducing CO_2 emissions?

These are not mutually exclusive – a reduction in methane is not, by definition, at the expense of CO_2. Methane and CO_2 emissions from oil and gas activity occur in different contexts but both are critical to climate action. Methane emission from the oil and gas sector is exclusively fugitive, while CO_2 results directly from the use of fossil fuels for energy (or flaring activity). In that sense, the only way to avoid CO_2 emission is to limit the use of fossil fuels and/or to securely capture it at source. Carbon capture and storage (CCS) is expected to be a highly expensive process. Methane emissions reduction concerns controlling fugitive emissions (for as long as an oil and gas sector exists). Thus, the only circumstance in which there would be direct conflict between methane reduction and CO_2 emission from oil and gas is the potential scenario where investment in methane reduction was made at the expense of investment in CCS (as CO_2 emissions happen at the point of combustion).

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