

Stakeholder Meeting of the Greenhouse Gas Emissions and Feedback Programme 12 March 2014, Royal Society, London

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Executive Summary

The Greenhouse Gases (GHG) Emissions and Feedback Programme (GHG Programme) held its first stakeholder consultation meeting on 12 March 2014 at the Royal Society in London. 38 participants from government, industry and the third sector discussed the state of the research in the Programme and requirements from stakeholders.

The GHG Programme, funded by the Natural Environment Research Council (NERC), comprises three individual projects: GAUGE focuses on atmospheric measurements and modelling over the whole UK, GREENHOUSE measures and model terrestrial biogenic GHG fluxes over the UK landscape, and RAGNARoCC analyses the GHG budget of the North Atlantic region. Together these consortia have started a programme of comprehensive measurements which will lead to improved GHG inventories and to a better understanding of the processes involved, and allow the independent verification of GHG emissions.

The meeting discussed expectations and requirements that science, society, policymakers and business have towards research into GHGs. The expectations from stakeholders are summarised by the following recommendations:

- **1. Communicate data and uncertainties:** The relevance of GHG measurements, the level of uncertainty associated with these measurements and the meaning of these uncertainties should be widely communicated to the general public and policymakers.
- **2. Evidence-based policies:** Political decisions and the legal framework regulating GHG emissions should be based on scientific evidence, and they should aim to provide long-term stability for investments. The GHG programme should provide suitable evidence that is usable and accessible to businesses, policymakers and other users.
- **3. Develop and support new business opportunities:** Monitoring and reducing GHG emissions offers opportunities for innovative engineering and service solution, particularly for small and medium-sized enterprises. The scientific community should support the development of such opportunities.
- **4. Continued stakeholder engagement:** The GHG Programme should continue to engage with stakeholders and extend these engagement activities to other stakeholder groups that are not yet involved, in particular small businesses, the media and the public.

About the meeting and this document

The Greenhouse Gases Emissions and Feedback Programme (GHG Programme) held its first stakeholder consultation meeting at the Royal Society in London on 12th March 2014.

The overarching objective of GHG Programme, which is funded by the Natural Environment Research Council (NERC) and involves a number of research partners, is to deliver improved greenhouse gas (GHG) inventories and predictions both for the UK, and for the globe at a regional scale. This is being done by developing a programme of comprehensive measurement and data analysis, focusing on the key GHGs carbon dioxide, methane, and nitrous oxide. Ultimately this should allow for the independent verification of GHG emission estimates, thus enabling the development of effective mitigation strategies.

The aim of this relatively small stakeholder meeting was to engage with interested, relevant parties from industry and government, by providing information on the background and context of the projects, along with an update on the progress of the projects, and an indication of future plans and expectations of the research.

A total of 38 participants attended the meeting: 29 invited representatives from selected stakeholder groups, and 9 representatives from the GHG Programme projects. Some invited participants had previous links to the GHG Programme research partners (e.g. from previous research activities, or through support letters), but an important objective was also to forge new links to a wider range of stakeholder groups.

The meeting was held under Chatham House Rules. Therefore, this document reports the contributions and discussions anonymously and does not attribute statements or identify individual participants. An exception are the main presentations, covering the research within the GHG Programme and the views from funders, which are publicly available on the GHG Programme website¹ and are referred to where appropriate.

This report aims to record the open and free discussions at the meeting, and opinions reported here are not official positions of the organisers.

¹ <http://www.greenhouse-gases.org.uk>

Research projects in the GHG Programme

The Programme comprises three projects, GAUGE, GREENHOUSE and RAGNARoCC, each focussing on a different aspect of the GHG budget, complemented by integrative activities. The focus is on the three most important GHGs, carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O).

The projects started at different times in 2013 and are now in their early stages. One of the aims of this stakeholder meeting was to inform stakeholders about the aims and the current status of these projects. This section gives short summaries of the individual projects and the view from the funders. More details can be found in the presentations, which are downloadable as PDF files from the GHG website².

GAUGE (Greenhouse gAs Uk and Global Emissions)

Prof. Paul Palmer (The University of Edinburgh) presented an overview over the aims and the current status of the GAUGE consortium. GAUGE works in the context of national and international commitments to reduce GHG emissions. The objective is to quantify the UK GHG budget (also in a European and global context) in order to monitor these reduction targets independently, and to understand the regional contribution of different sources and sinks.

The challenge is to develop a comprehensive, multi-year and interlinked measurement and data analysis programme. GAUGE uses a range of measurements. In cooperation with DECC, the existing network of tall tower sites, which use installations like telecommunication towers as platform for atmospheric measurements, has been enhanced by additional instruments and is already providing data, for example isotope measurements which allow to attribute the observed variability to natural and anthropogenic emissions. GAUGE and Defra are working with local communities and have installed gas analysers in several church towers in East Anglia quantifying GHG emissions from agricultural activities. The UK's Facility for Airborne Atmospheric Measurements (FAAM) provides its BAe146 research aircraft, funded by NERC, for a range of flights over the UK from May 2014 into 2015. Space-borne data links the research on UK emissions to larger scales.

Numerical models are then used to integrate the data and attribute the observed atmospheric variability to regional sources and sinks of GHGs, producing emission estimates and their uncertainties.

With this combination of novel measurements and modelling, GAUGE will deliver robust regional flux estimates of CO₂, CH₄ and N₂O.

GREENHOUSE (Generating Regional Emissions Estimates with a Novel Hierarchy of Observations and Upscaled Simulation Experiments)

Prof. Mathew Williams (The University of Edinburgh) presented an overview over the GREENHOUSE consortium. GREENHOUSE uses a bottom-up approach to investigate the processes of biogenic GHG emissions, which are determined by a complex net of plant-soil-microbial interactions. Currently, there are large uncertainties in our knowledge of some of these processes, and it is necessary to understand the response of GHG fluxes to drivers such as

² <http://www.greenhouse-gases.org.uk>

meteorological conditions, land use and land management. Taking into account landscape variability and topography, the overall goal is to develop spatio-temporal upscaling frameworks for terrestrial GHG fluxes over dominant UK land covers and land uses.

The consortium uses a hierarchy of measurements across the scales. The first intense field campaign has started in Lincolnshire over arable land, and future campaigns will look at intensive grazing and forestry. GREENHOUSE is also drawing together long-term measurements for temporal and spatial upscaling using satellite and airborne data of land surface, land cover and land temperature.

The data from these campaigns will be used to improve the parameterisation of biogenic processes in land use models. This will help to assess the impacts of land use practices and the uncertainties in GHG flux estimates due to landscape heterogeneity, model errors and other factors.

RAGNARoCC (Radiatively Active Gases from the North Atlantic region – Role of Climate Change)

Dr. Richard Sanders (National Oceanography Centre) summarised the RAGNARoCC project, which looks at the role of the North Atlantic in the global GHG budget.

The ocean is a small (but non-trivial) source of CH₄ and N₂O, but a massive sink for CO₂. Approximately a quarter of the anthropogenic carbon is stored in the oceans, mostly in the North Atlantic. The objective of RAGNARoCC is to understand better why the North Atlantic is such an important sink, and how stable it is. The RAGNARoCC activities will also help to shed light on the role of ocean acidification.

RAGNARoCC uses a combination of surface measurements, ocean interior measurements and modelling. Automatic sea surface measurements of CO₂ from ships of opportunity have been taken since 2002, and funds from the GHG Programme allow to continue this long-term programme. Observations of CH₄ and N₂O are sparse as they still require human intervention, but automatic, standalone systems are being developed within RAGNARoCC that can be deployed on ships of opportunity in future. Observations of the ocean interior, in particular the distribution of CO₂ with depth and CFCs as tracers of anthropogenic impacts, form the bedrock of our knowledge, but require cruises by specialised research vessels, so that data is only available ca. every five years. The first RAGNARoCC cruise, using the NERC research vessel James Clerk Ross, is planned for June/July this year.

Modelling activities will use satellite data of Sea Surface Temperature (SST) and wind to interpolate the sparse in-situ GHG measurements with the aim of providing more comprehensive maps. These will be used to investigate changes in the GHG fluxes that have been seen in Ocean General Circulation Models.

Integrative activities

The three research consortia are integrated and linked by a number of specific research activities. Data and models from different projects will be combined to improve terrestrial UK emissions and uncertainties and provide inverse estimates of North Atlantic fluxes. For example, integration work packages will measure the emissions from UK hotspots in greater detail – the first campaign on a UK landfill site is planned for August – and contribute to our understanding of GHG fluxes over shelf seas.

Related research activities

The researchers in the GHG Programme are involved in numerous national and international activities, but during the discussions at this meeting, it was suggested that closer and more formal links should be created to specific initiatives, in particular the European Union's Integrated Carbon Observation System (ICOS) research infrastructure³, and to Big Data projects, for example projects under the European Open Data Strategy⁴, as these may contribute useful expertise in making GHG inventories accessible to a range of users and applications.

It is particularly important to build on the significant one-off effort of this research programme to stabilise UK GHG research and accounting, and develop a succession plan for long-term monitoring and research.

Government institutions

DECC

Laura Bates summarised the role of DECC in the GHG Programme. DECC's responsibility is to report on the UK GHG inventory in the context of national and international GHG targets, and produce national UK statistics. Inventory emissions are largely calculated based on activity data and emissions factors, but atmospheric measurements are used for inventory verification purposes, in particular from a network of four tall towers in the UK and Ireland which are also used by GAUGE (see above).

DECC is interested in developing better anthropogenic CO₂ estimates. There is a need to improve the geographic resolution of emission estimates based on atmospheric measurements, as well as the accuracy and precision from atmospheric observations to reduce the uncertainties. Currently there are unresolved discrepancies between GHG inventories and trends from atmospheric modelling and observations that need to be understood better, and the consortia in the GHG Programme will contribute useful insight.

Defra

Dr. Luke Spadavecchia gave an overview over the role of Defra in the GHG programme. Defra is responsible for agricultural emissions reporting. Under the IPCC methodology, agricultural emissions include nitrous oxide from fertilisers, methane from manure management and methane from ruminant livestock. Emissions from fuel use (e.g. tractors, heating and cooling) and the sequestration of soil carbon are covered in other sectors. Agricultural emissions contribute slightly less than 10% of the total GHG budget and have decreased by about 20% since 1990, mainly due to the retraction of the agricultural sector.

The current inventory methodology has some shortcomings, e.g. it is incapable of representing efficiency measures. Therefore Defra and the devolved administrations are developing an improved inventory programme under the Agricultural Greenhouse Gas Platform initiative⁵.

The GHG Programme offers a unique opportunity to link Defra's extensive measurement network to the modelling and upscaling efforts in GREENHOUSE, while GAUGE can provide an independent check of Defra's improved inventory model.

³ <http://www.icos-infrastructure.eu>

⁴ <http://ec.europa.eu/digital-agenda/en/open-data-0>

⁵ <http://www.ghgplatform.org.uk>

NERC

Vicki Norton presented the view from NERC. NERC are the funder of the GHG Programme and the main driver developing the programme.

Within the NERC themes, specific challenges and research gaps were identified that the GHG Programme is designed to address: There is a need to increase our knowledge of the carbon cycle, to understand the biogeochemistry that is driving the Earth's system, and to inform mitigation strategies. Therefore, the GHG Programme aims to develop the capability to measure and predict sources and sinks of major anthropogenic greenhouse gases.

The new NERC strategy “The business of the environment”, published in November 2013, also defines “managing environmental change” as one of the main societal challenges that NERC will continue to address.

Stakeholder discussion and recommendations

An important aim of the meeting was to provide stakeholder input. An extensive open discussion collected feedback, ideas and opinions from the attendees. We also encouraged the invited stakeholders to leave comments and thoughts on some key issues in written form on whiteboards placed in the room.

The following sections summarise these open discussions and the feedback received from the stakeholders. We organised these ideas and comments into four general themes, expressed as recommendations. Recommendation 1 focusses on the communication between science and society at large, recommendations 2 and 3 look at requirements in the business sector, while recommendation 4 is aimed at improving future stakeholder engagement within the GHG Programme.

Recommendation 1: Communicate data and uncertainties

Public engagement is an increasingly important aspect of today's research environment. In most scientific disciplines one of the main drivers for engagement is the desire to foster scientific interest and curiosity.

However, the specific research of the GHG Programme entails the need for meaningful engagement with policymakers and the general public that goes beyond general scientific interest. Practically all sectors of society, both on the level of organisations and individually, will have to contribute to mitigation efforts, adapt and change their behaviour, if GHG emissions are to be reduced successfully. Compared to other scientific disciplines, engagement with the public and with policymakers about GHG research is therefore much more integral to managing our future.

One important question is how uncertainties should be addressed. In the international scientific community, significant efforts go into quantifying and reducing uncertainties, for example by intercomparing different measurements and different methodological approaches (e.g. bottom-up estimates from emission inventories versus top-down estimates from atmospheric measurements, or model intercomparisons and model validation with empirical measurements). The GHG Programme contributes to these efforts.

However, uncertainties cannot be removed completely and may even remain quite large in some specific questions for the foreseeable future, and society should resist the temptation to use such uncertainties as an excuse for inaction. This raises the question how the meaning of uncertainties

should be communicated in a useful way to policymakers and the general public. In this context, it is interesting to compare the public discourse regarding GHGs and climate change to the public discourse in other areas of science: In all disciplines, scientists are in general agreement about the broad questions and the bulk of the field, but uncertain or in disagreement about some details. In most disciplines, public events or media programmes tend to present mostly the areas of agreements as a coherent story, while debates about the areas of uncertainties and competing ideas take place mostly within the scientific community. In fields related to climate change, however, similar areas of uncertainty or disagreements tend to be picked up and get amplified and sometimes misunderstood in the public discourse.

These differences are also due to the fact that climate science and policy are much more in the public discourse, with much more concrete policy implications, than most other fields of scientific inquiry. Therefore, more detailed scrutiny also by non-scientists is to be expected, and it is not possible and not even desirable to avoid that.

Participants also expressed the feeling that large sectors of society are not interested in GHG research, as GHG emissions don't have immediate and direct effect on individuals. In contrast, there is considerable interest in the health effects of pollution. Can interest in GHGs be raised by linking them to other types of pollution? However, while GHG emissions are sometimes linked to other emissions, GHGs have no direct health effects, and in general the issues around GHG emission and mitigation are very different from other environmental concerns. Other ideas are necessary to make research into GHG emissions more interesting and relevant to a wide audience.

Recommendation 2: Evidence-based policies

Recommendations 2 and 3 are focussed particularly on the requirements of the business sector. The commercial world is an important stakeholder in the context of GHGs, but the role of businesses and industry is diverse and not easily defined in simple categories, reflecting the diversity of the modern economy. Two main aspects were identified: Companies are affected by regulatory frameworks aimed at reducing GHG emissions as well as other environmental legislation (Recommendation 2), but new business opportunities also arise out of the requirement to understand, monitor and reduce emissions (Recommendation 3, below). To a certain degree, larger companies ("big business") are more affected by the regulatory challenges, while "small business" benefits more from new opportunities. However, it should be noted that this is a simplified picture; most larger and international companies, e.g., have operations in different sectors.

Regulatory frameworks affect companies in different ways. One obvious issue is the need to reduce the consumption of fossil fuels, which directly impacts companies whose business is based on the production and trade of fossil fuels. Another, possibly more widespread issue is that many industrial processes are capital-intensive; they are long-term activities which rely on stable economic and regulatory conditions on time-scales of decades. This applies not only to the exploration of natural resources, but also manufacturing.

Companies are influenced by laws, by industry standards and by targets, and industry representatives at the meeting pointed out that businesses are not generally opposed to such regulatory frameworks. However, the main concerns are that regulations are based on solid science ("not on the whims of politicians", as one participant poignantly put it), that they are consistent and lead to stable regimes over decades, and that they create a level playing field. The last point is particularly relevant for multinational companies which are able to shift their operations to different countries, and companies that face international competition.

The UK's Climate Change Act, which was the result of a 20-year process and creates long-term targets, was mentioned as a positive example that respects these concerns while addressing societal needs. A negative example, on the other hand, is the framework for biofuel, which was initially (in the 1990s) strongly promoted, but then lost support due to the re-evaluation of land-use factors on GHG emissions accounting, leading to large economic uncertainties and inefficient use of capital investment. Aquaculture was mentioned as one area where there is currently a need to develop an evidence-based approach.

The scientific community can contribute information and datasets that policymakers need for an evidence-based approach, noting that it is also important to consider uncertainties appropriately (see recommendation 1). Once policy instruments are implemented, it is also necessary to monitor their impact on GHG emissions. In some areas, e.g. agriculture and land-use practices, it is particularly important to separate the impact of policy changes from other environmental changes or meteorological variability.

Recommendation 3: Develop and support new business opportunities

National and international GHG targets create many new business opportunities, both for established and for startup companies.

One particular area is the need to monitor emissions on a variety of scales, which creates not only an opportunity for instrument manufacturers, but also for service companies that set up monitoring networks operationally and process and analyse the data. However, there are numerous questions around the commercialisation of data and the concept of “science as a service”. Generally, cheaper, more frequent and regular long-term datasets are needed that are internationally comparable, but there are not enough opportunities to fund these.

International knowledge exchange also creates new opportunities. While many environmental and energy technologies are quite mature in industrialised countries, their use in emerging and developing nations is patchy. Consulting engineering companies have found many fields to work in, but the international economic and legal environment can be challenging; new technologies may need decades to get certified.

Generally, there is now a vibrant service and technology industry in mitigation and adaptation, with new technologies aimed at answering very specific questions being developed all the time, and new business models emerging.

The scientific community can support these business opportunities through knowledge exchange. This requires continuous engagement between the scientific community and commercial enterprises with the aim of establishing how commercial companies can help addressing scientific questions, and how scientific findings and the needs of the scientific community can create new business opportunities.

Recommendation 4: Future stakeholder engagement

Reducing GHG emissions is a challenge for the whole society, and the GHG programme intends not only to increase to our scientific understanding, but also contribute to the necessary societal debates. This meeting therefore gathered ideas and discussed which relevant players should be approached and be involved in future stakeholder engagement activities. However, in order to be attractive to key players, engagement activities have to be meaningful for each specific group. Instead of general stakeholder meetings, different events should be arranged that are tailored to specific stakeholder groups.

The GHG Programme already has well-established links to government organisations. Future activities should strengthen these links, in particular to the devolved administrations and also more regional and local levels. Such engagement with government groups and policymakers should aim to establish how the scientific community can provide data and information in suitable formats that are needed for evidence-based policies (see Recommendation 2).

Engagement with a wide range of businesses and industry should also be a focus, and there is potentially a lot of interest in GHG research due to the business threats, challenges and opportunities described above. Future engagement initiatives should bring the scientific and the business communities together, in particular with a view of finding and developing new opportunities for small and medium-sized enterprises. However, it is important to “speak the language of practitioners” to be relevant and worthwhile for industry.

A key group that also should be targeted more specifically are farmers - agricultural emissions contribute about 10% to the total UK GHG emissions, and changes in farming practice can reduce these significantly at low cost. Indeed, changes in agricultural practices can be both beneficial to the environment and economically sensible for the farmers; promoting the feeling of a win-win-situation can help to attract farming communities.

As GHG emission reduction is a challenge for the whole society, particular emphasis should also be placed on reaching the general public. One suggestion to achieve this was to invite journalists from the mass media to future stakeholder meetings. However, while such a meeting might be valuable for individual interested journalists, it may not be newsworthy enough to attract significant reporting, and other opportunities to engage the media and the general public will be more relevant. In particular, an important media opportunity will arise when the GHG Programme publishes its improved GHG inventories or other significant research findings.

To engage with such a wide range of different stakeholder groups successfully, the scientific community should seek access to additional translational skills and develop the expertise to communicate with other communities that will have different kinds of experiences, background knowledge and priorities. The GHG Programme should use a wide range of methods of engaging with stakeholders and society; besides meetings and academic publications, the science of GHGs and implications for society should also be communicated, e.g., in non-technical publications, websites, public engagement activities and on social media.