



Department  
for Environment  
Food & Rural Affairs

# The Greenhouse Gas Action Plan for Agriculture Review 2016

March 2017



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# 1 Introduction

1.1 The Greenhouse Gas Action Plan (GHGAP) for Agriculture is an industry led undertaking and the principal mechanism for delivering reductions in emissions from agriculture in England. The action plan brings together key organisations representative of the breadth of the agricultural industry to provide a catalyst for collective action. Government also contributes substantially to reducing GHG emissions through a range of initiatives, which complement the GHGAP, for example: the development of new Agri-technologies, and new Centres of Agricultural Innovation.

1.2 The 2016 review of the Greenhouse Gas Action Plan is a follow up to the review completed by Defra in 2012. This second review takes a critical look at the performance of the GHGAP during the period 2012 through to end of 2016. The review draws on evidence from a range of sources to illustrate the activities undertaken as part of the action plan and assess their effectiveness. The review aims to:

Establish the level of progress being made towards industries' commitment to a reduction target of at least 3 million tonnes of carbon dioxide equivalent per year (3MtCO<sub>2</sub>e) by the end of the third carbon budget period (2022).

Highlight the strengths and weaknesses of the approach and recommend changes that could improve performance.

Highlight the links between the GHGAP and Government's long term thinking for Food, Farming and the Environment.

Look ahead to the challenges that the GHGAP will need to address during the next phase of activity alongside other support from Government.

## 2 Summary: messages and recommendations

2.1 Good progress has been made – but, there is still more to do

It is estimated that a 1Mt CO<sub>2</sub>e reduction has been achieved as of 2016. The estimate of progress is sourced from the Agricultural Statistics and Climate Change publication<sup>1</sup>, modelled by looking at the impacts of current uptake of relevant mitigation measures that are covered by the GHGAP. Rates of uptake are mainly taken from the Farm Practices Survey<sup>2</sup> (FPS) which covers a range of mitigation methods, including those relating to

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<sup>1</sup> This Defra publication brings together a range of statistics that relate directly and indirectly to emissions and includes an annual summary of the GHG indicators.

<sup>2</sup> [www.gov.uk/government/statistics/farm-practices-survey-february-2015-greenhouse-gas-mitigation-practices](http://www.gov.uk/government/statistics/farm-practices-survey-february-2015-greenhouse-gas-mitigation-practices)

organic fertiliser management and application. The GHGAP promotes a wide range of measures not all of which are covered by the FPS, for example some activities around management skills and advice. These activities are fed into the review via the GHGAP progress report and Phase III strategy and activities<sup>3</sup>.

The GHGAP has helped to drive the uptake of mitigation methods that have delivered just under a third of the target reduction in emissions. To achieve the target of 3MtCO<sub>2</sub>e by 2022 the GHGAP has to drive further uptake of mitigation methods already proving effective. It must also be a vehicle for identifying and driving uptake of new mitigation methods that will increase the potential for emissions reduction. The pace at which mitigation methods are taken up needs to increase, in line with the ambition for reductions in emissions.

The next full review of the GHGAP will be in 2020. However, an ongoing dialogue between the GHGAP and Government will help to ensure that opportunities to maximise mitigation potential are fully exploited whenever possible.

## 2.2 Strengths and weaknesses - industry should lead but improvements in reporting required

Government's preferred approach is to continue with the voluntary GHGAP, with industry taking the lead and government providing support where appropriate, for example helping to identify the most effective mitigation methods.

There is further scope for the GHGAP to be more targeted and specific, identifying key technologies and approaches for the sectors with the greatest scope to reduce emissions by addressing productivity issues. The GHGAP could provide the catalyst required for industry to take a proactive lead in promoting strategies such as; better herd health planning or integrated nutrient planning and management.

The GHGAP should include measurable objectives linked to specific mitigation activities and a process for reporting their progress. Improved progress reporting will provide a key data source to enable links between activities and outcomes to be identified and measured. Attributing outcomes to specific activities is difficult, but improved data sharing by all parties should help to identify the links between activities and outcomes.

## 2.3 Links to Defra's long term plans for Food, Farming and the Environment

The outcome of the referendum to exit the EU provides an opportunity to develop a new vision for British food and farming and our relationship to the natural environment.

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<sup>3</sup> GHGAP progress report <http://www.cfeonline.org.uk/home/about-us/greenhouse-gas-action-plan/>

Improving resource efficiency, including reducing GHG emissions, will be an important part of the thinking that underpins the new vision of the future.

## 3 Background to the 2016 review

3.1 The Climate Change Act 2008 established a target for the UK to reduce its GHG emissions by 80%<sup>4</sup> by 2050. All sectors of the economy, including the agriculture sector, must contribute towards this target and to ensure that regular progress is made, a system of 5 yearly Carbon Budget targets was established to plan the trajectory of emissions reductions. These represent a 'cap' on the amount of GHGs emitted in the UK over a five-year period.

- Carbon Budget 1 - 26% below 1990 levels in 2008-12
- Carbon Budget 2 - 31% below 1990 levels in 2013-17
- Carbon Budget 3 - 37% below 1990 levels in 2018-22
- Carbon Budget 4 - 52% below 1990 levels in 2023-27
- Carbon Budget 5 - 57% below 1990 levels in 2028-32

The UK met the first carbon budget and projections show that we are on track to meet the second and third budgets. However, current projections are that the UK will face a challenge in achieving the reduction levels required in carbon budgets 4 and 5.

3.2 These targets apply to the economy as a whole and are not sector specific, so there is no separate budget for agriculture. Nevertheless, after setting a carbon budget, the Act requires the government to lay before Parliament its proposals for meeting the carbon budgets in a carbon plan. It is recognised that different sectors of the economy will need to reduce their emissions at different rates due to costs and limitations of available technologies. Reducing emissions from all sectors of the economy as cost effectively as possible relies on English agriculture reducing its annual emissions by at least 3MtCO<sub>2e</sub> by the end of 2022.

3.3 In order to achieve this goal a Climate Change Steering Group of representative industry bodies was set up. The Steering Group produced a frame work for action in 2010 (the Greenhouse Gas Action Plan<sup>5</sup>) following agreement that the 3MtCO<sub>2e</sub> per year figure was a realistic and achievable ambition. A first phase delivery plan subsequently set out the actions that the GHGAP partners planned to take forward over the period 2010 to 2012. The Carbon Plan<sup>6</sup>, published in December 2011 following the setting of the fourth carbon budget, reaffirmed the government's support for the GHGAP.

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<sup>4</sup> From 1990 levels

<sup>5</sup> <http://www.cfeonline.org.uk/home/about-us/greenhouse-gas-action-plan/>

<sup>6</sup> [The Carbon Plan: Delivering our low carbon future](#)

3.4 The 2012 Defra review of the GHGAP acknowledged the progress made by the industry so far and concluded that the overall ambition of reducing annual GHG emissions from agriculture by 3MtCO<sub>2</sub>e by 2022 was achievable, subject to continued focus and effort. The 2012 review also suggested that the industry should set out specific success criteria for how the novel approaches developed by the GHGAP will encourage change.

3.5 A subsequent review of Environmental Advice, Incentives and Partnership Approaches (EAIPA) for the farming sector in England<sup>7</sup> was published in March 2013. This set out the challenge to deliver a more integrated, streamlined and efficient approach to providing advice on the environment in England. One of its key messages was to recognise the contribution and effectiveness of voluntary led approaches, such as the GHGAP. These types of approaches are central to encouraging both effective environmental outcomes and efficient farm businesses. The report also highlights how the Campaign for the Farmed Environment (CFE), which brings together a range of industry, advice and environmental partners, has established a coherent approach across the key industry-led initiatives under its 2013-2016 Delivery Plan, including the GHGAP. The GHGAP was formally incorporated into the CFE on 1 April 2013.

3.6 Defra supports the GHGAP by providing scientific data to help understand the factors that drive GHG production and identifying the actions that can help to reduce it. In partnership with the Devolved Administrations, government is investing over £12.5 million over a four and a half year period to improve the Science base and to strengthen our understanding of on farm emissions through the GHG Research and Development Platform<sup>8</sup>. This work will refine the UK agricultural GHG inventory, the key tool for understanding the origin and magnitude of UK emissions.

3.7 In 2016 Defra are implementing a much improved agricultural inventory that will include UK specific emissions data for GHGs associated with soil nutrient management. A fully revised GHG inventory model is planned for 2017, which will include an improved representation of the UK livestock sector. When complete, this work should enable greater precision in reporting GHG emissions from the sector, including explicit accounting for on farm efficiency measures that improve agricultural efficiency. This will allow government, working with industry, to identify and target further measures to reduce emissions.

## 4 Devolved Administrations

4.1 As an additional reference we have looked at the approaches being taken in the Devolved Administrations to identify examples of good practice and lessons learned that could be of benefit to the GHGAP. European Union supported implementation plans and

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<sup>7</sup> [Review of environmental advice, incentives and partnership approaches for the farming sector in England \(27 March 2013\)](#)

<sup>8</sup> The UK GHG Research and Development Platform: [www.ghgplatform.org.uk](http://www.ghgplatform.org.uk)

support measures across all the Devolved Administrations will be kept under review in light of the UK vote to leave the EU.

## Scotland

4.2 Scotland has a number of initiatives including showcasing different mitigation activities (i.e. 'Farming for a better climate'), nutrient management planning for permanent pastures/soils. Two new measures were announced in response to the publication of the Scottish Greenhouse Gas Emissions Statistics for 2013<sup>9</sup>. These comprise of compulsory soil testing on all improved agricultural land; and new action to reduce wastage by improving livestock health.

## Wales

4.3 Following its Review of Land Use Climate Change (October 2014), the Welsh Government and the Industry are currently developing a detailed action plan which puts Climate Change at the core of mainstream agriculture and food policy development. The main areas of focus of climate change action are:

- Adaptation / Resilience
- GHG Mitigation
- Innovation and Commercial opportunity
- Developing Indicators and Monitoring Progress

4.4 The areas of focus will link directly with Environment (Wales) Act which will establish carbon budgets, and the Well-being of Future Generations Act which sets out the seven goals of sustainability and five new ways of working. This legislative framework will support multiple policy objectives for the land and the people of Wales. Going forward the emerging Strategic Framework for Welsh Agriculture – a high level collaboration between the Industry and government will be responsible for monitoring progress against the agreed actions.

4.5 The advisory service for Wales (Farming Connect), has adopted Climate Change as a cross-cutting theme. Farming Connect is tasked to integrate climate issues into its mainstream activity. A programme of Continuous Professional Development is being delivered to up-skill advisors and ensure that farmers have the relevant and practical advice to increase their farm business' economic and climate change resilience.

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<sup>9</sup> <http://news.scotland.gov.uk/News/Scotland-on-track-for-2020-climate-targets-19c0.aspx>.



## Northern Ireland

4.6 Northern Ireland has a well-established voluntary partnership, the Agriculture and Forestry Greenhouse Gas Implementation Partnership, comprised of government, the agriculture sector and environmental interests. The Partnership published its Phase One report on their 'Efficient Farming Cuts Greenhouse Gases Strategy and Action Plan' in 2014, highlighting the considerable progress made against the key objectives of raising awareness of on-farm mitigation and efficiency measures and establishing a robust research and evidence base on which local action can be taken.

4.7 The next phase of the Efficient Farming Implementation Plan is currently under development. The plan will focus on increasing the implementation of climate and environment efficiency measures. There will also be a focus on improving both the measurement and monitoring of performance. An important action is to establish a Northern Ireland average figure for the carbon intensity of key agricultural commodities, commencing with a litre of milk, which will direct future mitigation activities and ambitions for the sector. The ongoing need to raise awareness during this next phase is recognised and the Partnership will continue to promote resource efficiency messages, which has been found to be an effective way in which to engage the sector.

## 5 Industry's approach to reducing GHG emissions

5.1 The GHGAP is an overarching framework allowing fourteen organisations representative of the breadth of the agricultural industry in England to work together in common purpose. A Steering group provides a catalyst for collective action and enables a strategic approach to the delivery by seeking to avoid duplication and add value e.g. developing Sector Roadmaps is one of the strategic approaches adopted to focus on tangible gains through improved productivity. The overarching approach of the GHGAP is based on a set of core objectives:

Establish a robust partnership that will stimulate and deliver an industry-led approach thereby reducing the need for regulation.

- Improve awareness amongst farmers and growers of GHG emissions and of the particular farm practices that will improve efficiency and business performance, whilst simultaneously reducing emissions.
- Drive the implementation of on-farm practices that reduce GHG emissions per unit of production in a manner that promotes animal health and welfare and environmental protection by:
  - Improving the use of science continuously to update technical advice and decision making tools;

- Developing innovative, effective means of delivering business and technical advice to farmers and growers that motivates and enables them to adopt improved practices;
  - Enhancing partnerships and networks to improve the breadth of awareness in each sector and stimulate uptake and adoption of innovative and beneficial practices.
- Work effectively with the GHG Platform<sup>10</sup> funded by government to share information and data that will enable progress in reducing GHG emissions in the agriculture sector to be better estimated over time.

5.2 In this first phase of delivery, the GHGAP focussed on giving advisers the tools and knowledge to help farmers across a range of activities adding value to work already being taken forward. Consistency of message and providing easy access to the latest guidance and science was critical to ensuring that the industry made the link between improving production efficiency, land management decisions, and the associated benefits for farm profitability, and for GHG reduction. The 2012 review focussed on the first phase of delivery.

5.3 The second phase of delivery (2012-2015) has focussed on the consolidating the progress made in phase 1, strengthening both delivery and areas of collaboration and co-operation with existing industry and government initiatives.

5.4 The GHGAP Steering Group is committed to reporting on progress so that farmers and land managers can be confident that their changes in farm practice are leading to lower emissions. The Steering Group have worked closely with the UK GHG research and development platform to source data to improve the agricultural inventory. The Steering Group recognise that there is further work to be done in identifying robust indicators of progress and believe that monitoring the impact of the GHGAP's activities and hence changes in on-farm practice remain a challenge.

## 6 Methodology and evidence sources

6.1 The evidence sources used in the review provide a range of information highlighting both broad thematic trends and specific areas of detail. The evidence is both qualitative and quantitative. The qualitative evidence draws on opinions and experience from both government contracted and industry advisors in addition to members of the Steering Group.

6.2 Quantitative evidence is built up from established data and factual information. This approach enables the review to focus on elements of the GHGAP that are proving successful and those that are less effective; in some cases failing to engage or encourage

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<sup>10</sup> [www.ghgplatform.org.uk](http://www.ghgplatform.org.uk)

farmers to implement different mitigation activities. The evidence underpins an assessment of the relative strengths and weaknesses of the GHGAP and enables the review to provide constructive criticism, comment and recommendations. The review references three key quantitative evidence sources:

## **The 7th edition of Agricultural Statistics and Climate Change<sup>11</sup>**

The seventh edition is an overview of previously published national level statistics on agriculture and provides context to the current understanding of agriculture and GHGs.

## **2016 Farm Practice Survey data (February 2016 survey)**

This survey focusses on the 5 key areas activities that correspond to the GHGAP.

## **The GHGAP progress report**

This report is provided by the GHGAP steering group. The report details progress against activities identified as key deliverables in the GHGAP and includes 5 key areas highlighted in the Farm Practice Survey. The report provides both quantitative data (e.g. from the British Survey of Fertiliser Practice, Defra census, sector roadmaps and industry initiatives etc.) and qualitative information which includes case studies that illustrate how mitigation measures are put into to practice on farm.

6.2 The 2012 review evaluated progress across 5 key areas of activity which corresponded to indicators identified in the GHGAP. We have taken the same approach in the 2016 review to maintain consistency. Data from the 2012 FPS provides an established baseline against which we can assess progress against the same 5 key areas in the 2016 review. Not all of the reduction activities undertaken by the agriculture sector can be directly attributed to the GHGAP. However, all emissions reduction activity counts towards achieving 3MtCO<sub>2</sub>e reduction by 2022. The table displayed below summarises the 5 key areas and the corresponding GHGAP activity. The table also highlights Government actions in the same space. The table includes some relevant additional areas of activity.

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<sup>11</sup> [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/544518/agriclimate-7edition-9aug16.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/544518/agriclimate-7edition-9aug16.pdf)

## Key areas of activity

1	<b>Animal husbandry and improved health and welfare</b>	<ul style="list-style-type: none"> <li>- <b>GHGAP:</b> Improvements in prevention and management of chronic disease Initiatives, mainly through the Agricultural and Horticultural Development Board (AHDB). Raising awareness of subclinical disease/infections. Promoting feeding efficiency by working on an industry standard Ruminant plan and finding alternatives to soya.</li> </ul>
2	<b>Livestock breeding – genetic improvement potential</b>	<ul style="list-style-type: none"> <li>- <b>GHGAP:</b> Better genetic quality in dairy initiatives, mainly through AHDB, raising awareness of improvements in fertility and genetics.</li> <li>- <b>Government:</b> Defra is now working with industry to realise efficiency benefits from breeding via a £1.5M investment over 5 years in a Beef Genetic Improvement network.</li> </ul>
3	<b>Soil and land management</b>	<ul style="list-style-type: none"> <li>- <b>GHGAP:</b> Farmer engagement via the Campaign for the Farmed Environment (CFE). During 2016, with Government support, the CFE will be delivering events on resource protection which address the GHGAP’s priorities around soil and land management.</li> </ul>
4	<b>Crop nutrient/crop health management</b>	<ul style="list-style-type: none"> <li>- <b>GHGAP:</b> Improved uptake of precision nutrient management techniques. A range of collaborative activities including: additional training in GHG mitigation for advisers in crop nutrient management, manure management guidance and targeted activities through the ‘Tried and Tested’ campaign.</li> <li>- <b>Government:</b> Government is currently investing £160M in agri-technological innovation and development through the Agri-tech strategy, to help take our world class agricultural research to the farm. A number of projects focus on precision agriculture where farmers can use data from field sensors, drones or satellites to use only the fertilisers and pesticides they need, reducing costs and emissions.</li> </ul>
5	<b>Management, skills,</b>	<ul style="list-style-type: none"> <li>- <b>GHGAP:</b> Improvements in efficiency of milk production systems via extension activities FACTS<sup>12</sup> and Feed Advisor</li> </ul>

<sup>12</sup> Fertiliser Advisers Certification and Training Scheme (FACTS).

	<b>advice and guidance.</b>	<p>Register (FAR) training and productivity improvements captured by carbon foot-printing studies. Promoting use of continuing professional development (CPD) to help drive knowledge and uptake of GHG mitigation practices. Includes addition of GHG mitigation to FACTS training course, introduction of Feed Advisers Register, encouraging CPD amongst farmers and organising farmer events and activities.</p> <ul style="list-style-type: none"> <li>- <b>Government:</b> Defra is working with the Department for Business, Energy and Industrial Strategy (BEIS) on the Agri-Tech Strategy, which is investing £160m of government funding between 2014 and 2019 in agricultural technologies and innovations. The strategy is co-funded by industry and is addressing industry priorities. The funding is split between “Agri-Tech Catalyst” projects to accelerate the development of new Agri-technologies, and new Centres of Agricultural Innovation. These innovative technologies could further contribute to agricultural efficiency and the reduction of GHG emissions from the sector.</li> </ul>
	<b>Energy efficiency and renewables</b>	<ul style="list-style-type: none"> <li>- <b>GHGAP:</b> A range of information published by the GHGAP partners including updates on energy efficiency, renewable energy technologies and Government incentives.</li> </ul>
	<b>Cross sector initiatives</b>	<ul style="list-style-type: none"> <li>- <b>Courtauld 2025</b> is a commitment by stakeholders across the UK food &amp; drink system – from producer to consumer – to work together to respond to pressures on increasingly scarce resources. The aim is to feed the growing UK population by providing more with less. Courtauld 2025 will take a whole food supply chain approach to food sustainability. A key target will be a 20% per capita reduction in the GHG emissions associated with production and consumption of food &amp; drink in the UK – with an interim milestone of 5% per capita reduction by 2018.</li> </ul>

6.3 The qualitative evidence sources used in the review provide a range of information highlighting both thematic trends and specific areas of detail. A combination of one to one interviews with the GHGAP Steering Group, a targeted survey of farm advisors delivering the Farm Advisory Service (FAS) and published evidence from Industry provides the data that underpins the qualitative narrative.

## **One to one interviews with GHGAP industry task force members**

A series of interviews with members of the GHGAP Steering Group has helped to improve our understanding of how the action plan is managed, operates and delivers. The interviews have also provided insights into the evolving attitudes throughout the agriculture industry towards climate change, what motivates mitigation activity and the barriers to action. The process was objective and independent, being led by a Defra social scientist with experience in undertaking qualitative research. This work is covered by the Government Social Research standards that ensure that the research is robust and complies with the ethics code covering informed consent, confidentiality and use of the data.

## **Farming Advice Service (FAS) advisor survey**

This survey focuses on advisers contact with farmer clients, asking questions about the visibility of the action plan, mitigation and adaptation activities undertaken and farmer attitudes to climate change. The results are based on responses from a sample of 12 advisers with a collective client base of over 1,000 farms across England. Although climate change related advice is not the main focus of their activity they are still ideally placed to pick up on the penetration of the subject and levels of comprehension within the industry. The survey respondents are not part of the GHGAP partnership of organisations and therefore provide a comparative view.

# **7 Qualitative review findings**

7.1 A summary was drawn from interviews conducted with the Steering Group members directly involved with the strategic oversight and delivery of the GHGAP. The exercise consisted of a series of interviews with members of the GHGAP Steering Group to help improve our understanding of how the action plan is managed, operates and delivers.

## **Farmers are more responsive to integrated messages**

Industry is receptive to the climate change message, but it needs to be delivered in an integrated way. Climate Change and GHG emissions reductions were not seen as a feasible entry subject for engagement. Farmers relate positively to communication and messages that are delivered through the medium of improving practices e.g. nutrient management planning. Respondents noted some positive changes in the way the message about GHG reduction is being received; but the focus on productivity, will continue to be the key point of engagement going forward.

## **Confidence in the leadership and direction**

The Steering Group are strongly supportive of the governance and the leading role of National Farmers Union (NFU) and the Agriculture Industries Confederation (AIC); and regard the GHGAP as a success. There is recognition, however, that more can be done and the GHGAP provides a good platform for this. A lot of activity is co-ordinated through the steering group e.g. communicating messages tuned to improving productivity. The steering group provide evidence of 'on farm' uptake of better practice and understanding that is increasing efficiency and reducing emissions.

## **Recognition of the importance of focussing on communication**

Respondents focused on the need to give a consistent message aligned to existing activities, not a separate GHG message. Messages should be linked with those areas farmers are actively seeking advice on, for example production efficiency. The GHGAP should therefore focus on strengthening the knowledge base by providing evidence based advice and focussing on clear, succinct messages, delivered in a practical way.

## **Difficulties in attributing impact and measuring success**

There was general agreement that the 3Mt target is challenging, but it provides a focus for action, although, this may not directly resonate with farmers. All respondents highlighted the difficulty of measuring impact. Work on the new inventory was widely seen as an important step towards developing a better understanding of progress towards the 3Mt goal. Government's work, with the Devolved Administrations, to improve the inventory was recognised and the hope is that it will provide a clearer understanding of the baseline and outcomes that underpin the reduction target.

## **Good examples of impact**

There are good examples of impact, many of these are embedded in other initiatives focussing on crop storage, and generally improving practice e.g. nutrient management in cereals production. This illustrates the GHGAP strategy of not starting something new or duplicating effort. The GHGAP's messaging is integrated into existing initiatives allowing it to focus its efforts on filling the gaps.

Most interventions set out to improve sustainability and productivity more generally - which is key to the GHGAP. There was a consensus that management practice amongst most farmers is improving and that there are few technological barriers; although the need to work with farmers investment cycles is a key factor. There is also recognition that improvements take time – this is sometimes expressed as a behavioural lag and that profitability leads to a willingness to change.

## Clear link with government and shared goals

Respondents highlighted the need to continue to look for emissions reductions but stressed that industry bodies can only be facilitators in the drive to achieve the target – ‘we don’t run farmer’s businesses’. Some respondents noted that direct Defra and Committee on Climate Change (CCC) engagement is important both from a policy and evidence perspective i.e. the importance of statistical series data e.g. from the Farm Practice Survey. Many respondents do not currently see regulation as an option. This is based on the view that Defra is a department with a clear deregulatory agenda with a focus on supporting improvements in productivity and efficiency. Respondents also noted that there is greater scope for both thinking more holistically about land use and increasing collective working including aligning other investment incentives for example Countryside Productivity.

7.2 A summary of the responses to the survey of agricultural advisers working for the Farm Advisory Service.

- Although the survey results show broadly similar response patterns across respondents, they are from a small sample of advisers not necessarily involved in specific CPD on GHG mitigation (note: that FAS advisers were not a key target audience for the GHGAP). Advisers observed that there has been some increasing awareness of GHG related issues. The survey indicates that this is due to range of factors and not specifically the GHGAP. The survey also indicates that full engagement with the GHGAP is still relatively low amongst advisers and the majority of farmers are not aware of it. The conclusion that can be drawn is that key messages are being conveyed effectively but not necessarily directly linked to the GHGAP.
- There is still work to be done across the industry to increase understanding and awareness of the GHG mitigation practices. However, farmers are taking action to reduce emissions, although these are largely seen as by-products of efficiency improvements the term “climate change” was considered to be a turn off for many farmers.
- The advisers surveyed broadly categorised their clients as cautious about change, but the results also show that many farmers are keen to consider new ideas especially if they will improve farm efficiency. Key areas coming through for possible action to increase take up of mitigation measures were:
  - emphasis on the link between actions that reduce GHG emissions and also benefit farm profitability, and the link between profitability itself and action,
  - more and better information and advice,
  - financial incentives,
  - methods to reach farmers who don’t usually attend events.



### 7.3 Using the data collated for the review we have drawn the following conclusions:

- The GHGAP has an effective Steering group that demonstrates clear leadership and provides a catalyst for activity. Under the umbrella of the GHGAP the Steering group members represent and take forward actions under the banner of their individual organisations.
- The Steering group recognise the strengths of having an overarching framework (the GHGAP) to focus actions taken forward by their individual organisations and deliver maximum benefit.
- Theoretical models of behaviours suggest that awareness can influence attitudes and that, along with belief, can drive behaviours. In this case, that link is less pronounced as practices are more determined by other factors such as financial rather than changes in awareness and attitudes towards climate change. In this respect, outcomes, in terms of emissions reductions, are achieved by influencing actions through resource use and efficiency messages rather than trying to explain the emissions reduction story as the catalyst for actions.
- The findings suggest business reasons are the main motivation for taking action, which is apparent in responses from the FAS survey, Steering Group interviews and industry references.
- The Steering Group should be more pro-active in engaging the sceptical groups and individuals across the agriculture industry, concentrating on resource efficiency and improvements in productivity as the means to effect change.
- There is further scope for the GHGAP to be more targeted and specific, identifying key technologies and approaches for the sectors of the agriculture industry emitting the most significant levels of GHG emissions e.g. the livestock sector. The GHGAP could provide the catalyst required for industry to take a proactive lead in promoting strategies such as promoting better herd health planning or soil fertility management.
- The Steering group should work with and be supported by Government to deliver a more targeted approach for phase three of the GHGAP. Improving the level of awareness and engagement across the industry to ensure that the 'harder to reach groups are buying into the GHGAP.

## 8 Quantitative review findings

### 8.1 Farm Practice survey data key findings on emissions:

- Just under half of farms (48%) in 2016 considered it fairly or very important to consider greenhouse gases (GHG) when taking decisions about their land, crops and livestock. This is a slight decrease from 52% in 2015.

- In 2016, 57% of farmers reported that they were currently taking action to reduce greenhouse gas emissions from their farm. The most common actions taken by this group were recycling of waste materials from the farm (87%) and improving energy efficiency (79%). Whilst recycling of waste materials has not changed significantly over time improving energy efficiency has increased by over 10% compared to 2013 (the first year data are available).
- The most common motivation for taking any action was that it was considered to be good business practice to do so. This has been the case for the past three years.
- For those not taking action to reduce GHG emissions, the most common reason preventing them was a perception that their farms did not produce a significant amount of emissions.

## 8.2 The 7<sup>th</sup> edition of Agricultural Statistics and Climate Change<sup>13</sup>

- There are a wide range of farm practices that can reduce GHG emissions from agriculture. Monitoring the uptake of these mitigation methods provides an indicator of progress towards achieving the industry's ambition to reduce agricultural production emissions by 3MtCO<sub>2</sub>e by 2022 compared to a 2007 baseline.
- Mitigation methods related to nutrient management (e.g. fertiliser spreader calibration) collectively provide the greatest potential emissions reduction (0.9Mt CO<sub>2</sub>e). By 2016, uptake of these methods has been assessed to have delivered an estimated GHG reduction of just under 0.4Mt CO<sub>2</sub>e, around 37% of the maximum technical potential reduction for this method.
- By February 2016, approximately 1MtCO<sub>2</sub>e reduction per year in GHG emissions had been achieved across the wider range of farm practice. Nutrient management equating to almost half of all mitigation achieved.

8.3 The GHGAP progress report and Phase III strategy and activities<sup>14</sup>. During the second phase of its delivery the GHGAP has delivered a significant number of activities. The GHGAP has identified 15 on-farm actions providing the basis for continuing professional development schemes for advisers, and since 1st April 2013 has greatly improved local engagement as a result of coming under the Campaign for the Farmed Environment (CFE) national and local co-ordination and delivery umbrella. The majority of

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<sup>13</sup> *Agricultural statistics and Climate Change, 7<sup>th</sup> Edition, August 2016*, Department for Environment and Rural Affairs  
[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/544518/agriclimate-7edition-9aug16.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/544518/agriclimate-7edition-9aug16.pdf)

<sup>14</sup> <http://www.cfeonline.org.uk/home/about-us/greenhouse-gas-action-plan/>

this document reports on progress from 2012-2015 for each of the GHGAP’s priority areas, using the following structure:

- Key indicators of progress, outcomes, GHGAP activity and direction of travel
- Reflections on longer-term trends and GHGAP activity
- Case studies demonstrating change at the farm scale
- Identification of key next steps for the phase III (2016-2020)

8.4 Review of GHGAP: table of quantitative findings. Where possible a comparison has been made with 2012 data. Where data from a later year has been used, this is shown in the “data source”. Symbols have been used to provide an indication of progress.

Indicator description		Indicator symbol
Little or no change		≈
Insufficient or no comparable data		...
Improvement		✓
Deterioration		✗
Key activity area	<b>1. Management, skills and advice</b>	
Corresponding GHGAP activity	<ul style="list-style-type: none"> <li>• Promoting use of CPD to help drive knowledge and uptake of GHG mitigation practices. Includes addition of GHG mitigation to FACTS<sup>15</sup> training course, introduction of Feed Advisers Register, encouraging CPD amongst farmers and organising farmer events and activities.</li> </ul>	
Related survey data	<ul style="list-style-type: none"> <li>• % farmers who think it “very important” or “fairly important” to consider GHGs when taking decisions about their land, crops or livestock</li> <li>• % of farmers reporting that they were currently taking action to reduce GHG emissions from their farm.</li> <li>• % of farms not taking action to reduce GHGs citing “lack of information” or “too many conflicting views on the issue”.</li> </ul>	<p>48% ≈</p> <p>57% ≈</p> <p>64% ≈</p>
Data source	Defra Farm Practices Survey, 2016. Comparison with 2013 survey data.	

<sup>15</sup> Fertiliser Advisers Certification and Training Scheme (FACTS).

## GHGAP activity – Management, skills and advice

The GHGAP has driven the uptake of GHG mitigation knowledge by the suite of industry initiatives which aim to support the improving long-term trend. The increasing professionalism amongst advisers is of significant note i.e. dedicated commitment from feed advisers who have developed their competence to help livestock farmers implement GHGAP actions, specific CPD training for crop nutrition advisers on nitrogen use efficiency and the GHGAP's on-farm actions.

On a smaller scale, but a demonstration of the GHGAP's belief in the value of professional advice, the Agriculture and Horticulture Development Board (AHDB - beef and lamb) are introducing a 'Developing Beef Expertise' CPD scheme for beef advisers to ensure well-trained and experienced consultants and advisers continue to be available to the beef industry. Farmers expect to see improvement as a result of adopting the latest available advice or the trust in and reputation of the professional adviser is lost. The AIC's 'Value of Advice' report sought to evaluate the scope and influence of the advice available and explain how policy developments, including GHG mitigation are a key part of the annual CPD of advisers and an effective conduit for GHGAP messaging. The value of face-to-face locally targeted advice is also proven through Defra's Catchment Sensitive Farming's evaluation programme.

GHGAP - Progress report and Phase III strategy and activities

Key activity area	<b>2. Crop nutrient (and crop health) management</b>	
Corresponding GHGAP activity	<ul style="list-style-type: none"> <li>A range of collaborative activities including: additional training in GHG mitigation for advisers in crop nutrient management (see above), manure management guidance and targeted activities through the Tried and Tested campaign.</li> </ul>	
Related survey data	<ul style="list-style-type: none"> <li>% of all farms with nutrient management plan                             <ul style="list-style-type: none"> <li>% of cereal farms with nutrient management plan</li> <li>% of general cropping farms with a nutrient management plan</li> </ul> </li> <li>% of farmed area covered by all farms with a plan.                             <ul style="list-style-type: none"> <li>% of area covered by cereal farms with a plan.</li> <li>% of area covered by general cropping farms a plan.</li> </ul> </li> <li>% of farms using Tried and Tested to create their nutrient management plan.</li> <li>% of farms with a plan that update it annually.</li> <li>% of farms with a plan that refer to it 5 times a year or more.</li> </ul>	<ul style="list-style-type: none"> <li>55% ✘</li> <li>83% ≈</li> <li>77% ≈</li> <li>72% ✘</li> <li>90% ≈</li> <li>89% ≈</li> <li>16% ≈</li> <li>77% ≈</li> <li>24% ≈</li> </ul>

## GHGAP activity - Crop nutrient (and crop health) management

The GHGAP has built on existing collaborative effort, working in synergy with the Tried & Tested (T&T) campaign to promote the use of nutrient management plans, including guidance for feed planning and manure management. The emphasis has been on making good the gap in information provision to farmers who do not have access to professional advice. It is reasonable to assume that the 18% of farmers using the resources disseminated by the T&T campaign, from 2009, are doing so as a direct result of the joint activities of T&T and GHGAP.

The AHDB has taken ownership of updating the national fertiliser recommendations (RB209). This forms part of an ambitious and collaborative programme of work being overseen by an AHDB-led UK Partnership for Crop Nutrient Management, which looks to publish a new nutrient management guide as early as 2017. This is strategically important for the GHGAP as plans for updating recommendations will be intrinsically bound into a UK research and knowledge transfer strategy for nutrient management.

### GHGAP- Progress report and Phase III strategy and activities

	<ul style="list-style-type: none"> <li>• % of farms with a manure management plan.</li> <li>• % of farms with manure, slurry or fertiliser spreaders which are computer controlled with variable rate application.</li> <li>• % of farms (with a fertiliser spreader) testing spread pattern at least annually (British Survey of Fertiliser Practice, 2015).</li> <li>• % of farms with more than 80% of temporary grassland sown with clover mix.</li> </ul>	<p>62% ✘</p> <p>25% ✓</p> <p>63% ≈</p> <p>33% ≈</p>
Data source	Defra Farm Practices Survey, 2016 (unless otherwise stated).	

Key activity area	<b>3. Soil and land management</b>	
Corresponding GHGAP activity	<ul style="list-style-type: none"> <li>• Farmer engagement via Campaign for the Farmed Environment (CFE) events. The CFE network has delivered events on resource use efficiency and resource protection which have addressed the GHGAP's priorities around soil and land management.</li> </ul>	
Related survey data	<ul style="list-style-type: none"> <li>• % of farms testing the nutrient content of soil.</li> <li>• % of farmed area covered by farms testing the nutrient content of soil.</li> <li>• % of farms testing the pH of soil.</li> <li>• % of farmed area covered by farms testing the pH of soil.</li> <li>• % of livestock farms "always" reducing stocking rates when fields excessively wet.</li> </ul>	<p>69% ≈</p> <p>84% ≈</p> <p>74% ≈</p> <p>86% ≈</p> <p>72% ...</p>

	<ul style="list-style-type: none"> <li>• % of livestock farms “routinely” taking action to keep livestock out of water courses.</li> <li>• % of farms taking action in the previous 12 months to reduce soil compaction by: Using low-pressure set ups Improving drainage Removing compaction from headlands after harvest</li> </ul>	61% ...  54% (2012) 62% (2012) 66% (2012)
Data source	Defra Farm Practices Survey, 2016 (unless otherwise stated). Comparison with 2013 survey.	

<h3>GHGAP activity - Soil and land management</h3> <p>The GHGAP has benefited considerably from joining the CFE umbrella of initiatives. From 2013 to June 2015, the CFE network delivered 373 events on resource protection and resource use efficiency. These would have specifically addressed the GHGAP’s priorities of soil and land management and crop nutrient management. In 2013/2014, 6428 farmer engagements were achieved across 347 events.</p> <p style="text-align: right;"><b>GHGAP - Progress report and Phase III strategy and activities</b></p>
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Key activity area	<b>4. Livestock nutrition</b>	
Corresponding GHGAP activity	Focus on promoting feeding efficiency by working on an industry standard Ruminant plan and finding alternatives to soya.	
Related survey data	<ul style="list-style-type: none"> <li>• % of farms using ration formulation or expert nutritional advice when planning cattle and sheep feeding regimes either “always” or “most of the time”.</li> <li>• % of cattle and sheep on farms using ration formulation or expert nutritional advice when planning cattle and sheep feeding regimes either “always” or “most of the time”.</li> <li>• % of livestock farms with more than 80% of temporary grassland sown with high sugar grasses.</li> <li>• % of taking action to reduce GHGs that are improving nitrogen feed efficiency in livestock diets.</li> </ul>	35% ✕  44% ≈  21% ≈  27% ≈
Data source	Defra Farm Practices Survey, 2016. For nitrogen feed efficiency and the percentage of cattle and sheep on farms using ration formulation the comparison with 2013 survey.	

## GHGAP activity - Livestock nutrition

The use of ration programmes or expert advice increases with farm/herd size. Therefore, the actual numbers of cattle, pigs and poultry managed according to a ration plan or advice will be much higher than that implied by the 35% of farms, overall livestock, referenced above.

Expert opinion from the AIC Feed suppliers is that 70% of the dairy herd is fed according to diet formulation and advice specific to species/age/other requirements. In dairy herds which rely on a mix of home grown forages and purchased feeds for their nutrition, there has been a reduction in dietary protein levels, despite increases in milk yields, which will have resulted in lower nitrogen emissions and CO<sub>2</sub>e reduction. Pig and poultry systems are distinctively different. 95% of the pig herd and 95% of the poultry flock receive complete tailored diets formulated specifically for the age profile of the herd/flock. Due to supply chain incentives, half of grass area, less than 5 years old has been sown with high sugar grasses.

GHGAP- Progress report and Phase III strategy and activities

Key activity area	<b>5. Livestock health and fertility</b>	
Corresponding GHGAP activity	Initiatives, mainly through the Agricultural and Horticultural Development Board (AHDB), raising awareness of subclinical disease/infections, improvements in fertility and genetics.	
Related survey data	<ul style="list-style-type: none"> <li>• % of livestock farms with a written farm health plan. 51% ✕</li> <li>• % of livestock farms with a plan that “routinely” use it plans to inform disease management decisions. 49% ≈</li> <li>• % of livestock farms routinely undertaking animal health and welfare disease management training. 13% ≈</li> <li>• % of farms using rams with a high Estimated Breeding Value (EBV) when breeding lambs either “always” or “most of the time”. 21% ✕</li> <li>• % of lambs on farms using rams with a high EBV when breeding lambs either “always” or “most of the time”. 29% ≈</li> <li>• % of farms with beef cattle using bulls with a high EBV when breeding beef cattle either “always” or “most of the time”. 33% ≈</li> <li>• % of beef cattle on farms using bulls with a high EBV when breeding beef cattle either “always” or “most of the time”. 44% ≈</li> <li>• % of farms using bulls with a high Profitable Lifetime Index (PLI) when breeding dairy cattle either “always” or “most of the time”. 45% ≈</li> <li>• % of dairy cows on farms using bulls with a high PLI when breeding dairy cattle either “always” or “most of the time”. 68% ≈</li> </ul>	

Data source	Defra Farm Practices Survey, 2016. For proportion livestock (dairy cows, beef cattle and lambs) on farms using high PLI or high EBV bulls and high EBV rams comparison with 2013 Survey.	
Data sources	Defra Farm Practices Survey, 2016, Defra Farm Business Survey, 2011/12.	

<b>GHGAP activity - Livestock health and fertility</b>
<p>Focus on advancing livestock health and fertility has concentrated on improving genetic resilience and the widespread application of Farm Health Plans or Fertility Improvement Plans. Progress has been static over recent years but advancements in livestock nutrition and support from industry and Government-led R&amp;D should help to reinvigorate future progress. Additional gains in productivity can be made particularly by improving health and take up of genetic traits to convert nutrients to protein as effectively as possible.</p> <p style="text-align: right;"><b>GHGAP - Progress report and Phase III strategy and activities</b></p>

Additional activity area	<b>6. Progress on energy efficiency and renewables</b>	
Corresponding GHGAP activity	<ul style="list-style-type: none"> <li>A range of information published by the GHGAP partners including updates on energy efficiency, renewable energy technologies and Government incentives.</li> </ul>	
Related survey data	<ul style="list-style-type: none"> <li>% farmers taking action to reduce GHG emissions who were improving energy efficiency as part of this (comparison with 2013).</li> <li>% of farmers processing waste<sup>16</sup> by anaerobic digestion (comparison with 2012)</li> <li>% of farm businesses currently undertaking energy generation practices<sup>17</sup> (Farm Business Survey 2011/12).</li> <li>% of farm businesses intending to undertake additional energy generation practices<sup>1</sup> within the next 2 years. (Farm Business Survey 2011/12).</li> </ul>	<p>79% ✓</p> <p>5% ✓</p> <p>16% ...</p> <p>21% ...</p>
Data sources	Defra Farm Practices Survey, 2016, Defra Farm Business Survey, 2011/12.	

<sup>16</sup> Slurries, crops, other feedstocks from on the holding, other feedstocks from outside the holding.

<sup>17</sup> Solar panels, Biomass fuelled heating boilers, exporting of slurry / grass / manure /miscanthus / biomass, Wind turbines, other renewable energy technology, anaerobic digestion, other.





## GHGAP activity - Progress on energy efficiency and renewables

GHGAP partners publish information on energy efficiency and renewable energy technologies, updates about government incentive schemes and online commentaries. Although some of the GHGAP partners work on energy efficiency is of long standing, new initiatives like AHDB (potatoes)'s 'Storecheck' have been introduced as a contribution to delivering the GHGAP's strategy. The renewable energy and energy efficiency industries themselves already advertise widely in the farming trade press. A number of Best Practice guidance documents have been agreed or prepared jointly between the agricultural trade associations and renewable energy trade associations (e.g. on solar farm site selection and management for agricultural benefit and biodiversity, on production of crops feedstocks for anaerobic digestion, etc.). The NFU has also taken an active role in policy development with government departments, e.g. the 2013/14 Solar PV Strategy, the 2011 AD Strategy.

GHGAP - Progress report and Phase III strategy and activities

8.4 Conclusion based on the quantitative data: the figures suggest that there have been incremental improvements in places but that this is patchy and overall there is a need to build more momentum in order to ensure further progress. The next phase of the GHGAP should focus on activities that drive more up-take of the indicators that appear to be falling behind or showing no appreciable progress.

## 9 Next steps

9.1 Based on the findings of the review the following actions are recommended to strengthen the performance of the GHGAP during its next phase of activity:

### Industry should continue to take the lead in reducing GHG emissions from agriculture

Industry should continue to take the lead in reducing GHG emissions from agriculture. Continuing with a voluntary initiative is the preferred approach, building on the progress already made. But, we also recognise that the GHGAP has to change gear to close the gap on the mitigation target of 3MtCO<sub>2</sub>e per year. It has to be more pro-active and have a clear strategy for achieving its objectives over the next 4 years.

## **The GHGAP should set out a communications strategy that sets out how messaging will be improved**

The review's qualitative evidence suggests that the Steering group continue to raise the profile of the GHGAP messages and increase engagement with agricultural advisors and other key influencers. Working with, and communicating through, advice channels that farmers already trust will help to; deliver key messages, make the link between mitigation actions and improved productivity and engage those who are not currently taking action.

## **The GHGAP should take a pro-active lead in identifying and driving take up of technologies and approaches that deliver the most effective reductions of emissions**

There is scope for the action plan to be more targeted and specific - identifying key technologies and approaches for the most significant sectors of GHG emissions production, in particular the livestock sector. There is a key role for industry to take a proactive lead in promoting specific strategies, for example promoting better herd health planning or integrated nutrient planning and management. Such approaches make optimal use of available manures and slurries as well as taking soil nitrogen supply into account.

The Steering group should work within their individual organisations and with government to identify the opportunities to maximise benefits and drive progress forward.

## **The GHGAP should set out a reporting and evaluation strategy that defines how improvements to attributing, evaluating and reporting progress will be achieved**

Attributing outcomes from the GHGAP has proved difficult. But, improved data sharing by all parties will help to deliver a better understanding of the relationship between on farm activity and reduction potential. Improved progress reporting by the Steering group will also provide a clearer link between activity and outcomes.

The format of the 2015 Steering group report has provided a far greater degree of detail and focus. Going forward the GHGAP should ensure that delivery activities are linked to outcomes where possible. Where there is a reliance on aggregate data it would help to identify which indicators are most important and where possible link these directly to specific mitigation actions.

## **10 Longer term challenge**

10.1 Currently agricultural emissions make up about 9% of the UK total GHG emissions (2013). As a result of other industries reducing their emissions and increased agricultural production, agriculture's contribution to UK GHG emissions could potentially rise to 14%

by 2035. The challenge will be for farming businesses to continue to improve production but at the same time reduce impacts on the environment.

10.2 GHG projections have been made for the UK Agriculture sector for the years 2014-2030 using the 1990-2013 inventory submission model. Economically Optimistic and Pessimistic scenarios are presented. For the economically pessimistic projection there is a reduction in total GHG emissions (as CO<sub>2</sub>e) from 2014 to 2030 of about 8%. For the economically optimistic scenario there is an increase in total GHG emissions from agriculture of about 7%. In the central scenario there is little long term change in agricultural emissions with a reduction of about 1% by 2030.

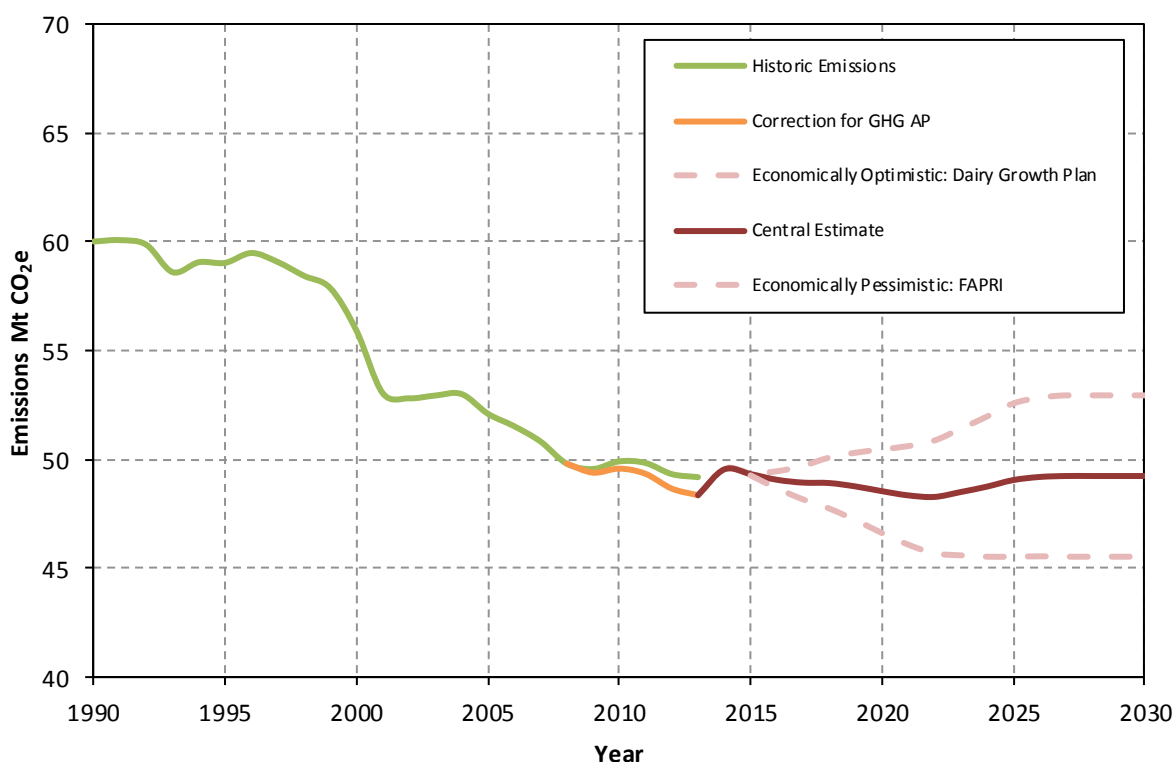


Figure 1: Historic and projected emissions of GHG from agriculture as Mt CO<sub>2</sub>e. The trajectory includes the impacts of policies.

10.3 Moving from carbon budget 3 to 4 there is scope to continue working with industry to deliver incremental mitigation measures. A good example is encouraging better herd health planning and uptake of energy efficiency measures:

- Addressing, through research and development, economically damaging endemic diseases that impact on livestock production should be a priority. Supporting the voluntary uptake of herd health planning could be a practical starting point.
- Promoting energy efficiency measures for space heating and grain drying should be a priority. This includes CHP and biomass boilers as well as improved insulation and temperature controls

- Encouraging the use of low emissions manure spreading technologies. This will have major air quality benefits as well.
- Voluntary approaches are the preferred way to change behaviour, but it may be necessary to implement policies to unlock some of this potential.

10.4 Incremental measures supported by a combination of industry initiatives, long term policy initiatives could go part of the way to delivering agriculture's share of carbon budget 4 and 5 reductions. However, the additional challenge presented by carbon budget 5 is likely to require serious consideration potentially radical approaches: transformational change driven by shifts in societal attitudes – potentially driven by policy intervention outside of the agriculture sector. The fifth carbon budget limits emissions to an annual average reduction of 57% over 2028-2032 (from 1990 levels).

10.5 Transformational change could also be influenced by independent industry led initiatives: Courtauld 2025 is a commitment by stakeholders across the UK food & drink system to work together and respond to pressures on increasingly scarce resources. The aim is to feed the growing UK population by providing more with less - taking a whole food supply chain approach to food sustainability. A key target will be a 20% per capita reduction in the GHG emissions associated with production and consumption of food & drink in the UK – with an interim milestone of 5% per capita reduction by 2018.

10.6 The Committee on Climate Change published its advice to government about the level for carbon budget 5 on 26 November 2015<sup>18</sup>. This recommends a range of specific cost effective mitigation measures for meeting the budget in the period between 2015 and 2032, although the CCC recognises that alternative measures could also be deployed in the future. There appears to be scope to reduce emissions from agriculture by pursuing improved productivity in the sector. For crops and soils this includes:

- Improving the nitrogen use efficiency plants via conventional breeding. There could also potential for GM or gene editing approaches, but more work is required to understand the full environmental and social implications of these technologies.
- Improved use of organic fertilisers such as manures, composts and anaerobic digestates. This includes improved storage, application planning and the possibility of pre-processing to improve the fertiliser replacement value and practicalities of transportation and use.
- Addressing soil compaction and improving our understanding of the role of 'soil health' in reducing emissions from agriculture.
- There may be scope to reduce emissions from fertilisers via the development of improved products that incorporate additives that reduce emissions of nitrous oxide and ammonia, such as inhibitors, polymer coatings or bio-stimulants. Whilst these are

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<sup>18</sup> [The Fifth Carbon Budget: The next step towards a low-carbon economy](#)

already commercially available further development may be required to understand and refine their efficacy and to reduce costs.

10.7 Reducing soil carbon emissions from peat soils is likely to become increasingly important. There is a role for agriculture in improving the climate impact of both upland and lowland peaty soils. Development of the evidence base is ongoing; this work will help us to better understand the impact of managing peaty soils on reducing emissions, particularly in the lowlands where a number of significant unknowns remain is being developed .

10.8 From the livestock sector improvements could be made through:

- Improved formulation of livestock diets, including better grassland utilisation, feed planning and matching of diets to livestock requirements
- Addressing economically damaging endemic diseases of livestock, improvements in animal health
- Livestock genetic improvement through improved breeding, particularly in the beef and sheep sectors

10.8 Meeting the challenge of carbon budgets 4 and 5 will potentially require the development of new agri-technologies, adoption of novel production systems and the development of innovative food products - possibly linked to changes in consumer behaviours, for example, reducing food waste.

10.9 Government is already investing in agri-technological innovation and development through the Agri-tech strategy. Defra is investing £160m in the UK Agri-Tech Strategy to help take our world class agricultural research to the farm. A number of projects focus on precision agriculture where farmers can use data from field sensors, drones or satellites to use only the fertilisers and pesticides they need, reducing costs and emissions. Defra has also set up a new Centre for Agricultural Informatics under the Agri-Tech Strategy. At least 8,000 data sets will be made freely available, helping food and farming achieve its full potential.

## 11 Conclusion

11.1 Government is required to ensure that GHG emissions are reduced in line with the targets set out in the carbon budgets across all industrial sectors. Defra has a specific responsibility for ensuring that the Agriculture sector reduces GHG emissions. Defra's current policy position is that the Agriculture sector should actively take the lead and continue with the GHGAP as the overarching vehicle for GHG reductions. Defra's relationship to the GHGAP has to be both supportive and critical; providing technical support but also keeping industry on course towards achieving reductions in GHG emissions.

11.2 Defra provides this support through a range of initiatives, for example: investing £1.5M over 5 years in a Beef Genetic Improvement network which focusses on breeding more efficient livestock to reduce emissions from agriculture by increasing the proportion of feed energy captured in food products. But, we also recognise industry has to develop its own solutions and momentum to achieve a reduction in GHG emissions by 3MtCO<sub>2e</sub> per year by the end of the third carbon budget period (2022).

11.3 It is likely that the challenge of meeting carbon budgets 4 and 5 will place increased expectations on the agriculture sector and therefore require a different approach to marshalling the sectors response. It however remains Defra's preferred option, for the foreseeable future i.e. the remainder of carbon budget 3, that industry continues to take the lead through the GHGAP. Industry is best placed to make choices about how to improve and implement on farm efficiencies. However, we also recognise that maintaining a collaborative dialogue with industry and a positive input into the process of delivering mitigation measures is beneficial. Defra's key role is to support the sector (specifically the GHGAP) by providing the science and evidence needed to ensure that mitigation activity is: focussed on the right measures, maximises reduction potential and is accurately reported.

11.4 Government is supporting investment and catalysing the development of innovative technologies that could play a part in meeting this challenge through the Agri-Tech Strategy. Government is also making significant investment in improving the Science base to strengthen our understanding of on farm emissions<sup>19</sup>. The Agriculture sector has to be informed, engaged and motivated; to that end Defra is, and will continue to, work in collaboration with industry to identify how we can most effectively support them.

## References

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<sup>19</sup> The UK GHG Research and Development Platform: [www.ghgplatform.org.uk](http://www.ghgplatform.org.uk)

- GHGAP progress report and Phase III strategy and activities  
[www.cfeonline.org.uk/home/about-us/greenhouse-gas-action-plan/](http://www.cfeonline.org.uk/home/about-us/greenhouse-gas-action-plan/)

## Annex A: GHGAP objectives going forward

Objective	Example outcome
<p><b>Management skills and advice</b></p> <p>To continually improve the knowledge and professionalism of advisers, farmers and growers by developing resources and management and business skills, filling in the gaps in CPD provision, and utilising the latest scientific updates.</p>	
<p>Produce an economic roadmap for implementation of technically feasible GHG and NH<sub>3</sub> reductions from manures and slurries</p>	<p>Technologies and practices promoted or implemented on-farm</p>
<p>Introduction of 'Developing Beef Expertise' and 'Developing Sheep Expertise' CPD programmes for beef and sheep consultants</p>	<p>Well-trained and experienced consultants and advisers available and in demand by farmers</p>
<p><b>Crop nutrient management</b></p> <p>Target continuous improvements in the accuracy of in-field measurement and application to optimise productivity in the cropping sector. Support the livestock sector in better manure management and the take-up of integrated nutrient management planning.</p>	
<p>Publish new AHDB Nutrient Management Guide</p>	<p>Nutrient management tools updated with the latest science to enable improved decision making</p>
<p>Promote new fertiliser spreading testing scheme</p>	<p>All spreaders - disc, boom and pendulum - are tested to the same standard</p>
<p>Increase manure management planning in beef sector</p>	<p>Campaign reverses apparent downturn in planning</p>
<p>Promote improved application of manures and sensing applications</p>	<p>Greater market penetration for precision technologies</p>
<p><b>Soil and land management</b></p> <p>Underpin productive and sustainable farming and the management of soil carbon by providing tools and information to help farmers and growers select the appropriate</p>	



management system and assess the capability of their land.	
Promote Healthy Grassland Soils to address soil structure, drainage and nutrients	Online resources and events in demand by livestock farmers
<b>Livestock nutrition</b> To improve understanding of the energy and protein requirements of livestock. Better planning of feed grown on-farm and what may need to be bought in. Promoting integration of feed and fertiliser strategies and improvements in feed conversion efficiency.	
Assess impact of tailored feed advice to 1000 farm businesses	Professional advice delivers demonstrable financial and mitigation benefits
Transfer of advice on quality forage production and integrated feed advice	GHG Research Platform results incorporated into feed and fertiliser adviser CPD.
Beef Feed Efficiency Project	Infrastructure for the measurement of feed efficiency in beef cattle delivered
<b>Livestock health and fertility</b> Promote integrated feed and health planning and assessment to manage risk of endemic disease and improve the efficiency of livestock production.	
Implement Sheep KPI project to encourage body condition scoring of ewes	Ewe body condition scoring is adopted as a tool to manage optimum ewe nutrition

# Annex B: Agricultural GHG Emissions

## Why Agriculture produces GHGs

Greenhouse gas emissions in agriculture are dominated by non CO<sub>2</sub> emissions that occur from three main sources:

- Emissions of methane from ruminant livestock burps: Ruminant livestock produce methane during their digestive processes. Micro-organisms in the rumen degrade carbon from feeds in the absence of oxygen, producing methane gas. This gas is subsequently emitted to air by eructation (burps). Emissions are affected by diet, health and livestock management. In addition it may be possible use treatments that regulate or destroy methane producing micro-organisms in the rumen.
- Emissions of nitrous oxide from fertilisers applied to land: Livestock excreta contain carbon and nitrogen that is subject to chemical transformation via biological processes. Depending on how excreta is managed and applied to land varying amounts of methane and nitrous oxide are produced.
- Emissions of methane and nitrous oxide from livestock manures during storage and application to land: A proportion of Nitrogen in fertilisers and manures is transformed to nitrous oxide during the biological processes of nitrification and denitrification. These processes are driven by soil bacteria and are mediated by soil type, soil management and weather. Emissions can be controlled to some extent by nutrient planning (quantity and timing), fertiliser application methods and management of soil condition.

In addition there are two CO<sub>2</sub> based sources of emissions from agriculture:

- Emissions of carbon dioxide from machinery use, heating etc.: these only account for about 9% of agricultural emissions. The 2016 inventory estimate of 4.7 Mt CO<sub>2</sub>e is likely an overestimate since agriculture, forestry and fisheries are conflated. These emissions can be controlled by low energy technologies, changes in management practice (e.g. minimum tillage) and implementation of renewable energy generation
- Emissions of carbon dioxide from land use change and land management: Soils store carbon at equilibrium concentrations that reflect the balance of organic material inputs versus biological turnover of carbon (breakdown of organic materials produces CO<sub>2</sub>). Croplands have lower soil carbon content than grasslands due to lower organic inputs and greater disturbance from ploughing etc. Across the UK lands converted to cropland produced about 12 Mt CO<sub>2</sub>e. About 10% of the cropland emissions result from historic drainage of lowland peat for agriculture. This is offset to some extent by land converted to pasture, which sequestered about 9 Mt CO<sub>2</sub>e. Agriculture was therefore a net source

of land use change emissions (3 Mt CO<sub>2</sub>e). Overall the land use land use change and forestry (LULUCF) sector was a net sink 9 Mt CO<sub>2</sub>e due to the large forest sink.

## How much GHG does Agriculture produce now?

As outlined above there are a number of sources of greenhouse gas emissions from agriculture. The Figure and table below summarise these for 2014, the most recent year national statistics are available for.

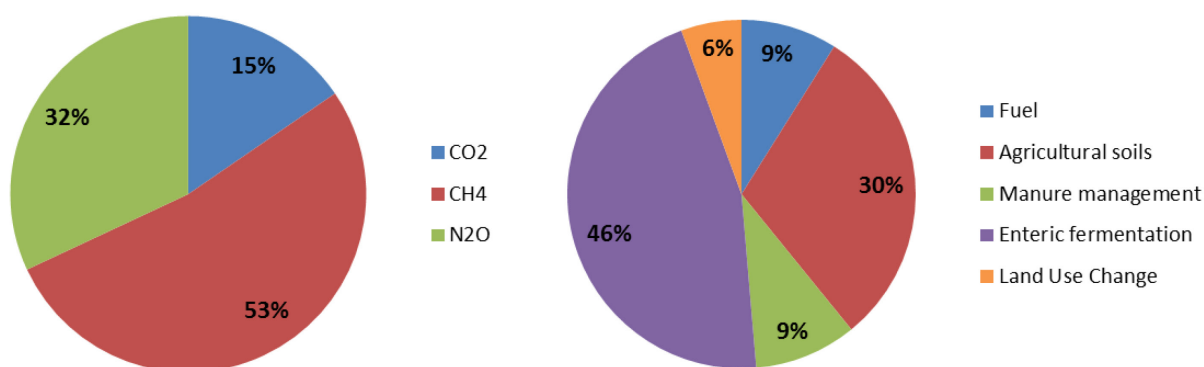


Figure 1: Breakdown of Agricultural Emissions by gas and source activity

Table 1: Sources of Agricultural Emissions

UK Agricultural GHG Emissions (2014) 1,000s tonnes				
	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O	CO <sub>2</sub> e
Fuel/Energy Use	4,109.1	2.8	1.6	4,654.5
Agricultural Soils	1,388.9	0.0	48.2	15,751.5
Manure Management	0.0	139.5	4.94	4,958.5
Livestock Enteric (burps)	0.0	953.8	0.0	23,846.0
Cropland Land Use Change	11,860.2	0.0	1.1	12,182.0
Grassland Land Use Change	-9,306.3	0.9	0.1	-9,254.1
<b>Total</b>	<b>5,498.0</b>	<b>1,096.1</b>	<b>54.7</b>	<b>52,138.4</b>

### Projections of Future GHG Emissions from Agriculture

GHG projections have been made for the UK Agriculture sector for the years 2014-2030 using the 1990-2013 inventory submission models. Economically Optimistic and Pessimistic scenarios are presented. For the economically pessimistic projection there is a reduction in total GHG emissions (as CO<sub>2</sub>e) from 2014 to 2030 of about 8%. For the

economically optimistic scenario there is an increase in total GHG emissions from agriculture of about 7%. In the central scenario there is little long term change in agricultural emissions with a reduction of about 1% by 2030.

Summary projections of GHG emissions are given graphically in Figure 2.

Figure 2

