

# Beef and Lamb Environmental Roadmap

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## Introduction: A Sustainable Future

Tackling climate change is arguably the most pressing global issue of our time, and the next few years are seen as a crucial time for action across the whole economy, including agriculture.

The UK is a signatory of the Paris Agreement which seeks to limit the global temperature rise to 1.5°C and has given effect to a number of its provisions in UK law through the Climate Change Acts. The UK's 2035 Nationally Determined Contribution (NDC) under the Paris Agreement commits the UK to reducing economy-wide greenhouse gas emissions by at least 81% by 2035, compared to 1990 levels<sup>i</sup>, aligning to the level of ambition in Carbon Budget 6 (2033-37) on the pathway to reaching net zero by 2050.

The Government has not yet set a sectoral target for UK agriculture, nor has Article 2 of the Paris Agreement been transposed into domestic law which requires signatories to lower net greenhouse gas emissions in a manner that 'does not threaten food production'<sup>ii</sup>.

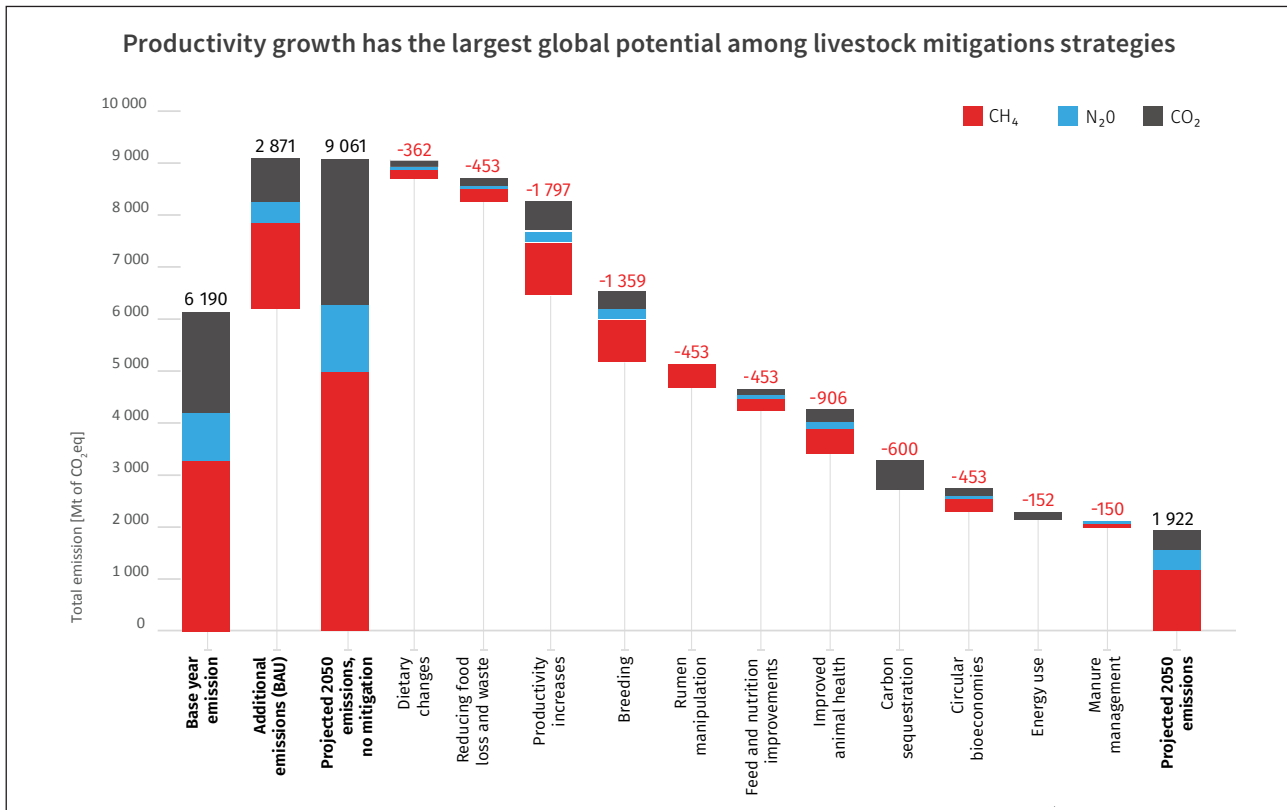
This Roadmap will seek to outline a route for the English and Welsh beef and lamb sector to work towards net zero by 2050, alongside other environmental goals, in a way that does not threaten UK food production and ensures economic sustainability of the sector. The focus of the Roadmap will be on emissions reductions in the first instance due to the UK's obligations under the Paris Agreement with the importance and extent of the sector's role in actively sequestering carbon also included as a fundamental component.

In the UK, agriculture as a total sector is estimated to account for 11% of total UK emissions, including 49% of all UK methane emissions (almost entirely from ruminants) and 71% of nitrous oxide emissions but just 1.9% of total UK CO<sub>2</sub> emissions<sup>iii</sup> with CO<sub>2</sub> being the largest emission in almost all other sectors of the economy.

*CAUTION: These figures, like almost all reference data in this area, are presented as CO<sub>2</sub> equivalent using Global Warming Potential 100 (GWP100) methodology to combine various GHGs into a single unit. There are a number of different methodologies which would create a significantly different view of the overall contribution of agriculture and livestock to warming, discussed later in the document.*

Any route to net zero requires the development and evaluation of mitigation or abatement strategies. A number of different organisations, both domestic and international, have proposed a range of abatement strategies for the beef and lamb sector.

The UN's Global Roadmap (2023) compared a range of strategies (see Fig 1 below). It concluded that the most promising ways to reduce emissions are by increased efficiency and productivity, focused breeding strategies, and proactive animal health management. Given this, and the need for 70% more food by 2050, the FAO goes on to determine that a 1.7% annual rise in global livestock production is required globally to achieve zero hunger targets. Ideally, most of that increase should come from countries such as the UK, where livestock production is among the most sustainable in the world, offering a unique opportunity to contribute to global food security whilst also protecting the environment. While each strategy is important to cutting emissions including the positive impact of genetics, feed efficiency, and animal health, dietary change globally has one of the lowest impacts.



**Figure 1. Pathway to lower livestock emissions. Source: FAO, 2023**

Base year and projected emissions to 2050 from livestock systems shown as a waterfall chart with a range of mitigation measures applied to showing their technical potential

**CAUTION:** It should again be noted that the chart is prepared on the basis of carbon dioxide equivalent emissions (CO<sub>2</sub>e) using the Global Warming Potential over 100 years (GWP100) methodology. If a different timescale is used, such as GWP20 or GWP\* a significantly different ranking of the abatement options would result.

British farming beef and lamb production is predominantly extensive and grass-based which is not the case in all major beef and lamb producing regions. Most global and regional comparisons show UK beef and lamb to be among the most sustainable, with emissions around one third lower than the global average.

The growing public interest, together with substantial political, environmental, and ethical pressures are now challenging the reputation of beef and lamb, with an increased demand for change. Given the enduring popularity of red meat among consumers, this pressure is perhaps more likely to be felt through regulatory interventions rather than consumer choice. UK Government plans to achieve net zero has been successfully challenged in the courts under the Climate Change Acts on more than one occasion<sup>iv</sup>, forcing the

Government to adopt more ambitious plans and this trend is likely to continue. To rise to this challenge, the English and Welsh beef and lamb sectors are working in multiple ways to simultaneously reduce environmental impacts, whilst increasing productivity.

To reach climate targets, avoid regulatory intervention, allay consumers' concerns and keep its place in future diets, the roadmap will show how livestock can contribute to the UK's legally binding target of net zero by 2050.

This document intends to set the scene for the beef and lamb sector demonstrating where the sector already is, what it needs to do, and sign-posting to the next steps. Subsequent phases will add value through identifying opportunities and evidencing progress.





## What is the Environmental Roadmap and what will it achieve?

The Roadmap aims to capture the ambition, goals, and commitments made towards improving the environmental sustainability of the English and Welsh beef and lamb sector.

The Roadmap reflects the collective position that the sector is striving to achieve. It encourages collaborative working to deliver action that will drive change at the sector level. In particular, the Roadmap will:

1. Show evidence of where the sector is now
2. Measure and report progress against industry targets
3. Identify mitigation measures that are evidenced and true
4. Identify evidence gaps and obstacles that could prevent us meeting the targets so the industry can decide how to tackle them

There are three cross-cutting issues, impacting progress in many areas, that will be considered as part of the Roadmap, that present both challenges and opportunities for the sector:

1. Farm data. There are many advantages of real farm data over broad averages, not least the ability of

individual farms to understand their impact and deploy relevant mitigations, however the many tools available (farm carbon calculators) are underdeveloped and inconsistent in their approach producing divergence in the estimates of individual farm impacts. Fortunately, this complexity has been acknowledged in the ongoing work of the Government's Food Data Transparency Partnership (FDTP)

2. Methodologies for combining different greenhouse gases into a single unit present particular challenges for agriculture. Unlike most other sectors of the economy, the vast majority of emissions are not carbon dioxide, and therefore the different methodologies deliver very different results.
3. Sequestration. Although widely acknowledged as an important effect of land management, the science underpinning the measurement and efficacy are underdeveloped and require more clarity. This can significantly impact the choice and priority of abatement options. Again, this is acknowledged by the FDTP.



Farmers do much more than produce food; they also provide a range of environmental services that are likely to become more important as we seek to limit climate change and environmental degradation. As custodians of 70% of the UK's land<sup>1</sup>, farmers provide a host of other 'public goods' including:

- producing safe, nutritious, and affordable food, rich in protein and essential vitamins and minerals that support human health
- protecting and promoting healthy and productive soils
- maintaining and adding to the millions of tonnes of carbon stocks locked up in our soils and trees
- improving water quality
- optimising biodiversity, both above and below

ground, often 'sharing' land with nature rather than competing with it.

- generating profits which contribute to overall economic growth
- managing landscape for social benefit
- underpinning the economic stability of rural communities

The Roadmap provides an excellent opportunity to highlight improvements to the environmental credentials of the English and Welsh beef and lamb sector. It will provide evidence of continual improvement enabling the sector to defend, protect and promote the home market and add value to exports by positively differentiating from products of other countries.





## What is the sector already doing?

Since 1990, there has been a 21% and 26% decline in UK cattle and sheep numbers respectively, perhaps largely due to various changes in the Common Agricultural Policy, such as the removal of headage payments in most of the UK. More recently, the numbers showed a further decrease between 2017 and 2020, but have been broadly stable since 2021, with 9.4 million cattle and 31 million sheep.<sup>vi</sup>

In 2022, the UK met 87% of its supply needs of beef and veal with home production, with mutton and lamb production exceeding net supply needs by 6.6%.<sup>vii</sup> However, we should be mindful that these overall figures do not show the challenge of carcass balance in order for our industry to deliver domestic consumer preferences.

The 2022/3 Farm Business Survey indicated almost all farms in England participated in at least one agri-environment activity including habitat creation (12%), woodland creation (20%) and soil management (46%)<sup>viii</sup>. Around half of all farms have registered some farmland within a specific scheme; among the most popular were hedgerow management, sowing of 'cover' crops or winter bird food and woodland creation. While many agri-environment schemes have clear decarbonisation and wider environmental benefits data on this is poor and this high level of participation does not currently provide any benefit to UK agriculture within the National Inventory. These linkages need to be improved.

The FAO highlight animal health as a key component to delivering sustainable livestock products<sup>ix</sup>. High standards of animal health and welfare underpin UK livestock farming, ensuring livestock are provided with comfort, feed, space, and the other essentials to allow them to thrive. Consistently treating animals well is not just the right thing to do, it also makes good business sense, as healthy, well-cared-for animals lead to reduced need for antibiotic usage, increased efficiency, and lower environmental impacts.

Breeding is another critical element of the FAO's *Pathways towards lower emissions*<sup>xiii</sup>, and the UK is at the forefront of genetic improvement in livestock. Genetic improvement and breeding practices in cattle and

sheep can contribute to reducing livestock emissions via herd and flock productivity and efficiency. Estimated breeding values (EBV) are used to value the genetic worth of animals using desirable traits such as meat production. In 2023, when breeding beef cattle, 32% of livestock holdings used bulls with a high EBV at least some of the time. In sheep, 36% used rams with a high EBV at least some of the time when breeding lambs<sup>x</sup>.

### Beef

Cattle in the UK are primarily fed on grass. They are ruminants, which convert plant material that is indigestible by humans to nutrient-dense food and readily available micronutrients and return carbon to the soil through their manures, reducing the requirement for emission-intense artificial fertilisers.

In fact, grass-derived feed amounts to 91% of the diet of UK beef cattle. This comprises fresh grass (74%) and conserved grass (17%), such as from hay, straw, and silage. The remainder of the diet is mostly made up of crop residues/co-products, grains, brassicas, and fodder beet<sup>xi</sup>.

From 1990 to 2021, there has been a decrease in the emissions intensity from cattle by 4%, i.e. emissions per unit of meat (CO<sub>2</sub>e per kg meat). This was due to both an overall decline in animal emissions and an increase in meat yield<sup>xii</sup>.



CAUTION: The international comparisons below use GWP100. GWP\* figures are included for domestic production only.

The UK has efficient beef production by international standards. The UK suckler beef footprint is estimated to be less than half the global average, at 49% of global average emissions<sup>xiii</sup>. Dairy-bred beef (Table 1) is estimated at 78% of the global average. Footprints based on UK farm data are for 32.37 kg CO<sub>2</sub>e/kg dwt and 22.05 CO<sub>2</sub>e/kg dwt for suckler and dairy beef respectively. For comparison, these figures are 11.65 CO<sub>2</sub>we/kg dwt and 10.27 CO<sub>2</sub>we/kg dwt respectively, when GWP\* is applied, more accurately reflecting the actual warming impact of the UK beef industry.

Beef from the dairy herd is estimated to have lower GHG emissions than suckler beef primarily due to the dam's emissions being largely attributed to the milk she produces, and shorter finishing times of entire dairy bulls.

## Sheep

Like cattle, sheep in the UK are also predominantly fed a grass-based diet. They are often farmed in hillier areas, particularly where cool summers and high rainfall make land unsuitable for growing crops. In these areas they demonstrate considerable resilience in their ability to turn grass from marginal land into nutritious protein and vital micronutrients. Careful management of sheep





grazing both in isolation or mixed with cattle enables the development of a mosaic of habitat in upland areas facilitating broader environmental benefits for both flora and fauna.

The UK sheep diet consists of 90% grass-derived feed – 60% from fresh grass and 30% from conserved grass – and the remainder mostly from other co-products/forages<sup>xiv</sup>.

The emissions intensity for sheep has fluctuated throughout the years between 1990 and 2021, although in 2021 it was estimated the emissions intensity was 5% higher than in 1990. Meat production and animal emissions also fluctuated between 1990 and 2021, with both showing similar overall declines of 24% and 20% respectively<sup>xv</sup>, meaning that despite animal emissions reducing, the kilogrammes of carbon dioxide equivalent per kilogramme of meat have increased due to a greater reduction in meat produced than animal emissions. This presents an opportunity for the sheep sector.

In Table 2, the footprint of UK sheep meat (both lamb and mutton) is estimated at 36% lower than the global average, at 37.4kg CO<sub>2</sub>e/kg meat<sup>x</sup>.

The farm type or system greatly affects the emissions in UK lamb production. Lowland systems produce less emissions per unit of output than upland systems. This is owing to the system being more productive (more kg meat) per hectare of land or per breeding ewe. The GHG emissions intensity of lamb produced by lowland systems was found to be 11 kg CO<sub>2</sub>-eq/kg of liveweight, compared with 13–18 kg CO<sub>2</sub>-eq/kg of liveweight for upland and hill systems<sup>xvi</sup>. However, upland farms arguably have greater opportunities for carbon sequestration and delivery of other ecosystem services.

As sheep are ruminants like cattle, enteric methane is also the greatest proportion of the GWP100 carbon footprint, followed by emissions from fertiliser and manure application due to nitrous oxide. The farm production footprint under GWP\* is around 1% of the GWP100 measure due to the marked decline in the overall population, although this will rise if the population stabilises.

**Table 1. Beef and Lamb gross emissions per unit of output GWP 100 (kg CO<sub>2</sub>e/kg product) and GWP\* (kg CO<sub>2</sub>we/kg product)**

Year	Up to	Metric	Dairy-bred beef	Suckler beef	Lamb & mutton
2000-2016	Cradle – Retail, Global <sup>a xvii</sup>	GWP100	33.3	99.5	39.7
	Cradle – Retail, UK <sup>xvii</sup>	GWP100	25.9	48.4	37.4
2018-2022	Farm-gate, UK <sup>b</sup>	GWP100	22.05	32.37	29.52
		GWP*	9.06	9.75	-0.13

<sup>a</sup> Poore and Nemecek, 2018. There are limited number of data points in each respective data set and is more limited in the country data set.

<sup>b</sup> Uses Agrecalc, carbon and efficiency calculator; data from farms with applicable enterprises 2018–2022, AR4 GWP. Mean gross emissions only, emissions to farmgate as CO<sub>2</sub>e/kg deadweight (dwt) and CO<sub>2</sub>we/kg deadweight (dwt). The GWP\* calculation is based on national emissions trends.



## What does the sector need to do?

The Roadmap will initially focus its strategic goals to drive change – facilitating collaboration, establishing baselines, measuring progress, reducing GHG emissions, and increasing carbon sequestration alongside managing existing carbon stores.

The Roadmap is a ‘living’ document that will change as the sector progresses. It is recognised that beef and lamb farmers are delivering multiple public goods covering an array of environmental targets. While the initial focus will be on decarbonisation, wider environmental metrics will be incorporated into the Roadmap over time.

The Roadmap will identify clear ambitions for the sector based on scientific evidence and industry knowledge, in adherence to both international and national legislative targets, taking heed of other industry and governmental initiatives that straddle the remit of the Roadmap.

The Roadmap will consider the opportunities for utilising agricultural data systems such as the Livestock Information Service and Multispecies Wales.

The Roadmap will also consider how climate adaptation sits alongside climate mitigation to ensure that the sector thrives in a changing climate, ensuring that all three pillars of sustainability; environmental, social, and economic are at the forefront.

The work that AHDB is undertaking on behalf of industry both in the Environmental Baseline Pilot and through delivering up-to-date marginal abatement cost curves (MACC) will be integrated into the Roadmap, demonstrating what the sector is already doing in a data-driven way and providing evidence in terms of the impact on farm profitability.

## Next steps

This document is intended to highlight the starting position of the beef and lamb sector with the intention of rapidly building upon this work throughout 2025 and beyond. It is envisaged that a second version of the Roadmap will be published in the early summer of 2025 setting the key environmental ambitions for the sector to 2050, agreeing milestones and their measures.

A third iteration will be released in the winter of 2025/26 to update evidence of progress against the agreed key environmental commitments, incorporating evidence from the Environmental Baseline Pilot, and publishing of MACCs.



## Endnotes

- i [UK shows international leadership in tackling climate crisis - GOV.UK](#)
- ii UN Framework Convention on Climate Change. 2016. [The Paris Agreement](#). Article 2.
- iii [Agri-climate report 2023 - GOV.UK](#)
- iv [Britain's climate action plan unlawful, high court rules | Green politics | The Guardian](#)
- v Defra. 2023. [Structure of the agricultural industry in England and the UK at June 2023](#). 4
- vi Defra, 2021. Structure of the agricultural industry in England and the UK at June <https://www.gov.uk/government/statistical-data-sets/structure-of-the-agricultural-industry-in-england-and-the-uk-at-june#history>
- vii Defra, 2022. Agriculture in the United Kingdom 2021. [National statistics Chapter 8: Livestock – GOV.UK \(www.gov.uk\)](#)
- viii [Farm Agri-Environment Activities in England, 2022/23 – statistics notice - GOV.UK](#)
- ix FAO, 2023. Pathways towards lower emissions – A global assessment of the greenhouse gas emissions and mitigation options from livestock agrifood systems. Rome. [Pathways towards lower emissions \(fao.org\)](#)
- x Defra, 2023. Farm Practices Survey February 2023 – greenhouse gas mitigation – GOV.UK ([www.gov.uk](#))
- xi [Gleam-i](#)
- xii Defra, 2024, Official Statistics Agri-Climate Report 2023. [Agri-climate report 2023 - GOV.UK](#)
- xiii Poore and Nemecek, 2018. [Reducing food's environmental impacts through producers and consumers. Science](#), Vol 360, Issue 6392, p987-992
- xiv FAO, 2020. Global Livestock Environmental Assessment Model – interactive GLEAM-I model. <http://gleami.org/input>
- xv Defra, 2024, Official Statistics Agri-Climate Report 2023. [Agri-climate report 2023 - GOV.UK](#)
- xvi CIEL, 2021. Net Zero Carbon and UK Livestock.
- xvii Poore, J. and Nemecek, T., 2018. Reducing food's environmental impacts through producers and consumers. Science 360, 987–992. DOI:10.1126/science.aaq0216



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