Briefing: AFN Network+ take-aways from a webinar where CCC answered questions on net zero, farming, diets & land

Based on an AFN Network+ webinar, held 07.04.25

Table of Contents

About the 7th Carbon Budget & this briefing

About this briefing:

This briefing is based on a webinar discussion with two members of the Climate Change Committee (CCC) team - Indra Thillainathan and Sandra Bogelein - given to the AFN Network+ community on the 7th April 2025. It is collated and written by Nina Pullman, food systems writer for AFN, and edited by Jez Fredenburgh, knowledge exchange fellow at AFN. You can also watch the webinar.

About the webinar topic:

The Climate Change Committee (CCC) published its Seventh Carbon Budget advice (CB7) at the end of February 2025. We read the headlines and reactions at the time, but now the dust has settled and it's time to dig deeper into the details:

What does the Seventh Carbon Budget really mean for farming, UK diets and the land based sectors? What are the challenges and opportunities in pursuing net zero? How did the CCC come to its conclusions and recommendations? What gaps in knowledge and data did it face and would the CCC like the research community and wider sector to help plug next time?

Two members of the CCC team – Indra Thillainathan and Sandra Bogelein – answer these questions and more. As well as giving an overview of what CB7 would mean for the wider economy and agriculture and land sectors more specifically, they covered:

- Common questions asked to the CCC about agriculture
- More info about the CCC's assessment that farmers could be better off under CB7
- Assumptions behind a shift away from average meat and dairy consumption & the most impactful levers to achieve this, plus health impacts
- Research and data gaps that the CCC faced when compiling the Carbon Budget advice

About the Seventh Carbon Budget:

The Climate Change Committee (CCC) published its 7th Carbon Budget advice on 26th February, which updated the 6th Carbon Budget advice published in 2020. The advice is widely seen as the most authoritative assessment of the UK's emissions across all sectors. It represents the independent statutory advice to the UK Government about what needs to happen to reach net zero by 2050.

About Indra Thillainathan:

Indra Thillainathan is Team Leader of the CCC's land, agriculture and nature team, covering both mitigation and adaptation. She oversaw the work on the Seventh Carbon Budget advice for the agriculture and land use sectors. She has a Masters degree in economics.

About Sandra Bogelein:

Sandra Bogelein is a Government Social Researcher with a PhD in environmental psychology. At the CCC she is the lead analyst for people and Net Zero and covers work on the most impactful low-carbon household choices and public engagement on Net Zero and adaptation.

Summary of key points

Main AFN take-aways from the Climate Change Committee's (CCC) presentation

Agriculture and land use emissions reductions will need to increase

- To reach the 2050 net zero target, there needs to be an 87% reduction on 1990 emission levels, across the UK economy, leaving the equivalent of about a quarter of current levels.
- The Seventh Carbon Budget advice (CB7) found that as emissions from energy supply and electricity generation move toward zero, other sectors will need to decarbonise further as well, including buildings, transport, industry, land and agriculture.
- Remaining residual emissions in agriculture could be offset by land use sinks. As tree planting and peat restoration increase, the land use net sink increases and helps to offset agricultural emissions.

No silver bullet can reduce livestock emissions to zero

- Agriculture is roughly the fourth highest emitting sector in the UK, accounting for 11% of total emissions today. Around 63% of these agricultural emissions comes from livestock, through enteric fermentation of ruminants, waste and manure.
- A further 24% of agricultural emissions come from soil management and 13% from machinery, including refrigeration systems, tractors and combine harvesters.
- Based on current technology, it's not possible to decarbonise livestock or soils in the same way as machinery. Instead, a range of measures can help reduce emissions including livestock feed and diets, reducing nitrous oxide release from crops, improving livestock health and robotic milking parlours.
- In addition, many of these can also provide yield or productivity improvements so it can be cost effective for the farmer to both reduce emissions and operating costs.

Reducing livestock numbers should come through diet change and supporting farmers to diversify

- Even after reducing emissions from soil and livestock using on farm measures, there will be a substantial amount of emissions remaining.
- The CCC also modelled how to take some land out of agriculture by reducing livestock numbers. The two levers to do this were dietary change towards lower-emission foods (an average 35% reduction in meat and 20% in dairy consumption by 2050), and supply side policies and incentives to support farmers to diversify land use beyond agricultural production.

Tackling food waste and crop yields will complement reducing livestock

- Reductions in food waste, which can reduce or avoid agricultural production, and improvements in crop yields, could help release land.
- By 2050, assessments show that average wheat yields increase by 10% and an assumed 10% of horticultural production will move to indoor systems.
- Combining all measures in total delivers 71% more emission savings, compared to relying solely on decarbonising machinery and on farm measures.

14% of agricultural land will need to be taken out of production by 2050

- Around 14% of agricultural land will need to be taken out of agricultural production by 2050 and used for a variety of measures, including peatland restoration and woodlands, with the latter increasing from 13% of UK area to 19%.
- The model also estimates that 3% of UK land area should be used for energy crops, agroforestry systems and creating more hedgerows.

Farmer diversification into energy, productive woodlands, and natural capital could boost income

- To measure the impact of diversification on farmer income, the CCC modelled 12 rural land use archetypes comprising roughly 55% of rural UK land area (*Centre for Ecology & Hydrology, Eunomia & University of East Anglia 2025; UK rural land use archetypes, part two*).
- On the model of intensive grasslands, two transitions were analysed, including planting productive woodlands, and secondly, land-sharing measures such as agroforestry and hedgerow, as well as energy crops and solar PV to provide private income.
- Under these models, while agricultural income from livestock production declined in line with a reduction in livestock numbers, that was offset overall by the increase in benefits from the public goods and emissions reductions.
- The transition provided a net increase in both private and social benefits ranging between £630-700 per hectare by 2050, demonstrating that if farmers are adequately incentivised, there's scope for them to diversify income.

Regenerative systems and blue carbon could be included in future budgets

- The CCC's advice is governed by robust evidence and guided by the greenhouse gas inventory for any measures to reduce emissions or increase sequestration.
- As a result, some measures and technologies are not currently included, such as blue carbon, regenerative farming or rewilding.
- These gaps in evidence will be revisited in the future when the evidence is sufficient to provide confidence in including them in future carbon budgets.

35% reduction in average red meat consumption needed by 2050

- The feasibility of shifting away from meat and dairy towards lower carbon foods was examined alongside other household actions, including switching to an electric car or low carbon heating like heat pumps when someone is ready to replace their existing car or heating system.
- The CCC recommendation is a 35% reduction in average meat consumption by 2050, compared to 2019 levels and a 20% reduction in dairy consumption.
- This includes a steeper reduction in red meat consumption, due to the higher emissions intensity.

Policy intervention will be required to reduce meat and dairy consumption

- Over the last few decades, people have started to eat less meat, with a sharper decline between 2020 and 2022, which may be down to the cost-of-living crisis. The long-term downward trend alone won't achieve the required shift away from meat and dairy to lower-carbon foods.
- Policy interventions can encourage a shift away from meat and dairy towards lower carbon foods.
- The CCC looked at a range of policy levers to reduce average meat consumption, including clear and consistent information about meat, climate change and health, and reducing the amount of meat in pre-prepared meals.
- Because of their popularity and the levers available to government, convenience foods (e.g. burgers) are likely to be where most plant-based replacements are used. There may be some switching to whole foods like pulses or legumes, but it's less clear how policy could achieve this.

Reducing meat and dairy can be compatible with healthy and nutritious diets if properly substituted

- The CCC collaborated with experts to assess how the replacement of some meat and dairy with plant-based alternatives, whole foods and some novel alternative proteins, would impact health and nutrition.
- The report found that the pathway is compatible with a healthy and nutritionally-balanced diet.
- There can be some negative nutritional impacts if someone reduces meat consumption and their existing diet is already unbalanced, or meat is not well substituted.

There are research gaps around how supermarkets could affect choices

- There is an evidence gap in studies looking at how a change in the supermarket offer, or

marketing of plant-based alternatives, would affect consumption trends.
- More research is also needed around what happens if meat and dairy alternatives become cheaper.

Key points from audience Q&A

Early stage technologies including feed additives are mostly not there yet

- CB7 analysed three feed additives: 3-NOP (e.g. Bovaer) is delivering significant results and has been approved by the Food Standards Agency. It is therefore most likely to be taken up.
- The budget also considered red microalgae species Asparagopsis, which offers the most abatement of all feed additives, but was excluded as it comes with potential environmental and health concerns, which would need to be addressed before it could be introduced.
- Other (non feed additive) technologies assessed included lowland peat restoration and dynamic water table management, including a paludiculture system.
- There are technical issues that need addressing with these water table management systems that means they are not deployed in CB7 until the early 2030s.

Soil carbon sequestration from grazing is limited in mature grasslands

- Despite the interests in the soil carbon benefits of grassland, evidence suggests that age of a grassland is the most critical variable factor for its sequestration potential.
- As part of the LUNZ Hub project, work will consider soil carbon and grasslands.

Dietary change is important alongside any carbon border management

- As with carbon-intensive industrial sectors, there may be a case for measures at the UK's border to ensure changes in agricultural production do not simply lead to imports of high carbon meat and dairy.
- The CCC analysis includes a reduction in average UK meat and dairy consumption, which is needed to avoid a reduction in UK livestock numbers being accompanied by an increase in imported meat and dairy.

Agroecological systems are more beneficial for soil than emissions

- Some regenerative and agroecological measures, like legumes, cover crops and agroforestry, are included in the CB7 pathway.
- Research commissioned by the CCC (*Agroecology – a Rapid Evidence Review, University of Aberdeen)* found that while agroecological systems have significant benefits for soil health and structure, the net impact on emissions of the majority of the agroecological farming practices considered, is less clear.

Theory of change is a mix of supply measures and demand adjustment

- The CCC analysis assumes a time lag between a market signal that people are eating less meat, and farmers taking a while to adjust.
- The CCC analysis includes a reduction in average UK meat and dairy consumption, which is needed to avoid a reduction in UK livestock numbers being accompanied by an increase in imported meat and dairy

Local procurement could be key in driving dietary change

- Procurement is a mechanism that could be used to buy less meat, and can increase the availability of alternatives and give people the opportunity to try them.
- The key message is the importance of reducing average red meat consumption, which helps reduce emissions and can have positive health impacts.

Extra audience Q&A

Extra audience questions answered by Indra Thillainathan and Sandra Bogelein (CCC team) on email, following the webinar.

– TREES –

Q: Why are woodland and grass included as binary options, and not agroforestry? Why was agroforestry chosen as a Land Use action? By definition shouldn't it be in the low-carbon farming practices?

The carbon benefits of planting trees on farmland (agroforestry) relate to the carbon sequestered by the biomass (above and below ground) and the soils. This means that these are accounted for in land use, land use change and forestry (LULUCF), part of the GHG Inventory. In reality, these can be seen as low-carbon measures for the farmer to adopt, but for the purposes of CB7, the benefits are counted per the GHG Inventory so we judge it to be a land use measure.

Q: Why not run ruminants in woodlands?

We did not model woodland pasture beyond the creation of silvopastoral systems which combines both trees and ruminant livestock. Woodland pasture is an area we would welcome more evidence on, and what appropriate assumptions to use (e.g.planting density).

Q: How much of the land which you expect to be released from agriculture for establishing trees, is actually suitable for trees?

Getting to 19% UK woodland area implies planting over 1 million hectares of trees between now and 2050. This is less than the estimated area of land that the Forestry Commission (2.9m hectares) deems to be 'low risk' for woodland consideration in England alone, when taking into account peatland soils, agricultural land quality, biodiversity and historic interests.

In reality, planting decisions will need to be taken at a site by site level to determine suitability, which is beyond the resolution of our modelling approach.

Q: How did you identify intensive pastures to be planted? In Scotland, one of the issues is permanent pastures with high soil carbon being ploughed up for intensive forestry.

Our modelling avoids the planting of trees on grassland on organic soils in recognition of the high loss of soil carbon that would result.

– LIVESTOCK & DIET –

Q: Low-input management of more diverse, permanent grasslands can support reducing livestock numbers as well as reducing GHG emissions. Why is there no recommendations specifically on this and are there any plans to include them?

This is an area we would welcome more evidence on.

Q: Can cows be carbon negative? I have heard this claimed many times but never seen any evidence. Is this due to the evidence for carbon sequestration still being in its infancy?

If this means that the methane emitted from the cow is offset by the increased carbon sequestration from the grassland it is grazing on, the evidence suggests that this does not hold true. Evidence indicates that permanent grasslands under mineral soils will reach an equilibrium with regards to carbon stores. Given the UK's permanent grassland is already mature, the soil carbon is already quite high and possibly already at an equilibrium thus scope to increase stores is limited. The LUNZ Hub Project will be considering this topic.

Q: Are you concerned that the focus on reducing red meat consumption could end up incentivising an increase in or maintenance of current levels of chicken consumption, which is driving serious river pollution already?

We advise that average meat consumption declines by 25% by 2040 and 35% by 2050 compared to 2019 levels, with a steeper reduction in red meat consumption (40% by 2050) to reflect the higher carbon intensity of ruminant livestock. This pathway is informed by the observed downwards trend in recent years and the health benefits of reducing red meat consumption. Our pathway assumes that all meat is replaced with different plant-based options, rather than substituted with other meat.

Q: Generally people have not been good at managing a balanced diet, how and why will they in the future?

Meat and dairy alternatives can be made attractive and affordable through information provision, increasing choice and availability of lower-carbon foods in public procurement, restaurant, and supermarket settings, changes to product composition, expanding alternatives such as alternative proteins, and ensuring lower-carbon alternatives are cheaper than meat and dairy products. With appropriate policy, and supported by a range of affordable and attractive alternative options, this shift can improve health outcomes. The extent of health benefits will depend on what types of meat and dairy are replaced and what they are replaced with.

Q: What kind of policy interventions would you like to see or envisage to reduce diet-related emissions?

The most promising levers include replacing a small amount (for example,15%) of meat and dairy content in pre-prepared meals with plant whole foods or alternative proteins; increasing choice and availability of lower carbon foods in public procurement, restaurant, and supermarket settings; and supporting more novel alternative proteins with improved taste and texture. Our citizens' panel was also clear that alternatives to meat and dairy need to be affordable. We will be publishing our method report in May which contains more detail on the different potential levers and the literature we reviewed.

– STRATEGIC LAND USE AND LAND USE CHANGE –

Q: Was there any attempt by the CCC to align UK proposals with Defra's Land Use Framework consultation for England, or vice-versa? There are, for example, differences in definitions (e.g. woodland) as well as differences in geographical scope. How would CCC evidence be built into the proposed Land Use Framework the government is exploring?

Our modelling was completed well before the LUF consultation was released. We look forward to exploring with Defra how the LUF could help deliver the emission reduction in agriculture and land use.

Q: Was it planned that LULUCF emissions balanced agriculture emissions?

No, this was not planned. An improvement in the GHG methodology for measuring LULUCF emissions since our CB6 advice in 2020 means that land use emissions in the GHG inventory are now lower than previously estimated. This means that under our pathway, there is a larger carbon sink by 2050 compared to CB6, which now allows it to offset emissions in agriculture.

Q: The national inventory splits the land-based emission sources into LULUCF and agriculture. In reality, the two categories overlap to some extent as farmers are often those who restore peatlands or plant woodlands. This is also reflected clearly in the 7th carbon budget. However, it is often impossible for farmers to claim the LULUCF sequestration on their farm because of the separation of agriculture and LULUCF on the national level. Is there a way to correct this error without double-counting emissions?

There should be no double counting of emissions as the two inventories report distinct emissions:

- **Agriculture GHG Inventory reports** the change in nitrous oxide and methane emissions of managing soils, livestock and their waste and manure management; and the energy use (CO_2) of running mobile and stationary machinery.

- **LULUCF reports** the changes in CO_2 (carbon) in the soils and biomass from land use, the change in management of land and forestry. For example, any management changes on arable land that changes soil carbon (such as the planting of cover crops) will be captured in the LULUCF inventory, while changes in N_2O (covers crops will reduce the need for applying fertilizer and therefore will reduce N_2o emissions) will be reported in the Agriculture GHG inventory.

– OTHER TOPIC AREAS –

Q: Do emissions from wildfires etc get taken into account in the assessment of emissions from agriculture and land use? If not, how are unpredictable events (but that will potentially increase in frequency/impact with climate change) accounted for in pathways and recommendations?

While we don't explicitly model wildfire events under our Pathway, we assume that undertaking some of the CB7 measures will increase the resilience of the natural habitat against the impacts of climate change, which includes wildfires. For example, restoring peat to a good ecological condition and sustainable management of broadleaved woodlands.

Q: What are the opportunities in expanding blue foods (seaweeds, molluscs and fish) to enhance sustainable diets and reduce land use pressures?

We have not assessed the evidence on blue foods.

Q: Has CCC made representations to Defra about official agricultural statistics? Our knowledge about farm practices and drivers of change in the agricultural sector is rather limited, partly by devolution but also by, for example, very low response rates to Defra surveys.

We have not made representations to Defra on this particular point.

Q: How were landowner/farmer decision-making included in the model? If not, why not?

We convened an Independent Agriculture Advisory group, which included some farmers as part of our CB7 work (their report is on our website); we also had engagement with a wide range of stakeholders that work closely with farmers.

Q: Where can local government have the biggest impact in land-use change and diet? Is there any potential from devolution or is it all better to be delivered at national government level?

We have commissioned a piece of research that looks at translating our Seventh Carbon Budget advice for local actors. This will be published this year.

Q: Why are you including energy crops as a way to reduce emissions? Industrial agrofuels have been shown to be the least efficient way to produce energy and also to be a false climate solution that actually increases emissions. We also do not have the land available.

Our modelling assumes that with diet change and other measures that release land out of agriculture, there is sufficient land to grow energy crops (3% of UK land area by 2050). An appropriately sited, sustainable UK supply of perennial energy crops is important in contributing to Net Zero by displacing fossil fuels and removing carbon from the atmosphere when combined with carbon capture and storage (CCS) technology.

About the AFN Network+

The AFN Network+ (UKRI Agri-food for Net Zero Network+) is a unique network of almost 3,000+ academics, researchers, third sector organisations, policy makers, and agri-food industry professionals from farmers to retailers.

Together, we are working to identify key research gaps that may be holding the UK food system back from transitioning towards a net zero UK by 2050, while also enhancing biodiversity and healthy ecosystems, nurturing livelihoods, supporting healthy consumer habits, and minimising the environmental impacts of overseas trade. Our findings will inform the next decade of research
investments in this area by UKRI (our funder and the UK research councils umbrella organisation).

Alongside our core research, we run in-person and online events, produce topical resources, and give out hundreds of thousands of pounds of funding a year.

The AFN Network+ is coordinated by the University of East Anglia, University of the West of England, University of York, and University of Leeds, and is a £5m, 3-year project funded by four research councils; the Biotechnology and Biological Sciences Research Council, Economic and Social Research Council, Engineering and Physical Sciences Research Council, and the Natural Environment Research Council.

Website: www.agrifood4netzero.net

Email: contact@agrifood4netzero.net

**LinkedIn:
www.linkedin.com/company/agrifood4netzero/**

X/Twitter: @AFNnetwork