A Net Zero Transition Plan for the UK Food System

THE AGRICULTURE TRANSITION: The methodology explained

Webinar 2

29th November 2024

IGD

Agenda

WELCOME

- Kirsty Saddler, IGD

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- David Kennedy, EY

OVERVIEW OF THE METHODOLOGY

- Dr Michael Macleod & Dr Daniel Fletcher, SRUC

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INTRODUCTION TO THE AGRICULTURE TRANSITION

A Net Zero Transition Plan for the UK Food System

David Kennedy, Partner: Corporate Sustainability, EY

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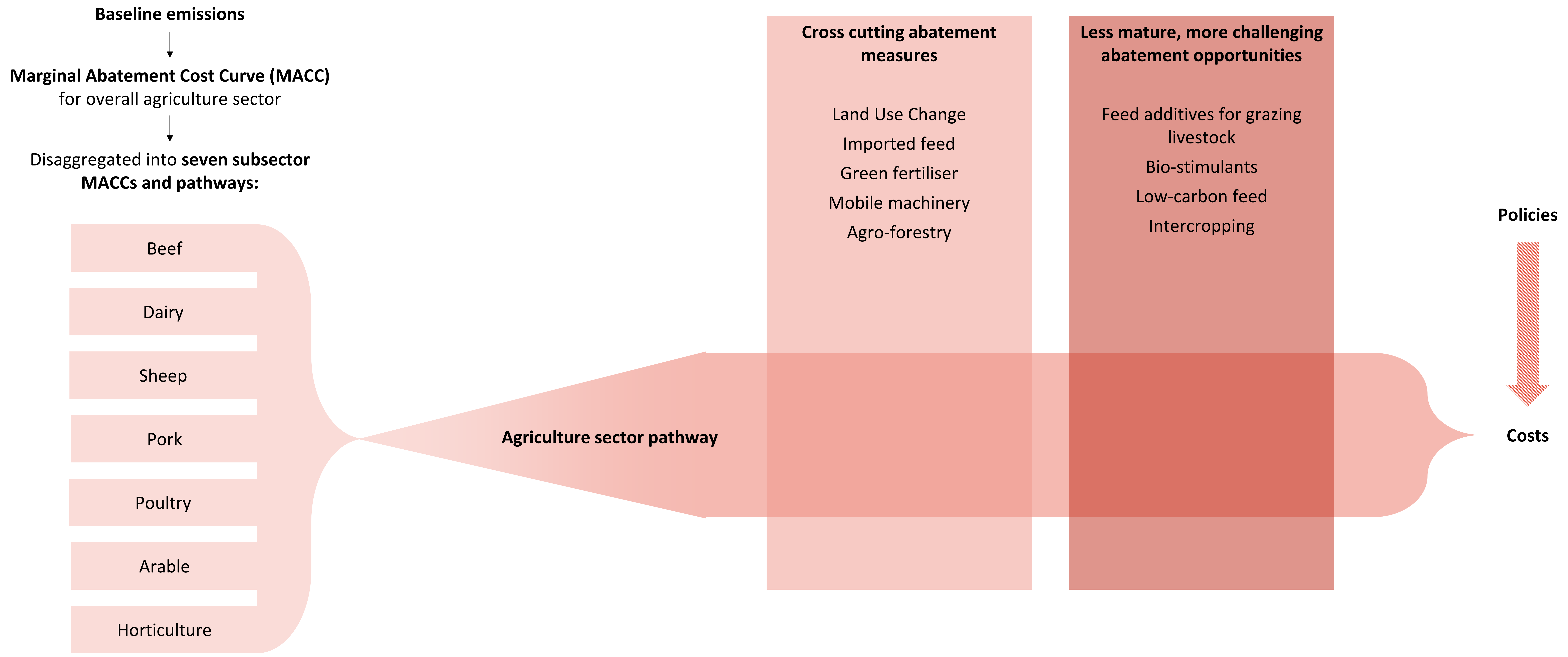
Reducing agriculture emissions in the UK and beyond: the approach

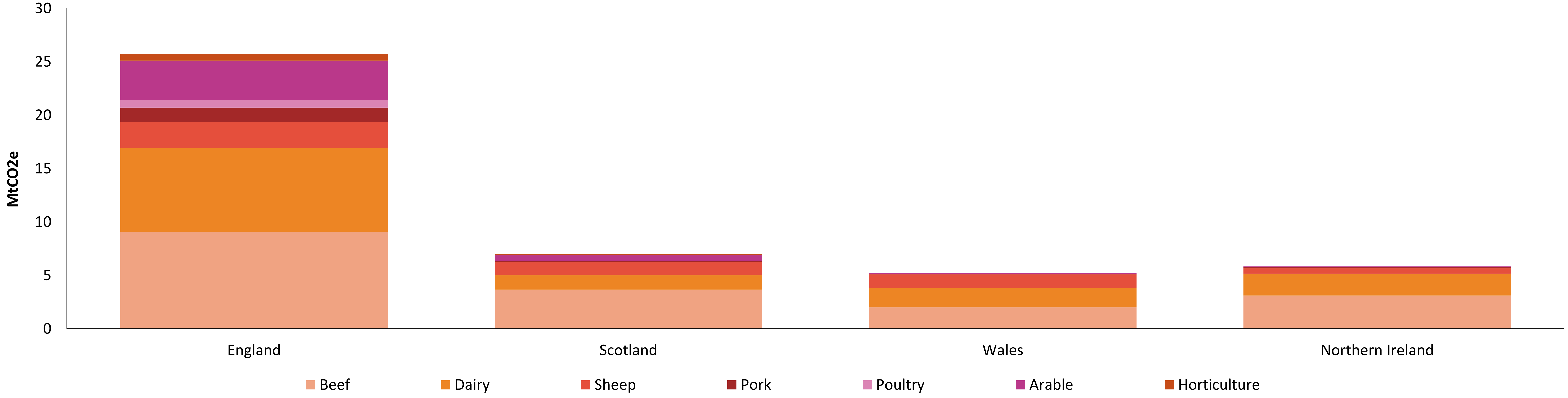


60% of the UK's agriculture related emissions are attributable to farming in England, with significant shares in each of the devolved administrations – where emissions are dominated by livestock farming.

Emissions across:

- England account for 59% of the total agricultural emissions in the UK, at 25.7 MtCO2e, including the majority of all sub-sector emissions.
- Scotland account for 16% of the total agricultural emissions in the UK, at 7 MtCO2e, with around half the emissions attributable to beef.
- Wales account for 12% of the total agricultural emissions in the UK, at 5.2 MtCO2e, where sheep makes up a relatively higher proportion of the footprint compared to other devolved administrations.
- Northern Ireland account for 13% of the total agricultural emissions in the UK, at 5.9 MtCO2e, where beef and dairy dominate.

Sub-sectoral emissions across the devolved administrations (2021)*



** Excludes emissions associated with land-use change and fertiliser production*

The deep cuts in agriculture emissions reflect modelled abatement from the range of measures related to soils and livestock, together with greening of fertiliser and sustainable land-use. Less mature or more challenging measures are also accounted for.

The High Scenario (see Agriculture section) for agriculture abatement includes extensive uptake across the set of measures below by 2035:

Sub-sector	Beef	Dairy	Sheep	Pork	Poultry	Arable	Horticulture	Cross-cutting
Main decarbonisation measures	• Grass-legume mix • Feed additives • Faster LWG • Improved health • Anaerobic digestion • Other manure management • Reducing feed crop emissions	• Grass-legume mix • Feed additives • Increased milking frequency • Anaerobic digestion • Other manure management • Reducing feed crop emissions	• Grass-legume mix • Feed additives • Improved health • Reducing feed crop emissions	• Improved health • Anaerobic digestion • Other manure management • Reducing feed crop emissions	• Reducing feed crop emissions • Poultry manure	• Soil pH • Nitrification inhibitor • Cover crops • Improved drainage • Reducing Nitrogen excess	• Soil pH • Nitrification inhibitor • Cover crops • Improved drainage • Reducing Nitrogen excess	• Decarbonising fertiliser production through use of hydrogen • Decarbonising mobile machinery • Agroforestry • Avoided land-use change

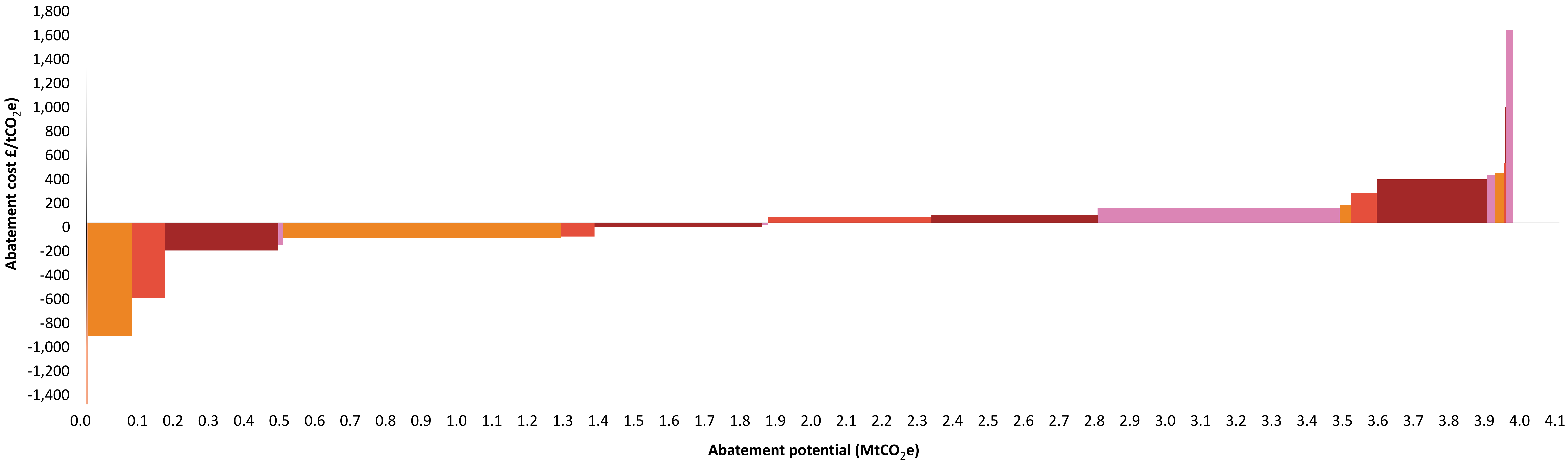
There are less mature / more challenging measures beyond the High Scenario, which together offer potential annual reductions of around 15 MtCO2e:

- Use of **feed additives for grazing livestock**, for which solutions are being developed, could save **3 MtC02e** annually in the UK.
- Use of **biostimulants to reduce use of fertiliser** and associated nitrous oxide emissions, which could save **1 MtCO2e** annually.
- Use of **low-carbon feed**, which could be available in the market at scale in the 2030s, offering a potential annual saving of around **3 MtCO2e**.
- **Inter-cropping** (i.e. intense agroforestry), which offers an annual saving of around **3 MtCO2e** across an area of 700 kHa.
- Application of the above to **imported agricultural products**, offering an annual saving of around 5 MtCO2e.

Soil carbon sequestration: the abatement potential includes soil carbon sequestration related to use of cover crops. The estimates used are specific to the UK and are relatively low compared to countries with better climate conditions (e.g., France). Should clear evidence emerge about higher potential, estimates should be updated. Soil carbon sequestration is also reflected in abatement from agroforestry.

Land use change: the analysis does not include sequestration due to land-use change, e.g., through tree-planting and peatland restoration. This could be regarded as additional, depending on the decision to be made early next year by SBTi. This would not attenuate the need for agriculture emissions reductions to meet carbon budgets, given that land-use change is already fully factored in here.

There is a total abatement potential of just over 4 $MtCO_2e$ from changed farming practices across the dairy sector. The MACC analysis shows that this comprises 1.9 $MtCO_2e$ from cost saving options, and 2.1 $MtCO_2e$ that would entail additional costs.



Cost saving

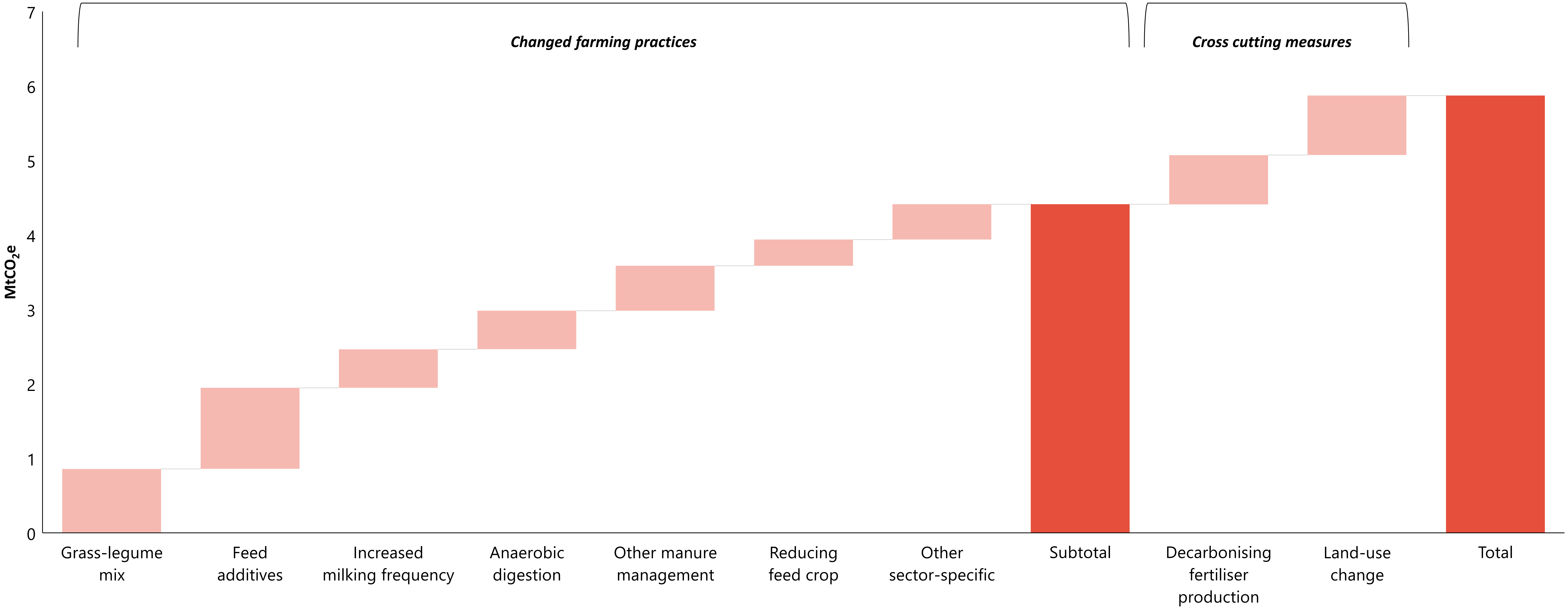
- Soil compaction
- Soil pH
- Improved drainage
- Genomics breeding beef
- Reducing N excess
- Grass-legume mix
- Precision feeding, dairy
- Increased milking frequency
- Lower emission breeding goal dairy

Additional cost

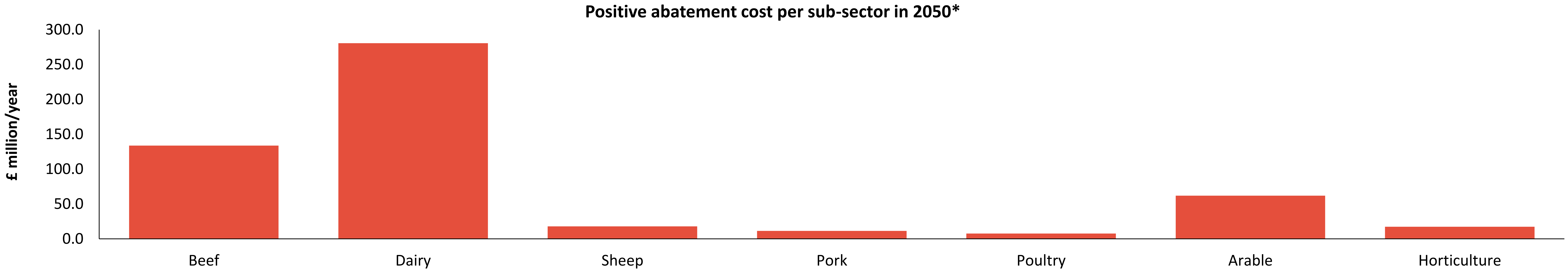
- AD cattle
- Nitrate feed additive dairy
- Cover crops
- Impermeable slurry cover dairy
- 3NOP dairy
- Variable rate nitrogen
- Nitrification inhibitor
- Improved crop NUE
- Urease inhibitor
- Biogas flaring dairy
- Triticale
- Slurry acidification dairy

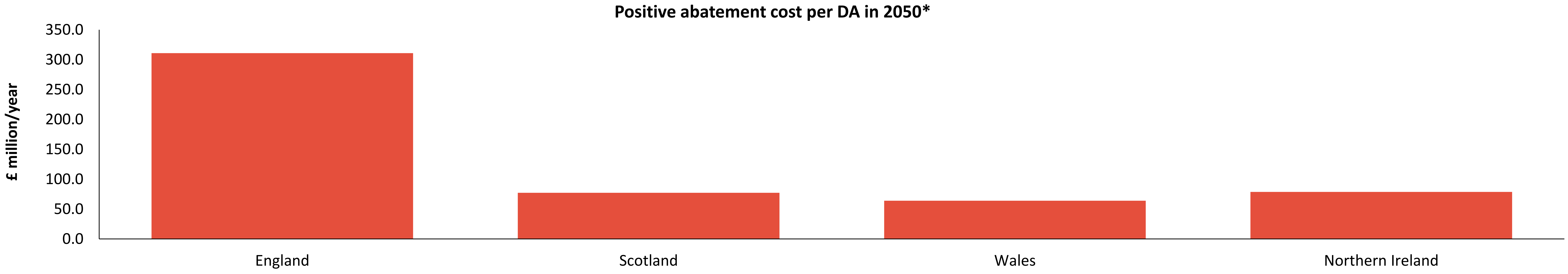
On top of changes in farming practices, there is the potential for an additional 1.5 $MtCO_2e$ of emissions savings from green fertiliser and avoided land-use change in 2050 within the dairy sector, bringing the total abatement potential for dairy to 5.9 $MtCO_2e$ in 2050.

Total abatement potential for the UK dairy sector ($MtCO_2e$/year) in 2050



For those measures that are costly, the total funding requirement is around £530 mn annually. The bulk of funding is required for beef and dairy farming, although funding is required across all subsectors. Across the nations of the UK, around 60% of funding needed is in England, with the remainder broadly equally distributed across the devolved administrations.





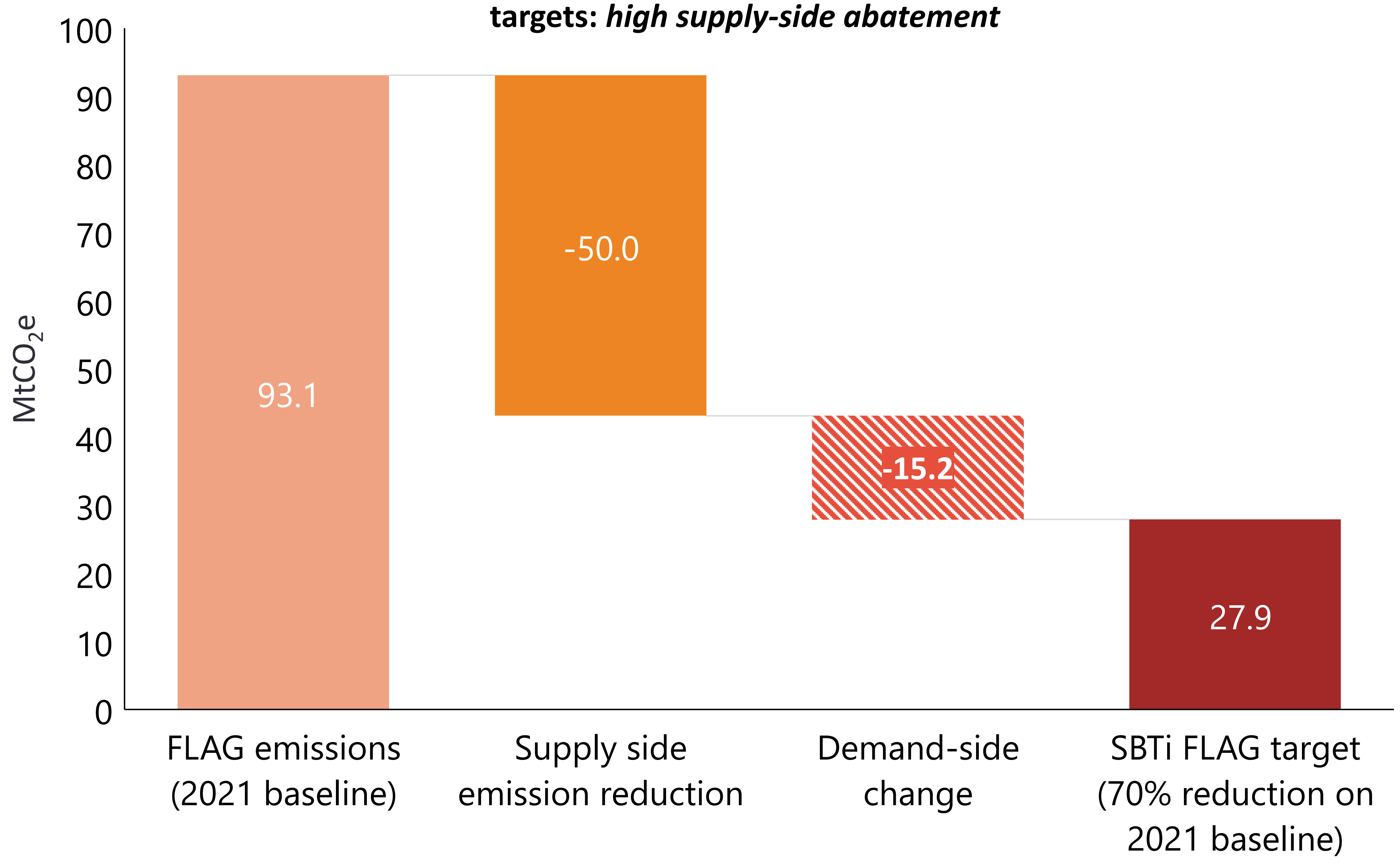
** Total includes positive abatement costs below £400/tCO_2e only*

The combination of supply-side reductions together with demand-side consumption change could lead to achievement of FLAG targets.

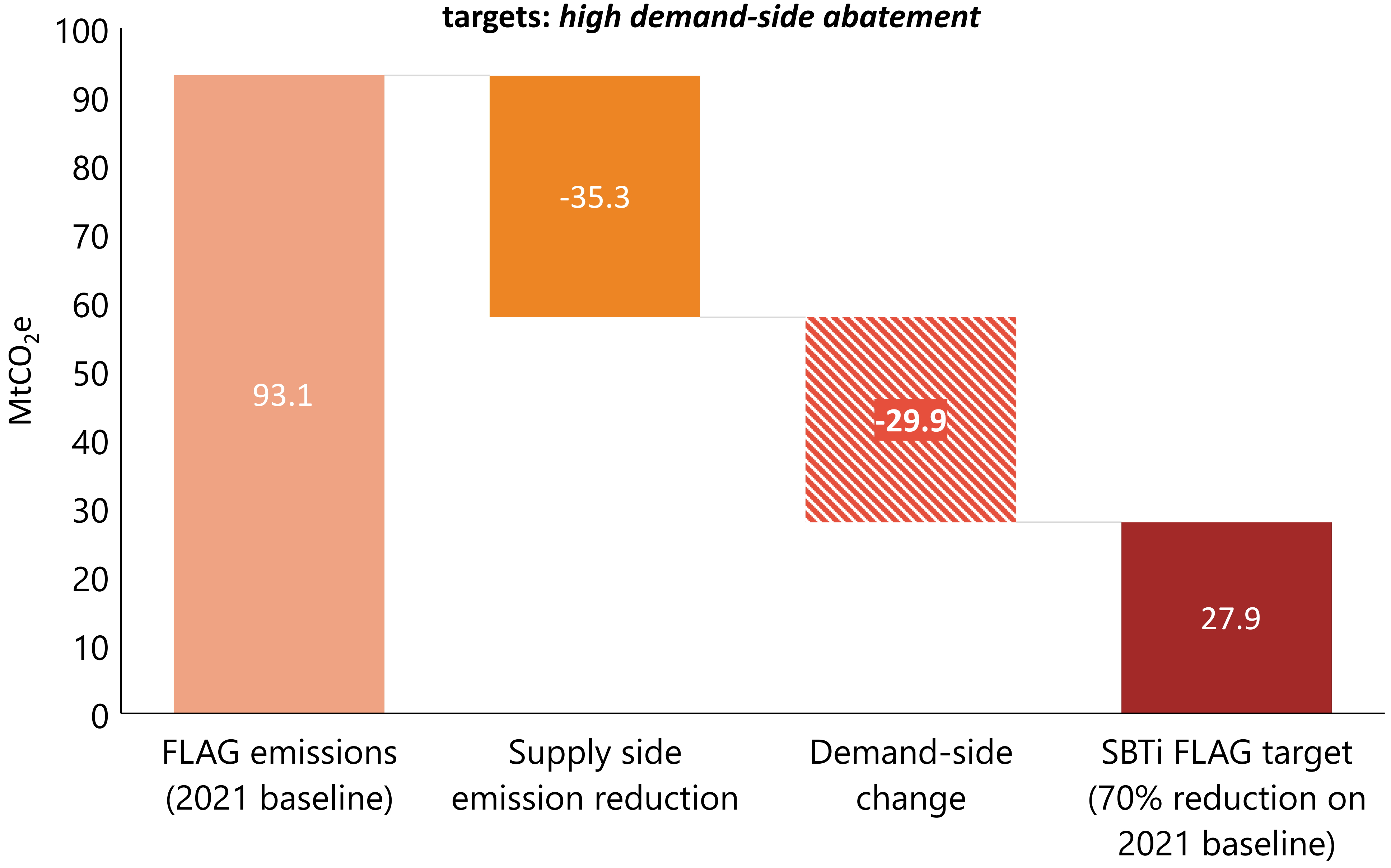
The chart on the left shows residual agriculture emissions in the high scenario plus less mature and very challenging abatement options. The former includes significant cuts from changed farming practice, with land-use change and fertiliser emissions having fallen to zero; the latter includes less mature and more challenging options from the previous page. Required emissions reductions from demand side measures to meet the 2050 SBTi FLAG are 15 $MtCO_2e$, around 23% of the total reduction on a 2021 baseline. Further supply-side reductions offset the impact of population growth.

The chart on the right shows residual agriculture emissions in the high scenario only (i.e. without abatement from less mature and very challenging measures). Required emissions reductions from demand side measures to meet the 2050 SBTi FLAG target are 30 $MtCO_2e$, around 46% of the total reduction on a 2021 baseline.

Illustrative contributions of supply-side and demand-side emissions reduction to meet FLAG targets: *high supply-side abatement*



Illustrative contributions of supply-side and demand-side emissions reduction to meet FLAG targets: *high demand-side abatement*



OVERVIEW OF THE METHODOLOGY

A Net Zero Transition Plan for the UK Food System

Dr Michael Macleod & Dr Daniel Fletcher, SRUC

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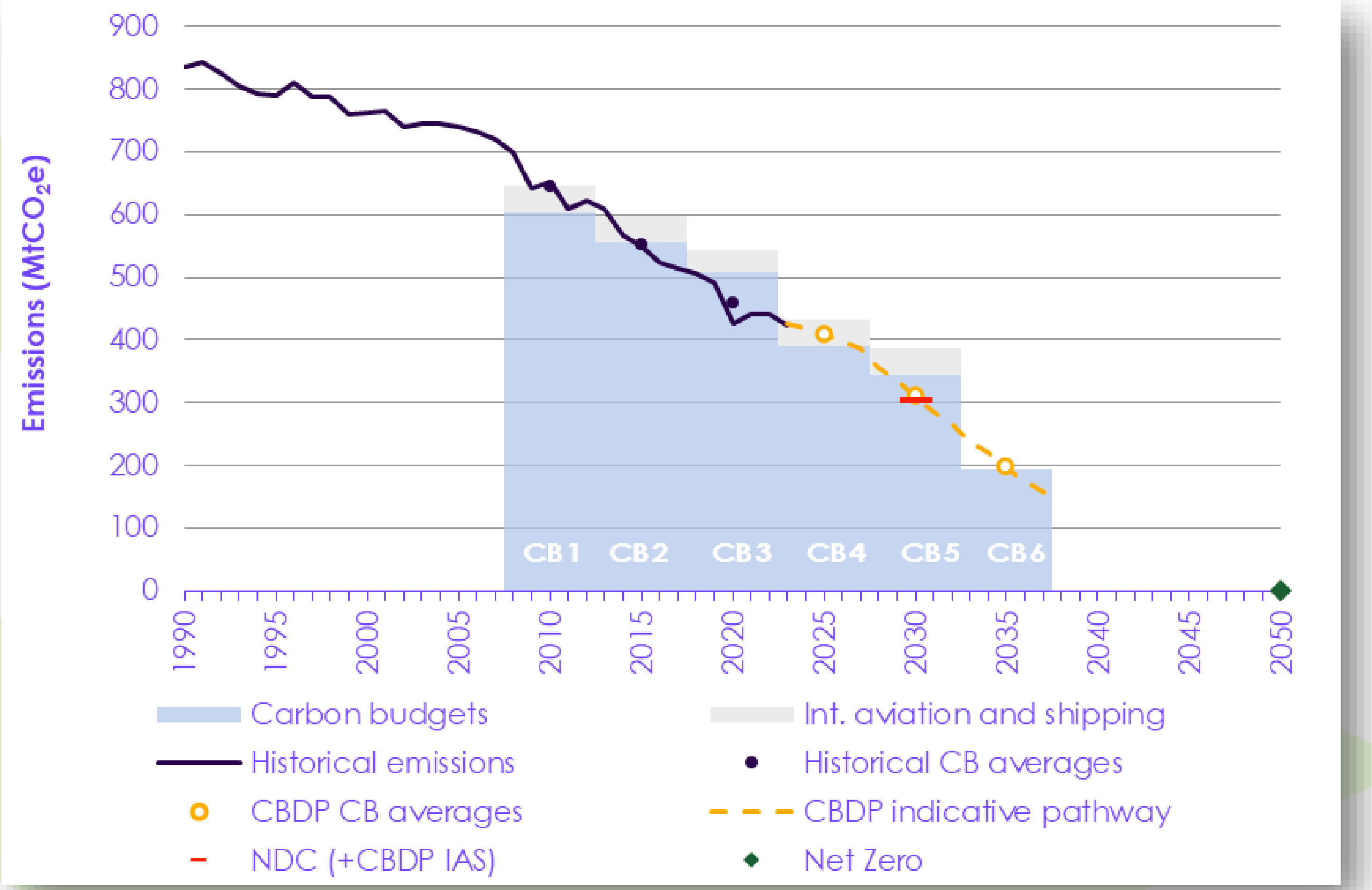
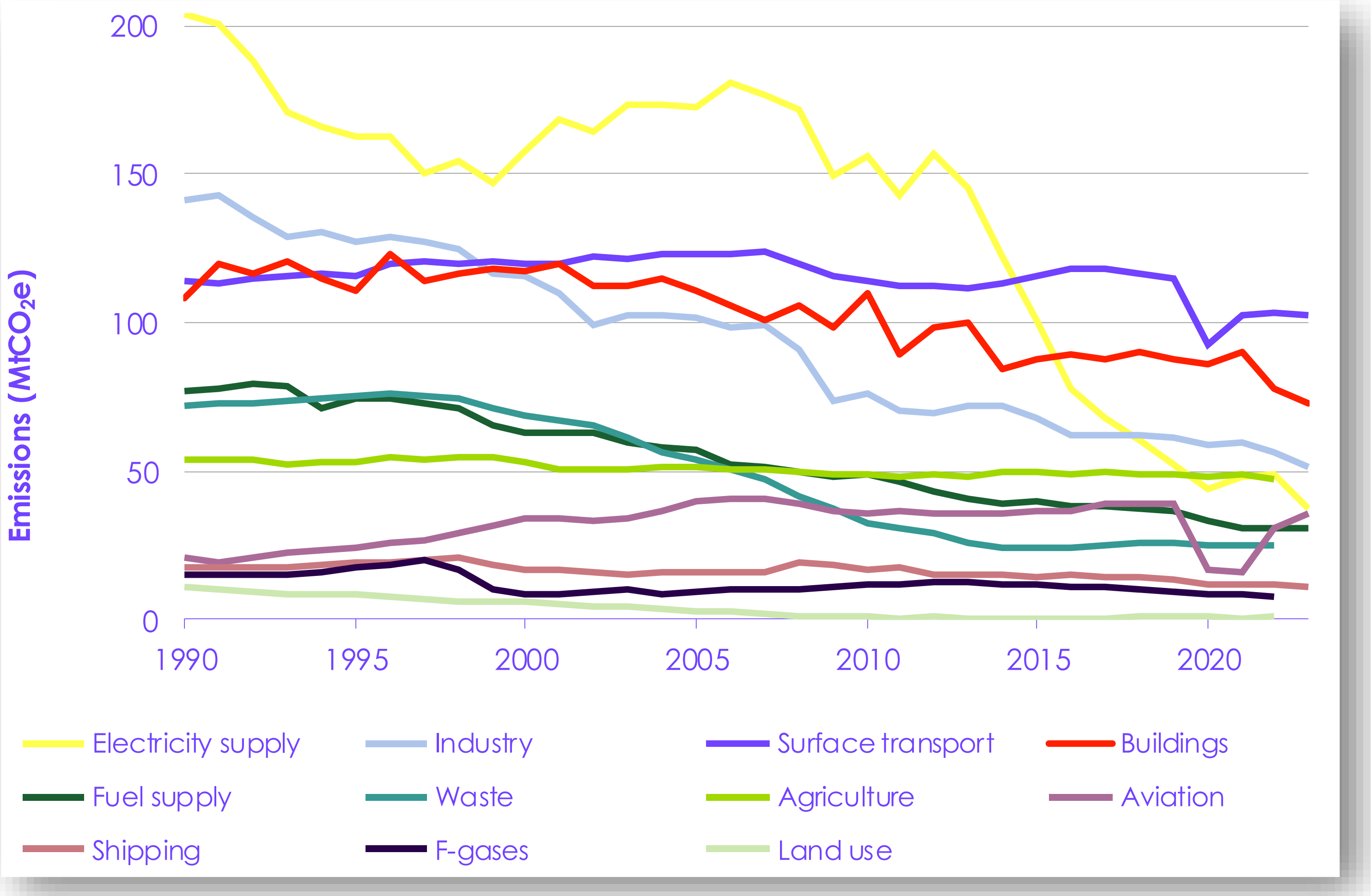
Towards Net Zero Agriculture in the UK

29/11/24
Michael MacLeod and Daniel Fletcher

UK targets and progress

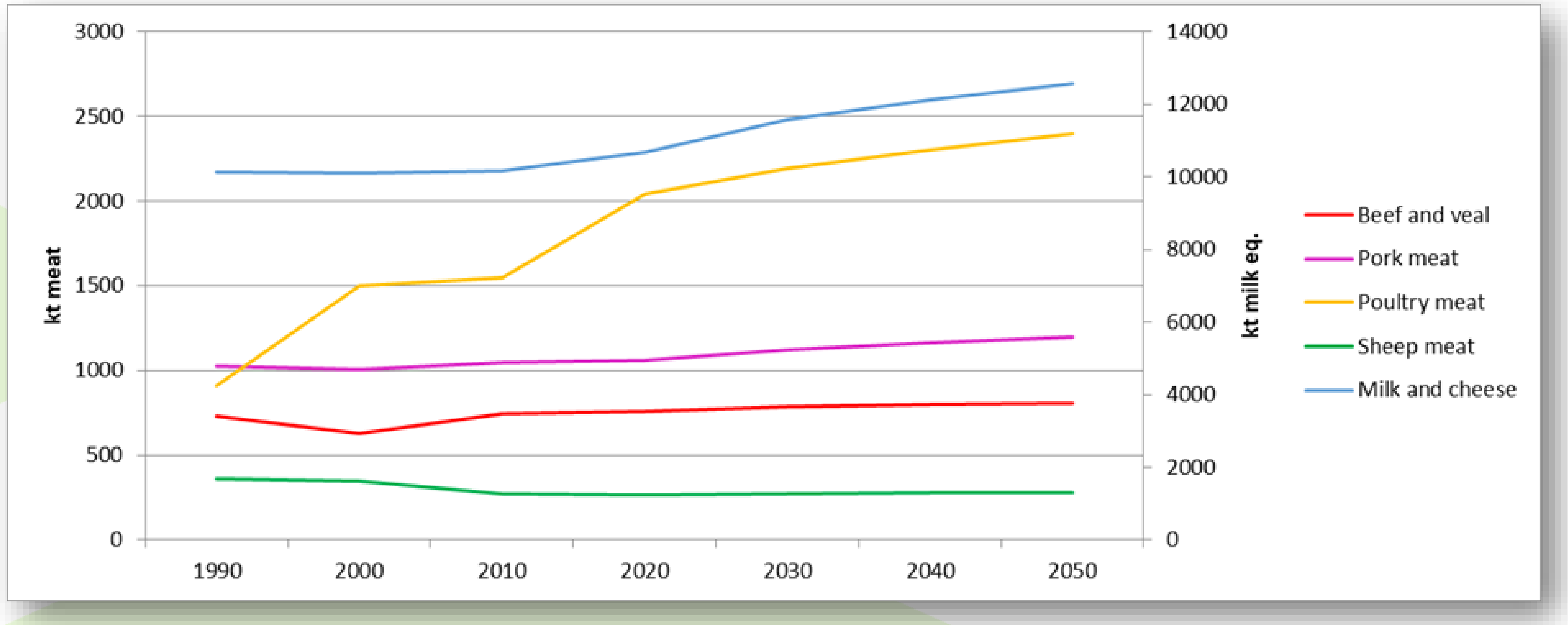
Progress (CCC 2024)



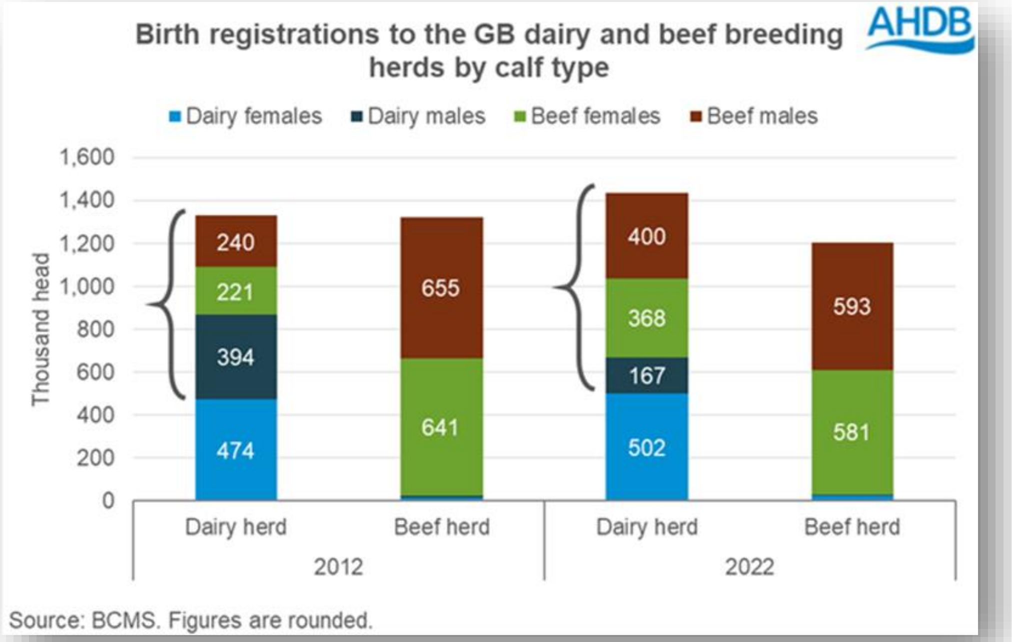


“Progress reducing emissions in the agriculture, land use and waste sectors has been slow over the past seven years but requires substantial acceleration over the coming seven years.” (CCC 2024, p17)

Baseline trends in demand and productivity



Estimated UK total consumption of meat and dairy (MacLeod 2024a)



Calves registered in Great Britain in 2012 and 2022 by calf type (AHDB 2023)

Will demand shifts reduce emissions?

- UK demand for livestock commodities is static or increasing, driven by increases in population.
- Might be scope for offsetting increases via reduced waste, but there seems to be little appetite for demand-side management in Govt, PM: *"I am not going to tell people how to behave"* (12/11/24)

Will farm productivity come to the rescue?

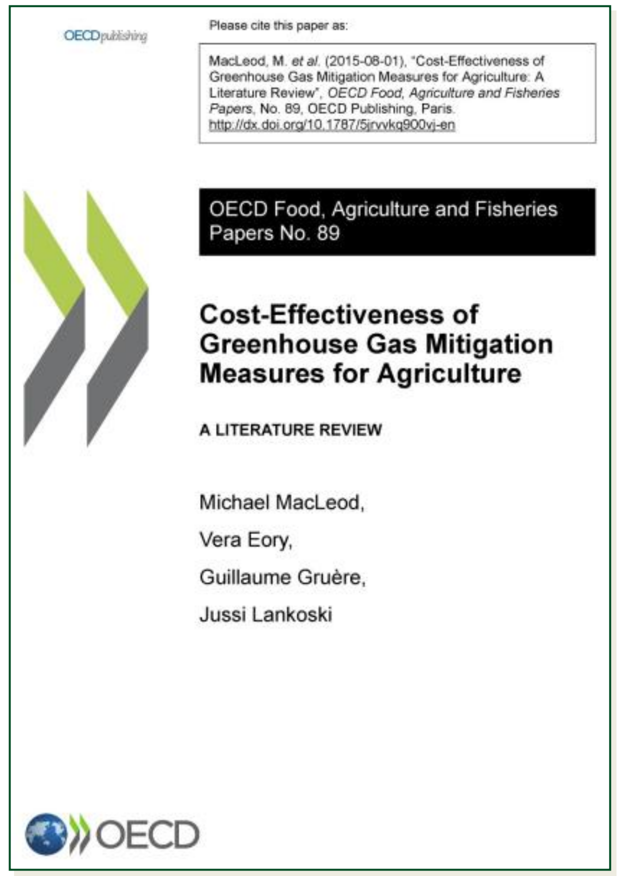
Trends are quite complex

- Suckler beef and sheep – past trends not encouraging.
- Dairy – reducing EI of milk and increasing the supply of low EI beef.
- Pigs and poultry – already high productivity, limited scope for further reductions in FCR?
- Crops - can NUE be improved while adapting to climate change?

What can we do to reduce supply-side emissions?

Supply-side mitigation measures

Category (italic) and sub-category	Category (italic) and sub-category
Cropland management	*Livestock management*
Agronomy	Nutrient use efficiency and feeding
Nutrient management	Specific agents and dietary additives
Structural and management changes	Animal health
Tillage and residue management	Structural and management changes
Water and soil management	Animal breeding, genetics and herd structure
Rice management	*Housing and manure*
Orchards	Housing total
Grazing land management	Improved manure storage and handling
Grazing intensity and timing	Anaerobic digestion and CH4 capture
Increased productivity	*Land use change*
Fire management	*Energy efficiency*
Water and soil management	
Management of organic soils	
Restoration of degraded lands	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OECD Food, Agriculture and Fisheries Papers No. 89

Cost-Effectiveness of Greenhouse Gas Mitigation Measures for Agriculture

A LITERATURE REVIEW

Michael MacLeod,
Vera Eory,
Guillaume Gruère,
Jussi Lankoski

OECD

https://www.oecd-ilibrary.org/agriculture-and-food/cost-effectiveness-of-greenhouse-gas-mitigation-measures-for-agriculture_5jrvvkq900vj-en

- There are hundreds of measures, and lots of evidence
- How do we translate this into comprehensible advice?
- Gradually…it is an ongoing process keeping analysis up to date:
  - – The baseline changes (e.g. dairy sector, electricity EF, deforestation rates and policy)
  - – New measures appear (e.g. feed additives, gene editing, breeding for lower CH4)
  - – Evidence changes (e.g. reduced tillage)

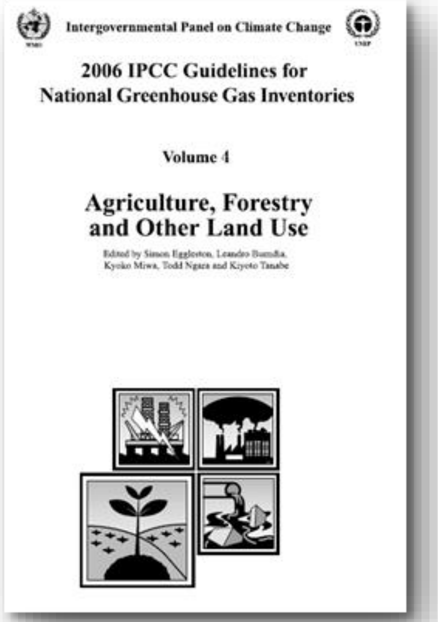
General approach

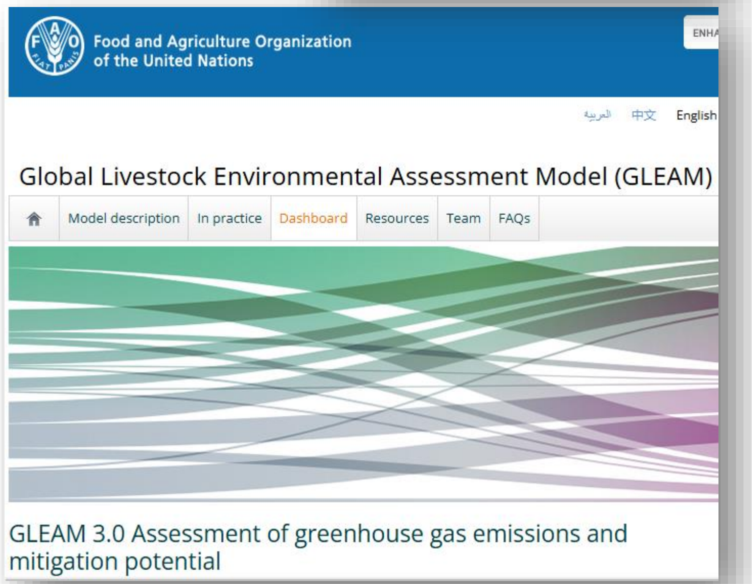
- Identify a subset of measures
  - Does it work in theory?
  - Is it likely to work in practice?
  - Are there risks of wider impacts?
- Review evidence on abatement rates and costs
- Estimate potential change in uptake
- Calculate abatement potential, cost and cost-effectiveness
- Examine interactions between measures and recalculate
- QA: project peer reviews, paper peer reviews, publication of assumptions, e.g. for Defra SCF0120:
  - https://randd.defra.gov.uk/ProjectDetails?ProjectID=20123&FromSearch=Y&Publisher=1&SearchText=clean%20%20growth&SortString=ProjectCode&SortOrder=Asc&Paging=10

General approach

- Big XL > Python (+ public interface?)
- Calculations based on IPCC guidelines, hence consistent with GHG inventory
- Activity data and other inputs from a range of sources
- Assumptions on mitigation measures based on published work as far as possible

- For the NZT Plan we:
  - Adapted our approach to enable sectoral analysis (e.g. dairy, sheep, etc.)
  - Expanded the scope to include emissions from imported feed and fertiliser production
  - Calculated LUC emissions from soy





Example assumptions: 3NOP

SRUC

3NOP is a chemical that reduces the excretion of enteric methane by ruminants when added to their rations (or introduced via a bolus). It does so by reducing the rates at which rumen archaea convert the hydrogen in ingested feed into methane.

2020 Assumptions, based on a review of 12 experimental studies

Applicability:	All beef and dairy cattle while housed
Current uptake:	0%
Effect on methane yield:	-20% (beef cattle) -30% (dairy cattle)
Effect on cattle performance:	None
Cost:	Not known.
CE:	Assumed £1/tCO2e
GHG to produce 3NOP:	Low, i.e. <10% of mitigation

2023 Changes made in light of new evidence (e.g. Duthie et al. 2023)

Applicability:	Housed cattle, >1year old, not organic herds
Effect on methane yield:	-20% (beef cattle) -25% (dairy cattle)
Cost:	~£50/cow.year

Example results: UK dairy

Emissions could be reduced by ~30% by 2035 with measures such as:

- Grass legume mixes
- Feed additives
- Genetic improvement
- Increasing the frequency of milking
- Covering slurry and/or capturing and flaring methane
- Optimising soil pH and using cover crops in feed crop production

Additional abatement may arise from:

- Improving dairy cattle health
- Reduced emissions from imported feed
- CH4 capture in housing
- Agroforestry
- Increased soil carbon sequestration (grass leys, biochar, soil carbonation etc.)
- Decarbonising mobile machinery
- Decarbonising fertiliser production
- Low carbon feeds

Questions and answers

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The reports

The Overview, Summary and Full Technical reports are available for download from www.igd.com/Social-Impact/Sustainability