AHDB Farm Excellence Platform Carbon Audits 2022 - 2023

Toby Townsend and Ryan Douglas, ADAS Climate and Sustainability

May 2023

Introduction

- **Background:** AHDB Monitor and Strategic Farms are an important element of AHDB's Knowledge Exchange role. Alongside demonstrating opportunities for improvements to business management, productivity and competitiveness, there is a focus on helping farms to increase environmental sustainability.
- **Project aim:** Measure carbon footprints for these farms and identify opportunities to reduce emissions.
- **Objectives:**
- GHG emissions assessments on Agrecalc for Monitor and Strategic Farms
- Bespoke carbon mitigation plan for each farm using farmer input
- Analyse and report data on uptake of practices and barriers
- Provide recommendations to enhance uptake of GHG mitigation practices on farm

Carbon Audit Process

First contact

- Introduction
- Outline project
- Data requirements

Carbon assessment

- Understand farm system
- Collect data
- Note current practices/recent improvements
- Engage farmers in the process
- Follow up by asking farmers to reflect on activity in 7 key areas

Action plan meeting

- Discuss footprint in context
- Answer farmer questions
- For each key area discuss:
- Current practice/ recent progress
- New practices
- Barriers and support needed

Final report

- Introduction and context
- Carbon footprint
- Summary of practices, plan, barriers and support for each key area

The dataset

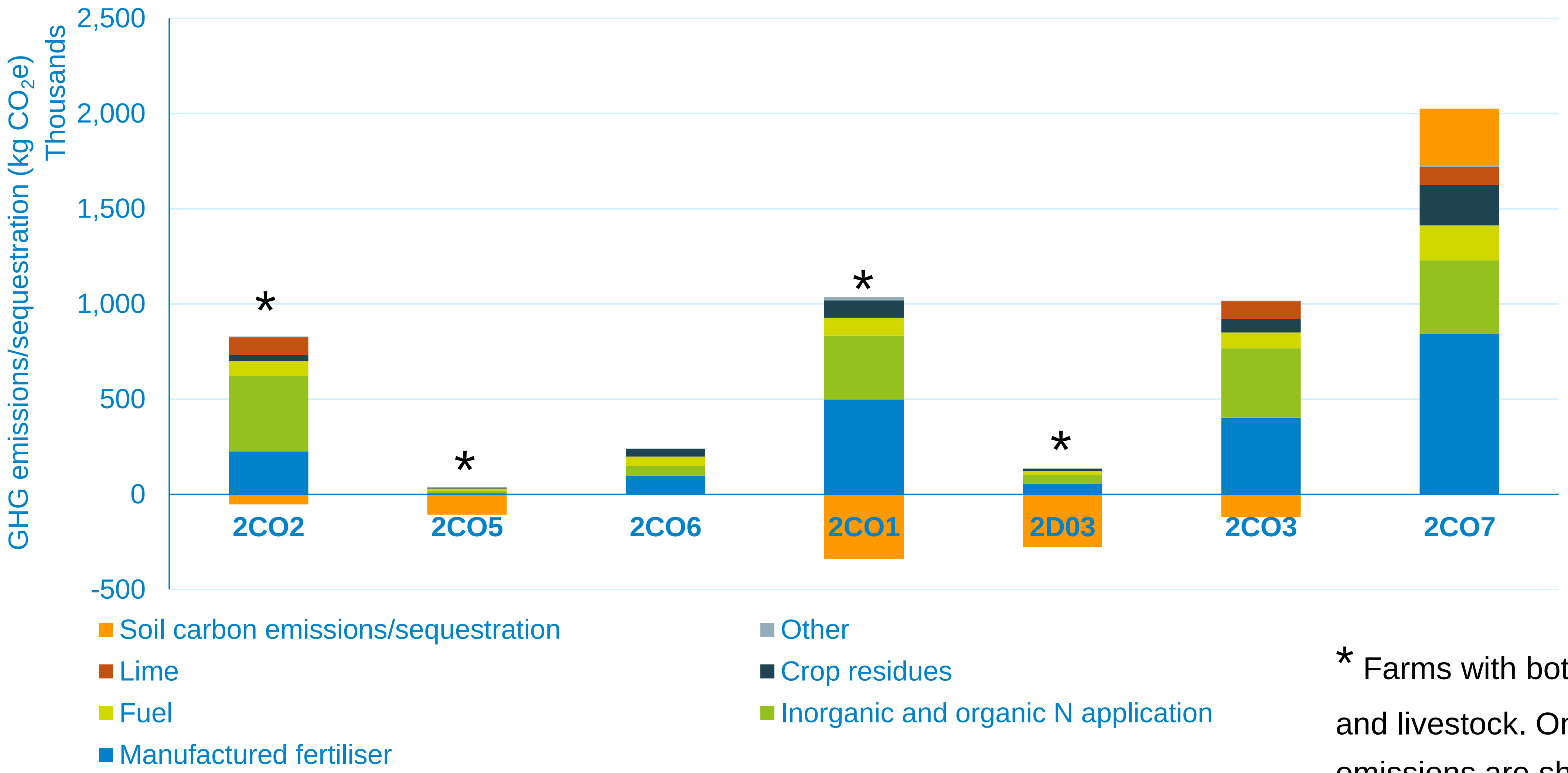
Arable

- 7 farms with an arable enterprise
- 3 of these also had a dairy enterprise
- 11 different crops
- 28 crop footprints
- When including soil carbon, GHG emissions for feed wheat ranged from -0.35 to 0.54 (avg. 0.22) kg CO_2e/kg grain
- When excluding soil carbon, GHG emissions for feed wheat ranged from 0.27 to 0.62 (avg. 0.37) kg CO_2e/kg grain

Dairy

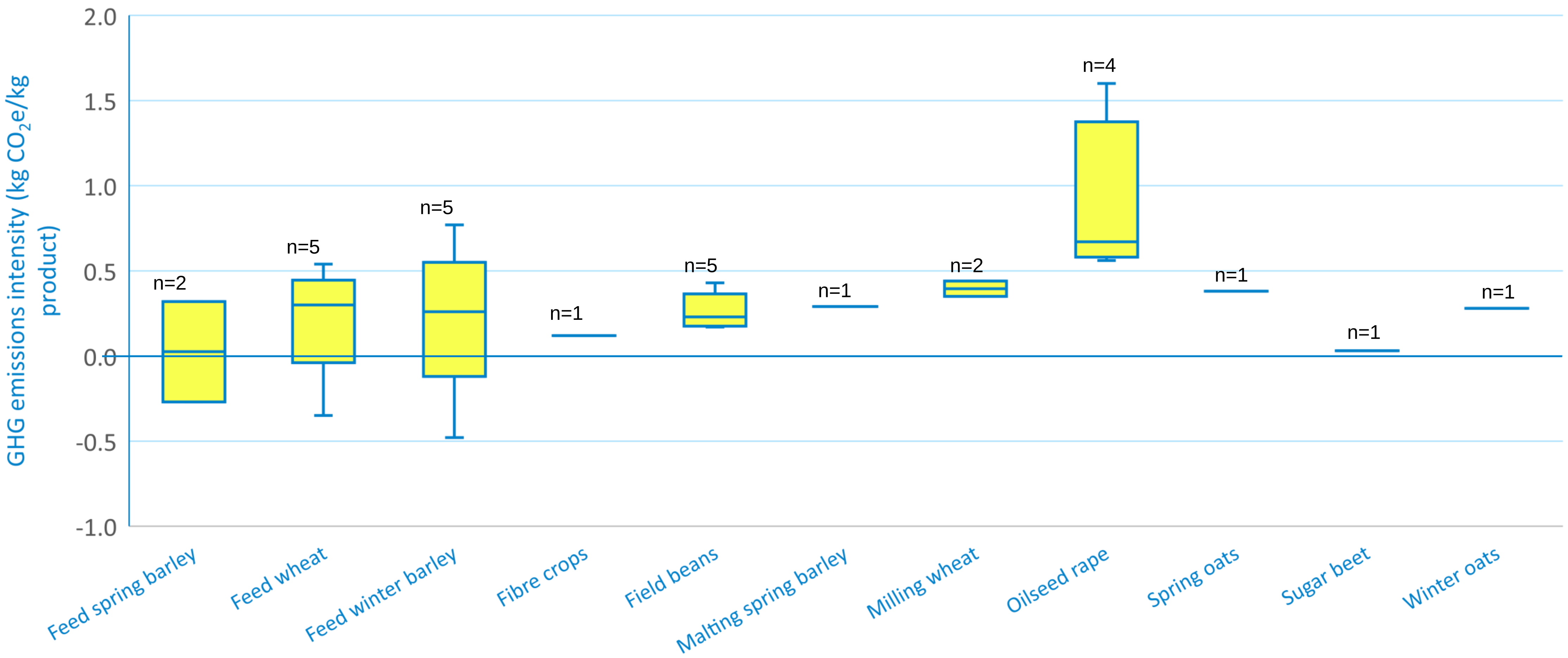
- 11 farms
- 3 of these also grew arable crops
- Even distribution between 3 distinct yield classes
  - <6k, 6-9.5k and >9.5k L/cow/lactation
- When including soil carbon, GHG emissions ranged from 0.56 to 1.12 (avg. 0.90) kg CO_2e/kg FPC milk
- When excluding soil carbon, GHG emissions ranged from 0.95 to 1.51 (avg. 1.22) kg CO_2e/kg FPC milk
- 5 farms completed carbon audits in the previous round of audits in 2020/2021

Farm-level arable enterprise emissions

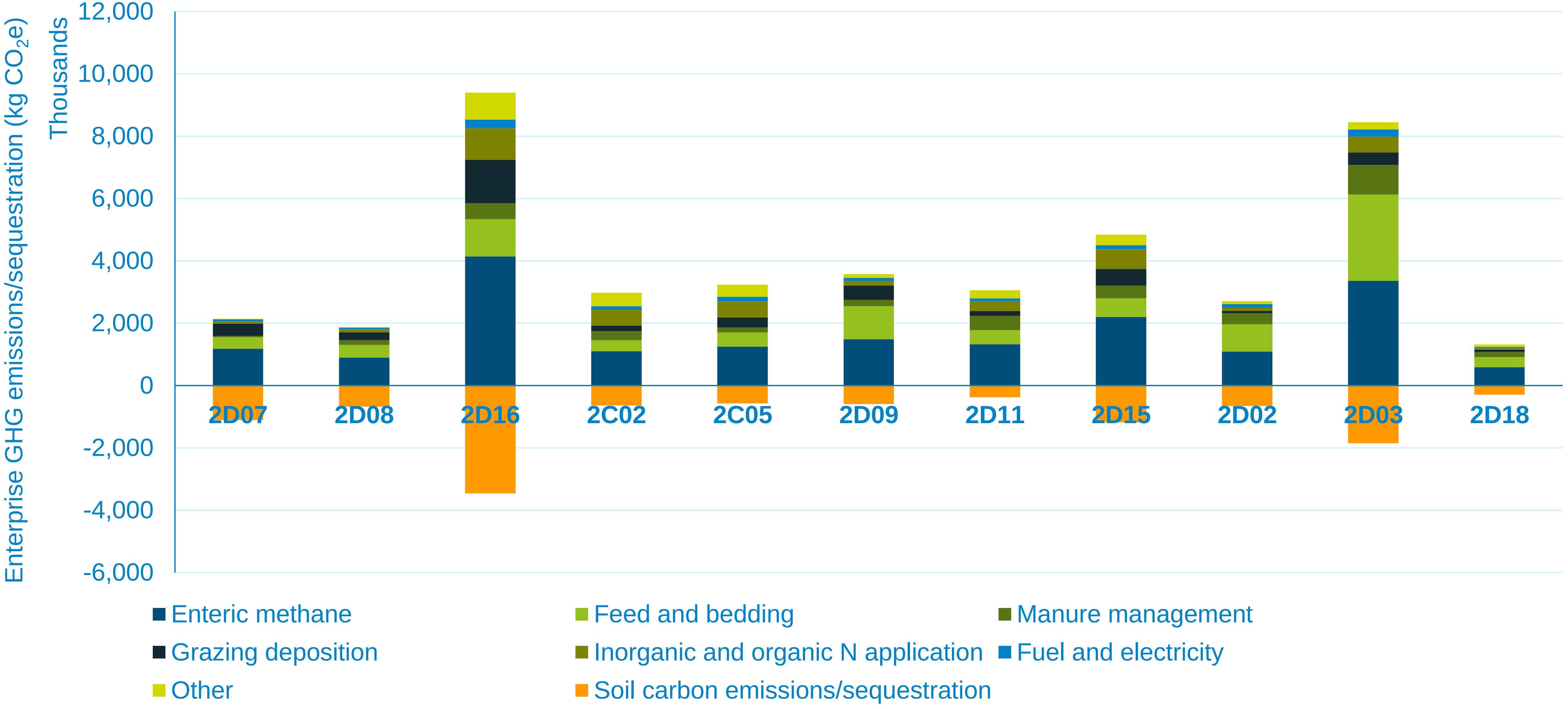


* Farms with both arable and livestock. Only arable emissions are shown here.

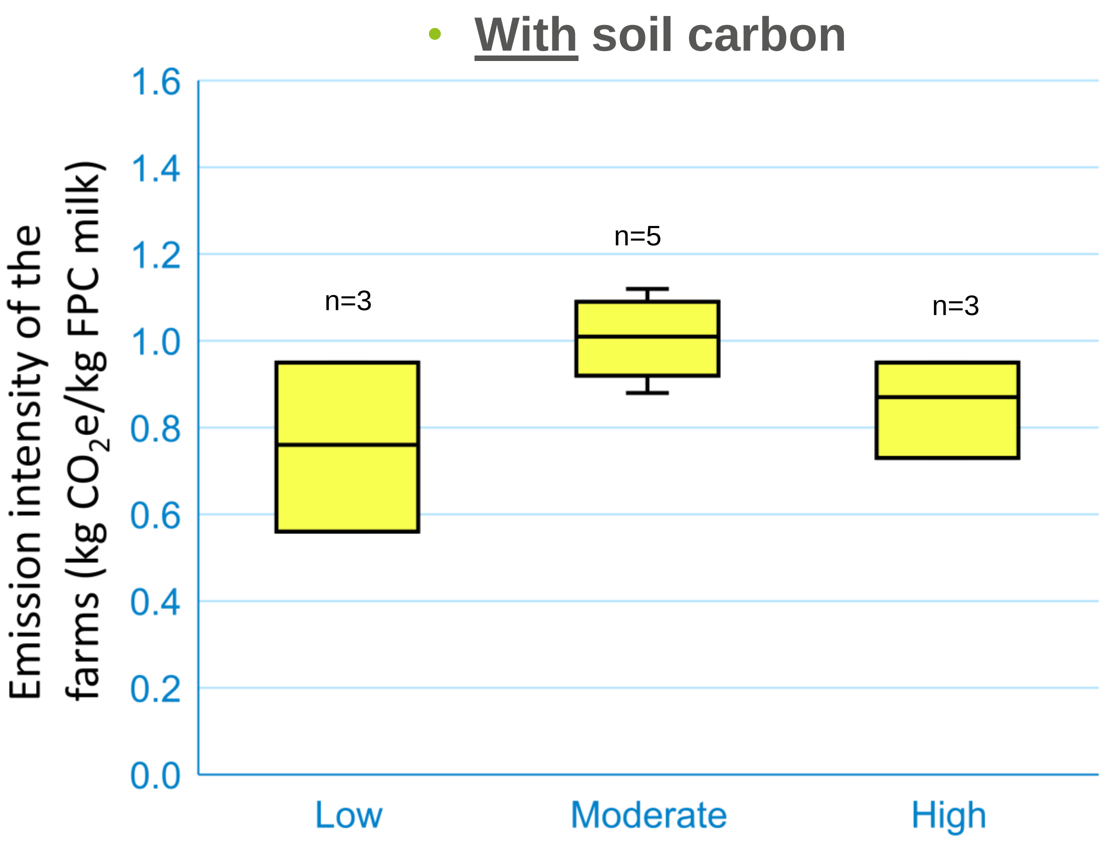
Arable emissions – enterprises (with soil carbon)

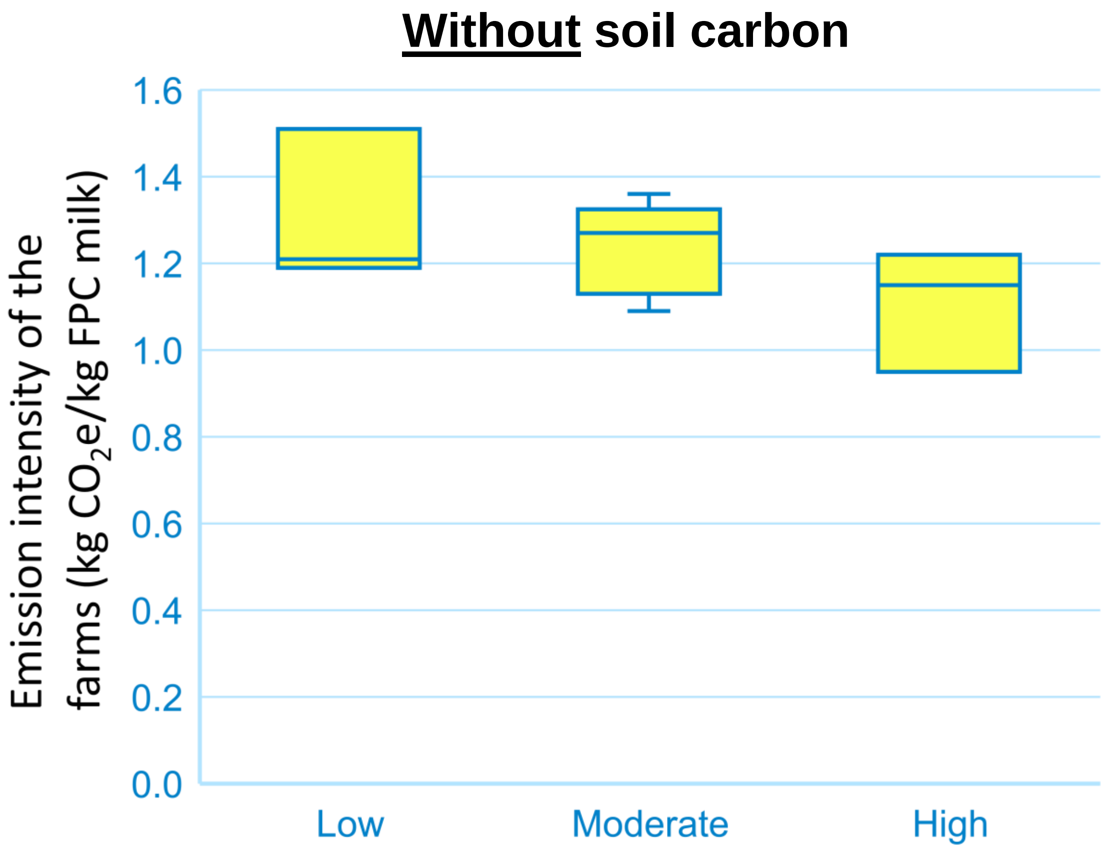


Farm-level dairy enterprise emissions



Milk production emission intensity





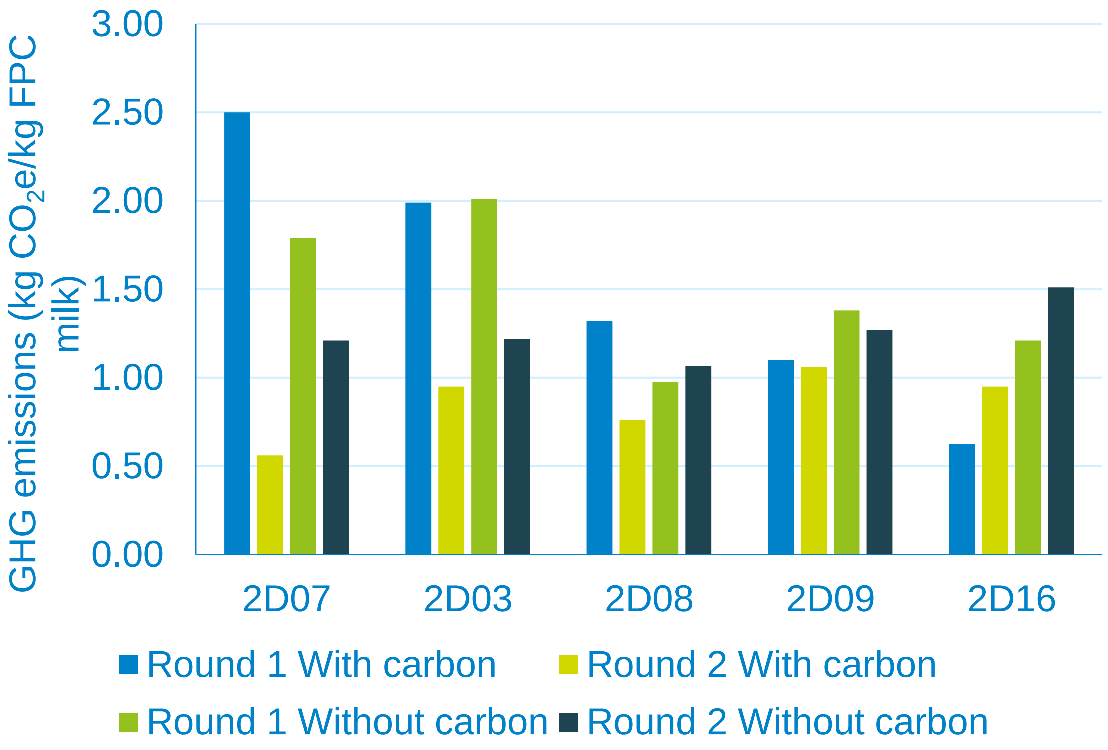
Low = <6.0k L/cow/lactation; Moderate = 6.0-9.5k L/cow/lactation; High >9.5k L/cow/lactation

Soil carbon

- Agrecalc quantifies changes to soil carbon based on:
  - Land-use changes (e.g. arable to grass)
  - Manure application
  - Soil management
- The calculations are a simplified view of soil carbon dynamics. These may show ‘direction of travel’ in how management practices are influencing soil carbon levels but should not be taken as accurate measurements of soil carbon.
- Soil carbon can have large impact on overall results with some audits showing soil carbon sequestration exceeding all other emissions.
- This can obscure the extent of emissions and give the impression that emission reduction is not required. For that reason, it is better to consider the carbon footprint without soil carbon losses or sequestration included.

Comparison to previous audits (5 farms)

- Five farms previously audited by AHDB.
- Including soil carbon: Three farms showed emission reductions of 42-78% over the two assessments while one farm showed no change and one farm showed an increase of 52%.
- Excluding soil carbon: Three farms showed emission reductions of 8-39% over the two assessments while two showed an increase in emissions of 10-24%.
- Differences in emissions between years resulting from:
  - Different input levels (e.g. feed, fuel)
  - Different output levels (e.g. yields of meat and milk)
- The 2021 data extracted previously (e.g. the PDF reports sent to farmers) differs from the data when rerun in the Agrecalc now. This is due to changes to emission factors and calculations in Agrecalc. Updated data has been used here.



Drivers of differences (without soil carbon)

- **2D07** – Emission reduction; lower purchased feed (2020 = 4,888 kg/cow; 2022 = 3,038 kg/cow), lower electricity use.
- **2D03** – Emission reduction; increased milk yield (2020 = 6,667 L; 2022 = 10,206 L); decreased purchased feed (2022 = 7,800 kg/cow; 2022 = 3,800 kg/cow). Increased emissions for beef due to lower beef sales in the 12-month assessment period.

2D08 – Slight emission increase; lower meat and milk yields (2020 = 234 kg & 6,095 L; 2022 = 167 kg & 5,818 L).

2D09 – Slight emission reduction; lower fertiliser use (2020 = 159 kg N/ha; 2022 = 58 kg N/ha).

2D16 – Increased emissions; higher fertiliser emissions. [Note: separate datasets in 2020 so challenges in making comparisons.]

Considerations for tracking emission reductions

- **Benchmarking considerations**

- Benchmarking is better suited to comparing trends over time. The data here has been skewed by year-to-year variation (e.g. yields due to weather conditions). Recording carbon footprints each year and creating a moving multi-year average will provide better insight.

- Maintain past data on carbon calculator and extract data for all years at the same time when making a comparison so that carbon footprints are recalculated with the latest emissions factors.

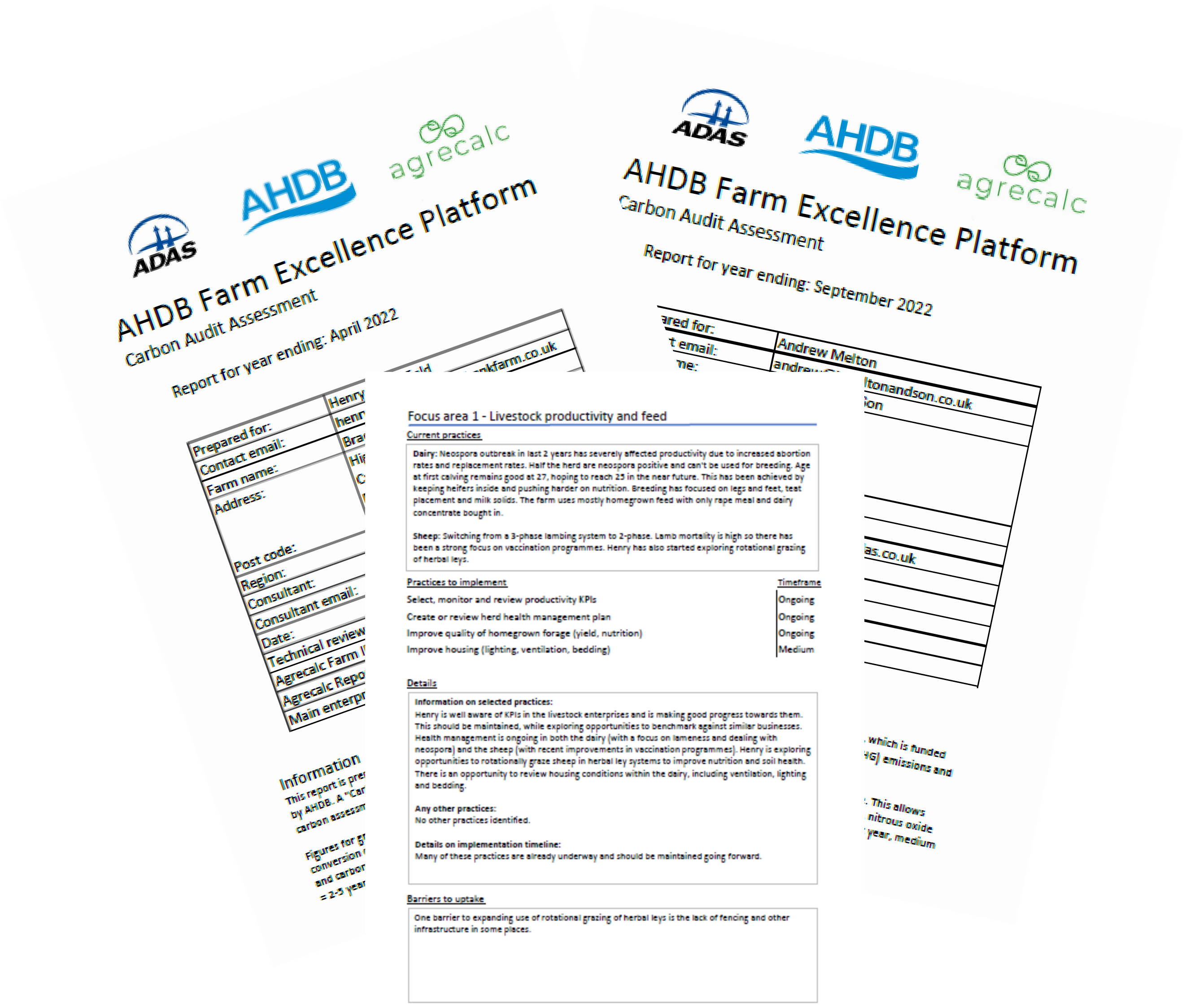
- **Carbon footprinting considerations**

- Data collection could be facilitated by using the same 12-month period for auditing each year and making sure that data sources (e.g. invoices) align with that.

- Track progress on carbon action plan and use KPIs where possible (e.g. fuel use per hectare). Currently, Agrecalc does not currently capture the impact of all the carbon plan options (e.g. limited scope with manure management), so data is not collected in Agrecalc. Recording progress separately will capture all actions, enabling a better understanding of how the farm is improving, and will enable previous carbon footprints to be updated should the Agrecalc methodology change in the future.

Carbon management plans

- Carbon management plans were created for each farm.
- These capture current and planned actions for reducing emissions and protecting and enhancing on-farm carbon stores.
- A timeline is provided for implementing these actions
- Barriers for their implementation are captured – this helps to identify where support can be provided by AHDB to overcome these barriers.
- The following slides show the actions set out in the carbon plans.



Focus area 1 - Livestock productivity and feed

Current practices

Dairy: Neospora outbreak in last 2 years has severely affected productivity due to increased abortion rates and replacement rates. Half the herd are neospora positive and can't be used for breeding. Age at first calving remains good at 27, hoping to reach 25 in the near future. This has been achieved by keeping heifers inside and pushing harder on nutrition. Breeding has focused on legs and feet, teat placement and milk solids. The farm uses mostly homegrown feed with only rape meal and dairy concentrate bought in.

Sheep: Switching from a 3-phase lambing system to 2-phase. Lamb mortality is high so there has been a strong focus on vaccination programmes. Henry has also started exploring rotational grazing of herbal leys.

Practices to implement	Timeframe
Select, monitor and review productivity KPIs	Ongoing
Create or review herd health management plan	Ongoing
Improve quality of homegrown forage (yield, nutrition)	Ongoing
Improve housing (lighting, ventilation, bedding)	Medium

Details

Information on selected practices:
Henry is well aware of KPIs in the livestock enterprises and is making good progress towards them. This should be maintained, while exploring opportunities to benchmark against similar businesses. Health management is ongoing in both the dairy (with a focus on lameness and dealing with neospora) and the sheep (with recent improvements in vaccination programmes). Henry is exploring opportunities to rotationally graze sheep in herbal ley systems to improve nutrition and soil health. There is an opportunity to review housing conditions within the dairy, including ventilation, lighting and bedding.

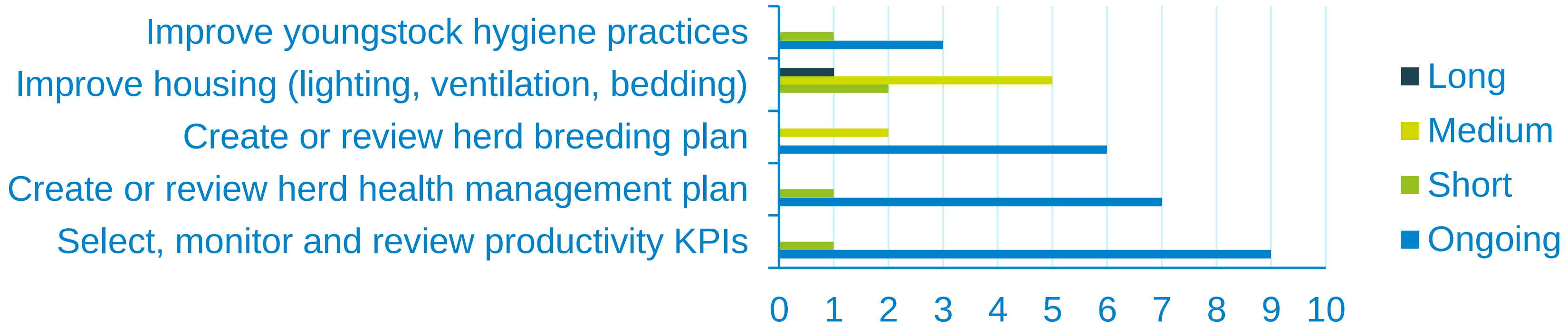
Any other practices:
No other practices identified.

Details on implementation timeline:
Many of these practices are already underway and should be maintained going forward.

Barriers to uptake

One barrier to expanding use of rotational grazing of herbal leys is the lack of fencing and other infrastructure in some places.

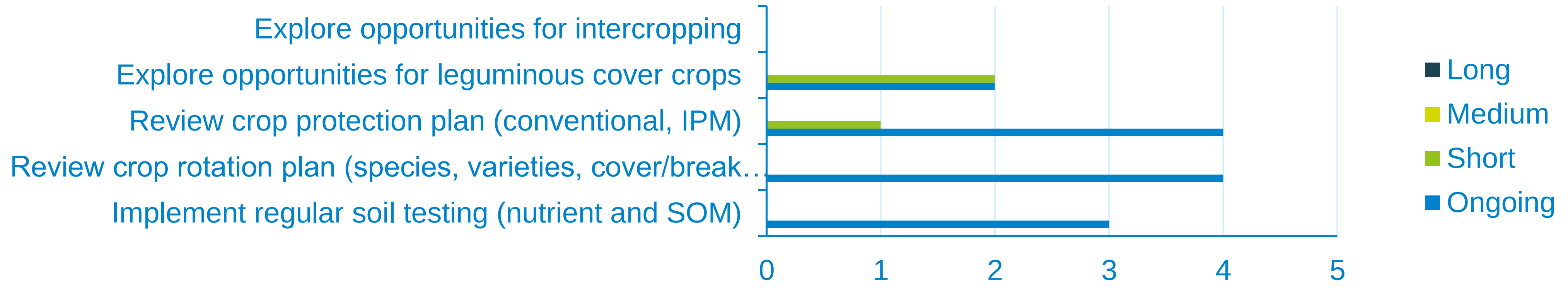
Livestock productivity



- **Actions**
- Monitoring relevant KPIs and active herd health management (regular vet meetings, proactive treatments, etc.) widely practiced.
- Review breeding plan – conscious decisions around breeding goals.
- Lots of interest in improving housing, from small (e.g. lighting) to large-scale improvements (e.g. new sheds).

- **Barriers**
- New housing – large capital investment required, economic benefits often unclear
- Interest in rotational grazing systems, but labour and equipment costs limiting uptake

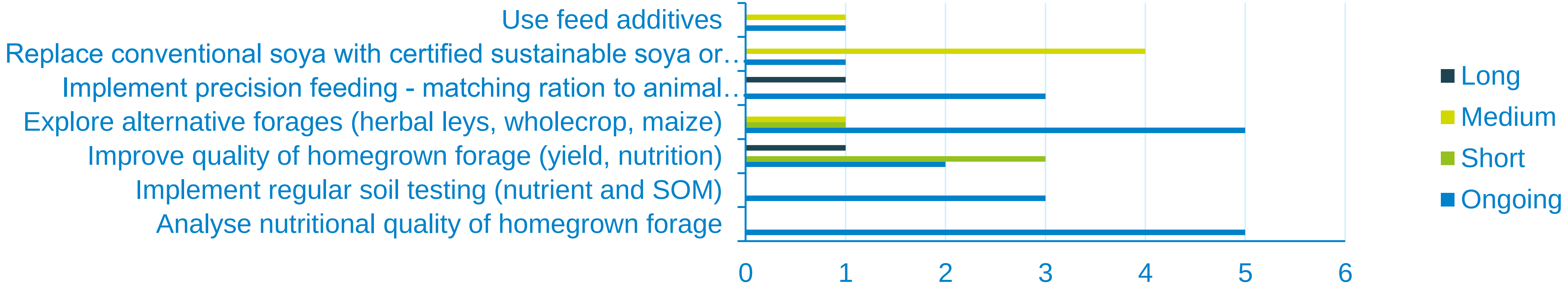
Arable productivity



- **Actions**
- All farmers were working on multiple practices
- Focus on nutrient management planning, variety selection and crop protection planning
- Some actions not captured within the list of actions in the carbon plan (e.g. benchmarking of KPIs)

- **Barriers**
- Limited identification of barriers – mainly focused on optimising current practices
- Some actions were not possible to expand – e.g. cover crops could only be grown in front of spring crops
- No engagement with intercropping

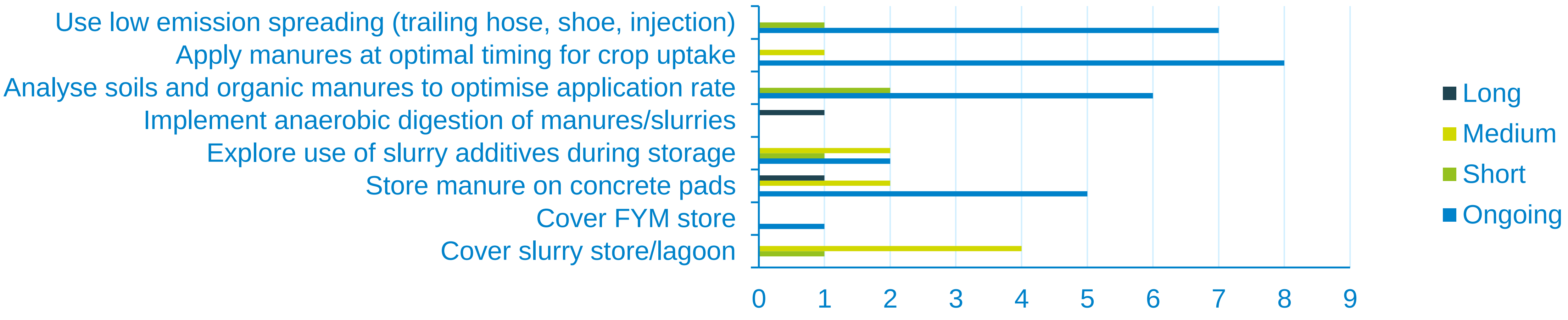
Feed



- **Actions**
- Focus on improving homegrown forage, monitor with nutrient analysis
  - Improve nutrition content of grass
  - Implement alternative forages

- **Barriers**
- Limited information on emissions breakdown of purchased feed (Agrecalc has limited feed module)
- Farmers are looking to replace soya, but it is difficult to find effective and economic replacements
- Feed additives and precision feeding difficult to include in grazing systems

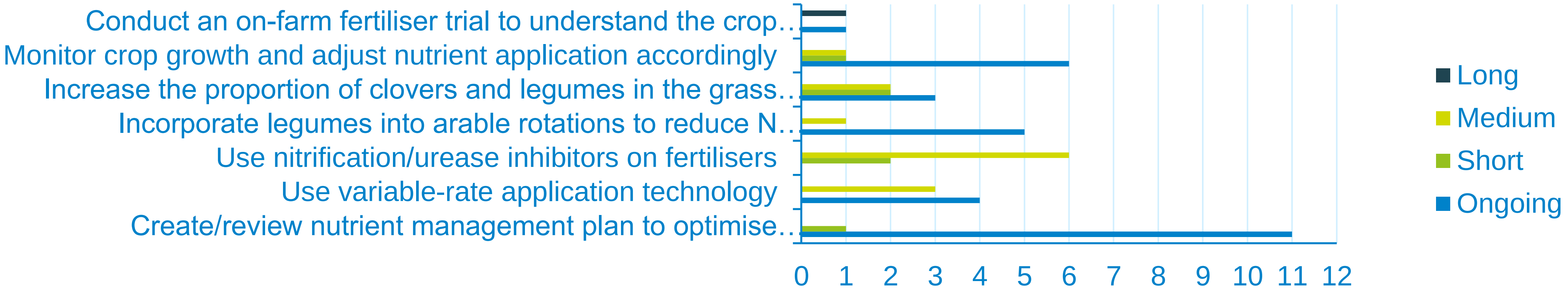
Manure management



- **Actions**
- Many farmers using low emission spreading, although no detail on types were captured
- Seem to be aware of optimal application timings and incorporating manures into nutrient management plans
- Interest in improving manure storage facilities

- **Barriers**
- Limits to low emission spreading when using contractors
- Lack of funds for investment in storage (covers, concrete pads)
- Some arable farms have limited access to manures

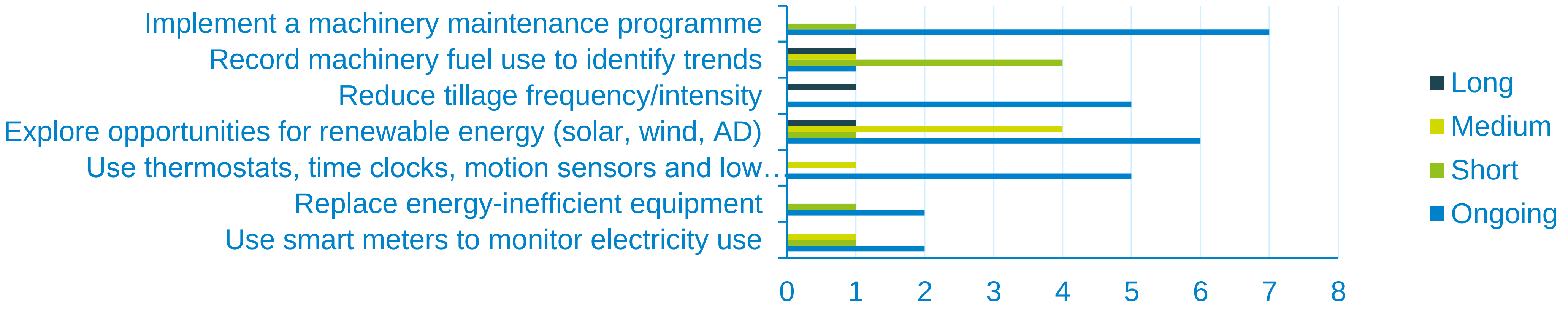
Manufactured fertiliser



- **Actions**
- All non-organic farms taking action to optimise manufactured N in arable and grass systems
- All arable farmers using nutrient management plans and most are either using or plan to use variable-rate application

- **Barriers**
- There is less focus on dairy farms to optimise nitrogen application levels
- Lots of interest in inhibitors but uncertainty about cost-benefit of these
- Variable rate application less well suited to small and awkwardly-sized fields

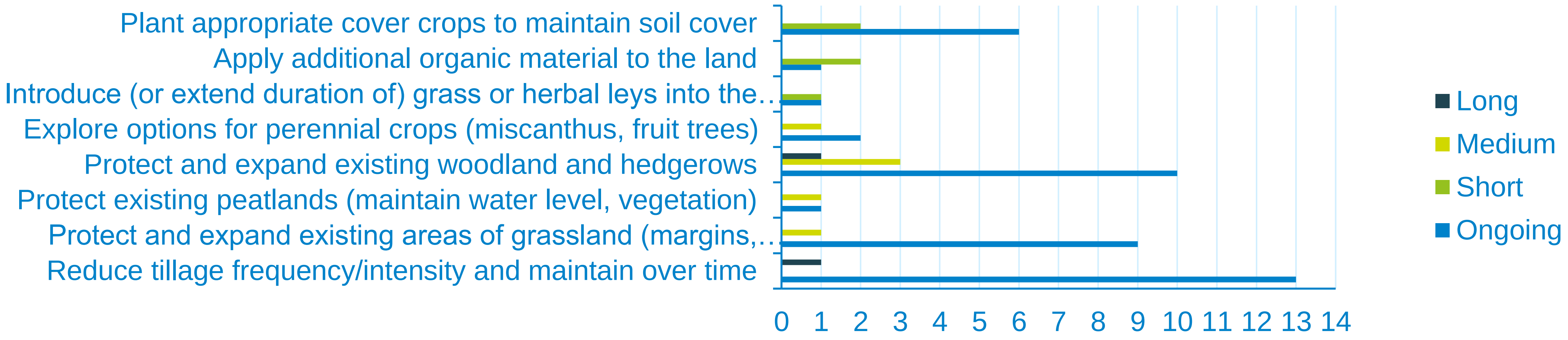
Energy



- **Actions**
- All farms reducing energy use through actions such as machinery maintenance programmes, installing energy-efficient equipment and reducing tillage intensity
- Reducing costs is key driver of energy reduction practices
- Energy is generally a small emission source in agriculture (<5% in dairy, 10-15% in arable)

- **Barriers**
- Expanding renewable energy restricted by costs, lack of grants, planning constraints and lack of grid capacity
- New equipment has considerable cost and ROI is not always clear
- Lots of interest in monitoring fuel use but many farmers have not had the time to invest in doing it yet

Carbon stores and sequestration



- **Actions**
- Reducing tillage intensity in all arable farms and most livestock farms
- Silvopastoral systems being tried on some farms
- Cover crops popular in arable systems

- **Barriers**
- Farmers are keen to expand farm carbon stores but need grants and other support
  - Lack of clarity on what funding is available (where to get the information, support to apply)
  - Uncertainty around future funding leading to delayed action
- Technical challenges around successfully growing cover crops

Summary – Reducing emissions in arable systems

- **Fertiliser** was the main emission source. Farmers already optimising nitrogen fertiliser application rate using nutrient planning and variable-rate application which should be continued. Opportunities for expanding legumes in the rotation and using inhibitors. There are emerging opportunities for fertilisers with lower production emissions (e.g. processed organic materials, fertiliser from blue or green ammonia). More efficient application methods (e.g. foliar N, fertiliser placement practices) can enable emission reductions.

- **Fuel** was the second greatest emission source. Farmers using best practice on machinery maintenance and generally upgrading equipment when cost-effective. Many farms are using reduced tillage approaches. Opportunities around recording fuel use (although takes time) and installing renewable energy – issues with planning, grid capacity, financing.

Summary – Reducing emissions in dairy systems

- **Enteric methane** was the main emission source. Farms are very active in monitoring relevant productivity KPIs and herd health planning. There is desire to improve housing conditions to support welfare and productivity but there are financial constraints. The main opportunities going forward are likely to be feed additives – 3NOP, nitrates, essential oils, etc. although, despite a robust evidence base, they are not currently captured in Agrecalc. Improving digestibility of the diet through improved silage production and alternative forages will also help to address enteric methane and reduce feed emissions simultaneously.
- **Feed and bedding** was the second greatest emission source. Farmers are focusing on improving quality of homegrown forage through better management or switching to higher-energy alternatives. There is desire to reduce soya but challenges finding cost-effective replacements.
- **Manure management** was the third greatest emission source. There is wide adoption of low emission spreading techniques and farmers are incorporating manures into nutrient management planning. There is desire to improve storage facilities, but lack of finance.

Recommendations – Reducing emissions

Barrier	Details	Recommendation
Cost of implementing practices	There are a range of grants available to support purchase of new machinery, building infrastructure (e.g. slurry stores), planting cover crops and hedgerows – but the information is difficult to access, spread across multiple places and there are often time-consuming and complicated application processes.	Create a central, regionally relevant, searchable repository of all grants and financial support available to support implementation of GHG mitigation practices, with simple practical information on how to apply, with links to further support if needed.
Technical challenges with implementation	Farmers have often tried new approaches but were unsuccessful due to lack of technical support to adapt the practice to their specific soil, climate and production system.	More bespoke information is needed on how practices can be adapted to suit different regions and production systems. The use of locally relevant case studies and monitor farms could support this.
Shortage of time and labour	Many practices, while labour saving long-term, require substantial time investment to set up.	Farmers need better clarity on the time and cost requirements of setting up new practices and the potential savings over a longer time-period. This data should be derived from case studies.
Planning and grid	There is a lot of appetite to install renewable	Clear advice needs to be provided for farmers

Recommendations – Reducing emissions

Barrier	Details	Recommendation
Variable-rate fertiliser	Fertiliser is the main emission source on arable farms (and substantial in some dairy farms). Variable-rate application is a robust way of optimising fertiliser application, saving money and GHG emissions without compromising crop yield, but uptake is low.	More research is needed to understand the specific barriers to variable-rate fertiliser application beyond the cost of equipment.
Fertiliser inhibitors	Evidence of substantial emission reductions but associated with a visible cost increase on what is already an expensive product.	More work needs to be done to evidence the cost-benefit of nitrification and urease inhibitors to support uptake by farmers.
Feed additives	There is substantial academic evidence of robust emission reductions using feed additives but this has not been translated into a farmer-facing context, nor has the cost-benefit been justified.	Translate academic literature on feed additives into a farmer-facing publication.

Recording carbon footprints

- Frequency – Recommended to collect annual data with a consistent 12-month period. Although an annual carbon footprint is not necessary, having the data to provide a moving multi-year average will help to identify trends in emissions. There is a need to support developing good data practices so that the right data is being recorded each year in the easiest way possible to facilitate this process.
- Dairy farms are already conducting carbon audits for buyers – There is a need to avoid duplication of the audit and instead focus support on identifying and implementing actions to reduce emissions.
- Benchmarking over time – There are issues with comparison with previous data (e.g. due to changes in the calculations and emission factors in the carbon auditing tools). There is a need to make sure updated data is used for comparisons.
- Soil carbon – The soil carbon calculations are unreliable and the data generated skews the carbon audit results, potentially giving misleading information to farmers. Focus should be on doing actions that support healthy soils without compromising emissions reductions.