



Suckler Beef Climate Scheme

Final Report

October 2020






A blueprint for sustainable suckler beef production in Scotland:

Recommendations to the Scottish Government on development and delivery

Prepared by the

Suckler Beef Climate Group

Final report

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Table of Contents

Chairman's foreword

By Jim Walker

The Scottish suckler beef herd is the engine room that drives economic activity and environmental management across large swathes of rural Scotland from the Northern isles to the Southern uplands. Suckler cows offer an irreplaceable way of turning grazing land, permanent pasture, and poor quality rough grazing on the hills and uplands of Scotland into a much sought-after, internationally renowned and high quality source of protein. Livestock offers the most efficient way of managing much of this land as a source of protein, and suckler beef systems have access to a ready market.

In June 2019[1] there were 16% fewer suckler cows in Scotland than in 2005[2], and a massive 20% less than in 2000[3] when the Scottish suckler herd counted just under 520,000 breeding females. It is estimated that looking after the current 417,000 suckler cows is responsible for providing approx. 20%[4] of Scottish agricultural employment[5]. This means that one in five people working in the Scottish farming industry are directly employed by the suckler beef sector, many of them in family-owned and family-run farming businesses. With nearly 4,500 jobs being created directly in the red meat processing sector and a further 30,000 jobs in the wider supply chain which includes feed manufacturers, vets, auctioneers, hauliers, builders and mechanics amongst others, red meat production including primary cattle rearing is a vital industry for Scotland, particularly in rural areas.

[1] Source: June Agricultural Census 2019 (https://www.gov.scot/publications/final-results-june-2019-agricultural-census/)
[2] Source: June Agricultural Census 2005 (https://www2.gov.scot/Topics/Statistics/Browse/Agriculture-Fisheries/PubFinalJune2005Excel)
[3] Source: June Agricultural Census 2000 (https://www2.gov.scot/News/Releases/2000/10/1ce275b2-280e-4634-834c-52a86653907f)
[4] This figure is based on standard labour requirements associated with beef cattle and grassland management
[5] **MOXEY A.** (2016). *An assessment of the economic contribution of Scotland's red meat supply chain.* [Online] Available from: https://www.qmscotland.co.uk/sites/default/files/economic-contribution-of-scotlands-red-meat-supply-chain.pdf (last accessed 1st October 2020).

Cattle farming accounts for 26% of total agricultural output in Scotland. This makes it the single largest and most important enterprise type within the Scottish farming industry[6] and proportionally more significant, and therefore more important, than elsewhere within the UK where it accounts for approx. 15% of agricultural output[7], or compared to the EU where that figure is below 8%[8]. Cattle production takes place on one out of five holdings in Scotland, and any major structural changes to the sector therefore have a significant impact on Scottish farming and indeed the Scottish economy as a whole. Were we to lose a further 20 or 30% of the suckler herd, as some have suggested in order to meet Scotland's climate change targets, this would result in a loss of over £160m to the Scottish economy and affect up to 12,000 jobs in areas with few alternative sources of employment, particularly during the current Covid-19 pandemic.

It is a fact that domestic food production will inevitably contribute towards a nation's total emissions, and Scotland is no different in that regard to any other country on the planet. But shifting these emissions abroad simply by cutting domestic food production in order to meet certain emissions reductions commitments does not resolve the issue itself, it merely exports the problem elsewhere and as such will not achieve a reduction in global net emissions. However, the conclusion should not be drawn that Scottish beef farmers cannot improve; they can. By being more productive, resilient and efficient, they will become more profitable and less reliant on public support, something the younger generation in particular craves. They can and will play a full part in combatting climate change by cutting emissions without significantly cutting numbers. A focus on domestic food production can deliver distinct benefits, most notably because every aspect of the land management and food production process can be monitored to ensure that practices are carried out with due consideration to the environment. Producing homegrown food is a desirable way of managing the land and has the added benefits of creating growth opportunities in the local economy as well as providing some degree of food security, the importance of which has yet again become all too clear during the current Covid-19 pandemic.

Scotland's suckler beef farmers have had to adapt to several seismic events over the years, from changes to the Common Agricultural Policy to the impact caused by Foot and Mouth Disease, and most notably the effects of the BSE crisis which closed export markets for 10 years. As such they have a history of responding to challenges, and the latest one that the world faces is climate change. The sector has already adopted innovative measures to play its part in fighting the challenge of climate change and is ready, willing and able to do more.

The SBCS will outline a path to reach achievable, clearly defined outcomes which will significantly reduce the emissions from the suckler beef sector, estimated to be just over 2.6MT CO_{2e} in 2018, in order to help Scotland reach its net zero commitment.

The scheme is designed in such a way that any suckler beef farmer wishing to participate will be able to join, regardless of business structure, type, size or location. The measures outlined in the scheme will be user-friendly to enable and encourage maximum uptake, and will highlight that reducing greenhouse gas emissions and improving the efficiency of suckler beef production in Scotland can – and will – work hand in hand.

[6] Source: Economic Report on Scottish Agriculture (https://www2.gov.scot/Topics/Statistics/Browse/Agriculture-Fisheries/PubEconomicReport

[7] Source: Agriculture in the United Kingdom 2019 (https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/904024/AUK_2019_27July2020.pdf)

[8] Source: Eurostat – Agriculture, forestry and fishery statistics – 2019 edition (https://ec.europa.eu/eurostat/statistics-explained/index.php/Performance_of_the_agricultural_sector#Value_of_agricultural_output)

The scheme criteria for entry and participation are innovative and meaningful, and the scheme will deliver on its defined objectives and targets by using a mixture of categories, each containing different management options that have the potential to deliver significant environmental and efficiency benefits along with likely improvements in business profitability. The uptake of various management options will provide access to relevant capital investment, continuous personal development (CPD) and training to ensure that businesses can utilise and incorporate innovative technology into their production systems. Access to innovative technology and relevant training will not only benefit individual farming businesses but will also generate additional labour opportunities within the Scottish suckler beef sector and beyond, thereby encouraging more people into the industry and particularly the younger generation which often offers already extensive knowledge and experience in dealing with information technology and electronic equipment.

The delivery of the scheme will be farmer-led but independently verified and audited to ensure that the products from participating farms meet standards that currently cannot be matched anywhere in the world. The sale and marketing of these products will be promoted by a trademark and a certification mark which will be licensed to users, thereby allowing participating farmers to reduce their reliance on public support to generate a profit margin, and gain some control over the marketing of their produce within a supply chain system that hasn't functioned properly for the last 25 years.

I am indebted to my group for their contribution to this report and the scheme it has inspired. Their enthusiasm, innovative ideas and grasp of the opportunities and challenges we face continue to provide the motivation that will drive forward these proposals in the most difficult circumstances.

The group would like to acknowledge the contribution of all those who made the effort to present to us and all those who replied to our consultation. Many of these ideas are captured in the management options we have incorporated into the scheme. In particular, I would like to thank Nigel Miller, NatureScot, and Chris Stark, Chief Executive of the Committee on Climate Change, for their input, advice and support.

Similarly, the team from SRUC, in particular Steven Thomson, Julian Bell, Gavin Hill and their colleagues for their tireless and ongoing work analysing and modelling the data required to evidence and support our work. Dr Andrew Moxey also needs a special mention for bringing his experience, knowledge and expertise inside Government to help guide and develop a workable scheme that can actually deliver the changes it promises.

Finally it would be impossible to overstate the contribution of Claire Simonetta from Mull in helping to deliver one of the most well thought out, detailed and professional pieces of work I have ever had the privilege to be involved in. Her effort, commitment and skill in the drafting of this report have been Herculean. She deserves huge credit for her work especially in the face of the IT and communication challenges we have faced between Mull and Sanquhar during a pandemic!!!!

This report represents the first stage on what will undoubtedly be a challenging but ultimately worthwhile journey. The next stage is the detailed design and development of the scheme that will deliver this new type of outcome driven approach to agricultural support. This will incorporate climate change, environmental and farm performance outcomes and improvements that offer a real chance of a better future not just for suckler beef farmers but all participating farmers.

Scotland has a unique opportunity to show the world that modern food production can operate hand in hand with a reduction in greenhouse gas emissions. The fight against global warming, the preservation of our precious biodiversity, and improving economic activity, employment and food security are so important we can't afford to wait any longer talking about them.

We need to act now.

1. Executive summary

Climate change has become a key priority for governments across the world and will require real action and commitment if we are to slow global warming. Recognising the urgency of the situation, Scotland has responded with ambitious targets, aiming to reduce its greenhouse gas emissions by 75% by 2030 and become a net-zero nation by 2045. In order to ensure that these targets can be met, every sector including the farming industry will be required to implement effective and high impact measures to drive down total greenhouse gas emissions and protect already existing carbon stores within our environment.

A recent study conducted by S. Thomson and A. Moxey (2020)[9] shows that the Scottish suckler beef sector has the potential to cut greenhouse gas emissions registered in the National Inventory by up to between 24% and 39%, and emissions abatement modelling carried out by J. Bell et al. (2020)[10] suggests that the adoption of 10 different on-farm measures can lower greenhouse gas emissions per unit of output by almost 38%. These studies draw on vast datasets using the most recent and up-to-date suckler beef data from the Cattle Tracing System, and together represent the most in-depth and robust analysis that has ever been carried out to assess and evaluate suckler beef cattle performance and emissions specifically relevant to Scotland. Their findings are consistent with other similar studies that were carried out independently of this report and which came to similar conclusions, namely that Scotland's farmers can indeed reduce emissions by at least 35% without the need to compromise current production levels. [11] [12]

Suckler beef systems are responsible for more than a third of Scottish agricultural emissions (S. Thomson and A. Moxey, 2020). Approx. 75% of these emissions come from methane produced during rumination (enteric fermentation), with a further 12% being generated during anaerobic decomposition within manure. Nitrous oxide accounts for an additional 14% of total suckler beef emissions and is associated with nutrient management. Carbon dioxide is typically a much less significant greenhouse gas in suckler beef systems, and its proportional contribution towards total enterprise emissions depends largely on the use of farm machinery.

In order to effectively reduce greenhouse gas emissions from suckler beef systems, mitigation actions should focus those areas causing the largest emissions. This includes enteric fermentation and manure management, along with soil and nutrient management, and the greatest gains can be made by focusing on breeding females. Within the Scottish suckler beef herd, breeding cows and heifers contribute more than half of the total emissions associated with the beef sector, and any efficiency gains targeting breeding females will therefore have the biggest impact and greatly reduce emissions from the suckler beef industry.

[9] **THOMSON S., MOXEY A.** (2020). *Estimated SBCS effects within the National GHG 'Smart' Inventory.* Edinburgh: SRUC.
[10] **BELL J., BEATON C., YOUNG M., HILL G., STOUT D., SELLARS A., THOMSON S., SPENCER M., MOXEY A.** (2020). *Suckler Beef Climate Change Group – Farm Carbon Case Studies*. Edinburgh: SRUC
[11] **VIVID ECONOMICS** (2019). *A climate of possibility: Harnessing Scotland's natural resources to end our contribution to climate change.* [Online] Available from: https://www.wwf.org.uk/sites/default/files/2019-01/WWF_Report_VIVID_Jan_2019.pdf (last accessed 4th July 2020)
[12] **LAMPKIN N., SMITH L., PADEL K.** (2019). *Delivering on Net Zero: Scottish Agriculture.* [Online] Available from: https://www.wwf.org.uk/sites/default/files/2019-12/WWF%20Net%20Zero%20and%20Farming.pdf (last accessed 4th July 2020)

There are already countless studies available to highlight the potential to reduce emissions from the cattle system, and some of these have been captured within this report.

For example, increasing the feed conversion efficiency of finishing cattle through targeted genetic selection can reduce methane emissions by 15% and lower feed inputs by up to 13%.

Improving breeding herd management by increasing the number of calves reared, reducing the mature cow size, and lowering the number of unproductive replacement heifers on the farm by calving down at 2 years old could reduce the emissions intensity of an average rearer finisher unit by almost 10%. Increasing cow longevity on farms where a younger age at calving is not feasible can potentially generate equally significant benefits by reducing the replacement rate. Building on the aforementioned gains by complementing such an improved breeding programme with better targeted feed rationing can greatly enhance the finishing performance and potentially allow for quicker finishing. Reducing the age at slaughter by 3 months for instance could therefore increase total emissions savings to more than 20%.

Improving cattle health through the control and, where possible, eradication of diseases such as BVD, IBR or Johne's could reduce emissions by more than 50%, and better liver fluke control can enhance cattle performance and reduce the associated emissions intensity by almost 10%.

Covering slurry stores and replacing broadcast slurry spreading equipment with low emission precision application attachments can lower emissions by 78% and 60% respectively.

And although not currently included within the Smart Inventory, methane inhibitors are showing very promising results, and studies have found that the inclusion of inhibitors such as 3NOP could reduce enteric methane production by 20%. Methane inhibitors are still in the very early stages of commercial use, but if the data collected in the UK and around the world continues to show its benefits, this could make a real impact within the suckler beef and wider cattle industry. This in itself could offer emissions savings that go beyond the current targets.

The above are just a few of the many examples that highlight the huge potential to effectively and efficiently reduce greenhouse gas emissions on Scottish suckler beef farms.

In order to achieve meaningful net emissions within the agricultural sector and capture the many opportunities to adopt effective mitigation measures at farm level, the Scottish Government set up the Suckler Beef Climate Group for the purpose of considering and proposing alternative mechanisms of support for the Scottish suckler beef sector to encourage widespread uptake of mitigation actions amongst farmers and achieve real reductions in greenhouse gas emissions.

In an attempt to ensure that real outcomes and targets can and will be achieved, the proposed Suckler Beef Climate Scheme (the "SBCS") will be an outcome-based and outcome-driven support mechanism aimed at reducing net greenhouse gas emissions from Scottish suckler beef herds by encouraging the uptake of new management practices and/or changes to existing ones. This includes the provision of part-funding towards appropriate capital items and training as part of the scheme and, where possible, further aims to ensure that the adopted measures can help to mitigate other environmental impacts, particularly through a focus on soil health and nutrient and grassland management.

The scheme aims will be achieved by focusing on the following two key outcomes:

- ***To reduce the emissions intensity[13] of suckler beef systems by improving on-farm production and greenhouse gas efficiencies through better input and resource utilisation***

- ***To maintain and, where possible, enhance soil carbon storage, and reduce greenhouse gas emissions from farmland through better soil and grassland management on suckler beef farming units***

Participating businesses will be able to choose from a suite of management options covering production efficiency improvements via cattle breeding, cattle monitoring and performance recording, cattle feeding and cattle health. Further management options will be available to protect and increase soil health, enhance grazing and grassland management, and improve nutrient management. These management options build on scientific research and case studies, and incorporate best practice that has shown to deliver real outcomes.

The scheme is designed to be inclusive to recognise that there is scope within every business to improve its efficiency, profitability and resilience whilst reducing net greenhouse gas emissions. The scheme will therefore be open to all types of suckler beef producers, regardless of farm type, security of tenure, production system, herd size, or the level of commitment as part of the scheme, so long as they fulfil certain minimum scheme requirements. The scheme represents a much more hands-on, farmer-led scientific approach using BAT (Best Available Technology) on Scotland's suckler beef farms.

In addition to the various management options that will be available for applicants to choose from, the group has identified several key criteria that should form the baseline minimum requirements of the scheme and be carried out by all participating businesses to ensure a common starting point and basis throughout the scheme. Many farming businesses already carry out some or all of these stipulations, and the scheme seeks to encourage suckler beef farmers across Scotland to adopt best practice and make it common practice within their systems.

[13] a reduced emissions intensity means a lower level of greenhouse gas emissions per unit of output

These requirements include

- completing a farm business carbon audit
- outlining a nutrient management plan
- carrying out soil, forage and manure analysis
- outlining a feed ration plan
- completing a breeding and marketing plan
- Continuous Professional Development including an annual meeting with a competent farm business adviser to assess business progress
- data sharing and beef sector collaboration
- identifying and committing to management aimed at enhancing biodiversity
- maintaining appropriate QMS Cattle Assurance Scheme accreditation

Participants will find that these minimum requirements already offer useful tools to start the process of making the cattle production system and general business management more efficient. They provide the baseline for industry best practice, and will ultimately play a crucial part in enabling businesses to make the same efficiency gains as summarised further above.

One stipulation in particular that is worth noting is the requirement to identify and commit to on-farm management aimed at biodiversity enhancement. Although the core aim of the scheme represents climate change mitigation, Scottish Government has also committed to contributing towards biodiversity targets as part of its ongoing Scottish biodiversity strategy, and aims to deliver on environmental outcomes by supporting agricultural businesses in taking steps to preserve and enhance local ecosystems and native habitats for key plant and animal species. Biodiversity enhancement will therefore form a secondary aim of the SBCS, and work is currently underway to develop the above minimum requirement into a meaningful on-farm strategy to assist farming businesses in delivering on this target.

The scheme deliberately concentrates on sector-specific initiatives to improve the production efficiencies of Scotland's suckler beef herds and reduce their impact on climate change. It has therefore not reviewed options for offsetting sequestration land use changes nor assessed any impacts from land use changes and/or other carbon sequestration ideas and measures, as this has never been part of the group's remit. That being said, these measures will play a vital role in Scottish agriculture meeting its climate change targets. There are many options available to farmers and land managers that can help to mitigate climate change, including the use of small-scale renewables and hydrogen as an alternative fuel for farm machinery, peatland restoration and protection alongside habitat preservation, and farm woodlands including agroforestry, hedging and silvopasture amongst many others.

Further options that are to date showing promising results and the potential to greatly enhance production efficiencies and with that help to reduce on-farm emissions were considered by the group but not included due to not yet being commercially available, or because further research will be required to quantify their exact impact on farm efficiencies and their ability to contribute towards mitigating global warming. Such research will be particularly beneficial and relevant by considering their benefits within a Scottish or British setting. Such options include, amongst many others, targeted selective treatment (TST) of livestock for the control of internal parasites and the setting up of national soil carbon and antibiotic usage databases.

Ultimately, the potential to reduce overall emissions associated with Scottish suckler beef production will depend on the widespread uptake of relevant mitigation actions amongst farmers, and will have to rely on a supportive and engaging policy and market environment. By doing things smarter and better, there is a huge opportunity for Scotland's suckler beef farmers to improve their production efficiencies for the benefit of the climate, the environment and their own future viability.

As every year goes by, more and more initiatives, innovations, research findings and entrepreneurial ideas emerge on how to combat climate change. By actively engaging with the latest research available, this scheme will address areas of production where the biggest issues are, and where the biggest gains can be made. Many measures are already in place and adopted on-farm, and their inclusion within this scheme alongside further best practice will enable suckler beef farmers and the wider Scottish agricultural industry to hit the targets that are being talked about. The data shows that this is possible, and with the knowledge and initiatives already available, real results are achievable.

The coming months will be used to further develop details of the proposed scheme and design a robust concept of application, implementation and monitoring. This includes further outlining the data evaluation and opportunity scoring aspects. A detailed proposal on the budgetary and cost implications of the scheme to government and individual businesses is being worked on and will be presented to government.

2. Introduction and background

Climate change and the threats associated with global warming have come to be widely recognised and are becoming increasingly obvious within our environment. In 2016, the United Nations Framework Convention on Climate Change (UNFCCC) introduced the Paris Agreement which requires countries to take measures to reduce their net greenhouse gas emissions to such an extent that limits an increase of global average temperatures to less than 2°C and preferably no more than 1.5°C on pre-industrial levels.

Scotland has responded with ambitious targets, aiming to reduce its greenhouse gas emissions by 75% by 2030 and become a net-zero nation by 2045. In order to ensure that these targets can be met, every sector including the farming industry will be required to implement appropriate changes to help Scotland reach net-zero by 2045. There is a general consensus that a particular focus will have to be put on the livestock sector which currently makes up 75% of total greenhouse gas emissions from Scottish agriculture (N. Lampkin et al., 2019). The Scottish livestock sector has already managed to reduce net greenhouse gas emissions over the last decades, but this was in parts achieved by a reduction in total livestock numbers, most notably within the Scottish suckler herd. Some UK-wide studies such as the recently published paper by the Committee on Climate Change on recommendations to reach net zero through land use[14] suggest that in order to meet national emissions reduction targets, a dietary shift is required to reduce red meat consumption and the corresponding livestock numbers. However, according to studies published by WWF Scotland (Vivid Economics, 2019[15]; N. Lampkin et al., 2019[16]), the Scottish agricultural industry has the potential to cut greenhouse gas emissions by 35% by 2045 to reach net zero targets without the need to compromise current production levels. This will in parts be achievable through management changes and efficiency gains within existing production systems, and farming is expected to play an important part in capturing carbon to offset other emissions.

Economic pressures, increasing input prices and a competitive market place mean that Scotland's suckler beef farmers are already working towards improving their production systems through efficiency gains, better targeting inputs, and closer control of various production variables. There is significant scope to further improve cattle systems through the use of management tools, the adoption of practical and innovative technological equipment, and a greater utilisation of readily available on-farm performance data to better drive and inform management decisions, and ultimately reduce greenhouse gas emissions.

[14] **COMMITTEE ON CLIMATE CHANGE** (2020). *Land use: Policies for a Net Zero UK*. [Online] Available from: https://d423d1558e1d71897434.b-cdn.net/wp-content/uploads/2020/01/Land-use-Policies-for-a-Net-Zero-UK.pdf (last accessed 9th October 2020)

[15] **VIVID ECONOMICS** (2019). *A climate of possibility: Harnessing Scotland's natural resources to end our contribution to climate change.* [Online] Available from: https://www.wwf.org.uk/sites/default/files/2019-01/WWF_Report_VIVID_Jan_2019.pdf (last accessed 4th July 2020)

[16] **LAMPKIN N., SMITH L., PADEL K.** (2019). *Delivering on Net Zero: Scottish Agriculture.* [Online] Available from: https://www.wwf.org.uk/sites/default/files/2019-12/WWF%20Net%20Zero%20and%20Farming.pdf (last accessed 4th July 2020)

However, the adoption of such investments and management changes, particularly those primarily aimed at emissions reductions where the immediate financial benefits may not be obvious, can be perceived as high-risk and therefore unjustifiable, especially where these are associated with significant initial expenditure and resulting cashflow concerns due to the unique and challenging economic climate of the agricultural industry. The variable and volatile nature of the agricultural market combined with a slow pay-back period for many investments which are aimed at delivering long-term benefits can make farm business budgeting and an assessment of the feasibility of and likely return on such investments extremely difficult.

A recent report on the importance of providing suitable funding to address Scotland's declared climate emergency states that "…current land management practices, market returns and rural policy do not encourage the change in activity to reduce emissions. Whilst many of the mitigation measures available will save farmers money in the long term, the upfront costs and perceived risks are often prohibitive." (Climate Emergency Response Group, 2020[17]).

Recognising that a wide-spread uptake of climate-friendly on-farm practices and technology will likely require government support, the Scottish Government has therefore set up the Suckler Beef Climate Group to undertake a study and propose the first of several agricultural support schemes aimed at helping farmers reach the necessary reductions in greenhouse gas emissions from their production systems through the provision of financial incentives and rewards for achieved outcomes. The scheme will focus on encouraging and recognising climate-friendly suckler beef production across Scotland with due consideration being given to the preservation of the ecosystem and the local biodiversity in line with the government's ongoing commitment to protecting the environment and native habitats as part of the Scottish biodiversity strategy[18].

The scheme is designed in such a way that any suckler beef farmer wishing to participate will be able to join, regardless of business structure, type, tenure security, size or location. The measures outlined in the scheme will be user-friendly to enable and encourage maximum uptake, and will highlight that reducing greenhouse gas emissions, protecting Scotland's environment, and improving the efficiency of suckler beef production in Scotland can – and will – work hand in hand.

[17] **CLIMATE EMERGENCY RESPONSE GROUP** (2020). *Funding the 12 immediate actions for Scotland's Climate Emergency Response.* [Online] Available from: https://www.changeworks.org.uk/sites/default/files/CERG_budget_briefing.pdf (last accessed 4th July 2020)

[18] Further information available via following weblink: https://www.gov.scot/policies/biodiversity/scottish-biodiversity-strategy/

3. Terms of reference

The Suckler Beef Climate Group was set up in early 2020 with the aim to come up with recommendations on how to develop a government-funded scheme aimed at climate-friendly suckler beef production over the course of several meetings throughout March. The following section outlines the terms of reference which were initially agreed and updated since then in line with the group's efforts to prepare a comprehensive document on a workable and practical scheme.

Purpose

1. The Scottish Government has committed to take action on climate change with legally binding targets to reduce greenhouse gas emissions. It has also committed to contributing towards biodiversity targets. It is important that agricultural businesses are supported to improve their environmental performance, whilst producing quality food for processing within the Scottish food and drink sector.
2. The Suckler Beef Climate Group will consider proposals for alternative mechanisms of support for the suckler sector to achieve:

    - Improved efficiency, productivity and profitability of beef produced from the suckler herd and the wider beef sector in Scotland;
    - Enhanced environmental contribution from the sector through identification of practical ways in which net greenhouse gas emissions of the beef sector can be reduced;
    - Mitigation of other environmental impacts of production and enhancing contribution to sustainable land use, especially soil health and grassland management.

3. The group should consider the financial implications of its proposals and consider the time-span over which any proposals should be implemented.

4. Separately to this work, the Scottish Government will consider what arrangements may be put in place to reduce greenhouse gas emissions for livestock farming in High Nature Value (HNV) areas.

Remit

5. The Suckler Beef Climate Group will develop proposals for a new scheme, taking account of:
   - Production based improvements focussed on:
     - Feeding
     - Breeding
     - Efficiency
     - Health improvements
   - Potential for capital investment improvements
   - Impacts on running costs
   - Supply chain improvements, in particular encouraging producer groups with the potential to improve market development
   - Grassland management including:
     - Fertiliser use
     - Grass mixtures
     - Soil improvement and health
     - Slurry and manure management
     - Carbon audits and actions
     - Liming

6. The Suckler Beef Climate Group may also offer advice with regards to the costs of the necessary actions and how these might be met, with an estimate of the budgetary implications of any support scheme that might be introduced.
7. The Suckler Beef Climate Group will provide a report to Scottish Ministers in March 2020 to setting out its conclusions to feed into the Scottish Government's Climate Change Plan 2018-30 update. The report should focus on how to reduce greenhouse gas emissions within the suckler herd and recommendations on a support scheme that is required to deliver that.

8. Between April and September 2020, the financial implications of the group's recommendations are to be explored alongside the implications for delivery of any support package that is recommended.

9. The Suckler Beef Climate Group shall reconvene in autumn 2020 to further consider its recommendations in the light of the findings on financial and delivery implications described in paragraph 6 above.

Chair and Secretariat

10. The Suckler Beef Climate Group will be chaired by Jim Walker representing the industry, and will be supported by ScotGov officials.

Ways of working

11. The Suckler Beef Climate Group will take an evidence-based approach to its work, can co-opt the support of academics, industry bodies or others to aid its deliberations, and will acknowledge the work of others where appropriate.

12. The Suckler Beef Climate Group should build on the work of the Beef Efficiency Scheme (BES) and should consider the work of the Agriculture and Climate Strategic Group, the Farming and Food Production Future Policy Group, as well as reports on Climate Change and Agriculture from the WWF and Committee on Climate Change

13. The Suckler Beef Climate Group may consider recommending an ''opt-in'' scheme which might be developed into a more comprehensive scheme (that would last over a number of years) or a phased introduction of any recommendations it makes. Members may also wish to consider to what extent the group or individuals from within it could support implementation.

14. The work of the Scottish Beef Climate Group will be transparent, and meeting papers may be published on the Scottish Government website.

Membership

15. The Suckler Beef Climate Group will include female and male representatives from across the suckler beef sector.

16. All members of the group will be required to register their interests at the first meeting.

17. The membership is listed in alphabetical order below:

Group members

Alistair Davidson

Robert Fleming

Iain Livesey

Bruce McConachie

Debbie McGowan

Hazel McNee

Claire Simonetta

John Struthers

James Young

Sophie Watt

Addendum

Due to an unprecedented situation presenting itself to Scottish Government with Covid-19, and resulting significant pressures being put upon government staff to respond to these difficult circumstances, the remit and timescale within which the Suckler Beef Climate Group was expected to work had to be adjusted in order to ensure that a complete set of recommendations with appropriate suggestions on the delivery of the scheme could be presented to the government and worked through by civil servants in order to minimise any delays caused as a result of Covid-19. This meant that the group has been working on the design of the scheme throughout the second and third quarter of 2020.

4. Overall scheme aims and objectives

The SBCS aims to reduce net greenhouse gas emissions from Scottish suckler beef herds by encouraging the uptake of new management practices and/or changes to existing ones. This includes the provision of part-funding towards appropriate capital items and training as part of the scheme and, where possible, further aims to ensure that the adopted measures can help to mitigate other environmental impacts, particularly through a focus on soil health, and nutrient and grassland management.

This will be achieved by focusing on the following two key outcomes:

- ***To reduce the emissions intensity of suckler beef systems by improving on-farm production and greenhouse gas efficiencies through better input and resource utilisation***

- ***To maintain and, where possible, enhance soil carbon storage, and reduce greenhouse gas emissions from farmland through better soil and grassland management on suckler beef farming units***

Improving the efficiency of on-farm production systems and associated business and resource management is widely known to be key to achieving optimum production outputs and with it greater profitability and business resilience. Efficiencies can be assessed and obtained at different levels but generally involve better targeting and utilisation of inputs and on-farm resources. This enables businesses to either increase the level of output per unit of input, or to maintain given outputs from reduced inputs by minimising wastage.

Efficiency gains and better input utilisation can be achieved by monitoring and recording cattle performance and other key variables within the production system as this can ultimately help businesses to better target inputs for an improved soil, crop or animal response, and to minimise input wastage. The collated information furthermore enables for more informed and effective decision-making to take place with regards to general business and enterprise management or production-based aspects such as breeding, feeding, and animal health. This will ultimately lead to better livestock performance, enhanced enterprise productivity and profitability, and increased business resilience.

More importantly however, such improvements to on-farm efficiencies can also achieve significant reductions in total greenhouse gas emissions from the production system, and lower the emissions intensity of the outputs.

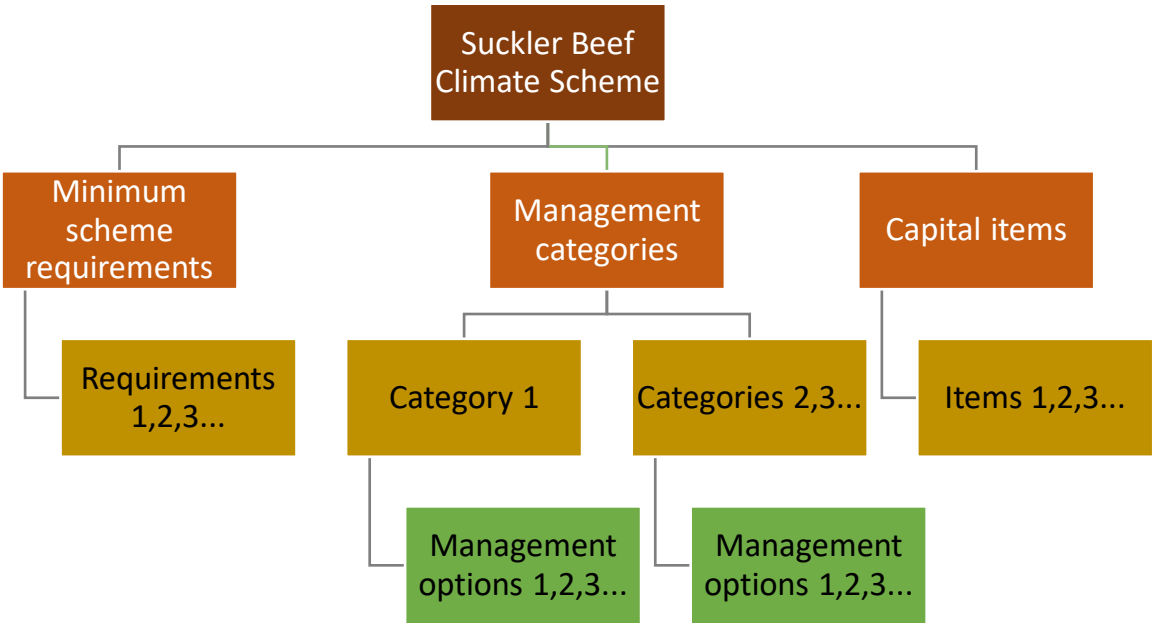
Further reductions of on-farm net greenhouse gas emissions can be delivered by adjusting or introducing specific on-farm soil and grassland management to protect and maintain existing soil carbon stores and, where possible, actively capture carbon from the environment and the cattle production system for long-term soil carbon sequestration.

5. Scheme overview

The SBCS is designed to be an outcome-based support mechanism and aims to encourage the uptake or continuation of best practice where significant benefits can be delivered to assist businesses in reaching their efficiency and environmental potential.

It is proposed that there are three major components to the scheme, namely the minimum requirements that participants must meet at the start and throughout the duration of the scheme, the management categories which each contain a collection of different optional management options for participants to choose from and commit to, and the capital items which can be accessed and claimed by committing to the relevant management options.

Broadly speaking, the scheme would consist of the following individual components (overleaf):



Participants can customise the scheme and choose their level of commitment in order to ultimately increase the effectiveness and impact of any adopted management activities. This structure should provide sufficient flexibility to tailor the various management activities to individual production systems by allowing different types of businesses to commit to and carry out on-farm actions and management that are relevant to their specific farm structure and environment, and which can be incorporated into their cattle enterprise to achieve real outcomes. The chosen approach is hoped to enable and encourage a wide uptake of the scheme amongst Scottish suckler beef producers by not being too prescriptive, and aims to reduce barriers to participation on grounds of business type, location and cattle system.

Recognising that a future agricultural support system will put a greater emphasis on delivering environmental goods and should take a more outcome-based approach, the SBCS should be designed with sufficient flexibility and potential for adaptation to allow the

modification of the scheme for incorporation into a future support scheme, whether that will be as part of a voluntary or compulsory scheme, and delivered through Pillar I or Pillar II.

Rather than designing the scheme as one fixed unit, it is therefore proposed that the scheme be developed as independently developed and stacked components that can easily be interlinked, combined and moved, thereby making any future adjustments to the scheme a simpler, cheaper and less time-consuming process.

The following chapters outline the proposed minimum requirements, management categories and options, and capital items that should be considered for inclusion in the SBCS.

6. Minimum scheme requirements

The SBCS aims to deliver a wide range of climatic and environmental benefits by encouraging on-farm best practice and the adoption of efficient suckler beef production measures. In addition to the various management options that will be available for applicants to choose from, the scheme has identified several key criteria that should be carried out by all participating businesses to ensure a common starting point and basis throughout the scheme.

Scottish agricultural businesses already have to comply with a multitude of legal stipulations concerning environmental protection and animal welfare, as well as animal, plant and public health, and are subjected to cross compliance inspections to ensure that their farming practices fall within the remit of official rules and regulations as outlined by Scottish and European legislation. There are two main aspects to cross compliance which include the **Statutory Management Requirements (SMRs)**[19] and the **Good Agricultural and Environmental Conditions (GAECs)**[20] as set out by the government's rural payments and services division.

The **Statutory Management Requirements** are broadly aimed at protecting the environment, farm animal and public health, and include measures that have to be taken by farmers to

- protect watercourses and reduce the risk of water pollution in Nitrate Vulnerable Zones
- protect special areas of conservation and important habitats of wild birds
- correctly identify and register livestock to ensure full traceability
- follow rules and guidance relating to livestock health and disease management to reduce the risk of diseases spreading to other livestock or humans
- minimise the risk of issues resulting from incorrect use or handling of livestock feed, livestock related substances, and plant protection products
- protect and maintain the welfare of livestock

The requirements on **Good Agricultural and Environmental Conditions** focus on the protection of watercourses, habitats, soils and landscape features located on agricultural land, and include measures concerning

- the protection of groundwater against pollution, including guidance on buffer strips along watercourses
- the protection of water resources, especially with regards to the abstraction of water for irrigation
- the protection of soil against erosion by maintaining a minimum soil cover and carrying out site specific management to limit erosion
- the maintenance of soil organic matter levels
- the protection and retention of landscape features

[19] Further details regarding the 'Statutory Management Requirements (SMRs) 2020' are available via following weblink: https://www.ruralpayments.org/topics/inspections/all-inspections/cross-compliance/detailed-guidance/statutory-management-requirements/ (last accessed 14th July 2020)

[20] Further details regarding the 'Good Agricultural and Environmental Conditions (GAECs) 2020' are available via following weblink: https://www.ruralpayments.org/topics/inspections/all-inspections/cross-compliance/detailed-guidance/good-agricultural-and-environmental-conditions/ (last accessed 14th July 2020)

In addition to the above rules and regulations that are already embedded within legislation and compulsory for Scottish farming businesses to comply with, the scheme also proposes the following additional commitments as part of the scheme. These criteria have been deemed relevant and can deliver distinct benefits to businesses, and as such may already be adopted and applied in full or in parts by a large number of prospective participants. They have been chosen for their importance, and due consideration has been given to ensuring that they are achievable by any suckler beef enterprise without causing barriers to entry and participation on the basis of certain business types and structures, or tenure constraints.

6.1. QMS Cattle Assurance

Requirement: For applicants to be accredited members of the *QMS Cattle (& Sheep) Assurance Scheme*[21] at the beginning of and throughout the SBCS contract duration. As part of this assurance scheme, participants are required to adhere to predefined standards of production and need to ensure that they comply with the assurance requirements at all times.

Relevance: Consumers are increasingly aware and concerned about the well-being of farmed animals and the environment, as well as the potential negative impact that can arise from poor farming practices. Businesses which are accredited under the QMS Cattle & Sheep Assurance Scheme have to adhere to and comply with a range of production standards concerning on-farm management and practices. This includes the rearing and production of beef within Scotland and to high legislative standards for animal health and welfare and environmental protection; best practice for any veterinary health treatments such as the use of antibiotics; detailed record-keeping of animal events, treatments and movements for full traceability; feed, health and contingency plans; and appropriate certification requirements amongst others.

Aim: Ensuring that businesses hold such an accreditation and adhere to the relevant standards gives consumers the reassurance that the beef originating from these accredited farms is Scottish, has been produced in line with full production and animal movement traceability and transparency, and with due consideration to safeguarding high animal health and welfare standards and environmental protection. Further reassurance that accredited businesses are compliant is given to consumers through an auditing regime taking place on an annual basis as part of the accreditation scheme to ensure that the assurance requirements are being met.

6.2. Continuing personal development

Requirement: For applicants to carry out continuing personal development on an annual basis as part of the SBCS. This may include a range of off-farm activities as well as an annual farm visit by an accredited adviser.

Relevance: Business development and the improvement of on-farm performance and efficiencies can be greatly stifled where the business struggles to obtain new knowledge about recent research findings, best practice or technological advancements.

[21] The QMS standards are available via following weblink https://www.qmscotland.co.uk/cattle-sheep-standards (last accessed 2nd October 2020).

Aim: Regular exchange and networking with a range of individuals including fellow farmers, industry professionals, academics and other experts and stakeholders can help to obtain knowledge about new on-farm practices and technological improvements, opportunities to optimise farm business management, encourage individuals to critically review and discuss current farm system operations at home, and lead to an increased uptake of new equipment or farming methods to improve farm performance efficiencies. This particular minimum requirement and the SBCS as a whole will offer significant opportunities for peer support and exchange amongst Scotland's suckler beef farmers. Learning from the best and from each other, and creating local support networks to this end is key to allow farmers to embrace changes to their business and within the agricultural industry with confidence. An open mindset and a willingness to adapt and change can ultimately help to improve on-farm efficiencies, boost on-farm profitability, and reduce production-related greenhouse gas emissions. Encouraging social interaction through face-to-face meetings, social interaction and workshops also delivers crucially important benefits for the mental health and well-being of individuals, especially for farmers who typically work on their own.

6.3. Carbon auditing

Requirement: For applicants to complete an annual farm carbon audit as part of and throughout the SBCS and define clear action points on the basis of the generated results to address any areas of particular weakness within their cattle production system.

Relevance: Inefficiencies within a production system not only impact on the farm's overall performance, profitability and resilience, but can lead to an increased emissions intensity associated with the enterprise as a result of poorer resource and input utilisation. Whilst cross-farm or cross-enterprise type comparisons can be difficult to capture on a like-for-like basis via carbon audits due to the uniqueness of different farming system, carbon auditing can be a very useful tool for individual businesses to compare their annually updated results to previous carbon audits, which can help to detect where progress is being made or highlight patterns within their specific system that may be impacting on their efficiencies.

Aim: An annual review of the farm's approximate level of greenhouse gas emissions per unit of output can provide a useful business-specific baseline from where to identify any inefficiencies within the production system that are causing unnecessarily high emissions per unit of output. Carbon auditing including a comparison of current performance against previous results from the same farm can therefore enable individual businesses to focus on areas of weaknesses within their farming operations and take steps to reduce their emissions intensity whilst improving general on-farm effectiveness for improved cattle performance and profitability.

6.4. Biodiversity enhancement

Requirement: For applicants to identify any key on-farm or local habitats requiring specific and targeted management in order to protect a vulnerable plant or animal species or community in line with the biodiversity aims forming part of the SBCS.

Relevance: The SBCS is primarily targeting the reduction in net greenhouse gas emissions from Scottish suckler beef cattle herds but also aims to deliver further environmental benefits to help the ecosystem and local biodiversity. Many important and native plant and animal species are struggling with an ever-changing climate, land use and farming changes, habitat deterioration, and other challenges.

Aim: Regardless of how large or small a farming business is, there is always a potential to target sward, grazing or general land management in such a way that it can deliver significant benefits for local (vulnerable) key species with minimal impact on farming operations. Identifying what (vulnerable) key species are present within the local area, and taking steps to support the creation, enhancement or preservation of suitable habitats to support such species could make a significant difference through individual on-farm commitments to species and habitat management. A small contribution per farm, spread across large areas of Scotland, can create a mosaic patchwork, thereby delivering potentially significant collective benefits, particularly for any migratory key species and colonies relying on geographical spread.

6.5. Soil analysis

Requirement: For applicants to carry out regular soil analysis on a rotational basis on all fields that receive lime, organic manure and/or synthetic fertiliser, and complete a nutrient management plan on the basis of that information throughout the duration of the SBCS. This includes basic soil testing to identify the current levels of pH, Phosphate (P), Potash (K) and Magnesium (Mg) for the purpose of better nutrient management, as well as a soil carbon analysis to identify the level of carbon currently stored on improved farmland.

Relevance: Soil is possibly the most important resource on any farm, and maintaining a healthy soil is key to ensuring good sward/crop performance which in turn determines how well livestock will perform. Outlining an effective grassland/crop and nutrient management plan can be very difficult to achieve without knowing the current nutritional status of the soil. Where inputs are inadequate or excessive, this can lead to wasteful or inefficient usage of inputs and potential associated environmental concerns, a deteriorating soil health, and poorer crop and livestock performance. Poorer livestock performance ultimately increases the emissions intensity and where soil health is being compromised, this can limit or reduce the soil's ability to maintain existing or accumulate additional carbon stocks for long-term storage.

Aim: A greater understanding of the pH and nutrient status of the soil enables businesses to better target any field management and associated inputs in order to ensure that soil health is maintained and optimum production performance obtained. This will help to improve on-farm soil management efficiencies, lower greenhouse gas emissions per unit of output through a better utilisation of inputs, and increase the potential for effective soil carbon storage. Soil carbon analysis will help to establish a better understanding of the extent to which different types of farmland soils are already storing carbon, which will allow for a better understanding to be gained of the likely impact of different farmland management on actual soil carbon stores and any further sequestration potential across Scotland's farmland.

6.6. Forage analysis

Requirement: For applicants to carry out annual sampling of all silage, haylage or hay used on-farm, including home-grown and/or purchased forages, as part of and throughout the SBCS, and outline a cattle feed rationing plan on the basis of the results. This includes individual sampling per cut and should be carried out separately for clamp and baled silage. Individual sampling should be carried out for forages purchased from different suppliers or in different batches.

Relevance: Planning an efficient and effective feed ration that meets the nutritional requirements of different animals at specific stages of production is impossible to achieve without knowing the nutritional value and quality of the feeds provided. This can lead to productivity and performance limitations where the diet cannot meet demands, or input wastage and potential calving issues where an oversupply is taking place. Such inefficient use of inputs can increase the emissions intensity of a given production system and ultimately impacts on business resilience and profitability.

Aim: A greater understanding of the nutritional value within on-farm feeds enables the business to adjust cattle rations accordingly in order to ensure that production demands of different animals or management groups are met by adequate and properly targeted dietary quantities, thereby improving on-farm feeding efficiencies and achieving better performance whilst avoiding waste. Analysing home-grown forages can also help to identify where changes to grassland management and forage production may be required to address any shortfalls, thereby improving the production of local and home-grown feed. This can help to reduce the need to purchase cattle feed from further afield or abroad and lower emissions associated with the transportation of any bought-in feed.

6.7. Manure analysis

Requirement: For applicants to carry out regular sampling of any organic manures applied to their fields, and outline their nutrient management plan and farm waste management plan accordingly. This includes both slurry and farmyard manure.

Relevance: Outlining an effective nutrient management plan that includes the use of organic fertilisers such as slurry can be very difficult without knowing the exact nutrient availability of the manure. This can lead to poor manure utilisation through wastage or a limited crop response, and result in potential environmental diffuse pollution concerns and increased greenhouse gas emissions.

Aim: A greater understanding of the nutritional value within organic manures enables businesses to adjust nutrient inputs to various fields accordingly in order to ensure that plant nutrient requirements are met by adequate and properly targeted nutrient input levels. This leads to better on-farm nutrient utilisation which helps to boost plant performance whilst avoiding waste, thereby minimising concerns over environmental implications through improved farm waste management. Better targeting of organic manures such as slurry or farmyard manure as a result of a known nutrient content can furthermore reduce the reliance on purchased synthetic fertiliser and ultimately lead to a reduction in greenhouse gas emissions from nutrient management.

6.8. Sector collaboration through data sharing

Requirement: For store producers to make any relevant performance and most recent treatment data of store cattle intended for sale available via central database, and for finishers to share the relevant weight performance and carcass classification for any processed fat cattle via the same database.

Relevance: Achieving an efficient system where the suckler herd produces stores of sufficient performance quality for finishing can be difficult when these stores are sold on without any information being fed back to the store producer with regards to their finishing performance. Likewise, it can be challenging for finishing systems to forecast the likely performance of different store animals when there is no baseline information available from the store producer. Not knowing what recent treatment recently purchased store cattle have received can cause further issues associated with double treatments within a short timeframe, or the performance being compromised as a result of the animal not being treated in a timely manner.

Aim: Closing the feedback loop between store producers and finishers to exchange relevant weight and performance data can therefore offer distinct opportunities for both parties by highlighting animals with superior or inferior performance, thereby allowing for better breeding and input management. In addition, providing information regarding recent veterinary treatments enables better health management to support good animal performance and minimise wasteful use of animal health products.

6.9. Breeding and marketing plan

Requirement: For applicants to complete a breeding and marketing plan at the start of the SBCS, and carry out an annual review throughout the scheme duration to update the plan where necessary.

Relevance: An effective farm business strategy should be closely aligned with a sound awareness of the production potential of the farm and on-farm resources such as the labour availability, existing or potential market demand, and how these two factors can be combined to match the most suitable production system to a relevant and realistic target market. More specifically for suckler beef enterprises, this includes choosing a suitable breeding, grazing and wintering system that can efficiently and effectively utilise given on-farm or locally available resources, and a focus on market outlets that are best suited to the chosen production system. In theory, a production and marketing strategy should be outlined at the onset of business activity and regularly reviewed to adjust to a changing economic and political climate.

The farming industry can be different in the way it approaches strategic business planning due to a variety of reasons including, amongst other factors,

- agricultural support mechanisms influencing economic decisions, or helping to off-set or hide the losses from inefficient farm enterprises;
- a traditional mindset focusing on the continuation of enterprises that have previously taking place on the farm for many generations;
- and sometimes because of an assumption that there is always a ready market for agricultural produce.

With an uncertain future of support payment mechanisms and budgets, climate change affecting growing conditions, parasitic cycles and whole production systems, different trends influencing consumer behaviour, and the ever-changing economic and political environment, there is an increasing need for farms to be actively managed as agri-businesses. This requires farmers to be aware of and able to respond to any external factors potentially impacting on their production outputs and business performance. A business without a sound strategy is less resilient and therefore more vulnerable to suffer any market, political or environmental shocks, especially when relying on support payments to make up any financial shortfalls as a result of inefficient on-farm production systems.

Aim: Outlining a breeding and marketing plan requires farmers to take a step back and critically assess their business, thereby giving them a chance to review the suitability of their breeding and/or finishing system and whether it matches the resources available to the farm, and actively consider different market outlets and how these tie in with their current cattle enterprise structure. This can encourage businesses to evaluate and compare different options available within the context and limitations of their farm, explore and adopt different systems, and may ultimately help to increase the resilience of individual businesses through an increased awareness of what it is they are trying to produce, how well they can produce it, and if their produce is actually sought after.

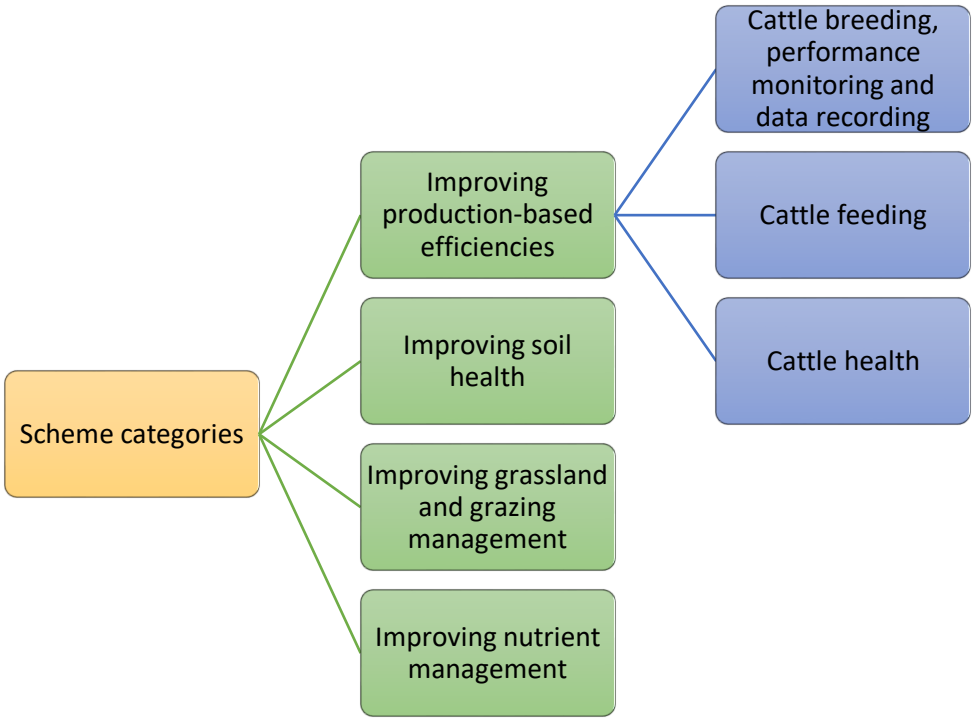
7. Scheme categories and management options

The scheme will target six main areas of production which have been identified as having the greatest potential to reduce net greenhouse gas efficiencies by improving performance and input utilisation, maintaining current soil carbon stores, and supporting further soil carbon sequestration where this is possible.

The emissions intensity of a suckler beef system can be reduced through better input utilisation and cattle performance, which in turn can be improved by focusing on key factors of production. This may include better breeding management, for instance by optimising herd productivity through careful selection of superior genetic potential to suit a specific system, aided by the use of performance monitoring and data recording technology. Apart from gains that can be made via better cattle breeding management, production-based efficiencies can also be enhanced through an increased focus on better targeting and planning of cattle nutrition and feed rationing, and by carefully managing herd health to ensure that underlying health conditions do not compromise herd productivity.

Further reductions in the emissions intensity and overall emissions associated with the cattle enterprise can likely be gained from better grassland, soil and associated (nutrient) input management. Improved soil management can also benefit the health of the soil, thereby maintaining and potentially increasing soil carbon stores whilst minimising the risk of soil carbon being released into the atmosphere as a result of poor in-field practices.

These key factors determining on-farm greenhouse gas emissions and carbon capture have been grouped into the following six scheme categories which are discussed in more detail in the following chapters:



There are many actions available to suckler beef producers that can help to improve system-specific performance efficiencies, reduce the environmental impact of suckler beef production, and improve business resilience and profitability.

Different aspects of suckler beef production were reviewed by the Suckler Beef Climate Group and discussed in terms of their likely potential to achieve the aims of the scheme, and any proposed management options were outlined and included on the basis of the following criteria:

- directly related and relevant to Scottish suckler beef production
- high impact – easy win scenarios; scheme to focus on obvious options that are widely accepted to deliver the necessary benefits
- main outcome of these options fits in with the aims of the SBCS
- the proposed activity is not currently funded through any other scheme(s)

Where possible, further consideration was also given to designing the management options in such a way that ensures the following:

- option is applicable to different production systems to suit the diverse nature of suckler beef enterprises across Scotland
- option encourages and allows for continuous improvements to be made to recognise participants at varying stages of production efficiencies
- option aims to minimise disadvantages and barrier to participation on the basis of a business being
    - a new entrant
    - a small unit
    - restricted by a short-term tenancy or grazing let
    - located in difficult areas in terms of remoteness, accessibility and connectivity
    - subjected to environmental constraints out with their control

The chosen management options are not aimed at reinventing the wheel. Instead, the scheme seeks to recognise businesses that are already implementing best practice and good management, whilst encouraging and supporting others in adopting and introducing new methods and technology and making changes to their systems to achieve the same efficiency improvements and emissions reductions.

As a result, many of the management options that have been recommended are already in use and in some cases widely adopted as ‘normal practice’ both within Scotland and across the world. Where possible, the scheme is therefore attempting to encourage further uptake of these best practice measures.

The following chapters provide a more detailed overview of the relevance and aims of each of the above categories along with an introduction to the various proposed management options that will be available to participating businesses to choose from and commit to.

7.1. Improving production-based efficiencies – cattle breeding, performance monitoring and data recording (Category 1)

Aims of category:

This category aims to encourage participating businesses to take steps to reduce the emissions intensity of their cattle production system(s) by

- improving the fertility and performance of breeding cows and heifers through targeted genetic selection and/or better herd management in order to ensure that breeding females generate optimum returns on inputs;
- improving the fertility and performance of breeding bulls by carrying out a bull fertility and fitness assessment in order to ensure that breeding males are able to perform and generate optimum returns on inputs;
- improving store and finishing cattle performance by monitoring their ability to efficiently utilise given inputs in order to highlight weaker aspects of the production system(s) that require attention, and take steps to address these weaknesses accordingly;
- improving the overall herd productivity, health, and welfare of rearer and finisher units through regular and/or continuous performance monitoring and recording (using precision livestock technology where applicable), and subsequent data-driven decision-making to enable better cattle management.

Relevance: Efficient cattle breeding, or the ability of a breeding cow or bull to convert inputs into live calves, is crucial to ensure that inputs and on-farm resources generate suitable returns. Increasing the number and/or genetic potential of the calves reared from a given number of breeding females helps to dilute such inputs and their emissions across a greater quantity of outputs, thereby improving the overall emissions intensity, efficiency and profitability of a breeding herd. If individual animals show a poor breeding performance as a result of fertility problems or other underlying genetic or management issues, this reduces the productivity of the suckler herd as a whole, thereby increasing greenhouse gas emissions per unit of output and potentially overall emissions whilst limiting cattle enterprise profitability.

The genetic potential of the breeding herd feeds directly into store and finishing cattle performance which is ultimately defined and limited by a combination of genetic factors, input management and general stockmanship. Targeted breeding, feeding and health management of suckler and/or finishing cattle significantly helps to optimise cattle performance and productivity, thereby improving production efficiencies and reducing the emissions intensity from the production system. This can be greatly enhanced and supported by carrying out relevant performance recording in order to highlight underlying whole herd management issues or identify individual animals that are impacting on the overall herd productivity.

In order for performance monitoring and recording, and subsequent decision-making on the basis of such records to be effective, it is important to assess performance traits that are of actual environmental and economic relevance. Apart from the most commonly used expressions to identify herd productivity such as the calving percentage, the use of a variety of general key performance indicators (KPIs) and the application of an effective breeding and culling strategy using multi-trait selection can feed into better targeted and informed decision-making to accelerate genetic and production improvements.

The adoption and installation of electronic equipment to monitor cattle, record relevant performance data such as weights, and analyse and review that data for informed decision-making can significantly help to improve the efficiency of the production system and optimise herd performance by supporting physical stockmanship with technological assistance that can offer more detailed and accurate supervision or data collection.

Significance: Research investigating the potential to reduce greenhouse gas emissions through livestock breeding and performance management identified the suckler beef industry as having significant potential to reduce emissions by improving breeding herd management, particularly through improved animal performance recording for better selection. The study states that "… genetic improvement in the beef sector has been slower and unlocking the untapped genetic potential in the beef cattle population may be aided by schemes that improve the recording of animal performance data…" (M. MacLeod et al., 2019[22]). According to a DEFRA study (2008)[23], a widespread uptake of improved cattle breeding management in line with improvements already being achieved by the most progressive breeders could lead to a reduction in greenhouse gas emissions from beef production of 5% over a period of 15 years.

[22] **MACLEOD M., LEINONEN I., WALL E., HOUDIJK J., EORY V., BURNS J., VOSOUGH AHMADI B., GOMEZ-BARBERO M.** (2019). *Impact of animal breeding on GHG emissions and farm economics.* [Online] Available from: https://publications.jrc.ec.europa.eu/ repository/bitstream/JRC117897/jrc_report_29844.pdf (last accessed 1st July 2020)
[23] **DEFRA** (2008). *A study of the scope for the application of research in animal genomics and breeding to reduce nitrogen and methane emissions from livestock based food chains. Research Project Final Report.* [Online] Available from: http://sciencesearch.defra.gov.uk/ Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=14662 (last accessed 1st July 2020)

7.1.1. Whole herd breeding efficiency

Relevance: The ability of the breeding herd to achieve and maintain optimum productivity is crucial to ensure that the production system is utilising inputs efficiently, and a core aspect to achieving this is the production of a live calf. Herd data pulled from the Cattle Tracing System (CTS) and prepared by J. Bell et al. (2020)[24] shows that there are herds that already achieve a 100% rearing percentage, i.e. every cow produces a live calf for selling or to retain as a replacement. However, a study undertaken by T. Geraghty (2018)[25] which assessed the performance of more than 1,800 suckler cows found that on average these herds only managed to achieve a rearing percentage of 82.4% and 83% respectively over two consecutive years. Of the cows that failed to rear a calf, 44% and 55% respectively were unproductive as a result of fertility issues. The above data suggests that there is a great need and potential to focus on targeted breeding management in order to improve the performance of the Scottish suckler herd and reduce the associated emissions intensity. Studies carried out by a range of organisations including WWF Scotland (N. Lampkin et al., 2019[26]) and Defra (2008)[27] have highlighted that there is a greater need to focus on genetic progress to improve productivity in the context of reducing emissions intensities from livestock production system. Breeding efficiencies can be improved by assessing whole herd performance as well as individual animal performance, each forming crucial aspects of good cattle management. Identifying whole herd productivity by using a range of key performance indicators (KPIs) can help to determine whether there are any aspects of the reproductive performance that may be compromised as a result of underlying whole herd management issues that require systemic management changes rather than being the result of individual unproductive breeding females.

KPIs have been recognised at industry and government level as being an extremely useful tool to combine business performance assessment with environmental considerations (S. Hewitt, 2018[28]; Defra, 2006[29]).

Aim: This management option aims to encourage participants to assess the annual average breeding performance of the herd as a whole using multi-trait assessment via a range of KPIs. The assessment will help to highlight areas where breeding herd management shows potential for improvement in order to enable informed decision-making and to carry out targeted adjustments to the production system to ultimately boost the production performance of the breeding herd.

[24] **BELL J., BEATON C., YOUNG M., HILL G., STOUT D., SELLARS A., THOMSON S., SPENCER M., MOXEY A.** (2020). *Suckler Beef Climate Change Group – Farm Carbon Case Studies*. Edinburgh: SRUC

[25] **GERAGHTY T.** (2020). *2019 Calf Loss Project Final Report.* Edinburgh: SRUC.

[26] **LAMPKIN N., SMITH L., PADEL K.** (2019). *Delivering on Net Zero: Scottish Agriculture.* [Online] Available from: https://www.wwf.org.uk/sites/default/files/2019-12/WWF%20Net%20Zero%20and%20Farming.pdf (last accessed 2nd July 2020)

[27] **DEFRA** (2008). *A study of the scope for the application of research in animal genomics and breeding to reduce nitrogen and methane emissions from livestock based food chains. Research Project Final Report.* [Online] Available from: http://sciencesearch.defra.gov.uk/ Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=14662 (last accessed 1st July 2020)

[28] **HEWITT S.** (2018). *A pilot project to evaluate key performance indicators for suckler herds and growing and finishing beef enterprises in England.* [Online] Available from: http://beefandlamb.ahdb.org.uk/wp-content/uploads/2019/02/61110007-Evaluating-Beef-KPIs-Final-report-150618.pdf (last accessed 2nd July 2020)

[29] **DEFRA** (2006). *Environmental Key Performance Indicators. Reporting Guidelines for UK Business.* [Online] Available from: https://assets.publishing.service.gov.uk/government/ uploads/system/uploads/attachment_data/file/69281/pb11321-envkpi-guidelines-060121.pdf (last accessed 2nd July 2020)

Apart from the most common breeding herd management tools available to farmers to improve whole herd performance, this may also include the introduction of high fertility and performance genetics through the use of artificial insemination, or reducing the calving period by synchronising breeding females amongst others. An increased whole herd productivity will lead to better resource and input utilisation, thereby reducing the emissions intensity of the cattle system and increasing enterprise profitability.

Emissions abatement potential: According to emissions modelling data provided by J. Bell et al. (2020), increasing the rearing percentage on a rearer finishing unit by 4% can reduce the emissions intensity of the cattle enterprise by 1.4%. This could for instance be achieved by improving whole herd breeding efficiencies. Although 1.4% may not appear to be a significant direct saving, increasing the number and/or quality of calves reared can potentially lead to notable indirect emissions reductions. According to the National Beef Association[30], the UK is only 75% self-sufficient with regards to domestic beef consumption. Improving herd performance through greater outputs from a given number of breeding females boosts domestic food production and security, thereby reducing the need for any shortfalls to be met via imported produce that may have incurred greater greenhouse gas emissions during production and transportation. Although the total emissions abatement potential from improving whole herd breeding efficiencies would need to be further quantified, it may be challenging to obtain the relevant data for imported beef.

Assessment option: Participating businesses should identify the average breeding efficiency of the whole herd on an annual basis by using the following key performance indicators, and utilise the resulting data to address any weaker aspects of the whole herd management system:

- calving percentage
- rearing percentage
- cow calving period
- heifer calving period

The data required to calculate the above individual KPIs can be drawn from the regularly updated CTS (Cattle Tracing System) database, thereby allowing for easy and robust validation of the results.

Applicability: This management option is applicable to suckler herds, which may include both store producers and rearer finisher units. Store producers and finisher units are encouraged to exchange relevant performance data to help accelerate whole herd efficiency improvements.

[30] Source of information: www.nationalbeefassociation.com

7.1.2. Cow efficiency

Relevance: The ability of breeding females to achieve and maintain optimum productivity is crucial to enabling efficient input utilisation within a given production system. Herd data pulled from the Cattle Tracing System (CTS) and prepared by J. Bell et al. (2020)[31] shows that there are herds that already achieve a 100% rearing percentage, i.e. every cow produces a live calf for selling or to retain as a replacement. However, a study undertaken by T. Geraghty (2018)[32] which assessed the performance of more than 1,800 suckler cows found that on average these herds only managed to achieve a rearing percentage of 82.4% and 83% respectively over two consecutive years. Of the cows that failed to rear a calf, 44% and 55% respectively were unproductive as a result of fertility issues. The above data suggests that there is a great need and potential to focus on targeted breeding management in order to improve the performance of the Scottish suckler herd and reduce the associated emissions intensity. Studies carried out by a range of organisations including WWF Scotland (N. Lampkin et al., 2019[33]) and Defra (2008)[34] have highlighted that there is a greater need to focus on genetic progress to improve productivity in the context of reducing emissions intensities from livestock production system. Breeding efficiency can be improved by assessing whole herd performance as well as individual animal performance, each forming crucial aspects of good cattle management: Assessing the productivity of individual cows by using a multi-trait assessment and selection approach which uses a range of key performance indicators (KPIs) can help to highlight if there are any aspects of the reproductive performance that may be compromised as a result of an inferior genetic potential of that particular animal to thrive and provide optimum performance within a given farm system environment. This allows for targeted culling of inferior and unproductive cows, thereby helping to improve the environmental and economic efficiency of the whole herd.

Aim: This management option aims to encourage participants to assess the breeding performance of individual breeding females using a range of KPIs. This will help to highlight cows of lesser productivity, i.e. a lower overall production potential or lesser suitability to thrive and perform within a specific production system, and enables for informed decision-making to carry out targeted culling of such animals and retain superior breeding females in order to boost the production performance of the whole herd. An effective culling strategy of poorer animals will help to achieve better resource and input utilisation to reduce greenhouse gas emissions per unit of output and increase cattle enterprise profitability.

[31] **BELL J., BEATON C., YOUNG M., HILL G., STOUT D., SELLARS A., THOMSON S., SPENCER M., MOXEY A.** (2020). *Suckler Beef Climate Change Group – Farm Carbon Case Studies*. Edinburgh: SRUC

[32] **GERAGHTY T.** (2020). *2019 Calf Loss Project Final Report.* Edinburgh: SRUC.

[33] **LAMPKIN N., SMITH L., PADEL K.** (2019). *Delivering on Net Zero: Scottish Agriculture.* [Online] Available from: https://www.wwf.org.uk/sites/default/files/2019-12/WWF%20Net%20Zero%20and%20Farming.pdf (last accessed 2nd July 2020)

[34] **DEFRA** (2008). *A study of the scope for the application of research in animal genomics and breeding to reduce nitrogen and methane emissions from livestock based food chains. Research Project Final Report.* [Online] Available from: http://sciencesearch.defra.gov.uk/ Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=14662 (last accessed 1st July 2020)

Emissions abatement potential: According to emissions modelling data provided by J. Bell et al. (2020), increasing the rearing percentage on a rearer finishing unit by 4% can reduce the emissions intensity of the cattle enterprise by 1.4%. This could for instance be achieved by improving individual breeding cow efficiencies. Although 1.4% may not appear to be a significant direct saving, increasing the number and/or quality of calves reared can potentially lead to notable indirect emissions reductions. According to the National Beef Association[35], the UK is only 75% self-sufficient with regards to domestic beef consumption. Improving herd performance through greater outputs from a given number of breeding females boosts domestic food production and security, thereby reducing the need for any shortfalls to be met via imported produce that may have incurred greater greenhouse gas emissions during production and transportation. Although the total emissions abatement potential from improving breeding cow efficiencies would need to be further quantified, it may be challenging to obtain the relevant data for imported beef.

Assessment option: Participating businesses should identify the breeding efficiency of individual females on an annual basis by using the following multi-trait assessment to apply an effective breeding and culling strategy:

- current reproductive success, i.e. barren or rearing a calf
- calving ease
- mothering ability
- calf vigour
- weaning weight ratio
- historic rearing percentage for second calvers and older cows

A large proportion of the data required to calculate the above individual KPIs for each cow relies on accurate record keeping by the farmer due to some of the relevant data not being available on the CTS database.

However, this particular management option does not reward businesses for achieving better average performance. Instead, it seeks to encourage participating farmers to assess individual cow performance by using different KPIs, and to rank the cows from most to least productive in order for the poorest performing females to be culled. It is therefore in the interest of the participating business to ensure that their record keeping is accurate so that they retain superior and better-performing cows.

Applicability: This management option is applicable to suckler herds, which may include both store producers and rearer finisher units. Store producers and finisher units are encouraged to exchange relevant performance data to help accelerate individual cow efficiency improvements.

[35] Source of information: www.nationalbeefassociation.com

7.1.3. Bull efficiency

Relevance: An efficient production system relies on careful bull selection and management to ensure that the sire's genetics complement the genetic characteristics of the breeding herd and meet the requirements of a specific production system, farming environment, and market outlet. Accessing genetic traits that help the herd achieve and maintain optimum productivity is important to enable efficient input utilisation within a given production system. This leads to a lower emissions intensity of the cattle enterprise, thereby lowering greenhouse gas emissions for each unit of output produced and sold off-farm. Such genetic improvement, accelerated through careful bull selection and performance assessment of the bull's offspring, is only possible if the bull is actually capable of producing offspring through good fertility, as well as a physical ability to mount the cow where natural mating takes place. A study undertaken by T. Geraghty (2018)[36] found that fertility issues were the single major factor depressing the calving and rearing percentage of the assessed cattle herds. Whilst one infertile cow means the loss of (typically) one live calf to the system, one infertile bull has far greater implications for overall herd productivity as a result of failing to impregnate a potentially large group or proportion of breeding females. According to P. J. Chenoweth and F. J. McPherson (2016)[37], as little as 65% of bulls being subjected to a bull breeding soundness examination are classed as satisfactory potential breeders. This leaves approximately one third of bulls being deemed unsuitable for breeding purposes, and quite clearly highlights the need to carry out thorough bull assessments in order to prevent sub-fertile bulls from stifling genetic improvements within the Scottish suckler beef herd.

Aim: This management option aims to encourage participants to assess the fertility and physical ability and fitness of breeding stock bulls via vet inspection in line with official guidance on bull pre-breeding examination as outlined by the British Cattle Veterinary Association. This will help to highlight any bulls with sub- or infertility issues, or where there are concerns about their physical fitness and ability to successfully mate, and enables for informed decision-making to carry out targeted culling of infertile or unfit bulls to ultimately boost the production performance of the breeding herd, thereby achieving better resource and input utilisation to reduce emissions intensities and increase cattle enterprise profitability.

Emissions abatement potential: According to emissions modelling data provided by J. Bell et al. (2020), increasing the rearing percentage on a rearer finishing unit by 4% can reduce the emissions intensity of the cattle enterprise by 1.4%. This could for instance be achieved by ensuring that only fertile bulls are being used. Although 1.4% may not appear to be a significant direct saving, increasing the number and/or quality of calves reared can potentially lead to notable indirect emissions reductions.

[36] **GERAGHTY T.** (2020). *2019 Calf Loss Project Final Report.* Edinburgh: SRUC.
[37] **CHENOWETH P. J., McPHERSON F. J.** (2016). *Bull breeding soundness, semen evaluation and cattle productivity.* [Online] Available from: https://www.researchgate.net/publication/297617886_Bull_breeding_soundness_semen_evaluation_and_cattle_productivity (last accessed 2nd July 2020)

According to the National Beef Association[38], the UK is only 75% self-sufficient with regards to domestic beef consumption. Improving herd performance through greater outputs from a given number of breeding females boosts domestic food production and security, thereby reducing the need for any shortfalls to be made up with via imported produce that may have incurred greater greenhouse gas emissions during production and transportation. The total emissions abatement potential from improving breeding bull efficiencies would therefore need to be further quantified, although it may be challenging to obtain the relevant data for imported beef.

Assessment option: Participating businesses should complete an annual vet inspection of individual stock bulls before the start of mating to determine the bulls as satisfactory or unsatisfactory for breeding, and carry out culling of unsuitable breeding males accordingly. The assessment includes an analysis of semen viability as well as a physical fitness examination of reproductive organs, heart and lungs, general mobility, eyes and mouth, and must be carried out by a vet with appropriate BCVA (British Cattle Veterinary Association) certification[39] to carry out a full pre-breeding bull examination. Participants are furthermore encouraged not to purchase breeding bulls unless these have recently passed their breeding examination.

Applicability: This management option is applicable to suckler herds, which may include both store producers and rearer finisher units, and includes systems using natural mating and/or artificial insemination.

7.1.4. Age at calving

Relevance: The amount of unproductive time spent on-farm, that is without producing a calf, can significantly influence the emissions intensity of individual cattle and the whole system due to the emissions of such animals having to be carried by the outputs generated by productive cows. An effective way to reduce the proportion of unproductive youngstock is to reduce the number of replacement females that the system has to support, or their unproductive time spent on the farm. There are different ways in which different types of production systems can achieve this, namely by increasing the longevity of breeding cows which enables businesses to reduce their annual replacement rate, or by reducing the age at first calving which reduces the unproductive time spent on-farm by the individual replacement heifer. Where the age at first calving can be reduced without compromising cow longevity, this can deliver multiple environmental and economic benefits by reducing both the number of replacement heifers as well as their time spent as unproductive animals. This requires careful heifer management to find the optimum balance between boosting productivity without compromising sustainability.

[38] Source of information: www.nationalbeefassociation.com
[39] Details available via: **PENNY C. D.** (2010). *The BCVA's bull pre-breeding examination certificate.* [Online] Available from: https://www.researchgate.net/publication/241845707_The_New_BCVA_Bull_Pre-Breeding_Examination_Certificate (last accessed 2nd July 2020)

Aim: This management option aims to encourage participants to review their current production system and explore options to reduce the age at first calving. The review should be carried out in the context of environmental and production variables that ultimately determine the cattle type that can be supported by the system. Where a system can support early-maturing cattle, accurate feed rationing together with a carefully outlined breeding management plan, for instance by accessing superior genetic potential through genomic trait selection, artificial insemination and the use of robust EBVs, can offer an effective means to reduce the age at first calving. This can deliver distinct benefits by not only cutting greenhouse gas emissions, but also by allowing for a quicker assessment of the breeding performance and potential of a cow to be made without the need to have to wait an extra year, which can lead to quicker genetic progress. Reducing the age at calving can under some circumstances be used as a helpful management tool to artificially reduce mature cow size, thereby lowering the amount of feeding that has to be provided solely to cover maintenance purposes. Where a breeding female is deemed unsuitable for breeding due to producing a poor calf or not rearing a calf at all, her younger age means that her cull value is likely to be higher.

The decision to reduce the age at first calving should only be made if this can realistically be achieved with the inputs and resources available to a given system, and where a system can support an earlier-maturing cattle type. In such a case, carefully planned breeding and feeding management can offer an efficient and effective way to enable maiden heifers to reach a suitable mating weight at a younger age.

However, it should be stressed that care has to be taken to maintain the health, welfare and well-being of breeding females at all times, and it is therefore strongly recommended that systems switching to a younger age at first calving should make use of internal pelvic scoring in order to ensure that their heifers have the pelvic capacity to deliver the calf without difficulties. An easy-calving sire should also be chosen and where systems experience increasing or otherwise notable calving difficulties, or struggle to get first calvers back in calf again, they are strongly advised to revisit their policy regarding age at first calving.

It should also be noted that reducing the age at first calving is not a feasible option for many systems due to environmental constraints or management, input and resource availability constraints, a focus on grass-based production, or other important factors dictating or determining what type of cattle and breeding strategy best suits their specific system. That does not mean that these systems are by default less efficient. A focus on working with good maternal bloodlines to maximise cow longevity can deliver quite distinct environmental and economic benefits as well. A greater longevity means that the business can afford to run a lower replacement rate, thereby reducing greenhouse gas emissions associated with unproductive replacement animals on the farm. A higher longevity also means that superior cows will over their productive lifetime produce more calves and potential replacement heifers, which can offer a different means of obtaining quick genetic progress.

Emissions abatement potential: According to emissions modelling data provided by J. Bell et al. (2020), reducing the age at first calving for heifers on a rearer finisher unit from 36 months down to 24 months can reduce the emissions intensity of the cattle enterprise by up to 6.9%. Some additional emissions reductions can also be achieved as a result of reducing the mature cow size by calving heifers at a younger age.

Using the same modelling approach provided by J. Bell et al. (2020), a rearer finisher system could reduce its emissions intensity by up to 8% by calving its heifers younger and as a result reducing cow size by 10% from 700kg down to 630kg.

Assessment option: Participating businesses should review their current production system to identify opportunities to reduce the age at first calving downwards, for example through better nutritional management to access the genetic potential for early growth and development where an early-maturing cattle type can be used within a given system.

Applicability: This management option is applicable to suckler herds, which may include both store producers and rearer finisher units, but may be less suited to more extensive farming units working with lower-input, native and/or slower-maturing cattle that are better suited to their particular system, environment and input/resource availability.

7.1.5. Genetic progress

Relevance: The genetic potential of an animal is determined by careful selection of its dam and sire, and this potential in turn determines the likely performance of that animal within a given environment. Assessing the breeding efficiency of the whole herd or individual breeding females and bulls using a range of key performance indicators can offer significant opportunities to identify superior and inferior cattle, or animals more suited for a specific production system, thereby enabling for targeted breeding and culling to take place to accelerate performance and efficiency improvements across the whole herd. This approach to achieving genetic improvements can be enhanced by making use of additional genetic and/or genomic information. Whether that includes the selection of the best genetic potential from maternal lines on the farm to produce homebred replacement females from known bloodlines in order to accelerate genetic progress, accessing high-performance bull genetics via artificial insemination, or the purchase of the bull with the most promising genetic/genomic profile to complement the genetics and performance of the breeding females, there are a range of programmes already in use across the suckler beef industry that can assess the likely breeding value of individual animals and capture very specific data about hereditary traits and likely performance levels of different bloodlines. It is therefore important to recognise the significant potential and make use of such data to achieve improvements in on-farm efficiencies. If used properly, this not only benefits the business at productivity and profitability level, but also contributes towards better animal health and welfare, and delivers distinct environmental and climate benefits.

Aim: This management option aims to encourage participants to review the current breeding programme in place and identify opportunities to accelerate performance efficiencies by enhancing appropriate maternal and finishing traits through (further) use of genetic and/or genomic data.

This may include the utilisation of genetic data collected at home or from breeders, through breed-specific programmes, or any other means of capturing, analysing and representing genetic and genomic data, for instance through a better awareness of myostatins and the opportunities and risks associated with focusing on specific myostatin strains. Such information can then be utilised to match bull breeding and performance traits to the specific needs of the cow herd and chosen market outlet by choosing a suitable sire for artificial insemination or natural mating, and consideration should be given to running a closed replacement system where this is feasible in order to achieve accelerated genetic improvements from known bloodlines that are best suited to thrive within that specific farm environment.

Making use of genetic and genomic data will help to achieve better and quicker performance and productivity improvements to ultimately boost the production efficiency of the breeding herd, thereby achieving better resource and input utilisation to reduce greenhouse gas emissions per unit of output, and increase cattle enterprise profitability.

For example, data provided by E. Wall, SRUC[40], shows that the use of superior genotype material via Elite maternal sires can result in potentially significant emissions reductions when compared to baseline data on current trends. The data suggests that total maternal greenhouse gas emissions could drop by 130kg of CO_2e over a 20 year period.

It is however crucial that there is a clear understanding of the risk associated with improper use of such genetic and/or genomic data, for example where that information has to rely on accurate and reliable data input. Inappropriate use of such data can result in unintended consequences arising from focusing on certain traits at the cost of others. Some past strategies have for instance put enhanced emphasis on traits aimed at maximising meat yields but neglected crucial maternal and fitness traits, thereby compromising animal health, welfare and longevity as a result of calving issues and poor locomotion. The selective focus on bulls with excellent calving EBVs has in some cases caused calving issues in their daughters as a result of a reduced pelvic capacity. Utilising a multi-trait selection approach which integrates a range of key performance indicators into animal-specific breeding profiles and programmes, and plots these against the animal's ability to thrive within a specific environment can help to negate the risks of singular and one-sided breeding programmes.

There is a huge opportunity to better utilise genetic information for environmental and economic purposes, but only if this information is accurate and reliable, properly used, and clearly communicated between breeders and buyers. It must not compromise animal health and welfare for other gains, and the consequences of specific genetic selection need to be fully understood. This will require commitment at farmer level as well as from continued research and development.

Emissions abatement potential: It is extremely difficult to accurately determine the emissions abatement potential from genetic progress and performance gains. In order to establish potential reductions, the improvements arising from genetic progress would need to be quantified.

[40] **WALL E.** (n. d.). *Innovation: improving livestock productivity.* Edinburgh: SRUC.

These may include better breeding performance, better or quicker finishing of animals, the ability to calve heifers at a younger age where the system and cattle type allows this, or the ability for a business to reduce feed inputs by improving the feed conversion efficiency (as outlined in the next sub-chapter).

Assuming that genetic progress within a rearer finisher unit could result in an increased rearing percentage by 4%, allow for heifers to be calved at 24 months instead of 36 months whilst at the same time reduce the mature cow size by 10%, and reduce the age at slaughter from 21 to 18 months, such a system could potentially reduce its emissions intensity by up to 20.5% according to emissions modelling data provided by J. Bell et al. (2020)[41].

Assessment option: This management option is closely interlinked with the other options forming part of the 'cattle breeding, monitoring and performance recording' category. Participating businesses should identify to what extent they make use of the wider genetic information available within their herd, and, where feasible and applicable, identify opportunities to pursue (further) genetic progress in addition to assessing herd, cow and bull breeding performance and efficiencies.

Applicability: This management option is applicable to suckler herds, which may include both store producers and rearer finisher units. Store producers and finisher units are encouraged to exchange relevant performance data to help accelerate genetic progress.

7.1.6. Feed conversion efficiency

Relevance: Cattle performance efficiencies on a store and/or finishing unit rely on optimising the balance between inputs and outputs. Increasing outputs without having to increase inputs accordingly means that the farm is better utilising inputs to generate greater outputs which improves cattle efficiencies, reduces associated greenhouse gas emissions per unit of output, and boosts overall cattle profitability. A major factor that can contribute towards applying improvements to the cattle production system involves close monitoring and recording of cattle performance in order to identify individual animals or cattle groups showing superior or inferior productivity. One way of assessing cattle performance includes the use of key performance indicators (KPIs), and some of the most commonly used KPIs within cattle finishing units are daily liveweight gains, age at slaughter, and days to slaughter.

Whilst all three KPIs are useful tools to assess the production performance of different cattle or cattle groups on the farm, they are unable to consider production efficiencies as they focus solely on yields without taking into consideration the level of inputs required to achieve such results, and they are more difficult to apply to the same extent across different farming systems as they rely heavily on the production system, diet, cattle type being used, as well as the overall management of those cattle. Depending on the location, availability of and access to resources, infrastructure and inputs, as well as environmental factors and challenges, different farms may specialise in and focus on a particular production system.

[41] **BELL J., BEATON C., YOUNG M., HILL G., STOUT D., SELLARS A., THOMSON S., SPENCER M., MOXEY A.** (2020). *Suckler Beef Climate Change Group – Farm Carbon Case Studies*. Edinburgh: SRUC

Whether that includes intensive finishing of continental-bred cattle with continuous housing on a grain-heavy diet, or extensive finishing on a grass-based diet using native cattle, these systems may be equally as efficient depending on how well they utilise the inputs and resources that are available to them, and how well they match their production system and choice of cattle type to naturally limiting or enhancing production factors.

Putting the above KPIs into an efficiency context by expressing the relative production performance of different animals with due consideration to the level of feed inputs required to achieve that particular performance level can therefore offer a useful tool to assess how well the cattle are utilising inputs for production, thereby giving the farmer a much more useful means of assessing cattle efficiency, and with it profitability. This can be achieved by means of measuring and evaluating the feed conversion efficiency of individual animals or different management groups. The feed conversion efficiency looks at the level of inputs required to generate one unit of output, or the level of outputs generated from one unit of input.

Focusing on improving the feed conversion efficiency can improve input utilisation and with it reduce any associated greenhouse gas emissions. A study by G Hailu (2018)[42] states that a focus on selectively breeding could reduce methane emissions by as much as 26% over a period of 10 years. For individual production systems, this approach will also ultimately lead to improved daily liveweight gains, reduced days to slaughter and a younger age at slaughter because the business selectively breeds for or purchases cattle that are better suited to its particular system and environment, and therefore better able to thrive.

Aim: This management option aims to encourage participants to assess the performance of store, forward store and finishing animals using the feed conversion efficiency KPI, and to take steps to focus on animals showing a superior feed conversion efficiency. The use of this KPI can highlight homebred store animals from potentially superior and inferior bloodlines as well as highlight a varying quality amongst any purchased stores or differing performances within different on-farm management groups. This enables for informed decision-making to carry out targeted adjustments to the production or purchasing system to ultimately boost the production performance of the cattle, thereby achieving better resource and input utilisation to reduce greenhouse gas emissions per unit of output, and increase cattle enterprise efficiencies and profitability.

Emissions abatement potential: Based on data provided by a study conducted by SRUC[43] involving more than 1,100 Stabiliser steers and bulls over a period of 5 years, improving the net feed efficiency by 30% could lead to a 15% reduction in methane emissions and a 13% reduction in feed inputs without compromising cattle performance.

Assessment option: Participating businesses should identify individual feed conversion efficiencies of store, forward store and/or finishing cattle as well as average feed conversion efficiencies of different management groups and batches.

This information should then be used to address weaker areas of the finishing system and general cattle management, or to inform on-farm breeding strategies or the choice of purchased cattle.

[42] **HAILU G.** (2018). *The role of animal genomics in reducing greenhouse gas emissions*. Ottawa (Canada): The Canadian Agri-Food Policy Institute (CAPI)
[43] **HYSLOP DR. J., ROEHE PROF. R.** (2017). *Net Feed Efficiency in Stabiliser Cattle*. Edinburgh: SRUC.

Applicability: This management option is applicable to rearer finisher, forward store and/or finishing units. Store producers and finisher units are encouraged to exchange relevant performance data to help accelerate genetic progress.

7.1.7. Livestock data capture

Relevance: Cattle enterprise efficiency and profitability relies on the business being able to identify and address any areas of weaknesses. In order to know whether the herd is performing well and detect any underlying management or animal-specific issues, cattle performance needs to be monitored, and relevant performance data captured in order to be analysed to make informed decisions about the general cattle management and breeding strategy. The way in which data is captured, and the type of data being captured, can make a significant difference to any business. The adoption of electronic equipment for instance collects and stores relevant and accurate data more efficiently for individual animals, thereby minimising the workload associated with performance recording and reducing the risk of error. This generates a more reliable dataset which, if fed into dedicated livestock recording software, can easily be accessed and analysed for further assessment of individual animals, bloodlines, or management groups. Enhanced performance recording allows for management decisions to be better targeted which in turn boosts business performance efficiencies and with it leads to a reduced greenhouse gas emissions intensity by culling animals known to be less productive, adjusting input systems, and improving the overall cattle production system and management.

Aim: This management option aims to encourage participants to identify the approach to livestock data recording and evaluation that is currently being carried out on their farm, and what steps have been or can be taken to make the process of data recording more efficient and robust. Where applicable and possible, participating businesses are encouraged to adopt a more accurate system of data recording using electronic equipment, in combination with cattle EID technology which will become compulsory in the near future, and dedicated livestock recording software. Efficient data recording frees up precious time which can be dedicated to valuable stockmanship tasks, and enables for informed decision-making to be carried out in order to improve cattle efficiencies, and with it reduce greenhouse gas emissions per unit of output as a result of a more productive and efficient cattle enterprise. This will also deliver financial benefits by boosting cattle profitability.

Emissions abatement potential: It is extremely difficult to accurately determine the emissions abatement potential from capturing and evaluating livestock data. In order to establish potential reductions, the improvements arising from better livestock data capture would need to be quantified. These may include better breeding performance, better or quicker finishing of cattle or improved health amongst others.

Assuming that better livestock monitoring and recording within a rearer finisher unit could result in an increased rearing percentage by 4% and reduce the age at slaughter from 21 months down to 16 months for instance, such a system could potentially reduce its emissions intensity by more than 8% according to emissions modelling data provided by J. Bell et al. (2020)[44]. It should however be noted that this scenario shows only one example of how livestock data capture could potentially improve production efficiencies, and the stated emissions abatement potential should therefore not be treated as absolute figure.

[44] **BELL J., BEATON C., YOUNG M., HILL G., STOUT D., SELLARS A., THOMSON S., SPENCER M., MOXEY A.** (2020). *Suckler Beef Climate Change Group – Farm Carbon Case Studies*. Edinburgh: SRUC

Assessment option: Participating businesses should identify their current system of recording cattle performance. This includes an assessment of whether current record-keeping is limited to data capture to comply with legislative requirements, whether there is individual or batch performance recording carried out for further analysis and to inform decision-making, whether this is done using dedicated livestock recording software, and whether the business makes use of electronic recording equipment and EID technology.

Applicability: This management option is applicable to suckler herds and finishing units.

7.1.8. Cattle weighing

Relevance: Knowing the average weight and weight changes over time of the herd as a whole, per management group, or of individual cattle is crucial for informed decision-making and targeted management. Cattle weight and weight gain data enables farmers to prepare more accurate feed rations, administer health treatments at the correct rate, calculate likely finishing dates for better planning, identify animals of superior bloodlines, and can highlight potential underlying health issues. Ensuring that a suitable cattle weighing system is in place which can be used on a regular basis to capture liveweight changes of different management groups within the herd over time can therefore significantly help to better target cattle management where required, which can enhance the efficiency of the production system and reduce any associated greenhouse gas emissions as a result. Better targeting inputs on the basis of known weights can also deliver important environmental benefits by reducing the risk of input wastage.

Aim: This management option aims to encourage participants to identify the current weighing system employed on the farm and the extent to which liveweight data of different batches and management groups, and of individual cattle, is recorded. Where applicable and possible, the management option encourages and/or requires participating businesses to carry out more regular cattle weighing to better inform nutritional planning and feed rationing, better target veterinary inputs, and calculate general cattle performance including better planning of the cattle finishing operation. This may include and/or require the putting in place of suitable weighing equipment, whether as stand-alone items forming part of the cattle handling system, or via incorporation into the race or handling stand (through modification of the current setup).

Emissions abatement potential: It is extremely difficult to accurately determine the emissions abatement potential from monitoring and utilising cattle weight data. In order to establish potential reductions, the improvements arising from collecting weight data would need to be quantified. These may include better breeding performance, better or quicker finishing of cattle and improved health as a result of more targeted feed rationing and accurate health treatment administration taking place. If weight data were to be used to accurately target and administer anthelmintic products, and this leads to an improved cattle performance as a result of better liver fluke control, it could lead to a 9% reduction in the emissions intensity of the cattle production system according to data provided by ADAS UK Ltd (2014[45]). It should however be noted that this scenario shows only one example of how the use of accurate cattle weight data could potentially improve production efficiencies, and the stated emissions abatement potential should therefore not be treated as absolute figure.

Assessment option: Participating businesses should identify their cattle weighing system by assessing whether they currently make use of any weight data, whether this is limited to individual or batch weighing as cattle are moved on or off the farm, or whether regular weighing is carried out. This includes weighing at key stages such as during handling for suckler herds, and weighing at a regular interval of at least once every 4 weeks for store and finishing cattle. The assessment will also include a review of how this weight data is utilised for feed rationing, health product administration and general cattle management.

Applicability: This management option is applicable to suckler herds and finishing units.

7.2. Improving production-based efficiencies – cattle feeding (Category 2)

Aims of category:

This category aims to encourage participating businesses to take steps to reduce the emissions intensity of their cattle production system(s) by

- improving the productivity and performance of breeding, store and/or finishing cattle by meeting nutritional demands through better feed rationing including the use of appropriate feed additives to ensure that the herd generates optimum returns on inputs;
- encouraging a greater focus on homegrown and local cattle feeds and avoidance of imported feed products to reduce emissions associated with feed transportation, make use of nutritionally important by-products and co-products from other industries, and focus on sourcing feeds from domestic systems where environmental and societal protection can be safe-guarded and monitored throughout the production process and beyond.

[45] **ADAS UK LTD** (2014). *Study to model the impact of controlling endemic cattle diseases and conditions on national cattle productivity, agricultural performance and greenhouse gas emissions*. [Online] Available from: http://randd.defra.gov.uk/Default.aspx?Menu=Menu &Module= More&Location=None&ProjectID=17791&FromSearch=Y&Status=3&Publisher =1&SearchText=greenhouse gas&SortString=StartMth&SortOrder=Desc&Paging=10# Description (last accessed 18th June 2020)

Relevance: The ability of livestock to convert feeding into adequate levels of outputs greatly depends on good nutritional planning and management of the cattle diet, and the production of high quality homegrown feeds. Identifying different nutritional requirements at key stages of production, and outlining targeted feed rationing on the basis of that information can help to ensure that the diet meets the demands of the various management groups without an under-supply compromising performance and productivity, or an over-supply causing wastage. Improving the utilisation of feed can optimise cattle productivity and production efficiencies whilst reducing greenhouse gas emissions per unit of output, especially where feed additives can be included within the cattle ration.

A greater focus on producing homegrown forages, and making the most of locally available feeds, can furthermore help to reduce the emissions intensity of the cattle enterprise by reducing the emissions associated with feed transportation, but only where homegrown and locally sourced feeds have been produced in an efficient manner. Taking full advantage of important and nutritionally valuable by-products and co-products from other sectors, such as draff from near-by distilleries, can deliver further climate benefits as the emissions from the production of draff are shared between the whisky industry and beef sector. An increased focus and reliance on homegrown and/or locally sourced cattle feed also helps to reduce or avoid the use of imported feed products that may originate from environmentally and socially questionable production systems, and which may be associated with increased greenhouse gas emissions.

7.2.1. Better targeted feed rationing

Relevance: Outlining a feed plan for different cattle groups at different key stages of production is absolutely crucial to achieve optimum productivity and performance by ensuring that the diet meets all the nutritional needs of individual cattle. This requires a sound knowledge of the basic nutritional requirements of cattle of varying ages and at varying levels of production, as well as an in-depth understanding of the dietary components of different feeds being considered as part of the cattle ration. Target production and performance levels should be known and accurate liveweight records and body condition scoring can help to better inform the exact daily feed intake requirements as a proportion of the average bodyweight of different management groups.

This can help to ensure that the chosen and formulated diet meets the demands of the cattle to achieve target performance, and avoids wastage as a result of including excess levels of feed that is not required. This approach to better targeting the feed ration improves input efficiencies associated with cattle feeding, which in turn benefits the environment by reducing the level of associated greenhouse gas emissions.

Aim: This management option ties in with the scheme requirement of carrying out forage analysis and completing a basic cattle feed ration plan, and aims to encourage participants to review their current feed ration management and planning and, where applicable, take steps to better target feed rationing to better utilise inputs. This option is particularly relevant for more intensive operations where housed cattle receive total mixed rations. However, the management option is also available to extensive grass-based systems where accurate rationing is more challenging but nonetheless possible by carrying out appropriate analysis of forage both harvested and/or in situ.

Better feed rationing will help to improve feed efficiencies whilst reducing any associated greenhouse gas emissions, and boosts cattle enterprise profitability by achieving optimum performance without the risk of wasting feed inputs.

Emissions abatement potential: It is extremely difficult to accurately determine the emissions abatement potential from improved cattle feed management as a result of better targeted feed rationing. In order to establish potential reductions, the beneficial impacts of improved feed rationing would need to be quantified. These may include better breeding performance, better or quicker finishing of cattle, the ability to calve heifers at a younger age where the system and cattle type allows this, or the ability for a business to reduce feed wastage and sell surplus home-produced cattle feed off-farm.

Assuming that better targeting of feed rations for breeding cows, replacement heifers and finishing cattle within a rearer finisher unit could result in an increased rearing percentage by 4%, allow for heifers to be calved at 24 months instead of 36 months, and reduce the age at slaughter by finishing males as bull beef at 13 months, such a system could potentially reduce its emissions intensity by up to 21.7% according to emissions modelling data provided by J. Bell et al. (2020)[46].

This scenario would of course not apply to every rearer finisher unit, but emissions reductions could nonetheless be gained.

Using the same emissions model for rearer finisher units, reducing the age at slaughter from 21 months to 18 months for instance could reduce emissions by 11.3% per unit of output which is much less significant but nonetheless an important contribution. It should however be noted that these scenarios show only two examples of how better targeted feed rations could potentially improve production efficiencies, and the stated emissions abatement potential should therefore not be treated as absolute figure.

Assessment option: Participating businesses should identify the current feed rationing system applied on-farm by assessing whether detailed feed rationing is taking place by using feed composition data, carrying out analysis of homegrown cattle feeds, and basing rations on up-to-date cattle liveweight, known nutritional demands in line with target production and performance, and body condition scoring data.

Applicability: This management option is applicable to suckler herds and finishing units but may be better suited to less extensive systems where the feed intake parameters are better known and controlled.

[46] **BELL J., BEATON C., YOUNG M., HILL G., STOUT D., SELLARS A., THOMSON S., SPENCER M., MOXEY A.** (2020). *Suckler Beef Climate Change Group – Farm Carbon Case Studies*. Edinburgh: SRUC

7.2.2. Feed additives

Relevance: The diet provided to cattle not only significantly influences the overall performance of a herd, but also directly determines the activity of the gastrointestinal system with regards to its ability to efficiently utilise nutrients, minerals and trace elements within the feeding provided. The composition of the diet furthermore influences the likely total daily feed intake of individual animals, and the level of methane being produced within the rumen. Feed additives can play an important role in enabling the digestive system to better utilise feed inputs which can lead to a reduced feed intake requirement without compromising current levels of cattle productivity and performance. This leads to a greater input utilisation efficiency which in turn reduces greenhouse gas emissions per unit of output from the cattle system. Additional reductions in the emissions intensity from the cattle enterprise can also be achieved as a result of some feed additives which have a direct impact on the quantity of methane being produced during rumen fermentation. Feed additives therefore play a key role in making cattle feeding more efficient whilst minimising associated greenhouse gas emissions.

A study conducted by V. Eory et al. (2015)[47] found the addition of nitrate within the cattle diet to result in a 20% reduction of enteric methane emissions.

Although the additive has to be carefully mixed into the cattle feed which means that the use of feed additives is only really practical in a housed system, the research clearly highlights the significant opportunity available to farmers to reduce methane emissions from their production system through the use of feed additives without having to change production levels or make any major management changes.

Aim: This management option aims to encourage participants to identify what opportunities they have within their business to use feed additives as part of the cattle diet, and to take steps to incorporate such feed additives where possible within the cattle ration in order to improve feed utilisation efficiencies and reduce feed related greenhouse gas emissions. This may include the use of a range of different additives such as lipids, nitrates, probiotics, 3NOP and, depending on its commercial availability, also seaweed. Each of these different types of feed additives offer distinct advantages for different systems.

Emissions abatement potential: According to emissions modelling data provided by J. Bell et al. (2020)[48], the use of 3NOP in housed cattle at 2g to 3g per animal per day could reduce methane emissions by 20% during the housing period. For an animal spending 6 months indoor and 6 months at grass, this would result in an annual emissions reduction of 10%. The same study shows that within a rearer finisher unit as modelled by J. Bell et a., the use of 3NOP as a methane inhibitor could reduce the emissions intensity of the cattle production system by 3.5%.

[47] **EORY V., MACLEOD M., TOPP C. F. E., REES R. M., WEBB J., MCVITTIE A., WALL E., BORTHWICK F., WATSON C., WATERHOUSE A., WILTSHIRE J., BELL H., MORAN D., DEWHURST R.** (2015). *Review and update of the UK agriculture marginal abatement cost curve to assess the greenhouse gas abatement potential for the 5th carbon budget period and to 2050.* [Online] Available from: https://www.theccc.org.uk/publication/scotlands-rural-collage-sruc-ricardo-energy-and-environment-2015-review-and-update-of-the-uk-agriculture-macc-to-assess-abatement-potential-for-the-fifth-carbon-budget-period-and-to-2050/ (last accessed 11th October 2020)

[48] **BELL J., BEATON C., YOUNG M., HILL G., STOUT D., SELLARS A., THOMSON S., SPENCER M., MOXEY A.** (2020). *Suckler Beef Climate Change Group – Farm Carbon Case Studies*. Edinburgh: SRUC

Assessment option: Participating businesses should identify the extent to which they are currently making use of feed additives to improve cattle productivity, and take steps to optimise their use to cut enteric methane emissions where this is possible and feasible within a given system.

Applicability: This management option is applicable to suckler herds and finishing units but is better suited to systems where cattle are housed for parts of the year or all year.

7.2.3. Homegrown feed and forage production

Relevance: Self-sufficiency, particularly with regards to cattle feeding which is a major aspect of the cattle production system, has many distinct benefits. It can help to reduce business exposure to fluctuating market prices and minimise any issues associated with an unknown quality and nutritional content of privately purchased feeds. Focusing on homegrown feed and forage production also requires businesses to critically review and assess their own grazing and feed or forage production system to optimise yields and quality where possible.

Controlling all or most aspects of the cattle diet by focusing on homegrown production means that the farming business can maintain important production factors in-hand and, depending on efficient use of inputs required to produce cattle feed, reduce greenhouse gas emissions associated with the potential long-distance haulage of cattle feeds and forages.

Aim: This management option aims to encourage participants to review their current reliance on purchased feeds, and to take steps to try and maximise homegrown forage and grazing production in order to become more self-sufficient and reduce the fuel use associated with feed transportation which helps to reduce greenhouse gas emissions. This can for instance be achieved by improving the general grassland management in order to obtain better forage yields and quality.

Emissions abatement potential: Emissions abatement modelling conducted by J. Bell et al. (2020)[49] and using a rearer finisher scenario has found that improved grassland management through a combination of introducing rotational grazing management in conjunction with better forage quality and a reseeding policy can reduce the emissions intensity of the production system by 6.3%.

Assessment option: Participating businesses should identify the proportion of the cattle diet that is provided by on-farm grazing and from homegrown forage and feed production on an annual basis.

Applicability: This management option is applicable to suckler herds and finishing units.

[49] **BELL J., BEATON C., YOUNG M., HILL G., STOUT D., SELLARS A., THOMSON S., SPENCER M., MOXEY A.** (2020). *Suckler Beef Climate Change Group – Farm Carbon Case Studies*. Edinburgh: SRUC

7.2.4. Locally sourced supplementary feed

Relevance: The vast majority of cattle enterprises rely to some degree on supplementary feeding to complement homegrown diets and make up any shortfalls in nutritional requirements which may not be met otherwise. There is a wide range of different types of supplementary feed available for farmers to purchase, some of which are produced within the UK and are specifically aimed at the livestock sector or are available as a co- or by-product from other industries such as distilleries.

However, where feeds have been imported, particularly from out with the European Union, these may have originated from unsustainable production systems associated with environmental exploitation and degradation, destruction of biodiversity and habitat loss, rainforest deforestation, and other serious issues such as the displacement of indigenous communities. They are out with the reach of strict legislation in place within Scotland and the UK aimed at safe-guarding the environment, ecosystems and local communities.

Such imported cattle feed products furthermore come with a high emissions intensity due to the long-distance transportation required to ship them to Scotland. Domestically grown livestock feeds on the other hand offer a much more sustainable, less emissions intensive option for supplementary cattle feeding. This includes valuable nutritional co- and by-products from other industries including draff from distilleries for instance which are a high-value feed source for many cattle enterprises across Scotland and should be made us of wherever possible.

Due to the two-staged use that these crops offer to the distilling or similar industry, followed by the livestock sector, they also have a lower emissions intensity due to the greenhouse gas emissions associated with their production being spread across two industries.

A focus on domestic livestock feeds including co- and by-products from other sectors can therefore significantly reduce the greenhouse gas emissions associated with supplementary cattle feed whilst also greatly enhancing the green credentials for environmental protection by ensuring that no unsustainable foreign feed products enter the Scottish beef sector.

Aim: This management option aims to encourage participants to review the supplementary feeding being used within the cattle enterprise in order to identify the various sources of the different ingredients and, where applicable, take steps to reduce or give up reliance on cattle feed components being imported from out with the EU and UK. This can be achieved by actively putting a greater focus on locally produced cattle feeds and making use of any nutritionally valuable co- and by-products.

Emissions abatement potential: A study by I. Leinonen et al. (2018)[50] shows that using distillery by-products such as draff or distiller's dark grains with solubles to replace soya or rapeseed within the cattle feed diet can for instance reduce greenhouse gas emissions by up to 1.219kg CO_{2e} per kilogram dry-matter of by-product fed. This is in large parts achieved by reducing the overall reliance on soya which in turn lowers emissions associated with land use changes for soya production that would otherwise be allocated to the cattle enterprise.

[50] **LEINONEN I., MACLEOD M., BELL J.** (2018). *Effects of alternative uses of distillery by-products on the greenhouse gas emissions of Scottish malt whisky production: a system expansion approach.* [Online] Available from: https://www.researchgate.net/publication/325011380_Effects_of_Alternative_Uses_of_Distillery_By-Products_on_the_Greenhouse_Gas_Emissions_of_Scottish_Malt_Whisky_Production_A_System_Expansion_Approach (last accessed 11th October 2020)

Assessment option: Participating businesses should identify the current proportion of the supplementary cattle feed that has been produced out with the UK or European Union, or for which the source is unknown. This assessment should be carried out on an annual basis.

Applicability: This management option is applicable to suckler herds and finishing units.

7.3. Improving production-based efficiencies – cattle health (Category 3)

Aims of category:

This category aims to encourage participating businesses to take steps to reduce the emissions intensity of their cattle production system(s) by

- improving overall cattle health in order to ensure that cattle performance and productivity and their ability to efficiently utilise given inputs are not limited by underlying health issues;
- improving overall cattle health by optimising the effectiveness and responsible use of animal health products through better targeting veterinary inputs; this may lead to an overall reduction in the quantity of animal health products used, thereby minimising the risk of exposure of local vulnerable wildlife to potentially harmful agrochemicals being carried into the environment.

Relevance: Diseases and parasitic presence are one of the major causes of inefficiencies in suckler herds across Scotland as they cause poor reproductive performance, stifle animal growth and development, and result in general ill-thrift with associated animal welfare issues and increased veterinary and/or disposal costs. Poorer cattle performance and higher mortality rates lead to an overall reduction in outputs and/or delays in getting animals to a suitable weight ready for sale, thereby resulting in additional input requirements. Diseases can therefore significantly increase the emissions intensity of affected cattle herds by severely compromising production efficiencies. Where animal health products are not used correctly to target specific issues in a timely manner, at the necessary rate, and using a suitable product, this can exacerbate any health problems and/or cause further issues associated with pathogenic or parasitic immunity and resistance to certain veterinary medicines, thereby compromising their effectiveness on-farm and across the wider agricultural industry going forward.

Poor cattle health and inadequate or inappropriate use of animal health products ultimately results in poor herd performance and productivity, causes inefficient resource and input utilisation, severely impacts on farm profitability, and can affect the mental health and well-being of the farmer.

Significance: A study conducted by ADAS UK Ltd (2014)[51] concluded potential increases in emissions intensities of between 4% and 130% depending on the type of disease or parasite affecting herd performance. With regards to the potential abatement potential of cattle health measures, resolving an underlying disease or parasitic issue could therefore lead to greenhouse gas emissions reductions of between 3.8% and 56% per unit of output and depending on the actual health issue impacting on cattle performance.

[51] **ADAS UK LTD** (2014). *Study to model the impact of controlling endemic cattle diseases and conditions on national cattle productivity, agricultural performance and greenhouse gas emissions*. [Online] Available from: http://randd.defra.gov.uk/Default.aspx?Menu=Menu &Module= More&Location=None&ProjectID=17791&FromSearch=Y&Status=3&Publisher =1&SearchText=greenhouse gas&SortString=StartMth&SortOrder=Desc&Paging=10# Description (last accessed 18th June 2020)

7.3.1. Bovine Viral Diarrhoea (BVD)

Relevance: Bovine Viral Diarrhoea is one of the most significant diseases impacting cattle health, welfare and performance. It severely affects cattle enterprise profitability and leads to a high cost to the Scottish agricultural economy as a result of poor reproductive ability and reduced resistance to disease. The potential environmental impact from BVD is quite significant, with research carried out on behalf of Defra and AHVLA showing that greenhouse gas emissions within a suckler beef herd affected by the disease may be increased by up to 130% per beef carcass (ADAS UK Ltd, 2014[52]). According to CHeCS[53], the economic impact of an outbreak of BVD in a suckler beef herd is equally as severe and can exceed £4,500 across a herd of 100 cows.

The Scottish Government initiated a voluntary BVD eradication scheme in 2010 which has since progressed to Phase 5 and which focuses on protecting the Scottish cattle population by identifying and removing persistently infected animals from the small proportion of remaining BVD positive or not negative breeding herds, along with imposing stricter movement and testing requirements[54].

Aim: This management option aims to encourage participants to take the BVD requirements as outlined as part of the BVD eradication scheme further to not only eradicate the disease from their herd if present, but to put measures in place to minimise the risk of further or future exposure to BVD. Ensuring that businesses participating in the SBCS are taking every precaution and necessary steps to help reduce the risk of BVD incidents will not only help to reassure the public that due consideration is being given to animal health and welfare but will also improve overall herd performance, thereby achieving better resource and input utilisation efficiencies in Scottish beef herds. This will ultimately help to reduce greenhouse gas emissions per unit of output and increase business profitability as a result.

Emissions abatement potential: Eradicating BVD within an affected herd can lower the emissions intensity of the cattle herd by up to 56%.

Assessment option: Participating businesses should review their BVD status on an annual basis by assessing whether their herd is certified negative (accredited), screened negative (tested), not negative but vaccinating, not negative, or whether there have been any cases of BVD-positive cattle at any point in the past 12 months. For store and finishing units, this assessment considers the BVD health status of the herds that their cattle originate from.

Applicability: This management option is applicable to suckler herds and finishing units.

[52] **ADAS UK LTD** (2014). *Study to model the impact of controlling endemic cattle diseases and conditions on national cattle productivity, agricultural performance and greenhouse gas emissions*. [Online] Available from: http://randd.defra.gov.uk/Default.aspx?Menu=Menu &Module= More&Location=None&ProjectID=17791&FromSearch=Y&Status=3&Publisher =1&SearchText=greenhouse gas&SortString=StartMth&SortOrder=Desc&Paging=10# Description (last accessed 18th June 2020)
[53] More information can be accessed via following weblink https://www.checs.co.uk/diseases/bovine-viral-diarrhoea-bvd/
[54] More information can be accessed via following weblink https://www.gov.scot/publications/guidance-bvd-eradication-scheme-phase-5-december-2019/

7.3.2. Infectious Bovine Rhinotracheitis (IBR)

Relevance: Infectious Bovine Rhinotracheitis is a major and highly contagious cattle disease which affects the upper respiratory tract of infected animals and which is found across a large proportion of suckler beef herds within the UK. Herds struggling with IBR positive cattle experience significant ill-thrift which severely compromise animal welfare, performance efficiencies and productivity, along with overall enterprise profitability.

The poorer production efficiency of an affected suckler beef herd can result in an emissions intensity of 20% above the normal average for a healthy herd (ADAS UK Ltd, 2014[55]), and studies carried out in dairy herds by the University of Reading (Craig Robinson Vets, 2020[56]) and Zoetis UK Ltd (2013)[57] have estimated the cost impact of IBR to be between £3,200 and £4,500 for 100 cows before taking into account any reproductive losses and treatment costs.

Aim: This management option aims to encourage participants to establish whether IBR is an issue on their farm, take the necessary steps to control and eradicate the disease from their herd where it is present, and put in place measures to minimise the risk of further or future exposure to IBR. Ensuring that businesses participating in the SBCS are taking every precaution and necessary steps to help reduce the risk of incidents involving a major cattle disease will not only help to reassure the public that due consideration is being given to animal health and welfare but will also improve overall herd performance, thereby achieving better resource and input utilisation efficiency in Scottish beef herds. This will ultimately help to reduce greenhouse gas emissions per unit of output and increase business profitability as a result.

Emissions abatement potential: Based on data by ADAS UK Ltd (2014), eradicating IBR within an affected herd can lower the emissions intensity of the cattle herd by up to 17%.

Assessment option: Participating businesses should review their IBR status on an annual basis by assessing whether their herd is accredited and/or vaccinated, tested negative, whether there have been any cases of IBR-positive cattle at any point in the past 12 months, or whether the health status is unknown. For store and finishing units, this assessment considers the IBR health status of the herds that their cattle originate from.

Applicability: This management option is applicable to suckler herds and finishing units.

7.3.3. Leptospirosis (Lepto)

Relevance: Leptospirosis is a major cattle disease found across a large proportion of suckler beef herds across the UK and causes reproductive issues including fertility problems, abortions and poor milk production. Depending on the system, it can be easily spread and compromises animal welfare, performance and productivity along with enterprise profitability.

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[55] **ADAS UK LTD** (2014). *Study to model the impact of controlling endemic cattle diseases and conditions on national cattle productivity, agricultural performance and greenhouse gas emissions*. [Online] Available from: http://randd.defra.gov.uk/Default.aspx?Menu=Menu &Module= More&Location=None&ProjectID=17791&FromSearch=Y&Status=3&Publisher =1&SearchText=greenhouse gas&SortString=StartMth&SortOrder=Desc&Paging=10# Description (last accessed 18th June 2020)

[56] **CRAIG ROBINSON VETS** (2020). *Infectious Bovine Rhinotracheitis (IBR).* [Online] Available from: https://www.craigrobinson-vets.co.uk/resource-library/infectious-bovine-rhinotracheitis-ibr/ (last accessed 30th June 2020)

[57] **ZOETIS UK LTD** (2013). *Is your herd protected against IBR?* [Online] Available from: https://www.zoetis.co.uk/_locale-assets/img/combat-ibr/new-rispoval-ibr-farmer-8pg-leaflet_approved-_clean_-13mar13.pdf (last accessed 30th June 2020)

According to CHeCS[58], Lepto is estimated to result in added costs of up to £106 per cow within affected herds.

Aim: This management option aims to encourage participants to establish whether Lepto is an issue on their farm, take the necessary steps to control and eradicate the disease from their herd where it is present, and put in place measures to minimise the risk of further or future exposure to Lepto. Ensuring that businesses participating in the SBCS are taking every precaution and necessary steps to help reduce the risk of incidents involving a major cattle disease will not only help to reassure the public that due consideration is being given to animal health and welfare but will also improve overall herd performance, thereby achieving better resource and input utilisation efficiency in Scottish beef herds. This will ultimately help to reduce greenhouse gas emissions per unit of output and increase business profitability as a result.

Emissions abatement potential: Research conducted by D. J. Bartley et al. (2016)[59] identified potential greenhouse gas emissions savings, but the nature of this disease, i.e. potential fertility issues, abortions and reduced milk yields, means that accurately determining the extent of its impact and accurately quantifying the resulting emissions intensity is difficult. Further research will be required to substantiate the potential savings from controlling Lepto, but the study confirms that emissions can be reduced.

Assessment option: Participating businesses should review their Lepto status on an annual basis by assessing whether their herd is accredited and/or vaccinated, tested negative, whether there have been any cases of Lepto-positive cattle at any point in the past 12 months, or whether the health status is unknown. For store and finishing units, this assessment considers the Lepto health status of the herds that their cattle originate from.

Applicability: This management option is applicable to suckler herds and finishing units.

7.3.4. Johne's Disease (Johne's)

Relevance: Johne's Diseases is found within a significant proportion of cattle herds across the UK and can be easily spread within a herd. Limitations associated with effective testing add further complications to identifying Johne's within a herd. It is a chronic wasting disease with symptoms progressively worsening, and it severely compromises animal welfare, performance and productivity along with enterprise profitability. According to ADAS UK Ltd (2013[60] and 2014[61]), greenhouse gas emissions resulting from the presence of Johne's within suckler beef herds may be increased by 40%, and financial losses as a result of Johne's can exceed £4,500 for a 100 head suckler cows herd as measured in England.

[58] More information can be accessed via following weblink https://www.checs.co.uk/diseases/leptospirosis/

[59] **BARTLEY D. J., SKUCE P. J., ZADOKS R. N., MACLEOD M.** (2016). *Endemic sheep and cattle diseases and greenhouse gas emissions.* [Online] Available from: https://www.researchgate.net/publication/309542180_Endemic_sheep_and_cattle_diseases_and_greenhouse_gas_emissions (last accessed 10th October 2020).

[60] **ADAS UK LTD** (2013). *Economic Impact of Health and Welfare Issues in Beef Cattle and Sheep in England.* [Online] Available from: http://beefandlamb.ahdb.org.uk/wp-content/uploads/2013/04/Economic-Impact-of-Health-Welfare-Final-Rpt-170413.pdf (last accessed 29th June 2020)

[61] **ADAS UK LTD** (2014). *Study to model the impact of controlling endemic cattle diseases and conditions on national cattle productivity, agricultural performance and greenhouse gas emissions*. [Online] Available from: http://randd.defra.gov.uk/Default.aspx?Menu=Menu &Module= More&Location=None&ProjectID=17791&FromSearch=Y&Status=3&Publisher =1&SearchText=greenhouse gas&SortString=StartMth&SortOrder=Desc&Paging=10# Description (last accessed 18th June 2020)

Aim: This management option aims to encourage participants to establish whether Johne's is an issue on their farm, take the necessary steps to control and, where possible, eradicate the disease from their herd where it is present, and put in place measures to minimise the risk of further or future exposure to Johne's. Ensuring that businesses participating in the SBCS are taking every precaution and necessary steps to help reduce the risk of incidents involving a major cattle disease will not only help to reassure the public that due consideration is being given to animal health and welfare but will also improve overall herd performance, thereby achieving better resource and input utilisation efficiency in Scottish beef herds. This will ultimately help to reduce greenhouse gas emissions per unit of output and increase business profitability as a result.

It is recognised that the eradication of Johne's can be very difficult, and so it should be a priority for participating businesses to take steps to try and control and contain the disease where possible in a first instance, as this will already help to significantly improve cattle health.

Emissions abatement potential: Based on data by ADAS UK Ltd (2014), controlling and where possible eradicating Johne's within an affected herd can lower the emissions intensity of the cattle herd by almost 30%.

Assessment option: Participating businesses should review their Johne's status on an annual basis by assessing whether their herd is risk accredited, tested negative, whether there have been any cases of Johne's-positive cattle at any point in the past 12 months, or whether the status is unknown. For store and finishing units, this assessment considers the Johne's health status of the herds that their cattle originate from.

Applicability: This management option is applicable to suckler herds and finishing units.

7.3.5. Responsible use of antibiotics

Relevance: Antibiotics are an extremely important medicine to control bacteria-related health issues in animals and humans, and their effectiveness and viability relies on proper use and targeting. Over-use of antibiotics leads to unnecessary input wastage, and inappropriate use of antibiotics including the administration of insufficient quantities in relation to bodyweight can result in a build-up of antibiotic-resistant strains of bacteria, thereby eventually rendering future treatments of bacterial infections ineffective within the agricultural industry and beyond.

Apart from the obvious risks associated with poorly targeted use of antibiotics, research has also found that cattle undergoing antibiotic treatment may show increased greenhouse gas emissions: According to T. J. Hammer et al. (2016)[62], emissions from dung deposited by cows undergoing antibiotic treatment were found to be 80% higher compared to untreated cows, and the findings suggested that alterations caused to the dung as a result of antibiotic use may potentially have an ecologically harmful impact, in particular on dung beetle.

The above highlight an obvious need to ensure that antibiotics are used responsibly.

[62] **HAMMER T. J., FIERER N., HARDWICK B., SIMOJOKI A., SLADE E., TAPONEN J., VILJANEN H., ROSLIN T.** (2016). *Treating cattle with antibiotics affects greenhouse gas emissions, and microbiota in dung and dung beetles.* [Online] Available from: https://royalsocietypublishing.org/doi/10.1098/rspb.2016.0150 (last accessed 30th June 2020)

Aim: In line with the recently published '*New recommendations for monitoring use of antibiotics on beef farms*' by the Agriculture and Horticulture Development Board (2019)[63] using data from the Cattle Health and Welfare Group's Antimicrobial Usage Subgroup[64] on how to measure and compare antibiotic usage on beef farms, this management option aims to encourage participants to better target antibiotic treatments for improved cattle health management, reduced levels of antibiotic use, and a lesser risk of antibiotic resistance building up. This will include the completion of appropriate training along with an annual assessment to establish how heavily reliant individual businesses are on antibiotics. This can provide an indication of how well antibiotics are used and should encourage participants to identify any issues that may be present on the farm where preventative measures can be put in place to reduce the overall need for antibiotic use. Ultimately, the aim is to reduce overall reliance on antibiotics within the cattle production system. Ensuring that businesses participating in the SBCS are taking every precaution and necessary steps to help reduce antibiotic use will help to reassure the public that due consideration is being given to animal health and welfare, as well as the future viability of antibiotics as an effective means to treat bacterial infection in animals as well as humans. Putting preventative measures in place and better targeting antibiotic treatments will minimise greenhouse gas emissions and any ecological risks directly associated with the treatment, and improve overall herd performance. The latter will help to achieve better resource and input utilisation efficiency in Scottish beef herds which will ultimately help to reduce greenhouse gas emissions per unit of output and increase business profitability as a result.

Emissions abatement potential: Based on data by T. J. Hammer et al. (2016), every treatment involving antibiotics that can be prevented through better cattle health management can reduce emissions from the dung of such animals by approx. 44% compared to cattle that are having to undergo antibiotic treatment.

Assessment option: Participating businesses should complete the online training course 'Animal Medicines Best Practice' programme (AMBP), more specifically the AMBP course on antibiotics in beef[65], and carry out any administration of antibiotics in line with official best practice. In addition, participants should review the level of antibiotic use on the farm on an annual basis by calculating the average treatment days per animal on-farm.

Applicability: This management option is applicable to suckler herds and finishing units.

[63] **AGRICULTURE AND HORTICULTURE DEVELOPMENT BOARD** (2019). *Antimicrobial resistance – Using antibiotics responsibly.* [Online] Available from: http://beefandlamb.ahdb.org.uk/wp-content/uploads/2019/02/AMRLeaflet2019_190207_AntimicrobialResistance.pdf (last accessed 22nd June 2020)

[64] **CATTLE HEALTH AND WELFARE GROUP - ANTIMICROBIAL USAGE SUBGROUP** (n.d.). *Measuring and comparing the use of antibiotics on beef farms Cattle Health and Welfare Group Antimicrobial Usage Subgroup (CHAWG AMU) Consultation Document.* [Online] Available from: http://beefandlamb.ahdb.org.uk/wp-content/uploads/2019/07/CHAWG-AMU-Beef-Benchmarking-Consultation-Document-July-2019.pdf (last accessed 22nd June 2020)

[65] Further information can be accessed via following weblink https://www.lantra.co.uk/course/ambp-antibiotics-beef

7.3.6. Responsible use of anthelmintics

Relevance: Anthelmintics include a range of products aimed at the control of endo-parasitic infestation such as liver fluke, gastrointestinal nematodes (gut worm) and lungworm. Flukicides and wormers are amongst the most commonly used anthelmintics in cattle farming to minimise health issues and poor animal performance associated with internal parasitic burden and damage. Inadequate or inappropriate use of anthelmintics not only risks medicine wastage along with the associated expense but can result in potential side effects affecting animal health as a result of over-treatment. Excessive use of anthelmintics can furthermore pose a risk to the environment by potentially harming vulnerable animals forming part of the local biodiversity. Where under-treatment takes place, it fails to adequately address the issue and can eventually lead to parasitic resistance against certain anthelmintics. This not only renders a specific product and its active ingredient ineffective within a farm, but can potentially result in wide-reaching animal welfare and economic damage across the industry if such resistant strains spread to other farms through livestock movements.

A failure to properly target the use of such products and/or inability to correctly administer the medicine ultimately results in poor animal performance and general ill-thrift along with associated welfare issues, productivity losses, and poor enterprise and carbon efficiencies. Liver fluke infestation for instance can increase the emissions intensity associated with suckler beef production by 10% as a result of poorer performance (ADAS UK Ltd, 2014[66]), which does not include the emissions implications associated with acute fluke causing on-farm mortalities.

Aim: In line with best practice guidance as outlined by COWS (2014[67] and 2020[68 69 70]) and The Moredun Foundation (2020), this management option aims to encourage participants to better target anthelmintic treatments including flukicides and wormers for improved cattle health management, reduced wastage, and to lower the risk of any parasitic resistance building up. This will include an annual assessment in order to establish how well best practice is being adopted for any endo-parasitic (routine) treatments. Ensuring that businesses participating in the SBCS are taking every precaution and necessary steps to better target treatments and reduce medicine use will help to reassure the public that due consideration is being given to animal health and welfare, as well as the future availability of anthelmintics as an effective means to treat endo-parasitic burden in livestock. Putting preventative measures in place and better targeting anthelmintic treatments will minimise the risk of harmful ecological consequences and improve overall herd performance. The latter will help to achieve better resource and input utilisation efficiency in Scottish beef herds to reduce greenhouse gas emissions per unit of output and increase business profitability.

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[66] **ADAS UK LTD** (2014). *Study to model the impact of controlling endemic cattle diseases and conditions on national cattle productivity, agricultural performance and greenhouse gas emissions*. [Online] Available from: http://randd.defra.gov.uk/Default.aspx?Menu=Menu &Module= More&Location=None&ProjectID=17791&FromSearch=Y&Status=3&Publisher =1&SearchText=greenhouse gas&SortString=StartMth&SortOrder=Desc&Paging=10# Description (last accessed 18th June 2020)

[67] **COWS (CONTROL OF WORMS SUSTAINABLY)** (2014). *Administering wormers (anthelmintics) effectively.* [Online] Available from: https://www.cattleparasites.org.uk/app/ uploads/2018/04/Administering-wormers-anthelmintics-effectively.pdf (last accessed 30th June 2020)

[68] **COWS (CONTROL OF WORMS SUSTAINABLY)** (2020). *Control of lungworm in cattle.* [Online] Available from: https://www.cattleparasites.org.uk/app/uploads/2020/01/ lungworm-231219.pdf (last accessed 30th June 2020)

[69] **COWS (CONTROL OF WORMS SUSTAINABLY)** (2020). *Control of roundworms in cattle.* [Online] Available from: https://www.cattleparasites.org.uk/app/uploads/2020/01/ roundworm-140120.pdf (last accessed 30th June 2020)

[70] **COWS (CONTROL OF WORMS SUSTAINABLY)** (2020). *Integrated parasite control on cattle farms.* [Online] Available from: https://www.cattleparasites.org.uk/app/uploads/2020/06/ integrated-control-190520-FINAL.pdf (last accessed 30th June 2020)

Emissions abatement potential: Based on data by ADAS UK Ltd (2014), appropriate liver fluke control can for instance reduce the emissions intensity of affected herds by up to 9%.

Assessment option: Participating businesses should review their animal health treatment system on an annual basis to assess how well any anthelmintic products are targeted. The assessment considers whether anthelmintics are administered as part of routine treatments involving one or several active ingredients, whether the administration rate is targeted at the estimated heaviest within a group or based on actual up-to-date liveweight data of individual animals, whether any precision technology and equipment such as an automatically adjustable dosing gun is utilised for greater accuracy, whether recent 'COWS' guidance is being followed, and whether testing has been carried out to identify the presence of any issues at the time of treatment.

Applicability: This management option is applicable to suckler herds and finishing units.

7.3.7. Calf health

Relevance: Calf performance relies on good health management and can be severely compromised by various health issues, with research listing pneumonia and calf scour as two of the most important causes of calf ill-thrift and possible mortality (ADAS UK Ltd, 2014[71]). Pneumonia has been identified as major cause of calf mortality by Beef Efficiency Scheme participants: According to the **'BES performance data and advice for your farm'** report sent out to participants in January 2020, 25.18% of calf disposals were due to pneumonia. Further investigation would be required to establish whether these cases were clearly diagnosed as pneumonia during a vet examination or post mortem, but the data nonetheless suggests that calf pneumonia is a serious health issue within Scottish suckler beef herds. According to ADAS UK Ltd (2014), greenhouse gas emissions per unit of output may be increased by 4% as a result of calf pneumonia and/or calf diarrhoea and the same study estimates economic losses to be ranging from £43 to £90 per calf which does not include further losses as a result of poor performance and potential mortality with associated disposal costs.

Aim: This management option aims to encourage participants to identify any underlying health problems causing ill-thrift or mortalities amongst calves in order to take the necessary steps to resolve any issues currently affecting calf health and wellbeing, and to put in place measures to minimise the risk of further or future calf health issues. Ensuring that businesses participating in the SBCS are taking every precaution and necessary steps to help reduce the risk of poor calf health will not only help to reassure the public that due consideration is being given to animal health and welfare but will also improve overall herd performance, thereby achieving better resource and input utilisation efficiencies in Scottish beef herds. This will ultimately help to reduce greenhouse gas emissions per unit of output and increase business profitability as a result.

Emissions abatement potential: Based on data by ADAS UK Ltd (2014), appropriate calf health management can reduce the emissions intensity of affected herds by almost 4%.

[71] **ADAS UK LTD** (2014). *Study to model the impact of controlling endemic cattle diseases and conditions on national cattle productivity, agricultural performance and greenhouse gas emissions*. [Online] Available from: http://randd.defra.gov.uk/Default.aspx?Menu=Menu &Module= More&Location=None&ProjectID=17791&FromSearch=Y&Status=3&Publisher =1&SearchText=greenhouse gas&SortString=StartMth&SortOrder=Desc&Paging=10# Description (last accessed 18th June 2020)

Assessment option: Participating businesses should review their calf health management strategy on an annual basis by assessing the incident rate of diseased or deceased calves. They should identify what calf health issues are occurring on-farm by consulting the vet for appropriate treatment, and/or by carrying out a post-mortem to determine the cause of mortality incidents. An effective calf health strategy should be outlined and incorporated into the annual cattle health plan to specifically address issues that have been identified on the farm.

Applicability: This management option is applicable to suckler herds, which may include both store producers and rearer finisher units.

7.3.8. Cow health

Relevance: Maintaining optimum cow performance relies on thorough health management and can be severely compromised by a variety of health issues including some of the aforementioned major cattle diseases such as BVD, IBR, Johne's and Lepto. Scientific studies have found that further health issues, particularly Neosporosis which severely affects reproductive performance, or mastitis and lameness, also cause significant issues with regards to poor cow performance: According to ADAS UK Ltd (2014)[72], mastitis and lameness have been identified as having amongst the highest economic impact within British dairy and suckler beef herds and can increase greenhouse gas emissions of affected herds by up to 6% and 4% respectively. With regards to Neosporosis, research carried out by P. J. Skuce et al. (2016)[73] estimated the potential to reduce the emissions intensity from affected cattle herds by up to 4.5% depending on the prevalence of the disease within the herd.

Aim: This management option aims to encourage participants to identify any causes of death or ill-thrift amongst cows other than the aforementioned major diseases listed as separate management options, in order to take the necessary steps to resolve any issues currently affecting cow health and wellbeing, and to put in place measures to minimise the risk of further or future health issues. This includes a particular focus on Neosporosis, mastitis and lameness. Ensuring that businesses participating in the SBCS are taking every precaution and necessary steps to help reduce the risk of poor cow health will not only help to reassure the public that due consideration is being given to animal health and welfare but will also improve overall herd performance, thereby achieving better resource and input utilisation efficiencies in Scottish beef herds. This will ultimately help to reduce greenhouse gas emissions per unit of output and increase business profitability as a result.

Emissions abatement potential: Based on data by ADAS UK Ltd (2014) and P. J. Skuce et al. (2016), appropriate cow health management can reduce the emissions intensity of affected herds by up to 5.6% depending on the underlying health issue.

[72] **ADAS UK LTD** (2014). *Study to model the impact of controlling endemic cattle diseases and conditions on national cattle productivity, agricultural performance and greenhouse gas emissions*. [Online] Available from: http://randd.defra.gov.uk/Default.aspx?Menu=Menu &Module= More&Location=None&ProjectID=17791&FromSearch=Y&Status=3&Publisher =1&SearchText=greenhouse gas&SortString=StartMth&SortOrder=Desc&Paging=10# Description (last accessed 18th June 2020)

[73] **SKUCE P. J., BARTLEY D. J., ZADOKS R. N., MACLEOD M.** (2016). *Livestock Health and Greenhouse Gas Emissions*. [Online] Available from: https://www.climatexchange.org.uk/ media/2031/livestock_health_ and_greenhouse gas.pdf (last accessed 29th June 2020)

Assessment option: Participating businesses should review their cow health management strategy on an annual basis by assessing the incident rate of diseased or deceased cows. This includes working towards the identification of any cow health issues occurring on-farm by consulting the vet for appropriate treatment, and/or by carrying out a post-mortem to determine the cause of mortality incidents. An effective cow health strategy should be outlined and incorporated into the annual cattle health plan to specifically address issues that have been identified on the farm.

Applicability: This management option is applicable to suckler herds, which may include both store producers and rearer finisher units.

7.4. Improving soil health (Category 4)

Aims of category:

This category aims to encourage participating businesses to take steps to protect and maintain existing soil carbon stores on their farmland, increase soil carbon sequestration where this is possible, and reduce greenhouse gas emissions from their production system(s) or as a result of soil carbon losses through poor farmland management by

- improving the overall health of the soil through better management of soil acidity, soil organic matter and carbon levels, and by preserving or restoring good soil structure and enhancing microbial activity;
- better targeting field management to enhance input utilisation and reduce fuel use.

The management options being proposed as part of this category will also benefit the wider biodiversity by enhancing suitable habitats for a wide range of animals and soil microorganisms, all of which rely on and contribute towards the healthiness of soils.

Relevance: Soil is one of the most important resources available to any farming business, and relies on a combination of different and complex physical, chemical and biological factors and processes, all of which are crucially important to preserve good soil functioning. If managed properly, healthy soils not only provide a suitable medium to facilitate good grass and crop growth as well as a habitat to a wide variety of animals and microorganisms, but they provide an effective solution for storing carbon long-term and can help to reduce the impact of flooding or drought thanks to a greater water infiltration and retention capacity. Their ability to draw carbon into the ground means that carbon losses can be minimised during the event of wildfires, where vast quantities of above-ground carbon stored in vegetation can be released. With climate change causing increasingly more frequent extreme weather and weather-related events including wildfires, it is therefore crucial to maximise below-ground carbon storage.

A good soil structure with suitable aggregation, i.e. sufficient porous space, is important to not only facilitate movement of water and air into and through the soil, but it enables for nutrients and minerals to travel freely to where they are required, and for plants to grow extensive root systems that can access additional reserves of water, air and nutrients. Organic matter and the carbon contained within help to stabilise such a soil structure and provide a habitat for important soil life, microorganisms and fungi to thrive and make nutrients and minerals available to plants in return for sugars which are released as root exudates into the soil by actively growing plants capturing carbon from the atmosphere via photosynthesis.

A healthier soil enables greater soil microbial and animal activity which helps to improve the condition of the soil as a growing medium and to make more nutrients and minerals available to plants. The plants experience improved performance as a result which increases their growth and with it the level of photosynthesis being carried out.

This leads to greater quantities of carbon being captured from the atmosphere and drawn into the plant and soil to provide important sugar food sources, which in turn maximises the flow of carbon from the atmosphere into the soil, thereby boosting soil carbon sequestration.

It is therefore absolutely crucial that farmers take steps to preserve the soil health of their farmlands. This will help to protect and maintain current soil carbon stores and encourage additional carbon capture from the atmosphere for long-term soil sequestration where possible. Good soil health will also promote better plant performance, enhance input utilisation efficiencies, and support local biodiversity and soil life. Improving soil health will not only deliver important climate and environmental benefits in the form of greater carbon storage and/or capture and enhanced biodiversity, but will result in improved cattle performance and enterprise profitability.

7.4.1. Correcting soil acidity

Relevance: The acidity or alkalinity of soil greatly depends on the base rock material that the soil is made up of. Calcareous parent material typically leads to very alkaline soils with a higher pH whereas peaty base material causes the soil to be acidic and have a lower pH. Rainfall is naturally acidic and can cause further acidification of soils, particularly in areas with high annual precipitation. Sandy soils are more likely to experience a faster rate of acidification than heavier clay-based soils, and a drop in pH can be further accelerated through the application of synthetic Nitrogen fertiliser.

If soils are too acidic, they can limit the growth, development and productivity of plants due to a reduced nutrient and mineral availability as a result of restricted soil microbial activity. This affects overall sward performance both in terms of feed quality and total output, and can cause poorer input utilisation efficiency, thereby increasing the emissions intensity of sward production along with the carbon footprint of the cattle enterprise. Ultimately, this may result in the need to purchase additional feed off-farm to make up the shortfall in home-grown feed production which further impacts on the emissions intensity of the farming enterprise and reduces overall cattle profitability.

Soil acidity can cause additional nutrient problems within systems seeking to supply Nitrogen from within the sward via legumes because a low pH can either prohibit or severely restrict the proper development and functioning of the Rhizobia bacteria responsible for forming the root nodules required for fixing Nitrogen. Acidic soils are furthermore believed to be the main source of agriculture-related nitrous oxide (N_2O) emissions and recent research has identified the correcting of the soil pH to be a crucial factor to reducing emissions of this potent greenhouse gas (M. Shaaban et al., 2020[74]).

[74] **SHAABAN M., WU Y., WU L., HU RONGGUI., YOUNAS A., NUNEZ-DELGADO A., XU P., SUN Z., LIN S., XU X., JIANG Y.** (2020). *The Effects of pH Change through Liming on Soil N_2O Emissions.* [Online] Available from: https://www.mdpi.com/2227-9717/8/6/702/htm (last accessed 8th July 2020)

With regards to the potential for soil carbon sequestration, restricted soil microbial activity as a result of a lower soil pH not only limits sward performance but reduces soil carbon sequestration due to the poorer plant growth and development limiting the level of photosynthesis, which in turn reduces the amount of carbon being drawn into the soil as important food source for soil microbial life.

Aim: This management option aims to encourage participants to establish baseline information about the current pH level of their farmland soils where this is currently unknown, and to correct soil acidity issues on any fields receiving inputs where this is required. This will contribute towards overall soil and microbial health to help enhance and increase soil carbon sequestration, and ensure that the plants are able to efficiently and effectively utilise any nutrients and minerals available within the soil or being added onto the farmland in order to reduce the emissions intensity of the cattle enterprise, along with any associated input wastage.

Emissions abatement potential: According to C. Henault (2019)[75], liming can reduce nitrous oxide emissions by up to 66% or an average of 49%.

Assessment option: Participating businesses should identify the current soil pH of their improved farmland areas and correct soil acidity issues on any fields receiving inputs in line with recent soil analysis results and lime application recommendations as outlined by B. Crooks et al. (2019)[76].

Applicability: This management option is applicable to suckler herds and finishing units.

7.4.2. Increasing soil organic matter

Relevance: The loss of soil organic matter is believed to be one of the major factors causing the increase in anthropogenic carbon dioxide emissions over the last 50 years (A. M. Silva-Olaya et al., 2013[77]). It has been recognised by a range of organisations including the Scottish Government (2009)[78] and the Soil Association (L. Payton et al., not dated)[79] as a key issue requiring attention due to its ability to not only enhance food and biomass production, but also because soil organic matter is a crucial factor in facilitating soil carbon storage and sequestration, contributes towards important habitats for local biodiversity, reduces soil erosion, maintains good soil structure, and helps to regulate water flow and quality.

[75] **HENAULT C., BOURENNANE H., AYZAC A., RATIE C., SABY N. P. A., COHAN J.-P., EGLIN T., LE GALL C.** (2019). *Management of soil pH promotes nitrous oxide reduction and thus mitigates soil emissions of this greenhouse gas.* [Online] Available from: https://www.nature.com/articles/s41598-019-56694-3#Sec11 (last accessed 11th October 2020)
[76] **CROOKS B., SINCLAIR A., EDWARDS T.** (2019). *Liming materials and recommendations (Technical Note TN714).* [Online] Available from: https://www.fas.scot/downloads/tn714-liming-materials-and-recommendations/ (last accessed 9th July 2020)
[77] **SILVA-OLAYA A. M., CERRI C. E. P., LA SCALA JR N., DIAS C. T. S., CERRI C. C.** (2013). *Carbon dioxide emissions under different soil tillage systems in mechanically harvested sugarcane.* [Online] Available from: https://iopscience.iop.org/article/10.1088/1748-9326/8/1/015014 (last accessed 8th July 2020)
[78] **SCOTTISH GOVERNMENT** (2009). *The Scottish Soil Framework.* [Online] Available from: https://www.gov.scot/binaries/content/documents/govscot/publications/advice-and-guidance/2009/05/scottish-soil-framework/documents/0081576-pdf/0081576-pdf/govscot%3Adocument/0081576.pdf (last accessed 9th July 2020)
[79] **PAYTON L., WHITE L., MICHIE D.** (n.d.). *Seven ways to save our soils: Scotland.* [Online] Available from: https://www.soilassociation.org/media/5560/scotland-seven-ways-to-save-our-soils.pdf (last accessed 9th July 2020)

Soil organic matter is important for storing significant quantities of carbon as it is the main medium for soil carbon storage. It typically contains a large proportion of carbon which can make up as much as 58% of the total mass of soil organic matter (S. Corsi et al., 2012[80]). The majority of organic matter is usually present within the soil in a stable form that allows for potential long-term carbon storage depending on the field management. As such, the levels of soil organic matter and soil organic carbon are closely correlated and provide a good indicator for overall soil health and the contribution of different soils to mitigating the effects of global warming (C. Lefèvre et al., 2017[81]).

Aim: This management option aims to encourage participants to identify current soil organic matter levels of their farmland through soil analysis and focus on field management that can increase the proportion of organic matter within their soils. This will contribute towards maximising long-term soil carbon storage and potentially further sequestration, and help to preserve or reinstate good soil structure for optimum water, nutrient and air holding capacity along with a greater water infiltration rate. A greater nutrient retention and availability will furthermore improve overall soil health and boost plant growth and development, thereby ultimately helping to reduce the emissions intensity of the cattle production system by allowing plants to better utilise nutrients and reducing input levels and/or wastage.

Carbon sequestration potential: On European (arable) farmland where soil organic matter levels are comparatively low and where there is scope to encourage and enable soil carbon sequestration, taking appropriate measures to boost and support the accumulation of soil organic matter could result in annual average increases of between 0.55 and 1.14t of carbon per hectare per annum (R. J. Zomer et al., 2017)[82].

Assessment option: Participating businesses should identify the current soil organic matter content of their improved farmland areas and take steps to maintain existing stores and, where possible, increase their soil organic matter levels.

Applicability: This management option is applicable to suckler herds and finishing units.

[80] **CORSI S., FRIEDRICH T., KASSAM A., PISANTE M., DE MORAES SA J.** (2012). *Soil organic carbon accumulation and greenhouse gas emissions reductions from conservation agriculture: a literature review.* [Online] Available from: http://www.fao.org/fileadmin/user_upload/agp/icm16.pdf (last accessed 10th October 2020)

[81] **LEFÈVRE C., REKIK F., ALCANTARA V., WIESE L.** (2017). *Soil organic carbon; the hidden potential.* [Online] Available from: http://www.fao.org/3/a-i6937e.pdf (last accessed 8th July 2020)

[82] **ZOMER R. J., BOSSIO D. A., SOMMER R., VERCHOT L. V.** (2017). *Global sequestration potential of increased organic carbon in cropland soils.* [Online] Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5686149/ (last accessed 11th October 2020)

7.4.3. Minimising soil disturbance

Relevance: The extent to which soils can capture carbon for long-term storage greatly depends on the tillage system that is adopted on the farm and the resulting level of soil disturbance that is impacting on the soil structure and health. Research carried out by A. M. Silva-Olaya et al. (2013)[83] found that conventional tillage could lead to the loss of 80% of the carbon that may be accumulated within the soil over a period of one year, whilst reduced and minimum tillage appeared to result in much lower losses of 12% and 2% respectively. Another study by S. Mangalassery et al. (2014)[84] identified conventional tillage as having a net warming potential of 26% to 31% higher than zero tillage, and concluded that zero tillage systems may play an important role in reducing greenhouse gas emissions due to enabling increased soil carbon sequestration and leading to reduced emissions associated with fossil fuel use. This is supported by evidence from a study that found soil carbon levels to be twice as high in the top 5cm of soils where no tillage was applied compared to a conventional tillage system, whilst soil carbon levels at a depth of between 5cm and 15cm appeared to be 10% higher for no-till than for conventional tillage (R. P. Mathew, 2012[85]). T. Garnett (2010)[86] states that carbon can be sequestered in soil "… *by reducing carbon losses*…" and "… *reducing soil disturbance (such as through reduced tillage)*."

When compared to zero tillage systems, conventional tillage has furthermore been found to negatively affect the activity and structure of soil microbial communities, thereby compromising the health of soil life and reducing the levels of soil carbon and nitrogen (R. P. Mathew, 2012). Mechanical soil disturbance as a result of field tillage also negatively impacts on the structural integrity of the soil which can greatly affect the air, nutrient and water holding capacity, and lead to a poorer water infiltration rate, which in turn can make soils less resilient to drought or flooding issues.

Switching to a reduced tillage system on the other hand can improve the ability of the soil to infiltrate and retain water, thereby enabling it to better cope with periods of lacking or excessive rainfall (S. Tallman, 2012[87]).

In order to maximise soil carbon sequestration and minimise greenhouse gas emissions associated with field cultivation, it is therefore crucial to review tillage systems currently being adopted on suckler beef farms, and to encourage the move from conventional to reduced/minimum and ultimately no-tillage strategies.

[83] **SILVA-OLAYA A. M., CERRI C. E. P., LA SCALA JR N., DIAS C. T. S., CERRI C. C.** (2013). *Carbon dioxide emissions under different soil tillage systems in mechanically harvested sugarcane.* [Online] Available from: https://iopscience.iop.org/article/10.1088/1748-9326/8/1/015014 (last accessed 8th July 2020)
[84] **MANGALASSERY S., SJÖGERSTEN S., SPARKES D. L., STURROCK C. J., CRAIGON J., MOONEY S. J.** (2014). *To what extent can zero tillage lead to a reduction in greenhouse gas emissions from temperate soils?* [Online] Available from: https://www.nature.com/articles/srep04586#:~:text=Minimum%20tillage%20practices%20have%20been,For%20example%2C%20Hermle%20et%20al.&text=observed%20net%20carbon%20sequestration%20to,20%20years%20of%20no%20tillage. (last accessed 8th July 2020)
[85] **MATHEW R. P., FENG Y., GITHINJI L., ANKUMAH R., BALKCOM K. S.** (2012). *Impact of No-Tillage and Conventional Tillage Systems on Soil Microbial Communities.* [Online] Available from: https://www.hindawi.com/journals/aess/2012/548620/ (last accessed 8th July 2020)
[86] **GARNETT T.** (2010). *Food Climate Research Network – Soil carbon sequestration workshop: Summary of discussion.* [Online] Available from: https://fcrn.org.uk/sites/default/files/FCRN_SoilCarbon_summary_0.pdf (last accessed 6th July 2020)
[87] **TALLMAN S.** (2012). *No-Till Case Study, Brown's Ranch: Improving Soil Health Improves the Bottom Line.* [Online] Available from: https://www.canr.msu.edu/foodsystems/uploads/files/no-till-brown_ranch_casestudy.pdf (last accessed 7th July 2020)

Aim: This management option aims to encourage participants to adjust their soil tillage system by reducing their reliance on heavy-tillage implements, and reduce mechanical soil disturbance where possible in order to optimise soil carbon sequestration for long-term storage and preserve or reinstate good soil structure for optimum water and air holding capacity along with a greater water infiltration rate. This will contribute towards overall soil and soil microbial health and the reduction in net greenhouse gas emissions from the cattle production system. Reduced tillage will furthermore reduce fuel and machinery use which leads to a reduction in the emissions intensity associated with field management whilst lowering the cost of production to the business.

The scheme recognises that many farming businesses across Scotland apply a field management system that includes ploughing as part of a multiannual crop rotation or reseeding programme instead of carrying out annual ploughing. This delivers distinct benefits compared to annual ploughing in terms of greenhouse gas emissions. Based on the aforementioned study by A. M. Silva-Olaya et al. (2013), a business switching from annual ploughing to ploughing every 5 years as part of a 5-year crop rotation and/or reseeding programme could potentially reduce the proportionate losses of the annually captured and stored carbon from 80% to 16% per year. Although this still exceeds the measured losses from reduced tillage (12%) and zero-tillage (2%) systems, it results in significant carbon sequestration benefits by potentially quadrupling the quantity of carbon left in the soil when compared to annual ploughing. This management option therefore takes into account how regularly conventional tillage is taking place within participating businesses.

Emissions abatement potential: Based on data by A. M. Silva-Olaya et al. (2013), switching from conventional tillage to reduced/minimum or zero tillage could reduce the losses of annually captured soil carbon by 85% and 98% respectively.

Assessment option: Participating businesses should review the tillage system that is applied on their improved farmland on an annual basis, and take steps to reduce tillage where possible.

For the purpose of this management option, the following definitions apply for different tillage systems:

- **conventional tillage**: the inversion of soil, possibly along with a previous crop or crop residue, involving soil disturbance to a depth greater than 10cm (4in); typical implements include ploughs and disc or power harrows amongst others
- **reduced/minimum tillage (conservation tillage)**: the manipulation of all or parts of the topsoil layer, possibly along with a previous crop or crop residue, involving soil disturbance to a depth of no more than 10cm (4in); typical implements include cultivators and rotavators along with harrows operating to an adjustable working depth amongst others
- **zero tillage (no-till**): no inversion of the topsoil or any previous crop (residue); soil disturbance limited to topsoil slotting and scratching, or subsoil drainage and/or compaction management; eligible field management includes direct-drilling, tine-harrowing and aerating, as well as sward-lifting/sub-soiling/mole-ploughing with subsequent rolling to close over gaps caused by subsoil cultivation

Applicability: This management option is applicable to suckler herds and finishing units.

7.5. Improving grassland and grazing management (Category 5)

Aim of category:

This category aims to encourage participating businesses to take steps to increase soil carbon sequestration on their farmland and reduce the emissions intensity from their cattle production system(s) by

- optimising grassland productivity through better grazing systems, targeted sward management including the use of legumes, herbs and diverse seed mixtures, and by making better use of alternative (winter) crops and deferred grazing where available and applicable.

The management options being proposed as part of this category will also benefit the wider ecosystem and local biodiversity by enhancing suitable habitats for a wide range of animals and soil microorganisms, and reducing soil erosion and nutrient losses.

Relevance: Grass is the main source of feeding for a vast majority of cattle enterprises across Scotland, many of which rely almost solely on grazed or preserved forages and fodder crops to meet the dietary needs of their cattle herds. Understanding what characteristics of a sward benefit cattle performance is important in order to target inputs accordingly and ensure that the sward is sufficiently productive without being exhausted by inadequate input management or unsustainable demands being put on it.

Planning effective grazing strategies in line with local weather conditions and grass growth, and exploring options to improve the sward contents in line with local environmental potential and constraints can greatly enhance sward productivity, thereby reducing the need for supplementary feeding. Purchased feed quantities can furthermore be minimised by looking at ways in which to produce as much of the winter diet as possible at home, whether that includes the production of preserved forages to supply to housed animals, standing fodder crops grazed in-situ where ground and weather conditions permit this, or by making use of the traditional concept of deferred winter grazing.

In addition to carrying out better targeted management on improved grassland, adequate management of upland grasslands by ensuring that no over-grazing is taking place can play a key role towards carbon sequestration by preserving important upland habitats, which also delivers secondary but nonetheless important environmental benefits by means of local habitat and biodiversity preservation and enhancement.

7.5.1. Maintaining ground cover

Relevance: A functioning ecosystem aims to maintain a covered ground at all times. This protects topsoil from being subjected to wind and/or water erosion, which in turn protects nearby watercourses from sediment pollution. An actively growing sward or crop utilises nutrients which may otherwise be lost into the atmosphere, leached into the groundwater, or washed off into nearby watercourses, whilst crop residue such as stubble can hold a certain amount of nutrients which reduces nutrient losses throughout the winter and makes nutrients available to following crops in spring.

Ground cover can also provide important habitats and food sources for local animals as well as for soil life, particularly during the winter when food is in limited supply and when there is little chance of anything else establishing on bare soil.

Ensuring that ground is covered can therefore benefit the climate through potentially reduced emissions, reduce topsoil losses, minimise the risk of sediment and nutrient pollution of watercourses, and deliver important benefits to support the local biodiversity and soil life.

Aim: This management option aims to encourage participants to review their current system of maintaining ground cover as part of their field management, and to take steps to reduce the length of time that soil is exposed for by maintaining a ground cover throughout or at least for the majority of the year. This is of particular relevance during the colder and wetter winter months when higher precipitation poses a greater risk of soil erosion and nutrient leaching. Maintaining a ground cover can be achieved by focusing on actively growing crops that typically remain in the ground for more than one season, i.e. grasslands, or seasonal crops including winter forage and fodder crops, cover and catch crops, undersown crops, and green manures. Ground cover can also be maintained in the form of residue from a previous crop, i.e. stubble.

Maintaining continuous ground cover will help to minimise greenhouse gas emissions and environmental concerns associated with nutrient losses via the atmosphere and/or leaching, as well as soil erosion with any associated potential implications for nearby watercourses.

Emissions abatement potential: Based on data by A. M. Silva-Olaya et al. (2013)[88], maintaining a ground cover by switching from conventional tillage to reduced/minimum or zero tillage could reduce the losses of annually captured soil carbon by 85% and 98% respectively.

Assessment option: Participating businesses should identify the length of time that the ground in different fields on their improved farmland is left without a ground cover on an annual basis.

Applicability: This management option is applicable to suckler herds and finishing units.

[88] **SILVA-OLAYA A. M., CERRI C. E. P., LA SCALA JR N., DIAS C. T. S., CERRI C. C.** (2013). *Carbon dioxide emissions under different soil tillage systems in mechanically harvested sugarcane.* [Online] Available from: https://iopscience.iop.org/article/10.1088/1748-9326/8/1/015014 (last accessed 8th July 2020)

7.5.2. Maintaining living roots

Relevance: The extent to which available nutrients can be utilised is directly dependant on there being actively growing plants present. An actively growing sward or crop, or more specifically its root system, is able to take up such nutrients which may otherwise be lost into the atmosphere, leached into the groundwater, or washed off into nearby watercourses. A continuously maintained and preserved living root system is also essential for providing an important habitat and food source for soil life which can be adversely affected if subjected to prolonged periods without actively growing plants enriching the soil. An absence of living roots means that there is no carbon being drawn into the soil, and the resulting unstable soil life community can lead to a lower rate of carbon sequestration. This can potentially significantly reduce the total annual level of soil carbon capture taking place. Ensuring that the soil contains living roots can therefore benefit the climate through potentially reduced emissions and increased carbon sequestration, minimise the risk of nutrient pollution of watercourses, and deliver important benefits to support the local soil life as well as a range of animals relying on actively growing plants as a food source.

Aim: This management option aims to encourage participants to review their current field management with regards to maintaining a living root system, and to take steps to reduce the length of time that soil is left without living roots. This is of particular relevance during the colder and wetter winter months when higher precipitation poses a greater risk of nutrient leaching. Maintaining a living root system can be achieved by focusing on actively growing crops that typically remain in the ground for more than one season, i.e. grasslands, or by following one crop immediately with another one, such as seasonal crops including winter forage and fodder crops, cover and catch crops, undersown crops, and green manures. This will help to minimise greenhouse gas emissions and environmental concerns associated with nutrient losses via the atmosphere and/or leaching, and help to support an active soil life and microbial community by ensuring that important soil cycles can be continued throughout the year.

Emissions abatement potential: Based on data by A. M. Silva-Olaya et al. (2013)[89], maintaining a living root system by switching from conventional tillage to reduced/minimum or zero tillage could reduce the losses of annually captured soil carbon by 85% and 98% respectively.

Assessment option: Participating businesses should identify the length of time that soil on their improved farmland contains a living root system on an annual basis. Unlike the management option aimed at maintaining ground cover, this management option requires actively growing crops to fulfil its aim. Any crop residue such as stubble or crops that have been sprayed off using a desiccant or herbicide are therefore not eligible.

Applicability: This management option is applicable to suckler herds and finishing units.

[89] **SILVA-OLAYA A. M., CERRI C. E. P., LA SCALA JR N., DIAS C. T. S., CERRI C. C.** (2013). *Carbon dioxide emissions under different soil tillage systems in mechanically harvested sugarcane.* [Online] Available from: https://iopscience.iop.org/article/10.1088/1748-9326/8/1/015014 (last accessed 8th July 2020)

7.5.3. Increasing legumes within the grass sward

Relevance: Nitrogen fertiliser can be a significant source of greenhouse gas emissions where applications are not carried out in a timely and properly targeted manner, and it is a costly input. Alternative sources of Nitrogen, such as from within the sward using Nitrogen-fixing legumes, can offer an efficient means of providing the grassland with a steady supply of this important nutrient. This helps to enhance sward productivity whilst reducing the risk of Nitrogen being lost into the atmosphere or washed out of the soil via leaching into nearby watercourses where it can cause environmental issues and damage aquatic ecosystems.

Focusing on supplying Nitrogen from within the sward via organic plant source rather than from synthetic fertiliser also delivers distinct benefits for the local ecosystem and soil life in particular due to the negative impact that synthetic fertiliser can have on soil microbial communities.

Aim: This management option aims to encourage participants to review the current legume content within their improved grasslands, and to take steps to maintain or increase the level of legumes in order to make the most of Nitrogen-fixation taking place within the sward. This will include careful consideration of the type of legume that is best suited to individual production systems and climatic and environmental constraints, and will rely on weed control being carried out in such a way that avoids the use of those herbicides that can severely affect clovers and other legumes. This will help to provide important Nitrogen supplies from within the sward whilst minimising greenhouse gas emissions and environmental concerns associated with nutrient losses via the atmosphere and/or leaching, and help to support an active soil life and microbial community through a reduced need for synthetic Nitrogen applications.

Emissions abatement potential: According to E. S. Jensen et al. (2011)[90], the use of leguminous plants can reduce Nitrous Oxide emissions by approx. 60% compared to cultivation of using crops that rely on added Nitrogen fertiliser. Although the inclusion of legumes within a grass sward is unlikely to achieve the above greenhouse gas reductions, it will nonetheless help to significantly reduce total emissions associated with the sward.

Assessment option: Participating businesses should assess the current legume content within their grass swards on an annual basis, and take steps to increase the level of legumes found on their grasslands where possible.

Applicability: This management option is applicable to suckler herds and finishing units.

[90] **JENSEN E. S., PEOPLES M. B., BODDEY R., GRESSHOFF P., HAUGGAARD-NIELSEN, ALVES, MORRISON M.** (2012). *Legumes for mitigation of climate change and the provision of feedstock for biofuels and biorefineries. A review.* [Online] Available from: https://www.researchgate.net/publication/257805335_Legumes_for_mitigation_of_climate_change_and_the_provision_of_feedstock_for_biofuels_and_biorefineries_A_review (last accessed 11th October 2020)

7.5.4. Sward diversity

Relevance: Grasslands are an ecosystem relying on intricate processes taking place between plants. Left to nature, they typically develop a diverse composition and include a wide range of plants, each with its own characteristics and ability to thrive in a certain environment and cope with specific climatic challenges. The more diverse a sward is, the more resilient it therefore becomes. Thanks to what would typically be a combination of different plants thriving in warmer and colder weather, such swards can also show prolonged growth thanks to an extended growing season.

Sward diversity contributes important benefits for the plants contained within. Different plants can capture and release various specific minerals and trace elements which may be traded within the sward using soil microbial communities. This can boost the overall health and productivity of the sward and with it enhance cattle performance through better grass growth and a greater supply of important nutritional elements along with potential health properties, e.g. via inclusion of herbaceous plants with anthelmintic properties.

A diverse sward can result in a diverse and complex root system with some shallower but wider growing roots, and other deeper tap roots reaching far into the ground. Such a better developed root system benefits soil health, provides increased access to nutrients, minerals and water, and supports important soil communities which rely on a living and diverse root system. A diverse sward not only supports a wide range of plants but with it attracts a multitude of animals all requiring their own specific habitat and different food sources, therefore greatly enhancing the local biodiversity both above and below ground.

Aim: This management option aims to encourage participants to review and identify the various plants currently grown within their improved grassland swards, and to take steps to maintain or increase sward diversity. This not only includes different grasses but also legumes and herbs, although further plant types such as brassicas may be deemed beneficial for inclusion as well.

Emissions abatement potential: Assessing the exact potential for grass sward diversity to reduce greenhouse gas emissions is extremely difficult, as the emissions abatement potential ultimately depends on a wide range of factors and the actual benefits arising from increasing sward diversity. Where a diverse sward contributes towards the overall quality and productivity of the grass and thereby enables improved grassland management through a combination of introducing rotational grazing management in conjunction with better forage quality and a reseeding policy, emissions abatement modelling conducted by J. Bell et al. (2020)[91] and using a rearer finisher scenario shows that this could reduce the emissions intensity of the production system by 6.3%.

Assessment option: Participating businesses should identify the sward diversity on their improved grasslands on an annual basis, and take steps to try and enhance the sward diversity where needed. For obvious reasons, weeds such as thistles, docks, rushes, buttercup and other plants deemed to be undesirable do not count towards sward diversity.

Applicability: This management option is applicable to suckler herds and finishing units.

[91] **BELL J., BEATON C., YOUNG M., HILL G., STOUT D., SELLARS A., THOMSON S., SPENCER M., MOXEY A.** (2020). *Suckler Beef Climate Change Group – Farm Carbon Case Studies*. Edinburgh: SRUC

7.5.5. Improved in-bye grazing management

Relevance: The way in which grasslands are utilised and grazed can greatly impact on their potential productivity and ability to recover, and the extent to which they can capture carbon. Grasslands that are grazed as part of a rotational or paddock system whereby stock is moved around fields to provide important grazing breaks can result in a greater level of carbon sequestration taking place than is the case with continuous grazing systems or grazing and cutting systems. It leads to a more efficient grass utilisation, less wastage, and increases the quality and yields of the grassland. Applying an effective rotational strategy can therefore help to not only boost grassland productivity for improved cattle performance, but can also increase soil carbon sequestration.

Aim: This management option aims to encourage participants to review the current grazing system applied on their improved grassland swards, and to take steps to rotate stock around fields to provide important grazing breaks for sward recovery.

This will help to increase sward productivity along with the quality of the grazing, thereby reducing the emissions intensity from the cattle diet as a result of a lesser reliance on supplementary feed, and can help to maximise soil carbon sequestration.

Emissions abatement potential: Emissions abatement modelling conducted by J. Bell et al. (2020)[92] and using a rearer finisher scenario has found that improved grassland management through a combination of introducing rotational grazing management in conjunction with better forage quality and a reseeding policy can reduce the emissions intensity of the production system by 6.3%.

Assessment option: Participating businesses should identify the grazing system applied on their improved farmland on an annual basis. A grazing diary will need to be kept where semi-rotational or rotational/paddock grazing is taking place to include dates of stock being moved out of or into a field, the total area of that field, and the stocking density per hectare.

Applicability: This management option is applicable to suckler herds and finishing units.

[92] **BELL J., BEATON C., YOUNG M., HILL G., STOUT D., SELLARS A., THOMSON S., SPENCER M., MOXEY A.** (2020). *Suckler Beef Climate Change Group – Farm Carbon Case Studies*. Edinburgh: SRUC

7.5.6. Improved upland and hill grazing management

Relevance: The way in which upland grasslands are utilised and grazed can greatly impact on their potential productivity and ability to recover, and the extent to which they can capture carbon. Many upland and hill areas store vast quantities of carbon, and inappropriate grazing systems can jeopardise the ability of those soils to not only retain current carbon stocks but also to capture further carbon. This is a particular issue where moorlands and peatlands are over-grazed and potentially also subjected to poaching damage due to inappropriate stocking levels being applied within the context of environmental and climatic constraints, the grazing value of the upland and hill vegetation, and additional grazing pressures from other livestock and wild herbivores including deer. In order to ensure that rough grazing areas can continue to safely act as vast carbon sinks, it is therefore imperative that the upland and hill vegetation and with it the soils are not damaged by over-grazing but instead maintained in suitable condition which requires targeted grazing and animal activity rather than a stock exclusion. This will maintain the upland vegetation in actively growing condition to capture additional carbon and provide a wide range of different habitats and food sources for the local upland biodiversity.

Aim: This management option aims to encourage participants to review the current grazing system applied on their rough grazing areas (i.e. hill and upland ground) with help of a herbivore impact assessment in order to establish whether current stocking densities are appropriate and sustainable to preserve upland and hill grazing areas in a good condition for carbon sequestration. The outcome from the herbivore impact assessment will then be used to allow participating businesses to apply targeted changes to their current upland grazing system where necessary.

Emissions abatement potential: Clear data on the potential to reduce emissions through better upland and hill grazing management is not yet available at this stage. However, peatlands are widely recognised as one of the most important carbon sinks in the world, and minimising any damage cause by inappropriate herbivore activity can therefore logically be assumed to be of significant importance in maintaining peatlands in a suitable condition as carbon sinks rather than a carbon source.

Further research is therefore needed to quantify the emissions abatement potential of maintaining peatlands in a suitable condition with the help of appropriate cattle/herbivore grazing.

Assessment option: Participating businesses should carry out an annual herbivore impact assessment in late winter to identify if the current grazing system applied on their rough grazing has caused over-grazing issues over the past 12 months. A grazing diary will need to be kept to reflect adjustments made on the basis of the outcome from the herbivore impact assessment.

The assessment will generate a result showing no, low, medium, high or very high impact. High and very high impact is undesirable as it suggests that damaging over-grazing is occurring along with potential site-specific poaching issues. No impact is equally undesirable as these upland and hill habitats require some grazing activity to maintain the vegetation in good condition and actively growing, which in turn enables carbon sequestration along with supporting biodiversity.

Applicability: This management option is applicable to suckler herds and finishing units but will be more relevant to suckler systems as these would typically be found on extensive upland units.

7.5.7. Outwintering systems

Relevance: Outwintering cattle is not suitable and possible for every system but can offer distinct advantages over housed systems by simplifying operations and relying on less infrastructure, machinery and equipment. It follows the concept of 'taking the cow to the feed', i.e. taking advantage of a natural system which involves as little inputs and resources as possible. Providing a standing crop for cattle grazing during the winter requires less machinery and fuel for harvest, transportation and feeding, needs no bedding, and does not rely on infrastructure which comes with associated emissions, particularly from cement manufacturing for concrete, and significant costs. Manure is deposited in situ, thereby avoiding the need for organic manure storage, handling and applications.

Overall, outwintering systems can therefore result in significant greenhouse gas emissions savings.

Aim: This management option aims to encourage participants to review the current wintering system for their cattle, and, where applicable, take steps to rely as much as possible on outwintering their herd. This can be achieved either by applying a deferred grazing system, or by growing alternative crops such as winter forage or fodder crops.

Emissions abatement potential: Due to the varied nature of different options available for outwintering cattle, it is difficult to establish an exact level of greenhouse gas emissions reductions. This relies on a multitude of factors including its benefit in reducing the need for inputs which would otherwise be needed, and these are closely related to specific systems. However, emissions abatement modelling conducted by J. Bell et al. (2020)[93] and using a rearer finisher scenario has found that improved grassland management, which could ultimately support outwintering systems on improved farmland ground through a greater availability and quality of grazing, could reduce the emissions intensity of the production system by 6.3%.

Assessment option: Participating businesses should identify their wintering system including herd time spent outdoors, and the level of supplementary feed being provided, on an annual basis.

7.6. Improving nutrient management (Category 6)

Aims of category:

This category aims to encourage participating businesses to take steps to reduce greenhouse gas emissions as a result of nutrient losses on their farmland, and reduce the emissions intensity from their cattle production system(s) by

- improving on-farm nutrient utilisation by better targeting nutrient inputs for an optimum crop response;

[93] **BELL J., BEATON C., YOUNG M., HILL G., STOUT D., SELLARS A., THOMSON S., SPENCER M., MOXEY A.** (2020). *Suckler Beef Climate Change Group – Farm Carbon Case Studies*. Edinburgh: SRUC

- reducing synthetic fertiliser inputs by maximising the use of slurry and farmyard manure along with alternative sources of Nitrogen.

The management options being proposed as part of this category will also deliver environmental benefits and help to protect the local biodiversity and soil life by reducing the risk of nutrient run-off or leaching into the surrounding ecosystem and watercourses, or adverse reactions within the target areas as a result of inappropriate nutrient management and untimely or poorly targeted applications. An increased focus on organic and within-sward sources of Nitrogen will deliver further benefits for soil microbial life as a result of a lesser reliance on synthetic fertilisers.

Relevance: Meeting nutrient demands of a grassland sward or crop is crucial to ensure optimum plant performance which in turn helps to support good cattle productivity. The main focus of any nutrient management plan typically lies with the major nutrients Nitrogen (N), Phosphorus (P), and Potassium (K), of which the plant requires higher amounts compared to other nutrients. Nutrients are expensive to purchase and, if left unused by the plant, can lead to environmental issues as a result of nutrient leaching and run-off into nearby watercourses or sensitive habitats where they can negatively impact the local biodiversity and damage ecosystems.

Further pressures on the environment are caused by greenhouse gas emissions caused by nutrient losses into the atmosphere through volatilisation, as well as the manufacturing and transportation of synthetic fertilisers, the storage and handling of organic manures, and the general application of organic or inorganic fertilisers. A report by N. Lampkin et al. (2019)[94] states that almost 50% of Scottish Nitrogen applications taking place during 2017, the equivalent to an average of 92kg of Nitrogen per hectare, were not taken up by the target crop and as a result were lost to the environment.

In order to support optimum sward or crop production for improved livestock performance whilst minimising the risk of negatively affecting the climate or environment, it is therefore crucial to better target nutrient inputs, reduce nutrient wastage, and take steps to avoid nutrient losses via greenhouse gas emissions where possible.

[94] **LAMPKIN N., SMITH L., PADEL K.** (2019). *Delivering on Net Zero: Scottish Agriculture.* [Online] Available from: https://www.wwf.org.uk/sites/default/files/2019-12/WWF%20Net%20Zero%20and%20Farming.pdf (last accessed 13th July 2020)

7.6.1. Covering slurry stores

Relevance: The way in which slurry is collected, handled, stored and applied can greatly influence the extent to which any nutrient losses via methane, ammonia and/or nitrous oxide emissions occur. A large proportion of slurry associated methane and nitrous oxide emissions occur during storage, and open slurry stores where the slurry has not formed a natural crust can significantly enhance the potential for greenhouse gas emissions.

According to a recent feasibility study, greenhouse gas emissions associated with slurry management contribute 7% towards total emissions from Scottish agriculture and 1.3% towards total Scottish emissions (J. Wiltshire, 2018[95]). The same study estimates that there is a potential to reduce agricultural greenhouse gas emissions by 180 kt CO_{2e} per annum if slurry stores were covered in order to prevent losses of ammonia into the atmosphere, which would equate to a reduction in total emissions from Scottish agriculture by 2%. With approx. 40% of this slurry, or 2.57 Mt, being produced by beef cattle, there is an opportunity for suckler beef producers across Scotland to cumulatively reduce annual emissions from slurry storage by 72 kt CO_{2e}. For every 100kg of slurry produced, this could potentially reduce emissions by 2.8kg and could lead to a reduction in total emissions from Scottish agriculture by 0.8%, therefore making the covering of slurry stores a major opportunity to deliver quick and significant results.

In addition to the obvious benefits of covering slurry stores for the climate, preventing entry of rainwater into the slurry store can, depending on local precipitation, significantly increase the storage capacity of slurry stores, thereby enabling the business to better target slurry applications as nutrient inputs rather than for simple waste management purposes. This not only makes better use of nutrients and minimises issues associated with limited slurry store capacity, but undiluted slurry results in a lesser requirement to having to handle large quantities, therefore reducing total application rates and numbers of applications to the fields which in turn reduces fuel use and associated expenses to the business.

A case study conducted by Defra, Natural England and the Environment Agency[96] found that covering the slurry store increased the farm's storage capacity by 25% which led to savings of more than £1,600 per annum.

Aim: This management option aims to encourage participants to cover their slurry stores in order to minimise any losses of valuable nutrients in the form of greenhouse gas emissions during storage of the slurry, and avoid slurry dilution with rainwater.

The latter will help increase the slurry storage capacity and enable more targeted slurry applications when plants are actively growing, rather than having to spread slurry for mere waste and storage management purposes. This will improve nutrient management efficiencies by supplying plants with nutrients when these are needed. Covering slurry stores will ultimately reduce greenhouse gas emissions occurring during storage, as well as during and after slurry applications. Further benefits for the business include a greater availability of nutrients on-farm and lower expenses associated with slurry handling and applications.

[95] **WILTSHIRE J.** (2018). *Slurry storage on Scottish farms – a feasibility study.* [Online] Available from: https://www.climatexchange.org.uk/media/2971/slurry-storage-on-scottish-farms.pdf (last accessed 11th July 2020)
[96] **CATCHMENT SENSITIVE FARMING** (n.d.). *Reducing Ammonia Emissions from Slurry Storage on Dairy Farms*. London: Defra.

Emissions abatement potential: A study by the Silsoe Research Institute (2000)[97] has found that covering a slurry store can reduce ammonia emissions from cattle slurry by 78%. This ties in closely with the aforementioned case study conducted by Defra, Natural England and the Environment Agency which noted similar emissions reductions of 80% and an additional Nitrogen availability of 360kg.

Assessment option: Participating businesses should cover any currently open slurry stores and assess the effectiveness of any existing slurry store covers in terms of minimising any potential greenhouse gas emissions or rainwater entry to ensure that the covers are functioning properly.

Applicability: This management option is applicable to any suckler herds and finishing units operating a slurry system.

7.6.2. Improving organic Nitrogen use efficiency

Relevance: Organic manures are a valuable source of on-farm nutrients and can provide a cost-effective alternative to purchased fertiliser to help boost plant growth and productivity. Making best use of this organic fertiliser does however depend on accurate and regularly updated nutrient planning, timely application(s) and efficient application methods. If Nitrogen inputs are not properly targeted, significant nutrient losses may occur into the atmosphere or into the nearby soil and water environment via volatilisation and/or leaching. This not only results in higher greenhouse gas emissions but can lead to environmental pollution concerns. Poorly targeted nutrient inputs also impact on enterprise efficiency and profitability as this can lead to a greater reliance on purchased fertiliser to meet plant nutrient demands.

Aim: This management option aims to encourage participants to better target manure applications in order to improve their organic Nitrogen use efficiency and as a result reduce greenhouse gas emissions and any associated nutrient losses during or after application.

Ensuring that organic Nitrogen is used efficiently relies on effective nutrient planning which considers the Nitrogen content of the manure, ideally using recent analysis, as well as the type of crop that is growing and its specific nutritional demands at different key stages of production as well as throughout the growing season. This information should then be used to calculate appropriate manure application rates. Manure should be applied in suitable weather conditions and when the crop is actively growing in order to ensure that the plants are able to properly utilise nutrient inputs at the time of application. Better utilisation of organic Nitrogen can be further enhanced by replacing less accurate application equipment such as broadcast slurry spreaders with precision application equipment for improved targeting of organic nutrients, e.g. through band-spreading, trailing shoe application or shallow injection.

This leads to improved nutrient use efficiencies, lower greenhouse gas emissions and a better enterprise performance.

[97] **SILSOE RESEARCH INSTITUTE** (2000). *The effects of covering slurry stores on emissions of ammonia, methane and nitrous oxide.* London: Ministry of Agriculture, Fisheries and Food.

Further benefits obtained from an improved utilisation of organic nutrients include improved profitability and additional greenhouse gas emissions savings as a result of a lesser reliance on manufactured synthetic fertilisers delivered to the farm from further afield. A greater focus on utilising organic manure as a source of Nitrogen can also enhance soil health by introducing additional organic matter onto fields, and can support vulnerable soil microbial communities by minimising their exposure to synthetic inputs that can adversely affect soil life. Soil animal and microbial communities including the extremely valuable and often underappreciated earthworm will also benefit from and be safe-guarded by better targeting of manures and a greater organic Nitrogen use efficiency due to a reduced risk of over-applications leading to environmental pollution issues and the killing of soil life.

Emissions abatement potential: A study conducted by J. M. Moorby et al. (2007)[98] found that maximising the utilisation of Nitrogen within manures, for instance by using a recognised fertiliser planning tool in conjunction with regular manure analysis, can reduce direct Nitrous Oxide emissions by up to 5%. According to the same study, further emissions reductions can be obtained by better timing manure applications during the growing season in line with conditions and plants actively needing nutrients, in which case Nitrous Oxide emissions can be reduced by an additional 2% to 10%.

Data provided within a case study conducted by Defra, Natural England and the Environment Agency[99] shows that the use of low emission precision spreading equipment can furthermore reduce ammonia losses by approx. 60% when compared to a splash plate spreader.

Data presented by J. Bell et al. (2020)[100] states that synthetic Nitrogen savings of 10kg per hectare can be made through improved planning of organic Nitrogen use, and again by switching to a low emission spreading system. Further reductions can be gained from the use of nitrification inhibitors by lowering Nitrous Oxide emissions by up to 50%.

When applying that research to a model farm scenario, emissions abatement modelling conducted by J. Bell et al. (2020) and using a rearer finisher scenario has found that improved manure and nutrient management together with the use of nitrification inhibitors can reduce the emissions intensity of the production system by 6.9%.

Assessment option: This management option ties in with the scheme requirement to carry out regular slurry analysis and to outline a nutrient and waste management plan. Participating businesses will be required to calculate their organic Nitrogen use efficiency on an annual basis, and aim to increase this efficiency where possible by taking appropriate steps such as the adoption of low emissions and precision spreading equipment, or by better timing and planning organic manure applications.

Applicability: This management option is applicable to any suckler herds and finishing units where slurry or farmyard manure is handled and applied to grasslands and/or crops.

[98] **MOORBY J. M., CHADWICK D. R., SHOLEFIELD D., CHAMBERS B. J., WILLIAMS J. R.** (2007). *A review of research to identify best practice for reducing greenhouse gases from agriculture and land management.* London: Defra.
[99] **CATCHMENT SENSITIVE FARMING** (n.d.). *Reducing Ammonia Emissions from Slurry Storage on Dairy Farms*. London: Defra.
[100] **BELL J., BEATON C., YOUNG M., HILL G., STOUT D., SELLARS A., THOMSON S., SPENCER M., MOXEY A.** (2020). *Suckler Beef Climate Change Group – Farm Carbon Case Studies*. Edinburgh: SRUC

7.6.3. Improving synthetic Nitrogen use efficiency

Relevance: Nitrogen is an important nutrient for healthy and productive plant growth and development. Where the Nitrogen supply from within the sward and soil or from organic manure sources falls short of the requirements of a specific crop, the application of purchased synthetic Nitrogen fertiliser can help to make up the shortfall in order to boost plant productivity and performance. Ensuring that Nitrogen is properly utilised by the plan does however depend on accurate and regularly updated nutrient planning, timely application and efficient application methods. If Nitrogen inputs are not properly targeted, significant nutrient losses into the atmosphere or the nearby soil and water environment via leaching may occur which not only results in higher greenhouse gas emissions but can lead to environmental pollution concerns and impact on enterprise efficiency and profitability.

Ensuring that Nitrogen is used efficiently relies on effective nutrient planning which takes into account the type of crop that is growing and its specific nutritional demands at different key stages of production and throughout the growing season. This information is then used to calculate adequate fertiliser application rates which should be carried out when the crop is actively growing and in suitable weather conditions to ensure that the plants are able to properly utilise nutrient inputs at the time of application. Better utilisation of Nitrogen fertiliser can be further enhanced by upgrading or replacing fertiliser application equipment with precision technology.

This can for instance enable businesses to carry out GPS mapping to plot areas within a field with differing Nitrogen fertiliser requirements using previous yield records or leaf cover, and utilise variable rate application equipment to target Nitrogen fertiliser levels accordingly between different regions within the field. This leads to improved nutrient use efficiencies and can significantly reduce the total quantity of fertiliser required, thereby lowering greenhouse gas emissions and improving enterprise performance and profitability.

Aim: This management option aims to encourage participants to better target purchased Nitrogen fertiliser in order to improve their synthetic Nitrogen use efficiency and as a result reduce greenhouse gas emissions and any associated nutrient losses during or after application. Boosting the efficiency of Nitrogen use leads to financial savings and additional emissions savings by reducing the reliance on manufactured synthetic fertilisers delivered to the farm from further afield.

Emissions abatement potential: A study conducted by J. M. Moorby et al. (2007)[101] found that well targeted Nitrogen applications can reduce direct Nitrous Oxide emissions by 5% by ensuring that plant Nitrogen requirements are not exceeded during application. This may be achieved by using a recognised fertiliser planning tool in conjunction with best practice recommendations and well-timed applications.

Emissions abatement modelling conducted by J. Bell et al. (2020) and using a rearer finisher scenario has found that improved manure and nutrient management together with the use of nitrification inhibitors can reduce the emissions intensity of the production system by 6.9%.

[101] **MOORBY J. M., CHADWICK D. R., SHOLEFIELD D., CHAMBERS B. J., WILLIAMS J. R.** (2007). *A review of research to identify best practice for reducing greenhouse gases from agriculture and land management.* London: Defra.

Assessment option: This management option ties in with the scheme requirement to complete a nutrient management plan as part of the requirement to carry out soil analysis. Participating businesses will be required to calculate their Nitrogen use efficiency from synthetic Nitrogen fertiliser on an annual basis, and aim to increase this efficiency where possible by taking appropriate steps such as the adoption of precision (variable rate application) equipment and by better timing and planning fertiliser applications.

Applicability: This management option is applicable to any suckler herds and finishing units that use synthetic Nitrogen fertiliser.

7.6.4. Reducing synthetic Nitrogen fertiliser use

Relevance: Nitrogen is an important nutrient for healthy and productive plant growth and development. Where the Nitrogen supply from within the sward and soil, or from organic manure sources falls short of the requirements of a specific crop, the application of purchased synthetic Nitrogen fertiliser can help to make up the shortfall in order to boost plant productivity and performance. However, synthetic Nitrogen fertilisers incur significant emissions long before they are being applied to a field, including from the manufacturing process and transportation to the farm. Their use can accelerate soil acidification which leads to a greater need for lime applications to avoid poorer plant performance as a result of a lesser ability to utilise nutrients where the pH is lowered. Synthetic Nitrogen fertiliser can also negatively impact on soil life communities which rely on symbiotic relationships with actively growing plants to exchange and trade nutrients from the soil and organic matter in return for carbon containing sugars that are released into the soil by the plants. If the plant Nitrogen requirement is mostly or fully met by synthetic Nitrogen fertilisers, there is no need for the plant to make sugars available to soil microbes, and this in turn leads to a decline in soil microbial activity and with it the deterioration of soil health as a whole. From an economic point of view, synthetic Nitrogen fertilisers are also expensive and can therefore significantly impact on enterprise profitability.

It is therefore in the environment's and farm's best interest to minimise reliance on synthetic Nitrogen fertilisers as much as possible by focusing on alternative sources of Nitrogen such as organic manures and Nitrogen-fixing legumes.

Aim: This management option aims to encourage participants to reduce their use of synthetic Nitrogen fertiliser through a combination of maximising the utilisation of organic manures and establishing (more) Nitrogen-fixing legumes within the sward. This requires a sound understanding of the total annual Nitrogen requirement of different crops in order to establish what proportion of that demand is currently being met by synthetic Nitrogen fertiliser, and where there are opportunities to reduce this. Reducing business reliance on synthetic fertiliser use whilst increasing utilisation of alternative sources of Nitrogen so as not to compromise grass/crop performance will lead to reduced greenhouse gas emissions, benefit soil health and soil life, and reduce costs associated with nutrient management.

This management option closely ties in with and complements other management options focusing on improving organic Nitrogen use efficiency and increasing the use of Nitrogen-fixing legumes within the sward.

Emissions abatement potential: Synthetic Nitrogen fertiliser use can be reduced by making better use of organic manures available to the farm. A study conducted by J. M. Moorby et al. (2007)[102] found that maximising the utilisation of Nitrogen within manures, for instance by using a recognised fertiliser planning tool in conjunction with regular manure analysis, can reduce direct Nitrous Oxide emissions by up to 5%. According to the same study, further emissions reductions can be obtained by better timing manure applications during the growing season in line with conditions and plants actively needing nutrients, in which case Nitrous Oxide emissions can be reduced by an additional 2% to 10%.

Synthetic Nitrogen use can be further reduced as stated by data presented by J. Bell et al. (2020)[103] which noted that savings of 10kg per hectare can be made through improved planning of organic Nitrogen use, and again by switching to a low emission spreading system.

Using emissions abatement modelling within a rearer finisher scenario, J. Bell et al. (2020) found that improved manure and nutrient management can reduce the overall emissions intensity of the production system by 2.8%.

Assessment option: Participating businesses should identify the annual Nitrogen requirements of their different swards/crops and assess what proportion of the annual Nitrogen requirement is being met by organic manures, Nitrogen-fixing legumes, and synthetic Nitrogen fertiliser.

Applicability: This management option is applicable to suckler herds and finishing units.

[102] **MOORBY J. M., CHADWICK D. R., SHOLEFIELD D., CHAMBERS B. J., WILLIAMS J. R.** (2007). *A review of research to identify best practice for reducing greenhouse gases from agriculture and land management.* London: Defra.
[103] **BELL J., BEATON C., YOUNG M., HILL G., STOUT D., SELLARS A., THOMSON S., SPENCER M., MOXEY A.** (2020). *Suckler Beef Climate Change Group – Farm Carbon Case Studies*. Edinburgh: SRUC

8. Capital items, collaboration and access to training

The group recognises that the uptake of best practice for the benefit of the climate and environment may often be prohibited by the initial capital cost required to invest in new infrastructure and equipment or upgrades to existing ones. It is therefore proposed that the scheme should make part-funding towards the acquisition of a list of pre-defined capital items available, but only where these tie in with the measures of the various management options. This means that participating businesses must commit to the relevant management option(s) before they can access a specific capital item. It is important to ensure that businesses can only access such grant-funding for items that provide actual value for money in order to prevent the scheme from supporting investments where these cannot be justified in terms of emissions reductions and/or efficiency purposes. Such grant-funding should therefore be subject to the participating businesses submitting a cost-benefit analysis where a case can be made by the applicants that the proposed investment serves the purpose of helping the cattle enterprise achieve the outcomes of the relevant management option(s).

The group strongly recommends that access to capital grant-funding should not be restricted to individual participating businesses. Instead, collaborative projects and producer groups should also be able to access funding through this scheme. This would open up access to innovative technology to a much wider range of businesses, and in particular support smaller producers by allowing farmers to join forces in order to be able to justify certain capital investments. Past government schemes have allowed for three or more businesses to jointly invest in capital equipment and receive financial support as part of such schemes. This should be encouraged and supported within this scheme to reduce barriers to access for capital grant-funding and maximise the adoption and utilisation of such items.

The group furthermore recommends that grant-funding towards capital items should be limited to a proportion of the actual cost of investment, and be capped at a pre-defined limit per business (per annum). Consideration should be given to the proportionate contribution being higher for collaborative applications, and for participants that are located in more disadvantaged areas of Scotland, much in line with other schemes.

The group also strongly recommends that access to capital items should trigger access to relevant training in order to ensure that businesses can make best use of newly acquired technology to fully utilise its potential for the benefit of the climate and environment, and to enhance on-farm efficiencies. This includes the provision of appropriate training to existing business employees but should also make training, possibly including apprenticeship programmes, available to enable businesses to take on apprentices, trainees and new employees. People are a hugely important part of the agricultural industry and despite significant technological advances, digitalisation and automation, always will be.

Consideration should be given to making such training count towards the CPD minimum requirement forming part of this scheme.

The following sections outline proposed capital items for which the group believes financial support should be made available through this scheme due to their distinct benefits for the climate and environment.

8.1. Lime

Capital option: For applicants to receive financial assistance towards the purchasing of lime as an environmental management tool part of the SBCS.

Relevance: The pH of soil greatly influences plant growth and performance by determining the availability and uptake of nutrients by the sward/crop from within the soil. If soil is too acidic, any nutrient inputs may not be sufficiently utilised by the plants. This can lead to poor input utilisation, limited crop response, nutrient wastage, and resulting environmental concerns due to a higher risk of nutrient leaching and increased greenhouse gas emissions, and reduced farm profitability through an inefficient nutrient management system.

Aim: The application of lime on the basis of up-to-date soil analysis helps to reduce soil acidity, thereby making nutrients more readily available to the plants while at the same time supporting and enhancing soil microbial activity which relies on a certain minimum pH. This ensures that any nutrients present in the soil or applied via organic or synthetic fertiliser can be utilised more efficiently to boost crop performance and reduce wastage. This helps to increase the availability of high quality home-grown livestock feed and reduces nutrient losses along with the resulting greenhouse gas emissions while delivering distinct benefits for the soil health.

8.2. Grass seed

Capital option: For applicants to receive financial assistance towards the purchasing of certain seed mixtures containing Nitrogen fixing legumes, suitable herbs and other plants for sward and animal health purposes, and/or a high diversity of different beneficial plant species.

Relevance: The composition of a grassland sward can significantly influence livestock performance and it is therefore important that the suitable plant types and varieties are chosen when carrying out full reseeding or surface-seeding across an existing sward. The chosen seed mixture and its specific requirements will also determine the level of field management and nutrient inputs that are needed in order to generate a suitable crop and animal response. A sward that contains a limited proportion of Nitrogen-fixing plants potentially requires high levels of Nitrogen fertiliser to meet plant nutrient demands. A lack of plant diversity can reduce sward resilience by making grasslands more vulnerable to adverse conditions such as drought or wet spells as a result of a lesser variety of different plants with individual characteristics and abilities to cope with differing environmental factors, and a limited diversity can shorten the growing season. This can lead to a higher requirement for crop inputs and a lower crop performance, thereby causing greenhouse gas and livestock performance inefficiencies.

Aim: Choosing a seed mixture that contains sufficient levels of Nitrogen-fixing legumes can help to reduce the overall reliance of the sward on Nitrogen fertiliser, thereby lowering fertiliser use and any associated greenhouse gas emissions. Sowing a diverse mixture which contains a range of different grasses, herbs and legumes in line with local soil, climatic and other environmental factors can build up sward resilience to withstand weather shocks and make the most of the growing season through early growth in the spring and late growth during autumn. Optimising sward production will help to improve livestock performance and a longer grazing season can reduce the need for supplementary feed purchases to address shortfalls in grazing systems. In addition, the inclusion of certain herbs can boost livestock performance through anthelmintic properties that can help to reduce the worm burden in grazed livestock without the need for additional animal health treatments.

These factors can significantly increase overall cattle efficiencies and reduce the emissions intensity from the production system, and a healthy and diverse sward contributes towards a healthy soil.

8.3. Covering slurry stores

Capital option: For applicants to receive financial assistance towards the expenses associated with covering slurry stores.

Relevance: The efficacy of slurry applications to a crop and with it the efficient utilisation of available nutrients to generate a suitable crop response depends on a number of factors including the way slurry is stored. The majority of greenhouse gas emissions associated with slurry management, and with it the atmospheric loss of important nutrients contained within the slurry, occur during storage. Open slurry stores may also have a limited storage capacity due to the addition of rainwater, which is a particular problem in areas where annual precipitation is high. This results in a potentially significant dilution of the collected slurry which not only leads to higher application rates necessary to obtain sufficient nutrient input levels, but requires for applications to take place more frequently due to the store reaching its capacity more quickly. More diluted slurry applications can increase the risk of nutrient leaching, and more regular applications as a means of waste management rather than nutrient management can increase greenhouse gas emissions and nutrient wastage, and use more fuel.

Aim: Covering open slurry stores significantly reduces greenhouse gas emissions associated with slurry storage, and preventing the dilution of slurry with rainwater can increase the storage capacity, thereby allowing for slurry applications to be carried out in a more targeted manner when the plants are actively growing and able to better utilise the nutrients. Lesser quantities of slurry can be applied without losing nutrients which in turn makes the whole process of slurry application more efficient, less time-consuming and cheaper. This leads to further reductions in greenhouse gas emissions associated with slurry handling and application.

8.4. Slurry spreading attachments

Capital option: For applicants to receive financial assistance towards the purchase of new slurry spreading attachments or upgrade of an existing slurry application system.

Relevance: The efficacy of slurry applications to a crop and with it the efficient utilisation of available nutrients for a suitable plant response depends on a number of factors including the way slurry is handled and applied. Poor handling or application practices can lead to the loss of nutrients which may result in significant greenhouse gas emissions and nutrient wastage. This not only results in a limited crop response and the potential need for additional fertiliser applications, but can lead to environmental concerns associated with diffuse pollution risks.

Aim: Ensuring that slurry is handled in such a way that minimises nutrient losses through volatilisation or leaching enables a farming business to obtain a better crop response from slurry applications and improved nutrient utilisation efficiencies. Such improvements can be gained from utilising low emissions slurry spreading equipment that is capable of better targeting slurry applications. This can potentially greatly reduce the need for any additional nutrient purchases and inputs, and reduce any associated greenhouse gas emissions and the risk of diffuse pollution issues occurring.

8.5. Precision livestock farming (PLF) and cattle monitoring technology

Capital option: For applicants to receive financial assistance towards the purchase of precision livestock and cattle monitoring equipment as part of a new setup or to upgrade an existing one.

Relevance: The ability to assess the performance of and monitor cattle groups and/or individual animals at different key stages of production or continuously is crucial to enable a farming business to identify superior bloodlines for breeding, select animals that are fit for sale and forecast when they reach their likely target weight, notice sub-performing animals to enable further investigation into potential underlying health and management issues, and allow for quick intervention where immediate issues such as calving difficulties or acute disease incidents occur. Precision input technology builds on such monitoring equipment and can utilise the collected information to better target any inputs such as feed or health treatments by allocating feed rations or administering products in line with known parameters.

Aim: Putting in place adequate cattle monitoring and performance recording equipment and/or precision input technology, or upgrading existing set-ups including the modification of cattle handling stands to incorporate weighing equipment for instance, enables the farming business to obtain clear data concerning animal productivity, health, genetic potential, and overall well-being. This allows for improved decision-making to take place, intercept early where problems arise, better target herd management and inputs to enhance cattle health, performance and welfare, and increase overall business planning and management. This helps to ultimately boost farm efficiencies and reduce greenhouse gas emissions per unit of output and overall.

8.6. Precision grassland and crop technology

Capital option: For applicants to receive financial assistance towards the purchase of precision grassland and crop monitoring and/or production equipment as part of a new setup or to upgrade an existing one in order to benefit the cattle enterprise.

Relevance: Obtaining optimum grassland and/or crop performance levels depends on a wide range of factors including soil status and nutrient availability, and the ability to translate that information into accurate field management and input levels. Visual assessment and assumptions in line with best practice or research information can provide helpful guidance but is usually insufficient as a means to accurately identify specific performance levels and requirements of different plants at certain stages of production and across various areas within and/or between fields.

Aim: Putting in place adequate grassland and/or crop monitoring equipment to collect in-depth soil, environment and crop data, and feeding the collated information into precision input technology to enable variable rate application for instance can significantly increase input utilisation by better targeting and meeting the needs of the plant, thereby helping to generate a better crop response for improved overall efficiencies and a reduced emissions intensity. Total quantities of greenhouse gas emissions may also be reduced where such technology can be used to reduce input levels as a result of better grassland and/or crop management.

8.7. Novel technologies

Capital option: For applicants to receive financial assistance towards the purchase of novel technological equipment aimed at reducing net greenhouse gas emissions as part of a new setup or to upgrade an existing one. This may include technology to reduce the emissions intensity of the production system, or to lower overall greenhouse gas emissions from the cattle enterprise.

Relevance: Technological advancements and innovation through research and development are constantly being made and include improvements to and upgrades of existing technology, as well as the introduction of new systems and equipment. Accessing grant-funding to support the investment in such technology can be challenging in the early stages when it has not yet been widely adopted and when awareness and the availability of supporting case studies may be limited.

Aim: The Suckler Beef Climate group recognises that novel technologies can play an important part in accelerating efficiency improvements and/or greenhouse gas emissions reductions/capture. The group therefore recommends that grant-funding should be made available for well explained and justifiable projects that can clearly demonstrate the benefits of such investment on the basis of robust scientific and technical data. Such technology may take the form of home-grown implements and concepts, or be developed by adopting 'best available technology' (BAT) concepts from other parts of the world to adapt to the particular needs of the domestic farming industry, with the relevant equipment being manufactured in Scotland. The Scottish Government has made it clear that investing in new technology, particularly green technology, will form a key part of its post-Covid economic recovery plan, and this strategy ties in closely with the core aims of the Agricultural Transformation Programme.

9. Emissions abatement modelling

The scheme will need to be able to capture the emissions abatement potential of different management options and specific on-farm activities and management changes. This relies on robust and reliable data that is relevant to suckler beef production within a Scottish setting. To this end, the scheme will be drawing on emissions and emissions abatement modelling conducted by J. Bell et al. (2020)[104] specifically for the SBCS. The modelling uses real data drawn from the Cattle Tracing System (CTS) to establish a profile of typical average herd data and performance, with due consideration also being given to the range of such performance as this can provide an important indication of the extent to which Scottish suckler beef producers can realistically be expected to improve their herd performances.

The study is an ongoing project and has so far produced an extremely comprehensive and detailed model aimed at capturing current greenhouse gas emissions data on an average rearer finisher unit.

Where possible, the modelling data has been used as reference point within this report to indicate potential emissions savings that can be gained within different management options. If the scenarios are stacked to assess the cumulative benefits of the modelled changes, the study shows that there may be a potential to reduce emissions per unit of output by almost 40% on baseline emissions for a typical average rearer finisher herd. Although not all measures may be applicable to every rearer finisher system in Scotland or to the same extent, they provide an extremely important starting point and quite clearly highlight the potential within Scottish suckler beef enterprises to curb emissions.

The next steps within this emissions modelling study include the development of similar models for other types of suckler beef systems that can typically be found across Scotland, including store producers and finisher units. Although their levels of emissions will vary from a rearer finisher unit, as will the availability of measures to achieve significant efficiency gains and emissions reductions, this initial model captures the whole primary production process from birth to slaughter, and hence includes a large dataset of useful information that is applicable to both breeding herds and forward store/finishing units.

[104] **BELL J., BEATON C., YOUNG M., HILL G., STOUT D., SELLARS A., THOMSON S., SPENCER M., MOXEY A.** (2020). *Suckler Beef Climate Change Group – Farm Carbon Case Studies*. Edinburgh: SRUC

10. Quality standard trademark

The standards of production to which participants will have to adhere as part of the minimum scheme requirements and through the various management options are deliberately stringent in order to encourage Scottish suckler beef farmers to take every step possible to achieve an optimum balance between environmental and economic sustainability whilst working towards the common net zero emissions target.

In order to recognise the efforts and achievements made by participating businesses, and to offer them a means of promoting their produce to the end consumer as climate-friendly food produced within an environmentally sustainable farming system, work is ongoing to register trademarks and certification marks to deliver this quality standard in collaboration with Quality Meat Scotland (QMS). Consumers will have reassurance that the product label represents sustainable beef production, and the SBCS can therefore act as an accreditation on top of the already widely recognised and important Scotch PGI brand. This will ensure that the industry responds to consumer concerns and trends through the provision of properly labelled, climate and environmentally friendly Scottish produce, and may help to generate a premium price for a premium product.

Potential for this will be explained more fully once the registration process has been completed over the next few weeks.

11. Additional scheme proposals

The recommendations put forward by the Suckler Beef Climate Group have been compiled, reviewed and presented on the basis of robust current knowledge and research, as well as the practical on-farm applicability of such findings and developments. The group does recognise that further advances are constantly being made within scientific studies and industry research, and recommends that these should be followed closely for potential future incorporation into the SBCS or other sector-related support mechanisms. The proposed mid-term scheme review will offer an opportunity during the initial pilot scheme to adjust and expand management options in line with new research findings emerging and industry management tools being developed. This approach to updating an agricultural support scheme on a regular basis is strongly recommended by the group and will enable the Scottish farming industry as a whole to progress and lead on crucial issues such as climate change.

The following comments highlight just a few of the many ongoing projects and debates that the group feels are worth noting and incorporating into the scheme once further research has been conducted, and/or the necessary tools been developed for practical on-farm application. The group has attempted to familiarise itself with as many relevant and ongoing scientific and industry-led projects as possible, but welcomes and encourages any proposals to explore additional studies and innovative ideas not mentioned within this report in order to review their potential for integration into the scheme.

Targeted selective treatment (TST)

TST refers to a concept whereby treatments are not administered routinely or to a whole group of animals but instead to individuals within regularly weighed management groups on the basis of specified indicators such as daily liveweight gains in an attempt to better manage and maintain animal health and to minimise the risk of anthelmintic resistance building up in parasites. The Moredun Research Institute has carried out promising trials within sheep flocks using nutritional data to predict the expected daily liveweight gains that lambs should reach, and treating those failing to reach those targets. Results have shown a potential to significantly reduce on-farm usage of wormers whilst enhancing animal performance. Additional trial work on cattle and the development of a commercially available tool to convert nutritional information into predicted daily liveweight gain targets would be extremely useful and should be considered for inclusion within the SBCS and/or other sector specific future agricultural support schemes once available.

Soil carbon database

The scheme includes a proposed minimum requirement for participating farmers to carry out regular soil analysis including measuring soil carbon stores on any farmland that receives inputs. This is intended to provide a starting point to help move towards a clearer understanding of the exact soil carbon levels that can be found across different types of agricultural land that is subjected to differing soil management, and ties in with recommendations put forward by the **Farming for 1.5°C** group in their *"Evidence submission on the Agriculture (Retained EU Law and Data) (Scotland) Bill to the Rural Economy and Connectivity Committee of the Scottish Parliament"* [105]. The data collated as part of the SBCS should be used as starting point to establish a Scotland-wide database, and compulsory soil carbon analysis should be rolled out across all farming sectors as recommended within the aforementioned report. Whilst the report proposes for such soil analysis to be carried out on enclosed farmland, consideration should also be given to carrying out some degree of upland soil analysis so as to establish a clearer picture of the likely carbon stores that are currently present across the actively farmed hills and uplands of Scotland. Such a nationwide real-life dataset will provide a valuable inventory for more accurate soil carbon accounting on the basis of farmland type and management going forward.

Antibiotic database

The scheme includes a proposed management option aimed at encouraging better use of antibiotics. In order to maximise the effectiveness of this option and enable better monitoring of actual antibiotic use, the setting up of a central database to track purchases and usage levels of antibiotics should be considered as part of this management option. This is suggested as an initial step before eventually rolling out such a database across all Scottish livestock sectors to better monitor and identify hotspots of antibiotic usage, and better target support to help those businesses who rely on higher levels of antibiotic use to address the underlying cause(s) of their heavier reliance and find long-term solutions through practical on-farm management changes.

[105] The full report can be downloaded via following weblink: https://www.farming1point5.org/reports

12. Further considerations and recommendations

The Suckler Beef Climate Group proposes a scheme that is targeted at and directly relevant to Scottish suckler beef production. However, the group recognises that there are a range of ongoing projects, studies and approaches to land management which, although falling out with the remit of the SBCS, are worth noting. The group recommends that where possible and feasible, collaboration should be sought and the multiple interests and benefits of different land management practices and uses integrated with one another.

Outcome-based agri-environment management

The group notes the recent news release regarding the ongoing pilot project aimed at developing a successor scheme to the old agri-environment climate scheme (AECS), and supports the proposed move towards an outcome-based scheme approach. This concept closely aligns with the outcome-based measures and principles proposed as part of the SBCS where participants will also be rewarded for actions that deliver actual results. The group recognises that the potential and need to deliver environmental, climatic and ecosystem benefits alongside the provision of domestic food security has become a key priority within agricultural policy, and that agri-environmental and climate-friendly measures will likely form a fundamental part of any future Scottish agricultural support schemes.

This may potentially include minimum requirements across all farming sectors, meaning that farming businesses wishing to access any agricultural government grant funding may be required to carry out basic environmental on-farm measures.

To this end, the group has proposed the inclusion of a minimum requirement aimed at biodiversity enhancement on participating farms as part of the SBCS, and close collaboration with relevant stakeholder organisations and experts has been initiated as part of the scheme development in order to design this minimum requirement in such a way that it is meaningful and effective. Various potential approaches are currently being reviewed, including a concept which requires participants to prepare a simple environmental audit of their farm in order to identify key biodiversity outcomes generated by the holding which would also inherently deliver climate benefits. This could potentially include the following four broad biodiversity priorities:

- Areas of grazed, semi-natural, species-rich, permanent habitats through the maintenance of sustainable grazing regimes; this would include grasslands, heaths, moorland, wetlands, flood plains, coastal land, field margins and corners
- Areas of ungrazed permanent habitats that form biodiversity corridors through the farm which would be continuously protected from potentially damaging activities; this would include hedgerows, water margins, watercourses, woodland and un-grazed permanent grassland, wetland, heath and bog
- Areas across the farm that could be released as a result of efficiency gains through this scheme in order to create or restore habitats to enhance the biodiversity potential of the farm through management supported by other agri-environment, woodland, or peatland restoration schemes
- Non-native invasive species that could be removed through participation in targeted agri-environment, woodland or species control schemes

As part of this requirement, farmers could prepare a range of outcomes and assess how well their management maintains habitat quality, and specific categories of outcomes could be listed for each of the above four main biodiversity components to assist participants.

Farmland forestry and hedging

The group supports well-planned and integrated farm woodland and agroforestry projects including the preservation of existing native and riparian woodlands, scrubs and natural regeneration, as well as silvo-pasture and hedges where the mutual benefits of forestry alongside farmland can deliver distinct benefits for the climate, local biodiversity and towards flood risk alleviation without jeopardising Scotland's domestic food security and the associated socio-economic and environmental benefits of a thriving agricultural sector.

Peatland restoration and preservation

The group also recognises the importance of preserving, restoring and properly managing peatlands, and therefore fully supports ongoing works and funding being made available to carry out peatland restoration across Scotland. In addition to restoring degraded peatlands, the group recognises that continued targeted and careful management of peatlands is crucial to ensure that they maintain current carbon stores and, where possible, are maintained in an actively growing state to sequester additional atmospheric carbon for long-term soil carbon storage.

Although peatland restoration falls out with the remit of the SBCS, appropriate peatland maintenance and preservation relies on good livestock management. The group has therefore proposed a management option which takes upland grazing management into consideration in an attempt to encourage participants to preserve the condition of on-farm peatlands and prevent (further) deterioration by maintaining appropriate upland grazing by cattle. The group recognises that despite the management option having the potential to deliver important benefits, there is an opportunity to develop the proposed measures further in an attempt to fully utilise upland livestock systems as a tool to enhance and protect fragile upland habitats rather than risking damage caused as a result of poorly informed and poorly applied agricultural activity. The group therefore welcomes any suggestions that the proposed management option can build on once the initial engagement has been secured from upland farmers.

Processor-industry collaboration and prime beef definition

The SBCS includes a proposed minimum requirement to encourage collaboration and data exchange between store producers and finisher units via provision of a centralised database. There are already many examples within the Scottish livestock sector where farming businesses work together and feed back or share relevant performance data with one another for the benefit of both businesses. The group proposes that upon successful introduction of the above database, consideration should be given, possibly during the mid-term review, to widening that database in order to bring processors and wholesalers on board as well to increase the flow of relevant information between the store producer, finisher unit, and the processor.

In addition and in light of an increasing awareness of the importance of supporting agricultural businesses in achieving efficiency gains within the bounds of what is feasible within specific production systems, the group also recommends that the current definition of what constitutes a prime animal be reviewed, namely that the minimum age at which a cattle beast can be classed as prime animal be reduced from the current 12 months to 10 months in line with a recent recommendation put forward by the National Beef Association[106]. This will not affect the vast majority of suckler beef producers and finisher units. It will however provide some more intensive finishing systems that work with early-maturing cattle types with a greater flexibility to supply their animals into the system when they are ready, rather than having to delay slaughter due to minimum age restrictions. The group recognises that there are distinct climate benefits which can be gained from providing such a flexibility due to the potential saving in inputs which would otherwise be required to maintain these animals in condition, and the emissions from the rumen activity and manure production generated during that additional period. The group stresses that this system only suits a minority of agricultural businesses where these efficiency gains are possible, and recognises that there are many different finishing systems across Scotland that work with a range of early to late maturing cattle types, forage or cereal based diets, varying resource and input availabilities, and environmental constraints. Whilst an age at slaughter of 12 months and younger may not work within their system, they can achieve distinct efficiency gains elsewhere within their own specific cattle enterprise and deliver equally significant climate and environmental benefits.

GWP*

The Suckler Beef Climate Group notes ongoing studies exploring options to increase the accuracy of the current approach to reporting on and estimating greenhouse gas emissions from different sources and industries. This includes the recently published research paper by J. Lynch et al. (2020)[107] which discusses the potential of better accounting for the atmospheric lifetime and warming impact of Methane amongst other greenhouse gases by upgrading the currently widely used GWP_{100} metric to GWP*. GWP_{100} measures the global warming potential of different gases over a period of 100 years where as GWP*, according to the study, shows potential to be able to provide a more reliable indication of the actual warming impact of specific levels of emissions by considering gases with a lower atmospheric half-life.

Agricultural labour availability

Whilst not necessarily directly related to climate-friendly farming, the Suckler Beef Climate Group wishes to highlight the importance of retaining people within the agricultural industry and encouraging new and young entrants into the farming sector. Technological advances and innovations have over the years contributed a great deal towards enhancing on-farm efficiencies and will undoubtedly continue to do so as new technological innovations and developments are being made. While technological equipment can support good stockmanship, it cannot fully replace the skills of a good stockperson.

[106] **NATIONAL BEEF ASSOCIATION** (2020). *Proposal to increase UK beef production and efficiency in conjunction with a reduction in CO2 emissions.* Hexham: National Beef Association.

[107] **LYNCH J., CAIN M., PIERREHUMBERT R., ALLEN M.** (2020). *Demonstrating GWP*: a means of reporting warming-equivalent emissions that captures the contrasting impacts of short- and long-lived climate pollutants.* Environ. Res. Lett. **15** 044023

The group therefore recommends that measures be put in place that enable new blood to enter the industry by encouraging and assisting existing businesses to take on additional staff, whether temporarily as part of traineeship, apprenticeship or work placement, or longer-term to become part of the team and contribute towards the growth and development of the business into a successful and resilient farming operation. Funding of such training should be provided with a particular focus on encouraging the younger generation into the industry. With an ever-increasing element of technological innovation within on-farm production systems, there are huge opportunities for young people, who tend to be much more familiar and comfortable with technological equipment, to become involved and contribute their own specific knowledge and abilities to complement the skillset already available within an existing business. With the Covid-19 pandemic having adversely affected many businesses and individuals, a successful green recovery as set out by government will need to consider the importance of maintaining a land-based labour market in order to sustain rural communities and the many benefits that these communities bring with them.

Green energy

The group furthermore supports the use of smaller scale on-farm green energy generation. The use of anaerobic digesters for slurry and manures and the production of hydrogen as an alternative fuel for farm machinery are two good examples of this. Biomass, solar, wind, hydro and CHP systems (combined heating and power) are also extensively used on Scottish farms and should be encouraged, especially as there are already some schemes in place (mainly across the UK) to support these climate friendly initiatives.

Additional government support

Where there is currently no government scheme in place to support investment in environmentally friendly infrastructure, equipment and other projects or programmes where the benefits for the climate are quantifiable, consideration should be given to introducing such technology onto Scottish farms in a scheme funded by the Scottish Government. Such funding could potentially come from the Agricultural Transformation Programme, albeit that this might require a cash injection to ensure that the budget can support the wide-spread uptake of such a scheme.

13. Closing comments

This report presents a comprehensive collection of recommendations put together by the Suckler Beef Climate Group after an extensive initial industry evidence gathering exercise and ongoing literature review. The proposed scheme is by no means a silver bullet, but instead an attempt to capture the concepts of best practice, latest research, and best available technology, and combine these into a workable, meaningful and effective new agricultural support scheme. As such, the scheme seeks to provide the best possible platform to encourage Scottish suckler beef farmers to reduce their net greenhouse gas emissions whilst increasing production-based efficiencies.

The coming months will be used to further develop details of the proposed scheme and design a robust concept of application, implementation and monitoring. This includes further outlining the data evaluation and opportunity scoring aspects. A detailed proposal on the budgetary and cost implications of the scheme to government and individual businesses is being worked on and will be presented to government. Recommendations on the workability of the biodiversity enhancement requirement will be prepared together with the relevant stakeholders.

The emissions abatement modelling prepared by J. Bell et al. (2020) will be developed further and expanded on to include dedicated models for each type of suckler beef system in Scotland in addition to the existing rearer finisher scenarios, and this will form an important and useful core aspect of determining the likely current levels of emissions occurring within different systems, and to what extend these may be reduced by taking different steps. The models are already being worked on and will provide an important basis to the development of this scheme.

While the remit of the Suckler Beef Climate Group was the development of proposals on a workable scheme to make suckler beef production more climate-friendly, it is important to recognise the role that Scottish agriculture plays not only with regards to the climate, but also for the environment and domestic food security. A recently published study states that "*reducing carbon emissions is a vital component of sustainable livestock systems, given climate change is our greatest global challenge, but it is not our sole challenge. A single focus on carbon may compromise gains needed in other sustainability metrics, such as food security and food quality, nutrient management, animal welfare, biodiversity, viability of rural communities and long-term farm profitability. This is an opportunity to tackle climate change while building systems that will help to deliver a sustainable farm and food future for our nation*." (CIEL – Centre for Innovation Excellence in Livestock, 2020[108])

The Scottish suckler beef herd has already experienced a dramatic decline over the last two decades as a result of policy changes, diseases including Foot and Mouth, and economic pressures. A further reduction of the Scottish suckler beef herd as a result of poor profitability, inadequate support and/or a changing policy landscape would not only impact on domestic food production and security, rural employment, and the contribution of land-based industries to the overall Scottish economy, but may cause the critical mass required to sustain the sector to drop below the threshold of viability across many parts of Scotland, thereby accelerating further losses amongst the suckler beef sector.

[108] **CIEL – CENTRE FOR INNOVATION EXCELLENCE IN LIVESTOCK** (2020). *Net Zero Carbon & UK Livestock*. [Online] Available from: https://www.cielivestock.co.uk/wp-content/uploads/2020/09/CIEL-Net-Zero-Carbon-UK-Livestock_2020_Interactive.pdf (last accessed 5th October 2020)

Scotland's farmers have served Scotland's economy and communities for decades if not centuries, and they have always managed to respond and react when needed. They managed to significantly increase food production after the war to help get a nation back on its feet, and they curbed back production several decades later when governments were struggling with food mountains. They adopted the use of inputs to boost production when governments encouraged and incentivised it, and they started to cut and reduce the reliance on these inputs when environmental concerns began to emerge.

The farming industry and with it the Scottish suckler beef sector is a big industry to turn around within the space of just a few years, but past experiences have shown that it can react when needed, and is willing to react to do what is deemed best by society and governments. It has proven that it is resilient and adaptable, and it will prove this again by rising to the challenge that is climate change.

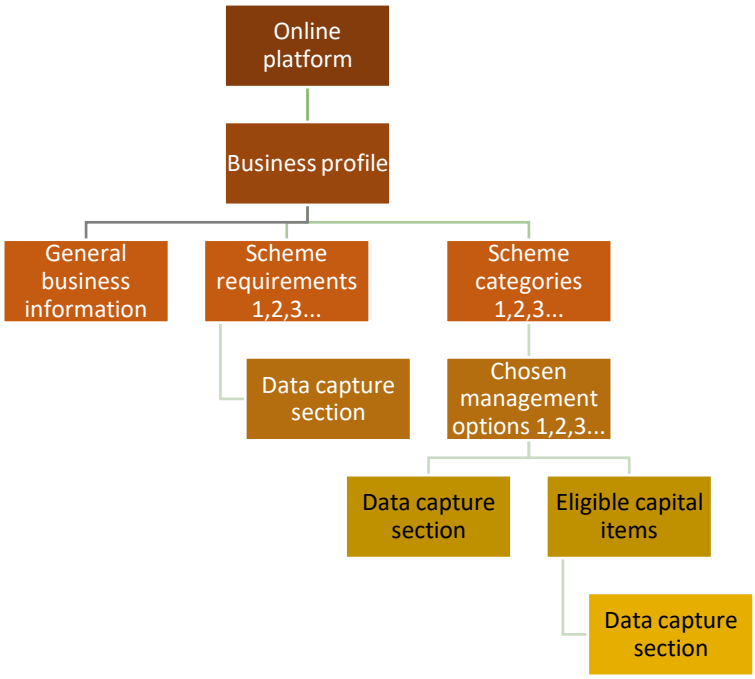
14. Scheme structure and delivery

While the above main body of the report outlines recommendations for the setting up of a workable scheme and potential management options, the following section provides a more detailed overview on a possible scheme structure and implementation. This is very much work in progress and ideas will be developed in discussion with ScotGov, RPID and others on how the scheme can be set up to ensure that it is simple and easy to operate, and incorporates the lessons learnt and feedback received from other schemes including the Beef Efficiency Scheme.

14.1. Scheme platform and data handling

It is proposed that the SBCS will be delivered via centralised and interactive online platform, similar in concept to the Beef Efficiency Scheme. Such a platform could be provided and managed either by a governmental or industry body and would be used to facilitate data submission by participants and their advisers, data validation and business scoring using embedded calculations and synchronisation with other online data sources where possible, and monitoring by the relevant official authorities for scheme compliance and inspection purposes.

Within the proposed online application, each participating business holds an individual profile where general business information can be uploaded alongside any data necessary as part of the scheme requirements and chosen management options. The profile consists of separate sections focusing on general business information relevant to provide a baseline for the scheme, and the various management categories and options that businesses may commit to as part of the scheme. External access to specific business profiles may be given to advisers assigned to individual participants to supervise and support, as well as to the relevant authorities for monitoring purposes. An illustration of this concept is provided below.



The data that participating businesses are expected to supply may include both numerical and textual information as well as any documentation for evidence purposes. Given the unprecedented impact of Covid-19 and the resulting difficulties this has created for on-farm visits and inspections, it is proposed to design this scheme in such a way that makes as much information and evidence available via online submission as possible. This will enable inspecting officers to carry out a large proportion of inspections via remote online assessments without the need to travel, thereby ensuring the continuation of business monitoring as part of the grant scheme without any disruptions and delays.

This approach would also help to simplify the inspection process for both the assigned officer and any participating businesses, and reduce the financial expense associated with physically carrying out on-farm inspections.

In order to minimise the time commitment required by participating businesses to upload data, reduce the risk of errors as a result of handling a large dataset, and to help simplify data submission, particularly for individuals struggling with difficulties such as Dyslexia or Dyscalculia, it is suggested that where possible, manual data input by the business should be complemented or assisted via provision of the following:

- Synchronisation with relevant online services to prepopulate specific sections; this may include the British Cattle Movement Service (BCMS) / Cattle Tracing System (CTS) database and ScotEID amongst others
- Drop-down menus where there is a limited number of pre-defined answers available
- Multiple-choice questionnaires where several pre-defined answers are possible
- Embedded calculations to generate the necessary result using basic data input without the need for manual calculations and adjustments to be made by the participants, e.g. calculating the calving percentage using data from the Cattle Tracing System (CTS)

In order to avoid any difficulties associated with data handling as a result of the GDPR rules and requirements (General Data Protection Regulation), the scheme should be designed in such a way that makes the scheme participants the collective owners of all data uploaded and submitted. By signing up to the SBCS, businesses agree to making available and sharing their data for the purposes of

- Data analysis and review to enable business (performance) assessment
- Monitoring and validation to ensure scheme requirements and deadlines are being met
- Collective and anonymous benchmarking exercises to feed into industry progress and performance literature and feedback reports where appropriate
- Collective and anonymous results analysis and review to inform policy makers and civil servants, and better guide and target policy-related decision-making where appropriate
- Collective and anonymous data usage to feed into any relevant studies and scientific research where appropriate

The above mentioned anonymised datasets should be made available in order to enable and/or feed into relevant research studies, and any trends and findings should be shared with the appropriate bodies and within the agricultural industry to help inform future policy and provide technical guidance, case studies and real on-farm results to farmers for the benefit of the Scottish suckler beef sector and the wider farming industry. The group recommends taking such an approach in order to ensure that the scheme can deliver multiple benefits and outcomes at different levels that go beyond the main aims of the scheme in return for taxpayer's money.

14.2. Scheme duration and mid-term review

The scheme will initially be run as a pilot and its duration will cover the agricultural transition period between 2021 and 2024. This includes a mid-term review after 2 years to update management options where needed and address any potential issues arising from the administration and delivery of the scheme.

The mid-term review will be used as an opportunity to assess, as far as is possible at such an early stage, the adoption, applicability and effectiveness of different management options and capital items where this is feasible in order to carry out adjustments and improvements as and where necessary. This will help to ensure that the scheme is user-friendly, effective, and can achieve its aim.

Some management options and capital items were considered during the initial designing of the scheme but have not been included due to there currently being limited evidence or no practical tools for on-farm application available, or because they have been deemed to be of secondary importance to other high-impact actions. These may be included during the mid-term review and may be made available to participants to ensure that the scheme is progressive and develops in line with new research and findings. Once the initial pilot scheme has come to an end, it will form the basis of future agricultural support for the Scottish suckler beef sector.

14.3. Eligibility

The scheme is open to any Scottish agricultural business that is registered as suckler beef producer with the Rural Payments and Inspections Division (RPID) and other relevant authorities including the Animal Plant and Health Agency (APHA). Eligible businesses must hold an individual Business Reference Number (BRN) and manage a suckler beef herd for the purpose of producing breeding, store and/or finishing cattle at the start of and throughout their participation in the SBCS. Businesses owning cattle for reasons other than to produce beef calves from a breeding herd, or to produce beef animals from a store or finishing unit to supply into the beef market, are not eligible. This includes non-breeding herds and any other cattle kept for non-commercial purposes, e.g. as pets or as a hobby.

There is no requirement for cattle keepers to have a suckler herd, meaning that businesses running a finishing unit without a breeding herd are eligible as well.

For the purpose of the scheme, dairy breeds are excluded. Eligible calves, stores and finishing cattle must have at least 75% beef genetics whilst eligible suckler cows must have at least 50% beef genetics and be bred to a beef bull.

In recognition of the important role that smallholders and crofters play within Scottish agriculture, this scheme is open to cattle systems of all sizes and there is no minimum number of cattle required in order for a business to be eligible, so long as participants own cattle in their own right at the start of and throughout the scheme duration.

14.4. Application process

The SBCS will be introduced as a pilot scheme and initial participation is therefore voluntary. Thereafter, the scheme or parts of it will be embedded into a future agricultural support system and may become compulsory to access future funding.

Once the scheme has been published, prospective participants will be able to access full guidance about the minimum requirements that must be met at the start of and throughout the duration of the scheme, and review the various management options and capital items that will be available. This guidance includes a detailed overview of the required activities and/or expected outcomes along with information about the relevance of and science behind the management options and capital items in helping to improve on-farm efficiencies and reduce net greenhouse gas emissions from the production system. Cross-referencing to relevant scientific and case studies will be available to help businesses make informed decisions when choosing management options as part of the scheme. This process offers the opportunity for applicants to consider and choose different management options and capital items that they wish to adopt on their farm, thereby giving businesses the ability to choose their level of commitment on the basis of what is feasible and applicable within their particular system.

It is proposed that the first stage of the application process will require businesses to express their interest by signing up via online platform that will be used to deliver the scheme, or through submission of an application form. Once registered, applicants should carry out any necessary actions to ensure that they comply with the scheme requirements as outlined further above. Many businesses already carry out (most of) the stipulated requirements, but others will need to introduce appropriate management which may take a few weeks or months.

The second stage of the application process involves confirmation of participation within the Single Application Form. This could involve a declaration of the chosen management options including any capital item(s) that the business wishes to claim as part of the relevant management option(s). A scheme offer contract will be issued to applicants for signing and returning which will finalise the application process.

In order to avoid the risk of creating a competitive disadvantage for any smaller businesses, or cattle enterprises that may already face significant challenges or are otherwise limited in their ability to commit to a range of management options, approval of applications should not be based on a scoring system requiring a minimum level of commitment or uptake of a diversity of management options. Instead, the initial process of application should involve validation of the business meeting all eligibility criteria and minimum requirements as previously discussed.

After an initial period for businesses to register interest in early 2021, the scheme will open for applications via submission of the Single Application Form in spring 2021. Subsequent application windows should be made available on an annual basis to allow new businesses and farms not previously signed up to enter the scheme. Upon successful application and acceptance of the scheme contract offer, businesses will commit to participating for the whole duration of the scheme.

In order to prevent barriers to entry and avoid unintended discrimination of businesses operating on less secure tenure terms, the requirement to sign up and commit for the whole duration of the scheme should exclude any suckler beef producers that are unable to obtain a tenancy with sufficient security to cover the full scheme duration. This includes businesses operating on a seasonal grazing lease or a limited duration tenancy coming to its end before the end date of the SBCS. In such a case, participating businesses should be permitted to sign up for the (remainder) duration of their seasonal/grazing lease or limited duration tenancy so long as there is a minimum duration left between the start date of their participation in the SBCS and the end date of their lease or tenancy. If such a business manages to renew its seasonal grazing lease or tenancy, submission of the appropriate documentation as proof should automatically increase the duration of their participation in the SBCS without the need for separate submission of a new application.

14.5. Initial and annual participation

It is proposed that the initial stage of participation involves capturing general business information. Farm enterprise data will be fed into the online business profile at the beginning of the scheme to capture any relevant information about the farmland area, field system and cattle production system. The general business information includes data about the land area and use, herd size and structure, market outlet and calving period, chosen cattle type/breed and other key aspects required to determine what management options are not relevant or applicable to certain businesses. Irrelevant options may include for example any options aimed at breeding management for finishing businesses, or slurry management for outwintering systems. This more generic farm business information will also form the basis for more specific cattle enterprise evaluation to establish the current and progressive position and performance of participating businesses, and, where necessary, will be reviewed and updated on an annual basis.

Once businesses have signed up to their chosen management options, potentially alongside a capital item claim relevant to those options, they are expected to commence the stipulated activities and/or take steps to achieve the listed outcomes of each management option. Apart from any changes to existing or the introduction of new on-farm management practices, this will involve data capture of varying degrees depending on the chosen management options and will include information relating to the calving performance. The gathering of calving records should commence in spring 2021 which will capture spring-calving herds and any herds calving thereafter. Winter-calving herds will be required to commence data capture from winter 2021/22 onwards.

Clear guidance should be provided as part of the scheme to assist participating businesses with data collection by outlining the type of data that needs to be collected, and the relevant sections within the online business profile should be developed in such a way that simplifies data submission by the participant.

15. Data evaluation and business assessment

Because the scheme is an outcome-based support mechanism, the main section of the online business profile should be dedicated to data collection and evaluation as part of any chosen management options. The uploaded data is used to carry out an assessment which focuses primarily on reviewing individual business performance within different areas of suckler beef production in order to identify the farm's current and progressive environmental and physical efficiency, and how this compares to other participants. In order to provide businesses with the tools that allow them to improve their current performance, it is important to

- Identify individual **management options** where the business is showing weaker performance; this could indicate that targeted and effective action can be taken to focus on specific areas of the production system in order to resolve the issue(s), e.g. by culling individual cows that are unproductive
- Identify any patterns where the business is showing poorer performance across several related management options and/or within individual **management categories**; this may indicate that systemic (management) changes are needed, e.g. by investigating underlying disease issues that are affecting whole herd performance, and outlining a disease control and eradication plan accordingly

The first stage of the annual assessment utilises the submitted data to evaluate the relative business performance within individual management options using either absolute targets or stipulated activities which will be defined in line with the overarching aim of a management option.

Businesses will endeavour to reach the overall aim, or target, of each management option but their starting point and ability to improve their system may vary. In order to capture their initial and subsequent annual performance as they progress through the scheme, the assessment will therefore offer several different 'scenarios', and businesses will be allocated the scenario which best reflects or describes their current performance. The intention of this approach is to recognise that some businesses may not (yet) be able to achieve the "end goal" of the option but are nonetheless taking steps within their production system in an attempt to contribute towards the reduction of greenhouse gases and improved production efficiencies. For instance, the management option aimed at minimising soil disturbance encourages the uptake of zero tillage field management practices and a move away from annual ploughing. Whilst the adoption of zero tillage can achieve the greatest emissions gains and therefore represents the overarching target of this management option, businesses that apply a biannual or multi-annual rotational ploughing system, or carry out minimum/reduced tillage, will be recognised for their lesser-impact but nonetheless important efforts and contribution as well.

Up to five scenarios, or performance levels, will be outlined for each management option and will correspond to an "opportunity score" ranging from 1 to 5. A lower score is allocated to better performance and a higher score to poorer performance to indicate that there is a greater opportunity to achieve significant improvements. Standardisation of the performance results for each management option through their expression as a numerical score from 1 to 5 is recommended as this will simplify the results section and overall business review.

Absolute targets will be used within the above scoring system where these are realistically applicable to any cattle production system without discriminating certain businesses on the basis of system, location, cattle type, environment or market outlet. These may include KPIs such as the calving percentage and calving interval, the herd health status for some of the major cattle diseases, the legume content of in-bye grasslands, or the tillage system to mention just a few.

Where the opportunity for individual businesses to achieve a specific performance level or target is heavily dependent on and variable between different production systems, absolute targets will not be used as these could lead to an unfair disadvantage for some businesses and overcomplicate the delivery and effectiveness of the relevant management options. In such a case it is suggested that participating businesses should instead have to carry out a specific activity rather than meeting an absolute target. This may for instance include the management option aimed at improving individual cow efficiency which requires participants to cull their poorest performing cows, regardless of their current average performance or how they compare to other suckler beef systems.

This approach will help to ensure that realistic and meaningful outcomes can be achieved regardless of the farm type, and means that different participants can apply the same management regardless of their system, their current performance, or the age of their business, and can work towards one common goal. It also ensures that where continuing improvements are possible, e.g. by continuously culling the poorest performing cows, this is encouraged and required as part of the scheme.

Once the participant's performance has been evaluated in line with the specific aims, targets and requirements of the management option(s), the generated results are translated into an opportunity score as mentioned further above.

The following table provides an example, for illustrative purposes only, of how the scoring system would work for management options using absolute targets:

Score 1	calving percentage equal to or greater than 98%
Score 2	calving percentage equal to or greater than 95%
Score 3	calving percentage equal to or greater than 92%
Score 4	calving percentage equal to or greater than 89%
Score 5	calving percentage less than 89%

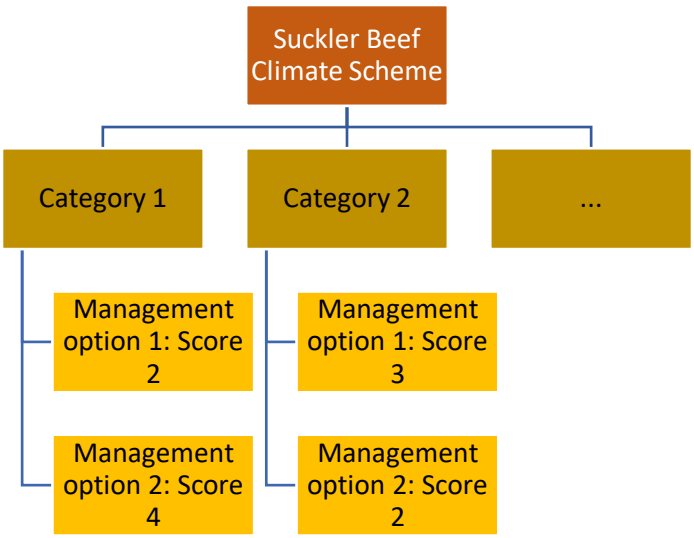
Using the above fictional scoring system, a business achieving a calving percentage of 94% would achieve a Score 3 which indicates a medium opportunity level to improve performance.

The following example table, again provided for illustrative purposes only, outlines how the scoring system may work where an absolute target is impossible to define, in this case by focusing on achieving a suitable pH level on any fields that receive inputs. As the ideal pH varies from farm to farm on the basis of their particular soil and crop type, defining an absolute pH target value is not feasible, and businesses are instead encouraged to correct soil acidity in line with their individual and specific soil needs:

Score 1	all fields receiving inputs are within recommended pH range
Score 2	all fields receiving inputs are no more than 0.1 units below the recommended pH level
Score 3	all fields receiving inputs are no more than 0.2 units below the recommended pH level
Score 4	all fields receiving inputs are no more than 0.3 units below the recommended pH level
Score 5	some or all fields receiving inputs are more than 0.3 units below the recommended pH level

According to this fictional scoring system, a business that has some fields at the recommended pH level and other fields sitting 0.2 and 0.3 units below the recommended level would receive a Score 4 for this particular management option. This indicates a medium to high opportunity level to improve performance.

The above scoring system will build a picture of business performance across different management options and within different management categories, as illustrated on the following page. This will provide a useful basis and starting point for businesses to easily identify individual management options or categories where they are currently achieving a higher score, i.e. where there is a greater opportunity to improve the current business performance. The opportunity score for each management option will feed into an average business performance score per scheme category by applying a weighting system as explained in the next chapter.



15.1. Weighting and opportunity scoring system

The different categories and their management options form the basis of on-farm activity aimed at reducing greenhouse gas emissions from the cattle enterprise. Although each category has been chosen due to its relevance and potential to contribute towards a net reduction in emissions associated with suckler beef production, some offer a greater emissions abatement potential than others. This is either because the activities being targeted are amongst the more significant current sources of emissions, or because the proposed measures are easier to adopt and incorporate into the current cattle production system.

A weighting system should therefore be considered as part of this scheme to emphasise the varying contribution of different areas of production to the overall goal of reducing greenhouse gas emissions and increasing efficiencies, and to allow for prioritisation of certain elements of suckler beef production when calculating the overall business score from the individual opportunity scores obtained within different management options. This will highlight areas where higher impact improvements can be made, and will help businesses focus on those aspects of the cattle enterprise which require attention to deliver immediate benefits and generate quick returns.

In order to reflect these differences, the 5-point scoring system that is used to assess individual business performance should also be used to represent the relative importance of the various management categories. A lower score is allocated to lower priority measures and a higher score is given to measures of greater importance. For example, diseases can have a significant impact on cattle performance, and focusing on herd health can therefore offer a huge potential to reduce emissions associated with underlying health issues. Any performance improvements gained from selective cattle breeding on the other hand can also reduce the emissions intensity, but typically to a lesser degree, at least in the short-term. A higher score would therefore be allocated to the management options associated with cattle health and the health category itself.

The proposed approach would use an overview showing the 6 different management categories as columns and the valuation and business assessment as rows. The categories are weighted for their relative importance towards delivering environmental and economic values, as well as their potential to deliver further benefits. This weighting is carried out by allocating an opportunity score from 1 to 5 as is the case with individual business scoring, with 5 being most and 1 being least significant, important and/or relevant for achieving a certain outcome.

The environmental value of each category forms the core aspect and main aim of the scheme, and includes the potential of each main management category to contribute towards

1) reducing the emissions intensity and/or net GHG emissions of the relevant activities
2) increasing soil carbon sequestration and/or maintaining and protecting existing soil carbon stores
3) protecting and/or enhancing the local biodiversity
4) reducing input wastage
5) reducing the use of chemical inputs including synthetic fertilisers and animal health products to protect local ecosystems from agro-chemicals where possible

Because it is important that environmental benefits can be delivered without negatively impacting on the ability of businesses to be profitable, and because a lot of environmental benefits go hand in hand with economic benefits (e.g. improving efficiencies), it is also essential to consider the potential economic benefits of each management category to individual businesses. The weighted scoring system therefore also assesses the potential of each management category towards

6) improving on-farm production efficiencies and enhancing input and resource utilisation
7) increasing business profitability, either as a result of better input utilisation efficiencies or improved outputs from given inputs and resources
8) enhancing business resilience by addressing current weaknesses within the cattle enterprise, improve efficiencies and profitability, increasing self-sufficiency etc.

There is also a significant potential for the SBCS to offer additional value for taxpayer's money and this has therefore been included within the assessment to consider how the scheme can

9) benefit the wider agricultural industry, for example by encouraging participants to better utilise antibiotics which ultimately may help to delay the development of antibiotic resistance
10) utilise the data uploaded by participants to inform future agricultural policy
11) utilise the data uploaded by participants to feed into relevant scientific research

The above three valuation overviews will form a standard section within the data and business evaluation section. Within each valuation overview, the sub-sections (red referring to the most important ones) have been given a percentage priority to add up to 100% in line with their relative importance within and contribution to the overall valuation outcome. For example, sub-sections 1 and 2 within the environmental valuation overview are the main aims of the scheme and have therefore been prioritised at 40% each, followed by sub-section 3 at 10% due to being a secondary aim of the scheme but nonetheless important to recognise. Sub-sections 4 and 5 are of lesser importance as stand-alone items but tie in closely with the other environmental sub-sections. These have therefore been given a 5% priority each.

The 11 sub-sections within each of the valuation sections will be individually scored within each management category using data from research studies and scientific literature concerning their potential benefits and likely impact level. A score of zero will be allocated where a particular outcome valuation is not relevant, e.g. cattle health does not impact on the extent to which soil carbon storage can be preserved and/or increased.

The priority of each sub-section is then used for a weighted adjustment of the individual scores within each management option, shown as adjusted 'weighted score' on the example overview. Within each of the 3 valuation overviews, these weighted scores are then added up to a total valuation score.

To generate an overall value score for each category, each total valuation score is again weighted for its relative importance against the others using percentage prioritisation to add up to 100%. On the example overview, the environmental value is weighted at 60% due to forming the core aim of the scheme, followed by the economic value at 30% due to its lesser but nonetheless significant importance, and the data and further value section at 10%. This allows to calculate an overall value score for each management category, with a higher value score indicating a category that is of greater importance in achieving significant outcomes.

In addition to highlighting categories with a higher potential to help deliver the aims and objectives of the scheme, it is important to combine these with the annual performance of individual businesses and identify management categories that require attention due to there being (greater) room for improvement both generally as well as specifically to the business.

A fourth section should therefore be considered as part of the analysis to review the business status of individual participants on an annual basis. This is the only section that will differ between individual participants, and includes the following sub-sections:

12) current business performance
13) capital infrastructure/investment needed
14) system applicability/ease of uptake

An example overview to illustrate how the above concept may be presented is provided on the following page.

		SCHEME CATEGORIES					
		Category 1		**Category 2**		**Category …**	
	Priority	Score (1-5)	Weighted score	Score (1-5)	Weighted score	Score (1-5)	Weighted score
Environmental value	**60%**		**2.25**		**1.9**		**3.4**
Reducing emissions intensity and net GHG emissions	40%	5	2	4	1.6	2	0.8
Increasing soil carbon sequestration/maintaining soil carbon storage	40%	0	0	0	0	5	2
Enhancing/promoting local biodiversity	10%	0	0	0	0	4	0.4
Reducing input wastage	5%	3	0.15	4	0.2	1	0.05
Reducing use of chemical inputs (medicines and synthetic fertilisers)	5%	2	0.1	2	0.1	3	0.15
Economic value	**30%**		**4.6**		**4.6**		**3.8**
Increasing production efficiency and input utilisation	40%	5	2	5	2	4	1.6
Increasing business profitability	40%	5	2	5	2	4	1.6
Enhancing business resilience	20%	3	0.6	3	0.6	3	0.6
Data and further value	**10%**		**3**		**2.6**		**2.2**
Benefitting wider agricultural industry	40%	3	1.2	2	0.8	1	0.4
Data value for policy purposes	30%	3	0.9	3	0.9	3	0.9
Data value for scientific/research purposes	30%	3	0.9	3	0.9	3	0.9
VALUE SCORE			**9.85**		**9.1**		**9.4**
Business status			**2.57**		**3.15**		**4.32**
Current business performance	90%	2.3	2.07	3	2.7	4.3	3.87
Capital infrastructure/investment needed	5%	5	0.25	4	0.2	4	0.2
System applicability/ease of uptake	5%	5	0.25	5	0.25	5	0.25
OVERALL SCORE			**25.3**		**28.7**		**40.6**

The 3 sub-sections are also weighted, with sub-section 12 for obvious reasons carrying the highest priority. Sub-sections 13 and 14 have a much lower priority but have been included as it is important to consider how relevant different management options are to individual businesses and whether there are any potential financial or other barriers present that may make uptake more challenging. These considerations will help to adjust the scoring of different management categories in line with prioritising areas where the business can make actual and immediate changes over other aspects that are less relevant and therefore more difficult to improve.

It should be noted that the opportunity scoring within each management category is based on importance, i.e. 5 for most important and 1 for least important. For the first 3 valuation overviews, this means that a higher score is allocated where there is a greater potential to deliver on the stated outcome.

Within the fourth section covering the business status, scoring is also carried out in accordance with importance which requires a slightly different approach, i.e. a focus on weaknesses or issues that are currently present:

12) current business performance: higher score awarded for greater potential for (further) improvements, i.e. more important because that particular aspect of the enterprise is currently weaker which may cause higher emissions and therefore requires attention; weaker aspects also have a greater potential for high impact changes and improvements

13) capital infrastructure/investment needed: higher score awarded where lower level of or no investment is needed, i.e. more important because immediate action can be taken with little or no initial investment being needed

14) system applicability/ease of uptake: higher score awarded for higher applicability, i.e. more important to focus on areas where improvements can generate highest impact.

The final step in prioritising different management categories to allow participants to focus on areas of greatest opportunity for improvement involves multiplying the value score from the first three standard sections concerning the various values of the categories with the business status score to generate the overall score for each category. A higher overall opportunity score highlights categories that require a greater focus from individual businesses.

For each management category, the chosen/proposed scoring concept will therefore generate an overall opportunity score that is a function of the relative potential of a management category to achieve significant benefits and the current business performance and scope to achieve higher impact improvements.

15.2. Data presentation via heat-mapping

It is suggested that the SBCS will use the concept of a heat-mapping matrix to compile the results from the data evaluation exercise into an easy to understand overview. This overview will help to clearly highlight areas where there are significant opportunities to improve the cattle production system by adjusting current management or introduce new measures in order to reduce greenhouse gas emissions, safeguard the environment, and improve cattle performance.

Heat-mapping is a visual business analytical tool that has been successfully used in the business world for many decades to review sales performance, efficiencies and other key processes. It is not related to the concept of physical land and landscape feature mapping and does not necessarily have to include geographical data. Instead, it is used to simplify complex datasets into a visual overview. Heat-mapping collates numerical information and validates this data against relevant business targets to plot business performance. There are different types of this business tool available and a multitude of ways to define a heat-mapping matrix to represent specific data values. The traditional heat-mapping design uses numerical data as baseline to compile an overview that uses different colours, shading or colour intensities to highlight key performances or priorities, often represented by a stronger colour such as red, where as other factors of lesser importance or concern may be highlighted by a lesser intensity or a more neutral colour such as green or blue. This visual representation can make it easier to highlight and detect aspects of the business operations that should be prioritised and require further focus because they have a greater impact on core processes and outcomes, or because they show distinct weaknesses.

An illustrative example of a heat-map is provided below:

	Product/ Option 1	Product/ Option 2	Product/ Option 3	Product/ Option 4
Outcome/ Value 1				
Outcome/ Value 2				
Outcome/ Value 3				
Outcome/ Value 4				
Outcome/ Value 5				

Score 5	
Score 4	
Score 3	
Score 2	
Score 1	
Score 0	

Heat-mapping can for instance be used to capture data about the sale of different products in different areas. Products may be represented along different columns and the areas being reviewed are listed along the rows. The centre of the matrix represents the sales figures for each product in each area, transferred from a separate data overview and expressed as a colour rather than numerical value. The visual representation of that data can make it very easy to detect patterns such as opportunities in areas with high demand for a particular product and can make the business aware of other regions where demand has dropped.

Depending on the chosen approach to data analysis, the information given within the overview can then be grouped by colour, thereby allowing for further analysis to investigate the potential for a common denominator causing better or poorer performance. Using the above example, this could for instance highlight a preference for a certain product brand within a specific area.

Heat-mapping is not a commonly used business analytics tool within the agricultural industry. However, it can be customised to represent datasets of particular relevance to a certain business or operation, and offers an easy and flexible form of communication without the need to include vast amounts of numerical data that can sometimes clutter up presentations and overviews, or distract readers from the key message of the exercise. This is of particular value where readers may struggle with text or numbers, for example as a result of suffering from Dyslexia or Dyscalculia. These distinct advantages in combination with a proven track record within the private business sector make heat-mapping a useful tool to incorporate into the SBCS.

Such a heat-map could include three separate layers to represent business performance per management category on the first layer, per management option on the second layer, and within any options using multiple KPIs on the third layer. Management categories, options and KPIs would be listed against the outcome values of the scheme.

Using the weighted opportunity scoring overview as basis, a draft proposal on how the heat-mapping overview could be designed is shown on the following page.

	SCHEME CATEGORIES		
	Category 1	Category 2	Category …
	Environmental value		
Reducing emissions intensity and net GHG emissions			
Increasing soil carbon sequestration/maintaining soil carbon storage			
Enhancing/promoting local biodiversity			
Reducing input wastage			
Reducing use of chemical inputs (medicines and synthetic fertilisers)			
	Economic value		
Increasing production efficiency and input utilisation			
Increasing business profitability			
Enhancing business resilience			
	Data and further value		
Benefitting wider agricultural industry			
Data value for policy purposes			
Data value for scientific/research purposes			
	Business status		
Current business performance			
Capital infrastructure/investment needed			
System applicability/ease of uptake			

Opportunity score
Score 5
Score 4
Score 3
Score 2
Score 1
Score 0

15.3. Guidance and support

The Suckler Beef Climate Group proposes that the initial and annual review of the business performance and progress should be carried out with guidance from an agri-business adviser with appropriate accreditation and specialist expertise within the area of agri-business farm and carbon efficiencies. The adviser, with input from the farmer, will prepare an in-depth business profile and will help to collate the necessary data needed as part of any chosen management commitments. This will ensure that farmers receive continued support as part of the scheme to assist with data collection, submission and analysis. The adviser will review the results generated during the annual assessment together with the participant, and discuss options available to address weaker aspects of the production system. The discussion will be utilised to agree on specific action points that the business will take forward during the coming year(s) to address priority areas within the cattle production system or overall enterprise management. Such action points may refer to weaker aspects of the current system where there is scope for improvements to be made, and/or the introduction of new on-farm measures or management practices to take advantage of further opportunities available to the business to reduce greenhouse gas emissions, support the local ecosystem and the biodiversity within, and/or enhance business efficiencies, profitability and resilience. The opportunity scoring overview will provide a useful baseline for these discussions and the outlining of an agreement on relevant action points.

The adviser should have remote access to the farm business profile and will help to ensure that data input as part of the scheme is standardised. The cost implications arising from these annual on-farm visits should be covered by the scheme, and the meeting should count towards the CPD minimum scheme requirement.

The group also recommends that a workshop, either delivered through farmer meetings or via webinar/online training, should be organised at the beginning of the scheme in order to help participating farming businesses understand the scheme structure and online platform used to facilitate the scheme, the management requirements and their expected outcomes, and the process involved in obtaining and uploading relevant data.

15.4. Rural connectivity and offline application

The online platform used to deliver the SBCS will be a core resource for participating businesses, and regular and timely data submission by participants will rely on good access. It is therefore imperative that good and stable rural connectivity is provided across all parts of Scotland, otherwise there is a risk that farming businesses in the most remote parts of Scotland face unnecessary difficulties associated with scheme compliance and data submission, and are limited in their ability to integrate data monitoring and recording systems via technological and electronic equipment to enhance business efficiencies and environmental gains. This ultimately causes an unfair disadvantage by preventing such businesses from experiencing the same efficiency gains that can be achieved across better-connected parts of Scotland. Many electronic setups including livestock monitoring CCTV, heat and service detection devices, tracking and health monitoring systems and other technology require mobile signal and/or access to internet via cable or wireless setup, and therefore rely on there being good connectivity.

Poor connectivity therefore means that affected farming businesses are potentially unable to make use of such technological advances which may impact on their ability to compete within the wider market place. This in turn could severely compromise their business profitability, resilience and ultimately their long-term viability.

Recognising that the provision of stable and reliable rural connectivity is a longer-term project and cannot realistically be achieved before the introduction of the SBCS, the group recommends that consideration be given to developing a downloadable offline application that can be used by participating businesses and their adviser to capture relevant data. This allows businesses to plan and complete any work associated with scheme compliance within their daily work schedule rather than having to wait for stable internet to be available, avoids data losses as a result of failing to save online progress, and enables the farmer and adviser to carry out their annual meeting, data submission and results evaluation without having to rely on reliable internet. Once the participant or adviser has access to stable internet again, the data captured within the offline application along with the generated results, agreed action points and any further comments and information can be uploaded onto the online application for verification, monitoring and inspection purposes.

15.5. Knowledge hub

Making relevant research literature, scientific studies, industry best practice, trials and case studies readily available is absolutely crucial if Scottish agriculture is to progress and improve its environmental and economic performance in line with new scientific findings and developments, and emerging best practice. It can sometimes be difficult for individual businesses to find the technical and/or relevant information that they are looking for, either due to time constraints limiting their ability to conduct a thorough online search, or because the publications are not easily found unless the individual knows how and where to access it.

As one of the core aspects of this scheme evolves around enabling efficiency gains within individual businesses and across the sector, it is important to provide farming businesses with the ability to efficiently and successfully access the relevant information needed to adopt new management practices and make changes to the existing setup.

It is therefore strongly recommended that the online platform used to deliver the scheme should include a knowledge hub where relevant information such as scientific papers, recent research and case studies relating to climate and environmentally friendly farming and improving on-farm efficiencies is collated and issued for public use. Such a centralised database where farming businesses can easily find relevant articles within topic-specific categories or by means of helpful and user-friendly search parameters will enable businesses to easier access information, thereby maximising the potential benefits of public funding being put towards such studies by ensuring that the results and findings can be accessed and utilised by a wide range of agricultural businesses.

15.6. Scheme concept transferability

The proposed scheme has been structured in such a way that allows for its basic concept to be easily transferred and applied to other (climate) schemes that may be rolled out for alternative agricultural production systems in the near future including dairy, arable and HNV enterprises. Many of its proposed components are relevant to other agricultural sectors, especially with regards to soil health and nutrient management which will be of particular importance and applicable to all sectors of agriculture. Such management options will therefore likely be embedded within other sector specific climate schemes.

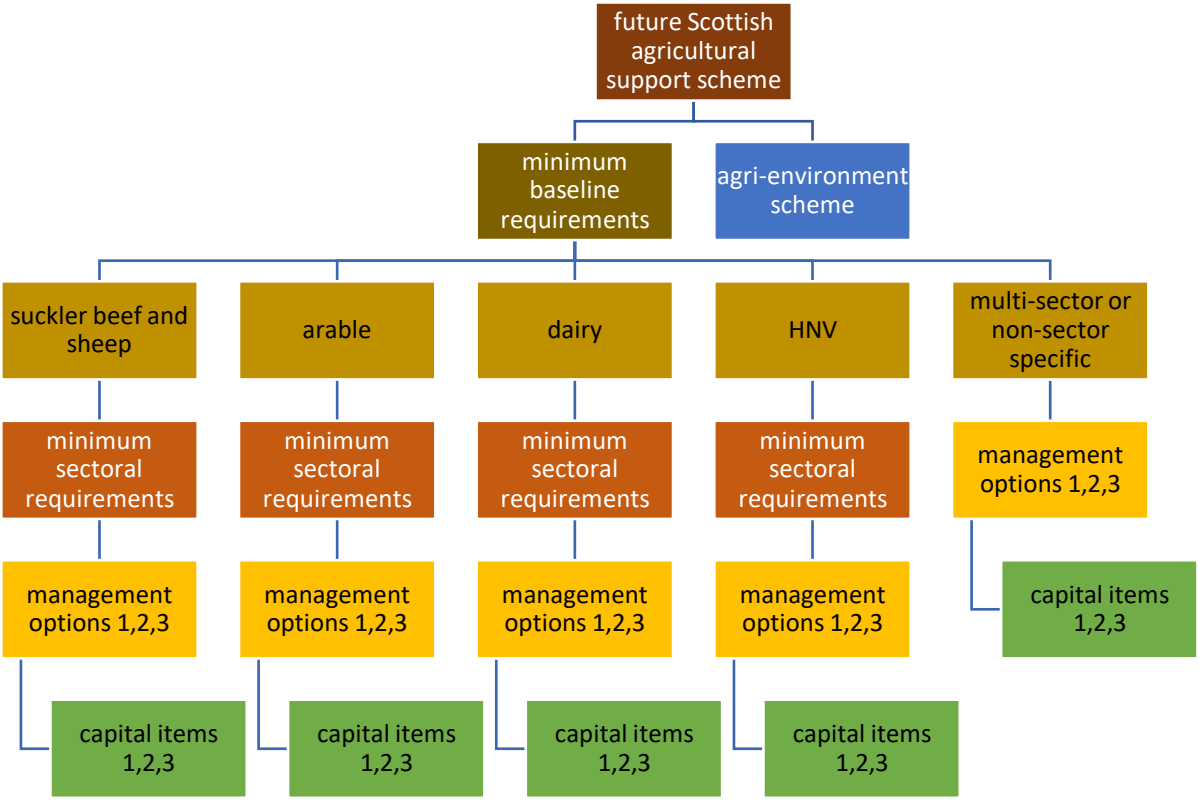
The suggested stacked component approach to designing this scheme means that integration with other sector specific schemes will be simple to achieve as Scottish agriculture moves towards a new agricultural policy and support scheme structure. This will be of particular relevance for the practical delivery of such a scheme within mixed farming businesses.

A future scheme concept could therefore be outlined in such a way that businesses will have to fulfil minimum baseline requirements, regardless of their specific farming activity. This may for instance include soil analysis, CPD, carbon auditing, and basic biodiversity enhancement.

Thereafter, businesses can access different enterprise-related management options and potentially any associated capital items, much like is proposed within the SBCS, but they may have to comply with some additional, sector-specific minimum requirements. For the beef sector, such stipulations include sector collaboration between store producers and finishers, or QMS Cattle Assurance certification, whilst livestock businesses in general would be required to carry out feed and forage analysis, and outline a breeding and marketing plan.

A separate section could be dedicated to agri-environmental management which would build on the baseline minimum biodiversity enhancement requirement, and which is discussed in some more detail further below.

A simplified example overview, for illustrative purposes only, of the potential structure of such a future agricultural support system is shown below.


future Scottish agricultural support scheme
minimum baseline requirements
agri-environment scheme
suckler beef and sheep
arable
dairy
HNV
multi-sector or non-sector specific
minimum sectoral requirements
minimum sectoral requirements
minimum sectoral requirements
minimum sectoral requirements
management options 1,2,3
management options 1,2,3
management options 1,2,3
management options 1,2,3
management options 1,2,3
capital items 1,2,3
capital items 1,2,3
capital items 1,2,3
capital items 1,2,3
capital items 1,2,3

16. Annex

The Suckler Beef Climate Group received a large number of literature to help inform its proposal for the SBCS. This includes various presentations that were given to the group along with responses being submitted by industry bodies, organisations and private individuals following the publication of a call for evidence. Further literature includes already published research documents, studies and discussion papers.

For the purpose of this report, the following attachments summarise the presentations given to the group as well as any documentation received in response to the call for evidence and specifically written up as evidence for the SBCS. Additional e-mail correspondence and documents that are already publicly available also proved an extremely valuable source of information but are not included within the below overview.

Annex I: Agricultural Industries Confederation Scotland – Evidence

Suckler Beef Climate Group – AIC Scotland Evidence.

The Agricultural Industries Confederation represent the Agri-supply industry here in Scotland, our members can play a key role in helping to meet many of the aspirations of the suckler beef group. Our members are heavily involved in the beef industry through our members roles in the provision of agricultural inputs and of equal importance, the provision of advice.

AIC Scotland represents the following sectors: Feed, Seeds, Crop Marketing, Crop Protection, Agronomy and Fertilisers. We are involved with a number of industry lead initiatives which aim to increase the sustainability of the industry, of particular relevance is the Feed Adviser Register which was launched in 2013. Full details of the this and the value of it can be found in the attached document (Status of Agricultural Knowledge – Development & Advice Spring 2018). This document provides an overview of the role which advice and knowledge transfer can have in improving productivity and environmental outcomes.

We see our role in terms of sustainability as two fold;

1. To improve reduce the environmental footprint of manufactured feeds and fertilisers.
2. To provide advice and knowledge transfer to help farmers become more efficient through schemes such as FAR, which help farmers feed their livestock more efficiently.

AIC are currently in the process of developing a set of sustainability road maps for the Agri-supply industry. These roadmaps seek to firstly chart the huge progress which has been made in improving our members environmental credentials, whilst simultaneously highlighting the options which members could adopt to further reduce their carbon footprint. The roadmaps will also serve as a mechanism to highlight to government the key roadblocks to change whether that be access to finance or level of risk associated with new green technologies.

One thing which we must be very aware of on our journey to a net zero future is the need to ensure that we do not export our production to third countries or undermine domestic production with unfair competition from imported products which are produced to much lower environmental standards.

With regard to the specific actions which the group are looking into I have added our views and suggestions where appropriate.

Feeding.

- Positive developments so far; through policy interventions and joint farmer/adviser relationships we have increased the conversion of Nitrogen in fertilisers and feeds by over 30% thus reducing nutrient surplus, increasing NUE and reducing emissions intensity.
- The carbon footprint of manufactured feeds has reduced by 36% over the last 30 years.

- There is more we can do; Increase funding into research into novel feed additives to mitigate methane emissions. The most common additives researchers are working with are plant extracts including fatty acids, dietary lipids, essential oils, condensed tannins and plant saponins. These additives generally manipulate the rumen fermentation environment to achieve greater efficiency. This range of feed additives has the potential to deliver the following improvements in ruminant nutrition;

    1. Increased feed conversion efficiency/productivity
    2. Stabilise rumen pH to reduce acidosis
    3. Increase dry matter intake
    4. Reduce methane production
    5. Improve meat quality

- Work is also being carried out with other feed materials such as seaweeds and activated charcoal. A number of our member companies are now selling such dietary additives which are proving to be effective and increase productivity.
- In our view key to improved feed efficiency is advice and knowledge transfer, which is what the Feed Adviser Register was set up to do. By ensuring farmers take advice from a FAR registered feed adviser we can improve feed efficiency and reduce the environmental footprint of production.
- One of the simplest things which the industry could do would be to ensure that existing best practice is adopted by all producers, if the performance of the top 10% could be replicated across the industry that would represent a huge environmental benefit.
- Sustainable protein sources – there are a number of new sources being actively researched these include by-products from human food production, algae and canola oils as well as the potential for using insect protein.
- AIC members are committed to the responsible sourcing of imported protein including soya.

Breeding

- Animal genetics – low emitting cows a recent study involving SRUC, The Roslin Institute and the Rowett Institute identified a genetic link between host animals, the microbial community in their digestive tract and the methane they produce. Identifying low emission families in groups of cows is a developing area, investing in R&D in this area could provide part of the answer to reducing emissions.

Health Improvements

- The group will be aware of the work done by AHDB on the creation of a Ruminant Health & Welfare Group which AIC has actively supported.
- The feed industry has a role to play in promoting uptake of ‘preventative nutrition’ with new feed additives being created which are intended to help animals be more resistant to disease.
- This needs to be combined with professional on farm advice as delivered through the Feed Adviser Register (FAR).

Capital Investment

- AIC believe that one of the most effective investments which government could make would be in access to advice. Our suggestion would be that the government could set up an access to advice fund. Knowledge transfer will be key in helping farmers to transition to net zero. Our members represent an existing knowledge transfer network with 5000 professionally qualified advisers delivering an estimated 44,000 conversations on farm every week. Making use of this tried and trusted network will be essential in delivering the kind of step change needed to achieve net zero by 2045.
- The advice fund could include a suite of recognised/accredited advice including that from crop agronomists, feed nutritionists alongside other specialists.
- No single adviser/person knows everything and therefore it may be prudent to allocate funds specifically to developing longer term farm plans, covering the variety of advice that is needed. It could be envisaged that a whole farm plan would point to the technical/investment/innovative solutions required.

Fertiliser Use

- There is interest among AIC members to set targets for further improvements in Nitrogen use efficiency for all crop types and grass – these would be best set and achieved at farm level. Further improvements could come by adopting the following practices;

1. Improving soil health and condition to improve nutrient uptake
2. Correction of soil pH levels
3. More attention given to achieving optimal nutrient balance, acting on soil analysis results to rectify imbalances
4. Better measurement of soil Nitrogen
5. Better measurement of organic N applied
6. The right fertiliser in the right place at the right time, at the right rate.
7. Improving levels of integrated nutrient management – combining all farm resources
8. Targeted application of fertilisers supported by soil mapping and precision application technologies.
9. Minimise soil compaction.

The current study by the Scottish Government into the effectiveness of nitrogen inhibitors in fertiliser will also be important in improving nitrogen use efficiency.

Clearly all these measures need to be taken in conjunction with professional advice from FACTS qualified advisers, whilst utilising precision equipment and adopting soil testing, something which many of our members can provide to ensure nutrients are targeted appropriately.

Grass Mixtures

We have members who are involved in the breeding and sale of grass seed coupled with professional advice on mixtures to maximise output. There have been significant advances in the seeds market with increased yield potential of varieties which allow for higher yield per unit of land coupled with carbon capture.

The Scottish Government should consider allowing the use of New Plant Breeding Techniques (NPBT's) to speed up development of new crop varieties with useful characteristics i.e. more disease resistance, more resource efficient, nutrient density. Consideration therefore should be given to revisiting the banning of gene-edited crops.

This also applies to the development of new legume varieties such as red and white clover which will play a growing part in the seeds market.

AIC Scotland want to work in partnership with the industry to improve the productivity and efficiency of the industry whilst improving our environmental credentials. Clearly key to this will be tailored and professional advice at a farm level, AIC Scotland members can play a crucial role in delivering this and in so doing helping to achieve an efficient and productive beef industry in the context of net zero.

Ian Muirhead, AIC Scotland Policy Manager.

Annex II: David Ismail, Fordel, Glenfarg – Evidence

Fordel
Glenfarg
Perth
PH2 9QQ

8th March 2020

To The Suckler Beef Climate Group

The ability of the Scottish beef industry to become more sustainable, both environmentally and economically, is by improving profitability, both through increasing efficiency but mostly through improving marketability with differentiation and desirable eating quality.

Scotland is one of the most expensive countries in the world to produce beef in, more comparable in cost structure to Japan, Switzerland, and Holland. Yet the countries that have beef sectors that achieve the highest prices in international premium markets are Japan, Australia and the USA, where top prices are paid for beef graded for eating quality, utilising various measurements ranging from tenderness, marbling, fat colour, texture suppleness, type of fatty acid content etc.

At present, the production of beef in Scotland is graded solely on a meat yield/external fat ratio, with the state controlled marketing body issuing assurance standard certification that no longer differentiates the beef from one farm to another, and is equal to the lowest common denominator, and no longer superior to the supply chain for any of our principal market retailers, whether the product originates in England, Ireland or elsewhere.

Improving the profit opportunity attached to strict environmental disciplines and investment can lead to the Scottish beef industry becoming a sustainable export leader.

Whether the focus becomes on grass fed only beef, or heavily marbled beef, the genetics, the technology, capabilities and farmers are available. Feed efficiency research or remodelling the beef cow is not necessary as the knowledge and technical skills are already available, just lacking the industry coordination and investment to be married to the existing army of progressive farmers currently being held back.

Carbon audits are a wonderful tool to provide measurement and assessment, but pointless without investment opportunities for the farm to restructure and modernise. In Holland, Japan and Switzerland, grants have been massively instrumental in ensuring the watercourses are beautifully managed right beside some of the most intensive livestock operations, where investment has been in automation and dung management facilities. Even in England, the grant structure has provided the combination of easy to access grants to fence off water courses, provision of water troughs, gateways, bridges etc, while also grants to invest in new technologies with livestock production, dung management etc. Further, subsidies have been instrumental in developing a new beef sector within England, with numerous farmers entering schemes with Natural England, producing grass-fed only beef, with native breeds on organic and species rich grassland. The type of cattle being sourced by such farms is more moderate than in Scotland, and arguably more naturally efficient. An example of the different level of progressiveness was highlighted recently at Farmax workshops for improved grassland management, where in Scotland just a handful of SAC consultants attended compared to in England where hundreds of farmers signed up for training.

A key cost difference incurred in Scotland is wintering, requiring shelter, bedding, feeds, labour, and the resultant manure, dung, slurry, or poaching. One way to assist with this cost is to turn manure from a liability into an asset, for example, requiring that arable fields must have the application of manure once in every four years to enhance carbon sequestration and soil structure. Improving soil structure, through greater and better dung/slurry management, not only facilitates greater carbon sequestration but also reduces imported fertiliser requirements. Improving grassland management, raising the ph with liming thereby extending the grazing window and aiding water absorption, combined with more suitable livestock genetics and performance, have all been shown as tools to be working towards a low carbon beef future, through science not fiction.

A more sustainable future for the beef industry in Scotland requires the Scottish government to be working more in partnership with Scottish beef farmers to achieve the desired goals in contrast to current role at Saughton House. An example would be the Beef Efficiency Scheme which has the correct ambition in philosophy but has been inept in implementation, a tragic waste of resources and is simply an academic's repeated attempt to reinvent existing wheels.

The genetics to deliver a modern environmentally sustainable beef industry are available, as are the progressively minded farmers, but cannot be implemented while the marketplace, including the governmental departments, are disjointed in priorities.

The combination of politics and circumstance provides our beef industry with a unique opportunity to put in place policies to create a low carbon beef future that markets a more desirable product thereby creating greater sustainability financially as well as environmentally.

Many best wishes

David Ismail

Annex III: Highlands & Islands Agricultural Steering Group – Evidence

SUCKLER BEEF CLIMATE CHANGE GROUP: CALL FOR EVIDENCE

Respondee: Highlands & Islands Agricultural Steering Group

This document is submitted in response to the Stakeholder letter from Michael O'Neill dated 21 February 2020.

Highlands and Islands Agricultural Support Group is a group comprised of all the local authorities in the Highlands and Islands with strong NGO support. We welcome the opportunity to give evidence to the Suckler Beef Climate Group (SBCG). The retention of cattle on holdings in our region is of substantial importance. Concerns about the loss of livestock, and especially of breeding cattle, has and continues to be, a serious issue for our area and has been foregrounded in all the work we have done since the group was formed in 2009.

We consider that extensively raised, grass fed cattle which typify this region play a significant role in the retention of people and services in our rural areas as well as providing significant environmental benefits in terms of, among other aspects, creation and maintenance of bird habitat. Our comments on the bulleted headings in your letter and are as follows:

Improving efficiency, productivity and profitability of beef produced from the suckler her and the wider beef sector in Scotland

1. This could be enhanced through the **creation and greater use of local abattoir or co-operative processing/marketing facilities,** and improved focus on the use of local food by large organisations and procurement systems generally. This would not only create a greater local market and closer link between local food producers/service providers and the end customer, but also improve security of the food chain and scope for vertical integration as well as significantly reduce Food Miles and impact on climate change.

2. It is recognised that currently there are challenges in ensuring the economic success of local abattoir facilities including substantial capital costs and ensuring consistency and continuity of supply. However, a good example is the co-operatively run abattoir and processing facility operated by SLMG in Shetland. This kills and processes cattle, sheep, and pigs, and has operated successfully without significant subsidies.

3. A greater cultural shift towards more **concerted use of co-operatives** at grass roots level with the appropriate access to innovative advice and funding, has the potential to positively contribute to the security of such facilities and issues of supply. Again, the Shetland case is a strong example, effectively operating subsidy free since it was set up, and within a co-operative structure.

4. **Greater focus should be given to procuring local food** by organisations such as NHS and local authorities. This has been pursued for many years, with very limited success. We would **suggest that a study be undertaken** to identify the primary obstacles which have prevented this to date and that SG tables discussions with the relevant parties on how a more "local approach" towards procurement might be achieved going forward, taking on board successes and lessons learned from other countries where appropriate. Clearly, cost efficiency must remain a factor however greater weighting to food miles and other aspects eg. contribution to local economy, should be given due credence against the current very financially driven assessments.

Enhancing the environmental contribution from the sector through identification of practical ways in which the greenhouse gas emissions of the beef sector can be reduced.

5. Most of the cattle raised in the Highlands and Islands are predominantly grass fed, with many of those in the North and West of our area being farmed on a very extensive basis utilising less productive grass and rough grazings. However, as a region challenged by remoteness including scattered populations and dependence on ferries, our cattle industry already incurs enhanced costs. If the wholesale loss of cattle from our rural areas is to be avoided, we would advocate that **priority be given to tools that not just aid greenhouse emissions, but which can also potentially reduce operational costs** e.g through collaboration, including machinery/equipment where our existing weather windows and distance allow.

Mitigating other environmental impacts of production and enhancing contribution to sustainable land use, especially soil health and grassland management and other on-farm habitats.

6. Much of the cattle industry in the Highlands and Islands is grass based and often very extensive in nature. With the exception of the more intensive and productive easterly coastline, parts of Caithness and Orkney, many of our cattle producers are based on **smaller holdings and crofts** where minimum inputs are already driven by both financial necessity and remoteness.

7. We consider that an increased drive for education/focus on the importance of soil structure, appropriate use of fertiliser (organic and inorganic) and appropriate grazing management can provide both positive environmental outcomes and assist financial efficiencies. Key to the success of this however is getting these messages to **those in the more remote areas and/or not already on-board.**

8. Within our boundary, in addition to unique environments/economies such as those on our **Island communities** e.g Orkney which has relatively significant cattle numbers, we also have the **Cairngorms National Park**, home to not only a large number of environmental designations and key species, but also upland breeding cattle units. The HIASG area therefore offers significant scope for pilot work to explore the future interaction and impact of climate change on a number of fronts.

9. The Highlands and Islands produces a considerable amount of very high health store stock, which is sold into finishing but also very important high health breeding stock. It is important to do what is necessary to ensure this important resource to the whole Scottish beef industry is not lost

   Drew Ratter, HIASG Chair

   9 March 2020

Annex IV: Institute of Auctioneers and Appraisers in Scotland – Evidence

IAAS

9 March 2020

Rural Centre,
West Mains,
Ingliston,
Newbridge,
Midlothian,
EH28 8NZ

Suckler Beef Climate Group Secretariat,
D1 Spur,
Saughton House,
Edinburgh,
EH11 3XD

By email to: Julie.brown@gov.scot

Dear Suckler Beef Climate Group Members,

Suckler Beef Climate Change Group Call for Evidence

I respond on behalf of the Institute of Auctioneers and Appraisers in Scotland to your call for evidence issued on 21st February 2020.

Greenhouse gas emissions from the livestock sector have been under the spotlight recently and IAAS has been active in this space in an effort to support the sector whilst also recognising that we all have a part to play in building on the efficiency gains of the last 30 years. Livestock markets want to have a leading role in the sector and as such we are fully supportive of efforts to reduce the sectors carbon intensity.

There must be recognition that the baseline accounting needs to be correct so that the sector is fairly treated, but also that it has a clear view of how and where improvements will have the best effect. Therefore, our first area of feedback for the group is:

- Alongside other stakeholders, persuade government and IPCC to utilise the GWP* methodology of measuring methane emissions.
- The study is linked here: http://dx.doi.org/10.1038/s41612-019-0086-4.
- There is a You Tube presentation from the NFU 2020 Conference linked here: https://www.youtube.com/watch?v=AtAsvoJY3ks - presentation from Prof. Myles Allen, one of the lead authors of the study who also sits on the IPCC.

Getting this baseline accounting right is vital to how we properly step forward.

This also leads to a consideration about the potential carbon storage in grazed land. Some form of study on the storage potential of grassland that could only be grazed by suckler cows and/or sheep may also provide some additional benefits to the environmental balance and accounting that goes on. A second area of feedback is therefore:

- Encourage government to undertake a fuller study into the sequestration ability of grassland managed under suckler cow production.
- Analysis of the wider contribution that suckler beef can have on mixed farming systems. For example, by introducing suckler beef to arable systems to rebuild soil organic matters thereby improving sequestration potential whilst reducing the use of nitrogen based fertilisers thereby minimizing nitrous oxide emissions. Can this improvement in land management through livestock negate the GHG emissions?

We would back up the suggested actions that the group may seek to examine particularly around grassland management, breeding, efficiency and health improvements.

Genetic gain in the suckled beef sector has been limited compared to other livestock sectors and we believe that there are some strides that could be made in this area. Whilst dairy related, the Fast Breeders project (https://www.sruc.ac.uk/news/article/2389/minister_gets_up_to_speed_on_fast_breeders) may offer some opportunities to consider how suckled beef breeding may improve to help reduce the GHG footprint. This could be from improved growth rates through to be better health traits as examples.

Improved manure and slurry management on farms could also offer opportunities to reduce GHG emissions. This could anything from covering slurry pits to minimize emissions to longer term storage to ensure timely application thus reducing use of synthetic fertilisers and the impact of these as previously noted.

The challenge with both of these areas is the investment required to ensure that they can be delivered. Current suckled beef economics makes it very difficult to justify additional capital and research spend. Therefore, we would support:

- A capital grant fund for all farmers to help manage slurry and manure more effectively.
- Research funding at a national level to support genetic improvement with additional funding at farm level to aid implementation of these recommendations.

Transport and movement are also key considerations in the beef sector and in rural areas. Moving away from fossil fuel power in rural areas seems a distant thought. Therefore, the group may wish to consider how rural areas can improve access to low emission technology on farm and whether capital support could be provided to speed the journey up.

- Consideration for capital funding to build biogas plants on farms to enable vehicles to run on gas produced on farm or for clean gas export.
- Potential for capital funding to enhance electric vehicle infrastructure on farm and in rural communities such as markets.

A vital part of the climate change story that is often overlooked is the value of water now and in the future. Scotland is blessed with water and water quality and the value of this will increase dramatically in future years as other areas of the planet suffer from water stress. We should be planning around better water usage

now and consideration should be given to:

- Collection and reuse of rainwater in livestock production.
- Longer term storage solutions to take advantage of surplus water to be used when deficient.

The key with any of these recommendations and potential changes will be how they are communicated, and the knowledge is exchanged. The reach of IAAS members means that they will communicate with more livestock farmers than other organisations on a regular basis. We can then help with message dissemination and facilitate knowledge exchange through market sites.

Finally, we wish the group success in its mission and offer our support as required.

Yours faithfully,

Neil Wilson
Executive Director
Institute of Auctioneers and Appraisers in Scotland
Tel: 07717 662055
Email: neil@iaas.co.uk

Annex V: National Farmers Union Scotland – Evidence

NFUScotland

Submission

Date	: 6 March 2020
To	: Suckler Beef Climate Change Group
From	: John Armour, Jonnie Hall, Ruth Taylor, Penny Middleton
Direct dial	: 0131 472 4000
E-mail address	: john.armour@nfus.org.uk

SUCKLER BEEF CLIMATE CHANGE GROUP: CALL FOR EVIDENCE

Introduction

1. NFU Scotland (NFUS) welcomes the opportunity to respond to the call for evidence launched by the Suckler Beef Climate Group (SBCG). Farmers and crofters in Scotland are on the front line experiencing the impacts of climate change and are committed to being part of the solution.
2. Scottish suckler beef producers are already undertaking a range of practical measures to reduce emissions. These include improving livestock health and efficiency, soil management and sequestration, efficient use of fertilisers, slurry and manure.
3. Scotland should be able to demonstrate that its beef production has a lower carbon footprint than competitors. The greenhouse gas intensity of beef produced in the UK is significantly lower than average global production. The greenhouse gas intensity of UK-produced beef is 48kgCO2e per kg of meat, while the global average is 99kgCO2e per kg.[1]
4. NFUS supports the Farming for 1.5 Inquiry on food, farming and climate. The Inquiry is looking to build consensus on the pathway for Scotland's food, farming and land-use sectors in the context of climate change. The views of this group will be of specific interest to the SBCG.

[1] Land use: Policies for a Net Zero UK, Committee on Climate Change, January 2020, https://www.theccc.org.uk/publication/land-use-policies-for-a-net-zero-uk/

Key messages

- The SBCG must give consideration to balancing benefits to productivity, biodiversity and habitats, and greenhouse gas emissions reduction.
- Output from this group should seek to inform delivery of improvements to management, through disease control and eradication, capital investment in infrastructure and information-led breeding decisions. Together these will result in mid to long-term gains to productivity and reductions in greenhouse gas emissions.
- Suckler beef farmers must be supported to reduce greenhouse gas emissions through the delivery of a scheme which incentivises on-farm productivity improvement.

Production based improvements

5. NFUS proposes that the BES be replaced with an effective Beef Improvement Programme. This should be informed by lessons learned from the BES, and with greater input from producer representatives. Poor administration of the BES did not deliver on ambitions to drive production-based improvements, incentivising breeders to collect data, regular carbon auditing, a national genetic analysis through on-farm tissue sampling.
6. Profitability is a priority for suckler producers. According to 'Farming for a Better Climate', using SAC data "achieving 5% greater calf numbers reducing barren cows and calf mortality could improve finisher cattle sales by over 3t liveweight per 100 cows and reduce greenhouse gas emissions by 10% per kg carcase weight"[2].
7. Marginal gains to whole herd fertility can lead to reductions in carbon emission intensity through:

[2] "How do we reduce emissions from beef?", Farming for a better climate, https://www.farmingforabetterclimate.org/downloads/practical-guide-how-do-we-reduce-emissions-from-beef/

- Ensuring appropriate nutrition to maintain fertility. The SBCG should consider what practical steps can be introduced to incentivise improvements to nutrition, for example through improved on-farm recording of rations.
- Improved recording of herd performance can give producers the information necessary to ensure improved breeding decisions. The success of a suckler herd is dependent on the fertility of replacement cows. Where these are being bred on farm it is vital that sires are chosen which demonstrate EBVs (Estimated Breeding Values) suitable for replacement cows. The SBCG should consider the approach to this in the BES, and how lessons learned can be built on and expanded in a future scheme. An effective Beef Improvement Programme that enables pragmatic actions would deliver this.
- The SBCG should consider how to incentivise ensuring an early start to calving replacements. Managing replacement heifers is an essential aspect to replacing the breeding herd. Generally, ensuring an early start to calving replacements at two years can shorten generational gaps and can improve genetic improvement.

8. The SBCG must consider changes to common practices around creep feeding that will result in improved productivity. Feeding of cows and suckled calves is an essential aspect of business performance. By the time a calf is 200 days old three quarters of its nutrient requirements will come from feeds other than milk.
9. NFUS note that work has been undertaken to identify the opportunities of reducing GHG (greenhouse gas) emissions through feed additives. Work has already been done on behalf of Scottish Government[3], which identifies that opportunities may exist to reduce GHG emissions but more work is needed to identify opportunities and costs of this. The SBCG should consider if additional funding should be targeted toward research in this area and, depending upon the outcome of this research, how these feed additives could be rolled out and used across the industry.

[3] 'Nutritional strategies to reduce enteric methane emissions', ClimateXChange, September 2016, https://www.climatexchange.org.uk/media/2033/nutritional_strategies_to_reduce_enteric_methane_emissions.pdf

10. Production diseases directly challenge the productivity of suckler herds. The SBCG should consider lessons learned from the ongoing BVD (Bovine Viral Diarrhoea) eradication scheme and consider further measures to tackle other endemic diseases in cattle, including IBR (Infectious Bovine Rinotracheitis). The SBCG should seek advice on how incentivisation could improve control and vaccination.

Capital investment improvements

11. The SBCG must explore opportunities for capital investments on suckler farms. Handling facilities, weight crates, EID readers can deliver improvements in productivity while maintaining high welfare and resulting in improved health and safety outcomes.

12. NFUS has already outlined capital investments which can be delivered in the livestock sector in our 'Steps to Change' paper[4]. Those relevant to suckler production and greenhouse gas emissions include:

- Data management systems for health and welfare, yield/weight gains, breeding and genetics.
- Electronic identification and data capture equipment, with herd/flock management software.
- New or refurbished housing systems, including fit-for-purpose handling facilities.
- Automated systems for feeding.
- Slurry and manure storage facilities and spreading equipment for better resource utilisation and emissions reduction.
- Fencing to improve grazing management and biosecurity.
- Renewable energy, including biomass and anaerobic digestion, to reduce energy costs of housing.

[4] 'STEPS TO CHANGE: A New Agricultural Policy For Scotland, NFU Scotland, https://www.nfus.org.uk/userfiles/images/Policy/Brexit/STEPS%20FOR%20CHANGE%20March%2020018%20-%20for%20email.pdf

Impact on running costs

13. The SBCG should consider how running costs and net margin relate to the GHG emissions intensity of a beef enterprise. The group should also explore opportunities to unlock on-farm investment via funding assistance and incentivisation. Current business profitability means that significant investment in the short term is unfeasible for many businesses - current running costs do not allow for significant capital expenditure.

14. Profitability is a challenge for suckler beef farms in Scotland. QMS figures for 2019 demonstrate an average net margin of -£202.41 per cow for hill suckler producers, a net margin of -£24.11 per cow for extensive upland suckler producers and a net margin of -£16.39 per cow on non-LFA lowground suckler herds.[5]

15. These figures, although using a relatively small sample size, do demonstrate significant variation between the top third and bottom third in each category. Businesses which perform better demonstrate a lower GHG intensity per liveweight kilogram (lwt kg). However, QMS figures reveal that within the non-LFA lowground category that the GHG emissions intensity is highest for the top third.

16. While QMS figures demonstrate a tight control of fixed costs on suckler beef enterprises, the low and deteriorating net margins highlight the challenge in delivering profitability.

17. Despite the anomalous figures revealed on non-LFA lowground production from the QMS Cattle & Sheep Enterprise Profitability report, it is generally assumed that improvements in productivity, and therefore comparative net margins, will result in lowering GHG emissions intensity.

[5] 'Cattle & Sheep Enterprise Profitability in Scotland, Quality Meat Scotland, 2019, https://www.qmscotland.co.uk/sites/default/files/20191111_qms_cattle_and_sheep_2019_pages_final.pdf

Grassland management

18. The SBCG should consider the practical actions which could be undertaken to enhance grassland productivity. Good grassland and soil management practices increase the storage of carbon dioxide through sequestration. Take up of these measures is dependent on location, with significant variation in Scotland due to soil type, climate and localised weather.

19. Productivity of grassland can be improved through fertilisation and seeding with high yielding species and legumes. This approach to enhancing productivity can also enhance the carbon stocks in grassland.

20. Support for liming would deliver on-farm productivity increases. However, NFUS understands that the net impact of liming on soil carbon is unknown. The SBCG should consider how liming could enhance environmental delivery in relation to suckler beef enterprises.

21. The availability of practical information would assist in decision making. NFUS has proposed on-farm environmental measures which could deliver national environmental benefits including:

- Soil health and nutrient management plans.
- Soil sampling and targeted input use.
- Enhancement of soil organic matter

Restoration and improving habitats on-farm

22. NFUS has outlined that measures should seek to deliver for climate change and the environment. Measures should improve water quality and biodiversity, but also embrace habitats, air quality and landscape character. NFU Scotland outlines the need to for support measures which deliver:

- Integrated Pest Management (IPM).
- Farmland biodiversity options for arable land and grassland.
- Pollen and nectar rich margins.
- Winter feeding options for wildlife.

- Management of the cultural and historic environment.
- Moorland management, including peatland restoration and bracken control.
- Habitat creation and management.
- Scrub and invasive species management.
- Management of designated sites, including SSSIs, SPAs and SACs.
- Arable reversion.
- Management of semi-natural and species rich grasslands.
- Creation and management of wetlands.

Conclusion

23. In 'Stability – The Platform for Change'[6], NFU Scotland outlines that steps must be taken from 2021 to enable Scottish agriculture's transition to lower emissions and deliver efficient production systems.

24. The Scottish Government must learn lessons from the Beef Efficiency Scheme, and focus on production efficiency, climate change and environmental aspects of the suckler beef sector. NFU Scotland proposes that the BES be replaced with an effective Beef Improvement Programme that enables pragmatic actions to deliver on this.

25. Additionally, NFU Scotland is proposing the newly establish Agricultural Transformation Programme should be used specifically to:

- Develop pilot schemes to reduce greenhouse gas emissions from agriculture.
- Encourage more woodland integration and agro-forestry on Scottish farms.
- Promote the multiple benefits of good grassland management.
- Encourage more farmers to invest in renewable energy, including bio-energy, to meet their energy needs.

[6] 'Stability – The Platform for Change, NFU Scotland, March 2020, https://www.nfus.org.uk/userfiles/images/Policy/Stability.pdf

- Support an evidence-based approach to crop production and selection.
- Explore the development of models to demonstrate and promote carbon neutral farms.
- Support measures to tackle losses through endemic disease and improve fertility and survival of livestock.

Annex VI: Quality Meat Scotland – Evidence

Suckler Beef Climate Change Group
Call for Evidence

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Date: 09 March 2020

Contents

1. Introduction

Quality Meat Scotland (QMS) is the Non-Departmental Public Body for the Red Meat Industry in Scotland. The red meat industry is a key sector for Scottish agriculture, worth in excess of £2 Billion to the Scottish Economy, and supporting 50,000 jobs within the supply chain.

QMS's revised strategy launched in February 2020 is based around four key pillars of activity: To Promote, Develop, Support and Protect the Scottish red meat industry.

We lead on several initiatives and projects that underpin the Scottish red meat brands Scotch Beef PGI, Scotch Lamb PGI and Specially Selected Pork, including the management and development of the QMS Quality Assurance Schemes which have a voluntary membership of 10,375 members.

QMS is a unique organisation in Scotland, with a unique footprint, covering each of the following sectors:- pig farming, cattle & sheep farming, abattoirs & processors, auction marts, hauliers, feed merchants, vets, butchers, chefs, supermarkets, farm shops, restaurants both commercial and publicly procured. This unique footprint covers full animal production, processing, butchery and cooking and QMS through its marketing of the Scotch Beef PGI, Scotch Lamb PGI and Specially Selected Pork Brands is the interface between the supply chain and consumers.

Purpose of this Response
This evidence is provided to the Suckler Beef Climate Group (SBCG) based around the data and evidence we have available as follows: -

- Farm greenhouse gas emissions in Scotland
- What our ongoing industry development work tells us about how we can identify solutions to move our industry forward.
- What our consumer insight information tells us about what consumers are looking for from a Scotch and Scottish red meat product

The purpose of this QMS response is to assist the Suckler Beef Climate Group (SBCG) to make decisions that will assist in the reduction of greenhouse gas emissions and to suggest ways that the production of beef in Scotland could be made more sustainable through:

1.0 Improving efficiency, productivity and profitability of beef produced from the suckler herd and the wider beef sector in Scotland

2.0 Enhancing the environmental contribution from the sector through identification of practical ways in which the greenhouse gas emissions of the beef sector can be reduced.

3.0 Mitigating other environmental impacts of production and enhancing contribution to sustainable land use, especially soil health and grassland management and other on-farm habitats.

What is Sustainable Beef Production?

Sustainability as it relates to food production can be a challenging word for all vested stakeholders to agree upon. After all, everyone is a stakeholder when it comes to food — 100 percent of us eat food. That said, broad agreement exists that sustainability encompasses a balance of environmental, social and economic considerations and that sustainability is about long-term focus. The United Nation's definition for sustainability is about "meeting the needs of the present without compromising the ability of future generations to meet their own needs."

For QMS sustainability is about producing safe and nutritious beef with a commitment to environmental stewardship, social responsibility and economic viability. In practice sustainability for the farming community is about being a caretaker to the animals, a custodian of the land and waters on farm, being part of a close-knit community, whilst aiming to make a profit while doing it. Simply, sustainability to farmers is leaving their business better than they found it, many farms in Scotland have been handed down from generation to generation and in terms of sustainability for current farmers it is ensuring that there is a profitable farm to pass on to the next generation.

1.1 What Can the Scottish Red Meat Industry Do to Assist in the Reduction of Greenhouse Gas Emissions?

Beef production is at the heart of Scottish agriculture. With an output of some £830.6m (*QMS Red Meat Industry Profile 2019)* the beef industry alone makes up 26.1% of Scottish agricultural output and is the biggest single sector of the Scottish agricultural industry. Almost 12,000 holdings draw some income from a beef enterprise *(Beef 2020: A Vision for the Beef Industry in Scotland)*.

However, beef farming in Scotland is not fulfilling its potential. Whilst prices paid per kilogram are higher than in other parts of the UK, and Scotch Beef is widely recognised for its quality, there are many areas of technical underperformance. If all performance opportunities could be maximised, the potential additional output could run into several hundred pounds per animal for the farmer *(QMS Enterprise Costings 2019)* improving both business and supply chain sustainability and profitability.

1.2 QMS Enterprise Profitability Survey and Analysis of BCMS Data

QMS collates a range of industry data to determine enterprise profitability for several different production systems found within Scottish Agriculture. This also incorporates estimates of GHG emissions from different beef production systems for several years (see Table 1). It highlights two things:

- considerable variation within production systems
- considerable variation between production systems

The data suggests that for many producers there is considerable potential to reduce GHG emissions. The data also shows a clear correlation between lower GHG emissions per kg of beef produced or emissions intensity (environmental sustainability) and enterprise gross margin (economic sustainability). However, it must be recognised that GHG intensity is only one part of environmental sustainability which also includes biodiversity and water quality for example.

The close correlation between emissions intensity and enterprise profitability also begins to highlight the measures that can deliver improved environmental and economic sustainability. These include:

- Animal Productivity
- Animal (growth) Efficiency
- Resource Efficiency: organic and inorganic manures, feed conversion rates, animal health.

1.3 Key Drivers for Increased Greenhouse Gas Emissions

One of the key drivers identified that leads to increased greenhouse gas emissions on farm is animal productivity, with fertility alongside neonatal losses all impacting on fewer calves being weaned and output being reduced. According to BCMS data, 26,131 beef-sired cattle under 22 months of age or less died on Scottish farms during the 2019 calendar year, making no positive contribution to the sector. Of these, 21,884 died at 12 months or less and 15,380 under 6 months.

Around 450,000 beef sired calves are born each year in Scotland so the on-farm losses below 22 months of age represent around 6% of potential beef production. In 2019 total calf registrations in Scotland were 552,721. The June census for Scotland recorded 593,200 beef or dairy cows and heifers on Scottish holdings that had had a calf. Extrapolation of this data suggests that in any one year around 93% of cows have a calf. Allowing for annual on-farm deaths this points towards a situation where only 88% of all cows in Scotland produce a calf that survives to one year old. This estimate is broadly consistent with the rearing percentages reported in the QMS Cattle and

Sheep Enterprise Profitability Report (2020 edition). Delivering 20,000 more cattle, equivalent to 3.4% more cows rearing a calf to the point of slaughter would increase

farm revenue by around £30m per year, as well as reducing the CO_{2e} for the farm business.

The following table demonstrates and as referenced earlier, there is significant variability both within and between production systems. Variable production systems are a unique feature of the Scottish livestock industry and the landscape that beef cattle occupy and are reared on. Within each production system, a differing set of physical and social barriers will exist to changing practices.

	Bottom Third		Average		Top Third	
	Kg output per cow	CO_{2e} / kg output	Kg output per cow	CO_{2e} / kg output	Kg output per cow	CO_{2e} / kg output
Hill Suckler Herds						
2015	222	35.4	270	29.2	324	26.8
2016	263	29.7	278	25.6	293	23.0
2017	198	40.3	258	26.4	330	21.0
2018	199	39.6	237	29.9	266	24.2
Upland Herds Selling At Weaning						
2015	258	24.2	266	26.1	282	25.6
2016	258	24.6	279	23.6	312	21.5
2017	249	29.7	269	27.1	313	28.3
2018	249	35.0	277	25.1	296	22.9
Upland Herds Selling Yearlings						
2015	334	21.8	347	21.7	374	20.7
2016	310	21.1	343	19.4	362	19.6
2017	344	20.9	345	20.2	345	18.9
2018	330	23.4	336	20.4	355	19.5
Lowground Suckler Herds						
2015	266	26.8	286	23.8	305	19.1
2016	268	30.8	288	30.1	326	33.6
2017	243	28.7	278	27.6	286	26.3
2018	258	21.0	277	23.4	291	26.0
Rearer Finisher Herds						
2015	475	17.3	489	17.8	515	17.6
2016	402	19.3	473	18.1	570	16.7
2017	358	22.0	439	20.6	537	16.3
2018	477	20.3	536	18.4	619	16.5

Source: QMS Cattle and Sheep enterprise profitability 2019 edition

1.4 Major issues within the red meat supply chain that need addressed

The need to change both our beef industry and more specifically our suckler beef industry is urgent. The industry faces a range of threats and challenges which will impact ongoing profitability. The main challenges from within the supply chain are;

A. **The Changing Farm Support System.** The farm support system in Scotland and the UK will be reformed. Scotland has chosen a two-step agricultural policy reform, with The Rural Support Bill giving the legislative base for agricultural support between 2020 and 2024, and a new Agricultural Bill being developed from 2024 onwards. Changing farm support system gives way to uncertainly and can delay investment decisions being made and can also impact on cashflow at farm level.

B. **Environmental Restriction.** Red Meat production is under intense pressure surrounding its potential environmental impact. The Scottish Government have declared a climate emergency and the Climate Change Bill was passed in October 2019 to set a pathway for Scotland to achieve net zero carbon emissions by 2040. The red meat industry will have to contribute to the meeting of these new climate change targets and will have to demonstrate activity to mitigate their carbon emission output. The more efficient the production system, the lower the environmental impact.

C. **Increased Market Competition.** Post Brexit, it is highly possible that future trade flows will give access to increased amounts of imported beef at zero or low tariff level, thus providing substantial market competition for Scottish livestock farmers. This means that Scotch Beef PGI will have to compete on price and quality.

D. **Changing Consumer Demand.** Consumers purchasing habits are changing at an accelerating rate. Consumers are gradually moving towards the purchase of products which carry environmental and social benefits in addition to the traditional attributes of price, fat level, and appearance. 1% of the population is vegan, 4% vegetarian and 9% meat reducers known as flexitarians. It is this group that is prepared to pay more for products with strong environmental and animal welfare credentials.

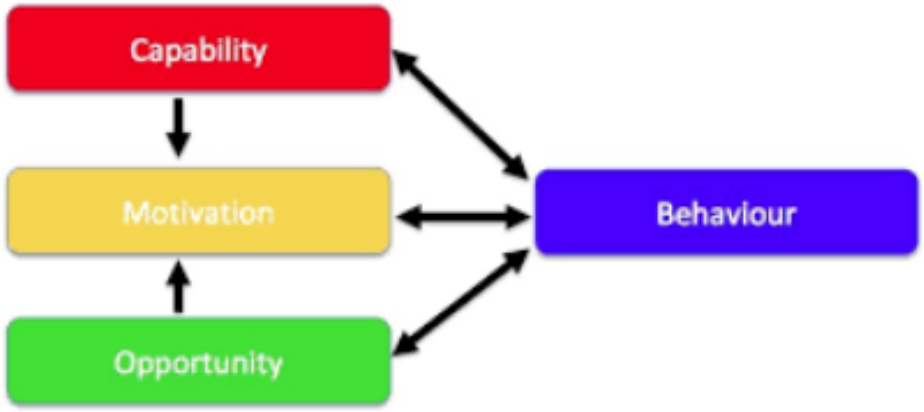
E. **Increasing Product Quality Credentials.** Many studies show the existing variability in beef eating quality. This is a challenge to the industry because research demonstrates that one poor eating experience can mean that the consumer avoids repurchasing it for up to three months, negatively impacting beef consumption. Other work shows that, where consistent quality can be demonstrated, product sales (and price) rise.

F. **Communication within the red meat supply chain.** We have a very disjointed sector whereby collaboration and communication between different constituent parts of the supply chain is poor, leading to mistrust, poor planning, business decision making ability, and overall a poor business operating environment. Many farmers producing store animals do not see themselves as part of the food supply chain, and consequently are not focused on producing the product quality and consistency required to give consumers a consistent quality meat eating experience.

2. Driving Behavioural Change

2.1 Impact and Evidence from current QMS activity

QMS delivers a range of activity and initiatives through its Industry Development department aimed at changing behaviour within the supply chain. These activities are developed using the COM-B model of behavioural change, whereby activity is undertaken that increases both the capability of individuals to change their behaviour (by increasing access and availability of skills and knowledge) and their motivation to change their behaviour (by connecting individuals with a likeminded peer group to maintain momentum between meetings).



Using the evidence generated from the QMS enterprise costings, QMS's Industry Development team has identified key areas of activity to focus on to both increase profitability of farm businesses, and reduce the GHG emissions of farming practices, these being:

- animal productivity
- animal (growth) efficiency
- resource efficiency: organic and inorganic manures, feed conversion rates, animal health.

Several specific project examples are detailed below that demonstrate where activity has led to behavioural change at farm level. Key learnings from each project are also highlighted. QMS also undertakes work within the pig sector in Scotland, the work and impact from which we have also highlighted as we feel there are actions and learnings from the way the pig sector operates that could be beneficial for Scottish beef farms to look at, particularly around production efficiency and supply chain collaboration.

2.3 Better Grazing

The QMS Better Grazing Programme aims to increase the efficiency of output of red meat production in Scotland by developing a knowledge exchange network where members can hear from specialist speakers on specific topics share their experience of increasing the kilograms of meat produced per hectare of land through the better utilisation of grass and the better use of resources. Over the last three years, QMS has delivered 75 workshops across Scotland to over 1000 farmers, on a range of topics detailed below:

Meeting	Topic	Speaker
1	Better grazing – setting the scene	Emily Grant
2	Profitable livestock production from pasture – opportunities and challenges	Trevor Cook
3	Precision grazing – systems, equipment and technology	James Daniels
4	Beating parasites at pasture – worms and fluke	Fiona Lovatt
5	Grazing for growth – Grass, rotational grazing and feed budgets	Poppy Frater
6	Wintering Strategies – Forage crops, all grass wintering	Rhidian Jones
7	Soil health and biology – Grazing, nutrients and carbon	Joel Williams
8	Minerals at Grazing	Fiona Lovatt
9	Multi-species swards – benefits, options and management	Helen Mathieu
10	Sward sticks to software – gathering and using data	Liz Genever

These workshops have proven to be extremely effective in inciting behavioural change at farm level. In an online survey to attendees of Better Grazing sent out in Spring of 2019, 97% of respondents said that they had made a change to the way they manage their business and their grassland resource as a result of attending a Better Grazing meeting. Specific examples of change from attendees include:

> "Introduced rotational grazing system with AWESOME results! Now looking at soil health, particularly with respect to multi species swards and also what we do with fertiliser applications."

"After much delay we will at last be setting up more efficient paddock grazing & refreshing the grassland with more diverse plants."

> "Rotational grazing, Multispecies leys, New fertiliser strategy Better management of ewe BCS"
>
> "Started rotational grazing sheep and paddock grazing cows and calves. It's given me confidence to go full bore into grassland improvement. It has made me think more about soil fertility, building organic matter and making sure pH is correct"

A key feature of QMS's Better Grazing work is the network and peer group interaction that the group sessions facilitate. Within the Better Grazing programme, two specialist pasture-based benchmarking groups, Graze+ North and Graze+ South bring together 30 farmers operating in the top 25% of producers from across Scotland. These farmers act as pathfinders within the industry and have been pioneering new grazing and pasture management methods that other farmers can then learn from. During feedback and evaluation sessions, the success of the Graze+ group has largely been identified as the peer support network that has been created and that group members now feel they have access too, giving both insight and confidence to try new things, and to share successes and failures with likeminded producers.

As a result of evaluation and feedback on our Better Grazing work, QMS will be launching in April 2020 a new network of Red Meat Sustainability Action Groups around Scotland. These groups will bring together groups of producers who are focused on implementing change on their beef and sheep farms, providing them with access to specialist technical support, and peer to peer support to accelerate and support changes being made that will reduce the carbon emissions. These new groups are designed to be an evolution of the exiting Better Grazing Programme, utilising the critical success factor of ensuring that a stable peer group is established to give producers confidence to take forward new ideas and implement changes on farm. They also aim to create a feedback loop to the QMS marketing team with a clear objective of defining what actions Scottish red meat producers are taking to tackle climate change, enabling consumer messaging to be developed based on the generated evidence base.

2.4 Monitor Farm Scotland

The Scottish Monitor Farm programme, 100% funded by The Scottish Government via the Knowledge Transfer and Innovation fund and co-delivered by QMS and AHDB Cereals and Oilseeds. The aim of the programme is to establish a group of farms to serve as monitor farms to help improve the profitability, productivity and sustainability of producers through practical demonstrations, the sharing of best practice and the discussion of up-to-date issues.

As highlighted in section 1.1, part of the issue that forms a barrier to change within the Scottish beef industry is the regional variation between production systems. The Monitor Farm Scotland programme aims to remove barriers to change that present themselves at a local level, using a place-based approach to ensure that solutions and innovations to change are developed form the bottom up, by local members of the farming community.

In the current programme, an emphasis has been on change within some of the harder to reach remote rural communities, with the project being represented in Shetland and Lochaber for the first time. Each individual monitor farm project is facilitated and led at a local level, with a strong emphasis on 'farmer led, farmer driven'.

The current monitor farm programme has identified significant progress in reducing carbon emissions from the suckler beef industry.

The Mitchell family, who host the Borders monitor farm, reduced the emissions associated with their suckler beef enterprise by 30% over the course of a 3-year period. They did this by focusing on technical efficiencies, moving their calving percentage from 85% to 94%, reducing their calving spread from 10 weeks to 6 weeks, and subsequently increasing the output from their beef enterprise by 25%.

John Howie, host of the North Ayrshire Monitor farm whilst not a suckler unit, also managed to make significant improvements to the carbon footprint of his beef enterprise, which is a specialist finishing unit. Focusing on making efficiencies on input use, carbon emissions reduced by 18% over a three-year period. This reduction was achieved by cattle growth rates being increased by focusing on genetics and ventilation within the finishing sheds; cattle sale weights being reduced, reducing the number of days cattle spent on farm, and using less purchased feed with a paddock grazing system in place to utilise the grassland resource better.

Most importantly, the Monitor Farm Programme can be used as a tool to galvanise farming communities at local level to take ownership of change. This is particularly evident in remote rural communities such as Shetland. During a personal development feedback session held in May 2019, attendees identified that the Monitor Farm Programme had:

- Helped to bringing the community together "The community factor of the monitor farm has been helping Shetland as a whole, Shetland's relative isolation has meant that the Monitor Farm project has been of a far greater benefit to this area that it might have been to a more centrally located community"

- Helped to motivate attendees to get things done, being able to pick out advice that suits your individual farm – "If you can get folk thinking differently, they are more likely to seek out further information".

- Looking at practices on other farms- discussing mistakes - "It has been refreshing to hear people openly speaking about what goes wrong" and looking at how things could work first hand through demonstrations at a local level.

The current monitor farm programme ran as a programme consisting of a network of 9 monitor farms across Scotland has also benefitted from being able to link up producers from different parts of the country to assess the impact location has on different farming practices.

One network innovation trial currently being completed was centred around the growing of fodder beet.

A network of 7 farms across Scotland all involved in the Monitor Farm Scotland programme came together to test and trial different varieties, sowing rates and fertiliser application rates involved with the growing of fodder beet. Virtual agronomy sessions were used to share knowledge and insight between the group members, with an eventual output being a network of local datasets that other farmers can use to grow and utilise fodder beet, presented in the form of a Scottish growers guide. Having farmer led and tested data from across the country will significantly increase the relevance and applicability of this data, making it easier to use by other farmers.

2.5 Scotch Beef PGI Performance and Traceability KTIF Project

Whilst knowledge exchange and knowledge transfer programmes have a place to play in driving behavioural change, they can be slow, and rely on the individual to take action, with the individual needing to be compelled into taking action in the first place. In order to speed up the rate of change within the Scotch beef supply chain, a radical change is needed to the way we approach decision making relating to breeding decisions within the suckler beef herd.

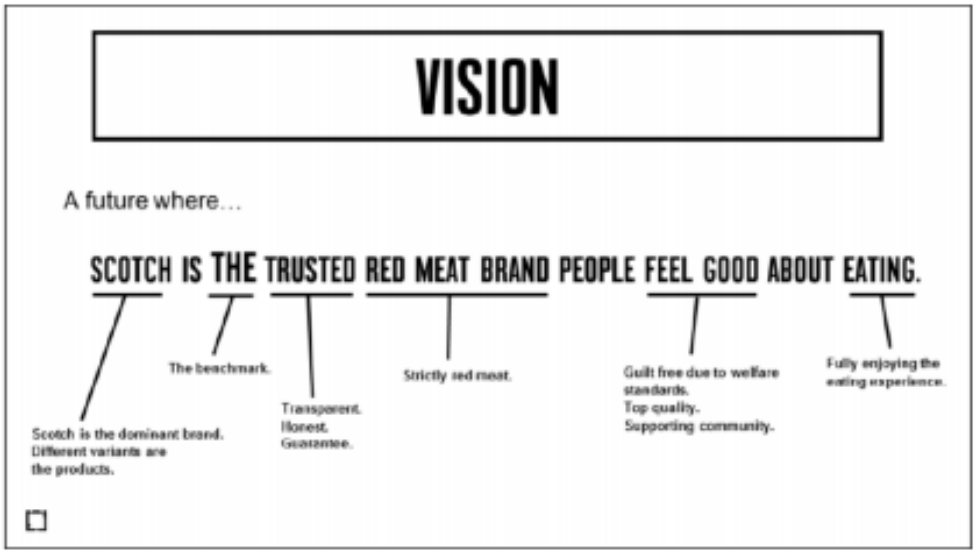
QMS has been considering what steps or programmes could be introduced to both help meet the challenges of the climate emergency and improve profitability within the Scotch Beef PGI supply chain. In December 2019 QMS was awarded funding from the Scottish Governments Knowledge Transfer and Innovation fund to undertake the Scotch Beef PGI Performance and Traceability project. This project is designed as a proof of concept project, that is looking to trial a concept developed by the QMS DNA Feasibility Working Group.

The feasibility study, approved by the DNA working group indicated that the model being developed in this project could yield massive benefits to the industry over a 10-year period, including unlocking up to £160,000,000.00 of cumulative, animal performance related benefit to the Scottish farming economy, representing a ROI of 350%. It would also develop a marketable USP for the Scotch beef brand, making it the only national brand of beef in the world to be 100% DNA verified, giving confidence to both consumers and farmers alike on the provenance and traceability of Scotch beef. In addition, the genetic information generated by this programme would enable Scottish farmers to significantly reduce the carbon emissions related to the production of Scotch beef, providing a secondary brand USP of being able to then market and capitalise on a low carbon beef protein product. Please see Appendix A for details of this proof of concept project

3. Consumer Insight of the Scotch Beef Brand

QMS has recently developed a new marketing strategy led by Director of Marketing and Communications Lesley Cameron, appointed in September 2019. This new strategy is underpinned by a strong evidence base of consumer and market insight that we can develop back down the supply chain to build a product and develop the Scotch beef brand via quality assurance schemes, that aligns with what our consumer base is looking for.

Work undertaken by marketing agency Weber Shandwick in 2018 outlined a vision for the Scotch brand which demonstrates a greater alignment between what consumers are looking for and pre farmgate practices.



What we know, and what is evident from consumer trend analysis is that there is currently a consumer trust crisis and transparency is being demanded within the food system more than ever before. Meat consumption is changing and becoming more conscious – consumers want to make ethical choices.

We want Scotch to become the benchmark for red meat in terms of welfare, transparency and quality. We want to provide a superior experience for people on both a functional and emotional level.

If we want to market a Scotch beef product that truly delivers for these consumers, we must align our production systems, and underpin those production systems with a trusted quality assurance system. Quality assurance standards are what sets Scotch meat apart from other red meat. There is a chain of trust from the farmers to the processors and every link in the chain puts in extra care to meet the assurance standards.

From the 2019 IGD Quality Assurance report commissioned for QMS, it was identified that 'Quality is front of mind for those seeking to 'eat less, eat better' and the Scotch Beef PGI brands offer a clear shortcut for consumers looking to make choices they can feel good about'

The same report highlighted that recognition of the Scotch Beef PGI brand is high (85% of shoppers in Scotland recognise the logo) with clear evidence that for shoppers the Scotch logos represent higher standards than products without the logos. Compared to products which don't have a Scotch logo:

- Two thirds (67%) of shoppers agree that the product has higher welfare standards

- 72% agree that the product is more easily traced to its farm of origin
- 56% agree that the product has higher sustainability standards

IGD polled shoppers in Scotland to gauge trust and confidence in Scotch Beef PGI.

- 70% believe Scotch Beef is the best available
- 85% believe Scotch Beef is a brand they can trust
- 54% would pay more for Scotch Beef

The report also highlighted key consumer claims as their reasoning behind purchasing Scotch Beef PGI, those being to support Scottish farmers; trust in the Scotch brand, and support of the long tradition of producing quality meat.

Reasons consumers claim to buy Scotch Beef PGI

- Supporting Scottish farmers
- Trust in the Scotch brand
- Long tradition of producing quality meat

Similarly, the recent *Provenance Perceptions* report from Scotland Food and Drink further quantifies the future trends with UK consumers, with 50% of Scottish consumers identifying that they intend to shop for more local products moving forward. Red meat was the most popular category to increase 'local' purchasing with 74% of consumers sampled indicating they placed an importance on locally sourced red meat (vs 66% for whisky by way of comparison).

The biggest risk to the future consumption of Scotch Beef PGI is from Scottish and UK consumers moving to a flexitarian diet. Whilst 94% of UK households buy meat, fish and poultry on a weekly basis (Kantar 2019), 38% of UK shoppers are following or interested in a flexitarian diet (IGD Shopper Vista, 30th Aug-1st Sept 19. Base 2103 UK grocery shoppers). In terms of brand positioning, this gives an opportunity reflected in the new QMS marketing strategy to attract, convert and retain consumers who are interested in a flexitarian diet, by positioning Scotch directly in line with their values, hence strengthening the brand story and product values from farm level upward are key to ensuring that the Scotch brand retains its integrity.

4. Conclusions

The need for change within our suckler beef industry is urgent, however the changes required are not just limited to farm level, they extend to the whole Scotch Beef PGI supply chain. We have to deal with facts, currently 66.5% of Scotch and Scottish beef is sold via multiple retailers, 2.5% through independent retailers, 11.5% through retail wholesalers, 12% through food manufacturers, 7% from food service and catering suppliers. 24% of beef sales by value are retained in Scotland, with 69% being sold to the UK, and 7% exported outside of the UK.

Each if these routes to market is controlled by many factors focused around what consumers are prepared to pay for. Therefore, it's important that an initiative so important as this is not done in isolation as there can be many learnings from other parts of the supply chain.

Different markets want different things, every supermarket wants something unique that the competition doesn't have, and every chef has to prove that their finest ingredients are finer than anyone else's!! When customers eat a really good piece of meat, they congratulate the chef, however if they get a poor piece of meat, they blame the butcher!

Poor communication between different constituent parts of the supply chain mean that there is no collaborative vested interest in succeeding as one industry. Barriers between these constituent parts must be broken down, with improved data flows across the supply chain. All data tries to do is increase the quality of decisions being made.

Any future programme or project taken forward in the suckler beef industry must start with the consumer first and foremost, and work to develop products back down the supply chain that improve margins and provide what consumers are looking for. The relationship between brand marketing, quality assurance and product development must be aligned, and formed as part of the same vision.

For the new programme to be successful it cannot work in isolation, it must be part of a range of solutions that lead towards production changes and positive behavioural change. Key challenges from within the supply chain include: - The changing farm support system; Environmental restriction; Increased market competition; Changing consumer demand; Increasing product quality credentials and open and transparent communication within the red meat supply chain.

If linking future funding to Continuing Professional Development, its essential that this doesn't not just add burden to the existing cluttered landscape. To gain credibility it needs to be linked to something meaningful for example a recognised qualification unit and not a turning up or tick box exercise. There needs to be specific actions to target "hard to reach learners" – the bottom 25% of producers who are most resistant to change.

Different regions in Scotland have differing physical and social barriers to changing and implementing new practices. Locally led, place-based projects are the best tool to deliver change across the whole Scottish industry

Different regions will be able to implement change at a different speed to others; however, everyone must contribute their data. This information can be used at local level and used to build up a national picture. This could be useful where new technologies, methods and practices are locally developed and could potentially be shared with other farmers to then try out on their own.

Consumer insight has identified that the Scotch brand is known and trusted in both the Scottish, rUK and worldwide markets, with consumers placing a high degree of trust with the Scotch Brand. This is both an opportunity and a threat, we must ensure that the brands continue to be underpinned by strong quality assurance schemes and that the integrity of the brands can be upheld.

Consumer trends are changing, and there is a greater importance being placed on the environment, and animal welfare. Consumers are questioning the ethics and integrity of food products more so ensuring that marketing campaigns are underpinned by a strong evidence base quantifying any claims is critical to retaining a consumer mass.

Product consistency is also a factor in driving consumer purchase, with shoppers indicating that a bad eating experience can make them 4x more likely to not repeat that purchase.

Appendix A

Scotch Beef PGI Performance and Traceability KTIF Project

Background

In late 2017, following industry concern following the horsemeat scandal, QMS established a cross industry Scotch Beef DNA Traceability working group to assess the feasibility of introducing DNA traceability across the entire Scottish beef supply chain. The initial study focused purely on looking at a methodology providing 100% traceability to the Scotch beef brand, which was found not to offer the ROI required to take forward. However, the report produced identified that there were other potential benefits to the industry from the wholesale collection of DNA information from the entire Scottish beef herd, and a second report was commissioned and undertaken by Dr Jonathan Birnie. This second report focused on a much wider scope of a methodology that enabled both 100% DNA traceability, alongside a programme that would substantially accelerate the genetic improvement of the entire Scottish beef herd by focusing on the maternal lines. On the back of the feasibility study, a KTIF application was lodged to trial the methodology in practice, and understand further the barriers that exist to a industry-wide roll out, with this KTIF project due to report in late 2020.

Project Objectives and Rationale

Maximising genetic potential of the Scottish beef breeding herd is perhaps the most significant opportunity to address the challenges identified in section 1.2, but broadly, farm breeding decisions are still made on the basis of phenotype. Because phenotypic expression is influenced by many external factors as well as genetic, breeding decisions are not always accurate and are not always made to serve a specific purpose, such as to reduce emissions or to increase fertility.

Cattle genetics in Scotland have advanced at a very slow rate. Over the same period, poultry and pig genetics have advanced substantially, allowing these producers to reduce their cost of production significantly.

Achieving what the pig and poultry sector has achieved has proven difficult within the beef industry because of the fragmentation that exists (the cattle finisher has little to no control over the genetics which are used in the animals he or she buys). This can, however, be transformed through centralising data management and the effective and thoughtful use of genetic techniques.

Meat eating quality and consistency can also be improved through the improved use of genetics. In Australia, Meat and Livestock Australia have developed a unique beef eating quality programme that gives a rating for every muscle within the beef carcase depending on what its anticipated eating quality experience will be. This methodology has been refined over the last 20 years, with the next stage to look at genetic and phenotypic associations associated with eating quality. The methodology being investigated could similarly be used to develop genomic associations with a meat eating quality matrix, essentially fast forwarding the Scottish beef industry to developing an industry that breeds for taste and product consistency- allowing a data generated payment model for eating quality to then be developed.

The basic methodology around the Scotch Beef PGI Traceability and Performance Programme is relatively simple.

1) Tissue samples are taken from the maternal Scottish Beef and Dairy herds and breeding sires.
2) Samples sent for central testing and analysis.
3) Concurrent data collection from farm and abattoir to associate with the DNA data. Data from the DNA analysis sent for statistical analysis and association of SNPs with phenotypic data.
4) Creation of a feedback loop to farm; the farmer must see benefit in the programme
5) Feedback to farm on breeding traits, stock eligibility for breeding and general farm performance benchmarking.

The key highlights from the feasibility study on this new methodology undertaken by Dr Jonathan Birnie were as follows:

1. There is an urgent need to improve the productivity of the Scottish beef breeding herd.
2. A **maternal DNA programme offers productivity improvement and full traceability** with a low error rate.
3. **An effectively run genetic performance and traceability programme could potentially benefit the** Scottish beef industry by over £160,000,000 over a 10-year period (full costings and cost/ benefit analysis available). **This is an estimated 350% return on investment over a 10-year period**. Through enabling across breed comparisons to deliver enhanced productivity performance, some of the financial benefits could be realised from the following areas:
    a. Faster growth
    b. Improved feed efficiency
    c. More consistent and suitable carcasses
    d. Improved meat quality
    e. Better fertility
    f. Increased longevity
    g. Reduced carbon impact
4. The **cost of a full genetic performance and traceability programme is highly dependent on the final testing programme chosen but are around £14,435,000.00 for the initial development and around £3,543,711.00 ongoing.**
5. The **benefits of the programme are very large and are cumulative** and will be realised over a number of years. However, significant amounts of data will be generated immediately, and this will be fed back to enable farmers to make improved management decisions on farm.
6. **This programme can provide the foundation for driving long term sustainability into the Scottish Beef industry.**
7. **This programme can additionally provide a foundation for implementation within the dairy industry;** however, this has not been quantified by this report.

8. **We have concluded that the only sensible approach to DNA tagging and identification in an industry wide programme is for the farmers to undertake the tagging themselves.** There will unquestionably be a higher error rate initially as a result, but the impact of error on integrity when using maternal DNA is much lower than for slaughter stock because the correct maternal DNA will be on record (if maternal tags are mixed up or the calf is registered to the wrong dam), and the offspring will still be traced to the correct farm. Secondly, using maternal DNA means that, should a sample be spoiled, it can be collected again.
9. **Any large-scale programme will require legislative change to deliver effectively**. The ICBF programme in Ireland benefits from changes to the CAP programme to support it, and this has greatly accelerated the programme. However, even in this scenario, many farmers have not participated and consequently legislation to enforce utilisation of DNA tags is essential. The legislation should probably be written to prevent the slaughter of offspring of animals of Scottish origin for which maternal DNA analysis is not recorded on a system. There will be some caveats around this, but broadly this would enforce use.
10. **Automated data flow from farm will be a crucial part of the programme.** Whilst information can initially be collected from other sources such as a processors, vets, feed firms etc, ultimately much information exists on farm which could greatly advance any genetic programme and methods of collecting, collating (from a range of different sources) and analysing this data must be designed as part of the programme at the start. As a consequence, we would recommend the inclusion of farm software specialists as part of any further programme development.
11. **The potential benefits of the programme must be effectively communicated to farmers**, government and ancillary industries to gain widespread support. Government is much more likely to support a programme which has cross-industry support.
12. **There are multiple beneficiaries of the programme,** including farmers, government, consumers, agri-business and the environment. This is important because it provides an argument for financial funding from government, funding organisations and the industry levy.
13. **The programme must avoid the pitfalls of some other schemes which attempted to address similar challenges.** The programme must start to feedback information as soon as it commences (to individual farmers and to the wider industry). It must make clear at the start that there will be winners and losers. It must not offer farmers the opportunity to opt-out. A communications professional should be involved in developing an industry communications plan and a method of information flow back to individual farmers.

Annex VII: Scottish Beef Association – Evidence

SCOTTISH BEEF ASSOCIATION

In response to the Scottish Government letter of 21 February regarding the **Suckler Beef Climate Change Group: Call For Evidence** please find below, in no particular order of importance, a list of proposals under various headings from the Scottish Beef Association for consideration: -

Production based improvements: -

- Feeding
  - ✓ A change of breeds is needed to some extent to maximise use of forage, reducing the need for bought in high protein and energy feeds.
  - ✓ Efforts should be concentrated achieving on better feed conversion efficiency from good quality grassland management (paddocks, rotational grazing), dedicated silage mixtures cut at optimum stage with legumes. Home grown carbon neutral rations including wholecrop. Cereal-based finishing on 1.5 tonnes of barley should be discouraged.
- Breeding
  - ✓ Invest in a common type of cow / bull mix that will allow carcases to finish off forage at 16 / 18 months at 320-330 Kg.
  - ✓ The use of smaller native cross cows and sires that are not focussed on muscle-leanness at the expense of natural fleshing and some fat cover should be encouraged.
  - ✓ The use of native breeds that mean more animals can be kept on the same acres will result in more kilos being produced for less labour input.
  - ✓ Cows which can calve with minimum attention and bulls with good calving EBVs which also have good growth rates should be encouraged.
- Efficiency
  - ✓ The use of GM technology that is proved safe should be embraced to enable crops to be less susceptible to disease and extreme weather conditions, whilst also being able to grow with less inputs.
- Health Improvements
  - ✓ Efforts to improve animal health through better disease control should be given full support.
  - ✓ Much more is now known about disease eradication that needs to be applied on-farm.
  - ✓ Trials by Animal Health Scotland have shown big differences in calving percentage between the top, average and lowest herds. Work is required to find out why and solutions need to be investigated.
  - ✓ Common protocols should be developed to wipe out BVD, Johne's, IBR, Coccidiosis.
  - ✓ A proper benchmarking scheme with a central database to control the use of antibiotics should be established.
  - ✓ Units with health issues must be given help and a timeframe to improve performance.
  - ✓ Improving animal health is a Win-Win and must be part of the package we are selling to consumers.

Page | 1

SCOTTISH BEEF ASSOCIATION

Potential for capital investment improvements: -

- Many farms still lack modern efficient handling equipment to allow for veterinary treatment, identification, weighing's etc. so grants should be made available to improve on this.
- Investigate how machinery required for suckler beef production could be to be fuelled by hydrogen / hybrid sources and how this can be achieved in the most cost-effective manner. Up to 25% fuel savings may be possible that results in low or zero emissions and an increase in torque.
- Fencing and water troughs including solar pumps to lift water from natural watercourses that are fenced off, should be given financial support.
- Grants for fencing, water troughs, cow tracks etc. to set up paddock grazing systems should be made available.
- If improved grassland performance is to be achieved, some financial encouragement for temporary electricity to manage paddocks and rotational systems along with water systems is required.

Impact on running costs: -

- Given the size of the suckler herd in Scotland (420K) and our current cost base as seen in the annual QMS costings, we cannot compete globally as commodity beef producers.
- Burning straw in power stations should be stopped and straw could then be used to help Scottish soils receive more organic matter and help animal welfare etc. The resultant reduction in the price of straw would also be welcomed.

Grassland management: -

- Fertiliser use
  - ✓ Investigate how fuel and fertiliser can be produced from hydrogen rather than conventional sources.
- Soil improvement and health
  - ✓ Most climate change scientists are coming around to accepting the idea that healthy soils are the best antidote to climate change through carbon sequestration.
  - ✓ Soil sampling to establish the pH should be encouraged, then apply the amount of lime required. This would enable more efficient use of fertiliser and less would be required.
  - ✓ Financial assistance to improve and maintain drainage is required. This would help to minimise soil erosion and flooding and given the current rise in annual rainfall this is vital. We must also clean out our much-neglected ditches.
  - ✓ Financial support for soil sampling, including worm counts, should be provided.
  - ✓ Measuring soil carbon sequestration with soil health surveys under actively managed pastures and paying beef / sheep farmers for their efforts to mitigate climate change should be funded by government.
  - ✓ Soil health is of utmost importance to aid the beef industry reduce its emissions, so drainage etc. are important and should be encouraged.
  - ✓ Funding should be given for faeces sampling pre-worming to help reduce damage to soil bacteria, insect life etc. from too much worming.

SCOTTISH BEEF ASSOCIATION

- ✓ Financial support should be given for Plantain seed to be used to help reduce nitrogen runoff.

- Grass mixtures
  - ✓ As only 2% of permanent pasture & TGRS is being reseeded a year, not including any RGR, there is huge scope to improve our productivity.
  - ✓ Financial assistance to improve our permanent and temporary grass is required.
  - ✓ Work is required to look closely at our grass seed mixtures and make more use of clovers to fix nitrogen in the soil.
  - ✓ More research is required to get new or improved grass and other forage crops that boost soil organic matter.
  - ✓ Funding is required to encourage growing natural anthelmintics like chicory in leys to control worms the old way.
  - ✓ Financial support is required to encourage greater use of clover in grass seed mixtures for soil conditioning, nitrogen and carbon sequestration etc.
- Slurry and manure management and soil improvement
  - ✓ To enable farms to remain competitive and meet emission targets, grant funding should be made available to purchase equipment that helps to reduce emissions such as slurry injecting or dribble bar equipment.
  - ✓ Slurry storage systems should also be grant funded to increase the benefit to crop nutrition along with soil health.
- Carbon audits and actions
  - ✓ An accurate method that can measure carbon capture of pasture and soils needs to be established.
  - ✓ More research is needed to accurately assess the methane emissions from suckler cows fed on mainly grass diets. This seems to be grossly exaggerated therefore more work is needed.
  - ✓ Better research and development is desperately required, along with better knowledge transfer, to allow us to be more efficient and reduce our carbon footprint.
  - ✓ Carbon sequestration from grassland management and reducing methane production with feed additives and fast finishing at lighter carcase weights i.e. 320 - 330Kg should be developed.
  - ✓ Financial support for farm woodlands and hedge planting schemes to encourage biodiversity and help with the costs of fencing off areas that are wet and not productive is required and will help to meet the overall environmental targets.
- Liming
  - ✓ Financial support to encourage more lime to be spread is required.
  - ✓ Reintroduce grant aid for soil testing, draining etc. that encourages good grass production that will result in increased photosynthesis, more growth and performance and more carbon sequestrated.
  - ✓ For grassland improvement financial support is needed from Government for soil testing and liming.
  - ✓ Substantial areas of land require to be limed before it will grow anything, and it will not happen without some pump priming.

SCOTTISH BEEF ASSOCIATION

- Restoration and improving habitats on-farm
  - ✓ Measures that increase insect life and therefore bird life should be encouraged. Rye grass is easily criticised as a 'monoculture' and greater diversity of plants in the sward would help to counter this.
  - ✓ Climate change scientists are coming around to accepting the idea that healthy soils are the best antidote to climate change through carbon sequestration.
  - ✓ Measures to encourage greater intervals between silage cuts to protect endangered birds such as the Curlew.

Brand Development: -

- Develop a new sustainable carbon brand that allows us to differentiate our beef. It must consistently eat as a guaranteed premium product (develop a meat classification system based on the best of Australian and American select brands). It must be based on the use of forage rather than grain and bi-product finishing. Home produced Legumes (clover, peas & beans etc) can be used along with wholecrop for finishing diets.
- A strong grass-fed brand that can survive in a free trading environment should be developed.
- The current slaughter industry in Scotland must be initially refocussed on those participants who are prepared to develop this brand under the financial control of the producers rather than the abattoirs who currently make up the rules and mix and match according to their customers whims.
- Benchmarking of performance within regional production groups along with sharing of knowledge to help develop and underpin the strength of the brand should be encouraged.
- If the health benefits of eating beef are going to be the next big USP for beef more emphasis should be placed on finishing beef from grass, measurable omegas, less antibiotics etc.

Other Measures: -

- Increase the level of funding from government for research to establish new technology, increasing the efficiency of feeding, breeding, soil fertility and other aspects of beef production.
- Future support must be focussed on encouraging efficiency and sustainability.
- There is a need to explain to consumers the steps that are being takien to provide our stock with the best husbandry practices available i.e. health, feeding, comfort etc. as advised and inspected by QMS.
- The message we have to get into the public domain is that meat does not harm our planet, indeed when done properly can improve our environment and provide improved habitats for our wildlife.
- Ideas must be measured against how they are going to impress the consumer rather than simply helping the producer (pull not push).

Additional Comments: -

- All the above measure would improve biodiversity resulting in increased insect life and encourage more bird species.

SCOTTISH BEEF ASSOCIATION

- Any measures that help soils, leys, grazing systems are to be encouraged.

- Low production land must go into a different support scheme to allow the industry to be seen to be successful.
- Farms carrying cows and sheep just for the sake of numbers should now be history.
- There is some concern that any future funding that is provided for liming and drainage etc. could result in those that have invested all along keeping things right get little or nothing, whilst others that have spent little could benefit greatly.

Annex VIII: Presentation 1 (Agriculture and Climate Change Statistics and Inventory)

Agriculture and Climate Change Statistics and Inventory

Keith McWhinnie

GHG stats

- In 2017 Scotland's emission figures stand at 46.4 Megatons Carbon Dioxide equivalent (MtCO2e).
- Scottish agriculture and related land use produced 9.7 MtCO2e or around 23 % of our nations greenhouse gas emissions.
- Agriculture and related land use has now seen a 4 MtCO2e (29.4 per cent) fall in net emissions since the 1990 baseline year.
- This reduction is mostly attributable to four factors;
  - Efficiency improvements in farming, such as higher milk yields per cow;
  - A reduction in the number of cattle and sheep;
  - A reduction in the amount of nitrogen fertiliser being applied; and,
  - A reduction in grassland being ploughed for arable production.

Different classifications

- The official Scottish statistics are a repacking of the UK GHG Inventory. There is no Scottish Inventory.
- Within this "Scottish" classification Agriculture emissions contribute around 7.6 MtCO2e and related land use around 2.1 MtCO2e.
- Within "agriculture" emissions can be broken down as such.

	GHG emissions ($MtCO_2e$)			
Type	1990	2017	Change	% change
Beef cattle	4.330	3.481	-0.850	-10%
Crops	1.333	1.342	0.009	0%
Dairy cattle	1.290	1.161	-0.129	-1%
Other livestock	0.251	0.192	-0.059	-1%
Sheep	1.365	1.093	-0.271	-3%
Uncategorised	0.319	0.295	-0.024	0%
Total	**8.889**	**7.565**	**-1.324**	**-15%**

- "Related land use" consists of aspects such as, Grassland converted to Cropland, Grassland remaining grassland, wetlands converted to grassland and cropland remaining cropland.

GHG inventory.

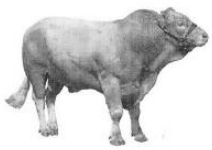
- In 1988 the Intergovernmental Panel on Climate Change (IPCC) was established. The IPCC guidance identifies the following sectors of the economy that should be monitored for anthropogenic GHG emissions :
  - Energy
  - Industrial processes and product use
  - Agriculture, Forestry and other land use
  - Waste
- The IPCC guidance defines agriculture emissions as:
  - Enteric fermentation - methane emissions from cows and sheep.
  - Manure management - methane and nitrous oxide emissions from animal waste.
  - Agricultural soils - carbon dioxide and nitrous oxide emissions from the production crops.
  - Field burning of agricultural residues - not applicable to Scotland as we do not burn crop residues.
  - Liming - carbon dioxide emissions from its application.
  - Urea application - nitrous oxide emissions from its application

2016 refinements to the UK inventory.

- The 2016 UK Inventory agricultural entry went through a significant refinement process. It has seen the development and introduction of the most detailed set of methodologies for measuring emissions from agriculture in the history of the UK Inventory and has increased the level of accuracy for agricultural emissions significantly.
- The new methodologies include refinements such as using UK-specific energy balance equations for feed in cattle, revised estimates for slurry excretion and new emissions factors for fertilisers that are spatially disaggregated according to soil type and rainfall.

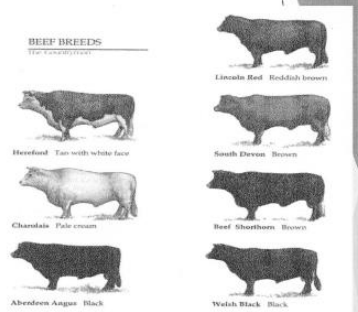
Beef sector

Previously



- 1 standard beef system
- Standard weights, diet and N excretion for sub-categories
- Annual numbers from JAS

New model



- 3 suckler herd systems: continental, lowland native, upland
- 6 roles and 15 age bands
- Monthly numbers from CTS
- System-specific diets and N excretion

Beef

- Beef cattle are disaggregated into 15 age bands, four breed types (Continental, lowland native, upland and dairy males) and six sub-categories by role, associated with different live weights, growth rates and management practices.
- The roles include heifers for breeding, beef females for slaughter, bulls for breeding, cereal fed bulls for slaughter, steers for slaughter and beef cows.
- Data from the CTS is used to populate the inventory categories at a monthly resolution for England, Scotland and Wales from 2005 onwards. System-specific live weights and LWG, time series
- Enteric methane emissions from other cattle, including dairy sector replacements and calves, and all beef sector cattle, are estimated using the same approach as for dairy cows but with different relationships between enteric emission and dry matter intake for lactating and nonlactating cattle.
- For lactating cattle (i.e. beef suckler cows) the same equation as for dairy cows. Calculations are performed at a monthly resolution, with characterisation of production, management and feed by dairy cow category for each month

Management practice changes - beef

Scotland

Practice	1990	2000	2010	2016
% on slurry systems	45	48	50	50
% slurry tanks covered (rigid)	0	0	0	0
% slurry tanks covered (floating)	80 (crust)	80 (crust)	80 (crust)	80 (crust)
% slurry lagoons crusted	80 (crust)	80 (crust)	80 (crust)	80 (crust)
% spread by trailing hose	0	4	7	9
% spread by trailing shoe	0	0	0	0
% spread by shallow injection	0	0	7	10
% slurry rapidly incorporated	11	11	11	11
% FYM rapidly incorporated	3	3	8	8

Inclusion of mitigation

- ***Implicit*** **mitigation methods**
  Are captured through changes in inventory source data e.g. uptake of Tried and Tested nutrient management; improved herd health management

- ***Explicit*** **mitigation methods**
  Are explicitly represented in the inventory structure e.g. use of nitrification inhibitors, dietary changes, manure management practices

Mitigation measures already being explored by Scottish Government.

- The SG has sought to improve our understand of "low carbon farming practices" and the level of GHG emissions reductions that they can achieve.
- In order for agriculture to play its part in emissions reductions we need farmers and crofter to embrace actions such as.
  - Improving livestock health.
  - Methane reducing feed additives.
  - Use of high starch diets.
  - Breeding for low methane emitting cattle.
  - Covering of slurry stores.
  - Trailing shoe or direct slurry injection.
  - Improved nutrient management.
  - Precision application of fertilisers and lime.
  - Use of nitrogen fixing legumes (clover in grassland peas and beans in crop rotation).

Annex IX: Presentation 2 (Future proofing the Scottish herd)

Future Proofing

The Scottish Herd

How primary producers can capitalise on our green credentials?

What is true….

- Less Beef and Lamb
- More Chicken and Pork

…….Data one sided, methane, carbon, growing negative picture…

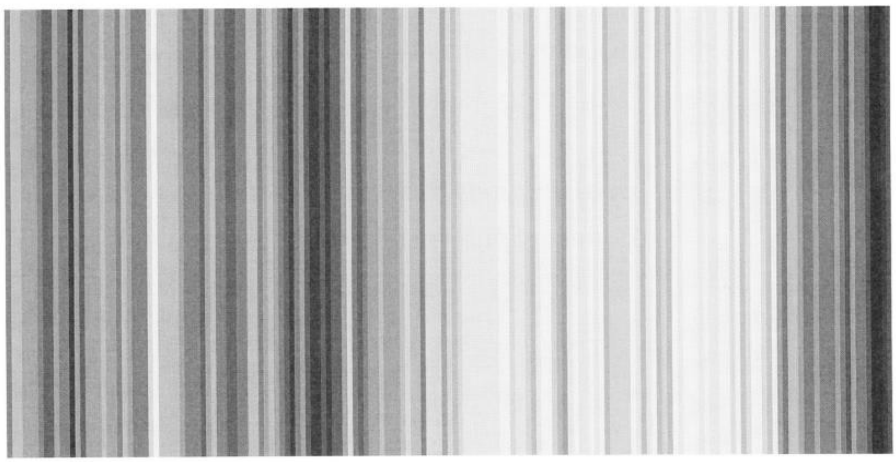
What do our shoppers say they want….

Changing Habits from what we know

- 60% of millennials shopping online
- Generation Sensible (Z) teetotallers = (quarter of 14 – 24 and accelerating)
- Consumers want more accountability and ethics
- Transparency – 'thoughtful shopping', research
- Power – social media

- NEED to dispel the mistruths

Our Climate Stripes



Is our faming combating this really?

Sustainability key to a credible food supply chain in Scotland

- **Biodiversity is about to become the 'buzz' word of the moment and business critical**
- 'New thoughtful' generation more likely to engage if the story is more visible
- Current climate – rewriting policy
- Message & Marketing
- Align efforts, positive rhetoric and strong strategy for rural producers

Get your facts right for'suckler beef'..

- Have you got a great product?
- Will the market buy it? Why?
- Do consumers want to buy 'climate positive beef'?
- Quality and sustainability locked in?
- What is our IP?
- Rearing & Grass?

How do we differentiate?

- Need to battle against global numbers being applied to local context
- Data, data, data - inputs per tonne of output, ph, nutrients in use or not

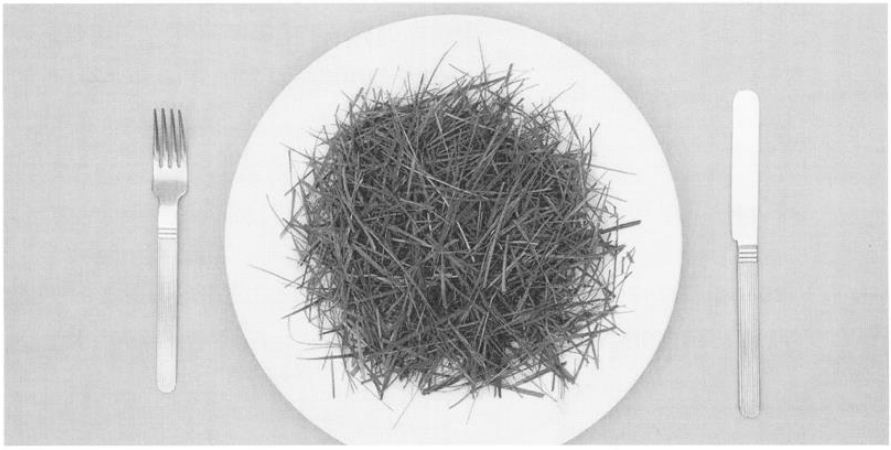
What might the brand be

Scotch Premier
Scottish through and through

Watch Outs
Careful not to denigrade Scotch?

- Scotch
- Scotch Premier Gold
- Scotch Green

What is it we are?



Again, we need to pin down the facts

- Biodiversity - what are you doing to restore and protect?
- Are there outputs for bioeconomy/ additional attributes? Leading edge
- Are progressive farmers more 'nature friendly farmers' or NOT? Be honest
- Self Assessing
- Are you masters of sequestration
- Claim virtues and minimise harm?
  Generation Z – 'but it matters to me'.. grass, soil, water, food
- Public sector procurement - nutrition (Good Food Nation) if we are funding agri - access for all

Food and farming brands elsewhere

- Bord Bia Origin Green
- Hoeve Naer
- Heihoeve
- Dutch pork welfare standards - tiering

You cannot make a silk purse out of a sows ear

What is it you do that adds value?
Debbie - Genetics
Robert - beef genetics, forage and self sustaining
Alistair - health and welfare, new initiatives
Bruce - rough grazing, improving condition and habitat
John - rural matters and community.....

Our strategy..stages

- https://www.youtube.com/watch?v=nSXIetP5iak

- Values &Simple message established
- Planned campaign (local, national and international) ..which?

Social Media – brilliance – local context is possible

- Domestic and international audiences can find you
- Monetary back up, more the bigger the ambition
- Consistency and purity of story

You as Influencers

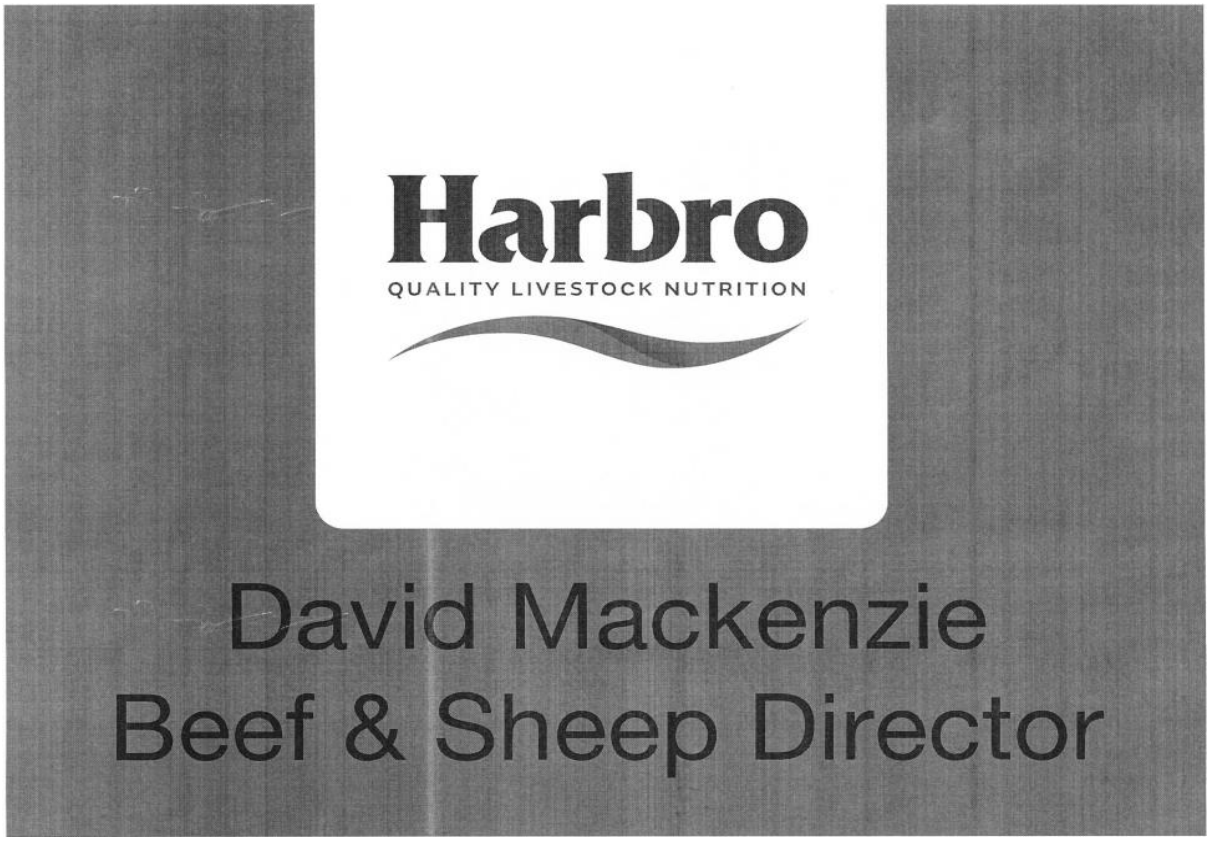
Why can't you be the new Tom Pemberton

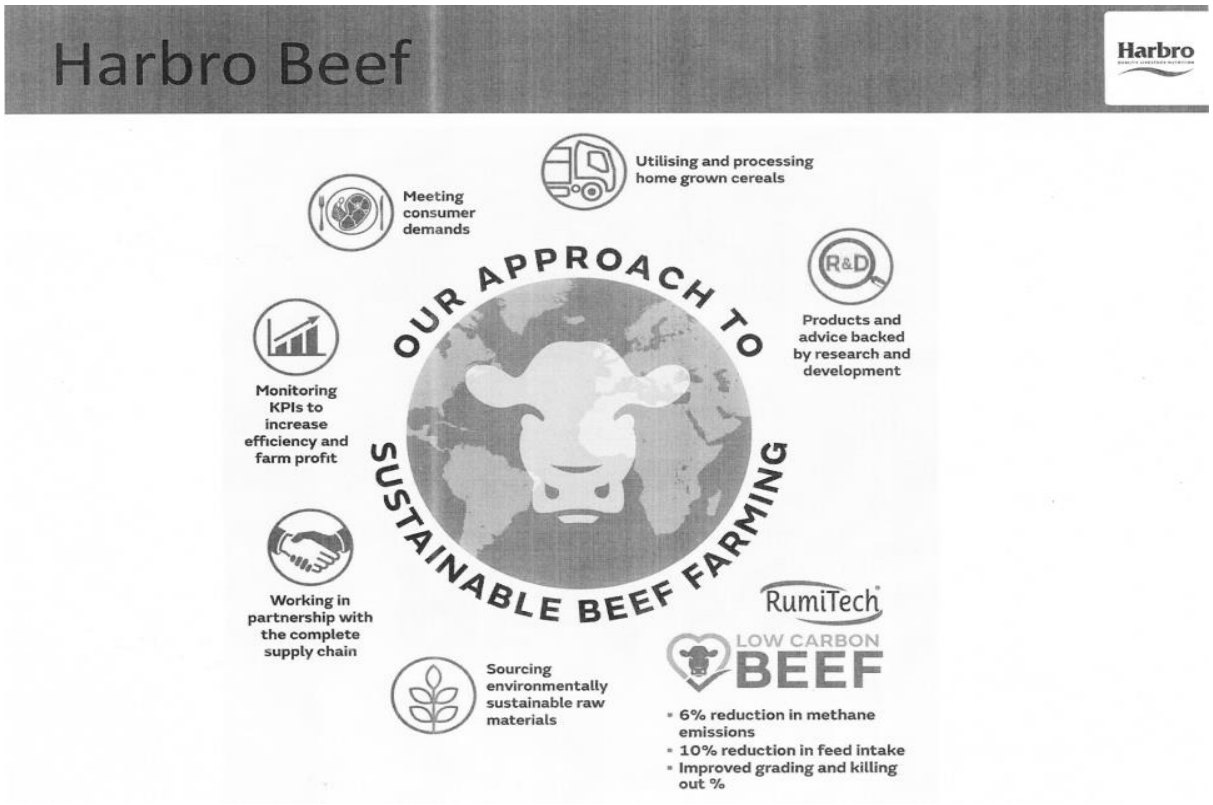
'The Scottish Herd'

Be who you are

AND WHAT YOU DO

Annex X: Presentation 3 (Harbro)





The Trial

Harbro

- A protocol for a trial was created by Glasgow Vet School, designed and managed by Professor Nick Jonsson, to test whether a new alternative source (**Maxammon**) would outperform the existing system.
- Trial start date: 27 July 2017.

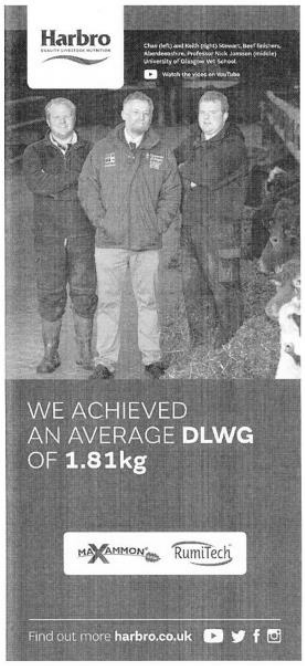
Trial overview:

- 2 groups in 4 pens: 2 Maxammon groups, 2 'control' propcorn groups; animals allocated to groups based on achieving equivalence of breed, age, body condition score and liveweight.
- 124 in Propcorn based group, 93 in Maxammon based group.
- All cattle subject to the same animal health.
- Cattle weighed at the start, middle and before being sent to slaughter.
- Both diets equal in protein.
- Feed continually tested using NIR.
- Fortnightly scour scoring.
- Rumen analysis at slaughter.

Results - production

Harbro

		Maxammon	Prograin
Kg/feed/head/day		14.81	15.41
Start of trial 27 July	Weight	480	483
57 days	Weight	592	584
	Average daily Liveweight gain	1.97	1.78
	Feed conversion ratio	6.09	6.26
102 days	Weight	665	649
	Average daily Liveweight gain	1.81	1.62
	Feed conversion ratio	7.13	8.02



Benchmarking farm efficiency – Harbro Pig KPI's

Benchmarking your Farm Efficiency – Harbro Pig KPI's

KPI	Top 5% 2018	Top 5% 2017	Top 5% 2016	Ave. 10 years ago
Kg meat sold per farrowing crate / yr	14000Kg	14000Kg	12600Kg	
Wean to Finish FCR	2.22:1	2.25:1	2.3:1	2.9:1
Wean to Finish Growth Rate	870	850	830	700
Deadweight Per Pig	92.5Kg	92Kg	88Kg	70Kg
KG Meat Sold per sow per year	2.8 Tonnes	2.76 Tonnes	2.4 Tonnes	1.45 Tonnes
Total income from a 500 Sow unit if at £1.60/Kg pig price	£2.21M	£2.21M	£1.92M	£1.16M
No. of Pigs Sold per Sow	30	30	26.5	21
Harbro HIPP Score	**630**	**610**	**570**	**250**

Harbro HIPP Score is a measure of a pig units overall efficiency

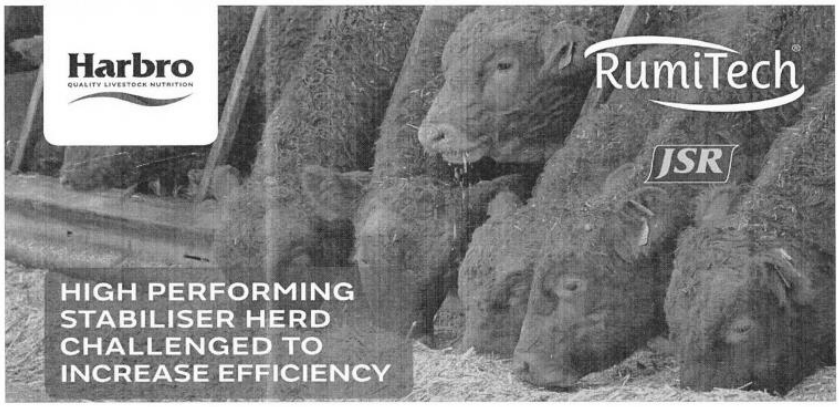
World Resources

- 2200 kgs Cereal - 1000 kgs of pig liveweight
  - Killing out at 75%
  - 750 kgs of pork
- 7000 kgs Cereal - 1000 kgs of liveweight
  - Killing out at 54%
  - 540 kgs of beef

Efficiency on beef

- To get 30 kgs extra liveweight
- At 3-7 months of age or 150 – 200 kgs = 90 kgs of feed required - 3 : 1
- At 15-20 months of age or 500 – 600 kgs = 270 kgs of feed required - 9 : 1

Harbro JSR Rumitech trial



	TRIAL GROUP (Rumitech)	CONTROL GROUP	IMPROVEMENT
DLWG	2.09	1.91	9%
FCR	5.5	6.14	10%
Back fat (mm)	67.83	75.90	12%
Eye muscle area	109.61	106.13	3%
Financial benefit	+£23.81/head		

Rumitech: Carbon reduction

Objective: Effect on Methane emission in beef cattle

Trial details: Carried out by Scotlands Rural College
Animals in trial: 36 Holstein Frisian steers (18 control and 18 trial)
Technique: individual metabolic open circuit chambers
Duration: 16 weeks
Performance measured between week 06 and 16 of the trial
Methane was measured at day 0, after 6 weeks and 16 weeks

Ration: grass silage: concentrate = 1:1 on dry matter basis
Supplementation: 1g AGOLIN RUMINANT per head/day

	CONTROL	RUMITECH	p	Diff. %
FCR	0.09	0.09	ns	
ADG kg	0.9 +/- 0.22	0.9 +/- 0.33	ns	
Ø DMI kg	9.8 +/- 0.79	9.8 +/- 1.36	ns	
Methane g/kg DMI day 0	23.1	22.2	ns	3.8
Methane g/kg DMI week 6	24.7	22.8	< 0,01	7.7
Methane g/kg DMI week 16	25.5	22.7	< 0,01	11.0

AT Wilson & Co, Brownhill of Annochie, Ellon, Scotland.

	Control	RumiTech	% Diff.
Number of Cattle	82	89	
Feed Intake (kg/head/day)	13.5	12.1	-10.4%
Feed Conversion Ratio (kg Feed/kg LWG)	9.44	8.8	-6.8%
Cost (£/T)	£160	£164	
Cost (£/kg LWG)	£1.51	£1.41	-5.0%

* 86 day finishing experiment, approx 550kg Liveweight at start of trial

There was no difference in live weight gain, but there was a daily feed intake reduction of 10.4%, a feed conversion ratio improvement of 6.8% and therefore a cost of production saving of 5%. Killing out percentage was 1% higher which is worth >£20/head.

Carbon Trust Approval

CERTIFICATE OF ACHIEVEMENT

HARBRO LTD.

has demonstrated that:

RUMITECH®

Is capable of significantly reducing enteric methane emissions and improving feed efficiency in dairy and beef cattle, without affecting productivity.

Carbon Trust Assurance Limited provides this certificate based upon our expert opinion following office-based review of product documentation, academic references and experimental results.

A detailed explanation of our opinion can be found in the associated report, available on request from Harbro Ltd.

Awarded: 21st December 2017 Valid Until: 20th December 2019

for and on behalf of Carbon Trust Assurance Ltd.

Morgan Jones, Associate Director Assurance

www.carbontrust.com

Glasgow Vet School residency: Reg Jones

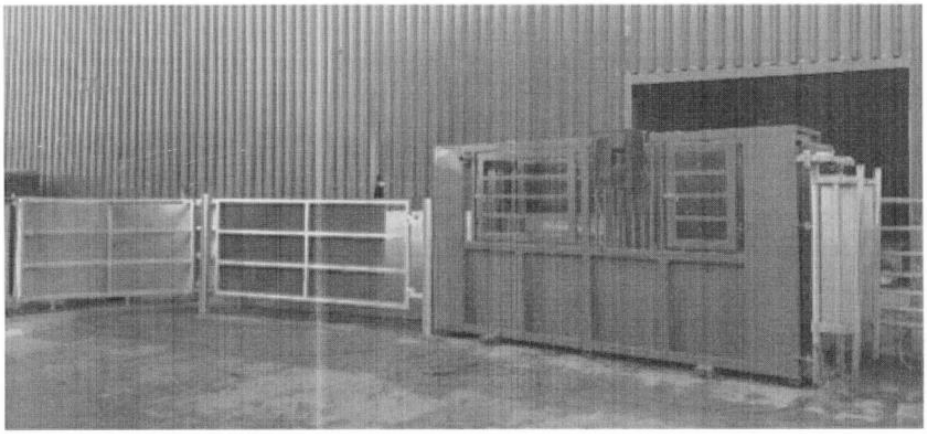
Harbro

- Signed agreement between Harbro and Glasgow Vet School
- PhD project over 4 years on beef & sheep nutrition
- Carrying out European College of Rumen Health Diploma Programme
- Investigating problems on farm, designing systems for best practice and on farm data analysis.
- Working under the supervision of Prof Nick Jonsson Professor of Animal Science, Dr Valentina Busin - Vet Clinician in Disease Investigation, David Mackenzie and Willie Thomson, Harbro.

Nucleus Farm

Harbro

Establish infrastructure and procedures to enable the recording of detailed performance data of finishing beef cattle with a view to conducting research on animal nutrition and animal management interventions.



Next steps

Harbro

2019/2020 trials include;

- Digital dermatitis
- Performance feeding
- Eating quality
- Feed conversions: By beef breed and dairy bred vs suckler bred

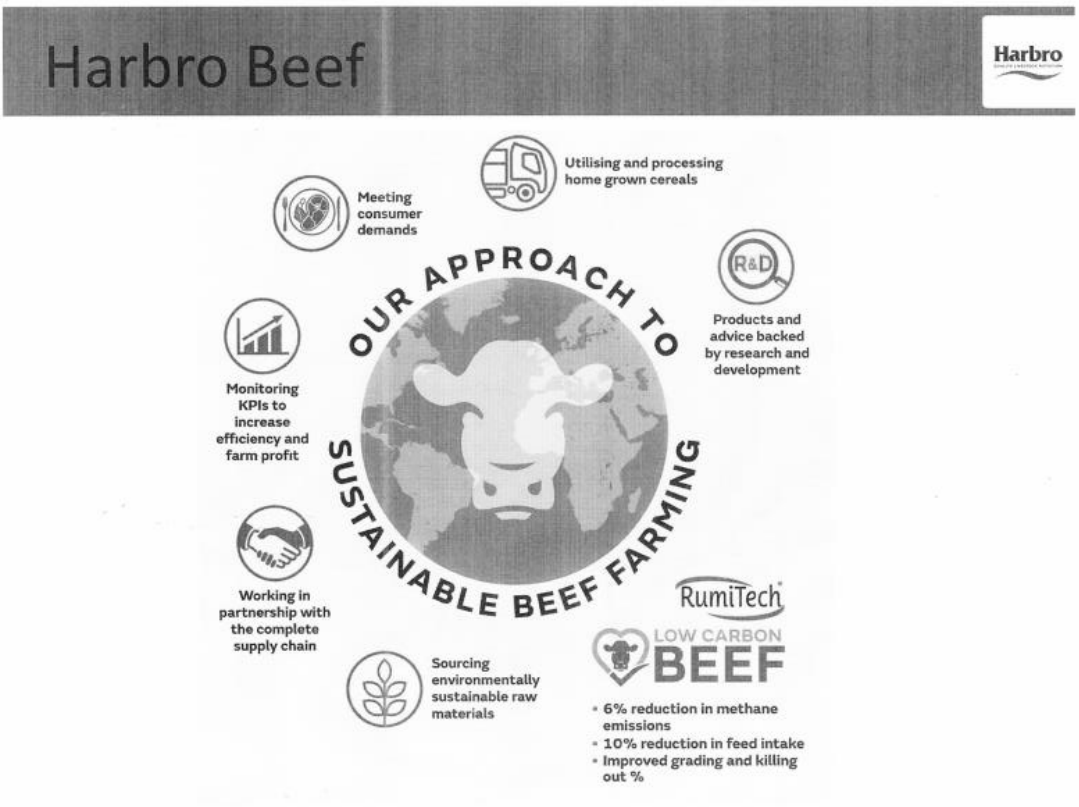
Nucleus Farm

Harbro

Background
The parties wish to establish infrastructure and procedures to enable the recording
of detailed performance data of finishing beef cattle with a view to conducting research on animal nutrition and animal management interventions.

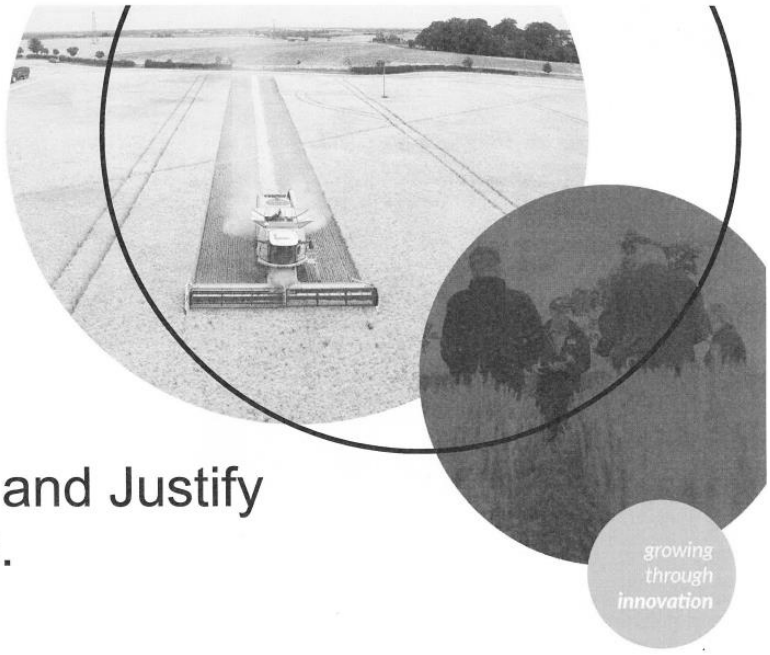
Outcomes
The Farm will be able to better quantify performance and costs of production of their cattle, which could lead to adjustments to genetics, management and nutritional inputs to improve performance. By improving the equipment on this farm, improving the quality of feedback on animal performance, ensuring that we are at the forefront of the industry, and thereby future-proof our ability to meet the goals of all partners in production of cattle on this site.

Harbro will work with the partners to understand the limitations
of animal performance (growth, feed efficiency, carcase value, among others), including the effects of production systems, genotype, management and nutritional inputs. In addition, there is a need to better understand the factors that determine the economic and environmental performance of beef production.


Harbro Beef
Harbro
OUR APPROACH TO SUSTAINABLE BEEF FARMING
Meeting consumer demands
Utilising and processing home grown cereals
R&D
Products and advice backed by research and development
Monitoring KPIs to increase efficiency and farm profit
Working in partnership with the complete supply chain
Sourcing environmentally sustainable raw materials
RumiTech
LOW CARBON BEEF
• 6% reduction in methane emissions
• 10% reduction in feed intake
• Improved grading and killing out %

Annex XI: Presentation 4 (Identify, target and justify nutrient inputs)

agrovista



Suckler Beef Climate Group.

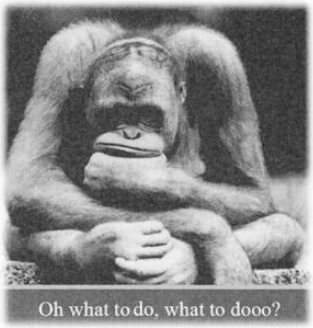
Identify, target and Justify Nutrient Inputs.

growing through innovation

Contents

agrovista

- Introduction
- Grid Mapping
- Scanning
- Muck and slurry testing
- Variable rate N?
- Summary of thoughts and questions.



Suckler Beef Climate Group – Pete Richardson Agronomist 2

Introduction

agrovista

Time- 15mins……

About me

About you

Organic input and balancing it

Walk before we run. BIG subject!

Get a handle on what is going on and target

Precision works in ALL crops

Suckler Beef Climate Group – Pete Richardson Agronomist 3

Grid Mapping

agrovista

Standard analysis is P, K, Mg, and pH

0.25, 0.5 or 1Ha Grids

Sample points/ grids are set up by us in the office

The sampler then uses a GPS device called a Yuma to be directed to each point where they collect 16 sub-samples to make up the grid sample

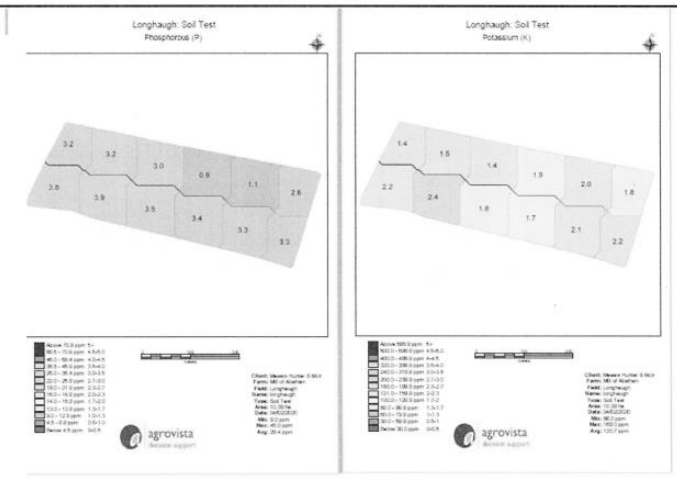
Usually a composite sample is also taken on a 1 per field basis

Suckler Beef Climate Group – Pete Richardson Agronomist 4

Grid Mapping

agrovista

- Examples of P & K results



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Grid Mapping

agrovista

- Examples of Mg and pH results

Suckler Beef Climate Group – Pete Richardson Agronomist 6

Grid Mapping

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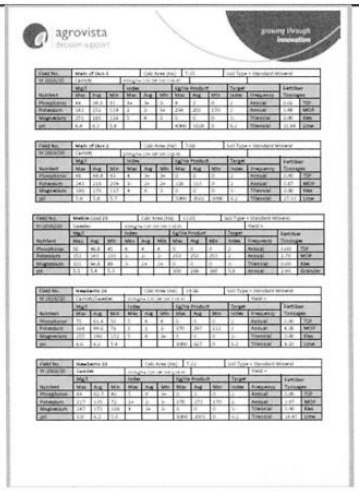
- Included in the price is 4 years of nutrient recommendations and machinery spreading files
- This requires a yearly conversation regarding cropping, base Fert etc. to provide the correct recs
- We can offer a range of composite samples from Broad Spectrum to Broad Spectrum Extra Solvita



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Soil Variation Scanning

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- Used to identify soil type variation within a field
- Base layer of information used in creating variable rate seed plans
- Zero disturbance, field scanned with a quad bike and small sledge
- The field only needs to be scanned once as soil type doesn't change!

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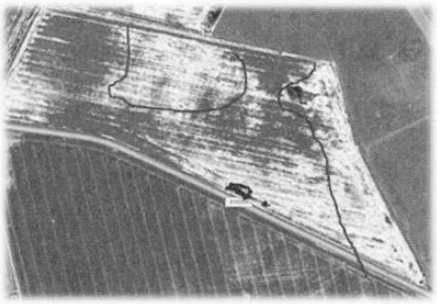
Soil Variation Scanning

agrovista

Soil Variation Scan

Red areas are lighter land
Blue areas are heavier land

Establishment Satellite Image



Green = Best Establishment
Red/Yellow = Poorer Establishment

Suckler Beef Climate Group – Pete Richardson Agronomist 9

Muck and Slurry Testing

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- **This is total nutrient, not all available**
- **N is the most finger in the air judgement**
- **Use experience from previous crop response**
- **Application methods critical**
- **Available total applied = base rate fertiliser**
- **Balance extra crop nutrient requirement**

Total Nitrogen	4.71
Phosphorus as P2O5	1.87
Potassium as K2O	5.76
Magnesium as MgO	0.70
Calcium as CaO	1.32
Sulphur as SO3	0.38
Copper Slurry	0.0086
Zinc Slurry	0.0170
Ammonium Nitrogen (kg/m3)	3.01
Nitrate Nitrogen (kg/m3)	0.01

Analysis	Results
Dry Matter (kg/m3)	63.20
pH	8.1

Slurry analysis

Suckler Beef Climate Group – Pete Richardson Agronomist 10

Variable Rate N

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- Agrovista has partnered with Hummingbird to provide our growers with a satellite imagery service
- They are a market leader and have the backing of companies like BASF and Beeswax Dyson Farming to name but a few!

Hummingbird Technologies

Suckler Beef Climate Group – Pete Richardson Agronomist 11

Hummingbird VR N

agrovista

- The platform allows you to create VR N application maps and spreading files in a slick process as many times per season as you require
- In this example more nitrogen is being given to the better preforming areas of the field although this can be swapped to the poorer areas receiving more

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Summary Thoughts and Questions

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Agronomist input

Less usage of processed fertiliser?

Improved yield?

Both??

Raises efficiency

Less waste

Justification of inputs

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Thank you

For more information please contact:

Andy Allison
Scotland Decision Support Specialist
07471 998518

www.agrovista.co.uk

@agrovistaUK

Annex XII: Presentation 5 (Genomics for beef)

Revolutions in Agriculture

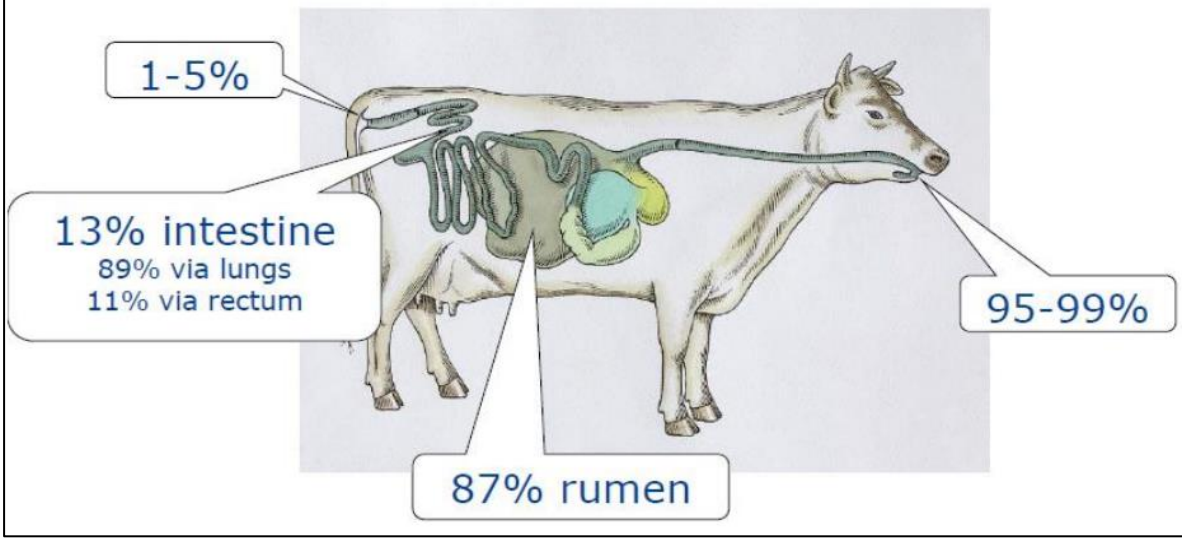
SRUC

- Fertilizer
- Pesticides (herbicides, insecticides, fungicides)
- Irrigation
- **Genetics – plant and animal**
- Nutritional management
- Reproductive tools
- Health/disease management
- Which of these revolutions will be required in the future?

Climate impact of agriculture:

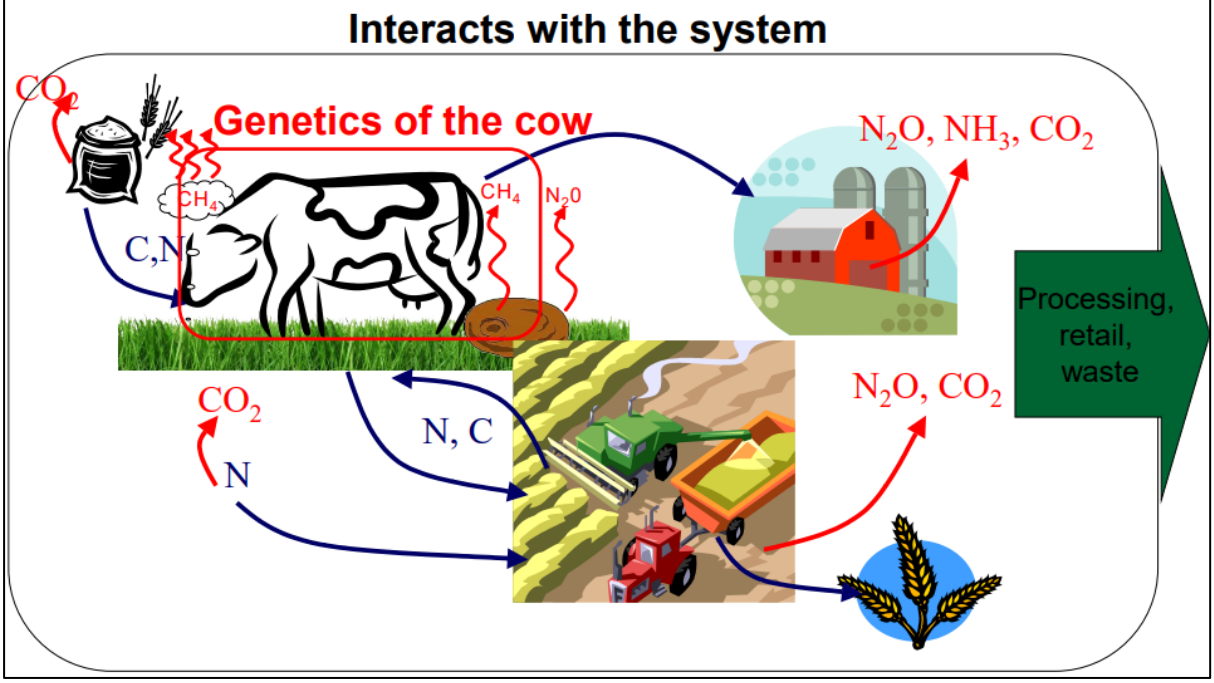
Greenhouse gas emissions from animals (ruminants)

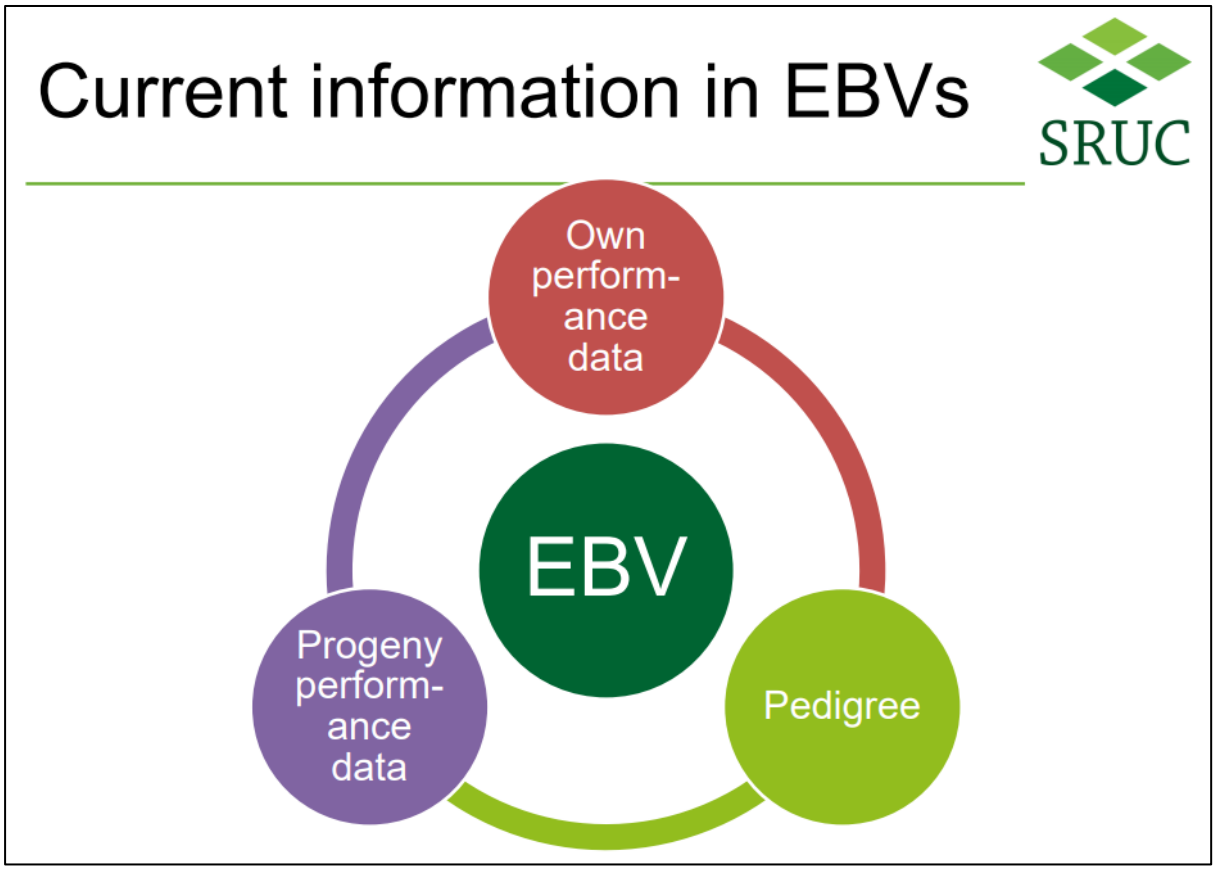
- The rumen is the first part of the stomach, where microrganisms digest cellulose from plant cell walls.
- Fermentation in the rumen produces methane which is released in burps.

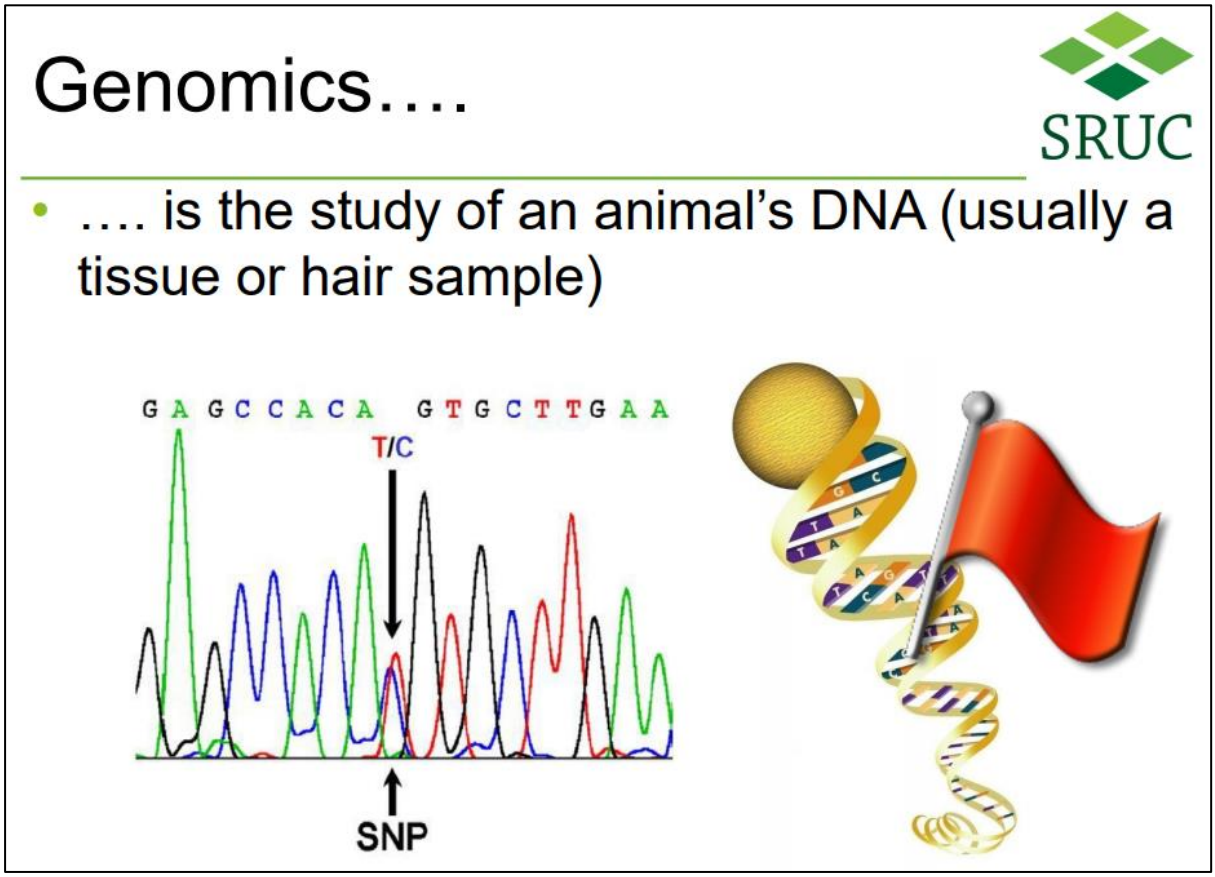


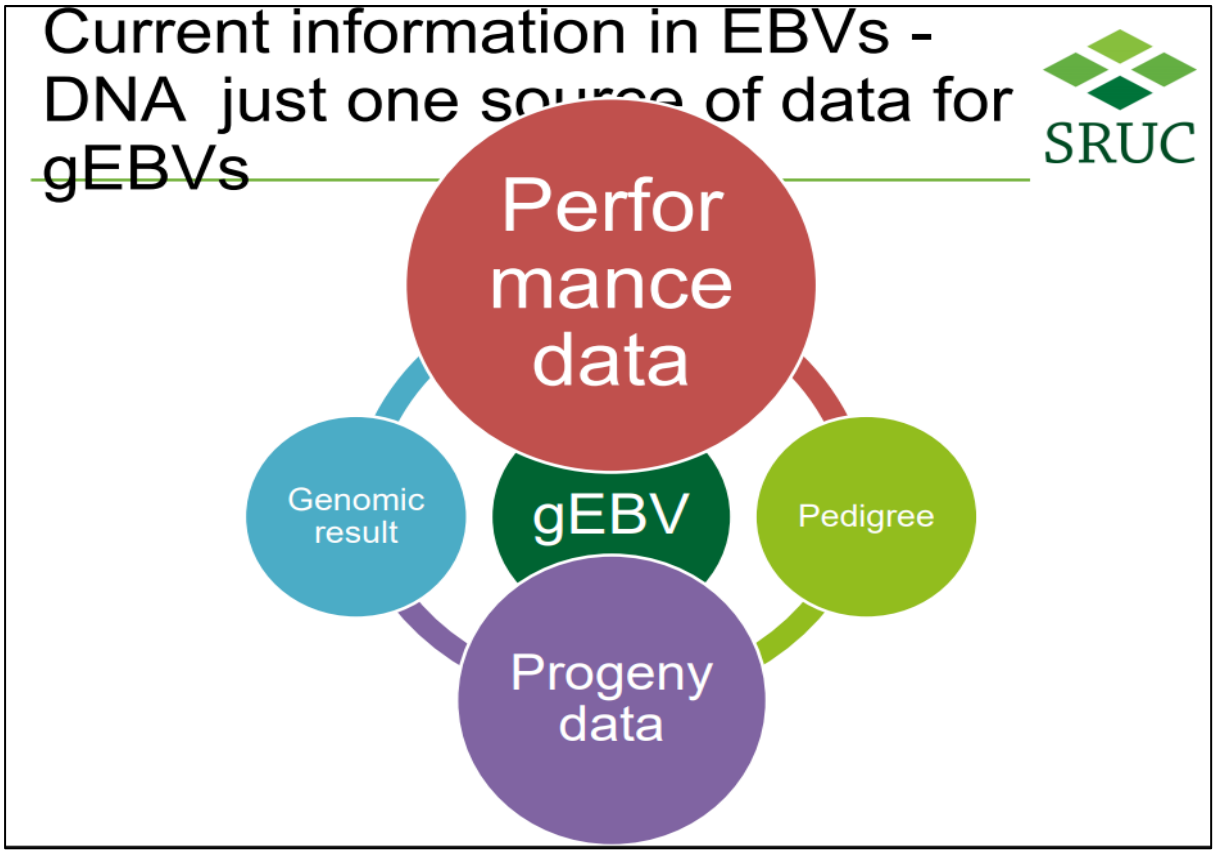
Climate impact of agriculture:

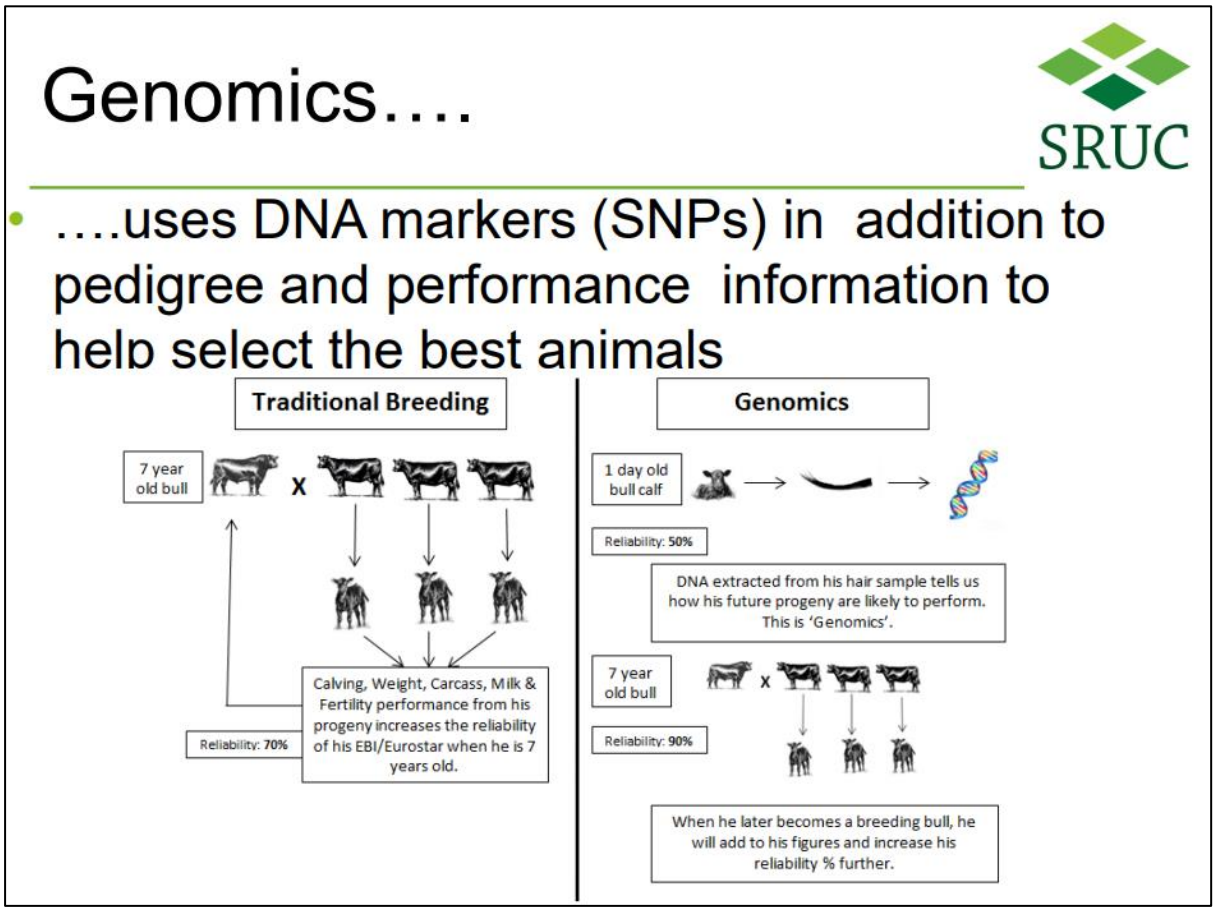
Greenhouse gas emissions from livestock systems




Current information in EBVs
SRUC
Own perform-ance data
EBV
Progeny perform-ance data
Pedigree

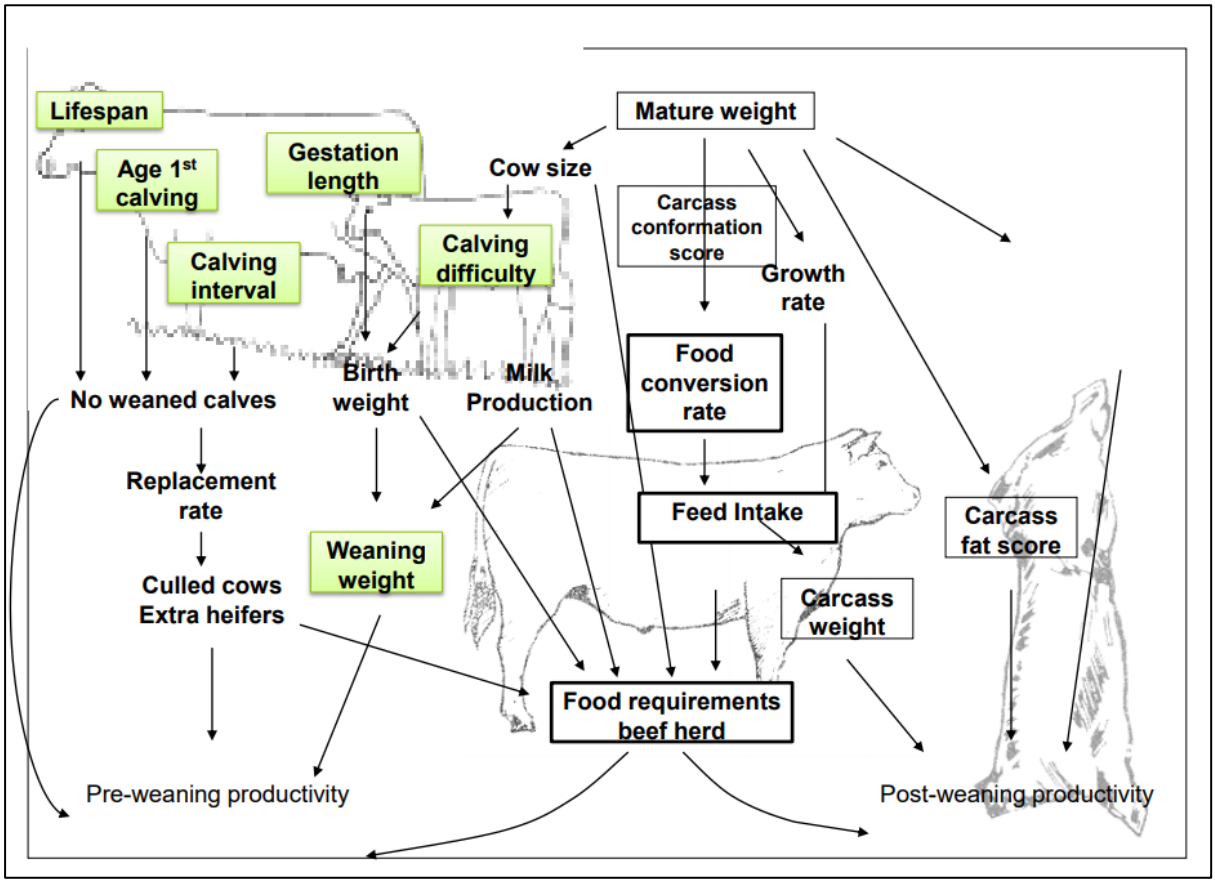

Genomics….
SRUC
…. is the study of an animal's DNA (usually a tissue or hair sample)
G A G C C A C A G T G C T T G A A
T/C
SNP


Current information in EBVs - DNA just one source of data for gEBVs
SRUC
Performance data
Genomic result
gEBV
Pedigree
Progeny data

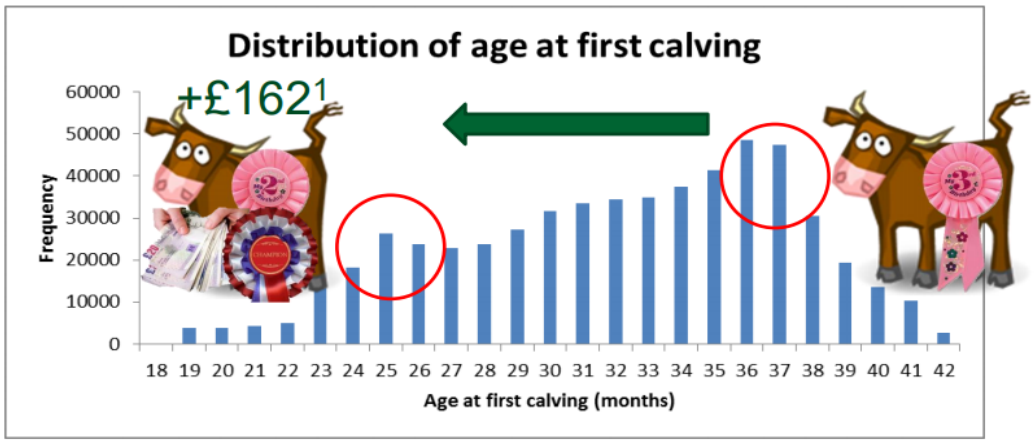

Genomics….
SRUC
….uses DNA markers (SNPs) in addition to pedigree and performance information to help select the best animals
Traditional Breeding
7 year old bull
x
Calving, Weight, Carcass, Milk & Fertility performance from his progeny increases the reliability of his EBI/Eurostar when he is 7 years old.
Reliability: 70%
Genomics
1 day old bull calf
Reliability: 50%
DNA extracted from his hair sample tells us how his future progeny are likely to perform. This is 'Genomics'.
7 year old bull
x
Reliability: 90%
When he later becomes a breeding bull, he will add to his figures and increase his reliability % further.

BES – Data benefits

- Better data, and using it (!), help farmers make the best breeding and management choices.
  - better rates of calving or growth
- A more sustainable Scottish beef sector – environmentally and economically.



Why maternal and calf traits?



- Most cattle are 36 months when they have their first calf
- Huge potential to reduce it to 24 months

1 Davies I. (2016, 03), Late-calving heifers costs beef farmers £4,000/year, http://www.fwi.co.uk/business/late-calving-heifers-costs-beef-farmers-4-000-year.htm

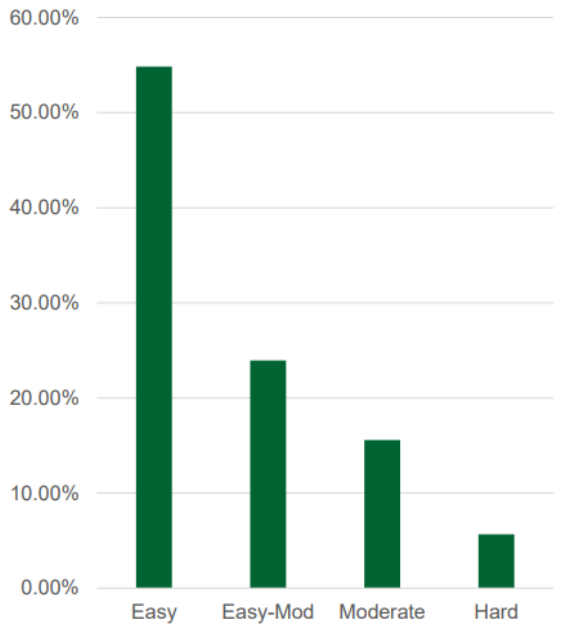
BES – Data benefits

- Nearly half a million calves in first 3 years
  - Over 12,000 sires
  - Over 237,000 dams
  - ~ 35 calves/sire
- 78 breeds and crosses
- Over 11% "purebred"

Breed	%age calves
Charolais	23%
Limousin	21%
Aberdeen Angus	20%
Simmental	17%
Salers	5%

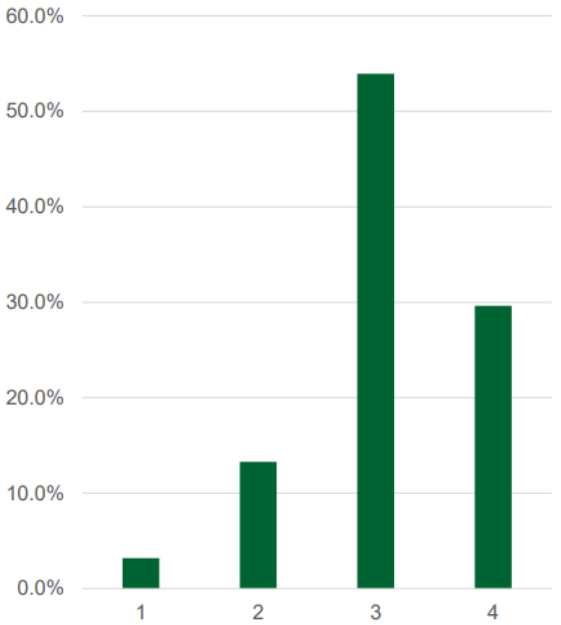
Highlights – calving performance

- 85.8% self calved
- ~2% vet assistances
- Some differences between breeds in calving difficulty
- Average calving interval for BES cows 405 days
  - Many beef farms are targeting more annual calving patterns



Highlights – calf vigour

- 3.5% calves were scored as weak and slow to suckle
- 5 times more likely to die before 12 months
- First hour of life critical
  - Cow:Calf interaction
  - Feeding/calving mgmt



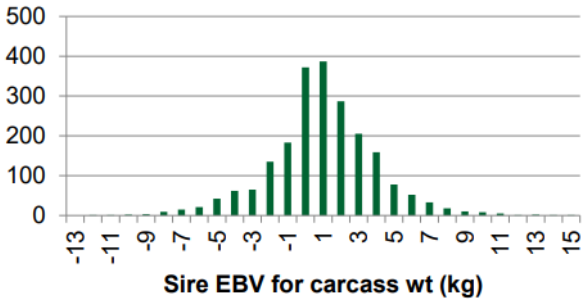
Highlights – health data

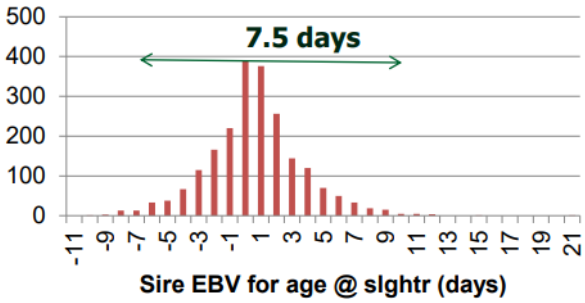
- Of the calves born into the scheme 7.6% of calves were born dead or died before they could be sold
  - Average age 163 days
- Stillbirth and pneumonia the most common reason given
- Value of linking to health scheme data (e.g., BVD, TB, Johnes…)

Disposal Reason	Percentage disposals
Abortion	2.55%
Asphyxiated/Suffocated	2.28%
Born dead	17.23%
Feet/Legs	1.11%
General Health Problems	7.03%
Infertility	1.04%
Injury	3.40%
Joint/navel ill	3.40%
Poor Condition	1.17%
Pneumonia	25.18%
Trampled after calving	3.45%
Poor Type	1.04%

Highlights - genetics

- Traits from historic data
  - Terminal traits from BCMS and carcass
  - 69,274 slaughter progeny
  - 2,158 sires from 10 breeds
  - h^2 net carcass wt = 21%
  - h^2 age @ slghtr = 19%
  - 7.5 days difference between top and bottom quartile genetics for age @ slaughter
  - 10.7 kg in carcass wt

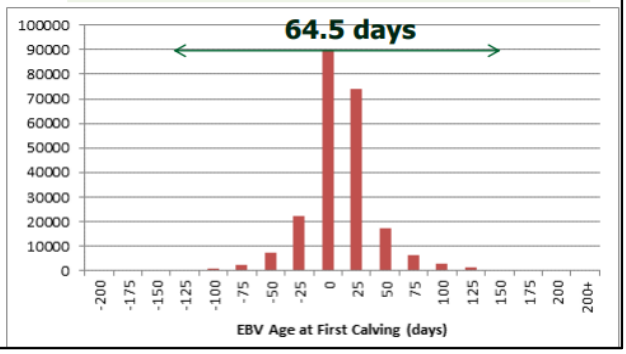




Highlights - genetics

- Traits from historic data
  - Maternal traits for BES herds
  - 85,494 cows (calved twice+)
  - 5,023 sires
  - AFC 31.2 months
  - CI 398 days
  - h^2 age @ 1st calf = 39%
  - 64.5 days difference between top and bottom quartiles in age 1st calving

Sire Breed	AFC (mon)
Aberdeen Angus	30.1
Simmental	30.4
Limousin	32.9
Stabiliser	26.3
Hereford	32.2
South Devon	32.7
Charolais	33.7



Genetic improvement tools already available

Breed societies

Charolais	Aberdeen Angus	Salers
Limousin	Simmental	Beef Shorthorn
Hereford	Stabiliser	British Blue

National Carcass Genetic Evaluations

Highlights - benefits

SRUC

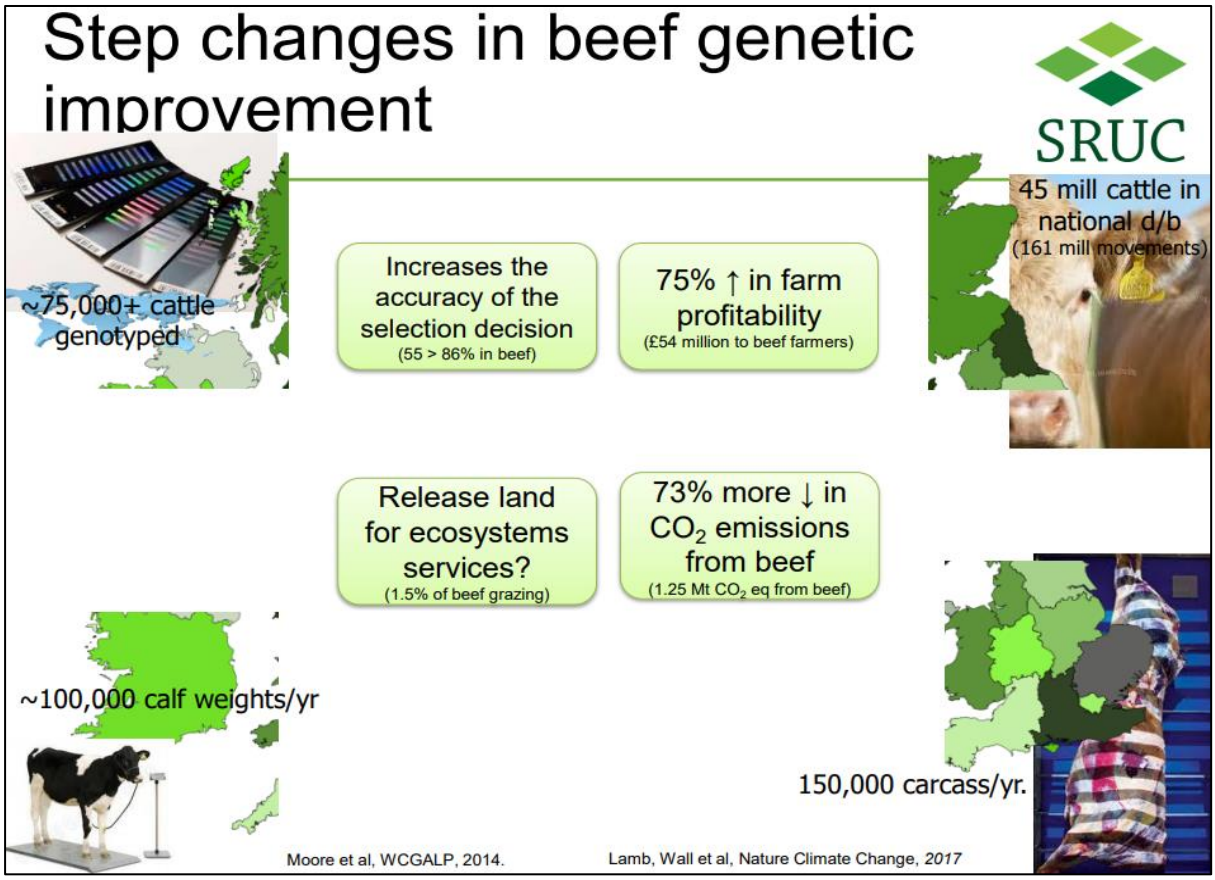
	Economic (£/cow calving)		GHG ($kgCO_2e$/cow calving)	
	10y	20y	10y	20y
5 yrs, AI proven	96	109	-356	-623
5 yrs, Young	67	77	-248	-436
5 yrs, Genomic	125	142	-464	-809
20 yrs, AI proven	143	344	-478	-2009
20 yrs, Young	102	261	-339	-1524
20 yrs, Genomic	183	427	-616	-2494

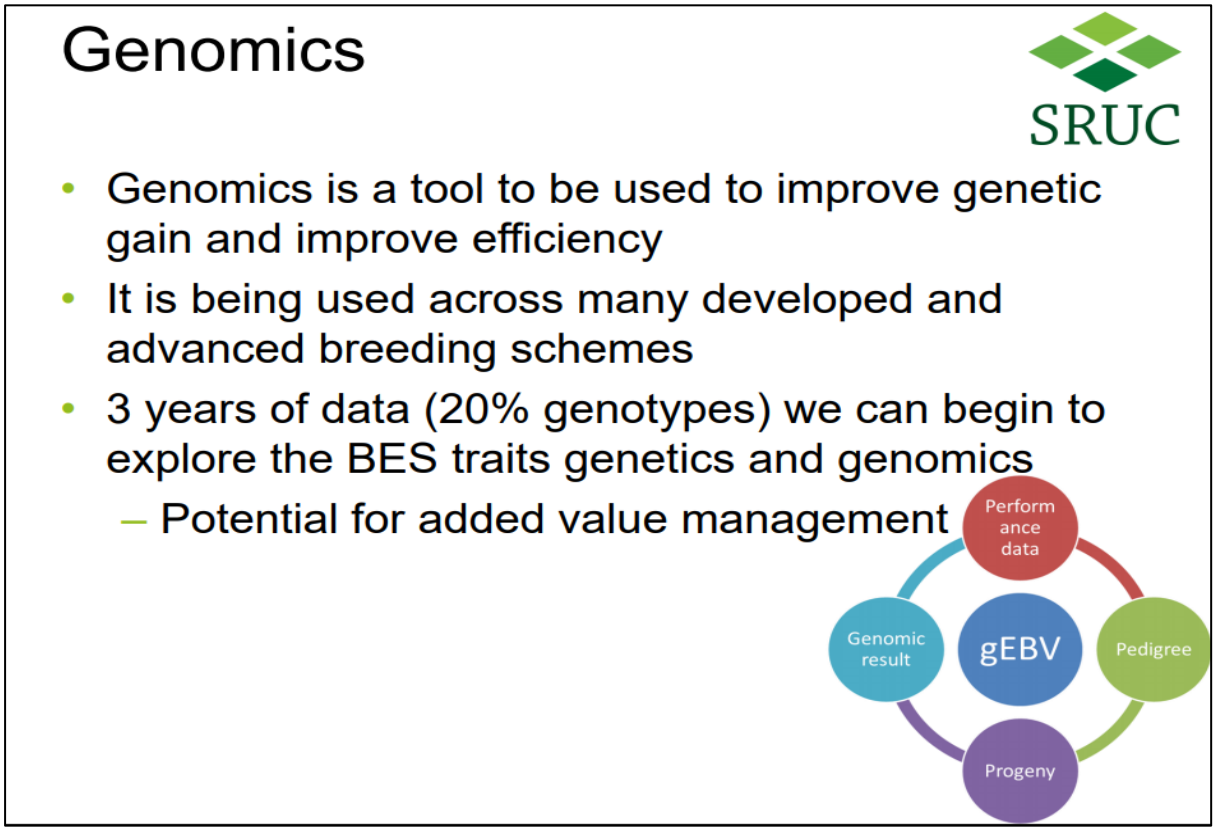
- AFTER 5 YEARS OF SELECTION
- Cumulative economic return of ***£47/cow calving***
- Cumulative GHG reduction ***95 kgCO2e/cow calving***

Value of Genetics

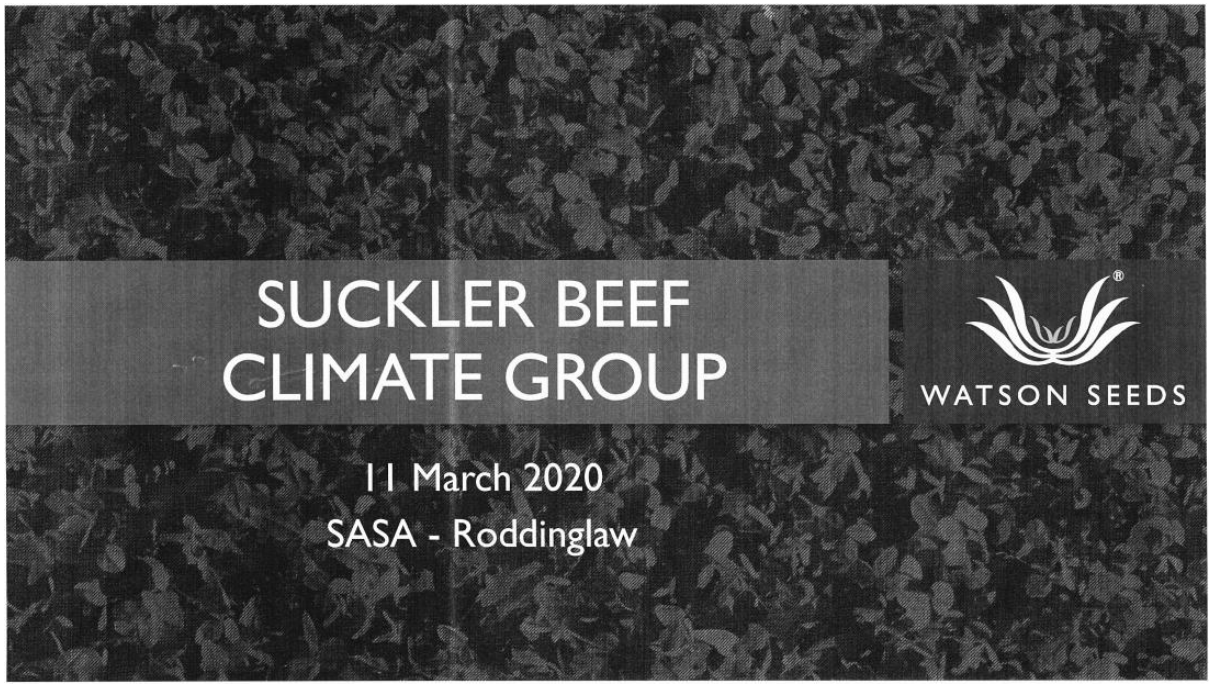
SRUC

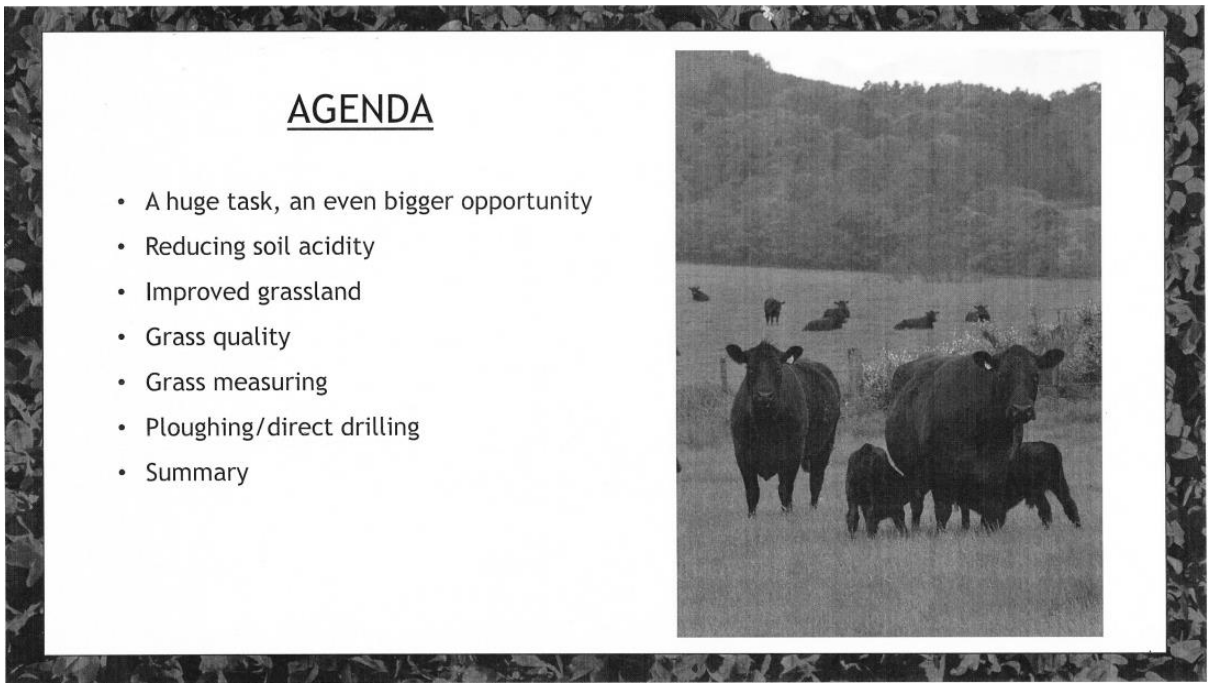
	Available	Estimated cumulative £	Estimated cumulative GHGs
Improving carcass efficiency	NOW	↑22% profit	↓10% in CO_2eq
Improving breeding efficiency	NOW	↑35% profit	↓18% in CO_2eq
Improving feed efficiency	SOON	↑40% profit	↓26% in CO_2eq
Genomic informed improvement	NOW (for some breeds)	~↑50% profit	~↓35% in CO_2eq
Integrating new plant varieties	Some development needed	~↑55% profit ?	~↓40% in CO_2eq ??
Integrating rumen bug genetic info	Some science still needed	~↑55% profit ?	~↓50% in CO_2eq ??


Step changes in beef genetic improvement
SRUC
~75,000+ cattle genotyped
Increases the accuracy of the selection decision
(55 > 86% in beef)
75% ↑ in farm profitability
(£54 million to beef farmers)
45 mill cattle in national d/b
(161 mill movements)
Release land for ecosystems services?
(1.5% of beef grazing)
73% more ↓ in CO_2 emissions from beef
(1.25 Mt CO_2 eq from beef)
~100,000 calf weights/yr
150,000 carcass/yr.
Moore et al, WCGALP, 2014.
Lamb, Wall et al, Nature Climate Change, 2017


Genomics
SRUC
• Genomics is a tool to be used to improve genetic gain and improve efficiency
• It is being used across many developed and advanced breeding schemes
• 3 years of data (20% genotypes) we can begin to explore the BES traits genetics and genomics
– Potential for added value management
Perform ance data
Genomic result
gEBV
Pedigree
Progeny

Annex XIII: Presentation 6 (Watson Seeds)





REVIEW OF POST UK PLOUGH UP PROGRAMME WW2

"Compared with permanent grass, rotational grass is more efficient not only as a producer of animal food but also as a soil restorer."

Research & practice report October 1947

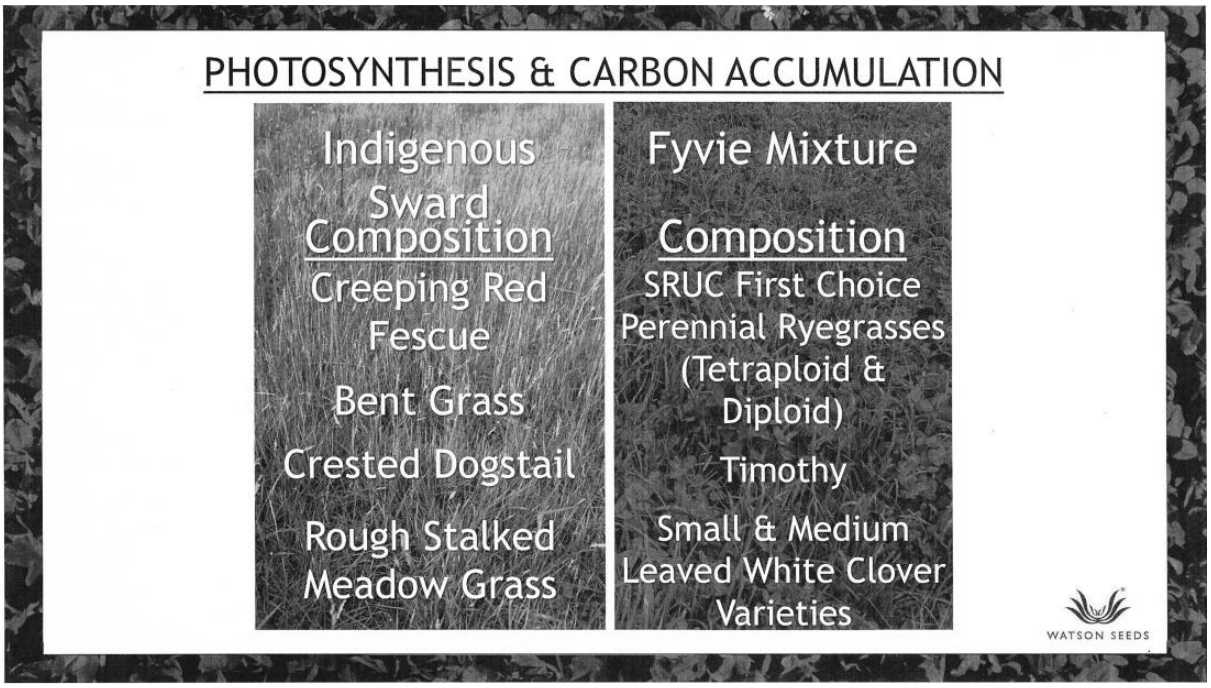
WATSON SEEDS

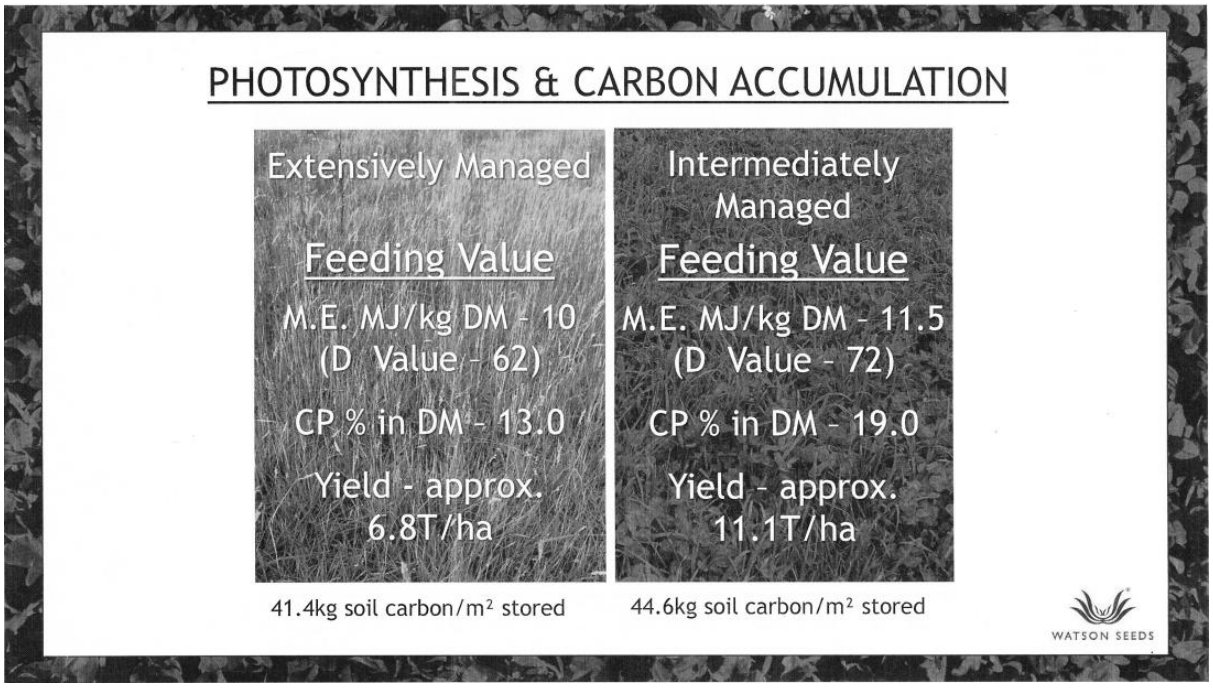
450 SOIL SAMPLES ANALYSED BY WATSON SEEDS PRE RESEEDING

pH	58.8% below 6.0	A low pH results in inefficient utilisation of NPK and poor overall plant health
Phosphorus	37.7% below Index 2	Phosphorus deficiency in the soil causes poor root development and plant establishment
Potassium	59.4% below Index 2-	Potassium deficiency has a profound influence on plant health and leads to inefficient nitrogen uptake
Magnesium	1.4% below Index 2	High levels of soil magnesium inhibits potassium availability and impacts on good soil conditions

All the above deficiencies are severely reducing potential animal performance and profit - unlock the potential on your farm.

WATSON SEEDS


PHOTOSYNTHESIS & CARBON ACCUMULATION
Indigenous Sward Composition
Creeping Red Fescue
Bent Grass
Crested Dogstail
Rough Stalked Meadow Grass
Fyvie Mixture
Composition
SRUC First Choice Perennial Ryegrasses (Tetraploid & Diploid)
Timothy
Small & Medium Leaved White Clover Varieties
WATSON SEEDS


PHOTOSYNTHESIS & CARBON ACCUMULATION
Extensively Managed
Feeding Value
M.E. MJ/kg DM - 10 (D Value - 62)
CP % in DM - 13.0
Yield - approx. 6.8T/ha
Intermediately Managed
Feeding Value
M.E. MJ/kg DM - 11.5 (D Value - 72)
CP % in DM - 19.0
Yield - approx. 11.1T/ha
41.4kg soil carbon/m² stored
44.6kg soil carbon/m² stored
WATSON SEEDS

IMPROVED FIELD PERFORMANCE FROM BETTER GRASS & CLOVER

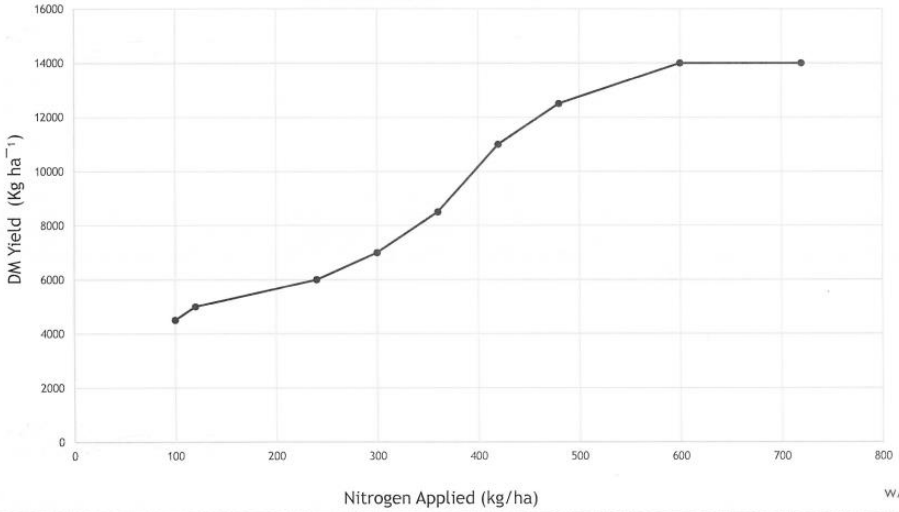
Samples at 30th May 2019

Castle Mixture	Net Energy	Calories	Protein	Digestibility	Lignin
UK Average Sward	7.59	559	15.60	75.22	2.94
Old Sward	7.23	505	10.12	69.38	3.29
Mingary	7.94	614	21.08	81.06	2.58

WATSON SEEDS

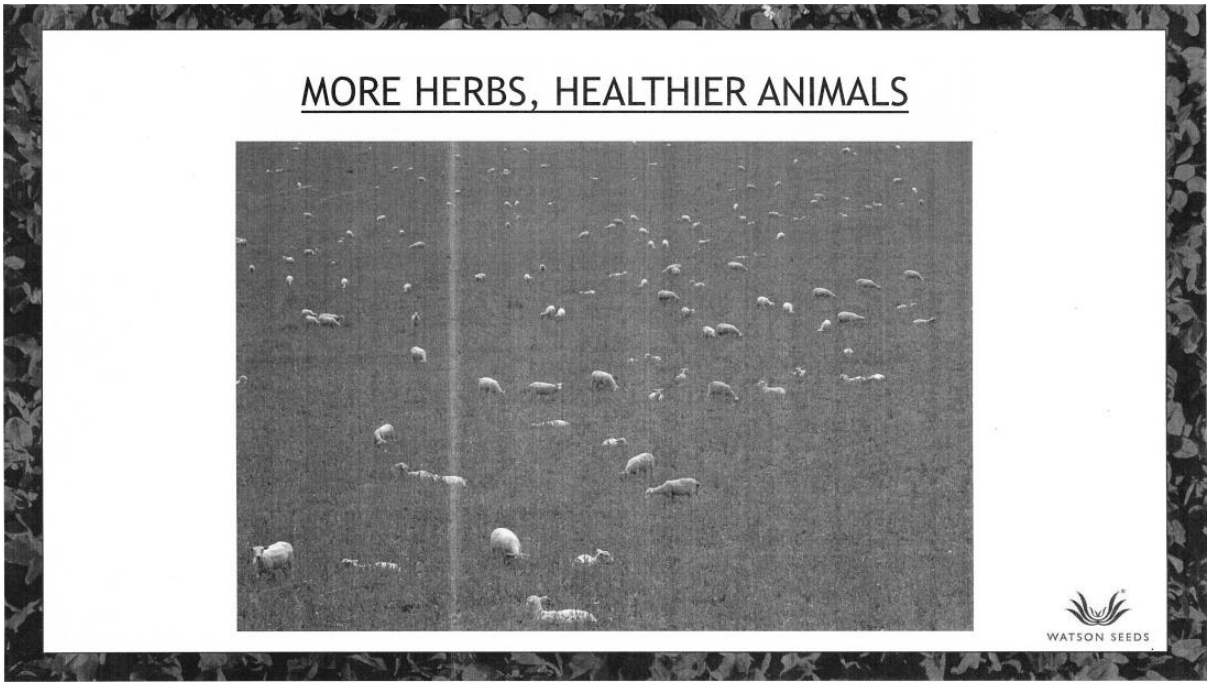
PLANT BREEDING OF PERENNIAL RYEGRASS

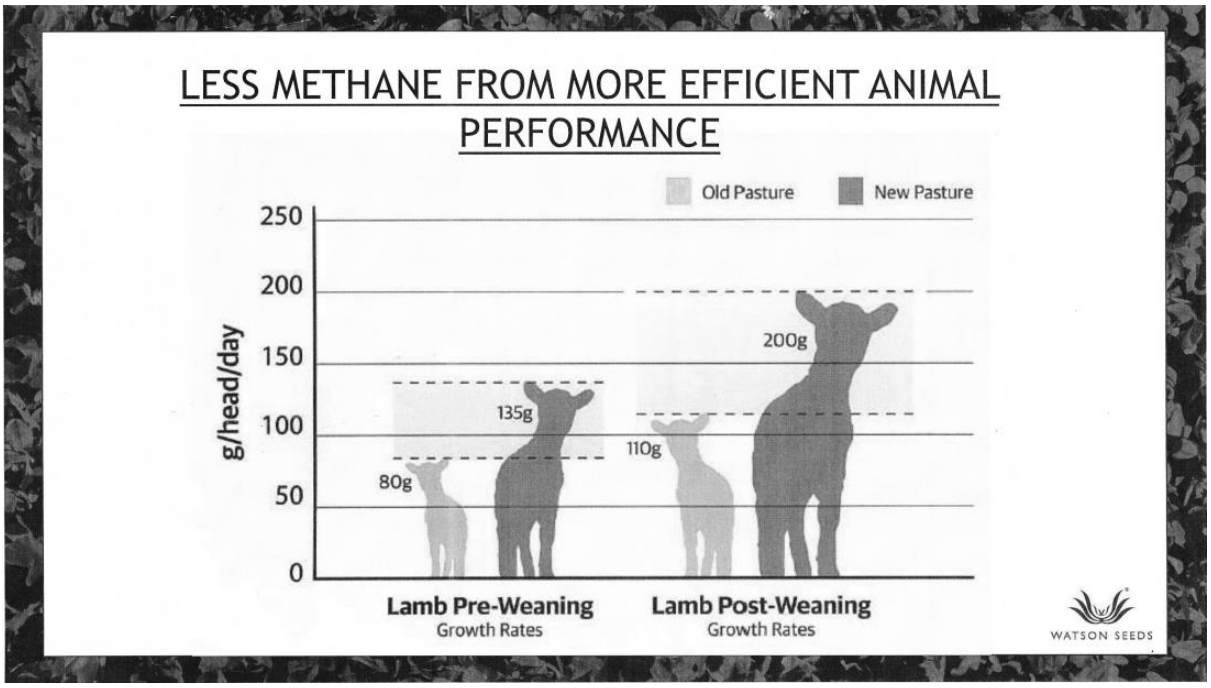
PREDICTED RESPONSE OF PERENNIAL RYEGRASS DRY MATTER YIELD IN RELATION TO APPLIED N

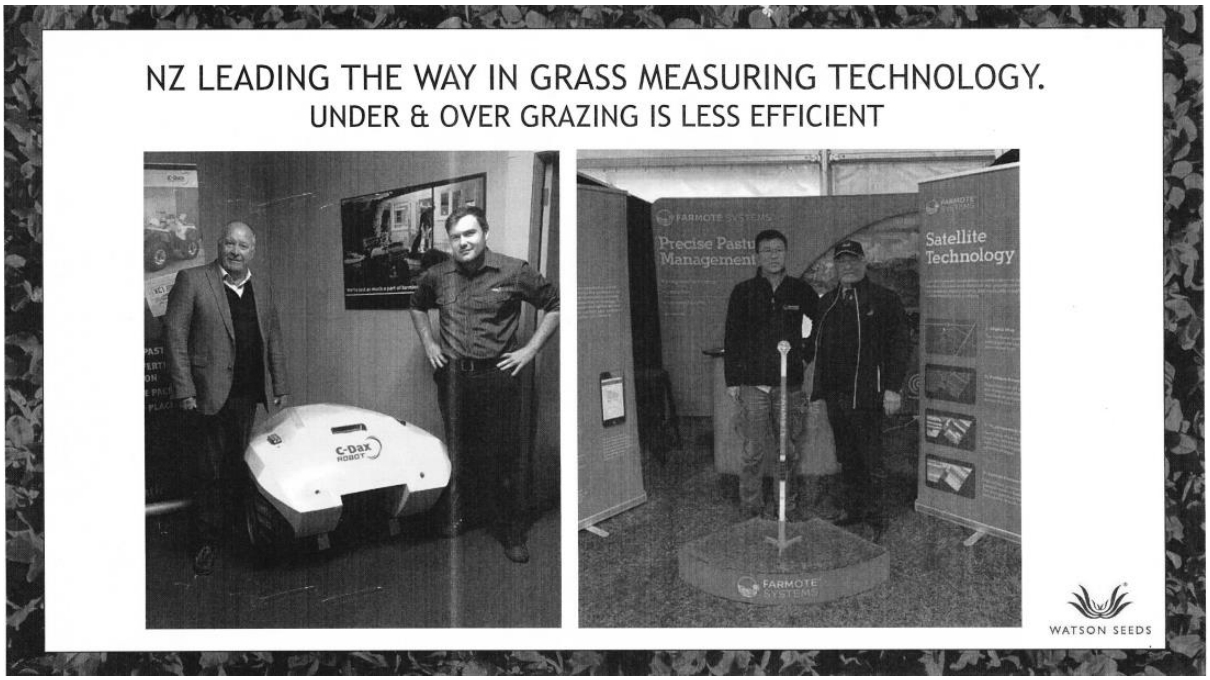


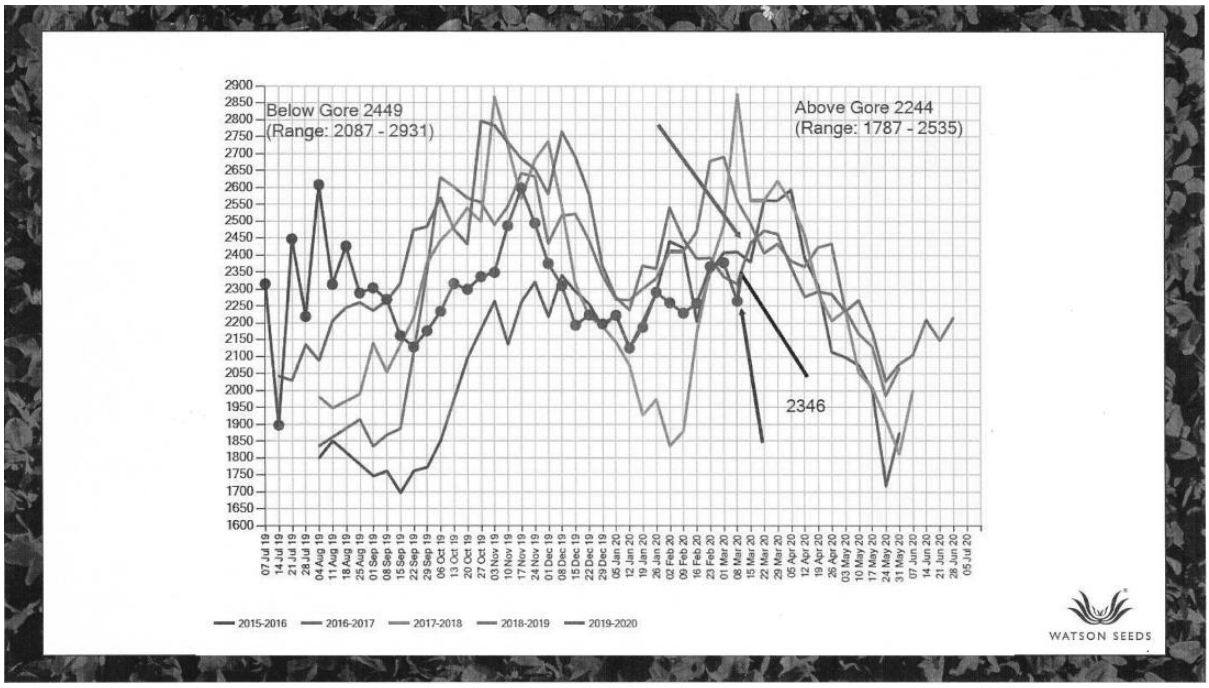
WATSON SEEDS

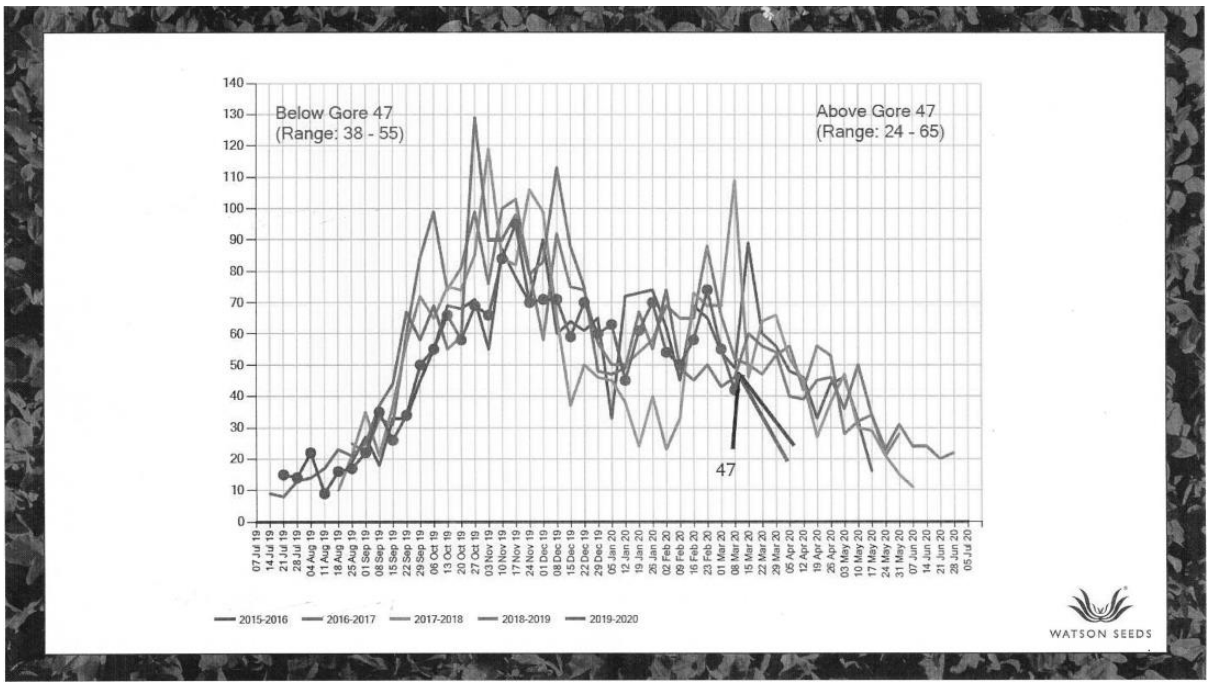

MORE CLOVER LESS SYNTHETIC FERTILISER
WATSON SEEDS


MORE HERBS, HEALTHIER ANIMALS
WATSON SEEDS

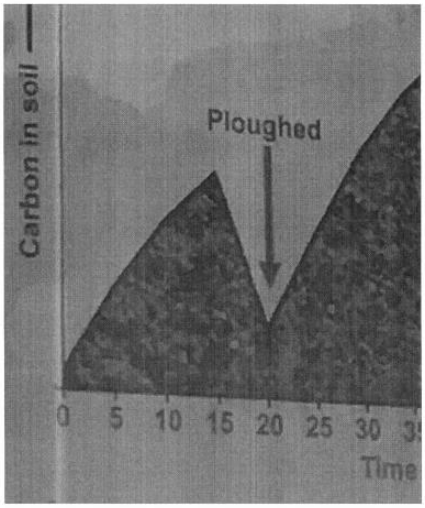

LESS METHANE FROM MORE EFFICIENT ANIMAL PERFORMANCE
Old Pasture
New Pasture
g/head/day
250
200
150
100
50
0
80g
135g
110g
200g
Lamb Pre-Weaning
Growth Rates
Lamb Post-Weaning
Growth Rates
WATSON SEEDS


NZ LEADING THE WAY IN GRASS MEASURING TECHNOLOGY.
UNDER & OVER GRAZING IS LESS EFFICIENT
C-Dax ROBOT
FARMOTE SYSTEMS
Precise Pastu
Management
Satellite
Technology
WATSON SEEDS


Below Gore 2449
(Range: 2087 - 2931)
Above Gore 2244
(Range: 1787 - 2535)
2346
2015-2016
2016-2017
2017-2018
2018-2019
2019-2020
WATSON SEEDS


Below Gore 47
(Range: 38 - 55)
Above Gore 47
(Range: 24 - 65)
47
2015-2016
2016-2017
2017-2018
2018-2019
2019-2020
WATSON SEEDS

LESS PLOUGHING, MORE DIRECT DRILLING



WATSON SEEDS

SUMMARY

We have an exciting opportunity ahead delivering a reduction in the carbon footprint of Scottish livestock farming. We will achieve this only by embracing the technology and innovations unfolding in the industry. This will require extensive collaboration and Government support to deliver a prosperous future for our farming industry.

WATSON SEEDS

Annex XIV: Presentation 7 (Delivering on Net Zero: Scottish Agriculture)

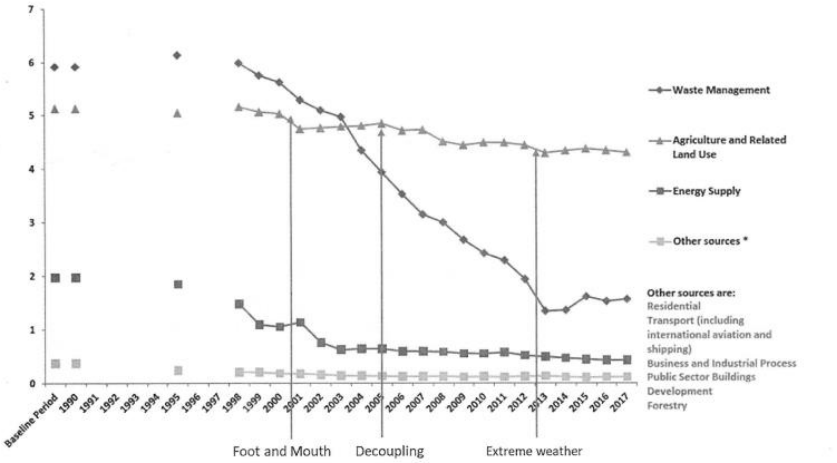
Delivering on Net Zero: Scottish Agriculture

Sheila George
Food and Environment Policy Manager
WWF Scotland

1

Methane (CH_4)

Chart B9. Methane (CH_4) Emissions by Scottish Government Sector, 1990 to 2017. Values in $MtCO_2e$

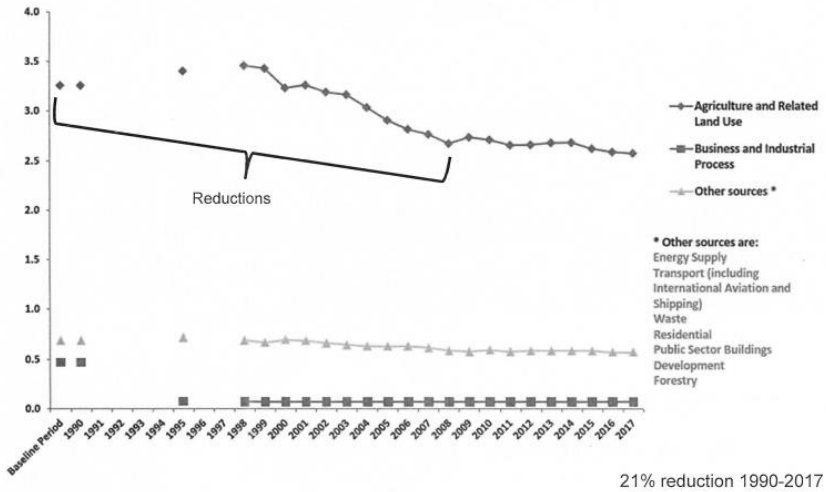


16.2% fall 1990-2017

2

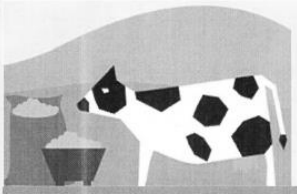
Nitrous Oxide (N_2O)

Chart B10. Nitrous Oxide (N_2O) Emissions by Scottish Government Sector, 1990 to 2017. Values in $MtCO_2e$



21% reduction 1990-2017

3



Securing enteric emissions reductions: Feed

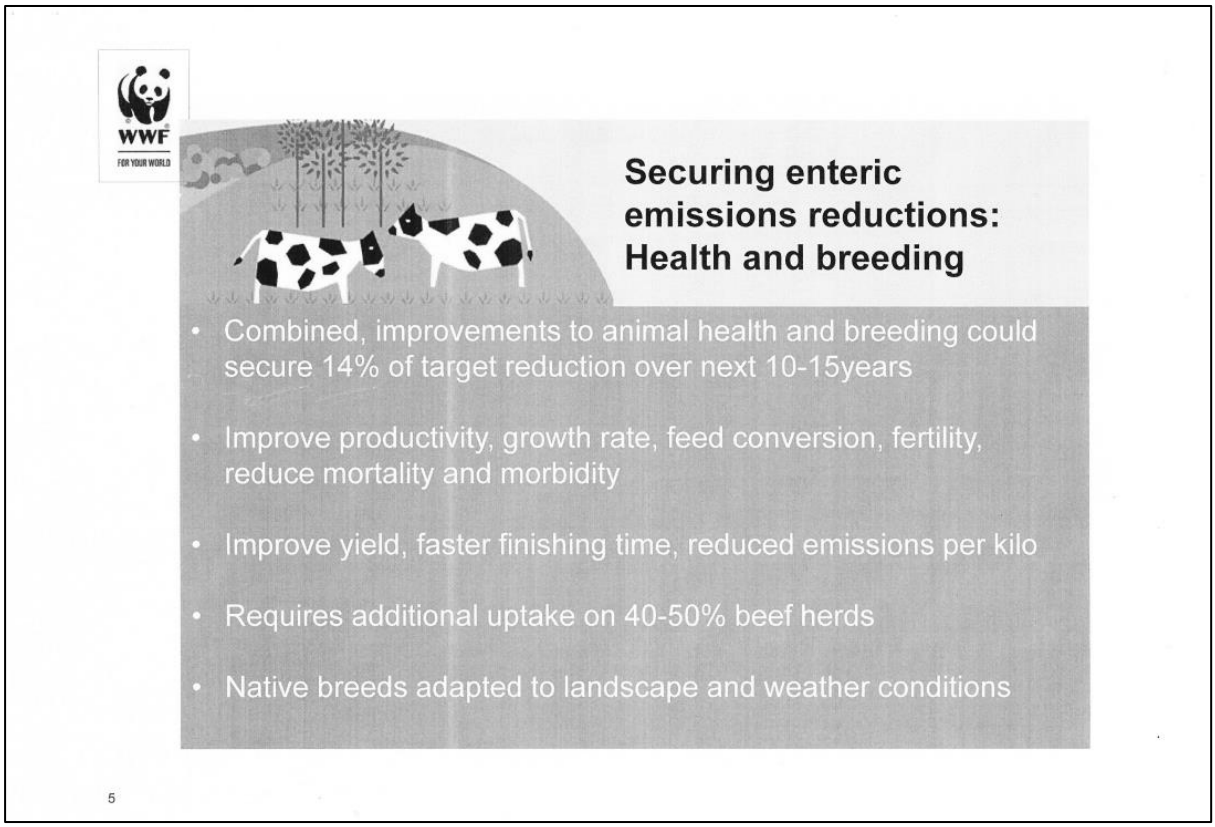
Additives

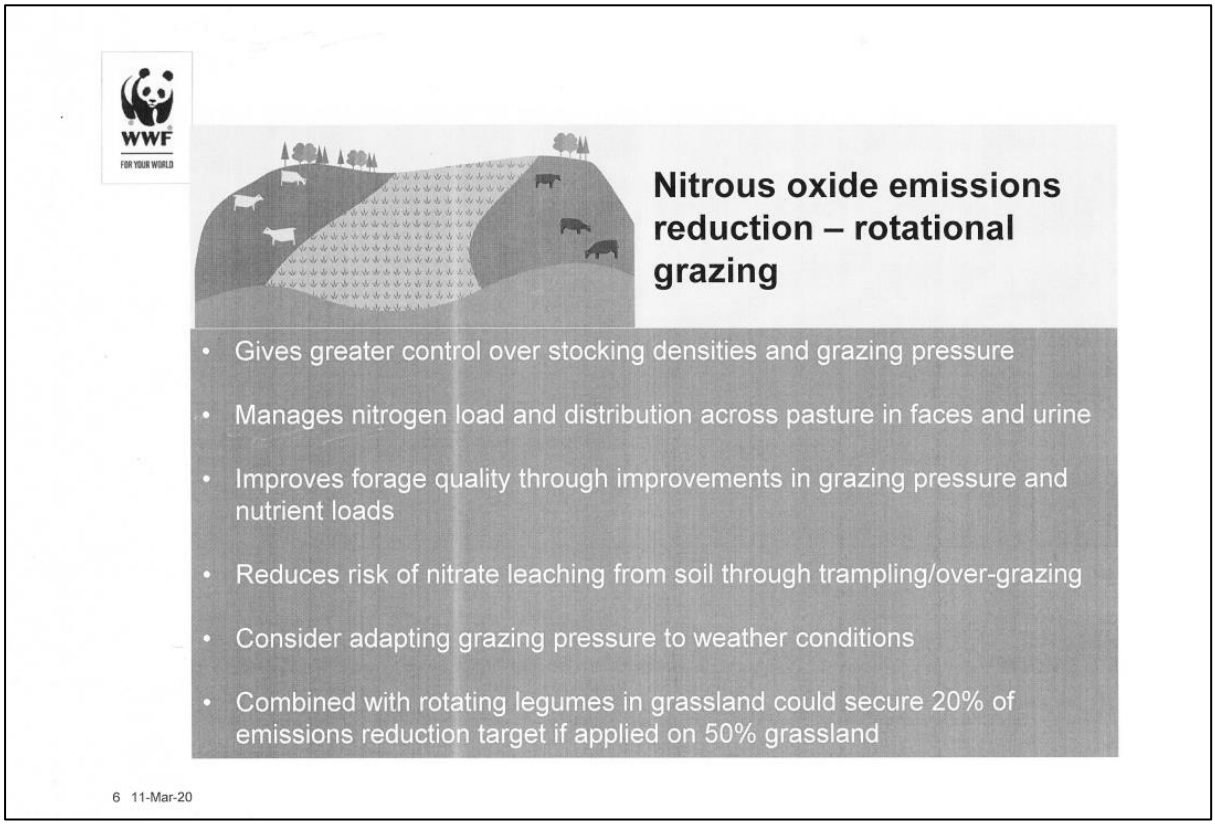
- 3NOP and nitrates offer greatest potential impacts
- 3NOP could offer potential reduction equivalent to 10% over target over 10 years
- Most relevant for dairy cattle but potential uptake for 40% beef cattle
- Need to balance with animal welfare considerations

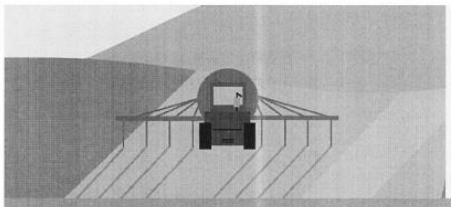
Forage quality

- Improving quality and digestibility of forgage, eg. by ensiling earlier or using rotational grazing to promote increased forage production

4


WWF
FOR YOUR WORLD
Securing enteric emissions reductions: Health and breeding
• Combined, improvements to animal health and breeding could secure 14% of target reduction over next 10-15years
• Improve productivity, growth rate, feed conversion, fertility, reduce mortality and morbidity
• Improve yield, faster finishing time, reduced emissions per kilo
• Requires additional uptake on 40-50% beef herds
• Native breeds adapted to landscape and weather conditions
5


WWF
FOR YOUR WORLD
Nitrous oxide emissions reduction – rotational grazing
• Gives greater control over stocking densities and grazing pressure
• Manages nitrogen load and distribution across pasture in faces and urine
• Improves forage quality through improvements in grazing pressure and nutrient loads
• Reduces risk of nitrate leaching from soil through trampling/over-grazing
• Consider adapting grazing pressure to weather conditions
• Combined with rotating legumes in grassland could secure 20% of emissions reduction target if applied on 50% grassland
6 11-Mar-20



Nitrous oxide emissions reduction – slurry and manure storage and application

- Covers on slurry stores can reduce emissions during storage but nitrous oxide emissions increase on application of slurry – need to combine with precision application
- Soil testing, slurry and manure testing
- Use of a nitrogen balance sheet to calculate nitrogen use efficiency

7 11-Mar-20

SYSTEMS APPROACHES

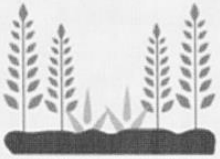
ORGANIC FARMING

CONVERSION TO ORGANIC FARMING HAS BEEN IDENTIFIED AS THE SINGLE HIGHEST EMISSIONS REDUCTIONS OPPORTUNITY, WITH A 40% UPTAKE ON TILLAGE AND GRASSLAND HAVING THE POTENTIAL FOR A 731 KTCO$_2$E REDUCTION.

AGROFORESTRY

AGROFORESTRY OFFERS AN IMPORTANT CARBON MITIGATION POTENTIAL, AT 569 KTCO$_2$E BASED ON 30% UPTAKE BY 2045.

CONSERVATION AGRICULTURE



AN UPTAKE OF THIS SYSTEM ON 50% OF TILLAGE (CUMULATIVE SHIFT, 10% EACH 5 YEARS UNTIL 2045) COULD CONTRIBUTE A 74 KTCO$_2$E REDUCTION.

8


WWF
FOR YOUR WORLD
A REDUCTION OF
38%
OF SCOTTISH AGRICULTURAL GREENHOUSE GAS (GHG) EMISSIONS IS ACHIEVABLE BY 2045
1
REVIEW AND REVISE FRAMEWORK OF ADVICE, TRAINING, INCENTIVES AND REGULATION
2
SET EMISSIONS REDUCTION TARGETS FOR AGRICUTLURE
3
IMPROVE QUALITY AND CONSISTENCY OF MONITORING AND REPORTING AND FILL DATA GAPS
4
BRING FORWARD A GOOD FOOD NATION BILL TO ADDRESS SYSTEM-LEVEL GAPS
9


WWF
FOR YOUR WORLD
Thank you!
10

Scottish Government
Riaghaltas na h-Alba
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