CHAIR'S PROGRESS REPORT ON THE FOOD VISION BEEF AND SHEEP GROUP

2nd November 2022

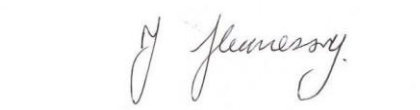
Contents

CHAIR'S FOREWARD

The Food Vision Beef Group, which comprises stakeholders from across the beef sector, has been working in a collaborative and productive manner since July 2022. While it is acknowledged that achieving a 25% reduction in agricultural greenhouse gas emissions will be very challenging, stakeholders are committed to the common goal of identifying measures which can reduce emissions while also protecting the viability of the more than 80,000 farm families engaged in beef production in Ireland. The variety of production systems and conditions in the beef sector coupled with the precarious economic situation on many farms makes the identification of such measures particularly difficult.

Over the course of our deliberations, a broad range of measures have been reviewed and debated. This exercise is continuing and at this interim stage this is NOT an agreed report rather it is an update on progress**.** The following progress report sets out 9 direct measures and 11 enabling measures that can contribute to the reduction of agricultural emissions from the beef sector. Further analysis is required to understand the volume of emissions that can be abated by these measures and the costs and/or loss of income that may arise due to the implementation of these measures. The analysis of costs will be particularly informative in understanding what level funding may be required to incentivise the changes needed in the sector. While the following progress report presents specific targets associated with each of these measures, these are purely indicative of the direction of travel and are as yet to be decided, final targets need to be informed by the afore mentioned analysis.

Following the publication of this progress report, the group will set about examining the analysis of these measures, which is currently being conducted by the relevant State Agencies. Our collective ambition is to arrive at a final report that sets out the path to the beef sector contributing to a 25%reduction in agricultural greenhouse gas emissions.



Professor Thia Hennessy

1. INTRODUCTION

The Food Vision Beef and Sheep Group was established by the Minister for Agriculture Food and the Marine in June 2022. The membership of the Group comprises representatives from the farm organisations, the meat processing sector, all relevant state agencies, academics and Department officials (see Appendix 1 for the membership of the Group).

The agriculture sector as a whole was directly responsible for 37.5% of national GHG emissions in 2021.[1] On an individual farm basis, there is evidence that farmers have taken several steps over recent years to improve further carbon efficiency per unit of output. However, taking the agriculture sector as a whole, the increase in agricultural output in recent years has contributed to increased Greenhouse Gas (GHG) emissions, as well as increased ammonia emissions. This is one of the key messages of the EPA's latest State of the Environment Report (SoER) (EPA, 2020)[2] and the July 2021 publication of Ireland's Provisional Greenhouse Gas Emissions 1990-2021. Urgent and effective action is needed to address these trends.

Following on from the Climate Action and Low Carbon (Amendment) Act 20213, hereafter referred to as the Climate Act 2021, in July 2022, the Government agreed ceilings for emissions from each sector of the economy to deliver a pathway towards a 51% reduction in total emissions by end of 2030.

The ceiling set for the agriculture sector will require that its emissions do not exceed 17.25 Mt CO_2 eq by the end of 2030, compared to a 2018 baseline of 23 Mt CO_2 eq.5. This will require a reduction in emissions of 5.75 Mt, or 25%, compared to 2018. Implementation of both Methane (CH_4) and Nitrous Oxide (N_2O) emissions reduction measures will be required to meet this target.

In addition to regulatory requirements, the consumers and trade customers for Irish meat products and ingredients all around the world are increasingly demanding proof of environmental sustainability and climate action. The Origin Green programme, which includes farm carbon

[1] https://www.epa.ie/our-services/monitoring--assessment/climate-change/ghg/latest-emissions-data/#
[2] State of the environment Report 2020

footprinting and farmer feedback reports, as well as sustainability targets for food companies and retailers, is a key asset in relation to maintaining and growing the value of Irish beef exports. However, these efforts will be undermined if carbon emissions associated with meat production do not decline.

The initial task of the Food Vision Beef and Sheep Group is to identify measures that the beef sector can take to contribute to reducing emissions from the agricultural sector. The focus of the Group has been exclusively on agricultural activities associated with emissions that are counted in the agriculture component of the national GHG inventory. Land use, land use change and forestry (LULUCF) has been allocated a separate target under the Climate Action Plan; a point noted throughout the group's deliberations.

This Progress Report for the Minister for Agriculture, Food and the Marine provides an update of the work of the Group to date and sets out a preliminary list of [20] potential measures for the beef sector. These potential measures are valuable for further exploration in the context of the Climate Act 2021 and the specific emissions reduction target for the Agriculture sector. It is important to note that none of these measures are agreed by the Group at this interim stage.

2. Overarching Factors Governing the Group's deliberations

It is accepted by the Group that there is a need now to significantly step up the implementation of new and existing measures if the 2030 targets for emissions reductions are to be achieved. These measures must be capable of being monitored and verified, so that they can be included in the national greenhouse gas emissions inventory. In its National Projections report the EPA highlighted the need for more explicit quantification of what each methane reduction measures is expected to achieve and details of the planned implementation pathway

It is however, crucial when considering sustainable development of the sector to consider the maintenance of primary producers' economic viability not only in terms of their ability to make a return for their endeavours, but also in helping to deliver on environmental and social sustainability. Social factors such as generational renewal, gender balance, education and training and wellbeing are important considerations in the context of this report. It follows therefore that the necessary and accepted actions that must be taken to reduce agricultural emissions from the beef sector have to be carefully considered so as not to undermine what is a vitally important driver of economic and social development in rural Ireland.

The group is conscious of the fact that the beef sector does not operate in isolation and there is significant interplay between the beef and dairy sectors, as over half of the annual beef output originates from the dairy herd. It is for this reason that the report considers the importance of enhancing and working to optimise the integration between the beef and dairy sectors.

The Irish beef sector accepts that it must modify its way of doing business if it is to contribute to the achievement of the demanding emission targets set for the agriculture sector. In doing so, the Group recognises that the Irish beef industry should be given the opportunity and supported financially to facilitate the transition. Livestock agriculture is fundamentally different to other economic sectors. In being prepared to change its farming practices, the industry is clear that a strict adherence to scientific developments should govern this transformation.

The science around biogenic methane is evolving and becoming clearer. A reduction of approximately 3% in biogenic methane emissions per decade would be sufficient to neutralise its

impact on further increases in global temperature. It is recognised that it will take a considerable length of time following stabilisation for the impact on global warming to be realised and that a reduction to net zero emissions from enteric fermentation is not feasibly attainable.

It is globally accepted that methane emissions must fall from all sources, be it fossil methane or biogenic methane generated from livestock and paddy rice cultivation. Falling methane emissions will have a cooling impact on the earth's climate. It is recognised that different sectors have different capabilities when it comes to reducing methane emissions. The Irish Government should continue to engage with global experts to ensure that National, EU and international policy reflects the latest science.

The Group recognises that a reduction of emissions associated with enteric fermentation is an absolute requirement for the achievement of the sector's carbon budgets under the Climate Act process. A number of proposed measures within this report will be crucial to the achievement of this objective in the short term. In the medium to long term, the adoption of scientific developments that can lead to reduced methane emissions per animal will play an important role, and it is clear that research investments in this area need to be scaled up.

The potential impact of any future disruption to live exports on the capacity of the measures proposed to deliver on the necessary emissions reductions is noted by the group as a risk factor. The volume of live cattle exports in 2021 was 247,163[3] , of which over 140,000 were calves. [4.] Disruption to this trade could substantially increase the volume of emissions nationally.

Further noted by the group is the relatively low profitability of the beef sector. According to the Teagasc 2021 National Farm Survey[5], cattle rearing systems had lower incomes and margins than all other key farming systems. While this is also accompanied by lower debt levels, the average age of a specialist beef producer is 58 according to CSO data, with the age profile of all farmers shifting over the last generation. The proportion of farmers under 45 has shifted to 20.8% in 2020 from 33.1% in 1991[6]. This highlights the need for measures proposed in this progress report to be developed taking account of both the economic and demographic challenges in the sector and the potentially limited capacity to make the necessary investment to adopt new technologies and work practices. The

[3] DAFM meat market report week 52 2021
[4] Beef Carcase Classification and Price Reporting - Annual Report 2021
[5] Teagasc NFS 2021
[6] https://www.cso.ie/en/releasesandpublications/ep/p-coa/censusofagriculture2020-preliminaryresults/demographicprofileoffarmholders/

availability of appropriate supports from government and or industry to facilitate uptake is a key consideration in the further development of these measures.

Thus, four overarching factors have governed the Group's response to its work. First the imperative of adhering to the best scientific advice, second the need to maintain and enhance our beef industry as a key contributor to the economy. Third the recognition that many of Group's recommendations will have crossover implication for other ruminant sectors and fourth the need to consider the cost of implementation, where it will be borne and what resources will be required. In this context, the Group expects that the beef sector will work with the dairy and tillage sectors in the development of an integrated strategy to promote and support climate change mitigation and sustainability best practice.

The Group also emphasises the critical importance of ensuring the maintenance of livelihoods for current and future generations of Irish beef farmers. In particular, there is a need to support generational renewal and young farmers and women in agriculture, who can adapt positively to the changes set out and technologies described in this report.

3. Goals of the Food Vision Beef Group

This Group has been established to advance the actions for the beef and sheep sector identified in the Food Vision 2030 strategy, taking account of the requirement for the sectors to contribute to achieving the targets set for the agriculture and land use, land use change and forestry (LULUCF) sector in the Climate Action Plan 2021.

The establishment of the Food Vision Beef and Sheep group was announced by the Minister for Agriculture Food and the Marine on 1st June 2022. The group, chaired by Professor Thia Hennessy, UCC, has met 6 times to date between 16th June and 25th October 2022.

The Group's first priority is to fulfil the Food Vision commitment to 'produce a detailed plan by Q2 2022 [delayed to Q4 2022] to manage the sustainable environmental footprint of the beef sector, including minimising total emissions, while making a positive contribution to improved water quality and biodiversity, in line with government policy'.

The Group has been tasked to provide an initial report to the Minister by end September 2022 [delayed to October] setting out measures that the beef sector can take to contribute to reducing emissions from the agricultural sector, with a final plan to be submitted by end November 2022. These reports specifically focus on agricultural activities associated with emissions that are counted in the agriculture component of the national GHG inventory. Land use, land use change and forestry (LULUCF) has been allocated a separate target under the Climate Action Plan; a point noted throughout the group's deliberations.

4. Trends in Emissions and Targets

a) Sectoral Emissions and Targets

The Government has agreed ceilings for emissions from each sector of the economy to deliver a pathway towards a 51% reduction in total emissions by end of 2030.

The ceiling set for the agriculture sector will require that its emissions do not exceed 17.25 Mt CO_2 eq. by the end of 2030, compared to a 2018 baseline of 23 Mt CO2 eq. This will require a reduction in emissions of 5.75 Mt, or 25%, compared to 2018.

The implementation of both Methane (CH_4) and Nitrous Oxide (N_2O) emissions reduction measures will be required to meet this target.

While the Land Use, Land Use Change and Forestry (LULUCF) sector, which has a separate target, is clearly of relevance to the beef sector, the focus of the Group is on the agriculture GHG inventory and ensuring that the beef sector reduces its sectoral emissions

Table 1- Climate Action Plan 2021 sectoral reduction targets, updated with Government announcement of July 2022

Sector	2018 emissions (Mt CO_2 eq.)	Sector emissions reduction targets set in July 2022 (Mt CO_2 eq.)	Sector percentage reductions targets set in July 2022
Electricity	10.5	3	75%
Transport	12	6	50%
Buildings	9	1 (commercial and public) 4 (residential)	45% (commercial and public) 40% (residential)
Industry	7.9	4	35%
Agriculture	**23**	**17.25**	**25%**
LULUCF	4.8	Deferred for 18 months to allow for the completion of the Land-Use Strategy.	Deferred for 18 months to allow for the completion of the Land-Use Strategy.

Other**	2	1	50%

** = F-gases, Petroleum Refining and Waste

5.25 Mt CO_2eq. of annual emissions reductions are currently unallocated on an economy-wide basis for the second carbon budget period (2026-2030). These will be allocated following a mid-term review and identification of additional abatement measures. This approach is consistent with both the Programme for Government and the Climate Act 2021.

b) EPA Emissions Data

The EPA publication Ireland's Provisional Greenhouse Gas Emissions 1990-2021[7] shows that total emissions from the agriculture sector in 2021 were 23.1 Mt CO_2eq, an increase of 3% on 2020.

Methane (CH_4) emissions originate from Enteric Fermentation, Manure Management and fuel combustion. In 2021, methane emissions contributed 69.6% of Agriculture sector emissions, and have increased by 1.8% since 2020. Nitrous Oxide (N_2O) emissions originate from Manure Management, Agricultural Soils and fuel combustion. In 2021, N_2O emissions contributed 24.8% to the Agriculture sector, and have increased 3.4% since 2020. Carbon dioxide emissions originate from Liming, Urea Application and fuel combustion. In 2021, CO_2 emissions contribute 5.6% of Agriculture sector emissions, and have increased by 17.3% since 2020.

Increasing methane emissions are evident in the gas share trend, 16.1Mt CO2 eq. (69.6% share) in 2021 compared to 13.5Mt CO2 eq. (67.2% share) in 1990, an increase of 19.3%. The current situation indicates methane emissions from agriculture are steadily increasing due to increased production.

Agriculture emissions by source category and by gas are presented in Figures 1 and 2.

[7] Ireland's Provisional Greenhouse Gas Emissions 1990-2021: Monitoring & Assessment: Climate Change: Air emissions Publications | Environmental Protection Agency (epa.ie)

Figure 1. Trend in Agriculture 1990-2021

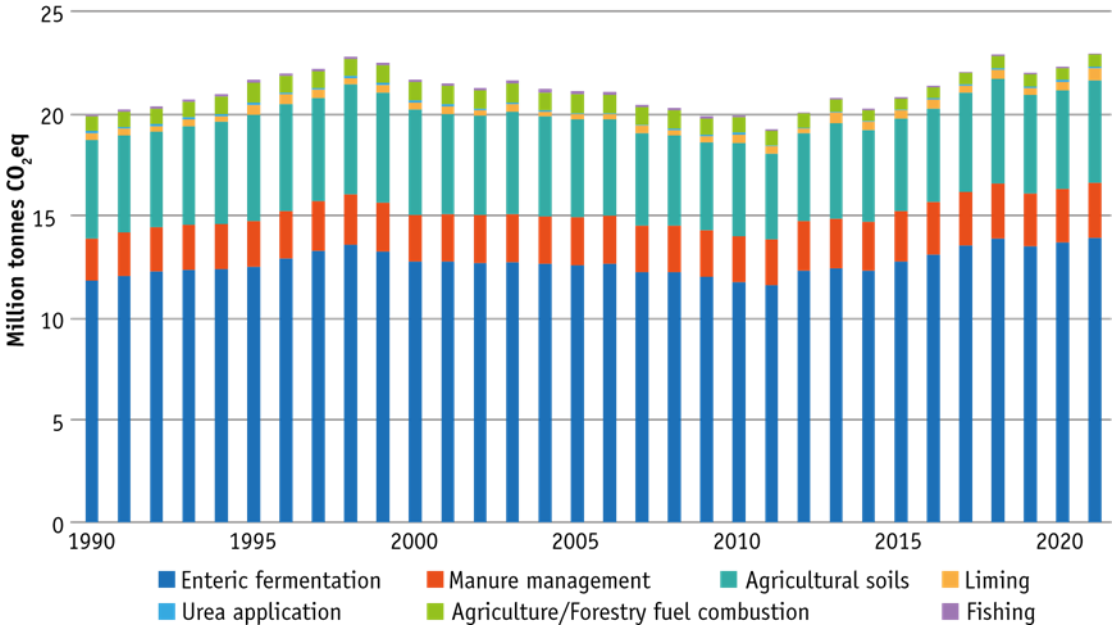


Figure 2. Trend in Agriculture, by Gas 1990-2021

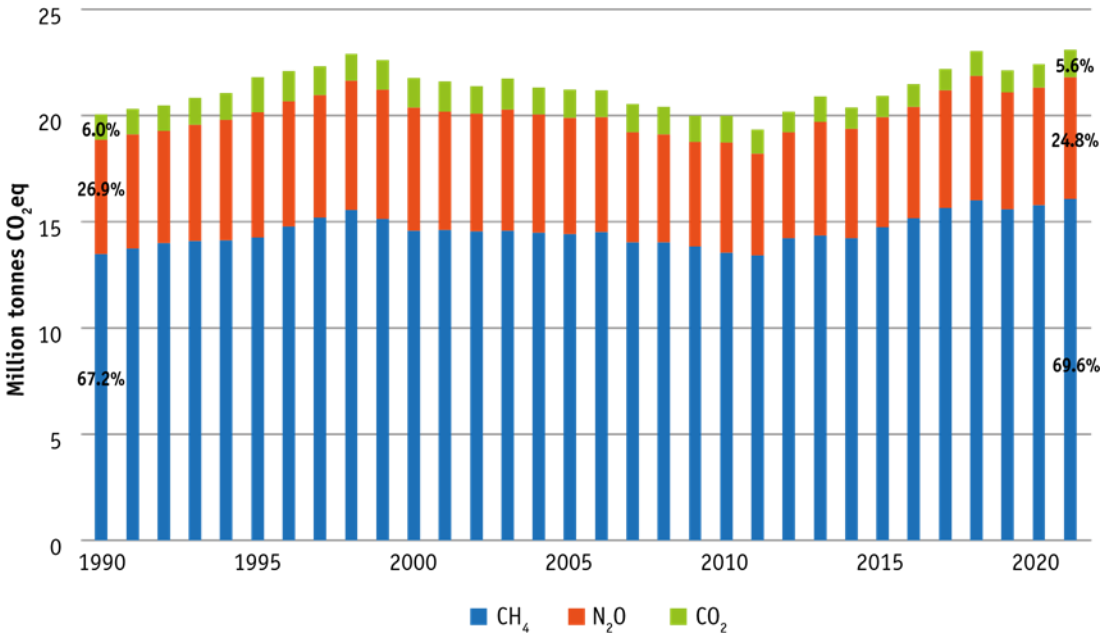
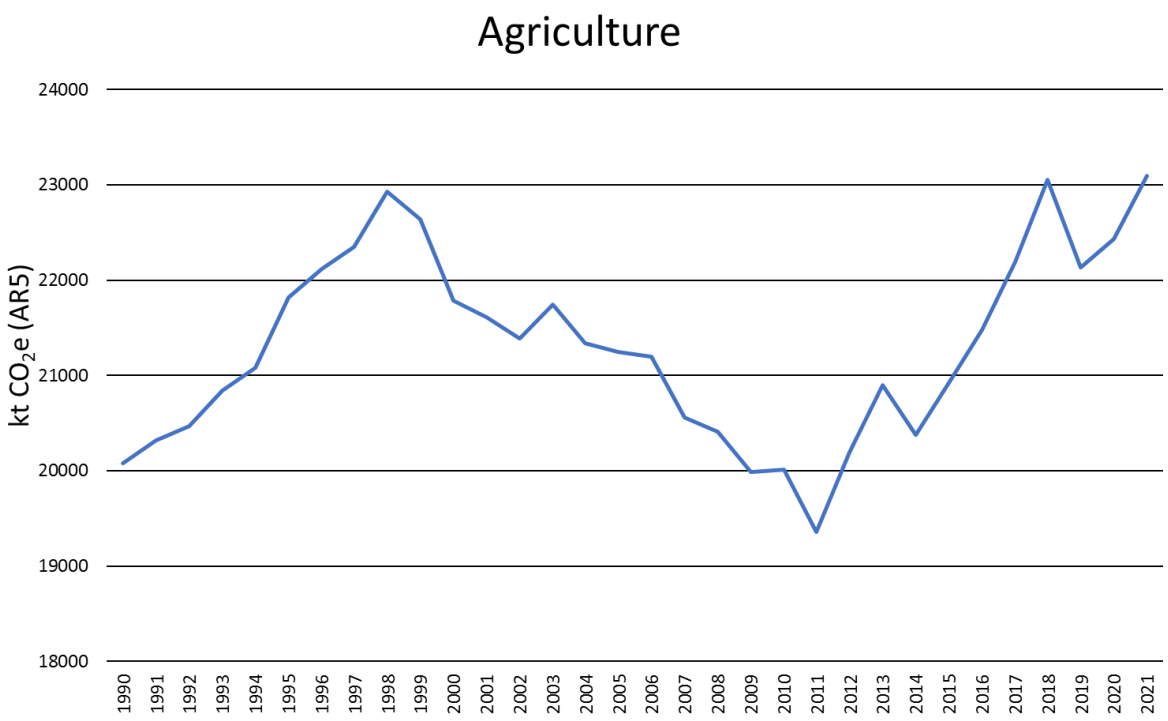


Figure 3 Agricultural emissions CO_2 equivalent (including fuel combustion) [8]



c) Projections of cow numbers, production and emissions

The Teagasc FAPRI-Ireland model generates projections of animal numbers, fertiliser use and crop areas on a regular basis. These projections are provided to the EPA on an annual basis and used in the sectoral forecasts of overall national emissions. The EPA published its 2022 Greenhouse Gas Projections in July 2022. The FAPRI model's forecasts out to 2030 are shown in Figures 4 – 6. These forecasts show that suckler cows are likely to decline to just over 600k head by 2030 (Figure 6. Average June and December figures).

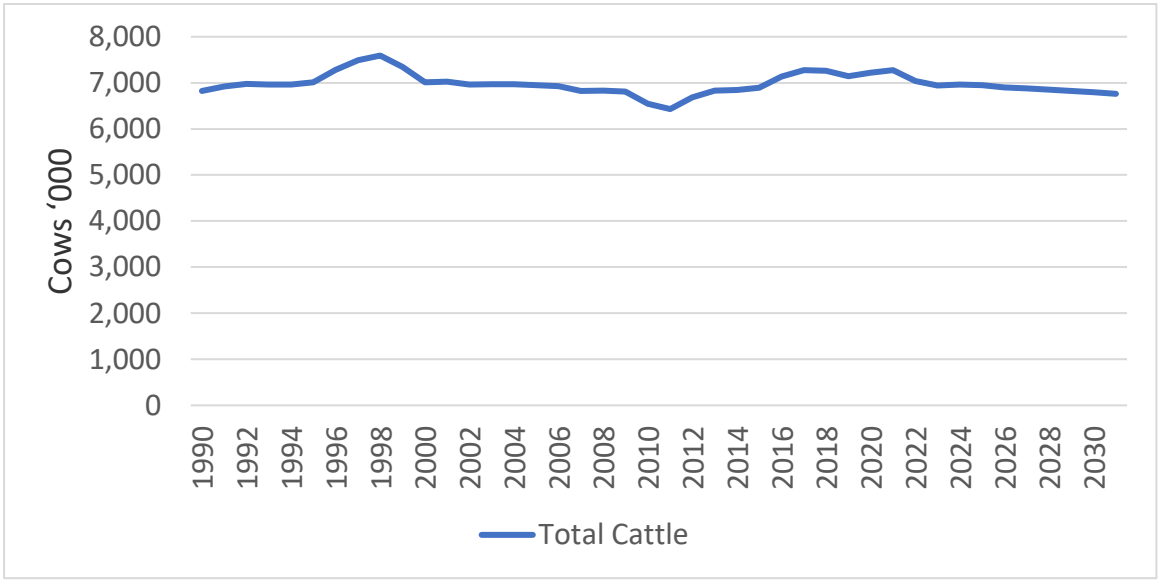
The EPA National GHG projections 2021 – 2024 showed that under the "with existing measures" scenario, emissions from the agricultural sector are projected to increase by 1.9% over the 2020 – 2030 period.

[8] Sources: Climate Change Advisory Council Carbon Budget Digest file and EPA GHG emissions estimates file (2021):
https://www.climatecouncil.ie/media/climatechangeadvisorycouncil/contentassets/documents/cbcbackgroundpapers/Carbon%20Budget%20Scenario%20Digest.xlsx
https://www.epa.ie/publications/monitoring--assessment/climate-change/air-emissions/GHG_Final-emissions-data_1990-2020_AR4_web.xlsx

These forecasts are conditional on assumptions regarding energy prices, and fertiliser prices as well as economic growth rates that prevailed prior to Russia's illegal war in Ukraine. The war has led to substantial increases in fertiliser prices and to a lesser extent in animal feed prices, that would be expected to further dampen growth expectations for cow numbers, production and emissions.

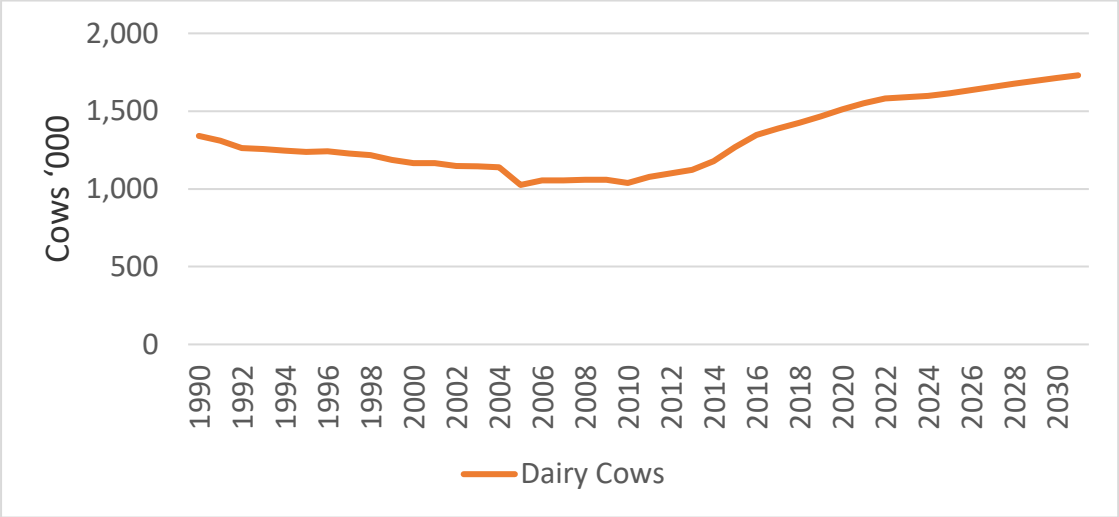
It is recognised that over two-thirds of Irish agriculture agricultural emissions comes from methane, the attainment of the sector's emissions reduction targets cannot be achieved without a significant reduction in methane emissions.

Figure 4 - Total Cattle numbers



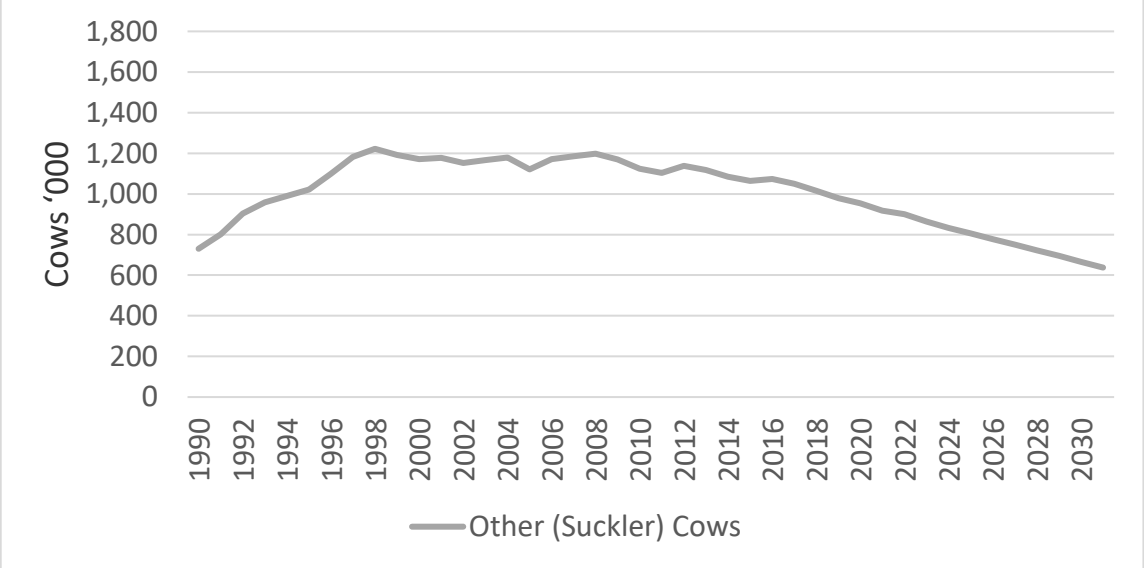
Source: CSO and FAPRI-Ireland model (2021)

Figure 5 - Total Dairy Cows



Source: CSO and FAPRI-Ireland model (2021)

Figure 6 - Total Suckler Cows



Source: CSO and FAPRI-Ireland model (2021)

d) Ireland's Nitrates Action Programme

Ireland's Fifth Nitrates Action Programme (NAP) has several measures that complement the measures set out in this report. These include the planned development of the Register of Chemical Fertiliser sales; improvements in compliance and enforcement such as an increase in derogations inspections from 5% to 10% and strengthening enforcement; chemical fertiliser control will start with a 10% reduction in the grassland application of chemical nitrogen limits applied nationally and may be increased to a 15% reduction nationally after the midterm progress review of the programme; increasing adoption of Low Emission Slurry Spreading (LESS); soil testing; limits on crude protein content in concentrated feeds; and amendment to livestock excretion rate bands.

The proposed National Fertiliser Database will provide for accurate tracking of fertiliser sales and will assist with the regulation of the fertiliser industry. This will contribute to the national targets to reduce fertiliser use and encourage improved nutrient use efficiency.

Recording fertiliser sales data at farm level within a national database will improve recording of quantities used and improve traceability regarding fertiliser use.

Table 2 sets out how chemical nitrogen is used across the sub sectors of Irish agriculture.

Table 2 – Approximate chemical nitrogen use per agriculture subsector*

Total 2021	Dairy	Beef and sheep	Tillage
399,000	200,000 (50%)	140,000 (35%)	60,000 (15%)

*Data from Teagasc National Farm Survey 2021

e) SUMMARY OF MACC (MARGINAL ABATEMENT COST CURVES) MEASURES

Teagasc researchers have performed an analysis of abatement potential for greenhouse gas emissions in Irish agriculture for the commitment period 2021-2030, this has led to the development of the Marginal Abatement Cost Curve which aims to identify the most cost-effective ways to generate abatement.[9] The development of the MACC is an iterative process and a revised MACC will be published in the coming months. The following is a summary outline of the mitigation measures currently incorporated in the MACC.

The current MACC report is based on 25 Mitigation Measures across

- Agriculture
- Land Use, Land Use Change and Forestry
- Bioenergy

Agriculture measures in the MACC can be broken into two groups:

Emissions intensity measures: Only deliver aggregate reductions if increased efficiency leads to reduced activity levels

Absolute measures: Reduce Emission Factors and reduce emissions even where activity is increasing Given the path of projected agricultural activity levels presented at the first meeting of the Group the focus is on absolute measures

The principal GHG emissions from Irish agriculture are Methane (CH_4) and Nitrous Oxide (N_2O)

The absolute measures in the MACC are mostly measures that *mitigate emissions of N_2O*

Measures are assumed to be phased in over the period 2021-2030

Most mitigation as modelled in the MACC occurs during the second budgetary period

- 1st budget period 3.42 MT CO2e cumulatively across measures for 2021-2025
- 2nd budget period 8.01 MT CO2e cumulatively across measures for 2026-2030

[9] Return of the MACC

Key measures are

- Fertiliser type
- Clover in Grass Swards
- Drainage (Mineral Soils)
- Low Emissions Slurry Spreading (LESS)
- Acidification of slurry

These five measures account for 85% of modelled mitigation

Other MACC measures to 2030 are:

- Slurry Acidification
- Lipids
- Protein in pig feeds

Other Measures – MACC+ & MACC++ which will be the future iterations of the MACC

- Feed additives at housing that reduce enteric Methane e.g., 3NOP
- Earlier Slaughter of Cattle
- Feed additives at grass
- Low emitting animals

The Group are largely supportive of the MACC measures Teagasc outlined for mitigating emissions and the overview of the process of refinement to MACC+ and MACC++ in the future.

A framework for the mitigation of emissions needs to be developed and implemented as soon as possible. This framework will include MACC measures which are evolving based on the latest research in the respective areas.

5. PROPOSED MEASURES

This section, and the accompanying tables, outline two categories of measures identified for climate-positive actions for the beef sector. The measures identified are being proposed for further analysis and evaluation only and do not constitute an agreement by the group to implement the measures.

Direct Impacts and Enabling actions

In considering climate-positive measures it is useful to distinguish between direct impact measures on GHGs which can be counted in the national agriculture inventory and enabling actions which, while not directly attributable to GHG reductions in the inventory, support the adoption of the direct measures.

Key to table of measures

Estimated CO_2 equivalent reduction: this column indicates estimated emissions reductions associated with the recommended measures by converting amounts of other gases to the equivalent of carbon dioxide with the same global warming potential (GWP).

Estimated Economic Costs at farm level: this column includes estimated economic costs at farm level of adopting the measure proposed. The estimates of economic costs presented here should not be interpreted as the level of public subsidy required to implement the measure. Most of these measures will require support from farmers, industry and Government, and the share of public funding required for each measure is beyond the scope of this report.

Target GHG: this column indicates which category of Greenhouse Gas will be targeted within the inventory by the recommended measure. It should be noted that all targets set out in this progress report are indicative and yet to be fully determined.

Timeframe*: this column provides an indicative timeframe in line with the Climate Change Advisory Council budget periods.

Short-term	2021-end 2025	First carbon budget period
Medium-term	2026-end 2030	Second carbon budget period
Long-term	2031+	Third and subsequent carbon budget periods

Direct Impact measures to mitigate Greenhouse Gas Emissions from the beef sector				
Measure	**Estimated CO_2 equivalent reduction**	**Estimated economic cost at farm level**	**Target GHG**	**Timeframe**
Measure 1 – Reduce age of slaughter by 2.7 months on average (TBD)			Methane	Medium/Long
Measure 2 – Reduce age of first calving to 24 months [TBD] on average			Methane	Medium/Long
Measure 3 - Development of methane-mitigating feed technologies			Methane	Short/Medium
Measure 4 - Target a 90% [TBD] replacement rate of CAN with Protected Urea by the end of 2025 for grass-based beef production systems		No additional cost Protected Urea is cheaper than CAN on a cost per kg of Nitrogen basis and while it may appear slightly dearer than standard Urea, it provides the same "effective N" for the plant as Urea at a 12% lower spreading rate.	Nitrous Oxide	Short-term
Measure 5- Reduce chemical N use in the beef sector by 30% [TBD] by 2030, with interim target of 20%{TBD} by 2025			Nitrous Oxide	Short-term Medium-term
Measure 6 – Increase Organic Production {target to be decided}			Nitrous Oxide	Short-term
Measure 7 – 7.a) Develop methane mitigating Breeding Strategies (carbon sub-index) 7.b) Develop methane mitigating Breeding Strategies (building efficiency traits)			Methane	Short-term (EF) Medium-Long term (DI)

Total CO_2 equivalent reduction For measures 1 to 7 inclusive				
Measure 8 – Voluntary Diversification Scheme			All	Short term
Measure 9 – Voluntary Extensification Scheme			All	Short term
Measures 8 and 9 would provide additional reductions.	**However, impact of Measure 8 & 9 depends on the level of participation in a voluntary scheme.**			

Enabling measures to support mitigation of Greenhouse Gas Emissions from the beef sector		
Measure	**Target GHG**	**Timeframe**
Measure 10 – Establish robust methodologies for measuring and monitoring GHG emissions and removals at individual farm level.	All	Short-term
Measure 11 – Commission a study on a carbon farming framework.	All	Short-term
Measure 12 – Improve Nitrogen Use Efficiency – Liming and soil pH- Ensure X% of beef farms are soil testing for pH.	Nitrous Oxide	Short-term
Measure 13 – Encourage clover adoption and MSS. Ensure all farmers have incorporated clover/multispecies on 20% of their farm grassland by end of 2025.	Nitrous Oxide	Short-term
Measure 14 – Increase adoption of Low-Emissions Slurry Spreading (LESS)- target x% adoption of LESS for all beef cow slurry manure by 2025.	Nitrous Oxide	Short-term
Measure 15 – Introduce Animal Health Measures listed in action 314 of the climate action plan 2021.	Methane	Short-Medium term
Measure 16 – Develop Energy Diversification Opportunities.	All	Medium-Long term
Measure 17 – Design a Climate Action Communications Strategy.	All	Short-term
Measure 18 – Increase investment in climate change research and KT and Establish an Agriculture and Climate Change Research Liaison Group.	All	Short-term
Measure 19 – Develop enhanced integration between the beef and dairy sectors.	All	Medium – Long term
Measure 20 – Support the role of young farmers and women in agriculture in implementation of the measures set out in this report.	All	Medium – Long term

A. DIRECT IMPACT MEASURES TO MITIGATE GREENHOUSE GAS EMISSIONS FROM THE BEEF SECTOR

Direct Impact measures to mitigate Greenhouse Gas Emissions from the beef sector
Measure 1 — Reduce age of slaughter by 2.7 months on average (TBD)
Impact on Inventory – Enabling Factor/ Direct Impact: **Direct Impact** Teagasc research shows that the variance between 28 month and 23 month finishing systems is in the region of 1T of CO_2e per head.
Recommendation The Climate Action Plan 2021 target was to move to average 24-27 months range. The average age of slaughter was 27 months in 2020 and is currently closer to 26 months. It is now recommended to reduce slaughter age by 2.7 months on average by producing beef cattle which reach desired slaughter weight earlier through the use of high beef merit genetics, improved health, better feed (forage/grazing) and more frequent live weight performance data are key objectives, with a target of months on average.
Key challenges: • Variances in conduciveness of different breeds/systems to realise gains in slaughter age reduction, Teagasc will provide profile for further analysis. • The effectiveness of this measure is dependent on cattle numbers not increasing as a result of earlier finishing. • The effectiveness of this measure is also dependent on earlier finishing not being achieved through increased use of concentrate feeding.
Key impacts measured in specific CO_2e Mt reduction projections **:** Reducing the age at slaughter to an average of 24 months from an average of 26 months could deliver 400KG CO_2e per head (based on a 1T saving for a 5 month variance) the current proportion of prime cattle slaughtered under 30 months is 85% of the average national kill of circa 1.7 million head.
Estimated Costs: Costs here would centre around investment in genetic and feed technologies and weight recording.

The estimated emission reductions through earlier age of slaughter are **not** based on the increased use of concentrates feeding.
Key contributing Factors (i.e., conditions or actions which could support the successful adoption and implementation of the measure.) • Availability of appropriate incentives through supports/market return. • Availability of appropriate knowledge transfer. • Targeting appropriate specific systems/breeds.
Cross cutting proposal linkages and alignment between the recommended measures in this report and relevant policies/strategies:
Timeframe: Medium/Long Term.
Responsibility: Farmers/Industry cross-collaboration /DAFM.

Measure 2 – Reduce age of first calving to 24 months [TBD] on average

Impact on Inventory – Enabling Factor/ Direct Impact: Direct Impact

Direct Impact

Teagasc research shows that reducing age at first calving from 36 to 24 months has the capacity to deliver a 0.5 t reduction in CO2e per cow.
The key enabling technologies are similar to those that facilitate earlier slaughter ages for beef cattle; in particular, higher daily live weight gains early in the animal's lifetime.

Recommendation

Reduce age at first calving to 24 months on average for relevant beef breeds and systems.

Key challenges

- The potential mitigation from this measure is dependent on there being no increase in the overall cattle population
- Variances in conduciveness of different breeds/systems to realise gains in calving age reduction, Teagasc will provide profile for further analysis.

Key impacts measured in specific CO_2e Mt reduction projections

Teagasc research shows that reducing age at first calving from 36 to 24 months has the capacity to deliver a 0.5 t reduction in CO2e per cow. Teagasc analysis shows that a reasonable rate of reduction in the period outlined is an average of 2.7 months in age of slaughter.

Estimated Costs: PLACEHOLDER

Key contributing Factors (i.e., conditions or actions which could support the successful adoption and implementation of the measure.)

- Availability of appropriate incentives through supports/market return.
- Availability of appropriate knowledge transfer.
- Targeting appropriate specific systems/breeds **.**

Cross cutting proposal linkages and alignment between the recommended measures in this report and relevant policies/strategies: Breeding strategies, animal health measures, feed technology adoption.
Timeframe: Medium/long term.
Responsibility: DAFM/Industry cross-collaboration.

Measure 3 - Development of methane-mitigating feed technologies
Impact on Inventory – Enabling Factor/ Direct Impact: Direct Impact Feed additive 3-NOP has proven efficacy to reduce enteric methane by approximately 30% in indoor systems as evidenced in a recent Teagasc research paper.[10] Marketing of the additive has recently been approved by the EU Commission, following an assessment by the European Food Safety Authority. Research is ongoing for pasture-based settings. 3-NOP in its current form can only be applied in in-door systems. A slow-release prototype is currently being developed for grazing cattle and is being tested in New Zealand. This 3-NOP variant should become available in 2023/24. This 3-NOP technology for grassland production system will be tested in the Meth-Abate project on dairy pasture-based systems. In addition to 3NOP, other feed additives including seaweed [asparagopsis] have shown positive results in reducing methane emissions, but further research is required on their efficacy in pasture-based systems.
Recommendation Research in emerging feed additives and feeding methods must be accelerated and supported for Ireland's pastured-based system to ensure early adoption and provide the necessary evidence to include the potential mitigation in the national inventory.
Key challenges: • Research to date has shown that 3NOP will reduce enteric methane emissions by approximately 30% for confined systems of livestock production. • Evidence-based published research of the efficacy of 3NOP for pasture-based use is a priority. • Farmers are likely to require support to encourage adoption of this measure.
Key impacts *measured in specific CO_2e Mt reduction projections* *Data specific to Beef Sector to added as available.*

[10] Teagasc note on carbon budgets, 29 September 2021 (source: Teagasc note on carbon budgets_September_29_2021.pdf (climatecouncil.ie))

Estimated costs *Data specific to Beef Sector to be added as available.*
Key contributing Factors (i.e., conditions or actions which could support the successful adoption and implementation of the measure.) • Co-ordinated cross-collaborative research efforts. • This research needs to be developed further and peer reviewed, and it is not anticipated that it would contribute to a reduction in the inventory until the second carbon budget period. • However, in anticipation of the availability of 3NOP, a discussion on costs and actions required for uptake of these technologies should be prioritised to ensure a maximum rate of adoption. • Industry and advisory services will play a central role in the uptake of feed technologies in the sector. • Immediate research is required to ensure that the technology is available to farmers and can be accounted for in the national inventory. Teagasc and DAFM will continue to support research of 3NOP. • Capacity to absorb additional costs.
Cross cutting proposal linkages and alignment between the recommended measures in this report and relevant policies/strategies
Timeframe: short/medium.
Responsibility: Whole sector cross-collaboration.

Measure 4 - Target a 90% {TBD}replacement rate of CAN with Protected Urea by the end of 2025 for grass-based beef production systems
Impact on Inventory – Enabling Factor/ Direct Impact: Direct Impact Research shows that replacing Ammonium based fertiliser (CAN) with Protected Urea is a technology that can significantly reduce nitrous oxide (N_2O) emissions. The acceleration of the adoption of urea-based technologies to replace ammonium-based fertilisers is recommended. Targets for this technology previously set out in Ag Climatise and Climate Action Plan 2021 with the ambition to have 65% of CAN use replaced with Protected Urea by 2030 (Cross sector target).
Recommendation: Recommendation is to accelerate uptake and target a 90% replacement rate of CAN with Protected Urea by the end of 2025 for grass-based beef production systems.
Key challenges: • Availability of Protected Urea.
Key impacts measured in specific CO_2e Mt reduction projections Protected Urea has lower nitrous oxide (N_2O) emissions compared to CAN and lower ammonia (NH_3) losses compared to Urea. 90% replacement of CAN equates to a **X Mt CO_2 eq.** reduction.
Estimated costs According to Teagasc estimates, Protected Urea is cheaper than CAN on a cost per kg of Nitrogen basis and while it may appear slightly more expensive than standard Urea, it provides the same "effective N" for the plant as Urea at a 12% lower spreading rate. Table 1. below shows the price increase in fertiliser between January 2021 and January 2022 available to DAFM. For Protected Urea, an additional €50 should be added to the price).

Table 1. Fertiliser Prices January 2021 - January 2022

Product	January 2021 (€ per tonne)	December 2021 (€ per tonne)	January 2022 (€ per tonne)
CAN	220	690	690-700
Urea	320	990	890-920
27-2.5-5	320	810	810-820
18-6-12	320	750	750-760

Table 2. Estimated cost of spreading 50kg Nitrogen

Product	€ per tonne	kg N/Tonne	Atmosphere	Estimated Cost of the spreading 50kg N
CAN	€750	270kg N (27%)	3.79%	€139/ 50kg N spread
NBPT Protected Urea	€1000	460kg N (46%)	3.70%	€109/ 50kg N spread
Urea	€950	460kg N (46%)	15.75%	€118 / 57kg** N spread

**According to Teagasc, Urea must be applied at a 12% higher N rate because of the higher N losses associated with it.

Table 2 demonstrates that Protected Urea is cheaper than CAN on a cost per kg of nitrogen basis. While the cost per kg of nitrogen is cheapest for straight Urea when the extra losses associated with straight Urea are accounted for, Protected Urea is more beneficial and cost effective for the application of Nitrogen.

Key contributing Factors (i.e., conditions or actions which could support the successful adoption and implementation of the measure).

• Support from industry for adoption • Two key factors to ensure uptake levels are supported include the availability of Protected Urea and the support of industry initiatives in cooperation with advisory services. • The establishment of the Fertiliser Database, which is planned to be operational in January 2023[11], will track fertiliser from import to end user. DAFM figure show that there was a 13.7% increase in the use of Protected Urea between 1st October 2020 to 31st March 2021 versus 1st October 2021 to 31st March 2022. Figures for 2022 will be available in October.
Cross cutting proposal linkages and alignment between the recommended measures in this report and relevant policies/strategies: feed technologies, reduced age at slaughter, reduced age at first calving.
Timeframe: short term.
Responsibility: DAFM / Agency/Industry Cross collaboration.

[11] gov.ie - National Fertiliser Database (www.gov.ie)

Measure 5- Reduce chemical N use in the beef sector by 30% {TBD}by 2030, with interim target of 20% by 2025
Impact on Inventory – Enabling Factor/ Direct Impact: Direct Impact Direct Impact. Chemical nitrogen use directly impacts the inventory. Research to date has shown that nitrous oxide emissions (24.8% of agriculture emissions**)** can be significantly reduced by better land management practices, replacing CAN fertiliser with Protected Urea, replacing chemical fertiliser with legume fixed atmospheric nitrogen, the use of low crude protein diets and improvements in soil pH. There is a need to work to reinforce and sustain practices at farm level that will support the reduction in chemical nitrogen dependence through the reduced application of CAN fertilizer, while maintaining output and productivity.
Recommendation Reduce chemical Nitrogen use in the beef sector by 30% by 2030, with interim target of 20% by 2025.
Key challenges: • Diversity of system types • Limited supply of clover/cost of reseeding and capacity of extensive farmers to invest in reseeding which given the existing low levels of adoption in the beef sector will require significant investment from a sector with relatively low incomes.
Key impacts measured in specific CO_2e Mt reduction projections For every 10,000 tonnes of chemical N removed, approximately 61,000 tonnes of CO_2 eq are abated. The individual farm level impact is not estimated in this report and is dependent on individual farm circumstances and the measures that can be implemented to negate the effects of reduced chemical nitrogen use on-farm such as improving soil fertility, efficiencies, and refinements in farm management practices.
Estimated costs TBD
Stakeholder Comments:

The cost of fertiliser currently will facilitate the reduction in N use, alternatives such as providing support for reseeding with red clover should be explored, the cost for extensive systems is currently prohibitive. Other soil health factors should be considered. Variance in system types makes developing targets more complex than for other sectors and consideration should be taken of potential impact on productive capacity and unintended knock-on effects of capacity to achieve gains under animal performance measures. Consideration for potential leakage into other sectors is needed as well as the impact of fertiliser use for different systems e.g. grass growth for anaerobic digestion. Stakeholders expressed the view that this measure should be primarily targeted towards farms which are availing of Nitrates derogations as this is where the greatest capacity for mitigation gains lies.
Key contributing Factors (i.e., these are conditions or actions which could support the successful adoption and implementation of the measure). • Availability of alternatives such as clover and supports for additional cost of reseeding. • Availability of information on potential impact of reduction in usage on different system types on productive capacity. • Cross impact of measures and consideration impact on ability to meet scheme targets needs to be clarified.
Cross cutting proposal linkages and alignment between the recommended measures in this report and relevant policies/strategies: Reduced age at slaughter, reduced age at first calving, feed technology adoption. Action 304 of the climate action plan is to reduce chemical nitrogen use to an absolute maximum of 325,000 tonnes (annually) by 2030, with an interim target of 350,000 tonnes by 2025).
Timeframe: Short/medium term.
Responsibility: Cross collaboration.

Measure 6 – Increase Organic Production {target to be decided}
Direct Impact. Increasing the uptake of organic production will lead to a reduction in the volume of fertiliser used.
Recommendation: Increase Organic Production {target to be agreed in consideration of targets under organic strategy and CSP}.
Key challenges: Markets must be developed that return the price premium required to maintain the economic viability of the farm before targets are set for increased production.
Key impacts measured in specific CO_2e Mt reduction projections **PLACEHOLDER**
Key Costs: PLACEHOLDER
Key contributing Factors (i.e., conditions or actions which could support the successful adoption and implementation of the measure). • Communicating the benefits of organic conversion to farmers. • Growing markets for organic produce. • The price point at which organic produce requires to be sold to maintain the income and profitability of the farm.
Cross cutting proposal linkages and alignment between the recommended measures in this report and relevant policies/strategies. Reduction in Chemical N usage. Increase organic production in line with the target in the CAP Strategic Plan of 7.5% of utilisable agricultural area being under organic production. EU level targets set under the Farm to Fork and Biodiversity Strategies are for a 20% reduction in fertiliser use.
Timeframe: Short-term.
Responsibility: All sector.

Measure 7– Development of methane mitigating Breeding Strategies
7.a) Develop methane mitigating Breeding Strategies (i.e., carbon sub-index vI). Continued selection on Eurostar index (both Replacement and Terminal), with additional emphasis on carbon related traits such as female fertility and earlier age of slaughter. 7.b) Develop methane mitigating Breeding Strategies (i.e., carbon sub-index v2). Inclusion of new traits within the carbon sub index, most notably the direct measurement of methane. The first strategy can be considered an enabling factor as it is more linked to efficiency factors (i.e., in the short term). The second strategy can be considered as having a direct impact and is expected to impact emissions in the medium to longer term.
Recommendation: Breeding strategies have an important role to play in sustainability and reducing emissions and are recommended for further research, delivery and implementation. As part of this, genotyping every calf in Ireland creates the possibility of developing more advanced genetic solutions to further improve the system efficiency of dairy and beef farms such as the inclusion of a methane efficiency trait in the breeding objective (e.g., methane produced per unit of feed consumed) and the more precise identification of animals suitable for particular systems of finish, in line with the industry's earlier finishing objectives.
Key challenges:
Key impacts measured in specific CO_2e Mt reduction projections According to Irish Cattle Breeding Federation (ICBF) data the following impact can potentially be expected from continuing to build on the work of programmes such as the Beef Data and Genomics Programme (BDGP) and the new Suckler Carbon Efficiency Programme as well as the development of the Dairy Beef Index in terms of delivering genetic improvement in addressing our ambitious national GHG mitigation requirements. ICBF have estimated a mitigation potential from genetic improvement on beef of some 200 KT by 2030 and 400 KT by 2035. A further 1 MT (by 2030) is achievable through systems and management changes associated with an earlier finishing age.

A key aspect of the above work is to ensure that the above gains are captured in the national inventory models. Work is well underway between ICBF, Teagasc and the EPA in this regard, with realised and projected genetic trends then being captured through annual changes in the Ym (methane efficiency) factors.

One of the significant benefits of the breeding strategy is that all participants ultimately receive the gain, albeit at different stages, depending on the participants use of technologies, such as genotyping, AI, sexed semen and voluntary culling/replacements strategies. Methane mitigating breeding strategies also have co-benefits such as animal health and welfare. The tangible impact of methane mitigating breeding and feeding technologies on the inventory can only be measured over time and their impact on the inventory will need accurate scientific measurement. Hence a key part of the breeding strategy is around building accurate genotyping and phenotyping systems to measure and validate any gains at the commercial farm level.

The new carbon sub-index will become available for inclusion in the EBI towards the end of this year. It is expected that a similar carbon sub index will be incorporated into the beef indexes (i.e., replacement, terminal and dairy beef) in 2023, with the potential inclusion of direct methane traits into these indexes thereafter (2024+).

Estimated costs

TBD

Key contributing Factors (these are conditions or actions which could support the successful adoption and implementation of the measure.)

- Involvement of all livestock sectors.
- The adoption of the new carbon sub-index should be encouraged in tandem with the overall EBI. This should initially focus on reflecting the cost of carbon in the existing traits and then develop out into new traits such as the direct measurement of methane and earlier age at slaughter.
- Adoption/incentivisation level.
- Linkage through to dairy through proposed national genotyping strategy.

Cross cutting proposal linkages and alignment between the recommended measures in this report and relevant policies/strategies: reducing age at slaughter and reducing age at first calving.

Timeframe: Short term (EF) medium to long term (DI).

Responsibility: DAFM/Agency/industry/farmer cross collaboration.

Measure 8 – Voluntary Diversification Scheme
Impact on Inventory – Enabling Factor/ Direct Impact **Direct Impact:** This scheme will only have a direct impact if structured in a way which ensures that reductions in breeding ruminants on a participating farm are not offset by increases in breeding ruminants numbers on that farm, or on other farms.
Recommendation Consider the potential of an incentive scheme for farmers to voluntarily diversify their farming activity away from breeding ruminants for a minimum number of years. An incentivised voluntary diversification Scheme that operates over a contract period should be considered. Under such a scheme, farmers would cease to have breeding ruminants in return for an appropriate incentive. The principles to be considered for such a scheme include: • A voluntary scheme to allow farmers to completely destock breeding ruminants for a contract period. • The scheme would operate over a contract period and provide an annual payment each year per breeding ruminants in line with stated and verified reductions. • The farmer could not calve any breeding ruminants and register births on AIM. • The benefit would be a reduction in breeding ruminants translating into a direct emissions impact. • Legally the commitment would need to be linked to the herd and the holding, therefore a farmer could not opt for the scheme and remove all their breeding ruminants and then transfer the holding during the contract and for the transferee to start a breeding ruminant enterprise on that holding.

- The contract period and the link to herd/holding are essential elements to ensure that a reduction in emissions is achieved and lasts over a period of time.
- However, the farmer would be able to diversify into other areas of farming activity not involving breeding ruminants, conditions on land leasing will need to be considered. Some conditions on participation and activity may be imposed to avoid land abandonment.

In developing a detailed scheme, there would need to be extensive consultation with stakeholders to ensure that the scheme is well understood and effective, and that unintended consequences are avoided.

Key challenges:

- Establishing the principles of such a scheme: the policy intent would be to reduce breeding ruminant numbers on participating farms, and subsequently in the overall national inventory. Therefore, the climate-positive effects of the scheme will not be realised if the land is merely recirculated within the breeding ruminant sector.
- Securing the level of public funding required to incentivise the adoption of the scheme.
- Complexity in attaching the reduction commitment to the herd and the holding over the contract period.
- Consideration of any unintended consequences must be part of the analysis before any scheme is introduced.
- Potential impact on intergenerational renewal and land use.
- Potential impacts on existing commonages requirements as well as requirements under CSP schemes.

Estimated Costs: PLACEHOLDER

Stakeholder Comments:

Stakeholders expressed concern that the proposed exclusion of all breeding ruminants would exacerbate land abandonment concerns, particularly on marginal land. This could have a negative knock-on effect on the economic and social sustainability of the relevant areas, particularly when the multiplier effect of cattle enterprises is considered.

Key contributing Factors (i.e., these are conditions or actions which could support the successful adoption and implementation of the measure). • identification of potential funding sources
Cross cutting proposal: linkages and alignment between the recommended measures in this report and relevant policies/strategies Breeding strategy development
Timeframe: Short-term
Responsibility: DAFM/industry cross collaboration

Measure 9– Voluntary Extensification Scheme
Impact on Inventory – Enabling Factor/ Direct Impact **Direct Impact:** The scheme will only have a direct impact if structured in a way which ensures that reductions in breeding ruminants on a participating farm are not offset by increases in breeding ruminant numbers on that farm, or on other farms.
Recommendation Consider the potential of an incentive scheme for farmers to voluntarily extensify their livestock activity by reducing the numbers of breeding ruminants on their holding for a minimum number of years. It should be open to farmers under such a scheme to partially reduce their breeding ruminant numbers over a contract period in return for an appropriate incentive. The principles to be considered for such a scheme include: • A voluntary scheme to allow farmers to partially destock breeding ruminants for a contract period. • The farmer would commit to a specific reduction number via culling at commencement of the contract. • The scheme would operate over that contract period and provide an annual payment each year per breeding ruminants in line with stated and verified reductions. • Terms and conditions on restrictions regarding breeding ruminants would be set out in the Reduction Scheme agreement at the time of application. • The benefit would be a reduction in breeding ruminants translating into a direct emissions impact. • Legally the commitment would need to be linked to the herd and the holding, therefore a farmer could not opt for the scheme and remove all their breeding ruminants and then transfer the holding during the contract and for the transferee to start a breeding ruminant enterprise on that holding. • The contract period and the link to herd/holding are essential elements to ensure that a reduction in emissions is achieved and lasts over a period of time.

- However, the farmer would be able to diversify into other areas of farming activity not involving breeding ruminants, conditions on land leasing will need to be considered.
- In developing a detailed scheme, there would need to be extensive consultation with stakeholders to ensure that the scheme is well understood and effective, and that unintended consequences are avoided.

Key challenges:

- Establishing the principles of such a scheme: the policy intent would be to reduce breeding ruminant numbers on participating farms, and subsequently in the overall national inventory. Therefore, the climate-positive effects of the scheme will not be realised if the land is merely recirculated within the breeding ruminant sector.
- Securing the level of public funding required to incentivise the adoption of the scheme
- Complexity in attaching the reduction commitment to the herd and the holding over the contract period.
- Consideration of any unintended consequences must be part of the analysis before any scheme is introduced.
- Potential impact on intergenerational renewal and land use.
- potential impacts on existing commonages requirements as well as requirements under CSP schemes.

Key Impact *measured in specific Mt CO_2e emission reduction*

This proposal is for a voluntary measure that can have a direct impact on emissions by reducing breeding ruminants on participating farms. The choice to participate would be for the individual farmer to make based on individual circumstances.

<u>The capture of emissions reductions data will be seen in reduced cow population and reduced nitrogen fertiliser use.</u>

Estimated Costs: PLACEHOLDER
Stakeholder Comments: Stakeholders expressed concern that the proposed exclusion of all breeding ruminants would exacerbate land abandonment concerns, particularly on marginal land. This could have a negative knock-on effect on the economic and social sustainability of the relevant areas, particularly when the multiplier effect of cattle enterprises is considered.
Key contributing Factors (i.e., these are conditions or actions which could support the successful adoption and implementation of the measure). • identification of funding sources. • Identification of diversification opportunities.
Cross cutting proposal: linkages and alignment between the recommended measures in this report and relevant policies/strategies Breeding strategy development.
Timeframe: Short-term.
Responsibility: DAFM/industry cross collaboration.

B. ENABLING FACTORS TO SUPPORT THE MITIGATION OF GREENHOUSE GAS EMISSIONS FROM THE BEEF SECTOR

Measure 10 – Establish robust methodologies for measuring and monitoring GHG emissions and removals at individual farm level.
Impact on Inventory – Enabling Factor/ Direct Impact: Enabling Factor
Recommendation Information on greenhouse gas levels at the level of the farm that is compatible with the national inventory is required to inform appropriate policy making. This information is also essential to enable farmers to manage their carbon levels. Agencies such as Teagasc, ICBF and Bord Bia have access to considerable data relevant to this task. The Group are of the view that collaboration between agencies and farmers and potential for partnership with the private sector should be prioritised, with the aim of generating carbon measurements/ assessments for dairy farms over the next two years. The measurement and monitoring of GHG emissions and removals and sequestration merits a wider multi-sectoral approach as the initiative progresses and needs to also include the measurement and removals of emissions from LULUCF. It is expected that a carbon calculator and decision-support tool will be developed as an integral part of the Signpost farm programme over the next two years, and in time this could be scaled up through the Origin Green programme.

Measure 11– Commission a study on a carbon farming framework
Impact on Inventory – Enabling Factor/ Direct Impact: Direct Impact: subject to building and operationalising an effective model **Recommendation** A comprehensive study should be undertaken to explore the potential of developing a carbon farming framework for methane and nitrous oxide emissions that would be suitable in an Irish context. There are a number of options identified in international research for the implementation of carbon farming, including state incentivisation for the reduction of carbon, state managed carbon trading arrangements, 'cap and trade', and various private sector initiatives. The European Commission has also committed to the development of a carbon farming framework, although the emphasis in this work to date has been limited to the land use, land use change and forestry (LULUCF) sector. The Group proposes reviewing the relevant literature and establishing an understanding of the challenges of implementation and the economic and social implications for dairy and the wider agriculture sector of such a framework. In an Irish context, particular attention should be paid to the emissions from livestock agriculture while recognising that a comprehensive carbon trading model would also need to include LULUCF emissions/savings as well as the contribution to energy and is dependent on the availability of verifiable farm-level emissions data.

Measure 12 – Improve Nitrogen Use Efficiency – Liming and soil pH- Ensure X% of beef farms are soil testing for pH [target to be agreed]
Impact on Inventory – Enabling Factor/ Direct Impact: Enabling Factor
Recommendation Liming plays an important role in improving soil fertility for better grass growth and is considered by the Group to be a crucial enabling measure to support the reduction of chemical N. Lime use is assumed to reach 2m tonnes usage by 2030 in the MACC with progress from current use of less than 1.345m tonnes occurring in a linear fashion between 2022 and 2030. It should be noted that liming does create a small increase in direct CO_2 emissions, but in the context of overall GHG balance, this is not considered important. Additional measures/supports on soil pH and liming element should be considered to support the upcoming Fertiliser Database ambitions.

Measure 13 - Encourage clover adoption and MSS. Ensure all farmers have incorporated clover/multispecies on 20% {TBD}of their farm grassland by end of 2025.
Impact on Inventory – Enabling Factor/ Direct Impact: Enabling Factor – Supports efficient use of fertiliser through compensation of reduced chemical N.
Recommendation Encourage clover adoption and MSS. Ensure all farmers have incorporated clover/multispecies on 20% of their farm grassland by end of 2025. The increased incorporation of clover in grass swards provides an immediate opportunity to reduce in fertiliser use, especially now that price of fertilisers has increased substantially, and there is an opportunity to make progress on this immediately to enable reduced chemical nitrogen use. It is an enabling measure in the Teagasc MACC and MACC analysis has assumed an uptake of 15% on beef farms in reseeded land between 2021 and 2030. However, a more ambitious uptake is required and recommended. The Group recommends that all dairy farmers should incorporate clover/multispecies swards on 20% of their farm grasslands by the end of 2025. The adoption of clover is considered a critical enabling measure by the Group and industry has already moved towards this goal. There was €1 million funding for the multi-species sward measure available to farmers in the 2022 season to support the establishment of approximately 8000 ha of the crop. Measures involving the adoption of MSS should be accelerated and supported by industry. Red clover and white clover are both advantageous and science supports the benefits of adoption. Further research is required; however, the widespread adoption of these technologies should be recommended. Further work on the effects of grazing management of Clover and Multi species sward on enteric fermentation is also required.

Measure 14 – Increased adoption of Low-Emissions Slurry Spreading (LESS)- target x% adoption of LESS for all beef cow slurry manure by 2025 [target to be decided]
Impact on Inventory – Enabling Factor/ Direct Impact: Enabling Factor. Direct impact on Ammonia emissions & enabling factor in mitigation of N_2O.
Recommendation Increased adoption of Low-Emissions Slurry Spreading (LESS)- target x% adoption of LESS for all beef cow slurry manure by 2025 [target to be decided] LESS technologies result in better recovery of Nitrogen during the application of organic manures. Ag Climatise sets a target of 60% of all slurry spread by LESS by 2022, 80% by 2025 and 90% by 2027. Teagasc NFS data show that 36% of slurry was spread with LESS in 2020 and this is already reflected in the EPA inventory as NH3. Investment in LESS is expensive for farmers. Time and significant investment are needed to maximise its adoption. Farmers have shown a willingness to embrace this technology and adoption is increasing. This momentum needs to be maintained and should be encouraged and incentivised through appropriate industry and state support. Information sharing to ensure widespread adoption is required. There is also an urgent requirement for additional slurry and soil water storage capacity on many dairy farms; government support should prioritise increasing slurry storage to facilitate increase nutrient use efficiency and improve water quality. Protected urea should become the nitrogen fertiliser of choice for grass-based livestock production, essentially leaving CAN as a tillage sector input.

Measure 15 – Introduce Animal Health Measures listed in action 314 of the climate action plan 2021
Impact on Inventory – Enabling Factor/ Direct Impact: **Enabling Factor**
Recommendation Introduce animal health measures listed in Action 314 of the Climate Action Plan 2021. This recommendation lists a series of measures addressing both regulated and non-regulated conditions, including BVD, TB, antiparasitic resistance, Johne's disease, clinical and sub-clinical mastitis, IBR and general livestock health and welfare (with an initial focus on calves). Improved animal health is also an essential support measure in the reduction of antibiotic use on farms.

Measure 16 – Develop Energy Diversification Opportunities
Impact on Inventory – Enabling Factor/ Direct Impact: **Enabling Factor** Enabling at farm level and Direct Impact across all national CO_2 reduction targets A range of viable energy diversification options are emerging that can be deployed at farm level. Micro-Generation electricity technologies on farms such as rooftop solar, Photovoltaic (PV) and wind turbines should be promoted. Carbon-mitigation benefits of these energy diversification technologies are attributed to the energy sector budget and not the agriculture sector and thus are not directly relevant to this report but should be considered as part of a Whole of Government response to energy diversification. Biomethane production via Anaerobic Digestion (AD) has the potential to be a key option to decarbonise heat/thermal demand within dairy processing. There is potential to have an impact on the Agricultural inventory. For example, there have been multiple business cases put forward by the Project Clover industry group Sustainable biomethane production can form an important part of the basis of a national biomethane strategy However, direct benefits to the agriculture inventory can only accrue where agricultural land currently supporting ruminants is used as gross feedstocks for AD instead. There are also possibilities to enable reducing emissions by using AD digestate as fertiliser and act as substitutes for traditional chemical fertilisers. Electricity and/or heat feed-in tariffs need to be more favourable for small-scale anaerobic digestion, but interest in such technologies is increasing in the current climate of rising input costs.

Measure 17 – Design a Climate Action Communications Strategy
Impact on Inventory – Enabling Factor/ Direct Impact: Enabling Factor
Recommendation: Develop targeted communications strategy to develop an increased awareness in the agriculture sector of obligations in respect of the specific agriculture target of 25%; highlighting farm-level actions which directly impact the agriculture inventory; to include farm efficiency education programme aimed at improving herd efficiency and performance, with income, labour efficiency, farmer well-being and farm safety as core KPIs and to identify opportunities for diversification.

Measure 18 –(a) Increase investment in climate change research and Knowledge Transfer **(b) Establish an Agriculture and Climate Change Research Liaison Group**
Impact on Inventory – Enabling Factor/ Direct Impact: Enabling Factor leading to the identification and adoption of new mitigation technologies.
Recommendation: 1. Examine the most cost-effective means of significantly increasing investment on Research and Knowledge Transfer on Climate Change and related matters. Input from private organisations undertaking research should also be considered. 2. Establish an ACCRLG to review all national and international research on agriculture GHG emissions and to ensure that information is communicated in a timely manner to the EPA to enable the most rapid incorporation that is possible of new scientific information into the inventory of Greenhouse Gases. The ACCRLG should foster cross-agency and academia-based, coordination, collaboration, and research ambition in key identified areas and should include a farmer and an industry representative. The ACCRLG should foster cross agency and academia based, coordination, collaboration and research ambition in key identified areas and should include a farmer and an industry representative.

Measure 19 – Develop enhanced integration between the beef and dairy sectors
Recommendation Develop mechanisms to enhance the integration between the dairy and beef sectors with a view to the following benefits. Develop mechanisms to enhance the integration between the dairy and beef sectors. Existing measures such as the Dairy Beef Calf Programme and Teagasc's Dairybeef500 programme support sustainable dairy beef production. Current research and direction in breeding strategies is also targeted at improving the quality of beef from the dairy herd without impacting on reproductive performance. With over half of beef produced now coming from the dairy herd, a strategic direction for better integration of the herds should continue to build on current schemes and ongoing research at Teagasc and ICBF. Building on these schemes to support integration between beef and dairy systems can be used to further sustainability goals and will also have a positive impact on the welfare of male dairy calves. Potential areas for development include enhanced use of high DBI sires in the dairy herd, enhanced use of sexed semen and targeted support to farmers rearing calves from the dairy herd. The recent EFSA opinion and recommendations on cattle transport, and in particular the transport of unweaned calves, may have a significant effect on future calf export potential. A successful dairy beef strategy will improve the resilience of the sector to potential shocks, with additional benefits for calf health and welfare.

Measure 20 – Support the role of young farmers and women in agriculture in implementation of the measures set out in this report
Recommendation Food Vision 2030 recognises that Generational Renewal and Gender Balance are critically important to ensuring the sustainability of primary producers under Goal 4 of Mission 2. This Group recognises that young farmers and women in agriculture bring new skills and new thinking to the farm enterprise, and will be key enablers of the adoption of new technologies and efficiency measures to reduce emissions on beef farms. Both groups require support to fully enable them to drive the change required for the full suite of measures set out in this Report. The Group recommends that a study be undertaken on the role young farmers and women can play in implementing the measures set out in this Report, ensuring that succession planning, generational renewal and gender equality are supported as policy priorities.

6. NEXT STEPS

While decisions on these measures have not been reached at this progress report stage, each measure will be considered for further development and evaluation, within a relatively short timeframe given the urgency of the issue, in terms of its emissions mitigation, implementation potential and economic cost.

The final report will aim to develop detailed metrics on potential GHG mitigation for each measure and identify economic costs at farm level as part of the analysis to determine the potential of each measure to deliver the necessary emissions reduction.

APPENDIX 1 – MEMBERSHIP OF FOOD VISION MEAT GROUP

FOOD VISION MEAT GROUP	
Organisation	**Name**
Chair	
Chair	Professor Thia Hennessy
DAFM	
ASG, agri-food strategy and sectoral development	Sinéad McPhillips
Head of Meat and Milk Policy Division	Maria Dunne
Climate Change Division	Dale Crammond
Farm organisations	
IFA – Irish Farmers Association	Brendan Golden
IFA – Irish Farmers Association	Tomas Bourke
ICMSA – Irish Creamery Milk Suppliers Association	Pat McCormack
ICMSA – Irish Creamery Milk Suppliers Association	John Enright
ICSA – Irish Cattle and Sheep Farmers Association	Edmund Graham
ICSA – Irish Cattle and Sheep Farmers Association	Eddie Punch
Macra	John Keane
Macra	Gillian Richardson /Elaine Hanrahan
INHFA - Irish Natura and Hill Farmers Association	Michael Mc Donnell
INHFA - Irish Natura and Hill Farmers Association	Tom Burke
ICOS - The Irish Co-Operative Organisation Society	Ray Doyle
Industry Delegation	
MII - Meat Industry Ireland	Philip Carroll
MII - Meat Industry Ireland	Joe Ryan/Sile Sweeney
ABP – Beef Products	Kevin Cahill
Kepak	Tom Finn
Dawn Meats	Paul Nolan
Liffey Meats	Derek McDermot

Agencies	
Teagasc	Kevin Hanrahan
Teagasc	Paul Crosson
ICBF – The Irish Cattle Breeding Federation	Andrew Cromie
Bord Bia	Joe Burke
UCD – University College Dublin	Alan Kelly
EPA – Environmental Protection Agency	Mary Frances Rochford
AHI - Animal Health Ireland	David Graham
Food Vision Beef and Sheep Group Secretariat	
DAFM Meat & Milk Policy Division **DAFM Meat & Milk Policy Division**	Valerie Woods Gregory Murray
DAFM Support	
DAFM Meat & Milk Policy Division **DAFM Meat & Milk Policy Division**	Lydia Bagge Oliver Fitzpatrick