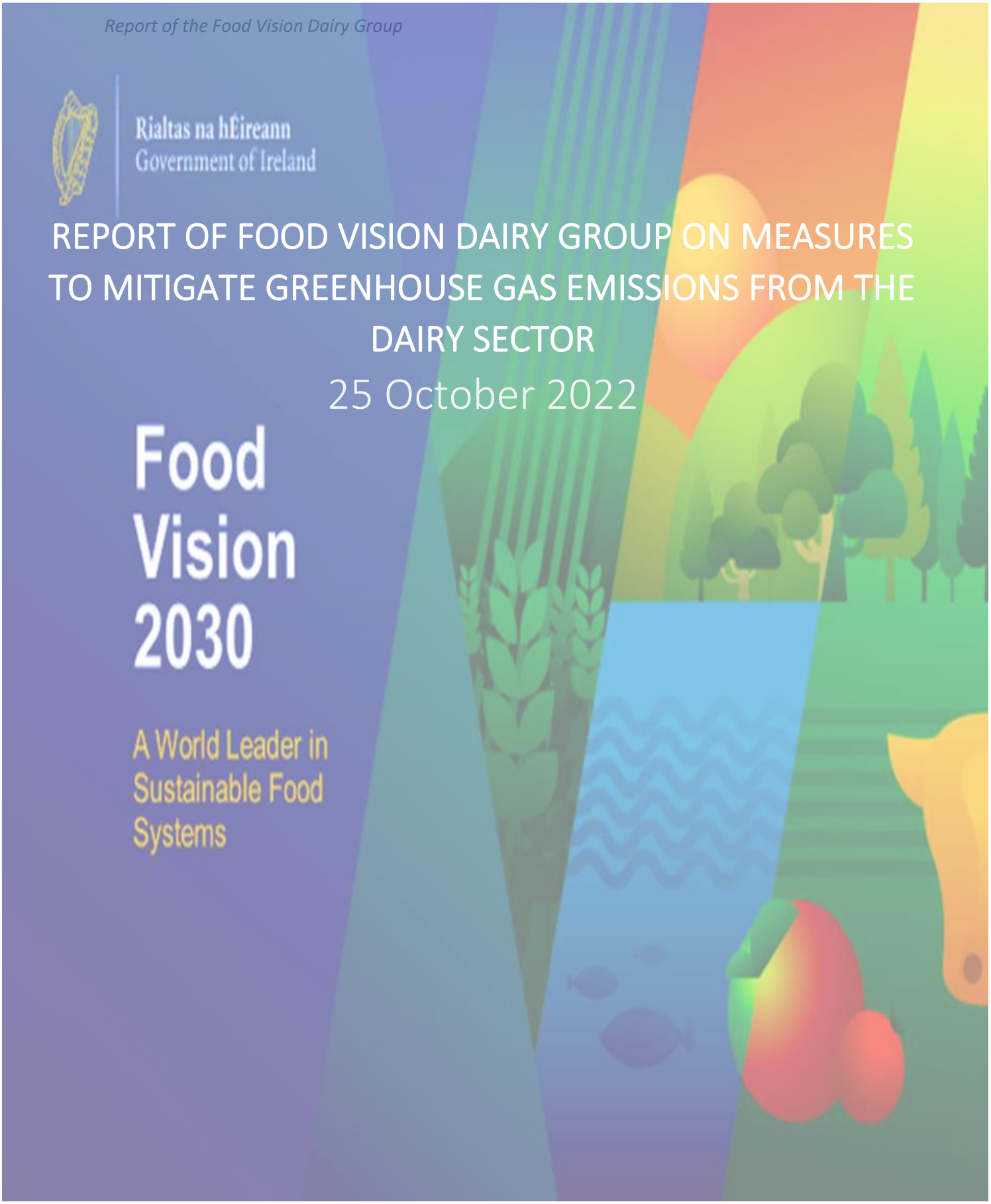
Rialtas na hÉireann
Government of Ireland

REPORT OF FOOD VISION DAIRY GROUP ON MEASURES TO MITIGATE GREENHOUSE GAS EMISSIONS FROM THE DAIRY SECTOR

25 October 2022



CONTENTS

PROPOSED MEASURES

A. Direct Impact measures to mitigate Greenhouse Gas Emissions from the dairy sector				
Measure	**Estimated CO_2 equivalent reduction**	**Estimated Economic Costs at farm level**	**Target GHG**	**Timeframe***
1. Reduce chemical Nitrogen use in the dairy sector by 27%-30% by end of 2030, with a reduction of 22%-25% in the short term (2025). *(This is a reduction from approximate usage in 2018 by the Dairy Sector of 204k tonnes to 143k - 149k tonnes by end of 2030)*	0.37Mt CO_2 eq. by end 2030 (0.185Mt CO_2 eq. by end 2025)	The Teagasc Nitrogen Reduction Analysis (2020) reported that a 30% reduction in chemical nitrogen would reduce profitability per hectare by 15%, assuming a linear reduction in profitability in a scenario where cow numbers are held constant, and the reduced grass production was made up by purchased feed. However, this study now needs to be updated to take account of the enabling measures 11-13 available to maximise Nitrogen use efficiency which mitigate against this cost.	Nitrous Oxide	Short-term Medium-term
2. Target a 100% replacement rate of CAN with Protected Urea by the end of 2025 for grass based dairy production systems	0.33Mt CO_2 eq.	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
3. Development of methane-mitigating feed technologies	0.43 -1.0Mt CO_2 eq.	Initial manufacturer reports suggest €75 – 100 per cow per year	Methane	Short-Medium term
4.a) Develop methane mitigating Breeding Strategies (Integrate the Carbon sub-index) 4.b) Develop methane mitigating Breeding Strategies (building efficiency traits in the herd) *(Direct Impact and Enabling Factor)*	Estimated 0.3-0.4Mt CO_2 eq.	Genotyping strategy initial costs is estimated by ICBF at €19m/ per annum for the dairy herd with cumulative cost estimates at €152m for dairy sector to 2030	Methane	Short-term (EF) Medium-Long term (DI)
Total CO_2 equivalent reduction for measures 1 to 4 inclusive	**1.43 – 2.1Mt CO_2 eq.**			

5. Voluntary Exit/Reduction Scheme	Estimated 0.45Mt CO_2 eq. per 100,000 dairy cows reduced. **Note that this is an indicative calculation only, not a policy recommendation.*	The indicative income foregone per dairy cow removed is estimated at €1,770 for farms exiting dairy and €2,910 for farms reducing numbers, see detail in Measure 5 section. **Note that this is an estimate only, not a recommendation- the level of public funding for any scheme would be a matter for further consideration.*	All	Short term
6. Adopt a common Co-op charter on sustainable milk production based on the family farm model.	The key impacts of the Charter will be determined based on the level of detail in the Charter and how it can have a direct effect on national dairy herd numbers.	n/a	All	Short-term
Measures 5 and 6 would provide additional reductions.	**However, impact of Measure 5 depends on the level of participation in a voluntary scheme; and impact of Measure 6 is difficult to quantify.**			

B. Enabling Factors to support the mitigation of Greenhouse Gas Emissions from the dairy sector The Enabling Actions are outside of the inventory but are important nonetheless in driving the adoption of the direct impact measures. Existing resources are outlined in the following sections.		
Measure	**Target GHG**	**Timeframe***
7. Establish robust methodologies for measuring and monitoring greenhouse gas emissions and removals at individual farm level	All	Short-term
8. Commission a study on a carbon farming framework	All	Short-term
9.a) Increase investment in Climate Change Research and in Knowledge Transfer 9.b) Establish an Agriculture and Climate Change Research Liaison Group	All	Short-term
10. Design a Climate Action Communications Strategy	All	Short-term
11. Increase the adoption of Low-Emissions Slurry Spreading (LESS). Target 90 - 100% adoption of LESS for all dairy cow slurry manure by 2025	Nitrous oxide	Short-term
12. Improve Nitrogen Use Efficiency – Liming and soil pH- Ensure 100% of dairy farms are soil testing for pH	Nitrous oxide	Short-term
13. Encourage Clover Adoption and Multi-Species swards (MSS)- ensure all dairy farmers have incorporated clover/multispecies on 20% of their farm grassland by end of 2025	Nitrous oxide	Short-term
14. Milk recording- strive to achieve 90% adoption rate by end of 2025	All	Short-term
15. Develop Energy Diversification Opportunities	All	Medium-Long term
16. Strengthen all Co-op Sustainability Programmes to prioritise measures that directly reduce the national inventory of GHGs	All	Short-term
17. Introduce animal health measures listed in Action 314 of the Climate Action Plan 2021	Methane	Short-Medium term
18. Develop enhanced integration between the dairy and beef sectors	All	Short-Medium term
19. Support the role of young farmers and women in agriculture in implementation of the measures set out in this report	All	Short-Medium term

CHAIR'S FOREWORD

The continued success of Irish agriculture as a major world exporter of food will increasingly depend on the sustainability of our food production system. While this Group's focus has been on the environmental dimension of sustainability, and specifically the challenge of greenhouse gas emissions, we were always mindful of the importance of economic and social sustainability. The greenhouse gas challenge is accentuated in Ireland because, unlike most other European countries, we don't have a legacy of large and heavy industry production. The share of the sector's emissions thus stands out in comparative terms. The Group has remained focused on the agriculture emissions' target reduction of 5.75 Mt CO_2 eq. which must be achieved by the end of 2030. With leadership from all stakeholders, the agricultural sector can take the significant and urgent steps that are required to reduce Ireland's environmental footprint and to reinforce the sustainability of our food system.

All farming enterprises have a role to play in reducing agriculture's impact on the environment, and dairy farming will be expected to lead on the transformational changes that are required. The removal of milk quotas has led to a welcome expansion in production, jobs and exports, but this expansion has also resulted in a number of unacceptable environmental pressures. The recommendations outlined in the Report can deliver a reduction of between 1.43Mt and 2.1Mt CO_2 equivalent if fully implemented. This range comes close to the estimated contribution of the dairy sector to total agricultural emissions. And it should be noted that this range does not account for the emissions reduction that can be delivered from the proposed voluntary exit/reduction scheme, should it be accepted by Government.

It is acknowledged that the proposed recommendations will require a transformational change in how agriculture is practiced in Ireland. As a consequence, the Group were clearly of the view that dairy farmers need to be supported financially in the transition and through the provision of enhanced advisory and research services. Given the significant public funding that is required, it is important to recognise that following the receipt of this Report by the Minister detailed negotiations at a senior political level will be required, in which Stakeholders have expressed a sincere willingness to participate.

The Food Vision Dairy Group was established to identify measures which the dairy sector can take to contribute to the stabilisation and subsequent reduction of emissions. The Group has worked tirelessly to realise this goal through a committed and collaborative process, supported by the Department of Agriculture Food and the Marine (DAFM) Secretariat. The Group has met on several occasions over a nine-month period to work towards the advancement of the actions identified in Food Vision 2030 for the dairy sector that will shape the future policy landscape. Concerns raised during the process have been noted, including areas of significant disagreement. However, the power of this document is that it is the outcome of serious stakeholder deliberation.

Food Vision 2030 established the ambition for Ireland's Agri-Food Sector to become a world leader in Sustainable Food Systems to 2030 and aims to achieve this in a "climate smart, environmentally sustainable" manner. Other policies and strategies which align with this Report have been identified and include AgClimatise (2020), the Climate Act 2021 and Climate Action Plan 2021, the CAP Strategic Plan (2022).

This Report, while focused on the dairy sector, will undoubtedly act as a reference point for the upcoming Food Vision Beef and Sheep Group Report as it explores similar emissions reduction requirements.

Stakeholder contributions have been invaluable in the generation of this Report and while there was a consensus on the needs which this Report must meet, differing views regarding the means to achieve these needs were noted throughout the process. It is clear that a more general polarisation exists in Ireland between the agricultural and environmental interest groups, and this is similarly acknowledged and reflected in this Report as there is not unanimity on all of the proposed measures or timelines. I am confident, however, that the detailed negotiations that will follow this Report will bring about a greater convergence of positions.

Looking to the future, sustainability will be the requirement from the domestic and international consumer and the changing global marketplace. This scenario presents a significant opportunity for Ireland as a world-renowned producer of high-quality food with a well-established national sustainability programme in Origin Green. To preserve and enhance this position, all participants in Ireland's agricultural system need to coordinate and cooperate with one another to realise our collective emissions' goals. The global climate crisis and sustained environmental pressures faced by every eco-system on Earth are more prevalent now than ever. It is our responsibility to endeavour to protect the land, resources, and unique beauty of Ireland in order to secure them for generations to come.

I acknowledge all the contributions made to this Report by stakeholders, state agencies and the Department Secretariat and thank all members of the Group for their arduous and serious engagement.

Professor Gerry Boyle, October 2022

1. INTRODUCTION

The Food Vision Dairy Group was established by the Minister for Agriculture Food and the Marine at the end of January 2022. The membership of the Group comprises representatives from the farm organisations, the co-op and dairy processing sector, all relevant state agencies, UCD and Department officials (see Annex for the membership of the Group).

The agriculture sector was directly responsible for 37.5% of national Greenhouse Gases (GHGs) emissions in 2021. 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 agricultural sector as a whole, the increase in agricultural output in recent years, particularly in the dairy sector, 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)[1] and the July 2022 publication of Ireland's Provisional Greenhouse Gas Emissions 1990 -2021[2]. Urgent and effective action is needed to address these trends.

Following on from the Climate Action and Low Carbon (Amendment) Act 2021[3], 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.[4]

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. As discussed in more detail later, an estimated 40% of GHG emissions from agriculture are directly associated with dairy sector activity.

[1] The urgency of climate action is also underlined in, for example:
Status of Ireland's Climate 2020 report (EPA, Met Éireann and Marine Institute, 2021)
IPCC Working Group II report: Climate Change 2022: Impacts, Adaptation and Vulnerability (2022), which highlights that the next few years are critical for actions to reduce greenhouse gas emissions globally
[2] Ireland's Provisional Greenhouse Gas Emissions 1990-2021: Monitoring & Assessment: Climate Change: Air emissions Publications | Environmental Protection Agency (epa.ie)
[3] Climate Action and Low Carbon (Amendment) Act 2021 [hereinafter *Climate Act 2021*].
[4] Section 9, Part 2, *Climate Act 2021*.
[5] Page 4, Sectoral Emissions Ceilings Summary Report, September 2022 (gov.ie - Sectoral Emissions Ceilings (www.gov.ie))

In addition to regulatory requirements, the consumers and trade customers for Irish dairy 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 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 dairy exports. However, these efforts will be undermined if the total carbon emissions associated with dairy production continue to grow.

The remit of the Food Vision Dairy Group was to identify measures that the dairy sector can take to contribute to "initially stabilising and then reducing emissions" from the agricultural sector. The focus of the Group has been exclusively on agriculture activities associated with emissions that are counted in the agriculture component of the national GHG inventory. Land use has been allocated a separate target under the Climate Action process, a point noted throughout the Group's deliberations.

An Interim Report submitted to the Minister for Agriculture, Food and the Marine on 27 May 2022 set out a preliminary list of recommended actions for the dairy sector. This Final Report comprises of an updated version of the Interim Report and provides additional recommended actions and impact metrics. The Report has been prepared through a process of collaboration and cooperation and represents a broad consensus on the key actions in the Group's view that are required in the context of the Climate Act 2021 and the specific ceiling set for emissions from the agriculture sector in July 2022. However, a number of farming organisations have raised concerns about the implications of these measures on farm income and viability. One stakeholder organisation (ICMSA) reserved its position on the Report as a whole based on a number of concerns, including the impact of the proposed Nitrogen usage on farm incomes, and the absence of a clear commitment on financial support and compensation for income losses that will be suffered. One stakeholder organisation (IFA) reserved their position on Measure 1 and 5. One stakeholder organisation (Macra) rejected measures 1 and 5.

EPA updated statistics

Since the EPA presented to the Food Vision Dairy Group earlier in this process, it has published the National Greenhouse Gas Projections 2021-2040 and National Greenhouse Gas Inventory 2021. An outline of the findings in respect of the Agriculture Sector are presented below.

The **EPA National Greenhouse Gas Inventory 2021**[1] shows that Agriculture emissions in 2021 were 23.1Mt CO_2 eq. an increase of 3.0% versus 2020. Agricultural emissions are now 15% higher than the 1990 level. The most significant drivers for the rise in emissions in 2021 were increased use of synthetic nitrogen fertiliser use of 5.2 % and higher dairy cow numbers of 2.8% with an increase in milk production of 5.5 % (Milk output per cow also increased by 2.5 %).

This is the 11th consecutive year that dairy cow numbers rose, therefore increased production was driven by a rise in livestock numbers in conjunction with an increase in milk yield per cow. In 2021, total cattle numbers increased by 0.8%. In 2021, liming on agricultural soils increased by 49.5%, a welcome measure in improving soil fertility, which should lead to a reduction in fertiliser nitrogen use in future years.

The **EPA National Greenhouse Gas Projections 2021-2040**[1] showed that under the 'with existing measures' scenario, emissions from the Agriculture Sector are projected to increase by 1.9% over the 2020-2030 period. A methane emissions reduction of almost 30% is required to achieve a 22% reduction in Agriculture emissions compared to 2018, which is the lower end of the range committed to in the 2021 Climate Action Plan.

The EPA's report outlines that these projections include an assumption that the agriculture sector would meet the lower end of its emissions reduction target as set out in the 2021 Climate Action Plan, in the absence of specific detail and data on the sectors methane reduction measures. However, the EPA notes that the emissions ceiling for agriculture has now been set a 25% reduction by end of 2030.

2. OVERARCHING FACTORS GOVERNING THE GROUP'S DELIBERATIONS

Dairy farmers are no less conscious than other sectors of society of the consequences of climate change. In recent years dairy farmers and the milk processors have been responsive to the environmental challenges facing society through their adoption of the available technologies set out in successive Teagasc Marginal Abatement Cost Curves (MACCs). However, 2021 data shows that overall emissions from the sector continue to increase.

The Climate Act 2021 outlines that the government must give due regard to '*the risk of substantial and unreasonable carbon leakage as a consequence of measures implemented by the State to pursue the national climate objective*'. Ireland's carbon footprint per unit of output is considered to be the lowest amongst milk-producing countries. It is also noted that the carbon footprint per unit of output has declined, as measured by GHG emissions per kg of fat and protein corrected milk (FPCM) production as evidenced by Bord Bia and Teagasc data over recent years. These carbon efficiency gains, however, have been offset by a growth in absolute GHG emissions from the sector as a result of the expansion of dairy production overall in Ireland and the increased number of dairy cows.

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,

The Irish dairy industry, and dairy farmers, accept that it must transform 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 dairy 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 adamant that a strict adherence to scientific developments should govern this transformation.

The social and economic importance of Irish agriculture and the distinct characteristics of biogenic methane in its contribution to global warming are acknowledged in the Climate Act

2021. The science of methane is evolving and is becoming clearer. Once methane emissions are stabilised and remain stable then the atmospheric concentration will stabilise. In order to ensure that their impact on the global temperature is stable, emissions should be reduced by around 3% per decade or offset by carbon dioxide removals which provides a similar climate impact. This would neutralise its impact on the global temperature. There is no basis in science therefore that requires emissions from enteric fermentation to be reduced to net zero. Of course, it is recognised that it will take a considerable length of time following stabilisation for the impact on global warming to be realised. It is a reasonable expectation that in time this scientific perspective will be reflected in the international protocols on climate change. A shift towards the concept of GWP* from the current method of equivalising different GHGs, namely, GWP100 would be one possible outcome from the evolving science, although this is not a given and must be agreed at international level through the IPCC processes.

However, 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 an initial stabilisation followed by 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 Group also emphasises the critical importance of ensuring the maintenance of livelihoods for current and future generations of Irish dairy 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.

The dairy and beef sectors are highly connected, and greater integration between the dairy and beef sectors is expected in the coming years. Through the processing of milk and beef and the upstream demand for inputs of goods and services that the Irish grassland agriculture sector generates, the sector is the mainstay of rural development. Notwithstanding this, the family farm model of dairy farming in Ireland is exposed to global developments, notably input and product price volatility. It follows therefore that the necessary and accepted actions that must be taken to reduce agricultural emissions from the dairy 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.

Another overarching consideration that has governed our work also needs to be stated at the outset. This Group is focused on actions that the dairy sector needs to take to making its proportionate contribution towards the target of a 25% reduction in agriculture emissions. The Group recognises the outstanding performance of the dairy sector in terms of output, jobs, and exports since the abolition of the dairy quota in April 2015 but recognises that this development has generated associated environmental pressures. The Group is conscious that the dairy sector does not stand in isolation from other ruminant sectors in Ireland and actions that it takes to stem the growth in emissions will also be relevant to the other sectors. Likewise, developments in other sectors will have implications for the dairy sector. It would be presumptuous, however, for this Group to suggest any action that should be taken in or by another sector. However, we do draw attention to such crossover effects where we make recommendations that will be relevant or have implications for other sectors.

Thus, three 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 dairy industry as a key contributor to the economy, and third the recognition that many of Group's recommendations will have crossover implication for other ruminant sectors. In this context, the Group expects that the dairy sector will work with the meat sector, particularly the beef sector, and tillage sectors in the development of an integrated strategy to promote and support climate change mitigation and sustainability best practice.

3. GOALS OF THE FOOD VISION DAIRY GROUP

The Food Vision Dairy Group was tasked with advancing the actions for the dairy sector identified in Food Vision 2030, the ten-year stakeholder-led strategy for the Irish agri-food sector. The activities of the Group must also take account of the requirement for the dairy sector to contribute towards achievement of the targets set for the agriculture and land use sector in the Climate Action Plan 2021. The Group's first priority is to:

'Produce a detailed plan by Q2 2022 to manage the sustainable environmental footprint of the dairy sector, including minimising total emissions, while making a positive contribution to improved water quality and biodiversity, in line with government policy'.

Food Vision 2030, Goal 1, Action 2

The Food Vision 2030 Strategy also committed to a reduction of at least 10% in biogenic methane by end of 2030 (compared to 2018), while recognising that this reduction target would need to be adjusted in line with national and international targets for the sector and in line with the development of scientific solutions.

Food Vision was finalised in summer 2021; with the Climate Act 2021 subsequently enacted and which set an overall legally binding target of a 51% reduction in total carbon emissions by end of 2030 for the Irish economy. The Climate Action Plan 2021, published in November 2021, set the target for the agriculture sector to reduce carbon emissions to between 16-18 Mt CO_2 eq. by end of 2030. In July 2022, the Government announced ceilings for emissions from each sector which require a reduction of 25% (5.75Mt) in emissions from agriculture by end of 2030 compared to 2018 levels of 23 Mt CO_2 eq.

In addition to regulatory requirements, the market and trade customers for Irish dairy products and ingredients are increasingly demanding proof of environmental sustainability as an entry point to market. Origin Green, backed by the Sustainable Dairy Assurance Scheme (SDAS) on dairy farms, represents a unique starting point in this regard. However as set out in Food Vision 2030, Origin Green will need to reflect a higher level of environmental ambition with a greater emphasis on stretch targets, in order to maintain a premium position for Irish dairy in the marketplace.

In accordance with the Food Vision Dairy Group Terms of Reference

'the Group has been tasked to provide an initial report to the Minister by end March setting out how emissions associated with the dairy sector can be stabilised and then reduced; with a final plan to be submitted by end May 2022'.

The remit of the Group will then move on to the additional sectoral actions identified in Food Vision 2030.

Meetings

The establishment of the Food Vision Dairy Group was announced by the Minister for Agriculture Food and the Marine on 28 January 2022, following stakeholder meetings with industry and farm organisation representatives. The Group, chaired by Professor Gerry Boyle, has met nine times in person, with an additional meeting online, between 07 February and 14 October 2022. Several bilateral meetings were also facilitated.

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 CO_2 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. As discussed in more detail later, an estimated 40% of GHG emissions from agriculture are directly associated with dairy sector activity.

While the Land Use, Land Use Change and Forestry (LULUCF) sector, which has a separate target, is clearly of relevance to the dairy sector, the focus of the Group is on the agriculture GHG inventory and ensuring that the dairy sector stabilizes and 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 targets for 2030 (set in July 2022)	Sector percentage reductions targets for 2030 (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.

EPA EMISSIONS DATA

The EPA publication Ireland's Provisional Greenhouse Gas Emissions 1990-2021[6] shows that total emissions from the agriculture sector in 2021 were 23.1Mt CO_2 eq. an increase of 3.0% on 2020. The most significant drivers for the increased emissions in 2021 were increased use of synthetic nitrogen fertiliser use of 5.2% and higher dairy cow numbers of 2.8% with an increase in milk production of 5.5%.

Methane emissions originate from enteric fermentation, manure management and fuel combustion. In 2021, CH_4 emissions contribute 69.6% to the Agriculture sector and have increased by 1.8% since 2020. Nitrous Oxide emissions originate from Manure Management, Agricultural Soils and fuel combustion. In 2021, N_2O emissions contribute 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% to the Agriculture sector and have increased by 17.3% since 2020.

Agriculture emissions are presented in Figures 1 and 2. Increasing methane emissions are evident in the gas share trend, 16.1Mt CO_2 eq. (69.6% share) in 2021 compared to 13.5Mt CO_2 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.

[6] 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 Emissions 1990-2021

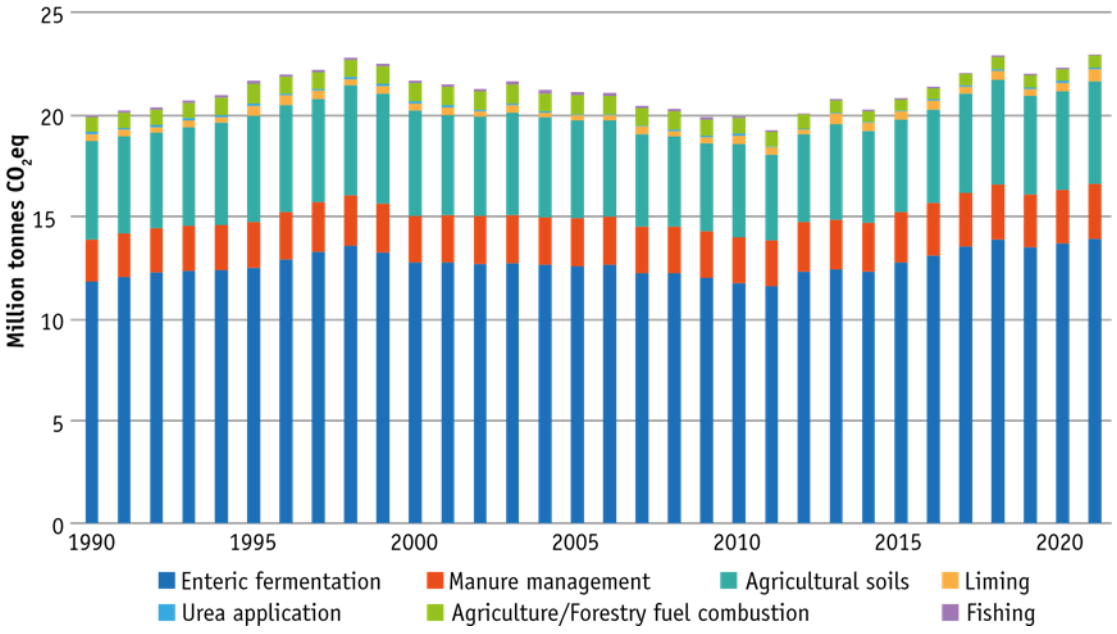
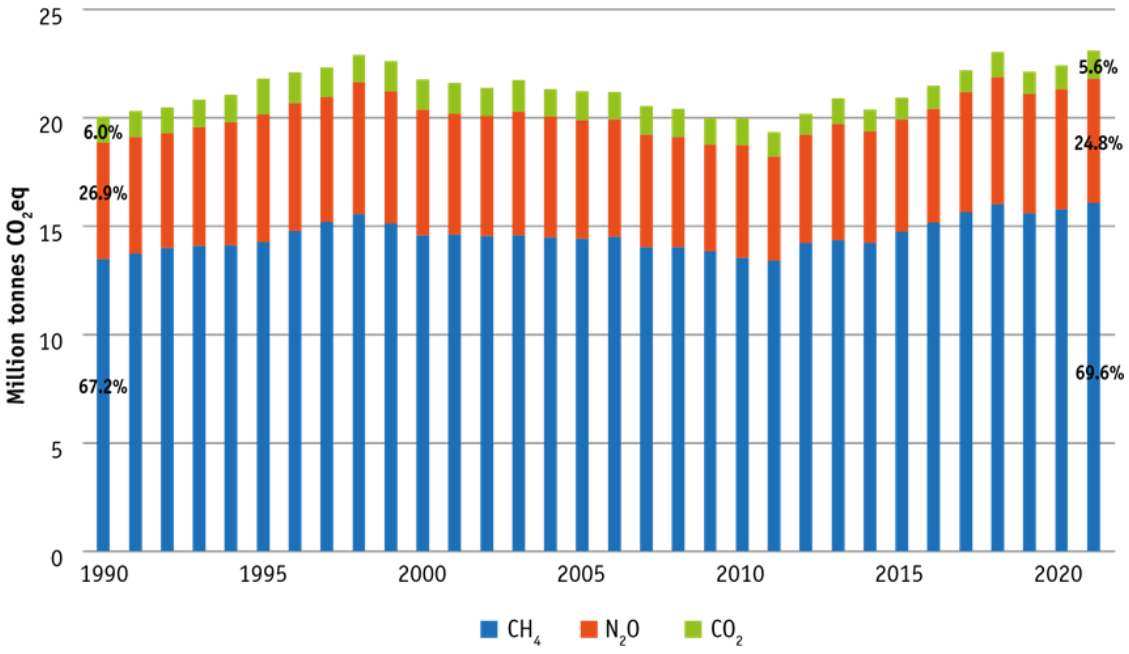


Figure 2. Trend in Agriculture Emissions by Gas type 1990-2021

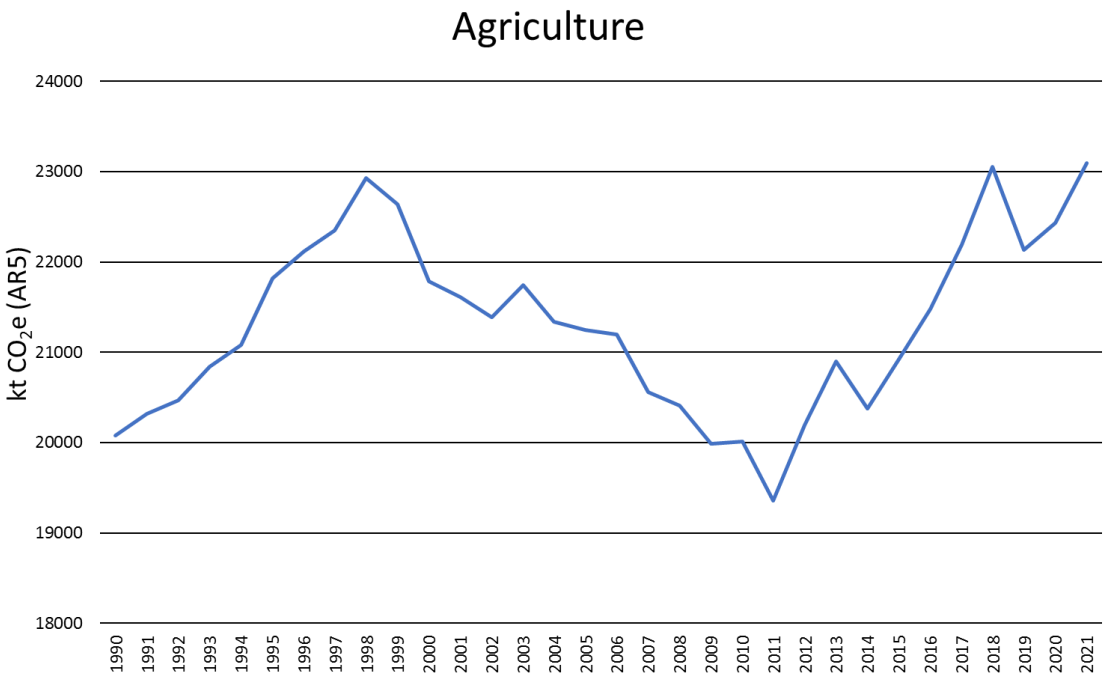


The EPA publication, Ireland's Provisional Greenhouse Gas Emissions 1990-2021 also notes that this is the eleventh consecutive year of increases in dairy cow numbers. Milk output per

cow also increased (2.5%), therefore increased production was driven by an increase in livestock numbers in conjunction with an increase in milk yield per cow. In 2021, total cattle numbers increased by 0.8% and sheep numbers increased by 0.3%, pig numbers increased by 4.5% and the poultry population decreased by 0.5%. Total fossil fuel consumption in agriculture/forestry/fishing activities remained at similar levels to 2020. In 2021, liming on soils increased by 49.5%, a welcome measure in improving soil fertility, which should lead to a reduction in fertiliser nitrogen use in future years.

Emissions from the agricultural sector have been on a generally upward trajectory since 2011, with growth in emissions associated with the increase in dairy cow numbers and milk yield before and since the abolition of milk quotas in 2015 and associated increases in fertilizer use.

Figure 3. Agricultural emissions CO_2 equivalent (including fuel combustion) [7]



[7] 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

Total emissions in 2018 were 23Mt CO_2 eq., with historically high chemical nitrogen usage associated with that year's drought, before falling back slightly. However, as evident above total emissions from the agriculture sector in 2021 were 23.1Mt CO_2 eq. an increase of 3.0% on 2020 and surpassing the 2018 peak.

GHG emissions from agriculture are currently measured on a production basis. Dairy farmers are producing each kg of milk with lower emissions per kg, and average milk output per farm has increased more than the average increase in GHG emissions per farm. However, the overall absolute GHG emissions from the sector have increased due to increasing cow numbers and higher yields.

For the purposes of compiling the greenhouse gas inventory (hereafter referred to as the "inventory") for the agricultural sector; which is the official record of agricultural emissions; the EPA average June and December dairy cow numbers. The trend in cow numbers is very clear from the table below which highlights an increase in dairy cow numbers over the most recent three years.

Table 2 – Average June and December Dairy cow numbers '000 (CSO livestock survey)

2015[8]	**2019**[9]	**2020**[10]	**2021**[11]
1,268	1,465	1,512 (+3.2% versus 2019)	1,554 (+6.1% versus 2020)

It is estimated that for every additional 10,000 dairy cows, approximately 45,000 tonnes of CO_2 eq. are added to the inventory. This includes all emissions associated with the dairy cow, i.e., enteric methane, manure management and direct and indirect nitrogen emissions. Thus, from

[8] June 2015: Crops and Livestock Survey June Final 2015 - CSO - Central Statistics Office, December 2015: Livestock Survey December 2015 - CSO - Central Statistics Office
[9] June 2019: Crops and Livestock Survey June Final 2019 - CSO - Central Statistics Office December 2019: Livestock Survey December 2019 - CSO - Central Statistics Office,
[10] June 2020: Crops and Livestock Survey June Final 2020 - CSO - Central Statistics Office, December 2020: Livestock Survey December 2020 - CSO - Central Statistics Office
[11] June 2021: Crops and Livestock Survey June Final Results 2021 - CSO - Central Statistics Office , December 2021: Livestock Survey December 2021 - CSO - Central Statistics Office

2020 to 2021, approximately 0.25Mt was added to the inventory due to the increase in dairy cow numbers.

An estimated **40% of total agriculture emissions** are associated with the dairy sector. This calculation is based on the number of dairy cows, and heifers, and the associated chemical nitrogen usage. It should also be acknowledged that the dairy and beef sectors integrated regarding dairy beef output from the dairy herd, with the related emissions counted in respect of the beef sector.

Table 3 sets out estimates of how chemical nitrogen is used across the principal sectors of Irish agriculture.

Table 3 – Approximate chemical nitrogen use (tonnes) per agriculture sector*

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

*Data taken from Teagasc National Farm Survey

The Irish dairy sector at farm and processing levels has undertaken significant investment since the removal of milk quotas in 2015. As a consequence, some dairy farms are carrying high debt repayments, although the level of debt on the average dairy farm is not high relative to international comparators[12]. The Group noted that any curtailment of production would adversely affect this group and could also negatively affect the prospects of many young farmers who aspire to a career in dairying.

At milk processing level, despite very significant investment in recent years, data from Dairy Industry Ireland indicates that there is currently less than 2.5% surplus capacity across the dairy processing industry during the peak weeks of milk processing. Processing capacity at peak is therefore limited, and this must be acknowledged in planning for the future of the sector.

[12] For example, the equity ratio (total assets – total liabilities/total assets) on Irish dairy farms in 2019 was 0.95, compared to an EU 27 average of 0.77, and equity ratios of 0.51 in France and 0.25 in Denmark (EU FADN data 2019).

b) Projections of dairy cow numbers, production and emissions from enteric fermentation

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 4-8. These forecasts show that dairy cows are likely to grow to 1.71m head by 2030 (Figure 5. Average June and December figures). This implies a reduced annual growth rate over the period to 2030 relative to the growth rate achieved in the period 2010-2020 (Figure 5). Overall milk production is expected to grow by a compound annual rate of 1.73% over the period 2020-2030 as compared to an observed annual growth rate of 4.8% per annum over the period 2010-2020 (Figure 7).

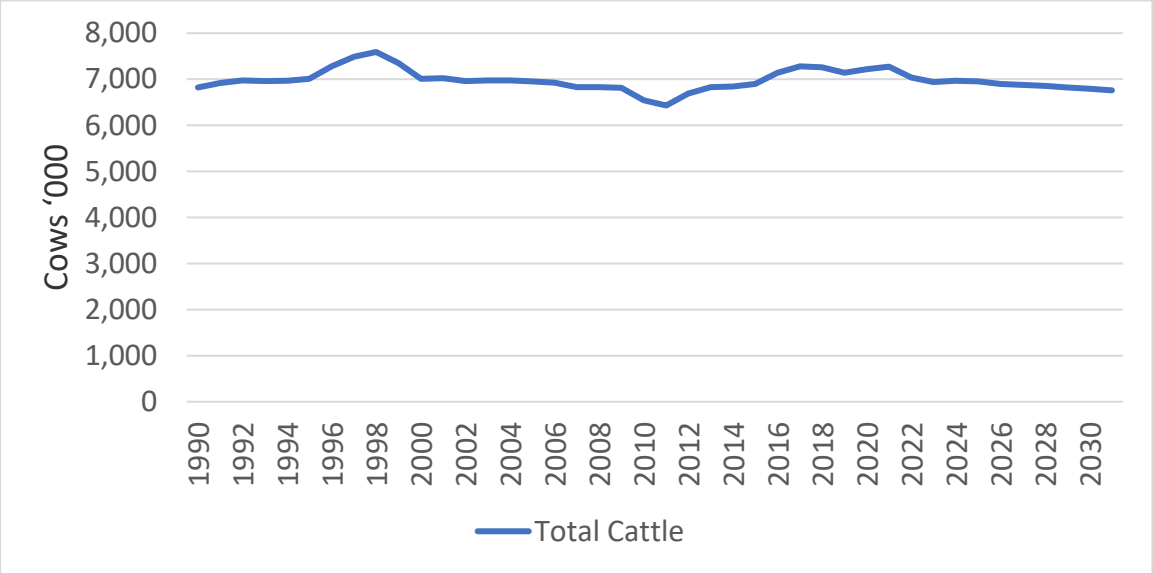
It is worth noting that this reduced annual growth rate is also in line with the most recent surveys of supplier production plans undertaken by the Irish dairy co-ops. The picture for national emissions from enteric fermentation is shown in Figure 8. This chart shows that despite the expected continued growth in emissions per dairy cow (based on increased yield) and projected increases in total numbers of dairy cow numbers, when taken together with the likely continued decline in suckler cow numbers (Figure 6), the overall national level of emissions from enteric fermentation is projected to be relatively stable to 2030. The **EPA National Greenhouse Gas Projections 2021-2040**[1] showed that under the 'with existing measures' scenario, emissions from the Agriculture Sector are projected to increase by 1.9% over the 2020-2030 period.

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 dairy cow numbers, production and emissions.

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

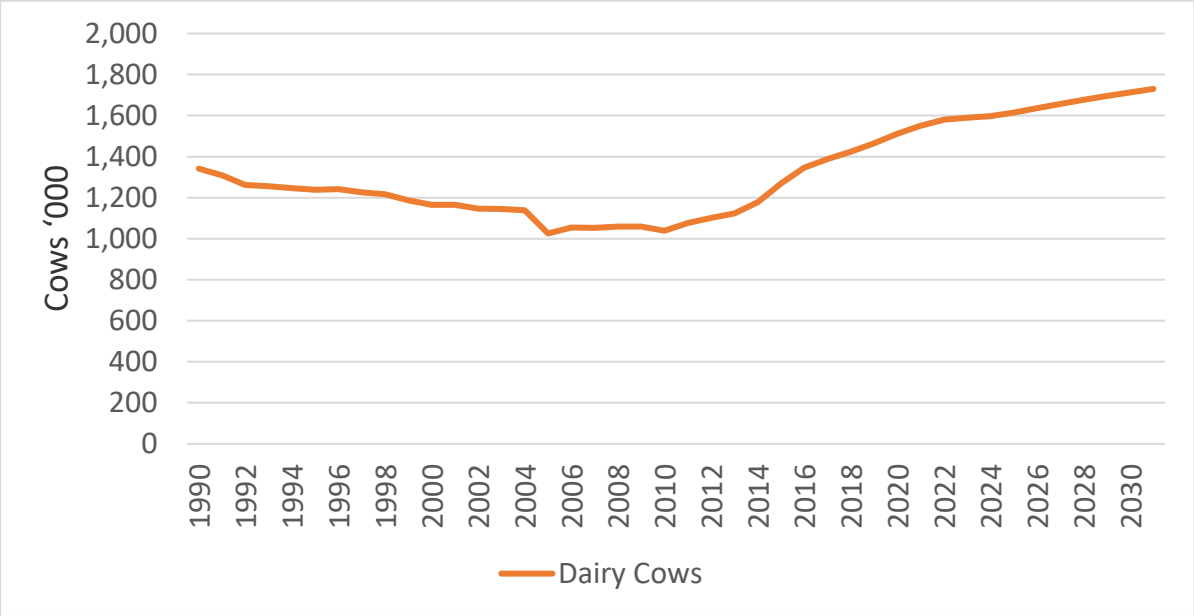
reduction in methane emissions. The Group recognises the need to reduce methane emissions and recommends that this should be achieved through the adoption of methane-reduction measures which are set out in Section 5 of this report.

Figure 4 - Total Cattle numbers, 000 head



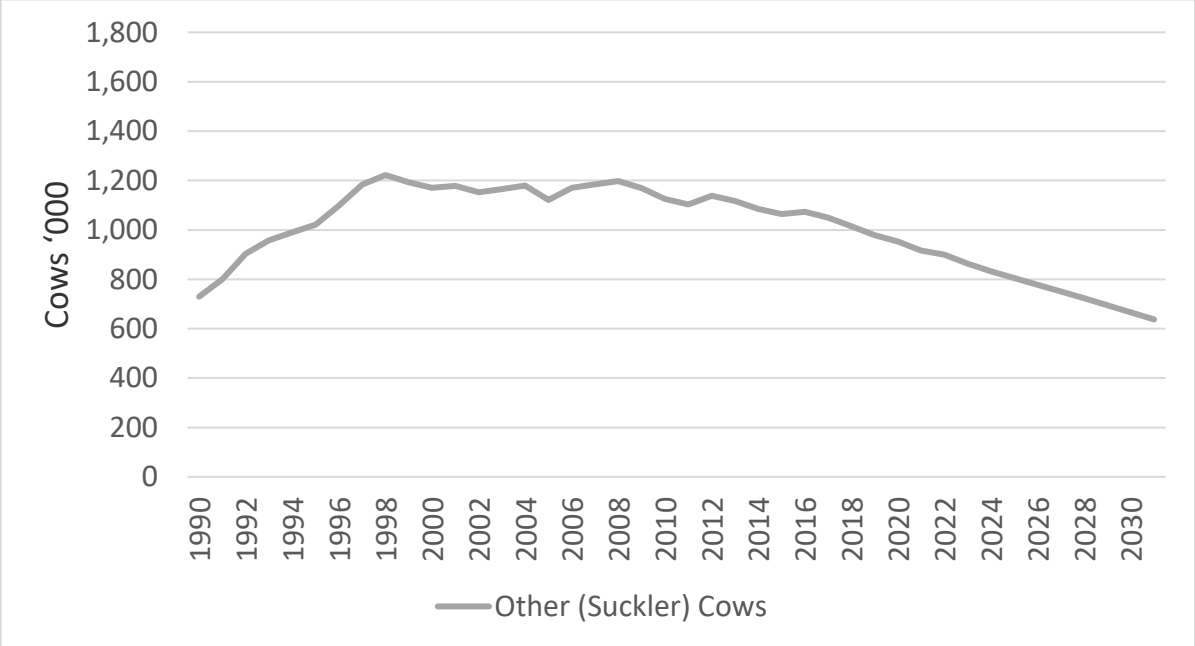
Source: CSO and FAPRI-Ireland model (2021)

Figure 5 - Total Dairy Cows, 000 head



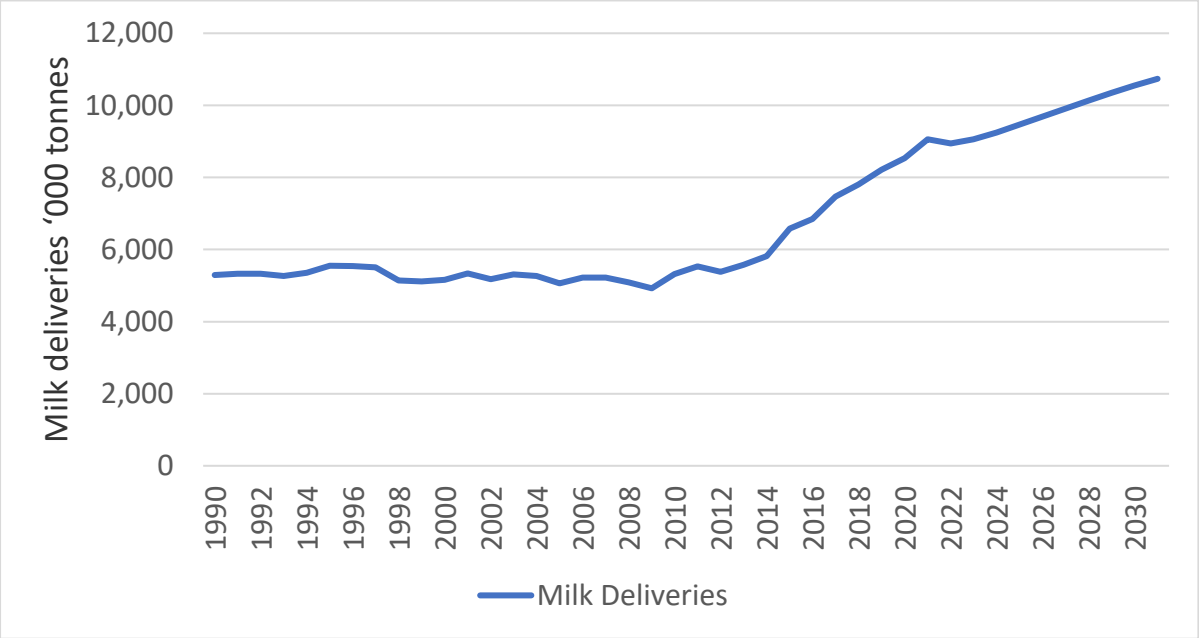
Source: CSO and FAPRI-Ireland model (2021)

Figure 6 - Total Suckler Cows, 000 head

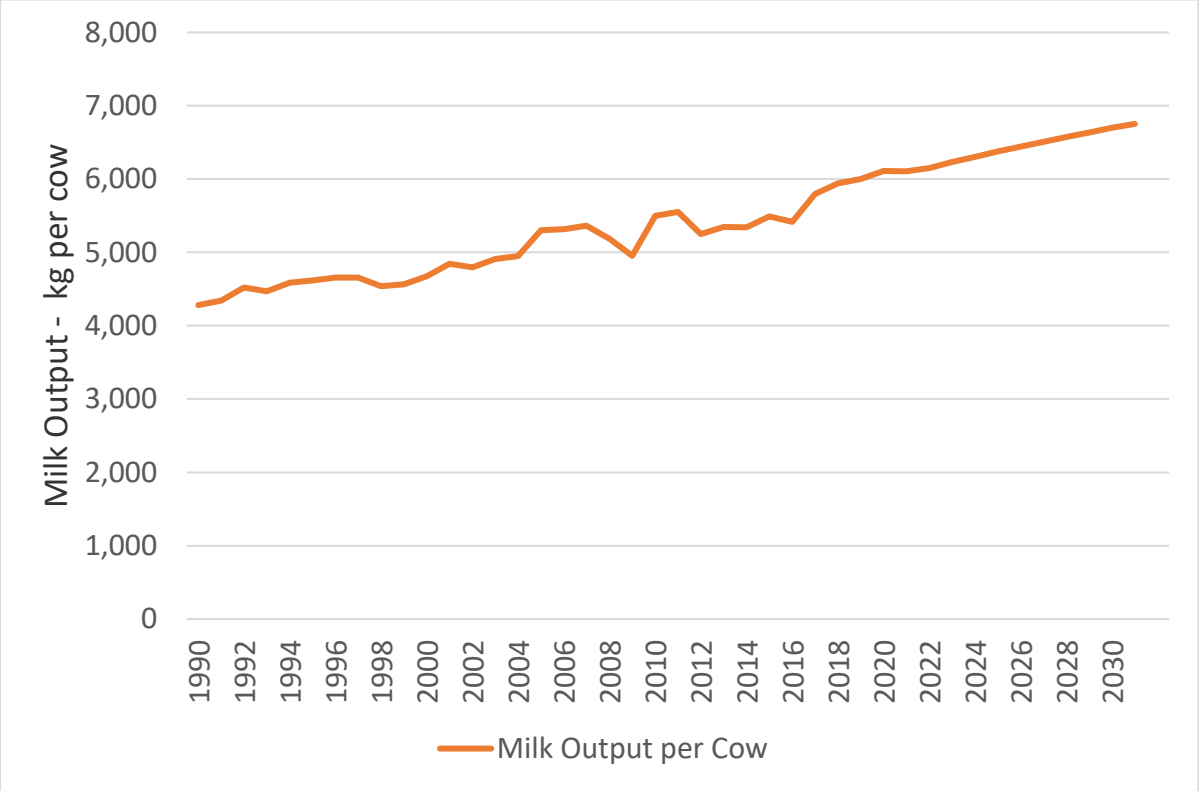


Source: CSO and FAPRI-Ireland model (2021)

Figures 7/7a - Milk Production (000 litres) and Milk Production per cow (litres)

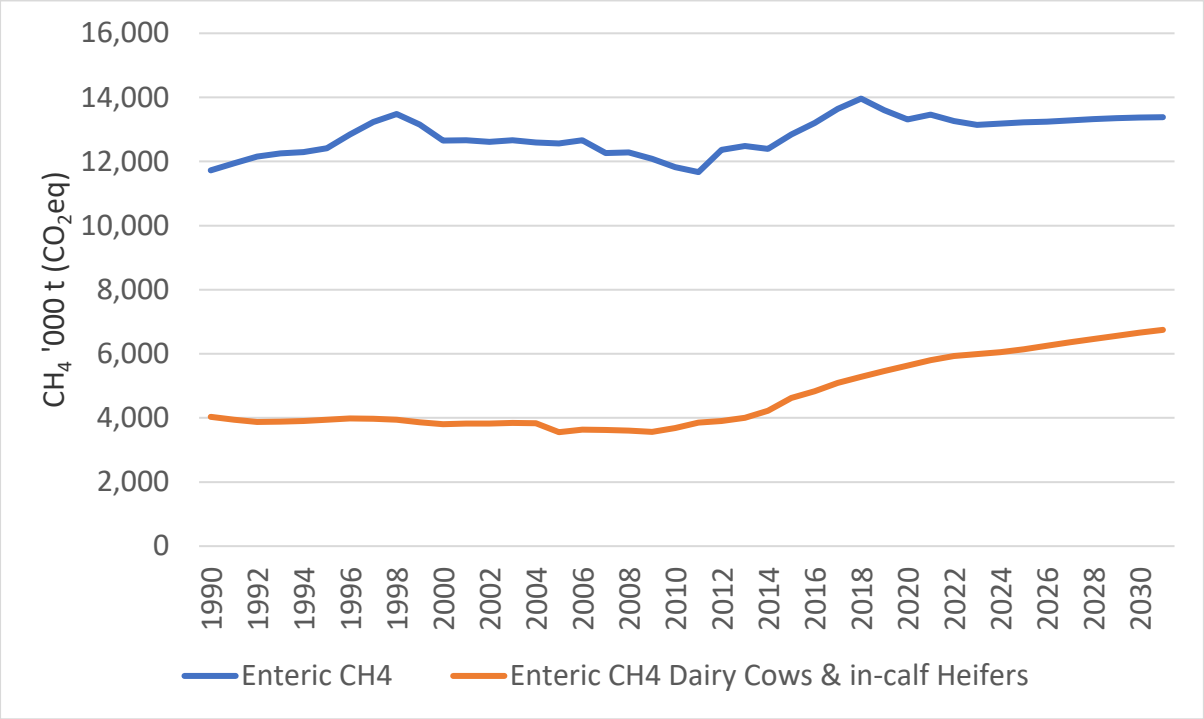


Source: CSO and FAPRI-Ireland model (2021)



Source: CSO and FAPRI-Ireland model (2021)

Figure 8 - Enteric Methane Emissions, 000 tonnes CO_2 eq (AR5)



Source: FAPRI-Ireland model (2021)

Note: Emissions projections of Enteric CH_4 are under Business-as-usual (BAU) scenario and do not account for mitigation measures incorporated with EPA "With Existing Measures" (WEM) Projections, see EPA (2022).[13]

c) Ireland's Nitrates Action Programme

Ireland's Fifth Nitrates Action Programme (NAP)[14] 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

[13] Business as Usual scenario – formerly Baseline scenario – is a projection (conditional forecast) of the future development of the Irish agricultural economy assuming policy (Common Agricultural Policy, Trade Policy) as currently agreed remains unchanged over the projection horizon (10 years): Donnellan and Hanrahan (2022) Teagasc Agricultural Activity Projections 2021.

[14] Fifth Nitrates Action Programme 2022-2025 (gov.ie - Fifth Nitrates Action Programme 2022-2025 (www.gov.ie))

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 interim 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.

Under the Nitrates Regulations a dairy farmer's chemical nitrogen and phosphorous allowances for grassland are determined by the farm's stocking rate and there is a limit on how much can be spread. The fertiliser sales database will provide details on the quantity and type of fertiliser used down to farm level. The database will be used to inform policy development and to verify compliance with the Nitrates Regulations. The Fertiliser Sales Database will be used to show farmers how much nutrients (N, P, K) they have purchased through their fertiliser to enable them to meet their obligations under the Nitrates Regulations. The Fertiliser Sales Database will be used to show farmers how much nutrients (N, P, K) they have purchased through their fertiliser to enable them to meet their obligations under the Nitrates Regulations. Eco-Scheme actions associated with reduced fertiliser use at farm level should continue to reward efficient farms. Farmers who take positive actions e.g. adoption of clover will be using below the maximum rates and this needs to be recognised in the administration of Nitrates Regulations reductions going forward.

It is also important to acknowledge that in recent years, Ireland's NAP has been used to address issues beyond water quality including greenhouse gas emissions, ammonia emissions and biodiversity. The Group recognises the importance of reversing recent trends in water quality and is committed to working jointly with all stakeholders to achieve this goal through the State and industry led ASSAP programme.

Ireland's new NAP contains specific measures to protect surface waters and groundwater from nutrient pollution arising from agricultural sources. It includes new provisions for the banding of Dairy Cow Excretion Rates**.** Three new excretion rate bands will apply to dairy cows from 2023: 80kg N/cow, 92kg N/cow and 106 kg N/cow. Herds will be assigned to one of these rates based on their historic average milk yield/cow. Currently all dairy cows are considered to produce 89kg N/cow per year so this change means the maximum number of cows per ha will reduce for most farmers to remain below the maximum permitted organic nitrogen load of 250 kg/ha in derogation (170kg for those not availing of a derogation).

There is also a requirement to conduct a review of water quality in 2023, with the possibility of reducing the maximum organic nitrogen limit from 250 kg N/ha currently to 220 kg N/ha from January 2024 onwards in areas where water quality is polluted or at risk of pollution.

5. PROPOSED MEASURES

This section, and the accompanying tables, outline two categories of measures identified for climate-positive actions by the dairy sector.

Direct Impacts and Enabling Factors

In considering climate-positive measures it is necessary to distinguish between **direct impact measures** on GHGs which can be counted in the national agriculture inventory and **enabling actions** which, while outside the inventory, support and enable the adoption of the direct measures.

Key to table of summary 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.

Timeframe*: this column provides an indicative timeframe in line with the budget periods set out in the Climate Act process.

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

A. Direct Impact measures to mitigate Greenhouse Gas Emissions from the dairy sector				
Measure	**Estimated CO_2 equivalent reduction**	**Estimated Economic Costs at farm level**	**Target GHG**	**Timeframe***
1. Reduce chemical Nitrogen use in the dairy sector by 27%-30% by end of 2030, with a reduction of 22%-25% in the short term (2025). *(This is a reduction from approximate usage in 2018 by the Dairy Sector of 204k tonnes to 143k - 149k tonnes by end of 2030)*	0.37Mt CO_2 eq. by end 2030 (0.185Mt CO_2 eq. by end 2025)	The Teagasc Nitrogen reduction Analysis (2020) reported that a 30% reduction in chemical nitrogen would reduce profitability per hectare by 15%, assuming a linear reduction in profitability in a scenario where cow numbers are held constant, and the reduced grass production was made up by purchased feed. However, this study now needs to be updated to take account of the enabling measures 11-13 available to maximise Nitrogen use efficiency which mitigate against this cost.	Nitrous Oxide	Short-term Medium-term
2. Target a 100% replacement rate of CAN with Protected Urea by the end of 2025 for grass based dairy production systems	0.33Mt CO_2 eq.	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
3. Development of methane-mitigating feed technologies	0.43 -1.0Mt CO_2 eq.	Initial manufacturer reports suggest €75 – 100 per cow per year	Methane	Short-Medium term
4.a) Develop methane mitigating Breeding Strategies (Integrate the Carbon sub-index) 4.b) Develop methane mitigating Breeding Strategies (building efficiency traits in the herd) *(Direct Impact and Enabling Factor)*	Estimated 0.3-0.4Mt CO_2 eq.	Genotyping strategy initial costs is estimated by ICBF at €19m/ per annum for the dairy herd with cumulative cost estimates at €152m for dairy sector to 2030	Methane	Short-term (EF) Medium-Long term (DI)
Total CO_2 equivalent reduction For measures 1 to 4 inclusive	**1.43 – 2.1Mt CO_2 eq.**			

5. Voluntary Exit/Reduction Scheme	Estimated 0.45Mt CO_2 eq. per 100,000 dairy cows reduced. **Note that this is an indicative calculation only, not a policy recommendation.*	The indicative income foregone per dairy cow removed is estimated at €1,770 for farms exiting dairy and €2,910 for farms reducing numbers, see detail in Measure 5 section. **Note that this is an estimate only, not a recommendation- the level of public funding for any scheme would be a matter for further consideration.*	All	Short term
6. Adopt a common Co-op charter on sustainable milk production based on the family farm model.	The key impacts of the Charter will be determined based on the level of detail in the Charter and how it can have a direct effect on national dairy herd numbers.	n/a	All	Short-term
Measures 5 and 6 would provide additional reductions.	**However, impact of Measure 5 depends on the level of participation in a voluntary scheme; and impact of Measure 6 is difficult to quantify.**			

B. Enabling Factors to support the mitigation of Greenhouse Gas Emissions from the dairy sector The Enabling Actions are outside of the inventory but are important nonetheless in driving the adoption of the direct impact measures. Existing resources are outlined in the following sections.		
Measure	**Target GHG**	**Timeframe***
7. Establish robust methodologies for measuring and monitoring greenhouse gas emissions and removals at individual farm level	All	Short-term
8. Commission a study on a carbon farming framework	All	Short-term
9.a) Increase investment in Climate Change Research and in Knowledge Transfer 9.b) Establish an Agriculture and Climate Change Research Liaison Group	All	Short-term
10. Design a Climate Action Communications Strategy	All	Short-term
11. Increase the adoption of Low-Emissions Slurry Spreading (LESS). Target 90 - 100% adoption of LESS for all dairy cow slurry manure by 2025	Nitrous oxide	Short-term
12. Improve Nitrogen Use Efficiency – Liming and soil pH- Ensure 100% of dairy farms are soil testing for pH	Nitrous oxide	Short-term
13. Encourage Clover Adoption and Multi-Species swards (MSS)- ensure all dairy farmers have incorporated clover/multispecies on 20% of their farm grassland by end of 2025	Nitrous oxide	Short-term
14. Milk recording- strive to achieve 90% adoption rate by end of 2025	All	Short-term
15. Develop Energy Diversification Opportunities	All	Medium-Long term
16. Strengthen all Co-op Sustainability Programmes to prioritise measures that directly reduce the national inventory of GHGs	All	Short-term
17. Introduce animal health measures listed in Action 314 of the Climate Action Plan 2021	Methane	Short-Medium term
18. Develop enhanced integration between the dairy and beef sectors	All	Short-Medium term
19. Support the role of young farmers and women in agriculture in implementation of the measures set out in this report	All	Short-Medium term

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

1. Reduce chemical Nitrogen use in the dairy sector by 27% - 30% by end of 2030, with a reduction of 22% – 25% in the short term (2025). (This is a reduction from 2018 approximate usage by the Dairy Sector of 204k tonnes to between 143k and 149k tonnes by end of 2030)
Impact on Inventory – Enabling Factor/ Direct Impact Direct Impact.
Recommendation The recommendation is to reduce chemical Nitrogen use in the dairy sector by 27% - 30% by end of 2030, with a reduction of 22% – 25% in the short term (2025). This is a reduction from 2018 approximate usage by the Dairy Sector of 204k tonnes to 143k -149k tonnes by end of 2030. Chemical nitrogen use directly impacts the inventory. Research to date has shown that nitrous oxide emissions (27% 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. A combination of financial supports and intensive advisory measures, such as, a dedicated advisory service along the lines of ASSAP, industry backing, and regulation will be required to achieve these ambitions. The adoption of Low Emission Slurry Spreading was at an average of 58% in 2020 with 47% for dairy liquid manure spreading and adoption is increasing. [15] Protected Urea should become the nitrogen fertiliser of choice for grass-based livestock production, essentially leaving CAN as a tillage sector input. The Nitrates Regulations have introduced a 10% reduction in maximum nitrogen recommended rates, with a further 5% reduction proposed. The enablers of nitrogen reduction and uptake of these measures needs to be encouraged. However, there will be a difficult transition period and there are a number of potential unknowns. The various enablers of N reduction include the forthcoming Fertiliser Database, the adoption of LESS and clover and multispecies swards, improved soil health as well as increased use of lime. Adoption of the enabling measures to reduce nitrogen will be the key challenge. Communication and education, particularly through the Signpost Farm Programme and the Agriculture Sustainability Support and Advisory Programme (ASSAP), will be of central importance. There will be a need to carefully monitor the impact of changes in fertiliser usage on farming practices. Policy

[15] 2020-Sustainability-Report.pdf (teagasc.ie)

development will need to consider and ensure that productivity is not undermined, that fodder shortages are avoided, that Protected Urea is widely used, that grass-based production is favoured over increased concentrate feed use and that a significant uptake of the enabling actions listed in the Teagasc MACC is assured.

Stakeholders Comments

The Group is broadly supportive of reducing chemical Nitrogen in the dairy sector. A number of stakeholders represented on the Group have raised concerns about the timeline for the achievement of the target. Concerns were raised regarding the practicality of achieving the targets over the proposed timeframe, having targets specifically for the dairy sector versus an overall agricultural sector target, the potential reduced farm outputs, the need for replacement feeds, the effects on dairy farm incomes, the requirement for continued research not yet completed science on the successful integration of clover and the time required for such systems to become adopted successfully. There was real concern across the farming organisations that the targets set out could lead to unintended consequences of potential fodder shortfalls and stressed the need for supports for farmers to deal with coping with fodder shortage emergencies. One stakeholder requested a study to accurately measure the impact of Nitrates Action Plans on stocking levels.

Measures regarding nitrogen use can have co-benefits for both climate and water quality. The EPA's water quality in Ireland 2016-2021 report was published on 14 October 2022. Among the key messages arising from the report, the EPA is calling for urgent and targeted action to protect and restore water quality in the next River Basin Management Plan (2022-2027), and full implementation of, and compliance with, the Good Agricultural Practice Regulations.[16]

One stakeholder organisation (Macra) rejected Measure 1. One stakeholder organisation (IFA) reserved its position on Measure 1. One stakeholder organisation (ICMSA) reserved its position on the Report as a whole based on a number of concerns including, the impact of the proposed Nitrogen usage on farm incomes, and the absence of a clear commitment on financial support and compensation for income losses that will be suffered.

Key Challenges

- The challenge for the Dairy Industry is to reduce inorganic fertilizer usage whilst maintaining optimal grass growth and productivity. Stakeholders raised concerns that unintended consequences could lead to localised fodder shortages and emphasised the importance of constant monitoring of the fodder situation on farms.
- Maintaining grass growth to levels that avoid any fodder shortages.
- Availability of clover seed, post-emergent sprays and protected urea
- It is important that in its efforts to reduce fertiliser usage, the industry is not undermined by the import of unregulated fertiliser supplies from outside of the State.
- Recognition of farmers who are already taking positive actions to reduce their Nitrogen usage

[16] Water-Quality-in-Ireland-2016-2021-Summary-Report.pdf (epa.ie)

Key impacts measured in specific CO_2e Mt reduction projections

A reduction of 61,000 tonnes of chemical N equates to approximately 0.37Mt CO_2 eq.

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

Based on the analysis published in the Teagasc Nitrogen Reduction Scenario Analysis report [17]– and assuming a linear reduction in profitability relative to nitrogen reduction of a factor of 0.5, as implied by the 10/20% N reduction scenarios modelled – it could be anticipated that a 30% reduction in chemical nitrogen would reduce profitability per hectare by 15%, if cow number were held constant and the reduced grass production was made up by purchased feed.

A further caveat to this analysis is that it was undertaken in 2020, prior to significant cost price inflation in inputs, particularly for fertiliser and feed, which should be borne in mind when interpreting the results. Similarly, this work reflects a milk price from 2019. Current indications are that the significant cost inflation in input costs in fertiliser and feed in 2022 will be offset by the increases in milk price, so it is likely these estimates would still approximately hold.

A major caveat is that the study does not take explicit account of improved nitrogen-use efficiency (measures 11-13) which mitigate against this cost, via optimizing soil pH and liming and extension of clover/multispecies on pasture swards. These interventions resulting from investment at farm level will contribute to offsetting the estimated impact on dairy profitability of the reduced chemical Nitrogen measure. The cumulative saving associated with all efficiency measures will deliver significant cost savings in this regard.

Key Contributing Factors

- A 27%-30% reduction in chemical nitrogen by end 2030 is an ambitious but achievable target. The success of the recommendation is conditional on having adequate additional advisory and research investment put in place to support farmers to adopt the critical enabling measures such as additional use of clover and MSS, LESS and Nitrogen use efficiency.
- Time and investment
- Roll out of a lime promotion programme.

[17] Review of the Influence of Nitrogen Application Rate, Soil Type and Agroclimate Location on Grass Production, Feed Budget, Nitrogen Use Efficiency and Farm Profitability (teagasc.ie)

• LESS equipment, • Management skills • Weather. • Update the science: Teagasc study on effect of Nitrogen reduction on farm incomes should be updated to take account of the enablers of Nitrogen use efficiency.
Cross-cutting Proposal, linkages and alignment between the recommended measures in this report and relevant policies/strategies *Climate Action Plan, Action 304/AgClimatise, Action 1 - Reduce chemical nitrogen use to an absolute maximum of 325,000 tonnes (annually) by end of 2030, with an interim target of 350,000 tonnes by 2025.* *CAP Strategic Plan. Pillar I - Eco Scheme Agricultural Practice 3 - Limiting Chemical Nitrogen Usage.* *Food Vision 2030, Mission 1, Goal 3, Action 1- …transition the agricultural sector to a lower chemical nitrogen use system.* 2. Target a 100% replacement rate of CAN with Protected Urea by the end of 2025 for grass based dairy production systems 9. a) Increase investment in Climate Change Research and in Knowledge Transfer 9. b) Establish an Agriculture and Climate Change Research Liaison Group 11. Increase the adoption of Low-Emissions Slurry Spreading (LESS). Target 90 - 100% adoption of LESS for all dairy cow slurry manure by 2025 12. Improve Nitrogen Use Efficiency – Liming and soil pH- Ensure 100% of dairy farms are soil testing for pH 13. Encourage Clover Adoption and Multi-Species swards (MSS)- ensure all dairy farmers have incorporated clover/multispecies on 20% of their farm grassland by end of 2025
Timeframe Short-term for N reduction and medium to long term for clover adoption
Responsibility DAFM / Agency/Industry cross-collaboration

2. Target a 100% replacement rate of CAN with Protected Urea by the end of 2025 for grass based dairy production systems

Impact on Inventory – Enabling Factor/ Direct Impact
Direct Impact

Recommendation
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 by the Group.

Targets for this technology are 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). The Group recommends that there should no further use of unprotected Urea beyond the end of 2025.

The recommendation of the Group is to significantly increase the speed of transition towards the use of Protected Urea on pasture. To achieve this, all stakeholders need to consider the establishment of concrete actions and supports for farmers as part of a wider discussion as to how we can reinforce and sustain practices at farm level that will reduce chemical N use, while maintaining output and productivity. Collaboration and commitment will be key throughout the industry in relation to ensuring the widespread availability of Protected Urea in the short term.

Key Challenges
- Availability of Protected Urea
- Structured dialogue with the fertiliser industry led by DAFM is required on supply chain and technical issues.
- A small number of farms experiencing difficulty with the efficacy of protected urea in specific soil conditions. Teagasc is carrying out research to identify the reasons for these difficulties.

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. 100% replacement of CAN equates to a 0.33Mt CO_2 eq. reduction

In the dairy sector, it is proposed that 140,000 tonnes of nitrogen will be applied in the form of Protected Urea. For every 10,000 tonnes of CAN replaced with Protected Urea, approximately 23, 571 tonnes of CO_2 eq. are abated.

The key impact measurement of emissions reduction for the uptake of Protected Urea detailed here is correlated to reductions in chemical nitrogen use for the dairy sector.

Estimated costs

Teagasc estimates demonstrate that 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.

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. Purchase of Protected Urea is also a measure provided for by the Coop Sustainability Action Programme.
Key Contributing Factors 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. Teagasc should continue to carry out further research on the small number of farms experiencing problems with the efficacy of protected urea to identify appropriate solutions. The establishment of the Fertiliser Sales Database, which is planned to be operational in January 2023[18], 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 Climate Action Plan, Action 307 - Increase the use of Protected Urea fertiliser. AgClimatise, Action 2 -Where chemical fertiliser is applied, promote the use of protected nitrogen products. 1. Reduce chemical Nitrogen use in the dairy sector by 27%-30% by end of 2030, with a reduction of 22%-25% in the short term (2025). (This is a reduction from 2018 approximate usage of 204k tonnes to 143k-149k tonnes by end of 2030.)
Timeframe Short-term Target is for end 2025, but could be progressed earlier; however, this is dependent on availability of Protected Urea.
Responsibility DAFM / Agency/Industry cross-collaboration

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

3. Development of methane-mitigating feed technologies

Discussed in detail at the additional online meeting of the Food Vision Dairy Group.

Impact on Inventory – Enabling Factor/ Direct Impact

Direct Impact

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.

The feed additive 3NOP has proven efficacy in the international scientific literature to reduce enteric methane by approximately 30% in indoor systems. This has been confirmed in an Irish context by Teagasc trials. 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.

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

0.43-1.0Mt CO_2 eq.

Enteric methane research on feed additives has shown some promise in indoor TMR systems with products like 3NOP or Bovaer from DSM. The lower end of the range is based on current science. A number of assumptions were required in order to complete the analysis. These include an enteric methane reduction of 30% when fed in a TMR setting, that 80% of the winter milk animals. It was also assumed that 15% of the spring calving cows would have access to TMR over the winter months. The table below sets out the level of mitigation potential based on these assumptions.

The goal is to develop a slow-release bolus that could achieve close to 30% reductions, and this would increase abatement to at least 1Mt. Given the uncertainties, the broad range include the potential based on the development of the bolus of 0.43 to 1.0Mt CO_2 eq for this direct impact measure.

3NOP feed additive potential by 2030	**Mitigation potential Mt CO_2 eq**
80% of winter milk cows fed additive by 2030 plus 15% of spring calving cows fed TMR diet by 2030	0.1
Feeding 3NOP to 85% of spring calving cows at milking twice a day (10% reduction in enteric methane)	0.33
Total based on current science	**0.43**
Development of slow-release bolus fed to 85% of spring calving cows (assumes additional 15% abatement- total 25%)	0.57
Total potential based on development of bolus	**1Mt**

Estimated costs

Costs per cow to be determined. Initial reports suggest €75 – €100 per cow per year as per manufacturer.

Key Contributing Factor

Availability of 3NOP

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. The use of this technology needs to be recorded in SDAS.

Immediate research is required to ensure that the technology is available to dairy farmers and can be accounted for in the national inventory. Teagasc and DAFM will continue to support research of 3NOP. Agreement on what further scientific studies is required to measure the effectiveness of 3NOP for dairy cows on pasture base. The outcome of this research should offer a robust scientific measurement per cow that can translate to the inventory

Cross-cutting Proposal, linkages and alignment between the recommended measures in this report and relevant policies/strategies

Climate Action Plan, Action 313 Progress the development of feed additives on methane emissions for use during the housing period. Action 323 Continue to invest in research to develop novel feed additives to reduce biogenic methane during the grazing season. AgClimatise, Action 7 Continue to invest in novel feed additives to reduce biogenic methane. Food Vision 2030, Mission 1, Goal 1, Action 5 Ireland will play a leading role in shaping how greenhouse gas emissions from livestock farming are understood and addressed. 9.a) Increase investment in Climate Change Research and in Knowledge Transfer 9.b) Establish an Agriculture and Climate Change Research Liaison Group
Timeframe Short-Medium term
Responsibility DAFM/Agency cross-collaboration

4.a) Develop methane mitigating Breeding Strategies (carbon sub-index)
Continued selection on EBI, albeit with additional emphasis on carbon related traits such as female fertility.

4.b) Develop methane mitigating Breeding Strategies (building efficiency traits)
Selection on new traits within the EBI, such as more accurate estimates of methane traits and/or earlier age at slaughter.

The first strategy can be considered an enabling factor and is likely to deliver 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.

Impact on Inventory – Enabling Factor/ Direct Impact

4.a) Develop methane mitigating Breeding Strategies (carbon sub-index) - Enabling Factor
The Economic Breeding Index (EBI) can be used to breed lower methane producing animals, across different genders, systems, breeds and within breed, increasing profitability and reducing the carbon footprint. One of the major benefits of breeding strategies, is that, unlike other mitigation strategies, all farmers ultimately get the benefits of improved genetics. In that context, there is 100% uptake of the measure. In addition, genotyping accuracy is 100% and provides surety regarding CO_2 eq mitigation potential. Again, this is important in having an accurate perspective on the GHG status of a given herd. Ireland (through ICBF and Teagasc) is now considered a world leader in this space, based on the combined principles of peer reviewed science, strong validation, and high levels of uptake at farm and industry level. It is important that these efficiency improvements when captured by Irish farmers, are, in turn, reflected in the compilation of the national inventory. Sexed semen also needs to be further encouraged as well as the adoption of the Beef Index to promote the breeding of high-quality dairy beef progeny.
At present, this strategy should be viewed as an enabling factor, because the approach is based on incorporating the cost of carbon within existing EBI traits. This will result in a modest level of mitigation However, if recent rates of increase in the national dairy herd are maintained, these gains are likely to be eroded. Hence the suggestion that it should be considered as an "enabling factor".

4.b) Develop methane mitigating Breeding Strategies (building efficiency traits) - Direct Impact
In time, with increasing emphasis on direct measurement of methane, coupled with the anticipated stabilisation of the national dairy herd, the level of potential mitigation will be increase at that stage, breeding strategies could be considered as having a direct impact on GHG requirements. It is important to note regarding the national inventory and projections, there is no genetic component to the inventory or projections currently i.e. there is no breeding parameter in the inventory. The realisation of reductions as they may arise will be reflected in the amount of methane per kilogramme of milk solids.

Recommendation
Recommended for further development for its long-term positive impact potential. Breeding strategies have an important role to play in sustainability and reducing emissions and are recommended for further research. Further detail on ICBF/Teagasc breeding strategies and metrics on what can be delivered in

terms of emission reductions towards 2030, are provided in the section on Metrics. Further consideration is needed on adoption rates in respect of targets and incentivisation proposals. Consideration of the direct measurement of methane (especially at grass), age of slaughter, dairy beef integration, genotyping (including DNA calf registration) will also be required. The later has a multiplicity of benefits for government, farmers and industry including (i) increased genetic gain, (ii) enhanced traceability, (iii) future R&D, (iv) market point of difference and (v) auditing re: GHG profiling at the herd/national level.

Key Challenges

- Efficiency gains from lower methane-emitting animals via EBI/breeding can only achieve reductions in emissions where animal numbers are stabilising and/or reducing.
- Research on breeding strategies must work to inform both EBI and the agriculture inventory (efficiency gained per unit)
- Funding costs of genotyping the herd – once-off and ongoing – would be significant. Establishing the correct forum/approach to ensure the equitable sharing of costs across all relevant beneficiaries will be key.

Key impacts measured in specific CO_2e Mt reduction projections

0.3-0.4Mt CO_2 eq.

DAFM requested the Irish Cattle Breeding Federation (ICBF), in collaboration with Teagasc, to undertake an assessment of the potential role of genetic improvement in addressing our ambitious national GHG mitigation requirements. A summary is provided of what methane mitigating breeding strategies can deliver using scenario modelling methodologies.

Accelerated gains in the genetic merit of dairy cows (as measured by the Dairy EBI) has been identified as a mitigation measure that can prove beneficial in the medium to long term. One of the significant benefits of the strategy is that all participants ultimately receive the gain, albeit at different stages, depending on the participants use of technologies, such as 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.

ICBF has suggested that genetics has the potential to deliver 0.3 – 0.4Mt of mitigation in dairy by end of 2030 through an increased focus on female fertility, direct measurement of methane emissions, genotyping of the national herd and opportunities around voluntary replacing of underperforming cows. The new carbon sub-index will become available for inclusion in the EBI towards the end of this year. The inclusion of methane traits in the carbon subindex is expected to be introduced within the next 1-2 years, however the impact on emissions will take several years to be significantly quantifiable.

It is likely that improvements in a methane efficiency trait will only be fully realised post 2030, with an expected mitigation of some 0.77Mt over an extended 15-year period. The new carbon sub index is recommended to be included *in tandem* with the current EBI index. This will initially focus on

reflecting the cost of carbon into existing traits, but then building out into new traits such as the direct measurement of methane and earlier age at slaughter.

Estimated costs

A report on the potential that can be delivered from developing methane mitigating breeding strategies was provided by ICBF and highlighted the following points.

An opportunity to mitigate up to 0.39Mt CO_2e each year in dairy, with an additional 0.19Mt CO_2e in beef by end of 2030. This would come through a range of initiatives including, (i) the introduction of a new carbon sub index, (ii) genotyping the national herd, (iii) direct measurement and inclusion of methane traits within the EBI and (iv) replacement strategies (including voluntary culling) that would favour lower methane emitting animals.

Cumulative costs by 2030 were estimated to be €152m for dairy (or approx. €19m/annum). These were based on a number of key costs/assumptions including (i) €10/animal for DNA calf registration, with farmers then contributing an additional €5/animal through their tags, postage and packaging (i.e., €15 total per animal), (ii) a "one-off" cost associated with genotyping the national dairy herd, including replacements (some 3m replacement stock at €15/animal), and (iii) a cost for methane phenotyping within the G€N€ IR€LAND breeding program of some €4.6m/annum.

Genotyping every calf in Ireland creates the possibility of developing more advanced genetic solutions to 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). Breeding for methane efficiency would significantly increase the potential impact of genetics to improve environmental efficiency.

Improve Herd EBI is also a measure provided for by the Sustainability Action Payment programme.

Key Contributing Factors

- Involvement of all livestock sectors
- The adoption of the new Carbon Sub Index should be encouraged *in tandem* with the overall EBI index. 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 measures.
- Linkage through to beef/sheep through proposed national genotyping strategy.

Cross-cutting Proposal, linkages and alignment between the recommended measures in this report and relevant policies/strategies

Climate Action Plan, Action 310
Increase focus on selection for traits that lead to lower methane production in the beef breeding programme.
AgClimatise, Action 3 Genotype the entire national herd by 2030 to underpin the developments of enhanced dairy and beef breeding programs that help achieve a reduction in our overall GHG output at a national level.

Food Vision 2030, Mission 2 Goal 1 Action 4 Continue progress on genetics, including genomic breeding strategies focused on animal health and welfare, production efficiency and methane efficiency, and market suitability of all offspring, including sexed semen. The role of livestock genetics in addressing national GHG mitigation requirements. AR Cromie[1], DP Berry[2], L Shalloo[2], T Kirk[3] & J Crowley[3]. 9.a) Increase investment in Climate Change Research and in Knowledge Transfer 9.b) Establish an Agriculture and Climate Change Research Liaison Group
Timeframe Short-term (EF) Medium-Long-term (DI)
Responsibility DAFM/Agency-collaboration

5. Voluntary Exit/Reduction 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 to encourage dairy farmers to voluntarily reduce or exit from the production of ruminant breeding livestock for a minimum number of years. It should be open to farmers under such a scheme to reduce completely or partially their breeding ruminant numbers in return for an appropriate incentive.

The principles to be considered for such a scheme include:

- A voluntary scheme to allow farmers to completely or 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.
- The farmer could not calve any breeding ruminants and register births on AIM where they had opted to completely reduce numbers.
- Where applicants opt for a partial dairy herd reduction in the scheme, terms and conditions on restrictions regarding breeding ruminants will 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.

Key impacts 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.

It is estimated that for every 10,000 dairy cows reduced, 45,000 tonnes (or 0.045Mt) of CO_2 eq. are removed from the inventory.

This is based on a methane contribution of 37,000 tonnes (122kg of methane per dairy cow in addition to 11.4kg methane per dairy cow in stored manure) and a Nitrous Oxide contribution of 8,000 tonnes (deposited by animal and chemical N) for every 10,000 cows.

Or for every 100,000 dairy cows reduced, 450,000 tonnes (or 0.45Mt) of CO_2 eq. are removed from the inventory.

The capture of emissions reductions data will be seen in reduced dairy cow population and reduced nitrogen fertiliser use.

Estimated costs

An analysis was conducted by DAFM to estimate the income forgone from production for the removal of a cow under the scheme.

The factors that influence the value of an individual cow comprise the following:

1. The cull value of the animal
2. The profit that could be generated in the production of milk versus the next best alternative (NBA) activity, e.g., beef attending or tillage
3. For farmers that might opt to exit milk production, the relevant profit metric would be Net Margin, whereas Gross Margin would be more appropriate for those that would opt to reduce a small number of animals
4. The number of expected remaining lactations

Using National Farm Survey data for 2019-2021, income foregone per dairy cow was compared with the income available from a weighted average of the 'Cattle Other' and the 'Tillage' farm systems. Two alternative income estimates from production are available, Gross Margin and Net Margin. Gross Margin is total output value per cow less direct costs of production; Net Margin is total output value per cow less direct and overhead costs of production.

A farm remaining in dairy production, but reducing cow numbers through participation in the scheme, would forego income from the cows removed and would also earn less income per cow remaining due to higher overhead costs per cow farmed. For such scheme participants ("Remainers") a Gross Margin income metric is appropriate. A farm exiting dairy production will see reductions in the overhead costs of production given their exit from dairy production and for such farms ("exiters") a net margin income metric is appropriate.

This approach to calculating the total value of a dairy cow removed under the scheme and the associated income foregone results in the following:

The total value per cow removed is made up of the cull (meat) value of the cow + income foregone as a result of removing the cow. The element of the cow's value for which the farmer will have to be offered compensation is the income foregone component only. The cull value of the cow would be recouped by the participating farmer from the purchaser of the culled animal (meat factory).

- If the cow removal is an element of a full destocking and exit from dairying appropriate income metric to use is Net Margin and the income foregone is €590 per lactation or €1,770 per dairy cow removed assuming three remaining lactations.
- If the cow removal is an element of a partial destocking where the participating farmer remains in dairy production but with fewer cows the appropriate income metric to use is Gross Margin and the income foregone per lactation is €970 or €2,910 per cow assuming three remaining lactations.

Note: these figures are indicative estimates only. It must be noted that the valuation of an animal will depend on the individual animal based on their grading, the remaining lactations, and the alternative enterprise adopted by the farmer.

Stakeholder Comments

A number of stakeholders represented on the FV Dairy Group have raised concerns about this measure, in particular about the limitations on activity on the land.
However, such a scheme can only be considered in the context of this Report if it can contribute to the stabilisation and reduction of emissions as reported in the national GHG inventory- unless land is removed from circulation for breeding ruminants and breeding ruminant numbers are reduced on participating farms, it will not have a climate impact.
One stakeholder organisation was concerned that the measure could hinder generational renewal and expressed concern about the impact of the measure on the access of young farmers to land; proposing as an alternative that farmers should be incentivised to transfer land to young, trained farmers who make specific commitments on emissions reductions.

Several stakeholders stressed that this scheme would require a significant public funding commitment to ensure take up. Funding initiatives by Co-ops are ultimately borne by farmer suppliers.

It was also noted:

- A similar scheme as suggested should be considered by other ruminant sectors through a similar consultation process.
- Restrictions on the future use of the land would have significant implications which need to be addressed in the development of any possible scheme:
  - Force Majeure and other unforeseen factors
  - Value of land and land mobility
  - Impact on generational renewal
- Consideration should be given to allowing the lands in question to be used by another farmer for dairy cows but provided that this does not result in a farmer's increase in total cow numbers.
- Scheme development would require detailed stakeholder engagement to avoid unforeseen consequences at the planning phase for such a scheme.
- Consideration of any unintended consequences must be part of the analysis before any scheme is introduced including the impact on the family farm model, geographical areas and implications for land availability/cost of leased land.

One stakeholder organisation (Macra) rejected Measure 5. One stakeholder organisation (IFA) reserved its position on Measure 5. One stakeholder organisation (ICMSA) reserved its position on the Report as a whole based on a number of concerns including, the impact of the proposed Nitrogen usage on farm incomes, and the absence of a clear commitment on financial support and compensation for income losses that will be suffered.

Key Contributing Factors

- 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

15. Develop Energy Diversification Opportunities
18. Develop enhanced integration between the beef and dairy sectors.

Timeframe

Short term

Responsibility

DAFM/Industry cross-collaboration

6. Adopt a common Co-op charter on sustainable milk production based on the family farm model.

Impact on Inventory – Enabling Factor/ Direct Impact
Enabling factor
Direct impact

Recommendation.
Stakeholders recognise the requirement to protect the family farm, grass-based model and to ensure that the sector continues to attract talented new entrants into dairying.

A high growth expansion model of dairy farming driven by large dairy herds is not seen to be consistent with this approach. Co-ops and farmers have shared the responsibility to protect sustainability values, in support of implementation of the Teagasc MACC and the recommendations of this Group.

The Co-op sector agrees to develop a Charter or Statement of Principles based on shared values that will protect and facilitate new entrants, where young farmers with enterprises consistent with the family farm operations are prioritised, alongside existing family farms and other priority categories recognised by individual Co-ops. The charter should underline the strengths of the Irish dairy industry and seek to outline what is important to the industry in the years ahead including a commitment to farm sustainability and to reducing GHG emissions from the dairy herd, whilst respecting the autonomy of Co-op boards and their management to responsibly protect the interests of their own businesses.

Key Challenges
- Agreeing a common policy across the sector.
- Milk supply rules in several co-operatives could pose legal difficulties in attempts to manage access to capacity.
- Protecting opportunities for existing family dairy farms and young farmers.
- Ensuring the competitiveness of the sector based on recognised sustainable milk production systems, whilst balanced against the need to efficiently utilise processing capacity.
- Defining the family farm. (FAO definitions references family farm operations, farm management, predominance of family labour on farm).
- Greater alignment required between the requirements of new entrants and opportunities through policy initiatives.

Key impacts measured in specific CO_2e Mt reduction projections

The Irish dairy sector has a significant role to play in reducing the absolute level of national greenhouse gas emissions. Considering the sustained future demand for dairy, it's equally important the Irish dairy sector in the future remains profitable and internationally competitive, therefore both objectives

need to be addressed. The Co-op charter works indirectly by directing the Coops to support common principles and the adoption of mitigation measures by their members. The mitigation measures are the directly impactful actions undertaken

The key impacts of the Charter will be determined based on the level of detail in the Charter and how it can have a direct effect on national dairy herd numbers. The development of a common Co-op Charter will incorporate implementation strategies to reduce emissions and will be linked to the implementation of the other recommended measures in this Report, in particular recommendation 16 on development of effective Sustainability programs.

A whole of sector and whole of government approach is required for the measure to have a key impact and a strong communication plan is required to be developed with immediate effect as per recommendation 10 of the report.

Co-op surveys that will gather independent empirical data to inform the Charter will be developed in Q3/Q4 2022. The survey should direct specific questions and determine timeframes by gathering data across Co-ops on the number of potential new entrants in the sector, succession planning among existing suppliers (number of dairy farmers that plan to retire in the next 5-10 years, number of farmers with/without identified successors), as well as other priority categories of milk suppliers. The data will inform decision making by Co-ops on accepting applications for new entrants including cow numbers.

Details of the associated projections calculations and possible routes for inclusion in the National Inventory remain to be established for this measure. Until this data is compiled, and a charter is developed it is difficult to assign metrics to this measure.

A strong commitment from Co-ops in the Charter is required to support the reduction of GHG emissions by their members. Co-ops will commit to supporting and helping their members to reduce emissions at individual farm level by adopting the Teagasc MACC measures and the continuous development of Co-op Sustainability Programmes.
The following statements of principle will need to be addressed in a Charter:

- Agreeing a common policy across the sector.
- Milk supply guidelines. The Terms and Conditions for any new Milk Supply Agreements will be informed by relevant Environmental and other Regulatory requirements with a particular emphasis on supporting the family farm model.
- Protecting opportunities for existing family dairy farms and young farmers.
- Ensuring the competitiveness of the sector based on recognised sustainable milk production systems, whilst balanced against the need to efficiently utilise processing capacity.
- Greater alignment between the requirements of new entrants and opportunities through policy initiatives.
- Supports for generational renewal, young farmers, and existing family farms

Defining the family farm and support volatility tools to protect the family farm model.

Resources

A modest supporting budget is required to publish the Charter.

Key Contributing Factors

- Supports for generational renewal, young farmers and existing family farms

• Volatility tools to protect the family farm model.
Cross-cutting Proposal, linkages and alignment between the recommended measures in this report and relevant policies/strategies Food Vision 2030, Mission 1 Goal 1 Action 2 Produce detailed plans by Q2 2022 to manage the sustainable environmental footprint of the dairy and the beef sectors. 16. Strengthen all Co-op Sustainability Programmes to prioritise measures that directly reduce the national inventory of GHGs
Timeframe Short term The Co-op charter can be developed and agreed by Dairy Co-ops within a relatively short timeframe by the end of 2022. There is a requirement for independent data collection to get a holistic view of the industry and support is required from other parties such as Teagasc.
Responsibility Industry cross-collaboration

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

7. Establish robust methodologies for measuring and monitoring greenhouse gas emissions and removals at individual farm level.
Impact on Inventory – Enabling Factor/ Direct Impact Enabling action
Recommendation Information on all greenhouse gas emission (GHGs) 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 dairy co-ops 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, as well as the contribution of sustainable energy. 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.
Key Challenges • While the EU Commission carbon farming proposals are currently limited to the LULUCF sector it will provide a framework for expanding to other greenhouse gases across Member States; • EU operational examples are limited for a farm level with only a few internationally. • The large scale deployment of measurement, reporting and verification process at farm level to take into account the individual conditions at farm and even field level.
Key impacts measured in specific CO_2e Mt reduction projections The recommendation commits to establishing a baseline of GHG emissions at farm level. By establishing a farm baseline, future options to reduce emissions will be enhanced. This measure is an enabling measure since it doesn't itself lead to any reduction in the inventory. The information created is a necessary enabler of any future carbon trading scheme and Carbon Farming policy via production of knowledge and evidence of the impact of further mitigation action at farm level. Emissions in the Agricultural inventory cannot be offset by sequestration actions provided by the Land Use, Land Use Change and Forestry (LULUCF) category.

The enabling framework to develop a carbon farming model, with the potential for trading, and which rewards farmers for emissions reductions and removals, including through potential private investment already underway under The Climate Action Plan 2021 and is led by DAFM and includes EPA, Teagasc, Bord Bia, , DECC, ISIF, with plans to finalise by Q4 2023.The Group are of the view that collaboration between agencies and dairy co-ops and potential for partnership with the private sector should be prioritised immediately, with the aim of generating carbon measurements for dairy farms over the next two years.

The Teagasc Sustainability Digital Platform (under development in partnership with Bord Bia and the ICBF could be the tool to do this. It will need to be able to take account of all sequestration and energy contributions and will also need to be able to account for all enterprises on the farm. This partnership could be enhanced by drawing on relevant private sector expertise.

Resources

There will be set costs e.g., to set up a national calculator and annual operation costs to update the estimates at farm level as farmers mitigate through adopting technologies or reducing activity.

There is a requirement for additional on-farm advisory support to encourage farmers to incorporate these actions, as planned in an enhanced Signpost Advisory programme.

Key Contributing Factors

- Access to timely farm-level emissions data to aid the decision-making process at farm-level.
- Close coordination on development of data collection, protection and use approaches between all agencies and stakeholders to ensure synergies with all existing systems, particularly Bord Bia's Sustainable Dairy Assurance Scheme which includes almost all dairy farms.
- Progress on carbon farming strategy and policy at the EU-level.
- Clear and appropriate communication at farm level

Cross-cutting Proposal, linkages and alignment between the recommended measures in this report and relevant policies/strategies

Climate Action Plan, Action 322 -Develop an enabling framework to facilitate the roll out of a national carbon farming programme.
Food Vision 2030, Mission 1 Goal 1 Action 4 - Roll out 'Carbon Farming'.

8. Commission a study on carbon trading framework
9.a) Increase investment in Climate Change Research and in Knowledge Transfer
9.b) Establish an Agriculture and Climate Change Research Liaison Group
10. Design a Climate Action Communications Strategy

Timeframe Short-term Finalise the development of an enabling carbon framework as set out in the Climate Action Plan 2021 by Q4 2023. 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 year and will provide a basis for measurement, reporting and verification at farm level. A working model for a dairy farm is being developed by Teagasc, with inclusion of other enterprises to follow. As part of the Signpost Programme's Advisory Campaign in 2021, Teagasc and Bord Bia collaborated on a campaign to encourage farmers to engage with climate action. The campaign focused on raising awareness among farmers of their Carbon Footprint through the Farmer Feedback Report and engaging with a Teagasc advisor for decision-making on-farm. The "Know Your Carbon Footprint" campaign under Teagasc's Signpost Programme is underway and will include farmer participation, media partnership, direct communications via text and newsletter, webinars, discussion groups and advisor training.
Responsibility DAFM/Agency cross-collaboration

8. Commission a study on a carbon farming framework

Impact on Inventory – Enabling Factor/ Direct Impact
Enabling Impact

Recommendation

In parallel with Measure [7], the Group recommends that a comprehensive study 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

Stakeholder Comments

A number of stakeholders represented on the Group raised concerns about the potential for particular types of trading arrangements, such as a Cap-and-Trade model to result in a *de facto* restriction on cow numbers and/or production. They were also concerned that carbon credits could leak from Agriculture to other sectors.
Agreement to the commissioning of detailed research/exploring the potential of carbon farming framework should not be interpreted as agreement to any particular model, but a review of best international practice to identify what model of carbon farming might best suit the Irish dairy sector.
Further stakeholder comments included that a framework needs to ensure that carbon rights from agriculture (tillage, beef, dairy, sheep) are fully retained and ring fenced for the agri-sector as a whole. The early adopters of climate efficiency measures must be recognised in the event of a future carbon farming arrangement.

Representatives expressed reservations about researching a measure which may have implications for other agricultural sectors. Concern was expressed that the study is restricted to methane and nitrous oxide emissions, and that the study should also take account of removals.

Key Challenges

- Implementation of a carbon farming model and a trading system, in particular would be likely to require a detailed administrative framework to facilitate carbon farming, involving the robust measurement of total GHG emissions at individual farm level (see Measure 7), the assignment of rights and the creation of a trading system, while recognising that a comprehensive carbon model, including LULUCF, depends on further development of an EU model of 'carbon farming', in which it is envisaged that every farmer should have access to verifiable emissions and removal data.
- EU Commission carbon farming proposals are currently limited to the LULUCF sector and at present there are few examples of operational models in the EU (for example Label Las Carbonne) and only a few exist internationally.

Key impacts measured in specific CO_2e Mt reduction projections

This proposal is for a study to explore the potential of a carbon farming framework with the objective of reducing total emissions associated with the dairy sector.

This recommendation should be driven through the interdepartmental working group chaired by DAFM which is already tasked to deliver an enabling carbon farming framework under the Climate Action Plan process.

Estimated costs

The cost of the study recommended in this measure have not been determined as part of this report.

Providing a cost for a carbon farming model has yet to be carried out in an Irish context. How a carbon farming schemes should be administered is another requirement of a study. From an administrative viewpoint, a carbon farming mechanism requires farm- or processor-level data to monitor, report and verify emissions (i.e., transaction costs) which could be substantial at the outset; however, such costs could reduce over time as systems are established, technologies improve and those involved learn and become more familiar with the processes. Each farm would need to know their total annual net emissions. Such a model could entail potentially very significant administrative costs for DAFM and partners in establishing and operating such a mechanism.

Key Contributing Factors

- This recommendation should be considered within the context of the Climate Action Plan commitment of developing an Enabling Carbon Framework which is being guided by an interdepartmental Working Group, chaired by DAFM.
- Consultation with dairy stakeholders on the scope and findings of this study is recommended to ensure that all relevant considerations are covered.

• This study should work in tandem with the European Commission regulatory proposal for carbon farming, expected at the end of Q4 2022. • Access to timely farm-level emissions data to aid the decision-making process at farm-level • Progress on carbon farming strategy and policy at National and EU level • Research should include an assessment of the economic, social and environmental implications of carbon farming for Irish agriculture.
Cross-cutting Proposal, linkages and alignment between the recommended measures in this report and relevant policies/strategies AgClimatise, *Action 17* 7. Establish robust methodologies for measuring and monitoring greenhouse gas emissions and removals at individual farm level 9.a) Increase investment in Climate Change Research and in Knowledge Transfer 9.b) Establish an Agriculture and Climate Change Research Liaison Group
Timeframe Short-Medium term
Responsibility DAFM/Agency cross-collaboration

9.a) Increase investment in Climate Change Research and in Knowledge Transfer
9.b) Establish an Agriculture and Climate Change Research Liaison Group

The Group recognises that there is an urgent need to greatly increase investment in Research and Knowledge Transfer on climate change and related sustainability matters. The need for increased resourcing and investment in Research and Knowledge Transfer was discussed throughout the meetings of the Food Vision Dairy Group.

Impact on Inventory – Enabling Factor/ Direct Impact

Enabling Factor leading to the identification and adoption of new mitigation technologies in the medium to long run.

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.

Initial areas to consider include:
1) Past and ongoing research in CH_4 and Nitrogen related emissions from dairy (and beef)
2) ongoing mitigation research i.e., 3NOP and other additives
3) Slurry amendments (acidification)- developing a cost-effective mechanism to reduce slurry methane emissions. Research into slurry additives and the mild acidification of slurry continues to show promise as a new technology. Aim to maximise the potential benefits of advancements in technology. A cost-benefit analysis on installation/maintenance of acidification systems on dairy enterprises needs to be established. Current safety concerns of acid use and adverse effects on structures and certain soils requires evaluation.
4) Identify gaps in knowledge and assess what is needed to address these gaps
5) Existing resources and infrastructure in the country to measure methane (i.e., Greenfeed) in both young and adult ruminants
6) Capacity during 2022 and 2023 to increase the number of studies using the resources/infrastructure identified
7) Further investment required (research and infrastructure costs)
8) Examine the establishment of a group to examine and address the evolving best practice and support the key changes of climate and sustainability implementation (Continuation of Existing DSI Forum)
9) Ongoing research on how best to incorporate clover into existing swards across all soil types needs to be completed and optimised for an Irish context. The incorporation of MSS is a relatively new concept for Irish dairy farmers and there needs to be further research before its widespread use

can be advised. Changing from a perennial ryegrass sward to a clover sward or MSS on farm will take a significant amount of time and cost. Clover and MSS Safe sprays must be available in the Irish market to control weeds in these swards.
Key Challenges • Requirement for robust scientific evidence and peer reviewed publications. • Research needs to capture positive practices at farm-level. • Identifying the funding required for enhanced Research and KT investment in climate change and related matters. • Continuation of joined up approach on sustainability and climate change from a whole of Government/whole of sector basis post- Food Vision Dairy Group.
Resources DAFM is committed to increasing its spending on climate related research by 40% in the period 2021-2025 (compared to a base in 2020). The level of investment in climate related research and knowledge transfer may need further examination in the context of facilitating the direct measures detailed in this report.
Key Contributing Factors • Ongoing liaison with the Agriculture and Land Use Inventory Refinement, Projections, Policies and Measures Group to ensure that future studies conducted, and measurements taken within those studies, are not duplicated, can be collated, and will meet the EPA's requirements (number of projects, sites, and measurements) for inclusion in the national inventory calculations. • Establishment and contribution of Teagasc National Agricultural Sustainability Research and Innovation Centre (NASRIC)
Cross-cutting proposal, linkages and alignment between the recommended measures in this report and relevant policies/strategies Relevant to all proposed N_2O and CH_4 measures.
Timeframe Short-term
Responsibility DAFM/Agencies/Dairy Research Ireland/Academia

10. Design a Climate Action Communications Strategy

The requirement for increased and enhanced farmer communications in the climate action space was discussed throughout the meetings of the Food Vision Dairy Group.

Impact on Inventory – Enabling Factor/ Direct Impact

Enabling factor

Recommendation

Develop a targeted communications strategy, to be jointly led by Teagasc and Bord Bia, 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

Purpose/key challenges

- Targeted approach is urgently required directed at the 1500 herds in continuous high growth expansion mode to ensure that responsibilities under the Climate Action Plan and the consequences of business expansion are understood.
- Scope of the agriculture inventory and the associated distinction between direct actions and enabling actions must be communicated to farmers and wider agri-food stakeholders in all sectors to empower them to take actions on their farms that directly affect the agriculture inventory, while recognizing the value of enabling actions to support the adoption of these direct measures and that also improve biodiversity and water quality.
- The processing sector has a key responsibility to ensure that there is consistency in messaging on climate change and sustainability.
- Communicate to the farming community and the general public on what farmers are currently doing to ensure positive climate actions are recognised and highlighted.
- Communication to the public that there is a cost associated with sustainability and food prices need to reflect these costs.

Resources

Adapt existing communication strategies to promote the measures proposed by this report. Bord Bia, Teagasc and Industry to fund.

Key Contributing Factors

- Establishment and contribution of Teagasc Centre of Excellence in Agri-Food and Climate Change
- Industry support in messaging.
- Ongoing development of existing metrics by Bord Bia, Teagasc, ICBF to communicate farm carbon footprint including GHG emissions and nutrient management planning to farmers through accurate and timely communication.
- Building on Teagasc/Bord Bia collaboration on communications based on the Signpost programme.
- Development of common messaging /comms strategy on climate change/sustainability best practice on a broader whole of government /whole of sector basis.

Cross-cutting proposal, linkages and alignment between the recommended measures in this report and relevant policies/strategies

Relevant to effective implementation of all measures.

Timeframe Short-term
Responsibility DAFM / Agency/Industry cross-collaboration

11. Increase the adoption of Low-Emissions Slurry Spreading (LESS). Target 90 - 100%* adoption of LESS for all dairy cow slurry manure by end of 2025
Impact on Inventory – Enabling Factor/ Direct Impact Enabling Factor. This measure has a direct impact on Ammonia emissions and is an enabling factor in the mitigation of N_20
Recommendation 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 67% of slurry was spread using LESS on dairy farms in 2021 and adoption is increasing. This is reflected in the EPA inventory as NH_3. 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.
Key Challenges • Adoption and support; physical constraints, such as machine availability should be addressed to ensure continued progress. • LESS equipment is more difficult when soil trafficability is poor. In turn, this will necessitate greater support and investment in slurry storage to ensure a greater buffer when soil and weather conditions are unsuitable for land-spreading. • The range of 90% to 100% provides for land types that are unsuitable for LESS equipment*
Resources LESS is prioritised for investment in the CAP Strategic Plan 2023-2027 under the On-farm capital investment scheme. The scheme will include support at 40% grant rate for with a higher investment rate of 60% offered to young farmers and women farmers to support generational renewal and gender balance. Investment ceilings will be increased to €90,000 with separate ceiling for LESS equipment. As this scheme is demand-led, the annual indicative financial allocation for this intervention varies year on year, dependent on the number of projects receiving funding. The total indicative financial allocation for this intervention is €100m. The first three years of the programming period is primarily financed via the Rural Development Programme 2014-2025. Investments for women farmers will be funded from CSP from 2023. A total of €440m will be made available under On-farm investments over the period 2021-2027, of which €340m will be funded from the Rural Development Programme in the period 2021-2025. [19]

[19] Page 31, On-farm capital investment scheme, Summary of Ireland's draft CAP Strategic Plan 2023-2027 (gov.ie - The CAP Strategic Plan 2023-2027 (www.gov.ie))

LESS is an action supported under ACRES Scheme. LESS is also a measure provided for by the Sustainability Action Payment programme.
Key Contributing Factors Grant availability.
Cross-cutting proposal, linkages and alignment between the recommended measures in this report and relevant policies/strategies 1. Reduce chemical Nitrogen use in the dairy sector by 27% -30% by end of 2030, with a reduction of 22%-25% in the short term (2025). (This is a reduction from 2018 approximate usage of 204k tonnes to 143k-149k tonnes by end of 2030)
Timeframe Short-term
Responsibility DAFM / Agency/Industry cross-collaboration

12. Improve Nitrogen Use Efficiency – Liming and soil pH- Ensure 100% of dairy farms are soil testing for pH
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.
Key Challenge To ensure the majority of dairy farms are approaching optimum soil pH to ensure maximum nutrient use efficiency
Resources Soil Sampling and Appropriate Liming is considered an eligible practice for a farmer to receive the Eco-Scheme Payment detailed in the CAP Strategic Plan 2023-2027. Support is based on an annual payment for all eligible hectares covered by the commitments, i.e. farmers will receive payment on all eligible hectares on their holding. Payments will be made on additional costs incurred and income foregone as set out in the EU Regulations under Article 31 (7) (b) of the CAP Strategic Plan Regulation. An expected 129,000 eligible farmers could participate in the scheme, and the payment per hectare will be impacted by the actual participation rate. As an indicative figure only, if 85% of the eligible hectares currently claimed by farmers participate in the scheme successfully and assuming all hectares receive the same payment rate, the payment rate would be approximately €77 per hectare. Based on a ring fencing for Eco-Schemes of 25% of the Direct Payments ceiling, the annual indicative financial allocation for this intervention is estimated at approximately €297 million per annum, amounting to a total indicative financial allocation of approximately €1.485 billion for the period 2023-2027. [20] Soil Nutrient Management Planning is also a measure provided for by the Sustainability Action Payment programme.

[20] Page 10, Eco-scheme, Summary of Ireland's draft CAP Strategic Plan 2023-2027 (gov.ie - The CAP Strategic Plan 2023-2027 (www.gov.ie))

Key Contributing Factors Time and investment required
Cross-cutting proposal, linkages and alignment between the recommended measures in this report and relevant policies/strategies 1. Reduce chemical Nitrogen use in the dairy sector by 27%-30% by end of 2030, with a reduction of 22%-25% in the short term (2025). (This is a reduction from 2018 approximate usage of 204k tonnes to 143k-149k tonnes by end of 2030)
Timeframe Short-Term
Responsibility DAFM / Agency/Industry cross-collaboration

13. Encourage Clover Adoption and Multi-Species swards (MSS)- ensure all dairy farmers have incorporated clover/multispecies on 20% of their farm grassland by end of 2025.

Impact on Inventory – Enabling Factor/ Direct Impact

Enabling Factor, allows efficient use of fertiliser through compensation for reduced chemical N.

Recommendation

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 25% on dairy farms and 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.

Key Challenges

- Encouraging adoption through intensive advice
- Sourcing seed and clover safe sprays

Resources

There was €1 million DAFM funding for the multi-species sward measure available to farmers in the 2022 season.[21]

Sowing of a Multi Species Sward, on at least 7% of the farmers eligible area in the year s/he selects this is considered an eligible practice for a farmer to receive the Eco-Scheme Payment detailed in the CAP Strategic Plan 2023-2027.

[21] gov.ie - Multi Species Sward Measure (www.gov.ie)

Support is based on an annual payment for all eligible hectares covered by the commitments, i.e. farmers will receive payment on all eligible hectares on their holding. Payments will be made on additional costs incurred and income foregone as set out in the EU Regulations under Article 31 (7) (b) of the CAP Strategic Plan Regulation. An expected 129,000 eligible farmers could participate in the scheme, and the payment per hectare will be impacted by the actual participation rate. As an indicative figure only, if 85% of the eligible hectares currently claimed by farmers participate in the scheme successfully and assuming all hectares receive the same payment rate, the payment rate would be approximately €77 per hectare. [22] Clover use and Multi-species swards are also measures provided for by the Sustainability Action Payment programme.
Key Contributing Factors Investment in Research and Knowledge Transfer
Cross-cutting proposal, linkages and alignment between the recommended measures in this report and relevant policies/strategies 1. Reduce chemical Nitrogen use in the dairy sector by 27% - 30% by end of 2030, with a reduction of 22%-25% in the short term (2025). (This is a reduction from 2018 approximate usage of 204k tonnes to 143k – 149k tonnes by end of 2030) 10. Develop a Climate Action Communications Strategy
Timeframe Short term
Responsibility DAFM / Agency/Industry cross-collaboration

[22] Page 10, Eco-scheme, Summary of Ireland's draft CAP Strategic Plan 2023-2027 (gov.ie - The CAP Strategic Plan 2023-2027 (www.gov.ie))

14. Milk recording- strive to achieve 90% adoption rate by end of 2025

Impact on Inventory – Enabling Factor/ Direct Impact
Enabling Factor

Recommendation
Policy should further encourage the uptake of Milk Recording, highlighting the financial and animal health benefits in particular.
Increased levels of milk recording will help the decision-making process at farm level in informing strategic culling, and while having an enabling influence on GHG emissions, improved animal health and is also an essential support measure in the reduction of antibiotic use on farms. Action 309 of the Climate Action Plan 2021 targets a 90% adoption of milk recording by 2025.

Key Challenges

- Availability of milk recorders, the quality of the equipment used for recordings and the reliability of some of the results
- Scaling up of industry infrastructure
- Driving behavioural change to overcome the barriers to the adoption of milk recording and thereafter implementing management decisions based on information generated.
- Ensuring that farmers and service providers are sufficiently familiar with milk recording results to make the best use of information that is generated.

Resources
Milk pricing structures by Co-ops through their Sustainability Action Payment programmes will incentives farmers to increase adoption.

Key Contributing Factors
- Engagement at farm level
- Engagement of Co-ops
- Ongoing work of the AHI CellCheck programme

Cross-cutting proposal, linkages and alignment between the recommended measures in this report and relevant policies/strategies
17. Introduce animal health measures listed in Action 314 of the Climate Action Plan 2021

Timeframe
Short term

Responsibility DAFM/Agencies/Industry/AHI

15. Develop Energy Diversification Opportunities

Discussed at the third meeting of the Food Vision Dairy Group.

Impact on Inventory – Enabling Factor/ Direct Impact

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 dairy 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
Direct benefits to the agriculture inventory are possible from biomethane production as emissions of both CH_4 and N_2O are reduced for manure management when manure is digested as it is removed from storage.
Furthermore, direct benefits to the agriculture inventory can also occur where agricultural land previously 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.

Recommendations

- Biomethane production should be considered a potentially important diversification option given rising input costs.
- Carbon Farming using a farmer-centric approach presents opportunities for diversification of farm enterprises; and supported uptake of these opportunities for farmers is recommended.
- The Group recommends that an integrated business case for sustainable biomethane production as the basis of a national biomethane strategy should be developed based on a private sector Carbon Farming initiative.
- Consider the potential to deliver a long-term roadmap for an indigenous biomethane industry based on sustainable feedstocks.

- Work with policy makers to ensure that Irish farmers are credited with emissions reduction efforts on their land and financially rewarded.

Key Challenges

- Defining production as an economic activity to inform agriculture inventory.
- Economies of scale and the requirement for a co-operative model to support the bioeconomy including carbon farming and an indigenous biomethane sector.
- Timing of national policy and economic stimulus to the development of a farm based, sustainable AD/Biomethane industry.
- Addressing the planning process for AD plants

Resources

DAFM currently provides grant aid through the TAMS scheme to assist farmers with solar investments. The grant aid under TAMS is available at the standard rate of 40%, with a higher grant rate of 60% available to qualified young farmers. It is proposed that support for renewable energy investments will continue under the new Capital Investment Scheme as part of the CAP Strategic Plan.
Renewable energy generation is also a measure provided for by the Sustainability Action Payment programme.

Key Contributing Factors

- Climate Action Plan 2021 recognises the key role of energy diversification such as biomethane, PV and wind to decarbonise sectors of the economy. Whole of Government response required
- Economic viability of the sector for the individual farmer
- Addressing planning, marketing and finance issues are key for success.
- Encourage small-scale anaerobic digestion (SSAD).
- REPowerEU – leverage on EU strategy and policy for energy security, storage, and energy pricing.
- Teagasc will commission it's Biomethane Pilot Demonstration Plant.

Cross-cutting proposal, linkages and alignment between the recommended measures in this report and relevant policies/strategies

5. Voluntary Exit/Reduction Scheme

Timeframe

Medium to Long-term

Responsibility

DAFM/Agency/ Department of Climate Action/Energy and SEAI/ Farm org/cross collaboration

16. Strengthen all Co-op Sustainability Programmes to prioritise measures that directly reduce the national inventory of GHGs
Impact on Inventory – Enabling Factor/ Direct Impact Enabling Factor
Recommendation The Group acknowledges the positive work of state agencies, Co-op specific sustainability programmes and the work done by all the co-ops in the roll out of sustainability programs, in the development of ASSAP and including support for the Sustainable Dairy Assurance Scheme (SDAS), ASSAP, the Teagasc SignPost Farm Programme, Joint Programmes with Teagasc, herd health and milk recording initiatives, solar energy projects and tree planting programmes. The Group recommends that future versions of these sustainability programmes should focus on providing higher levels of support for any actions that can directly support the reduction of GHG emissions in the national GHG Inventory. The Group recommends that all co-ops should strive to introduce sustainability programmes in line with the climate mitigation outcomes recommended by this report and in line with the Teagasc MACC and AgClimatise. The Group noted the importance of financial incentivisation in encouraging the uptake of these sustainability measures at farm level.
Key Challenges Measures in co-ops sustainability programmes should aim to have an impact on emissions.
Resources Sustainability Programmes are in place in most Co-ops and financial incentivisation at farm level would vary depending on the individual Co-op. Many of the measures listed in this report are provided for under the Sustainability Action Payment programme.
Key Contributing Factors Co-op engagement
Cross-cutting proposal, linkages and alignment between the recommended measures in this report and relevant policies/strategies 6. Adopt a common Co-op charter on sustainable milk production based on the family farm model.
Timeframe Short-term
Responsibility Industry stakeholders

17. Introduce animal health measures listed in Action 314 of the Climate Action Plan 2021.
Impact on Inventory – Enabling Factor/ Direct Impact Enabling Measure
Recommendation 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). These measures concern efficiency gains and animal health and welfare measures have an important role in maintaining export markets. Consistent with the commitment in Climate Action Plan 2021 to improve the health of the national herd, stakeholders should continue to work together to progress existing activities and prioritize new measures for implementation.
Key Challenges • Obtaining EU approval for national BVD eradication programme as a precursor to applying for freedom; management of subsequent transition to post-eradication surveillance. • Industry-wide agreement required for a national IBR programme, with associated legislative support. • Promotion of Parasite Control TASAH in 2022 to maximise engagement. • Promotion of registration in the Irish Johne's Control Programme.
Resources Animal health and welfare measures are provided for by the Sustainability Action Payment programme (Herd Disease Screening, Participating in Beef Twenty20 Club, Udder Health – SCC Improvement).
Key Contributing Factors • AHI convenes cross-industry Implementation Groups on BVD, CellCheck (the national mastitis programme), Johne's disease and IBR. • Significant work modelling options for a national IBR programme has been carried out by AHI, and there is already a significant level of vaccine usage (more than 3 million doses sold annually). • DAFM has recently initiated national bulk tank milk surveillance for BVD, Johne's disease and IBR. • DAFM has convened a TB Forum and 3 associated Working Groups to progress control of TB. • ICBF has extensive experience in managing data from national animal health programmes, developing dashboards for farmers and service providers to present results, and using these to contribute to improving genetics related to animal health. • Increasing uptake of milk recording provides cost-effective samples for testing for Johne's disease.

Cross-cutting proposal, linkages and alignment between the recommended measures in this report and relevant policies/strategies 14. Milk recording- strive to achieve 90% adoption rate by end of 2025
Timeframe Short to Medium term
Responsibility DAFM/AHI/Agencies/Industry. Input from a wide range of other stakeholders, including farming and veterinary organisations, processors, ICBF, Teagasc and UCD.

18. Develop enhanced integration between the dairy and beef sectors
Impact on Inventory – Enabling Factor/ Direct Impact Enabling Measure
Recommendation 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.
Key Challenges Profitability challenges associated with rearing calves from the dairy herd Developing a sustainable and economically viable dairy beef sector Appropriate engagement of beef and dairy sector Requirements for dedicated facilities to facilitate dairy beef enterprises on farm. Knowledge transfer, training and upskilling of participants.
Resources The Dairy Beef Calf Programme is currently funded by the Irish exchequer. New participants in the sector may have additional infrastructure and knowledge building requirements.
Key Contributing Factors

Knowledge transfer and advisory service
Cross-cutting proposal, linkages and alignment between the recommended measures in this report and relevant policies/strategies 4.a) Develop methane mitigating Breeding Strategies (carbon sub-index) 4.b) Develop methane mitigating Breeding Strategies (building efficiency traits) 10. Design a Climate Action Communications Strategy
Timeframe Short term
Responsibility DAFM/ICBF/Agencies/Industry cross collaboration

19. Support the role of young farmers and women in agriculture in implementation of the measures set out in this report

Impact on Inventory – Enabling Factor/ Direct Impact
Enabling Factor

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 dairy 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.

Key Challenges

- The current trend in the age of dairy farmers is not decreasing, standing at 52 in the 2020 Census of Agriculture; and the overall share of all farm holders aged under 45 fell from 35% to 21% between the 2000 and 2020 Censuses of Agriculture[23].
- The 2020 Census of Agriculture recorded that 27% of those working on farms were women, but that they represent 13.4% of farm holders[24]; further, approximately half of female farm owners are aged over 60 according to DAFM's client database[25].

Resources
Significant supports will be provided for women and young farmers under the CSP for 2023:

- Complementary Income Support for Young Farmers (CIS-YF) – which will build on support available under the Young Farmers Scheme from 2015 to 2022 – will provide payments, to appropriately qualified farmers under the age of 40, in the years immediately following the young farmer setting up as head of a holding. Payments are available for up to five years under the intervention, up to a maximum of 50 hectares., with payments expected to fluctuate but average approx. €178/ha across the 2023-27 CAP period. [26] This is a significant rate increase over the similar scheme in the current CAP period (€68 approx.).

[23] CSO Census of Agriculture 2020 figures (CSO pxStat).
[24] CSO Census of Agriculture 2020
[25] DAFM Annual Review and Outlook 2021, Page 63.
[26] Page Nine, Complementary Income Support for Young Farmers (CIS-YF), Summary of Ireland's CAP Strategic Plan 2023-2027 (gov.ie - The CAP Strategic Plan 2023-2027 (www.gov.ie))

- The Young Farmers' Capital Investment Scheme provides financial help to young farmers to upgrade their agricultural buildings and equipment. It helps them to meet the capital costs associated with the establishment of their enterprises. Grant aid is paid at 60% up to a maximum of €80,000 per holding.[27]
- The On-Farm Capital Investment Scheme will make enhanced grant aid for investment available to Young Farmers and Women Farmers, at 60% rather than the standard rate of 40%, to support Generational Renewal and Gender Balance.[28]
- A tax credit is available at national level, of €25,000 over five years, to assist with the transfer of farms within Succession Farm Partnerships, promoting and supporting the earlier intergenerational transfer of family farms.
- The CAP Strategic Plan 2023-27 contains a Collaborative Farming Grant. This intervention provides support of up to €1,500, based on 50% of vouched costs, for each of the following: (a) the establishment of farm partnerships and (b) advice costs for an older farmer to assist in succession/retirement planning.
- A European Innovation Partnership call for proposals to incentivise generational renewal through succession/partnership arrangements in agriculture.
- Measures in the CAP Strategic Plan 2023-27 have been developed with a gender-aware perspective, and Objective Eight (Vibrant Rural Areas) includes the promotion of gender equality. The new CAP will include the possibility for women-only Knowledge Transfer groups; a European Innovation Partnerships call for proposals to incentivise women's participation in agriculture; improved recording, collection and reporting on gender data across all CAP schemes; and the National CAP Network will be leveraged to increase the involvement of all women in the implementation of the CAP.[29]

A number of agri-taxation measures are in place to facilitate land mobility and intergenerational transfer.

Key Contributing Factors

- CSP Supports for young farmers and women in agriculture
- Implementation of Food Vision actions to support young farmers and women in agriculture

Cross-cutting proposal, linkages and alignment between the recommended measures in this report and relevant policies/strategies

7. Establish robust methodologies for measuring and monitoring greenhouse gas emissions and removals at individual farm level.

Food Vision 2030, Mission 2, Goal 4 (various actions).

[27] gov.ie - Young Farmers' Capital Investment Scheme (www.gov.ie)

[28] Page 31, On-Farm Capital Investment Scheme, Summary of Ireland's CAP Strategic Plan 2023-2027 (gov.ie - The CAP Strategic Plan 2023-2027 (www.gov.ie)). Women farmers aged 41-66 years will be able to avail of this scheme.

[29] Summary of Ireland's CAP Strategic Plan 2023-2027 (gov.ie - The CAP Strategic Plan 2023-2027 (www.gov.ie)).

Timeframe Short- Medium term
Responsibility DAFM and all Industry stakeholders

6. CONCLUSION

The Irish Government is committed to becoming carbon-neutral by 2050 and operating an economy with net-zero greenhouse gas emissions. This national strategic objective to be climate neutral by 2050 is set out in the Climate Act 2021. The transition to a climate-neutral society is both an urgent challenge and an opportunity to build a better future for all. All parts of society and economic sectors are expected to play a role – from the power sector to industry, transport buildings, agriculture and forestry.

The Government has determined that the agriculture sector must reduce its GHG emissions by 5.75Mt CO_2 eq. by the end of 2030. This implies that the proportionate contribution from the dairy sector would be at least 2.3Mt CO_2. This report sets out the milestones and measures for the dairy sector to move towards achievement of these demanding targets.

The membership of the Food Vision Dairy Group accepts the overarching need for the dairy sector to stabilise and then reduce its emissions, to contribute to the challenging emissions reduction target set for the agricultural sector, as well as the meeting the demands of the marketplace, and maintaining the economic viability of our farm family model. Action needs to be urgent because we are already well into the second year of the first carbon-budget period. The Group acknowledges that the dairy sector directly accounts for an estimated 40% of total agricultural emissions, and 50% of total Nitrogen use, and therefore has a responsibility to show leadership. The Group draws attention to how dairy farmers have responded to the challenge, especially through actions such as the use of LESS technology, the use of Protected Urea and greatly increased use of lime. The Group also recognises that the dairy sector is not solely responsible for the climate challenge facing the agriculture sector and supports an integrated approach involving all stakeholders in the various sectors.

This Report has been prepared through a process of collaboration and cooperation and represents a broad consensus on the key actions that are required for the dairy sector to contribute to the challenging emissions reduction target set for the agriculture sector. The measures set out in Section 5 of the Report were discussed in detail among the Group. Not all measures received unanimous agreement, with significant reservations expressed from farming organisations in relation to the financial impact of some of the measures.

From the outset of its deliberations the Group considered it essential to clarify how different actions contributed *directly* (e.g., reductions in chemical N and in methane) towards a reduction in the national inventory of greenhouse gases versus actions that *enabled* this reduction to be brought about (such as, the use of clover, LESS etc). The Group are also of the view that this critical distinction needs to be prominent in all communications with farmers on how emissions can be reduced and in the design of incentivisation measures to encourage behavioural change among farmers.

The Report sets out a series of actions, initially focusing on the need to reduce nitrous oxide emissions. This will mean reductions in chemical nitrogen usage on farms, and a rapid shift to Protected Urea for livestock producers and greater use of legumes.

It has been more challenging to get a consensus on actions to reduce methane. The Group noted that projections show that the level of dairy production is expected to exhibit much lower growth up to 2030 compared to recent years. In relation to total agriculture emissions, and enteric fermentation in particular, emissions are projected to approach stabilisation by the end of the decade. It is also expected that recent changes in the Nitrates Action Plan will further curtail emissions. The Group is also of the view that further scientific solutions that are in development will achieve significant mitigation of emissions. The prospects for the use of emissions inhibiting feed additives, and in particular 3NOP which is under research at Teagasc are very positive. Breeding Strategies can also play an important role in addressing the methane fraction of emissions.

The 19 recommended measures in this Report are set out in the form of outline measures. Some will require considerable additional effort to design robust and effective policy interventions. Stakeholders emphasise the need for them to be included in continuing consultations with a view to the further development and successful implementation of the proposed measures.

The Group estimates that the dairy sector can contribute between 1.43 – 2.1Mt of CO_2 eq, based on the direct measures to significantly reduce chemical nitrogen, target 100% take-up of protected urea, development of methane-mitigating feed technologies and methane mitigating breeding strategies. This range is of course dependent on a number of assumptions concerning the take up of these measures.

The reduction/exit scheme proposal could deliver direct reductions in methane, but this would be dependent on timing and take-up of a voluntary scheme and would need to be carefully designed and managed to avoid unforeseen consequences. A study into the potential of a carbon farming framework, and the commitment on a common Co-op charter, also offer potential for direct impacts on emissions, but these are difficult to quantify.

The Group recognises, that all the proposed measures will require further refinement in terms of design and estimated cost and impact.

Other proposed actions, such as, the need for greatly enhanced investment in research and knowledge transfer will require a substantial commitment exclusively from public resources.

The Group considers that a failure to reduce emissions associated with dairy production will impact negatively on the future economic viability of the sector, by undermining the sustainability credentials which are an important factor in the success of Irish dairy. However, it is also important to acknowledge that many of the measures which could contribute directly to emissions reductions will have a direct economic impact on profitability of milk production at farm level.

The Group recognises therefore that while regulatory instruments are necessary to achieve the stretching emissions reductions targets, there will be a complementary requirement for significant financial support from both the Government and the private sector for many of these measures. As these proposed measures are developed in more detail, further consideration will need to be given to the type and level of resources required, as well as their financing, targeting and sources of funding, and their relative contribution to emissions reductions which can be counted against the inventory. In particular, farmer stakeholder representatives emphasised that a significant public financial commitment will be required to support the uptake of the recommended measures, to ensure a just transition for farmers.

The Group emphasises the necessity to support and facilitate young farmers entering the sector and in developing their farming enterprise in consideration of all proposed measures. Cross-sectoral efforts to mitigate emissions from the dairy sector must acknowledge the importance of generational renewal to the continued environmental, economic, and social sustainability of

the sector, and indeed the essential role which young farmers, and women in agriculture, will play in leading innovative approaches to climate action.

All the parties represented on the Group understand that each has a huge responsibility to greatly increase their efforts at reducing emissions. The Group view the suite of 19 measures set out in this Report as a package which is carefully balanced to ensure that measures that will directly impact on reducing the national inventory of GHG emissions are supported by a series of enabling measures. The Group are therefore adamant that individual measures cannot be "cherry picked" without severely diminishing the overall effectiveness of the package of measures. The Group recognises therefore that, taken together, the proposed measures will require a transformational change throughout the entire dairy value chain but especially among farmers.

Annex – MEMBERSHIP OF FOOD VISION DAIRY GROUP

FOOD VISION DAIRY GROUP	
Organisation	**Name**
Chair	
Chair	Professor Gerry Boyle
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	Stephen Arthur
IFA – Irish Farmers Association	Tadhg Buckley
ICMSA – Irish Creamery Milk Suppliers Association	Pat McCormack
ICMSA – Irish Creamery Milk Suppliers Association	John Enright
Macra	John Keane
Macra	Gillian Richardson
ICOS - The Irish Co-Operative Organisation Society	John O'Gorman
ICOS - The Irish Co-Operative Organisation Society	Eamonn Farrell
Industry	
DII - Dairy Industry Ireland	Conor Ryan
DII - Dairy Industry Ireland	Conor Mulvihill
Ornua	John Jordan
Dairy Sustainability Ireland	Joe Crockett
Agencies	
Teagasc	Kevin Hanrahan
Teagasc	Pat Dillon
ICBF – The Irish Cattle Breeding Federation	Andrew Cromie
Bord Bia	David Kennedy
UCD – University College Dublin	Karina Pierce

EPA – Environmental Protection Agency	Mary Frances Rochford
AHI - Animal Health Ireland	David Graham
Food Vision Dairy Group Secretariat	
DAFM Meat & Milk Policy Division **DAFM Meat & Milk Policy Division** **DAFM Meat & Milk Policy Division** **DAFM Meat & Milk Policy Division**	Damien O'Meara Laura Egan Hanagh Byrne Lydia Bagge
DAFM Support	
Meat & Milk Policy Division **Economics and Planning Division**	Karl Redmond John Clarke