

How can Irish farmers be encouraged to meet GHG emission targets?

The Role of the CAP

A report for



NUFFIELD IRELAND Farming Scholarships

by Pat O'Meara

2019 Nuffield Scholar

November 2020

Sponsored by:

Golden Jubilee Trust



© 2008 Nuffield Ireland.
All rights reserved.

This publication has been prepared in good faith on the basis of information available at the date of publication without any independent verification. Nuffield Ireland does not guarantee or warrant the accuracy, reliability, completeness or currency of the information in this publication nor its usefulness in achieving any purpose.

Readers are responsible for assessing the relevance and accuracy of the content of this publication. Nuffield Ireland will not be liable for any loss, damage, cost or expense incurred or arising by reason of any person using or relying on the information in this publication.

Products may be identified by proprietary or trade names to help readers identify particular types of products but this is not, and is not intended to be, an endorsement or recommendation of any product or manufacturer referred to. Other products may perform as well or better than those specifically referred to.

This publication is copyright. However, Nuffield Ireland encourages wide dissemination of its research, providing the organisation is clearly acknowledged. For any enquiries concerning reproduction or acknowledgement contact the Executive Secretary.

Scholar Contact Details

Patrick O'Meara

Ballinagrass, Coolbawn, Nenagh, Co.
Tipperary

Phone: 086 8265728

Email: Packo77@gmail.com

In submitting this report, the Scholar has agreed to Nuffield Ireland publishing this material in its edited form.

NUFFIELD IRELAND Contact Details

John Tyrrell
Executive Secretary, Nuffield Ireland
Phone: +353-87-256 3501
Email: exec@nuffield.ie

Executive Summary

The EU's Common Agricultural Policy (CAP) was first introduced in 1962. The CAP's initial priorities were to deliver food security through guaranteed prices for farmers. Over the past 6 decades, it has been regularly reformed and has evolved away from pure production and market support to direct financial support subject to regulatory compliance requirements. The most recent reform took place in 2013 and the next reform is currently being negotiated.

CAP has a crucial regulatory and economic importance for European farmers. In Ireland direct payments funded through CAP equate to c. 70% of farm income and account for more than 100% of farm income in the cattle and sheep sectors. The future direction of CAP will be decisive for the Irish agricultural sector and individual farmers.

The EU Commission's Agricultural Directorate (DGAGRI), the Agriculture Council (agriculture ministers from the member states) and the EU Parliament collectively decide the CAP, and it has been reformed to deliver on four main areas:

- 1) Adequate and stable farm incomes
- 2) Safe and affordable food, produced sustainably
- 3) Support for the socio-economic fabric of rural areas
- 4) Food security

However, more recently, societal expectations, legally binding GHG emission targets, including most recently the Paris Accord have also influenced demands to be delivered through the CAP budget.

In the last year, the EU has published the European Green Deal and its Farm to Fork and Biodiversity Strategies, which it intends to influence the new CAP. Climate change is one of nine objectives called out for the current reform, and now is the time to be debating and shaping the direction of CAP.

This report presents practises that can deliver GHG emissions reductions, looking at examples from the USA, France, England, Republic of Ireland and Northern Ireland. In the absence of

heavy industry, agriculture accounts for one third of Ireland's emissions and needs to show climate leadership.

The science of GHG emissions is complex, with much work still to do to correct anomalies in terms of verification of soil sequestration, carbon leakage and the impact of the methane lifecycle. However, we need to act now on the legally binding targets up to 2030, and influence the regulations for the post 2030 era as we work towards carbon neutrality.

The report makes the following recommendations:

- The faster adoption of the Marginal Abatement Cost Curve (MACC) measures must be the wider agri industry's top priority. An Agri Sustainability Stakeholder Forum must be established, modelled on the Food Harvest 2020 Forum, c. 30 members representing the wider sector, from farmers to retailers. The group must seek to secure rewards for practises that assist agriculture in meeting its 2030 GHG emission targets.
- The sector must promote behavioural change on Irish Farms. This requires making GHG emission reduction relevant to farmers.
 - Targets need to be relevant and be communicated in a language that farmers can relate to (e.g. litres of diesel rather than tonnes of carbon);
 - The Knowledge Transfer (KT) programme must include an element on reducing GHG emissions;
 - Demonstration farms should be open to the majority of farmers not in KT groups;
 - Build on the Agricultural Sustainability Support and Advice Programme (ASSAP) voluntary model, adding advice on reducing GHG;
 - Market signals from produce purchasers that pay a bonus for the uptake of GHG reducing measures;
 - Develop the Carbon Navigator to include farm environment and financial goals; and
 - Include a training / educational element in the CAP Eco Schemes.

- The new Environment Scheme (Pillar II) proposed by the Irish government must be designed with one compulsory element on reducing GHG emissions.
- Stock numbers and GHG emissions are clearly strongly linked. It is clear that if the national herd continues to grow there will be consequences. The trend over the past decade of land moving from extensive beef production to more intensive dairy farming has been a driver of this. Extensive beef farming needs to be a desirable alternative to intensive farming. A Low GHG emissions beef brand needs to be established to encourage it to remain in place by providing a financial reward for extensive beef production - develop a new brand e.g. LOCO Beef / GLAS Beef.
- Re-wetting certain peatland to halt carbon release and commence sequestration must be considered. A specific peatland rewetting scheme must be established.
- In the next CAP deal, Eco Schemes will be a large element (20 – 30%) of the Basic Income Support Scheme (BISS) and should be used to deliver the Teagasc MACC. Many of the additional asks under the nitrates derogation could become options under the Eco scheme. Eco Schemes need to be multi annual to have the greatest impact and must provide an incentive beyond the income foregone/cost incurred formula. Failure to do so could limit the uptake of 14 of the 27 measures in the Teagasc MACC.
- Building on the success of the Farm Waste Management Scheme where grant aid was 60%, Ireland should seek permission to increase grant aid for capital expenditure to 60% for investment subsidised under CAP (TAMS scheme) when it relates to investments to reduce GHG emissions.

Contents

Executive Summary	3
1. Personal Introduction	8
2. Foreword	10
3. Nuffield Journey And Research Approach	12
4. Acknowledgments	14
6. Aims And Objectives	16
7. Introduction	17
Introduction To Climate Change And Greenhouse Gas Emissions	17
Introduction To The Common Agricultural Policy (CAP)	19
Background On CAP	19
CAP Reforms And Wider Social Demands	20
What Does CAP Currently Look Like?	20
When Will The Next Reform Of CAP Take Place?	21
Importance's Of CAP For Irish Farmers	21
8. Climate Change and GHGs	24
What Is Climate Change?	24
What Are GHGs?	24
What Level Of GHGs Is Ireland emitting?	24
What Is The Trend In Emissions Of GHG From Agriculture?	26
What Level Of GHG Reduction Does Ireland Need To Achieve?	27
What Are The Main Activities That Are Generating Greenhouse Gases?	27
What Are The Main Options To Reduce Greenhouse Gases?	29
Challenging The Current Accounting Methodologies	30
9. Options to Reduce Ireland's Greenhouse Gas Emissions	31
GHG Marginal Abatement Cost Curve	31
Reducing Livestock Numbers	33
Sequestration Of Carbon In Pasture, Soils And Hedgerows	34
Rewetting Of Peatland	34
10. Potential Farm Practices That Will Deliver Reduced GHG Emissions And Provide An Economic Return	36
Fertiliser And Soil Management:	36
Improved Genetics:	36
Animal Health:	36
Knowledge Transfer:	37
Farmer Feedback:	37
11. The Common Agricultural Policy	39
The Future of CAP?	39
What Are The Main Options Of Support?	40
12. Examples of Initiatives to Help Reduce GHG Emissions	43
USA:	43
France	44
Northern Ireland	45
England	45
Republic of Ireland	46
13. Conclusions	47
14. Recommendations	50
15. References	53
13. Appendices	54
Appendix 1 Timeline for the Current CAP Reform:	54

Appendix 2: 1: Marginal Abatement Cost Curve for agriculture for 2021-2030 (methane and nitrous oxide abatement).....	55
Appendix 3: Online Farm Survey	55
Appendix 4: USDA NRCS Ranking Tool for Resilience and Carbon Sequestration.....	60
Appendix 5: Example of CAP'2ER diagnosis results® from the Low Carbon Farm	62

1. Personal Introduction



My name is Pat O'Meara and I am a dairy farmer from near Nenagh in County Tipperary. I was the youngest of four children who enjoyed the rural lifestyle with a keen interest in sport. My parents ran a mixed enterprise farm (tillage, beef, forestry and sheep) and a large portion of my free time was spent helping out on the farm.

I have always had a keen interest in Agriculture so following secondary school, I completed a degree in Agricultural Science in 1999 (UCD). As was the case on many Irish farms then, returning home to full-time farming wasn't an option. As a result, I decided to take up a role in the agricultural finance sector with AIB.

Throughout my career in AIB, the organisation and its staff were very supportive of personal and professional development. As a result, completed a Graduate Diploma in Business Studies from Dublin Business School and qualified as a Financial Advisor (QFA). In my time with AIB, I worked in two main roles, firstly in formulating bank strategy for the agri and wider business sector and secondly from 2005 dealing directly with farmers on financial matters.

After initially being based in Dublin with AIB, I took up the position of Agricultural Advisor in Nenagh in 2005. This move afforded me the opportunity to take over the farm from my parents. I ran the farm on a part-time basis with their assistance.

In 2014, with the pending abolition of milk quota I converted my tillage and beef farm to a dairy farm. I established a Spring calving, grass based, dairy operation and over the past seven

years I have grown the herd to just over 200 dairy cows on a mixture of owned and leased land.

In 2018 I got married to Siobhan and we live in our family home overlooking the river Shannon and a short distance from my farm. We have a busy household as we had our first child in May 2019 and Siobhan runs her own child care business on the outskirts of Nenagh town.

As if 2019 wasn't a hectic enough year, I also made the decision to leave AIB following 20 years of service and am now farming full-time – a position I always wanted to be in.

2. Foreword

Over the past two decades I have become increasingly aware of the threat of climate change. With education I have grown to realise the implication for me and others around the world. I have also grown very concerned with the pace of progress. To date there has been very modest sanctions for those not meeting agreed International Greenhouse Gas (GHG) emissions targets. I am very concerned at prospect of another decade passing and looking back at missed opportunities.

In Ireland, we have missed the 2020 EU effort Sharing target. Agriculture accounts for 33% of national GHG emissions and the sector is on a trajectory of increasing GHG emissions rather than a significant reduction. I believe that we are facing significant curtailments in the manner that we farm if we do not tackle the issue immediately, specifically around the area of livestock numbers.

I believe that we need to provide financial incentives to alter people's behaviours. From a farming point of view, the CAP has the firepower to achieve this. Since the introduction of CAP, it has been a catalyst for much change across European Agriculture and in many instances, the level of successes it has enjoyed, has led to significant reforms. When one considers that it accounts for 2/3rds of Irish Farm income it is not surprising that farmers adapt to its policy direction.

From my career in AIB and my involvement in farming I have seen first-hand the impact of CAP and its positive contribution on Irish Agriculture. Firstly, it provided a level of certainty for a portion of income, secondly it provided market price supports when needed, thirdly it provided access to finance, fourthly it rewarded desirable behaviour change and finally, through grant aid it helps to put infrastructure in place. The model of driving behaviour through both regulation and incentives has served us well.

When I consider my home farm, I have asked myself, 'Am I part of the solution or part of the problem'? Being part of an expanded dairy sector, using the nitrates derogation, the general

public and policy makers, view me as being a significant part of the problem. I fear a significant backlash in terms of additional regulations, if we do not tackle the issue of GHG emissions. It is a very uncomfortable position to be in and also results in lack of clarity for the future direction of the business.

3. Nuffield Journey And Research Approach

At the start of this journey I undertook a review of relevant Irish, EU and international literature on Greenhouse Gas Emissions and incentive schemes to gain an understanding of the issues and the potential solutions.

My overseas travel included 4 continents from the USA, to several parts of Europe, the Middle East and Africa. A significant portion of this travel was part of the organised Nuffield Programme through both the Contemporary Scholar conference and the Global Focus Programme. My study programme was interrupted due to the Covid 19 travel restriction as I had planned on travelling to The Netherlands and Switzerland in April 2020. This was disappointing as The Netherlands has a lot of experience dealing with managing intensive Agriculture and the challenge that it brings.

I engaged with a wide range of farmers and stakeholders across Ireland to determine how farmers could be assisted to deliver on ambitious GHG emissions targets. In October / November 2020 I conducted an online survey where 280 Irish farmers responded to questions relating to my study and I have included the full results in the appendix.

Like so many others in recent times, I adopted my plan in line with the new restrictions, focussing more on the literature, attending relevant online conferences and webinars in particular.

Table 1 Countries visited as part of my Nuffield Scholarship

Country	Date
USA	March 2019
Qatar	April 2019
Kenya	April 2019
Northern Ireland	September 2019

Italy	September 2019
Belgium	October 2019
England	January 2020
The Netherlands	Postponed due to Covid 19
Switzerland	Postponed due to Covid 19

4. Acknowledgments

- Throughout this scholarship, TJ Flanagan, Chief Executive of ICOS has always been supportive and available to me. I want to thank him for his great assistance and the sponsorship of the Golden Jubilee Trust Fund who made this study possible.
- I would like to thank Nuffield Ireland, and in particular John Tyrrell, Karen Brosnan and Geoff Dooley for this amazing opportunity to study a topic so relevant and timely to Irish Agriculture.
- I would like to thank my former employer, AIB Bank for the support and encouragement the provided while completing this study and in particular, a fellow Nuffield scholar, Tadhg Buckley.
- I would like to thank my mentor, Bill O’Keeffe for his support and advice throughout the process.
- Thank you to the many people around the world, who were so generous with the time and knowledge, and assisted me with this project.
- Thank you to Pat Bogue and Catherine Lascurettes for review this report and sharing their wisdom.
- Thank you to my fellow Nuffield Scholars, and in particular to two groups, my fellow Irish scholars and the scholars who travelled with me on the African GFP, you have made this such an enjoyable / interesting / life changing experience.

5. Abbreviations

CAP:	Common Agricultural Policy
GHG:	Greenhouse Gases
ESD:	EU Effort Sharing Decision
MACC:	Marginal Abatement Cost Curve
EPA:	Environment Protection Agency
CO ₂ eq:	Carbon Dioxide Equivalent
FAPRI	Food and Agricultural Policy Research Institute
NIRO	Northern Ireland Renewable Obligations
BISS	Basic Income Support Scheme
BPS	Basic Payment Scheme
USDA:	United States Department of Agriculture
NRCS	Natural Resources Conservation Service
ASSAP	Agriculture Sustainability Support and Advisory Programme
GLAS	Green, Low-Carbon, Agri-Environmental Scheme
TAMS	Targeted Agricultural Modernisation Scheme
N ₂ O	Nitrous Oxide
CO ₂	Carbon Dioxide
CH ₄	Methane
GWP	Global Warming Potential
LESS	Low Emission Slurry Spreading
BDGP	Bovine D Genomic Programme
KT	Knowledge Transfer
AHDB	Agriculture and Horticulture Development Board
CNIEC	National Interprofessional Centre for the Dairy Economy
AFBI	Agri-Food and Bioscience Institute
UNFCCC	United Nation Framework on Climate Change

6. Aims And Objectives

The overall aim of this report is to objectively look at how Irish farmers can be encouraged and supported in achieving the ambitious GHG emission targets.

The objectives of the research work were to:

- a) Examine farming practices that have the potential to reduce Ireland Agricultural? Greenhouse gas emissions.
- b) Identify farm practices which are the most financially attractive for Irish farmers.
- c) Explore how The Common Agricultural Policy could assist in the reduction of GHG emissions by 10-15% (by 2030) and provide supports to farmers to increase the adoption of appropriate practices.

7. Introduction

Irish farmers by international standards, are carbon efficient producers of food (Healy, 2019, per comms). Despite this, climate change continues to be a major challenge that needs to be tackled. International agreements mean that Irish farmers need to deliver on action plans to significantly reduce GHG emissions.

The purpose of this report is to objectively look at how Irish farmers can be encouraged and supported in achieving the agreed ambitious GHG emission reduction targets of 10-15% by 2030, as set out in Ireland's Climate Action plan. This report will help to inform debate over the coming years as the current CAP reform is debated.

Introduction To Climate Change And Greenhouse Gas Emissions

Climate Change is one of the biggest challenges facing people across the globe. Polar ice caps are melting and as a result the sea is rising. In some regions extreme weather events and rainfall are becoming more common while others are experiencing more extreme heat waves and droughts. These impacts are expected to intensify as the years pass.

Even if all Carbon Dioxide emission ceased today and there were no further emissions, the temperature would likely continue to rise out to 2050 and beyond (Fitzgerald, 2020, seminar). The impact is likely to become much more severe as the century progresses – the cost to Ireland and the cost to the planet will be much greater in terms of disruption to societies and economies (Fitzgerald, 2020, seminar).

In Ireland, we are in an unusual position in regard to our GHG emissions profile. Arising from low levels of industrialisation and a strong dependence on agriculture, the agri food sector is the biggest single contributor at a national level to GHG emissions (Fitzgerald, 2020, seminar). It is also in the sector interest to address Climate change as no other sector of Irish society deals more often with the issues of climate disruption than farmers (Creed, 2019, article).

Arising from the high GHG emissions profile, Agriculture is often unfairly targeted in terms of its contribution to climate change and what its role should be in dealing with climate change (O'Meara, 2020, seminar). Many argue that agriculture should be seen as part of the solution

to climate change. Further detail on the profile of emissions from agriculture will be dealt with in Chapter 8 of this report.

When delivering a solution to reduce GHG emissions, it is important that enough nutritious food continues to be produced. A key element of the 2015 Paris Agreement¹ references the importance of food production – Article 2.1 highlights the importance of protecting food production while reducing GHG emissions.

Unlike many countries around the world, Ireland has developed a Climate Action plan². The plan sets ambitious targets for all sectors to guide Ireland on a pathway to deliver on the target to achieve net zero greenhouse gas emissions by 2050. The contribution from agriculture to this national ambition is significant and includes not only a commitment to efficiency gains in livestock production and fertiliser use, but also carbon removal through forestry and management of organic soils, as well as opportunity for a contribution to energy production and efficiency (Creed, 2019, article). The Marginal Abatement Cost Curve (MACC), developed by Teagasc, is the foundation of the Climate Action Plan for the sector and will be discussed in detail in Chapter 9.

From a wide range of conversations and presentations, it is clear that one of the major challenges to overcome is that many experts on the topic of GHG emissions hold the view that there are shortcomings in how certain items are being dealt with. These include:

- a) Carbon leakage / carbon efficiency;
- b) Sequestration of carbon by grassland, hedgerows; and
- c) Global warming potential of methane.

For the purpose of this report, I have not debated these three shortcomings, but recommended that actions are based on the current regulations. These items need to be addressed and corrected if appropriate. It is reassuring to see that significant moves have

¹ The Paris Agreement is an agreement within the United Nations Framework Convention on Climate Change, dealing with GHG emissions mitigation, adaption, and finance, signed in 2016

² The Climate Action Plan 2019 is Ireland's all of government plan to tackle climate break down and achieve net zero greenhouse gas emissions by 2050.

been recently announced on the treatment of bio-methane but further more work is required in this area.

According to Professor John Fitzgerald, Chair of the Climate Change Advisory Council, the issue of GHG emissions has been known since 1990 but not addressed. It would have been a lot less costly if the issues were tackled back then. He outlined that an objective of the Council has been to enhance farm incomes and security, while substantially reducing GHGs in the sector. The Council believe that is possible for a win : win scenario, which would leave the agricultural community better off and emissions reduced, however this may prove more challenging than it sounds (Fitzgerald, 2020, seminar).

Introduction To The Common Agricultural Policy (CAP)

Background On CAP

The CAP was first launched in 1962, and is a partnership between agriculture and society, and between Europe and its farmers. At the time of its introduction, Europe was still recovering from World War II and food security was a major issue. The CAP has evolved since that time and it now has the following aims:

- a) Supporting farmers and improving agricultural productivity, ensuring a stable supply of affordable food;
- b) Safeguarding European Union farmers to make a reasonable living;
- c) Helping tackle climate change and the sustainable management of natural resources;
- d) Maintaining rural areas and landscapes across the EU; and
- e) Keeping the rural economy alive by promoting jobs in farming, agri-foods industries and associated sectors and promoting generation renewal.

An important component of CAP is that it is a common policy for all EU countries. This is achieved through similar rules for the majority of the funds distributed, which includes direct payments and market measures. The CAP is managed and funded at European level from the resources of the EU's budget.

CAP Reforms And Wider Social Demands

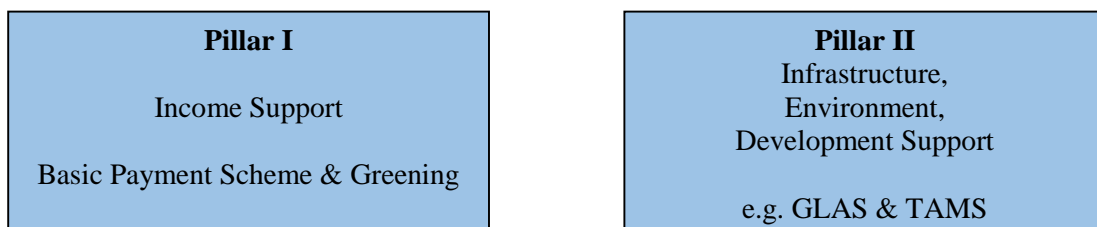
The first major reform of CAP was in 1992 when the MacSharry reform took place and resulted in the introduction of direct payments to farmers to prevent a fall in income following the reduction of support prices for cereals and beef. An important element of the direct payments was that they were linked to production – a coupled payment.

Agenda 2000, meant as a review of CAP, actually resulted in the second major reform. Greater emphasis was now being placed on food safety and the environment. This reform saw the introduction of funding specifically reserved for rural development measures (Pillar II and the income support farmer payment became Pillar I), with an aim to improve rural communities through economic and social schemes. The next reforms in 2003 and 2008 broke the link between production and direct payments, where farmers were paid based on their historical level of activity. The 2008 reform signalled the end of milk quota in 2015.

The last reform in 2015, saw the introduction of a Greening Payment, a compulsory scheme that all member states had to adhere to. It also saw the first phase in the re-distribution of payments through convergence. The Basic Payment Scheme (BPS) and related Greening Payment accounts for 70% of all direct payments to farmers.

What Does CAP Currently Look Like?

The CAP currently consists of a two Pillar structure. Pillar I is common across the EU and is aimed directly at income support for farmers. In Ireland, this equates to >70% of direct Payments (Department of Agriculture, Food & the Marine, 2019, publication). This money is paid to an individual per eligible hectare of farmed land based on the number and value of the entitlements held.



There is a significant amount of flexibility for member states within Pillar II. Firstly, there is an element of co-funding and secondly there is more flexibility to tailor rural development

programmes to fit their unique challenges and capabilities. This is delivered through initiatives such as targeted grant aid, environment schemes and innovative projects.

When Will The Next Reform Of CAP Take Place?

The EU is currently in a well-advanced stage in the process of reforming CAP. Details of the timeline for the reform is outlined in the Appendix 1. Following the publication of the EU Commission proposal in October 2018, both the Council of Agricultural ministers and the EU Parliament have recently agreed their negotiating mandates. The Commission, The Parliament and The Council of Agricultural ministers are now entering a trilogue process to reach a final agreement on the CAP legislation. It is expected that the New CAP will be in place in January 2023.

Importance's Of CAP For Irish Farmers

Irish farmers receive support from CAP from a number of measures as outlined in Table 2. From this table it is clear that the vast majority of support is through the three elements – Basic Farm payment (€1,209 million), Area of Natural Constraints (ANC) (€228 million) and Green Low Emissions Agri Environmental Scheme (GLAS) (€228 million). These elements accounted for 94% of the direct payments in 2018. The table also demonstrates that specific schemes can be developed where a need arises, which is very relevant for this project.

Table 2: Estimated Direct Payment to Farmers (National & EU) during 2018

	Estimated 2018 Total Expenditure
	€ Millions
SCHEME	
Basic Payment Scheme	1,209.000
Areas of Natural Constraint	228.666
Sheep Welfare Scheme	17.650
Beef Data & Genomics Programme	47.451
Burren Programme	1.002
Hen Harrier Scheme	1.154
Knowledge Transfer Scheme	21.665
Disease Eradication Schemes	18.086
BSE Scheme (slaughter of herds)	0.124
Scrapie Eradication Programme	0.028
Forestry	
Forestry Premia	68.089
Bioenergy	0.000
Rural Environment Protection Scheme	0.101
AEOS	7.445
Organics	10.499
GLAS	228.349
Total	1,837.644
Total Without Forestry	1,769.555

S: Department of Agriculture, Food and the Marine

From any analysis of farm income, it is clear that CAP funding is providing a significant element of the turnover on Irish farms. On average, Irish farmers received a payment of €9,500 in 2018 and this equated to 74% of Family Farm Income. The reliance on the direct payments differs significantly between sectors where it ranged from 34% in dairying to 158% in cattle rearing (sucklers). It is clear that the support of CAP must continue to assist farm income.

Teagasc have classified only 32% of Irish farms viable, therefore, any significant reduction in direct payments could have a dramatic impact on the structure of Irish Agriculture and in turn rural communities.

Table 3: Headline Results from the National Farm Survey

	Dairying	Cattle Rearing	Cattle Other	Sheep	Tillage	All Farms
% of farms represented	35%	18%	24%	14%	7%	100%
Direct Payments	21,022	13,098	16,226	18,980	22,451	17,244
FFI	61,446	8,311	14,560	13,297	40,650	23,333
DPs as % of FFI	34%	158%	111%	143%	55%	74%

S: Teagasc National Farm Survey 2018

8. Climate Change and GHGs

What Is Climate Change?

Climate change means a significant change in the measures of climate such as temperature, rainfall, or wind, lasting for an extended period – decades or longer. It can result from natural processes and factors and more recently due to human activities through our emissions of GHGs. The current global aim is to tackle climate change resulting from human activities whose GHG emissions are changing the composition of earth's atmosphere (EPA, 2020).

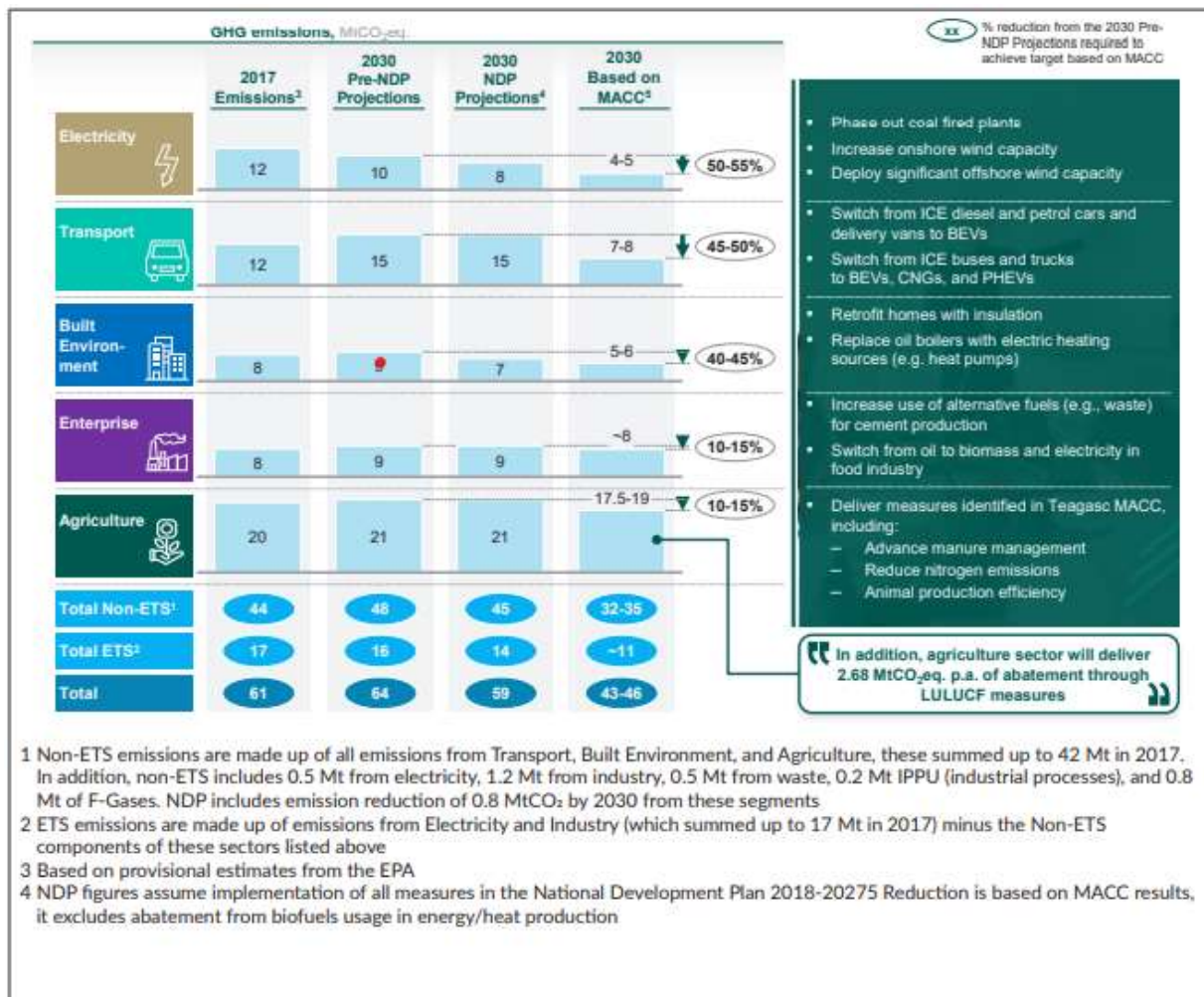
What Are GHGs?

A wide range of gases known as GHGs contribute to climate change. The most important GHGs are carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O) (Climate Action Plan, 2019). These gases are all very relevant to the agricultural sector, the warming potential of these gases all differ with CH₄ being 28 times more potent than CO₂ and N₂O is 298 times more potent than CO₂ (as outlined in table 6).

What Level Of GHGs Is Ireland emitting?

According to the Environment Protection Agency (EPA), and shown in Figure 1, Ireland emitted 61 m tonnes CO₂ equivalent in 2017 and agriculture accounts for 33% of this (20 m tonnes). Based on EPA projections in Figure 1, emissions will increase to 64m tonnes in 2030 without implementing any targeted measures and agriculture will continue to account for 1/3 of this increase.

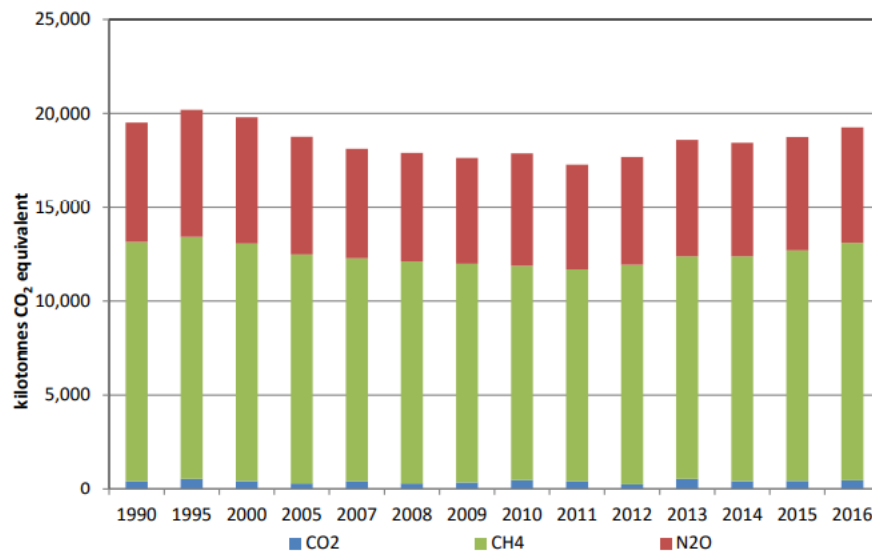
Figure 1: Indicative Sectoral Targets for Ireland to 2030



S: Climate Action Plan, 2019

It is clear from the targeted reduction in the transport, households and industry, as outlined in Figure 1, that as a country we will need radical changes to take place to achieve the targets set. Transport and household sectors must achieve a 45 – 55% reduction in emissions by 2030, while agriculture must achieve a reduction of 10 – 15% (Fitzgerald, 2020). It is being set a much less stringent target than other sectors of the economy because it is much more difficult for Agriculture to achieve drastic reductions (Fitzgerald, 2020).

Figure 2: Total emissions from Agriculture by Gas (1996 – 2016)



S: EPA, Ireland's National Inventory Report (2018, 2019)

It is worth noting that Ireland has the highest agricultural emissions contribution of any the EU member states. (Harris, 2020, per comms). This coupled with our population, results in Ireland having 5 times more agricultural GHG emissions per head than the EU 28 average (4.0 vs 0.8 tonnes CO₂ eq). Figure 2 clearly highlights that methane is the sectors main GHG and accounts for 65% of agricultural emissions, followed by N₂O which accounts for 32%.

What Is The Trend In Emissions Of GHG From Agriculture?

The performance of the agricultural sector across Europe demonstrates how difficult it is to reduce emissions, as they have only reduced by 1% in the period 2005 to 2016 (Eurostat, 2020, website). It is worth noting that there were significant incentives to aid the reduction of emissions such as a 30% Greening element in the BFP, environment schemes, grant aid for technology and afforestation schemes during this period and still only a modest reduction was achieved.

In Ireland, the trend from 2005 to 2017 shows just a modest increase in emissions of c. 2%. This however masks a worrying trend: while there was a reduction of 9.5% in the first six years, there was an increase of 12.8% in the last six years as demonstrated (Table 4). This increase in the past six years is driven by the increasing livestock numbers, and in particular, dairy cow numbers.

Table 4: Trends in Agriculture GHG Emissions

Timeframe	Percentage Change	Absolute Change CO ₂ eq
2005 – 11	-9.5%	-1.9 mt
2011 – 17	+12.8%	+ 2.3 mt

S: Climate Action Plan (Environment, 2019)

What Level Of GHG Reduction Does Ireland Need To Achieve?

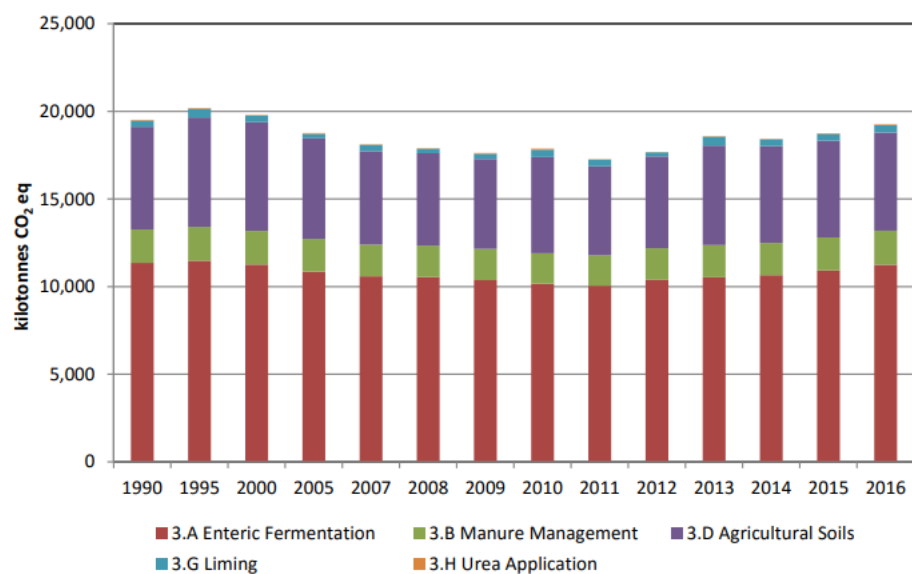
Emissions are rising in both the overall Irish economy and in the Agricultural sector (Climate Action Plan 2018, 2019). We have at least identified the issue and now as a country, we must begin to address it. Developments including The Citizens Assembly on Climate, The Climate Action Plan and a commitment to rising carbon tax in the Programme for Government are highlighting the importance of addressing the issue.

At a national level, Ireland must reduce emissions by 40% by 2030 and should be carbon neutral by 2050. All sectors must take action (Fitzgerald, 2020) to achieve this. As part of the Climate Action Plan, a Marginal Abatement Cost Curve (MACC) has been developed for all sectors to highlight the most efficient means of Ireland reaching its 2030 commitment. Based on this plan, total national emissions would reduce to between 43-46 m tonnes and agriculture's emissions would reduce to between 17.5 and 19 m tonnes (Figure 1) by 2030 (Climate Action Plan 2018, 2019).

What Are The Main Activities That Are Generating Greenhouse Gases?

The GHG emissions profile (Tables 5 & 6), highlights enteric fermentation is consistently the main source of agricultural emissions and accounts for more than half the agriculture emissions (56%). This is followed by losses from our soils (29%) and then losses from slurry (10%).

Figure 3: Greenhouse Gas Emissions Profile for Agriculture (1990 – 2016)



S: EPA, Climate Action Plan (2018, 2019)

Table 5 Agriculture Emissions 2018 (EPA)

Agriculture / Forestry fuel combustion	680.35	3%
Urea application	38.13	0%
Liming	457.45	2%
Agricultural soils	5907.36	29%
Manure Management	1970.84	10%
Enteric fermentation	11,543.21	56%
Total	20,597.34	100%

Table 6 Global Warming Potential (GWP 100) of main GHG (Mitloehner, 2020)

Carbon Dioxide (CO ₂)	1
Methane (CH ₄)	28
Nitrous Oxide (N ₂ O)	298

What Are The Main Options To Reduce Greenhouse Gases?

Teagasc, through the MACC, identifies, quantifies and analyses the cost benefit on a range of GHG mitigation measures. While the list is not exhaustive, it provides a package of measures, which can deliver the required emissions reductions. There are four main areas in its approach:

- a) Stabilise methane emissions through increased efficiencies.
- b) De-couple nitrous oxide emissions from production via nitrogen efficiency and use of low emission fertilisers and spreading techniques.
- c) Absorb CO₂ via carbon sequestration in forests and soils while also reducing CO₂ emissions from hotspots (organic soils).
- d) Fossil fuel displacement has the potential to offset fossil fuel emissions either by energy saving or substitution bioenergy.

The Irish government has clearly backed the Teagasc MACC to deliver the required emissions reductions and as a result it is the foundation for the Climate Action Plan for the sector. It is clear from media reports, social media posts and interviews, that a significant cohort of people both in Ireland and internationally believe, that a reduction in livestock numbers should be a key element of any solution. Emissions are closely aligned to the size of the national herd (Tynan, 2019, per comms). The logic behind this is two-fold, firstly it is an obvious means of reducing emission and an opportunity to go significantly beyond Ireland's target of 10-15% reduction in agricultural GHG emissions and secondly, it overcomes a potential issue in the event that the MACC does not fully deliver on our required reduction. Many, including Tom Tynan (member of cabinet of European Commission for Agriculture and Rural Development) and Bill Callanan (Chief Inspector, Department of Agriculture, Food & the Marine) were particularly concerned around the trend of increasing dairy cow numbers and the impact this will have on GHG emissions. Figure 4 demonstrates the movement of the dairy and suckler cow numbers over the past 30 years. The MACC demonstrates the 10-15% reduction in GHG emissions can be achieved while livestock numbers increase based on FAPRI modelling.

Many of the people I spoke with, including Tom Tynan, John Fitzgerald, John Muldowney (Climate Change Policy, Department of Agriculture, Food and the Marine), voiced concerns over the required speed of adoption of mitigation by farmers and implementation of policies to meet our GHG emission targets.

Challenging The Current Accounting Methodologies

Countries signed up to the Paris Agreement 2015 and this agreement is based on certain methodologies to measure GHGs. Based on emerging science, the previous calculation to measure the GHG impact of CH₄ are being challenged. Research in UC Davis and University of Oxford are leading the way in calling for a change.

Carbon Leakage: This refers to where production of good is transferred to other countries with laxer emission constraints and as a result a possibility of an increase in total emissions. There are two elements to Carbon leakage, firstly Professor Frank Mitloehner, UC Davis, highlighted that in the USA, the last thing the regulators wanted was for farmers to leave the state and take their GHG emissions with them and emit them somewhere else and then lose important economic firepower. Many, including Dr Laurence Shalloo, Teagasc, Moorepark, believe that carbon efficiency should be a major consideration rather than total emissions. The result from reducing output and it being replaced from a less efficient source is that the economic return is lost and that global GHG emissions increase.

Calculation of global warming potential (GWP) of methane: There are two different models of calculating the global warming potential of methane – GWP 100 and GWP*. The GWP 100 is required to be used by regulations when reporting Ireland GHG emissions, but work carried out by Professor Myles Allen, from Oxford University, questions the accuracy of this metric and has developed an alternative metric - GWP*. The main difference between these two metrics, is that with the GWP* it shows methane emissions are stable when livestock numbers are stable i.e. they are not adding to global warming, while using the GWP100 methodology, CH₄ is adding to global warming. Adopting the new metric would result in a significant reduction in the agri sectors GHG emissions but still would not alter our need to reduce GHG emissions and maintain the livestock numbers in the national herd.

9. Options to Reduce Ireland's Greenhouse Gas Emissions

Throughout my travels I engaged with many experts who disagree with how certain elements of GHG emissions are calculated e.g. CH₄ as outlined in the previous chapter. Overall, many industry specialists believe that the net emissions from the Agri sector are being significantly overstated. However, as Professor John Fitzgerald outlines, there are two stages that need to happen before new methods are included. Firstly, methods must be scientifically proven i.e. research must be published in reputable peer reviewed journals to be acceptable to the scientific community including the United Nations Framework Convention on Climate Change (UNFCCC). Secondly, for the reduced GHG emissions to be accounted, any change must be scientifically verifiable. It is important that we bear this in mind when making recommendations.

GHG Marginal Abatement Cost Curve

Teagasc produced a Greenhouse Gas MACC for the agri sector (O'Meara, F. seminar). The curve quantifies the abatement potential of a range of mitigation measures, as well as their associated costs / benefits. A total of 27 measures are recommended to deliver a 30% reduction by the final year, 2030 provided that there is full uptake of all measures.

Professor Gary Lanigan, a Researcher in Teagasc, says meeting the interim climate target in 2030 is extremely challenging for the agriculture, forestry and land-use sectors. The MACC projects a mean annual reduction of 6.19 Mt CO₂ eq in the period 2012 to 2030. The annual cost of delivering the 27 measures are estimated at €233 million per annum. However, when efficiency savings are included, the cost is reduced to €34m per annum.

Table 7– Summary of the MACC (Teagasc, 2019)

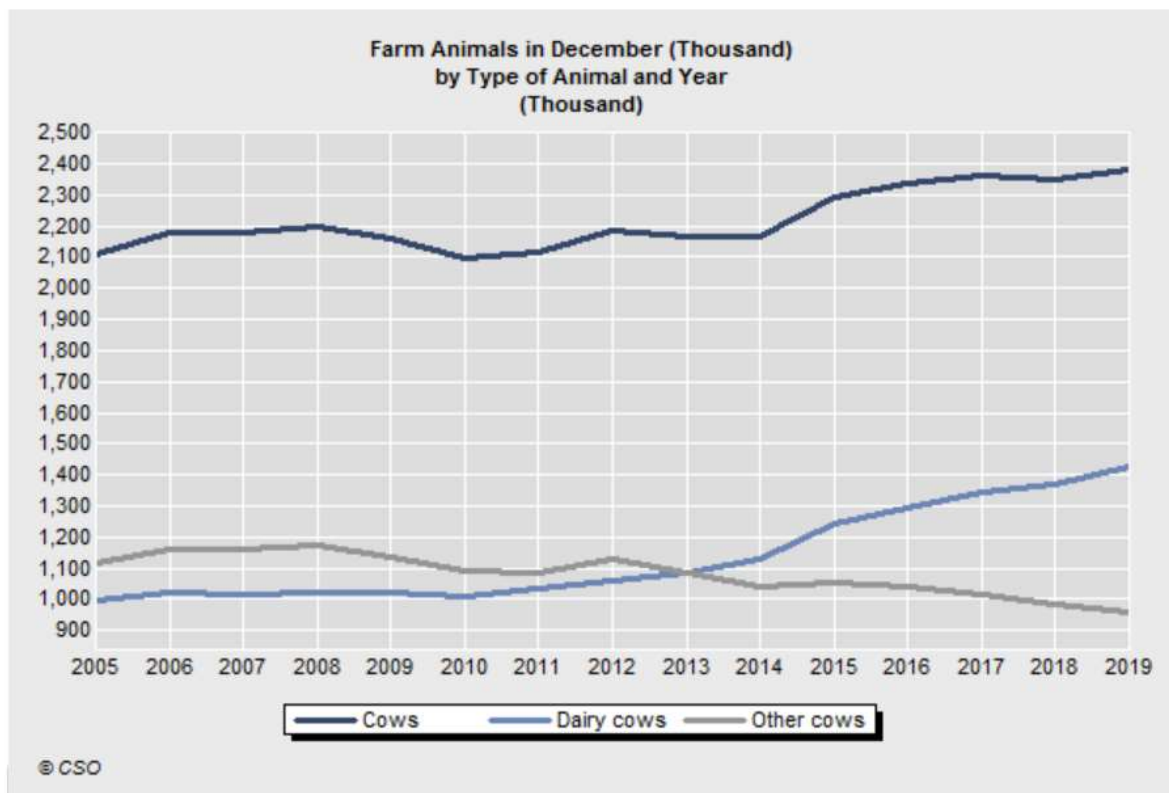
Measure	Cost €/per t / CO ₂ Eq	Mitigation MT CO ₂ EQ	Cost € m
Improved Beef Maternal traits	-602	0.025	- 15.25
Beef Genetics – Optimised live-weight gain	-215	0.061	- 13.1
Dairy EBI	-200	0.43	- 86

Nitrogen-use efficiency	-124	0.112	- 13.95
Improved animal health	-46	1.131	- 6.05
Sexed Semen	-27.3	0.024	- 0.66
Extend grazing	-96	0.065	- 6.3
Inclusion of Clover in pasture swards	-6.9	0.069	- 0.48
Fertiliser Type (reducing N emissions)	+ 8.31	0.521	+ 4.2
Draining we mineral soils	+16.2	0.197	+6.1
Reduce Crude Protein in pigs	+12	0.05	+0.61
Slurry amendments	+49.3	0.027	+1.35
Adding Fatty acids to dairy diets	+76.1	0.035	+2.7
Low emission slurry spreading	+187	0.117	+21.9
Total Agricultural Mitigation		2.864	-104.93
Grassland Management	-41	0.262	-10.7
Forestry	45	2.1	97.4
Water table manipulation of organic soils	10.9	0.44	4.84
Tillage management – cover crop	86	0.108	9.3
Tillage Management – straw incorporation	279	0.0605	16.9
Total Land Use Mitigation		2.9705	117.74
Energy efficiency on farm	-359	0.029	-160
Wood Biomass for energy generation	-30.7	0.759	-23.4
Short rotation Coppice & Biomass for Heat Production	-20	0.179	-3.58
Short rotation Coppice & Biomass for Electricity Production	-10	0.187	-1.96
Anaerobic Digestion	115	0.224	25.8
Biomethane	280	0.150	42
Oil Seed Rape for Biodiesel	90	0.174	15.6
Sugar beet for bioethanol	200	0.029	-4.97
Total for Energy Mitigation		1.731	-110.51
Overall Total		7.5655	-97.7

Reducing Livestock Numbers

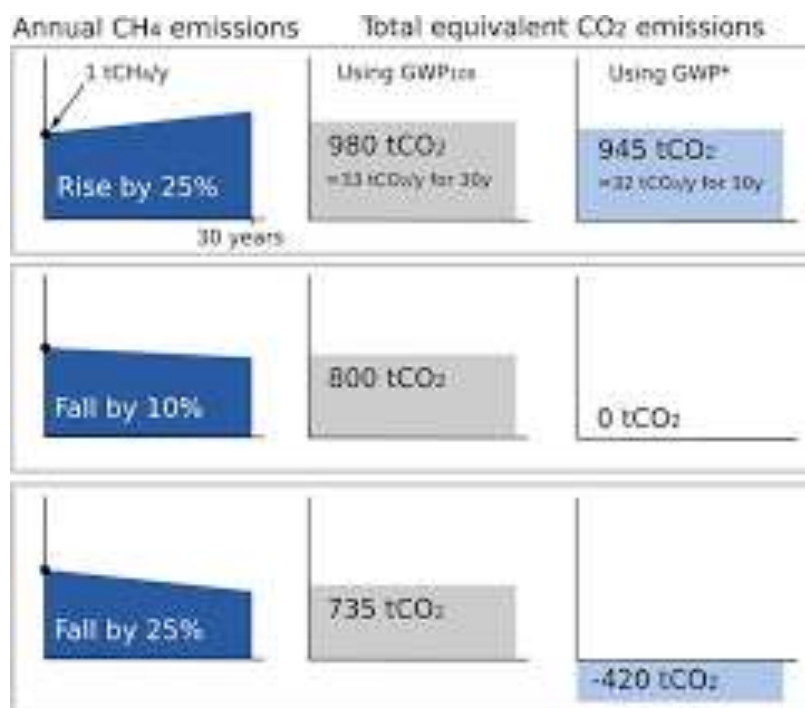
With the very high proportion of CH₄ as a proportion of Ireland's Agricultural GHG's arising from enteric fermentation, an obvious potential method to reduce GHGs is to reduce the size of the national herd. Many, especially representatives of environmental bodies, have called for this.

Figure 4: Irelands Suckler & Dairy cow number 2005 – 2019



While Professor Frank Mitloehner, is an advocate for sustainable livestock production, his work clearly shows that falling livestock numbers leads to falling methane emissions, and has a cooling effect rather than a warming effect. Figure 5 demonstrates the dramatic difference between a 25% increase or decrease in stock levels. The figure also demonstrates the official impact using the different appraisal systems – GWP* & GWP 100 which has already been discussed.

Figure 5: Effect of movement in Annual Methane emissions



S: Frank Mitloehner (2019)

Sequestration Of Carbon In Pasture, Soils And Hedgerows

Dr Dario Fornara, a researcher at Agri-Food and Bioscience Institute (AFBI), estimates that Irish soils are sequestering 1.1 to 2.2 tonnes of carbon per hectare of carbon each year and this could increase with improved management. At Devenish's research farm in Dowth, county Meath, the target is for 3 tonnes / ha CO₂ eq to be sequestered each year and they calculate that the woodland and hedges are sequestering 4.5 tonnes / ha CO₂ eq per annum. Dr Frank Mitloehner also backed up this view, highlighting results from trials in California that demonstrated grassland soils sequestered greater levels of Carbon compared to forestry. There is a large challenge in proving the level of sequestration at farm level.

Rewetting Of Peatland

In the Republic of Ireland, Peatland covers 17.2 per cent of the land surface or 134 million hectares of Ireland (An Foras Taluntais, 1981, Publication). Fully functional, healthy peatlands are the most effective long-term carbon store and sink on the planet. They currently account for just 3% of the global land surface but store 42% of all soil carbon and exceed all the carbon stored in all other vegetation types including, the world's forestry (International Union for Conservation for Nature, Nov 2017 brief). According to Dr Shane

Regan, Trinity College, Dublin, peatlands are currently emitting up to 2m tonnes CO₂ eq each year.

10. Potential Farm Practices That Will Deliver Reduced GHG Emissions And Provide An Economic Return

The Teagasc MACC provides an excellent roadmap for Irish farmers to reduce their GHG emissions. By carrying out many of the measures it will both reduce GHG emissions and increase profit. Some of these items, particularly genetic, will leave a positive legacy beyond the timeframe of a particular scheme.

Fertiliser And Soil Management:

The adoption of two measures of the MACC will account for 80% of Ireland ammonia abatement. These two measures are Low Emission Slurry Spreading (LESS) and Protected Urea which are already being successfully used by some Irish farmers. With this level of abatement, their adoption needs to be prioritised. Soil testing, cover crops, grazing infrastructure and use of soil nutrient management plans will all improve efficiencies.

Improved Genetics:

The overall goal is to produce more or the same output from lower levels of inputs and as a result make the national herd more efficient from both a GHG emissions and financial point of view. In short, on the dairy front, this is about lower fewer replacements and dairy cows, producing more milk solids over their lifetime and dry stock producing more meat while being slaughtered at a younger age. According to Prof Donagh Berry, Centre Director, Vista milk, there are two elements to this. Firstly capturing more data will lead to the more accurate genetic evaluation in the future. This capture includes milk recording, weighing animals and weighing their progeny and also genotyping animals. The second element is around encouraging the use of the best genetic possible and this is following the Economic Breeding Index (EBI) and Star breeding programmes but also encouraging more use of AI instead of stock bulls.

Animal Health:

Similar to improved genetics, the goal is to produce more output from lower levels of inputs. Poor animal health leads to higher levels of mortality and poorer performance. Improved infrastructure (calf housing, footbaths, roadway etc.) increased vaccination programmes and

introduction of Herd health plans will lead to improvement on farm performance and in turn a more carbon efficient production system (Berry, D. 2020 per comms).

Knowledge Transfer:

Previous studies have shown that membership of Discussion Groups have increased farm profits. Many of the people I spoke to identified the need for a range of programmes and recommended. They reference discussion groups, demonstration / model farms and widen the Agriculture Sustainability Support and Advice Programme (ASSAP)³ to reducing GHG emissions. The ASSAP is currently focused on water quality and since its introduction in 2018 has achieved a 96% acceptance rate on farms and an 89% success rate where the farmer agrees to carry out measure aimed at improving water quality (Meehan, 2020).

Farmer Feedback:

An online survey was conducted as part of this research in October and November 2020. The survey was distributed through discussion groups, Nuffield Ireland members, twitter and personal contacts. A total of 280 Irish farmers completed the survey. While the full survey results are included in the appendices, a summary of the main findings are outlined below. It should be noted that it is not a representative sample of the entire farmer population in Ireland and is heavily weighted towards dairy farmers, larger scale farmers and farmers availing of the Nitrate's Derogation.

Key findings of the survey include:

- 41% of farmers surveyed plan to further increase livestock numbers over the next 3 years while 51% plan on maintaining numbers at current levels.
- Importantly as the MACC is the main focus of the Government to achieve our GHG emission targets, the majority (76%) of farmers surveyed had little or no knowledge of the MACC implications on the farm and approximately half (54%) of farmers had little knowledge of GHGs implications on the farm.

³ ASSAP Agricultural Sustainability Support and Advice Programme working with farmers in a free and confidential advisory service to help improve water quality

- Farmers indicated that areas that are currently not eligible for Basic Farm Payment should be included. The survey indicated that 76% believed that areas of a field planted / allowed to 'go wild' should receive payment and this increased to 84% for riparian zones along rivers. A lower amount, but still a healthy majority (65%) believe it should be paid on rewetted peatland.
- Interestingly, the farmers surveyed indicated a significant difference on their likelihood to adopt certain technologies depending on the grant aid available. With a 40% grant rate, 33% said they would use LESS equipment and this increased to 48% with a 60% grant rate. 34% indicated that they would use 100% AI if a 40% grant was available on heat detection aid and this rose to 56% with a higher grant rate. The number doubled (22% to 44%) that would definitely install PV Panels if the grant rate was increased from 40 to 60%.
- The vast majority of farmers indicated that a price signal for their produce would be a worthwhile development as 84% are likely to adopt measures to reduce GHG emission to avail of a premium price.

11. The Common Agricultural Policy

The Future of CAP?

While the next reform of CAP is not likely to be agreed until 2021, much work has been completed to establish the framework for the next Reform. Climate is a key driver of the current reform, proposed in June 2018 by the previous EU Commission, and the publication by the new EU Commission in December 2019 of the EU Green Deal goes further in that direction. The EU Green Deal (Europa.eu) is a set of policy initiatives by the European Commission with the overarching aim of making Europe climate neutral by 2050.

For the agricultural sector, the European Green Deal includes a Farm to Fork Strategy, and a Biodiversity Strategy. The CAP's nine key objectives outlined in Figure 6 are coherent with the aims of the Green Deal. Three of the objectives relate directly to the environment and with one specifically on climate change actions. A new and important step is for each member state to develop a CAP Strategic Plan. This will need to be signed off by the EU Commission and will identify the national priorities.

Figure 6: The 9 CAP objectives



In May 2020, the EU Commission presented their Farm to Fork strategy and this highlighted a number of priorities. According to the EU, it is at the heart of the European Green Deal aiming to make food systems fair, healthy and environmentally friendly. This Strategy aims to balance producing enough nutritious affordable food for everyone while protecting the future of the planet. It sets out to make Europe the first climate neutral continent. This will be achieved through investment in research and new technologies, in transforming how we produce, distribute and consume food.

This strategy will certainly influence the next CAP reform as it sets to transform the EU food system with the following targets:

- 50% reduction in the use and risk of pesticides.
- 20% reduction in the use of fertilisers.
- 50% reduction in sales of antimicrobials used for farmed animals and aquaculture.
- 25% of agricultural land used for organic farming.

What Are The Main Options Of Support?

Based on the EU Commission CAP proposal, there is an increased amount of options for environment support as outlined in Figure 7. Outlined below are the main options that could be used to encourage Irish farmers to reduce their GHG emissions.

Figure 7: The new Green Architecture



S: Europa, 2020

Basic Income Support Scheme (BISS):

The BISS is a compulsory scheme for all member states and offers a basic layer of income support to farmers. The payment is based on payment entitlements, activated on eligible land and mostly decoupled from production. The payment each farmer receives is a function of the area they farm. It is paid on an annual basis and is subject to the applicant adhering to a wide range of regulations (and subject to cross compliance).

Eco Schemes:

These schemes are a new part of the current proposal and as a result are not fully defined. The funding is taken from the BISS and it is aimed at protecting the environment and climate. It is proposed that the scheme is voluntary and that payments would equate to up 30% of the BPS. It is proposed the scheme will have lower levels of administration and that it would be based on annual commitments.

Targeted Agricultural Modernisation Scheme (TAMS):

TAMS is a scheme to support on-farm investment. It is co-funded by the EU and the National Exchequer under the Rural Development Programme. It provides, typically 40% (up to 60%) grant aid for specific capital projects.

Environment Scheme (under Pillar II):

The Green, Low-Carbon, Agri-Environment Scheme (GLAS) is the current environmental scheme in place and helps tackle climate change, preserve biodiversity, protect habitats and promote environmentally friendly farming. Ireland's Budget 2021 has made funds available to develop a new environmental scheme.

Area of National Constraints:

The Areas of Natural Constraints (ANC) scheme provides payments to people farming land in designated disadvantaged areas. Its aim is to support the continuation of farming in these area by compensating farmers for the additional costs involved in farming such land. A key requirement to qualify for this payment is to have a minimum stock rate on the land of 0.15 LU / Ha.

Organic Farming Scheme:

The Organic Farming Scheme provides financial support to encourage production of organic foods. The scheme has not been available to new applicant since 2018 but received additional funding in Ireland's Budget 2021. Financial support is paid on two stages of conversion

Develop specific schemes:

The option is available under the Rural Development to develop specific schemes relevant to each country.

12. Examples of Initiatives to Help Reduce GHG Emissions

USA:

At the United States Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) have taken a two-pronged approach to encouraging their farmers and ranchers to deliver voluntary environmental solutions. According to Dr Adam Chambers, USDA – NRCS, farmers and ranchers have relied on both aspects and it is the twin component that is central to delivering the desirable outcomes. The overall objective of the programme is to increase US Agricultural Production by 40% while cutting the environment footprint of US Agriculture by 50%.

1) Technical assistance

These are typically 'tools' that the USDA have developed over time to assist farmers plan the activity and impact of their actions. Their 'Comet Planner' is a 4 step, easy to use planner allows users explore potential atmosphere benefits of carbon sequestration in soils or biomass based on standard measurements. It provides a general guide to the potential impacts of carrying out a wide range of conservation practises (USDA, website, 2020).

As a follow on to Comet Planner, the USDA have Comet Farm which estimates the carbon footprint for all or part of your farm and allows the user evaluate different options to reduce GHG emissions and sequester more carbon. As special-explicit data on climate and soil conditions for the farm location are used in conjunction with detailed information for the field and livestock operation, it produces an accurate estimate tailored to your specific situation.

2) Financial Assistance

The Environment Quality Incentives Programme (EQUIP) is part of the 2018 Farm Bill and provides financial assistance to agricultural producers to deliver on environmental priorities, including carbon sequestration. Figure 8 below, is an example of the potential payment based on the conservative practises chosen and the acreage.

Figure 8: Screenshot of the Comment Planner

Step 2: Select your agricultural system

☐ Cropland
 ☐ Orchard or Vineyard
 ☒ Grazing Land

Step 3: Select a NRCS Conservation Practice Standard, Conservation Practice Implementation, and Payment Scenario associated with conservation planning objectives that best describe your project. You may add multiple practices, including from different agricultural systems, by returning to Step 2

Conservation Practice Standard (CPS)

- ☒ Compost Application (CPS 608)
- ☒ Hedgerow Planting (CPS 422)
- ☒ Prescribed Grazing (CPS 528)
- ☒ Range Planting (CPS 550)
- ☒ Riparian Forest Buffer (CPS 391)
- ☒ Silvopasture (CPS 381)
- ☒ Tree/Shrub Establishment (CPS 612)
- ☒ Windbreak/Shelterbelt Establishment (CPS 305)

Conservation Practice Implementation

- ☒ Compost (C/N > 11) Application to Grazed Grassland
- ☒ Compost (C/N > 11) Application to Grazed, Irrigated Pasture

Payment Scenario
(Note: Payment scenarios may have different payment rates, but do not affect GHG reductions)

- ☐ Compost from certified composting facility
- ☒ On-farm produced compost

Step 4: Enter the enrollment amount associated with each conservation practice you selected

Approximate Carbon Sequestration and Greenhouse Gas Emission Reductions and Payments Associated with Selected Conservation Practices*
(Metric Tonnes CO₂ equivalent per year / T₂₀)

NRCS Conservation Practices <small>(Link practice name to documentation)</small>	Enter Unit Value (acres or feet)	Carbon Dioxide	Methane Oxide	Methane	Total CO ₂ Equivalent	Estimated 10Y payment dollars to be Project Team
1000 Wetlands, CR Cover Crop (CPS 245) - Add Non-Legume Seasonal Cover Crop to Irrigated Cropland - One species	35 Acres(s)	1	0.1	0	1	\$5,352.00
1000 Wetlands, CR Compost Application (CPS 608) - Compost (C/N > 11) Application to Grazed, Irrigated Pasture - On-farm produced compost	50 Acres(s)	230	-2	0.3	229	\$60,000.00
Total		231.00	-8.90	0.30	224.40	\$65,352.00

*Negative values indicate a loss of carbon or increased emissions of greenhouse gases
 *Values were not estimated due to limited data on reductions of greenhouse gas emissions from this practice
 *Final payment may be different than estimated payment, pending application review and approval

[Download Results](#)

France

The concept for the Low Carbon Farm was established in 2012 and the following year received funding from the EU. The programme is run by CNIEL (National Interprofessional Centre for the Dairy Economy) and is a sector approach that supports French dairy farmers to reduce their GHG emissions. The approach unites farmers, advisory services and processors with the common goal to reduce GHG emission on farms by 20% over a 10 year period. The overall objective is to attract all 60,000 dairy farmers in France to participate and as a result reduce GHG emission by 2 million tonnes per annum (low-carbon-dairy-farm, website, 2020).

In attracting farmers, it does not just focus on carbon emission reduction, but rather looks at improving financial performance. To date, the programme includes 9,300 dairy farmers and on average, this has resulted in 250 acres being farmed with sustainable biodiversity, feeding an average of 2058 people and storing 19,393 kgs of carbon in their soils. The benefits for the farmer are to have a more sustainable farm which results in higher profits – a win: win scenario.

There is a three-step approach to the programme.

- 1) Carry out a technical, economic and environment review of the farm.
- 2) Identify the potential actions to improve the technical, economic and carbon footprint.
- 3) Build a plan with the farmer that is adapted for their individual farm.

Northern Ireland

Anaerobic Digesters: It is estimated that there are in the region of 100 anaerobic digesters in Northern Ireland with the majority of these being 500MW in size. The Northern Ireland Renewables Obligations (NIRO) has been the main support mechanism for encouraging increased renewable electricity. The NIRO places a legal requirement on all Northern Ireland licensed electricity suppliers, since April 2005, to provide evidence that a specified quantity of the electricity is supplied to final customers can be accounted for by generation from renewable sources.

The farm visited which is a 500 MW digester, typically use up to 11,000 tonnes of silage (Fresh weight) at 28 – 30% Dry Matter. In the region of 500 acres is used to produce this over three cuts and the digester pays €30 per tonne for the silage (providing sales of €660 per acre for the farmer). The digester also uses 300,000 litres of waste dairy product per month. To minimise the amount of fertiliser used, the digestate from the plant is spread back on the land and creating a circular environment.

England

Farm Carbon Toolkit is one of three such initiatives in the UK and was set up in 2009 by two farmers. The Not For Profit organisation has experienced a rapid growth in users in 2020 after a re-launch of its online tool. Since the start of the year it has attracted 3,500 new subscribers (compared with 2000 in the previous 10 years).

There are a number of elements to this organisation:

- **Website & backup support:** This provides farmers with a carbon calculator to calculate the carbon impact of their business and then a toolkit to a wide range of the options to reduce it.

- Communications: Their message reaches a large target audience through their involvement in discussions groups, farm walks, scripting articles and partnering with processors and AHDB.
- Consultancy: The organisation provides consultancy for individual or organisations that are looking to improve their carbon emissions. Typically, large estates or supply chain companies use this service as they strive to become Carbon Neutral.
- Project work: As their main income source, this is where the organisation puts forward a carbon related project and obtains funding to carry it out (Wilson, 2020, per comms).

Republic of Ireland

Scohaboy Bog:

The Cloughjordan Community group was established in 2006 with the aim to protect and enhance the positive aspects around Cloughjordan village including the Scohaboy bog. The bog is 450 hectares in size and is part of a National Heritage Area just outside Cloughjordan village in county Tipperary. The bog was very familiar to locals as 44 of them had turbary rights to cut turf there (Turbary is the ancient right to cut turf, or peat, for fuel on a particular area of bog).

The Cloughjordan/ Scohaboy project is part of Coillte's fourth LIFE project and it's second on raised bog. At this stage a total of 300 hectares of bog has been restored over two stages. The project is 'Demonstrating Best Practise in raised bog restoration in Ireland.' According to Gearoid O'Foighil, community co-ordinator for the Scohaboy raised bog restoration programme, the project needs to assess the proportion of the bog that will become active peat forming before it can accurately predict the GHG emission impact. According to their lead ecologist, Dr. Shane Regan (Trinity College) the NEE (net ecosystem exchange) from peatlands is remarkably consistent. A square meter of Sphagnum takes in 0.5 tonnes of CO₂ eq per hectare each year. In contrast, degraded habitat (heather) and bare peat emits 1-2 tonnes of CO₂ eq per hectare each year. While restoration can only lead to modest gain in carbon sequestration, it arrests significant emissions from degraded peatland.

13. Conclusions

This research focused on two items, firstly the challenge that Ireland has to achieve in meeting its GHG emissions targets and the major role the agricultural sector has to play in this. Secondly, the role that the Common Agricultural Policy (CAP) and co-funding by Irish Government could play to assist Irish farmers deliver on their GHG emission targets. The research was informed by ongoing actions to encourage farmers to reduce GHGs emissions both nationally and globally.

Now is the ideal time to seek the introduction of measures to encourage farmers to reduce GHG emissions as a number of influential policies are all focused on tackling climate change. The EU Commission launched its Green Deal in 2019, its Farm to Fork and Biodiversity Strategies in 2020 and the EU is on track to deliver the next CAP reform in 2021. All these policies and strategies can potentially ensure that Ireland delivers on its GHG emission targets. In addition, the Irish Government has outlined its Climate Action Plan and on the agricultural front needs to reduce emissions significantly. The most recent Programme for Government provides significant additional financial support to assist with the reduction of GHG emissions by all sectors, including agriculture.

It is very encouraging to see the developments that have materialised over the past two years since I started my studies. Much is being done to encourage farmers to reduce their GHG emissions. These initiatives include:

- Research: Teagasc and Irish Universities continue to carry out research into approaches to reducing GHG emissions.
- Policy Formation: At Irish, European and global levels, Climate Change has risen in terms of its importance – The Paris Agreement, Farm to Fork Strategy in Europe and the latest Programme for Government includes a number of Carbon related initiatives including plans for a new Environment scheme. The Climate action plan is now a key consideration when delivering an new policies.
- Regulations: All farmers, but particularly those availing of the Nitrates Derogation, have additional conditionality including use of LESS, use of clover in pasture, nutrient management plans and hedge row management.

- Incentives: There is a wide range of support schemes that currently incentivise GHG's efficiencies and emission reductions – BDGP, GLAS, Afforestation.
- Education through Know Transfer (KT) groups, Bord Bia Audits and farm sustainability report.
- Taxes in the form of Carbon tax.

Thankfully there are many potential solutions but they need to be prioritised. The Climate Action Plan and the Teagasc Marginal Abatement Cost Curve (MACC) are excellent roadmaps for the sector to follow. The MACC in particular takes a balanced approach in how to achieve targets in the least costly manner. There is strong merit to all the 27 measures that are being recommended. The Climate Action Plan also identifies other priorities for the sector including biodiversity, air and water quality.

An underlying assumption to the MACC is that Ireland maintains its overall herd size – any increase will result in an increase in our GHG emissions and failure to achieve our target. The current trajectory needs to be changed and based on the recent rate of expansion of the dairy herd, either regulation or incentives will be required to alter the emission trend.

Most people agree on the principle of using CAP and National Exchequer funding to support the reduction of GHG emission. While the overall budget is sizeable, it is finite and in practice it will mean taking money from one group of farmers and giving it to another group. This makes it political sensitive and adds an additional layer of complexity.

From researching this topic, it is clear that reducing GHG emissions is a complex issue. While there are many potential solutions there is a concern that the current accounting system for carbon emissions has fundamental flaws. Promising recent scientific work has shown the different nature of methane emissions relative to CO₂ in particular, but further research is required in this area and in the accounting of carbon sequestration in grassland / hedgerows. If those gain sufficient scientific acceptance to alter official carbon accounting methods, Irish GHG emission obligations could be positively impacted. However even if these changes materialise, methane will continue to contribute a large portion of Irelands GHG emissions.

Despite all of these initiatives, farmers are not adopting the new technologies quickly enough. Increased efforts and resources need to be invested to assist behaviour changes. Similar to the adoption of the 'plastic bag levy' or 'smoke free work places', it is important that Irish farmers adopt the measures in the Teagasc MACC curve. The focus now must be to firstly have the supports in place to assist farmers reduce their GHGs but most importantly they must be assisted to adopt the new practices in a speedy fashion.

14. Recommendations

- Reducing GHG's emissions is one of the key environmental priorities for Ireland. With our GHG emissions rising, coupled with the slow adoption of the MACC measures, the wider Agri Industry needs to put its resources and efforts to deliver on Ireland's environmental challenges. An Agri Sustainability Stakeholder Forum should be established, modelled on the Food Harvest 2020 Forum comprising of approximately 30 members representing the wider sector, from farmers to retailers and including NGOs. A key consideration for the group must be to investigate the possibility of delivering a price differential that rewards the uptake of prescribed practises that assist agriculture in meeting its 2030 GHG emission targets.
- A key element of Ireland's strategy to reduce GHG emissions needs to be focussed on driving behavioural change on Irish Farms. Many of the key steps to aid the reduction of GHG emissions are already in place from legislative change, financial incentives, social acceptability (peer pressure) and improved margins. The key area that needs to be tackled is around making the issue relevant to each individual farmer.
 - Targets need to be relevant and be communicated in a language that farmers can relate to (e.g. speak in terms of litres of diesel rather than tonnes of carbon);
 - The Knowledge Transfer (KT) programme needs to include an element on reducing GHG emissions;
 - Have demonstration / model farms open to the large majority of farmers who are not already in traditional discussion groups;
 - Build on the excellent work of the Agricultural Sustainability Support and Advice Programme (ASSAP), which prioritises voluntary engagement by farmers to tackle water quality, and extend it with a focused element on reducing GHG emissions;
 - Market signals from purchasers that pay a bonus for the uptake of desirable actions that will help reduce GHG emissions;

- Further develop the Carbon Navigator to include farm environmental and financial goals; and
 - Include a training / educational element on the Eco scheme.
- The new proposed Environment Scheme (Pillar II), which was part of the Programme for Government published by the Fine Gael/Fianna Fail/Green coalition last June, is a powerful opportunity to support actions that Irish farmers can take to reduce GHG emissions. The scheme should be designed with **one compulsory element on reducing GHG emissions**.
- With such a strong link between stock numbers and GHG emissions, it is clear that if the national herd continues to grow there will be consequences. The trend over the past decade of land moving from extensive beef production to more intensive dairy farming has been the driver of this. Extensive beef farming can be in many forms, from suckler cows to rearing the progeny from the dairy herd, but it needs to be a desirable alternative to intensive farming. **A Low GHG emissions beef brand** needs to be established to encourage it to remain in place by providing a financial reward for extensive beef production – develop a new brand e.g. LOCO Beef / GLAS Beef.
- There are two GHG reasons to re-wetting certain peatland – firstly it stops the release of carbon and secondly it starts sequestration. Peatland rewetting should be encouraged by establishing a specific peatland rewetting scheme. Key elements to consider in a **peatland rewetting scheme** include:
 - A focus on specific types of peatland and geographical circumstances where only targeted areas will be affected by the rewetting;
 - The scheme needs to be appealing to communities and groups of farmers;
 - Monetary reward will need to cover the cost of rewetting, the margin currently being achieved from the land and a reward for the sequestration of carbon;
 - The term of the scheme needs to extend significantly beyond the normal 5/7 years and in excess of the current forestry premium – in reality the funding will need to be linked to the Carbon Tax; and
 - Land should be eligible for Basic Income Support Scheme payments.

- In the next CAP deal, Eco Schemes will be a large element (20 – 30%) of the Basic Income Support Scheme (BISS, in Pillar 1) and should be used to deliver the Teagasc MACC. This will have an impact on farmers currently operating under the Nitrate's derogation as many of the additional requirements could become options under the Eco Schemes. The schemes need to deliver on fertiliser & soil management, improved genetic, increased education and animal health. I believe the scheme needs to be multi annual to have the greatest impact and it needs to go beyond offsetting cost incurred and income foregone, to avoid limiting the uptake of 14 of the 27 measures in the Teagasc MACC.
- Building on the success of the Farm Waste Management Scheme where grant aid was 60%, Ireland should seek permission to increase grant aid for capital expenditure to 60% for investment subsidised under CAP (TAMS scheme) when it relates to investments to reduce GHG emissions such as Low Emissions Slurry Spreading (LESS) equipment, heat detection aids, genomic testing, solar PV systems and calf housing. The additional cost of increasing the grant aid from 40% to 60% should be funded through the Carbon Tax.

15. References

Siobhan Walsh, CAP explained Why and when was it set up? 30th March 2018, Agriland
Incorporating white clover into pasture-based production systems to increase performance – Seminar on the 29th May 2020 – hosted by Matt Ryan – Bran McCarthy & F Coughlan

CAP: Thinking out of the Box – Further modernisation of the CAP – why, what and how? 2017 – Authors Professor Allan Buckwell, Professor Alan Matthew, David Baldock, Professor Erik Mathijs
Irish Farmers Journal, 2nd May 2020, Irish grasslands can sequester millions of tonnes of carbon dioxide every year.

Newfoodmagazine.com

Teagasc Signpost Webinars series:

- Use of Protected Urea
- Low Carbon Dairy farming
- Reducing Slurry Emissions
- Maintaining the Derogation
- Land management – Drainage and water table control
- Options to reduce GHG Emissions
- Reducing GHG Emissions in Irish Agriculture

Webinar ‘The new CAP and the EU Green Deal – 2nd June 2020 (Irish Farmers Journal)

Webinar ‘Greenhouse gases and agriculture – 16th October 2020 (Irish Farmers Journal)

Government of Ireland, Climate Action Plan, 2019

<https://ec.europa.eu/eurostat>

<https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/programs/financial/?cid=nrcseprd1328426>

https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

<https://www.teagasc.ie/media/website/publications/2018/An-Analysis-of-Abatement-Potential-of-Greenhouse-Gas-Emissions-in-Irish-Agriculture-2021-2030.pdf>

<https://www.epa.ie/climate/communicatingclimatescience/whatisclimatechange/>

www.economy-ni.gov.uk

<http://www.low-carbon-dairy-farm.com/>

<http://www.epa.ie/pubs/reports/air/airemissions/ghg/nir2018/Ireland%20NIR%202018.pdf>

www.epa.ie/climate/communicatingclimatescience

<https://www.teagasc.ie/media/website/environment/soil/Peatlands-of-Ireland.pdf> - peatlands of Ireland

Healy, J. (October 2019) Personal Communication. President, Irish Farmers Association

Dr O'Meara, F. (January 2020), Director of Research, Teagasc

Prof Fitzgerald, J. (January 2020) Climate Action in Agriculture seminar, Chairman of Climate Change advisory council

Department of Agriculture, Food & the Marine , 2019, Annual Review and Outlook

Creed, M. (2019) Foreword, A to Z of Climate Change, Minister for Agriculture, Food & Marine

Harris, B. (April 2020) Personal Communication, Department of Agriculture, Food & the Marine

Wilson, R. (October, 2020) Personal Communications, Farm Carbon Toolkit

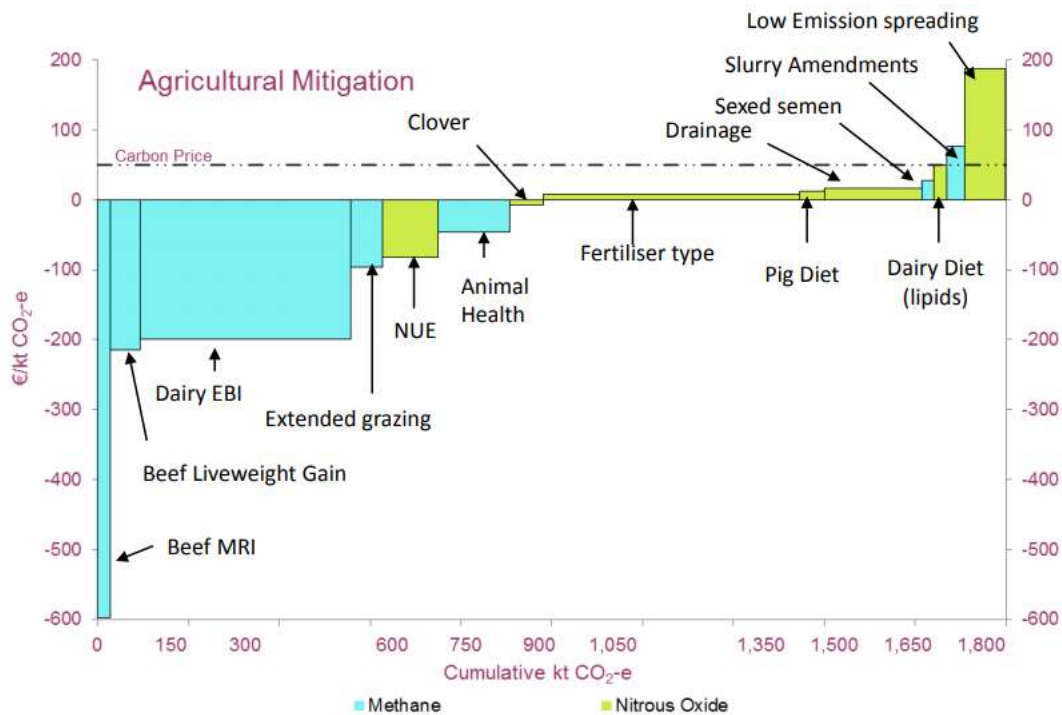
13. Appendices

Appendix 1 Timeline for the Current CAP Reform:

<ul style="list-style-type: none"> • June '18 	<ul style="list-style-type: none"> • EU Commission's DGAGRI publishes proposal, announced by EU Agri Commissioner Phil Hogan
<ul style="list-style-type: none"> • October '19 	<ul style="list-style-type: none"> • New Commission, headed by Ursula von der Leyen, approved by European Parliament
<ul style="list-style-type: none"> • December '19 	<ul style="list-style-type: none"> • European Green Deal launched by EU Commission
<ul style="list-style-type: none"> • May '20 	<ul style="list-style-type: none"> • Farm to Fork and Biodiversity strategies launched by EU Commission
<ul style="list-style-type: none"> • July '20 	<ul style="list-style-type: none"> • MFF (Multiannual Financial Framework, the EU budget) agreed, with additional €8bn for Recovery Fund (COVID 19/Brexit)
<ul style="list-style-type: none"> • October '20 	<ul style="list-style-type: none"> • Council of Agricultural Ministers agree position on CAP Reform
<ul style="list-style-type: none"> • October '20 	<ul style="list-style-type: none"> • EU Parliament agree position on CAP Reform
<ul style="list-style-type: none"> • November '20 	<ul style="list-style-type: none"> • Poland and Hungary threaten veto on MFF/Recovery fund over "rule of law" mechanism
<ul style="list-style-type: none"> • Nov '20 – Spring '21 	<ul style="list-style-type: none"> • Trilogues between EU Commission, Agriculture Council and European Parliament take place to negotiate and finalise legal agreement for new CAP
<ul style="list-style-type: none"> • During '21 	<ul style="list-style-type: none"> • Member States Finalise National Strategic Plans and have them vetted by EU Commission
<ul style="list-style-type: none"> • 2021-2022 	<ul style="list-style-type: none"> • Transition period with new budget, but "old rules" to secure continuity of farm payments.
<ul style="list-style-type: none"> • Jan '23 	<ul style="list-style-type: none"> • New CAP is in place




















Appendix 2: 1: Marginal Abatement Cost Curve for agriculture for 2021-2030 (methane and nitrous oxide abatement).

Values are based on linear uptake of measures between the years 2021-2030 and represent the mean yearly abatement over this period. Dashed line indicates Carbon cost of €50 per tonne CO₂










Appendix 3: Online Farm Survey

1. What age bracket are you in?			
		Responses	Percent
Under 35 years:	<div></div>	70	25%
35-50 years:	<div></div>	136	48.57%
51-65 years:	<div></div>	68	24.29%
Over 65 years:	<div></div>	6	2.14%
Total Responded to this question:		280	100%
Total who skipped this question:		0	0%
Total:		280	100%












2.			
Which of the following best describes your farming enterprise?			
		Responses	Percent
Dairy only:		143	51.07%
Dairy and other:		53	18.93%
Mainly beef:		43	15.36%
Mainly sheep:		8	2.86%
Mainly tillage:		4	1.43%
Mixed enterprises:		21	7.5%
Other:		8	2.86%
Total Responded to this question:		280	100%
Total who skipped this question:		0	0%
Total:		280	100%
3.			
How many hectares are you currently farming (owned and rented/leased)?			
		Responses	Percent
Up to 40 ha:		43	15.41%
41-60 ha:		48	17.2%
61 - 80 ha:		57	20.43%
Over 80 ha:		131	46.95%
Total Responded to this question:		279	99.64%
Total who skipped this question:		1	0.36%
Total:		280	100%
4.			
Did you avail of the Nitrates Derogation in 2020?			
		Responses	Percent
Yes:		147	52.88%
No:		131	47.12%
Total Responded to this question:		278	99.29%
Total who skipped this question:		2	0.71%
Total:		280	100%
5.			
What if any changes have you made in your farm practices in the past 5 years to reduce the Greenhouse Gas Emissions on your farm?			
		Responses	Percent
1:		252	100%
2:		215	85.32%
3:		159	63.1%
Total Responded to this question:		252	90%
Total who skipped this question:		28	10%
Total:		280	100%
6.			
What if any changes do you plan to make in the next 5 years to reduce the Greenhouse Gas Emissions on your farm?			
		Responses	Percent
1:		220	100%
2:		171	77.73%
3:		109	49.55%
Total Responded to this question:		220	78.57%
Total who skipped this question:		60	21.43%
Total:		280	100%

7. Which of the following practices do you currently undertake or plan to undertake on your farm?					
	N/A	Yes	No but Intend To	No and No Plans	Total
Sexed Semen:	39(14.13%)	79(28.62%)	69(25%)	89(32.25%)	276
AI:	27(9.85%)	225(82.12%)	3(1.09%)	19(6.93%)	274
Genomic Testing of Stock:	35(12.68%)	93(33.7%)	73(26.45%)	75(27.17%)	276
Protected Urea:	9(3.21%)	176(62.86%)	70(25%)	25(8.93%)	280
Milk Recording:	62(22.46%)	177(64.13%)	20(7.25%)	17(6.16%)	276
Low Emission Spreading of Slurry:	9(3.25%)	217(78.34%)	40(14.44%)	11(3.97%)	277
Incorporating Clover in Reseeding:	5(1.8%)	216(77.7%)	40(14.39%)	17(6.12%)	278
Total Responded to this question:				280	100%
Total who skipped this question:				0	0%
Total:				280	100%

8. What best describes your plans for overall livestock numbers in the next 3 years?			
		Responses	Percent
Maintain herd numbers within +/- 5%:		142	50.9%
Increase herd numbers by more than 5%:		114	40.86%
Decrease herd numbers by more than 5%:		23	8.24%
Total Responded to this question:		279	99.64%
Total who skipped this question:		1	0.36%
Total:		280	100%

9. How would you describe your understanding of Greenhouse Gas Emissions on your farm?			
		Responses	Percent
Full understanding of the level of Greenhouse Gas Emissions on my farm:		20	7.14%
Good understanding of the level of Greenhouse Gas Emissions on my farm:		108	38.57%
Partial understanding of the level of Greenhouse Gas Emissions on my farm:		114	40.71%
Little understanding of the level of Greenhouse Gas Emissions on my farm:		29	10.36%
No understanding of the level of Greenhouse Gas Emission on my farm:		9	3.21%
Total Responded to this question:		280	100%
Total who skipped this question:		0	0%
Total:		280	100%

10. To what extent are you aware and understand the Marginal Abatement Cost Curve (MACC) for agriculture and the implications for your farm?			
		Responses	Percent
Full understanding of the MACC implications for my farm:		15	5.36%
Good understanding of the MACC implications for my farm:		53	18.93%
Partial understanding of the MACC implications for my farm:		58	20.71%
Little understanding of the MACC implications for my farm:		79	28.21%
No understanding of the MACC implications for my farm:		75	26.79%
Total Responded to this question:		280	100%
Total who skipped this question:		0	0%
Total:		280	100%

11. What are the main ways to improve your awareness and understanding of reducing Greenhouse Gas emissions at farm level? Please select no more than 3 options												
											Responses	Percent
Monitor Farms:											82	29.39%
Research Farms:											115	41.22%
Focus on GHG within Discussion Groups:											94	33.69%
Advisory/Consultants Information Meetings/Events:											133	47.67%
Large scale open days/events:											57	20.43%
Printed/Online Information:											55	19.71%
Media Articles/Information:											76	27.24%
On-Farm Calculators:											92	32.97%
MACC Assessments/Recommendations for Your Farm:											67	24.01%
Measures within Basic Payment Schemes/Compliance:											46	16.49%
None:											2	0.72%
Total Responded to this question:										279	99.64%	
Total who skipped this question:										1	0.36%	
Total:										280	100%	

12. Do you think that the Basic Farm Payment should be made on the following land?												
	Yes	No	Total									
Areas of field that are let go wild/trees planted on them:	209(75.72%)	67(24.28%)	276									
Peatland area that is rewetted:	182(66.42%)	92(33.58%)	274									
Riparian zones along waterways:	230(84.25%)	43(15.75%)	273									
Total Responded to this question:										280	100%	
Total who skipped this question:										0	0%	
Total:										280	100%	

13. On a scale of 1 (not at all likely) to 10 (definitely), how likely would you be to adopt Low Emission Spreading of Slurry if the following incentives were available?												
	N/A - all contracted spreading	1-not at all likely	2	3	4	5	6	7	8	9	10-definitely	Total
40% Grant Aid on Equipment:	92 (33.33%)	8 (2.9%)	5 (1.81%)	6 (2.17%)	10 (3.62%)	17 (6.16%)	15 (5.43%)	18 (6.52%)	11 (3.99%)	4 (1.45%)	90 (32.61%)	276
60% Grant Aid on Equipment:	83 (30.07%)	5 (1.81%)	4 (1.45%)	0(0%)	0(0%)	9 (3.26%)	5 (1.81%)	10 (3.62%)	13 (4.71%)	14 (5.07%)	133 (48.19%)	276
Total Responded to this question:										279	99.64%	
Total who skipped this question:										1	0.36%	
Total:										280	100%	

14. On a scale of 1 (not at all likely) to 10 (definitely), how likely would you be to use 100% AI if the following incentives were available?												
	1-not at all likely	2	3	4	5	6	7	8	9	10-definitely	Total	
40% Grant Aid on Heat Detection System:	52 (19.26%)	9 (3.33%)	14 (5.19%)	10 (3.7%)	23 (8.52%)	16 (5.93%)	20 (7.41%)	24 (8.89%)	9 (3.33%)	93 (34.44%)	270	
60% Grant Aid on Heat Detection System:	47 (17.41%)	3 (1.11%)	4 (1.48%)	7 (2.59%)	12 (4.44%)	8 (2.96%)	11 (4.07%)	18 (6.67%)	9 (3.33%)	151 (55.93%)	270	
Total Responded to this question:										274	97.86%	
Total who skipped this question:										6	2.14%	
Total:										280	100%	

15.
On a scale of 1 (not at all likely) to 10 (definitely), how likely would you be to install Solar/PV Panels on the farm, if the following incentives were available?

	1-not at all likely	2	3	4	5	6	7	8	9	10- definit ely	Total
40% Grant Aid on Solar/PV Panels:	32 (12.03%)	10 (3.76%)	15 (5.64%)	29 (10.9%)	44 (16.54%)	25 (9.4%)	27 (10.15%)	23 (8.65%)	3 (1.13%)	58 (21.8%)	266
60% Grant Aid on Solar/PV Panels:	12 (4.38%)	4 (1.46%)	6 (2.19%)	4 (1.46%)	16 (5.84%)	17 (6.2%)	24 (8.76%)	41 (14.96%)	29 (10.58%)	121 (44.16%)	274
Total Responded to this question:										277	98.93%
Total who skipped this question:										3	1.07%
Total:										280	100%






16.

How likely are you to join the next environment scheme (future GLAS/REPS type scheme)?


	Responses	Percent	
Very Likely:	84	30%	
Likely:	57	20.36%	
Uncertain:	63	22.5%	
Unlikely:	40	14.29%	
Not at all Likely:	36	12.86%	
If unlikely/uncertain, why not?:	95	33.93%	
Total Responded to this question:		280	100%
Total who skipped this question:		0	0%
Total:		280	100%

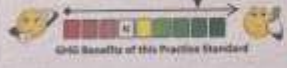


17.


If there was a premium price available for producing meat/dairy/grain with lower Greenhouse Gas Emissions, would it encourage you to adopt measures to reduce the emissions from your farm?

	Responses	Percent
Very Likely: 	131	46.95%
Likely: 	104	37.28%
Uncertain: 	33	11.83%
Unlikely: 	7	2.51%
Not at all Likely: 	4	1.43%
Total Responded to this question:	279	99.64%
Total who skipped this question:	1	0.36%
Total:	280	100%

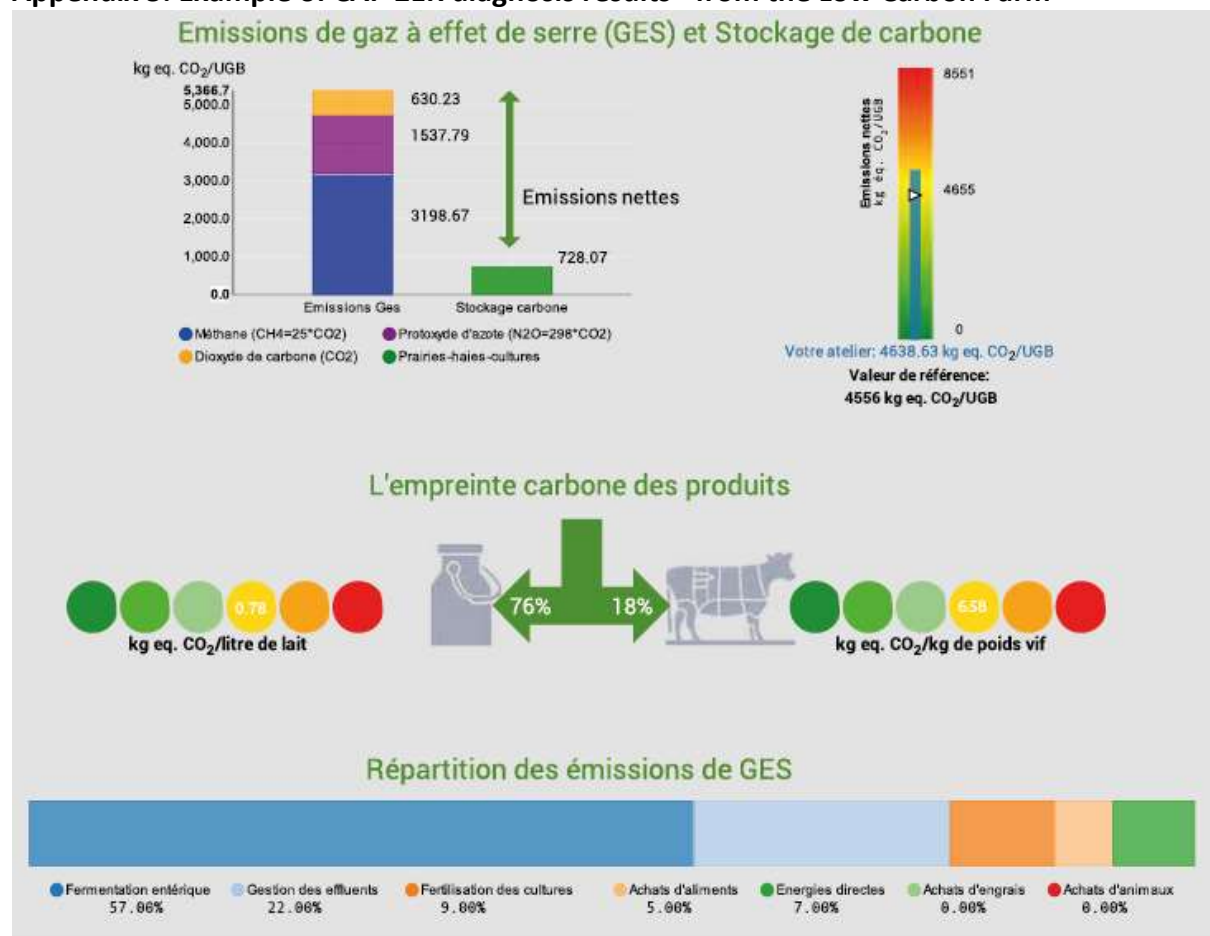
Appendix 4: USDA NRCS Ranking Tool for Resilience and Carbon Sequestration

NRCS Practice Standards that Build Resilience to Extreme Weather Events and Sequester Carbon			
Qualitative Ranking N=Neutral	Practice Code	Practice Standard and Associated Information Sheet	Beneficial Attributes
	327	Conservation Cover (Information Sheet)	Establishing perennial vegetation on land retired from agriculture production increases soil carbon and increases biomass carbon stocks.
	329	Residue and Tillage Management, No Till/Strip Till/Direct Seed (Information Sheet)	Limiting soil-disturbing activities improves soil carbon retention and minimizes carbon emissions from soils.
	379	Multi-Story Cropping	Establishing trees and shrubs that are managed as an overstory to crops increases net carbon storage in woody biomass and soils. Harvested biomass can serve as a renewable fuel and feedstock.
	380	Windbreak/Shelterbelt Establishment (Information Sheet)	Establishing linear plantings of woody plants increases biomass carbon stocks and enhances soil carbon.
	381	Silvopasture Establishment	Establishment of trees, shrubs, and compatible forages on the same acreage increases biomass carbon stocks and enhances soil carbon.
	512	Forage and Biomass Planting (Information Sheet)	Deep-rooted perennial biomass sequesters carbon and may have slight soil carbon benefits. Harvested biomass can serve as a renewable fuel and feedstock.
	612	Tree/Shrub Establishment (Information Sheet)	Establishing trees and shrubs on a site where trees/shrubs were not previously established increases biomass carbon and increases soil carbon. Mature biomass can serve as a renewable fuel and feedstock.
	606	Forest Stand Improvement (Information Sheet)	Proper forest stand management (density, size class, understory species, etc.) improves forest health and increases carbon sequestration potential of the forest stand. Managed forests sequester carbon above and below ground. Harvested biomass can serve as a renewable fuel and feedstock.

Qualitative Ranking N=Neutral	Practice Code	Practice Standard and Associated Information Sheet	Beneficial Attributes
	332	Contour Buffer Strips (Information Sheet)	Permanent herbaceous vegetative cover increases biomass carbon sequestration and increases soil carbon stocks.
	391	Riparian Forest Buffer (Information Sheet)	Planting trees and shrubs for riparian benefits also increases biomass carbon sequestration and increases soil carbon stocks.
	601	Vegetative Barrier	Permanent strips of dense vegetation increase biomass carbon sequestration and soil carbon.
	650	Windbreak/Shelterbelt Restoration (Information Sheet)	Restoring trees and shrubs to reduce plant competition and optimize planting density increases carbon sequestration.
Qualitative Ranking N=Neutral	Practice Code	Practice Standard and Associated Information Sheet	Beneficial Attributes
	311	Alley Cropping	Trees and/or shrubs are planted in combination with crops and forages. Increasing biomass density increases carbon sequestration and enhances soil carbon stocks.
	390	Riparian Herbaceous Cover	Perennial herbaceous riparian cover increases biomass carbon and soil carbon stocks.
	550	Range Planting (Information Sheet)	Establishing deep-rooted perennial and self-sustaining vegetation such as grasses, forbs, legumes, shrubs and trees improves biomass carbon sequestration and enhances soil carbon.
	603	Herbaceous Wind Barriers (Information Sheet)	Perennial herbaceous vegetation increases biomass carbon sequestration and soil carbon.
Qualitative Ranking N=Neutral	Practice Code	Practice Standard and Associated Information Sheet	Beneficial Attributes
	346	Residue and Tillage Management, Ridge Till (Information Sheet)	Ridge planting promotes organic material accumulation that increases soil carbon. Reconstruction of ridges in the same row year after year will maximize organic matter buildup in the row. Shallow soil disturbance maintains soil carbon in the undisturbed horizons.

Qualitative Ranking N=Neutral	Practice Code	Practice Standard and Associated Information Sheet	Beneficial Attributes
	342	Critical Area Planting (Information Sheet)	Establishing permanent vegetation on degraded sites enhances soil carbon and increases carbon sequestration by adding vegetative biomass.
	344	Residue Management, Seasonal (Information Sheet)	Managing residue enhances soil carbon when crop residues are allowed to decompose on a seasonal basis, increasing soil organic matter and reducing soil disturbance.
	345	Residue and Tillage Management, Mulch Till (Information Sheet)	Soil carbon increases when crop residues are allowed to decompose, increasing soil organic matter and minimizing soil disturbance.
	386	Field Border (Information Sheet)	Permanent vegetative field borders sequester carbon and increase soil carbon content.
	393	Filter Strip (Information Sheet)	Herbaceous vegetation in filter strips has slight carbon sequestration benefits and enhances soil carbon.
	412	Grassed Waterway (Information Sheet)	Perennial forbs and tall bunch grasses provide slight carbon sequestration benefits, minimize soil disturbance, and increase soil carbon.
	422	Hedgerow Planting (Information Sheet)	Woody plants and perennial bunch grasses increase biomass carbon stocks and enhance soil carbon.
	543	Land Reclamation Abandoned Mined Land (Information Sheet)	Establishment of permanent trees, shrubs, and grasses on abandoned and unmanaged lands increases biomass carbon stocks and enhances soil carbon.
	544	Land Reclamation Currently Mined Land (Information Sheet)	Establishment of permanent trees, shrubs, and grasses increases biomass carbon stocks and enhances soil carbon. Pre-mining baselines are important to establish prior to evaluating any carbon benefits.
	589C	Cross Wind Trap Strips (Information Sheet)	Perennial vegetative cover increases biomass carbon stocks and enhances soil carbon. Minimized soil disturbance also enhances soil carbon.

Appendix 5: Example of CAP'2ER diagnosis results® from the Low Carbon Farm



S: <http://www.ferme-laitiere-bas-carbone.fr/>