Positive Steps towards a low carbon future for the Irish dairy sector

icos
Irish Cooperative Organisation Society

A Report by the ICOS Climate Change Working Group

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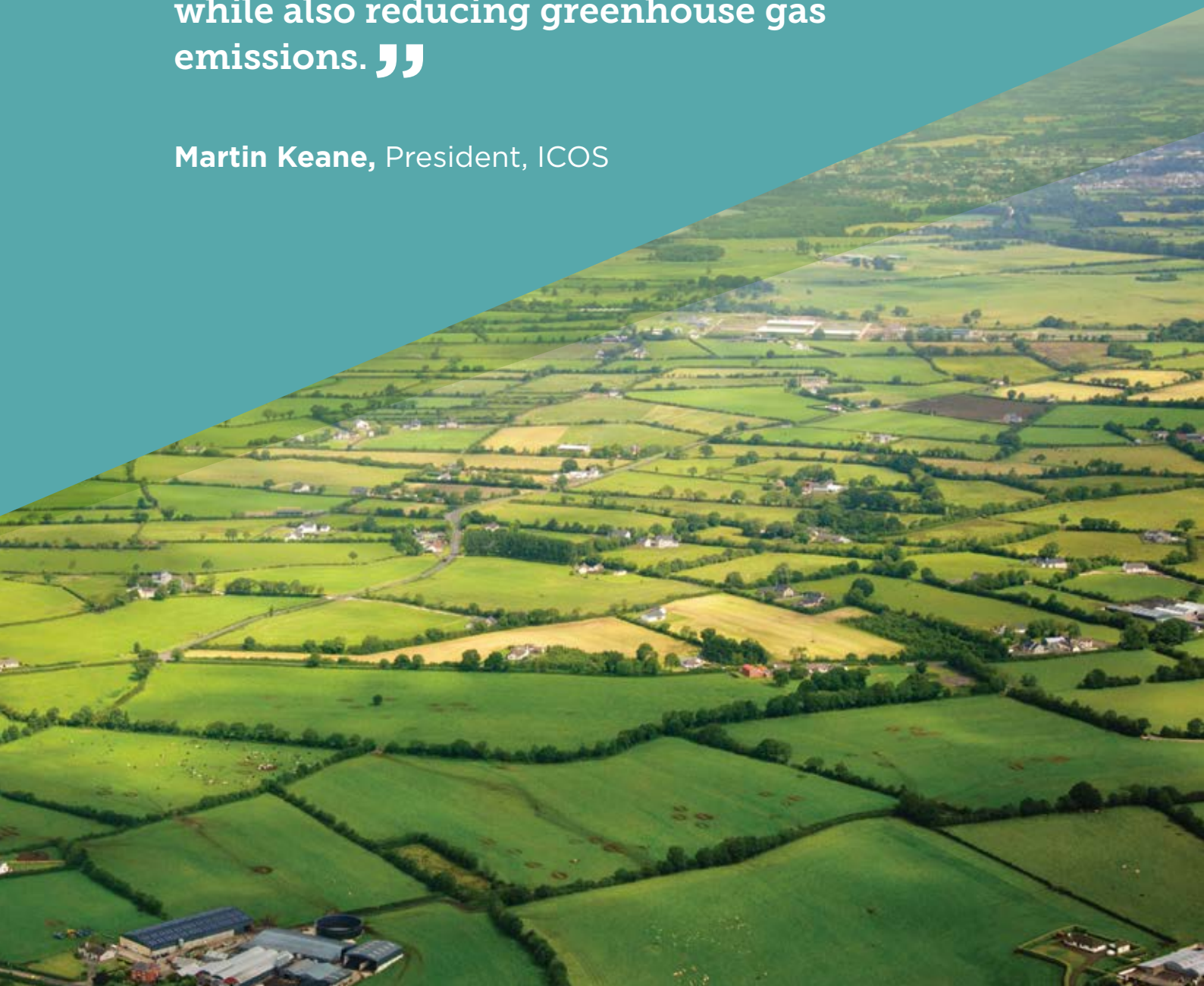
Martin Keane, President, ICOS



ICOS represents over 130 co-operatives in Ireland – including the Irish dairy processing co-operatives and livestock marts – whose associated businesses have a combined turnover in the region of €14 billion, with some 150,000 individual members, employing 12,000 people in Ireland, and a further 24,000 people overseas.

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EXECUTIVE SUMMARY

The Irish Co-operative Organisation Society (ICOS) established a Climate Change Working Group in 2016 following the adoption of the Paris Agreement. This report is a result of discussions held by the Working Group with a range of external experts involved in climate change policy, science and research.

An important function of ICOS is to ensure that co-operative directors elected to oversee their businesses are fully aware of the strategic challenges facing the business environment in which they operate. It is evident that public policy in relation to climate change is evolving very rapidly at National, European and International level. This will result both in challenges and also opportunities for Irish agriculture and food production.

The overall purpose of the report is to equip co-operative directors with a strong understanding of the strategic challenge posed by climate change. The report also outlines a set of recommendations for the Government, state agencies and wider industry to enable Irish agriculture and in particular the Irish dairy sector to make real progress towards a low carbon future. Additionally, the report demonstrates the sustainability credentials of the Irish dairy sector and its capacity to develop in a sustainable manner supporting family farms and employment opportunities in rural areas.

In Ireland, the dairy industry above all other industries has a deep cultural and economic tradition with butter making a key part of rural life for many centuries. The development of the Irish co-operative movement at the turn of last century has helped to transform the sector into the modern businesses of today. The co-operative movement in Ireland is reinforced by the bedrock of the family farm. The family farm and co-operative ownership are the key sustainability building blocks of the entire industry.

The Irish Government in July 2017 published its first Climate Change National Mitigation Plan, which together with the National Policy Position on Climate Change has a stated objective of carbon neutrality for agriculture, forest and land use sectors, so long as sustainable food production is unaffected. The concept of carbon neutrality requires a balance between net emissions and removals. This is a demanding challenge for the entire sector due to the limited mitigation potential in agriculture.

The report recognises that there is no magic bullet solution. Ultimately, we conclude that the effective and widespread sharing of win-win solutions that generate efficiencies at farm level and benefits to the environment is the biggest challenge for all stakeholders to address. The importance of knowledge sharing cannot be overestimated.

Ultimately, mitigation in agriculture and food production will require thousands of farmers implementing more efficient processes and management practices over a sustained period of time. Moreover, climate change mitigation measures must be sustainable at every level as imposing expensive solutions on farmers is a non-runner. Continued focus must be on the promotion of solutions that improve farm financial performance, while also reducing greenhouse gas emissions. Further, there are clear relationships between mitigation measures in the area of climate change and measures to improve water and air quality. These measures need to be maximised in the context of an expanding dairy sector following the ending of milk quotas.

The Irish dairy sector was capped by milk quotas for over 30 years, preventing an industry with a strong competitive advantage to deliver its true value in terms of employment, economic activity and export earnings. Ireland's low cost, grass based system with cows at grass for up to 300 days a year delivers the highest animal welfare, environmental and biodiversity standards. Our approach is underpinned by Origin Green, a national sustainability programme which includes the Sustainable Dairy Assurance Scheme.

I am extremely proud that Irish dairy farmers have been independently assessed as the most carbon efficient in Europe. As farmers, working collectively through our co-operatives we are producing nutritious, safe and healthy dairy foods for an expanding global population. At farm level, we have seen great advances in terms of productivity, efficiency and milk quality standards over recent years. In addition, greenhouse gas emissions from agriculture in Ireland today are 3.5% below 1990 levels.

Globally the carbon metrics of Irish agriculture and the economic value of dairy to Ireland is unrivalled. That said, the dairy industry acknowledges its responsibility to develop in the post quota era in a manner that protects the environment and, as an industry, we fully adhere to the principle of sustainable intensification.

Following an introduction setting the scene, the report outlines the role of co-operatives in delivering sustainable growth and reviews the development of public policy related to climate change and agriculture. The sustainability credentials of the Irish dairy sector are outlined in detail and the importance of fostering knowledge sharing is explained. Finally, a set of recommendations are put forward endorsed by the Working Group and the Board of ICOS.

Martin Keane
President

Acknowledgements

ICOS would like to sincerely thank the members of the Working Group for their time, effort and commitment to this important initiative, especially the subgroup tasked with finalising the report and its recommendations.

ICOS would like to acknowledge our appreciation to all external speakers for giving up their free time to deliver presentations to the working group. Their deep expertise and knowledge in the area of climate change was greatly valued by the Working Group and made this report possible.

Membership of the ICOS Climate Change Working Group (WG):

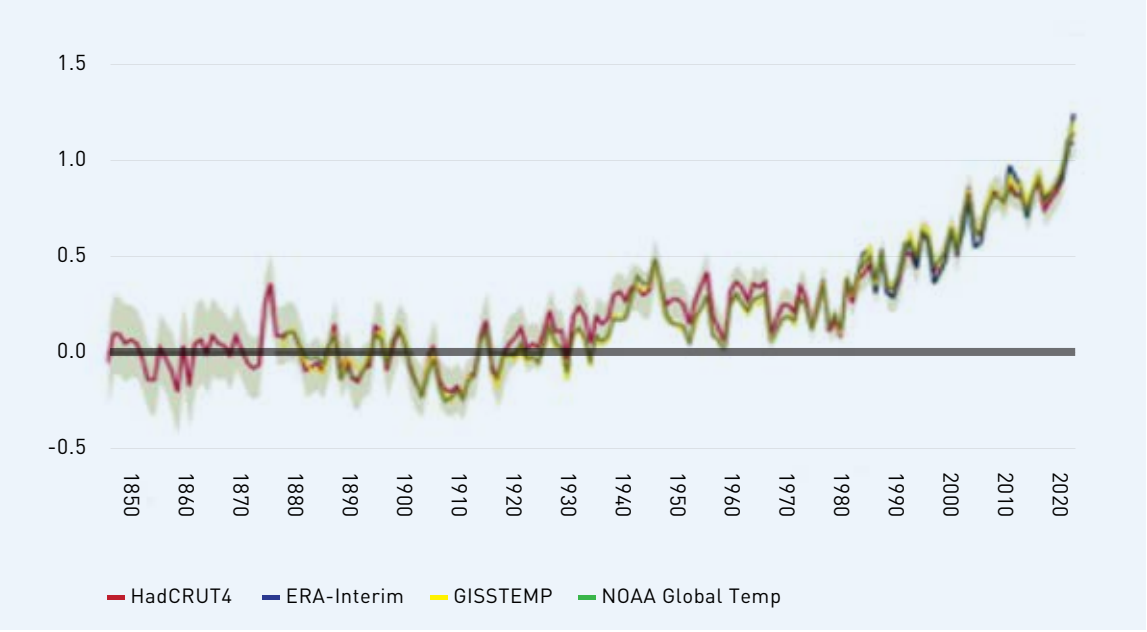
Martin Keane	Irish Co-operative Organisation Society Ltd	Chairman
Michael Spellman	Irish Co-operative Organisation Society Ltd	Vice Chairman
Eamonn Farrell	Irish Co-operative Organisation Society Ltd	Secretary
Jerry Long	Irish Co-operative Organisation Society Ltd	
Jerry Ryan	Arrabawn Co-operative Society Ltd	
Paul Cullinan	Aurivo Co-operative Society Ltd	
Anthony Walsh	Aurivo Co-operative Society Ltd	
Enda Buckley	Carbery Group	
Sinead Treanor	Carbery Group	
Dave Fitzgerald	Dairygold Co-operative Society Ltd	
Ciara Donovan	Dairygold Co-operative Society Ltd	
John Fitzgerald	Glanbia Ireland	
Audrey O'Shea	Glanbia Ireland	
Sean McCarthy	Kerry Agribusiness	
Paul Crosson	LacPatrick Co-operative Society Ltd	
Rory Farrell	Lakeland Dairies Co-operative Society Ltd	
Philip Cocoman	Ornua Co-operative Society Ltd	
Jeanne Kelly	Ornua Co-operative Society Ltd	
Kieran Maguire	Tipperary Co-operative Society Ltd	
Peter Murphy	Tipperary Co-operative Society Ltd	

Setting the Scene - Climate Change and the Irish Dairy Sector

Climate change due to global warming is an important strategic challenge facing Irish and global agriculture.

The evidence that our planet is warming due to human activity is unequivocal[1]. Global temperature has increased by 0.85 degrees since 1880 as outlined in Figure 1[2].

FIG 1 | Global Temperature since 1880

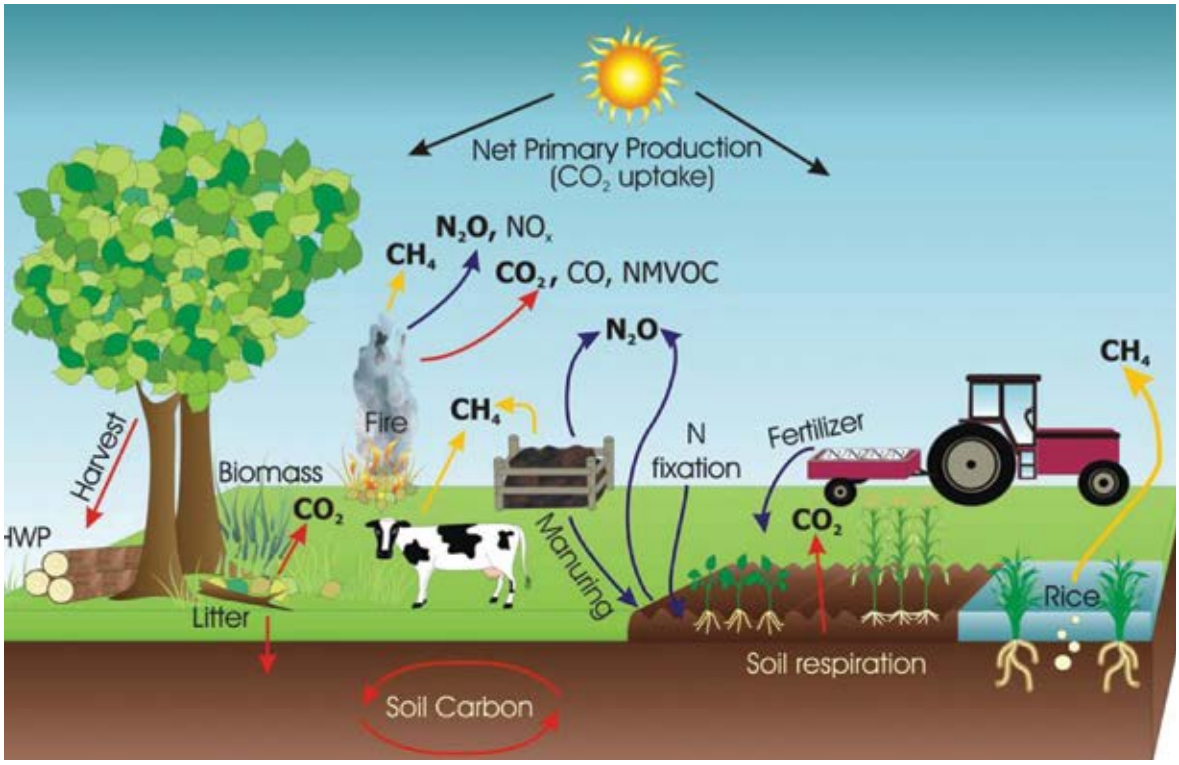


Source: European Environment Agency[3]

Global warming is caused by increasing levels of greenhouse gases in the atmosphere[1]. There are many greenhouse gases particular to various economic activities. In Ireland, farming activity due to complex natural processes results in greenhouse gas emissions, predominately methane through enteric fermentation from the digestive systems of ruminant livestock and stored manure and nitrous oxide results from soils. This is illustrated in Figure 2.

1 Carbon dioxide, methane, nitrous oxide, hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF6) are greenhouse gases.

FIG 2 | The main greenhouse gas emission sources/removals and processes in managed ecosystems



CO (Carbon Monoxide); CO_2 (Carbon Dioxide); CH_4 (Methane); N (Nitrogen); N_2O (Nitrous Oxide); NO_x (Nitrogen Oxide); NMVOC (Non-methane volatile organic compounds).

Source: IPCC[4]

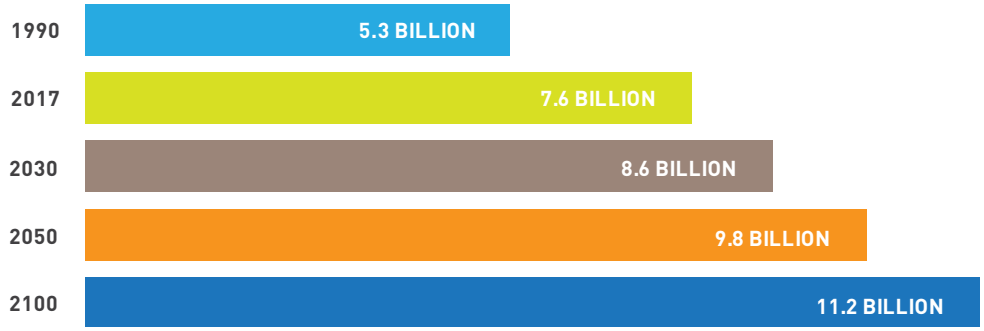
As described in Figure 3, the UN estimates that the world population is expected to increase from 7.6 billion today, to reach 8.6 billion in 2030, 9.8 billion in 2050 and surpass 11.2 billion in 2100[5]. Agricultural systems throughout the world will have to provide extra food to feed a growing population.

Globally, the nexus of water, food and energy security is central to sustainable development. The UN Sustainable Development Goals includes several priority areas relevant to agriculture and food production including the zero hunger target by 2030, the sustainable use of natural resources and climate action[6].

By 2050, the planet will need to produce 70% more food, while conserving available land, water and energy resources and reducing greenhouse gas emissions[7]. The challenge is exacerbated by the reality that one third of food produced for human consumption is wasted[8]. Consequently, effective climate change policy measures at Global and EU level must address both demand and supply related factors.

The report will examine on-farm emissions along the dairy food chain, which contribute between 78% and 83% of total life cycle emissions[9]. In this context, the agri-food sector can positively address climate change in a number of ways bearing in mind that climate change mitigation strategies must be measurable, verifiable and additional.

FIG 3 | Global Population Projections



Source: UN

This includes reducing emissions through the adoption of cost effective mitigation measures at farm level. However, the mitigation potential of agriculture and food production is limited compared to other economic sectors. This is because emissions from the agri-food sector stem from biological processes.

Consequently, the widespread adoption of mitigation measures in agriculture will require significant investment and resources in knowledge sharing programmes. The report includes the concept of knowledge sharing in preference to knowledge transfer. According to a recent Nuffield Scholarship Report, the term knowledge transfer is obsolete and implies a top down approach to adult learning[10]. ICOS agrees with this conclusion as the expertise, capabilities and know-how of farmers must be fully utilised so as to achieve the widespread adoption of climate change mitigation measures.

Additionally, soil management, improved grassland management and afforestation as illustrated in Figure 2 are vital mitigation measures in the toolbox needed to reduce emissions associated with food production. In fact, soils can store three times the amount of carbon located in the atmosphere and four times more carbon than above ground vegetation[11].

Forestry and agriculture are fundamentally linked as every new hectare of woodland grown must come from agricultural land. There is also real potential in Ireland to increase forest cover with only 11% of Ireland's total land area under forestry, compared to the EU average of 37%. The objective of forestry policy in Ireland is to increase forest cover to 18% by 2046.

Moreover, individual farmers and groups of farmers with appropriate support can further mitigate against climate change through the uptake of renewable energy technologies and production of renewable fuels. For example, biogas from anaerobic digestion and solar panels on farm buildings.

Finally, a critical factor to consider is that agriculture will be impacted by evolving climatic conditions. In an Irish context, this is likely to mean more extreme storms, wetter winters and drier summers by mid-century. In order to minimise the impact of climate change on Irish agriculture, ICOS welcomes the development of an adaptation plan for the sector by the Department of Agriculture, Food and the Marine.

The role of co-operatives in delivering sustainable growth

Dairy farming is deeply ingrained into the cultural and social history of Ireland. From the 17th century, butter has been an important Irish export through the famous Cork butter market. The 19th century witnessed the formation of co-operative creameries throughout Ireland.

Today, the Irish dairy sector remains chiefly farmer owned and controlled. Our co-operative approach is a resilient and successful business model which endeavours to support co-op members in good and bad times. Fundamentally, the Irish co-operative movement is built on the foundation of the family farm model. The agri-food sector provides much needed employment in rural areas, enabling rural communities to prosper, and families from one generation to the next to live and work in their local area.

The three pillars of sustainability are economic, social and environment. These pillars of sustainability are closely aligned with the core co-operative ethos of better farming, better business and better living.

FIG 4 | The three pillars of sustainability

Source: ICOS

For a farm to be truly sustainable the farming enterprise must have a viable future that includes protecting the natural capital on which it relies. The sector is strongly committed to the sustainable growth of the dairy industry that protects the environment, ensures a sustainable living for family farms and fosters economic activity and employment in rural Ireland.

Sustainability is a key focus of the Irish dairy sector at processing and farm level. At processing level, Irish dairy co-operatives in recent years have made significant investments in green technologies and lean manufacturing to drive energy efficiencies.

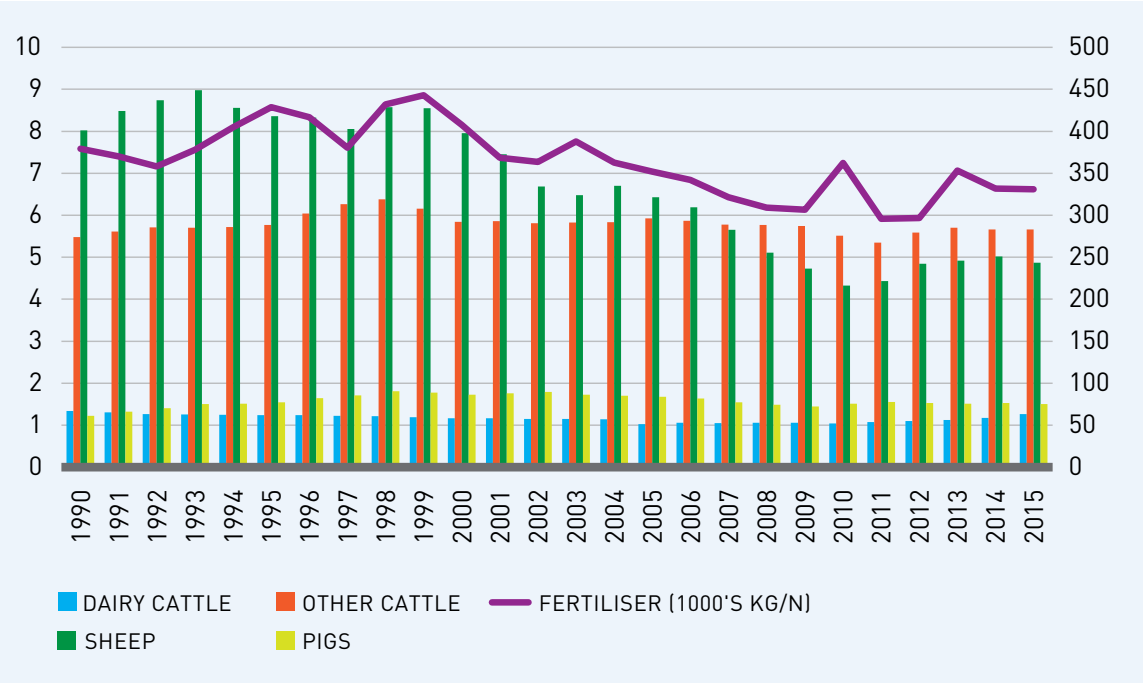
There are seven co-operative principles including 'education and training' of co-operative members and 'care for the community'[12]. Irish dairy co-operatives in particular are investing significant resources in farm advisory and support teams to upskill and train their members. Significant resources are deployed by co-operatives in assisting members with the requirements of the Sustainable Dairy Assurance Scheme, milk quality programmes and a range of herd health initiatives. Furthermore, the proactive role played by the co-operative sector in delivering a co-ordinated response to the fodder crisis in 2013 is an example of the sectors commitment to its members and the broader rural community.

Public policy in the area of climate change and agriculture

Greenhouse Gas (GHG) emission inventories are calculated based on activity data (e.g. cattle numbers or fertiliser sales) and emission factors (emissions associated per activity).

Figure 5 below details the population of animals and usage of fertiliser in Ireland over the period since 1990, which is the basis for calculating agricultural emission inventories[13].

FIG 5 | Movement in livestock populations and fertiliser usage in Ireland 1990-2015



Source: DAFM

Teagasc is projecting that dairy cow numbers will increase to 1.6 million head by 2025 (from 1.35 million head in 2016)[14]. However, the Environmental Protection Agency (EPA) estimates that the beef herd will contract by 11% between 2020 and 2035 from 5.6 million head to 4.9 million head[15].

Methane and nitrous oxide are the main GHG's resulting from farming activity. Methane is 25 times more potent as a GHG than carbon dioxide but only remains in the atmosphere for a period of 12.4 years. Nitrous oxide is 298 times more potent as a GHG. It has a longer atmospheric lifetime of 120 years. For emission inventories, methane and nitrous oxide are converted into carbon dioxide equivalent.

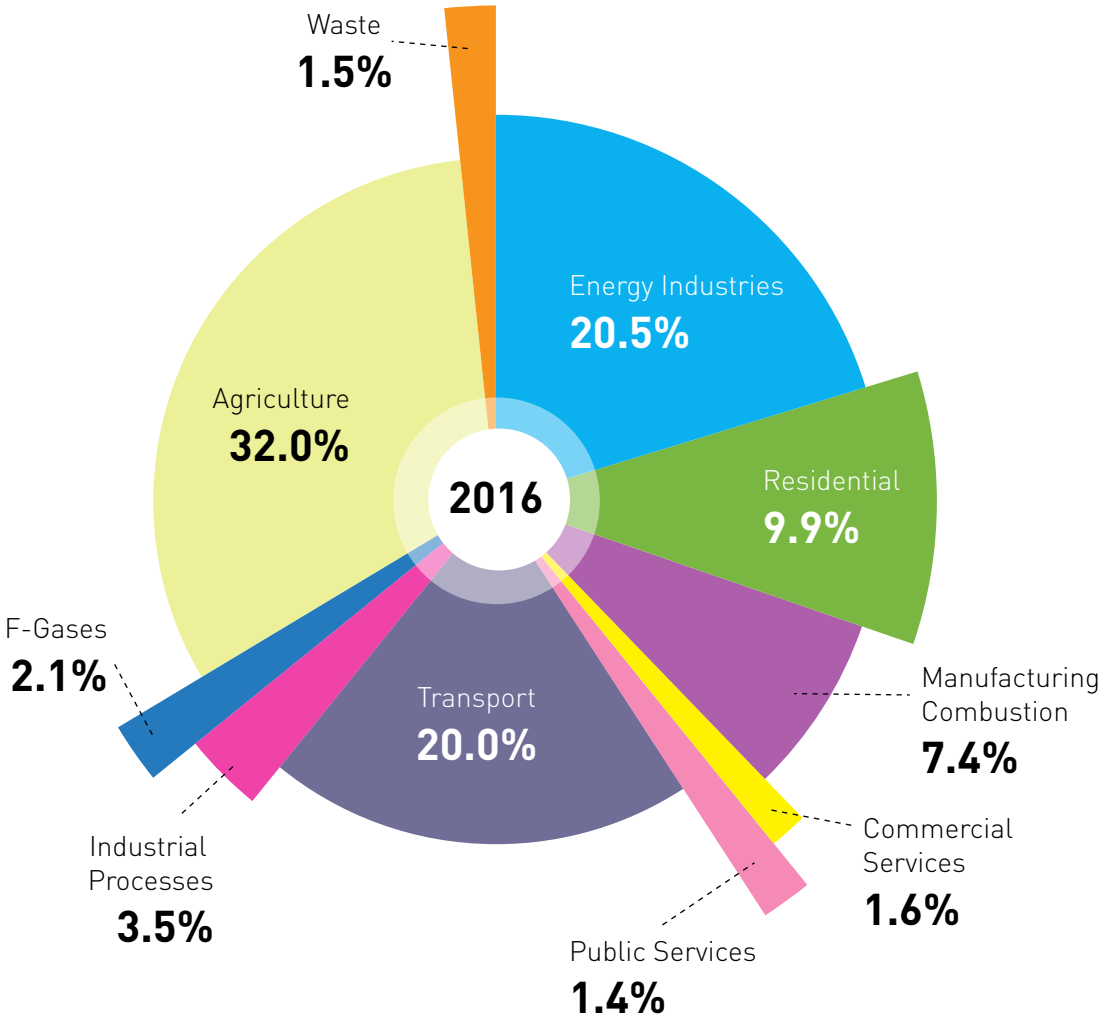
It is necessary to recognise the shorter lifespan of methane in the atmosphere. As such, methane can be described as a flow gas, compared to other GHG's which build in the atmosphere over a longer time horizon.

In addition, ICOS welcomes the work undertaken by Teagasc to refine emission factors to Irish conditions. This relates to nitrous oxide emissions based on fertiliser type, dung and urine deposited Nitrogen and timing of application and impact of soil type.

Teagasc has shown that the emission factor for dung and urine deposited during grazing is considerably lower than the Intergovernmental Panel on Climate Change (IPCC) default value used to calculate the levels of emissions from Irish agriculture. In this context, it is critically important that the emission factors used to measure GHG's under Irish conditions accurately quantify the contribution of Irish agriculture and food production to climate change.

As outlined in Figure 6, agriculture in Ireland accounted for 19.5 million tonnes (mt) CO2 eq in 2016, equating to 32% of total annual emissions[17]. Energy industries (20.5%), Transport (20%), Residential (9.9%) and Manufacturing (7.4%) also contributed significantly on a sector by sector basis.

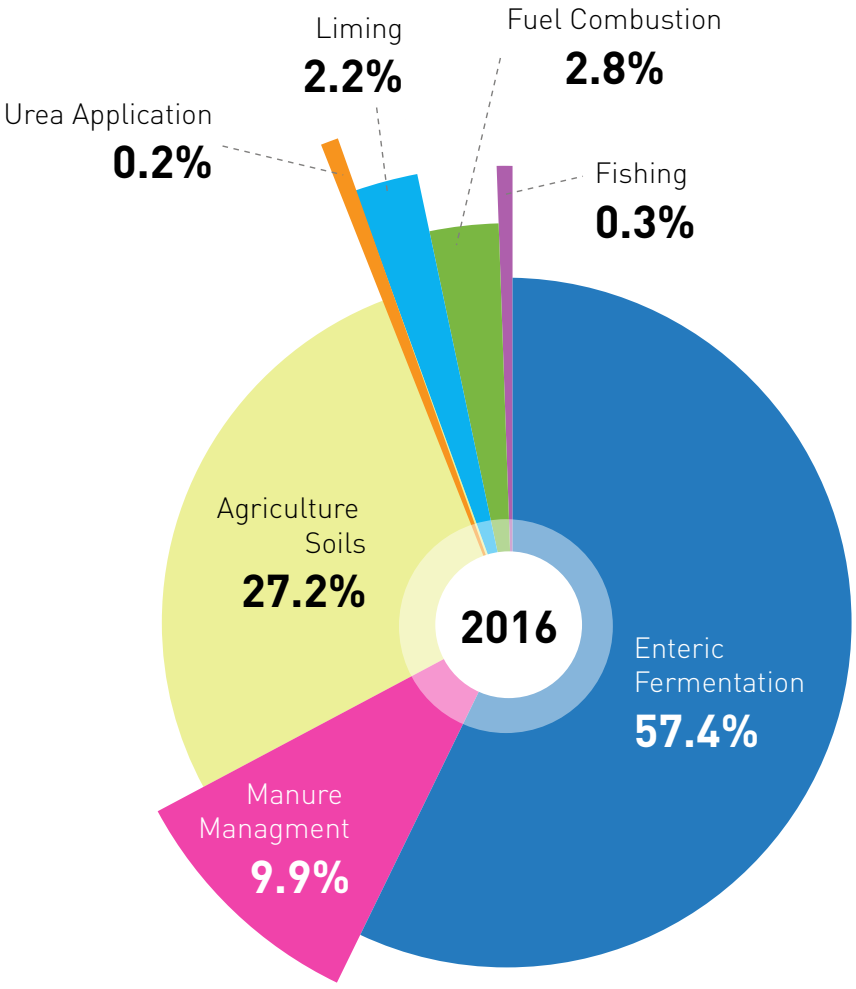
FIG 6 | GHG's Per Economic Sector in Ireland (2016)



Source: EPA

As outlined in Figure 7, enteric fermentation (57.4%), agricultural soils (27.2%) and manure management (9.9%) make up the majority of emissions from Irish agriculture. Liming (2.2%), fuel combustion (2.8%), fishing (0.3%) and urea application (0.2%) contribute to a smaller extent.

FIG 7 | Breakdown of Agriculture GHG's by activity (2016)

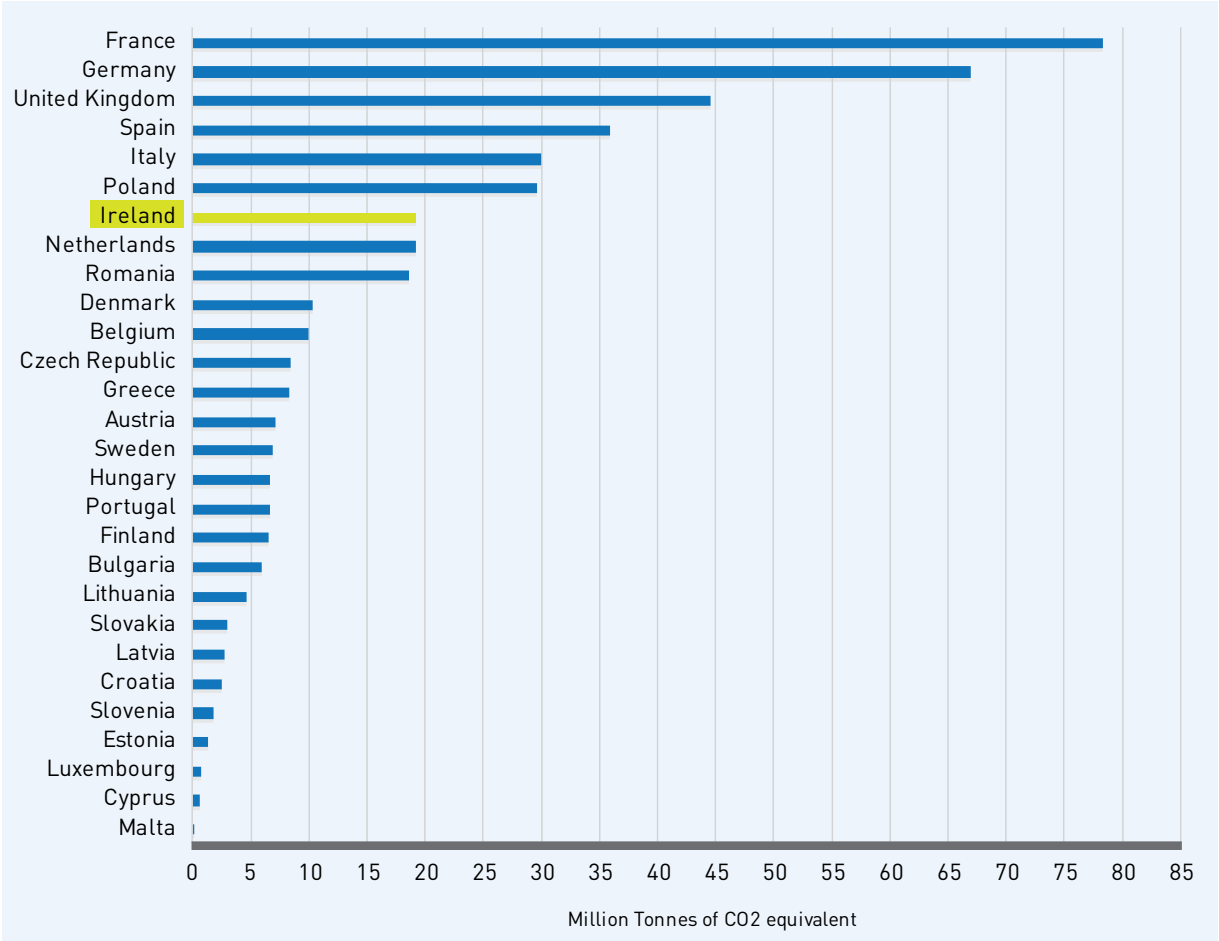


Source: EPA

The proportion of emissions from Irish agriculture is above the global (24%) and EU average (10%). This is due to the relatively large size of our livestock sector and the nature of the Irish economy, which lacks heavy industry. As a result, a disproportionate picture emerges in Ireland as to agriculture's impact on climate change.

As illustrated in Figure 8 below, agricultural emissions in Germany at 66.95 mt CO2 eq are more than three times larger than Irish emissions, yet comprise 7% of total German emissions. Meanwhile, UK emissions at 44.61 mt CO2 eq from agriculture are double the size of Irish emissions, yet comprise 8% of total UK emissions. Among developed nations, only New Zealand has a similar emissions profile with 47.9% of its GHG emissions from agriculture at 38.4 mt CO2 eq (again roughly twice the size of Irish agricultural emissions)[18].

FIG 8 | EU-28 GHG Emissions and Agriculture

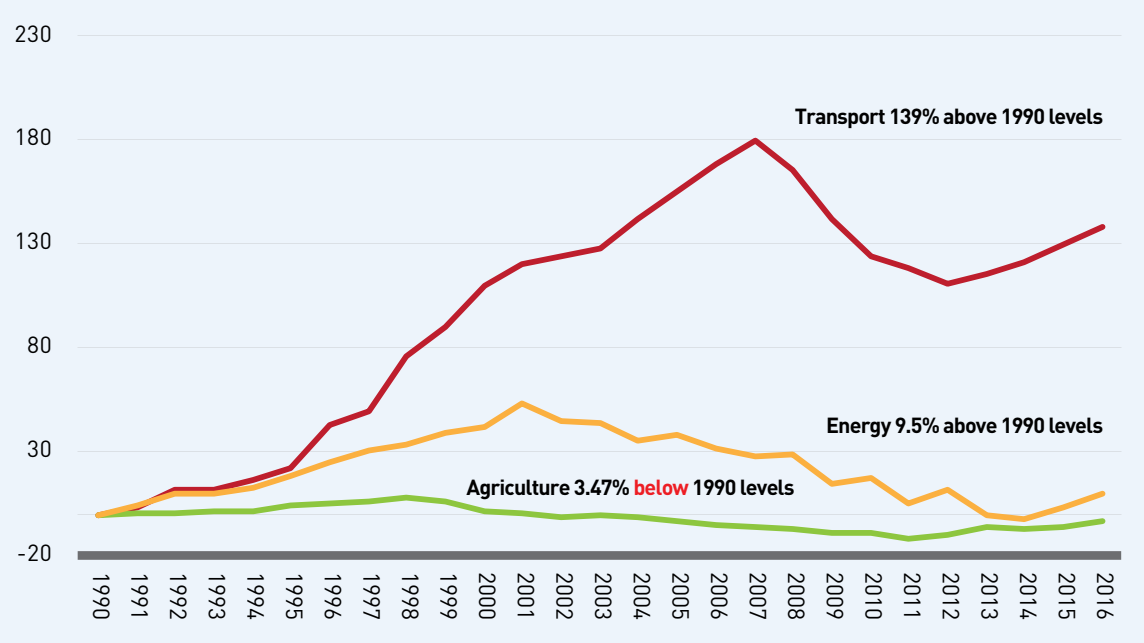


Source: Eurostat[19]

Trends in Irish GHG Emissions since 1990

Since 1990, the baseline year used by the UN to measure climate change reduction, emissions from agriculture in Ireland have fallen by 3.5%. In sharp contrast, emissions from transport have increased by 139%, with energy emissions also up by 9.5%. This is outlined in Figure 9 below.

FIG 9 | Trends in Irish GHG Emissions



Source: EPA[20]

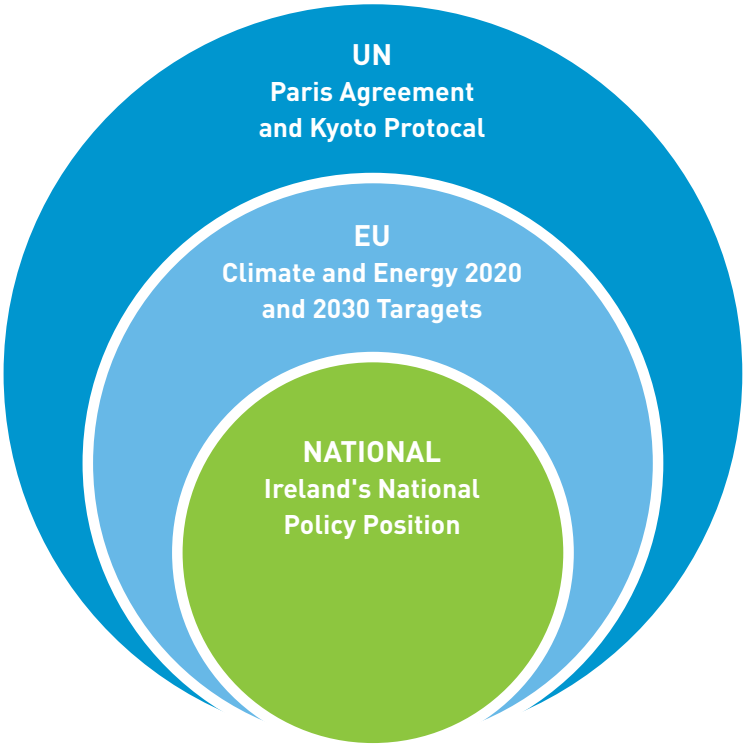
Policy failure to recognise carbon efficient food production

Regrettably, existing climate change policy does little to encourage the consumption of food with a low carbon footprint. In 2010, the EU's Joint Research Centre independently verified that Irish dairy production has the lowest carbon footprint in the EU. The failure to recognise carbon efficient food production is a major shortcoming. As a result, the prospect of carbon leakage is a distinct possibility. Carbon leakage will arise in a scenario where food production is curbed in a country with an efficient production system due to carbon reduction targets but increases in another country with a higher carbon footprint and less rigorous reduction targets.

Climate Change Policy at UN, EU and National

Public policy at international, EU and national level is interlinked with a shared objective to continuously reduce GHG levels in the atmosphere over the short, medium and long term.

FIG 10 | Climate Change Policy Actors



Source: ICOS

The UN Response

In 1992, UN countries signed an international treaty known as the UN Framework Convention on Climate Change (UNFCCC)[21]. The Paris agreement adopted in December 2015 at the UNFCCC Conference of Parties (COP-21) is the latest policy framework established at global level, superseding the Kyoto Protocol.

The Paris agreement reaffirms the objective of limiting global temperature increase to well below 2 degrees Celsius above pre industrial levels, while pursuing efforts to limit the increase to 1.5 degrees.

All parties to the Paris agreement submitted pledges known as Nationally Determined Contributions (NDC). The EU's NDC to the Paris agreement is a binding reduction of at least 40% in GHG emissions by 2030 below 1990 levels.

The EU Response

EU Member States are committed under the EU's low carbon roadmap that, by 2050, the EU should cut its emissions to 80% below 1990 levels.

The Period 2013 to 2020

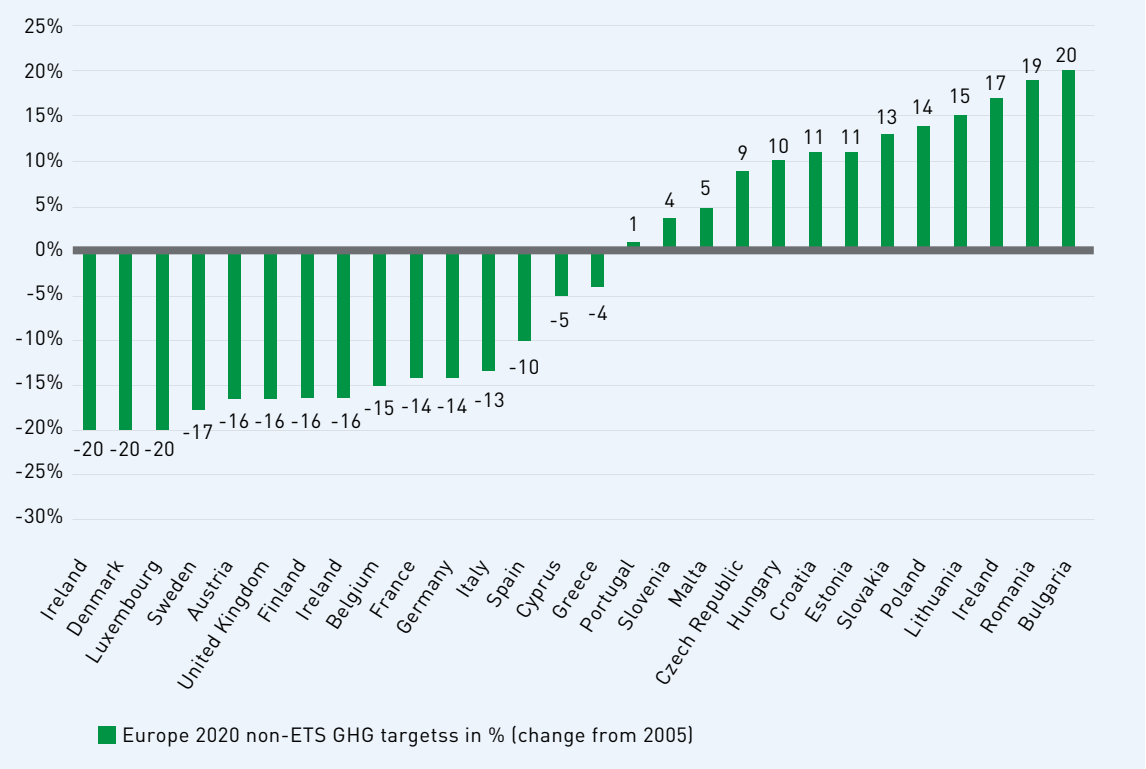
In the immediate term, the 2020 Climate and Energy Package is a set of binding legislation with separate measures for large scale facilities under the Emissions Trading System (ETS) and for sectors not covered under the ETS such as agriculture, housing, transport and waste. Irish dairy processors operate under the ETS system.

The non ETS sectors are legislated under the Effort Sharing Decision (ESD), which established binding reduction targets for Member States for the period 2013 to 2020[22]. Furthermore, Ireland is committed to producing from renewable energy at least 16% of all energy consumed by 2020[23].

As outlined in Figure 11, the ESD set national targets based on economic wealth, measured by GDP per capita. The ESD has an overall EU wide objective of a 10% reduction in combined emissions from agriculture, transport, households etc. across the EU.

Ireland, Denmark and Luxembourg were assigned the largest target of 20% reduction in emissions from non ETS sectors by 2020 below 2005 levels.

FIG 11 | Allocation of Non ETS Reduction Targets by EU Member State (2013-2020)



Source: European Commission[24]

Ireland faces a distinct challenge in meeting its 2020 targets compared to other EU Member States due to the composition of the Irish economy. The agri-food sector is Ireland's largest indigenous industry contributing to 7.6% as a percentage of GVA to the overall economy. Mitigation is therefore particularly challenging due to the limited options available to primary agriculture[25].

The European Council Conclusions in October 2014

The European Council, which represents the highest decision making authority in the EU adopted its 2030 Climate and Energy Framework in October 2014. As outlined in Box 1, the European Council in its conclusions specifically addressed the unique position of agriculture by recognising in particular its lower mitigation potential and the need for coherence between food security and climate change objectives.

Further, the European Council called on the European Commission to recognise in its future policy framework the contribution the sector can make in terms of carbon sequestration, including afforestation.

This is a game changer. In doing so, the European Council recognised the concept of sustainable intensification. The Food Wise 2025 Strategy also incorporates sustainable intensification as an overarching objective for Irish agriculture[26]. Essentially, the concept of sustainable intensification means that food production will have to increase in a manner that protects the environment[27].

BOX 1 | Section 2.14 of the European Council Conclusions October 2014

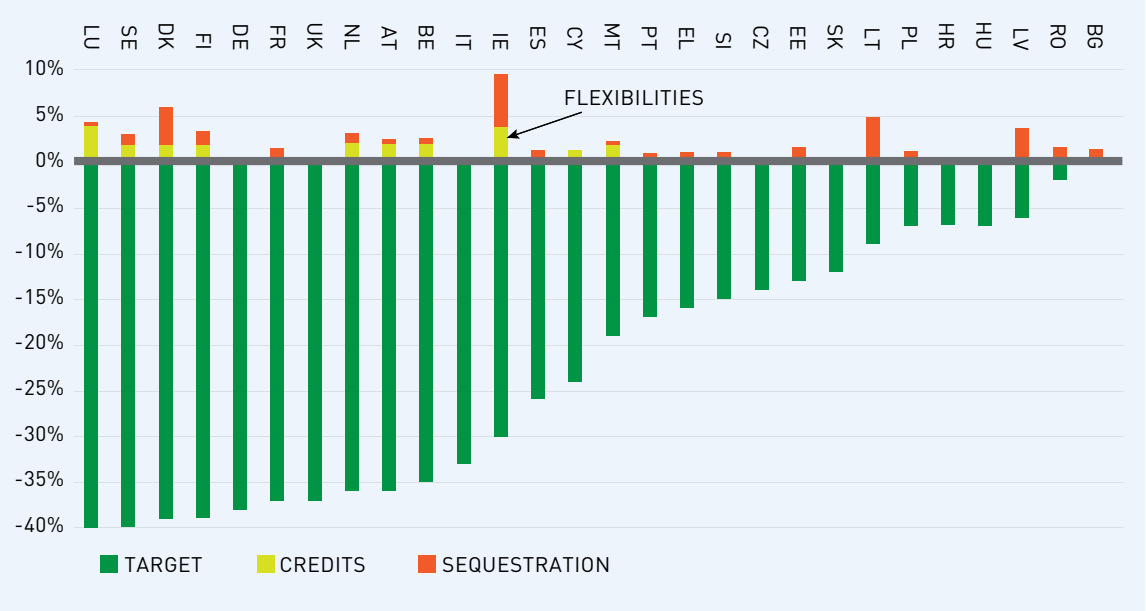
> 2.14 the multiple objectives of the agriculture and land use sector, with their lower mitigation potential, should be acknowledged, as well as the need to ensure coherence between the EU's food security and climate change objectives. The European Council invites the Commission to examine the best means of encouraging the sustainable intensification of food production, while optimising the sector's contribution to greenhouse gas mitigation and sequestration, including through afforestation. Policy on how to include Land Use, Land Use Change and Forestry into the 2030 greenhouse gas mitigation framework will be established as soon as technical conditions allow and in any case before 2020.

The Period 2021 to 2030

Under new legislative proposals issued by the European Commission in July 2016, the ETS sectors have been assigned a 43% reduction below 2005 levels by 2030. Meanwhile, the non ETS sectors have been assigned a 30% reduction below 2005 levels by 2030.

The 2030 Climate and Energy Framework includes a new Effort Sharing Regulation with each EU Member State assigned national targets for the period 2021 to 2030. Outlined in figure 12, the 2030 targets assigned to Member States vary from 0% to 40% with Ireland required to reduce emissions by 30% below 2005 levels by 2030.

FIG 12 | Allocation of Non ETS Reduction Targets by EU Member State (2021-2030)



Source: Teagasc[28]

In a new departure from the Effort Sharing Decision 2013-2020, Member States have been allocated flexibilities under the revised Effort Sharing Regulation to ensure greater fairness including a once off flexibility from the ETS and the use of credits from the land use, land use change and forestry (LULUCF) sector. Ireland has been allocated a 4% flexibility from the ETS and a 5.6% credit from LULUCF, potentially reducing Ireland's overall 2030 target to 20.4% below 2005 levels by 2030.

According to the European Commission access to these credits is higher for Member States with a larger share of emissions from agriculture in line with the guidance from the European Council, which recognises the lower mitigation potential of agriculture.

The inclusion of LULUCF credits is welcome. However, the addition of an arbitrary cap on carbon sequestration is questionable, set at 5.6% in the case of Ireland. This will prevent the maximum use of carbon sinks to offset emissions and inhibit the achievement of carbon neutrality as a horizon point for the agricultural sector.

Ireland's National Policy Position on Climate Change

At national level, the Irish Government in 2014 adopted a National Policy Position on Climate Change[29]. The National Policy Position sets an ambitious reduction target in carbon dioxide emissions of at least 80% compared to 1990 levels by 2050 across electricity generation, the built environment and transport sectors. In parallel, it sets out an approach to carbon neutrality in the agriculture and land use sector including forestry, which does not compromise capacity for sustainable food production.

The Climate Action and Low Carbon Development Act 2015 provides the statutory basis to transition the Irish economy towards the objective as set out under the National Policy Position on Climate Change. The Department of Communications, Climate Action and the Environment is responsible under the Act for the development of National Mitigation and Adaptation Plans. The Act also established the Climate Change Advisory Council, which provides regular reports on Ireland's progress in achieving its national policy goals and EU reduction targets.

In preparation for Budget 2018, the Department of the Taoiseach Risk Assessment has identified climate change as a significant challenge, noting that non-compliance charges will become payable in the event of failing to meet our legally binding EU targets[30].

For 2020, the EPA has estimated that non ETS sector emissions are projected to be 4% to 6% below 2005 levels by 2020[31]. Agriculture and transport emissions dominate the non ETS sector in Ireland. Despite the ending of milk quotas and a significant increase in milk volumes, agriculture emissions are projected to only marginally increase by 1.5% to 2% above 2005 levels. Due to continued improvements in efficiency, emissions per kg of milk solids are likely to decrease over this same period.

The National Mitigation Plan published in July 2017 includes a carbon budget, which estimates a gap to target. The gap between projected emissions and the total amount Ireland can emit to stay within the reduction targets is 13.7 mt CO2 eq in 2020 and 89 mt CO2 eq in 2030 using a business as usual scenario. This indicates that while Ireland is likely to breach its emissions budget in 2020, a much greater challenge will arise during the 2021-2030 period.

Due to the limited mitigation potential of agriculture, the proportion of emissions from the agricultural sector is likely to increase as other sectors decarbonise due to technological advancements e.g. electric car transport.

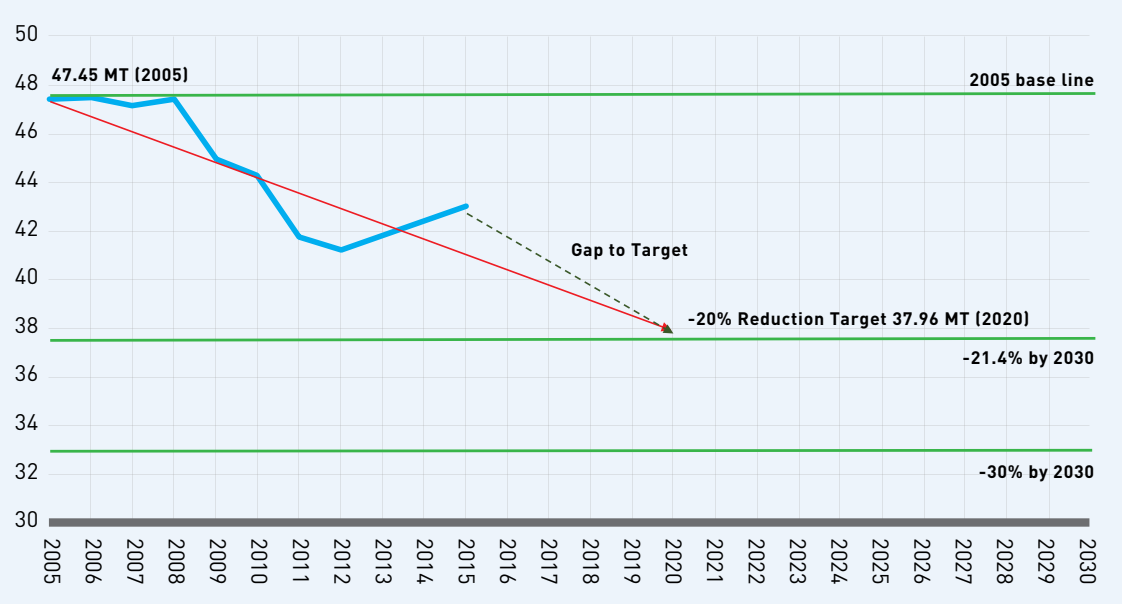
It is therefore vital to take a wider understanding of the potential of the agricultural sector to contribute to climate change mitigation. For example, there is significant potential for small scale renewable energy projects on farms. However, from a climate change accounting perspective, it is the energy sector that will benefit from the reduction in GHG emissions associated with on-farm renewables and energy efficiency improvements on farms. Another limiting factor relates to fertiliser use. For example, where fertiliser use is reduced then the emissions from the production of that fertiliser is not credited.

In the area of renewable energy, ICOS believes there is significant learnings from the Netherlands with the Dutch Government providing a €200 million subsidy for the installation of solar panels on farm buildings and a separate €130 million subsidy for the installation of biogas digesters.

Summary of International, EU and National Targets

Figure 13 below summaries Ireland's non ETS targets for the period to 2020 and 2030. Further, it outlines the potential gap to target. In Tables 1 to 5, the range of GHG reduction targets established at UN, EU and National level are outlined.

FIG 13 | Ireland's 2020 and 2030 (proposed) targets for the Non ETS sectors



Source: EPA/ICOS

TABLE 1 | GHG reduction targets at UN – Assigned to the EU

UN Agreement	Reduction target	Period	Baseline
Kyoto Protocol (1st Stage)	8%	2008-2012	1990
Kyoto Protocol (2nd Stage)	20%	2013-2020	1990
Paris Accord – EU's National Determined Contribution	40%	2021-2030	1990

TABLE 2 | Emissions Trading System reduction targets - EU level

Period	Reduction target	Baseline
2013-2020	21%	2005
2021-2030	43%	2005

TABLE 3 | Non ETS reduction targets - EU level

Period	Reduction target	Baseline
2013-2020	10%	2005
2021-2030	30%	2005

TABLE 4 | Non ETS reduction targets – Assigned to Ireland

Period	Reduction target	Baseline
2013-2020	20%	2005
2021-2030	30% (20.4% with credits)	2005

TABLE 5 | Long term reduction targets at EU and National level

Region	Reduction target	Period	Baseline
EU	80%	2050	1990
Ireland*	80%	2050	1990

*Excludes agriculture and the land use sector

Ireland as a partner of choice for sustainable agriculture

Ireland's dairy products and ingredients are sold in over 155 countries worldwide, valued at €3.38 billion. The dairy sector exports to a multiple of Ireland's national population, a nutritious food source that is certified as the most carbon efficient in Europe.

Grass based dairy and beef production is the backbone of Irish farming and underpins the cost competitiveness and sustainable credentials of Irish agriculture and food production.

Livestock in Ireland is reared on permanent pasture, with grass or silage making up to 83.6% of a typical dairy cow diet. There are 6.6 million cattle in Ireland including 1.35 million dairy cows. 81% of all agricultural land is used for grass production (hay, silage or pasture).

The importance of grass based agriculture is highlighted by the decision of the Department of Agriculture, Food and Marine to designate 2017 as the Year of Sustainable Grassland to acknowledge this most important productive and sustainable source of livestock nutrition.

Ireland benefits from a temperate climate, perfect for growing grass and a long grazing season. This enables superior animal welfare conditions on Irish farms, greatly valued by customers throughout the world. Globally 80% of milk is produced in confinement based production systems, in contrast to Ireland where cows are at grass for up to 300 days a year.

Most importantly it is worth remembering that Ireland's sustainable production system enables ruminant cattle to convert grass, which is a material non-digestible to humans into valuable protein nutrition such as milk and meat. In comparison, confinement based systems use edible protein to produce more protein. For example, one third of the world's cereal output is used as animal feed for poultry, pork, dairy and beef production. It is vitally important to consider the full life cycle of a production system when assessing livestock emissions.

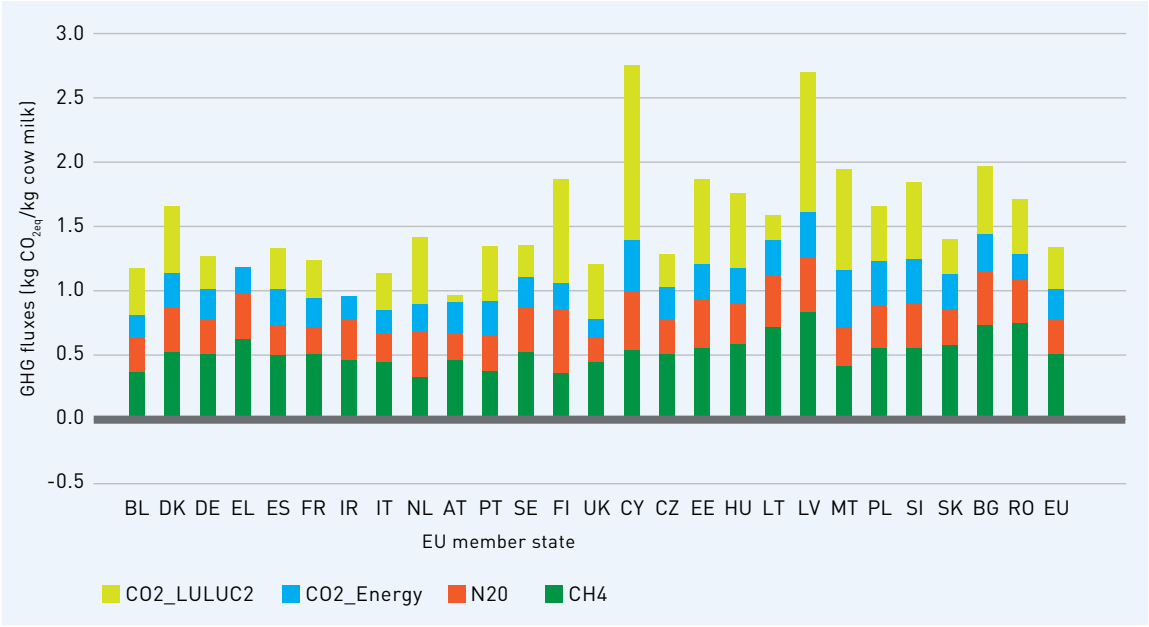
Milk and dairy products derived from grass fed cows has superior composition and sensory qualities. For example, increased beta-carotene from fresh pasture gives Irish butter its characteristic yellow colour and beautiful taste.

Dairy foods are a rich source of essential nutrients that contributes to a healthy and nutritious diet. In the European diet, dairy provides 40% to 70% of total calcium intake. Dairy makes an important contribution to riboflavin, vitamin B12 and iodine intake. Additionally, dairy delivers high quality protein, phosphorus, zinc and potassium in the European diet[32].

There are serious health risks associated with non-dairy diets described as a "ticking time-bomb" by the Irish and British Osteoporosis Society. A deficiency of dairy in diets, especially among teenagers and young adults who are more susceptible to so called fad diets will result in the development of weaker and more fragile bones with long term health consequences[33].

The European Commission's Joint Research Centre Report in 2010 recognised Ireland's dairy sector as the most carbon efficient in Europe (See Figure 14). Irish milk emissions were 1kg per kg of product, compared to the EU average of 1.4 kg per kg of product. Ireland's emissions per kg of beef were 18.4 kg per kg of product, well below the EU average of 22.2 kg per kg of product.

FIG 14 | GHG Emissions per kg of milk by EU Member State



Source: EU's Joint Research Centre[34]

Irish farmland systems have a competitive advantage in terms of biodiversity with rich networks of wildlife areas on many Irish farms including field boundaries, hedgerows, transitional grasslands, greenways and woodland.

A study of grassland farms in the South East of Ireland found that 14.3% of the land area on farms comprised of biodiversity habitats, a proportion substantially greater than estimates from other European countries[35].

Furthermore, more than 40% of the global population is projected to be living in areas of severe water stress by 2050 with agriculture accounting for 70% of global withdrawals of water. A study conducted on Irish dairy farms has shown that the average water consumption is 6.5 litres of water per litre of milk produced. This is dramatically below any international standard, with drought often commonplace in major dairy regions throughout the world.

Irish farmers also abide by a wide range of cross compliance obligations under the Common Agricultural Policy (CAP) and the Greening element under pillar one. They also take part in a range of climate focused schemes under the Rural Development Programme such as the Beef Data and Genomics Programme (BDGP), the Green Low Carbon Agri Environment Scheme (GLAS), Knowledge Transfer Programmes, the Targeted Agricultural Modernisation Scheme (TAMS) and the Afforestation scheme.

There are also several examples of positive initiatives to drive sustainable farming such as the Smart Framing Programme developed by the Irish Farmers Association and the Pasture Profit Index and the Nutrient Management Programme (NMP) online tool developed by Teagasc.

The Sustainable Dairy Assurance Scheme:

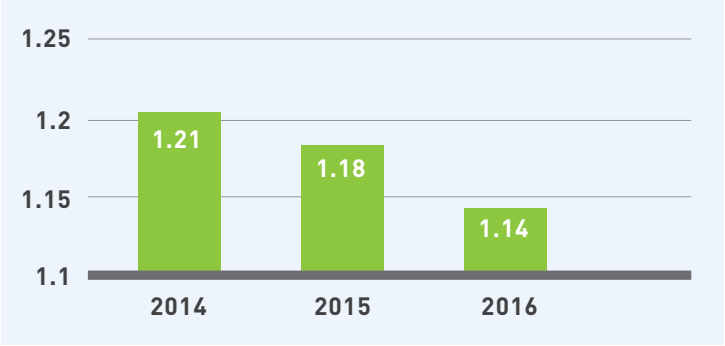
With the help of Bord Bia and Origin Green, Ireland is positioning itself as a partner of choice globally for sustainably produced milk and dairy products.

The Sustainable Dairy Assurance Scheme independently audits our farm's credentials and is an essential component in meeting customer expectations and maximising returns from global markets.

Each participant in SDAS carries out a carbon assessment using the carbon navigator tool which measures key performance criteria such as the grazing season, EBI, Nitrogen fertiliser, manure management and energy usage.

The carbon navigator tool creates the average carbon figure for production on the farm and also indicates where the greatest potential saving can be made in both carbon emissions but also very importantly in financial savings. In doing so, it has mainstreamed the message that carbon efficiency goes hand in hand with economic efficiency.

FIG 15 | Average Carbon Footprint on Irish Dairy Farms 2014-16



Source: Bord Bia[37]

As illustrated above in Figure 15, since carbon assessments began across dairy farms in Ireland in 2012, there has been a consistent downward trend in the average carbon footprint on Irish dairy farms. The carbon footprint of fat and protein corrected milk has reduced from 1.21kg CO2e/kg in 2014 to 1.14kg in 2016.

Important sustainability initiatives and actions at national and international level

Dairy Sustainability Ireland: The Irish dairy sector is fully committed to ensuring the adoption of best practice at farm level to help improve water quality standards and broader environmental objectives. The recent establishment of Dairy Sustainability Ireland is an example of a unique joint industry, farmer and government approach. Dairy Sustainability Ireland will include in its initial phase six co-operative led pilot projects to improve nutrient management planning and on farm point source pollution.

Dairy Sustainability Framework: Irish dairy processors are key members of the dairy sustainability framework. The Dairy Sustainability Framework (DSF) has been developed through a global collaboration within the dairy sector. The DSF established 11 global criteria including GHG's accompanied by statements of strategic intent.

4 per 1000 Initiative: ICOS endorses the "4 per 1000 initiative" launched at the UNFCCC Conference of Parties (COP-21) in December 2015. This means that a 0.4% increase in the world's soil carbon stock per year would make it possible to stop the present increase in atmospheric CO2. The aim of the Initiative is to demonstrate that agriculture and agricultural soils in particular, can play a crucial role where food security and climate change are concerned.

Global Alliance on Climate Smart Agriculture: Furthermore, ICOS supports the work of the Global Alliance on Climate Smart Agriculture. This initiative aims to develop the three objectives of Climate Smart Agriculture, which are to sustainably increase agricultural productivity and incomes; adapt and build resilience to climate change and reducing or removing greenhouse gas emissions from agriculture, where possible.

Fostering Knowledge Sharing

While climate change mitigation associated with agriculture and food production is limited, efforts are continuously being made at farm level to reduce emissions through more efficient management practices.

As detailed in Table 6 below, while certain measures will require further research, there are a range of technical and cost effective mitigation options that ICOS believes should be incorporated into a structured knowledge sharing programme on climate change mitigation. In the context of the debate on the CAP Post 2020, the Commissioner for Agriculture and Rural Development, Phil Hogan has emphasised the need to increase support for advisory and extension services to mitigate climate and water quality challenges. The revised marginal abatement cost curve by Teagasc will also provide an up-to-date cost/benefit analysis of mitigation measures at farm level assisting this process.

TABLE 6 | Farm level mitigation measures

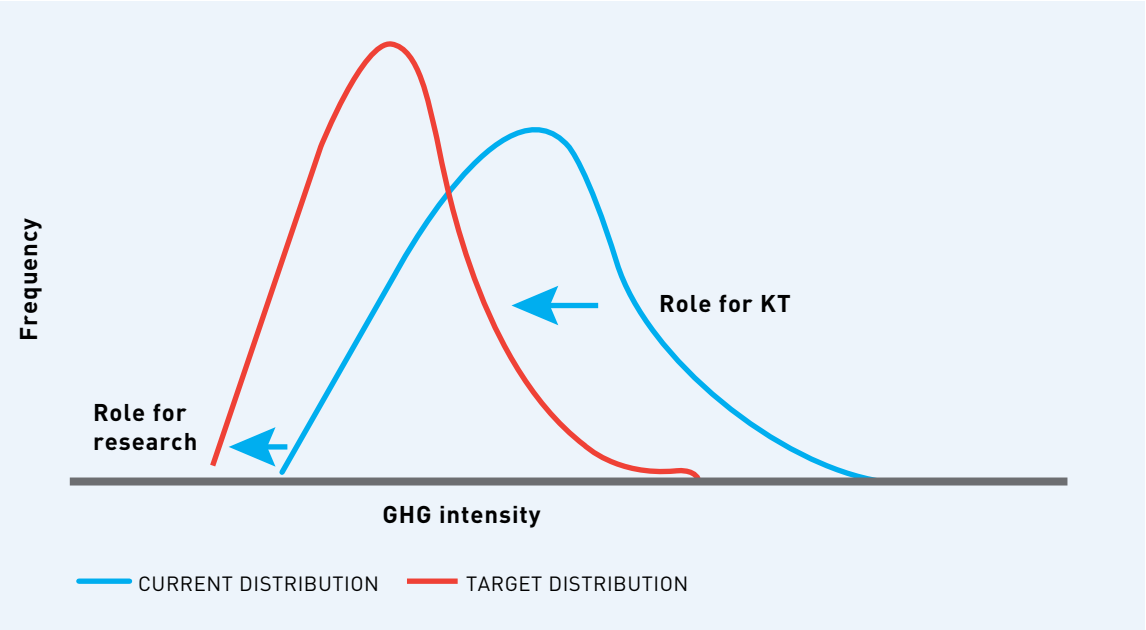
MITIGATION MEASURE	OVERVIEW
EXTENDING THE GRAZING SEASON	Extending the grazing season at early and late lactation improves the digestibility of feed fed to cows and reduces emissions associated with animal housing and storage of slurry.
GRASS CLOVER	A grass clover system has the potential to reduce nitrogen use resulting in less nitrous oxide emissions, while maintaining grass dry matter production per ha.
NUTRIENT MANAGEMENT PLANNING	Better nutrient management planning will improve soil fertility by optimising the use of slurry and applying nutrient inputs in proper balance. Better nutrient management will also generate improvements in water quality standards. For example, lime is key for maintaining good soil pH and fertility. However, lime application rates today are significantly below application levels in the 1980's.
MANURE MANAGEMENT	The timing and method of land spreading can influence nitrous oxide and ammonia emissions from agriculture. Spreading in spring as opposed to summer is more efficient for mitigation of both ammonia and GHG emissions due to soil and climatic reasons. Switching from a splash plate to trailing shoe equipment will also significantly reduce emissions. Further, additives to slurry can reduce methane from housing and manure storage.

MITIGATION MEASURE	OVERVIEW
NITROGEN FERTILISER	Teagasc research trails on a range of grassland types demonstrates that the use of urea protected with an inhibitor called NBPT can reduce greenhouse gas emissions, while delivering a similar yield to CAN. There is need for further research into these promising findings including an analysis on the residue impact on food quality standards.
IMPROVED GENETIC MERIT	Improved genetic merit through EBI can reduce emissions by improving fertility, reducing calving interval and lower replacement rates, increasing milk yield and composition and improved animal health.
SEXED SEMEN	Sexed semen offers significant potential to maximise dairy heifer calf numbers, while also facilitating increased usage of quality beef bulls.
AGE AT FIRST CALVING	By reducing age at first calving, the lifetime performance of the cow increases overall. There is scope for further improvement across the dairy herd with 63% of heifers calved at 22-26 months of age in 2017.
COW'S DIET	With grass based systems there can be an oversupply of protein to the cow, with spring grass in particular high in protein. GHG emissions can be reduced by increasing the emphasis on the energy value of feeds instead of crude protein levels. The supplementation of lipids can reduce methane emissions without impacting milk yield. However, solutions will have to be tailored to our grass based system before widespread adoption.
ANIMAL HEALTH	Ensuring the highest animal health status in herds will contribute to reduced GHG emissions as healthy animals are more productive and there is a lower replacement rate. Improved biosecurity and herd health practices will also contribute to the reduction in antimicrobial usage. In this context, ICOS supports greater uptake of milk recording, and its use in on-farm decision making.
ENERGY EFFICIENCY	Energy usage on dairy farms can be significantly reduced with effective pre cooling in a plate heat exchanger, the use of variable speed drive vacuum pumps and variable speed milk pumps.

Role of Research and Knowledge Sharing

Research into climate change mitigation and the uptake of more carbon efficient management practices must go hand in hand. As outlined in figure 16 below, new research can reduce the GHG intensity of food production but knowledge sharing has an important and equal role in bringing the majority of farmers closer to the most efficient producers.

FIG 16 | The roles of research and knowledge transfer/sharing



Source: Teagasc[38]

Recommendations

1. Knowledge Sharing

ICOS fully endorses the recommendation by Commissioner Hogan to increase funding for extension and advisory services targeted at addressing climate change and other sustainability challenges. ICOS believes that additional support should be used to establish a structured knowledge sharing programme on climate change including one to one engagement and discussion group formats. The programme should be developed with the involvement and support of the DAFM, Teagasc, Bord Bia, co-ops and farm organisations. A detailed understanding of the reasons preventing the adoption of effective mitigation measures should also be carried out including an examination of factors limiting the adoption of best practices such as information gaps, time and cost. The linkages between research and knowledge sharing should be guided by the revised Teagasc Marginal Abatement Cost Curve.

2. EU Budget

The continuation of a well-resourced and strong Common Agricultural Policy (CAP) post 2020, which supports active farmers is an absolute essential. The existing Rural Development Programme includes several important climate change focused initiatives including GLAS, TAMS and the BDGP resulting in positive uptake at farm level. Expenditure cuts to the CAP budget will have a detrimental impact on the ability of the agricultural sector to adopt climate change mitigation measures.

3. Sustainable Dairy Assurance Scheme

ICOS believes that the achievement of full certification under the SDAS is an achievable and realistic ambition, and should be completed in 2018. Teagasc, Bord Bia and the principle stakeholders should continuously examine the use of the carbon navigator as a decision support tool for farmers to ensure that they receive the maximum benefit from the process and information collected.

4. Incentivising carbon efficient food production

While recognising the ongoing need to reduce emissions from agriculture, ICOS supports the development of new and innovative policy options to encourage the consumption of carbon efficient foods. Ultimately, the location of carbon emissions is irrelevant to the climate, it is therefore logical to actively encourage and support food production in regions where it is proven to be less harmful to the climate.

5. Nutrient Management

There is significant scope to improve soil fertility levels in Ireland. The health of our soil is a key factor in the production of food in an environmental and sustainable manner. ICOS recommends the following initiatives in the area of nutrient management:

- **Soil testing:** ICOS recommends that co-ops give consideration to incentivising soil testing for member suppliers as a means to improve nutrient management planning. However, renewed focus is needed by advisory and extension services to ensure soil test results and recommendations are implemented and better understood.
- **Lime Promotion:** ICOS recommends the launch of a national lime promotion campaign to increase application rates, improve soil pH levels and maximise grass yield and availability.
- **Greater use of trailing shoe equipment:** Low emission slurry spreading such as trailing shoe equipment delivers nitrogen to the soil in a more accurate and consistent way. Grant aid is available for low emission slurry spreading under TAMS II and actions are also contained under the GLAS scheme. Nevertheless, the vast majority of farmers and contractors still use traditional splash plates. We recommend the greater up-take and use of trailing shoe equipment by farmers and contractors including the extension of grant aid to agricultural contractors.

6. Sexed Semen

Extensive use of sexed semen has the potential to increase dairy heifer calf numbers, while also enabling an increase in crossbred beef calves. ICOS calls on stakeholders to prioritise further research trials into this area to identify bulls that have no reduction in fertility in sexed sorted semen. All stakeholders including the Department of Agriculture should further consider the potential of developing a permanent sexed semen sorting lab in Ireland.

7. Biodiversity

Sustainability without biodiversity is not sustainability. Irish farmland systems have a unique competitive advantage when it comes to biodiversity and wildlife. In the context of the Reform of the CAP, farmers should be incentivised to maintain on a voluntary basis a habitat management plan on their farms including hedgerow networks, transitional grassland areas and greenways.

8. Afforestation

Ireland has a target to increase forest cover from 11% of total land area to 18% by 2046. This will require an additional 450,000 ha under forestry by mid-century. There is real potential for afforestation in Ireland to offset farm based emissions. However, the targets established will not be achieved without a significant increase in planting from current levels. In the first instance, ICOS recommends the removal of the replanting obligation, which is a significant barrier preventing farmers from converting agricultural land into forestry. In addition, to assist with afforestation targets, ICOS believes that livestock farmers would welcome a worthwhile agro-forestry initiative using native broadleaf trees to increase forestry cover, provide shelter belts, offset emissions and increase biodiversity.

9. Energy Efficiency

Milk pre-cooling and variable speed drives for milking machine vacuum pumps can deliver significant savings in electricity costs and carbon emissions. ICOS welcomes the pilot project developed by Teagasc and the Sustainable Energy Authority of Ireland to make grant aid available for the installation of variable speed drive applied to the vacuum pumps and variable speed milk pumps. This positive initiative should be expanded and rolled out on a permanent basis to dairy farmers nationwide. ICOS recommends the greater availability of three phase power at reasonable cost in rural areas to enable greater uptake of energy efficient technologies on farms, as well as on farm renewable energy infrastructure.

10. Renewable Energy

ICOS fully agrees with the vision set out by the EPA that every farm can be its own power plant. We agree that there is an overwhelming need for transformational thinking to deal with climate change. Unfortunately, the reality is that the current renewable energy options at farm level are uneconomical. Payback periods on investments can vary considerably with solar photovoltaics and solar thermal panels the most feasible options at present. Sensible financial tools are required to stimulate widespread uptake of on-farm renewable energy projects.

ICOS is specifically recommending the following farm scale measures related to renewable energy:

- **Grant aid for solar panels on farm buildings:** ICOS urges the Government to initiate a grant aided solar micro generation scheme using farm buildings in partnership with agricultural co-operatives.
- **AD Biogas:** ICOS calls for a clear governmental strategy involving meaningful support to maximise the potential of AD biogas in Ireland including farm level co-ops, developed in conjunction with the Water Framework Directive objectives. It is a proven technology with significant potential to reduce emissions from stored slurry and manure, reduces nitrous oxide emissions and offset fossil fuel as an energy source.
- **Renewable energy co-ops:** ICOS urges the Government to prioritise the establishment of community led and co-operative projects in the area of renewable energy and micro generation.

11. Research and Technology

Despite the factors limiting mitigation in agriculture, there is a clear need to fund new research and develop new technologies designed to reduce emissions from agriculture. There are exciting innovations in this sphere at different stages of development, which requires ongoing support. These include extracting valorisation from agricultural manure, LIDAR imaging technology to measure carbon sequestration, innovative dietary strategies such as the role of seaweed in reducing methane emissions, smart grassland systems using multi species swards and precision agriculture technology.

Conclusion

ICOS is strongly committed to the sustainable growth of the dairy industry that protects the environment, ensures a sustainable living for family farms and fosters economic activity and employment in rural Ireland. The dairy sector is built on the foundation of co-operative ownership and the family farm model, which underlines our sustainability credentials.

With the help of Bord Bia and Origin Green, Ireland is positioning itself as a partner of choice globally for sustainably produced milk and dairy products. Ireland's low cost, grass based system with cows at grass for up to 300 days a year delivers the highest animal welfare, environmental and biodiversity standards.

Independently, Irish dairy farmers have been assessed as the most carbon efficient in Europe. Globally, agriculture and food production systems will have to provide extra food to feed a growing population. In this context, dairy foods are a rich source of essential nutrients that contributes to a healthy and nutritious diet. The recognition of carbon efficient food production is essential, if the enormous challenges of climate change and global food security are to be addressed in the immediate future.

While recognising the responsibility of the dairy sector to develop in a sustainable manner, the mitigation potential of agriculture is limited with emissions stemming from biological sources. While the report recognises that there is no magic bullet solution, we emphasise the importance of knowledge sharing. Ultimately, the widespread adoption of mitigation measures in agriculture will require significant investment and resources in knowledge sharing programmes.

The report outlines several positive steps that the dairy sector and key stakeholders can take to ensure a low carbon future. However, our recommendations will require the full backing and support from the Irish Government to ensure their implementation.

List of Figures

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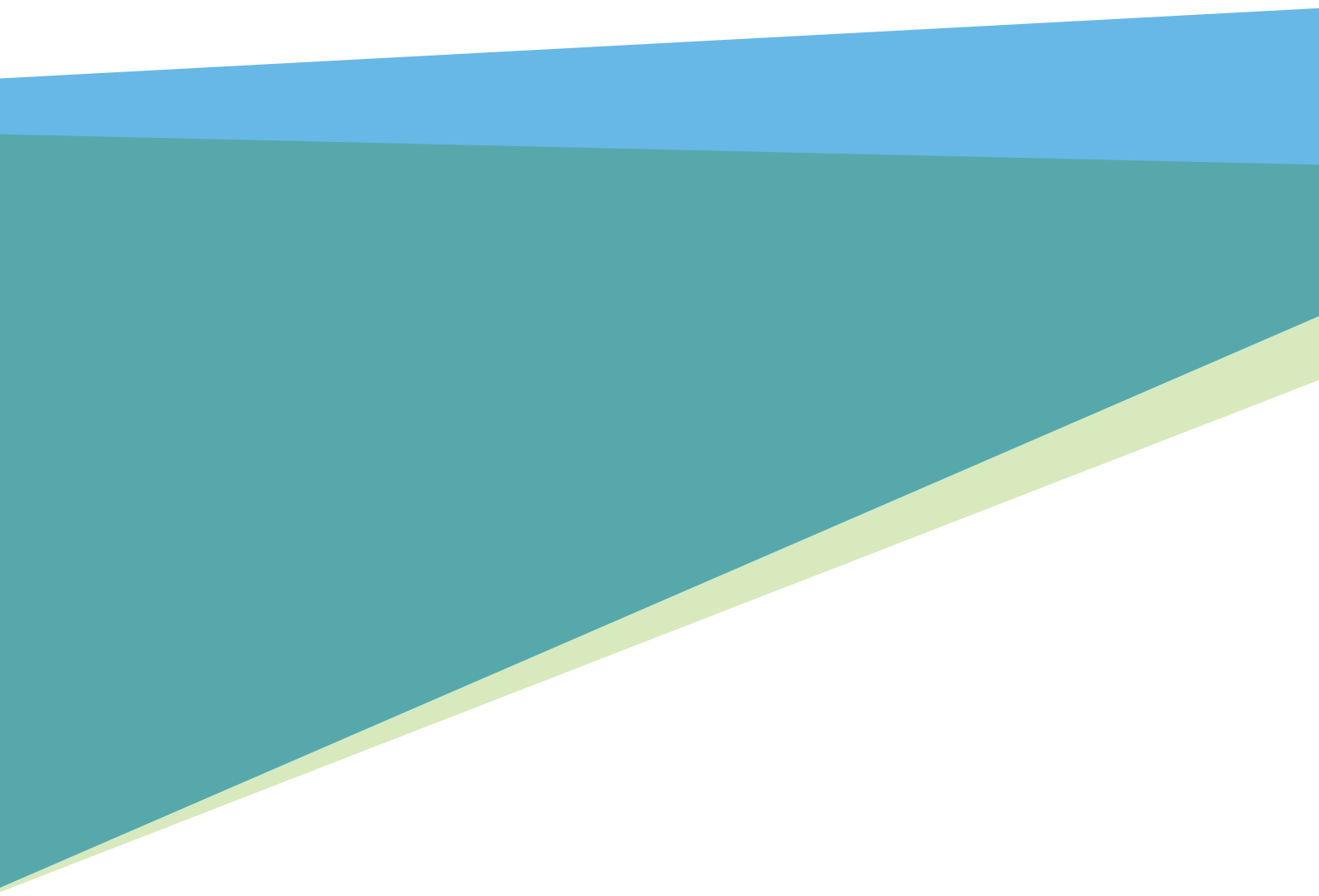

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