Opening Statement,
Teagasc,
14.04.21

Teagasc statement to the Oireachtas Agriculture Committee

The Climate Action and Low Carbon Development Bill – implications for agriculture.

14 April 2021

Introduction and overview of climate targets for agriculture

- **AgClimatise – A Roadmap Towards Climate Neutrality** was published by DAFM in December 2020 and set out a vision for a climate neutral agriculture by 2050. This Roadmap was developed to deliver the 2030 climate ambition as set out in the 2019 Climate Action Plan. This equated to a 10-15% reduction in agricultural greenhouse gas (GHG) emissions by 2030, which would result in total annual agricultural emissions of 17.5-19.0 mT of CO_2e by 2030. The Roadmap is based on stable biogenic methane emissions over the period to 2030, i.e. a stable national bovine herd. The actions in the Roadmap are primarily based on the **Teagasc Greenhouse Gas Marginal Abatement Cost Curve (MACC)**.
- While the AgClimatise Roadmap was focused on achieving the targets in the 2019 Climate Action Plan, it was prepared with a view to being updated given the increased ambition of the European Green Deal and the Programme for Government.
- The Climate Action and Low Carbon Development Bill sets a target for Ireland of net zero GHG emissions by 2050, with an interim target of a 51% reduction, relative to 2018, to be achieved by 2030. Sectoral climate budgets are to be proposed on a 5 year basis by the Climate Change Advisory Council (CCAC) starting in 2021.
- Agriculture accounts for approximately one third of Irish GHG emissions. They are driven mainly by the size of the national cattle herd and nitrogen fertiliser use and have moved over a narrow range in the last 30 years. While agricultural GHG emissions were trending downward over the 2000s, that trend has reversed over the last decade, as an increase in the GHG emissions associated with dairy cows has not been fully matched by a reduction in GHG emissions from other cattle.
- Current scientific understanding indicates that reducing Irish agricultural GHG emissions through technical means is challenging, particularly so for biogenic methane produced by pasture-based ruminants. However, this is now a major area of scientific research in Teagasc and elsewhere, which should yield positive results in the coming years.
- However, in the short term, major reductions in agricultural GHG emissions, equivalent to the 51% required nationally by 2030 when the Climate Action and Low Carbon Development Bill is passed by the Oireachtas would require a substantial reduction in the amount of agricultural activity in Ireland.
- There is no prospect in the current decade of scientific solutions alone being capable of delivering agricultural GHG emission reductions of this magnitude (7% per annum for the 10 years to 2030).
- There is international scientific discussion on how biogenic methane should be accounted in climate change targets, with some scientists proposing a separate target for biogenic methane. The Climate Action and Low Carbon Development Bill sets out that the distinct characteristics of biogenic methane are to be taken into account by the Minister, the Government and the Climate Change Advisory Council (CCAC).
- In relation to land use, carbon sequestration by forestry makes an important contribution to off-setting GHG emissions, and will contribute most of the 26.8mT of offsetting allowed in the 2021-2030 period. However, in recent years planting targets are not being met which is a concern for the post 2030 period, particularly as a lot of Irish forests will mature after 2030.
- Teagasc provides projections of future agricultural activity levels (animal numbers, agricultural land use, fertiliser use) that are used by the EPA in their projections of GHG emissions from Irish agriculture. Teagasc have met with the incoming CCAC chairperson and other Government Departments as part of the process of developing Ireland Carbon Budget for the period towards 2030.

- Teagasc economists and environmental scientists have undertaken scenario analysis evaluating the contribution of the measures in the DAFM Ag Climatise strategy to reducing GHG from agriculture and what other changes might be needed in light of the potential increased ambition on reducing GHG emissions set out in the Climate Action and Low Carbon Development Bill. This analysis has been provided to Government and shared with the CCAC.

Irish agriculture in an international context

- Irish agriculture is mainly grassland based, with about 90% of agricultural land under grassland, by far the highest percentage in Europe. As a result, Irish agriculture is dominated by ruminant livestock production (dairy, beef and sheep).
- Measured against other developed countries, Irish agriculture is relatively extensive, with low stocking rates and low levels of imported feed and synthetic fertiliser use on most of our farms.
- The grass-based nature of livestock production in Ireland gives it certain positive environmental characteristics in terms of close integration between livestock and crops grown for feed, manure recycling, low food versus feed competition, biodiversity and landscapes, and soil quality and organic carbon content. The carbon footprint or emissions per kg of Irish milk and meat are low by international standards, with one EU study showing Irish milk to have the joint lowest carbon footprint in the EU and the 5th lowest footprint for beef. Indicators of Irish farming environmental performance are detailed in the annual Teagasc Sustainability Report.
- Grasslands are an enormous store of (soil) carbon, but if this land is converted to crop production, some of this soil carbon is released into the atmosphere as a greenhouse gas. For a range of reasons, much of Ireland's grassland area is agronomically and economically unsuited to crop production.
- Given the low carbon footprint of Irish milk and meat, Ireland can continue to strive to meet growing international market demand for food so as to contribute to global food security and avoid carbon leakage, whilst at the same time meeting environmental obligations including those related to climate change.

Responding to the additional ambition in the Climate Action and Low Carbon Development Bill

Teagasc is engaged in a number of research and knowledge transfer actions that are particularly relevant to the ambition of carbon neutrality. These are summarised here and set out in more detail in the following pages. Together, they represent a coherent set of actions to carry out the research required to fill the knowledge gaps and to lead climate action by the agri-food sector. If adequate resources can be made available to implement these actions in full and at pace, it will maximise the contribution of agriculture to Ireland's climate ambitions.

Action 1: Implement the Signpost Programme. This is an all of industry programme led by Teagasc to achieve implementation of measures and technologies already developed and available to reduce greenhouse gas emissions, and which were outlined in the 2018 Teagasc GHG MACC. Implementing measures we already have available has to be the first step.

Action 2: Research new technologies to mitigate greenhouse gas emissions. Researchers are actively pursuing promising new technologies and farm practices to reduce emissions of methane

and nitrous oxide, the two most important agricultural GHG. These technologies and farm practices include feed additives, dietary oils, halides and seaweed, livestock breeding, animal lifetime efficiency, optimisation of soil pH and nutrient levels, changes in fertiliser type and amount used, manure acidification, multi-species swards, and the soil microbiome.

Action 3: Quantify and maximise carbon sequestration in soils and woody biomass. Soils and woody biomass (forests, woodlands, trees and hedgerows) store huge amounts of carbon, and there are opportunities to sequester additional carbon (or reduce losses from peaty soils), thereby offsetting residual emissions of GHG. Teagasc is establishing the **National Agricultural Soil Carbon Observatory** (funded by Department of Agriculture, Food and the Marine) and is building a very significant research programme on carbon sequestration using this infrastructure.

Action 4: Biogenic methane. Biogenic methane such as methane from ruminant livestock is different from other greenhouse gases because of its biological origin and its relatively short life span in the atmosphere. A new metric, GWP* has been proposed to replace the current GWP100 metric for biogenic methane. In a situation of stable biogenic methane emissions from a stable national bovine herd, there is much less long-term additional warming based on this GWP* metric than using the current method, GWP100. This issue has been widely discussed by scientists internationally and some propose setting a separate target for biogenic methane in climate targets. It is a critical issue for Irish agriculture as biogenic methane makes up about 60% of agricultural GHG emissions. Teagasc is actively involved in these discussions at an international level to better understand the implications for agriculture and climate change of a differential reduction commitments for *biogenic* methane.

These four areas of action are outlined in more detail in the following pages.

I. The Signpost Programme: leading climate action by Irish farmers

While the 2018 publication by Teagasc of the GHG MACC recognised the potential for the mitigation of GHG emissions from Irish agriculture, it also highlighted both the scale of on-farm change required and the need to support farmers in the uptake of the various measures. In response to this identified need, Teagasc developed a proposal for the Signpost Programme.

The Signpost Programme is a multi-annual campaign to lead climate action by all Irish farmers, and achieve early progress in reducing gaseous emissions from Irish agriculture (while also improving water quality, maintaining and improving biodiversity and creating more profitable and sustainable farming enterprises). It will also act as a test bed for on-farm carbon sequestration measurements. The programme will be delivered in collaboration with all relevant industry partners (milk and meat processors) and state bodies, such as Bord Bia. A co-design approach – involving farmers and all partners and stakeholders – will be used to ensure that solutions for climate action are fit for purpose, meet farmers' needs and are usable.

The objectives of the programme are three-fold:

a. To lead and support the transition of Irish farming towards more sustainable farming systems;
b. To reduce GHG emissions from Irish agriculture; and
c. To reduce the overall environmental footprint of agriculture (specifically, to reduce ammonia emissions, improve water quality and improve biodiversity).

The programme will be built around a network of 100 demonstration farms (the "Signpost Farms") and will also include the Signpost Advisory campaign (mobilising all Teagasc Advisory and Education resources) to engage and support all farmers on their decarbonisation journey. The challenge of achieving on-farm change (leading to a reduction in GHG emissions) at pace and scale is significant. However, Teagasc is confident that the collaborative, co-design approach favoured by the Signpost Programme can deliver results.

II. Research for new mitigation technologies – (A) methane

Teagasc, in collaboration with industry stakeholders, are pursuing several complementary strategies to mitigate ruminant methane. These strategies include actions to reduce daily methane output of animals, concurrent with improvements in life-time efficiency metrics. In developing such strategies, both breeding and non-breeding based approaches are being evaluated by Teagasc.

- *Reductions in daily methane emissions*. Ireland has growing capability to research methane and now has access to 28 high-tech apparatuses for the accurate measurement of daily methane production in dairy, beef and sheep; the majority of these are owned by Teagasc, and it hoped that capacity can be further expanded in the coming months. This equipment is being used to measure daily methane production both in grazing and indoor-fed ruminants in Teagasc research centres in order to a) set a baseline of emissions and b) quantify the inter-animal variability in methane emissions. The equipment has been used to assess the potential of feed additives to reduce methane while also being used to quantify the contribution of the Irish dairy, beef and sheep breeding programs to reducing daily methane emissions. Some promising feed additives are under development and will be researched for suitability for deployment in Ireland. In particular, effective feed additives will be modified to ensure their slow-release for delivery on pasture based systems. While other feed additives have not delivered significant reductions in emissions, considerable exploitable genetic variability has been detected in dairy and beef cattle and sheep.

- *Life-time efficiency*. Improved life-time efficiency can be achieved through greater longevity of the mature herd and shortening the duration from birth to slaughter in growing animals (without compromising carcass merit) with a strong emphasis on maximising the quantity of grazed grass in the diet. The national breeding indexes are delivering greater animal longevity thereby diluting the carbon emitted in the unproductive life stages across a longer productive life; greater longevity can lead to more offspring being destined for slaughter (i.e., shorter lifetime) but also when coupled with the potential to use (sexed) semen of more terminal sires, can also improve the efficiency of growth. Teagasc research is concluding on the development of a national genetic evaluation for age at slaughter in cattle, which complements the Teagasc research on the same trait in sheep. Deployed by the ICBF/Sheep Ireland, this approach has the potential to considerably reduce methane emissions per animal. Recent research has shown that the Economic Breeding Index (EBI) is delivering reduced emissions per unit of product. Data from the Teagasc Next Generation Herd has shown that for each €10 increase in EBI, there is a corresponding reduction in the carbon footprint per unit of product of 1%. However, total overall emissions did not change. The increase in animal productivity was offset by earlier mean calving date and a lower replacement rate. Shortening days to slaughter has a direct effect on the carbon footprint of the meat produced through a lower overall maintenance requirement for a given carcass weight as well as having a direct impact on the inventory through lower absolute average livestock numbers.

- (B) Nitrous Oxide

The Teagasc 2018 GHG MACC focuses on reducing emissions through reducing the amount of nitrogen fertiliser that is spread on farms while maintaining production levels. These measures focus on switching to protected urea, adoption of clover to reduce synthetic fertiliser requirements, improving soil fertility through liming and P/K fertilisation, and use of low emission slurry spreading technologies. The national inventory currently can capture the reduced nitrogen fertiliser and the switching to protected urea. Further research is being carried out to investigate new measures to further reduce nitrous oxide (N_2O) emissions and to provide new national emission factors to enable the measures to be incorporated into the national inventory.

- *New low emission fertilisers and manure:* research is focusing on evaluation of existing compound fertilisers which account for about 50% of nitrogen fertiliser use in Ireland. There are indications that some compound fertilisers could reduce fertiliser emissions by 40% compared to high emitting fertilisers. Research is investigating a range of measures to further reduce emissions from the storage and spreading of manure. Slightly acidifying manure or processing manure into bio-fertiliser can reduce emissions and increase the nitrogen fertiliser value of manure contributing to reducing chemical fertiliser requirements on farms.
- *Reducing chemical Nitrogen fertiliser use:* this involves improved manure management and reducing mineral fertiliser application to account for manure nitrogen applied. Improved nutrient management planning will provide farmers with spatially, temporally and soil specific advice to minimise nitrogen fertiliser use through the optimisation of all other nutrients in soil and manure. Incorporation of legumes and other forage species has been shown to substantially reduce nitrogen fertiliser requirements and also to reduce the impact of droughts. The area of multispecies swards is being investigated and has the potential to also reduce nitrogen fertiliser use, soil emissions, enteric methane, enhance soil carbon sequestration and improve water use efficiency.

- *The soil microbiome:* Emissions of nitrous oxide from fertiliser and carbon sequestration in soil is controlled by soil biological processes. The soil microbiome is an active area of research and new tools are being employed to understand the link between farm management practices, the soil microbiome and GHG emissions. One recently published research example has found that when farmers improve soil fertility to the recommended optimum for pH and phosphorous, that nitrous oxide emissions are reduced due to the effect that improved soil fertility has on the soil microbiome. Further understanding of the link between soil management and the soil microbiome will help us to identify new measures to reduce GHG emissions and increase soil carbon sequestration. Research is now focus on generating emission factors for soil fertility so that it can be incorporated into the national inventory.

III. Carbon sequestration

The 2018 Teagasc GHG MACC identified a number of strategies to increase carbon sequestration including afforestation, the management of peaty agricultural soils to reduce CO_2 losses in these systems as well as optimal grassland and cropland management on mineral soils. It was calculated that these measures could deliver the full 26.8 million tonnes CO_2e allowed as offsetting over the 2021-2030 period. However, there are significant challenges in terms of ***measurement and verification*** of soil carbon sequestration, particularly in grassland soils, and in terms of the low rates of afforestation over the last number of years, which threatens to considerably reduce the forest C sink.

Irish grasslands are a significant carbon store, with mineral and peaty agricultural soils under grasslands containing between them over one billion tonnes carbon – 500 million tonnes is stored in mineral grassland soils and between 500 -700 million tonnes in grassland on peat soils. Teagasc, via funding from the Department of Agriculture, Food and the Marine is establishing a **National Agricultural Soil Carbon Observatory (NASCO)** over the next number of months. This Research Platform consists of a series of 12 CO_2 flux monitoring towers, which are being established at long-term monitoring benchmark sites (where soil carbon will also be monitored). In addition, the Agricultural Catchments Programme is establishing a further four CO_2 flux monitoring towers which will form part of the NASCO infrastructure.

Teagasc and partners in universities have already initiated a large research programme that will use this research platform to

a) assess the carbon sequestration capacity of grasslands and croplands,
b) assess the impact of management on C sequestration and
c) quantify the impact of drainage and re-wetting on agricultural peat soils.

The research will also combine CO_2 flux tower data with drone and satellite remote sensing and state-of-art carbon cycle models. This will allow us to model the impact of future climate change and farm management practice and practice changes on carbon sequestration as well as crop, grass and forest yields.

The NASCO platform is also important for Ireland's participation in international research initiatives on carbon sequestration. It will provide ecosystem level sites for Ireland's participation in ICOS, the EU Integrated Carbon Observation System. Teagasc is also a partner in the European Joint Programme (EJP) on Soil which is an EU-wide initiative to quantify carbon sequestration in

grasslands and croplands and as part of EJP projects, research is being conducted on the mechanisms that govern sequestration in croplands, grasslands and peatlands.

Carbon sequestration in Woody Biomass

Increasing perennial biomass via increased adoption of forestry, agroforestry and use of hedgerows/shelterbelts offer direct and easily verifiable options to enhance carbon sequestration and can also provide biomass for fossil fuel displacement.

(i) Hedgerows**:** Preliminary estimates for hedgerows and non-forest woodland (excluding field area) suggest that hedgerows have the potential to sequester 0.66-3.3 t CO_2/ha/year excluding emissions related to hedgerow management (Black et al., 2014). However, there has been a lack of direct measurements. Teagasc is conducting research in this area as part of the Farm Carbon project, which seeks to measure the total amount of carbon stored in hedgerows and in the soils underneath them as well as the rate of carbon sequestered per year. This project will also assess the impact of management on both Carbon sequestration and biodiversity within hedgerow systems.

(ii) Forestry and Agroforestry: Teagasc have a large number of projects investigating the impact of management on forest yields (and hence C uptake), including investigating the response of tree species to climate change and the genomic evaluation for the sustainable improvement of Sitka spruce. Teagasc, in conjunction with UCD are also assessing thinning management in order to establish Continuous Cover Forestry. New agroforestry trials are being established in Teagasc in conjunction with AFBI, QUB and UCD. These studies will, in an all-island context, evaluate agroforestry systems with a view to investigating their feasibility of use in Irish agriculture. An assessment of ecosystem services will be conducted and economics of silvopasture will be modelled. A life-cycle analysis of silvopasture will be carried out. Field trials will be established to investigate forage species suitability for understorey growth. Agroforestry sites will be used to quantify controlled ammonia dispersion and the rate of carbon sequestration in the trees and the soil will also be estimated.

IV. Biogenic methane

Biogenic Methane is emitted from biological processes including livestock. As part of the biogenic cycle, plants absorb carbon dioxide from the air, and through the process of photosynthesis convert it to glucose, and use this to make plant fibres and other carbohydrates. Ruminants are then able to break down this fibre in the rumen, emitting a portion as methane. After about 12 years, the methane is converted to carbon dioxide through hydroxyl oxidation. That carbon is the same carbon that was removed by photosynthesis. It is therefore recycled carbon and there is *no net change* in atmospheric CO_2. In the case of fossil fuel carbon, the CO_2 produced is effectively new carbon released from permanent carbon stores and therefore must be treated differently because it inputs *additional CO_2* into the atmosphere and contributes to global warming. Under the GWP100 (global warming potential over 100 years) system currently used in national inventories, it is assumed that methane has a warming effect that is 28 times that of CO_2 over 100 years. GWP* is a newly proposed metric to account for the short life span and biological origin of biogenic methane. Under GWP*, there is a much higher warming effect but this effect is over a shorter period. In simple terms, the principle is that because methane has a short lifespan of approximately 12-15 years, if emissions remain stable, atmospheric concentrations remain stable and there is little additional warming effect caused by the current emissions. In a situation where the biogenic methane

emissions remain constant (i.e., a stable national bovine herd), there is much less long-term additional warming based on this calculation than using the current method (i.e. GWP100). Reducing methane can be associated with a cooling effect.

Because of the significant difference between biogenic methane and fossil fuel derived CO_2, scientists propose setting a separate target for biogenic methane in climate targets. This is currently the subject of much international scientific discussion and Ireland is very much involved in dedicated international groups assessing this metric (e.g., Technical Advisory Group on Methane as part of FAO-LEAP, and the Livestock Research Group of the Global Research Alliance for Climate Change).