Paul R Price: opening statement 24 March 2022

I thank the Joint Committees for the opportunity to provide evidence on the crucial subject of reducing Ireland's agricultural emissions which will be essential in achieving Ireland's first statutory carbon budget programme as set out in the 2021 Climate Act. I am a Research Assistant in the Faculty of Engineering and Computing at Dublin City University (DCU), researching climate science and low carbon transition policy.

In my current research I am funded as a Carbon Budgeting Fellow through the Climate Change Advisory Council (CCAC) and have looked at agriculture, forestry and land use as they relate to Ireland's climate action and SDG objectives. Previously, in EPA-funded climate change research projects working with Professor Barry McMullin, I have looked at Ireland's potential for negative emissions technologies and what is needed to achieve an effective economy-wide low carbon transition aligned with our commitment to the Paris Agreement. I would like to make it clear that my opening statement and my responses today are mine alone and in no way do I speak for DCU or the Council.

It is important to recognise that greenhouse gas (GHG) and ammonia emissions are accounted by the Environmental Protection Agency in standardised national inventory data reporting to the UN and the EU. Therefore, policies and measures are only useful if they can be verifiably accounted in the national inventory, which requires any new technology or emissions measurement update to pass EPA and international peer review, a process that can take years whereas mitigation action is needed now.

Anthropogenic GHG emissions, mostly due to the activities of wealthy nations, have increased global average surface temperature to 1.2ºC above the pre industrial, resulting in damaging climate change impacts that are most immediately affecting the world's poorest. The most important GHG is carbon dioxide primarily from fossil fuel burning. However, the small remaining global GHG budget to stay within the Paris Agreement's 1.5ºC guardrail threshold for dangerous climate change is now being depleted very rapidly. Therefore non-CO2 GHGs, especially methane, and emissions from agriculture, forestry and land use must also be reduced as a matter of great urgency, otherwise the carbon budget for even rapid energy transition is unfeasibly small. Reducing methane emissions is especially important because this can actually *reverse* its warming impact, unlike carbon dioxide or nitrous oxide which accumulate, increasing their warming impact even as emissions decrease. Research at DCU and UCC, and recently by the CCAC, indicates that meeting a fair share Irish GHG budget requires 50% reduction in methane emissions and 50% reduction in nitrous oxide emissions in addition to cutting CO2 rapidly to net zero, before 2050. The bulk (93%) of Irish emissions of both methane and nitrous oxide arise from agriculture, mostly from cattle through enteric fermentation and manure management. In per capita terms, Ireland has the highest methane and nitrous oxide emissions in the EU.

This hearing is focussed on opportunities to meet the requirement to reduce GHG and ammonia emissions in Ireland's agriculture sector. As a starting point, it is crucial to understand which previous combinations of policies and measures have reduced emissions and which have failed to do so. The recent past gives us a good guide. Agricultural sector GHG emissions peaked in 1998 then fell steadily to 2011, but since 2010 emissions have

risen rapidly. Ongoing EU policies were in place for the period of falling emissions up to 2011, particularly the milk quota limit on total national dairy production. During that period, based on EPA inventory data, the GHG and nitrogen-use *efficiency* of milk production improved up to 2005 but has not improved significantly since then. Though the data is noisier, the same is true for beef production. This means that any increase in milk or beef production now results in more emissions. This is what happened as soon as the milk quota started to be released from 2010 onward, and especially from 2013 onward: milk production increased rapidly, therefore dairy methane emissions have increased just as quickly, as has nitrogen-excretion from dairy cows.

As inventory emissions per kg of milk or beef have stablised, we know that a quota on production is an effective way to limit inventory emissions. Similarly we now know that in Ireland *removing* the milk quota on dairy production has been an effective way to *increase* emissions.

Therefore, two questions for these Committees are:

First, has this emissions-production linkage and quota-effectiveness been well understood by experts? Literature review indicates that experts understand this very well. Teagasc research in 2008 noted that declining GHG and ammonia emissions since 2000 had "*been falling since then due to declining ruminant livestock numbers and fertilizer N [Nitrogen] use*" and a far more demanding ammonia emissions ceiling was anticipated as a driver for further reductions. Specifically, looking at the large potential incoherence between Food Harvest 2020 and climate action, in modelling of dairy and suckler cow numbers researchers correctly projected:

> *"if agriculture is required to reduce its GHG emissions in future years, that achievement of the Food Harvest output targets would make the achievement of any reduction in emissions of GHG from Irish agriculture more difficult."*

Looking back in 2020, a Department of Agriculture's senior advisor on GHG policy stated that the period under the milk quota up to 2011 represented "*genuine sustainable intensification*" due to nitrogen fertiliser use reduction and fewer dairy cows to produce the same amount of milk.

Second, given that the effectiveness of production quotas to limit emissions and enhance efficiencies was well understood, have any of the measures proposed or implemented since 2010 been as effective or even somewhat effective in curtailing sectoral emissions? The simple answer is, no, they have not – if anything, measures *targeting* efficiency have helped *increase* emissions because there has been no effective limit on production. The Teagasc Marginal Abatement Cost (MAC) curve measure and the Origin Green "Carbon Navigator" programme have focused on farm-based efficiency and management measures such as the economic breeding index, manure management etc, but, as Teagasc have noted, such measures will only cut total agriculture emissions if they add up at the national level through cuts in animal numbers or production. Instead, as we have seen over the past decade, without any limits on production or numbers, or GHG pricing to incentivise low GHG choices, such efficiency measures result in cost savings that can then be reinvested by land-based

enterprises in more activity (i.e., more absolute production) thereby, if anything, *increasing* total emissions.

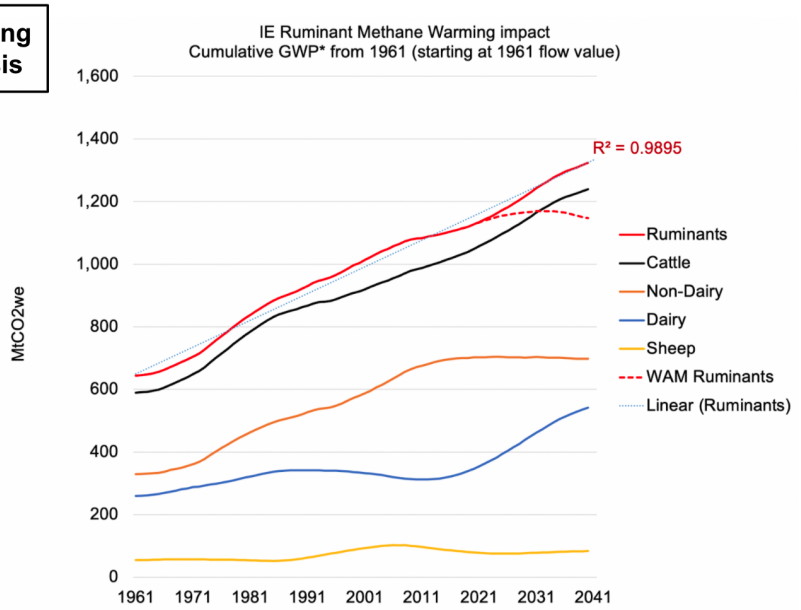
Modelling has consistently shown that a large decrease in beef cattle production would be *required* to compensate for emissions growth from higher emitting dairy cows, but no policy to *ensure* such a compensating reduction in beef and sheep production happened without fail has been seriously considered until the current Ukraine emergency added to the declared climate and biodiversity emergencies. Early on, MAC researchers identified water quality, GHGs, and biodiversity as key environmental failure risks for the expansionary Food Harvest 2020 policy unless effective measures were introduced. EPA reports indicate that all of these failures came to pass by the 2020 target date, indicating that the policy has indeed failed, yet media reports now indicate that dairy cow numbers are anticipated to reach 1.8 million by 2025, exceeding Teagasc road map projections and requiring more fertiliser and feed inputs.

Ireland ruminant CH4 warming analysis using GWP* analysis

Remarkably linear rise in aggregate ruminant warming impact.

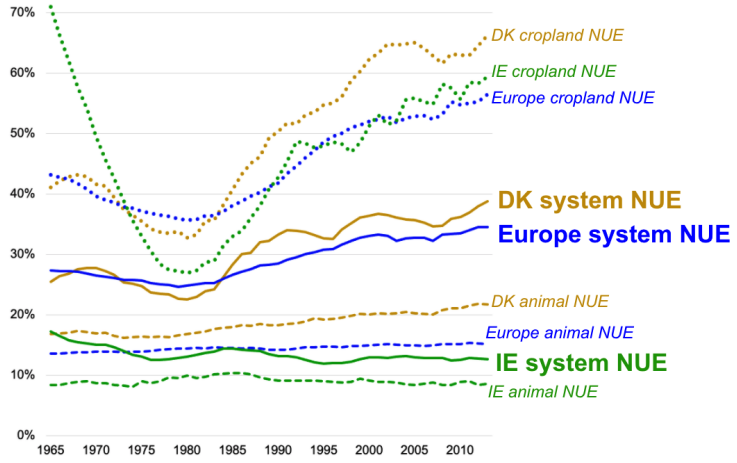
Only during milk quota era from 2000 to 2010 was there a notable easing of this trend.

Linear trend suggests path dependency.



My research based on collated FAO data and GWP* analysis (see figure above) shows that the methane warming impact of Ireland's cattle and sheep has risen linearly since 1961, at first due to beef and sheep emissions rising up to 2010 and then with much increased dairy production since 2010. It is important to note though that some other EU nations also specialise in animal-derived food production yet have far lower methane emissions. Denmark's intensive agriculture model has higher protein exports than Ireland yet has less than half the methane emissions because, since 1985, Danish agriculture has decreased the ruminant fraction of its animal protein production to below 35% (more pigs and poultry instead) and has decreased its grass feeding of ruminants to near-zero, instead feeding animal indoors with domestically grown grain. I am not endorsing this form of agricultural intensification but the comparison with Denmark (see figures below) does indicate that by focussing on – and recently, further intensifying – its grass-based and ruminant-dominated system Ireland has chosen to persist with and further intensify a very high emissions form of agriculture, driven by increased inputs of imported fertiliser and feed.

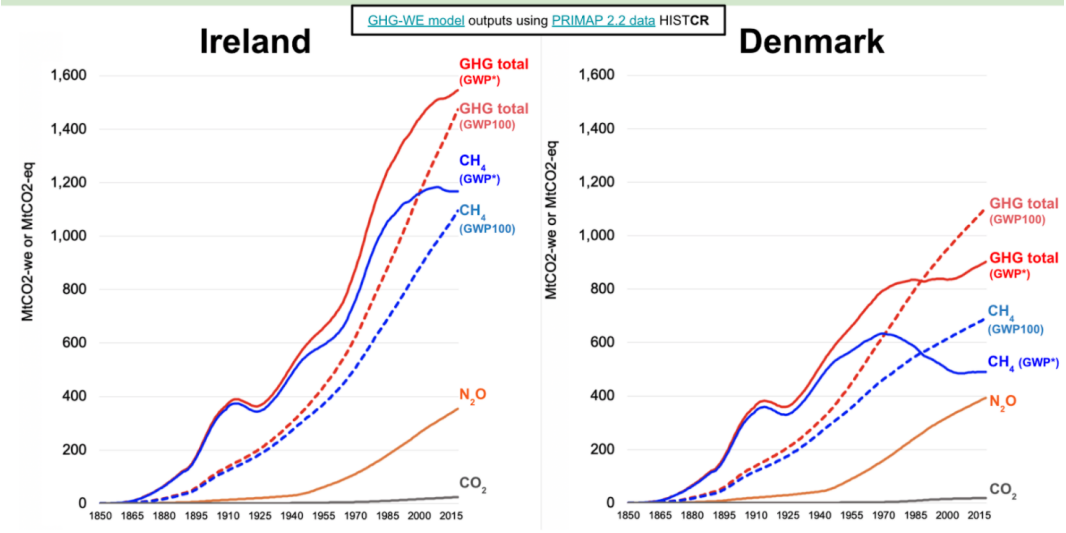
EU context 1961–2013: Ireland has low agri-system Nitrogen Use Efficiency (NUE)



Data: FAO as collated by Billen et al. 2021.
Own charts based on 5-year running average and analysis of total N output to input ratio.

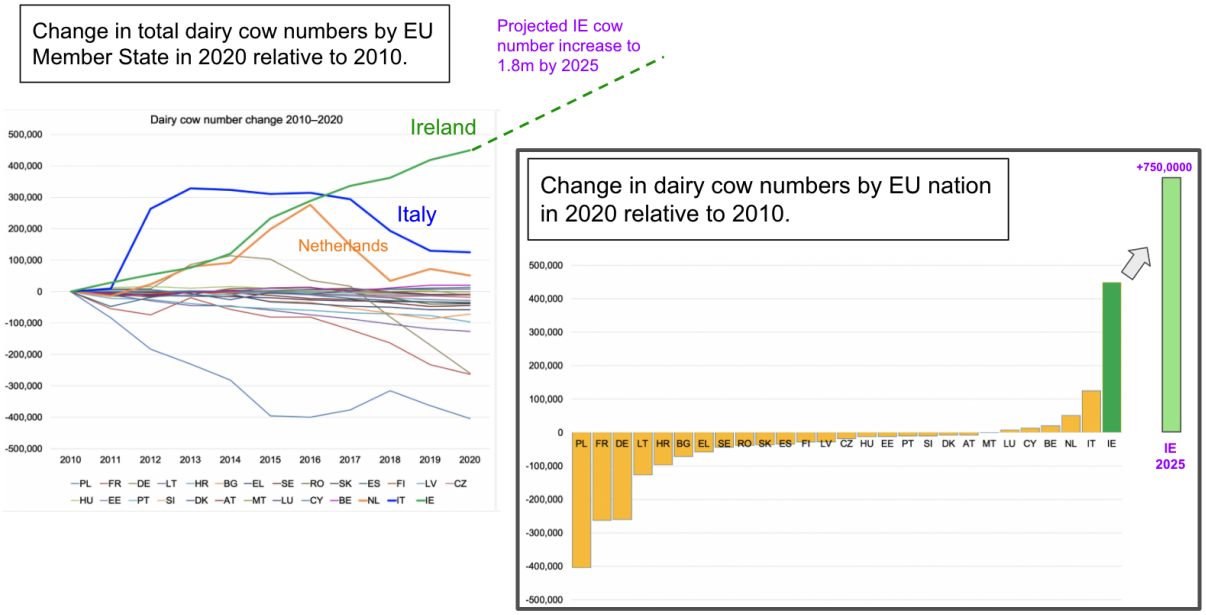
Low NUE may not have been considered a problem in the past.
More so now?
– Fodder crises
– Global food security
– Food sovereignty

Agricultural sector contributions to global warming: GWP* metric (vs GWP100)
Shown as *cumulative emissions* 1850–2018



As we have seen in repeated fodder crises and now with the impact of Russia's invasion of Ukraine this policy has also resulted in a sector that lacks resilience, being highly vulnerable to climate and external price shocks. No other EU Member State has maintained an increase in dairy cow numbers since 2010 anything like as aggressively as Ireland, and other nations have pulled back.

EU context: Ireland's ongoing increase in dairy cow numbers is an extreme outlier



A milk or meat quota is effective in cutting emissions because it effectively limits nitrogen input usage, so a more productive agri-food system can produce the same amount from a given amount of nitrogen input. Nitrogen is the key element in the proteins essential for plant, animal and human growth, but it is also a primary driver of damaging agricultural pollution by nitrous oxide, ammonia and nitrates to water. More plant growth (grass and other feed) boosted by fertiliser results in more carbohydrate being available for conversion to methane by ruminant digestion.

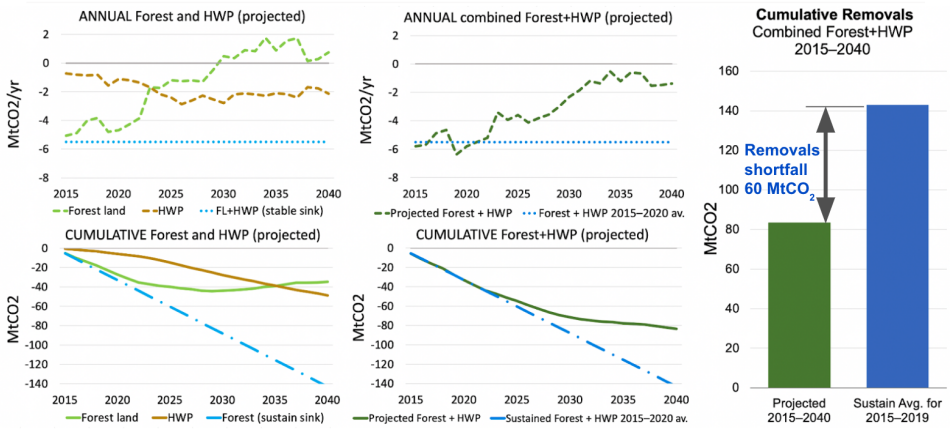
The critical importance of regulated nitrogen use is exhaustively addressed in the European Nitrogen Assessment, including clear messages in its Summary for Policymakers. Unfortunately, the FAO data shows that Ireland's agri-food production system has very low nitrogen use efficiency (NUE) – one of the worst, if not the worst in Europe, far below the EU average. And, N efficiency has reduced further since 2013 due to tillage land conversion to dairy. Since 1961 Ireland has increased nitrogen fertiliser use by a factor of twelve yet grass protein production has only doubled and tillage protein has fallen, a case of greatly diminished return on input even though output has gone up. By contrast, Denmark's fertiliser input has decreased since 1985 yet output has been maintained.

My main message to the Committees today is that the key opportunity to cut agricultural emissions and pollution is to enforce a policy limit on the total use of nitrogen fertiliser and feed inputs through national *nitrogen budgeting*, with subsidiary watershed-level N-budgeting. This is an essential prerequisite for cutting GHG and ammonia emissions. It is also crucial in limiting local air pollution (acidification and particulates) and water pollution (eutrophication). Nitrogen budgeting and regulation would help to improve agri-food system nitrogen usage – as well as aligning farm supports and consumer pricing to deliver in this regard – and can increase national food sovereignty and global food security. Climate change science has repeatedly pointed out that dietary change toward *reduced*meat and

milk production and consumption, particularly in developed countries, is now essential to align with the Paris Agreement temperature goals.

Within land emissions planning it is essential to include bioenergy crop production which, in the absence of strong governance measures, could easily *increase* emissions. Due to increased harvest rate, in part for biomass energy, the amount of Irish forest-related annual carbon sequestration is projected to fall over the next decade resulting in a “carbon cliff” reducing the potential increase in forest carbon stock by 60 $MtCO_2$. As we are in a climate emergency requiring carbon budgeting, imposing restrictions on harvesting may well be cost effective relative to many energy mitigation options.

Forestry: Reduce harvest to avoiding the carbon cliff?



Likewise, increasing biomethane production via anaerobic digestion (AD) as a climate mitigation option appears to be a highly questionable option. Firstly, limiting fossil fuel use would need to be *guaranteed*, otherwise the energy produced is only additional not substitutional. Secondly, and very concerningly, analysis which I have carried out of recent AD research findings combined with the high levels of fugitive methane emissions seen in field measurement of AD plant data shows that only AD feedstocks with a very high proportion of slurry to silage solids and plants with very low fugitive methane emissions could reduce global warming relative to fossil fuel use: but the gas yield from such feedstocks is correspondingly very low. Unfortunately the section on bioenergy in the recent SEAI Heat Study is based on use of a high silage mix, which likely has no climate benefit, and the real world observation of problematic AD fugitive emissions is not acknowledged.

In summary, what is needed is urgent mitigation starting today, because, as we have seen, promises of mitigation tomorrow may not be delivered, so we should be very cautious about misplaced optimism. There is the danger that a focus on technical measures may result in delay that distracts us from regulating when regulation is needed. We do need to recognise what works and what does not. To limit emissions and pollution, production quotas have been shown to work in Ireland, and international experts recommend nitrogen budgeting to cut emissions and environmental pollution. We need to consider these options seriously along with aligned policies on farm supports and consumer pricing to deliver a far more nitrogen efficient agri-food system for Ireland that can also better support global food security.