The Climate Bill, Agriculture, Land Use, and Forestry

John FitzGerald, 27th April 2021

1. Introduction

This note focuses on three related issues that have important implications for the carbon budgets. While this note is, hopefully, correct in its interpretation of the relevant science, it focuses briefly on the social and economic implications of how the carbon budgets treat agriculture and land use. This includes consideration of the distributional implications (just transition) and the economic costs and potential direct employment effects. This note is a first stab at considering the issues. As more research becomes available through the ad hoc committee, our understanding of the issues may change. Thus, the conclusions here are tentative in nature.

In the context of the climate bill, this note first considers how to make the agricultural sector climate neutral. It then briefly considers some of the issues on land use and, finally, it examines the potential interaction of carbon taken out of the atmosphere through expanding forestry and the use of timber to replace cement in the construction sector.

In this note I try to avoid dealing with the complex issues of how greenhouse gases are measured. I use the accounting currently used by the EU, which measures the emissions based on their impact on global warming without consideration of their longevity in the atmosphere. However, I do discuss the important implications for the carbon budgets and climate policy of methane's short lifetime in the atmosphere.

A number of memo items that may be useful in providing context for the discussion are given in Table 1

Table 1

Greenhouse Emissions, 2019, MtCO2e (GWP(AR4))

	Million Tonnes	% of total
Total emissions	60	100
Agricultural methane	13.7	23
Agricultural NOx	6.4	11
Non-agricultural emissions	39.9	67
		€
Carbon Tax, 2021		33.5
Carbon Tax, 2030		100
Carbon price, Public Expenditure Guidelines, 2050		260

2. Climate Neutral Agriculture

I first present the likely implications of the Climate Bill for the treatment of agricultural emissions in the carbon budgets and I then spell out a rather different path, which would also deliver climate neutrality in agriculture by 2050, but at much lower social and economic cost. However, this latter path would not be consistent with the Bill but it does provide a useful counterfactual in understanding the implications of the approach adopted in the Bill. Obviously, it will be the Council's role to develop carbon budgets in accordance with the Act when it passes the Oireachtas.

2.1 Climate Bill – Agriculture

The Climate Bill requires a 51% reduction in all greenhouse gases by 2030 relative to 2018. The advice from UCC MAREI, based on preliminary runs with their TIM model, is that this target can only be achieved if agricultural emissions fall by a substantial amount. For illustrative purposes, I assume that there needs to be a 33% fall in agricultural emissions. This is less that the reduction of 51%, required for all other greenhouse gas emissions (GHG) in the Bill. Without such a reduction, the TIM model suggests that there is no realistic way of meeting the Bill's target reduction in GHG emissions for 2030. Even with such a reduction in agricultural emissions it will mean that the reduction in emissions from energy by 2030 will have to exceed 60%, an exceptional rate of reduction by international standards.

The Bill makes no allowance for the short life of methane and it appears to me that it makes no provision for offsetting emissions with the sequestration of carbon in forestry and biomass through changing land use. This note proceeds on that basis. However, an alternative reading of the Bill would interpret the phrase in the Bill "total amount emitted" as being net of removals. This would allow the possibility of a slightly less drastic reduction in gross emissions. (The current EU law makes limited allowance for such sequestration in the period to 2030.) The Council needs to get legal advice on the correct interpretation of the Bill.

Table 2: Effects of Cutting the Cattle herd by 33% by 2030, 2020 prices

Farmers Income (Net Value Added)	€ Million	473
Food processing		
Value Added	€ Million	447
Wage Bill	€ Million	350
Employment	(000)	9.0
Total Cost each year	€ Million	919
Reduction in annual methane emissions	M tonnes CO2e	4.6
Reduction in annual GHG (methane & NOx) emissions	M tonnes CO2e	6.7
Cost per tonne of GHG emissions reduced each year	€	137
Reduction in stock of methane in atmosphere 2050[1]	M tonnes CO2e	47.3
Reduction in stock of GHG in atmosphere 2050	M tonnes CO2e	90
Cost per tonne GHG in atmosphere reduced, 2050[2]	€	204

While, as I discuss later, scientific advances promise technological ways of dramatically reducing methane emissions from cattle in the long-term, they are most unlikely to be widely deployed at scale until the 2030s. Thus, there is not a significant technological solution to dramatically cutting methane emissions by 2030.

[1] As set out in https://www.mdpi.com/1996-1073/13/4/800?type=check_update&version=2, the formula used here for deriving the stock of methane in the atmosphere, X, with a constant emission rate of 1 after T years is :

$$X = 1 * \sum_{t=1}^{T} \exp(\frac{-t}{12.4})$$

[2] The cost is taken to be the loss of income over the 20 years 2030 to 2050.

The work by Teagasc suggests that there are ways of significantly reducing NOx emissions from agriculture but there is currently no known way of eliminating them. This is acknowledged in the IPCC report, 2019, which indicates that the remaining NOx emissions in 2050 will need to be offset by sequestration using artificial methods, probably at considerable expense.

Teagasc research, incorporated into the Climate Action Plan, 2019, envisaged a 10% to 15% reduction in agricultural emissions by 2030 at a cost of €57 a tonne of GHG abated. This would be achieved through a range of innovations affecting NOx and also, to a lesser extent, methane. The CCAC recommended that an additional c. 10% cut could be made by reducing cattle numbers, especially cutting the beef herd by around 1 million. Because farmers, on average, make nothing from producing beef, the cost to farmers and society from such a change would be low. In addition, any direct costs could be offset by using some of the land freed up to grow trees or biomass, providing an alternative income stream.

Without additional technological solutions the only way to reduce methane emissions by 33% is to cut the cattle (and sheep) herd by around 33% by 2030. The current herd size is 7.3 million cattle. It would need to be reduced to around 5 million by 2030 if the target for emissions in the Bill is to be achievable. I assume dairy and beef cattle numbers are reduced equally. Because dairying is profitable, this will have a major impact on farm incomes. Also, cutting the produce of the agricultural sector by 33%, which provides the inputs to be processed in the dairy and meat processing sectors, would also cut the value added in manufacturing by a third. The same reduction would apply to the wage bill and employment in these industrial sectors. The potential impacts are summarised in Table 2, based on a 33% reduction in herd size. (A reduction of a half would have proportionate effects to those shown in the Table.)

The figures are for loss of income in 2030 at 2020 prices. Farm Incomes would be permanently reduced by around €470 million each year over the period to 2050 and beyond. Thus, the long-term cost would be a large multiple of the single year cost.[3] The reduction in farm income excludes any effect on farm subsidies under the CAP. The reduction in farm income is an approximate figure and Teagasc could provide a better estimate.[4]

The figures for value added, the wage bill and employment in the food processing sectors are for 2017 and are taken from EUOSTAT Structural Business Statistics. This suggests a loss in value added of around €450 million a year in manufacturing, with a reduction in the wage bill of €350 million and a reduction in employment of around 9,000.[5]

Because all of the farm income accrues in rural areas, and most of the food processing also occurs in rural areas, nearly all of the loss of income will accrue in rural areas. Also, farm incomes and the income of those working in the food processing sector are in the lower half of the income distribution. Thus, the loss of income will have very negative distributional effects, hitting poorer household and poorer regions (just transition). At today's prices the direct loss of national income would amount to 0.4% of GNI*.

[3] This assumes no replacement activity on the land that might be encouraged by the fall in rents but, by definition, there would still be a net loss.

[4] The proportion of farm income coming from cattle, sheep and dairying is assumed to be the same as the share of gross output of these sectors in total agricultural gross output.

[5] Because the meat processing sector is partly staffed by a continuing inflow of immigrant workers the effect on unemployment would be muted.

These estimates are first round effects. They take no account of the fact that some of those who lose their jobs may find alternatives and that farmers may be able to make income in other ways from their land. This could reduce the costs to the individual and to society. However, no account is taken of the loss of tax revenue and the probable need for the state to substantially compensate the losers, necessitating a rise in taxation or a cut in expenditure elsewhere.

2050 target

Because the Climate Bill does not take account of methane's short lifetime in its definition of climate neutrality, the only way that livestock production could continue in 2050 is if there was an ever-increasing stock of forestry and continuing peatland restoration in Ireland, to offset the constant flow of methane and NOx from any continuing livestock production. This is obviously not feasible and the use of alternative methods of sequestering carbon are likely to be too expensive to make this worthwhile. Thus, it is likely that, given the definitions used in the Bill, nearly all livestock production would have to end by 2050. This would approximately treble the annual costs shown in Table 2.

This necessity to eliminate all cattle and dairy farming in Ireland by 2050 contrasts with the UK Climate Change Committee's latest carbon budget calculations for the UK, which assume a reduction of 40% to 60% in agricultural methane emissions in Northern Ireland by 2050, not complete elimination. For Scotland they envisage a reduction in methane emissions of between a fifth and a third by 2050.

"Carbon" Budgets to 2030

The Council is required to prepare carbon budgets for the period 2021 to 2025 and 2026 to 2030 consistent with the reduction in all emissions of greenhouse gases by 51% by 2030. They should also be consistent with achieving climate neutrality by 2050. In drawing up the carbon budgets the Climate Bill also requires the Council to take account of "relevant scientific advice, including with regard to the distinct characteristics of biogenic methane". The Council must also take account of the employment, competitiveness effects and climate justice implications of its proposed budgets.

As set out below, this may require the Council to effectively draw up separate preliminary budgets for methane and other greenhouse gases, allowing for different speeds of adjustment consistent with emissions of all gases being reduced by 51% by 2030. The different speeds of adjustment may be needed to take account of the issues specified in the Bill. Having determined the correct allocation of emissions to the two budgetary periods, consistent with the requirements of the Bill, the final budgets submitted to government would combine the methane and non-methane budgets to give an overall total.

Table 3: Proportion of methane in atmosphere in years after initial emission

	% left after years
10 years	45
15 years	30
20 years	20
50 years	2
60 years	1
100 years	0

Table 3 shows what proportion of methane emissions that remain in the atmosphere after a range of years. It uses the formula for the decay of methane set out earlier in this note. This means that the effect on the stock of greenhouse gases in the atmosphere in 2050 of delaying reducing emissions, for example from 2025 to 2030, is relatively low relative to the size of the initial emissions.

Table 4 shows the effects of assuming that methane emissions are cut by a third in 2030 rather than 2025. The reduction in the stock of methane in the atmosphere is not that different depending on whether the cut is made in 2025 or 2030. Because the loss of income from farming and related manufacturing is significant due to the related reduction in cattle numbers, the loss of an additional 5 years of farm income means that the cost per tonne of methane (carbon equivalent) reduced in the atmosphere in 2050 is almost €450 from a reduction in 2025 compared to around €390 where the reduction takes place in 2030. On its own, this would argue for delaying the reduction till the second carbon budget period.

Table 4: Effects of cutting methane emissions in 2025 or 2030

Cut in emissions	%	0	33%	33%
Cut from	year		2025	2030
Stock in atmosphere 2050	kt	188582	137399	141304
Reduction	kt		51183	47278
Cost	€M	0	22982	18386
Cost per t	€		449	389

However, there are two issues that may militate against a delayed cut:

1. Methane is largely a complement to NO2 in agricultural production. Cutting methane by cutting the herd will also result in a reduction in NO2. The lower the emissions of NO2 over the decade to 2030 the lower the stock in 2050 (it is a long-lived gas).
2. A delayed cut in methane would involve a major cull of animals at the end of the period whereas a steady reduction could probably be achieved by natural means.

It will require further research to determine the right path for methane reductio over the two carbon budget periods. However, because of its different properties, the Council needs to consider the appropriate time path for methane separately from that for other gases before arriving at the final carbon budget recommendations.

2.2 Alternative Path to Climate Neutral Agriculture

It is useful to begin with the 2050 target to reach carbon neutrality and spell out what a climate neutral agricultural sector would look like, and then work back to what it would mean for 2030.

Beginning with methane, a short-lived gas, climate neutrality would require the permanent stock of methane in the atmosphere to be offset by a permanent increase in carbon sequestered in wood or biomass through a change in land use.

As set out in Matthews 2021[6], there are a range of technological possibilities on the horizon which could reduce the methane emissions from cattle by between 30% and 80%. These involve changing the feedstock of cattle by including certain additives. Introducing clover and other legumes in pasture swards is a way of reducing N2O emissions because less N fertiliser is needed. If successful,

[6] http://capreform.eu/mitigating-agricultural-emissions/

it is likely to be the 2030s before it could be feasible to deploy these technological solutions at scale. However, if the research is successful, once deployed, they could achieve a major reduction in methane emissions.

For example, the current stock of methane in the atmosphere attributable to Irish agriculture probably amounts to between 175 and 200 million tonnes of CO2 equivalent. With unchanging cattle numbers, no technological change, and no change in on-farm land use to increase carbon sequestration, the stock of methane in the atmosphere would be little changed in 2050.[7]

If a 50%[8] reduction in methane emissions from the same stock of cattle were achieved by technical change in the 2030s, this would reduce the stock of methane in the atmosphere by 2050 by between 50 and 75 million tonnes and serve to actually reduce global warming, in contrast to the contribution from all other sectors. In the very long term, the reduction would be close to 100 million tonnes. In addition, if farmers changed land use to grow more trees or biomass this could permanently sequester carbon equivalent to the methane in the atmosphere, completely neutralising the effect of agricultural methane on climate change.

It would make sense from an incentive point of view to make the agricultural sector responsible for achieving climate neutrality in their sector by allowing them to count the carbon sequestered through changes in land use. While it would probably not be feasible to insist on climate neutrality at an individual farm level, it would certainly make sense at the sector level.

This leaves the problem of the substantial emissions of NOx by the agricultural sector. While technical change should see significant cuts over the coming decades, there will probably still be substantial emissions of NOx from agriculture in 2050. Because it is a long-lived gas, offsetting its climate effects by ever increasing hectarage of forestry would probably not be feasible after 2050. Instead, the farm sector would have to pay for industrial scale sequestration of NOx. This could be very expensive, taking up a quarter or more of farm income at current prices. However, if this requirement for climate neutrality in agriculture were applied across the EU, the effect would be that prices would rise significantly, offsetting a significant part of the rise in farm costs from paying for NOx offsets.

Thus, it is possible to envisage an agricultural sector in 2050 which is completely carbon neutral, with a continuing substantial stock of livestock. This could be achieved at much lower cost to the individual and society than following the path prescribed by the Climate Bill. This provides a counterfactual against which the Bill's implications can be measured.

As in all other sectors, technical change will play an essential role in reaching climate neutrality in agriculture. However, if the technological change does not deliver in agriculture there would remain the option of reducing the herd in the 2030s, still reaching the same reduced stock of methane in the atmosphere in 2050. This fall-back position is not available in other sectors if technology fails to deliver.

Implications for 2030

If the Bill is not altered then, as outlined above, the cattle herd will have to fall by around 33% by 2030, with major costs to society. However, as also outlined above in the alternative path to climate neutrality in agriculture, as technological developments are deployed it would then be possible in

[7] This contrasts with all other sectors and gases where the stock of GHGs in the atmosphere related to their activity will be much greater than it is today.

[8] The effects for a 30% or and 80% reduction would be proportionate to the figure for a 50% reduction.

the 2030s to grow the herd again and still reach full climate neutrality in 2050. This would make no sense economically, providing for an unnecessarily expensive path to decarbonisation by 2050.

If the Bill were modified to exclude methane, then a separate target would have to be set for methane for 2030. As indicated above, if the Climate Action Plan 2019 targets for agriculture were supplemented by the cut of around 1 million in livestock numbers, previously recommended by the CCAC, this would limit the costs of the change and would put agriculture on a path to fully neutralising the climate change effects of its methane emissions by 2050.

This would still leave the continuing NOx emissions which would have to be reduced by close to 50% if the Climate Bill's target for long-lived gases is to be achievable by 2030. As outlined above, in the long run the agricultural sector should have to pay for the permanent sequestration of its NOx emissions by industrial means. However, in the period to 2030 it would be appropriate to see that payment made to subsidise the more rapid change in land use to sequester carbon in trees or biomass. Individual farmers could avoid a charge by changing how they use some of their land, or else pay other farmers to make the change for them. To allow this option would require a change in the Bill, not only in how it treats methane, but also in allowing sequestration in trees and biomass to be counted as an offset to emissions of long-lived gases. If it turns out that the Bill does allow sequestration to be counted in the 2030 target, then the option of sequestration could be taken into account in preparing the draft carbon budgets.

3. Land Use Change and Forestry

Recent research suggests that up to 200 million tonnes of carbon dioxide could be sequestered by 2050 through expanding land devoted to forestry and biomass and managing bogs appropriately. This potential saving must be seen in the context of a budget for total Irish emissions of greenhouse gases to 2050 of between around 400 million tonnes and 800 million tonnes.[9] Thus, sequestering carbon could increase our allowable emissions to 2050, consistent with meeting our climate goals, by between 25% and 50%.

However, natural sequestration of carbon dioxide in trees takes considerable time. For the first 10 or 15 years of a new tree the amount sequestered is small. It is only later in a tree's life that the amounts sequestered are really large. Thus, to achieve the 200 million tonnes of sequestration by 2050 it is very urgent to change land use and plant new trees. If it is delayed a number of years, the 200 million target for 2050 will not be achievable.

Licenses are needed for a range of processes in forestry including harvesting, developing roads to access the timber etc. Today, there is a complete blockage on the forestry sector due to the operation of the licensing system. This has seen production of timber grind to a halt and has also stopped all significant new planting.

Talking to the farming community, the licensing system is a massive obstacle. To apply for a license is a complicated process, adding to the costs for farmers. The processing of the licenses is a time-consuming process to ensure due diligence. In turn, the appeals system takes time. Even after an appeal, development can be delayed by judicial review. The current Chief Justice, early in his term, spoke of how complicated and expensive such processes are and how better solutions are needed.

An alternative would be to abolish the licensing regime and replace it with a regulation regime enforced by the EPA. The regulations could be framed to deal with objectives on climate change,

[9] These figures are taken from the note for the Council on the work of the ad hoc committee. They use a different metric. The figures using the metric used in this note are not currently available.

biodiversity, water pollution etc. This is the regime that currently works for all other agricultural activities – raising livestock, growing barley etc.

Whatever solution is adopted, it is very urgent that progress in the forestry sector is accelerated rather than stopped. Currently the Bill, because it may not recognise carbon sequestration in the 2030 target, may not provide any incentive for a ramping up of sequestration.

4. Forestry, Cement and the Built Environment

Currently emissions of greenhouse gases from cement production amount to around 3 million tonnes a year. These emissions could rise further as a result of a ramping up of investment in housing and green infrastructure over the coming decade.

These emissions are very hard to reduce. While the fossil fuel energy used for heat could be replaced by hydrogen at considerable cost, the only option to reduce the process emissions is to collect them and store them geologically.

An alternative approach is to make technical changes which would substantially reduce the need for cement. In much of Europe and the US timber frame dwellings are the norm rather than the use of concrete blocks. They are the norm because they are cheaper. Prior to the breakdown of the forestry sector, the proportion of timber frame dwellings was rising in Ireland. That is now going backwards because of the halt in supply of timber.

Research in Cambridge shows major benefits from replacing cement with timber in commercial buildings. The researchers built a 300-meter four-story building with timber rather than cement. This reduced the carbon content of the building from 310 tonnes, if it had been built with cement, to 126 tonnes. In addition, the timber locked up in the building captured 540 tonnes of carbon. If buildings survive for an average of fifty years this "temporary" sequestration of carbon is also very important.[10]

If Ireland shifted to timber framed buildings from cement this could potentially produce a major reduction in cement use and related emissions. If cement emissions continued at their current level to 2050 this would contribute 90 million tonnes to total Irish emissions. If, for example, emissions could be halved by use of timber this would reduce Irish emissions by 45 million tonnes by 2050, before taking account of any "temporary" sequestration of carbon. Such a change would be likely to come at low cost and, in the case of housing, might even reduce the cost of production.

A move to timber frame building would support the development of a market for forest products. In turn, this would make changing land use to forestry more attractive.

As in the previous two sections, an obstacle to the development of this way of reducing Irish net emissions is the fact that the Bill does not allow any benefit from carbon sequestration in 2030, though it does make provision for it in counting the 2050 targets.

5. Conclusions

Should the Council draw the Department's attention, formally or informally, to the problems with the Bill and the possible social and economic implications of the definitions used in the Bill?

If the Bill is enacted unchanged, then the CCAC will have no choice but to recommend carbon budgets to 2030 requiring a major reduction in livestock numbers with the related major social and economic costs. These social and economic costs must be considered in the context of the costs that

[10] However, under current rules, it could not be counted in the stock of net emissions.

will arise in reducing emissions in the energy sector. It is possible that these costs might turn out to be lower than the costs of reducing emissions in some other sectors.

The decision on the reduction in GHG emissions in agriculture and the role of sequestration through changes in land use must be made first, before using the TIM model to examine the best way of reducing other GHG emissions by 2030. In turn, the results from TIM will be combined with the allocation of the reduction in agricultural emissions and non-agricultural emissions to the periods 2020-2025 and 2025-2030, determining the total carbon budget for the two periods.

Changes in land use and the natural sequestration of carbon are clearly crucial in helping Ireland meet its target of becoming climate neutral by 2050. The current huge obstacle to developing this vital channel need to be addressed with extreme urgency. Failure to do so will entail very substantial social and economic costs for the country in meeting its climate goals.