Climate Mitigation Policies for Europe:

The Net Zero Target and the Agriculture, Forestry and Land Use Sector


1. The point of departure for this note is the AFOLU gap between annual agricultural emissions (CH4 and N2O) and annual net sequestration under LULUCF. For the EU in 2017, this gap amounted to 191 Mt CO2 eq. (440 – 249 net LULUCF sequestration).

For some countries (such as the UK), the gap is relatively bigger than the EU gap because of the relative lack of forest cover. In 2015, 21 Member States had over 30 per cent forest or other woodland cover, Hungary 24 per cent and Belgium 23 per cent, compared with Denmark 15 per cent, UK 13 per cent, Netherlands and Ireland 11 per cent (Eurostat). Moreover, the inclusion of revised estimates for emissions from peatland may indicate a net UK LULUCF source.
2. The structure of EU agriculture emissions in 2017 is shown below, from *Annual EU GHG Inventory 1990-2017 and Inventory Report 2019, Fig. 5.3.*

It will be seen that the weight of livestock in the emissions is 3.A.1 (CH4 from enteric fermentation from cattle, 38 per cent) plus 3.A.2 (CH4 from enteric fermentation from sheep, 5 per cent) plus 3.B.1 (CH4 from manure management, 9 per cent) plus 3.B.2 (N2O and NMVOC emissions from manure management, 5 per cent), the 3.B emissions being overwhelmingly attributable to cattle. However, because arable land is also used in part to grow livestock feed, a proportion (unquantified) of 3.D.1 (direct N2O emissions from managed soils, accounting for 31 per cent of emissions) and 3.D.2 (N2O from atmospheric deposition, N leaching and run-off, accounting for 7 per cent of emissions) is also attributable to livestock (and principally cattle) systems. *The livestock sector will require significant support in the transition to Net Zero.*

1. *Annual EU GHG Inventory 1990-2017 and Inventory Report 2019, Fig. 5.3*
It should be noted that emissions are reported as CO2 eq based on a 100-year Global Warming Potential (GWP), following international practice for non-CO2 gases in National Inventories and using the values in AR4/1, Table 2.14. Because of the short atmospheric lifetime of CH4 at 12.4 years, use of its 100-year GWP of 25 significantly discounts its effect compared with the 20-year GWP of 72. By comparison, this discount effect does not occur with N2O, with an atmospheric life of 121 years, GWP/100 of 298 and GWP/20 of 289. The application of 20-year GWPs to EU agricultural GHG emissions would bring CH4 emissions in 2017 from 52 per cent to 76 per cent. At the same time, AR5/1, Tables 8.7 and 8.A.1, revises the GWPs: hence CH4 GWP/100 would now be 28 with GWP/20 of 84, and N2O GWP/100 would be 265 compared with GWP/20 of 264. These AR5 GWP/100 values are expected to be introduced in National Inventories under the Paris Agreement in 2022-2023, although non-CO2 GHGs will still be reported at GWP/100.

2. EU GHG Emissions from Agriculture in 2017 at 20-year GWP
3. Detailed figures are not readily available for the proportion of crops from arable land that become livestock feed, but Figure 5.2 (b) from Climate Change and Land (IPCC, 2019), indicates the global growth in use of crop production for animal feed since 1960.

All this would suggest that livestock numbers, and especially cattle numbers, which according to Buckwell, Safe Operating Space for European Livestock (RISE, 2018) are, conservatively, twice as high in the EU as needed for grazing permanent pasture, are central to reducing GHG emissions from agriculture.

This might be done, potentially, by bringing numbers of cattle into line with permanent pasture, reducing as far as possible prior cycles of emissions from the use of arable land for growing livestock feed, and reallocating the arable land in question either to bioenergy (typically within the annual cropping rotation) or LUC (principally afforestation).

Manipulation of the C: N balance in diet, and manure management, are good complementary measures but fundamentally are probably too marginal to be game-changers, in particular because of difficulties of measurement, verification and permanence. Moreover, intensification locks livestock systems into prior cycles of emissions.

3. Climate Change and Land (2019), Fig. 5.2 (b)
4. Reducing use of N-based fertiliser would also be an option. This might be achieved by longer arable rotations. For example, the Holkham estate (Norfolk, UK) has lengthened cropping rotations to improve fertility, using a six-year rotation avoiding consecutive straw crops (winter barley, oilseed rape, winter wheat, potatoes, spring barley, sugar beet) while the Esterházy estate (Burgenland, Austria) converted to organic agriculture in 2003, introducing a nine-year rotation which includes lucerne and oats or another fodder crop for grazing livestock (currently 120 animals).

There are a number of issues here, however. Although longer rotations might allow more scope for biofuels, some of the crops might be less profitable and require support. At the same time, the Esterházy yields of 3.3 t/ha durum wheat are considered acceptable because of the hot, dry conditions of the Pannonian climate (annual rainfall 450-600 mm), where conventional yields are 4 t/ha, but not viable in areas of slightly higher rainfall.

This indicates that more work would need to be done to establish the viability of this option.

Precision farming and use of cover crops are useful complementary measures, but are likely to be too marginal to be game-changers, and too open to issues of measurement/verification and permanence. A problem with precision farming is that in any one year, too many other factors will make it difficult to fine-tune applications between different parts of a field.

Meanwhile, current plant-breeding work at Cambridge offers the hope of developing strains of plant that will fix their own Nitrogen.

5. Increasing Carbon Sequestration

Bearing in mind the need for additionality, verification and permanence, the most attractive measures will involve LUC through afforestation or, where appropriate, a switch from arable to permanent pasture. Afforestation ought to be treated also as a climate adaptation (resilience) measure, while locally (e.g., restoration of flood plains) conversion to permanent pasture would be more appropriate.
However, the design of sylvicultural systems will be very important in order to optimise resilience, carbon stock and potential for substitution. There must be a preference for mixed and, eventually, uneven-aged, continuous cover structures, coupled with use of a periodic forest inventory (setting out standing volumes by species and age classes) for management.

There is, however, considerable scope for improving undermanaged small woodlands.

Restoration (re-wetting) of peatland is, bearing in mind the size of the carbon stock in peat, and therefore the potential sink in re-wetted peat, another essential, albeit localised measure.

It should be noted that the C benefits, while significant, are not rapid, and the CALM methodology developed as an adjunct to D. Viner et al., *Climate Change and the European Countryside* (Climatic Research Unit, University of East Anglia, ELO and Country Land and Business Association, 2006, Annex I) averaged C gain in peaty soils over 300 years in UK conditions.

Because of the time-lag in optimising additional sequestration and substitution, it is necessary to take a view of 2100 as well as 2050, because the structure of net zero will potentially change over this time.

6. Energy and Material Substitution

This is very much part of afforestation and moving land within the arable rotation away from supporting housed livestock systems. At one end of the scale, the scope is indicated by wooden blocks of flats being built in, e.g., Sundby (Stockholm) and elsewhere. The need to develop strong markets here is clear. One way would be through appropriate building regulations.
7. A summary of some available measures

**Afforestation**

- Planting grants to establish new afforestation
- Thinning grants for management to enable optimum growth
- Annual stewardship grant (comparable, e.g., to Higher Level Stewardship in UK)

Trading of carbon in post-1990 afforestation on the basis of time-limited certificates linked to the periodicity of the forest inventory. Under such a system, the onus would be on the buyer to renew.

**Introduction of a requirement for a forest inventory** as a condition of C trading and of grants for above a given area (say 0.5 ha).

**Agroforestry**

These are essentially complementary measures which will increase local resilience, e.g. hedgerow planting and/or management, and planting trees on permanent pasture. Additional carbon benefits could be obtained by planting hedgerow trees.

Stewardship-type grant for the above, depending on level of ambition

**Livestock**

- Buy-out of excess livestock numbers (herds or part herds). This could be timed to coincide with normal replacement. It would be for consideration whether this might be also structured as a kind of capital/retirement payment.
- Stewardship grants for livestock on permanent pasture at agreed stocking rate
- Compulsory manure management for housed livestock, including when seasonally housed
Complementary measure: adjust feed balance of housed livestock, where additional emissions are not generated

Peatland restoration grants

There will already be some experience of this, and there are about 100 schemes of different sizes in Scotland.

Reducing use of artificial N fertiliser

Support of N-fixation through the inclusion of leguminous crops within a lengthened arable rotation

Precision farming. This is an important but essentially complementary measure.

Bioenergy

Development of the bioenergy option for break crops within the annual arable rotation and for cereals failing to reach milling or malting quality, e.g. bioethanol as a use for feed-quality wheat or barley and for sugar beet.

Support for Miscanthus and short-rotation coppice.

ENDS

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