Technical Annex 6: Agriculture and land use, land use change and forestry

This Technical Annex supports the agriculture and land use, land-use change and forestry (LULUCF) chapter of the report, *Meeting Carbon Budgets - 2016 Progress Report to Parliament*, covering the following sections:

1. Anaerobic digestion
2. Soil carbon
3. Detailed assessment of policies
4. Indicator table

1. Anaerobic Digestion

In our main report, we stated that Anaerobic Digestion (AD) should only be supported where it is delivering genuine emissions reduction. A recent study commissioned by Defra[1] assessed the environmental impacts of growing maize for AD.

The study was based on a review of recent UK research on maize production on diffuse water pollution, soil quality and biodiversity, supplemented with analysis from June Agriculture Survey data to identify which agricultural activities were being displaced by maize production. Qualitative evidence was also gathered from four case studies of AD plant.

While there was significant variation in impacts of maize cropping according to scale, region, soil type and rainfall, the study found:

- Maize grown on well managed cropland was unlikely to have greater environmental impacts than displaced cropping.
- Maize grown on grassland is likely to lead to an increase in GHG emissions.
- There were concerns that maize production could increase the risk of soil erosion.
- Water quality could be a concern, as an increase in soil erosion can result in the movement of soil sediment and nutrients such as nitrogen and phosphorus into the watercourse.

The most significant environmental impacts from the AD process, relative to growing maize as a feed for livestock, are the emissions of methane during biogas production and emissions from methane and ammonia from digestate storage and application of the digestate. The study found these were likely to have differing impacts:

[1] ADAS and Ricardo Energy & Environment 2016 'Impacts of agricultural maize cultivation on agricultural land rental prices and the environment' http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=2&ProjectID=19655

- Methane emissions in a well-designed and managed AD process are likely to be lower as the fugitive emissions in the plant will be lower and the digestion process more complete than on livestock production.
- Ammonia losses from crop-based digestate were greater than from the application of cattle slurry, reflecting the higher pH of food-based digestate.

The study highlighted that assessing the full GHG footprint of on-farm AD is complex. A full assessment must also consider the potential impacts from indirect land use change. It is important that industry and Government continue to monitor this footprint and work together to deliver best practice, to ensure that AD is delivering genuine emissions reduction.

2. Soil carbon

Increasing soil carbon and minimising losses from degraded peatland and other soil types are important for reducing greenhouse gas emissions. Peatlands are particularly important as they store about 40% of soil carbon in the UK. In addition to the carbon benefits, there are synergies with efforts to adapt to climate change. For example, the restoration of peatland can improve water quality, while increasing soil organic carbon can improve soil structure and fertility. Given this, we stated in our main report the need for action to improve the condition of degraded soils, and to limit damaging practices such as peat extraction for horticultural use and intensive rotational burning on upland moors.

In its recent report on soil health[2], the Environmental Audit Committee (EAC) recommended urgent action to increase carbon levels in all soils, including peat. It specifically recommended that Government, in its upcoming 25-year Environment Plan, should set out specific, measureable and time-limited plans to:

- Meet the goal to increase agricultural soil carbon levels by 0.4% per year, which is the initiative[3] launched by the French Government and signed up to at the Paris COP21.
- First halt and then reverse peatland degradation while minimising the impact on agricultural capacity. This includes taking tougher action to tackle land use practices which degrade peat, such as unnecessary burning and draining when crops are absent.
- Ensure the results of its research into lowland peat management inform its 25-year environment plan.

Along with further recommendations on clearing up contaminated land and the need for on-going monitoring of soil conditions, the EAC concluded that it found no evidence that policies were being put in place to meet the Government's 2011 aspiration[4] that all soils should be managed sustainably by 2030.

3. Detailed assessment of policies

In Chapter 6 we set out our assessment of the impact of policies intended to reduce emissions in the agriculture and land use, land use change and forestry (LULUCF) sectors. We classified those

[2] Environmental Audit Committee (2016), *'Soil health'*

[3] The 0.4% is a worldwide average http://4p1000.org/understand

[4] Defra (2011), *'The Natural Choice: securing the value of nature'*.

policies at risk of failing to deliver savings, either due to design and delivery problems, or because there is no policy in place. Table A6.1 sets out our rationale for classifying policies 'at risk' or where there is policy missing.

Table A6.1 sets out the rationale for at-risk and policy missing savings.[5]

Table A6.1: Assessment of current and planned policies

Policy	Detail: Policy 'at risk'
Afforestation policies	Tree planting rates across England and the devolved administrations are below the 15,000 ha/year between now and 2030 required to contribute towards the fifth carbon budget. There are no policies in place to develop agro-forestry schemes in the UK.
GHG Agricultural Action Plan	This targets cost-effective measures, but reliance on a voluntary approach risks the delivery of carbon savings. No mechanism is in place to evaluate if the policy is delivering emissions reductions in line with the ambition of the Plan, and experience to date is that emissions are not falling.
	Detail: Missing policy
No policy beyond 2022	There is no policy instrument in place beyond 2022 to deliver additional emissions savings in agriculture to the end of the fifth carbon budget period.

[5] See DECC's Annex D: Policy savings in the projections at https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2015

4. Indicator table

Table A6.2: The Committee's agriculture indicators						
Agriculture		Budget 2	Budget 3	Budget 4	2014 trajectory	2014 outturn
Headline indicators						
Emissions (indicative % change from 2007 reflecting LCTP ambition scaled to UK) *						
CO_2e emissions**		-7%	-10%	-12%	-4.8%	-0.4%
GHG emissions (% change in tCO_2e against 2007)	N_2O	-5%	-8%	-17%	-3.5%	3.4%
	CH4	-8%	-10%	-9%	-5.5%	-2.6%
	CO_2*	n/a	n/a	-21%	n/a	n/a
Source emissions (% change in tCO_2e against 2007)	Soils	-6%	-9%	-17%	-4.1%	4.2%
	Enteric fermentation	-7%	-10%	-11%	-4.6%	-2.7%
	Animal waste	-12%	-18%	-6	-8.2%	-3.1%
	Machinery/fuels*	n/a	n/a	-17%	n/a	n/a
Drivers***						
tN_2O emissions per thousand hectares of arable land	2007 = 1.6	1.5	1.4	-	1.5	1.8

Table A6.2: The Committee's agriculture indicators						
tN_2O emissions per thousand hectares of pasture land	2007 = 1.0	0.9	0.9	-	0.9	0.9
tCH4 emissions per tonne of cattle and calf meat, dressed carcase weight	2007 = 14.9	14.0	13.5	-	14.2	13,8
tCH4 emissions per thousand litres of milk	2007 = 0.67	0.61	0.57	-	0.63	0.68
tCH4 emissions per tonne of sheep and lamb meat, dressed carcase weight	2007 = 13.5	12.7	12.3	-	12.9	13.4
tCH4 emissions per tonne of pig meat, dressed carcase weight	2007 = 1.2	0.9	0.7	-	1.0	1.1
tCH4 emissions per tonne of poultry, dressed carcase weight	2007 = 0.06	0.04	0.04	-	0.05	0.06
AGRICULTURE		Budget 2	Budget 3	Budget 4	2014 trajectory	2014 outturn
Supporting indicators						
Farming Practice Measures where greater confidence exists (e.g. proven technology, considered best practice, consistent abatement results) but uncertainty about baseline use.						
Nutrient management – including improved mineral and organic N timing, separating slurry and mineral N, using composts, and making full allowance for manure N	% of hectares where measures are in place	Better evidence about current farming practice is required to develop full trajectories.				
Livestock management – including breeding for fertility and productivity	% of livestock of different production/fertility efficiency	Better evidence about current farming practice is required to develop full trajectories.				

Table A6.2: The Committee's agriculture indicators						
Manure management	% of manure/slurry stored in covered tanks or lagoons	Better evidence about current farming practice is required to develop full trajectories.				
Anaerobic Digestion	Installed AD capacity using manures (MW)****	68	102	n/a	5% of holdings have AD (2014)	
Measures that require further evidence to establish appropriateness and effectiveness in UK and in regional contexts						
Soil management (reduced tillage/drainage), nitrification inhibitors, and using more N-efficient plants (species introduction and improved N-use plants)	% of hectares where measures are in place	Not suitable for all hectares. Requires development of evidence base to resolve possible conflicts with other goals and to determine applicability, GHG benefits and costs under different conditions.				
Livestock management (including maize silage and dietary additives in form of propionate precursors or ionophores)	% of livestock consuming different diets and feed additives	Not suitable for all animals/farms. We will monitor the development of the evidence base around these measures, including applicability, net GHG benefits and resolution of possible conflicts with other sector goals.				
Policy Milestones						
Government policy review (2016): • Review the voluntary approach • Consider policy options for intervention • Set triggers for intervention		2016				Defra has not yet published
Government to set out in their emissions reduction plan for new policies and measures to deliver emissions reductions to 2030		2016				
Deliver the new Smart Inventory, without further delay		2017				On-target for 2017 roll-out
Other drivers						
Crops/soils: Crop yields (e.g. cereals), cropping areas, N_2O emissions per hectare of cultivated land, N_2O emissions per unit of fertiliser use, output of product per unit of fertiliser use.						
Livestock: tCH_4/tonne dressed carcase weight (cattle & calves), weight of carcase produced per day of age, calves produced per cow per year.						

Table A6.2: The Committee's agriculture indicators	
General: We will monitor development of the evidence base and R&D support for the various mitigation measures. We will also track upcoming CAP reform negotiations (to be complete by 2014) and implications for farming practice and emissions.	
LAND USE, LAND USE CHANGE AND FORESTRY	By 2030
Headline indicator	
Emissions (annual savings from carbon sequestration by 2030)	
CO_2 sequestered	2.4 $MtCO_2e$
Supporting indicators	
UK woodland planting	• At least 15,000 hectares/year between 2015 and 2030 • Development of agro-forestry schemes
Development and implementation of a woodland creation programme	Government ambition for England of average rate of 5,000ha/year by 2060
Agro-forestry	Address financial and non-financial barriers to uptake
Include upland and lowland peat emissions in the LULUCF inventory	By 2018
Develop a policy framework to increase peatland restoration	By 2017

*For the fourth carbon budget period, % change in tCO_2e is against the projected business as usual emissions in 2027.
**CO_2 abatement potential not factored into first three budget periods, and 2007 levels are based on actual.
*** Broadly consistent with LCTP ambition and agriculture industry roadmaps to the third carbon budget period. Intensity indicators for budget periods assume constant output. Should output exceed assumed levels then lower intensities would be needed to deliver absolute emissions reduction. Industry roadmaps only set to 2022, and therefore indicators not relevant for the fourth carbon budget period. New indicators will be developed for the fourth carbon budget period in next year's progress report.
****Handling beef, dairy and pig manures and slurries.

Note: Numbers indicate amount in last year of budget period i.e. 2017, 2022, 2027.

Key: n Headline indicators n Implementation indicators n Milestones n Other drivers