

Chair's Report of the CCC Land Use Advisory Group
Policies for Agriculture, Forestry and Land Use

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Executive summary

1. The Advisory Group welcomed the clarity of the identified pathways for the Agriculture, Forestry and Land Use (AFoLU) contributions to the Net Zero 2050 target, and broadly agreed the mix and magnitude of actions as achievable given the right incentives.
2. Early action is needed but uncertainties of Brexit and future trade relationships make it unlikely that post Brexit agricultural and environmental legislation will be fully operational before 2024, catching-up will therefore be required in subsequent years.
3. Given the multiple actions required from the multiple actors in AFoLU and that agriculture and environmental policy are devolved, strong UK leadership and coordination is essential. Climate change mitigation should be the number one priority for land management policy. This should be reflected in aligned objectives and timings (30 not 25-year plans) for the new legislation and may require a new UK-level institution. Implementation must be administered at a lower level with active engagement of land managers through appropriate sub-national organisations.
4. Land managers' understanding of the origins and accounting for GHG in their sector must be helped. Government should certify a methodology for GHG accounting for land-based businesses which links to inventory accounting. There are gaps in scientific knowledge about the non-CO₂ gases and the applied science of the effects of management practices.
5. The actions in the three areas of (i) reducing beef and dairy consumption and food waste, (ii) reducing agricultural emissions and increasing agricultural productivity, and (iii) inducing land-use change to forestry, bioenergy and peat restoration are unlikely to work at the same pace. More analysis is required to anticipate the impacts of different rates of progress in these three areas on markets and trade.
6. Communication and societal acceptance will be required for the mix of actions for AFoLU. The balance between red and white meat production & consumption, whether the reduced agricultural area is farmed more or less intensively, and issues concerning food trade balance will attract strong debate.

Key policy levers for AFoLU are listed:

Dietary change and food waste: education, information, campaigns, public procurement, food industry engagement for plant-based recipes, portion sizes.

Five sets of actions for agriculture and land use.

A. Agricultural emission reduction and productivity: stronger enforcement of existing and proposed new regulations (Nitrates Directive, Water Framework Directive & Clean Air Strategy), to encourage: methane inhibiting feed additives, nitrogen use and other resource efficiency, farm nutrient plans, legumes in rotations, manure management equipment grants.

- B. Afforestation:** initially generous tree planting grants & payments to first thinning, thereafter encourage private sector carbon credits, public land management schemes to pay non-carbon benefits, strong information and help on what, where, how to plant and manage, research on tree disease, breeding and climate resilience, encouraging material substitution in building codes.
- C Farm woodland management, hedgerows & agroforestry:** simplifying bureaucracy of certification, assisting infrastructure for processing the materials, utilising public land management schemes for non-carbon benefits and hedgerow management, information, education and demonstration farms for agroforestry.
- D Bioenergy:** creating confidence in the market through obligations for biomass material use, or contracts for difference with electricity generators, using public land management schemes for non-carbon benefits, encouraging emergence of trusted intermediaries for coordinating and facilitating collection and processing of materials.
- E Peat restoration:** Inducement to rewet peat by paying part of upfront costs and ongoing compensation. Projects based on the Peatland Code might attract private funds for this. Enforcement of management of peat within Sites of Special Scientific Interest (SSSIs), obliging water authorities and public owners to bring peat to favourable condition, and banning peat burning can all impact part of the upland peats. R&D on how to do paludiculture at scale, and for management prescriptions to reduce emission on lowland peat short of ceasing agriculture.

Cross-cutting actions for all these include: education, access to farm-level guidance, revising the definition of agriculture, ensuring tenancies and common land are included in actions.

Overall, a regulatory approach to require farmers to contain emissions is inappropriate as the administration and metrics at farm level are infeasible, and the sector has enough to absorb with Brexit, loss of subsidy and potential trade competition. Better to ride the public wave of climate concern and unify around this scientifically-based, climate-centric, strategy for food, farming and countryside. Encourage in developing the move away from red meat and be generous in helping farmers change land use and reduce emissions with some simple measures: a new afforestation scheme, methane inhibitors and legumes in rotations. Strong clear leadership is required to overcome inertia and get the ball rolling.

Policies for Agriculture, Forestry and Land Use

Introduction

1. The Land Use and Agriculture advisory Group was convened in summer 2019 and met three times. The group was asked to support and critically assess the development of the CCC's report on land use policy. The members of the group were:

Patrick Begg	National trust
Simon Billing	Eating Better
Allan Buckwell	Emeritus Prof Agricultural Policy, Imperial College (Chair)
Iain Donnison	Aberystwyth University
James Hepburne Scott	Forest Carbon
Stephen Ramsden	University of Nottingham
Mark Reed	Newcastle University
Jonathan Scurlock	National Farmers Union
Susan Twining	Head of Land Use, Country Land and Business Association

2. The group benefited from presentations of interim results of two consultancy reports on the policies for agriculture and land use change and economic impacts of potential measures, and presentations from the CCC land use team and other colleagues. It was clear from these reports and presentations that the CCC staff have the required background information and a good systematic structure to review the barriers to uptake of necessary changes and to evaluate the mix of potential policies to induce the changes. It was therefore judged that the most useful contribution of this report is not to try and produce a detailed policy analysis, 'measure by measure', but rather to deploy the Advisory Group's experience of policy making and implementation in the land-based sectors to help guide how the difficult challenges of inducing change in land use and management can be met. It is acknowledged that the group's expertise related predominantly to England with less knowledge of Scotland, Wales and N. Ireland.

The contribution to UK Net Zero 2050 by Agriculture and Land Use Change

3. The group based its consideration on the collection of actions in agriculture, land use, land use change and forestry (LULUCF) as spelled out in Chapter 7 of the Net Zero Technical report, with further detail elaborated in the CCC's November 2018 Land Use report. These documents concluded that the two sectors should be considered together, that it was not feasible to reduce agriculture's emissions to zero by 2050, and that some offsetting can be achieved by LULUCF actions. The suggested scale of actions reduces Agriculture, Forestry and Land Use (AFoLU) net emissions by around 64% by 2050 leaving 21 MtCO_{2e} annual emissions. The mix of actions to achieve these deep cuts takes account of the expected continued growth of UK population (by 9m or 13% by 2050) and assumes that the UK should broadly maintain its current degree of self-supply of food (i.e. does not increase imports). The three main actions and their components are:
 - i. **Reduce agricultural emissions** (methane from enteric fermentation and waste and manure management, nitrous oxide from soils, carbon dioxide from energy use in farming and forestry)
 - a. Directly (e.g. by methane inhibition in cattle, better soil management),
 - b. Through productivity improvement (e.g. breeding, feed efficiency, animal health),

- c. By reducing per capita consumption, and thence production, through diet change (20% less red meat and dairy products) and waste reduction.
 - ii. **Release arable land and grass land** from agriculture (~22%).
 - iii. **Induce land use change** to reallocate land released by farming as follows with the average annual rates of change over 30 years indicated:
 - a. Increased afforestation (~30k ha/yr)
 - b. Agroforestry*, woodland management and hedgerows* (~13k Ha/yr)
 - c. Perennial bioenergy crops* (~23k Ha/yr)
 - d. Peat restoration in uplands and lowlands (24k Ha/yr)
4. This is the first time such a clearly articulated comprehensive set of actions for AFoLU to contribute to climate change mitigation has been quantified and spelled-out in public. This is an important first step and the next task is to explain it to the sectors and businesses affected. This task has a long way to go.
 5. Broadly, the group does not dissent from these judgements of what is necessary and achievable given the right incentives in place, nor from the CCC assessment of the mix and approximate scale of actions summarised above. Two qualifications concerned specific assumptions. First, the scale of land use change to accommodate the additional population seems incomprehensibly large (a 58% increase in settlement land to accommodate a 14% increase in population amounting to one million Ha by 2050). Second, the assumed increase in agricultural productivity for both crop yields and animal stocking densities to offset the reduction in agricultural area, seems high and potentially poses conflict with broader environmental objectives and visions for future agriculture. These two assumptions drive in opposite directions for the land use release by farming, so perhaps the combination does not significantly disturb the overall assessment of the scale of the other land use changes required. A smaller conversion of agricultural land for development could permit a lower degree of further intensification of the remaining agricultural land. More modelling should be undertaken to explore the interactions between land use change and the balance between production¹, consumption and trade and the effects on GHG emissions require further scrutiny and more explicit modelling and debate.

Agriculture and land use are difficult sectors; Brexit adds to the challenge.

6. The climate change mitigation for agriculture and land use is difficult first, because there are *multiple interventions* and changes of behaviour required – this poses a coordination challenge. Devolved governance for agriculture and land use significantly complicates this. Second there is a *large number of highly heterogeneous actors* who will have to be engaged: land managers, industries up and down-stream of land management, and consumers too. The land management businesses number several hundred thousand including farmers, foresters and nature managers with a wide range of motivation from highly commercial, with income completely dependent on land management; to life-style operators who have substantial income outside their land management. These rural

* Strictly, the land with agroforestry, hedgerows and miscanthus would still be classified as agricultural land, so it is not released from this category of usage.

¹ This refers both to the total production and the balance between broad crop groups cereals/oilseeds, fruit & veg and livestock.

businesses are mostly micro-scale although with a wide range of size and structures, owner occupiers, mixed tenure, tenants and contract operators. They are geographically dispersed occupying 88% of UK territory. The climate actions must also involve many in the food chain; upstream agricultural supply sector (including seed, feed, fertiliser, plant and animal health products, water, machinery, other technology, energy, finance and advice) and downstream food and fibre processing, food service (canteens, restaurants) and distribution sectors. Because of the centrality of consumption adjustment in the climate actions identified, all citizens have a part to play because we are all food consumers. Third, the *complexity of some of the technical relationships* between the actions and emission reduction or additional sequestration are not well understood (e.g. enteric fermentation and soil chemistry), and their permanence is difficult to guarantee (e.g. soil carbon sequestration is easily reversed and afforestation faces increasing fire and tree disease risk). Fourth, there are *strong interactions between climate and other environmental concerns*. There is potential for actions deployed to reduce/increase emissions/carbon store either to enhance or degrade other variables which are of strong societal concern, especially water and air pollution, biodiversity and ecosystem function and cultural landscape. Fifth, *the measurement basis is not well developed* for on-farm emissions and sinks. These are not easily linked to the emission factors used in national inventories, and current emission factors are not closely related to detailed management practices. Monitoring Reporting and Verification (MRV) is therefore a challenge.

7. Quite apart from the climate challenges, this sector in the UK is under more policy uncertainty now than at any time since the late 1930s. This is because most of the significant policies affecting land management (the Common Agricultural Policy (CAP), environmental policy, trade policy, competition policy, and policies for plant and animal health, welfare and movements, and for food standards) are based on EU regulations and directives which are all now subject to change as the UK leaves the EU. Food and agriculture enjoy considerably higher border protection than other sectors of the economy this means the sector feels vulnerable to the possibility of this protection being lowered as part of new free trade negotiations post-Brexit.
8. In particular, the Government announced that the core of agricultural support under the CAP, the so-called basic payments, will be phased out over a number of years and replaced by a system of assistance for provision of (mostly environmental) public goods and improving productivity². The combination of the removal of these supports and potentially lowered border protection *ceteris paribus* would reduce existing resource misallocation costs, and critically, it should also reduce the scale of inducements necessary to bring about some of the land use change signalled. These changes, if they occurred suddenly (for example on 1st February 2020, or 1 January 2021 after a no-deal exit from the EU) have the potential to be highly disruptive for some farming sectors. This would undoubtedly affect the administration and impacts of schemes to encourage climate action. In any case the new environmental schemes are not likely to be operational before 2024.
9. These choices highlight the difficult balances to be struck in agricultural policy. Border protection, and therefore higher than otherwise food prices, plus generous direct taxpayer subsidies to farming are conventionally analysed by economists as (nationally)

² The Agriculture Bill is likely to re-emerge if the Conservatives form the next government, but many details of agricultural supports are not finalised.

welfare-reducing measures that encourage inefficient resource allocation and some have been environmentally harmful subsidies. However, these economic efficiency arguments are not prominent in the public discourse. This focuses more on choices between what are commonly termed intensive, industrialised agriculture versus sustainable farming systems such as organic farming, and relative environmental and welfare standards of home produced versus imported foods. These issues are flagged because the climate actions envisaged imply intensified production on a reduced agricultural area, and potentially further action at the border to reduce emission leakage.

Three horizontal issues for agriculture and land use

10. The implications from this are first that there is significant *inertia to be overcome* to get some momentum on emission reduction in these sectors. Second, there is still a large *communication task* to convince land managers that the changes required are in their own long-term business survival interests, and to persuade food consumers that the changes are in their own health and long-term environmental security interests. Third, that bringing about the above complex set of changes in farming and land use will require a great *many policy levers* to be pulled. This will require *sufficient institutional capacity and strong coherence and coordination across the devolved administrations* and the numerous public agencies in each territory. Fourth, the process must be set up to *learn by doing*, the easiest changes will be made first and marginal costs of abatement may rise. The process will have to adapt as it is discovered which emissions reductions and which land use changes are working and which ones seem impervious to change. This poses a challenge to have flexibility to respond to success and failure of actions yet at the same time to provide sufficient consistency in scheme rules to build trust to get good initial, and then sustained, engagement in the necessary actions. This last point has particular force for farmers in England where the administration of both Common Agricultural Policy supports have experienced a very poor record of IT systems, mapping and payment on time.
11. A convincing fresh start with strong leadership is required to set off on the new path. This will necessitate a strong, clear and sustained prioritisation and messaging from the top that all food and land sector actors have to play their role. Even with this leadership most of the actions required will take time to gather momentum and show benefits. The most important first step is to clarify the governance of setting this process in motion.

1 Governance

12. **Top level strategic governance.** Of necessity the CCC is a UK institution providing the basis for UK participation in the international Climate negotiations. The CCC's role is to advise on appropriate UK climate targets, setting pathways for achieving these and advising on policies needed to deliver them. It has no executive powers for actions on AFoLU, or any other sector. It is understood that a new cabinet committee chaired by the Prime Minister has been created to oversee climate policies. Because agriculture and many aspects of environmental policy are devolved there is no unified executive authority for these sectors for the UK. An important question is to consider if a new, properly resourced UK-wide body is needed for the AFoLU sectors. Its duty would be to provide the leadership, policy coherence, communications, UK oversight and powers to induce corrective action from the Devolved Administrations (DAs) for all AFoLU actions.

13. It is further suggested that that the ***strategic priority for the AFoLU sector has to be climate action*** to bring about the transition outlined. Society has agreed we are in an emergency so we have to behave accordingly. This should then be clearly reflected in the main legislative acts of each of the devolved administrations. This is not sufficiently the case to date in the three main new post-Brexit English proposals which have been presented to Parliament, the Environment and Agriculture Bills and for the Office for Environmental Protection³. This should be corrected, and also the periodicity of targets and milestones (2030, 2040, and 2050) should be aligned for all such policies in all the DAs.
14. It will be controversial whether to prioritise climate over other goals of agricultural and land use policy⁴. Of course, food security is always at the base of agricultural policy. The UK is also signed up to International commitments to halt and reverse biodiversity loss, and to EU legislation to reduce water and air pollution. The case for prioritising climate is that: (a) it *is* an emergency, and without corrective action climate change is the principal threat to long-term food security. Without a new energised, clear and sustained message we will not overcome the inertia, (b) the climate motivation provides a clear logic for the combination and integration of measures demanded this is less so for the other issues of concern, (c) for each measure taken for climate reasons the impacts on the other variables - biodiversity, water, air, landscape - should be assessed and sensitively managed, (d) most of the actions, especially dietary change and the land use change options, offer the capability to deliver multiple environmental benefits especially biodiversity restoration, and (e) where short run trade-offs are unavoidable the societal choice should favour climate action because uncontained climate change is damaging itself for food production, biodiversity and ecosystems.
15. With the UK strategic mechanisms to prioritise climate action for AFoLU in place, the ***implementation must be conducted at a lower spatial level*** for the agricultural and especially the land use change measures. This has to allow local and regional inputs to the siting especially of large changes in land use and thus cultural landscape and to enable the greatest possible landscape, catchment and biodiversity gain. It is hard to be prescriptive about the agency to take the lead in each of the DAs. The key may be to make funding available centrally but with conditions on local consultation which incentivise the coming together of public, charitable and private organisations to bid for and manage some of the schemes which most need local assent.
16. Using the English examples (there are corresponding bodies in Scotland, Wales and N Ireland), given there is no regional tier of government in England, and following systematic cuts over the last decade there are low regional staffing levels in government agencies. There is therefore no obvious regional organisation that could mastermind local implementation for the whole country. There may therefore be different solutions found around the country. This will have to include a lead responsibility from amongst government departments and/or agencies (Defra, Natural England, Environment Agency, Rural Payments Agency, Forestry Commission), but also landscape bodies (National Parks, Areas of Outstanding Natural Beauty, Nature reserves, Local Planning

³ These Bills were in suspense at the time of writing and may return after the December general election depending on the outcome.

⁴ It can be argued that whilst agriculture and land use account for about 9% of EU GHG net emissions (excludes peat emissions), they are responsible probably for a much higher proportion of biodiversity loss (maybe approaching 80% i.e. their share of land). It is suggested that nonetheless climate mitigation should take priority for the next few decades.

Partnerships, Local Nature Partnerships), the numerous trusts (River Trusts, Woodland Trusts and the National Trust) local authorities (County Councils, and Borough and District councils), and also other organisations Colleges, Research Institutes, Universities and local Forums (e.g. Tweed Forum). This is a highly fragmented and confused institutional landscape and is not likely to adapt or simplify quickly. This could hamper progress which makes it all the more important that the top-level priority is agreed with a UK coordinating body holding the DAs to account and then the DA lead organisation ensuring coordination at the lower level.

17. Local and regional differentiation in how the incentive schemes are operated and controlled will inevitably produce differentiation in results. It could also result in stasis and disillusion amongst land managers if too many organisations and consultations are required. Two ways of avoiding this are first to engineer into the incentive schemes for land use change a 'presumption to plant trees' under clear general principles for regard to the other vital concerns. Second, it is vital that there is sound (national) coordination of establishment of baselines and monitoring of progress so that lagging areas can quickly be identified to give the opportunity to learn from the more successful areas.

2 Knowledge, understanding and attitudes.

18. The combination of actions (in Paragraph 3) under consideration for the AFoLU sectors is not well known or understood. A key task once this package, or whatever replaces it, is adopted as government policy is to ensure it is widely explained and justified. Reactions to date suggest that whilst the land use change actions are seen as challenging, because they require sustained change for three decades at rates only briefly ever achieved, they do provoke interest and general approval. These are changes that the public and land managers can understand and, in principle, can get behind. The agricultural emission reductions are, and are seen as, technical and only of interest to those directly affected. It is the consumption changes which provoke some strong reaction.
19. Suggestions that the livestock sector is 'outside its safe operating space' have been increasingly common in the last 15 years. The same message has been heard from scientists studying nutrient (Nitrogen and Phosphorus) balances, human health, as well as GHG emissions, and from many NGOs. They all suggest consumption of livestock products in developed and many transition economies should be reduced for a combination of human health, environmental and animal welfare reasons. It is unfortunate that some groups are driving strong animosity and direct action against individual businesses in the livestock and meat trade. Understandably, these general and specific actions have provoked a strong reaction from livestock farmers who see their livelihoods threatened.
20. It is clear from arguments offered that there is still a long way to go to help farmers and the public understand better the scientific basis of the impacts of food related GHG emissions on climate and the logic of the accounting procedures for these gases. In the absence of good understanding some farmers are striking defensive attitudes claiming they are being demonised and victimised. It is important to try to take the emotion out of these matters. A frequently encountered complaint from farmers is that they are not credited with carbon they claim they are locking into soils, especially in permanent pastures. These farmers (and others) don't appreciate the difference between equilibrium processes such as annual grass (and crop) growth and their consumption and

respiration by animals and humans, versus permanent and growing sinks of carbon. This needs more communication. As do the soil carbon impacts of low-till and no-till farming and the effects of conversion of land from conventional to organic farming.

21. However, some land managers have become familiar with the recent, technical, issue of how to account for methane emissions as a relatively shorter-lived greenhouse gas. This has emerged from work by the Oxford Martin School^{5,6}. This clearly has implications for the accounting of agriculture's contribution to climate change, indicating a unique opportunity for AFoLU to actively reverse some of its impact on global temperature, which isn't possible in most other sectors. The current CCC conclusions are that it is not the right time to move now to a new metric for methane as the UK has to be consistent with UNFCCC/Paris Agreement decisions. The AFoLU pathway is broadly consistent with global pathways for agri-methane and there are opportunities for cost effective abatement of agri methane that if not taken up would require greater effort from other sectors. Such scientific developments must be kept under constant review. Communicating these issues require attention at all levels, schools, agricultural college and university curricula, and in communications with the land-based community on climate change. This demands high level coordination, or it will not happen.

3 Business-level GHG accounting, targets and MRV

22. A high proportion of farmers (numerically that is, not based on area or output) do not utilise basic cost accounting or other tools of business management such as detailed nutrient management. Such farmers are unlikely to consider carbon accounting. However, those managing the majority of agricultural output are more tuned into business and management accounts and performance benchmarking. Although the environmental performance of farming has been prominent in debates about the industry and has been a component of policy for almost three decades, there is still a dearth of accepted and routinely used environmental accounts and benchmarking for farms. Carbon calculators have been around for 15 years and there are many available, the two most common are the Cool Farm Tool and the Carbon Cutting Toolkit. A commonly observed remark from farmers is that they cannot manage what they don't measure but each C calculator gives different results and none is authenticated by any official source. These deficiencies should be put right. As the climate pathways indicated by the CCC clearly show that agriculture and land use must be integrated, then it is reasonable for land managers to expect that there is a methodology for performing basic GHG accounts for any land-based business developed by industry but certified by government. This must be robust, evidence-based consistent and universal. Furthermore, this tool should then be deployed in farm surveys to establish benchmarks which should be reported with the same degree of thoroughness and consistency over the years as is done for the Farm Business Survey, which is paid for by Defra currently as part of the EU Farm Accounts Data Network (FADN).
23. Upon constructing these accounts it will quickly become apparent that the level of detail farmers would like about the way they manage their crops and animals exceeds the level

⁵ <https://www.oxfordmartin.ox.ac.uk/downloads/reports/Climate-metrics-for-ruminant-livestock.pdf>

⁶ Allen, MR, Shine, KP, Fuglestvedt, JS, Millar, RJ, Cain, M, Frame, DJ, & Macey, AH: A solution to the misrepresentations of CO₂-equivalent emissions of short-lived climate pollutants under ambitious mitigation. *Climate and Atmospheric Science*, 1(1), 16. <https://doi.org/10.1038/s41612-018-0026-8> (2018).

of detail available in agricultural emission factors. The factors utilised in national inventory accounting have to be based on well-established evidence collected according to methodologies agreed internationally through the IPCC. These are inevitably slow to catch up with new technologies to reduce farm emissions, for example new feeding and breeding techniques to inhibit methane production in ruminants. This could be a significant barrier to progress if farmers make investments to adopt new technologies to reduce emissions and are not 'officially' credited with improved performance. It is right to deploy resources⁷ to minimise the gaps between progress on emission reduction in the field and officially measured national progress, for example by deploying where possible Tier 3 locally adapted farm level emission factors. In the meantime progress in adopting climate actions will mostly have to be measured by proxies indicating the uptake of what are judged to be lower carbon practices.

Specific advice about policies for each element of the package.

Consumption change and food waste reduction

24. Time precluded this aspect receiving much attention from the Advisory Group, and a separate seminar was arranged. This section is nonetheless included because of the integral role it has in the package of measures for AFoLU. If the reductions in consumption do not materialise then even if inducements to change land use out of food production to store carbon in biomass and peaty soils are successful it will mean drawing-in more food imports. This of course would mean offshoring more of our food emissions. Changing consumer dietary choices requires actions from individual consumers and the food chain mostly downstream from farming. This is a totally different audience and requires quite different actions from all the other elements of the package which are aimed at land managers – farmers and foresters.
25. The barriers to change consumption behaviour are the deep-seated cultural connections between humans and farm animals. Culinary practice for many generations has placed meat at the centre of the largest meal of the day and certainly at special and festive occasions. There is also a strong sense of the place of grazing animals in our most treasured pastoral landscapes. These cultural preferences can and do evolve. There is already a slow decline in red meat consumption. Given the different dietary and eating habits between demographic groups there can be reasonable expectations that this trend will continue. Younger people are less addicted to the 'meat and two veg', 'sit down and eat three meals a day', pattern of their parents and especially their grandparents. More frequent snack-based eating patterns may also be more likely include poultry and pork-based meats than beef and lamb. There is greater appeal towards vegetarian, flexitarian and vegan diets amongst the young and especially women, which can influence dietary choices of their children in future. The question is whether these trends are sustained and whether they are progressing widely and fast enough to bring about the scale of consumption change sought. The 20% cut suggested by the CCC is at the low end of the suggestions by other bodies which range from 40% to 90% cuts in livestock product consumption.

⁷ As in the work on the Smart Inventory improvements, see <https://www.theccc.org.uk/wp-content/uploads/2018/08/PR18-Chapter-6-Annex-The-Smart-Agriculture-Inventory.pdf>

26. The policies to progress this are mostly at the soft end of measures: education, information, communication and campaigns. These are already widely in use, emanating from public bodies, scientists, NGOs, journalists and health, food and life-style writers. Public health and environmental bodies certainly publicise their official dietary and life-style (exercise) advice, government could be more active on this. Beyond this the main public action is in setting the example through all food procurement for schools, hospitals, public services, prisons and canteens and at all public catering from local authorities to International Heads of Government meetings. This can influence quantities i.e. portion sizes, better quality and the content of meals. It does not mean no red meat or dairy, but a noticeable and signalled cut in red meat and dairy and always offering vegetarian options.
27. The food industry should play a role in bringing about this dietary shift. It should be expected that meaningful corporate social responsibility will require them to explain to their customers the ways in which they are contributing to climate aware eating. This could include a variety of practices such as developing many more recipes and products based on plant, fungal and insect protein, the choice of protein used in convenience and pre-prepared snacks, sandwiches, fast foods and meals, portion sizes of red meat, and voluntary reporting of associated emissions with their products⁸. They also have a critical role in reducing waste and valorising co-products throughout the production, processing, storage, transport and retail chain. The development of cultured protein is at too early a stage to judge either its consumer acceptability or the feasibility of up-scaling to make a noticeable difference.
28. Whether to introduce a tax on red meat and dairy is clearly a high-level political decision. This should be informed by detailed analysis. This will reveal the complexity of such a measure. What would be the basis, collection point and level of the tax? Could it take account of production method/breed? What is the price elasticity of demand and thus impact on consumption and emissions? What substitution in consumption would take place – towards plant protein or white meat? From the point of view of fairness if a carbon tax approach is to be used at all then it should apply to all agricultural and land-based emissions and not just red meat and dairy.
29. The Advisory Group did not have time to discuss food waste reduction. This is already the focus of a great deal of attention. The CCC will no doubt be aware of the work of WRAP and the efforts underway to avoid and reduce waste, and to recover energy and organic matter content from food waste.

Five sets of actions for agriculture and land use.

30. For each set of actions the barriers to change are listed and a brief discussion of the scope for changing the **regulatory baseline**, introducing **direct** and **enabling policy** measures and mentioning some of the issues of **measuring and reporting** progress. The relative contributions of public and private funding of the actions will be mentioned.

A. Reduction of farm emissions and increase in agricultural productivity

31. **The main barriers to change** in this sphere relate to the non-CO₂ emissions. The science of the processes involved in methane and nitrous oxide emissions at farm level are not fully understood. These emissions cannot practicably be measured at farm level, and

⁸ The Organisation Eating Better sets out many of these suggestions. <https://www.eating-better.org/betterbyhalf>

there is no simple or single way to reduce or stop them. There is a long list of actions which can help reduce them. The current Defra farm emission reduction work has identified the GHG abatement potential of over 30 such measures. The main barrier is not an unwillingness by farmers to reduce emissions, nor even a fear that it might involve costs, it is (rightly) presumed there could be help to meet such costs. It is a combination of not knowing what emissions are associated with production, and the frustration of not knowing what to do and concerns about conflicting objectives. This indicates that a strong part of the remedy is to work harder and more closely with farmers to explain how the emissions come about and to identify for each farming situation the technology and practice changes most likely to reduce them. The challenge for farm (and forest) CO₂ emissions from tractor and other mobile machinery, and power, cooling and heating (e.g. crop drying) is essentially no different to the considerations for decarbonising transport and power in other business sectors. The advisory group did not discuss these issues.

32. **Policy approaches.** From first principles, invoking the polluter pays principle suggests setting a clear demanding regulatory baseline coupled with either producer-level taxes on GHG emissions, or embracing the sector in a cap and trade scheme. These would be expected to be efficient because they impose most burden on the biggest emitters and incentivise producers to discover the least cost way of abating the pollution, including the option of ceasing the activity altogether. However, there are practical issues of implementing such an approach because of the complexity of measuring the emissions at business level for the three gases and allowing for the variety of management practices in farming, and the farm-by-farm administration would be a challenge.
33. Other problems of the GHG tax approach concern distributional issues and leakage. Farmers could feel they were treated unfairly if they were the only sector confronted by such taxes, and in any case for its optimal effect the tax should be economy wide. Although often suggested, an economy-wide carbon tax has not yet been pursued. It is also the case that taxing agricultural pollution would raise food prices. Food prices are indeed considered socially too low as they do not embrace either the pervasive environmental externalities associated with food production, or the external costs on the health service of the widespread overconsumption of calories and protein and associated ill health. Therefore, raising prices could be considered a useful part of the solution encouraging lower consumption. However, raising food prices has a regressive effect because food expenditure makes up a larger share of household expenditure in poorer households. This would necessitate offsetting changes in welfare supports which could be offset from tax receipts – easy to say but hard to effectively deliver.
34. If the UK were to be an early adopter of GHG emission charges for agriculture this would reduce competitiveness of the domestic sector and lead to leakage as agricultural imports increase, exporting the associated emissions. A recent OECD report⁹ cited estimates that if such taxes were imposed in all the OECD countries but not elsewhere, the leakage would amount to one third of the emission reduction. The fewer the countries imposing such a tax the higher such leakage.
35. The current UK discourse, and not least the framing of the current English Environment and Agriculture bills, suggest that the political choice is that emission taxes are not under

⁹ Enhancing Climate Change mitigation through agriculture, OECD (2019) <https://www.oecd-ilibrary.org/sites/16af156c-en/index.html?itemId=/content/component/16af156c-en&mimeType=text/html> yet .

serious consideration as the central approach for agricultural emission reduction. Instead the focus is a twin track approach comprising first a catalogue of policy measures to stimulate uptake of specific practices and technologies focussed on reducing farm emissions, and second, more general measures to improve agricultural productivity. Each of these should include incentives for adoption of specific practices plus important enabling measures such as information, education, training and advice¹⁰.

36. Trying to induce reductions of non-CO₂ farm emissions directly by **adding to the regulatory baseline** is not likely to be fruitful. GHG reduction could be incorporated into the cross-compliance requirements attached to the remaining and soon-to-be-declining basic payments which are a central part of farm supports under the CAP. Difficulties of doing this are first the leverage will diminish and disappear over the seven-year phase-out envisaged in the Agriculture Bill. Second the administrative challenge of dealing with individual farm emissions. Third is the practical challenge of defining and measuring the emission reduction requirement and the sanctions if they are not met. It is suggested that developing practicable farm-level metrics must be done anyway. It is essential for Defra to think through how most practicably to help farmers (directly or indirectly through proxies) measure their emissions. The cross-compliance requirement would then be to require farmers to perform the analysis, which then becomes part of benchmarking schemes. This would be a constructive first step for farmers to manage these emissions. However, it would make little sense to measure emissions alone; they should also include the LULUCF components. This takes us back to land-based business carbon calculators (paragraph 22).
37. **Other potential regulatory drivers** which might be harnessed to reduce farm emissions are the Nitrates Directive, Water Framework Directive and the Clean Air Strategy. Nitrate Vulnerable Zones apply to 58% of English agricultural land. Within these zones the use of fertiliser and organic matter is limited under Defra Guidance. Catchment Sensitive Farming is an advice programme operated by Natural England. These approaches could be extended and tightened. The main farm-level actions to reduce water pollution by nitrates and phosphate and air pollution by ammonia seek to improve efficiency of nutrient use in both crop and animal production, to encourage less leaky manure and slurry management, and to substitute digestate from anaerobic digestion. These all offer potential to reduce GHG emissions. More effective enforcement of these (long) existing regulations would be beneficial. It poses the question why enforcement is not already as effective as it could be? This is partly the inherent costs of policing diffuse pollution and it may also be explained by the reduced resource commitment to enforcement. Devoting more resource to enforcement plus engaging better regulation principles as indicated in the Stacy Farm Inspection and Regulation Review (FIRR)¹¹ would help.
38. A more positive way to approach this is through the implementation of the new (English) Environmental Land Management Scheme (ELMS). The thrust of this proposed new element of agricultural policy is to pay farmers for delivering environmental public goods. A key part of such a scheme should be facilitation and farm environmental planning which it is suggested should include the farm-level practices necessary to curb all pollutants

¹⁰ This is expected to be broadly the approach taken in Defra's Farm Emissions Reduction Plan which is in preparation but has not been seen by the Advisory Group.

¹¹ <https://www.gov.uk/government/publications/farm-inspection-and-regulation-review>

including GHG emissions. This turns the polluter-pays principle on its head and offers assistance to help polluters reduce their emissions¹². But if it succeeds in inducing the necessary changes it could be money well spent. Because ELMS will be a voluntary participation scheme it will not be taken up by all farms. This suggests that enforcement action for the environmental directives (and their UK successors) should include greater targeting on farms not in ELMS.

39. **Productivity improvement** is a strong part of the rhetoric supported both by Defra and the industry. It is perceived that agriculture has a poor record of productivity growth compared to other countries and improving this record should be an important part of adjusting to the new post-CAP policy regime¹³. Climate change mitigation adds another reason to improve productivity. It requires emissions per tonne of product to be reduced and this implies higher efficiency of production. The arguments tend to be made through relatively simple partial productivity indices. For example, the more efficient the conversion of forage and feeds into meat and milk, the less time to fatten an animal, the higher the yield per animal, then the lower the emissions per Kg of meat or milk. Fewer, faster growing, larger and higher-yielding animals will result in lower total emissions. Similarly, the higher the nitrogen use efficiency of crops through soil management, crop breeding and nutrition, the lower the emissions per tonne of crop. This logic is sound as far as it goes. However, it does not address the biodiversity and landscape impacts or animal welfare considerations of the more productive and more intensive agriculture (as measured by both inputs and outputs per hectare).
40. This takes us back to the difficult societal choices and priorities. This is a contested area. Simplifying, there is a technology optimism school which points to the utilisation of big data, artificial intelligence, digitisation, GPS and robotics in land management plus the intelligent use of molecular genetics and gene editing to improve animal and plant varieties by building-in natural disease and pest resistance and thus resilience. These technologies offer ways both to improve productivity and dramatically reduce unwanted environmental externalities. An opposing school of thought argues that it is the reductionist 'scientific' approach to food production which has led to over-simplified farming systems dependent on 'artificial' manufactured inputs which have systematically degraded soils and dramatically reduced biodiversity, and this system is unsustainable. They argue that only a complete system change to agroecology can restore functioning ecosystems in the soil and around farming systems. Such systems will have lower input and food output intensities by design. Others suggest that elements of both approaches can be combined. A key issue in understanding these tensions is whether we continue to measure productivity by only including the marketed outputs of land management (i.e. the provisioning ecosystem services) and not all the goods and services too. It is not the job of the CCC to resolve this, but these competing world views will impact on the choice of policy measures to tackle climate change. Unless these are agreed, then it will be difficult to establish clear policy.

¹² This pragmatic view was endorsed by the Stacy Farm Inspection and Regulation Review (FIRR).

¹³ Productivity measurement in this context only ever includes the marketed outputs of the businesses or sectors, and not the non-market regulating and cultural services of land management businesses. It also pays no attention to negative outputs of the businesses such as biodiversity loss, pollution or soil erosion.

41. **The interaction between changes in consumption, in agriculture itself and land use change.** The logic of the package of measures for AFoLU is that it is not considered possible to eliminate agricultural emissions by 2050¹⁴. Therefore, the target is to reduce them as much as is feasible, but also to reduce the total agricultural area and the total volume of emission intensive agricultural production in order to make room for land use change. It is the new and additional land use change which stores carbon in soils and biomass netting-off continued agricultural emissions. In the context of a growing population the only way to balance markets is to reduce consumption. Three sets of policies are required for the three elements of the package: one set of inducements to reduce emissions; a different set of inducements to attract tree planting, bioenergy and peat restoration; and a third set of measures to encourage dietary change and waste reduction. The economic outcome depends on the relative scale and effects of the three sets of actions.
42. The economic outcome of the interaction of the three groups of measures depends on the size of the shifts in supply and demand and the international trade response. The contraction in domestic supply as land is attracted out of farming and into the other land uses will mostly depend on the determination, resources and practicality of measures with which these land use changes are incentivised. It is harder to envisage big offsetting productivity improvements. This has been on the policy agenda for decades and is in farmers' own interests, yet measured productivity growth remains stubbornly low. Removal of subsidies and any consequential restructuring of farms, the adoption of new technologies including gene editing, and the professionalisation of land management are policies which could bring about a break from the past. The first of these is probable, the second favoured by the sector itself, but the third is resisted by the sector. As far as meat consumption and waste reduction are concerned there are few politically acceptable big ideas for inducing change so the demand shifts therefore are likely to be incremental. It is therefore possible that the reduction in UK grown livestock products outweighs the other effects. Simple economic analysis predicts that the result will be an increase in imports unless trade restrictions are imposed. This is conjecture, the conclusion is that the implications of different rates of progress in the three elements of the climate action for agriculture should be analysed to think through the responses that may be necessary. It is also essential to model the land use changes in sufficient detail to ensure that the release of land from agriculture is coherent with the land needed to provide for the changed balance of consumption. Turning to the specific policies.
43. **Direct policy measures** would encourage emission reducing practices and discourage practices associated with high emissions. Reducing methane from ruminants means reducing the number of animals, the emissions per animal or both. The CCC do not make references to direct measures to reduce ruminant numbers by buy-out or herd retirement schemes. Defra could consider such approaches as part of the withdrawal of CAP basic payments¹⁵. The advisory group's view is that the CCC are correct to focus on reducing demand by acting on dietary change and incentivising land use change. Farmers are likely to be more willing to accept changes in the market rather than direct measures to reduce herds. The latter might generate farmer resistance when it is the aim to enlist

¹⁴ Perhaps these can never be eliminated depending on the continuation of ruminant livestock farming and our ability to manipulate the metabolism of lignocellulose in the rumen and the nitrogen cycle in the soil.

¹⁵ The idea of delinking CAP basic payments as they are reduced and withdrawn is a related more general idea under consideration.

cooperation over the difficult matter of livestock emissions. Time should be given to see the impacts of the CAP support withdrawal and any change in UK trading stance with the EU and third countries emerges post Brexit. The initial focus should therefore be on reducing emissions per animal.

44. A great deal of research is underway to discover feed additives to suppress methane production in the rumen. Several products are already being trialled to establish the evidence base that they work, and the impacts on the animals. This approach will mostly impact cattle (not sheep) and unless the inhibitors can be incorporated into licks or other such delivery devices for grazing animals, their application will mostly be for dairy cattle and beef finished in yards. As these products become commercially available the policy choice to encourage their uptake is, through information to encourage their adoption, subsidies for feed compounders or feed supplement providers to include them in feeds, or requirements for their inclusion. In short, who should bear the initial cost? Given the structures in the food chain, if costs are imposed on the feed compounders they are sure to be passed through to farmers. Farmers are less likely to be able to share these costs with their buyers. However, meat processors and dairies could be encouraged to absorb a share of the costs and to label their products as sourced from lower carbon suppliers. They could also pass on some of the costs to consumers who then may pay a little more to reduce the climate damage caused by the food they consume. Alternatively retailers could provide assistance to farmers in their supply chains to encourage the shift as occurred with high sugar forage grass.¹⁶
45. The other dimensions to work on to reduce methane emissions are animal health and breeding. Healthy animals perform more efficiently, they have lower mortality (avoiding wasted emissions), grow more quickly and produce more milk for a given level of nutrition. The same is true for animal welfare conditions which, in turn, will impact animal health. These areas are already subject to regulation. It is not clear that there are missing regulatory requirements which could impact on animal health and welfare which could yield GHG emission reductions. Breeding does have a role to play by identifying livestock lines which have inherently lower rates of methane. The mechanism for lower methane production and how this difference in metabolism impacts on other aspects of the animals' growth and development have to be investigated. The key point is that low methane production has now been added to the list of objectives of ruminant breeding. The main policy requirement on these issues is research and then, as always, getting the research results into application in the field. Assistance with manure management to reduce methane emissions is another heading to be considered.
46. Corresponding tools to help reduce nitrous oxide in soils under crop production are currently less promising than the methane inhibitors. The complex physics, chemistry, biology and microbiology of the nitrogen cycle in soils is not well understood. The precise roles of the multitude of soil bacteria and mycorrhiza and other soil microorganisms is under active investigation. Current knowledge points to a range of farm practices to reduce N₂O emissions. Maybe the simplest are the measures to reduce applied nitrogen over the rotation, and one way of achieving that is to encourage longer rotations which

¹⁶ An example of this is from 2011 with Asda and reported in multiple media outlets: <https://www.talkinggrass.co.uk/2011/10/26/grass-breeding-technolog-high-sugar-grass-varieties-farmers/>

include grasses and especially legumes¹⁷. Others approaches include nitrogen inhibitors, controlled release fertilisers, ensuring maximum nitrogen use efficiency not least by requiring an explicit nutrient management plan for every farm, soil management to produce well structured, aerated and drained soils. Such actions could be mandated through cross-compliance whilst it still survives and in the future they could be encouraged/required of all recipients of ELMS payments. More broadly, the reduction of nitrous oxide in crop production is certainly a candidate area for more research. The need is for both basic research on the nitrogen cycle in the soil and then the applied research trials to provide the evidence basis for on-farm management practices influencing the soil structure, and function, identifying the appropriate metrics for farmers to better manage these processes in soil, and guide them in nutrient management and cropping. Guidance is needed on what should be measured (organic matter content, carbon content, structure, pH, cation exchange capacity) and the appropriate response to the measurements.

47. It is reasonable to consider if a nitrogen fertiliser tax could be helpful in inducing more careful nitrogen use in crop production. The general judgement has been that the response relationship of crop production to N use is such that a high rate of tax would be necessary to bring about much reduction in use. Although more recent work¹⁸ has indicated that many farmers could rationally reduce N fertiliser 15% to 20% and be financially better off. This is the sort of improvement in efficiency that should be uncovered by much closer management of application rates through precision farming which can also take account of in-field variation in soils. If the goal of a N tax is reduction of GHG emissions (and other pollution) this begs the question why only mineral nitrogen would be taxed; the application of nitrogen as farmyard manure and slurry is less precisely calibrated and involves at least as much leakage. A fertiliser tax may be a crude measure given the poor understanding of the nitrogen pathways in soil and how to curb N₂O. There are examples (Poole Harbour) where water companies have devised schemes to reduce nitrogen used in the catchment by arranging auctions amongst the farmers for use of the nitrogen allocation. This kind of decentralised approach should be encouraged.

B Afforestation

48. **Barriers.** Growing trees is a very different business to raising animals and growing crops. Farmers and foresters are quite different resource managers, with different skill sets, mentality and time horizons. Of course, many and probably most, farmers have trees on their farm in hedgerows, copses and woodlands, and some grow fruit trees commercially. However, until the recent growth in the fuelwood market, most farm woodland has been notable for under management and, unless there is a game bird shooting activity, zero revenue generation. The principal barriers for farmers to plant significant numbers of trees are the economics, the fact that it is a permanent land use change, the risks in forestry, the bureaucracy in obtaining licence to plant and fell trees, and sheer lack of knowledge, expertise and advice. The large upfront capital requirement for planting and long lag measured in decades before revenues from timber appear and the uncertainties

¹⁷ Such change in the arable rotation, which has potential to provide multiple soil organic matter, pest and weed control and biodiversity benefits, will require animals to utilise the forage. How this relates to policies to reduce ruminant production has to be carefully considered.

¹⁸ ADAS work through the Yield Enhancement Network.

of the future timber market are economic disincentives for farmers. The current land market shows a considerable discount for forest/woodland compared to agricultural land¹⁹. The risks associated with forest management seem to be increasing with forest fires and tree disease. The current ash die back not only renders the investment void but brings liability issues of diseased trees adjacent to roads and public paths.

49. The **policies** to address these barriers are direct policies to bring about inducements to plant or encourage natural regeneration of trees and important enabling policies. There are no opportunities to induce tree planting via changes to the regulatory baseline. There are concerns and some anecdotal evidence that land owners putting planting plans on hold for fear of “jumping the gun” on ELMS. It is essential that this risk is eliminated immediately to avoid another “start-stop” scenario, fatal to sector confidence.
50. The direct policies will mostly concern establishing the necessary inducements to stimulate land managers to change grassland and moorland into forestry²⁰. This will involve covering an appropriate share of the up-front planting and management costs, and then annual payments thereafter to cover foregone revenue streams perhaps up to first thinning (maybe 15 years). This system exists, though varies between DAs. There are several streams of benefits which will arise from new afforestation and there could be several streams and sources of the funding to pay for these benefits both public and private. The benefits throughout the life of the trees are the flow of carbon sequestered above and below ground, fuelwood and biomass from thinnings, water filtration, flood prevention benefits, biodiversity and public amenity value. The end of life commercial value of the forest is the timber and usable biomass produced.
51. Public policy has several roles to play in this. First, if the climate strategy for AFoLU is to be launched with some vigour and determination to signal a new era of rural land management then a practical centrepiece could be a new scheme of publicly funded forest planting and management grants. Such a scheme much simpler to access than the present arrangements in England which discourage many applicants and their professional advisors. The Scottish arrangements are proving successful. The Welsh Glastir scheme is attractive but seriously underfunded. There will need to be a greatly expanded resource of woodland management advice and training so that the right trees can be planted in the right place and be properly managed. UK forestry has suffered in recent years from frequent changes in policy objectives and grant regimes. Because it is a long term business frequent changes are inappropriate and off-putting. Consistency will generate the necessary confidence. The new scheme should be set at generous levels for a specified number of years and accompanied with a well-prepared strategy and information about the targets – which must surely be to exceed the proposed 30,000 ha per year within, say, five years²¹. To be clear, the suggestion is that public funding is used to set the ball rolling at the desired pace, to attract serious interest in this shift in land use. This funding is primarily aimed at securing carbon sequestration but in such a way

¹⁹ Although this differential would be expected to narrow especially for poorer quality grazing land as agricultural subsidies are removed and forestry and other perennial crops are encouraged.

²⁰ Grassland is specified because it will generally be more expensive to attract arable land into forestry. Of course, there should be no exclusion on arable land offered for conversion to forestry – subject to its appropriateness for landscape and other considerations.

²¹ Starting from the current low base, and knowing how long it takes to assemble, launch, and see practical results from a new tree planting scheme, there is likely to be many years of sub-target planting unless the ambition is high. But also the targeted area of new forest has to allow for the expected substantial loss of forest from Ash Die Back and other tree disease and the removal of forest on peat.

as to deliver the many other co-benefits of forest cover. Subsequent rounds of encouragement can ensure that other private funding sources are brought to bear discussed below. There must be clear guidance on what to plant, the technicalities of density and mix of conifers and broadleaf species and appropriate local consultation on deciding where. Each devolved territory will have its appropriate institution to oversee this, e.g. the Forestry Commission in England. Successive future tranches of planting grants would then learn from the experience of the first, and also look for shared public-private funding opportunities. The point is to get early momentum and success in new planting with strong public support given the climate change objective.

52. The second role for public policy is to oversee how the flows of benefits from tree planting should be paid for. Early days experience of the Woodland Carbon Code (WCC) in attracting private sector co-funding is encouraging. The WCC ensures that woodlands thus co-funded are genuinely additional and permanent; that they will be sustainably managed (harvested woods will be re-stocked) in accordance with the UK Forestry Strategy and that carbon calculations are conservative and consistent. WCC projects are verified through independent certification bodies. The well-tried mechanism of challenge funds required planting projects to bid for funding from a challenge fund pot. Successful projects will be those representing best value for the taxpayer by receiving co-funding from the private sector. The government could do more to stimulate the flow of private sector funding. The aim should be, over time, for private funding to lead the way with grants in support rather than vice-versa.
53. A third, public policy role is to use public funds to directly purchase public goods whose delivery cannot otherwise be incentivised. This relates to the many co-benefits of forests planted to store carbon, it will chiefly apply to biodiversity and the ecosystem services it provides including cultural services such as amenity and recreation. The ELMS framework in England is an obvious vehicle for arranging this. It is important that the legislation is drawn sufficiently widely and that the subsequent funding is adequate to include this at the scale of new afforestation envisaged. A second example of public funding of co-benefits from forest planting (in addition to its primary purpose of storing carbon) is Local Authorities or Internal Drainage Boards setting contracts for trees of the appropriate type and placement to mitigate floods. A third, and significant new source of funding could be the use of the concept of Net Environmental Gain from urban development in which developers have to fund the replacement of biodiversity (and other e.g. Carbon) loss from development. This may also link to the idea of developing conservation covenants as a vehicle for these co-benefits.
54. If anything, forest creation may not suffer from a lack of potential funders. There is recent evidence of a dramatic increase in private sector interest. Indeed there is a risk of public money crowding out private funds. A critical consideration is therefore how to mobilise these multiple funding sources private and public in a coherent way which does not lead to multiple scheme overlap, each with different rules, and application procedures leading to confusion, or worse, disillusion amongst applicants.
55. A fourth public policy role is to ensure the enabling conditions are in place for the substantial growth in national forest cover. This includes, college and university education, training, skills provision, and advisory services directed at the forest sector. Government agencies, the Forestry Commission, Natural England and the Rural Payments Agency are reported to be struggling to meet even the present low levels of

demand for their services. They will need to be steadily expanded with suitably qualified staff.

56. Investment will be required to ensure the necessary tree breeding (public and private sectors) and nursery stock provision (private sector). The sector has for too long lacked the confidence to invest sufficiently in these areas. Critically important is also to induce the appropriate utilisation and permanent locking of carbon in the additional home-grown timber. The decision to plant trees with some commercial exploitation as the trees mature requires faith that there will be a buoyant market for the products (saw logs and thinnings) and may seek risk management tools such as fixed price contracts. Boosting the market for timber requires more explicit encouragement in planning and building codes to substitute wood fibre products (such as gluelam and fibreboard) for more emission dense materials such as steel, concrete and plastics. Much less attention has been paid to material substitution than energy substitution, this balance should be corrected.
57. Two other public policy issues concern public ownership and taxation of forestry. Given the uncertainty surrounding Brexit and future trading relationships between the UK, the EU and the rest of the world, it is not clear what the economic context will be for the surge in afforestation being called-for. In extremis, in the most difficult circumstances particularly for upland grazing agriculture, it is possible that much land could come on the market in a short space of time. This could be seen as an opportunity for public investment to expand nationally owned forest. It would equally be looked at closely by private landowners and institutional investors. As the driving force for an expanded forest is climate change mitigation, it is to be hoped that the primary consideration of the policy response in these circumstances is to support the ownership regime which is best placed to yield the desired expansion and management of the forest resource to store carbon. A similar approach should apply to the tax regime for forest owners and managers which currently defines certain woodland incomes to be not taxable for income and corporate tax purposes. The question is whether there is any reason not to extend this to other new income streams in forestry.

C Farm woodland management, hedgerows and agroforestry

58. Many if not most farms have hedgerows and some copses and small woodlands, the Tree Council suggests that one-third of all UK trees are found outside formal woodland and forests²². The barriers to planting more woodlands and more purposefully managing existing woodlands are: costs, low returns, sometimes difficult access, and poorly developed infrastructure for extracting, transporting and utilising the material. In many woods, especially if there is shooting interest and more recently as the market for firewood and wood chip has expanded, there is low-level management in the form of some thinning, weeding, coppicing, pollarding, fencing and other deer management, disease monitoring and pest control.
59. To achieve the CCC suggested target of 80% of existing broadleaf woodland under management to for example UK Forest Standard will require principally three kinds of policy actions. The first three are enabling policies. One is to provide information, advice and specifically to show the evidence on the kinds of additional management and how it

²² See also https://www.forestresearch.gov.uk/documents/2699/FR_Tree_cover_outside_woodland_in_GB_statistical_report_2017.pdf

can bring carbon sequestration and biodiversity benefits. The second is to stimulate the provision of necessary infrastructure to mobilise the harvesting and sale of provisioning services particularly fuel wood. A third enabling policy is to ensure that the certification of woodland management is not in itself an obstacle to better management because of excessive bureaucracy. For some situations the flow of new revenues could fund the additional management which also provides biodiversity, flood protection and other amenities. In other cases other sources of funding will be required to pay for the management for public goods. This can (in England) be another heading for funding under the ELMS. Alternatively, the non-carbon benefits may be candidates for whichever of the other public or private schemes mentioned above (paragraph 53) could be operated at the smaller, and fragmented scale of farm woodland. Carbon credits can only apply to new planting, but many small woodlands, especially those on reasonable soils with adequate water could produce significant sequestration by appropriate replanting of smaller hardwoods (like cherry or dieback resistant ash). The obstacle to more and wider hedgerows is essentially the forgone income from the adjacent agricultural activity. In principle the ELMS scheme can include inducements to overcome this. Hedgerow management along roads and public paths introduces an additional landscape consideration of maintaining an open vista.

60. Agroforestry defined as the purposive inter-planting of agricultural and horticultural crops with lines or areas of trees (silvo-arable farming) is scarcely developed in the UK. Even the not-uncommon practices of managing free range poultry and pigs in woodlands is rarely referred to as silvo-pasture. The prime obstacles are therefore unfamiliarity with the concept and the benefits it can offer. This indicates the principal policy to help stimulate farmers to move in this direction are education, training, demonstration and pilot projects and associated publicity. Another obstacle is a hangover from the regulations underpinning the CAP which are extremely strict about what is defined as agricultural land and especially the number and density of trees permitted on agricultural land. These rules were a disincentive to consideration of agroforestry. Such restrictions should disappear as UK legislation replaces the CAP regulations.

D Perennial bioenergy crops

61. The prime motivation to stimulate the area of such crops is to effect land use change from arable or grassland to perennial crops such as miscanthus and short rotation coppice (SRC) and short rotation forestry (SRF) which locks up additional carbon in soil, and some non-harvested biomass. The end use of the harvested biomass could be for fibre board, or a multitude of other such materials including bio-based plastics, or for energy. Any displacement of fossil fuel energy from by burning these materials is credited to the energy sector not agriculture. It is anticipated that such energy production will be combined with carbon capture and storage (CCS) once that technology becomes available. The carbon sequestration will depend on the nature of the land use change, i.e. the initial land use and the soil carbon content at that point, and end-use of the biomass.

62. These are relatively low-input, low-output systems and although their gross margins might be low compared to, say, cereals net margins might be higher²³. Lack of knowledge about such information might be a deterrent to farmers turning over agricultural land to these crops. Uncertainty that the necessary infrastructure for utilising harvesting, collecting and utilising the biomass is in place reliable contracts on offer may be barriers. It also makes a difference if the fact of planting such crops is deemed to remove the land from being classified as agricultural land.
63. A direct policy instrument which could reduce the uncertainties and attract planting of these crops, especially at a time of agricultural policy change and uncertainty, is an obligation on electricity generators to incorporate a proportion of appropriately defined and sourced renewable energy. Alternatively, some of the risks of price uncertainty might be mitigated through the use of so-called Contracts for Difference²⁴ with power generators. It is not expected that this activity should rely on direct public funding. However, appropriately planted and managed SRC can provide significant biodiversity and amenity value, and energy crops can provide flood mitigation benefits. These should not be excluded from ELMS payments.
64. Enabling policies to stimulate this sector could include loan schemes for initial planting costs for early adopters which decline as planting costs reduce with scale up. There is certainly a need for information, advice and perhaps demonstration projects. There is also a need for R&D to better understand the impacts of these crops on soils and soil carbon, optimal rotations and production of the planting materials to reduce establishment costs. Landscape considerations will seek to avoid large monocultures of such crops. It would be highly beneficial for making progress and reducing uncertainty if a greater number of trusted intermediaries (like Terravesta and Iggesund) are encouraged, such organisations or perhaps cooperatives can create confidence and provide a degree of advice, coordination and facilitation of collection and processing perhaps on a regional basis. Such intermediaries could be private sector companies or local colleges or other institutions.

E Peat restoration

65. The peat soils in the UK represent a significant stock of carbon²⁵. Their drainage for use in agriculture and forestry is resulting in these soils being oxidised so peatlands are currently large net emitters of carbon. Re-establishing a functioning peatland is accomplished by re-wetting the land, typically through drain blocking, and encouraging peat forming vegetation to return. It may not be appropriate for re-establishment of natural peatland habitat on all areas of peat soil. However, a reduction in GHG emissions can be achieved through partial re-wetting, establishing more permanent peat soil vegetation cover and amending soil management.. There are quite different considerations for peat restoration in the uplands and the lowlands. The suggested scale of restoration is large, to increase peaty soils in near natural or rewetted condition by 89%, most of this to be achieved in upland peat.

²³ Terravesta offer a comparison on their webpage indicating an average net margin of £543 £/ha for Miscanthus compared to arable of £212: <https://www.terravesta.com/miscanthus/#growing>

²⁴ These are a mechanism for supporting large-scale low-carbon electricity generation, which guarantees a flat (indexed) price for the electricity over 15 years.

²⁵ Lindsay (2010) reports a minimum value of 3.1Mt C in the Peatbogs and Carbon Report, p76.

66. **Upland peat.** The obstacles to restoration are the familiar mix of financial and non-financial. These upland areas were considered to have been 'improved' to bring them into agriculture mostly for extensive grazing of cattle, sheep. However, it is noted that such grazing enterprises are generally not profitable and are largely being kept in place by CAP payments. Additionally, the policy of discouraging red meat consumption may further depress the returns from this activity. Some of these peatlands are also grouse moors which support a sporting activity which provides income to the involved estates. The non-financial barriers to peat restoration are partly resistance to change activity and landscape from what are seen as 'traditional' uses. There is knowledge of how to restore peat. A range of successful methods have been tried and there is much innovation and adaptation to meet different local and regional challenges. It is a long slow process, measured in decades, to reduce emissions with the goal eventually of creating an ecosystem which is sequestering carbon. A constraint on delivery of upland peat restoration may be contractor and practitioner capacity. Site accessibility raises costs and uplands projects are seen as less attractive in a competitive market (lowland jobs are 'easier' to deliver if contractors have the luxury of choice in a market with ample restoration projects and few contractors).
67. There are several ways in which, in principle, the regulatory baseline could be used to change peat soil management. Those owning peatland sites designated as SSSIs could be required to bring them into favourable condition. Water authorities could be obliged to restore peatlands they own. However these two categories only account for a small fraction of the area. Grouse moor burning could be prohibited. Public bodies which own peatland could be obliged to bring them into favourable condition. The likely effectiveness of such measures and their contribution to the overall target can only be assessed through empirical study. For several of these measures much depends on the capacity to enforce the regulations.
68. Direct policies to bring about the management change can use grants for up-front costs and some annual compensation payments. Apart from special cases such as water companies owning the peatland, the funding for this will come from the public purse. The Peatland Code has been established to encourage private funding through the sale of emissions benefits following peatland restoration. This code sets out minimum requirements and a consistent quantification methodology that validated and verified projects must adhere to. This gives the buyer assurance of delivery over the long-term timeframe of the projects. Peatland Code projects are a minimum of 30 years and whilst carbon emissions are reduced through restoration actions, the overall emissions story of peatland code projects remains a reduction in emissions not sequestration.
69. As with afforestation there is a political judgement whether public or continued private ownership offers the most likelihood of effective achievement of peat restoration. There will be co-benefits which accompany peat restoration, so financing these through public good payments schemes (like ELMS in England) is one possible route. There also may be social side effects of peat restoration of large areas in the uplands which result in employment losses and further depopulation in already sparsely populated areas. These may necessitate transitional help.
70. **Lowland peat.** The main difference with lowland peat is that some of these soils support the most productive agricultural land in the country producing high yielding field scale vegetables with gross margins much larger than most arable crops. Not all lowland peat

is cultivated – some is in grazing livestock production and some holds remaining areas of natural/semi-natural habitat. Regulatory approaches could include cross-compliance with residual CAP payments whilst they last to encourage good farming practices which minimise carbon loss, cover crops, seasonal water table management. Such cross compliance could also be attached to recipients of public environmental (ELMS type) payments, although it may be that participation in such schemes is lower in lowland peat farms. The extraction and use of peat for horticulture should be prohibited provided corresponding action can be taken on imports. Direct policies to induce lowland peat restoration should start with the lower-grade land growing the least remunerative products. Further research is required to provide the evidence for what practices short of abandoning this highly productive land for food production can be deployed to slow carbon emissions and degradation of the peat if not to turn it to a carbon sink. Research and then communication are also required on the scope for paludiculture.

71. Further research is required to provide the evidence for what practices short of abandoning this highly productive land for food production can be deployed to slow carbon emissions and degradation of the peat. This should include supporting the R&D needed to deliver paludiculture at scale. Small projects are ongoing e.g. Little Woolden Moss in the UK and Saxony, Germany. But support is required for crop growing methods and market development for wet peatland production.

Three final cross cutting issues were flagged but not bottomed out by the Group.

72. In the light of the climate-driven need to integrate land management for agriculture, woodland, forestry and agroforestry we must widen the **definition of agriculture** in agricultural policy, planning policy and tax policy.
73. **Tenanted land.** Bringing about long-term land use change from agricultural use to forestry, agroforestry, woodland, perennial bioenergy crops or restored peat will always require the consent of the landowner. About 30% of UK agricultural land is farmed under tenancy agreements. Many combinations of owned and tenanted land are possible. Some tenants rent land from multiple landowners, traditional estates may have several tenants and also farm in hand. Any of these structures may also have contract farming arrangements over other land.
74. Generally, a farming tenant will have little knowledge, experience or desire to be involved in tree planting with life span much longer than their tenancy. This is traditionally seen as a landowner responsibility. It is reasonable to pose the question whether tenanted land and current tenancy legislation – which has in any case recently been under review – is likely to inhibit the land use change under discussion. It could be an inhibition. It could happen in either direction a landowner willing to change land use and an unwilling tenant, or vice versa. The healthiest resolution of any landowner – tenant dispute is always to sit down and discuss and negotiate. It is not clear what legal remedies are necessary or available to deal with this issue. It should certainly be kept under review and monitored as policies to induce land use change are defined and implemented.
75. Changing land use on **common land** also raises specific issues which will have a bearing especially for change from agriculture to afforestation and peat restoration. Most common land is privately owned, but is used by commoners exercising their rights, mostly for grazing. For many such graziers the profitability of sheep is already low and depending on Brexit outcomes may worsen. Climate related land use change policies

may therefore provide a new opportunity with scope for commoners to negotiate shares in the benefits of afforestation for example whilst retaining some grazing rights.