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Committee on Climate Change call for evidence: 2018 bioenergy review

The National Farmers' Union of England and Wales (NFU) believes that the many forms of bioenergy have a major role to play, alongside other renewables, in the decarbonisation of the UK economy. There are significant opportunities to supply domestic bioenergy feedstocks (annual and perennial crops, agricultural co-products and residues) from the land-based economy.

The NFU represents 55,000 members in England and Wales, involved in 46,000 farming businesses. In addition, we have 55,000 countryside members with an interest in farming and the countryside.

The NFU is the largest farming organisation in the UK, providing a strong and respected voice for the industry and employing hundreds of staff to support the needs of NFU members locally, nationally and internationally. We are engaged with government departments covering agriculture, rural affairs, environment, energy, climate change, employment, infrastructure and transport issues, directing policy into real economic opportunities for rural diversification and job creation. The NFU champions British agriculture and horticulture, to campaign for a stable and sustainable future for our farmers and growers.

With 75 per cent of national land area in the agricultural sector, NFU members have a significant interest in land-based renewable energy production, where they can benefit directly as energy producers themselves or as hosts for energy plant developed by others. Our own market research, as well as that of other organisations, suggests that nearly two-fifths of farmers and growers have already invested in some form of renewable energy production for self-supply or export to other users. We estimate that farmers own or host about 70% of Britain's solar power capacity, over half of AD capacity and the majority of wind power, while playing a significant role in the supply or fuelling of renewable heat.

The NFU believes that domestic land-based renewable energy will be delivering about a quarter of UK clean energy needs by the early 2020s, faster and cheaper than many other low-carbon energy options. This message is consistent with our vision for farming delivering a wide variety of goods and services to the UK economy, centred upon but not limited to food production. We are especially supportive of farmer-owned small and medium scale renewables projects, particularly schemes which deliver multiple benefits from the land or which help farmers to achieve local environmental objectives (e.g. resource protection, biodiversity).

General comments

The NFU has engaged with staff and members of the CCC since 2008, on the evidence base for reducing agricultural and land-based emissions, on how farmers and growers can contribute to the

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decarbonisation of other parts of the economy, on land use and potential greenhouse gas removals, and on the previous 2011 CCC Bioenergy Review.

The NFU recognises that bioenergy has a major role to play in a low-carbon economy, particularly where other decarbonisation options are limited. British farmers and land managers are involved in the supply of crop feedstocks for liquid transport biofuels (domestic production as well as UK feedstock exports to Germany); the production of AD feedstocks like maize, rye, beet and grass silage; supply of wheat and oilseed rape straw to power stations; supply of wood fuels (logs, chips) from farm woodland; and the growing of a modest area of perennial energy crops like miscanthus and short rotation coppice willow.

According to Government statistics, farmers account for around 30% of the uptake of the non-domestic Renewable Heat Incentive (RHI) scheme, installing mostly small and medium sized biomass systems. We estimate that the current total number of around 15,850 biomass boilers with a capacity of 3500 MW has created new demand for about 3 million tonnes of biomass fuels, a proportion of which is being supplied domestically, adding value to the rural economy.

Contrary to recent Government statements that biomass is a "scarce resource" which cannot be deployed more widely, the NFU believes that a wide variety of both domestic and imported bioenergy fuels, amounting to tens of millions of tonnes per year, will continue to be supplied in the following decades. According to expert opinion on worldwide biomass supply, "the basic premise that land availability is the key constraint is demonstrably wrong"; another biomass industry view is that "well-managed demand for biomass creates its own supply response". Many authorities agree that bioenergy is more likely to play a strategic rather than a transitional role among renewable energy resources – in Britain, across the rest of Europe and worldwide. However, consistent UK government policy measures that recognise the versatility and flexibility of the many biomass fuel options are required, as previously identified in the 2012 Bioenergy Strategy but not since implemented.

The NFU would like to offer the following general comments on selected sections of this consultation, and more detailed individual answers to the remaining questions.

On questions 1-5 (GHG emissions and sustainability of bioenergy imports), through our engagement with BEIS officials as well as private sector investors, we recognise that imported biomass and other biofuels mostly deliver real GHG emissions savings, and the modelled scenarios under which net emissions would be high are very unlikely to occur. Like many other biomass industry stakeholders, the NFU also realises that net emissions from bioenergy will need to decrease further in the future, in order to play a continuing role in decarbonisation. At present, US wood fuel pellet production uses mostly low value forest residues and thinnings, and there is little evidence that it displaces other wood products. North American timber harvesting is largely driven by the cycles of demand from the construction industry, and wood pellet production would have to grow around tenfold before it had a significant wider market impact. We are aware of potential development benefits in some exporting countries, e.g. markets for old rubber trees in West Africa which would otherwise be burned on site as waste wood.

On questions 6-11 (Sustainability policy and certification) the NFU is satisfied that the current framework applicable to a range of bioenergy support measures (RHI, RO, CfD, FITs, RTFO) is reasonable and proportionate, including schemes such as the Biomass Suppliers List and the Sustainable Fuel Register (for non-wood fuels). We have participated previously with government in the Biomass and Biogas Sustainability Implementation Group hosted by BEIS (previously DECC), which was particularly well-run in its early gestation. The NFU recognises that reasonable and achievable GHG savings goals for bioenergy power generation will need to be adjusted as grid carbon intensity declines with decarbonisation of the generating fleet; this will be necessary if bioenergy is to continue to perform a supporting role through flexible, despatchable generation.

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On questions 12-17 (Supply of bioenergy feedstocks), we recognise that credible and up-to-date estimates for global bioenergy resource potential through to 2050 are provided in the latest 4th edition (2017) of *Renewable Energy: power for a sustainable future* (Peake, S.R., ed), Oxford University Press. Optimistic forecasts of potential bioenergy supply on this timescale are around 1100-1500 EJ per year, although a more widely agreed figure would be 100-200 EJ per year. The latter forecast is about 2-3 times current supply, but this is likely to be a greater multiple of current final bioenergy use, given the substantial expected increases in energy efficiency with a transition away from predominantly traditional bioenergy supply chains.

The UK waste-based bioenergy resource is likely to be limited to a few tens of millions of tonnes per year (perhaps 500 PJ or 140 TWh). For example, the relatively optimistic estimates of Welfle et al. (2014) suggest 33-72 Mt/year over the period 2020-2030. The same analysis suggests that bioenergy from UK waste would need to be supplemented by agricultural residues and energy crops, the latter requiring specific policy measures to encourage land use for this purpose.

Despite recent interest in algal biofuels, there are only limited prospects for commercially competitive production of algal bioenergy feedstocks, due to both capital and operating costs. Future production of algal biomass within the emerging global bioeconomy is more likely to be directed towards fine chemicals and pharmaceuticals. Research and pilot-plant demonstrations, mostly in other EU member states, now suggests that a '3rd generation' of synthetic renewable fuels may emerge in the future as 'electro-fuels' (also known as ReFiNBOs), using low-cost surplus renewable electricity to drive hydrolysis of water and the Sabatier catalytic reaction to make hydrocarbons (e.g. Schaaf et al., 2014). Although such synthetic fuels will not require an additional supply of bioenergy feedstocks, it will be most important that their carbon source is predominantly from captured biogenic CO2, in order to minimise net CO2 emissions to atmosphere.

On questions 30-32 (GHG emissions reporting and accounting), the NFU does not recognise the existence of a weakness in the international accounting rules, although this has been the subject of a lot of rather unscientific media-based controversy. At their point of use, bioenergy fuels and fossil fuels remain distinctly different in origin, and it is meaningless to compare their gross emissions for the purposes of climate change accounting. What is important is to estimate and compare their net emissions at an international level, over appropriate time scales and spatial scales. Some UK companies, as well as the UK and EU administrations, have led the way in accounting for such life cycle emissions by setting tough standards for feedstock reporting and certification. Verification is often available from national forest inventories to assess whether overall standing biomass stocks are indeed being maintained or possibly increasing across a region.

Detailed response to selected consultation questions

Scaling up UK sustainable supply

> *18. What are the main opportunities to scale-up the supply of sustainably-produced domestic bioenergy supply in the UK? Where possible please provide details on the scale of opportunity.*

The NFU recognises that an increased supply of agricultural feedstocks will be needed to fuel a growing bio-based economy, including a large fleet of biomethane plants and new processes such as synthetic gas from biomass.

We believe there are opportunities to further expand production of annually harvested non-food crops within arable rotations, such as maize and hybrid rye as break crops, thereby supporting a much larger fleet of AD biomethane installations than at present. The present area of crops for AD (about 75,000 ha) could theoretically increase more than ten-fold, if it were considered critically important to decarbonise heat supply quickly using the most readily available technology. Such a large 'land take'

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would nevertheless provide secure long-term offtake contracts for farmers, enabling them to re-invest this diversification income back into food production.

In addition, there is a well-established technical potential, backed up by extensive research, to convert a modest fraction of current arable land and long-term grassland to perennial energy crops (previous estimates have ranged from 350,000 ha to 500,000 ha or more). Such crops like miscanthus and short rotation coppice willow may be used for power generation, industrial and domestic heating boilers, or potentially as feedstock for gasification, manufacturing bioSNG for distribution through the gas network. This may include scope for increased bioenergy production from short rotation coppice and short rotation forestry on upland farms, as a form of diversification compatible with the likely direction of post-Brexit agricultural policy.

19. What risks are associated with scaling-up domestic supply and how can these risks be managed?

There is a common perception that increased domestic bioenergy production would be at the expense of food security, biodiversity and landscape. However, farmers have used land for generations for both food and non-food purposes, largely in response to market prices – and it may be argued that a land-based contribution to decarbonising heat should be weighed against these other imperatives in deciding policy. An evidence base is also growing that land use can be truly multi-purpose, providing both food and energy products while delivering environmental benefits such as biodiversity, water management and carbon storage. Ecosystem services derived from well-managed woodland or enhanced farmland biodiversity found within perennial energy crops are both instances of this.

To give another example, demand for the most common AD crop feedstock, maize, does not yet seem to have driven an increase in the UK total area of maize (which is still mostly grown for dairy forage). In 2016, the Defra/ADAS project SCF0405 found no conclusive evidence beyond anecdotes that AD plants caused a local increase in land rents, and determined that environmental impacts of growing maize for AD can be mitigated by simple measures like good nutrient management planning and post-harvest chisel ploughing.

20. What 'low-regrets' measures should be taken now (e.g. planting strategies) to increase sustainably-produced domestic bioenergy supply?

The NFU has previously called for the Government to offer more effective long-term support for a programme to develop domestic perennial energy crop supply chains. We proposed a planting strategy aiming at 5000 ha/year in the short term, rising to 25,000 ha/year after a number of years. This would require a shift from supply-side measures to more market-based policy; e.g. incentivising fuel-buying users to offer improved terms of trade, sharing more of the risk with growers. A really large-scale supply chain demonstration project would also help, e.g. with an initial goal of 5000 ha of new planting, satisfying a demand for about 50,000 tonne/year of feedstock. It is regrettable that such policy measures were not followed up after the recommendations of the 2012 Bioenergy Strategy. Complementary 'low-regrets' measures could include the reform of agri-environmental support to reward growers for the biodiversity benefits of minimally-managed crops like short rotation coppice willow and miscanthus.

21. What international examples of best-practice should the UK should look to when considering approaches to scaling-up domestic supply?

22. What policy measures should be considered by Government to help scale-up domestic supply?

See Q20 above.

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Best-use of bioenergy resources

23. Gasification has been identified as a potentially important technology for unlocking the full potential of bioenergy to support economy-wide decarbonisation.
a) What are the likely timescales for commercial deployment of gasification technologies?
b) What efficiencies and costs are likely to be achieved? What scope is there for improvement and/or cost reductions over time? Please differentiate between feedstocks where possible/necessary.
c) What are the main barriers and uncertainties associated with the development, deployment and use of gasification technologies?
d) What risks are associated with gasification technologies and how can these be managed?
e) What policies and incentives are required to facilitate commercial deployment?

The NFU has begun to consider gasification as a possible future market for domestically-produced biomass, as a source of low-carbon pipeline gas or for upgrading to synthetic aviation fuels. There seems to be widespread stakeholder agreement that production of bioSNG from a variety of biomass feedstocks, complementing and supplementing existing mature AD biomethane technology, may offer a more realistic technical pathway than replacement of fossil natural gas with 100% hydrogen.

24. Bioenergy with Carbon Capture and Storage (BECCS) has been identified as a key potential mechanism for achieving the UK's 2050 carbon target due to the 'negative emissions' it could offer.
a) What are the potential timescales for commercial deployment of BECCS technologies?
b) What are likely to be the optimal uses of BECCS (e.g. electricity generation, hydrogen production)?
c) What efficiencies and costs are possible?
d) How will performance and cost differ according to feedstock type? What are likely to be the optimal feedstock types for BECCS? What are the implications for domestic supply vs imports (e.g. feasibility, considerations in scaling up over time)?
a. What are the main barriers and uncertainties associated with the development, deployment and use of BECCS?
b. What are the risks associated with the pursuit of BECCS that go beyond the risks that relate to supplying sustainable feedstocks and CCS more generally? How can these be managed?

The NFU recognises that BECCS (Bio-Energy with Carbon Capture and Storage) is indeed a key technology combination that will complement other measures in achieving ‘net zero’ emissions in the future, due to its comparative technological readiness and ability to be deployed at scale. Realistic estimates of the timescale for its commercial deployment are around 15-20 years, which means that enabling measures are required immediately to prepare the way. The likely unique role of BECCS provides an important rationale for developing other large-scale biomass supply chains in the meantime, since a thriving bioenergy industry would be a prerequisite for its cost-effective deployment. BECCS or BECCUS (Bio-Energy with Carbon Capture, Utilisation and Storage) may also be deployable at relatively small scale in the future, e.g. by adapting an AD biomethane plant to convert biogenic CO2 into extra methane using renewable hydrogen and catalysing the Sabatier reaction, or by similarly converting into methane the relatively concentrated CO2 waste stream from ethanolic fermentation of biofuel. Bio-ethanol production has already been coupled to CCS at the Archer Daniels Midland facility in Decatur, Illinois, capturing 1.1 million tonnes of CO2 per year.

25. Once developed BECCS is a technology that could be deployed in many different countries around the world. What principles and mechanisms should be used to determine where BECCS is deployed and how any associated negative emissions are accounted for? Should any UK participation in any international BECCS scheme be counted as additional to efforts to meet domestic carbon budgets?

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26. There is currently substantial interest in the development of 'advanced' biofuels for use in sectors such as aviation, shipping and/or heavy duty transport.
a) What are the most promising technologies/processes for advanced biofuel production up to 2050? Please provide details on each technology/process including advantages/disadvantages, timescales for commercial deployment, feedstock type, fuel type and end-user.
b) What efficiencies and costs are likely to be achieved? What scope is there for improvement and/or cost reductions over time? Please differentiate between technologies/processes.
c) What are likely to be the optimal feedstock types for advanced biofuel technologies?
d) What are likely to be the optimal end-uses of advanced biofuel technologies?
e) What are the main barriers and uncertainties associated with the development, deployment and use of advanced biofuel technologies?
f) What risks are associated with the pursuit of advanced biofuel technologies and how can these be managed?
g) What policies and incentives are required to facilitate commercial deployment of advanced biofuels?

The NFU recognises that renewable transport policy needs to foster new technologies, but it must also support the existing biofuels industry. The level of demand needs to be lifted, both in the short term and in the decade 2020-2030, to enable further investment in both crop-based and 'advanced' biofuels. Government policy focussed exclusively on waste-derived and advanced biofuels will not necessarily help UK supply chains, since in biofuels markets in many parts of the world such distinctions are not made between the feedstock sources of biofuels once the basic sustainability criteria have been met. In our response to the recent Renewable Transport Fuels Obligation (RTFO) consultation, we suggested that the 'advanced biofuel' sub-target should be additional to the baseline RTFO goal rather than allowing the substitution of one biofuel for another. It does not make sense to displace existing low carbon fuels with other forms of biofuel; instead the fossil share of the fuel supplied must be replaced, i.e. 'development bioethanol' should displace petrol rather than first generation bioethanol.

The NFU believes that the main barrier associated with development and deployment of advanced biofuels is uncertainty around Government policy making. The current RTFO proposed changes are welcome after a 7-year hiatus, but the "stop/go" approach to policy does not give industry the confidence it needs to make long term investments which will take a number of years to reach commercialisation.

We support the potential for agricultural co-products, residues and wastes, for example cereal straw, to be used to produce cellulosic ethanol. See also our remarks above about the potential for '3rd generation' synthetic renewable fuels (electro-fuels / ReFiNBOs) made using low-cost surplus renewable electricity combined with previously captured biogenic carbon, as a possible route to low-carbon aviation fuel. We anticipate that bio-ethanol (and its derivative ethylene) as well as methane, both bio-based and synthetic, are likely to be important platform chemicals for fuels and other products in the future bioeconomy

27. In 2015 the Government published the Industrial Decarbonisation and Energy Efficiency Roadmaps to 2050. These Roadmaps explored decarbonisation options across multiple industrial sectors and the estimated deployment potential, timescales, cost data and abatement for each option (including bioenergy). Are there any substantial changes from these estimates that the CCC should consider when assessing abatement options in industry? If so please provide your reasoning and details of any recent evidence that relates to these changes.

28. In our 2011 review we identified wood in construction as a potentially effective method of CCS and a high priority 'non-energy' use in our best-use hierarchy.
a. What lifecycle GHG emissions savings can be achieved by using WIC? Under what circumstances does WIC fail to deliver GHG emissions savings? Please consider the full range of impacts associated with using WIC including substituted product emissions (e.g. cement), product equivalence (impacts on co-products), end-of-life options and biogenic carbon storage.

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b. What is the potential for increasing the amount of wood used in construction in the UK? What are the barriers and how can they be overcome?
c. What is the potential for using UK-produced timber in construction rather than imports? What are the barriers and how can they be overcome?
d. What is the expected lifetime of different wood products in construction (e.g. cross-laminated timber)?
e. What currently happens to wood in construction at the end of its useful life? What other viable options should be developed?

Bioenergy adds value to the use of WIC, reducing wastage of fixed carbon through the use of short-lived timber by-products and residues. However, the NFU considers that allocation by market value is preferable to overly prescriptive best-use hierarchies, although we recognise that some policy interventions may be required to regulate and enable markets to function efficiently (e.g. in diverting waste construction wood away from landfill towards re-purposing or ultimately energy recovery). In addition to WIC, we believe there are significant opportunities for agricultural feedstocks (fibre crops, straw) among the prospects for engineered or chemically-modified bio-based structural materials which have long lifetimes and low carbon losses in production. These include acetylated wood, gluelam, hemp-lime biocomposites, and other bio-based panel products and insulation products, many of which have struggled over the past decade to break into the traditionally very conservative construction sector.

29. There are also a number of other potential non-energy uses of bio-feedstocks including bio-based plastics and bio-based chemicals.
a. What other non-energy uses of bio-feedstocks have the most potential through to 2050 in terms of GHG abatement, cost, timescales and market size?
b. What are the barriers to increasing these non-energy uses and how can these barriers be overcome?
c. What risks are associated with the pursuit of other non-energy uses of bio-feedstocks and how can these be managed?
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The NFU believes the UK's strong research base in industrial biotechnology should be able to support a growing bioeconomy, which directly and indirectly can drive GHG abatement. Most manufactured goods will be plant-based, with a few exceptions such as insulating materials made from wool fleeces or products derived from animal fats. The peculiar properties of bio-based products need to be more explicitly recognised, and rewarded or encouraged (e.g. vegetable oil fuels with high flashpoint for confined spaces like mines; biolubricants and hydraulic oils with enhanced biodegradability for work in environmentally sensitive locations). Replacement of single-use plastic packaging with biodegradeable fibres or bioplastics (e.g. in food retailing and food service, online sales of fast-moving consumer goods, collection of food waste) represents a major opportunity to deliver a zero waste strategy with substantial greenhouse gas savings. We agree with other stakeholders that virgin bio-based feedstocks will be essential in some applications where consumer acceptability or product quality are critically important; a strong bioeconomy cannot be built upon secondary resources alone.

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