REA Response:
Role of Biomass in Achieving Net Zero: Call for Evidence.

The Association for Renewable Energy & Clean Technologies (REA) is pleased to submit this response to the above call for evidence. The REA represents industry stakeholders from across the whole bioenergy sector and includes dedicated member forums focused on green gas, biomass heat, biomass power, renewable transport fuels and energy from waste (including advanced conversion technologies). Our members include generators, project developers, fuel and power suppliers, investors, equipment producers and service providers. Members range in size from major multinationals to sole traders. There are over 500 corporate members of the REA, making it the largest renewable energy trade association in the UK.

1. Do you give permission for your evidence to be shared with third party contractors for the purpose of analysis

Yes.

Chapter 1: Biomass Availability

2. What is the potential size, location and makeup of the sustainable domestic biomass resource that could be derived from the a) waste, b) forestry, c) agricultural sectors, and d) from any other sources (including novel biomass feedstocks, such as algae) in the UK? How might this change as we reach 2050?

As BEIS will be aware, it is difficult to provide comprehensive figures that fully demonstrate biomass availability across all bioenergy feedstocks. Below we provide a list of useful resources which provide a strong basis for understanding the extent of biomass availability.

Overly conservative estimates for biomass availability do not reflect reality.

Biomass is a limited resource, but that is not the same as being scarce. As indicated by the question, there are a wide variety of supply chains, all of which are also subject to commercial market dynamics that sees demand drive availability. It is unlikely that any modelling done today will fully reflect possible biomass availability in the future, as supply chains innovate, and demand drives further biomass production. As such, we caution against government assuming overly conservative estimates of biomass availability which are neither apparent in the industry today or supported by different feedstock availability models. Instead, strong sustainability governance arrangements, as are already in place, should be relied upon to ensure biomass is being used correctly, with the market being able to direct where within the bioenergy industry different feedstocks are best used.

Current modelled domestic and international supply can meet future demand.

The REA suggest that there remain significant amounts of potential for growing domestic feedstock production in the UK, as well as sustainably increasing biomass imports where required. Within the REA's 2019 Bioenergy Strategy[1], we set out how the bioenergy sector could sustainably provide up to 16% of the UK's energy needs across power, heat, and transport. The feedstock requirements for achieving this were mapped out against Ricardo's AEA's (2017)

[1] REA (2019) REA Bioenergy Strategy, https://www.r-e-a.net/resources/bioenergy-strategy-phase-3/

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Biomass Feedstock Availability, commissioned by BEIS.[2] The strategy concluded that meeting the levels of potential bioenergy growth was possible if the UK maintained sustainable biomass imports while making good use of the potential domestic feedstocks that could be developed within the UK by 2032. This includes the development of domestic forestry feedstocks and energy crops, including perennial crops like miscanthus and willow.

The REA Bioenergy Strategy proposed that domestic feedstocks could largely meet 2032 bioenergy heat and transport demand, while recognising that additional imported resources would be required, notably solid biomass pellets, for large scale power generation, increasing to around 400 PJ (111 TWh) – in line with the Climate Change Committee (CCC) sustainable bioenergy growth scenarios.[3] Additional liquid biofuels for transport would also need to come from international markets (between 100 and 150 PJ), depending on the volumes available from the UK). It is the industries view that with the presence of strong sustainability governance arrangements, additional import levels could be sustainably procured and be in accordance with UK's fair share of biomass resources.

Forestry Commission statistics indicate significant potential for increased domestic biomass forestry resource

The latest Forestry Commission Statistics for 2020 indicate trends of continued modest growth of UK forest inventory and increasing levels of forests coming under certified management. As at March 2020 there were 1.39 million hectares of certified woodland in the UK. Part of this growth can be attributed to increased demand for low value forestry products driven by the Renewable Heat Incentive and Renewable Obligation, underwriting investment in new managed woodlands. However, there is 3.2 million hectares of woodland in the UK, suggesting there remains large areas of underutilised and unmanaged woodlands, a proportion of which would become available if demand for bioenergy feedstocks increased.[4]

Government should ensure it makes full use of data already available through the Biomass Suppliers List

BEIS should be aware that, as operators of the Biomass Suppliers List (BSL), they do already have a wealth of data available to them concerning the UK wood heat biomass market. In considering biomass availability and sustainability this data should be reviewed and shared across relevant Whitehall teams. The data includes:

- Tonnage figures for each biomass fuel type
- CO2 emission data by fuel type
- Moisture content data by fuel type
- Total number of authorisations by business size and supplier type
- Country of raw material origin and subsequent tonnage
- Self-Supplier raw material tonnages
- Tonnage of sustainable biomass sold in the UK

[2] Ricardo's AEA's (2017) *Biomass Feedstock Availability,* https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/597387/Biomass_feedstock_availability_final_report_for_publication.pdf

[3] CCC (2018) Biomass in a low carbon economy, https://www.theccc.org.uk/publication/biomass-in-a-low-carbon-economy/

[4] Forestry Commission (2020) *Forestry Statistics 2020*, https://www.forestresearch.gov.uk/tools-and-resources/statistics/forestry-statistics/

We understand that the BSL shall be highlighting this data as part of their response to this call for evidence.

Perennial Energy Crops (PECs)

Growth in domestic feedstock supply for bioenergy will also come from energy crops, in particular PECs, incorporating Short Rotation Coppice (SRC) like willow and miscanthus, as well as short rotation forestry (SRF). The CCC highlight the need to increase the growth of energy crops by around 23,000 hectares each year to deliver 2MtCO2e emissions savings in the land sector and an extra 11 MtCO2e from harvested biomass. Overall, the CCC's Ambitious Scenario, assumed bioenergy crops are grown on 0.7 million hectares, producing 15 oven-dried tonnes per hectare by 2050.[5] Such crops are typically grown on economically marginal land, and can be used as a feedstock across the heat, power and transport bioenergy sectors.

In addition, such crops provide longer term reliability to both feedstock users, providing diversification in feedstock sources and reducing dependency on cereal crops which can have high price volatility. Therefore, enabling plants to use a higher percentage of perennial crops provides more predictable costs to bioenergy sites and longer-term contracts for growers.

However, Defra data indicates no significant trends in increased growth of perennial energy crops in the UK.[6] Widescale take up will require dedicated policy measures and reward for the numerous benefits provided by PECs. With the phasing out of EU subsidies, the UK's Environmental Land Management Scheme (ELMS) will be a crucial for driving land use aligned to net zero ambitions, especially providing steady and long term income for the developers of PECs.

The UK also needs to make the most of its biogenic waste resources.

The availability of waste resources for use in bioenergy will be subject to the implementation of DEFRA's Waste and Resource Strategy. We strongly support work to improve both food and non-food recycling rates. By ensuring economically recyclable material is appropriately treated, feedstock homogeny is increased which delivers efficiencies in conversion from anaerobic digestion, energy from waste sites and waste wood sites. We, however, note a continuing need for the UK to export 3.5 million tonnes of waste to Europe, due to a lack of adequate waste management capacity in the UK, which could be re-shored.[7] The UK also currently produces 4.5 million tonnes of waste wood per annum, for which there is an equal end-use demand, including biomass power production.

In addition, the implementation of mandatory food waste collections will also increase the availability of biogenic waste from commercial and municipal sources that should be being used for bioenergy or composting applications. Defra's policy on food waste collections must not be

[5] CCC (2020) Land Use: Policies for a Net Zero UK, https://www.theccc.org.uk/publication/land-use-policies-for-a-net-zero-uk/

[6] DEFRA (2020) Area of crops frown for bioenergy in England and the UK : 2008 – 2019, https://www.gov.uk/government/statistics/area-of-crops-grown-for-bioenergy-in-england-and-the-uk-2008-2019

[7] DEFRA (2020) *Waste and Recycling Statistics,* https://www.gov.uk/government/collections/waste-and-recycling-statistics

delayed if opportunities from these resources are to be maximised under the upcoming Green Gas Support Scheme (GGSS).

The UK is also underutilising the potential of food and drink waste coming from the agri-food and drink sector. WRAP (2018) estimates that food manufacturing produces 1.5 Mt of food waste per year, with 6,700 SMEs accounting for 97% of businesses. It is also estimated that roughly 90 million tonnes of agricultural manures and slurries are generated each year[8], with less than 4 million tonnes being required by all the anaerobic digestion plants currently operational or under development in the UK.[9] As suggested by the CCC, no biodegradable waste should be heading to landfill by 2025.[10] As such, there needs to be greater visibility of the amount of food and drink waste arising in the agri-food sector, and elsewhere, with sector support to see it sent to appropriate facilities in line with the waste hierarchy, including for use in composting, anaerobic digestion and advanced conversion technologies.

A biomass availability taskforce should be established to get cross-stakeholder agreement on availability.

Given the diverse range of feedstock supply chains, and studies considering biomass availability, the REA propose a cross stakeholder taskforce that could compile existing data and commission new research to get cross stakeholder agreement on sustainable available biomass supplies. This will likely need to be a recurrent taskforce that is able to consider new information as it becomes available and as the industry continues to innovate and develop. The REA would be happy to support the establishment of such a taskforce.

Further biomass availability evidence:

- Dale, V. et al. (2017) Status and Prospect for renewable energy using wood pellets from the southeastern United Stated, *GCB Bioenergy*, 9: 1296-1305. https://doi.org/10.1111/gcbb.12445
- Reid A. Miner, Robert C. Abt, Jim L. Bowyer, Marilyn A. Buford, Robert W. Malmsheimer, Jay O'Laughlin, Elaine E. Oneil, Roger A. Sedjo, Kenneth E. Skog, Forest (2014) 'Carbon Accounting Considerations in US Bioenergy Policy', *Journal of Forestry*, Volume 112, Issue 6, November (2014) Pages 591–606, https://doi.org/10.5849/jof.14-009
- Welfle, A, Holland, R, Donnison, I & Thornley, P 2020, *UK Biomass Availability Modelling: Scoping Report* . Supergen Bioenergy Hub., https://www.research.manchester.ac.uk/portal/en/publications/uk-biomass-availability-modelling(dc9b413c-11e7-4158-b42a-12bed870ca46).html
- Forestry Commission (2020) Forestry Statistics 2020, https://www.forestresearch.gov.uk/tools-and-resources/statistics/forestry-statistics/
- Anthesis & E4Tech, 2017. Review of Bioenergy Potential: Technical Report For Cadent Gas Ltd. https://cadentgas.com/nggdwsdev/media/media/reports/futureofgas/Cadent-Bioenergy-Market-Review-TECHNICAL-Report-FINAL-amended.pdf

[8] Royal Agricultural Society of England, *A Review of Anaerobic Digestion Plants on UK Farms*, https://www.fre-energy.co.uk/pdf/RASE-On-Farm-AD-Review.pdf

[9] NNFCC, 2021. *Anaerobic Digestion Deployment in the UK*, https://www.nnfcc.co.uk/publications/report-anaerobic-digestion-deployment-in-the-uk

[10] CCC (2019) Net Zero The UK's contribution to stopping global warming, https://www.theccc.org.uk/publication/net-zero-the-uks-contribution-to-stopping-global-warming/

- Renewable Fuels Agency (2008) The Gallagher Review of the indirect effects of biofuels production, https://www.unido.org/sites/default/files/2009-11/Gallagher_Report_0.pdf
- OFWAT (2021) Bioresource market information, water and sewage companies, https://www.ofwat.gov.uk/regulated-companies/markets/bioresources-market/bioresources-market-information/
- Interreg North-West Europe, European Regional Development Fund (2020) Designing value chains for carbon based elements from sewage; Market Potential Study, https://www.nweurope.eu/media/12964/201230_market-potential-study-final_01.pdf
- **See Annex 4:** Biomass Sustainability and Availability – A briefing note produced by Biomass UK, highlighting key points associated with this question[11]

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3. What are the current and potential future costs of supplying these different biomass feedstock types, and the key environmental and land-use impacts (positive or negative) associated with supplying and utilising these different types of biomass, e.g. impacts on GHG emissions, air quality, water quality, soil health, biodiversity, food security, land availability, etc?

Biomass Pellet Costs

Market intelligence consultancy, Hawkins Wright, has produced a briefing for the REA for the purposes of this call for evidence, providing information on current costs and expected future market dynamics for industrial biomass pellets, imported heat pellets and alternative solid biomass fuels. The full briefing paper is submitted with this response as **Annex 1**.[12]

In summary the briefing highlights:

Industrial Pellets:

- The average spot price of industrial/utility grade wood pellets (used for power/CHP generation) is £115/t CIF between 2014 – 2021
- The largest cost component in the supply of wood pellets is almost invariably the cost of the wood fibre raw material. In the first quarter of 2021, the cost of wood fibre comprised 38% of the average cost of supplying wood pellets to CIF ARA.

Heat Pellets:

- The size of the UK heating pellet market is estimated to be 550,000-600,000t/y, of which about two thirds is imported.
- In 2020/21, the wholesale price of heating pellets in the UK was in the range £120-125/t (€135-140/t), ex-warehouse (in bulk) according to market participants.
- The UK's forests produced 2.6M green tonnes of wood fuel in 2019.

Alternative solid fuels:

- Energy crops grown for use in power/CHP and for heating include miscanthus and Short Rotation Coppiced (SRC) willow and poplar. In 2019, the area of miscanthus grown in

[11] See Annex 4: https://www.r-e-a.net/wp-content/uploads/2021/06/REA-Annex-4-BUK-Biomass-Sustainability-and-Availability.pdf

[12] Annex 1: Full Hawkins Wright briefing provided direct to BEIS, not available for wider circulation.

England was 8,171ha, producing around 100,000 dry tonnes depending on an estimate of yield. Of this, about half was used in UK power stations. The area of SRC in 2019 was 2,233 ha, producing around 25,000 dry tonnes depending, again, on the yield estimate used.

Market dynamics mean certain feedstocks may become cheaper as demand increases.

While it is generally true that increasing demand will drive higher feedstock prices, this is not consistent as economies of scale mean higher demand will enable buyers, especially larger players, to be able to command greater efficiencies within their supply chain. As the global wood pellet market matures and develops, the costs of wood pellet production can be expected to fall. Supply chain efficiencies, economies of scale, and engineering and technology improvements could all help to lower the costs of wood pellet supply.[13]

The continued decarbonisation of supply chains through low carbon innovation and efficiency gains in cultivation, production and transportation could also open new supply markets to the UK, which currently would be too carbon intensive to use. If done in accordance with strict sustainability governance arrangements, these new markets may also lead to a wider global market where prices are kept low. Such imports should continue to be independently certified, such as through the Sustainable Biomass Program. If the UK did start to see significant level of imports from new markets, impact assessments could be commissioned to ensure sustainability standards and verify life cycle analysis calculations.

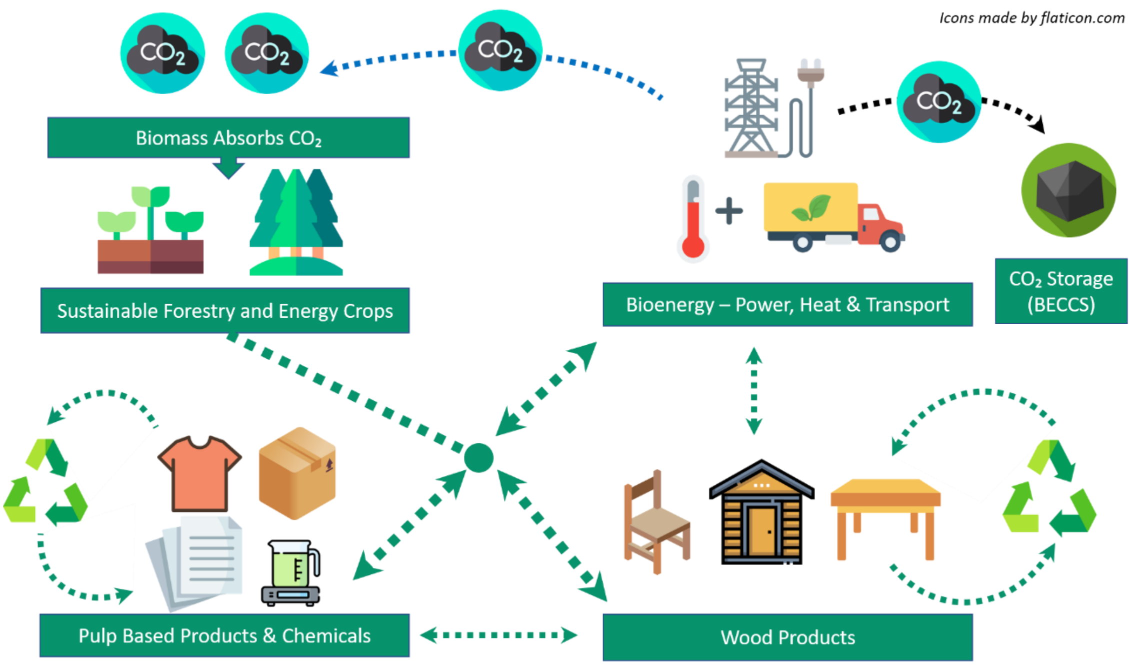
Bioenergy also supports development of higher value wood and bio-based products.

It is also important to consider feedstock prices in view of broader forestry market dynamics and the benefits that predictable long-term revenues deliver to the forestry or agricultural sector. For virgin biomass, bioenergy feedstocks are typically setting a floor price for the lowest value residues and offcuts. Predictable demand for these products provides an additional secure revenue stream in addition to that received for higher value products. As such, if Government encourages more wood being used in construction, as recommended by the CCC, then availability of offcuts and thinning will also increase, lowering feedstock prices, but also leading to a healthier forestry sector overall.

Similar dynamics can be observed in the development of high-value specialist biobased materials from energy crops, including speciality chemicals based on cellulose or lignin, wood-based textiles, bio-based plastics, and many others, seeing further displacement of fossil fuel use. Ultimately such materials enter a bio-based circular economy, with waste produced from both production and disposal generating bioenergy feedstocks as the lowest-value product in the value chain.

Figure 1: Biomass and carbon flows between the biobased material, wood products and bioenergy sectors within a circular economy.

[13] Annex 1: Full Hawkins Wright briefing provided direct to BEIS, not available for wider circulation.



Policy should further consider biogenic waste gate fees.

Price dynamics are different where municipal or agricultural waste feedstocks are being used. Except for waste wood sites, who often pay for feedstock, bioenergy sites using wastes will likely receive a gate fee to take the waste. For anaerobic digestion and energy from waste sites, the gate fee is a significant proportion of the revenue required to make the site commercially viable. Government policies that see commercial and industrial biogenic wastes diverted from landfill and used in energy production will help drive demand for bioenergy capacity and raise gate fees.

This also has implications for innovation, for example advanced conversion technologies (ACT) developers, like gasification, are currently primarily focused on refuse derived fuel (RDF) as a feedstock partly due to the gate fee providing necessary revenue to underwrite the project, which could not be achieved with virgin biomass that needs to be paid for. WRAP provide publicly available information on gate fees, demonstrating an average gate fee of about £40/tonne, but with a significant range between technologies.[14]

Policies should drive the delivery of more homogenous waste streams, requiring less sorting, and higher gate fees. Such waste streams will be beneficial to the ACT and AD sectors where more homogenous feedstocks drive efficiencies in conversion. These dynamics will need to be considered by DEFRA in the implementation of the Resource and Waste Strategy, which will have a bearing on how BEIS look to develop the bioenergy sector in the future.

Green House Gas (GHG) Benefits

The GHG benefits associated with the current contribution from bioenergy were estimated in the REA Bioenergy Strategy, which used the current GHG performance from a range of bioenergy options presently deployed and the fuels which they are replacing. A consideration of all three major sectors – electricity, heat and transport indicates that, in total, bioenergy reduced GHG

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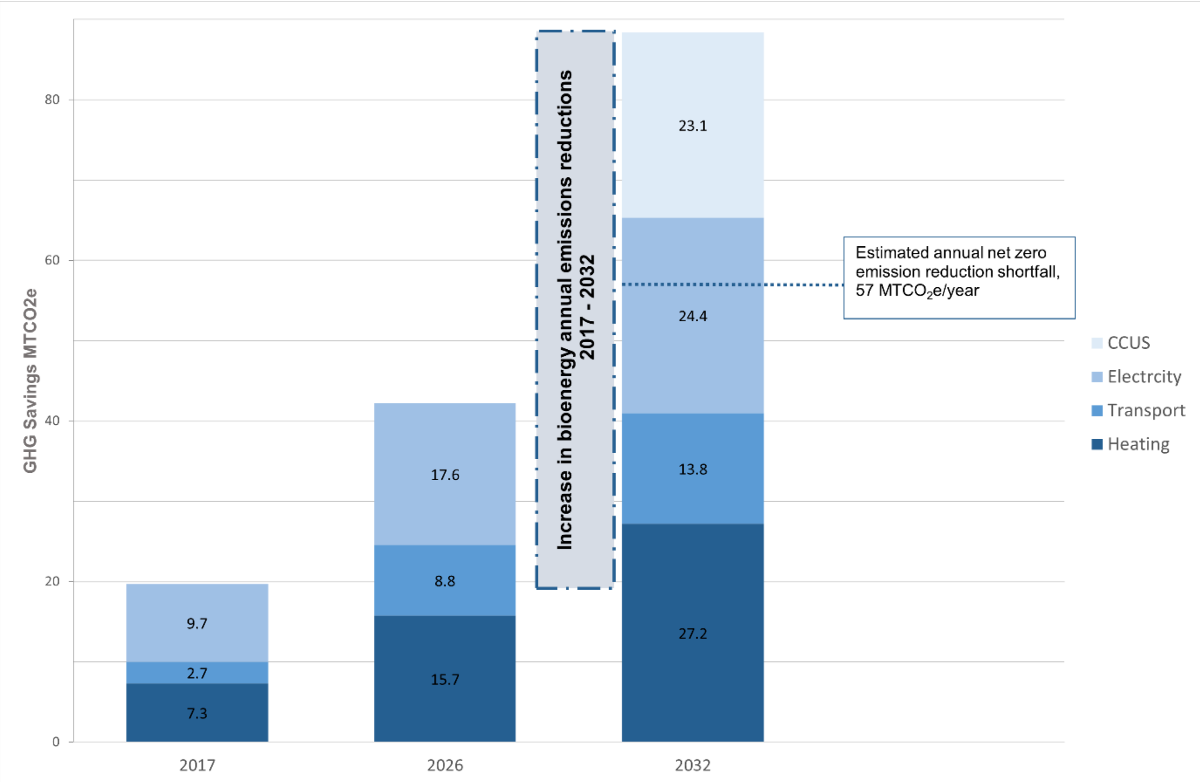
[14] WRAP (2020) Gate Fees Report 2020, https://wrap.org.uk/resources/report/gate-fees-report-2020

emissions by some 19.7 MTCO2e in 2017. This corresponds to around 3.8% of total UK emissions for that year (513 M Tonnes CO2e).[15]

The REA Bioenergy Strategy estimated GHG benefits associated with the contribution from bioenergy in 2026 and 2032 based on emission factors for the fuels most likely to be replaced. In total the reduction in GHG emissions due to fossil fuel replacement amounts to some 65 MTCO2e in 2032. A further 23 $MTCO_2e$, could be saved due to recycling or storage of CO_2 separated from bioenergy processes (existing processes and newly installed capacity with purposed designed capture systems), making a total of 80 $MTCO_2e$. This compares with a total projected annual GHG emissions of 353 $MTCO_2e$ in 2032. As identified within the bioenergy strategy this would be enough to keep the UK on track with its 5th Carbon Budget targets, overshooting the expected shortfall, as demonstrated in Figure 2.

Figure 2: Projected Bioenergy GHG savings if Projected Growth of Bioenergy Sector is realised, as stated in the REA's Bioenergy Strategy



Source: REA Bioenergy Strategy (2019)

Note further non-GHG benefits are explored in answer to question 4.

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4. How do we account for the other (non-GHG) benefits, impacts and issues of increasing our access to, or production of domestic biomass (e.g., air quality, water quality, soil health, flooding, biodiversity)?

Delivering positive environmental and land-use benefits from increased biomass use needs to be done via both the 'stick' of sustainability governance to prevent negative impacts (which is already in place), along with a 'carrot' of appropriately rewarding additional benefits provided by

[15] REA (2019) REA Bioenergy Strategy, https://www.r-e-a.net/resources/bioenergy-strategy-phase-3/

good land use or environmental practices associated with cultivating feedstocks. Points in relation to sustainability governance are answered in response to Chapter 3, while accounting and rewarding these benefits are listed below.

Benefits realised from increasing access and growth to biofuel supplies:

Biodiversity

Where done correctly, in accordance with strong forestry and agricultural practices, bioenergy production has led to more diverse habitats, or helped preserve important resources. This is due to working forests providing revenues that incentivise maintenance of forest land, as well as governance arrangements enforcing strong forestry practices. Examples of this being the case can be seen in both US and the UK.

In the US a recent synthesis of almost 20,000 articles concerning the effect of forest management techniques on biodiversity in South-eastern US, the research team found that the majority of studies report no negative impacts of forestry practices on biodiversity, concluding that "claims of large-scale damage to biodiversity of woody bioenergy in Southeastern US are not supported," and that "adverse impacts are mostly from studies of short duration conducted soon after extraction" [16] . Similar reports are also seen in the UK where the market for forest thinnings, created by the RHI and RO, is credited with helping bring more UK woodland into management with consequent biodiversity benefits.[17]

It is noted that positive forest management involves the removal of infested or diseased trees which also helps to protect the wider health of the forest.[18] For example, In the Southern US forest thinning helps support open pine ecosystems which many imperilled species are dependent on.

In general, to mitigate impacts on biodiversity, biomass production needs to be assured that healthy forests are rewarded, making it commercially sensible for forests to be managed and biodiversity to be maintained. Of equal importance, therefore, is also compliance and enforcement with good forestry and agricultural practice. In the UK this includes the UK Forest Standard.[19] Internationally this includes complying with the FAO's Principles for Responsible Investment in Agriculture and Food Systems as approved by the Committee on World Food Security.[20] Support and regulation around bioenergy feedstock production therefore provides the additional level of regulatory oversight that supports implementation of these rules.

[16] Gillian Petrokofsky, Oliver Hooper, Leo Petrokofsky, Alice E. Gant, William J. Harvey, Katherine J. Willis, (2021) 'What are the impacts of the wood pellet industry on biodiversity in Southeastern USA? A systematic evidence synthesis,' *Forest Ecology and Management*, Volume 483, 2021, https://doi.org/10.1016/j.foreco.2020.118773

[17] Forestry Commission (2020) *Forestry Statistics 2020*, https://www.forestresearch.gov.uk/tools-and-resources/statistics/forestry-statistics/

[18] Woody Biomass Utilization Benefits https://forestsandrangelands.gov/woody-biomass/benefits.shtml

[19] UK Forest Standard https://www.gov.uk/government/publications/the-uk-forestry-standard

[20] FAO/Committee for World Food Security, Principles for Responsible Investment in Agriculture and Food Sytems, http://www.fao.org/3/a-ml291e.pdf

Energy crops, especially perennial crops, have also be shown to deliver biodiversity benefits. Studies on Willow SRC[21] and Miscanthus[22] have demonstrated that under current management practices a mixed farming system incorporating willow SRC can benefit native farm-scale biodiversity. The growth of such crops provides a stable refuge and food source for both invertebrates and Hymenoptera (larger order insects, including bees), both aiding pollination and supporting natural predators of crop pests.

Wildfire Mitigation

In addition, bioenergy demand rewards the removal of deadwood, and management of the underbrush, which contributes to the avoidance of wildfires in the US. The removal of this 'ladder fuel' creates fire breaks and is part of the solution to addressing the extended wildfire seasons that are expected to become more common due to climate change.[23 & 24]

Flooding Mitigation

In 2020, large parts of the Midlands, Yorkshire and Wales received unprecedented rainfall, and in some cases a month's worth of rain fell in just 24 hours. The Environment Agency themselves called this 'uncharted territory' for flooding but expects it to be a an increasingly common occurrence. Growth of bioenergy feedstocks, both in terms of forestry and energy crops, is providing nature-based solutions to flooding prevention.

Trees play a key role in reducing the amount of water reaching the ground, as well as creating soils that can absorb more water. Conifers are particularly good in this regard and can lead to between 25-45% less water reaching the ground per year compared with grass. Broadleaf can also lead to between 10-25%. In turn, this canopy cover leads to drier soils underneath which can absorb more water.

Perennial Energy Crops (PECs) can also be effective when planted on floodplain or flood-prone areas. PECs such as dense willow or miscanthus have a high hydraulic roughness, meaning they slow the spread of water across the floodplain, and it takes longer for water to reach the main channel. This can be achieved quickly, within three years. The resulting impact is a quickly established solution that provides extra time for villages and towns situated downstream, on the banks of flood prone rivers, where they can remove valuables and protect properties. As willow and miscanthus are extremely resilient, in some cases even thriving in flood conditions, and do

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[21] Rebecca L. Rowe, Mick E. Hanley, Dave Goulson, Donna J. Clarke, C. Patrick Doncaster, Gail Taylor,(2011) 'Potential benefits of commercial willow Short Rotation Coppice (SRC) for farm-scale plant and invertebrate communities in the agri-environment' *Biomass and Bioenergy,* Volume 35, Issue 1, https://doi.org/10.1016/j.biombioe.2010.08.046

[22] Emmerling, C. and Pude, R. (2017), Introducing Miscanthus to the greening measures of the EU Common Agricultural Policy. *GCB Bioenergy, 9: 274-279.* https://doi.org/10.1111/gcbb.12409

[23] Seth Ginther, Biomass Magazine (2018) 'Climate and Fire, Why Biomass Matters to Both' http://biomassmagazine.com/articles/15824/opinion-climate-and-fire-why-biomass-matters-to-both

[24] Milton Marks Commission on California State Government Organization and Economy (2018) *Fire on the Mountain: Rethinking Forest Management in the Sierra Nevada* *https://lhc.ca.gov/sites/lhc.ca.gov/files/Reports/242/Report242.pdf*

not need to be harvested every year, they can provide a flood benefit and still be there the following year for harvesting. [25, 26 & 27]

The benefits in flood prevention should be recognised in payments to landowners and developers either via flood management plans from local authorities or through central government, such as via the Environmental Land management Scheme.

Carbon sequestration and utilising low-grade land

It is possible for land use change, or change in agricultural practice, to have positive impacts leading to increased levels of carbon in plants and soils. For example, a change to no-till practice can improve carbon levels. If land is reforested, degraded soils are managed and planted with suitable crops to restore productivity, or perennial crops are planted on land previously used for annual crops, then net carbon increases can occur over time. Afforestation of degraded or abandoned land can provide substantial carbon benefits while also providing significant resources for sustainable local food and energy use. Providing economic uses for some of the products can be an incentive for afforestation or better land management. More specific examples of these benefits include:

Forestry Management: Wood pellets and biomass derived from processing and harvesting residues, thinnings and low grade roundwood from sustainably managed working forests –has a positive impact on the forest industry, forest carbon stocks and helps to ensure that forests stay as forests rather than being converted to agriculture or urban development. Analysis of historical trends in the US South has shown that, as demand for wood products increased over the last 60 years, management practices have also improved to increase forest growth rates and more than double the amount of carbon stored in the working forests from 4 billion m^3 to 8.4 billion m^3. This improvement is statistically correlated to increasing demand.[28]

Perennial Energy Crops: Perennial Energy Crops such as miscanthus or short rotation coppice (SRC), like willow, have significant potential to sequester carbon in root systems. As a biproduct of the biomass crop itself, this has a has net zero cost. Domestic biomass supply chains using these crops are already responding and increasing in scale due to market pull of an active and growing bioenergy sector. A recent study by miscanthus developer Terravesta demonstrates Miscanthus is a net carbon negative feedstock with the potential to capture net 0.64 tonnes of carbon (2.35 tonnes CO_2e) per year in the ground, the amount being proportional to the biomass

[25] Henriette I Jager, Esther S Parish, Matthew H Langholtz, Anthony W King, (2020) 'Perennials in Flood-Prone Areas of Agricultural Landscapes: A Climate Adaptation Strategy', *BioScience*, Volume 70, Issue 4, April 2020, Pages 278–280, https://doi.org/10.1093/biosci/biaa006

[26] De Vega, J.J., Teshome, A., Klaas, M. *et al.* Physiological and transcriptional response to drought stress among bioenergy grass *Miscanthus* species. *Biotechnol Biofuels* **14,** 60 (2021). https://doi.org/10.1186/s13068-021-01915-z

[27] Kam J., Traynor D., Clifton-Brown J.C., Purdy S.J., McCalmont J.P. (2020) Miscanthus as Energy Crop and Means of Mitigating Flood. In: Naddeo V., Balakrishnan M., Choo KH. (eds) Frontiers in Water-Energy-Nexus—Nature-Based Solutions, Advanced Technologies and Best Practices for Environmental Sustainability. Advances in Science, Technology & Innovation (IEREK Interdisciplinary Series for Sustainable Development). Springer, Cham. https://doi.org/10.1007/978-3-030-13068-8_115

[28] Forest2Market (2017) *Historical Perspective on the Relationship between Demand and Forest Productivity in the US South,* *https://www.forest2market.com/hubfs/2016_Website/Documents/20170726_Forest2Market_Historical_Perspective_US_South.pdf*

yield but excludes the actual biomass itself. Similar benefits could be achieved with other perennial feedstocks.[29 & 30]

Sequential or Double Cropping: There are significant opportunities to further expand production of annually harvested non-food feedstocks within arable rotations, such as hybrid rye, maize and herb-rich grass leys as break crops.

The government should consider the merit and potential role of sequential or double cropping in the UK. There may be some parts of the UK where this approach, or one adapted to our climate, can be adopted. This approach has been developed mostly in Southern Europe, pioneered by the Consorzio Italiano Biogas (CIB) to integrate anaerobic digestion with agro-ecology. It is a highly sustainable model that has proven to deliver a significant reduction in GHG emissions from agriculture and carbon sequestration, as well as to restore soil health and organic matter. CIB has called it Biogasdoneright® model (BDR), which describes a set of practices that link biogas production to sustainable agriculture and is being implemented on a large scale in Italy.

Under BDR, food production is not adversely affected by double crops as these are typically grown in seasons when most food cropland is fallow. Therefore, food and feed production are not displaced when producers adopt sequential cropping. The 'energy crops' represent 'additional carbon' – that is carbon removed from the atmosphere by the BDR cropping system above and beyond the carbon fixed by current agricultural practices.

Evidence collected from the biogas sector shows that proper biogas production based on sequential cropping is a sustainable activity. Furthermore, it is a powerful solution leading to decreased greenhouse gas (GHG) emissions, protection of biodiversity and restoration of soil quality through agroecological innovation and organic fertilisation.[31 & 32]

More research needs to be carried out in the UK to understand whether double cropping is possible and could be adopted in the UK given the different climate.

Sanitation and localised waste management in line with the waste hierarchy

The sanitation benefits provided by energy from waste applications of bioenergy should also be recognised. Energy recovery, anaerobic digestion, and advanced gasification conversion technologies all mitigate the release of greenhouse gases from landfill and provide necessary waste management capacity in line with the waste hierarchy. In 2018 the UK sent 7.2 million tonnes of biodegradable municipal waste to landfill. [33] By contrast, the CCC has called for there

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[29] Terravesta (2021) *Carbon Life Cycle* https://www.terravesta.com/wp-content/uploads/2021/04/Terravesta_miscanthus_carbon_report.pdf

[30] Adams and Lindegaard (2016) A critical appraisal of the effectiveness of UK Perennial energy crops since 1990, *Renewable and Sustainable Energy Reviews*, 55, 188 – 202 https://www.sciencedirect.com/science/article/abs/pii/S1364032115012058?via%3Dihub

[31] EBA (2020) *Evidence collected by EBA shows positive impact of sequential cropping on GHG reductions, biodiversity and soil quality*, https://www.europeanbiogas.eu/evidence-collected-by-eba-shows-positive-impact-of-sequential-cropping-on-ghg-reductions-biodiversity-and-soil-quality/

[32] ARTFuels (2020) Biogas Done Right in Transport; the sustainable way to produce food, feed and biomethane. https://www.europeanbiogas.eu/wp-content/uploads/2018/10/Biogas-done-Right-extended-2.pdf

[33] DEFRA (2020) UK Statistics on Waste https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/918270/UK_Statistics_on_Waste_statistical_notice_March_2020_accessible_FINAL_updated_size_12.pdf

to be no biodegradable waste sent to landfill by 2025 [34], ensuring that the UK, makes the most of this energy resource and reduces emissions. DEFRA commissioned modelling suggests that meeting the CCC 2025 target could see annual GHG emissions from landfill fall from some 151Mtonnes CO_2eq in the baseline to 45Mtonnes by 2050, and that 95% of this avoided emission would be methane that would otherwise be released to the atmosphere.[35]

The UK waste wood market is also now already structured so that higher quality waste wood is recycled into animal bedding or panel board (1.5mt) and the balance of lower quality mixed waste wood (3 mt) can be utilised by biomass power plants compliant with latest regulatory standards (Industrial Emissions Directive Chapter IV). This ensures full recovery of all UK waste wood, preventing harmful methane emissions from landfill.

The ability to utilise waste (both biogenic and non-biogenic) arising from industry, agriculture, the agri-food sector, or municipal waste, helps the development of circular economies and an important component of local authority waste management strategies, while delivering renewable energy solutions in hard-to-treat sectors, including aviation. It is important that policies should promote bioenergy technologies that deliver localised solutions to local waste volumes, delivering economic and environmental efficiencies, with reduced transport requirements.

The role of energy from waste in waste management must therefore be recognised across energy and environmental policy, requiring joined up thinking between the implementation of the Resource and Waste Strategy and the Biomass Strategy.

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5. How could the production of domestic biomass support rural employment, farm diversification, circular economy, industrial opportunities, and wider environmental benefits? This can include considerations around competition for land, development of infrastructure, skills, jobs, etc.

The UK's Bioeconomy Strategy, published in 2018, estimates that the sector is today worth £220 billion and indirectly supports 5.2 million jobs, of which the bioenergy sector is an integral part. [36] The role of bioenergy tends to be played down in discussions of the bioeconomy, but its important role in complementing other products and as a test bed for regulation (notably on sustainability) needs to be more fully recognised in strategies and action plans. Critically demand for feedstock production provides diversified revenues to farmers, foresters, and landowners

[34] CCC (2019) Net Zero – The UK's Contribution to stopping global warming, file:///C:/Users/MSOMME~1/AppData/Local/Temp/Net-Zero-The-UKs-contribution-to-stopping-global-warming.pdf

[35] Resource and Waste Solutions Partnership (2020) Financial Costs and Climate Change Impacts of Current and Future Landfill Operations, page 42, http://randd.defra.gov.uk/Document.aspx?Document=14981_DefraLandfillwastefinal.pdf

[36] BEIS (2018) *Bioeconomy strategy: 2018 to 2030*, *https://www.gov.uk/government/publications/bioeconomy-strategy-2018-to-2030*

across the bioeconomy, demonstrating how intertwined the growth of bioenergy feedstock is with wider bio-based industries. [37]

Current bioenergy jobs, including feedstock supply.

Overall, REA REview 2020 estimated that the bioenergy sector in 2017 contributed £6.5bn to the UK economy and provided over 34,000 jobs, which increases to over 46,000 jobs once biomass feedstock production is also included (see table 1).[38]

Table 1: Economic Contribution of Bioenergy and Feedstock Production

2016-17	**UK**		
Renewable Energy Sub Sectors	UK Total £m	Number of companies	Full Time Equiv. Jobs
Anaerobic Digestion	371	158	3,003
Biofuels	1,675	607	9,978
Biomass Boilers	889	312	6,663
Biomass CHP	393	159	2,605
Biomass Dedicated Power	697	224	4,473
Energy from Waste	1,027	400	8,085
Production of biomass including wood for fuel	1,541	648	11,304
Totals	**6,592**	**2,509**	**46,112**

Source: REA REview 2020

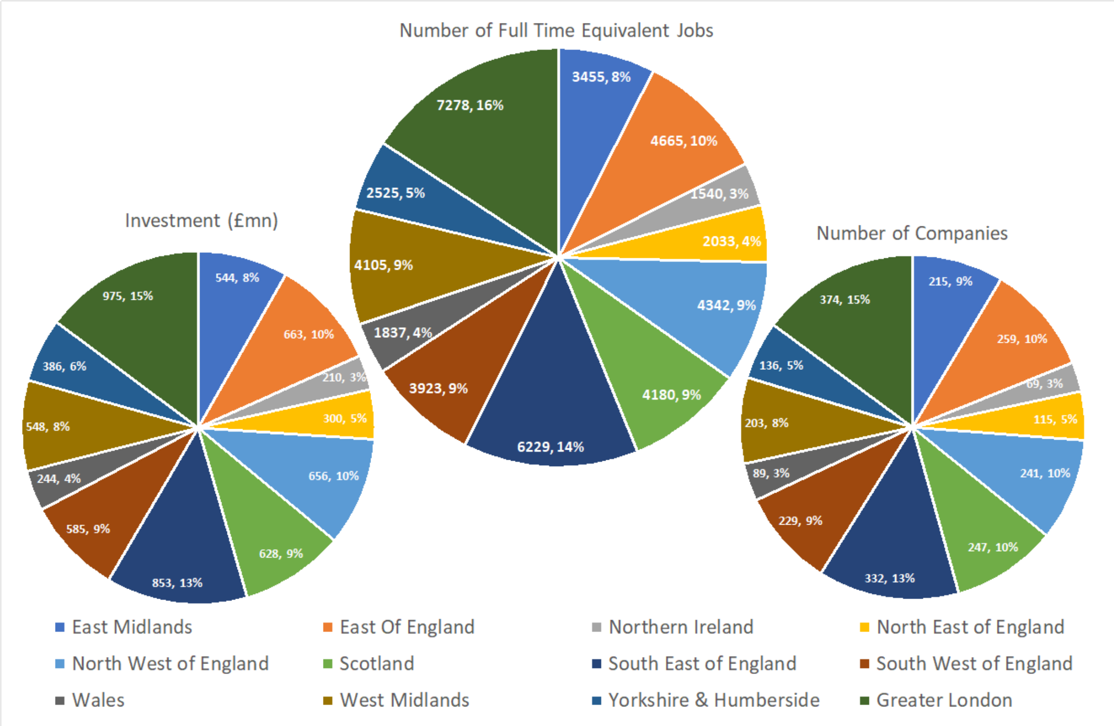
The nature and supply chains of bioenergy means the sector drives significant levels of jobs creation. For example, the operation of biomass boilers could involve professionals involved in sustainable forest management, transportation, pellet production, boiler installation, wood fuel supply and system maintenance. There could easily be 10 to 15 individual professionals associated with the installation, operation, and supply of biomass systems. Similar supply chains and professions are required for other bioenergy sectors, while the addition of bioenergy carbon capture and storage will see yet further jobs created around the transportation and storage of the captured carbon.

Furthermore, given the predominantly rural application of bioenergy and feedstock cultivation, jobs are well dispersed across the UK, especially benefitting rural employment. See figure 2 and 3.

Figure 2: Full Regional Dispersal of All Bioenergy Economic Factors, 2017.

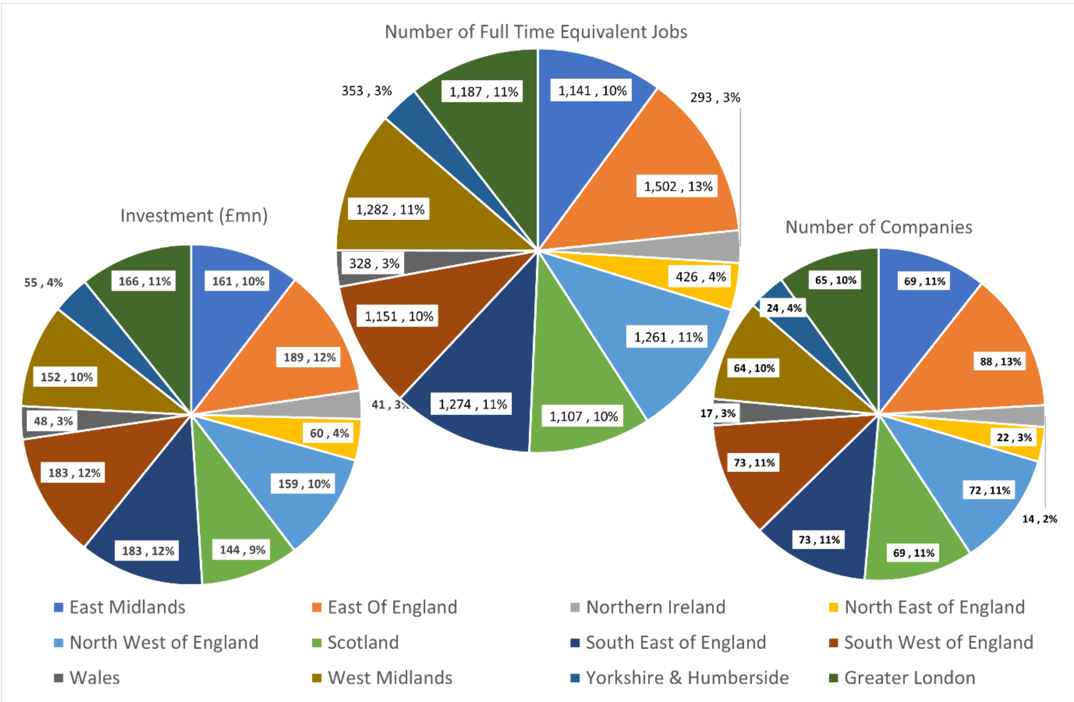
[37] Junginger, H.M., Mai-Moulin, T., Daioglou, V., Fritsche, U., Guisson, R., Hennig, C., Thrän, D., Heinimö, J., Hess, J.R., Lamers, P., Li, C., Kwant, K., Olsson, O., Proskurina, S., Ranta, T., Schipfer, F. and Wild, M. (2019) 'The future of biomass and bioenergy deployment and trade: a synthesis of 15 years IEA Bioenergy Task 40 on sustainable bioenergy trade', *Biofuels, Bioproducts and Biorefining,* 13 (2): 247-266. doi:10.1002/bbb.1993

[38] REA (2020) *REview, The Authoritative Annual Report on the Renewable Energy Sector*, https://www.r-e-a.net/resources/review-2020/



Source: REA REview 2020

Figure 3: Regional Dispersal of Biomass Feedstock Production Only - 2017



Source: REA REview 2020

120,000 projected jobs delivered by a strong bioenergy sector

The REA Bioenergy Strategy made preliminary estimates for the number of jobs that would be stimulated if the projected growth of the bioenergy sector was realised, by scaling up the number of jobs in each sector according to the proposed increases in energy delivered. The results indicated a rise of between 80,000 to 90,000 by 2026 and to 100,000 to 120,000 jobs by 2032 across the whole bioenergy sector.

In biomass production alone growth in jobs was modelled to reach 13,500 jobs in 2026 and 22,000 jobs in 2032.

Providing a base for other bioeconomy sectors and ensuring forests stay forests

In theory, the growth of the bioeconomy could lead to increased competition between the use of biomass resource for food and feed, materials, chemicals, and energy. In practice, such competition is reduced because the value of bioenergy products is generally much lower than those used for other sectors. As has been examined in Question 3 and 4, wood pellets and biomass derived from processing and harvesting residues, thinnings and low grade roundwood - harvested from sustainably managed working forests – has a positive impact on the forest industry, forest carbon stocks and helps to ensure that forests stay a forests rather than being converted to agriculture or for urban development. In doing so bioenergy feedstocks effectively set the price floor for lower value forestry products, providing additional revenue to suppliers of higher value forestry products and underwriting investment by foresters and landowners in more managed areas.

Delivering a circular economy

At the other end of the supply chain, bioenergy provides a sustainable route for biogenic waste management, utilising waste produced from other bioeconomy sectors to ensure energy recovery. Waste wood is already well utilised in the biomass power sector, providing a disposal route for materials, sometimes hazardous, that would otherwise end up in landfill.

Similarly, collaboration with the agri-food sector could see significant volumes of food waste products and process effluents utilised in anaerobic on-site digestion plants to produce biogas/biomethane and biofertiliser. Biogas or biomethane can provide part of the heat requirement for the beverage or food manufacturing process, which can replace some of the fossil fuel heat, especially within processes that have a significant heat requirement (distilleries, breweries etc.), or it can be used to fuel the company’s own vehicle fleet. The biofertiliser can be returned to the land to replace carbon intensive fertilisers and benefit the soil health.

Developing standards for other bioeconomy sectors

All bioeconomy sectors, whether producing feedstock for energy production or something else, will need to ensure materials are produced sustainably. Bioenergy has been in the vanguard of developing modern standards for sustainable sourcing and stewardship of feedstocks. These principles should also be applied to the wider (conventional) bioeconomy including to forestry, agriculture and land-use more generally, and also to new biomaterials.

International examples – Growing the bioeconomy

The England Tree Action Plan recognises the need for significant reforestation across the UK.[39] Equally the CCC Net Zero report has called for up to a fifth of agricultural land to shift to alternative uses that support emission reduction such as afforestation, biomass production and peatland restoration. The report also called for increased woodland and hedgerow planting on farms - a doubling of current tree planting rates and the extension of hedgerow length by 40%.[40] By looking at other parts of the world, we can see how sustainable bioenergy can play a crucial role in optimising land use.

In the United States, for example, overall forest resources have increased by more than 50% during the last 60 years and by 94% in the US Southeast.[41] This has been achieved by incentivising landowners to convert underutilised land to forestry and has been accompanied by an even larger increase in the demand for forest products from sustainably managed forest, including feedstocks for bioenergy.

Most of the trees harvested in the US Southeast forest-based economy are used to make long-lived products such as housing construction and furniture. The US Southeast provides one-sixth of the timber that is used globally each year, and forests cover 99 million hectares (Mha) of land (more than 45% of total area) in the region. The forest industry contributes nearly USD 48 billion annually to the regional economy. [40]

In Sweden, the total standing volume of trees has doubled in the last 100 years. This is largely because of Sweden's commitment to bioenergy, including more than 40% of their heat networks being powered by sustainable biomass. [42] The current forest cover in Sweden amounts to 28 Mha, of which 23 Mha are productively managed forests, (a land area like that of the United Kingdom). Around 300,000 small-scale private forest owners own half of the forest land. The market for bioenergy provides jobs for the whole country, of great significance for smaller, rural, communities.[43]

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[39] DEFRA (2021) *England Trees Action Plan 2021 to 2024*, https://www.gov.uk/government/publications/england-trees-action-plan-2021-to-2024

[40] CCC (2019) Net Zero – The UK's Contribution to stopping global warming, file:///C:/Users/MSOMME~1/AppData/Local/Temp/Net-Zero-The-UKs-contribution-to-stopping-global-warming.pdf

[41] USDA Forest Service (2009) US Forest Resource Facts and Historical Trends. https://www.fia.fs.fed.us/library/brochures/docs/Forest%20Facts%201952-2007%20English%20rev072411.pdf

[42] Werner (2017) 'District heating and cooling in Sweden', *Energy*, 419-429, https://doi.org/10.1016/j.energy.2017.03.052

[43] European Association of Remote Sensing Companies (2016) Copernicus Sentinels' Products Economic Value: A Case Study of Forest Management in Sweden https://issuu.com/earsc/docs/case_report_-_forest_management_in_

6. What are the main challenges and barriers to increasing our domestic supply of sustainable biomass from different sources?

Recognise forest economies, product end-uses and security of offtake contracts to grow supply.

The primary barriers to realising growth of domestic bioenergy feedstocks is a lack of landowner and investor confidence in a consistent and stable demand for future bioenergy products. This makes it difficult to have long term stable offtake contracts with bioenergy users, which is necessary to provide confidence to landowners to commit to investing and growing trees for biomass supply or energy crops.

A lack of clear policy relating to both the growth of separate bioenergy sectors, or adequate reward for growing forestry or agricultural products, are a barrier to further growth of the sector. Forestry and growth of energy crops must be seen by landowners and developers as a long-term profitable exercise, one that is able to compete with other land uses, especially when feedstock cultivation could provide additional environmental benefits.

Forestry policy in the UK so far fails to recognise forest economies for increasing afforestation. It is especially disappointing that the Government recently published England Tree Action Plan fails to support this, despite welcome and ambitious targets for increasing tree cover and perennial energy crop planting. The absence in the action plan for ensuring long term revenue and paybacks for landowners, and recognition of end uses for forestry products, means the Action plan is unlikely to succeed and the ambitious targets will, again, be missed. [44]

Use the Environmental Land Management Scheme to reward domestic feedstock production.

The UK now have an opportunity in the design of the Environmental Land Management Scheme (ELMS) to reward the growth of the domestic supply of sustainable biomass for bioenergy, along with the further environmental benefits that can be realised such as flood mitigation, biodiversity, soil improvement, pollination services etc. This involves rewarding landowners for growing commercial plantations, perennial energy crops or other energy crops on their land where it is appropriate to do so. In addition, carbon sequestration within these crops, such as within soil or in root systems, should also be rewarded within an active carbon market or through a negative emissions payment. In doing so landowners will be provided a clear business case for the growth of domestic feedstocks and environmental benefits are rewarded.

Urgent clarity on perennial energy crop and forestry inclusion in ELMS is needed now, as land developers commit to future land uses for considerable lengths of time, requiring sufficient confidence to ensure needed levels of domestic feedstock growth is achieved.

Consistent and stable bioenergy policy, such as provided by the RHI, RTFO or RO, drives demand for domestic feedstocks.

As it stands the main demand for domestic forestry pellets in the UK is expected to decline due to their being no comparative replacement to the Non-Domestic Renewable Heat Incentive or the Renewable Obligation (which starts to come to an end in 2027). Both mechanisms drove the installation of biomass systems and demand for domestic feedstocks. Both schemes can be seen to have helped bring significant amounts of UK forestry into management, with the revenues

[44] DEFRA (2021) *England Trees Action Plan 2021 to 2024*, https://www.gov.uk/government/publications/england-trees-action-plan-2021-to-2024

from biomass feedstocks forming an important part of the business case for developing access to and managing healthy productive forests.[45]

The lack of any clear policy support for the biomass heat sector is now a major cause for concern in terms of driving further development of domestic feedstocks as the current sectors driving demand decline. Continuing to label the biomass heat sector as 'niche' without providing sufficient evidence the potential size of the market, is itself a barrier to feedstock producers suggesting the market has limited potential for demand growth (see answer to question 13).

A similar story is true of the renewable transport fuel sector, where a lack of supportive policy has left the sector in limbo and stifled the ability of farmers to sustainably grow energy crops. The hiatus in policy, especially given delays to legislating for E10, has damaged investor confidence in the sector. Industry needs government to be clear an about the future role of biofuels in order to open up domestic supply chains again. This includes ensuring as ambitious targets as possible under the Renewable Transport Fuel Obligation. A consultation on the RTFO closed April 2021 and proposed modest increases in targets. The consultation sets out that DfT's preferred option would see volumes of renewable transport fuel actually fall in the ten years from 2022 and halve over the same period in a high EV uptake scenario.[46]

In the power sector, clear policy intentions are also required as to post-2027, when contracts under the Renewable Obligation start to come to an end. [47] This affects biomass power and energy from waste sites currently supported under the RO. Those developing biomass feedstock supplies for these sites require long term off-taker contracts, a lack of certainty around whether such sites will continue after 2027 makes providing certainty on offtake difficult and disincentivises landowners developing supplies for them.

Landfill gas is also supported by the RO, with the CCC recommending the introduction of policy instruments post-2027 to support capture and beneficial use of landfill gas, to avoid leakage of methane to the atmosphere. [48]

Sustainable energy crop growth needs to be encouraged

The CCC has called the expansion of energy crop growth to increase by around 23,000 hectares per year in order to deliver 2 MtCO2e emissions savings in the land sector and an extra 11 MtCO2e from the harvested biomass (e.g. when used with CCS).[49] Government policy therefore need to now encourage the sustainable growth of energy crops, particularly perennial energy

[45] Forestry Commission (2020) *Forestry Statistics 2020*, https://www.forestresearch.gov.uk/tools-and-resources/statistics/forestry-statistics/

[46] This is because the Obligation is expressed as a percentage of road fuel sales – if the total demand for liquid fuel falls, so does the absolute volume of renewable fuels needed to meet it. See figures 6 and 7, pages 24-25 DfT (2021) Targeting net zero -Next steps for the Renewable Transport Fuels Obligation, https://www.gov.uk/government/consultations/amending-the-renewable-transport-fuels-obligation-rtfo-to-increase-carbon-savings-on-land-air-and-at-sea

[47] Ofgem Public reports on Accreditation End dates can be found here: https://www.renewablesandchp.ofgem.gov.uk/Public/ReportManager.aspx?ReportVisibility=1&ReportCategory=0

[48] CCC (2020) Policies for the Sixth Carbon Budget and Net Zero, https://www.theccc.org.uk/wp-content/uploads/2020/12/Policies-for-the-Sixth-Carbon-Budget-and-Net-Zero.pdf

[49] CCC (2020) *Land use: Policies for a Net Zero UK* https://www.theccc.org.uk/publication/land-use-policies-for-a-net-zero-uk/

crops and other inedible crops which can be used across power, heat and renewable transport fuels, including in advanced conversion technologies.

Similarly, the anaerobic digestion sector now includes many agricultural practitioners around the UK, demonstrating the ability to grow a range of energy crops within farming rotation and allocating small amounts of their farms to the use of crops from green gas and other renewable energies. The fears around land use change or fuel vs food have not materialised, in part due to the UK's strong sustainability criteria which is already in place to ensure the growth of energy crops is done in the right way. In addition, as mentioned in question 4, there is evidence to demonstrate how sequential or double cropping can be used as a further route to sustainably encourage further energy crop growth.

Consistent policy in this regard will drive sustainable demand levels for energy crops for use across bioenergy sectors.

Need to rebuild investor confidence following previously failed policies.

Government should be aware of previously ineffective ambitions to grow domestic feedstock, which has damaged industry confidence in participating in future schemes. A review of UK perennial energy crops policies since the 1990's demonstrates how a lack of long-term consistent support and bureaucratic barriers have stopped perennial crops realising their full potential in the UK. [50] This is despite agricultural residues and perennial crops having been highlighted as of strategic importance for growing domestic supply in the Governments 2012 biomass strategy. [51]

This stop-start approach has damaged developers and investor confidence. For example, in the 1990's, DEFRA funded several initial pilot schemes to encourage growth of domestic feedstocks such as short rotation coppice. This resulted in the sector tooling up and starting to invest in such crops only for the government policy never to fully follow the ambition. Investors who lost money previously are unlikely to have confidence in future policy unless strong government commitment is made with clear future ambition that is followed through.

Regulatory regime for felling needs to be more flexible to help de-risk innovative projects.

England has one of the tightest and administratively burdensome regulatory regimes around felling licences in the UK. While important that high standards are maintained, playing a significant role in sustainability governance arrangements, the administrative burden needs to be reviewed if new innovative biomass feedstocks are going to be encouraged. Current felling arrangements can become a barrier to market for landowners and farmers considering the growth of agroforestry plantations, as once committed, the felling license mandates continued replanting of trees. Introduction of a new more flexible licence, specifically for new attempts at agroforestry and short rotation forestry, which allows the developer to revert to agricultural practices if the project proves unviable, would help to de-risk new developments, and enable more landowners to try to cultivate biomass feedstocks on appropriate land. Such a licence

[50] Adams and Lindegaard (2016) A critical appraisal of the effectiveness of UK Perennial energy crops since 1990, *Renewable and Sustainable Energy Reviews*, 55, 188 – 202 https://www.sciencedirect.com/science/article/abs/pii/S1364032115012058?via%3Dihub

[51] DECC, Dft, DEFRA (2012) UK Bioenergy Strategy, page 28, https://www.gov.uk/government/publications/uk-bioenergy-strategy

could be trialled within specific areas first to see if this is effective in delivering new biomass developments.[52]

De-risk innovative solutions through independent advice for developers and commercialisation grants

General knowledge of innovative energy crops, their advantages or possible returns, is low across the agriculture and forestry sector. Having clear independent advice available about new crops is required to help de-risk and encourage new developments. Government funding should look to address this problem.

For many crops there are now significant amounts of demonstration plantations available, with strong data to show their suitability and commercial potential, however, grant support for commercialisation would also be beneficial in seeing greater take up of innovative energy crops or forestry practices.

Maximise access to biogenic waste feedstocks by evolving the waste hierarchy and opening under-utilised sectors, like the agri-food sector.

As mentioned, the CCC has called for all biogenic waste to be diverted from landfill by 2025. Introduction of mandatory food waste collections from households is positive in this regard, but there also remains underutilised food waste from sectors such as the agri-food process sector, where large amount of organic waste is produced and currently not diverted to compositing or anaerobic digestion facilities.

To further encourage the innovative use of this waste, the waste hierarchy should also be evolved, so that the use of biogenic waste in energy recovery for production of renewable fuels should be considered a form of recycling, rather than energy from waste, meaning it is seen as higher up the waste hierarchy.

Roadside verges provide an additional source of AD feedstock

Grass roadside verges could provide an additional source of biomass feedstock, especially for use anaerobic digestion. Removing cuttings also has added benefits in terms of encouraging wildflower, and thereby insect, biodiversity.[53] Trials in Lincolnshire have proved successful.[54] However, a barrier remains as the verges are not managed as a crop, the cuttings are considered a waste and thereby restricted from being used under environmental regulations. Adaptions to the regulatory system could open this source of domestic feedstock for crop-fed AD plants.

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[52] Policy Exchange (2019) *Bigger, Better Forests* https://policyexchange.org.uk/publication/bigger-better-forests/

[53] Guardian (2020) On the verge: a quiet roadside revolution is boosting wildflower, https://www.theguardian.com/environment/2020/mar/14/on-the-verge-a-quiet-roadside-revolution-is-boosting-wildflowers-aoe

[54] Farmers Weekly (2018) Bespoke verge harvester collects AD feedstock from roadsides, https://www.fwi.co.uk/machinery/grassland-maize/grassland-equipment-mowers/bespoke-verge-harvester-collects-ad-feedstock-from-roadsides

7. What is the potential biomass resource from imports compared to the levels we currently receive? What are the current and potential risks, opportunities and barriers (e.g., sustainability, economic, etc) to increasing the volumes of imported biomass?

The role of imported biomass needs to be recognised to meet the UK's future net zero energy demands.

Imported biomass has so far been fundamental to the development of bioenergy industries in the UK. While it is crucial domestic supplies increase, imports will also continue to be essential to meeting UK net-zero energy demands. As previously described, recognising the biomass potential of the UK will require additional imported resource, along with increased domestic supply. Notably, volumes of imported solid biomass pellets for large scale power generation (including BECCS) will need to double to around 400 PJ (111 TWh). Additional liquid biofuels for transport would also need to come from international markets, between 100 (28 TWh) and 150 PJ (42 TWh), depending on the volumes available from the UK. However, these figures are well in line with suggested sustainable scenarios set out by the CCC.[55] The industry is confident that such levels can be procured for the UK inline with, and exceeding, stringent sustainability standards.

Government should also be aware that it is not only feedstocks that are imported but other biomass derived products such as green gas used directly as a transport fuel. While we hope to see a greater proportion of these derived from domestic sources, dependent on waste and AD policy, there is likely going to continue to be a need for imports in line with sustainability arrangements.

US Southeast Forest resources continues to grow allowing for increased UK and global imports.

The US Southeast continues to have huge areas of forest resource, with over 1.1 million square kilometres of forest land. About 3% of the forest in the US Southeast is harvested for forest products each year. Of this, less than 4% goes to the export pellet industry. Overall, industrial wood pellet manufacturers are using less than 0.1% of the total forest resources in the region each year to produce bioenergy.[56]

Furthermore, such harvests are being driven by primary wood sectors such as construction, furniture, or paper, sourced from certified managed forest areas. These sectors drive the availability of low-value residues, or by products, that are ideal for bioenergy use. Overall, this harvesting and manged forest activity is shown to be accompanied by a steady increase in forested areas since the mid-1950s, with carbon stocks having nearly doubled. [57] Studies suggest there is no evidence to indicate that the biomass industry is driving any decreases in carbon stocks.[58]

The US Department of Energy estimates that the US has over 1 billion dry tons of additional forest and agriculture resources available each year to sustainably supply a growing global

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[55] CCC (2018) Biomass in a low carbon economy, https://www.theccc.org.uk/publication/biomass-in-a-low-carbon-economy/

[56] https://www.forest2market.com/hubfs/2016_Website/Documents/20151119_Forest2Market_USSouthWoodSupplyTrends.pdf

[57] US Forest Service (2020) Forestry Inventory and Analysis, https://www.fia.fs.fed.us/

[58] Status and Prospects for renewable energy using wood pellets from the south-eastern United States. Dale, V et al 2017. Available here: https://onlinelibrary.wiley.com/doi/full/10.1111/gcbb.12445

bioeconomy. [59] This suggests that the US Southeastern region alone can sustainably increase biomass supply, not only to the UK, but globally as well.

See Annex 4: Biomass Sustainability and Availability – A briefing note produced by Biomass UK, highlighting key points associated with this question[60]

See Annex 5: Biomass Policy Properties, produced by Biomass UK.[61]

Global innovation in biomass feedstocks suggest global demand for biomass is well below assessed sustainable potential.

Government will be aware that the International Energy Agency recently published their analysis for a global pathway to reaching Net Zero Emissions. Within this pathway bioenergy is seen to play a significant role with global modern bioenergy use raising to 100 EJ by 2050, meeting almost 20% of total energy needs. They compare this against recent estimates from the IPCC that suggest sustainable bioenergy potential to be between 150 -170 EJ, once UN Sustainable Development Goals are achieved. Even when accepting a significant level of uncertainty, and accounting for more conservative estimates, the IEA conclude that global demand will fall well below potential sustainable availability. Crucially they demonstrate that this potential is also due to a shift in biomass feedstocks being used. By 2050 forest and wood residues will continue to play a significant role but will also be matched by an increase in the use of organic waste streams and short rotation woody crops, both of which are expected to increase significantly to be major players in meeting bioenergy demand. Longer term bioenergy policy in the UK therefore needs to be cognitive of the fact that global bioenergy supply chains will evolve, with sustainable production expected to remain ahead of demand.[62]

Consistent bioenergy policy is required to ensure continued sustainable imports.

As has already been expressed, consistent energy policy and commitment to growth of bioenergy sectors across heat, power, and transport, in line with stringent sustainability governance, drives demand and creates the market conditions for sustainable imports, with long term contracts. By addressing the policy gaps identified in answer to question 13, BEIS can avoid barriers to realising the sustainable growth of biomass feedstocks.

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[59] US Office of Energy Efficiency and Renewable Energy (2016) Billion-Ton Report https://www.energy.gov/eere/bioenergy/2016-billion-ton-report

[60] See Annex 4: https://www.r-e-a.net/wp-content/uploads/2021/06/REA-Annex-4-BUK-Biomass-Sustainability-and-Availability.pdf

[61] See Annex 5: https://www.r-e-a.net/wp-content/uploads/2021/06/REA-Annex-5-Biomass-Policy-Priorities.pdf

[62] IEA (2021) *Net Zero by 2050, https://www.iea.org/reports/net-zero-by-2050* in particular figure 2.20 page 77 and figure 2.28 page 91.

Chapter 2: End Use of Biomass

8. Considering other potential non-biomass options for decarbonisation (e.g. energy efficiency improvements, electrification, heat pumps), what do you consider as the main role and potential for the biomass feedstock types identified in Question 2 to contribute towards the UK's decarbonisation targets, and specifically in the following sectors?

- **Heat**
- **Electricity**
- **Transport**
- **Agriculture**
- **Industry**
- **Chemicals and materials**
- **Other?**

Government should aim to build on existing bioenergy sectors, letting the market direct resource use, rather than trying to restrict biomass to one end-use.

It is recognised that bioenergy is one tool amongst a wide range of solutions needed to fully decarbonise the UK. However, as identified in the REA Bioenergy Strategy, biomass will continue to have a strong role to play in all the sectors listed in this question and it would be inappropriate to start to restrict the use of biomass to any-one sector, thereby undermining a existing industry. Given the contribution bioenergy already makes within these sectors (see table 2) it is essential that future energy policy builds on the success of these existing sectors, providing immediate carbon savings while the UK moves forward with the energy transition. Given the wide variety of feedstocks available, as previously identified, and separate supply chains, the most efficient allocation of resources will be led by the market operating in accordance with sustainability governance arrangements.

Instead, government should take a broad principle-based approach that drives all bioenergy sectors to deliver further desirable environmental, social, and economic outcomes (see question 10). The sector itself will be able to respond to changing demands as the energy transition evolves, with use of different biomass supply chains dictated by the characteristics of the biomass supplies involved. It is important that this market process is actively enabled, if further strategically important bioenergy uses are to be delivered, coming from the successful growth of existing sectors.

Table 2: Current Contribution of Bioenergy to decarbonisation of Power, Heat and Transport sectors Today

Energy Sector	Bioenergy percentage of renewable generation for energy sector (2019)	Bioenergy percentage of total UK energy sector demand (2019)	Technologies	Feedstocks	Estimated GHG savings in 2017
Power	28% of renewable power	11% of power demand	Biomass Power BECCS	virgin biomass	9.7 $MtCO_2e$ compared to

				pellets and chip	equivalent gas generation
			Landfill gas, AD, Waste to Energy, Biomass CHP	waste wood biogenic waste arising from food, agriculture, and sewage	
Heat	82% of renewable heat	4% of heat demand	Biomass Boiler; stoves and fireplaces; AD (Biomethane to Grid); CHP; Biofuels (including BioLPG)		7.3 $MtCO_2e$ based on Ofgem RHI emission assumptions.
Transport	Estimated 92% based on Renewable Energy Directive sustainability criteria.	5.1% of total road and non-road mobile machinery fuel.	Bioethonol	Corn (43%), and other energy crops	2.7 $MtCO_2e$ based on Department for Transport (DfT) assumptions.
			Biodiesel	Used cooking oil (79%), and other waste arising.	
			Biomethane	Food Waste	
Source: BEIS (2020) *Digest of UK Energy Statistics (DUKES) 2020,* Available at: https://www.gov.uk/government/statistics/digest-of-uk-energy-statistics-dukes-2019 DfT (2019) *Statistical Release Renewable Fuel Statistics 2019 Fifth Provisional Report* Available at: https://www.gov.uk/government/statistics/renewable-fuel-statistics-2019-fifth-provisional-report REA (2019) *REA Bioenergy Strategy Phase 3: Delivering the UK's Bioenergy Potential.* www.bioenergy-strategy.com					

Domestic feedstocks could be used to meet heat and transport demand, while further imports will be required for bioelectricity and some renewable transport fuels

The paragraphs below are simplifications but indicate the principal ways in which feedstocks are likely to be used by 2032 as identified in the REA Bioenergy Strategy, taking account of the characteristics of fuels involved:

Wood fuels: the UK-based supplies of wood fuel from forestry, sawmill residues and arboricultural applications are assumed to be principally used to supply heat markets, where there is a good match between the widely dispersed nature of the supply and likely markets in rural areas.

Perennial crops (such as miscanthus and short rotation forestry): will also be used to supplement the products from forestry and timber industries in the heating market. Significant volumes are also likely to go towards power production which can provide long term offtake contracts. The volumes required by 2032 imply a planted area of some 450,000 hectares by then (assuming a yield of around 10 oven-dry tonnes/ha/year).

Solid biomass fuels (such as wood pellets): from overseas markets, currently used for large scale power generation, are likely to be the fuel of choice for expansion of this type of use, given the need for large-scale supply chains. Delivering the fuels in quantity by sea and rail has cost and GHG benefits.

Waste fuels (such as MSW and waste wood): are assumed to be principally used in large scale CHP plants given the need for the plants to be fitted to meet Waste Incineration Directive emission standards. They will supply a proportion of the heat required for the expansion of urban heat networks. Some material could also be diverted to thermal gasification for heat or renewable transport fuels or used in industrial processes such as cement manufacture.

"Wet wastes" (such as food wastes, sewage sludge and animal manures): will be primarily used to produce biogas (along with landfill and sewage gas) which can either be used directly or upgraded to methane for heat and transport uses.

Crops designed for biogas production: will be used to complement wet waste supplies.

Agricultural wastes (mostly cereal straw): will be used in a number of applications, but its characteristics favour its use to complement other agricultural resources as a feedstock for anaerobic digestion, or as a feedstock for making cellulosic ethanol as a supplement to other ethanol feedstocks, rather than as a feedstock for combustion or gasification.

Non wood fuels will also continue to be developed and likely be used across heat, power and transport depending on specific feedstock characteristics and market demand. Currently a number are used in the renewable heat market, as registered on the Sustainable Fuels Register (SFR).[63] For Example: waste coffee, refined olive stones, olive pomace, husks (e.g. oat husks, sunflower husks) and shells from food processing, AD digestate, conservation arisings e.g. bracken, gorse and heather (the latter could be harvested rather than burnt in situ as per current practice) [64] and even horse manure. [65]

Other biofuels crops: can be produced where this provides agricultural benefits without impacting on food production and supplemented by fuels imported from the international market (principally to serve the transport market but with other applications such as bioLPG for heating, or as a blending fuel in heating oils).

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[63] Sustainable Fuel Register, https://www.sfregister.org/

[64] SFR (2020) Conservation arisings... a plentiful sustainable biomass resource, https://www.sfregister.org/updates/conservation-arisings-plentiful-sustainable-biomass-resource

[65] SFR (2020) Horse owners have access to a large amount of biomass fuel, https://www.sfregister.org/updates/horse-owners-have-access-large-amount-biomass-fuel

9. Out of the above sectors, considering that there is a limited supply of sustainable biomass, what do you see as the priority application of biomass feedstocks to contribute towards the net-zero target and how this might change as we reach 2050? Please provide evidence to support your view.

Policies must build on existing sectors, encouraging innovation and prioritising desirable environmental, social and economic outcomes, rather than just promoting end-uses,

The REA caution against creating policies designed to direct biomass supplies to determined priority end-uses. Such policies risk being a blunt instrument that may prioritise future carbon savings, but fail to promote further environmental or social benefits, including achieving more immediate carbon abatement. In the longer term, such prescriptive policies may prove detrimental to the delivery of strategically important technologies like BECCS and gasification technologies, especially if existing sectors shrink thereby disrupting supply chains, jobs and expertise required to deliver the necessary innovation. A process economist refer to as endogenous growth.

Being too prescriptive reduces the industry's ability to evolve and respond to market demands. Policies determining end use now, could quickly prove outdated. For example, the anaerobic digestion sector was originally established by responding to demand for renewable power production, supported through the Feed-in Tariff and Renewables Obligation. However, market demand for gas and heat decarbonisation means the technology is now focused on biomethane production to be injected into the gas grid or used in transportation. Further diversification is possible as the hydrogen market develops, and the AD sector responds to demand and price signals. Equally investment today in fuelling infrastructure for biomethane into road vehicles is paving the way for hydrogen fuelling in the future. Such market dynamics are typical as a sector develops, both building upon what has already been achieved while responding to new demand.

As such, designing policies that continue to support conventional bioenergy technology now, will not stand in the way of new technologies and applications in the longer term. Rather this approach will provide a solid basis for the introduction of these technologies as market opportunities develop, which in turn will determine how biomass resources are best used in accordance with market demand. Government policies should instead focus on rewarding the environmental and social benefits delivered by different solutions, with innovation being supported through clear market signals that allow for their development out of existing sectors.

Bioenergy requires short, medium and long term policy goals so that innovation can be delivered and ensure investor confidence is maintained.

Bioenergy opportunities across heat, power and transport can be considered in three groups of immediate, development or strategic opportunities (see table 3). The delivery of all three categories is required to see the bioenergy potential realised, with development and strategic opportunities building on the continued growth of already available sectors like biomass heat, AD, existing biomass power sites and renewable transport fuels. These provide both immediate carbon reductions and establish supply chains, jobs and expertise. They also can make the most of existing infrastructure, ensuring affordable routes to decarbonisation, making future innovation cheaper.

As such bioenergy policy should also reflect these categories, with short term policy that maintains existing sectors and supply chains; medium term policy that ensures commercialisation of important development opportunities; and longer-term policy that focuses on strategically important technologies like BECCS and gasification, delivered from existing sectors.

Policy design around short, medium and longer term objectives also builds investor confidence with a clear a government trajectory for where the sector is headed. It is largely the same investors who are investing in the existing sector who will also finance future innovations. Seeing existing bioenergy sectors contract undermines investor confidence, leading to a higher cost of capital for future innovations.

Table 3: Bioenergy Immediate, Development and Strategic Opportunities

	Heat	Power	Transport
Immediate opportunities – technologies that can be further deployed now delivering immediate carbon abatement.	Recognise existing contribution to decarbonisation under the RHI and expand the use of pellets/chips in ***biomass boilers.*** This is particularly in larger residential developments, hard to treat off gas grid properties and for commercial or industrial sites where high heat loads are required. (See **Annex 2)**[66] **Biomethane production** via AD using existing infrastructure and appliances. With added benefit of digestate as a by-product. (See **Annex 3**)[67]	Maintain generation from **existing biomass power plants** beyond current support mechanisms to ensure continuing benefits from low carbon electricity generation. Expansion of the use of **residual biogenic wastes** including those from municipal and commercial and industrial waste streams (after economic reuse and recycling activities), **waste wood** and other waste fuels low carbon generation.	Expansion of **bioethanol and biodiesel** use by ramping up the blending levels, adopting an E10 blend of ethanol within gasoline and other higher blend levels for biodiesel. Using **Biomethane** as replacement of diesel, notably for logistics and HGV sectors using existing gas infrastructure. It can also be used to fuel non-road mobile machinery including agricultural and forestry tractors.

[66] See Annex 2: https://www.r-e-a.net/wp-content/uploads/2021/06/REA-Annex-2-Biomass-Heat-Case-Studies.pdf
[67] See Annex 3: https://www.r-e-a.net/wp-content/uploads/2021/06/REA-Annex-3-Biogas-and-ACT-Case-Studies.pdf

Development Opportunities - technologies or resources which need further technology or market development, but which could contribute to energy needs between 2024 and 2032.	Low carbon options for **heat networks** using biomass fuels heat in new or existing installations utilising combined heat and power (CHP), including EfW sites. Using **Bio-LPG , or other biofuels**, in buildings and industry as drop-in fuel using existing heating systems, especially in hard to treat off gas grid homes. Conversion of solid **biomass or waste gasification** for expansion of biomethane supply for gas grid injection or hydrogen production. With biochar as useful by product. When coupled with CCS technology this can deliver negative GHG emissions (BECCS). Production of biohydrogen from steam methane reforming of biomethane.	Demonstrate and start to deploy large-scale **bioelectricity generation with CCUS** by demonstrating carbon capture with subsequent use or storage and of new bioelectricity capacity specifically designed to be optimised for CCUS	Replacement of **aviation and shipping fuels** with sustainable biofuels as fuels become available to provide carbon reductions. There are possibilities of co-production benefits with biofuels used in heating, such as BioLPG.
Strategic Opportunities - options involving carbon capture use and storage which will be needed in the longer term, and which need to be demonstrated by 2026, and deployed at a significant scale by 2032 with a view to further expansion thereafter.			

Government should also look to other international trajectories of bioenergy growth.

Finally, Government should also consider other international trajectories for bioenergy use. While the UK leads bioenergy sector development, including sustainability criteria, its trajectory for growth, as defined by the CCC[68], is at odds with what is expected to happen in other European countries. For example, countries like Germany, France and Austria all expect heat applications with bioenergy to grow and play an increasingly important role in decarbonising the heat sector alongside other non-biomass solutions. This is all based on further development of existing sectors including biomass boilers and anaerobic digestion. UK plans seem so far to be at odds with this, suggesting biomass will only have an undefined 'niche' role to play in heat decarbonisation (see answer to question 13 for further information). We raise concerns that such an approach could undermine the existing heat decarbonisation approach in the UK, stopping bioenergy from playing its part, especially in hard-to-treat areas.

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10. What principles/framework should be applied when determining what the priority uses of biomass should be to contribute to net zero? How does this vary by biomass type and how might this change over time?

The REA support the development of a principles-based approach, whereby policy supports and rewards desired outcomes rather than just end-uses. This will provide a balanced pathway across bioenergy use in power, heat and transport, while pushing individual bioenergy sectors to be delivering further environmental, social, and economic benefits, while promoting innovation. Different feedstocks and conversion technologies have different characteristics, further underlining the importance of having a wide variety of bioenergy technologies. Such principles include:

Carbon savings in accordance with full life-cycle analysis

Carbon savings, naturally, remains a key metric for environmental policy, above that of actual end use. Methodologies for full life cycle analysis of emissions are well established for different bioenergy feedstocks and technologies. These need to be promoted with policy focused on driving the highest GHG savings above the importance of the overall end use of the energy. This includes recognising the benefit of immediate carbon reductions from established bioenergy sectors within power, heat and transport, as further strategically important sectors are established.

Ability to deliver carbon storage.

In considering full life cycle analysis, carbon storage potential can also be recognised. This is not only post-combustion but across supply chains. For example, carbon removals from AD plants can be stored and growth of perennial energy crops can provide carbon storage at the point of cultivation.[69]

Rewarding energy conversion and scale efficiencies

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[68] CCC (2018) *Biomass in a Low-Carbon Economy*, https://www.theccc.org.uk/publication/biomass-in-a-low-carbon-economy/

[69] It was suggested by one REA member within the industry roundtable with BEIS that the price of carbon storage could form the baseline against which the marginal abatement cost of any technology is measured, suggesting anything that costs more then this should be parked. Further analysis and industry consultation is required to see if this is a sensible proposals that would drive cost effective decarbonisation. Analysis would need to be sensitive to the crude oil price as many/ most marginal abatement costs from biogenic supply chains are reduced when crude oil price increase.

Efficiency of conversion is currently poorly recognised within biomass policies. Direct production of heat from biomass has the highest conversion efficiency matching those of fossil fuels and approaching 90%.

Transformation of biomass to other energy products will mean a loss of efficiencies, especially if going through multiple conversions to get to a particular end use. For this reason, there are advantages in projects moving to larger scales, gaining improved efficiencies and lowering capital costs. Coproduction also increases efficiencies, such as the production of biofuels (such as BioLPG) as a coproduct of sustainable aviation fuel (SAF) or biodiesel.

Improved efficiencies, in energy conversion, scale or coproduction should therefore be promoted in bioenergy policy, to ultimately provide the best economic and GHG returns.

Given many strategically important innovations, like the addition of bioenergy carbon capture and storage, could see the reduction in efficiencies in conversion technologies, it is important that the base technology producing the energy conversion, should have a high efficiency to begin with to realise the best carbon savings.

Reward localised circular economies utilising regional feedstocks.

Further efficiencies are also realised in terms of geographical location with production of wastes, or localised biomass feedstocks, being produced either on-site or within the local region, avoiding transport costs and related emissions. This provides economic, energy and carbon efficiencies.

Policies should promote bioenergy technologies that deliver localised solutions to local waste volumes and create circular economies. Examples include on-site anaerobic digestion, where agriculture or agri-food waste is used onsite to provide energy for further commercial activities (See Annex 3)[70]. Similarly advanced conversion technologies also tend to be smaller scale projects and modular in nature, providing solutions to specific localised waste streams.

Separately, the use of localised virgin wood chips or locally grown energy crops within biomass heat or CHP sites, with feedstocks coming from well managed sustainable sources, further drives local efficiencies and improved GHG results.

Rewarding further environmental benefits

Bioenergy policy needs to be designed in conjunction with environmental land management policies so that further environmental benefits beyond carbon abatement are also rewarded and encouraged. As described in question 3 and 4, growth of domestic biomass feedstocks, when done right, can include delivering biodiversity, sustainable agricultural practices, carbon sequestration in soils, as well as flooding and wildfire management. Such policies also compliment increases in hedgerow growth, avoiding harmful flailing practices, and delivering the 40% increase in hedgerow length as recommended by the CCC.[71]

[70] See Annex 3: https://www.r-e-a.net/wp-content/uploads/2021/06/REA-Annex-3-Biogas-and-ACT-Case-Studies.pdf

[71] CCC (2019) Net Zero – The UK's Contribution to stopping global warming, file:///C:/Users/MSOMME~1/AppData/Local/Temp/Net-Zero-The-UKs-contribution-to-stopping-global-warming.pdf

These benefits should be rewarded through land management policies, building them into the design of the Environmental Land Management Scheme and national tree strategies, while also recognising that the best route to realising these benefits is to ensure market demand is in place to make it viable for land managers to grow such products.

Recognising further social and economic benefits

As described in answer to question 4, bioenergy can also provide a wide range of different social and economic benefits. Large numbers of skilled rural jobs, diversification of revenue streams for agriculture and waste management or sanitation benefits from the disposal of wastes. In addition, biomass power provides benefits to the electricity grid, providing dispatchable power that compliments the increased use of decentralised non-bioenergy renewable sources, such as solar and wind. Such grid benefits should also be prioritised and recognised.

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11. When thinking of BECCS deployment, what specific arrangements are needed to incentivise deployment, compared to what could be needed to support other GGR and CCUS technologies as well as incentivising wider decarbonisation using biomass in the priority sectors identified?

REA are supportive of a CfD Based Business Model, plus negative carbon Payment, for large scale BECCS

The REA are supportive of market-based leavers that reward both the energy production, along with a payment for the negative emissions achieved. A CfD based mechanism adapted for BECCS would allow biomass power projects to receive a reliable revenue for the power generated, along with any additional benefit for services provided to the grid. A separate carbon payment is then provided to reward negative emissions. Set at a £/tonne level the payment will need to cover both the operational costs of capturing carbon, along with transporting and storing it. Over time, assuming the UK ETS matures successfully, the carbon payment will likely be able to transition to a straight market-based price that ensures ongoing revenue for negative emission production.

Such business models should not be limited to only post-combustion carbon capture. A similar approach would work well for other BECCS (non-power) applications, This includes:

- The addition of carbon capture to anaerobic digestion facilities. It should be noted that carbon capture is already taking place in the AD sector with the drink industry being the main off taker.
- Thermal gasification plants that produce green gases such as biomethane and/or biohydrogen coupled with CCUS/CCS. The REA is very supportive of the business models being developed by BEIS for low-carbon hydrogen production (likely to be a variable premium payment). As for biomass power projects, an additional, separate incentive should be given to reward negative emissions from bio-hydrogen production under GGR policy.
- A separate carbon payment that rewards negative emissions could also support biogenic carbon stores produced from perennial energy crops at the point of cultivation.

Further consideration is required to support the retro-fit of BECCS on medium and small scale existing biomass plants and have a sensible trajectory to achieve this.

Specific consideration is also needed as to whether proposed business models for BECCS are adequate to accommodate the retrofitting of CCS on existing small and medium scale biomass power heat or CHP plants, (including those using waste wood) where the size of investment required will remain a significant barrier to deployment until the cost of CCS technologies fall. Government will need to consider the time trajectory required to see existing infrastructure retro-fit BECCS, ensuring that such sites can continue to be able to produce energy and have a sensible pathway to also deliver negative emissions by sometime in the 2030s. This must be considered as BECCS business models are further developed by government. [72]

The REA are supportive of ongoing work streams to explore these different business models, as well as welcoming energy from waste being included within proposals for Industrial Carbon Capture Contracts.

Efficiency of biomass conversion should also be considered.

Business model proposals for BECCS have so far also not considered conversion efficiencies provided by applications of BECCS to commercial and industrial scale biomass heat projects. Direct production of heat from biomass has the highest conversion efficiency matching those of fossil fuels and approaching 90%. Industrial biomass heat demand also provides a particularly stable demand profile, maximising possibility for carbon capture. Such applications of BECCS should also be supported.

There should be stakeholder engagement on what is defined as "CCS Ready"

It would be beneficial if government and industry worked together to establish a better definition for what is meant by 'CCS-ready'. This should include ensuring CCS can be retrofitted when the technology is available and that there is a viable business model to see it delivered. This will also need to consider the readiness of the transport and storage network. Having a strong definition in place should go some way to alleviating concerns over industrial biomass not being 'best use' by providing a clear pathway to also having CCS installed and negative emission delivered.

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12. How can Government best incentivise the use of biomass, and target available biomass towards the highest priority applications? What should the balance be between supply incentives and demand incentives and how can we incentivise the right biomass use given one feedstock could have multiple uses or markets?

Government should focus on a principle-based approach that drives GHG savings, and other social and economic benefits, rather than focusing on priority end-uses.

As has been described in previous answers, the government incentives should focus on the delivery of a range of environmental, social, and economic benefits, which incentivise and push bioenergy sectors to further innovation, rather than focus on specific end-uses. Development of these technologies will create both demand and supply that will allow the market to direct

[72] BEIS (2021) Carbon Capture, Usage and Storage An update on the business model for Industrial Carbon Capture https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/984119/industrial-carbon-capture-icc.pdf

resources to best use, determined by the specific characteristics of that resource. This will require both supply incentives, such as supporting growth of domestic feedstocks, and demand incentives that support the further innovation within existing technologies (such as the applications of BECCS), however this will be made more efficient by building upon existing sectors with established supply chains and expertise.

Policy should recognise shared market benefits of biomass feedstocks.

As described, bioenergy feedstocks typically set a floor price for the lowest value residues and offcuts. Predictable demand for these products provides an additional secure revenue stream in addition to that received for higher value products. As such, for the most part, bioenergy tends to complement rather than compete with multiple end uses. For example, increasing the amount of wood grown for construction will lead to an increase in offcuts or residue material. Bioenergy provides a revenue stream for this material rather than competing for the use of higher value wood products going to construction.

Equally, some bioenergy pathways lead to multiple products and uses, expanding the market, rather than competing for resources. Anaerobic digestion, for example, see the production of both biomethane and digestate that can be spread to land as a fertiliser. ACTs can also deliver biochar, and the production of biofuels (such as BioLPG) can be done as a coproduct of sustainable aviation fuel (SAF) or biodiesel.

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13. Are there any policy gaps, risks or barriers hindering the wider deployment of biomass in the sectors identified above?

Both current and potential future energy policy gaps are opening, which creates a barrier to further deployment, undermining existing bioenergy sectors and stopping further development that leads to future innovation. We highlight:

There remains no comparable replacement to the Non-Domestic RHI, leaving Biomass Heat without a route to market, while being labelled as 'niche' despite the size of the hard-to-treat heat sector.

There is currently a lack of commercial or industrial heat decarbonisation support, with no comparable replacement to the Non-Domestic RHI. Large scale heat decarbonisation, in which biomass has an important role to play, currently has no route to market with the biomass heat sector expected to contract as a result. This will have negative consequences for delivering heat decarbonisation, including possibilities for powering green heat networks, and delivering highly efficient bioenergy carbon capture and storage system on biomass heat sites. The lack of route to market means there are already examples of both existing and potential new biomass heat sites reverting to oil boilers, effectively reversing progress made on heat decarbonisation to date.

Similarly, bioenergy continues to be labelled as having a 'niche' role to play in heat decarbonisation, without a clear identification of the size of the market where biomass or other biofuels, could be the most appropriate solution for heat decarbonisation. The size of the 'hard to treat' domestic off gas grid sector is estimated to be 20% of all domestic properties by BEIS, equating to 260,000 domestic properties where low temperature heat pumps might not be suitable. [73] Added to this is the significant potential role biomass is expected to play in commercial and industrial sector decarbonisation where the high heat loads from biomass currently provide the most cost-effective route to the decarbonisation of public buildings, such as schools or hospitals, or powering green heat networks. While electrification will likely form the largest role in heat decarbonisation, the purported 'niche' role for biomass is still an estimated 10 times larger than the existing biomass heat market. [74]The label 'niche' has itself become a barrier as policy assumes the numbers involved to be insignificant, despite a strong sector with established supply chains, continuing to be needed to achieve full decarbonisation.

See Annex 2: Biomass Heat Case Studies demonstrate the range of commercial, industrial and domestic applications biomass heat is already being used in and will continue to do so. [75]

The Renewable Transport Fuel Obligation target continues to lack ambition

The recently consulted changes to the Renewable Transport Fuel Obligation, remain unambitious, even with the potential for the obligation to raise to the higher level proposed of 5%. Even at this higher level, modelling suggests that total volume of renewable transport fuels is estimated to be only slightly higher in 2035 than in 2022. Such low growth potential will fail to support a strong renewable transport sector from which the development of further development fuels is required if renewable transport fuels are to be helpful in decarbonising hard to treat sectors such as aviation.

Existing bioelectricity sites require clarity post-2027

There is current uncertainty around government ambitions for existing biomass power sites once RO contracts start to come to an end in 2027. Plant operators and feedstock producers are looking for certainty now if they are to start considering further investment in such sites, such as the retrofitting on BECCS within the 2030's. Clear government policy around need to maintaining existing operational biomass sites is needed now to maintain sector confidence.

See Annex 5: Biomass Policy Properties, produced by Biomass UK.[76]

The Environmental Land Management Scheme Needs to reward energy crops, especially perennial energy crops and agro-forestry

As described in chapter 1, there is a significant gap in environment land management policy to reward the growth of perennial energy crops and agro-forestry developments for the environmental services provided to the environment including carbon sequestration, soil fixing

[73] Delta-EE (2018) *Technical Feasibility of Electric Heating in Rural Off-Gas Grid Dwellings*, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/762596/Technical_Feasibility_of_Electric_Heating_in_Rural_Off-Gas_Grid_Dwellings.pdf . Note 20% of 1.3 million off-gas grid domestic properties is 260,000 properties.

[74] The RHI has deployed 17,110 accredited biomass boilers in the ND RHI and 12,370 accredited biomass boilers in the domestic RHI, totalling 29,480 as of May 2020.

[75] See Annex 2: https://www.r-e-a.net/wp-content/uploads/2021/06/REA-Annex-2-Biomass-Heat-Case-Studies.pdf

[76] See Annex 5: https://www.r-e-a.net/wp-content/uploads/2021/06/REA-Annex-5-Biomass-Policy-Priorities.pdf

and biodiversity. This should be built into the development of the Environmental Land Management Scheme and within revision to future national tree strategies.

The overall invisibility of bioenergy, in particular perennial energy crops and agro-forestry developments, in the recently announced England Tree Action Plan or Woodland Carbon Schemes, means their remains a vacuum of funding or enablers to support the expansion of such feedstocks. This is a major failing of current policy development and demonstrates a lack of joined up thinking between environmental and energy decarbonisation needs. This must be addressed by this Biomass Strategy.

The regulatory regime for ACT's must be improved, with funding provided to the Environment Agency to develop a more appropriate regime.

A major barrier to the further deployment and development of advanced conversion technologies (ACTs) remains having a suitable environmental regulatory scheme in place to effectively support the sector. Most ACT developments in the UK are currently focused on the gasification of RDF, although in other countries it is equally common to find biomass-to-energy conversion plants. As such, sites are regulated under the same rules as energy from waste incineration sites, determined by Chapter IV of the Industrial Emissions Directive, despite being a fundamentally different technology with a cleaner GHG emission profile, higher operating efficiency and very different end-products.

The Environment Agency have made attempts to start to reform the regulatory approach for ACT's, specifically where:

1) end-of-waste status is achieved on the syn-product
2) Where the particulate emissions from the use of that product is no worse than a fossil fuel comparator.

However, a lack of funding from the EA means their End-of-Waste Panel does not currently function, providing no confidence to developers that their end products meet the necessary criteria. At the same time the EA also, lacks the funding to commission new research on particulate emission values in order to create sensible fossil comparators for gas or oil against which to regulate new ACT developments.

As a result the regulatory regime for ACT's remains both confusing and not fit for purpose. The EA have expressed interest in addressing these issues but require the funding to do so. This should be addressed by government and industry as a matter of urgency. This will help lead to projects focused on virgin biomass and waste biomass feedstocks and, if proven market demand and contribution to net zero can be effective at scale, strategically important fuel production, such as hydrogen or aviation fuels.

Government must support the role that off the gas grid biogas/biomethane can play in decarbonising the food supply chain via a financial support mechanism like the Green Gas Support Scheme (GGSS) or a similar, appropriate mechanism.

Government bioenergy policy does not fully recognise the role that biogas and biomethane can play in decarbonising the food supply chain. There is a lack of Government support for smaller onsite AD, or AD off the gas grid that could help decarbonise the farming and agri-food sectors. For example, the GGSS will not support biogas heat plants, or plants that produce biomethane off the gas grid; it will only support biomethane injection into the gas grid.

Brewdog, the largest craft brewery in Europe, is installing at one of their sites a biogas plant to convert beer residues into bioenergy, with associated water clean-up, river discharge and biomethane upgrade. The innovative onsite biogas plant will allow the site to replace natural gas, which accounts for 50% of its carbon footprint and will be replaced with an increasing supply of biomethane from 2022 onwards. This case study is described more in detail in Annex 3.[77]

Although this is a gas to grid plant, there are many other smaller breweries and distillers that are too small to make a gas to grid plant economic, or are off the gas grid, but will wish to match the aim of Brewdog to supply heat to the brewery and fuel to HGVs. It is therefore critical that smaller projects (off grid) are supported through the GGSS or an equivalent mechanism even if they are unable to inject gas into the gas grid.

A new report by the Royal Agricultural Society of England (RASE) is being currently produced that will identify the challenges faced by the farming sector and changes required to decarbonise food production and the rural economy. It will discuss mechanisms for change, introduce innovative technical opportunities and raise new business model applications. This follows the publication of their 2011 report "Anaerobic Digestion Plants on UK Farms" and the visionary "Refuelling the Countryside" report (2014).[78] We will be happy to submit the full report to BEIS once it has been published.

See Annex 3: provides case studies demonstrating high quality biogas and ACT projects, mostly utilising Agri Food and drink industry residues.[79]

Defra's policy on food waste collections must not be delayed

Measures from Defra to introduce mandatory collections of food wastes are only expected to commence from 2023/2024 at the earliest. Defra's recent consultation on Household and Business Recycling in England have proposed some derogations which will see further delays in the implementation. The Green Gas Support Scheme, on the other hand, is expected to start in Autumn 2021 so there is likely to be a time gap between the two which may lead to a lack of sufficient waste feedstocks being available at the beginning of the Green Gas Support Scheme for new plants.

It is therefore crucial that there are no delays in the implementation of Defra's policy to mandate separate food waste collections from households and businesses in England, to improve access to food wastes and underpin further generation of biomethane.

[77] See Annex 3: https://www.r-e-a.net/wp-content/uploads/2021/06/REA-Annex-3-Biogas-and-ACT-Case-Studies.pdf

[78] RASE reports available here: https://www.rase.org.uk/reports

[79] See Annex 3: https://www.r-e-a.net/wp-content/uploads/2021/06/REA-Annex-3-Biogas-and-ACT-Case-Studies.pdf

Chapter 3 – Sustainability and Accounting for Emissions

14. How should potential impacts on air quality of some end-uses of biomass shape how and where biomass is used?

Air quality is best regulated through environmental permitting for medium and large-scale biomass sites, as is currently the case, not sustainability criteria.

Particulate emissions resulting from the use of biomass and wastes in medium and large-scale biomass heat or power sites is already well regulated. While the UK was a member of the European Union, emissions standards were set through the Industrial Emissions Directive (Above 50 MW)[80] and the Medium Combustion Plant Directive (1 MW – 50 MW).[81] These set specific emissions limits in line with Best Available Techniques and where recently reviewed with ~ 66% tightening of NOx limits, ~ 60% tightening of SO2 limits, and ~ 60% tightening of PM limits. All these requirements remain in place in the UK and continue to be enforced through environmental permitting arrangements regulated by the relevant authority in England, Scotland, Northern Ireland, and Wales. . Commitments within the UK-EU withdrawal agreement also ensure there is no watering down of current requirements by either party.[82]

Sites operating with environmental permits are required to collect data at regular intervals, depending on the substance being monitored. For most emissions this includes weekly measurements and monthly submissions. Biomass sites, whether using virgin feedstocks or waste, already have transparent data available and a high degree of regulation to ensure emissions affecting air quality are safe.

Public Health England have done several studies on the impacts of emissions, with particular focus on municipal waste incinerators, conducting studies in 2009[83] and 2019[84]. Their position remains consistent that "modern, well run and regulated municipal waste incinerators are not a significant risk to public health".[85]

Given the above, air quality issues relating to medium and large-scale biomass sites should continue to be regulated through environmental permits, which stringently and transparently determine their emissions and the type of feedstock they are able to use. We believe these requirements to be appropriate and that attempts to implement further air quality criteria beyond the work of the Environment Agency, such as trying to direct biomass locations within energy policy, risks creating contradictions and would fail to lead to any benefits for public health.

[80] Environment Agency (2021) Industrial Emissions Directive (IED): environmental permits issued, https://www.gov.uk/government/collections/industrial-emissions-directive-ied-environmental-permits-issued
[81] Environment Agency (2019) Medium combustion plant and specified generators: environmental permits https://www.gov.uk/guidance/medium-combustion-plant-and-specified-generators-environmental-permits
[82] European Commission (2021) The EU-UK Trade and Cooperation Agreement, https://ec.europa.eu/info/relations-united-kingdom/eu-uk-trade-and-cooperation-agreement_en
[83] PHE (2009) Municipal waste incinerator emissions to air: impact on health, https://www.gov.uk/government/publications/municipal-waste-incinerator-emissions-to-air-impact-on-health
[84] Imperial College London (2019) Major study finds no conclusive links to health effects from waste incinerators, https://www.imperial.ac.uk/news/191653/major-study-finds-conclusive-links-health/
[85] PHE (2019) PHE statement on modern municipal waste incinerators (MWIs) study, https://www.gov.uk/government/publications/municipal-waste-incinerators-emissions-impact-on-health/phe-statement-on-modern-municipal-waste-incinerators-mwi-study

***Biomass boilers, regulated through stringent installation, fuel and maintenance standards, should have no restrictions on deployment, even in urban on-gas grid areas*.**

As with larger scale biomass sites, existing EU regulations relating to residential heating are already implemented within the UK market. The eco-design scheme for solid fuel boilers (Commission Regulation (EU) 2015/1189) and local space heaters (Commission Regulation (EU) 2015/1185) sets minimum efficiency and maximum emissions levels for biomass heating technologies. These requirements ensure all new biomass heating installations emit minimum levels. However, specific requirements for biomass boilers go well beyond this, as described below.

Biomass boilers that are installed under the Renewable Heat Incentive and commissioned after 2013 are required to meet the RHI air quality requirements. These set limits on the emissions a product can produce. PM emissions must not exceed 30 grams per gigajoule net heat output, and NOx emissions must not exceed 150 grams per gigajoule net heat output. Products affected by these requirements must have an RHI Emission Certificate, which includes information about the product, the test laboratory, tested fuel types, and emissions. Analysis of these certificates suggests that biomass boilers, in general, have been tested at particulate matter emission levels that are considerably below the legal limit. A survey conducted of REA wood heat members emission certificates during a previous BEIS consultation demonstrated average PM of as low as 5.18 grams per GJ from currently operating installations - a fraction of required safe limits set by the RHI. [86]

Furthermore, biomass boiler systems can see even lower emission where flue gas filters are fitted. These are mature technologies which are readily available, with advances in electrostatic precipitators having further potential for implementation and retrofit on existing systems. In addition, innovation in boiler design continues to evolve, with ever decreasing emission profiles. For example, boiler manufacturer Ökofen have this year launched their ZeroFlame technology boilers where levels of particulate matter are close to zero, with results verified by TUV Austria. [87]

Fuel quality is also important, and the REA has welcomed the recent BEIS decisions to introduce mandated fuel quality standards for biomass fuels. Much of this further formalises existing certifications schemes already operational in the UK, which ensure only clean fuels are used. Such schemes include EN*plus*[88] for pellets, GoodChips[89] for wood chip and Woodsure 'Ready to Burn'[90] for a range of wood fuel products. Similarly, the introduction of maintenance standards is equally as welcome and something the biomass heat industry has been calling for for a long time.

However, future biomass heat policy should fully commit to learning the lessons on standards experienced during the RHI. The Wood Heat Forum of the REA have previously recommended adoption of a Biomass Quality Management scheme for the UK. This would regulate system efficiency and emissions of non-domestic installations, mandating high-quality installations operated correctly on the right fuel. Such a scheme could be modelled on the QM

[86] WHA and REA response to BEIS RHI Consultation – Biomass Combustion in Urban Areas https://www.r-e-a.net/resources/beis-rhi-consultation-biomass-combustion-in-urban-areas/
[87] Ökofen (2021) ZeroFlame Technology, https://www.oekofen.com/en-gb/zeroflame/
[88] UK Pellet Council (2020) EN*plus* Scheme, http://www.pelletcouncil.org.uk/enplus-scheme/
[89] GoodChips (2001) https://goodchips.eu/about.html
[90] WoodSure (2021) https://woodsure.co.uk/about-woodsure/

Holzheizwerke program[91], a joint Swiss-Austrian-German initiative which was first implemented in Switzerland in 2000. QM Holz covers the entire process of designing, procuring, installing and setting to work a biomass heating system, from initial brief to end of life and disposal. It has been extremely successful in raising performance (and thereby reducing emissions) across the biomass sectors in Switzerland, Austria and Germany by providing clarity of responsibilities across the supply chain and measurable minimum standards. Using and being measured against QM Holz is a requirement for the receipt of public investment in a biomass plant in most Swiss Cantons and in some regions of Austria and Germany.

Given the above, and the opportunity to continue to improve standards, it remains concerning that recent BEIS consultations continue to propose restrictions to the use of biomass boilers in urban or on-gas grid areas. This is largely due to a conflation of biomass boiler emissions with other worse biomass heat applications. Excluding background concentrations, peak emissions from domestic fireplaces and non-Defra Exempt stoves (commonly used as secondary heating for aesthetic reasons as well as comfort) are thought to contribute up to 31% of the concentrations in air of $PM_{2.5}$, particulate matter harmful to health.[92] These forms of heating are meant to be regulated by Clean Air Zones and DEFRA Exemptions, both of which are currently poorly enforced with low awareness about the legal requirements amongst both suppliers and users. Emissions from wood-fuelled biomass- boilers, by comparison, are far smaller and controllable using high-performance filters and regulated standards, as discussed here.

It should also be noted that biomass boilers, due to their ability to meet higher and varying heat loads, have a particularly strong role to play in commercial applications, including public sector buildings such as hospitals, schools, public swimming pools, council offices and innovation in district heating schemes. The RHI has also demonstrated that biomass provides one of the best values for money of any technology at these scales covered by the scheme, averaging £460/ kW installed, across the range of biomass tariffs in the Non-Domestic RHI - half that of any other technology.[93] Such buildings are, however, commonly located within on-gas grid areas.

The proposed urban restrictions ignore the results that can be achieved from deploying Best Available Techniques (BAT), adopts an approach seen nowhere else in the world and sets a dangerous and difficult-to-reverse precedent which will further obstruct the deployment of renewable heat. Ultimately this will make the full decarbonisation of the UK heat requirements more expensive, whilst not addressing the primary causes of emissions. Biomass heat policy would be better suited to focusing on the regulation of high-quality installations, maintenance, and fuel standards, rather than restriction on where biomass can be used.

See Annex 2: Biomass Heat Case Studies demonstrate the range of commercial, industrial and domestic applications biomass heat is already being used in and will continue to do so. [94]

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[91] QM Holzheizwerke (2021) https://www.qmholzheizwerke.ch/de/qm-holzheizwerke/was-ist-qm-holzheizwerker.html

[92] Environmental Research Group -King's College London (2017) Airborne particles from wood burning in UK cities,(page 4) https://uk-air.defra.gov.uk/assets/documents/reports/cat05/1801301017_KCL_WoodBurningReport_2017_FINAL.pdf

[93] BEIS (2020) RHI monthly deployment data: December 2020 (Annual edition) – Sheet S1.1, https://www.gov.uk/government/statistics/rhi-monthly-deployment-data-december-2020-annual-edition

[94] See Annex 2: https://www.r-e-a.net/wp-content/uploads/2021/06/REA-Annex-2-Biomass-Heat-Case-Studies.pdf

Increased Biofuels will not impact air quality.

The European Commission has concluded that increasing bio-content of transport fuels "will not negatively impact air pollution", suggesting the introduction of E10 will not impact air quality. [95] Rather, E10 could prompt the replacement of older vehicles, which are inherently more polluting than newer vehicles. Hydrotreated Vegetable Oil / Gas to Liquid Fuels (sometimes known as paraffinic diesel) are clean, high-quality diesel fuels made from a wide variety of feedstocks, and are associated with NOx emissions and particulate matter reductions.[96]

Fuels produced from waste or woody biomass using the Fischer-Tropsch are hydrocarbon fuels which contain very low levels of aromatics and sulphur. They have significant air quality benefits for heavy goods vehicles and aviation with emissions of particulates (>90% reduction), sulphur (>90% reduction), NOx (up to 10% reduction), carbon monoxide and unburnt hydrocarbons.[97]

Biomethane in transport also leads to a modest improvement in particulate matter emissions and NOx levels.[98]

Mitigating risk of ammonia emissions linked to AD digestate spreading

AD also produces a digestate, which is a useful high-quality fertiliser and soil improver. The storage and use of the materials on the land does produce some ammonia emissions. These are currently estimated at 3% of total ammonia emissions, but the volume of such could rise as more AD plants come on stream, so appropriate to consider how best to constrain the resulting emissions.

This can be done by covering digestate stores and particularly by using improved and efficient digestate spreading technologies. There is a much better understanding by the farming and land spreading community of the benefits of correct application of digestate to land, as this not only reduces the environmental risks associated with its deployment to land but also improves its efficacy as a fertiliser replacement. This has led already to a significant move to more efficient spreading technologies, which distribute the digestate directly to the soil near the growing crop, or the use of shallow or deep injection techniques, which prevent any ammonia volatilisation taking place.

It is also important that AD producers have sufficient digestate storage facilities so that they can store the materials until the optimum time and conditions for spreading the materials, and that the storage is covered.

The REA agree with the proposals of the Governments Clean Air Strategy, which commits to introducing legislation that will require digestate in England to be spread using low-emission

[95] EC (2017) Impact of higher levels of bio components in transport fuels in the context of the Directive 98/70/EC of the European Parliament and of the Council of 13 October 1998, relating to the quality of petrol and diesel fuels and amending Council Directive 93/12/EEC, https://op.europa.eu/en/publication-detail/-/publication/ec1f67bd-5499-11e7-a5ca-01aa75ed71a1/language-en/format-PDF

[96] ASFE (2017) Air Quality Policy, http://www.synthetic-fuels.eu/

[97] Anderson, B. E. and e. al. (February 2011). Alternative Aviation Fuel Experiment (AAFEX), NASA Langley Research Center; and Elgowainy, A., et al. (2012). Life-cycle analysis of alternative aviation fuels in GREET, Argonne National Laboratory (ANL)

[98] Emissions Testing of Gas-Powered Commercial Vehicles. LowCVP, (2017) 2017.https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/581859/emissio ns-testing-of-gas-powered-commercial-vehicles.pdf

spreading equipment by 2025, and digestate stores to be covered by 2027 (but both of these measures may be phased in earlier for digestate or large volumes of slurries). There will be a full public consultation before decisions are made as to the types of covers required and the date they will be required from. The upcoming Green Gas Support scheme will also introduce measures to ensure new biomethane plants do not result in more ammonia emissions from digestate.

Taken together these measures will be sufficient to reduce any significant risks associated with higher levels of AD, and energy policy should not restrict the use of AD considering such requirements are implemented.

Strict measures to limit any negative impacts on human health, communities and the environment from biowaste activities.

In 2020 the Environment Agency consulted on a review of permits for biowaste treatment including anaerobic digestion. This is as a result of the publication of the revised Waste Treatment BREF and is aimed at bringing permits in line with it and ensuring they operate to the Best Available Techniques (BAT). It follows from the EA's incidents and audit data from anaerobic digestion plants. The review of permits will result in the implementation of the BAT requirements set out in the BREF in the reviewed permits (i.e. plants will have to be designed and operated with best available techniques). The EA will also publish a guidance document describing 'appropriate measures' for the biological treatment of wastes.[99] The appropriate measures are the minimum standards that operators must meet to comply with their environmental permit requirements. In summary, the review will see the implementation of higher design and operational standards (standard good practice requirements and more capital investment improvements) for AD facilities.

15. Are our existing sustainability criteria sufficient in ensuring that biomass can deliver the GHG emission savings needed to meet net zero without wider adverse impacts including on land use and biodiversity? How could they be amended to ensure biomass from all sources supports wider climate, environmental and societal goals?

The UK's current sustainability governance is world leading and already more than mitigates risks, going beyond EU RED II criteria, requiring no immediate adjustments.

The UK's bioenergy sustainability governance framework has evolved considerably over time and is widely regarded as one of the most comprehensive frameworks globally. Policy and regulations have evolved to take account of new issues and scientific understanding. Industry has worked with government bodies to develop and implement these regulations, and will continue to do so, ensuring that the carbon emission claimed can be reliably verified.

All the government bioenergy support schemes – the Renewable Heat Incentive (RHI), Renewables Obligation (RO), Contracts for Difference (CfD), Feed-in Tariff (FIT), and Renewable Transport Fuel Obligation (RTFO) schemes – have associated bioenergy regulations and reporting requirements that must be fulfilled. This includes:

[99] EA (2020) Appropriate measures for the biologival treatment of waste, https://consult.environment-agency.gov.uk/environment-and-business/appropriate-measures-for-the-biological-treatment/

- Projects supported under the RHI, RO, FIT and CfD schemes must provide information on the land from which the biomass is sourced, to minimise impacts on carbon stocks and biodiversity, and on criteria which account for the life cycle GHG emissions of the biomass.[100]
- Additional sustainability requirements apply for the use of feedstocks for electricity or heat use that are based on virgin wood. The Timber Standard for Heat and Electricity sets out wood-fuel land criteria covering a range of social, economic and environmental considerations that reflect good sustainable forest management practices and are based on internationally agreed principles.[101]
- Projects under the RTFO must also meet sustainability criteria to be eligible for support, including minimum greenhouse gas criteria and must not be produced from areas with high biodiversity nor from land with high carbon stocks, such as forests or land which was undrained peatland.[102]

The UK's sustainability governance has both influenced, and been informed by, the development of the EU Renewable Energy Directive (RED), with UK requirements going beyond even the latest revisions to biomass sustainability criteria introduced as part of RED II.[103] The EU's Joint Research Centre (JRC) recently published an in-depth review of EU sustainability criteria, within which they conclude that the implementation of RED II will be sufficient to mitigate negative impacts associated with the biomass pathways reviewed.[104] Given UK requirements already go beyond this, Government should have a high degree of confidence in the existing governance sustainability arrangements.

Bioenergy governance is delivering identifiable GHG savings according to the Life Cycle Analysis Methodologies

Current governance arrangements have adopted robust Life Cycle Analysis (LCA) methodologies for determining supply chain emissions of bioenergy feedstocks. These methodologies ensure all operators follow a consistent process for determining supply chain emissions. There are extensive databases which allow the calculation of the emissions associated with different activities. For example, the European Commission lists default values for carbon savings for

[100] Sustainability Reporting for RO, https://www.ofgem.gov.uk/system/files/docs/2018/04/sustainability_reporting_guidance.pdf, , RHI Sustainability Guidance; https://www.ofgem.gov.uk/system/files/docs/2018/05/sustainability_audit_guidance.pdf, LCCC CfD Sustainability Criteria Guidance, https://www.lowcarboncontracts.uk/publications/lccc-sustainability-criteria-guidance; RTFO guidance, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/947710/rtfo-guidance-part-2-carbon-and-sustainability-2021.pdf

[101] BEIS Woodfuel Advice Note, 2017, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/594136/Woodfuel_Advice_Note_v2_Feb2017.pdf and DECC (2014) Timber Standard for Heat & Electricity, https://www.gov.uk/government/publications/timber-standard-for-heat-electricity

[102] DfT (2021) Renewable Transport Fuel Obligation Guidance Part Two Carbon and Sustainability2021: 01/01/21 to 31/12/2021, https://www.gov.uk/government/publications/renewable-transport-fuel-obligation-rtfo-guidance-2021

[103] European Commission (2021) Renewable Energy Directive – guidance on the sustainability criteria for forest biomass used in energy production https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12943-Renewable-Energy-Directive-guidance-on-the-sustainability-criteria-for-forest-biomass-used-in-energy-production_en

[104] JRC (2021) The use of woody biomass for energy production in the EU, https://publications.jrc.ec.europa.eu/repository/handle/JRC122719

nearly 250 specific bioenergy options.[105] The result depends on the detailed design of the supply chains, the conversion processes used and the fossil fuel that is being replaced (the counterfactual). LCA's show that many bioenergy pathways can have much lower supply chain emissions than fossil fuels, often 80/85% lower than those emitted by the fossil fuel equivalent. In some cases – involving anaerobic digestion (AD) of wastes or carbon capture and storage - production and use of bioenergy can lead to a net reduction in GHG emissions.

For the UK, LCA analysis shows the extent of GHG savings associated with bioenergy:

- For biomass heating the average GHG emission value for Biomass Suppliers List Fuels is 10.9gCO_2/MJ, which provides an 87.5 % GHG saving compared to the EU fossil heat average. Figures for feedstocks on the Sustainable Fuel register, are on average even lower, depending on the nature of the feedstock.[106]
- For power generation under the RO in 2015/16 RO sustainability reporting indicates emission equivalent to 28 g CO_2e/MJ, an 86% reduction compared to the EU fossil fuel comparator
- In transport, the overall savings from biofuels in 2017 were estimated by DfT at 70%.

Overall, as described in question 3, the REA Bioenergy Strategy found that GHG savings from bioenergy in 2017 alone accounted 19.7 MTCO_2e, and estimated the total reduction in GHG emissions due to fossil fuel replacement amount to some 65 MTCO_2e in 2032.[107] Savings have continued to increase, with the savings in 2019 estimated at 83%[108]

Furthermore, as transport decarbonises, using either biofuels or electrification, supply chains can be expected to deliver yet further GHG savings.

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[105] (European Commission, 2016a). European Commission (2016a), Proposal for Directive on Renewable Energy, Annexe 5, European Commission, Brussels.

- [106] SFR (2020) averages (g CO_2/MJ) from all applications (up to Oct 2020):

Straw - Cereal - Bale	2.2
Grass - Bale	2.3
Straw - Non-cereal - Bale	2.9
Miscanthus - Bale	3.3
Grass - Canary - Bale	4.6
Miscanthus - Chip	5.6
Digestate - fibre - pellets	13.4
Olive Pomace - Bulk	15.7
Husks - Non cereal - pellets	17.5
Coffee grounds - Mix - Pellet	21.2

From Lindegaard 'Update on the Sustainable Fuel Register & Perennial Energy Crops' Slide 7 presented at Wood Heat 2020 conference. https://www.r-e-a.net/wp-content/uploads/2020/10/S2-WH2020-Kevin-Lindegaard-Sustainable-Fuels-Register-Update-on-SFR-and-Perennial-Crops.pdf

[107] REA (2019) REA Bioenergy Strategy, https://www.r-e-a.net/resources/bioenergy-strategy-phase-3/

[108] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/932933/renewable-fuel-statistics-2019-final-report.pdf

Governance arrangements do consider biodiversity and land use change.

Governance arrangements also consider both direct land use change (LUC) and indirect land use change (ILUC). UK sustainability arrangements, in accordance with RED, excludes support for biofuels (including imports) made from raw materials obtained from converted high-carbon stock land or land with high biodiversity value. The RO, CfD and RTFO, make specific provision to include emissions from direct land-use change into the calculation of GHG. The RHI also ensures that only fuel that meets strict land use criteria is used by mandating fuels are appropriately registered to the Biomass Suppliers list[109] or Sustainable Fuels Register.[110] Further, RTFO reports show adjusted GHG savings if an 'iluc factor' is applied.

Furthermore, RED II means that distinction is also being made between crops with a high and low ILUC risk. For example, the UK RTFO will limit the contribution from crop-based biofuels to a maximum of 4% of the 7.25% biofuel provision, with that maximum reducing to 2% in 2032, while also providing higher rewards to waste-based feedstocks.

The RHI and the future GGSS also place strong limits on the use of crops to produce biomethane (to constrain the use of crops like maize). RHI payments are also reduced if more than 50% of the biogas/biomethane is made from any feedstocks that are not wastes or residues (e.g. any crops). This is one area where sustainability governance could be further refined in conjunction with the schemes rules, with crops not being counted towards the 50% threshold where they complement traditional agricultural production. For example, 'break crop' feedstocks which are grown in close rotation with food/feed crops and meet sustainability criteria should be counted towards the above threshold. Similarly, no restrictions should apply to crops defines as 'non relevant crops' under the RTFO or certified as low ILUC risk feedstocks as per RED II (See information on carbon sequestration and utilising low-grade land in Q4).

In terms of biodiversity, to be eligible under the UK support schemes, it is necessary to demonstrate that the production of bioenergy feedstocks does not take place on land classified as having high biodiversity value since 2008, as defined by the European Commission.[111]

Sustainability governance arrangements are working – delivering increasing forest inventories and carbon stock.

As described in question 7, the primary sources of both imported and domestic biomass are both experiencing increases in forest inventory and carbon stock resulting from well managed forests and the production of bioenergy feedstocks being done in accordance with strict sustainability governance requirements.

In South-eastern US, harvesting of wood products and managed forest activity is shown to be accompanied by a steady increase in forested areas since the mid-1950s, with carbon stocks

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[109] Biomass Suppliers List (2020) Land Criteria Guidance, https://biomass-suppliers-list.service.gov.uk/Content/Documents/BSL%20Land%20Criteria%20Guidance%20-%20V2.0.pdf

[110] Sustainable Fuel Register (2019) SFR Guidance Notes – Section 7 "Land Criteria" https://www.sfregister.org/sites/default/files/sfr-guidance-notes-v1.6.pdf

[111] European Commission Regulation No 1307/2014 of 8 December 2014 on defining the criteria and geographic ranges of highly biodiverse grassland for the purposes of Article 7b(3)(c) of Directive 98/70/EC of the European Parliament and of the Council relating to the quality of petrol and diesel fuels and Article 17(3)(c) of Directive 2009/28/EC of the European Parliament and of the Council on the promotion of the use of energy from renewable sources https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOL_2014_351_R_0002

having nearly doubled. [112 & 113] Studies suggest there is no evidence to show that the biomass industry is driving any decreases in carbon stocks.[114] Similarly, Catchment Area Analysis, conducted by Drax, based on data from the US Forest Service, indicates an overall increase in inventory, and therefore increased rates of carbon stored, in the forests they source directly from.[115] This further accords with Forest2Market research showing that the number of timberland acres has remained stable in the US South, increasing by 3%. At the same time, total inventory has doubled (+108%, from 142.1 to 296.1 billion cubic feet) as growth has outpaced removals. [116]

Similar findings can also be found in the UK, albeit on a smaller scale. The 2020 Forestry Commission Statistics indicate trends of continued modest growth of UK forest inventory and increasing levels of forests coming under certified management. As at March 2020 there were 1.39 million hectares of certified woodland in the UK. Part of this growth can be attributed to increased demand for low value forestry products driven by the Renewable Heat Incentive and Renewables Obligation, underwriting investment in new managed woodlands.[117]

See Annex 4: Biomass Sustainability and Availability – A briefing note produced by Biomass UK, highlighting key points associated with this question. [118]

Long-term government commitment to whole-system science-led sustainability governance, along with industry transparency, will ensure the governance arrangements remain fit for purpose.

It is recognised that the sustainability of biomass supply chains continues to be rightly scrutinised by a broad section of environmental stakeholders, with sustainability being both a complicated, and sometimes controversial, area. Complicated supply chain interactions have been previously recognised by Government, with DECC commissioning The Biomass Emissions and Counterfactual (BEAC) model in 2014[119], followed by scenario analysis in 2016.[120] This analysis stressed that there are extreme scenarios where negative sustainability impacts are

[112] US Forest Service (2020) Forestry Inventory and Analysis, https://www.fia.fs.fed.us/

[113] Sustainability guidelines and forest market response: an assessment of EU pellet demand in the south-eastern United States, Galik, CS and ABT RC 2016. Available here: https://onlinelibrary.wiley.com/doi/epdf/10.1111/gcbb.12273

[114] Status and Prospects for renewable energy using wood pellets from the south-eastern United States. Dale, V et al 2017. Available here: https://onlinelibrary.wiley.com/doi/full/10.1111/gcbb.12445

[115] Drax Group Catchment Area Analysis, US South's biomass sourcing areas analysed. Available here: https://www.drax.com/sustainable-bioenergy/the-us-souths-biomass-sourcing-areas-analysed/#chapter-1

[116] Forest2Market Historical Perspective on the Relationship between Demand and Forest Productivity in the US South, Jefferies H et al, 2017. Available here: https://www.forest2market.com/hubfs/2016_Website/Documents/20170726_Forest2Market_Historical_Perspective_US_South.pdf

[117] Forestry Commission (2020) *Forestry Statistics 2020*, https://www.forestresearch.gov.uk/tools-and-resources/statistics/forestry-statistics/

[118] See Annex 4: https://www.r-e-a.net/wp-content/uploads/2021/06/REA-Annex-4-BUK-Biomass-Sustainability-and-Availability.pdf

[119] DECC (2014) Life Cycle Impacts of Biomass Electricity in 2020, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/349024/BEAC_Report_290814.pdf

[120] Ricardo (2016) Use of North American woody biomass in UK electricity generation: Assessment of high carbon biomass fuel sourcing scenarios, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/600477/PED60674_final_report_270416_Tec_Report_FINAL_v2_AMENDMENTS_ACCEPTED.pdf

realised, however, it concludes that these scenarios do not occur due to both strict governance arrangements and forest economies that mean only low-grade wood residues go towards bioenergy feedstock production.

However, despite such analysis, criticism continues to be levelled at the sector due to a focus on extreme high carbon scenarios. A very recent review published in April this year, conducted by 28 academics, highlight how alternative assessment methods can build on differing assumption and be done at selective scales to deliver differing sustainability conclusions around biomass. To address this, they stress the importance of full system approach methodologies that look at short, medium and long term climate benefits.[121] Such an approach should be maintained when considering the evolution of sustainable governance arrangements.

By both promoting and regulating for clear science-led sustainability governance, government demonstrate ongoing confidence in existing sustainability arrangements, which in turn ensures both industry and public confidence is maintained in the sector.

The industry also recognises it has an important to role to play maintaining government confidence. To do so the industry understand the need to continue to increase the level of transparency around supply chains and be able to independently verify the impact of their activities. Sections of industry are already doing this, examples include Enviva's Track and Trace System[122], Drax's Responsible Sourcing Policy[123] and, the Biomass Heat Works Campaign[124] all focusing on broader public messaging about how biomass supply chains work and how the environment is protected.

Any future evolution of sustainability governance should be science-led and proportional.

While the REA is confident that today's governance arrangements are fit for purpose, we also accept a need to evolve the sustainability regime as demand from biomass feedstocks increases, technologies and the science evolves, as well asother global biomass markets (both in term of production and use) open up. Such evolution should:

- Remain science-led and be done in collaboration between Government and industry.
- Be proportionate and not hinder current proven approaches to sustainable biomass provision.
- Continue to use principle-based approaches over blunt prescriptive criteria which could fail to recognise regional differences in forests and management requirements.
- Ensure that business and investor confidence is maintained by Government publicly showing long-term support for the sector and sustainability governance regime.

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[121] Cowie, A.L., Berndes, G., Bentsen, N.S., Brandão, M., Cherubini, F., Egnell, G., George, B., Gustavsson, L., Hanewinkel, M., Harris, Z.M., Johnsson, F., Junginger, M., Kline, K.L., Koponen, K., Koppejan, J., Kraxner, F., Lamers, P., Majer, S., Marland, E., Nabuurs, G.-J., Pelkmans, L., Sathre, R., Schaub, M., Smith, C.T., Jr., Soimakallio, S., Van Der Hilst, F., Woods, J. and Ximenes, F.A. (2021), **Applying a science-based systems perspective to dispel misconceptions about climate effects of forest bioenergy**. *GCB Bioenergy.* https://doi.org/10.1111/gcbb.12844
[122] Enviva, Track and Trace https://www.envivabiomass.com/sustainability/responsible-sourcing/track-trace/
[123] Drax, Responsible Sourcing Policy, https://www.drax.com/sustainable-bioenergy/responsible-sourcing/#chapter-1
[124] Biomass Heat Works, https://www.biomassheatworks.co.uk/

16. How could we improve monitoring and reporting against sustainability requirements?

Improve consistency of sustainability requirements between bioenergy support mechanisms.

There are inconsistencies in sustainability requirements across different bioenergy support mechanisms. For example, the RTFO includes the category 'dedicated energy crops'. The definition covers crops that are ligno-cellulosic and non-food cellulosic material and which are grown for the purpose of being used as fuel (and not food or feed). Biofuels derived from these materials are double rewarded. However, no such determination is made within the RHI or new Green Gas Support Scheme (GGSS) , where payments are reduced if more than 50% of the biogas/biomethane is made from any crops. The GGSS should be made consistent with the RTFO to avoid market distortions in support.

Consistency should also be sought for how innovative feedstocks are monitored between different support mechanisms. For example, all support schemes should include ways for incentivising best practice, and maximising environmental benefits, from perennial energy crops. This will ensure developers have access to heat, power and transport markets in order to further develop the growth of these domestic feedstocks in the UK.

Consistency in sustainability monitoring across the economy, including recognition of carbon emissions being accounted for in the land sector.

There is a general need for greater consistency in reporting and accounting across the wider economy. No other imported products into the UK must meet the level of sustainability standards/ regulations applied to bioenergy. This includes when considering supply chains for the import of fossil fuels, which can have higher average GHG emissions associated with transportation. Greater transparency across other supply chains will, in turn, lead to more accurate comparisons on emissions. [125]

Similarly, there is current precedence for lifecycle emissions of biomass, which considers whole supply chains, to be directly compared to only stack emissions of other electricity generation technologies, leading to further inaccuracies. There also needs to be greater understanding of how biogenic carbon emissions are reported under international carbon accounting frameworks in the land sector, alongside removals, through reporting of changes in carbon stock.[126] This is an important accounting principle, which is not always appropriately reflected in how emissions are reported.

Align monitoring and reporting terms to those used in the forestry industry.

Basic consistency in terminology and definitions used in monitoring and reporting, against those terms used across the entire biomass supply chain could also be improved. For example, use of

[125] The EU (and the UK) have recently decided that the fossil petrol/diesel value against which transport fuel GHG savings are measured is too low – and are increasing it by 12%. In other words, the GHG savings of all renewable transport fuels used since 2010 has been systematically under-reported by a significant margin. See pages 63-64 of the recent RTFO consultation: [Targeting net zero – Next steps for the Renewable Transport Fuels Obligation (publishing.service.gov.uk)]
[126] JRC (2021) The use of woody biomass for energy production in the EU, https://publications.jrc.ec.europa.eu/repository/handle/JRC122719

the term “whole trees” in some circles is misaligned to the terminology used more widely by experts on the ground, who use “low grade roundwood” to define that feedstock type.

Recognise by-products from AD and ACT in monitoring and reporting.

By-products resulting from anaerobic digestion or advanced conversion technology (ACT) can also deliver yet further GHG emission savings, displacing other high carbon alternatives. Such savings are not yet recognised in monitoring and reporting requirements. For example, digestate from AD is counted for its energy content rather than GHG emissions reductions from displacement of mineral fertiliser. Biochar, a by-product of from biomass ACT, is also used as soil ameliorant for both carbon sequestration and soil health benefits. Methodologies exist by which the carbon performance can include savings provided from by-products, which would provide yet further transparency around sustainability benefits.

Examine what further data is already being collected by biomass operators and could be usefully submitted to government to increase transparency.

It would be worthwhile Government reviewing what other data is already being collected by biomass operators and what further data regulators may find beneficial. The UK’s strict sustainability criteria for biomass, require annual and monthly reporting to Ofgem. However, large biomass operators are collecting data at more regular intervals and with greater granularity then currently required by the legislation, especially if certified under a voluntary scheme like the SBP. As such government may wish to review what data is available and potentially seek further submission, perhaps on a voluntary basis. This may help the regulator and government get a more accurate picture of residues used for biomass feedstock in the UK, increasing transparency, which in turn will improve decision making on the future of sustainability requirements.

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17. What alternative mechanisms would ensure sustainability independent of current incentive schemes (e.g., x-sector legislation, voluntary schemes)?

Voluntary certification schemes need to remain a key route to demonstrating sustainability compliance.

Voluntary independent certification schemes provide a route for both complying with national requirements and going well beyond them. Two examples include the Sustainable Biomass Program (SBP), largely focused on biomass power value chains; and the Roundtable on Sustainable Biomaterials (RSB), mostly looking at biofuel and ‘farm to tank’ value chains.

Such voluntary schemes include a comprehensive set of requirements covering carbon and other environmental, social and economic criteria. For example:

- The SBP includes 38 forestry specific indicators which are designed to ensure that forests are maintained or increased, biodiversity is preserved, and that forests of high conversion value are preserved. Such indicators map against the Forest Stewardship Council (FSC), the Program for the Endorsement of Forest Certification (PEFCTM), and those systems recognised by PEFC, such as the Sustainable Forestry Initiative (SFI).

Indicators specifically include labour rights, air, water and conservation issues as well as GHG and biodiversity issues.[127]

- The RSB principles include biodiversity, human labor rights, conservation, soil, air quality, water, technology inputs and waste management and land rights as well as greenhouse gas criteria, applied throughout the value chain.[128]
- Voluntary schemes are very widely used in the RTFO – in 2019 over 99% of all renewable fuel supplied under the RTFO was certified by voluntary schemes.[129] The majority of these use ISCC (International Sustainability and Carbon Certification). This has the additional benefit for both producers and regulators in that it is based on a rigorous assessment of the site prior to the production of fuel, backed up by regular subsequent audits – therefore reducing risk that the fuel produced will be found to be non-compliant after it has been used.

Importantly such schemes include routine independent audits of supply chains and mitigation measured. Audit reports, including emission data, is readily available for submission to Government and are also publicly available, providing an extra level of transparency.

Such voluntary schemes are also recognised internationally, with the SBP being used in to certify pellets across 31 countries and 322 certified organisations as of March 2021. [130] Similarly, the RSB is now used across 20 countries, and includes recognition by the UN Environment Programme.[131]

Such schemes have become the recognised international standards for doing biomass correctly, going beyond national legislated requirements and providing independent verification of standards across whole international supply chains.

Evidence provided through such certification routes is considered 'Category A' compliance within UK sustainability governance arrangements. Given their international reach and comprehensive approach to verification of sustainability standards, those already adhering to such schemes will continue compliance with such schemes, even after existing support schemes, against which sustainability standards are legislated, come to an end. As such, voluntary schemes should remain a core route to demonstrating sustainability compliance in accordance with future legislation.

Use of mandated registers, like the Biomass Suppliers List and Sustainable Fuel Register can be evolved to continue to maintain sustainability standards for biomass heat use.

Mandated fuel registers like the Biomass Suppliers List (BSL)[132] and Sustainable Fuel Register (SFR)[133] have proved useful mechanism for regulating fuel supply for use in biomass heat applications. Both schemes have evolved becoming the main regulatory route for ensuring

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[127] Sustainable Biomass Program, Overview https://sbp-cert.org/wp-content/uploads/2018/10/SBP_Overview_Final_Mar18.pdf
[128] RSB (2021) The RSB Standard, https://rsb.org/the-rsb-standard/about-the-rsb-standard/
[129] DfT (2021) Targeting net zero – next steps for the Renewable Transport Fuels Obligation, https://www.gov.uk/government/consultations/amending-the-renewable-transport-fuels-obligation-rtfo-to-increase-carbon-savings-on-land-air-and-at-sea
[130] SBP (2021) Facts and Figures, https://sbp-cert.org/about-us/facts-figures/
[131] RSB (2021) Recognition, https://rsb.org/the-rsb-standard/recognition/
[132] BSL (2020) Biomass Supplier List – Sustainability Criteria, https://biomass-suppliers-list.service.gov.uk/about
[133] SFR (2020) Sustainable Fuel Register, https://www.sfregister.org/

standards on sustainability, GHG emissions and land use criteria by legislating that only fuels registered on these schemes can be used in RHI accredited systems.

Recently BEIS have announced that fuel quality will also be a requirement for fuel registration under the BSL,[134] providing yet further basis for the importance of voluntary certification schemes such as the EN*plus,* GoodChips or Woodsure[135], providing independent audit and certification routes. The BSL also maps against the FSC, PEFC and SBP certifications.

Future legislation can be built upon the BSL and SFR's by maintaining them as a key route for ensuring continuing sustainability of fuels used in biomass heat applications.

Future legislation should continue to maintain a Category B option for demonstrating compliance

While Category A, by utilising certification schemes, will remain the primary route for demonstrating compliance for the majority of sector. Category B routes, through self-reporting and bespoke evidence or assessments, should also continue to be allowed as a viable compliance route.

Category B provides a valuable alternative route for innovative or marginally economic biomass sources. This will prove essential both for opening new biomass resources or innovative crops, or where the user is using such low volumes that certification becomes unviable. The flexibility of category B compliance should be maintained in future legislative requirements.

It should be considered if appropriate to apply sustainability governance arrangements to UK ETS

It is recognised that current governance arrangements are currently tied to relevant support mechanisms, which will come to an end in the next few years. Given the long-term aim of the industry is to operate within a mature carbon market, where negative emissions from bioenergy application are rewarded, it may prove appropriate to apply sustainability governance arrangements to the future evolution of the UK ETS. Ensuring, that those rewarded through the market are operating in line with stringent sustainability governance requirements.

At this stage it remains unclear as to what practical implications this approach may have. Biomass should remain zero rated in the UK ETS on the basis that removals and emissions of the embedded carbon is accounted for in the land use sector, in accordance with IPCC international accounting guidelines, and a requirement for the scheme being linked to the EU ETS. Furthermore, the industry would want to ensure that any application of sustainability governance is applied fairly across the whole carbon market, so that all areas of the economy are meeting sustainability standards as stringent as those applied to biomass, to ensure a fair market. However, the REA are supportive of government further exploring this suggestion, in close consultation with industry, to understand if it would be an appropriate place to see governance requirements applied.

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[134] BEIS (2021) Non-Domestic Renewable Heat Incentive: ensuring a sustainable scheme - government response, https://www.gov.uk/government/consultations/non-domestic-renewable-heat-incentive-ensuring-a-sustainable-scheme

[135] BSL, Fuel Quality, https://biomass-suppliers-list.service.gov.uk/about

18. What additional evidence could suppliers of biomass-derived energy (for heat, fuels, electricity) provide to regulators to demonstrate they meet the sustainability criteria?

Review what data is already being collected by biomass operators as part of voluntary certification schemes.

As highlighted in question 16, it would be worthwhile Government reviewing what other data are already being collected by biomass operators and what further information regulators may find beneficial. The UK's strict sustainability criteria for biomass, requires annual and monthly reporting to Ofgem. However, large biomass operators are collecting data at more regular intervals and with greater granularity then currently required by the legislation.[136] This is certainly the case for biomass suppliers and operators accredited by certification schemes such as Sustainable Biomass Program. [137]

Improve consistency of data collection, sharing and analysis between Ofgem and BEIS

There is an impression of there being inconsistent data sharing between BEIS and Ofgem. Data being collected by Ofgem as part of scheme regulation does not always seem to be reviewed and used by BEIS. For example, data on feedstock use within the RHI, collected by Ofgem for compliance purposes, does not appear in BEIS's public reports. It would help scheme transparency if it did so.

As such, government may wish to review both the available data from biomass participants on certification schemes, perhaps seeking further submissions on a voluntary basis, as well as review if they are making the most of data already available to them through the regulator or other government bodies, such as the Biomass Suppliers List (see question 2)

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19. How do we improve global Governance to ensure biomass sustainability and what role does the UK play in achieving this?

Make strong international statements in support of existing sustainability governance arrangements and voluntary schemes, highlighting their positive impact.

The UK must maintain its current leadership position by making clear and unequivocal commitments to both bioenergy use and continuing implementation of stringent sustainability governance arrangements.

In doing so, the UK should continue to engage with, and inform, international governance arrangements, such as continuing to retain alignment with RED II sustainability requirements where appropriate. In addition, UK government should seek out best case practice from elsewhere and remain up-to speed with new academic science-based evidence arising from studies conducted in areas where biomass is being sourced.

[136] Drax Group Forest Scope. Available here: https://forestscope.info/

[137] SBP Certification Scheme Standards Available here: https://sbp-cert.org/documents/standards-documents/standards/

The UK's endorsement of voluntary certification schemes, such as the SBP, RSB, and ISCC also helps ensure that these continue to have global recognition and authority across international supply chains. These, therefore, become the definition for what 'good biomass' is, enabling international companies to exceed the requirements of any one national legislation and thereby raise standards across the globe.

The UK should use opportunities like COP 26 in Glasgow to demonstrate the strength and effectiveness of existing sustainability governance arrangements, showcasing the environmental, social, and economic benefits that have been achieved both within the UK and internationally through biomass supply chains. This should lead to discussions on further global collaboration on bioenergy innovation. UK based companies are ready to contribute to these efforts as well as provide advice and expertise to other nations or businesses undergoing similar transition pathways.

Maintain a principle and regional based approach to sustainability governance criteria

Equally the UK should maintain its principle and regional-based approach to sustainability governance, avoiding blunt criteria which could fail to recognise regional differences. For example, placing restrictions on feedstocks (type, diameter) could undermine the ability for the regional markets to set the price for the lowest value forestry material undermining good forest management. Blunt restrictions could result in harmful land conversions depending on regional requirements.

See Annex 5: Biomass Policy Properties, produced by Biomass UK. [138]

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20. How should the full life cycle emissions of biomass be reflected in carbon pricing, UKETS, and within our reporting standards?

Consistency between the EU ETS and UK ETS should be maintained.

As is the case in the EU ETS, biomass should continue to be zero rated in the UK ETS given its carbon neutral designation and its strategic role in decarbonisation. Similarly, energy from waste should maintain its current exemption given the role it plays in sanitation and avoiding methane emissions from landfill.

Consistency of approach will be required if the UK ETS and EU ETS are to be linked, which should remain the objective of both parties to deliver advantages in terms of market liquidity, price discovery and potential to attract abatement from across Europe, rather than just the UK. This also remains important for the avoidance of competitive distortions between UK and EU markets, ensuring a level playing field for industry and minimising the risk of carbon leakage. [139]

There needs to be consistency with how life cycle emissions are dealt with between sectors, to avoid damaging market signals.

[138] See Annex 5: https://www.r-e-a.net/wp-content/uploads/2021/06/REA-Annex-5-Biomass-Policy-Priorities.pdf

[139] See Joint Trade Associations Letter on Linkage between UK and EU Emissions Trading Systems (2021) for further information: https://www.isda.org/2021/04/15/joint-trade-associations-letter-on-linkage-between-uk-and-eu-emissions-trading-systems/

There also needs to be total consistency in how technologies and sectors subject to the UK ETS are treated. Inclusion of full biomass life cycle emissions, but not life cycle emission of other fuels, risks creating market signals that favour fossil fuel use, counter to the purpose of the ETS and damaging to the UK's net zero ambitions.

Biomass life cycle emissions are best regulated through sustainability governance arrangements and suitable certifications. Well established life cycle emissions methodologies exist for this purpose. It may be appropriate that any UK ETS benefit received by biomass be subject to compliance with the sustainability criteria, but not for life cycle emissions to be directly reflected in the UK carbon price itself.

Over time the carbon price should reward negative emissions from BECCS and nature-based greenhouse gas removal solutions.

Over time, once the negative emission sector is established, direct government support for bioenergy carbon capture and storage, or nature-based solutions to GHG removal, should aim to transition to a straight market-based mechanism. This will likely be provided through the evolution of the UK ETS, to enable ongoing revenue for negative emission production.

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21. How should BECCS be treated for domestic and international GHG emissions accounting and reporting? What are the implications of existing reporting rules on our ability to deliver negative emissions, when for instance, land use change emissions and stored CO2 are being accounted for in different countries?

As has been demonstrated, the bioenergy sector already has well established GHG methodologies and accounting procedures for life cycle emissions. Methodologies build from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (and 2019 refinement) which confirm:

1) That CCS supplied with biofuels creates negative emissions.
2) That end-of-life emissions for biomass are accounted for within the Agriculture, Forestry and Other Land Use (AFOLU) sector. [140]

As a result, existing methodologies are already able to take into consideration land use emissions and carbon stores. Such methodologies should be able to be adapted to account for negative emissions from BECCS and then used to help inform the national accounting mechanism for all Green House Gas Removal (GGR) technologies.

It is worth noting that life cycle methodologies are also able to account for carbon capture relating to byproducts of bioenergy activities, such as biochar from the use of biomass in advanced conversion technologies.

Alongside the formalisation of existing methodologies to account for negative emissions, continuation of a robust sustainability framework will need to be applied to all GGR technologies to mitigate any risk of negative direct or indirect impacts on land use emissions. Where possible, technologies should be promoted where they serve to increase carbon stocks.

[140] IPCC (2019) 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2: Energy https://www.ipcc-nggip.iges.or.jp/public/2019rf/vol2.html

Finally, it important that accounting methodologies do not encourage the offsetting of emissions in one sector, with the negative emissions of another. Decarbonisation needs to happen simultaneously across the economy and the delivery of negative emissions in one sector, such as power, should not be used as an excuse to delay the decarbonisation of another, such as heat or transport. As such negative emissions should be promoted across all sections of the economy.

Chapter 4: Innovation

22. Given the nature and diversity of the biomass feedstock supply (as referenced in Chapter 1), what specific technologies are best positioned to deliver the priority end uses (as referenced in question 9), and how might these change as we reach 2050?

Government should incentivise desirable outcomes across the existing bioenergy industry, rather than prioritising specific technologies.

The REA recognises that future bioenergy use will change and evolve as the market responds to strategic policy drivers that reward specific environmental benefits. As identified by the CCC within their 'hierarchy of best use for sustainable biomass resources'[141], technologies like BECCS and Gasification are of strategic importance for delivering both negative emissions and using biomass to decarbonise hard to treat sectors, with both needing to be well established by 2050.

However, trying to focus policies purely on end-use technologies will be a blunt tool in terms ensuing the most effective delivery of desired benefit across the whole energy system. In both the case of BECCS and gasification, neither technology is particularly new, rather it is their commercial and novel application to existing bioenergy sectors that needs to be realised. To do this, government should focus on:

1) Ensuring existing bioenergy sectors across heat, power and transport remain strong creating a good commercial basis for deployment of innovative technologies, building on existing supply chains, expertise, and jobs. This means addressing immediate policy gaps across these sectors (as described in question 6,) including support for fuel switching to decarbonise heat, increasing ambitions within the RTFO to 2032 and beyond ; and providing post-2027 sector confidence for bioelectricity.
2) Maintaining the current sector will maintain investor confidence in existing biomass applications, lowering the cost of capital for financing future innovations.
3) Use principle-based policies that reward specific environmental, social or economic outcomes (such as negative emissions, development of aviation fuels or hydrogen production) rather than blunt policies focused on specific end-use technologies. This will drive innovation across multiple energy sectors and see a wider adoption of innovative solution that will deliver desired outcome. For example, this is especially true for the developing hydrogen market where a strong outcome based approach will drive production from a number of low carbon sources, while price and usage factors continue to be addressed by the market.
4) Use these policies to create long term markets, in which multiple technology solutions can participate and be rewarded for desirable outcomes, such as negative emissions.

By following the above, and maintaining strict sustainability governance arrangements, the market will automatically direct biomass resources to solutions that deliver desirable outcomes, rather than government trying to pick technology winners. The creation of markets for these benefits also means the most efficient and cost-effective methods for enabling biomass to play its role in realising net zero emissions are incentivised.

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[141] CCC (2018) Biomass in a low-carbon economy Available at https://www.theccc.org.uk/publication/biomass-in-a-low-carbon-economy/

23. What are the barriers and risks to increasing the deployment of advanced technologies (e.g., gasification, pyrolysis, biocatalysis) and what end use sectors do you see these being applied to?

The current ACT sector is focused on municipal waste feedstocks, rather than virgin biomass, this should continue to be supported to establish the sector commercially. This will require cross -Whitehall collaboration.

It is recognised that advanced conversion technologies (ACTs), producing a range of energy outcomes, still need to be deployed commercially within the UK. However, there remains high interest in the sector as developers and investors are incentivised by revisions to the Renewable Transport Fuel Obligation, as well as increasing government interest in renewable aviation fuels and bio-hydrogen. It should be recognised this support previously came from the RO and CfD which focused only on power production, rather than the potential for the technology to decarbonise hard to treat sectors or deliver bio-hydrogen.

Existing developments within the sector are currently primarily focused on using municipal solid waste (MSW) or refuse derived fuel (RDF) as a feedstock, as opposed to biomass. This should be welcomed, as it increases application of the circular economy, diverts waste from landfill and makes better use of our waste resources, without competing for virgin biomass feedstock that is already used in efficient heat or power production. The use of waste feedstocks also helps make these technologies more commercially viable as the gate fee on waste provides a significant revenue stream helping to build a viable commercial offer. Government should continue to support the deployment of ACT technologies using RDF and MSW, as a route to establishing the sector and lowering cost, after which it the sector may be able to switch to biomass feedstocks. The sector believes there is a role for biomass used in ACT, especially when considering waste biomass feedstocks such as waste wood or by-prodcuts from forestry agriculture and plant production. This will be especially true if there becomes a proven market for the delivery of strategically important fuel production such as hydrogen or aviation fuels.

Given the above, development of energy policy for development of the ACT sector must coordinate with both the implementation of the government Waste and Resource Strategy, administered by DEFRA, and development of the RTFO and Jet Zero Council, administered by DfT. Like all areas of bioenergy, ACT deployment especially requires cross-Whitehall collaboration. As such, the development of the Government Biomass Strategy must include clear integrated departmental priorities for ACT technology, which is based on a strong and equal understanding across departments of the commercial realities of the technology.

The environmental regulatory regime for ACT's must be improved, with funding provided to the Environment Agency to develop a fit for purpose regime.

A major barrier to the further deployment and development of advanced conversion technologies (ACTs) remains having a suitable environmental regulatory scheme in place to effectively support the sector. Most ACT developments in the UK are currently focused on the gasification of RDF, although in other countries it is equally common to find biomass-to-energy conversion plants. As such, sites are regulated under the same rules as energy from waste incineration sites, determined by Chapter IV of the Industrial Emissions Directive, despite being a fundamentally different technology with a cleaner GHG emission profile, higher operating efficiency, and very different end-products.

The Environment Agency have made attempts to start to reform the regulatory approach for ACT's, specifically where:

1) end-of-waste status is achieved on the syn-product
2) Where the particulate emissions from the use of that product is no worse than a fossil fuel comparator.

However, a lack of funding for the EA means the End-of-Waste Panel does not currently function, creating uncertainties for developers around end products. At the same time the EA also lack the funding to commission new research on particulate emission values for fossil comparators for gas or oil, against which to regulate new ACT developments.

As a result, the regulatory regime for ACT's remains both confusing and not fit for purpose. The EA have expressed interest in addressing these issues but require the funding to do so. This should be addressed by government and industry as a matter of urgency.

Development of viable end-product markets must be established to drive ACT deployment.

Crucial to the success of establishing an ACT sector in the UK is ensuring the development of significant demand for desirable end-products, including sustainable aviation fuels, biofuels for use in transport or heating, hydrogen and byproducts like biochar or negative emissions. Establishment of these markets through obligation mechanisms like the RTFO, heat fuel switching support or a market for negative emissions, will help to secure business models against which developers and financiers can start to develop new projects.

Reduced feedstock risk by delivering more transparent and homogenous waste streams, with appropriate gate fees for ACT

A further current barrier to ACT development is the level of risk associated with consistent and long-term access to appropriate waste feedstocks. As previously discussed, the implementation of DEFRA's Resource and Waste Strategy, is expected to deliver greater transparency around waste availability. If done effectively, by reforming the overall waste management system, it should also create more homogenous waste streams at higher gate-fees which provide both quality feedstocks and confidence in the development of new ACT sites.

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24. In what regions of the UK are we best placed to focus on technological innovation and scale up of feedstock supply chains that utilise UK-based biomass resources?

There are a wide variety of opportunities for the growth of the bioenergy sector across the UK varied:

- As already recognised by Government within the Energy White Paper, the REA supports the establishment of CCUS and hydrogen clusters, especially around areas with existing bioenergy sectors. This includes Avonmouth, Teesside and the Humber. Such developments should also be seen as beneficial to the growth of Freeports in the UK.

- Domestic biomass feedstock development and further growth of the green gas sector means growth of rural jobs, with specific potential for developments near biomass demand centres. This can either be in terms of large-scale power demand or biofuel refineries, or more regional demand from an established renewable heat sector. Generally, policy should aim to encourage transport efficiencies to recognise further GHG savings from transportation.
- Development of Environmental Land Management Scheme could drive further growth of agricultural diversification if environmental benefits of perennial energy crops and agro-forestry are appropriately rewarded. Certain areas of the UK have similar issues that could be addressed by increased perennial energy crop e.g. high level of flood events, water quality issues, low woodland cover, high fuel poverty, high off gas grid, need for pollination services etc. This includes The SW, Herefordshire, Worcestershire and Monmouthshire, Cumbria could really benefit from an support strategy that supports planting PECs.[142]
- The North-East of England remains a key region for biofuel refineries to produce bioethanol and biodiesel. The introduction of E10 will further help support the sector and feedstock producers in these areas.
- Bioenergy also presents a wide range of jobs across all regions of the UK, as demonstrated in question 5.

The Energy Technology Institute have previously developed a Bioenergy Value Chain Model, which considers available biomass resources, UK geography, technology options and logistics networks. Government should revisit and update this model to further explore regional potentials. [143]

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25. Post-combustion capture on biomass electricity generation is one method in which BECCS can be deployed to deliver net-zero. Specifically, how could innovation support be targeted to develop the maturity of other BECCS applications, such as biomass gasification?

REA are supportive of a CfD Based Business Model, plus negative carbon Payment, for large scale BECCS

The REA are supportive of market-based leavers that reward both the energy production, along with a payment for the negative emissions achieved. A CfD based mechanism adapted for BECCS would allow biomass power projects to receive a reliable revenue for the power generated, along with any additional benefit for services provided to the grid. A separate carbon payment is then provided to reward negative emissions. Set at a £/tonne level the payment will need to cover both the operational costs of capturing carbon, along with transporting and storing it. Over time, assuming the UK ETS matures successfully, the carbon payment will likely be able to transition to a straight market-based price that ensures ongoing revenue for negative emission production.

[142] See Lindegaard (2014) Impact of energy crops at a regional level, Presented at Impact of Energy Crops Seminar 2nd December 2014, https://www.r-e-a.net/logistec-impact-of-energy-crops-presentation-dec-2014-for-upload/

[143] ETI (2015) Overview of the ETI's Bioenergy Value Chain Model (BVCM) Capabilities, https://www.eti.co.uk/library/overview-of-the-etis-bioenergy-value-chain-model-bvcm-capabilities

Such business models should not be limited to only post-combustion carbon capture. A similar approach would work well for other BECCS (non-power) plants, for example thermal gasification plants that produce green gases such as biomethane and/or biohydrogen coupled with CCUS/CCS. The REA is very supportive of the business models being developed by BEIS for low-carbon hydrogen production (likely to be a variable premium payment). As for biomass power projects, an additional, separate incentive should be given to reward negative emissions from bio-hydrogen production under GGR policy.

Further consideration is required to support the retro-fit of BECCS on medium and small scale existing biomass plants and have a sensible trajectory to achieve this.

Specific consideration is also needed as to whether proposed business models for BECCS are adequate to accommodate the retrofitting of CCS on existing small and medium scale biomass power heat or CHP plants, (including those using waste wood) where the size of investment required will remain a significant barrier to deployment until the cost of CCS technologies fall. Government will need to consider the time trajectory required to see existing infrastructure retro-fit BECCS, ensuring that such sites can continue to be able to produce energy and have a sensible pathway to also deliver negative emissions by sometime in the 2030s. This must be considered as BECCS business models are further developed by government. [144]

The REA also welcome energy from waste being included within proposals for Industrial Carbon Capture Contracts. The development of such business models will also need to consider the retro-fit market, where CCS is not yet an attractive proposition for investors, lowering the IRR of such facilities. Such business models must also be made available to ACT sites using waste or biomass, providing a level playing field for the reward of negative emissions and positive environmental outcomes.

Efficiency of conversion should also be considered.

Business model proposals for BECCS have so also not considered conversion efficiencies provided by applications of BECCS to commercial and industrial scale biomass heat projects. Direct production of heat from biomass has the highest conversion efficiency matching those of fossil fuels and approaching 90%. Industrial biomass heat demand also provides a particularly stable demand profile, maximising possibility for carbon capture. Such applications of BECCS should also be supported.

There should be stakeholder engagement on what is defined as "CCS Ready"

It would be beneficial if government and industry worked together to establish a better definition for what is meant by 'CCS-ready'. This should include ensuring CCS can be retrofitted when the technology is available and that there is a viable business model to see it delivered. This will also need to consider the readiness of the transport and storage network. Having a strong definition in place should go some way to alleviating concerns over industrial biomass not

[144] BEIS (2021) Carbon Capture, Usage and Storage An update on the business model for Industrial Carbon Capture
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/984119/industrial-carbon-capture-icc.pdf

being 'best use' by providing a clear pathway to also having CCS installed and negative emission delivered.

Dedicated support for the development of commercial scale Advanced Conversion Technologies is Required

As described, in question 23 there remains market barriers to the commercial deployment of ACT technologies, these need to be addressed in order see the technology delivered at scale and allow the technologies to also consider carbon capture as part of the project design. Dedicated support for ACT technologies should be provided to see this sector established. This should be in addition to a progressive carbon price that rises over time driving GHG efficiencies across the economy.

The interaction between the delivery of both ACT developments and proposed CCUS business models needs to be carefully considered.[145] Currently addition of CCUS is a substantial additional project cost, which could undermine the overall commercial business case unless there is a clear established market for either negative emission or for the renewable product being produced, such as hydrogen.

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26. What other innovation needs to take place in order to reduce life cycle GHG emissions and impacts on air quality in biomass supply chains? Are all of these easily achievable, and if not, what are the barriers?

Further GHG gas emission reductions will be possible following the further decarbonisation transportation, either using biofuels or electrification. This will need to happen at all scales, from international transportation of large supplies of biomass feedstock, requiring decarbonisation of shipping, along with transportation of relatively small volumes of biomass or waste, over small distances, for use in =localised bioenergy uses such biomass heat, anaerobic digestion or energy from waste facilities.

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[145] BEIS (2020) https://www.gov.uk/government/publications/carbon-capture-usage-and-storage-ccus-business-models

List of Annex

REA Annex 1 Pellet Cost Data Produced By Hawkins Wright
Annex 1: Full Hawkins Wright briefing provided direct to BEIS, not available for wider circulation.

REA Annex 2 Biomass Heat Case Studies
https://www.r-e-a.net/wp-content/uploads/2021/06/REA-Annex-2-Biomass-Heat-Case-Studies.pdf

REA Annex 3 Biogas and ACT Case Studies
https://www.r-e-a.net/wp-content/uploads/2021/06/REA-Annex-3-Biogas-and-ACT-Case-Studies.pdf

REA Annex 4 BUK Biomass Sustainability and Availability
https://www.r-e-a.net/wp-content/uploads/2021/06/REA-Annex-4-BUK-Biomass-Sustainability-and-Availability.pdf

REA Annex 5 Biomass Policy Priorities
https://www.r-e-a.net/wp-content/uploads/2021/06/REA-Annex-5-Biomass-Policy-Priorities.pdf