REA
RENEWABLE ENERGY ASSOCIATION

REA Response to House of Commons BEIS Select Committee Call for Evidence on Carbon Capture Usage & Storage

Introduction

The REA is the largest trade body for renewable energy in the UK, members include all parts of the bioenergy supply chain as well as all other forms of renewable power, heat and transport.

The application of Carbon Capture Usage & Storage (CCUS) we believe should be prioritised to Bioenergy plants in the future. In that way all of the benefits of stable, dispatchable 'baseload' renewable power will be secured while sequestering emissions from the atmosphere during the feedstock's growing process. There are already suitable sites for such plants identified and undertaking development work in the UK, to enable this to become a reality with the right support, thereby utilising existing supply chains and synergies.

Such 'Negative Emissions Technologies (NETs)' are seen as a way of achieving net zero emissions within the wider economy as they capture previously emitted greenhouse gasses from the atmosphere which can then be stored. The development of CCUS in low-carbon power generation unlocks the use of CCUS in sectors where there are few alternatives for decarbonisation for example industrial processes.

As part of the International Energy Agency (IEA)'s recently published Technology Roadmap, modern bioenergy plays an essential role in the IEA's 2º C global warming scenario, providing nearly 17% of the final energy demand in 2060 compared to 4.5% in 2015. It would be very difficult to replace this important contribution and still meet our required targets and bioenergy is particularly important in sectors for which other decarbonisation options are not available.

The IPCC have highlighted Bioenergy with Carbon Capture and Storage (BECCS), as central to their emissions reduction pathways (in the 2014 mitigation section of their 5th Assessment report). Moreover, if we are to keep global temperature changes to 1.5° C warming, as is considerably preferable from a scientific perspective, the application of BECCS becomes even more important, especially its rapid deployment given the pressing need to reduce emissions in the next decade.

The BECCS opportunity

The CCC's modelling illustrates a GHG saving from BECCS by 2050 equivalent to removing roughly 50% of the UK's then emissions (at 49Mt $C0_2$ a year)[1], which highlights the scale of the opportunity available.

The CCC's 2011 review developed a hierarchy of appropriate uses for bioenergy feedstocks based on minimising costs and maximising abatement and concluded that if CCS technology is available it is appropriate to use bioenergy in applications with CCS, making it possible to achieve negative emissions under the right circumstances. This could include power and/or

[1] ETI, https://www.eti.co.uk/insights/the-evidence-for-deploying-bioenergy-with-ccs-beccs-in-the-uk

heat generation, hydrogen production, and biofuels production for use in aviation and shipping.

This technology could also be applied to the UK's industrial sector, one of the parts of the economy which has to date been harder to decarbonise, and much of which is near to coastal areas.

The potential exists for public backing to reduce the costs of CCUS just as has been the case with many renewable technologies in recent years (the cost of offshore wind having halved in the past 3 or 4 years, for example) – this will .

It is a prerequisite for deployment of BECCS to have an existing and thriving biopower industry and developers. It is therefore vital that biopower is included in support schemes and continues to be supported to further improve supply chains, drive down costs, increase efficiencies, and lower emissions, otherwise BECCS will be more costly to achieve.
It is, consequently, concerning that BEIS continues to limit biopower and other fuelled technologies in the Contracts for Difference scheme. Biomass power is currently constrained in routes to market, as the CfD scheme does not support conversion of coal to biomass power or new-build biomass power-only projects, while Biomass CHP projects have been subject to a 150MW cap, which prevents larger, more efficient projects from bidding into the auctions.

Similarly, the Government is proposing setting very tight GHG emission limits for new biomass power projects in the CfD scheme, which would see the GHG saving requirement raised from 80% compared to EU fossil power average to 95-96%. Analysis of the RO sustainability data would suggest that this would only be achievable for 14% of the total tonnage being reported (and 28% of all consignments) under the RO should similar projects apply again. If the even stricter <25kg CO2eq/MWh proposal would be applied, then only 7% of the total current tonnage (and 17% of consignments) would be able to meet the requirements.

Finally, to account for all of the costs of a reliable energy system, it is necessary to view the system as a whole, considering the "whole system costs" associated with deploying each low-carbon technology and assigning a value to technologies that provide both security and dispatchability. The biomass sector is primarily upstream (i.e. focused on electricity generation), but it has a significant role to play in the midstream (transmission, distribution and ancillary services), and thereby creates cost benefits to the downstream (i.e. retail) market. Biomass power is currently the only large-scale renewable technology that provides consistent power that is easily dispatchable to meet fluctuations in energy demand and can serve as backup power generation to balance the grid alongside variable renewables. Without biomass as a backup, generators must rely on fossil fuels – whether gas, coal, or diesel – to produce on demand energy. The full cost (both monetary and environmental) of security to the grid, ensuring flexibility, and 'keeping the lights on' is not considered.

The UK should use a whole-system analysis to evaluate the costs of different energy projects within the CfD to minimise cost to the consumer and overall cost of GHG mitigation. The GHG emissions from gas or diesel generators within the capacity market should be considered when comparing variable renewables with bioenergy in addition to the cost of variability, security of supply, balancing, and transmission.

The work going into the creation of an international biomass pellet supply trade, which is led by the UK biomass power sector, is, therefore, the first step along the path to biomass with CCUS and negative emissions, and the sector must be supported through the existing support schemes in order to deliver future BECCS projects.

The CO_2 and H_2 from CCUS technologies do not have to be directly stored to be environmentally advantageous. For example, these could be feedstocks for fuels of non-biological origin, and results in the production of more fuel whilst fossil carbon-based feedstocks are left in the ground. This utilisation potential should be maximised wherever possible in the UK's policy on CCUS.

Conclusion

Bioenergy with CCS (BECCS) offers a unique opportunity to not only generate carbon free power in the UK, but also reduce emissions, while at the same time supporting jobs, rural economies and sustainable forestry and land management. The IPCC and CCC both state that BECCS can deliver highly significant emissions reductions and the IPCC make clear it is central to meeting our emission reduction pathways. Moreover, there are already sites identified as suitable and potentially able to deploy, BECCS in the UK, utilising existing supply chains and infrastructure.

BECCS projects should therefore be prioritised in any future support or pilot scheme. In the meantime, it is also vital to continue support for bioenergy projects in the existing Contracts for Difference (CfD) scheme, in order to maintain and build on the supply chains, skills and expertise in the industry and ensure a successful future BECCS industry.

We would of course be happy to discuss anything in this response further with the Committee.

REA, August 2018

Appendix on background to Biomass power below

Appendix – Why Biomass is the right technology for CCUS

The biomass power and heating industry employs over 24,000 people in the UK and supports vital investment outside of the south-east[2]. Below is a background briefing on some of the pertinent issues relating to the industry.

Forestry & vital role supporting good woodland management
Biomass energy production plays a vital role in supporting well managed woodlands and does not compete with other finished products or mature industries as the pellets used in energy generation are sourced from the 'offcuts' (thinnings and small branches) or trees, rather than the trunks or more valuable whole tree components. As demand for paper has decreased with the move to digitisation, the energy feedstock component of sawmills' business has played an important role in ensuring the viability of such businesses.

The UK's woodland area has continuously increased every decade since the war, with UK woodland area increasing from 11.3% in 1999 to 13.0% in 2015. Of the area in the EU, 41%, or 178 million ha, is covered with forests and other woodland, with about 75% of that area potentially available for wood supply[3].

The *State of Europe's Forests 2015 Report*[4] from Forest Europe concludes:

- "Between 2005 and 2015 the average annual sequestration of carbon in forest biomass, soil and forest products reached about 720 million tonnes, which corresponds to about 9% of the net greenhouse gas emissions for the European region
- "Despite the fact that the European forest sector was affected by the recent global economic recession, it seems now on a steady path of recovery. Europe still remains one of the world's biggest producers of equivalent roundwood and has moved from being a net importer of primary wood and paper products to a net exporter. In particular, as reported in the document, information on total roundwood production was provided by 38 countries, representing 60% of the forests in the Forest Europe area.
- "Sustainable forest management in Europe is directly contingent on sustainable markets for forest products and vice versa. The consumption of roundwood and all of its products and by-products is a factor in the sustainable development of the forest sector. Profitability in most forests is dependent upon sales of roundwood, and, to a growing extent, sales of forest residues for energy. The revenue from sales of wood supports most activities and treatments in forests."

Building on this last point, The European Commission's *Study of the Wood Raw Material Supply and Demand for the EU Wood-processing Industries* states:

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[2] REA, 2018, REView 2018, https://www.r-e-a.net/news/review-2018-concern-as-british-renewable-energy-sector-growth-begins-to-cool
[3] Study on the Wood Raw Material Supply and Demand for the EU Wood-processing Industries, http://ec.europa.eu/DocsRoom/documents/11920
[4] FOREST EUROPE, 2015: State of Europe's Forests 2015, http://www.foresteurope.org/fullsoef2015

- "The sawmills are in a key position because saw logs are the most valuable parts of the trees and hence the most interesting one from the wood sellers' point of view. To get the market of wood raw material running, it is therefore extremely important that the sawmills are profitable and act as drivers for the wood market. This brings also pulpwood as well as energy wood to the market and other forms of woodworking industries, pulp and paper industries as well as power plants can benefit from this as well as from the industrial residues. This trickle-down effect is often referred to as a 'cascade'."

Finally, Eurostat data shows that from 2014 to 2015 EU forest and other woodland gained 322.800ha in coverage, which means that EU forests are increasing by the equivalent size of a football pitch every minute, and this trend is likely to have continued.

Biomass Power – reduced emissions

Biomass power generation can be evidenced to provide significantly lower emissions in comparison to fossil fuel generation, even before any CCUS applications. The data released under the RO sustainability reporting requirements indicates a significant GHG saving when using life-cycle calculations (table 3). In the latest reporting year of 2015/2016, the weighted average emissions for production of biomass power saving compared to coal and 86% compared to the EU fossil fuel comparator.

Table 3: GHG emissions reported under the RO 2013 - 2016

RO reporting period		g CO_{2eq} / MJ	GHG saving compared to **EU fossil power average**	GHG saving compared to **coal**
2015/16	**Weighted Average**	**28.28**	**86%**	**89%**
	Average	20.57	90%	92%
2014/15	Weighted Average	32.60	84%	87%
	Average	25.83	87%	90%
2013/14	Weighted Average	36.94	81%	85%
	Average	30.65	85%	88%

Note: Based the RO "Biomass Sustainability Report 2015-16 dataset" released by Ofgem, analysed by the NNFCC. Comparator for EU Fossil power average is 198g CO_{2eq}/MJ, as per the EU Report on Sustainability requirements for biomass[5]. The UK Government's benchmark figure for GHG emission from coal is 250.8g CO_{2eq}/MJ. The weighted average is per tonnage of feedstock.

[5] EU comparators for heat and electricity are on p17 of the EU report on the requirement for sustainability criteria for solid biomass and biogas: http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:0011:FIN:EN:PDF.

Other peer-reviewed research articles such as Wang et al. (2015) [6] assessment of US-sourced pellets and Lamers et al. (2014)[7] on pellets sourced from British Columbia, Canada have made similar assessments in terms of potential GHG savings. Other studies looking at lifecycle emissions of biomass power generations also find comparable results, such as Beauregard et al. (2012)[8] on GHG reduction in Quebec, Canada, or Zhang et al. (2009)[9] in Ontario, Canada.

Peer-reviewed research by Miner et al. (2014)[10] similarly finds that increased demand for wood can trigger investments and increase forest area and forest productivity. Over 100 researchers and academics from leading US university forestry resource programmes have signed a letter to underline that economic factors influence the carbon impacts of forest biomass energy; the carbon benefits of sustainable forestry are well established; and, measuring the carbon benefits of forest biomass energy must consider cumulative carbon emissions over the long term[11].

In addition, there are wider grid benefits from bioenergy generation, as bioenergy is easily dispatchable to meet fluctuations in energy demand and can serve as backup power generation to balance the grid alongside variable renewables. The whole system cost of biomass should be considered when comparing it to other low-carbon generation. This has been highlighted by *Biomass UK* and *USIPA* in their white paper "Bigger picture, lower cost - Lowering the cost of the energy transition through a whole system costs approach"[12]. Update figures, which have been calculated after the latest CfD round by Aurora Energy Research, are available upon request.

There is furthermore an opportunity for the UK to exports its stringent sustainability standards to other countries and regions through the import of biomass fuels. Every supply chain that feeds into UK biomass import has to comply with the GHG emission criteria and land-use criteria on sustainability and legality. Although wood

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[6] Wang, W., Dwivedi, P., Abt, R., & Khanna, M. (2015). Carbon savings with transatlantic trade in pellets: accounting for market-driven effects. Environmental Research Letters, 10(11), 114019, http://iopscience.iop.org/article/10.1088/1748-9326/10/11/114019

[7] Lamers, P., Junginger, M., Dymond, C. C., & Faaij, A. (2014). Damaged forests provide an opportunity to mitigate climate change. Gcb Bioenergy, 6(1), 44-60, http://onlinelibrary.wiley.com/doi/10.1111/gcbb.12055/full

[8] Beauregard, R., Bouthillier, L., Bernier, P. Y., Paré, D., Thiffault, E., Levasseur, A., & St-Laurent-Samuel, A. (2012). Scientific advisory report–The use of forest biomass to reduce greenhouse gas emissions in Quebec, https://www.mffp.gouv.qc.ca/english/publications/forest/forest-biomass.pdf

[9] Zhang, Y., Mckechnie, J., Cormier, D., Lyng, R., Mabee, W., Ogino, A., & Maclean, H. L. (2009). Life cycle emissions and cost of producing electricity from coal, natural gas, and wood pellets in Ontario, Canada. Environmental science & technology, 44(1), 538-544, http://www.canadiancleanpowercoalition.com/files/4312/8330/0349/BM8%20-%20Zhang%20et%20al%202010%20EST%20Wood%20pellet.pdf

[10] Miner, R. A., Abt, R. C., Bowyer, J. L., Buford, M. A., Malmsheimer, R. W., O'Laughlin, J., ... & Skog, K. E. (2014). Forest carbon accounting considerations in US bioenergy policy. Journal of Forestry, 112(6), 591-606, http://www.ingentaconnect.com/content/saf/jof/2014/00000112/00000006/art00007

[11] Bullard et al. (2014), Letter to EPA Administrator Gina McCarthy, 6 Nov 2014, https://nafoalliance.org/images/issues/carbon/resources/NAUFRP-EPA-11-6-2014.PDF

[12] Biomass UK & USIPA (2017), Bigger picture, lower cost. Lowering the cost of the energy transition through a whole system costs approach, https://biomass-uk.org/wp-content/uploads/2017/09/Bigger-Picture-Lower-Cost-the-case-for-Whole-System-Costs.pdf. Biomass UK is part of the REA and represents its biomass power members.

pellets are a low-value product and are unlikely to impact the wider timber industry, UK sustainability standards for pellets and biomass fuels could positively impact the global standards for sustainability.

Sustainability policy

The UK sustainability framework for biomass power is the most rigorous globally, and has been mandated by the UK Government following months of consultations and stakeholder input. To comply with UK regulations, pellet producers hold chain of custody and fibre sourcing certifications from internationally-recognized forestry certification schemes such as FSC, SFI, PECF, SBP, and others. Fuel suppliers are audited by independent, third-parties on a routine basis to maintain these certifications, in accordance with international auditing standards. Data on GHG emissions and forest legality and sustainability are submitted to the independent regulator, Ofgem, who determines compliance with UK regulations.

Supply of bioenergy feedstocks

There have been many estimates of global bioenergy resources. Deng et al. (2015)[13] have made country-based, bottom-up assessment of the land-based global biofuel (bioethanol and biodiesel) potential, and Wood et al. (2015)[14] from Imperial College London have provided an overview of research of land availability. The U.S. Department of Energy has also made assessments in their *2016 Billion-Ton Report*[15].

Bioenergy can make a significant contribution to meeting 2050 climate change targets. Assumptions on the share of international resource which can be accessed by the UK are problematic as in a globalised economy, there are many products where UK supply does not meet UK demand, and many products depend on earth resources such as the production of paper, batteries, cotton, food, and electric vehicles, with bioenergy being no different. There should be no reason why the UK should be restricted in the use of specifically bioenergy feedstock, as long as it is sustainably sourced and complies with regulations. If UK companies can pay for sustainable feedstock that complies with the land-use and GHG criteria, then there should be no restrictions on this, as there are no restrictions for purchase of imported paper products, for example. There is a surplus of timber and wood fibre supply in North America that they rightly export, which helps support the local forestry sector. In the UK, there is a shortage of wood fibre and timber products, which we, therefore, import in the form of paper, bioenergy feedstock etc.

[13] Deng, Y. Y., Koper, M., Haigh, M., & Dornburg, V. (2015). Country-level assessment of long-term global bioenergy potential. biomass and bioenergy, 74, 253-267, https://www.sciencedirect.com/science/article/pii/S0961953414005340
[14] Woods, J., Lynd, L. R., Laser, M., Batistella, M., de Castro, V. D., Kline, K., & Faaij, A. (2015). Land and bioenergy. Bioenergy: bridging the gaps, 9, http://bioenfapesp.org/scopebioenergy/images/chapters/bioen-scope_chapter09.pdf
[15] U.S. Department of Energy (2016), 2016 Billion-Ton Report: Advancing Domestic Resources for a Thriving Bioeconomy, https://energy.gov/eere/bioenergy/2016-billion-ton-report

Scaling up UK sustainable biomass supplies

There are many opportunities to scale-up the supply of sustainably-produced domestic bioenergy supply in the UK, and Defra has determined that only around 2% of the UK arable area of just over 6 million hectares has been used for cropping for energy applications. When considering the total UK agricultural area of 17.4 million hectares this equates to just under 0.8% of total agricultural area.

The ETI's Bioenergy Value Chain Model shows that the UK could convert a total of 1,400,000 ha of UK land to bioenergy crops by the mid-2050s without impacting on the level of UK-grown food consumed, by planting a mixture of Miscanthus, SRC willow and Short Rotation Forestry (SRF). ADAS estimates that 1.0 – 1.8Mha of land could be spared for bioenergy production with minimal or no impact on food production, with the biggest short-term barrier being market conditions. Welfle et al. (2014) find that "indigenous biomass resources and energy crops could service up to 44% of UK energy demand by 2050 without impacting food systems. [Their research] scenarios show, residues from agriculture, forestry and industry provide the most robust resource, potentially providing up to 6.5% of primary energy demand by 2050. Waste resources are found to potentially provide up to 15.4% and specifically grown biomass and energy crops up to 22% of demand."

Increased production and use of domestic feedstock would also have a beneficial impact on job creation in the rural economy. ADAS (2016) found that 9,100 full-time job equivalents (FTE) would be created in the bioenergy sector by 2055, with 5,600 FTE in the short rotation forestry sector, 1,300 FTE in the short rotation coppies sector, and 2,200 FTE in the miscanthus sector, if 1.4Mha was converted to bioenergy production[16]. This does not include ancillary jobs, such as administrative roles, finance, and marketing, or any jobs beyond the initial journey off the farm.

The benefits of increased use of domestic feedstock are wide-ranging. Cambridge University's report '*The Best Use of UK Agricultural Land*' highlight that "land can deliver multiple benefits – such as forestry or perennial crops providing both a source of timber and energy as well as water management, carbon storage and wildlife benefits"[17]. In particular flood management and water protections have been highlighted by Forestry Research (the Forestry Commission's research agency). They find that "*energy crops can offer additional advantages for water protection, flood risk management and climate change mitigation by enhancing pollutant uptake and sediment retention, more rapid establishment of vegetation roughness (especially for SRC) and increased carbon sequestration, as well as a more attractive and faster economic return for landowners*"[18]. The planting of second-generation energy crops such as Miscanthus and willow can also improve the biodiversity of agricultural landscapes. Haughton et al. (2016) found that replacing annual arable crops with perennial, dedicated biomass crops results in significant, large-scale changes to the abundance and composition of plant and invertebrate biodiversity indicators, and there are a "greater abundances of biodiversity indicators

[16] ADAS (2016), RELB: Job implications of establishing a bioenergy market, Available at: http://www.eti.co.uk/library/adas-relb-job-implications-of-establishing-a-bioenergy-market

[17] Cambridge Institute for Sustainability Leadership (2014), The Best Use of UK Agricultural Land, https://www.cisl.cam.ac.uk/publications/natural-resource-security-publications/best-use-uk-agricultural-land

[18] Forest Research (2011), Woodland for Water: Woodland measures for meeting Water Framework Directive objectives https://www.forestry.gov.uk/pdf/FRMG004_Woodland4Water.pdf/$FILE/FRMG004_Woodland4Water.pdf

in biomass crops at the landscape scale"[19]. Dedicated biomass crops, when intensively managed, can increase the landscape diversity and create "resilient, multifunctional landscapes".

In addition, there are many research papers published on this area, such as:

- ADAS (2017), *Refining Estimates of Land for Biomass*, https://d2umxnkyjne36n.cloudfront.net/insightReports/160519_BI2012_D12_Extension-report_v2-1_FINAL.pdf?mtime=20170725131030
- Welfle et al. (2014), *Securing a bioenergy future without imports*, Energy Policy, Volume 68, May 2014, Pages 1-14, http://www.sciencedirect.com/science/article/pii/S0301421513012093
- Haughton, A. J., Bohan, D. A., Clark, S. J., Mallott, M. D., Mallott, V., Sage, R. and Karp, A. (2016), *Dedicated biomass crops can enhance biodiversity in the arable landscape*. GCB Bioenergy, 8: 1071–1081. doi:10.1111/gcbb.12312
- ETI (2015), *Bioenergy Delivering greenhouse gas emission savings through UK bioenergy value chains*, http://www.eti.co.uk/insights/delivering-greenhouse-gas-emission-savings-through-uk-bioenergy-value-chains
- ETI (2015), *Insights into the future UK Bioenergy sector, gained using the ETI's Bioenergy Value Chain Model (BVCM)*. Available at: http://www.eti.co.uk/insights/bioenergy-insights-into-the-future-uk-bioenergy-sector-gained-using-the-etis-bioenergy-value-chain-model-bvcm/
- ETI (2017). *Increasing UK biomass production through more productive use of land*. Available at: http://www.eti.co.uk/library/an-eti-perspective-increasing-uk-biomass-production-through-more-productive-use-of-land
- ADAS (2016), *RELB: Job implications of establishing a bioenergy market*, Available at http://www.eti.co.uk/library/adas-relb-job-implications-of-establishing-a-bioenergy-market

[19] Haughton, A. J., Bohan, D. A., Clark, S. J., Mallott, M. D., Mallott, V., Sage, R. and Karp, A. (2016), Dedicated biomass crops can enhance biodiversity in the arable landscape. GCB Bioenergy, 8: 1071–1081. doi:10.1111/gcbb.12312