Bioenergy Review (2018) - Call for Evidence

Information on organisation / individual submitting response

If you are responding on behalf of an organisation please provide a brief description of your organisation and your role within this organisation.

This response has been collated by a group of NGOs from the UK and USA, namely:

- **Natural Resources Defense Council (NRDC)** combines the power of more than three million members and online activists with the expertise of some 500 scientists, lawyers, and policy advocates across the globe to ensure the rights of all people to the air, the water, and the wild. https://www.nrdc.org/
- **ClientEarth** uses law as a tool to mend the relationship between human societies and the Earth. We work in Europe and beyond, bringing together law, science and policy to create practical solutions to key environmental challenges. https://www.clientearth.org/
- **Southern Environmental Law Center (SELC)** has used the power of the law to champion the environment of the Southeast for more than 30 years. SELC is widely recognized as the Southeast's foremost environmental organization and regional leader. SELC works on a full range of environmental issues to protect our natural resources and the health and well-being of all the people in our region. www.SouthernEnvironment.org
- **The Partnership for Policy Integrity (PFPI)** uses science, legal action, and strategic communications to promote sound energy policy and to help citizens enact science-based policies that protect air, water, ecosystems, and the climate. Our current work focuses on biomass energy, and oil and gas extraction. http://www.pfpi.net/
- **Biofuelwatch** provides information, advocacy and campaigning in relation to the climate, environmental, human rights and public health impacts of large-scale industrial bioenergy. In the UK, the current key focus of Biofuelwatch's work is on biofuel and biomass electricity. http://www.biofuelwatch.org.uk/
- **Dogwood Alliance** has worked with diverse communities, partner organizations and decision-makers to protect Southern forests across 14 states for over 20 years. We do this through community and grassroots organizing, holding corporations and governments accountable and working to conserve millions of acres of Southern forests. https://www.dogwoodalliance.org/

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GHG emissions and sustainability of bioenergy imports

Our 2011 Bioenergy Review concluded that UK and EU regulatory approaches should be strengthened to better reflect estimates of the full lifecycle emissions of bioenergy feedstocks, taking into account both direct and indirect land-use change impacts. Whilst changes have been made to these regulatory frameworks, both life-cycle emissions and the wider sustainability impacts of bioenergy remain highly contested issues, particularly in relation to bioenergy imports. Given the potential role for bioenergy in the UK's low-carbon transition, and the potential increase in bioenergy feedstock production in the future, it will be essential that policy is based on the latest available evidence and that bioenergy is genuinely sustainable.

The term 'sustainable' here is used to cover a wide-range of issues relating to GHG emissions, biodiversity, water use, land-use, land-rights, air-quality and other social and environmental issues.

1. What is the latest evidence on lifecycle GHG emissions of biomass and other biofuels imported into the UK? How could this change over time as a function of scaling up supply? We are particularly interested in evidence that considers the full range of relevant issues including changes to forest and land carbon stocks, direct and indirect land-use change and wider market effects.

The latest evidence on lifecycle GHG emissions of biomass demonstrates that the type and scale of biomass being imported into the United Kingdom, primarily from the Southeastern United States, is resulting in the immediate increase of carbon dioxide (CO2) emitted to the atmosphere at the point of biomass combustion, negative net climate impacts in the short- to medium-term, and the degradation of highly biodiverse natural forests.

In 2016, the U.K. imported approximately 4.1 million metric tons of wood pellets from the U.S. to be burned for electricity. These UK-bound wood pellet imports are derived primarily from feedstocks and harvesting practices that result in high-carbon bioenergy scenarios. Specifically, a 2016 report by the European Commission concluded that EU biomass demand is being met with wood pellets that are primarily sourced from whole trees in the U.S. Southeast.[1]

Additionally, since 2013, on-the-ground investigations conducted by journalists and local NGOs have provided critical insight into the supply chains for wood pellets exported by Enviva, the largest exporter of wood pellets from the Southern U.S. and the primary supplier to Drax Power. The investigations revealed the unsustainable logging practices used to source wood for several of Enviva’s North Carolina and Virginia wood pellet mills, including from clearcut wetland forests. The most recent investigation (February, 2017) found that mature hardwood forests were cut down to source Enviva’s wood pellet mill in Sampson County, North Carolina. The images from this investigation, which follows similar investigations in prior years, again expose the unsustainable logging practices being used to provide biomass

[1] European Commission, COWI, *Environmental Implications of Increased Reliance of the EU on Biomass from the South East U.S.*, ENV.B./ETU/2014/0043 (2016), https://publications.europa.eu/en/publication-detail/-/publication/8005fb30-81e9-4399-9b19-01af823fa42d

to Enviva and spotlight the significant quantities of whole trees and other large-diameter wood—biomass feedstocks known to be high-carbon—entering Enviva's supply chain.[2]

Burning this biomass for large-scale electricity-only generation does not provide carbon benefits compared to fossil fuels. A 2015 analysis commissioned by the Southern Environmental Law Center (SELC) and conducted by the Spatial Informatics Group (SIG) found that the net lifecycle emissions of CO_2 from burning wood pellets from the high-carbon scenarios present in the Southeast U.S. would be 3.4 times higher than continued use of coal over 100 years.[3] Modeling commissioned by the Natural Resources Defense Council (NRDC) and likewise conducted by SIG concluded that "[e]ven when whole trees make up as a little as 12 percent of pellets, . . . burning pellets still produces emissions comparable to natural gas . . . for approximately 50 years."[4] In fact, an update to the SELC-commissioned SIG analysis, conducted in 2017, found that Drax emitted 31.3 million tons of CO_2 from burning biomass from 2013 to 2016 and predicted that Drax would emit another 12 million tons of CO_2 in 2017 alone—an annual amount of CO_2 emissions approximately equal to the UK's total annual goal for reducing carbon emissions.[5]

Numerous other studies, including but not limited to the 2017 reports by Chatham House[6] and the European Academies Science Advisory Council,[7] a body representing the national science academies of each of the EU's member states, analyzed the lifecycle GHG emissions resulting from bioenergy produced using wood pellets derived from high-carbon sourcing scenarios in the U.S. Southeast and concluded that burning this biomass increases atmospheric carbon in the short- and medium-term, and may not result in climate benefits for several decades or longer. Scientists from around the world agree that using standing trees for power production is increasing atmospheric carbon significantly rather than reducing it, as demonstrated by a January, 2018 letter to the European Parliament signed by nearly 800 scientists.[8]

Most recently, in January 2018, Sterman, et al. developed a dynamic bioenergy lifecycle analysis capable of tracking carbon stocks and taking into account multiple land types and regions. After analyzing various scenarios, the paper concludes that, "although bioenergy

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[2] NRDC, Dogwood Alliance, & SELC, *European Imports of Wood Pellets for "Green Energy" Devastating U.S. Forests* (2017), https://www.nrdc.org/resources/european-imports-wood-pellets-green-energy-devastating-us-forests

[3] Spatial Informatics Group, *Carbon Emission Estimates for Drax Biomass Powerplants in the UK Sourcing from Enviva Pellet Mills in U.S. Southeastern Hardwoods using the BEAC Model* (2015), https://www.southernenvironment.org/uploads/audio/2015-05-27_BEAC_calculations_SE_hardwoods.pdf.

[4] NRDC, *Think Wood Pellets are Green? Think Again* (2015), https://www.nrdc.org/sites/default/files/bioenergy-modelling-IB.pdf.

[5] Spatial Informatics Group, *Biomass Stack Emission Estimates for Drax Power Plants in the UK 2013-2017* (2017) (attached, as report not yet published online).

[6] Duncan Brack, Chatham House, *Woody Biomass for Power and Heat: Impacts on the Global Climate* (2017), https://www.chathamhouse.org/publication/woody-biomass-power-and-heat-impacts-global-climate.

[7] European Academies Science Advisory Council, *Multi-Functionality and Sustainability in the European Union's Forests* (2017), http://www.easac.eu/fileadmin/PDF_s/reports_statements/Forests/EASAC_Forests_web_complete.pdf.

[8] Letter from Scientists to the European Parliament Regarding Forest Biomass (updated Jan. 14, 2018), https://www.dropbox.com/sh/sqhn0b4h6dwvq65/AADnK8Q18AAFaCeWvbZ40vFGa?dl=0&preview=UPDATE+800+signatures_Scientist+Letter+on+EU+Forest+Biomass.pdf.

from wood can lower long-run CO_2 concentrations compared to fossil fuels, its first impacts is an increase in CO_2, worsening global warming over the critical period through 2100 even if the wood offsets coal, the most carbon-intensive fossil fuel." Perhaps most important, this newest peer-reviewed study on the subject concludes that, "harvesting existing forests and replanting with fast-growing species in managed plantations can worsen the climate impact of wood biofuel" because the "equilibrium carbon density of managed plantations is lower than unmanaged forests" and therefore "carbon sequestered in plantations never offsets the carbon taken from the original forest."[9]

Because so much of the UK's biomass comes from the Southeastern United States, it's important for the CCC to have information specific to that resource. According to Forisk, a U.S.-based wood-industry tracking service, it is common to assume that two tonnes of green wood are required to make a tonne of finished pellets, but the actual number is higher:

> *"This 2-to-1 assumption is widely used for presentations, models, and back-of-the-envelope estimates; however, published and industry research indicates that the actual conversion rate is 2.2 green short tons per short ton of pellets. Bark content critically affects the conversions for pellets, and is often not explicitly noted when conversions are reported, leaving the reader to assume if bark is included or excluded in the estimate. Bark content of delivered roundwood often accounts for anywhere between 10-13%. Bark is often collected during the debarking process and used to fuel boilers in biofuel production if feedstock arrives as roundwood, but not often used in biofuel production due to chemical composition. For pellet projects, most newly announced pellet capacity in the US assumes roundwood pulpwood feedstock as a primary component, for which the 2.2-to-1 conversion applies."*[10]

In fact, since the 2.2:1 ratio represents only roundwood, this figure still underrepresents the actual biomass carbon removed from the land when trees are harvested to make wood pellets. Including tops and branches of trees that are generally burned for process heat in making pellets, and belowground biomass that is left to decompose and emit CO_2 after trees are harvested, means that the actual ratio is probably 2.85:1 or even higher.[11]

In addition, the UK biomass emissions calculator does not include emissions of climate-forcing trace gases, but an abundance of evidence suggests that it should. There are at least two places in the biomass-to-pellet sourcing chain where trace gas emissions can be significant. First, nitrous oxide (N2O) emissions from fertilizer added to tree plantations can be significant, a phenomenon that is well-documented. For instance, Castro et al (1994) found that N2O emissions from fertilized pine plantation soils were 8-600 times higher than from control soils, and further, that soils were less effective at taking up methane when they were fertilized.[12]

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[9] Sterman, et al., *Does Replacing Coal with Wood Lower CO_2 Emissions? Dynamic Lifecycle Analysis of Wood Bioenergy* (2018), http://iopscience.iop.org/article/10.1088/1748-9326/aaa512/meta.

[10] Lang, Amanda, *Revisiting Wood-Use Conversions and Projections for Bioenergy Projects* (2014), http://forisk.com/blog/2014/08/12/revisiting-wood-use-conversions-projections-bioenergy-projects/

[11] Partnership for Policy Integrity, unpublished data; available at slide 18: http://www.pfpi.net/wp-content/uploads/2016/12/PFPI-UK-Biomass-talk-Dec-14-2016.pdf

[12] Castro, M. S., W. T. Peterjohn, J. M. Melillo, P. A. Steudler, H. L. Gholz and D. Lewis, 1994. "Effects of nitrogen fertilization on the fluxes of N2O, CH4, and CO2 from soils in a Florida slash pine plantation."

There is also abundant evidence that methane emissions from wood chip and sawdust piles at pellet plants, as well as finished pellets themselves, can show elevated methane (CH_4) emissions. This is ironic, because the wood pellet and biomass industry often claim that simply leaving forestry residues in the field (rather than collecting and them to be burned as fuel) increases methane emissions from decomposition – yet this is not the case, because residues decomposing in the field rarely become anaerobic enough for methane formation to occur (the bacteria that generate methane do not tolerate oxygen). However, piles of wood chips, sawdust, and finished pellets at wood pellet facilities can themselves be enormous sources of methane.[13] Some studies have found high methane concentrations that, if taken into consideration, cause manufacturing and transport emissions to exceed emissions of coal – even without taking the CO_2 from biomass combustion into account.[14] Methane emissions from pellets are well documented by the industry,[15] and are a safety hazard during pellet storage and transport.[16]

Canadian Journal of Forest Research 24(1): 9-13. http://www.nrcresearchpress.com/doi/abs/10.1139/x94-002?journalCode=cjfr#.WnN3R6inE2w

[13] PCFPlus Research (2002). *Methane and Nitrous Oxide Emissions from Biomass Waste Stockpiles – Final Report*. PCFplus Research. Washington DC: https://wbcarbonfinance.org/docs/CH4_emissions_from_woodwaste_stockpiles.pdf

[14] Röder, M., C. Whittaker and P. Thornley (2015). "How certain are greenhouse gas reductions from bioenergy? Life cycle assessment and uncertainty analysis of wood pellet-to-electricity supply chains from forest residues." Biomass and Bioenergy 79: 50-63. https://www.sciencedirect.com/science/article/pii/S0961953415001166

[15] Kuang, X., et al. 2008. "Characterization and Kinetics Study of Off-Gas Emissions from Stored Wood Pellets." Annals of Occupational Hygiene 52: 675-683, https://www.ncbi.nlm.nih.gov/pubmed/18714087 ; Yazdanpanah, F., et al. 2014. Measurement of Off-Gases in Wood Pellet Storage. Advances in Gas Chromatography. X. Guo. Rijeka, InTech: https://www.intechopen.com/books/advances-in-gas-chromatography/measurement-of-off-gases-in-wood-pellet-storage

[16] Melin, S. 2008. Safety in handling wood pellets. Summary of the proceedings of BioEnergy Conference and Exhibition 2008. Prince George, BC., See: http://bioeconomyconference.com/wp-content/uploads/2015/10/2008_Proceedings.pdf

2. Under what circumstances can imported biomass and other biofuels deliver real GHG emissions savings (considering full life-cycle emissions and indirect/wider market effects)? Conversely, what evidence is there for ruling out certain sources on the grounds of lifecycle GHG emissions or sustainability risks?

According to a 2015 report by Forest Research, the greatest emissions savings that can be achieved between now and 2050 come from energy scenarios with the lowest contribution from biomass. Conversely, the highest levels of emissions from land use are caused by scenarios with the highest contributions of biomass to energy generation.[1] Thus, if the UK Government's goal is achieving genuine carbon reductions and compliance with its obligations under the Paris Accord and its own Climate Budgets, the answer is less, not more, biomass.

Most specifically, to encourage investment flows towards truly low-carbon biomass and efficient biomass energy uses, and away from known high-carbon sources and the least efficient bioenergy projects, significant evidence now points to the need for UK policymakers to, at a minimum, (1) rule out subsidies or other incentives for biomass electricity generated from roundwood from standing trees; and (2) require any forest biomass used to generate electricity to be burned only in efficient installations cogenerating heat alongside power. Even then, available supplies of true wastes and residues would be quite limited and put to higher value use outside the electricity sector.

Imported biomass for electricity generation cannot deliver real GHG emissions savings within a relevant timeframe for addressing climate change at the scale at which it is currently employed in the UK, nor at the scale at which it is envisioned for future employment. As discussed in the response to question 1, current UK biomass demand has led to the use of whole trees and other large-diameter wood, including from clearcut hardwood forests in the Southeast U.S. Numerous independent institutions, government bodies, and scientists have analyzed the lifecycle GHG impacts of burning biomass from the Southeast U.S. and have concluded that doing so will result in an increase of atmospheric CO_2 for multiple decades or longer. While these studies conclude that burning true saw-mill residues or post-consumer wastes could potentially reduce atmospheric CO_2, assuming these wastes and residues have no alternative higher-value end use, they also establish that such practices are not currently occurring and, even if they were, would provide insufficient quantities of biomass to meet current demand.

Despite this reality, the UK Government's 2017 Clean Growth Strategy (CGS) envisions a 36% increase in the use of bioenergy by 2023. The use of imported biomass or biofuels to meet this increased utilization of biomass cannot be done while achieving genuine carbon reductions, as required by Principle 1 of the Government's Bioenergy Strategy:

[1] Forest Research, *Carbon Impacts of Biomass Consumed in the EU: Quantitative Assessment* (2015), https://ec.europa.eu/energy/sites/ener/files/documents/EU%20Carbon%20Impacts%20of%20Biomass%20Consumed%20in%20the%20EU%20final.pdf.

Policies that support bioenergy should deliver genuine carbon reductions that help meet UK carbon emissions objectives to 2050 and beyond. This assessment should look—to the best degree possible—at carbon impacts for the whole system, including indirect impacts such as ILUC, where appropriate, and any change to carbon stores.

According to the aforementioned January 2018 analysis by Sterman, et al., the only scenario that resulted in a reduction of atmospheric carbon was scenario 1.[2] In scenario 1, "biomass is assumed to have the same carbon emissions per EJ of end-use energy as coal, including the same combustion and processing efficiency and supply chain emissions." This scenario also assumes that, "25% of the biomass is removed from each hectare of the harvested forest by thinning, not clear cutting." Evidence collected on sourcing for Enviva's mills in North Carolina and Virginia does not support such an assumption. Sterman, et al. further concludes that existing managed plantations cannot meet the growth in demand for wood pellets without diverting their harvest away from demand for other uses.[3]

Moreover, as explained in a 2015 letter from the SELC, Drax's sourcing data from 2014 demonstrates that "[o]f the total wood biomass sourced by Drax from the United States approximately 80% is derived from OFGEM categories that in whole or in part include whole trees."[4] A supply from forestry thinnings removing only 25% of the biomass is very unlikely to provide the volume Drax requires. Even under this scenario, it takes 100 years for atmospheric CO2 to be lowered by .026 ppm.

In addition to reforming UK biomass sourcing standards to exclude the highest carbon sources of biomass from subsidies, UK policymakers must also ensure adequate enforcement of sourcing standards. The UK's current definitions of biomass "wastes" is overly broad, incentivizing the clearcutting of Southeastern U.S. forests that would have been uneconomic to harvest selectively for timber, with a significant portion of whole "low value" or "bent" trees used for wood pellets. Unfortunately, sustainability standards promoted by the bioenergy industry are demonstrably insufficient to prevent such unsustainably harvested wood from entering the supply chains of Drax and others. These critical inadequacies are discussed in detail in various reports by UK-based Biofuelwatch[5], as well a 2017 study by NRDC and Dogwood Alliance into the Sustainable Biomass Program (SBP)[6]—discussed in greater detail in our response to Question 4.

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[2] Sterman, et al., *Does Replacing Coal with Wood Lower CO_2 Emissions? Dynamic Lifecycle Analysis of Wood Bioenergy* (2018), http://iopscience.iop.org/article/10.1088/1748-9326/aaa512/meta.

[3] Ibid, page 23.

[4] Letter from Southern Environmental Law Center, to UK and EU Policy Makers, *New Study Shows Drax/Enviva Reliance on Southeast U.S. Hardwoods for Pellets Will Result in Greater Carbon Emission than Continued Reliance on Coal* (June 2, 2015, updated Feb. 1, 2017), https://www.southernenvironment.org/uploads/words_docs/1501149_1.pdf?cachebuster:64.

[5] Biofuelwatch, *Sustainability Standards for Bioenergy*, http://www.biofuelwatch.org.uk/category/reports/sustainability-standards/ (several reports available for review).

[6] NRDC & Dogwood Alliance, *The Sustainable Biomass Program: A Smokescreen for Forest Destruction and Corporate Non-Accountability* (2017), https://www.nrdc.org/resources/sustainable-biomass-program-smokescreen-forest-destruction-and-corporate-non.

3. Currently the UK imports a significant proportion of wood pellets for biomass electricity production from North America, particularly the south-east USA.

   a) What are the wider market impacts of demand for wood pellets on forestry management practices and carbon stocks at the landscape level in North America?

Demand for wood pellet production in the Southeastern U.S. has increased dramatically over the last 6 years and is projected to continue to increase at a rapid pace. Much of this increase was driven by U.K. imports. According to Forisk, an independent consulting firm that analyzes forest supplies, the U.K. accounted for 40% of the global industrial wood pellet consumption—about 4.1 million tons of the world's 10.6 million tons (excluding pellets used for residential or heating purposes) in 2014. Global industrial pellet demand is projected to increase from 10.6 million to 25 million tons over the next five years (excluding pellets for heat), with "[t]he largest projected increase to occur in the U.K., where demand will grow an additional 8.8 million tons."[1]

Various mainstream media outlets, including a 2013 investigative report by the Wall Street Journal[2], have investigated and documented the changes brought about by this increased demand for wood pellets. Loggers from the Southeast U.S. interviewed for the article stated, "The logging industry around here was dead," but with Europe's demand for wood pellets, "we can barely keep up." Loggers also said that the demand for wood to supply Enviva wood pellet mills was so high that "you can justify shovel-logging again [clear felling using roads of felled lumber in the swamp]," and that Enviva was "paying for some swamp logging." Prior to this increased demand, hardwood pulpwood was either left on the site or the site itself was considered uneconomic to harvest and was therefore left untouched.

In 2014, the U.S. Forest Service Southern Research Station published a report entitled, "Effect of Policies on Pellet Production and Forests in the U.S. South". This report projected pellet demand in the region that could require up to 49 million green short tons per year by 2020.[3] *See: Table 5, p. 15*. The study concluded that projected pellet demand in the coastal South would result in more than a doubling of pine pulpwood prices by 2025 (from 2012 prices). *See* Figure 17, p. 27. Hardwood pulpwood prices were projected to increase by roughly 30% by 2016 and remain 20% higher than 2012 prices through 2040.[4]

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[1] Forisk Consulting, How Can Global Demand for Wood Pellets Affect Local Timber Markets in the U.S. South? (May 2015): http://forisk.com/blog/2015/06/02/how-can-global-demand-for-wood-pellets-affect-local-timber-markets-in-the-u-s-south/

[2] Justice Scheck & Ianthe Jeanne Dugan, The Wall Street Journal, Europe's Green-Fuel Search Turns to America's Forests (May 27, 2013), https://www.wsj.com/articles/SB10001424127887324082604578485491298208114.

[3] *Abt, Karen, et al.*, Effect of policies on pellet production and forests in the U.S. South: a technical document supporting the Forest Service update of the 2010 RPA Assessment, *U.S. Forest Service (2014),* https://www.srs.fs.usda.gov/pubs/47281

[4] The model used by the authors included an assumption that this doubling of prices for pine pulpwood would eventually result in increased planting of pines by landowners. Using this assumption, the model concluded that pine pulpwood prices would retreat to 20-30% higher than 2012 prices by 2040. We would note that the authors' projection that higher prices would lead to increased pine plantations is speculative. Landowners may not be willing to make the long-term investment in planting pine based on a subsidized market that could shrink dramatically or even disappear in the future. If demand for pellets stays strong, landowners may

These increases in pine pulpwood and hardwood pulpwood prices would have significant impacts on the U.S. domestic pulp market. Already, U.S. companies consuming pulpwood for paper and wood product production have complained of the competitive impacts of subsidized EU and U.K. pellet demand. U.S. pulp and paper companies sought an inquiry into the subsidies for Drax's conversion of their third unit (unit #1).[5] *See* paragraphs 43-47. The U.S. companies submitted data showing that the price of pine pulpwood in the U.S. southeast increased by 25% between 2011 and 2014 and the price of hardwood pulpwood increased by 53%. According to the complaint filed, the increase in wood pellet production caused these price increases. *See* paragraph 45. The U.S. industry claimants also asserted that "subsidies are diverting U.S. forest fibre stock from traditional consumers; that the primary fibre stock utilized for pellets is pulpwood and not residual fibres and that subsidies risk compromising the regional sustainability of the U.S. forest." See paragraph 47.

Dr Matthew Hansen's Global Forest Change work at the University of Maryland shows that the Southeastern U.S. is the most heavily disturbed forest landscape in the world. Over a decade, roughly one-third of the tree cover is either re-growing or cleared. Due to disturbance, the forest is on average younger and therefore holds less mass and carbon stock. See Global Forest Watch animation from satellite images centred at Ahoskie, North Carolina, home to one of the biggest pellet plants in the United States.[6] Forest loss (pink) is increasing relative to forest gain (blue). This represents the turning of the landscape into a tree farm.

b) What evidence is there that wood pellet production displaces other uses of forestry products in North America? (e.g. panel board or lumber production)

In a 2015 study, RISI projects U.S. wood pellet exports will increase from 3.9 million metric tons in 2014 to 10.6 million metric tons in 2019.[7] According to RISI, the vast majority of feedstock used to produce pellets in the U.S. South is pulpwood (76%) and clean sawmill residuals (12%) that could otherwise be used to make paper and wood products. Concurrently, RISI projects a resurgence in the oriented strand board (OSB) markets, spurring 6% annual growth in roundwood consumption by that industry over the same period. Pulp output in the U.S. South is expected to remain flat throughout the forecast period. In aggregate, the U.S. South's demand for all pulpwood and lower-grade feedstock will increase 2.2% annually from 2015-2019. The RISI study also observes that, "[g]oing forward, the overall share of pulpwood [trees used to make pellets] will grow, relative to mill residuals [or wood waste], as production shifts to larger industrial facilities that rely more predominantly on pulpwood."

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choose simply to harvest more of their existing pine and hardwood stands to meet pellet demand. Whether landowners will plant pines on agricultural lands depends on many factors including the prices of agricultural products. And if land is taken out of agricultural production, its yield may need to be replaced by agricultural production elsewhere, having additional carbon emissions implications.

[5] European Commission, State Aid SA.38760 (2016/C) – United Kingdom, Investment Contract for Biomass Conversion of the First Unit of the Drax Power Plant (2016), http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC_2016_046_R_0003#search=%22%22.

[6] http://www.globalforestwatch.org/map/10/36.27/-76.98/USA/grayscale/loss,forestgain?tab=analysis-tab&begin=2001-01-01&end=2015-01-01&threshold=30&dont_analyze=true

[7] RISI, *An Analysis of UK Biomass Power Policy, US South Pellet Production and Impacts on Wood Fiber Markets* (2015), http://docplayer.net/25281897-An-analysis-of-uk-biomass-power-policy-us-south-pellet-production-and-impacts-on-wood-fiber-markets-prepared-for-the-american-forest-paper.html.

Using the ability to pay numbers of the Renewables Obligation Certificates (ROCs) and Contracts for Difference (CfD) schemes, the RISI study calculates the price at which pellet manufacturers could purchase wood and still break even. RISI finds that under the RO scheme, "US South pellet producers would be able to pay approximately $48 [per green short ton] of delivered fiber or $26 [per green short ton] of stumpage at breakeven," while under the CfD scheme, "US South pellet producers would be able to pay approximately $75 [per green short ton] of delivered fiber or $53 [per green short ton] of stumpage at breakeven." Under either scheme, the subsidies enable pellet producers to out-compete other market participants by paying prices that are substantially higher than the current average pulpwood stumpage price in the South, which is about $11 per green short ton, according to RISI.

The RISI study also shows that prices for both hardwood and softwood pulpwood in the Southern US have increased dramatically from 2011 to 2015: 27% for softwood and 56% for hardwood. These figures indicate pellet demand has already raised pulpwood prices and distorted the market as a result of the existing subsidies.

c) What are the most likely alternative/counterfactual uses of forestry products used for wood pellet production?

We are not responding to this question.

d) How are these wider market impacts (sub-questions a-c) likely to change over time if demand for wood pellets significantly increases?

Forisk concluded that increased UK demand for industrial pellets will increase stumpage prices by about 30% to 40% in the Southern US over 2015 to 2019.[8] On the conservative end of the estimate, assuming no increase in demand for paper or OSB, increased demand from biomass-burning plants could increase average stumpage prices in the U.S. South by 31% in the next five years. Additional risks of undersupply lie in a recovery in U.S. housing which is realistically expected. It will boost demand for OSB and, along with a significant increase in pulpwood demand, lead to even higher stumpage and delivered wood costs in the U.S. South. This increase in demand is projected to occur at the same time as large-scale wood pellet projects commence operations. Including expected demand for pulpwood and OSB alongside pellet demand, stumpage prices could increase by 41% in five years across the South, with the greatest impacts occurring in North Carolina, Tennessee, Arkansas, and Texas.

The tightening wood pellet market in the U.S. and EU is already visible from the expansion of the wood pellet market into new areas: Russia, CIS countries, Brazil, China. This is problematic because scientists have recognized that if more land and forests are being used for bioenergy, this can cause market distortion locally, regionally or globally, and endanger the supply of biomass for other uses, e.g. food, feed and fibre.

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[8] Forisk Consulting, How Can Global Demand for Wood Pellets Affect Local Timber Markets in the U.S. South? (May 2015): http://forisk.com/blog/2015/06/02/how-can-global-demand-for-wood-pellets-affect-local-timber-markets-in-the-u-s-south/

4. Aside from GHG emissions, what evidence is there of other sustainability impacts associated with imported biomass or other biofuels? What evidence is there for how these might change as a function of scaling up supply (from the US, and internationally)?

Biodiversity

As previously stated, the primary source of the UK's wood pellet imports is the Southeastern U.S., where the wood pellet manufacturing industry has increased rapidly in the past few years. A map created by SELC, and updated in January 2018, shows the operating and proposed wood pellet mills in the Southeast U.S. exporting to Europe, of which there are 21 operating and 15 proposed.[1] This map highlights a major concern with the wood pellet industry in the Southeast U.S.—the biodiversity impacts of sourcing from the region's natural longleaf pine and hardwood forests. As illustrated by the map, wood pellet mills in the Southeast U.S. are clustered together with presumed sourcing areas that overlap with each other and fall within or along the North American Coastal Plain, a region recently recognized as the 36th Global Biodiversity Hotspot. A biodiversity hotspot is an area rich in diversity, but which is severely threatened.

The region's highly biodiverse natural longleaf pine and bottomland hardwood forests are primarily at risk from the wood pellet industry. The negative biodiversity impacts of clearcut bottomland hardwood forests and the conversion of natural forests to pine plantations are discussed in a forthcoming SELC report.[2] According to this report, in 2016, the UK's demand for wood pellets "required harvesting approximately 303 square kilometers of forests in the southeast U.S.," which equates to "an area the size of the New Forest in England (376 sq. km., or more than 50,000 Wembley stadiums)" in a little over a year. *See* calculations provided in Footnote 9 of the report.

Additionally, the European Commission's 2016 report on the environmental impacts of relying on biomass from the Southeast U.S. recognized the "direct negative ecological consequences" of increased harvesting of upland hardwood forests and the potential conversion of these forests to pine plantations.[3]

The wood pellet industry often claims that its practices result in more forests, not less, and therefore has positive climate impacts. This argument is flawed for several reasons. First, there is little evidence supporting the industry's claim that forests are being replanted after harvest. Second, as discussed above, Sterman, et al. concluded that replanting natural forests for fast-growing pine plantations may actually increase CO_2 emissions.[4] Third, these arguments disregard the negative impacts on biodiversity of converting natural forests to

[1] Southern Environmental Law Center, *Southeast U.S. Wood Pellet Plants Exporting to Europe*, https://www.southernenvironment.org/uploads/maps/SELC_WoodPelletExportMap_2018_0123+table.pdf (last updated Jan. 23, 2018).

[2] Southern Environmental Law Center, *Burning Trees: The Truth about Woody Biomass, Energy, & Wildlife* (Jan. 2018): PDF attached.

[3] European Commission, COWI, *Environmental Implications of Increased Reliance of the EU on Biomass from the South East U.S.*, ENV.B./ETU/2014/0043 (2016), https://publications.europa.eu/en/publication-detail/-/publication/8005fb30-81e9-4399-9b19-01af823fa42d

[4] Sterman, et al., *Does Replacing Coal with Wood Lower CO_2 Emissions? Dynamic Lifecycle Analysis of Wood Bioenergy* (2018), http://iopscience.iop.org/article/10.1088/1748-9326/aaa512/meta.

monoculture pine plantations. According to the U.S. Forest Service, pine plantations are "generally poor wildlife habitat," especially "when compared with natural pine and hardwood forests."[5]

The Southeast U.S. is home to hundreds of species of conservation concern, many of which are listed as threatened or endangered under the Endangered Species Act. According to a 2015 report by the NRDC, the potential sourcing area for operating and proposed mills in the Southeast U.S. "include[s] critical habitat for up to 25 different species that are federally listed as imperiled or endangered."[6] Additionally, a 2013 report by the National Wildlife Federation (NWF) discussed the "large number of species of high conservation concern" that inhabit natural pine forests and "are known to show adverse effects from landscape scale conversion of longleaf pine to plantation forestry."[7] In particular, SELC identified thirty species of birds of conservation concern that are harmed by the loss of mature hardwood forests in Southeast U.S. Coastal Plain.[8]

A 2015 report by Dogwood Alliance[9] discusses the many concerning impacts from the expansion of the wood pellet manufacturing industry:

- Loss of amenity and increased urbanization of rural landscapes could limit the attractiveness of the region as a location for new residents and businesses.
- Expansion of biomass pellet manufacturing in the U.S. Coastal South will raise timber prices in the short term and could change the industry structure for decades to come.
- Pellet manufacturing will increase at the expense of lumber, panel, and paper manufacturing, in which job creation is stronger than in pellets.
- Due to subsidies, both private and public investment is diverted away from enterprises and/or economic development opportunities that could, in an undistorted market, produce higher returns or greater public benefit.
- When the subsidies end, the boom in pellet manufacturing in the U.S. will turn into a bust. At that time, excess capacity including plants and workers will be idled, and the region will be left with unneeded factories, lost jobs, and degraded forest ecosystems.

An upcoming report from Dogwood Alliance[10] details the ecosystem service value of wetland forests in the south and highlights the discrepancy between timber values (up to $1,200 per

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[5] David N. Wear & John G. Greis (Eds.), USDA Forest Service, *Southern Forest Resource Assessment* 55 (Sept. 2002), https://www.srs.fs.usda.gov/pubs/gtr/gtr_srs053.pdf.

[6] NRDC, *Bioenergy Threatens the Heart of North American Wetland Forests* 1 (Oct. 2015), https://www.nrdc.org/sites/default/files/southeast-biomass-exports-FS.pdf.

[7] National Wildlife Federation, Forestry Bioenergy in the Southeast United States: Implications for Wildlife Habitat and Biodiversity (Dec. 23, 2013), https://www.southernenvironment.org/uploads/publications/forestry_bioenergy_in_the_SE_U.S..pdf.

[8] Southern Environmental Law Center, *Wood Pellet Industry Destroys Forests and Harms Birds of Conservation Concern*, https://www.southernenvironment.org/uploads/words_docs/Wood_Pellets_Birds_of_Conservation_Concern_Handout.pdf.

[9] Dogwood Alliance, *Wood Pellet Manufacturing: Risks for the Economy of the U.S. South* (2015), https://www.dogwoodalliance.org/wp-content/uploads/1999/11/finaleconreport2015.pdf.

[10] Dogwood Alliance, "Treasures of the South: The True Value of Wetland Forests," 2018, https://www.dogwoodalliance.org/treasures-of-the-south

acre) and preservation values ($18,600 per acre). Although the report does not closely detail the wood pellet industry in the U.S. South, other reports, such as NRDC's 2015 report, make the case that forests that would be left untouched (like many swamps) will be targeted for wood pellets because it is a low-quality product. The impact is a huge concern.

In 2016 alone, the UK's biomass demand required harvesting approximately 303 square kilometers of forests in the Southeast U.S. The area of forests harvested every year will only increase as demand increases and supply scales, resulting in more adverse impacts on the region's globally recognized biodiversity.

Air pollution

The biomass industry has significant air quality impacts, both at the manufacturing and end use stage. Wood pellet manufacturing facilities, especially those in the Southeast U.S., are generally located in poor, rural communities. A 2017 analysis by Dogwood Alliance showed a 75% increase in particulate matter after Enviva's Sampson, North Carolina wood pellet mill began operation.[11] Particulate matter, especially fine particulate matter (PM2.5), emitted from these facilities can cause serious health problems, such as asthma attacks, cardiovascular disease, lung cancer, and premature death. Once the wood pellets are manufactured and shipped to the U.K., they are burned for electricity causing further air quality impacts.

According to a 2017 Biofuelwatch report, burning wood at the Drax power station has resulted in more than a doubling of harmful particulate pollution.[12] Additionally, a 2018 report by Fern discusses evidence demonstrating that, "tens of thousands of EU citizens are dying prematurely every year as a result of exposure to air pollution from burning solid biomass," as well as other health impacts including cancer, cardiac and respiratory complaints, and asthma attacks.[13]

Legality

Moreover, it will be important to consider the legality of biomass stemming from regions such as eastern Europe, Latin America, West and Central Africa, and Asia. On top of the requirement for sustainability in UK law, the EU's Timber Regulation requires that *all* woody biomass imported into the EU is also legally sourced.[14] Operators are required to carry out due diligence to assess the risk that the wood they use was harvested illegally. Looking at the trade in timber generally, the risk of illegality within the abovementioned regions is higher than in the US and Canada. Laws surrounding forest management are often unclear and uncomprehensive in these regions of the world, leading to greater risks of illegality. Any

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[11] Dogwood Alliance, *Biomass Facilities Impact Air Quality in Surrounding Neighborhoods* (2017), https://www.dogwoodalliance.org/wp-content/uploads/2017/08/Air-Quality-Fact-Sheet.pdf.

[12] Biofuelwatch, *Briefing: Drax Power Station Emissions - Coal-to-Biomass Conversion Increases Levels of Dangerous Small Particles* (July 2017), http://www.biofuelwatch.org.uk/wp-content/uploads/Drax-and-air-quality-briefing_final.pdf.

[13] Fern, *Covered in Smoke: Why Burning Biomass Threatens European Health* (2018), http://www.fern.org/report/biomassandhealth.

[14] ClientEarth (2014) 'What does the EU Timber Regulation mean for the biomass industry?' *Bioenergy regulations* https://www.clientearth.org/biomass-and-the-eu-timber-regulation/.

illegality in the harvesting of timber would extend to wastes, residues, commercial thinnings or other by-products from the forest harvest used to produce wood pellets.

According to IEA Bioenergy, trade in biomass is expected to grow.[15] This is likewise indicated by the announcement by the nineteen countries of the 'Biofuture Platform,[16]' in which subscribing countries indicate that they will increase the use of wood for energy generation. If wood pellet supply is scaled up internationally and expands to other regions of the world, beyond North America, there is a risk that biomass demand drives deforestation of the world's remaining forests.

If demand for biomass grows, forested countries of the world's tropics (Latin America (Argentina, Brazil, Chile, Colombia and Mexico), West Africa and Mozambique) and of eastern Europe (Russia and Balkan countries) may be the next sourcing targets.[17] In many of these potential exporting countries, deforestation is a significant challenge and large-scale exports could exacerbate this. Poor governance creates significant risk of biomass demand contributing to deforestation and forest degradation.[18] Issues of unclear land tenure and property rights, weak law enforcement capacity, incentives to convert natural forest land to other uses, and insufficient human resources to monitor forests could all contribute to natural forests, including those with high biodiversity or high carbon stock value, being (over-) exploited for biomass.[19]

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[15] IEA Bioenergy (2017) 'Global Wood Pellet Industry and Trade Study 2017' http://task40.ieabioenergy.com/wp-content/uploads/2013/09/IEA-Wood-Pellet-Study_final-2017-06.pdf.

[16] Biofuture Platform (2017) 'Major Countries Agree to Develop Sustainable Biofuels Targets and Scale Up Low Carbon Bioeconomy' http://biofutureplatform.org/wp-content/uploads/2017/11/NEWS-RELEASE-Major-Countries-Agree-to-Set-Biofuels-Targets-and-scale-up-Bioeconomy.pdf.

[17] IEA Bioenergy 'Global Wood Pellet Industry and Trade Study 2017' (2017) http://task40.ieabioenergy.com/wp-content/uploads/2013/09/IEA-Wood-Pellet-Study_final-2017-06.pdf; IEA Bioenergy 'Global Wood Pellet Industry Market and Trade Study' (2011) http://task40.ieabioenergy.com/wp-content/uploads/2013/09/t40-global-wood-pellet-market-study_final_R.pdf.

[18] European Commission, 'Questions and answers on deforestation and forest degradation' (2008) europa.eu/rapid/press-release_MEMO-08-632_en.pdf; BirdLife (2016) Black Book of Bioenergy.

[19] Lawson, Sam. "Consumer Goods and Deforestation: An Analysis of the Extent and Nature of Illegality in Forest Conversion for Agriculture and Timber Plantations" Forest Trends (2014).

5. Are there any benefits resulting from importing biomass or other biofuels into the UK (e.g. development benefits)? How might these vary internationally? What are the conditions required for any benefits to be realised?

In the Southern U.S., communities have been negatively impacted by the wood pellet industry, primarily through increased noise and dust pollution, threats to clean drinking water and health impacts from the release of particulate matter, such as asthma and allergies.[1],[2] The Rising up with Richmond County[3] film demonstrates environmental justice concerns by the communities affected by a proposed Enviva pellet mill.

Attorneys for Environmental Integrity Project have found that wood pellet mills systematically violate the Clean Air Act's major source permitting requirements by failing to install the best available control technology. Numerous facilities emit VOCs well above the major source threshold but have not installed any controls to reduce VOC emissions, despite the Act's clear mandate to do so.[4]

Internationally, forests provide livelihoods for 1.6 billion people, more than 25% of the world's population.[5] Safeguarding forests and the benefits they provide to the global climate and more directly to the people who live nearby is therefore very important to equitable and sustainable development and any biomass market must take this into account.

To date, the main country of the global South with plans to export biomass to the UK is Brazil. Therefore, we take Brazil as a case study for development impacts from the biomass industry on the global South. Unfortunately, there have been significant challenges and few benefits. Primarily, significant 'land grabs' characterise tree plantations in Brazil, where local communities struggle to secure recognition of and uphold their traditional rights over land. This lack of recognition of customary rights of local communities is a common development challenge across the global South. Large-scale land appropriations for tree plantations in Brazil have led to increases in land conflict and violations of communities' traditional land rights, resulting in evictions and the displacement of local communities from their territories.[6]

Large-scale tree plantations in Brazil have increased land prices, decreased food and energy security and depreciated local economies. Tree plantations in Brazil have also affected the

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[1] Dogwood Alliance (2017) Human Health Factsheet https://www.dogwoodalliance.org/wp-content/uploads/2017/08/Human-Health-Fact-Sheet.pdf

[2] Clean Air Carolina (2017) Despite Industry Claims, Wood Pellet Industry Is Bad for Human and Planetary Health https://cleanaircarolina.org/2017/04/despite-industry-claims-wood-pellet-industry-bad-human-planetary-health/.

[3] Dogwood Alliance, "Press Release: Rising Up with Richmond County to Stop a Proposed Enviva Pellet Mill," 2017, https://www.dogwoodalliance.org/2017/06/press-release-rising-up-with-richmond-county-to-stop-a-proposed-enviva-pellet-mill/.

[4] Environmental Integrity Project (2017) Wood Bioenergy Project http://www.environmentalintegrity.org/what-we-do/wood-bioenergy/

[5] http://www.forestpeoples.org/sites/fpp/files/publication/2012/05/forest-peoples-numbers-across-world-final_0.pdf

[6] Winfridus Overbeek (2011) 'The new trend of biomass plantations in Brazil: tree monocultures' http://wrm.org.uy/articles-from-the-wrm-bulletin/section1/the-new-trend-of-biomass-plantations-in-brazil-tree-monocultures/

water table, with a reduction in the volume of water flowing through the streams and rivers, with resulting detriments to local populations' water security.[7]

Learning from the cases of U.S. Southeast and Brazil, an obvious condition required for any benefits to be realised is the free, prior and informed consent (FPIC) of any communities living in or around the proposed biomass sourcing area. In addition, in countries of the global South, it will be very important to guarantee secure land tenure to local communities, to avoid 'land grabs'.[8],[9],[10]

[7] Goncalves de Souza and Winfridus Overbeek (2013) 'Eucalyptus Plantations for Energy: a case study of Suzano's plantations for wood pellet exports in the Baixo Parnaiba region, Maranhao Brazil' (http://wrm.org.uy/wp-content/uploads/2013/11/eucalyptus-plantations-for-energy.pdf)

[8] World Rainforest Movement (2013) 'Tree plantations in the South to generate energy in the North. A new threat to communities and forests' http://wrm.org.uy/wp-content/uploads/2013/04/Tree_plantations_in_the_South_to_generate_energy_in_the_North.pdf

[9] Timberwatch Coalition and World Rainforest Movement, (2017) 'Industrial tree plantations invading eastern and southern Africa' http://wrm.org.uy/wp-content/uploads/2016/10/2016-10-Plantations-in-ES-Africa-TW-WRM-med-screen.pdf

[10] European Parliament (2012) 'Impact of EU Bioenergy Policy on Developing Countries' Directorate-General for External Policies: https://www.ecologic.eu/sites/files/project/2013/2610_21_bioenergy_lot_21.pdf

Sustainability policy and certification

The sustainability framework for bioenergy in the UK has evolved significantly since 2011. Changes have included the tightening over time of lifecycle GHG emissions limits for bioenergy supported under Government incentive schemes, changes to EU rules on liquid biofuels and the development of certification schemes. Nonetheless questions remain regarding the current framework's capacity to guarantee high sustainability standards.

The term 'sustainability framework' refers here to the policies, regulations and incentives in place to promote bioenergy sustainability in the UK.

6. What are the strengths, weaknesses and gaps of the current sustainability framework for bioenergy in the UK? How could the current sustainability framework for bioenergy in the UK be improved to address these issues?

This answer will focus on the UK's sustainability framework for woody biomass used in electricity production.

The UK's sustainability framework is not strong enough to guarantee large-scale woody biomass use does not harm the environment. The sustainability standards are weak and flawed and cannot offer any guarantee that large-scale woody biomass burning for electricity does not increase GHG emissions or harm the environment. Fundamentally, the UK's sustainability framework (and the Sustainable Biomass Program - see detail in our response to Question 7) confuse 'sustainable forest management' (SFM) with the overall climate impact and environmental sustainability of burning biomass for energy in the UK.[1]

GHG criteria

Considerations of how the GHG criteria - which form one part of the UK's Sustainability Criteria - would be improved are captured in our response to Question 9.

Land criteria

The land criteria are based largely on principles, rather than detailed standards. They focus heavily on policies and procedures, rather than outcomes, and do not require full compliance with those procedures. The result is that these criteria provide only limited protection for certain high biodiversity and high carbon stock areas from conversion for bioenergy.

The UK's woody biomass sustainability criteria do not include any restrictions on sourcing woody biomass from primary forests (including old growth forests), nature protection or highly biodiverse areas, peatlands, former wetlands or former continuously-forested areas. This is in contrast to the criteria for non-woody biomass, which do include these sourcing restrictions. This is a significant weakness, as there is evidence that woody biomass sourcing is harming primary forest and biodiverse areas. In the Southeastern U.S., coastal bottomland

[1] Biofuelwatch (2016) Why the UK's new Sustainability and Greenhouse Gas standards for Biomass Cannot Guarantee sustainability or low carbon impacts http://www.biofuelwatch.org.uk/wp-content/uploads/Biomass-Sustainability-standards-briefing1.pdf; Why the UK's new Sustainability and Greenhouse Gas Standards for Biomass still allow biomass to pollute more than coal. http://www.biofuelwatch.org.uk/wp-content/uploads/MPs-briefing-on-biomass-sustainability-standards.pdf

forests, which are recognised as a World Biodiversity Hotspot,[2] are being clear-cut to supply the pellet manufacturer Enviva[3], and natural forests are being converted into tree plantations.[4]

From a climate perspective, it is particularly important that natural forests are not converted into tree plantations, as recent research shows "the equilibrium carbon density of managed plantation is lower than unmanaged forest, so carbon sequestered in plantations never offsets the carbon taken from the original forest".[5] The 2014 UK Department of Energy and Climate Change BEaC study also demonstrates that any increase in the harvest of natural forests due to biomass will increase CO_2 emissions to be greater than coal over a 40-year timespan.[6]

The UK's woody biomass sustainability criteria also do not restrict the type of woody biomass eligible for subsidies. There is abundant evidence that stumps and roundwood are high-carbon feedstocks. Use of such feedstocks should be ineligible for energy subsidies or other policy incentives, which should be restricted to true wastes and residues.

The UK's sustainability framework should:

- Restrict biomass harvest from primary forests, nature protection or highly biodiverse areas, wetlands, peatland, former wetlands or former continuously-forested areas.
- Restrict the use of whole trees and other large-diameter wood (roundwood and stumps) to prevent any additional pressure to cut down additional trees for bioenergy production.

Establishing operator compliance with the sustainability criteria

The process established to monitor compliance with the sustainability criteria is a weakness of the current UK framework, as it does not require sufficient assessment and oversight by Ofgem. Ofgem relies on biomass-burning plants to self-report on their sourcing. This process is open to gaming, as well as inadvertent misrepresentations. Biomass operators appoint their own auditors and pay for audits of their reports.

As the regulator responsible for assuring that biomass use for electricity in the UK is sustainable, Ofgem should take a more active role in assessing biomass operator's compliance. Currently, Ofgem has no remit or budget to effectively police or enforce the sustainability standard.

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[2] Critical Ecosystem Partnership Fund (2017) 'Announcing World's 36th Biodiversity Hotspot North American Coastal Plain' https://www.cepf.net/stories/announcing-worlds-36th-biodiversity-hotspot-north-american-coastal-plain.

[3] NRDC, Dogwood Alliance, & SELC, *European Imports of Wood Pellets for "Green Energy" Devastating U.S. Forests* (2017), https://www.nrdc.org/resources/european-imports-wood-pellets-green-energy-devastating-us-forests

[4] Kittler, B. et al. 2016. Environmental implications of increased reliance of the EU on biomass from the South East US. European Commission, http://bit.ly/2i5WySH.

[5] Sterman, et al., *Does Replacing Coal with Wood Lower CO_2 Emissions? Dynamic Lifecycle Analysis of Wood Bioenergy* (2018), http://iopscience.iop.org/article/10.1088/1748-9326/aaa512/meta.

[6] Stephenson, A.L. and MacKay, D.J.C. (2014) *Life Cycle Impacts of Biomass Electricity in 2020*, DECC https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/349024/BEAC_Report_290814.pdf

7. Ofgem has identified a number of certification schemes that it considers appropriate for demonstrating compliance with the 'Land Criteria' under the Renewable Obligation sustainability standards. Are these certification schemes adequate? Why/why not? How could they be improved?

Most of the standards and procedures for certification schemes approved by Ofgem are highly deficient in many important respects.

First and foremost, they all ignore crucial aspects of forest carbon accounting - forest carbon losses are ignored or rely on faulty, generic regional data. Regional data is unlikely to adequately capture management trends and problems in the forests from which biomass producers are sourcing, both because of the scale of data collection, and because regional data simply is not collected for some topics covered by the standards. Existing regional data also fail to capture the effects of biomass logging, given that widespread commercial biomass extraction is a relatively new practice. None of the schemes require producers to calculate the carbon emissions associated with carbon stock changes resulting from biomass harvests. Some examples of emissions sources and carbon stock changes include soil disturbance and reductions in soil carbon stores. The amount of carbon in forest soils can rival the amount in the trees. Emissions associated with logging and disturbing wetlands and peatlands can be especially significant. These two ecosystems store vast amounts of carbon and logging operations disturb the soil, causing the carbon to be released. As a result, the standards tell us nothing about the carbon emissions impacts associated with burning a specific biomass feedstock.

On forest sustainability and legality, many of the standards (with the exception of the Forest Stewardship Council (FSC) standard) typically fail to provide robust, performance-based thresholds and protections. Under the standards, risk assessments can be conducted with a fundamental lack of objectivity (often carried out by the biomass producers themselves), consistency, and connection to the management of actual source forests, and they rarely require on-the-ground verification of the source forests. Standards frequently point to regional-scale data, the “existence of a strong legal framework in the region,” “regional best management practices,” and other options likely to have little connection with the actual biomass logging and other relevant forestry practices. Furthermore, existing regulations are often quite weak, allowing large-scale clearcutting, old growth logging, wetlands logging, and conversion of natural forests to plantations – particularly on private forests in the Southeast. Likewise, forestry laws in many regions do not preclude short rotation logging that removes regrowth before it has replaced carbon stores that may have been lost during prior logging. Key states in the US Southeast do not even require reforestation after logging. Federal and state laws in the US also tend not to protect important categories of High Conservation Value (HCV) forests, high carbon stock forests, or prohibit use of GMO species or use of Pesticides classified as Type 1A and 1B by the World Health Organisation and chlorinated hydrocarbons.[1]

[1] Climate for Ideas (United Kingdom), Forests of the World (Denmark), Dogwood Alliance (United States), Hnutí DUHA (Friends of the Earth Czech Republic), Les Amis de la Terre (Friends of the Earth France), Greenpeace, Sierra Club of British Columbia, Suomen Luonnonsuojeluliitto (Finnish Association for Nature Conservation), Netherlands Centre for Indigenous Peoples. “On The Ground 2011: The controversies of PEFC and SFI.” http://mobil.wwf.de/fileadmin/user_upload/PDF/On_The_Ground_2011.pdf

A 2017 report by NRDC and Dogwood Alliance spotlighted these critical flaws in the Sustainable Biomass Program (SBP) standard and raised serious questions about the standard's ability to provide credible assurances of biomass sustainability and carbon emissions intensity.[2] Key findings of the comprehensive analysis of the SBP include:

- The SBP does not require calculation of emissions at the smokestack when biomass is burned, essentially classifying biomass 'carbon neutral', on a par with truly clean energy technologies such as wind and solar. As noted, recent scientific studies have concluded that burning biomass for electricity—in particular whole trees and other large-diameter wood—increases carbon emissions when compared to coal and other fossil fuel for decades.
- The SBP ignores several crucial aspects for forest carbon accounting allowing assessments to be conducted with a fundamental lack of objectivity, consistency and connection to the management of actual source forests and rarely require on-the-ground verification.
- The SBP Feedstock Standard lacks concrete, performance-orientated thresholds and protections, and thus provides little assurance regarding environmental or social protection in source forests.

Yet, the SBP remains the only certification scheme that the UK Biomass Sustainability Standard recognises as certifying sustainability in all relevant areas.

As an industry-dominated scheme, the SBP is also vulnerable to serious conflicts of interest. Until recently, its chair was Dorothy Thompson, CEO of Drax. In 2016, SBP certified two new Drax pellet mills in Mississippi. The certification of seven million hectares of diverse forest and tree plantations consisted of an audit of Drax's reports on the mills and a seven-hour site visit.[3]

[2] NRDC. The Sustainable Biomass Program: Smokescreen for Forest Destruction and Corporate Non-Accountability. 2017. https://www.nrdc.org/sites/default/files/sustainable-biomass-program-partnership-project-ip.pdf.

[3] Biofuelwatch, *Sustainability Certificate Obtained by Drax 'Reveals UK Biomass Sustainability Standards to be a Scam, Say Environmental Campaigners*, (2016): http://www.biofuelwatch.org.uk/2016/drax-sbp-pr/.

8. What certification schemes currently represent 'best practice'? Why?

The Forest Stewardship Council (FSC) standard currently represents ‘best practice’ when it comes to forest sustainability and legality. However, even this relatively robust standard does not adequately account for carbon stock changes resulting from biomass harvests. In 2014, the former CEO of FSC described chain of custody certification as a myth.[1]

[1] https://fsc-watch.com/2014/09/16/former-fsc-boss-admits-core-part-of-fsc-system-is-a-myth/.

9. Ofgem has set out approaches to calculating bioenergy GHG emissions for demonstrating compliance with the 'GHG Criteria' under the Renewable Obligation sustainability standards. Are these approaches adequate? Why/why not? How could they be improved?

The operator of a UK biomass facility must prove that they achieve a GHG emissions saving from using biomass to generate electricity compared to fossil fuels, "across the lifecycle". However, the UK's GHG criteria only includes harvest, processing and transport emissions, and excludes emissions from changes in the carbon stock of a forest, foregone carbon sequestration of forests or indirect impacts on carbon stocks in other areas of land (all together 'land-use changes'), and from combustion.[1]

The GHG criteria is a weakness of the UK's framework. Land-use changes can have significant impacts on the total GHG intensities of some types of bioenergy feedstocks, and therefore need to be accounted for. In addition, assuming that biomass is zero-rated at the stack, as the UK's GHG criteria does (Schedule 2 of the ROO 2015), erroneously presumes that forest regrows quickly and fully offsets the emissions from biomass combustion[2] and relies on flawed international land-use accounting.[3] Full re-absorption of CO_2 by forest regrowth may take over 100 years, and so the short-term impact of woody biomass is an increase in CO_2. This short-term increase in emissions from biomass may worsen the irreversible impacts of climate change, as biomass burning puts CO_2 into the atmosphere now, just when we need to be reducing it.

The GHG criteria would be strengthened by accounting for emissions from:

- The combustion of biomass;
- Changes in the carbon stock of a forest;
- Foregone carbon sequestration of forest land; or
- Indirect impacts on carbon stocks in other areas of land, resulting from re-directing biomass from other uses, such as using wood to make paper, furniture and construction materials.

[1] Stephenson, A.L. and MacKay, D.J.C. (2014) *Life Cycle Impacts of Biomass Electricity in 2020*, DECC https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/349024/BEAC_Report_290814.pdf

[2] Sterman, John D. *et al* (2018) Does replacing coal with wood lower CO2 emissions? Dynamic lifecycle analysis of wood bioenergy *Environmental Research Letters* http://iopscience.iop.org/article/10.1088/1748-9326/aaa512

[3] RSPB (2016) 'Bioenergy: A Burning Issue' https://www.rspb.org.uk/globalassets/downloads/documents/positions/climate-change/bioenergy---a-burning-issue.pdf

10. Please highlight any further measures you feel are required to ensure bioenergy feedstocks used in the UK are sustainable and deliver significant life-cycle GHG emissions savings. Why are these measures needed?

In September 2012, Tim Searchinger pointed out an important inconsistency in the 2012 UK Bioenergy Strategy.[1] The Strategy sets out some important Principles:

Principle 1: Policies that support bioenergy should deliver genuine carbon reductions that help meet UK carbon emissions objectives to 2050 and beyond. This assessment should look – to the best degree possible – at carbon impacts for the whole system, including indirect impacts such as ILUC, where appropriate, and any changes to carbon stores.

It also warns that the use of the entire tree for bioenergy is undesirable, as it is generally associated with sub-optimal carbon scenarios and can result in increased greenhouse gas emissions.

Nonetheless, the Government then also declares that bioenergy is low-carbon and should form a central part of UK renewable energy policy. We would like to alert the CCC to this inconsistency that gave a green light to "low-carbon bioenergy".

Efficiency requirements for biomass-burning plants

Forest derived biomass should only be used in the most efficient applications. The UK government should rule out the use of forest biomass in large-scale, inefficient power plants that do not use ‘co-generation’ technology to produce combined heat and power.

Government subsidies

Subsidies for industrial-scale biomass-burning for electricity should be phased out. BEIS recently decided to reduce financial support provided to large-scale power plants that convert from burning coal to biomass under the ROCs.[2] In the consultation on these proposed subsidy changes, the Government acknowledges that compared to other renewables, biomass co-firing or conversion from coal provides little or no carbon savings, and that the cost of any savings is very expensive.[3] While the decision by BEIS to reduce these ROC subsidies is a positive step, it does not appear to have discouraged further coal to biomass conversion, which would be a logical step given the acknowledgements above.[4]

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[1] Searchinger, Tim, ‘Sound principles and an important inconsistency in the 2012 UK bioenergy strategy’ 2012 http://ww2.rspb.org.uk/Images/Searchinger_comments_on_bioenergy_strategy_SEPT_2012_tcm9-329780.pdf.

[2] UK Government (BEIS) Response to consultation on controlling the costs of biomass conversion and co-firing under the renewables obligation. (January 2018) https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/674228/Government_Response_-_Consultation_on_costs_of_biomass_conversion.pdf.

[3] UK Government (BEIS) Consultation on controlling the costs of biomass conversion and co-firing under the renewables obligation. (2017) https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/645002/Biomass_cost_control_con_doc_final.pdf

[4] For example, Drax announced on the same day that it will continue with the conversion of a fourth unit to biomass: Business Green (17 Jan 2018) ‘Drax to proceed with new coal to biomass conversion following

Coherence with the circular economy

There is only a limited amount of biomass feedstock available today and many competing uses for the resource. In line with the circular economy, the UK must ensure a 'cascading use' of wood products. In other words, wood products destined for recycling or reuse must not go to energy uses instead.[5] The 2014 DECC analysis shows that displacement of non-bioenergy wood uses to bioenergy (e.g. a high demand for wood results in the displacement of wood used for other purposes) will have significant GHG emission increases.

This should result in a consideration of how to limit the forestry wastes and residues that can be used for energy, based on the waste hierarchy. The EU's Action Plan for the Circular Economy aims to "ensure coherence and synergies with the circular economy when examining the sustainability of bioenergy" in its renewable energy policies.[6]

government subsidy reforms' (https://www.businessgreen.com/bg/news/3024616/drax-to-proceed-with-new-coal-to-biomass-conversion-following-government-subsidy-reforms)

[5] Sini Eräjää, (2016) 'Biomass and the EU's circular economy equation' https://www.eubioenergy.com/2016/01/05/biomass-and-the-eus-circular-economy-equation/

[6] EU's Action Plan for the Circular Economy (http://ec.europa.eu/environment/circular-economy/index_en.htm)

11. Some large UK users of imported biomass use a risk-based approach to assess the sustainability risks associated with importing biomass from specific jurisdictions. What is the role for these approaches?

Risk assessments are often the sole step in determining if source forests comply with a sustainability standard. Yet they need not be conducted by objective third parties. Rather, they can be conducted by the biomass producers themselves, despite the inherent conflict of interest in identifying risk in their supply areas. A scan of available SBP risk assessments and audit reports for example, confirms that SBP certified biomass producers in the United States virtually never identify such risks. The SBP also gives biomass producers wide latitude to choose their own verifiers (i.e., data sources) to gauge whether their source forests are likely to comply with the SBP Feedstock Standard. This allows biomass producers to cherry-pick verifiers and data to produce more favorable results, including data that has little connection to management practices in their source forests. As mentioned above in response to Question 7, a 2017 report by NRDC and Dogwood Alliance highlights these and other critical weaknesses in the SBP.[1]

An additional concern is that some of the Ofgem recognized standards (e.g., PEFC and SBP) endorse other deficient sustainability standards. For example, under the SBP, biomass producers are not required to conduct risk assessments for operations certified by the Sustainable Forestry Initiative – a standard that routinely allows the conversion of natural forests to plantations and does not fully protect old growth forests, bottomland hardwood forests, and other rare ecosystems.

In addition, risk assessments may be undertaken on a regional level, which does not require an assessment of the risk of unsustainable forest management at the forest stand level. In other words, a risk assessment shows that the wood comes from a region with a low risk of (for example) illegal logging, threats to forests of high conservation value, or conversion of natural forests to tree plantations. It does not demonstrate that an individual forest stand has a low risk.

As mentioned in our response to Question 7, regional risk assessments place strong reliance on national and state laws. As described in a 2014 NRDC fact sheet, in the U.S. Southeast, such laws do not restrict clearcutting in sensitive forests, wetlands, etc.[2] Thus, regional risk-based analysis does not ensure protection of biodiversity. If a risk assessment is to be used to determine sustainability, assessment should be at the most granular scale possible - namely, the forest stand level. If data at this scale is not available, this should be an indication of a greater risk to the environment.

[1] NRDC. The Sustainable Biomass Program: Smokescreen for Forest Destruction and Corporate Non-Accountability. 2017. https://www.nrdc.org/sites/default/files/sustainable-biomass-program-partnership-project-ip.pdf

[2] NRDC. “The Truth About the Biomass Industry: How Wood Pellet Exports Pollute Our Climate and Damage Our Forests.” 2014. https://www.nrdc.org/sites/default/files/wood-pellet-biomass-pollution-FS.pdf

Supply of bioenergy feedstocks

In our 2011 Bioenergy Review we considered scenarios for the amount of sustainable bioenergy resource available to the UK over the coming decades. Our central 'Extended Land Use' scenario suggested that around 10% of the UK's primary energy demand could be met from bioenergy in 2050, with over half coming from domestic feedstocks. We are now looking to develop new supply scenarios through to 2050 to reflect the latest evidence on sustainability and different assumptions about the potential future availability of imported and domestically produced bioenergy resources.

To support the development of these scenarios and our wider work, the CCC is currently undertaking new analysis on how the use and management of land in the UK can deliver deeper emissions reduction and increased sequestration. This analysis will provide updated data on the potential supply of non-waste and non-food bioenergy resources from UK sources. For projections of international bioenergy resources and waste-based UK bioenergy resources we will review the latest evidence and publicly available literature. We are particularly interested in quantitative estimates of resource potential, broken down by feedstock type, that are underpinned by explicit assumptions relating to sustainability.

12. What are the most credible and up-to-date estimates for global bioenergy resource potential through to 2050, broken down by feedstock type? What key assumptions underpin these estimates?

    Please provide details of any assessments of global bioenergy resource explicitly tied to sustainability standards (covering GHG emissions, biodiversity, water use, land-use, land-rights, air-quality and other social and environmental issues)

The groups represented in this response share serious concerns about the use of large-scale bioenergy as it will encroach on available land for growing food, fibre, and natural eco-systems. Putting false hope and scarce resources into bioenergy locks us into this path and distracts from the radical change in our energy demands and systems that must take place. Some research suggests that bioenergy could meet 20% of the world's total annual energy demand by 2050. Yet doing so would require an amount of plants equal to all the world's current crop harvests, plant residues, timber, and grass consumed by livestock. This 2015 paper by the World Resources Institute explains why the world should avoid dedicating land to bioenergy production if it is to sustainably feed the global population in 2050.[1]

A report conducted by the U.S. Forest Service as part of the Southern Forest Futures Project stated that, "Production of woody biomass for bioenergy can help meet energy goals, but can also stimulate accelerated harvesting, with potentially negative implications for forest ecosystems…decreased forest productivity…increase erosion…degrade forest habitat…reducing biodiversity. However, changes from agricultural systems to forests might improve habitat conditions. Further, the high-grading of stands generally observed during some timber harvesting might be eliminated with biomass harvesting."[2]

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[1] Searchinger, Tim and Ralph Heimlich, *Avoiding Bioenergy Competition for Food Crops and Land*, World Resources Institute, January 2015: http://www.wri.org/publication/avoiding-bioenergy-competition-food-crops-and-land

[2] US Forest Service, Southern Forest Futures Project (2013): https://www.srs.fs.usda.gov/pubs/44183 Low, medium, and high bioenergy demand projections (Ch. 10); sustainability issues with bioenergy (pg. 249)

13. What is the latest evidence relating to the availability of 'marginal' and abandoned agricultural land for growing bioenergy crops (where possible, reflecting broader sustainability requirements e.g. water stress, biodiversity, social issues)? Is this evidence adequately reflected in global resource estimates?

There are widely varying definitions for 'marginal land', which in turn is leading to widely differing estimates of its availability. "Marginal land" may refer to land with low productivity (compared to European standards), inaccessible land or land that is not used for agricultural purposes for a variety of reasons: e.g. nature conservation. However, so-called 'marginal' lands are often highly biodiverse and support indigenous communities in ways that are not recognised by the authorities or companies that designate them as such. For example, the Cerrado, the tropical savannah ecoregion of Brazil, is often included in global estimates of marginal land, because it is seen as "not productive". In reality, the Cerrado is a hugely import ecosystem. Characterized by enormous ranges of plant and animal biodiversity, World Wide Fund for Nature named it the biologically richest savanna in the world, with about 10,000 plant species and 10 endemic bird species.[1]

Further, land is often officially classified as "marginal" because it is not privately owned. It may be communal land, often used for grazing, food crops, and also for collecting medicinal plants, but can also refer to, wetlands, swamps or mountainous terrain. Because communities rarely hold the land titles to communally used land, it can be difficult to prevent it from being sold.[2]

Turning marginal land into European-style agricultural land would often not only mean destroying the way of life of its current users (e.g. nomadic cattle herders), but also require large investment, e.g. into fertiliser irrigation etc. As such, investments in poor countries are often only possible for foreign companies—a practice which facilitates land grabs. Land grabs for bioenergy are well-documented and have often been without Prior Informed Consent, brutal, and even murderous. A 2008 joint report by the Gaia Foundation, Biofuelwatch, African Biodiversity Network, Salva La Selva, Watch Indonesia! discuss these issues in depth.[3] A case focused on production of the energy crop jatropha on marginal lands in Kenya offers further information on this topic.[4]

Proponents often claim that so-called marginal lands unsuitable for growing food crops could be efficiently used by certain bioenergy crops that thrive on such marginal land. The prime example for this is jatropha, which has been touted as a wonder crop for marginal lands. But research looking at jatropha growing in Africa and India over the last 10 years have shown

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[1] Conservation International, Biodiversity Hotspots: https://web.archive.org/web/20080506090731/http://www.biodiversityhotspots.org/xp/Hotspots/cerrado/Pages/default.aspx

[2] FOE Europe, "Africa: up for grabs", 2010, http://www.foeeurope.org/agrofuels/FoEE_Africa_up_for_grabs_2010.pdf.

[3] Biofuelwatch, Joint report on Agrofuels and the Myth of Marginal Lands (2008) http://www.biofuelwatch.org.uk/2008/agrofuels-and-the-myth-of-the-marginal-lands/.

[4] Biofuelwatch, A Case Study for Small Scale Farmer in Kenya Marginal lands (2008) http://www.biofuelwatch.org.uk/2008/kenya-food-versus-jatropha/.

that such expectations were unfounded. Jatropha yields on marginal land lagged expectations and were, in most cases, also marginal.[5]

Similarly, claims that jatropha needs little water turned out to be false. A 2009 study examining the water footprint of bioenergy found that, "The claim that jatropha doesn't compete for water and land with food crops is complete nonsense".[6] According to the research, jatropha can grow with little water and can survive through periods of drought, but to flourish, it needs good growing conditions just like any other plant. "If there isn't sufficient water, you get a low amount of oil production."[7]

In Mozambique, researchers did not find a single example of jatropha growing well on marginal soil: "On the contrary, almost all of the jatropha planted in Mozambique has been on arable land". The researchers found that irrigation was essential for healthy growth in plants during the early development phase, even in areas were the rainfall ranged from 800mm to 1,400mm. Furthermore, in the southern region of the country, where the lower rainfall limit is around 600mm, constant irrigation was often required."[8]

Of further concern, the soil carbon emissions from converting marginal or set-aside land are high. Fargione et al in 2008 identified a 48-year carbon debt from converting abandoned cropland to corn ethanol. The authors stated, "At least for current or developing biofuel technologies, any strategy to reduce GHG emissions that causes land conversion from native ecosystems to cropland is likely to be counterproductive."[9] The European Union's Joint Research Centre found that "the cost benefit analysis is not encouraging: rather than growing biofuel feedstocks on marginal land, growing other vegetation (e.g. Eucalyptus) to store CO_2, would be more efficient than the entire biofuel lifecycle."[10]

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[5] The Extraordinary Collapse of Jatropha as a Global Biofuel, http://pubs.acs.org/doi/abs/10.1021/es201943v

[6] Gerbens-Leenes, Winnie, et al., *The water footprint of bioenergy*, Proceedings of the National Academy of Sciences of the United States of America, June 2009: http://www.pnas.org/content/106/25/10219

[7] McKenna, Phil. *All Washed Up for Jatropha?* MIT Technology Review, June 9, 2009: https://www.technologyreview.com/s/413746/all-washed-up-for-jatropha/

[8] The jatropha trap? The realities of farming jatropha in Mozambique"; FOEI https://reliefweb.int/report/mozambique/jatropha-trap-realities-farming-jatropha-mozambique.

[9] Fargione, Joseph et al., *Land Clearing and the Biofuel Carbon Debt*, Science, 29 Feb 2008: http://science.sciencemag.org/content/319/5867/1235.

[10] Critical issues in estimating ILUC emissions, JRC, http://iet.jrc.ec.europa.eu/remea/critical-issues-estimating-iluc-emissions-outcomes-expert-consultation.

14. What are the most credible and up-to-date estimates for the amount of bioenergy resource that could be produced from UK waste sources through to 2050? Where possible please state any assumptions relating the reduction, reuse and recycling of different future waste streams.

We are not responding to this question. We refer the CCC to the evidence put forward by the Wood Panel Industries Federation.

15. What factors (opportunities, constraints, assumptions) should the CCC reflect in its bioenergy resource scenarios through to 2050?

Several recent papers focus on land availability, fresh water usage, and risks to other planetary boundary limits as it relates to bioenergy, and, in particular, negative CO_2 emissions scenarios reliant on biomass with carbon capture and storage (BECCS). This group would like to particularly alert the CCC to three:

- a February 2018 paper by Heck, et al[1],
- a February 2018 report from the European Academies of Science Advisory Council (EASAC) examining the role of negative emissions technologies, such as BECCS, in achieving Paris Climate Agreement emissions reduction targets, in which the authors underscore the risks of enormous loss of biodiversity and warn that relying on such technologies to compensate for failures to adequately mitigate emissions may have serious implications for future generations[2],
- Smith, et al. on the *Biophysical and economic limits to negative CO_2 emissions*.[3]

[1] Heck, Vera, et al., *Biomass-based negative emissions difficult to reconcile with planetary boundaries*, Nature, February 2018: https://www.nature.com/articles/s41558-017-0064-y.epdf?referrer_access_token=FyHZ6WYmSKjlBrKhCtNeHdRgN0jAjWel9jnR3ZoTv0OkhNv1HkUO82XZFYuXtY4ghzZ93ua-L9-FMDelOMcCTnQQIDQ8i5DSWVrqPPYEtdYoAWS1ODx6Qt54NV6SFX5W7N2bHUXgqlRxVW_UYKkdyg1kTAf3DIW8IU3gRdmWlgJFadYhnGLdAWFCzefSt47Bk67WNjI90Z24KPEhRya54qyLrr_vI0CIiOeG0bZOp8YlwoMQgUJVL5WWPXZWxFH12jTn2gSgkhGIUu60_T-p3AyA0KrmOaATzDR-a4SVNiCBecjHhfVMnBza6SzHrTzoNTphuOn-_RMiD3EBfEcCKg%3D%3D&tracking_referrer=www.washingtonpost.com&tid=a_mcntx

[2] European Academies Science Advisory Council, *Negative emission technologies; What role in meeting Paris Agreement targets?* February 2108: https://easac.eu/publications/details/easac-net/

[3] Smith, et al., *Biophysical and economic limits to negative CO2 emissions*, Nature, 2016: https://www.nature.com/articles/nclimate2870

16. What should be the assumptions on the share of international resource which can be accessed by the UK (e.g. per capita, current or future energy demand)?

The UK only represents roughly 1% of the global population. Yet, the 2012 UK Bioenergy Strategy assumed that 10% of global freely-traded bioenergy would be available to the UK.[1] In a world where bioenergy demand is rapidly increasing globally, this is both unrealistic and deeply unfair. Any global fair share assumption should be based on a per capita share (UK approx. 1% of world population).

Further, the current BEIS CfD consultation is looking at emissions thresholds for biomass of 40 or 25 kg CO_2e p MWh, which could not be achieved with imported feedstock.[2] Drax currently achieves emissions that average 122kg CO_2e per MWh, with lowest emissions at 35.5kg per MWh. BEIS' recent consultation on cutting costs from biomass ROC subsidies admitted that, "When compared with [other genuinely low-carbon renewable] technologies, carbon savings from biomass conversion or co-firing are low or non-existent."[3]

17. What are the prospects for the development and commercial production of 3rd generation bioenergy feedstocks (e.g. algae)? What are the timescales, costs, risks, opportunities and abatement potential of using algae to make biofuels?

We are not responding to this question.

[1] UK Government (DfT, DECC, DEFRA) UK Bioenergy Strategy, 2012, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48337/5142-bioenergy-strategy-.pdf

[2] UK Government (BEIS), Contracts for Difference For Renewable Electricity Generation. Consultation on proposed amendments to the scheme (2017) https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/668382/Contracts_for_Difference_for_Renewable_Energy_Consultation_on_proposed_Amendments.pdf.

[3] UK Government (BEIS), Consultation on Controlling the Costs of Biomass Conversion and Co-Firing Under The Renewables Obligation (2017) https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/645002/Biomass_cost_control_con_doc_final.pdf.

Scaling up UK sustainable supply

An objective of our current work on bioenergy is to better understand and reflect the potential for scaling-up of the supply of sustainably produced domestic (UK) bioenergy resources through to 2050. We aim to identify and develop policy recommendations for 'low-regrets' measures/strategies that can be implemented in the near term.

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

Recent work with the former Department of Energy and Climate Change highlights the potential for the utilisation of the biomass produced as a by-product from the management of nature conservation areas.[1]

Habitats managed for the benefit of nature conservation are dynamic systems and regular management is required to maintain many habitat types as such. This work can generate large volumes of a range of different biomass types, which are generally underutilised and often a challenge and costly to dispose of.

The scale of the opportunity is estimated to be in the region of the following[2]:

Habitat type	Area in the UK (Ha)	Percentage of area cut annually	Ha cut	Dry Tonne per ha
Reedbed	1,287	5%	64.35	7
Wet grassland	7,457	75%	5,592.75	4
Lowland Fen	1,665	10%	166.5	9
Upland acid grassland	21,679	10%	2,167.9	2
Mixed heath (gorse, heather & bracken)	3,156	10%	315.6	3.6

[1] Mills, Sally, "Wetland Conservation Biomass to Bioenergy End User Report," RSPB and DECC, 2016, https://ecosystemsknowledge.net/sites/default/files/wp-content/uploads/DECC%20Biomass%20to%20Bioenergy%20End%20User%20Report_0.pdf

[2] Mills, Sally, Osgathorpe, Lynne and Dutton, Adam, "Energy for Nature," RSPB and Defra, 2015, https://ww2.rspb.org.uk/community/ourwork/b/martinharper/archive/2016/01/20/energy-for-nature.aspx

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

There is a risk of biodiversity loss if biomass were to be sourced from land managed for nature conservation. To manage this risk, regulation would be needed to ensure that the areas harvested were done so for biodiversity benefit and not for the generation of biomass.[1] This regulating would need to include a requirement that all management work must be undertaken according to a nature conservation five-year management plan. This plan needs to be approved by the relevant governing body and will detail reasons for habitat management together with amounts and type to be carried out.

A drive to increase the UK's domestic supply of bioenergy through deployment of energy crops, reforestation or afforestation could result in significant land-use change. This can have knock-on emissions impacts and substantial impacts on natural habitats. In areas where afforestation takes the place of land formerly used for agriculture, there may be an opportunity cost where this land may otherwise have been converted to habitats with greater biodiversity benefit.

Searchinger *et al* also note that carbon opportunity cost calculations demonstrate that 'alternative uses [to biofuels] of any available land are likely to do more to hold down climate change'. In other words, estimates that presume large-scale dedicated use of land for bioenergy only count the benefits of using the land but not the costs. A far less risky use of land for energy (on 73% of land worldwide) is solar PV; 1 hectare of solar PV produces the same energy outputs as 100 hectares of biofuels.[2] To increase the chances of low-carbon savings from scaling-up domestic supply of bioenergy supply, the carbon costs of using land for bioenergy much be considered.

[1] Williams, Matt. 'Done right, UK-sourced biomass can help wildlife and provide energy', (2015) https://ww2.rspb.org.uk/community/ourwork/b/climatechange/archive/2015/07/29/done-right-uk-sourced-biomass-can-help-wildlife-and-provide-energy.aspx.

[2] Tim Searchinger, Tim Beringer and Asa Strong "Does the world have low-carbon bioenergy potential from the dedicated use of land?" *Energy Policy* Volume 110, November 2017, pages 434-446, http://www.sciencedirect.com/science/article/pii/S0301421517305104.

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

Protection of the UK's existing forests and regeneration of disturbed forests are important 'low-regrets' measures to reduce the UK's emissions of GHGs. Instituting continuous forestry cover will enhance carbon stocks and maintain the productivity of high-value timber for durable and long-term end uses – such as wood in construction, but not necessarily electricity generation.

Increasing the UK's forestry cover meets the aims of the Paris Agreement to 'conserve and enhance sinks and reservoirs of all greenhouse gases not controlled by the Montreal Protocol, including biomass, forests and oceans'[1] and 'to reduce emissions from deforestation and forest degradation.'[2] It also aligns with the Clean Growth Strategy to 'increase the amount of UK timber used in construction' as a Greenhouse Gas Removal strategy.

As discussed in Question 19 with relation to land for nature conservation, protection and regeneration of the UK's forests must place biodiversity protection, carbon savings and (where appropriate) high-value timber production at the forefront. In so doing, any use of products from domestic forests for biomass (wastes and residues) is a secondary use and not the predominant driver of the forest management.

[1] *Paris Agreement*, adopted on 12 December 2015, Article 4.1(d).

[2] *Paris Agreement*, adopted on 12 December 2015, Article 5(2).

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

There is no best-practice example of a country that has a sustainable domestic supply. However, the CCC may want to look to the bioenergy policies set by the U.S. state of Massachusetts as guidance.

Massachusetts's standards include four main requirements, which together ensure that only those biomass fuels that reduce carbon pollution are eligible for credit under the state's Renewable Portfolio Standard. The key innovation of the policy is a "belt and suspenders" approach that combines restrictions on high-carbon biomass resources with a minimum efficiency requirement for bioenergy installations:

- Restrictions that limit "Eligible Biomass Woody Fuels" predominantly to timber harvest residues (tops and branches left after a logging operation) instead of whole trees from the operation. Because these residues would normally decay and release their carbon very quickly on the forest floor, these fuel sources are in fact good from a carbon emissions standpoint.
- A limit on the amount of eligible biomass residues removed from a forest site. This ensures that sufficient woody material is left on the forest floor for nutrient cycling and wildlife habitat.
- A requirement that biomass-fired power plants conduct lifecycle emissions analyses and demonstrate emissions reductions of at least 50% over 20 years. This establishes strict criteria for carbon accounting and ensures that actual reduction in emissions are being created.
- A requirement that encourages the most efficient use of eligible biomass: overall efficiency of a biomass generation facility must be 50 percent to qualify for one-half Renewable Energy Credit (known as a "REC") per megawatt hour of electricity, with credit increasing linearly to a full credit once overall efficiency hits 60% or above.

A 2012 fact sheet by the NRDC offers more detailed information about Massachusetts' biomass regulation, as well as links to the full state rule. [1]

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

We are not responding to this question.

[1] Yassa, Sami. *New Rules in Massachusetts Offer Model for Rewarding Good Biomass*, NRDC Fact Sheet, May 2012: https://www.nrdc.org/sites/default/files/massachusettsbiomass.pdf.

Best-use of bioenergy resources

Our 2011 review developed a hierarchy of appropriate uses for bioenergy feedstocks based on minimising costs and maximising abatement. We 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 heat generation, hydrogen production, and biofuels production for use in aviation and shipping. If CCS is not available, bioenergy use could be skewed towards heat generation in energy-intensive industry, and to biofuels in aviation and shipping, with no appropriate role in power generation or surface transport. In either case, we concluded the use of woody biomass in construction should be a high priority given that this can potentially secure negative emissions through a very efficient form of carbon capture.

We are now looking to update this analysis to reflect the latest technological and market developments. We are particularly interested in technologies such as biomass gasification, CCS and advanced second and third generation biofuels as well as the potential role of hydrogen to support decarbonisation across the economy. To support our consideration of these areas, the CCC is currently undertaking analysis into the potential of the hydrogen economy and we are planning to undertake further investigation into non-energy uses of bioenergy resources.

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

We are not responding to this question.

24. Bioenergy with Carbon Capture and Storage (BECCS) has been identified as a key potential mechanism for achieving the UK's 2050 carbon target due to the 'negative emissions' it could offer.

a) What are the potential timescales for commercial deployment of BECCS technologies?
b) What are likely to be the optimal uses of BECCS (e.g. electricity generation, hydrogen production)?
c) What efficiencies and costs are possible?
d) How will performance and cost differ according to feedstock type? What are likely to be the optimal feedstock types for BECCS? What are the implications for domestic supply vs imports (e.g. feasibility, considerations in scaling up over time)?
e) What are the main barriers and uncertainties associated with the development, deployment and use of BECCS?
f) What are the risks associated with the pursuit of BECCS that go beyond the risks that relate to supplying sustainable feedstocks and CCS more generally? How can these be managed?

a) – d) We are not providing a response to these parts of the question.

e) Biofuelwatch's report on BECCS includes an analysis of current record of CCS, as well as of the impacts of supplying bioenergy at the scale required.[1]

f) The deployment of BECCS poses significant risks to the natural environment due to the scale of land-use change that would be required to result in any meaningful impact on the concentration of CO_2 in the atmosphere.

If negative emission technologies (NETs) are used to remove significant amounts of CO_2 from the atmosphere then they need to be deployed on a large scale. In the case of BECCS and afforestation, which are used in 87% of the 2°C scenarios reviewed in the IPCC AR5, this will involve using a lot of land - the most extreme case used nearly half of the earth's land surface area. According to a recent report by the European Academies Science Advisory Council, BECCS demand for land could be significant, compete or overlap with land availability for reforestation/ afforestation or food production and have potentially severe implications for biodiversity and food security.[2]

Land is not, however, the only thing that could be affected. All NETs typically use either a lot of land or water or energy or nutrients or money or several of these at once.[3] Indeed, some could significantly affect albedo (the reflectance of the Earth's surface) which in turn could affect global heat balance and hence warming or cooling. A paper published in 'Nature' in

[1] Biofuelwatch, "Last-ditch climate option, or wishful thinking? Bioenergy with Carbon Capture and Storage", 2016, http://www.biofuelwatch.org.uk/2016/beccs-report-hbf/.

[2] European Academies' Science Advisory Council (EASAC), "Negative emission technologies: What role in meeting Paris Agreement targets?" 2018, https://easac.eu/fileadmin/PDF_s/reports_statements/Negative_Carbon/EASAC_Report_on_Negative_Emission_Technologies.pdf.

[3] Smith, Pete et al, "Biophysical and economic limits to negative CO2 emissions" Nature Climate Change, 2016, volume 6(1), pages 42-50.

January 2018 draws attention to the conflict between NETs like BECCS and the concept of 'planetary boundaries' that may be breached by its environmental impacts.[4]

Many models with BECCS assume that bioenergy is intrinsically low-carbon. In fact, there is no scientific basis for assuming that BECCS can deliver negative emissions after full emissions accounting for biomass in the power sector. Even if power plant emissions from burning forest biomass are fully captured and injected into the subsurface, cutting down trees will almost certainly result in a lasting carbon debt for two reasons. First, it is difficult to ensure that the trees will be replanted and kept intact. Second, older trees have been shown to sequester atmospheric carbon at a higher rate, so a permanent carbon debt is created when an older and larger tree is replaced with a younger one. Not only will it take years (likely decades) for the new tree to reach the size of the felled one, but during that time period the now felled tree would have grown even larger if it had been left in place. This "forgone sequestration" from additional biomass harvest in the forest creates a lasting carbon debt.[5]

Moreover, there is energy used across the biomass harvest and processing chain, which means that even if all flue gas carbon were to be captured, BECCS would still release a significant proportion of the carbon that may be captured in crop growth, given the right circumstance.[6] CCS also demands large amounts of extra primary energy and therefore biomass feedstock, resulting in more up-front climate and environmental impact.

One of the great risks of BECCS and bioenergy in general is that it gives the impression that we can continue 'business as usual', because we can grow our energy base and recover from overshoot with Negative Emissions. Neither are realistic and divert effort from a proven emission reduction option: conservation and regeneration of native ecosystems, peatlands and forests to sequester carbon and support complex life on the planet. Relying on NETs instead of emissions cuts could fail and result in severe global warming.[7]

BECCS demand will very likely be met primarily through crop and tree monocultures (resulting in direct and indirect land-use change) and/or from more intensive or extensive logging of forests. Other more sustainable bioenergy sources are either not available on a large scale (e.g., genuine waste products or new plantations planted specifically to produce biomass) or are not commercially viable with current technology (e.g. algal biofuels).

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[4] Heck, Vera et al, "Biomass-based negative emissions difficult to reconcile with planetary boundaries," Nature Climate Change, 2018, http://go.nature.com/2npMlVy.

[5] Vivid Economics, "Money to Burn," NRDC, 2016, https://www.nrdc.org/sites/default/files/uk-biomass-replace-coal-clean-energy-ib.pdf.

[6] European Academies' Science Advisory Council (EASAC), "Negative emission technologies: What role in meeting Paris Agreement targets?" 2018, https://easac.eu/fileadmin/PDF_s/reports_statements/Negative_Carbon/EASAC_Report_on_Negative_Emission_Technologies.pdf.

[7] European Academies' Science Advisory Council (EASAC), "Negative emission technologies: What role in meeting Paris Agreement targets?" 2018, https://easac.eu/fileadmin/PDF_s/reports_statements/Negative_Carbon/EASAC_Report_on_Negative_Emission_Technologies.pdf.

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

The Committee on Climate Change has previously made clear its view that the UK should prioritise domestic action to reduce emissions.[1] Given this, any participation in an international BECCS scheme should not be counted as a contribution towards the carbon budgets targets. Instead, the carbon budgets should be met through domestic action. Relying upon international schemes such as BECCS risks delaying domestic action to reduce emissions now. Action in the future is both worse for the climate and may be more expensive than action today.

[1] https://www.theccc.org.uk/wp-content/uploads/2016/10/UK-climate-action-following-the-Paris-Agreement-Committee-on-Climate-Change-October-2016.pdf

26. There is currently substantial interest in the development of 'advanced' biofuels for use in sectors such as aviation, shipping and/or heavy duty transport.

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

a) A study commissioned by the UK Department for Transport investigated a list of 25 potential advanced biofuel feedstocks in a holistic approach including sustainability, availability, competing uses and cost. It found that that all most all of the investigated feedstocks either had significant competing uses (e.g. sewage sludge, crude glycerine, black liquor), sustainability risks (e.g. short rotation coppice, small roundwood), or they were currently too expensive to produce (e.g. micro- and macro-algae). Only animal manure and the bio-fraction of municipal solid waste (MSW) and commercial and industrial (C&I) waste were found to have significant potential with low additional sustainable risks, at an acceptable cost.[1]

Biofuelwatch has conducted a series of studies on biotechnology for bioenergy.[2] They include two studies of algal biofuels and case studies of biotech companies. The final report of the series concludes they are unacceptably risky.[3]

b) We are not responding to this question.

c) The best feedstocks are wastes and residues that have no other competing uses. A study by the European Climate Foundation identified available and appropriate waste and residue feedstocks at the European level, as well as the appropriate environmental constraints on the use of these resources.[4] Similar types of feedstocks that minimise environmental impacts would be the best resources for advanced biofuels in the UK.

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[1] ARUP URS and E4tech, "Advanced Biofuel Feedstocks – An Assessment of Sustainability", 2014, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/277436/feedstock-sustainability.pdf.

[2] Biofuelwatch, "Biotechnology for Biofuels" http://www.biofuelwatch.org.uk/campaigns/biotech-for-biofuels/.

[3] Biofuelwatch, "Microalgae Biofuels - Myths and Risks," 2017, http://www.biofuelwatch.org.uk/wp-content/uploads/Microalgae-Biofuels-Myths-and-Risks-FINAL.pdf.

[4] European Climate Foundation, "Wasted: Europe's untapped resource. An Assessment of Advanced Biofuels from Wastes & Residues," 2014, https://europeanclimate.org/wp-content/uploads/2014/02/WASTED-final.pdf.

d) We are not responding to this question.

e) A key uncertainty is that the term “advanced biofuels” is poorly defined. It is used variably in the context of the conversion technology involved or the feedstock used. For example, the most successful biofuel marketed as ‘advanced’ is hydrotreated vegetable oil (HVO), and especially Neste Oil’s “NExBTL renewable diesel”, much of it made from palm oil. The EU definition of advanced biofuels includes biofuels made from ligno-cellulosic material. The same woody feedstocks used for such biofuels are already being used in large-scale biomass heat and power generation, with severe sustainability impacts.

f) While research into potential future biofuels remains crucial, the availability of truly sustainable feedstocks remains extremely limited and setting unrealistic targets for such fuels without considering availability and sustainability implications could risk dependence on fuels that are “advanced” only in name. We caution strongly against driving demand for “advanced biofuels” that – directly or indirectly – causes environmental harm similar to that caused by first generation biofuels.

g) We are not responding to this question.

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

The Government's Roadmaps to 2050 place a heavy reliance upon bioenergy in order to achieve decarbonisation and model as if there is no limit to supply (known as 'Max Tech'). However, this is false and results in roadmaps for different sectors of the economy relying on the same feedstocks. This approach does not take resource constraints into account.

Competition for scarce bioenergy resource needs to be accounted for. Moreover, bioenergy resources should be directed towards those sectors that are hardest to decarbonise, such as heavy industry.

28. In our 2011 review we identified wood in construction as a potentially effective method of CCS and a high priority 'non-energy' use in our best-use hierarchy.

   a. What lifecycle GHG emissions savings can be achieved by using WIC? Under what circumstances does WIC fail to deliver GHG emissions savings? Please consider the full range of impacts associated with using WIC including substituted product emissions (e.g. cement), product equivalence (impacts on co-products), end-of-life options and biogenic carbon storage.
   b. What is the potential for increasing the amount of wood used in construction in the UK? What are the barriers and how can they be overcome?
   c. What is the potential for using UK-produced timber in construction rather than imports? What are the barriers and how can they be overcome?
   d. What is the expected lifetime of different wood products in construction (e.g. cross-laminated timber)?
   e. What currently happens to wood in construction at the end of its useful life? What other viable options should be developed?

We are not responding to this question.

29. There are also a number of other potential non-energy uses of bio-feedstocks including bio-based plastics and bio-based chemicals.
    a. What other non-energy uses of bio-feedstocks have the most potential through to 2050 in terms of GHG abatement, cost, timescales and market size?
    b. What are the barriers to increasing these non-energy uses and how can these barriers be overcome?
    c. What risks are associated with the pursuit of other non-energy uses of bio-feedstocks and how can these be managed?

a) We are not responding to this question.

b) One of the main barriers to increasing the use of bio-based plastics or chemicals is the competing demand from other industries and the constraints on land availability. Whether for biofuels for transport, for BECCS or for bioplastics, generating biogenic resources can cause an increase in harvesting from existing ecosystems and habitats or drive land use change through conversion to crops or trees.

c) Deploying bio-based resources for non-energy uses could have significant environmental impacts because it can drive the same types of land use change associated with energy uses. For example, many bioplastics are based on the use of purpose-grown crops (similarly to biofuels for transport). This is useful because we can learn lessons from the environmental impacts already caused by crop-based biofuels.

The deployment of crop-based biofuels has resulted in significant impacts on the natural environment. Around 80% of bioplastic feedstock growth is predicted to take place in Asia. The growth of biofuel crops such as oil palm has already had devastating effects on habitats and wildlife in countries such as Malaysia and Indonesia, as well as elsewhere in the world. Further pressure from the production of bioplastic crops could increase these impacts on extremely rare and sensitive ecosystems.

There is strong dispute over claims about the quantity of ‘abandoned’ or ‘degraded’ land that could be used for crop production and isn’t already vital for wildlife, people or carbon sequestration. An IEEP assessment (commissioned by Birdlife Europe) of the available land for energy crops in Europe concluded that there is a very limited amount available.[1] If the land on which bioplastic crops are grown is converted from a high-carbon type (such as unimproved grassland or forest), or if food or feed crops are displaced and grown elsewhere (causing indirect land conversion) then bioplastics will have a very significant greenhouse gas impact. This has been the experience with the use of biofuels for transport. Recent research by the European Commission has found that biofuel crops have, in many cases, had a significant negative carbon impact since their introduction.[2]

Most biodegradable or bio-based plastics require specific industrial conditions to ensure their proper recycling or degradation. The replacement of some petroleum-based material with

[1] Institute for European Environmental Policy (IEEP), “Space for energy crops – assessing the potential contribution to Europe’s energy future,” commissioned by Birdlife International, 2014, http://www.birdlife.org/sites/default/files/attachments/IEEP_2014_Space_for_Energy_Crops_0.pdf.

[2] Valin, H. *et al* “The land use change impact of biofuels consumed in the EU. Quantification of area and greenhouse gas impacts,” Ecofys, IIASA and E4tech, 2015, https://ec.europa.eu/energy/sites/ener/files/documents/Final%20Report_GLOBIOM_publication.pdf.

plant-based material may make it possible to recycle an item but may not make it biodegradable. No product has yet been approved as biodegradable under marine conditions.

The incineration, anaerobic digestion or landfilling of bioplastics can all result in the release of CO2 or methane (23 times more powerful as a greenhouse gas than CO2) emissions.

GHG emissions reporting and accounting

GHG emissions reporting rules for bioenergy are different to those for other forms of energy. Emissions relating to the use (combustion) of bioenergy resources are not reported in the country of use but rather in the country where bioenergy resources are produced. Only Annex 1 countries under the Kyoto Protocol currently account for land-use emissions as part of binding emission reduction targets. In addition under Paris Agreement rules emissions (as under the Kyoto Protocol) will be reported against land-use baselines that may already assume a degree of land-use change. For these reasons and others, bioenergy GHG accounting has been criticised for not properly reflecting the impacts of bioenergy.

30. What are the strengths and weaknesses of the current approach to GHG emissions accounting for bioenergy in the UK and internationally? Specifically, what are the main gaps in the current land use emissions accounting rules?

The existing UK rules for accounting for emissions from biomass used for heat and power do not account for the emissions released by the combustion of the feedstock. Instead only harvest, transport and processing emissions are accounted for. In the case of solid woody biomass this is because emissions from forest management are supposed to be accounted for in the land use, land use change and forestry (LULUCF) emissions sector rather than the energy sector. However, as described below, the land use emissions accounting rules are fundamentally flawed and the emissions are not properly accounted for. In addition, there is an incorrect perception or assumption among many decision makers that bioenergy is automatically low- or zero-carbon because of the CO2 absorbed while the vegetation has been growing.[1]

For transport biofuels, indirect land use change (ILUC) emissions remain unaccounted for, despite the fact that these are a significant source of emissions. In fact, they mean that many types of biofuels deliver meagre emissions savings or even result in emissions increases relative to the petrol and diesel that they replace. The European Commission has published clear evidence showing this.[2]

This means that biofuels and biomass appear far less carbon intensive than they actually are and are thereby perversely incentivised.

When it comes to forest biomass, this problem is compounded by rules for accounting for emissions that contain loopholes: as a result, significant quantities of emissions are never accounted for. The current EU and international LULUCF rules for accounting for emissions contain several specific weaknesses. These weaknesses result in large quantities of emissions generated from the use of forest biomass for energy never being accounted for. Two reports published by research institute Chatham House highlight these weaknesses.[3]

[1] Tim Searchinger, Tim Beringer and Asa Strong "Does the world have low-carbon bioenergy potential from the dedicated use of land?" *Energy Policy* Volume 110, November 2017, pages 434-446, http://www.sciencedirect.com/science/article/pii/S0301421517305104.

[2] Valin, H. *et al* "The land use change impact of biofuels consumed in the EU. Quantification of area and greenhouse gas impacts," Ecofys, IIASA and E4tech, 2015, https://ec.europa.eu/energy/sites/ener/files/documents/Final%20Report_GLOBIOM_publication.pdf.

[3] Brack, Duncan. "Woody Biomass for Power and Heat Impacts on the Global Climate," Chatham House, 2017, https://www.chathamhouse.org/sites/files/chathamhouse/publications/research/2017-02-23-woody-biomass-global-climate-brack-final2.pdf; Brack, Duncan. "The Impacts of the Demand for Woody Biomass for

There are some key ways in which these weaknesses arise:

- The use of projected reference level baselines. Many parties to the Kyoto Protocol took the option of setting projected reference level baselines for accounting for land use emissions. Instead of accounting against a historical baseline, countries are allowed to project the future level of emissions they predict. Any emissions under this baseline are not accounted for. And any savings against this baseline are seen as an emissions reduction. Meanwhile, only emissions exceeding the projected baseline are ever accounted for. If policies encouraging the use of biomass for energy are included within the projected baseline then these emissions will not be accounted for. Of the 35 countries under the Kyoto Protocol accounting for forest management emissions, 32 of them have opted to use projected reference levels.
- Some countries, which are not party to the Kyoto Protocol, do not account for their land use emissions at all as part of the international framework. If forest biomass is imported from these countries then the carbon impacts of forest harvesting will not be counted in the country of origin. Meanwhile, if the country using the biomass for energy does not count the emissions from the combustion, then these emissions may never be accounted for at all, even though their effect on the climate is very real.
- If a historical reference level is used it may reflect past emissions that are higher than emissions levels today. Therefore, there will actually be headroom within which emissions could increase without breaching the baseline.

Power and Heat on Climate and Forests," Chatham House, 2017, https://www.chathamhouse.org/sites/files/chathamhouse/publications/research/2017-02-23-impacts-demand-woody-biomass-climate-forests-brack-final.pdf.

31. What are the risks, in terms of GHG emissions, associated with importing biomass or other biofuels from countries that have not committed to limiting or reducing emissions under the Kyoto Protocol or Paris Agreement? How can these risks be managed?

The risks of importing biomass or biofuels from countries not accounting for land use emissions is that the emissions released by the use of these fuels may never be accounted for. The biofuels or biomass may therefore appear to be low-carbon when they may not be. This can perversely incentivise the use of high-carbon biomass for energy purposes. For example, high-carbon forest biomass is currently being imported from the US to the UK in the order of millions of tonnes of wood per year. While the evidence clearly shows that this type of biomass is high-carbon, it is perceived as low-carbon when used in the UK energy system.

In the 12 months July 2015-June 2016, the UK imported 5.5 million tonnes of biomass from the US and Canada. If all of this was used for energy, then up to 7.8MtCO2 may have gone 'missing', never being accounted for in the countries of origin nor in the country of use for energy. Meanwhile, Finland uses significant amounts of domestically harvested wood for energy, but it accounts for its forest management emissions against a projected reference level baseline. Because increased harvesting from bioenergy is built into this baseline, significant quantities of emissions are not being accounted for (i.e. only emissions exceeding the projected reference level will be formally counted as an emission). By 2020, up to 21MtCO2 could go unaccounted for in Finland due to the design of the land use emissions accounting rules. These figures come from the reports published by Chatham House.[1]

One way to address this risk is to rule out high-carbon biomass feedstocks, such as banning the use of whole trees and stumps. Many of the companies currently using biomass are increasingly confident in their claims that they can rely in large part on wastes and residues. Therefore, ruling out the high-carbon feedstocks should prove relatively unproblematic.

Meanwhile, efforts should continue at the EU and United Nations level to fix problems with the rules for accounting for emissions. These rules need to comprehensively cover all countries, and the use of projected reference level baselines should be abandoned in favour of the universal adoption of accounting against a historical base year or base period.

[1] Brack, Duncan. "Woody Biomass for Power and Heat Impacts on the Global Climate," Chatham House, 2017, https://www.chathamhouse.org/sites/files/chathamhouse/publications/research/2017-02-23-woody-biomass-global-climate-brack-final2.pdf; Brack, Duncan. "The Impacts of the Demand for Woody Biomass for Power and Heat on Climate and Forests," Chatham House, 2017, https://www.chathamhouse.org/sites/files/chathamhouse/publications/research/2017-02-23-impacts-demand-woody-biomass-climate-forests-brack-final.pdf

32. What alternative method(s) for bioenergy emissions accounting should be considered? What would the implications of these alternative method(s) be?

If these emissions continue to go unaccounted for in the land use sector (and the rules are not fixed) then one alternative could be to account for the emissions in the energy sector. However, such an approach may be complex and would have implications for land use sector accounting as well.

Even if the UK were not to formally account for the emissions from biofuels and biomass in the energy sector, it could nonetheless introduce proxy accounting, and rule out feedstocks not meeting a certain level of emissions reductions (based on full accounting) within a given climate-relevant timeframe. For example, emissions reductions that will be delivered in 20 or 30 years by woody biomass are too late for meeting 2050 goals to reduce emissions, as we need to be urgently cutting emissions from our energy sector today.

Indicators

As part of the 2018 Bioenergy Review the CCC is planning to develop a set of indicators to track progress towards key bioenergy outcomes. We envisage these will cover key areas such as sustainability, policy development, supply and best-use.

33. What key areas should be reflected in these indicators?

It is difficult to answer this question without knowing what key bioenergy outcomes the CCC is considering. Based on this consultation, the CCC appears to be considering all avenues of growing the "bioeconomy". However, sustainability and climate impacts are typically considered on a sector-specific basis, in isolation from resource pressures that arise from the totality of bioenergy sourcing. For example, biomass sourcing must be considered across all sectors with an identified demand and in addition to wood sourcing for traditional wood products industries. Given mounting demand for biomass as a replacement for coal, oil, gas and plastics, on top of the global economy's demand for food and fibre, both the domestic and global supply of truly low-carbon and broadly sustainable biomass is likely to be very modest. It is thus critical that this limited supply go towards its highest value end uses in sectors with few or no low-carbon alternatives, and certainly not for electricity generation.

Moreover, we struggle to identify indicators for some of the key sustainability and climate impacts of biomass. For example, what type of indicator could be used to measure the amount of land grabbing that is directly or indirectly driven by biomass? Another difficult area for an indicator is how to determine the amount of GHG emissions from land use, land use change and forestry (LULUCF) that are missing from the international GHG accounting framework, due to the LULUCF accounting loopholes?

In light of these concerns, some suggested indicators are:

- Impact on biodiversity and the natural environment: is there a risk that the biomass being used could have a harmful impact on habitats or biodiversity? This should require an assessment at the most granular scale possible (for example, regional level assessments of risk are too broad-scale in order to identify potential impacts on the ground). Where on-the-ground data are not made available, this should be considered to represent a greater risk to the natural environment.
- Harm to ecosystem integrity: does the harvesting or production of the biomass pose a risk to ecosystems and the services they provide to people.
- Genuine emissions reductions: does the source of bioenergy create a real GHG emissions reduction compared to other energy options, taking into account land use change, foregone sequestration and loss of carbon stocks. Wherever possible, the full, actual emissions should be quantified.
- Carbon emissions payback timeframe: if an emissions reduction is achieved, what timeframe is it delivered within. Strong consideration should be given to this, since delaying emissions reductions today will result in greater costs in the future, both financially and to the climate.
- Efficiency of use: is the biomass feedstock being used in the most efficient way possible to generate energy, including considerations to limit biomass energy to only high efficiency cogeneration.
- Voluntary certification schemes: certification should not be used as a proxy for sustainability, as they do not guarantee biodiversity protection or carbon savings.

Certification schemes should not be included as an indicator (i.e. number of projects with a voluntary certification scheme)

- Prioritisation of limited biomass supply: in the context of the economy-wide energy transition, if biomass is used, the limited supply of genuinely sustainable biomass should go towards its highest value end-user. This might be, for example, aviation fuel, but certainly should not be for electricity generation.

34. Please provide details of any examples of international best-practice in the area of bioenergy indicators.

We are not responding to this question.

Other

35. Please submit any further evidence that you would like us to consider.

We would like to submit evidence on the economics of biomass, compared to other renewable energy generation technologies.

The economics of biomass compared to solar and wind

A 2017 study[1] commissioned by the Natural Resources Defense Council and conducted by Vivid Economics and Imperial College concluded that solar and wind can reliably meet the UK's needs for new electricity capacity—and they can do so more cost-effectively than new biomass, even when the costs of integrating solar and wind into the grid are fully accounted for. The study demonstrated that during cold, dark, windless periods, the UK electricity system can meet its needs for generation and reliability without needing to add new biomass capacity as it phases out coal.

The economic modelling of the UK power sector conducted for the analysis shows that by 2020, biomass will be higher cost than onshore wind and solar from a total economic cost perspective. By 2025, in all cases, biomass will be higher cost than all forms of wind and solar. Even if already installed, biomass capacity will be running at reduced capacity. This is due to high fuel and carbon costs for these facilities. Instead, it is cheaper build completely new solar and wind capacity, even when the costs of integrating them into the grid are fully accounted for. Biomass will be too costly to meet day-to-day electricity demand and will also not be able to compete with least-cost options to meet the reliability requirements of the electricity system (i.e. to accommodate peak demand). In 2025, it is more cost-effective to deploy a combination of wind, solar and natural gas generation to meet the objective of reliability of supply than to deploy biomass generation, even in order to meet the UK's legally binding carbon constraints. These results hold true even for scenarios that do not fully account for biomass carbon emissions and their associated costs.

Further work now being conducted by Vivid Economics and Imperial College is examining these results in more detail. This further research will show how each aspect of system security (reserve, response and inertia requirements) are met without new biomass being constructed. This additional analysis is due to be completed in March 2018.

[1] Vivid Economics and Imperial College, "Money to Burn II," Natural Resources Defense Council (NRDC), 2017, https://www.nrdc.org/resources/money-burn-uk-needs-dump-biomass-and-replace-its-coal-plants-truly-clean-energy.