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Beyond BECCS: **The Case for a Reduced Reliance** **on Bioenergy Carbon Capture and** **Storage in Meeting Net Zero**

Report Summary

Key Messages:

- **The UK can meet net zero with far lower levels of bioenergy with carbon capture and storage than currently planned by the UK Government or the Climate Change Committee.**
- **This will help to reduce energy bills, increase Britain's energy security, and protect forests and nature.**

The climate emergency has fast become the greatest threat to biodiversity globally. Crucially, both are interlinked and tackling both are mutually supporting goals.¹ At 2°C of warming, one in ten of all species would find themselves at a high risk of extinction.² Yet, at the same time, a critical ally in tackling the climate emergency is nature itself, and we will rely upon it to adapt to a rapidly changing climate as well as to store and sequester carbon.³ It is therefore vital that the UK is successful in meeting its legally-binding net zero emissions target by 2050 but also that our efforts to reach net zero do not compromise biodiversity, and where possible work to restore it.⁴

In achieving net zero, it will be impossible to reduce all sources of greenhouse gas emissions to zero, and some of them will need to be offset (mopped up) by greenhouse gas removal from the atmosphere. To do this, and to generate electricity too, the Government is increasingly looking to develop bioenergy with carbon capture and storage (BECCS).

This is when biomass (energy crops, waste, and wood) is burned to generate electricity, hydrogen or to fuel heavy industry. This biomass is counted as zero carbon (even if burning it releases lots of carbon dioxide) so it would, on paper, create negative emissions if it was captured and stored. It is assumed this can offset ongoing pollution from other activities like flying, farming or heavy industry.

1 Pörtner et al. (2021), IPBES-IPCC co-sponsored workshop report on biodiversity and climate change; IPBES and IPCC. Access online [here](#).

2 IPCC (2022), Summary for Policymakers: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Access online [here](#).

3 IUCN (2022), Policy Brief: NbS in the post-2020 Global Biodiversity Framework Targets. Access online [here](#).

4 State of Nature Partnership (2023), State of Nature. Access online [here](#).

Challenges with BECCS:

Although BECCS may be a necessary part of achieving net zero in the UK, a heavy reliance is highly problematic for six key reasons:

1. **It is a suite of technologies that don't yet exist together at a commercial scale, and therefore relying on it to achieve net zero is a gamble.**⁵
2. **It may not always deliver the expected levels of negative emissions**, particularly if relying on burning wood from forests⁶, due to:
 - a. Long carbon payback periods ranging from a few years to centuries
 - b. Foregone sequestration which is the sequestration that would have occurred if the biomass was not harvested
 - c. Outdated international accounting rules which mean the UK does not have to count the climate impact of harvesting forest biomass from other countries
3. **There is evidence that biomass harvests to fuel bioenergy in the UK is harming forest ecosystems and nature.**⁷
4. **It requires huge land use either to cut down trees from forests or to grow energy crops**, which may compete with nature and food production either in the UK or overseas.⁸
5. **It can delay or deter real action to reduce emissions.**⁹
6. **BECCS will cost vast sums of money to fund**, both to operationalise and to subsidise the electricity and negative emissions generated. These costs will be passed onto UK households.¹⁰

New research commissioned by RSPB and WWF-UK shows that the UK can achieve net zero with far lower levels of this technology than currently planned for. This research modelled the UK energy system and resulting land use changes across four scenarios:

- The Reference scenario is similar to the Climate Change Committee's Balanced Net Zero Pathway.
- Alternative Future 1 (AF1) meets net zero with a lower reliance on BECCS removals and relies heavily on behavioural shifts and nature restoration.
- Alternative Future 2 (AF2) meets net zero with a moderate reliance on BECCS but is more technology reliant.
- BECCS Failure closely matches the Reference Scenario, but carbon capture and storage technology fails to materialise.

Neither organisation advocates for any one of the specific scenarios presented in this work, and instead seeks to present the trade-offs that are associated with different options

5 IEA (2021), About CCUS, IEA, Paris. Access online [here](#) and Hauber (2023), Norway's Sleipner and Snøhvit CCS: Industry models or cautionary tales?, IEEFA. Access online [here](#).

6 EASAC (2019), Forest Bioenergy, Carbon Capture and Storage and Carbon Dioxide Removal: an update. Access online [here](#) and NRDC (2021), A Bad Biomass Bet. Access online [here](#).

7 NRDC, Dogwood Alliance & SELC (2023), Global Markers for Biomass Energy are Devastating US Forests. Access online [here](#).

8 Fuss et al. (2018), Negative emissions-Part 2: Costs, potentials and side effects. Environmental Research Letters, 13(6), [063002]. Access online [here](#).

9 McLaren et al. (2019), Beyond "Net-Zero": A Case for Separate Targets for Emissions Reduction and Negative Emissions. Front. Clim.1:4. Access online [here](#).

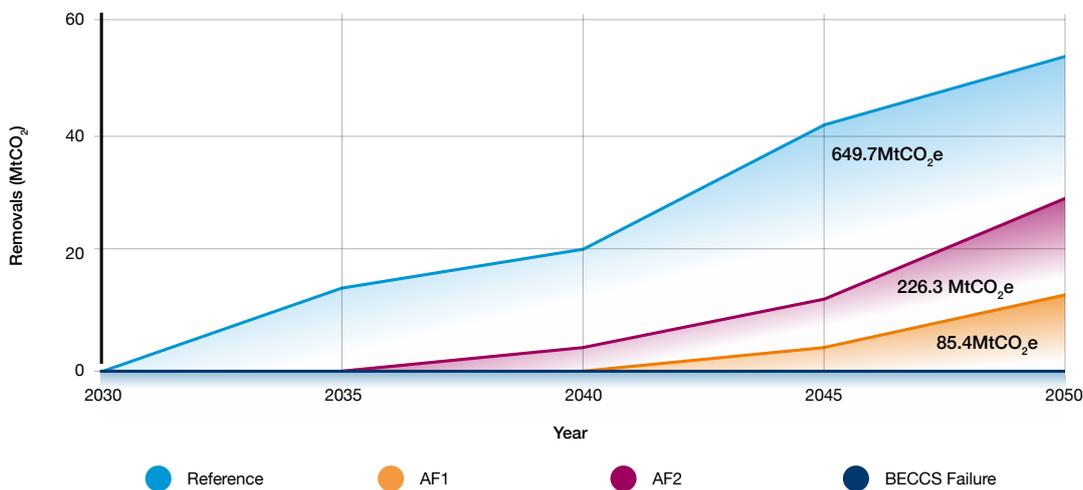
10 Ember (2021), Understanding the cost of Drax BECCS plant to UK consumers. Access online [here](#) and Element Energy & Vivid Economics (2021), Investable commercial frameworks for Power BECCS. Access online [here](#).

Key Results

The modelling in this research shows that **the UK can reach net zero and keep the power on with a significantly reduced reliance on BECCS** as well as eliminate unabated biomass generation from 2030.

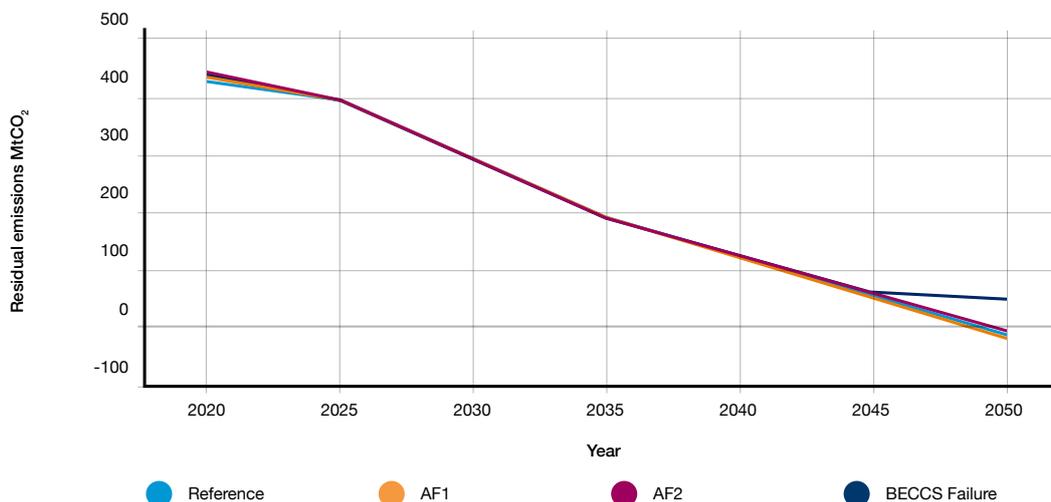
- The UK can reach net zero and keep the power on with a much lower reliance on BECCS. Two scenarios (AF1 and AF2) significantly reduce the UK’s reliance on BECCS to get to net zero, whilst also eliminating unabated biomass generation from 2030.**
- This will require greater action to electrify the economy, restore nature and reduce high-carbon demand.**

Figure 1: Annual removals from power-BECCS and hydrogen-BECCS in 2050 across modelled scenarios. Cumulative emissions across the time period are represented by the figure under the line of each scenario. Note that in the BECCS Failure scenario, there are no removals from BECCS before 2050



- If we rely heavily on BECCS and it fails to materialise as a scalable technology, then net zero could be missed altogether and cost society far more. If the UK takes additional steps to decarbonise, net zero could still be reached even if BECCS deployment is later and lower.**

Figure 2: Emissions pathways across scenarios

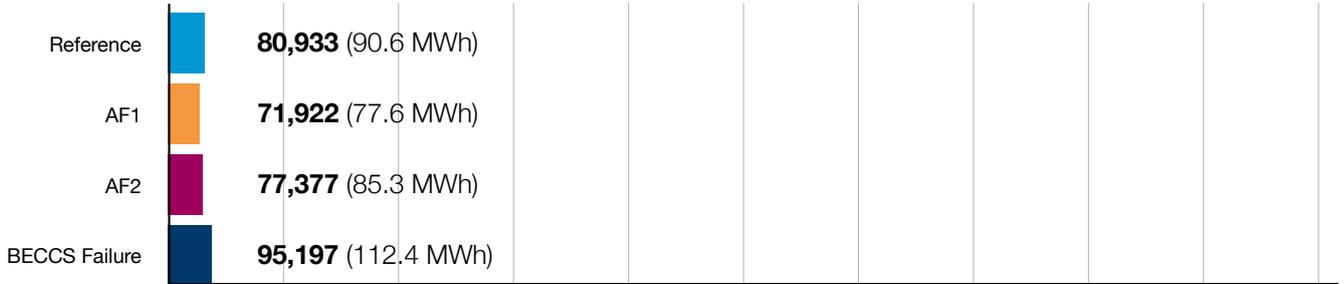


4. Reducing the UK’s use of BECCS frees up more land for nature restoration.

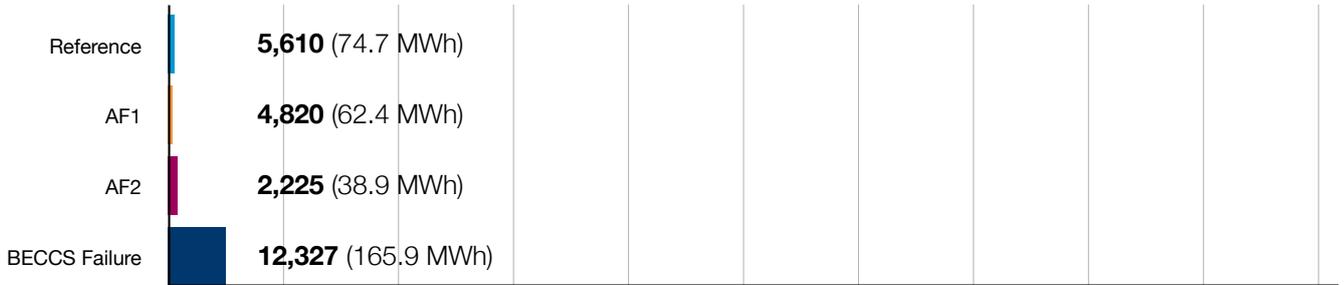
5. Trade-offs with food production and wider ecosystem services must be managed carefully.

Figure 3. Land area use for onshore wind, solar and domestic bioenergy crops across scenarios in 2050 (hectares)

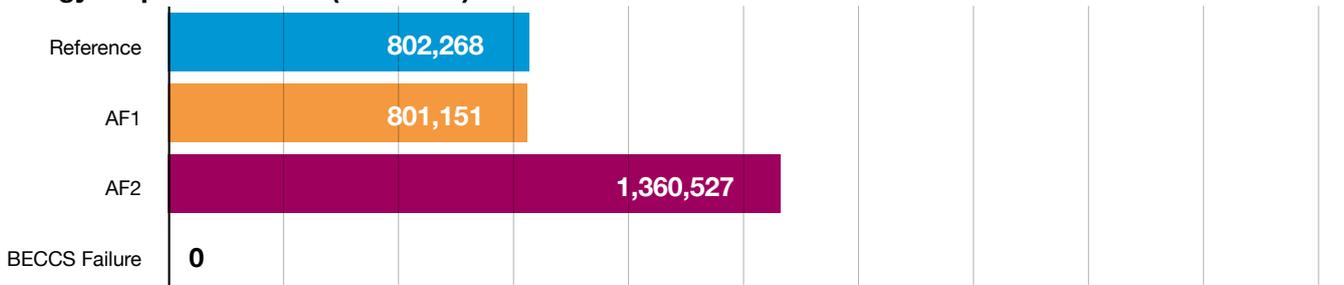
Solar



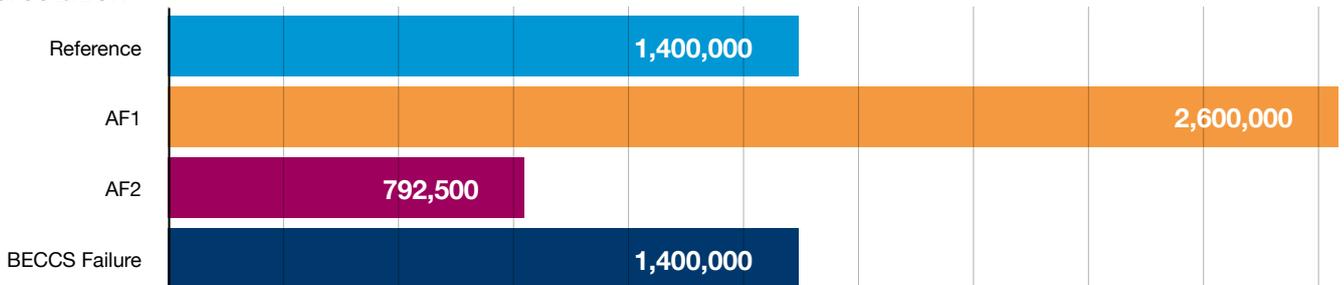
Onshore wind



Bioenergy crops for BECCS (domestic)



Afforestation



Totals: Reference 2,288,811 AF1 3,477,893 AF2 2,232,629 BECCS Failure 1,507,524

Recommendations

Based on the insights gained from our modelling, we recommend that the UK Government takes four key steps to reduce our reliance on BECCS and restore nature across the UK:

1) Apply a precautionary approach to BECCS:

- **Constrain BECCS to the levels of genuinely sustainable, feedstock available**, prioritising genuine wastes, by-products and residues sourced in the UK first.
- **Subject all feedstocks to a sustainable biomass hierarchy and more ambitious, consistent sustainability criteria than currently used.**¹¹
 - The criteria should include a wider scope of environmental factors than what is currently included (to incorporate soil carbon changes, water resources etc.), as well as a wider assessment of the environmental (and social) risks associated with a feedstock than purely life cycle analysis. This means an assessment of resource and land competition (including indirect land use change).
 - It should also implement a common GHG emissions methodology and account for carbon payback periods and forest carbon, which should be Paris Agreement-compatible.
 - The criteria should ensure that 100% (instead of 70%) of woody biomass feedstocks are proven sustainable.
- **The UK Government should rule out eligibility for energy subsidies of any wood from forests (including roundwood, thinnings, branches, bark, stumps).** Moreover, there should be no imports of any wood from primary forest whatsoever.
- **BECCS projects must be effectively regulated with stringent monitoring and verification across the entire supply chain.** The findings suggest that the UK may not be able to achieve net zero without BECCS and so it is important that BECCS as a technology succeeds. This will require effective regulation from biomass sustainability through to the permanence of carbon storage to ensure that negative emissions are delivered without sustainability breaches.

2) Eliminate unabated biomass power generation

- **Unabated biomass generation should not be supported by public finances after 2027.** The CCC has been clear that continuing to burn trees for energy is bad for the climate and for people's pockets and this analysis has shown it is not necessary to meet net zero. BECCS plants that are not capturing at a suitably high rate of 90-95% should not receive any subsidies for electricity generation.

¹¹ 3Keel Report for RSPB, (2022). Biomass for energy: A framework for assessing the role of domestic feedstocks in the UK's energy transition, technical report.

3. Invest in nature restoration and reward farmers for protecting nature and storing carbon

- **In the right locations, farmers should be rewarded for planting trees and restoring nature on their farms.** Large scale afforestation, whilst it can be highly beneficial for nature, can undermine UK food production and so spatial prioritisation will be crucial; areas of low-productivity should be prioritised (alongside dietary shifts, improving crop yields, reducing food waste and prioritising crops for human food production over livestock feed production). However, this should avoid priority habitats where possible.
- **Only incentivise bioenergy crops on low productivity land and within nature-friendly farming systems.** Although genuine wastes and residues should be prioritised via a sustainable biomass hierarchy, there may be some value in growing a limited area of bioenergy crops domestically. This should never be in areas with high value for nature and, to assist with this, the upcoming Land Use Framework should identify where the optimal locations might be and how much could be grown.
- **Invest more to restore priority habitats and protect wildlife.** According to calculations by Wildlife and Countryside Link, the Government is not investing enough per year to guarantee the restoration of nature and habitats. This means natural habitats that can store carbon, provide health benefits, and support wildlife, will be left in a poor state or not created.¹²

4. Go much further and faster on decarbonising across the economy and reducing energy demand.

- **Speed up the rollout of onshore wind and solar whilst avoiding harm to nature as far as possible.** This should be accompanied by electricity market reform to ensure households begin to benefit from the lower costs of renewables.
- **Implement a clearly defined and ambitious strategy to reduce demand for energy substantially by 2050.**¹³ This could include efforts to reduce the number of flights taken each year by those who fly the most, shift diets to those that are more sustainable and healthier, and insulate homes across the country.

¹² Wildlife and Countryside Link (2021), Chancellor urged to commit at least £1.2bn annual nature funding ahead of climate talks. Access online [here](#).

¹³ Barrett J., Betts-Davies S., Garvey A. & Marsden G. (2023), The missed opportunity – ignoring the evidence on energy demand reduction. Centre for Research into Energy Demand Solutions. Oxford, UK. Access online [here](#).



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The research team developed new modelling, took part in structured discussions, and offered feedback around the role BECCS may play in future UK Energy Pathways to net zero. The interpretation and write up contained in this report, however, represent the views or opinions of RSPB and WWF.

Further details on the modelling work will be presented as a journal paper to be submitted for publication by the research team in early 2024.

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WWF-UK: Leanne Atkinson, Jo Furtado, Isabella O'Dowd

RSPB: Mair Floyd-Bosley, Alex Mackaness, Matt Williams

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