

**A STATEMENT BY SCIENTISTS AND ECONOMISTS
ON BECCS FROM FOREST BIOMASS
(February 26, 2021)**

The 87 undersigned scientists and economists submit this letter in response to the Department of Business, Energy and Industrial Strategy and HM Treasury consultation and call for evidence on greenhouse gas removal (GGR) options. This letter focuses exclusively on the problems associated with a specific GGR technology—bioenergy with carbon capture and storage (BECCS) as applied to the burning of wood from forests.

Forests lead all other ecosystems in annually removing atmospheric carbon dioxide and accumulate carbon for centuries in the biomass of living and dead trees and in soils. Without the growth of trees in forests and other terrestrial plants, the annual increase in atmospheric carbon dioxide would be approximately 31% greater than it currently is.

Forest bioenergy is adding increasingly large amounts of carbon dioxide to the atmosphere and reducing the capacity of forests to absorb atmospheric carbon dioxide, making it more difficult to reach net zero carbon as the stated goal for limiting global temperature. Adding carbon capture and storage (CCS) technology to a bioenergy plant does not resolve this issue. Bioenergy with Carbon Capture and Storage (BECCS) has not been demonstrated at scale, and based upon existing CCS for coal, it would remove relatively little of the life cycle emissions and add substantially to the cost of electric power generation.

BIOENERGY ACCOUNTING

Utilizing incomplete accounting systems, it has been claimed that replacing fossil fuels with burning wood is carbon neutral. It is argued that replacement trees will eventually remove the carbon dioxide that was emitted at the time of burning. These claims fail to account for foregone removal of atmospheric carbon dioxide by harvested trees, the loss of carbon and nutrients from soils and soil compaction due to harvest, and the substantial fossil fuel emissions associated with harvesting and processing wood into forms suitable to burn for commercial scale heat and electricity.

Commercial scale bioenergy electric power emits more carbon dioxide per unit of electricity than does coal and more than twice as much as natural gas fueled facilities. Even if forest regrowth were to remove the previously emitted carbon dioxide from all sources, proper carbon accounting shows it cannot do so during the short climate mitigation window of one to three decades from now. In the case of whole trees and other large diameter materials, it can take anywhere from 40 years to several centuries for forest regrowth and the associated carbon accumulation just to reach emissions levels associated with fossil fuels. Forest “thinnings” in the US southeast have been shown to generate a carbon debt that lasts for over 40 years. In a power-generating scenario that uses forestry residues that would

otherwise decay and release their carbon, parity with fossil fuels is reached only after a few decades.

The ongoing growth of forests (termed Proforestation) has been demonstrated to accumulate more carbon dioxide out of the atmosphere than reforestation of the harvested areas that produced the wood fuel. In fact, newly planted forests will never accumulate as much as an older forest during the multi-decadal time periods when it is needed. We do not have decades to centuries to wait.

BIOENERGY WITH CARBON CAPTURE AND STORAGE (BECCS)

Earlier in the past decade, an argument was made that burning wood and capturing the carbon dioxide to store it in appropriate geological structures would lead to negative emissions. The idea arose when climate modelers were trying to find what needed to be done to halt further increases in atmospheric carbon dioxide and were stuck with a dilemma. Any practical phasing out of carbon dioxide emitting fossil fuels left a gap between the remaining emissions and the ability of natural systems like forests, wetlands, grasslands and soils or the oceans to remove them.

Instead of simply calling attention to the gap, the modelers identified a not yet existent technology, Bioenergy with Carbon Capture and Storage. These imagined facilities would burn wood, and the emitted carbon dioxide would be captured and stored out of the atmosphere. In this oversimplified analysis these facilities would be carbon negative.

But since burning wood for energy is not carbon neutral in relevant time frames, capturing the carbon dioxide will not make it carbon negative. In addition to the stack emissions at a bioenergy plant, there are several categories of additional emissions, the harvesting, transport, and processing emissions, and the loss of carbon from soils and forest residues following harvest. Then there is the foregone removal of carbon dioxide had the harvested trees been allowed to keep growing. These emissions cannot be captured.

CARBON DIOXIDE CAPTURE AND STORAGE (CCS) TECHNOLOGY

Any analysis about the future implementation of commercial scale BECCS must examine the Carbon Dioxide Capture and Storage (CCS) technology that is in use today.

Assumptions regarding the carbon capture potential of CCS for coal and natural gas fired electric power stations proved to be overestimated in practice because of incomplete life cycle accounting, underestimating the additional electricity needed to capture the CO₂, and the inefficiencies of the capture process itself. A major facility operating CCS at scale in the United States, Petra Nova in Texas, reported a 92.4% carbon capture before shutting down in summer of 2020, but another analysis finds it only captured 55.4% of CO₂ at the stack from coal combustion. Electricity for carbon capture requires an additional 0.5 kWh per kWh of electricity produced by the plant. The electricity was supplied by a natural gas generator, and the gas

combustion emissions were released to the atmosphere. This reduced overall emissions removal to just 33.9% of total CO₂ emissions. Over a full life cycle including upstream emissions, Petra Nova's carbon capture reduced emissions by only 10.8% over 20 years. The Petra Nova facility did not include a storage component because the captured CO₂ was utilized for enhanced oil recovery, so those gas transportation and storage emissions would need to be added for a BECCS facility. Petra Nova CCS ceased operations in the summer of 2020 due to a loss of market for the recovered CO₂.

The realities of existing CCS technology demonstrate that contrary to assumptions, BECCS is unlikely to remove very much CO₂ from the lifecycle of a wood burning facility, and will forego the proforestation potential for carbon accumulation out of the atmosphere when it is most needed.

THE ECONOMICS OF BECCS

Electricity from burning wood is more expensive than most other technologies other than nuclear power and emits greenhouse gases and air pollutants, whereas less expensive zero emission alternatives like wind or solar emit none. Capturing carbon dioxide from bioenergy will utilize CCS developed for coal plants.

The Petra Nova coal plant processed just 31% of the stack emissions from a 654 MW boiler. The cost of the extra carbon capture equipment was \$1 billion. Overall, the cost of the capture technology added 74% (\$4200/kW) to the cost of the plant (\$5700/kW). The costs would be even higher for a BECCS plant that must account for the cost of the CO₂ storage process.

In the U.K., billions of pounds have already been spent to make expensive wood burning to produce electricity feasible. Far superior alternatives to coal include zero carbon sources like the U.K.'s highly successful off-shore wind, to which battery and mechanical storage can be added at far less cost than BECCS with far greater reduction in greenhouse gas emissions.

IMPLICATIONS OF BECCS FOR UK CLIMATE POLICY

The UK Committee on Climate Change (CCC) has been clear that before bioenergy can play a role in decarbonization, the UK must undertake a host of reforms to its biomass accounting rules and sourcing safeguards on the supply chain side: "There are a *number of gaps* in the framework which *must be addressed* (in particular around accounting for changes in carbon stocks in existing forests in the sustainability criteria)." (See page 17, *emphasis added*).

The modest CO₂ removal, biomass carbon loss, elevated air pollution levels, and high cost must be recognized. Clear evidence points to the fact that a large proportion of the biomass imported into the UK energy market is coming from roundwood (whole trees) that is degrading forests and their associated biodiversity. Claims of sustainable forestry for this fuel source even if true will not reduce the growth of atmospheric CO₂ stocks. This does not move the UK towards its goal of becoming zero net carbon by 2050.

Even in the scenarios depicting the most aggressive reliance on domestic UK sources, imports will continue to play a major role. The main CCC scenario still requires importing 21% of UK biomass, and one of the other scenarios presented has imports accounting for as much as 42% of total biomass supply by 2050. At the scale of demand being contemplated, bioenergy will continue to increase pressure on land and forests, along with adverse consequences for water, and biodiversity.

As the UK government considers how GGR technology will play into its commitments to achieve net zero emissions by 2050, we urge you to reject policies aimed at promoting commercial scale implementation of forest bioenergy and forest Bioenergy with Carbon Capture and Storage (BECCS).

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