A low-biomass clean power system for the UK is achievable

A 2030 clean power system for the UK is possible whilst reducing reliance on expensive, imported biomass.

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Lead author: Frankie Mayo

About

This report considers a low-biomass 2030 clean power system, a case study built on National Energy System Operator (NESO) 2030 Clean Power data, reviewing the potential effects of reduced unabated biomass generating capacity.

Highlights

55%

The 2030 power system remains stable with a 55% reduction in biomass power generation

60 TWh

GB remains a net exporter to neighbouring countries

60%

Reduction in biomass generation capacity

Executive Summary

Low biomass use in 2030 is achievable and increases the benefits of clean power

A low-biomass clean power system is stable and has reduced levels of expensive biomass fuel imports. Biomass power generation is reduced by over 50% while the UK remains a net exporter of electricity.

New 2030 clean power modelling by Ember shows that biomass generation can be reduced by half to just 2% of total electricity generation in 2030. A low biomass system is desirable because it can lower bills, reduce UK reliance on volatile imports, and because imported biomass carries with it a risk of high emissions.

A low-biomass comparison to the 2030 Further Flex and Renewables pathway in the NESO Clean Power report has been modelled with biomass capacity reduced by 2 GW compared to the current total. The equivalent to all but one unit of large-scale biomass is modelled to come offline in this clean power analysis, with power imports making up most of the reduction, as well as a slight increase in gas use for power (14%). Although biomass is a small proportion of total generation, it can have an outsized impact on energy bills. Biomass power costs £138/MWh under a Contract for Difference (2024 prices), 80% higher than the average price of generating electricity using gas in 2024.

01 55% reduction in biomass power generation

The clean power system remains stable with a 55% reduction in biomass power generation, compared to Ember's modelling of the NESO Clean Power 2030 scenarios for an equivalent weather year.

02 GB remains a net exporter of power

Annual power exports total 60 TWh in a low-biomass clean power system. Power imports make up for the majority of reduced biomass power generation. However, overall the country remains a net power exporter in both the low-biomass, and Further Flex and Renewables, clean power systems.

03 60% reduction in biomass power capacity

A pathway is achievable which retains the equivalent of a single unit of dispatchable large-scale biomass power while reducing expensive biomass power generation overall.

Ember clean power modelling has a lower level of gas use than in NESO reporting, due to small differences in weather assumptions and European power flows. Compared to analysis aligned with the NESO 2030 Clean Power Further Flex and Renewables pathway, a low-biomass clean power sensitivity shows similar levels of renewable power generation, with a less than 1% increase in the gas power share of total generation, and a 10% increase in power imports, though the UK remains a net exporter.

Reliance on imported biomass threatens the benefits of clean power. It is often more expensive than gas power with emissions potentially higher. Biomass power in a clean power system is assumed to be a necessary compromise, this modelling shows that is not so clear cut.

Frankie Mayo
Senior Energy & Climate Analyst - UK,
Ember

Analysis

Reducing biomass power generation increases the benefits of clean power

New 2030 clean power modelling shows that biomass generation can be reduced by half to just 2% of total electricity generation in 2030 while the grid remains stable and decarbonised.

A clean power system with low-biomass power is achievable

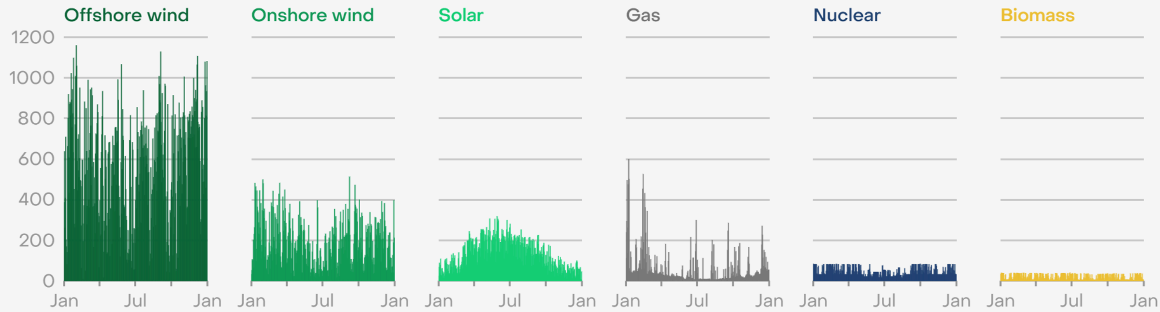
Ember modelling, built on the NESO 2030 Clean Power Further Flex and Renewables pathway data shows that a stable and decarbonised energy system can be achieved with low reliance on biomass. In this scenario, biomass generation is largely replaced by power imports, while Great Britain remains a net exporter to Europe. The share of gas in total generation would increase by less than 1% and small changes to generation from other renewable sources would be needed.

Wind and solar PV drive a 2030 clean power system with low-biomass capacity

A stable, clean power system with low levels of biomass power has been modelled, with a large increase in renewable energy (+82 GW) and a reduction in biomass power in 2030 (-2 GW). Reductions in biomass capacity lead to a 55% reduction in biomass generation, while the energy system remains stable. A year of demand and supply has been modelled with wind and solar power alone making up over 80% of total generation, and biomass power supplying just 2%. Although biomass power is a small component of the energy system, due to its high cost of generation and potential carbon impacts, it has an outsized impact.

Wind and solar make up 80% of generation with occasional spikes in gas use in a low-biomass clean power system

Daily generation (2030 - GWh)



Source: Ember analysis
Indicative weather year

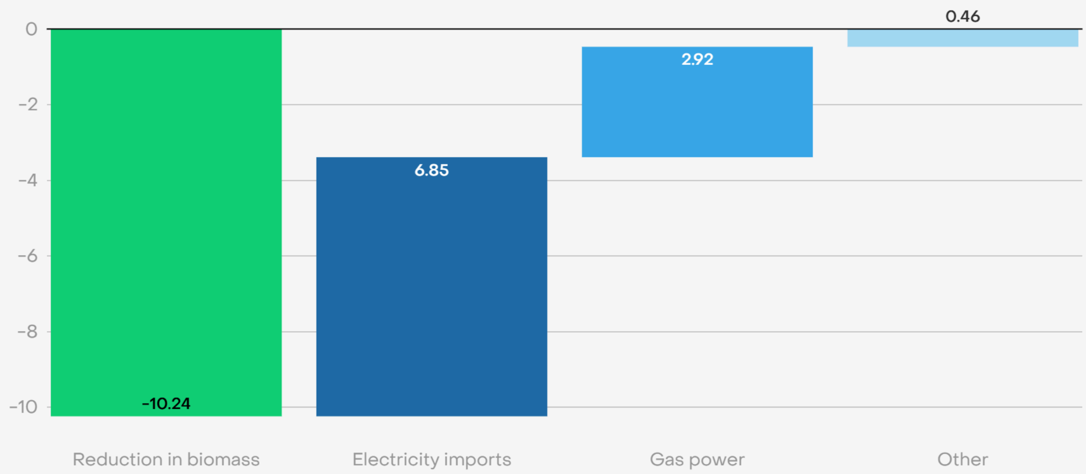
EMBER

System remains stable with biomass capacity equivalent to a single unit

Generating capacity for other power generators has been kept aligned with NESO analysis. However, the equivalent of only one unit of Drax, the largest biomass power plant, is retained from the existing large-scale biomass fleet, reducing total capacity by 2 GW. Compared to 2023, a large increase in capacity is modelled for solar and wind power, while nuclear capacity decreases by 2.5 GW due to planned closures. Between 2023 and 2030, in Ember low-biomass modelling, wind power generation triples, whereas gas power generation falls by two-thirds. In 2030, compared to NESO-aligned Ember modelling, the reduction in power generation using biomass (-10 TWh) is largely met by an increase in electricity imports from interconnected markets (6.9 TWh), with a 14% rise in generation using gas (2.9 TWh) and slight increases in generation from other technologies (0.5 TWh). The balance between higher imports or increased gas use reflects the price difference between interconnected markets, and the overall interconnection capacity available.

In a low-biomass clean power system, biomass is mostly replaced by imports, though GB remains a net exporter

Change in 2030 compared to NESO Clean Power aligned modelling (TWh)



Source: Ember 2030 model with low-biomass, Ember 2030 model aligned with NESO 2030 Clean Power analysis

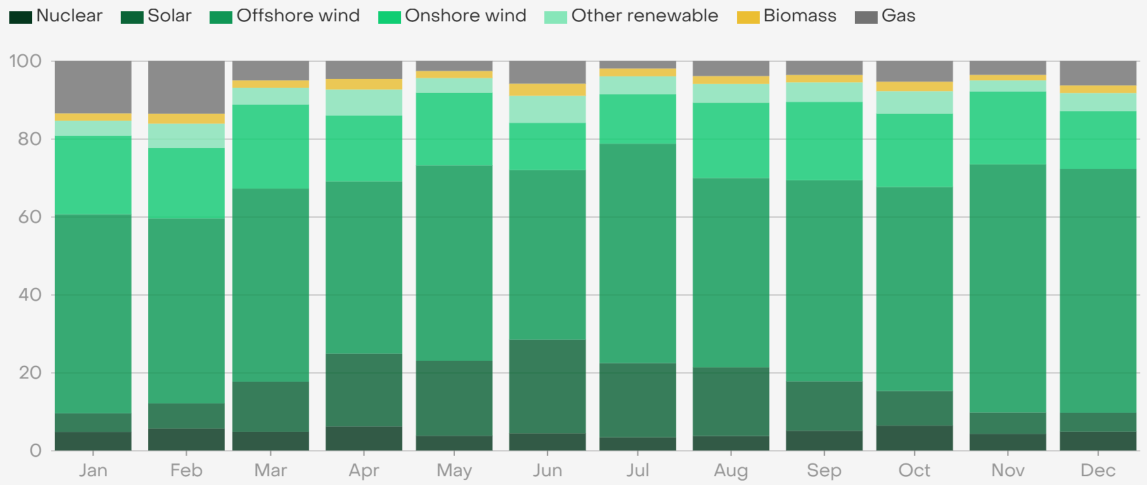
EMBER

A low-biomass clean power Great Britain remains a net exporter

In a clean power scenario by 2030, the UK becomes a net exporter of electricity (60 TWh), highlighting the importance of interconnection capacity with neighbouring countries. Reducing the use of biomass power in a clean power system decreases net power exports by just under 10% (-7 GW) while, in both low-biomass, and the NESO 'Further Flex and Renewables' 2030 power systems, Great Britain becomes a net exporter. This represents a significant change from the current energy system, as Great Britain currently uses electricity imports to meet demand. Within a low-biomass clean power system, renewable technologies supply the majority of generation, with sporadic spikes in gas use to meet weather or demand-related requirements, and biomass generation supplies a third of the electricity generated by fossil gas.

Biomass power falls to 2% of generation in a clean power system with low-biomass

Monthly generation (2030 - %)



Source: Ember analysis of a low-biomass clean power system

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A low-biomass system increases the benefits of clean power

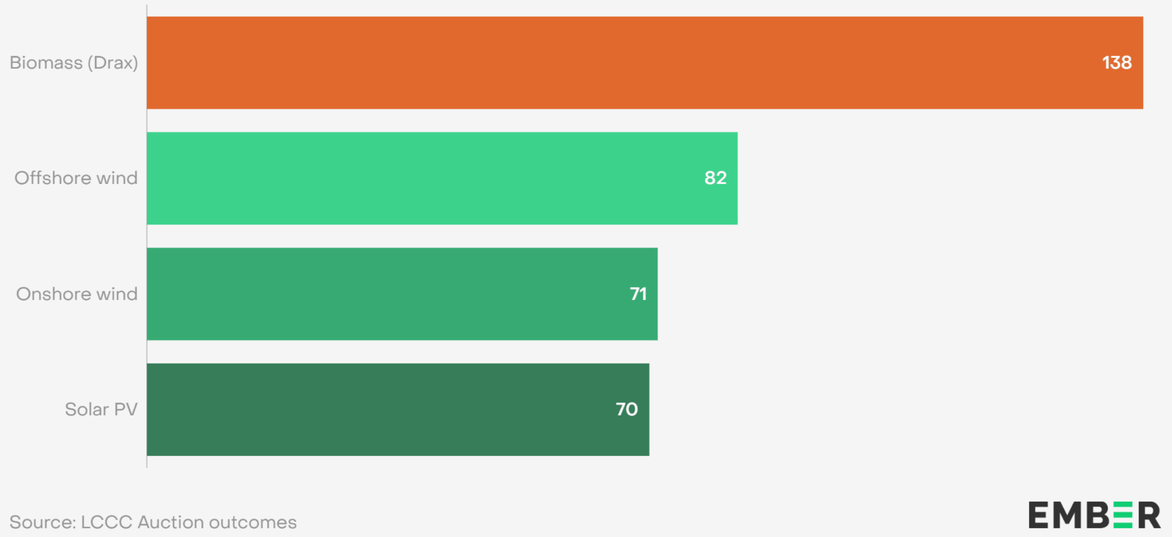
Biomass power remains 80% more expensive than fossil gas in 2024, and almost double the price of onshore wind. Reducing the use of large-scale unabated biomass in a clean power energy system compounds the cost and energy security benefits of reducing gas use by cutting both fuel import reliance, and reducing the use of high-cost energy fuels.

Cutting biomass generation can help reduce costs

Gas prices have been rising across 2024, though biomass Contract for Difference (CfD) prices remain 80% higher. In 2024, the cost of generating electricity using gas has averaged £77/MWh, which is 80% higher than the pre-energy crisis average of £43/MWh (2017-2020), but biomass is even more expensive. CfD support for biomass power generation at Drax is £138/MWh (2024 prices), far above the most recent wind and solar CfD auction levels (£82/MWh for offshore wind and £70/MWh for solar in AR6 2024). Although a low-biomass power system involves a slight increase in modelled gas use, the wholesale cost reductions of a clean power system can still be delivered, due to a large reduction in high-cost biomass power generation.

Prices for wind and solar have reduced to around half of biomass prices

Prices from most recent annual Contracts for Difference round per technology (2024 prices, £/MWh)



Source: LCCC Auction outcomes

Emissions savings from biomass power are not guaranteed

Unfortunately, not only may the cost of generating power from biomass raise prices in a clean power system, but the assumed carbon savings from biomass is far from guaranteed. There is a mounting body of evidence and expert opinion that this assumption is critically flawed and must be overturned. The European Academies Sciences Advisory Council states that using woody biomass for power "is not effective in mitigating climate change and may even increase the risk of dangerous climate change". Furthermore, BBC investigations have shown examples of rare old growth forests being cut down and turned into wood pellets, increasing the potential ecological harm inflicted. While the scientific debate increasingly suggests that burning biomass could actually be contributing to climate change, energy bill payers in the UK are bearing the cost. In 2023 Drax received an estimated £539m in public subsidy under the assumption that it provides emissions-free power.

Import reliance means energy security remains a concern for biomass power plants

Large-scale biomass power generators are highly dependent on imports. In 2023, Drax power station consumed 5.8 million tonnes of wood biomass, none of which was sourced in the UK. The UK imports around 50% of its gas requirements, and is the third-largest importer of timber in the world, after China and the USA. Altogether, the UK produced only 0.3 million tonnes of wood pellets in 2023, meaning that Drax power station consumes just under 20 times the UK's domestic pellet production annually.

Drax is a wood pellet producer as well as a consumer of pellets at Drax power station, meaning that energy supply is just one of its competing priorities. When pellet prices soar, it may be more profitable to sell the fuel on the market rather than use it to generate power in the UK. The result of this equation is that during times of high electricity demand in the European gas crisis in 2022, Drax's power plants sat idle for weeks, costing the UK consumer an estimated £639 million in foregone cost reductions. Alongside gas power plants, UK biomass power plants therefore also represent an energy supply risk.

Conclusion

Steps towards a low-biomass clean power system

A clean power system with reduced biomass capacity relies less on fuel imports and expensive power generation, increasing the benefits of clean power without risking energy system stability.

Recent NESO modelling did not include a low-biomass clean power pathway. However Ember modelling suggests it is achievable and could compound the benefits of clean power. Although biomass power plants make up a small proportion of the total power system, they can have an outsized impact due to the high cost of generating electricity using biomass.

Dispatchable thermal power can help support a stable energy system with low use of gas in power generation, but the capacity of biomass can be minimised while stability is retained. A pathway is achievable therefore which includes the equivalent of a single unit of dispatchable large-scale biomass power, while reducing unnecessary and expensive biomass power generation overall.

Methodology

Comparison between models

Large scale biomass capacity in this sensitivity is reduced to the equivalent of a single operating unit of Drax, whereas other generation capacity is kept aligned with the 'Further Flex and Renewables' pathway in the NESO 2030 Clean Power report. Ember has also modelled a clean power counterfactual fully in line with the NESO 2030 report (i.e. without biomass capacity reductions) as well as a low-biomass option. The clean power counterfactual results are strongly correlated with the NESO modelling, but for consistency of comparison, results are reported against the Ember counterfactual 2030 model, rather than the 'Further Flex and Renewables' pathway.

Biomass capacity in the 2030 low-biomass power system is reduced by 2 GW, for the purposes of modelling the remaining total is equal to the equivalent of one unit at Drax, plus existing small-scale biomass units. However, this capacity could be formed from a larger number of smaller scale biomass units, which would have different implications for domestic biomass feed stocks when compared to large-scale biomass units.

Acknowledgement

Cover image

An aerial panorama view of Drax Power Station showing Biomass storage tanks and carbon capture in Yorkshire, United Kingdom

Credit: Clare Jackson / Alamy Stock Photo