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# MONEY TO BURN? THE U.K. NEEDS TO DUMP BIOMASS AND REPLACE ITS COAL PLANTS WITH TRULY CLEAN ENERGY

The United Kingdom's electricity system is undergoing a major transformation. Under the Climate Change Act of 2008, the U.K. committed to cutting greenhouse gas (GHG) emissions by at least 80 percent from 1990 levels by 2050. The U.K. also has an aging power sector and a program of scheduled retirements of all coal plants by 2025, and so needs new investment to ensure reliability of supply[i] in the period 2020–2025 and beyond.

The U.K. has relied heavily on biomass—basically plant matter used for energy—to build new electricity capacity and meet climate targets. Today, biomass represents the lion's share of U.K. "renewable" electricity generation. However, recent science shows that many forms of biomass—especially biomass from forests—result in higher carbon emissions than do coal and natural gas. At the same time, the costs of building low-carbon alternatives to biomass, like wind and solar, have fallen rapidly and are expected to continue declining.

A new study commissioned by the Natural Resources Defense Council and executed by Vivid Economics, a London-based consultancy with expertise in U.K. energy systems, examines the economics of biomass relative to these alternatives for meeting reliability of supply and decarbonisation objectives for the U.K. power system over the next decade. The study concludes that in the period 2020–2025, wind and solar are likely to be the least-cost way to ensure U.K. reliability of supply while also achieving power sector decarbonisation goals, not biomass.

## U.K. RULES STILL FAIL TO FULLY ACCOUNT FOR THE CARBON TOLL OF BURNING BIOMASS

Recent science—including research from the U.K. government's own previous Department of Energy and Climate Change (DECC)—has found that burning biomass derived from whole trees and other large-diameter wood increases emissions relative to coal and natural gas for decades.[1,2] The emissions risk associated with biomass has been reflected to a limited degree in government safeguards, including overall emissions limits on biomass. However, all biomass is still treated as a "carbon neutral" fuel; U.K. policy only requires utilities to account for emissions associated with the cultivation, processing, and transport of biomass, not power plant emissions when biomass is combusted for electricity or forgone carbon sequestration in the forest from the additional harvest of biomass for energy.[3]

## WIND AND SOLAR ARE THE LEAST-COST WAY TO POWER THE U.K., NOT BIOMASS

The study compares the economics of biomass and other renewables (onshore wind, offshore wind, and large-scale solar photovoltaic) under varying assumptions about the total economic cost of each. Total economic cost includes technology costs (capital and operating costs), the costs of ensuring reliability of supply,[ii] and the costs of carbon pollution, based on three assumed levels of biomass carbon intensity. Two reflect only partial emissions accounting, and one reflects a conservative estimate of the full emissions associated with biomass, based on the U.K. government's own calculator (see Table 1). The Technical Appendix provides a detailed description of all cost assumptions and the *WeSIM* model.

i Represents the number of hours per annum in which, over the long-term, it is statistically expected that supply will not meet demand. Our modelling assumed this is three hours per year, in line with the current standard for the U.K. power system.

ii Known as system integration costs (SICs), these include the costs associated with backup generation required to "firm up" wind and solar, as well as the costs associated with increasing the flexibility of the system to adapt to fluctuations in demand.

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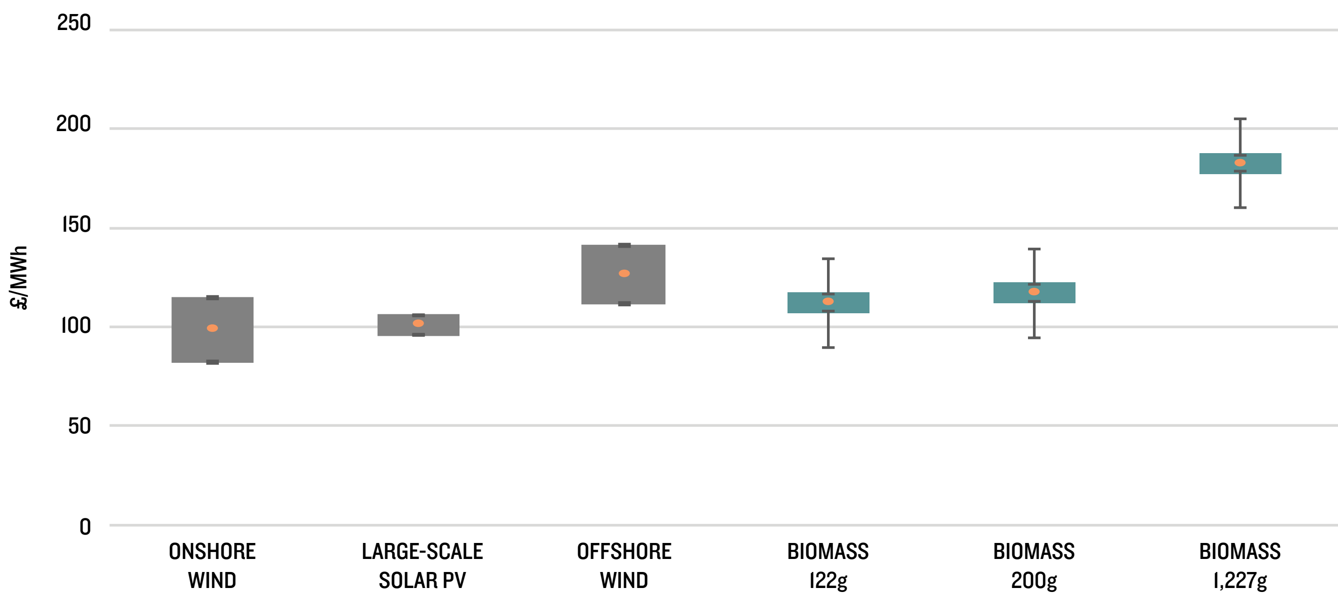
### TABLE 1: BIOMASS EMISSIONS SCENARIOS MODELLED

| SCENARIO DESCRIPTION | EMISSIONS ACCOUNTING | $KGCO_2$/KWH |
|---|---|---|
| Estimate of Drax biomass[a] | Partial accounting, including cultivation, processing, transport | 122 |
| U.K. emissions limits for 2020–2025[b] | Partial accounting, including cultivation, processing, transport | 200 |
| SELC low estimate using BEAC calculator[c] | Full emissions accounting | 1,277 |

*Sources:* a. Drax (2015) Biomass Supply. b. Represents the upper limit of allowed emissions from cultivation, processing, transportation. c. Represents the low end of estimates of full emissions accounting from SELC (2015) Carbon Emissions Estimates for Drax biomass power plants in the U.K. sourcing from Enviva Pellet Mills in the southeastern U.S. hardwoods using the BEAC model. SELC used a scenario including 17% mill residue (scenario 3), 48% fine forest residues (scenario 7), and 35% from additional hardwood harvests (scenario 13).

### FIGURE 1: TOTAL ECONOMIC COSTS IN 2020



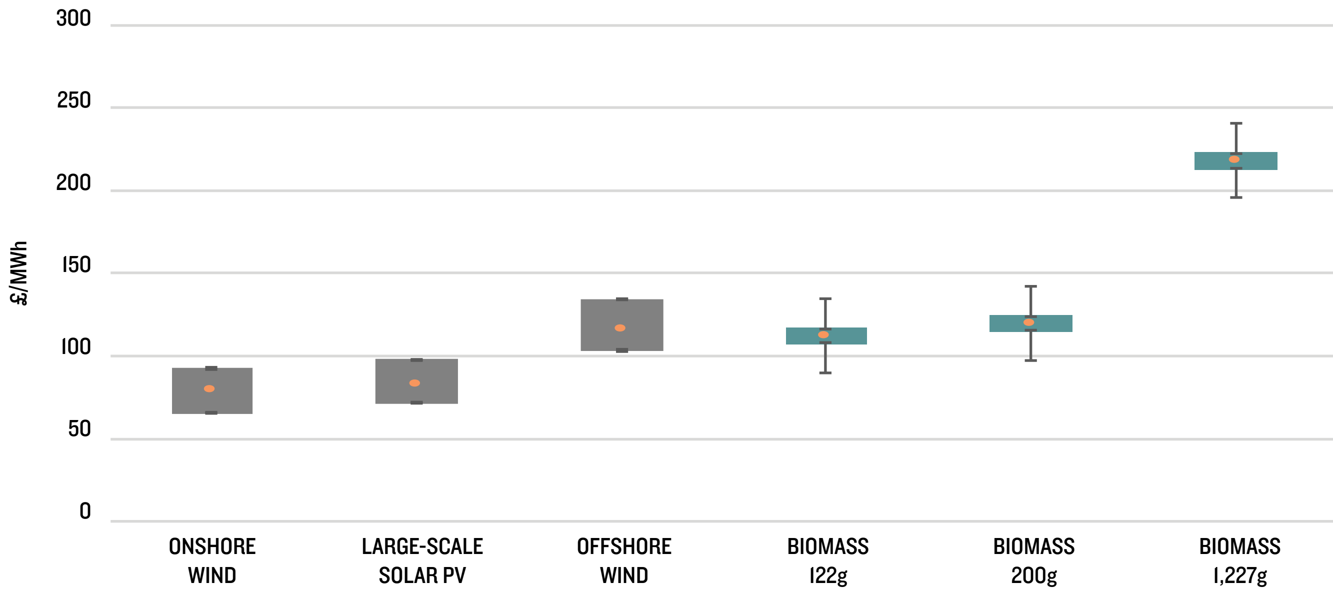

In 2020, accurately accounting for power plant emissions from burning biomass and their associated carbon costs results in biomass being uneconomic relative to alternatives (see Figure 1). Even for scenarios that do not include a full accounting of biomass carbon emissions, the total economic cost of biomass is comparable to or higher than the total economic cost of onshore wind and solar. In 2025, as their costs continue to fall, wind and solar are likely to be the least-cost way to ensure U.K. reliability of supply, not biomass. This holds true across all emissions scenarios examined (see Figure 2).

## RENEWABLES ARE THE CHEAPEST, CLEANEST, AND FASTEST-DEPLOYING TECHNOLOGIES TO REPLACE COAL

A further review of cost data shows that the costs of building low-carbon alternatives to biomass, in particular wind and solar energy, have been falling rapidly and are expected to continue declining.[4,5] By contrast, the potential for biomass technology costs to fall is limited. Biomass conversion is already a mature technology, so comparatively little capital cost reduction is expected over time; fuel costs, which make up the bulk of biomass costs, are highly uncertain; and it is now widely understood that biomass emits more carbon than coal within timeframes relevant for solving climate change.[6,7]

U.K. policymakers seeking to achieve both reliability of supply and power sector decarbonisation should not plan to replace retired coal plants with expensive and dirty biomass conversions and should instead invest in lower-cost wind and solar. Policymakers should also curb biomass subsidies, strengthen sustainability requirements for biomass sourcing, require utilities to fully account for biomass emissions, and place an overall cap on biomass for energy to reflect limited supplies of truly sustainable low-carbon sources.

## FIGURE 2: TOTAL ECONOMIC COSTS IN 2025




ENDNOTES

1 Stephenson, A. L., and D. MacKay, "Life Cycle Impacts of Biomass Electricity in 2020: Scenarios for Assessing the Greenhouse Gas Impacts and Energy Input Requirements of Using North American Woody Biomass for Electricity Generation in the U.K.," U.K. Department of Energy and Climate Change, July 2014.

2 Colnes, A., et al., "Biomass Supply and Carbon Accounting for Southeastern Forests," Biomass Energy Resource Center, Forest Guild, and Spatial Informatics Group, February 2012. Harmon, M., "Impacts of Thinning on Carbon Stores in the PNW: A Plot Level Analysis," Oregon State University, May 2011. Mitchell, S., M. Harmon, and K. O'Connell, "Carbon Debt and Carbon Sequestration Parity in Forest Bioenergy Production," *GCB Bioenergy*, May 2012. Repo, A., et al., "Sustainability of Forest Bioenergy in Europe: Land-use-related Carbon Dioxide Emissions of Forest Harvest Residues," GCB Bioenergy, March 2014. Stephenson, A. L., and MacKay, D., "Life Cycle Impacts of Biomass Electricity in 2020." Ter-Mikaelian, M., et al., "Carbon Debt Repayment or Carbon Sequestration Parity? Lessons from a Forest Bioenergy Case Study in Ontario, Canada," *GCB Bioenergy*, May 2014. Walker, T., et al., "Biomass Sustainability and Carbon Policy Study," Manomet Center for Conservation Sciences, June 2010.

3 The U.K. carbon methodology is based on the EU's Renewable Energy Directive (RED) methodology; see page 5 of Stephenson, A. L., and MacKay, D., "Life Cycle Impacts of Biomass Electricity in 2020," https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/349024/BEAC_Report_290814.pdf. Annex V of the RED details the emissions methodology, whereby "13. Emissions from the fuel in use, Eu, shall be taken to be zero for biofuels and bioliquids." See European Parliament, "Directive on the Promotion and Use of Renewable Energy from Renewable Sources and Amending and Subsequently Repealing Directives 2001/77/EC and 2003/30/EC," April 2009, http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009L0028&from=EN. However, the RED methodology originally covered only liquid biofuels. The methodology was then extended to solid biomass: "12. Emissions from the fuel in use, Eu, shall be taken to be zero for solid and gaseous biomass." See Annex 1, European Parliament, "Report on Sustainability Requirements for the Use of Solid and Gaseous Biomass Sources in Electricity, Heating, and Cooling," February 2010, http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52010DC0011&from=en.

4 International Renewable Energy Agency (IRENA), "Wind," 2016, http://costing.irena.org/technology-costs/power-generation/wind.aspx. Catapult Offshore Renewable Energy, "Cost Reduction Monitoring Framework," 2015, https://ore.catapult.org.uk/our-knowledge-areas/knowledge-standards/knowledge-standards-projects/cost-reduction-monitoring-framework/.

5 IRENA, "Solar Photovoltaics," 2016, http://costing.irena.org/technology-costs/power-generation/solar-photovoltaics.aspx.

6 U.K. Department of Energy and Climate Change, "Electricity Generation Costs," December 2013,. https://www.gov.uk/government/publications/electricity-generation-costs-december-2013.

7 Colnes, A., et al., Biomass Supply and Carbon Accounting." Harmon, M., Impacts of Thinning on Carbon Stores in the PNW." Mitchell, S., M. Harmon, and K. O'Connell, "Carbon Debt and Carbon Sequestration Parity." Repo, A., et al., "Sustainability of Forest Bioenergy in Europe." Stephenson, A. L., and D. MacKay, "Life Cycle Impacts of Biomass Electricity in 2020." Ter-Mikaelian, M., et al., "Carbon Debt Repayment or Carbon Sequestration Parity?" Walker, T., et al., "Biomass Sustainability and Carbon Policy Study."