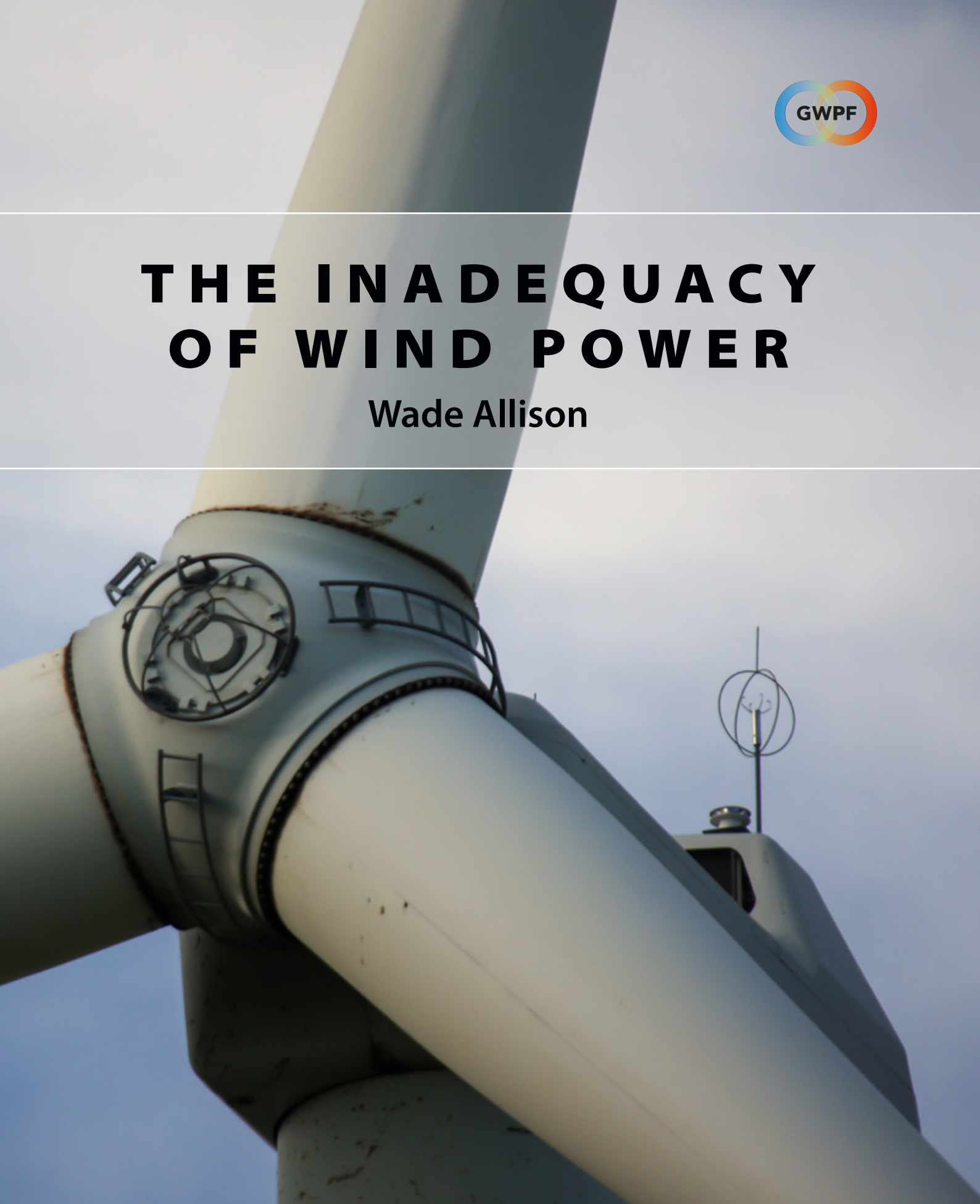




THE INADEQUACY OF WIND POWER

Wade Allison



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About the author

Wade Allison is Emeritus Professor of Physics at the University of Oxford, and a Fellow of Keble College. In addition to teaching mathematics and physics at Oxford and researching at CERN, he is also deeply involved in medical physics and the biological effects of radiation, on which he has published three books: *Fundamental Physics for Probing and Imaging* (OUP, 2006), *Radiation and Reason* (2009) and *Nuclear is for Life* (2015). He is the Honorary Secretary of the Supporters Of Nuclear Energy (SONE), which was started by Bernard Ingham and others. He is a member of International Scientists for Accurate Radiation Information (SARI).



The inadequacy of wind power

The plan dramatically to cut the combustion of fossil fuels was accepted at the 2015 Paris Conference. The instinctive reaction around the world has been to revert to 'renewables', the sources of energy delivered intermittently by the power of the Sun. Unfortunately this power, attenuated by the huge distance that it must travel to reach the Earth, is extremely weak. That is why, before the advent of the Industrial Revolution, it was unable to provide the energy to sustain even a small global population with an acceptable standard of living.

Today, modern technology is deployed to harvest these weak sources of energy. Vast 'farms' that monopolise the natural environment are built, to the detriment of other creatures. Developments are made regardless of the damage wrought. Hydro-electric schemes, enormous turbines and square miles of solar panels are constructed, despite being unreliable and ineffective; even unnecessary.¹

In particular, the generation of electricity by wind tells a disappointing story. The political enthusiasm and the investor hype are not supported by the evidence, even for offshore wind, which can be deployed out of sight of the infamous My Back Yard. What does such evidence actually say?

That the wind fluctuates is common knowledge. But these fluctuations are grossly magnified to an extent that is not immediately obvious – and has nothing to do with the technology of the wind turbine. The energy of the wind is that of the moving air, and, as every student knows, such energy is $\frac{1}{2}Mv^2$, where M is the mass of air and v the speed. The mass of air reaching each square metre of the area swept by the turbine blade in a second is $M = \rho v$, where ρ is the density of air: about 1.2 kg per cubic metre. So, the maximum power that the turbine can deliver is $\frac{1}{2}\rho v^3$ watts per square metre.

If the wind speed is 10 metres per second (about 20 mph) the power is 600 watts per square metre at 100% efficiency.² That means to deliver the same power as Hinkley Point C (3200 million watts) by wind would require 5.5 million square metres of turbine swept area – that should be quite unacceptable to those who care about birds and to other environmentalists.

But the performance of wind is much worse than that, as a look at the simple formula shows. Because the power carried by the wind depends on the *third* power of the wind speed, if the wind drops to half speed, the power available drops by a factor of 8. Almost worse, if the wind speed doubles, the power delivered goes up 8 times, and as a result the turbine has to be turned off for its own protection. This is not related to the technology of the turbine, which can harvest no more than the power that reaches the area swept by its blades.

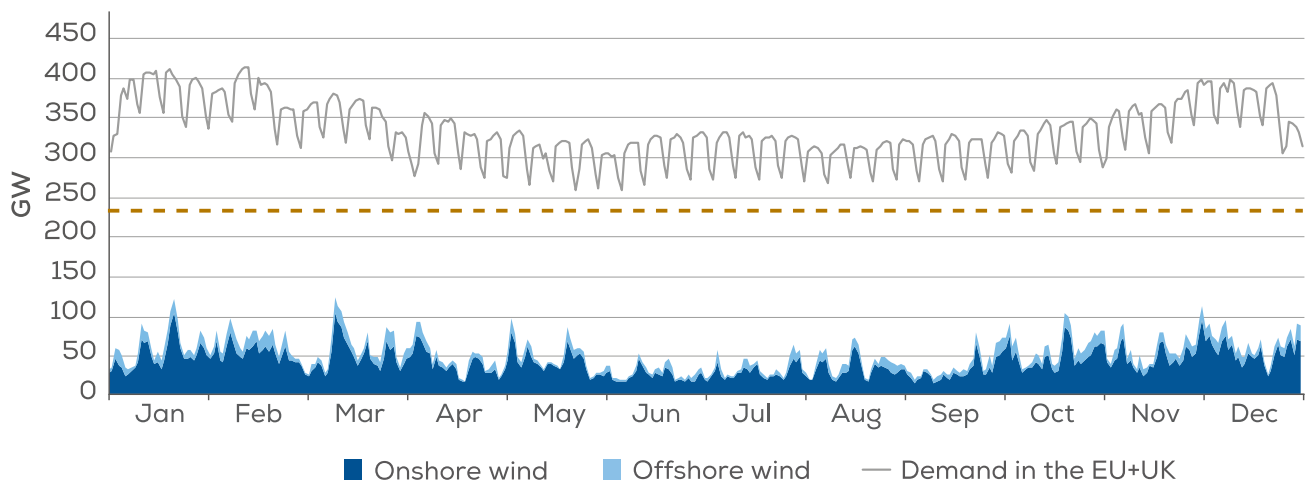


Figure 1: Power demand and generation in EU+UK in 2021

Source: WindEurope

The effect of the enhanced fluctuations is dramatic. In Figure 1, the blue area shows the total EU and UK wind energy generated each day in 2021. The installed nominal generating *capacity* was 236 GW (the brown dashed line), but the highest *output* in the year was 103 GW (26 March). This is not the headline plot that the industry shows to its investors, the media and politicians, but it comes from their own published annual WindEurope Report.³

The wind blows somewhat more steadily offshore than onshore, as every sailor knows. Nevertheless, the unreliability inherent in wind energy persists. Figure 2 shows the wind power generated by all UK offshore windfarms in March 2022, as presented online on the Crown Estate website.⁴ Over some periods, it rose to the nominal installed capacity of 10 GW. However, for 8 days at the end of the month it averaged no more than 1.2 GW. The green rectangle (added) illustrates that 8.8 GW was not available for this time, presumably because the average wind speed halved. That much energy, 1600 GWh, is 1000 times the capacity of the world's largest grid storage battery (1.6 GWh at Moss Landings, California). Battery technology has its own problems. It can provide for laptops and other portable applications, even car batteries at up to 75 kWh, but larger batteries have problems with safety⁵ and mineral shortages.⁶ Batteries 20 million times larger are never going to be available and storage batteries will never make good the failure of offshore wind farms, even for a week. And the wind can drop for longer periods than that.

However, the bluster of windfarm politics, as pursued by the UK Government, ignores evidence, it seems. The industry is keen to promote onshore wind also. However there the fluctuations are greater than offshore and the political deterrence from My Back Yard is stronger. Consequently, the Government has promoted offshore projects. On 6 October 2020, Boris Johnson an-

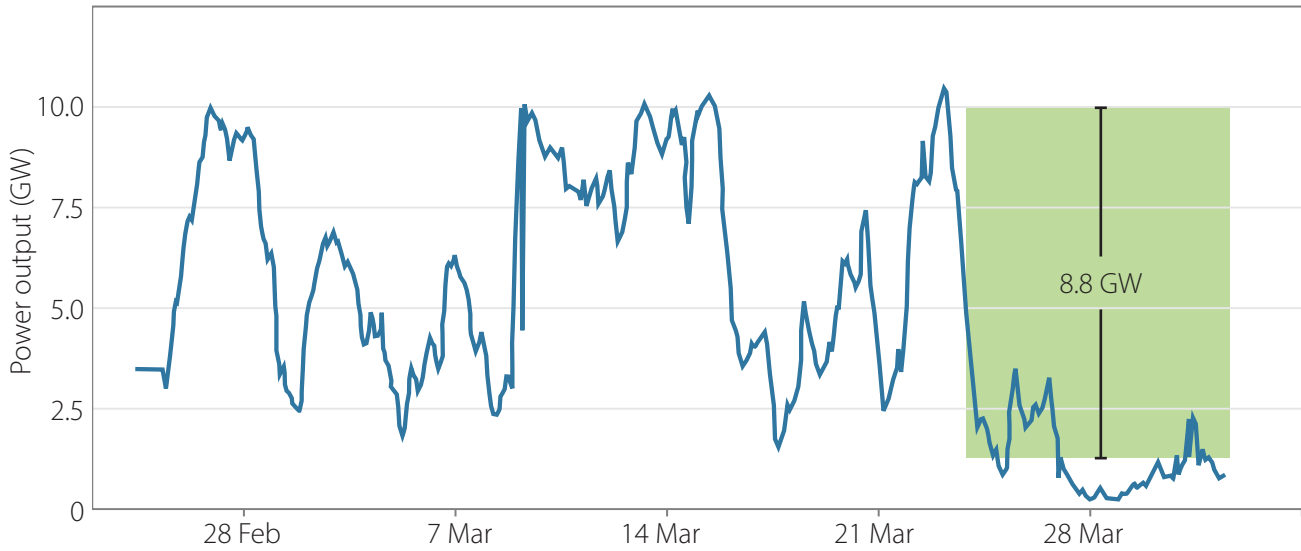


Figure 2: Offshore wind production in the UK, March 2022

Source: Redrawn from Crown Estate data.

nounced that ‘wind farms could power every home by 2030’. He continued to harangue the public in Churchillian tone ‘Your kettle, your washing machine, your cooker, your heating, your plug-in electric vehicle – the whole lot of them will get their juice cleanly and without guilt from the breezes that blow around these islands.’ He was describing Government policy to expand existing offshore wind power from the existing capacity of 10.4GW by an additional 40GW, in addition to the already installed onshore capacity of 13.6GW.

The significant word in the announcement was ‘could’. Evidently, offshore wind might provide such lighting in the UK – sometimes. But Great Britain needs reliable energy all the time. British consumers should follow the example of Alice who, in negotiating terms with the White Queen, insisted on clarification of the day on which jam should be delivered.⁷ Evidently, they should not look to wind power for reliable energy, but elsewhere.¹

With general energy shortages, the war in Europe, high prices and the likelihood of failures in electricity supply, many popular scientific presumptions underlying energy policy should be questioned. Wind power fails on every count.

Notes

- 1 <https://www.mdpi.com/2673-4362/3/3/13>
- 2 Coincidentally, this is about the same power per sq. m as the solar flux on the illuminated globe. However, the share of this received at the latitude of the UK is reduced, especially in winter and at night, of course, when most energy is needed.
- 3 <https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2021-statistics-and-the-outlook-for-2022-2026/>
- 4 On its website, Crown Estate publishes a plot showing the running output over the previous 30 days. <https://www.thecrownestate.co.uk/en-gb/what-we-do/asset-map/>.
- 5 https://www.researchgate.net/publication/352158070_Safety_of_Grid_Scale_Lithium-ion_Battery_Energy_Storage_Systems
- 6 <https://www2.bgs.ac.uk/mineralsuk/statistics/rawMaterialsForALowCarbonFuture.html>
- 7 https://en.wikipedia.org/wiki/Jam_tomorrow

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People are naturally concerned about the environment, and want to see policies that protect it, while enhancing human wellbeing; policies that don't hurt, but help.

The Global Warming Policy Foundation (GWPF) is committed to the search for practical policies. Our aim is to raise standards in learning and understanding through rigorous research and analysis, to help inform a balanced debate amongst the interested public and decision-makers. We aim to create an educational platform on which common ground can be established, helping to overcome polarisation and partisanship. We aim to promote a culture of debate, respect, and a hunger for knowledge.

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