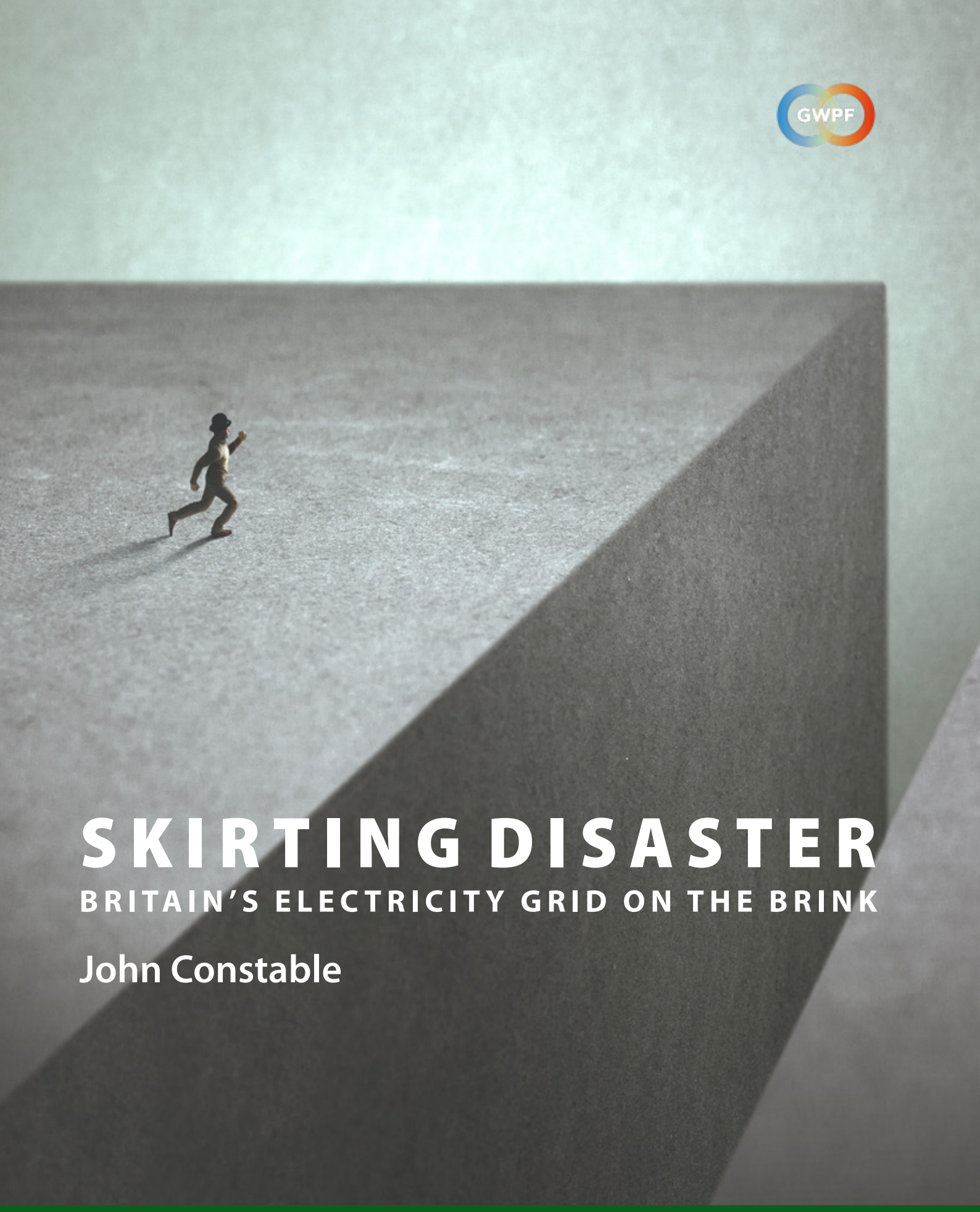

SKIRTING DISASTER

BRITAIN'S ELECTRICITY GRID ON THE BRINK

John Constable

The Global Warming Policy Foundation
Note 24

Skirting Disaster: Britain's Electricity Grid on the Brink

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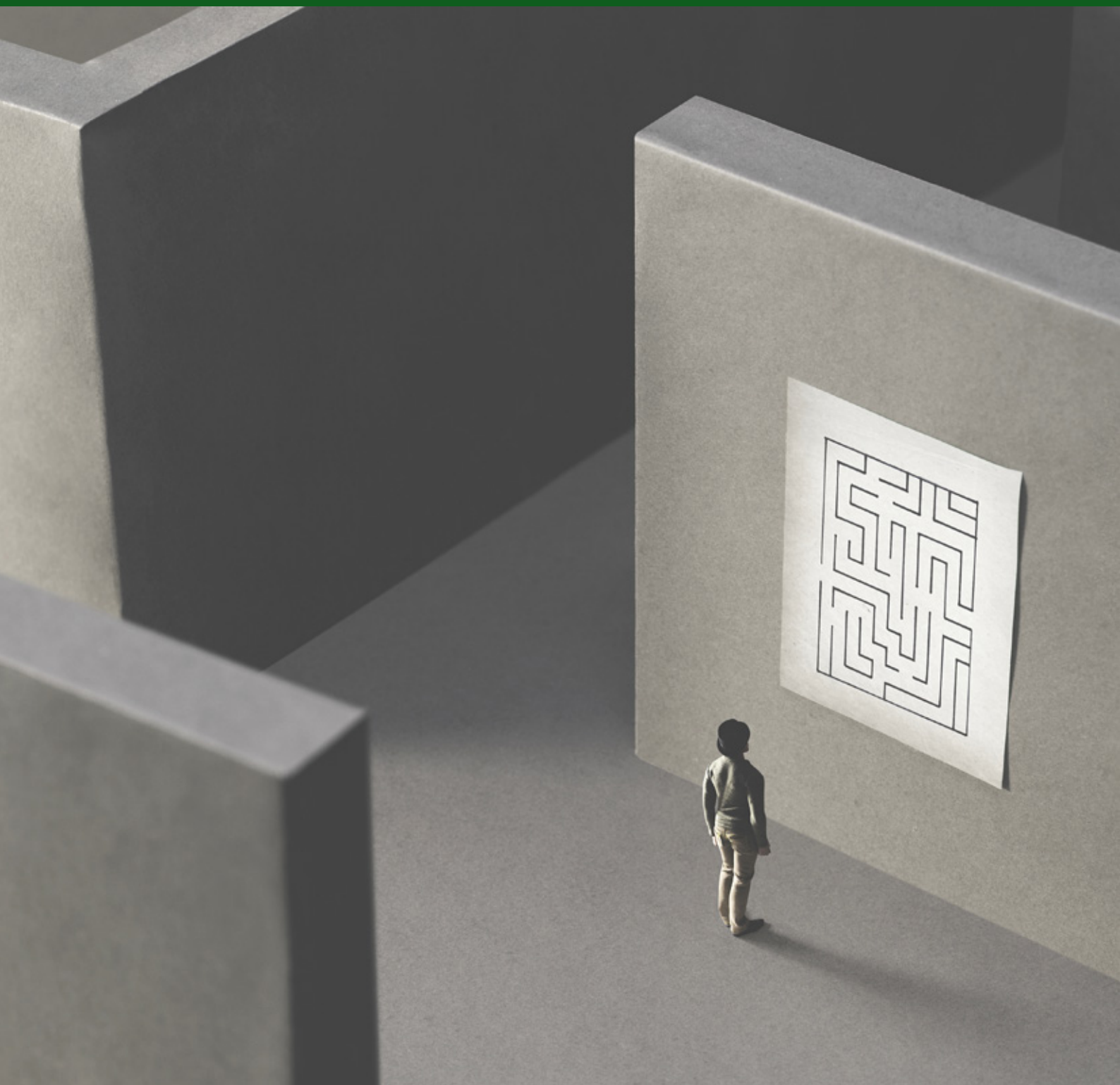

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About the author

John Constable is is a member of GWPF's Academic Advisory Council and the energy editor of the Global Warming Policy Foundation.

1. Summary

On two consecutive recent days – 4 and 5 November 2020 – National Grid, the UK's Electricity System Operator, issued System Warnings in the form of Electricity Margin Notices, alerting the markets to a reduced system margin. In large part this is due to low levels of wind power as a result of a very large high pressure system that covers the whole of the UK, bringing the first frosts of the winter.

At peak load on 4 November, the UK's entire transmission-connected wind fleet, amounting to 18,000 MW of capacity, was providing a mere 3,000 MW, just 17% of its possible output.

The last of the UK's remaining coal plants stepped in and provided over 2,264 MW of generation, alongside other conventional forms of generation. For a government that claims to be 'Powering Past Coal' this is deeply embarrassing.

The UK's electricity sector is now so fragile that a normal weather event causes it to wilt like a hothouse plant left out in the frost, and the prospects for the future are deeply troubling.

Much of the conventional capacity that has been stabilising the system in the last two days, particularly coal, is scheduled for rapid closure in the drive towards Net Zero. This hasty policy has long looked overambitious, it now appears dangerous as well as ruinously expensive.

The government has become a hostage to renewables industry lobbyists, inside and outside Westminster, and will not spontaneously initiate an inquiry into the threat to energy and national security or admit failure. The GWPF is calling for MPs to initiate their own investigation of the perilous state of the United Kingdom's electricity system.

Amongst the questions that MPs should be asking are:

- Why was National Grid caught out by the weather, and how much has their mistake cost consumers?
- How can we quickly pause and unwind the increasingly dangerous reliance on renewables and wind power?
- Does the UK have to extend the lives of coal and older gas generators in order to limit the risk of security of supply and control consumer costs?
- Should the UK create a market that delivers a long-term cost-minimisation strategy for electricity?

The engineering of our electricity industry is a national embarrassment, with National Grid sent into a panic by the first mild frosts of winter, and consumer costs at horrific levels. The renewables policy of the last twenty years is to blame and government must now change course.

2. Skirting disaster

The sudden onset of cold weather has brought more clear evidence that the United Kingdom's wind-dominated electricity system is weak and extremely expensive to run.

A high-pressure system has resulted in unexpectedly low levels of wind power, low temperatures, and higher demand. Consequently, generation margins are low, resulting in repeated System Warnings from National Grid. Nuclear and fossil fuels, including the handful of remaining coal-fired power stations, are stabilising the system. There has been no interruption of supply, but with both gas and coal stations set to close as part of the low-carbon transition, the future looks dark and unaffordable. The government is compromised and unable to address the imminent disaster. In the national interest, MPs must institute their own inquiry.

The United Kingdom is currently near the centre of a very large high-pressure system, extending from the mid-North Atlantic to Moscow. High pressure systems bring low winds and low temperatures (Figure 1).[1]

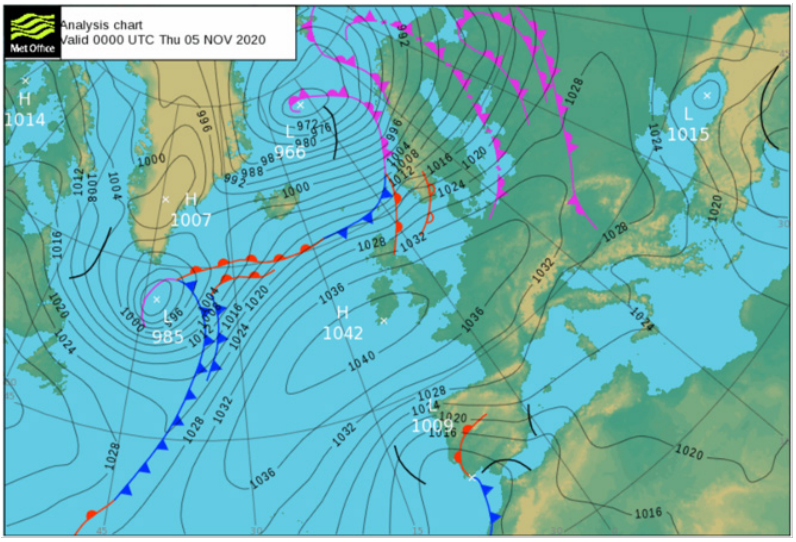

Figure 1: Met Office ground pressure chart for 5 November 2020.
Source: Met Office.

For two days running, on 4 and 5 November 2020, National Grid, the UK's Electricity System Operator issued system warnings, alerting the markets to a generation margin shortfall. This was needed largely because of low levels of wind power resulting from the high-pressure system.

The purpose of such system warnings is to bring forward generation or controllable demand and thus reduce the risk to security of supply. The warnings were successful in this respect, and at 13:00 on 4 November National Grid cancelled its warning.

Demand peaked that day at about 43 GW, as can be seen in Figure 2,[2] from the market data provider, Elexon, which shows contributions from the various fuels and interconnectors by half-hour settlement period. The figure shows

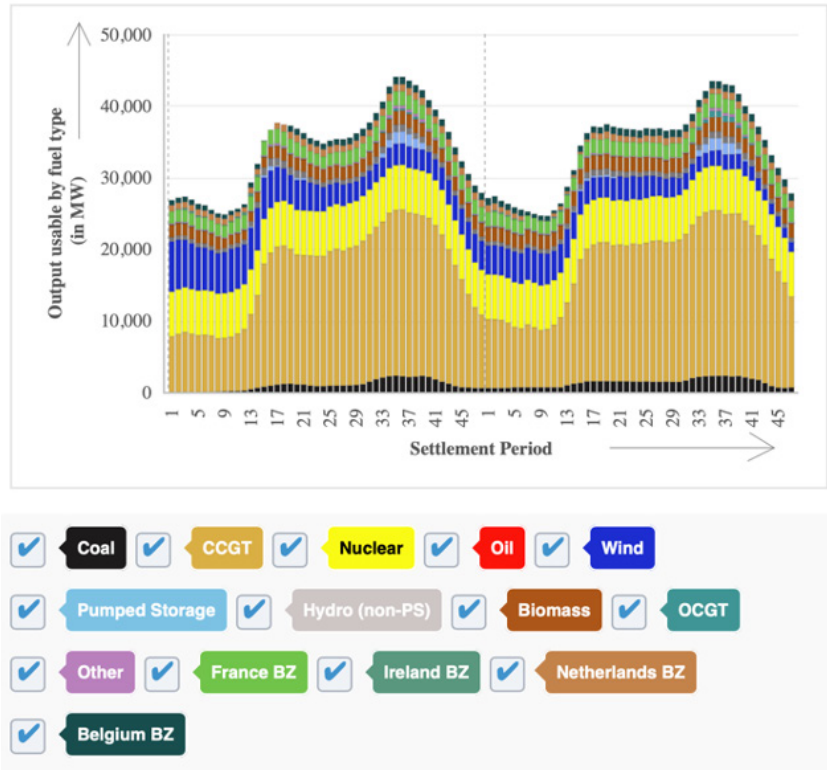

Figure 2: Transmission system fuel mix 4–5 November 2020.
Source: Elexon.[2]

all 48 half-hourly settlement periods on 4 November and 47 settlement periods on the following day.

The UK's 18,000 MW of wind capacity was providing only 17% of its possible output (3,000 MW), shown in the royal blue bars in the chart. The bulk of demand was met by 6 GW of nuclear and 23 GW of combined-cycle gas turbines (CCGTs): nearly the all of the 27 GW CCGT fleet currently in the market.

There were also critically important contributions over the peak hours from the last of the UK's remaining coal plants, which provided over 2,264 MW of generation (black bars in the chart above). Other notable contributions included 355 MW of fast reacting open-cycle gas turbines (OCGTs), and 1,642 MW of pumped hydro storage. These generators are almost certainly those that responded to National Grid's system warning.

In the evening of the 4th, National Grid issued a second system warning, announcing a shortfall for the peak demand period on the 5th, a warning that was confirmed at 10.00 the following morning. One supplier, Octopus, began emailing time-of-use metered customers with an offer: if they were prepared to reduce their consumption between 16:30 and 18:30 by half or more over the peak period, then the remaining electricity would be unbilled. Octopus was presumably intending to bundle this demand reduction and sell it to National Grid for a price that would more than cover the offer of unbilled consumption.

Many others will have offered their services, and National Grid cancelled at 14:00, indicating that sufficient generation and controllable demand had been obtained.

Wind power on the 5th was even less effective than on the 4th. During the ramp up in demand from 16:00 onwards, wind output was just over 2 GW, just over 10% of the fleet's capacity.

Coal, which had been operating since the early hours of the previous day, was generating 2 GW and itself ramping up with demand, as was gas-fired generation.

As can be seen above in Figure 2, demand peaked at about 43 GW in settlement period 35. Coal was providing about 2,250 MW at this time, with CCGTs some 23,000 MW, nuclear 6,200 MW, pumped storage at 1,782 MW, and OCGTs a striking 870 MW.

In spite of the lamentable performance of wind power there was no system failure. The much depleted, demoralised and despised conventional generators saved the day. The UK government continues to boast of "Powering Past Coal',[3] while as a matter of fact relying on this fuel, and indeed on fossil fuels and conventional energy generally, including nuclear, to guarantee security of electricity supply. How much longer that can continue is questionable.

As recently as 2018 there were some 12,000 MW of coal-fired capacity available in the UK, but this had fallen to 6,800 MW by 2019.[4] Over that year, the remaining units at Cottam (2 GW) and Aberthaw (1.6 GW) also closed, shortly afterwards followed by Fiddler's Ferry (1.5 GW) in March this year, and 230 MW at the smaller Uskmouth station.

This leaves, at present, only units 1, 2, and 4 at West Burton (1.5 GW), the four units of Ratcliffe (2 GW) and units 5 and 6 at Drax (1.3 GW), a total of 4.8 GW. A sizeable part of that remaining coal capacity was active on the 4th, Ratcliffe providing about 1 GW, West Burton just under 900 MW and Drax somewhat under 650 MW. On the 5th the pattern was repeated.

None of this coal plant is scheduled to remain in the market for much longer, and timely replacement is far from guaranteed, for coal is not the only high-quality generator type being driven from the system by policy. The markets are so poisoned by ill-considered climate-policy coercions, particularly support for renewables, that even gas generators are struggling. In August this year, the administrators of the failed Calon Energy suspended operation at two large gas-fired power stations, the 20-year-old Sutton Bridge (800 MW), and the 10-year-old Severn Power (850 MW). One of the administrators explained that:

> The recent and ongoing challenges facing the UK power market mean that these power stations are currently not generating sufficient returns to continue trading effectively.[5]

Neither Sutton Bridge nor Severn Power are in the markets at present.

The UK electricity supply industry is in a sad and embarrassing condition. Government policy has wagered everything on wind power, a third-rate generator that would never have grown to its current levels in a market driven by economics in the consumer interest and constrained by engineering. The wager has been lost, and this was not only foreseeable but was foreseen.

As a matter of fact, it has long been understood that even large wind fleets would be almost completely becalmed as a result of extensive high pressure systems. As long ago as 2008, Oswald, Raine and Ball, in a now classic paper in *Energy Policy*, used Met Office data to model output from a large distributed UK wind fleet and predicted exactly what we have seen in the last few days. Commenting on a weather chart showing a high-pressure system sitting over the UK they wrote:

> An event like this, in say 2020, with 25 GW of wind installed in Britain with large wind installations in neighbouring countries would lead to a simultaneous and large increase in demand on other plant.[6]

These findings have been repeatedly confirmed, most recently by Linnemann and Valana in 2017, who wrote:

> One essential physical property of wind power is its large spatiotemporal variation due to windspeed fluctuations. From a meteorological point of view, the electric power output of wind turbines is determined by weather conditions with typical correlation lengths of several hundred kilometres. As a result, the total power output of the wind power plants distributed across Europe over several thousand kilometres in north–south and east–west direction is highly volatile and exhibits a strong intermittent character.[7]

None of this advice has been heeded by the British government, and though National Grid's current difficulties were predicted repeatedly by many engineers and analysts, no corrective action was taken and these problems and their costly solutions are now becoming a regular and indeed a normal part of system operation.

A key indicator of this fact is that UK electricity system balancing costs have risen sharply since the introduction of renewables began in 2002 and are still on a rising trend. Balancing Services Use of System (BSUOS) charges were just under £400 million per year in 2002, topped £1 billion a year in 2014, were £1.4 billion last year and are on track to be around £1.8 billion this year (Figure 3).

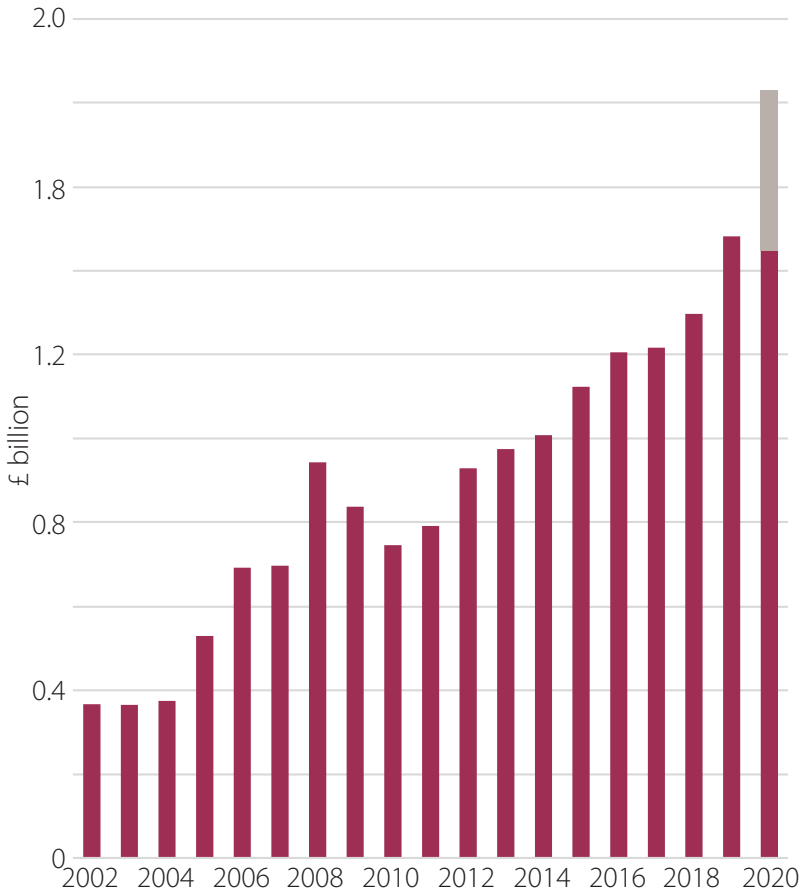

Figure 3: Balancing Services Use of System costs 2002–2020.

Red indicates actual recorded costs, grey the author's estimate for the remainder of 2020. Source: Data from BM Reports, chart by the author.

And this increase in cost is charged to a sharply declining quantity of electricity consumed, 320 TWh in 2002 and down to slightly under 260 TWh in 2019, meaning that the balancing cost per unit of electricity supplied to consumers has increased by over 400% in nominal terms.

The fact that electricity consumption has fallen so far in so short a time should be a matter of deep concern, but it is easily explained. In 2002 subsidies to renewables were trivial, today they are £10 billion per year and still rising. Add

to this sum the system management charges and it is no wonder that electricity is becoming unaffordable. This is in effect price rationing.

With every passing moment it becomes more expensive to paper over the cracks in British energy policy, and there is now a clear and pressing risk to national well-being and security. Government's irrational obsession with weather-dependent renewables, and in particular with wind power, is to blame.

Apart from its high capex and opex, wind power is very difficult to manage, with a geographical distribution and an output profile that pays no regard to consumer or system-management needs. The current crisis provides a perfect example. In the ten days prior to the system margin notice (27 October to 3 November), UK consumers paid wind generators over £18 million to reduce generation, over £6 million a day on two occasions. But a few days later, when electricity was actually required, wind power was mostly absent without leave, except in some parts of Scotland where it was still surplus to requirements. Indeed, in a delicious irony, during the very moments of peak demand on 4 November, when coal, and pumped storage and aeroderivative OCGT turbines were propping up a cold, windless Britain, we were still paying wind turbines in Scotland a total of £40,000 an hour to reduce output, with a grand total of £500,000 over 4 November. And this is in spite of the £1 billion Western Link interconnector between Scotland and England that was designed to prevent such payments.

It is now plain to see that the UK electricity industry is a chaotic joke, with the consumer and the national interest sacrificed repeatedly to save government face and the revenues of the renewables industry.

It is unlikely that the Department of Business, Energy and Industrial Strategy has any remaining will to tackle the situation, and the Secretary of State himself, Alok Sharma, is compromised by his position as chairman of the COP 26 climate negotiations next year. He will do nothing.

As a result, it is now up to Parliament to force government's hand and demand a cold-hearted, root and branch inquiry into the grotesquely expensive mess on which the United Kingdom relies for electricity.

MPs should be asking narrowly focused questions about the immediate problems:

- Why was National Grid caught out by a foreseeable high pressure system bringing low wind?

- What is the total cost to consumers of buying generation on and demand down to address the margin shortfall.

But they should also put the entire renewables-based

Net Zero policy agenda into the spotlight. We have squeaked through this time, but the future is looking extremely uncertain:

- Do we need to extend the lives of coal and older gas generators in order to control consumer costs and limit risks to security of supply?
- Are renewables paying their share of fixing the management problems they cause?
- Are system management costs out of control?
- How can we unwind our now obviously mistaken commitment to renewables and wind power?

And finally:

- How do we change course and create a market that delivers a long-term UK cost-minimisation strategy for electricity?

Notes

1. https://www.metoffice.gov.uk/weather/maps-and-charts/surface-pressure
2. https://www.bmreports.com/bmrs/?q=eds/main.
3. https://poweringpastcoal.org
4. Digest of United Kingdom Energy Statistics 2020. Table 5.8. Major Power Producers.
5. https://www.bbc.co.uk/news/uk-wales-53895806
6. J Oswald et al., 'Will British weather provide reliable electricity?', *Energy Policy* 36 (2008), 3202–3215.
7. T Linnemann and GS Vallana, 'Wind energy in Germany and Europe', VGB Powertech 8 (2017), 70–79. https://docs.wind-watch.org/VGB-Windstudie-2017-Teil-1-EN.pdf

About the Global Warming Policy Foundation

The Global Warming Policy Foundation is an all-party and non-party think tank and a registered educational charity which, while openminded on the contested science of global warming, is deeply concerned about the costs and other implications of many of the policies currently being advocated.

Our main focus is to analyse global warming policies and their economic and other implications. Our aim is to provide the most robust and reliable economic analysis and advice. Above all we seek to inform the media, politicians and the public, in a newsworthy way, on the subject in general and on the misinformation to which they are all too frequently being subjected at the present time.

The key to the success of the GWPF is the trust and credibility that we have earned in the eyes of a growing number of policy makers, journalists and the interested public. The GWPF is funded overwhelmingly by voluntary donations from a number of private individuals and charitable trusts. In order to make clear its complete independence, it does not accept gifts from either energy companies or anyone with a significant interest in an energy company.

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