REDUCING EMISSIONS
Without breaking the bank

Andrew Montford

The Global Warming Policy Foundation

GWPF Note 20

COVER

The cover shows the CO_2-driven turbine for NetPower's pilot zero-emissions power plant.

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Contents

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1 Introduction

The economic research firm Moody's Analytics recently reported that, even taking a wildly pessimistic view of the future, unabated global warming would enhance the GDP of the UK by around 0.25% annually by 2048.[1] The result is somewhat surprising, but does suggest that recent developments on the climate-policy front look ill-advised. At the end of June 2019, Parliament nodded through a proposal to target a 100% reduction in our net carbon dioxide emissions by 2050. There was little or no scrutiny of the proposal, and in particular of the costs. The plan came with an advertised price tag of something over a trillion pounds, but this turned out to be a figure presented net of (alleged) benefits.[2] The actual amount that must be spent clearly runs to many trillions, and even that figure assumes that Westminster can force through a series of authoritarian measures to drive down energy demand. Either way, we appear to be embarking on a multi-trillion-pound spending spree to help prevent a small enhancement to our GDP.

The government and its advisors are assuming that the vast majority of energy in this brave new world will be delivered by windfarms. There is, however, a critical problem with this idea. Onshore wind, which is relatively cheap, requires vast areas of land. Assuming that energy demand could be slashed to the extent envisaged, you'd still need at least 15% of the UK's land area. Alternatively, you could use offshore windfarms. These are twice the price but, given our lack of space, will probably end up the preferred option. And either way, windfarms' output is delivered intermittently, requiring backup of some kind, probably from combustion of biomass (which requires phenomenal quantities of land – perhaps as much as a third of the UK land area) or hydrogen (which is very expensive).

Despite the absurdity of the numbers, and the environmental horrors it will produce, 'net zero' has become the centrepiece of public policy. Fortunately, an alternative approach to electricity generation looks to be just over the horizon. New technology may be about to ride to the rescue, or at least make the UK's wind- and solar-centric policy look extremely silly.

2 New nuclear

We have only two serious non-intermittent forms of low-carbon energy: nuclear and hydro.[3] Hydro is hard to expand because we simply don't have enough valleys suitable for flooding, while nuclear, for all its theoretical promise, has proven hard to deliver in practice, with projects across the world delivered late and wildly over budget.

However, the rule book on nuclear energy may be about to be ripped up. Energy experts have long been interested in the possibility of building lots of small reactors in factories rather than a single huge one, as at Hinkley Point. The UK government has been a laggard in this area,[4] although there have recently been signs that realisation is dawning.[5] but the

1 Under the wildly pessimistic RCP8.5 scenario, UK GDP is still enhanced. See Chart 11 in Lafakis C et al. (2019) *The Economic Implications of Climate Change*. Report, Moody's Analytics. https://www.moodysanalytics.com/-/media/article/2019/economic-implications-of-climate-change.pdf.

2 Will there be any benefits if major economies like China and India do not follow suit?

3 I set aside the suggestion that biomass burning is 'low-carbon'. For all practical purposes it is not.

4 Dawson A (2018) *Small Modular Nuclear: Crushed at birth*. Briefing 33, The Global Warming Policy Foundation.

5 Meechan B (2020) Nuclear: Trawsfynydd site could pioneer Rolls-Royce mini reactor. BBC News Online, 14 February 2020. https://www.bbc.co.uk/news/uk-wales-51460208.

potential is great. The idea behind these so-called small modular reactors (SMRs) is that you replace economies of scale with economies of volume. In other words, by the time you have built your tenth module, you are very good at it, and costs fall precipitously, or that's the theory.

Having much smaller reactors has other benefits too. The major risk with a nuclear reactor is overheating, and big reactors need pumps to ensure an adequate flow of cooling water around the core. They also need back-up electricity supplies in case anything goes wrong (and back-up to the back-up as well), adding greatly to the cost and complexity. However, with a small reactor, natural convection is enough to ensure the core doesn't overheat, so you can do away with all these accretions, adopting instead a so-called 'passive' safety approach. This should be both safer and cheaper.

In 2018, an American vendor called Nuscale Energy announced that it had cleared a key hurdle in gaining regulatory approval for its SMR design, along the way convincing regulators that the passive safety approach was viable.[6] Full regulatory approval should be achieved in 2020, which is just as well, because Nuscale has a customer waiting in the wings: work should start on the first operational plant, in Utah, in just two years' time, with the first power delivered in 2026.

Economies of volume and passive safety may not be the only ways that costs will be driven down. Modularisation should mean much lower regulatory costs. After all, if regulatory approval has been given to Nuscale's design as built in Utah, there is no reason it shouldn't equally be given to a second power station in, say, California, almost 'on the nod'. And equally to reactors in Calgary or Clacton for that matter.

Costs are therefore potentially coming down across the board. Nuscale is suggesting that the Utah plant will produce electricity at a cost somewhat above onshore wind, but well below offshore,[7] although the true costs are undoubtedly higher because of state support. However, lower costs will presumably be expected for future plants, as those economies of volume kick in. Moreover, an SMR has the huge advantage of producing a reliable electricity supply, unlike renewables, which need some sort of back-up to cover periods when the wind doesn't blow or the sun isn't shining.

Large-scale nuclear power plants tend not to be used to 'load follow' – in other words to ramp up and down to match changes in demand. This is more to do with economics than engineering.[8] Although SMRs should be more flexible, they are still not ideal in this regard. One way round this is to maintain output but to use any spare production for some energy-hungry industrial process that is not time-critical: desalination or chemical manufacture have been proposed. How this jigsaw is to be fitted together for mutual advantage is never spelled out, leaving the whole idea somewhat speculative.

However, another new technological development that is about to go live is a different story.

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6 https://newsroom.nuscalepower.com/press-release/company/us-nuclear-regulatory-commission-approves-key-safety-aspect-nuscale-powers-adv

7 The price quoted is $65/MWh, but this figure is artificially low, because of various kinds of state support. See https://analysis.nuclearenergyinsider.com/nuscale-targets-smr-staff-costs-below-nuclear-industry-average. Onshore wind averages $60/MWh and offshore is $130/MWh. See https://www.irena.org/publications/2019/May/Renewable-power-generation-costs-in-2018.

8 With so large a capital investment the operators will lean towards maximising their load factor and the return on capital.

3 Carbon-free fossil fuels

A pilot power station in Texas is currently in the final stages of its testing. NetPower's plant is the first to use a radical new approach to power generation called the Allam Cycle. The brainchild of a British engineer called Rodney Allam, the plant still burns fossil fuels, giving a lot of heat and a lot of carbon dioxide, just like a normal power station. However, in a standard power station, the heat is used to produce steam, which in turn drives the turbine to make electricity. Allam's genius was to realise that you could use the carbon dioxide itself to drive the turbine, after which it can be sold for use elsewhere or pumped underground for long-term disposal.

What is even better, it turns out that if the conditions are correct, carbon dioxide is rather better at driving a turbine than steam is. The engineering required is sophisticated, but the designers believe that the improved fuel efficiencies will more than compensate for any extra costs involved along the way. In other words, the system should deliver energy below the cost of conventional gas turbines, but with the huge added advantage that carbon capture is built in, rather than being a costly add-on. And because it's a gas turbine, it should be capable of load following.

The results from the pilot plant have apparently been very good so far, and NetPower has announced plans for a first commercial-scale plan.[9] It is also working on a coal-fired version. The commercial plant is supposed to be up and running by 2022, which means that even allowing for a certain amount of hype on the company's part, we should know if the technology is viable in the very near future.

The project team are currently suggesting that the commercial plant will deliver electricity at around 1.6p/kWh.[10] If true, this would make it considerably cheaper than even the super-optimistic (some would say 'implausible') predictions for power from onshore wind farms in the UK, of around 4p/kWh.[11]

4 Conclusions

We may thus be at the threshold of a revolution in the way we generate electricity. Not a manufactured revolution, like the one that has brought the environmental horrors of wind and solar, and has filled the pockets of rent-seekers at the expense of everyone else, but a real revolution that makes power cheaper and more reliable, and one that rewards innovation and risk-taking rather than political influence. What a pity it would be if we were to cover our landscapes with unreliable wind turbines at just the moment when a better way forward emerged.

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9 Patel S (2019) 300-MW Natural gas Allam aycle power plant targeted for 2022. *Power*, 27 November. https://www.powermag.com/300-mw-natural-gas-allam-cycle-power-plant-targeted-for-2022/.

10 Bill Brown, CEO of 8Rivers Capital, the owner of NetPower, the company which is developing the La Porte site, gave a figure of 2.1c/kWh, while speaking to Fox Business Network. The price assumes that the company will sell the carbon dioxide and other gases for enhanced oil recovery, which is only possible for plants located near oilfields. See https://www.youtube.com/watch?v=wjxO6CfqJxM.

11 Although a simple comparison is misleading, since wind power is intermittent. Correcting that could more than double the cost of onshore wind. If NetPower's claims are correct, their costs may be an order of magnitude smaller than wind power.

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.

GWPF NOTES

1	Matt Ridley	A Lukewarmer's Ten Tests
2	Susan Crockford	Ten Good Reasons not to worry about Polar Bears
3	Ross McKitrick	An Evidence-based Approach to Pricing CO_2 Emissions
4	Andrew Montford	Climate – Public Understanding and Policy Implications
5	Andrew Montford	Consensus? What Consensus?
6	Various	The Geological Perspective Of Global Warming: A Debate
7	Michael Kelly	Technology Introductions in the Context of Decarbonisation
8	David Whitehouse	Warming Interruptus: Causes for the Pause
9	Anthony Kelly	Global Warming and the Poor
10	Susan Crockford	Health Polar Bears, Less Than Healthy Science
11	Andrew Montford	Fraud, Bias and Public Relations
12	Harry Wilkinson	UK Shale Developments
13	Peter Lilley	The Helm Review and the Climate-Industrial Complex
14	Constable and Hughes	Bubble or Babble?
15	Patricia Adams	The Road from Paris: China's Climate U-Turn
16	Mikko Paunio	Saving the Oceans: And the Plastic Recycling Crisis
17	John Christy	The Tropical Skies: Falsifying Climate Alarm
18	Gordon Hughes	Who's the Patsy? Offshore Wind's High-stakes Poker Game
19	Ray Bates	What Caused Hurricane Lorenzo?
20	Andrew Montford	Reducing Emissions without Breaking the Bank
21	Andrew Montford	£3 Trillion and Counting: Net Zero and the National Ruin

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