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Net Zero Review

This is my individual response to the Net Zero Review call for evidence published on 29 September 2022. I am responding on the basis of experience gained in the modernisation of the UK telecommunications infrastructure.

I am a former Director of the European telecommunications practice of Arthur D. Little, the technology and management consultancy. In the 1990s I was an advisor to the Department of Trade and Industry during the Government's 'Duopoly Review' which radically changed the telecommunications industry.

I am a commercially published historian in the area of 19th century social history.

I have already submitted a response to the Review of Electricity Market Arrangements and I will not address here the recommendation that I made in that submission[1].

Background

The UK's Net Zero plan of 2021 is one of the most ambitious attempts by any nation to fulfil its obligations under the Paris Climate Accords of 2015. Some have criticised the plan for imprecision or lack of progress. My criticisms are different and my purpose in making this submission is to show that, under a new management regime, implementation of Net Zero can create additional UK economic growth even if it does not achieve all of its goals.

The overriding objective of the Net Zero exercise should be to convince private investors to exploit the UK's unique energy generation resources, particularly its wealth of offshore wind. This objective should now receive as much attention as achieving the Government's commitments to combatting climate change. The increase in hydrocarbon prices and global instability since publication of the Net Zero plan should mean that the elimination of UK net emissions becomes almost a by-product of market-driven modernisation and economic growth. But this will require a different approach to implementation.

In the paragraphs below I will briefly critique the current management of Net Zero implementation and then give recommendations for change.

Current implementation

A striking characteristic of the UK's approach to harnessing new energy technology is the very high level of hands-on management by government in Whitehall. This has encouraged a bureaucratic approach to modernisation of the power infrastructure.

The centralisation of executive power can produce a swift policy response to national opportunities. The Net Zero plan can be seen as an example of this, but detailed design and implementation should depend less on Whitehall departments and more on suppliers, system operators, and consumers.

[1] http://netzero.hugh-small.co.uk/wp-content/uploads/2022/09/REMA-consultation-response-from-Hugh-Small.pdf

Government bureaucracy can produce implementation solutions but they are typically not such as to reassure investors. Government can select technologies and power generators by competitive auction, and can devise competitive distribution arrangements. It can deal with unforeseen problems by using ad-hoc windfall taxes, bailouts, and consumer grants. But the political unpredictability of these will not inspire confidence in investors who must finance the very large capital expenditures required. Government's provision of financial guarantees to investors in its chosen technologies also inspires public criticism from advocates of other technologies deprived of public funding. Such criticism, whether objective or interested lobbying, intensifies the political uncertainty.

Reports published as part of the bureaucratic decision-making process do not inspire confidence, to judge from two important recent publications: the *Consultation Document on the Review of Electricity Market Arrangements* (REMA) and *Digitalising our energy system for net zero: Strategy and Action Plan 2021*. The first is a catalogue of unsolved problems in adapting today's wholesale trading arrangements to zero-carbon power. BEIS proposes to develop solutions to these problems "through extensive engagement with [the] energy sector". It would be advisable to involve other sectors too, including EV, telecoms, and consumer goods manufacturers who can develop applications which regulate demand and thus make the power system more flexible.

The REMA consultation document does not show insight into how cheap intermittent zero-carbon energy could increase overall productive demand. It frequently invokes time-shifting, but only as a way to reduce demand peaks: "Temporal flexibility (shifting when electricity is consumed or generated) is important for lowering system costs, it smooths demand peaks". This ignores the important fact that time-shifting can benefit the economy by helping to *increase* overall demand and system usage, not just moving some demand from one time period to another.

The second document, *Digitalising our energy system for net zero* recognises only the advantage of redistributing demand within a 24-hour period, as in the pre-digitalised era. It claims that digitalisation will provide:

> *more ways for consumers to actively participate in the energy market, including selling energy generated from their rooftops or using smart controls to shift their demand to periods of the day when prices are lower.*

The document goes on to imply that the main benefit of digitalisation is computerised batch data collection for central planning purposes rather than controlling the system in real time:

> *This will require an enormous step-change in the system's ability to understand and react to its increasingly complex energy flows. The success of this step-change relies on the digitalised exchange of data to facilitate an energy system which can accelerate, automate, plan, and anticipate processes far better than at present.*

It is understandable that civil servants and electricity industry professionals who have been working with firm baseload electricity in a relatively un-computerised network will find it hard to imagine how cheap intermittent energy and digitalisation together can change the way energy is used. New and independent thinking is needed.

Recommendations

To make Net Zero successful the government can take three steps to make the power network more market-oriented and supportive of economic growth:

- Rapidly eliminate government support for renewable generation.
- Bill consumers based on current wholesale price.
- Follow an industrial strategy that exploits intermittent renewable energy.

1. Rapidly eliminate public financial support for generators

The Government guarantees wholesale prices for zero-carbon generators by conducting CfD auctions, and these guarantees have been reduced by ever-lower winning bids (particularly for wind power) over successive auction rounds. A conclusion that competition is bringing down the cost of generation may be only partially justified. Recent academic studies have found evidence that bids have been below actual cost[2]. Whatever the reason for this finding, it implies that there are hidden risks to public finance. Also, political opponents have misused the new evidence to cast doubt on the Net Zero concept, which increases uncertainty for investors.

A costly problem with the government's CfD auctions for wholesale energy is that it is not joined-up with the process of expanding transmission network capacity. Already this autumn tens of millions of pounds weekly of public money are being paid to generators for turning down their output because of network constraints.[3]

Government departments remain enthusiastic about participating in energy procurement because within their limited remit they are succeeding. Nevertheless, government financial participation and financial support will not bring as much benefit to the economy as would contracts directly made between private-sector generators and local distribution networks. In other countries, notably Chile, this occurs and the government provides no guarantee or other form of financial support to zero-carbon generators. The contracting parties are not able to agree unless the transmission network and other services are in place (joined-up) whether provided by a public company or otherwise.

The Government should *regulate*, not participate.

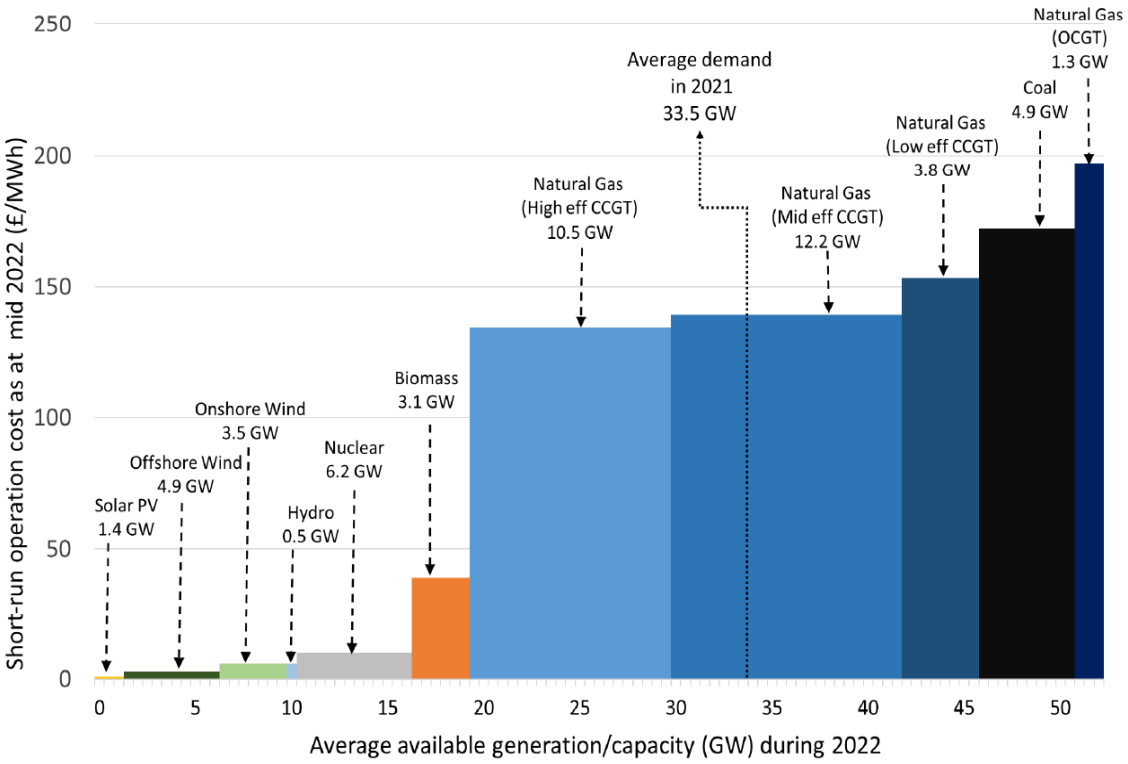
2. Ensure that retailers bill consumers based on current wholesale price.

In the days when hydrocarbon-fuelled generation was always needed to meet demand, consumer bills were based on the wholesale price of energy. This enabled consumers to regulate their consumption in line with varying generation costs caused by changing fossil fuel prices. Now that periods exist in which Combined Cycle Gas Turbine (CCGT) plants are not needed, these signals from the wholesale market are no longer available to consumers. Contrary to popular belief, during these periods the 'price of gas' does *not* set wholesale prices and nor does it affect retail prices. Retail prices during these increasingly frequent zero-carbon periods are set by the inadequacy of the retailers' billing systems, designed in a fossil-fuelled era. Correcting this anomaly is essential. In the long term, a large software investment is required, but in the current energy crisis a simple hack will do,

[2] Aldersey-Williams et al. Better estimates of LCOE from audited accounts. *Energy Policy* · May 2019

[3] https://www.current-news.co.uk/news/wind-generation-hits-highest-ever-availability-with-a-peak-of-17-6gw

The anomaly is clear from the following detailed 'merit order' or 'supply/demand' graphic usefully created recently by Michael Grubb of UCL.



The trading system sets the wholesale price at the level imposed by the most expensive generator currently in use. With average demand at 33.5 GW, the vast majority of the time the price for raw wholesale energy was set by CCGT at between 13.5 and 15.3 p/KWh. After network charges, profit, overhead etc. the consumer paid nearly 30p. The variation in raw CCGT wholesale energy charges of about 1.8 p/KWh was therefore only a small fraction of the price seen by the consumer. If there was no cheaper generator than gas, there would be little point in complicating the billing software to show different unit prices depending on the type of CCGT used. The consumer would be unlikely to respond. But when demand dropped below 20 GW, the wholesale price fell off a cliff. Whenever demand was less than a quarter of the annual average, offshore wind was setting the wholesale price at 0.6 p/KWh. During those periods the unit price charged to the consumer was up to twice the price that it would have been if the billing system had reflected the wholesale price as it was originally designed to do.

What can be done to correct this billing anomaly, and how urgent is it? The most helpful characteristic of the newest energy technologies is that the periods when they will set the wholesale price can be *predicted* to a certain extent by weather forecasts, independent of the anticipated level of demand. This should enable retailers to make refunds to consumers who use more electricity (perhaps if they also turn down the gas thermostat) in response to wind forecasts. It can hardly be argued that retailers are entitled to retain the profits created by the shortcomings of their billing software.

The urgency of a fix is growing as more and more wind energy is coming onstream, pushing CCGT out of the picture more frequently. There may also be a slump in demand due to the increase in electricity prices this year, which would cause demand to spend more time in the cheaper zero-carbon zone where consumers are overcharged. The National Grid Electricity System Operator's Winter Outlook modelling assumes that there will be no such reduction in demand. That may be from a need to examine worse case scenarios. But though a demand slump would reduce the probability of blackouts, it will leave large amounts of virtually free power left unused because of the billing anomaly. Refunds, coupled with publication of wholesale prices both current and predicted, would create what the electricity industry calls Demand Side Response (DSR), where consumers take price into account.

3. Follow an industrial strategy that exploits intermittent renewable energy

Wind and solar will produce the bulk of UK-generated zero-carbon energy, and until now their intermittency has been regarded as a handicap. An industrial strategy that uses this form of energy without expensive backup generation capacity will remove the handicap, promote economic growth, and create an environment that is more attractive to investors in zero-carbon generation.

Until now most electrical energy has been traded in a wholesale market arrangement in which only continuous 'firm' or 'baseload' energy could be bought and sold. This market was designed to suit fossil fuel-generated energy which was most efficiently produced by a continuous industrial process. To trade in this market, therefore, intermittent generators have to contract with firm energy backup suppliers in a 'capacity market'. The cost of this backup has become known in the industry as "the cost of intermittency" although it really only the cost of adapting to an obsolete trading arrangement.

Unforeseen industrial uses for intermittent electrical power will emerge, particularly when capacity becomes available that is surplus to predicted firm energy demand. Temporary surplus generating capacity is an inevitable result of intermittent generation destined to provide a fixed amount of firm power. BEIS modelling shows that by 2035 there will be surplus wind generation capacity for about 50% of the time, and the surplus will exceed 25 GW for 10% of the year. By 2050 the surplus will be in the dozens of GW for half the year. Because this surplus results from seasonal weather patterns rather than from fluctuations in demand, it will often persist for days on end. Non-traditional electro-intensive industries such as indoor agriculture (using high-intensity LEDs to drive photosynthesis) will become viable. New manufacturing industries that can use intermittent production (including automated factories that can be supervised remotely) will flourish. These activities may make it less necessary to rely on green hydrogen as an intermediate product; instead of storing power via an inefficient process it can be used to create value immediately. This is a strategy followed by Norway (aluminium production) and Chile (copper mining). The strategy is aligned with the intermittency patterns of those countries' zero-carbon resources.

The carbon-free pedigree of intermittent capacity will expand Britain's export opportunities. Britain, the EU, and other countries will have a carbon-pricing regime covering many of their domestic industries. A Carbon Border Adjustment Mechanism (import tariff) will be employed that puts imports on equal footing with domestically-produced goods of the same carbon footprint. Domestically-produced goods that have a *lower* carbon footprint will be at an advantage. This could address a common criticism of Britain's Net Zero goal: that it seeks to reduce *domestic* emissions only and that some of the reduction has been realised by abandoning manufacture and importing from countries that create more emissions than Britain did, thus aggravating global warming. An early decarbonisation of Britain's power sector holds out the prospect of 'reshoring' selected manufacturing capacity, for additional economic growth.

Chile may have almost unique advantages, including indigenous copper reserves and zero-carbon energy resources of all types. But the UK has advantages that are equally unique including copious offshore wind, natural deep-water harbours and a manufacturing capacity that is effectively in mothballs. It may be that Chile's advantages have enabled it to develop its market-oriented anergy system described earlier, which might provide a model for the UK.

Finally it should be remembered that Britain was the world's leading economic power by 1760, before the emergence of coal officially began the Industrial Revolution. Our advanced economy was based on intermittent zero-carbon power: wind to drive the merchant fleet and water to drive the textile mills. It may be that our recent romance with firm power from fossil fuels has caused us to credit coal with starting the Industrial Revolution, but the steam engine could also be viewed as the product of industrialisation rather than its cause.