

To: Business Secretary Greg Clark; Defra Secretary Michael Gove; Brexit Secretary David Davis

Cc: all Tory MPs and MSPs

The Infeasibility of our 80% Decarbonisation Plans

Introduction

Emeritus Professor of Physics Hal Lewis famously said:

"The global warming scam ... is the greatest and most successful pseudo-scientific fraud I have seen in my long life as a physicist".

However this note is not directly about global warming or climate change. It focuses on the problematic outcomes of "*tackling climate change*", to use that well-worn political cliché. It does this by use of simplified, practical calculations on future national energy consumption which bring out the sheer infeasibility and futility of what the government is trying to do.

Unavoidably, an analysis of this technical subject cannot be adequately conveyed in just a few short paragraphs or bullet points. However I believe my text should be easy to understand and I hope you agree that this is a crucially important national issue. If you do not have time to read all the way through I hope you will at least read the Summary and Conclusions.

Summary

The recent ministerial statement on electric cars prompts me to respond with practical calculations which illustrate the sheer infeasibility of the government's energy decarbonisation policies. For simplicity these calculations are limited to the easily understandable sectors of road transport and domestic heating. Together these account for about 50% of UK final energy consumption whereas the legally binding 2050 Climate Change Act decarbonisation target covers the entire economy.

My calculations show that in order to electrify road transport and domestic heating the UK could have to build the equivalent of about 60 new Hinkley Point C nuclear power stations or an impossible 250,000 wind turbines. The total cost and impact on our energy bills would be horrendous, with Hinkley Point C currently estimated at £20 billion and rising. Yet even if this additional electricity supply could be procured it is unlikely that it would lead to an overall decarbonisation much below present levels.

The government needs to undertake a comprehensive, open-minded review of its unachievable Climate Change Act and climate and energy policies. It should belatedly acknowledge that the Paris Climate Agreement is a very bad deal for the developed countries, obliging them to use expensive, ineffectual renewables in an unachievable attempt to make big cuts in their CO₂ emissions while populous developing countries like China and India get a free pass to greatly increase their own emissions. The only G20 countries left committed to CO₂ emissions reductions are responsible for just 11.3% of global emissions. The developing countries are planning to build many hundreds of cheap, reliable coal-fired power stations which will still be running long after 2050. Paris will do little or nothing for the global climate, like Kyoto before it.

The government should also take the opportunity of Brexit to distance the UK from the misguided and economically damaging climate and energy policies of the EU.

Decarbonising Road Transport

Data on UK energy usage are taken from "Digest of UK Energy Statistics" ([Dukes](#)) and "Electricity Consumption in the UK" ([ECUK](#)). Terminology: GW = gigawatt (billion watts); TWh = terawatt hour (trillion watt hours).

Total UK road transport energy consumption in 2016 was 41,450 ktoe ([ECUK](#) page 10) = 482 TWh. A slightly lower figure calculated from the annual road transport fossil fuel consumption of 12.0 million tonnes of petrol and 24.6 of diesel ([Dukes](#) Table 3B) comes to 469 TWh. The latter figure, which relates more directly to decarbonisation, is almost 40% more than the 339 TWh ([Dukes](#) §5.18) of UK electricity generated in 2016. Note also that 64 Mtoe ([Dukes](#) §5.17) = 744 TWh of fuel was used to generate this electricity, an overall efficiency of just 46%.

(In passing, the detailed breakdown of the [Dukes](#) fuel consumption figures shows that low fuel economy goods vehicles and buses are responsible for over a third of UK road transport fuel consumption. Will these all be electrified with the massive batteries they will need for their heavy weight and high mileage? Also in passing from [ECUK](#), fast-growing aviation, which would be very costly to decarbonise, currently accounts for 23% of UK transport energy consumption versus 74% for road transport and 2% for rail.)

There is debate on the relative efficiency of electric vehicles versus internal combustion engine vehicles. Electric vehicles have a more efficient drivetrain and do not incur the losses of petrol refinement but offsetting these are the heavy losses incurred in the generation (see the 46% figure above) and distribution of electricity, battery charging losses and losses incurred in the mining and processing of the lithium for the batteries. It is possible that switching to electric vehicles might do little more than move the CO₂ emissions from the tailpipe to the power station chimney and achieve [no net CO₂ emissions savings](#) unless the electricity used to charge them can be decarbonised. The unlikely prospects of that being achieved to any meaningful extent are analysed below.

So for this rough calculation I'll assume that the overall fuel efficiency of electric and petrol/diesel vehicles is the same, I'll ignore the projected 16% growth in the UK population by 2050 and I'll use the above all-electric UK road transport estimate of an additional 469 TWh of electricity per year.

Decarbonising Domestic Heating

The breakdown of 2016 domestic energy consumption by fuel type ([Dukes](#) §1.1 page 30) was electricity 9,284 ktoe and fossil fuels (coal, oil, gas, etc) 29,932 ktoe = 348 TWh. The latter is about 3% more than the 339 TWh of UK electricity generated in 2016. It is assumed that the plan is to convert it all to electricity using heat pumps, resistive heating, heat networks, etc.

Domestic electricity costs about four times as much as domestic gas per unit (kWh) and these breakdown figures show that domestic fossil fuel consumption uses over three times as much energy as domestic electricity. Thus switching from home fossil fuels to electricity could send future domestic energy bills through the roof and into the stratosphere, on top of the huge domestic capital expenditure that would be required and all the other sky-high green taxes consumers are having to shoulder.

Decarbonisation of domestic heating could be politically infeasible on these cost and disruption grounds alone.

As with electric road transport, switching to electric domestic heating may do nothing more than shift the CO₂ emissions from the house to the power station. Electric

domestic heating could be less efficient overall than fossil fuel domestic heating due to the heavy losses incurred in the generation and distribution of the electricity.

I'll again ignore the projected 16% growth in the UK population by 2050 and assume that the switch to 100% electric domestic heating will require an additional 348 TWh of electricity per year.

Calculating Future Electricity Generation Capacity

I will use the much delayed Hinkley Point C nuclear power station as a standard measure of our future national capacity requirements. Hinkley Point C is designed for a massive power output of 3.2 GW, almost three times the average of our existing nuclear power stations. This output equates to about 25 TWh per year assuming a 90% capacity factor to allow for outages.

(In passing, the agreed strike price for Hinkley Point C is very high, almost as expensive as combined offshore and onshore wind power, locking us into a guaranteed, CPI inflation adjusted cost which is well over double the current wholesale price of gas. To what extent has the high Hinkley price been set by having previously awarded such inordinately high subsidies to unreliable wind power?)

The figures above mean that all-electric UK road transport and domestic heating would need an additional annualised electricity generation capacity equivalent to $(469 + 348) \div 25 = 33$ Hinkley Points. However the actual rather than the annualised total is much higher when peak demand is taken into account.

Most electric vehicle charging will probably take place in the evenings and overnight when the vehicle owners are at home. Although most urban vehicles will not need a full charge every day they may well get plugged in daily for a top-up. Most commercial vehicles could well need a big charge every day. Only time will tell what charging patterns and regimes will evolve but it would seem prudent to allow for a daily peak which is above the annual average so for the purposes of this calculation I will apply an uplift of 50% on the annualised figure to allow for peak demand.

Domestic heating will be heavy throughout the evenings and will obviously peak in winter. My own domestic meter readings show that my weekly winter peak gas heating usage can be about 50% higher than my annual average, equating to a daily peak of over double my annual average because my heating is switched off overnight. The national peak ratio could be even higher as most working families (I'm retired) will have their heating switched off while they are out at work/school. However for this rough calculation I'll use a domestic heating peak demand of double the annualised figure.

When these peak patterns are factored in the actual capacity figure rises to, coincidentally, 28 new Hinkley Points each for road transport and domestic heating, i.e. a total of 56. And remember that this is just for electrifying road transport and domestic heating, not the entire economy which could be much worse - [this paper](#) submitted to a parliamentary advisory group estimated that UK heating alone could need a peak supply of 300 GW which equates to just over 100 Hinkley Point equivalents.

As a rough cross-check on road transport, 50% of 35 million electric vehicles plugged in at the same time to chargers with a modest average rating of 4.5 kW would need 79 GW which equates to 28 Hinkley Point equivalents.

I will round up from 56 to 60 new Hinkley Points to allow for the replacement of our remaining coal power stations and our current fleet of eight aged nuclear power plants which are all due to be shut down over the next decade or so.

To put this in context, current UK peak demand is about 61 GW which equates to about 21 Hinkley Point equivalents. Electrification of road transport and domestic heating could require roughly a tripling of current UK electricity generation capacity.

This massive increase in electricity generation capacity would need a massive expansion of the national, regional and residential grid infrastructure. The latter, to deal with the logistics of electric vehicle charging, could be very disruptive and costly.

Decarbonising Electricity Generation

When the Climate Change Act with its legally binding 80% decarbonisation target was passed into law in 2008 the politicians who supported it presumably imagined that supposedly near emissions-free renewables could supply most of our future energy needs. As the years have gone by it is surely becoming obvious to even the most wishful thinking of reality-deniers (if they ever bother to give any serious thought to this important issue) that this is nowhere near feasible, on both technological and cost grounds.

These expensive so-called renewables are impractical, energy sparse and cannot be deployed on the necessary scale, besides which they achieve nothing like the system-wide CO₂ emissions savings claimed of them. Politicians have bamboozled themselves with statistics on CO₂ emissions reductions relative to a pseudo-scientific, "plucked from thin air" two degrees political target and the percentage share of renewables in our energy mix, as if that has any real significance. They are failing to see the woods for the trees on the infeasibility of what they are trying to achieve, as the following analysis explains.

The share of 2016 UK electricity generation by main fuel type (Dukes Chart 5.3) was: coal and gas 51%, nuclear 21% and renewables 24%. The contributions of the three main renewables (Dukes Table 6B) were wind 11%, bioenergy 9% and solar 3%. The 2016 installed capacity of all renewables was 36 GW, with a load factor of under 30% for wind and just 11% for solar (Dukes pages 188-9).

The sheer futility of trying to decarbonise the entire economy using these renewables is obvious when their electricity generation contributions are expressed as puny percentages of UK final energy consumption (ECUK page 5): wind 2.3%, bioenergy 1.8% and solar 0.6%. As explained below there are severe practical constraints on increasing the national penetration of these renewables.

So if we are to build the equivalent of 60 new Hinkley Points to supply all-electric road transport and domestic heating (it would be many more to meet the 80% decarbonisation of the entire economy), how could this be structured?

The first obvious point to make is that they could not all be emissions-free nuclear which is only suited to supplying baseload electricity. Many would have to be dispatchable gas-fired power stations (or clean coal or "cheating" biomass) to provide essential grid balancing minute by minute every day of the year, much as in the current mix. Moreover a change of balance is needed from favouring intermittent renewables over conventional plant as this has increased the risk of blackouts, with last winter's national capacity margin (the safety buffer between peak electricity demand and available supply) at a challenging 5% - it used to be a comfortable 20%.

We can immediately rule out an expansion of expensive solar power as its output falls to zero overnight and to near zero over the cold, dark midwinter months. In any case deploying too much intermittent solar power would make grid balancing even more

difficult and could create grid instability problems were too much uncontrollable solar electricity to be generated on a sunny summer weekend when demand is low.

A massive expansion of expensive wind power can also be ruled out. It is astonishing that a government minister could even consider deploying wind power to support our postulated all-electric future: peak road transport and domestic heating alone could need about 250,000 new wind turbines of standard 2.2 MW rated output with an average capacity factor of under 30%. Quite apart from the utter infeasibility of such a deployment - our current total is about 8,000 - he ignores the fact that the entire UK is sometimes becalmed for days on end during anti-cyclonic conditions. No expensive pie in the sky electricity storage scheme or capacity market standby contract could bridge such a huge, indeterminately-long energy gap. The minister should take the advice of establishment climate and energy "experts" with a large pinch of salt. The former government chief scientific advisor Professor Sir David MacKay [warned years ago](#) of the futility of trying to use wind power as a source of national electricity supply.

In any case the danger of grid damage or instability due to too much wind electricity when the wind is too strong is even more of a constraint. This problem can be partly but expensively managed by discarding the excess wind electricity and paying the contracted owner for the loss but there is a rough rule of thumb which puts an upper limit on wind power expansion, namely that wind power share of national electricity output cannot be more than its own capacity factor, i.e. about 28%. That would allow not much more than an infuriatingly pointless doubling of current wind power capacity.

Expensive, inefficient plant biomass (wood) which generated 6% of 2016 UK electricity should not be considered a renewable at all as it is neither sustainable nor low-emissions. It also emits high levels of carcinogenic particulates. The Drax power station units expensively converted to burn biomass in the form of wood pellets made from clear-felled North American forests create CO₂ emissions higher than the locally mined coal they used to burn. Biomass is only classified as renewable because of a scientifically disputed EU dispensation to make decarbonisation look more feasible. We should surely drop this self-deluding pretence after Brexit.

The government has increased our dependence on electricity supplied from abroad via international interconnectors, with more planned over coming years, no doubt all part of the EU's drive for "ever closer union". This arrangement suits the government's "carbon" accounting as the foreign CO₂ emissions used to generate these imports are simply ignored. Interconnectors play a useful role in short term balancing but there is no prospect that they could make more than a small contribution to our all-electric electricity supply; net imports in 2016 were less than one Hinkley Point equivalent (Dukes Table 5A). In any case this is a double-edged sword as we cannot be sure that the supply will be available when we really need it, especially with France planning to run down its reliable nuclear fleet in favour of green diversification and many European countries struggling with tight power margins to meet EU-imposed energy directives. These interconnectors could even go into reverse just when we need them most! For post-Brexit energy security we should perhaps build a couple more Hinkley Point equivalents to avoid this dependency.

Thus we are drawn inexorably to the conclusion which has been obvious all along, namely that to power our economy with reliable 24/7 electricity we need a mix of predominantly nuclear and gas (perhaps with clean coal), much like the present mix which stands at 51% fossil fuels, actually 57% if wood biomass (clear-felled forest) is reclassified as fossil

fuel. Intermittent wind and solar are redundant to this end: the only reason to deploy more would be to try and save more CO₂ emissions, but that would be at the penalty of further eroding the commercial viability of our indispensable fossil fuel plants (ignoring currently highly subsidised, unsustainable biomass). Achieving the required mix assumes that suppliers can be persuaded to make the necessary huge investments in new plant which is unlikely with our incoherent current energy policies which are designed to force essential fossil fuel plants out of business.

The reluctant acknowledgement that fossil fuels are essential to our established methods of electricity generation and distribution prompts demands from green activists for carbon capture and storage (CCS) to be fitted to fossil fuel power stations as a last hope of salvation. This is the process whereby the CO₂ emissions from the power station could, at significant energy cost, be extracted and pumped into underground reservoirs where they would be sealed away for posterity. Most attempts globally to develop this technology (also used for enhanced oil recovery) have been abandoned, including the government's own planned pilot at Peterhead.

There is no evidence that CCS is [viable](#) on the national scale required, it would be extremely expensive, it would not capture all the CO₂ emissions, it would be dangerous (the Lake Nyos leakage killed nearly two thousand people), it will never be taken up globally and so it would have negligible impact on global emissions. All it would do is hasten the economic decline of UK plc.

Thus the only realistic conclusion is that there is no prospect of reducing our CO₂ emissions much below present levels. The 2050 80% decarbonisation target is a fantasy. Continued efforts to achieve this unattainable target are pointlessly driving up energy bills and making UK plc less competitive. Such efforts are pointless because (i) for practical engineering reasons renewables can only achieve limited national penetration so their emissions savings (which in any case are over-rated) are correspondingly limited, and (ii) even if the UN IPCC's unproven theory of man-made CO₂ global warming were valid, most of the world's countries have not bought into it and [only pay lip service](#) to it, so our own efforts have relatively limited impact globally. For example by 2030 China and India are planning to double and triple their respective CO₂ emissions.

If responsible government ministers had reached this realistic conclusion years ago they could have saved us all a great deal of heartache, e.g. businesses made uncompetitive by high renewable energy costs and green taxes, households driven into fuel poverty (35% in wind power-obsessed Scotland) and precious landscapes despoiled by ineffectual wind farms.

Climate Change

Our hapless energy policies are built on foundations of sand, slave to the UN IPCC's unvalidated theory of dangerous global warming due to man-made greenhouse gas emissions. Yet despite steadily rising levels of atmospheric CO₂ (which is helping to green the planet and improve crop yields) and despite flagrant adjustments by the establishment custodians of global temperature records to make global warming look worse, there have been only about 20 years of sustained global warming in the past 70 years. That brief warming spell happened back in the 80s and 90s and there is nothing to prove that it wasn't caused by natural climate variability, e.g. the result of a series of stronger than usual sunlight-fuelled El Ninos. The unadjusted satellite temperature record shows no perceptible global warming for about the last 20 years (the so-called

"[pause](#)" or "[hiatus](#)"), just the randomly fluctuating warmings and coolings of El Ninos, La Ninas and other entirely natural weather events.

So why all the establishment hysteria over [CO2 and alleged man-made global warming](#), especially when its "solutions" are so obviously infeasible and unaffordable? Most real world climate indicators such as intensity of solar activity and periodicity of natural oceanic cycles suggest that global temperatures are most likely to fall over coming decades. This contrasts starkly with the virtual reality computer model based predictions put out since 1990 by the compliant "follow the money" scientists of the politicised UN IPCC that, based on their pseudo-scientific assertion that atmospheric CO2 is the main driver of global climate, global temperatures would rise steadily and significantly. That has simply not happened.

Dr Piers Corbyn, physicist brother of Jeremy, agrees with Professor Hal Lewis (see Introduction). On the Andrew Neil [politics show](#) he denounced "UN IPCC fraudulent science" as "a con" and called for more public debate on climate change. We're still waiting.

The Committee on Climate Change

The Committee on Climate Change is the independent body which advises the government on implementation of the Climate Change Act. It comes across as a kind of high priesthood of "climate change". Its 2017 [Report to Parliament](#) is almost hysterical, twisting the truth and distorting reality to warn of a looming man-made thermageddon which is nowhere to be seen on the real world horizon. They are obviously committed propagandists as they use the weasel phrase "climate change" all the time, as in "Climate change is happening, not waiting". A more reasonable, less loaded form of words would be "postulated man-made climate change" or the old-fashioned phrase climate alarmists stopped using when global temperatures stopped rising, hypothetical anthropogenic global warming (AGW). The Committee shows itself to be uncritically committed to the anti-scientific political claim that [the science is settled](#).

The Committee's 2015 [Fifth Carbon Budget](#) (1928-1932) comes across as an academic study in self-delusion. For example it hopes that expensive, unviable CCS will be implemented on a large scale. It blithely talks of 400 TWh of expensive new offshore wind power, ignoring the impracticalities of such an expansion: about 70,000 new 2.2 MW turbines which couldn't be deployed anyway because of the grid instability this would create. It also wants a huge expansion of expensive solar which generates nothing overnight and next to nothing in midwinter. It assumes a carbon floor price of an eye-watering £78/tonne by 2030 which would severely discourage gas power stations essential for grid balancing yet at the same time they want a big expansion of gas power in this budget, except that they want to phase it all out in later budgets. A detailed analysis of this wishful thinking, deliberately misleading "plan" [is given here](#).

The government response to this carbon budget is long overdue, perhaps because it has finally realised that it has painted itself into a corner with no way out other than by, to mix metaphors, doing a U-turn.

Conclusions

We are living in times of so-called austerity because of a large national deficit which is proving very difficult to get under control. We are also on the brink of Brexit when as a nation we need to be as "match fit" as possible if we are to survive competitively and prosper by developing new markets.

So why are we undertaking an astronomically expensive upheaval of our national energy infrastructure in the name of "climate change" - creating widespread fuel poverty, damaging our national competitiveness and forcing businesses and jobs out of the country to save emissions only to have the same emissions generated by developing economies abroad - when the whole upheaval has no hope of reaching the climate objective of a "low-carbon economy" and will have only an imperceptible effect on "saving the planet"?

If the decarbonisation calculations in this note are anywhere near the right ballpark they confirm that the government has its head stuck firmly in the sand over its muddled, unattainable energy policies. Basic engineering reality dictates that so-called renewables like wind, solar and biomass can never supply more than an insignificant percentage of the energy we need to keep our society working. Our 80% decarbonisation plans are going nowhere: the illusory progress to date, achieved by picking low-hanging fruit such as the "dash for gas" switch from coal to gas for electricity generation, simply cannot be extrapolated. The government should take with a large pinch of salt the biased and untrustworthy advice of the [climate alarmist media](#), the [renewables industry](#), the [Met Office](#) and other "follow the money" hangers-on to the climate change bandwagon, including the [Chairman](#) of the Committee on Climate Change.

The government has got itself into this mess because the supranational establishment, led by the UN with its ulterior political agendas (global governance, global redistribution of wealth), has painted itself and all conforming governments, which now excludes the USA, into a corner over the unproven and non-existent (or at best indiscernible) alleged problem of dangerous man-made global warming.

The government needs to pause its ineffectual efforts and undertake an objective, unprejudiced review of the alleged problem of "climate change". If that leads to a long-overdue epiphany (like the Emperor's New Clothes) and if the government can summon up the courage, it should channel the currently prevailing anti-establishment mood to take a defiant stand against the supranational establishment's untenable climate and energy orthodoxy. As most ordinary people nowadays are sceptical of the politically contrived global warming scare this approach would have widespread voter support. It would also confound the other political parties (bar Ukip) who are all innumerate and illogically (because the imposed "solutions" hurt the poor the most) obsessed by "climate change".

After Brexit we will no longer be constrained by the EU's pointless directives to achieve an arbitrary percentage share of ineffectual renewables in our energy mix. Any negotiation concessions to remain party to such EU climate and energy policies must be firmly ruled out. We must take back control!

Finally, the Scottish Government [needs to be reined in](#) to stop it despoiling the countryside with yet more unwanted, unworkable windfarms. The SNP's misguided policies have already reduced Scotland to dependency on England for imported backup electricity to keep the lights on when the wind doesn't blow, and that's with two Scottish nuclear power stations which they abhor still running.

Yours faithfully,

Douglas S Brodie
Nairn, August 2017

PS: I am sending this note to all Tory MPs and MSPs as an act of guerrilla warfare (!) against a political class which shamelessly refuses to listen to reasoned argument or engage in reasoned debate on the issue of so-called "climate change".

PPS: If it is felt that this note is lacking in references, relevant details may be found in my previous offerings:

[The Disadvantages of Wind Power](#), January 2017

[Open Letter to Mr Pete Wishart, MP](#), January 2016

[Why the Climate Change Act should be Repealed](#), November 2015