



No.134 October 2021

Special Edition on the Draft National Policy Statements

As we wait for the Government to publish its long-delayed net-zero strategy - expected this week - in this edition of nuClear News we take a look at the Department for Business, Energy and Industrial Strategy's (BEIS's) consultation on its revised energy National Policy Statements.

The draft documents, which were published on 6th September are available here:

<https://www.gov.uk/government/consultations/planning-for-new-energy-infrastructure-review-of-energy-national-policy-statements>

The consultation closes at 11.45pm on 29th November 2021.

The Government is inviting responses via the online e-consultation platform, Citizen Space and says responses will be most useful if framed in direct response to the questions posed, though further comments and evidence are also welcome.

Respond online at: <https://beisgovuk.citizenspace.com/energy-development/energy-nps>

Responses outwith the e-consultation platform should be sent after contacting BEIS at energyNPS@beis.gov.uk

The package of draft energy NPSs, and their supporting documents, covered by this consultation are:

EN-1 Overarching National Policy Statement for Energy;

EN-2 Natural Gas Generating Infrastructure;

EN-3 Renewable Energy Infrastructure;

EN-4 Gas Supply Infrastructure and Gas and Oil Pipelines

EN-5 Electricity Networks Infrastructure

EN-6, which currently sets out the planning and consents regime for nuclear projects deployable before 2025, will not be amended as part of this review. As such it is not part of this consultation.



Here we focus on EN-1.

Background

The forthcoming Net Zero Strategy will detail how the Government will meet its pledge to bring the UK's carbon emissions down to "net zero" by the year 2050. It is expected to be published this week (18th – 22nd October). It will cover everything from shifting away from petrol and diesel cars to adopting greener heating in homes. The *Daily Telegraph* reports that funding for a new nuclear power plant will be announced before the 2024 election. (1) According to *The Times*, the Heat and Building Strategy will be unveiled this week too, (2) and the Financial Times says nuclear power will be at the heart of the strategy. The creation of a "regulated asset base" (RAB) model will be the key to the delivery of a future fleet of large nuclear power plants. Under this program, households will be billed for the cost of the plant via an energy tax long before it starts producing electricity, which could take a decade or more from the time where the final investment decision is made. EDF plans to use an RAB model to finance a new 3.2GW plant at Sizewell, and US nuclear company Westinghouse is planning to revive plans for a nuclear power plant at Wylfa. Ministers are also backing smaller modular reactors (SMRs) which are being developed by a consortium led by Rolls-Royce. Supporters of SMRs say these could be built in factories and have lower costs and risks than large atomic plants. (3)

But with chancellor Rishi Sunak and Prime Minister Boris Johnson seemingly at loggerheads over how much to spend on creating a net zero economy, there could be last minute delays and changes to the two strategy documents. (4)

Introduction

The first version of the National Policy Statement for Energy (EN-1), published in 2011, reflected the Government's Greenhouse Gas (GHG) emission reduction target at the time, which was 'at least 80% by 2050'. After the UK ratified the Paris Agreement in 2016, this was increased to 'net zero' by 2050.

In December 2020, the UK set out its Nationally Determined Contribution (NDC) to reduce GHG emissions by at least 68% from 1990 levels by 2030. In April 2021, the Government announced the sixth carbon budget (CB6) and as a result will legislate to reduce GHG emissions by ~78% by 2035 compared to 1990 levels. This new NPS, therefore, needs to reflect these new targets.

The UK Government has now made a landmark commitment to decarbonise the UK's electricity system by 2035. (5) Although the Prime Minister has pledged that all of Britain's electricity will come from renewable or nuclear sources by 2035, (6) it will be virtually impossible for new nuclear, apart from Hinkley Point C (HPC) to make any significant contribution towards this goal. Assuming all goes according to plan, which it rarely does when it comes to building nuclear plants on time, Sizewell C (SZC) is not expected to come online until around 2034 at the very earliest. Rolls Royce is not expecting to have its first Small Modular Reactor (SMR) operating until the 2030s but all 16 planned won't be running until 2050.

Tackling climate change is urgent, so it requires the fastest and cheapest solutions. The arguments in favour of expanding nuclear power rarely, if ever, address this. Nuclear generation



costs more per kWh than energy efficiency programmes and renewable generation so it displaces less carbon per pound spent. Nuclear power is, therefore shrinking and slowing climate protection compared with choosing the fastest, cheapest tools. Reducing carbon emissions sooner rather than later also increases cumulative carbon savings by 2050. (7)

Whilst the Government's commitment to decarbonising electricity by 2035 is to be welcomed, this submission examines the Government's unhealthy obsession with nuclear power. Against all the evidence it seems to believe that nuclear power can become competitive with renewables, yet experience tells us otherwise. The argument that nuclear power is somehow required to balance the intermittency of renewables makes no sense. In any case the recent spate of reactor shutdowns with 7 reactors offline, 5 of which were unplanned shutdowns, suggests that nuclear too suffers from intermittency.

At the same time the renewable industry is becoming increasingly confident that it could provide 100% of the UK's electricity supplies with the system balanced with flexibility, smart grids, storage, and international grid connections. (8) The latest model showing how this might be done comes from Wartsila Energy. (9)

Assessment of Electricity Demand

In August 2010 the Association for the Conservation of Energy (ACE) asked the Government if it had "carried out a long-term assessment of the costs and benefits of energy saving/efficiency as against those of energy generation?" And was told "there is not something specific in the public domain on this question." Asked if there was any information not in the public domain, the answer was no.

ACE concluded that on the basis of no assessment of long-term electricity needs the first set of Nation Policy Statements had decreed 10 new nuclear power stations were needed. (10)

Without presenting any evidence of a recent assessment of the costs and benefits of energy saving compared to energy generation the EN-1 Draft for Consultation states that:

"...decarbonisation is likely to require an increased use of electricity in domestic and industrial heating and transport, which is expected to outweigh increases in energy efficiency (see paragraph 3.3.3), potentially leading to a doubling or more of electricity demand by 2050." (para 3.3.10)

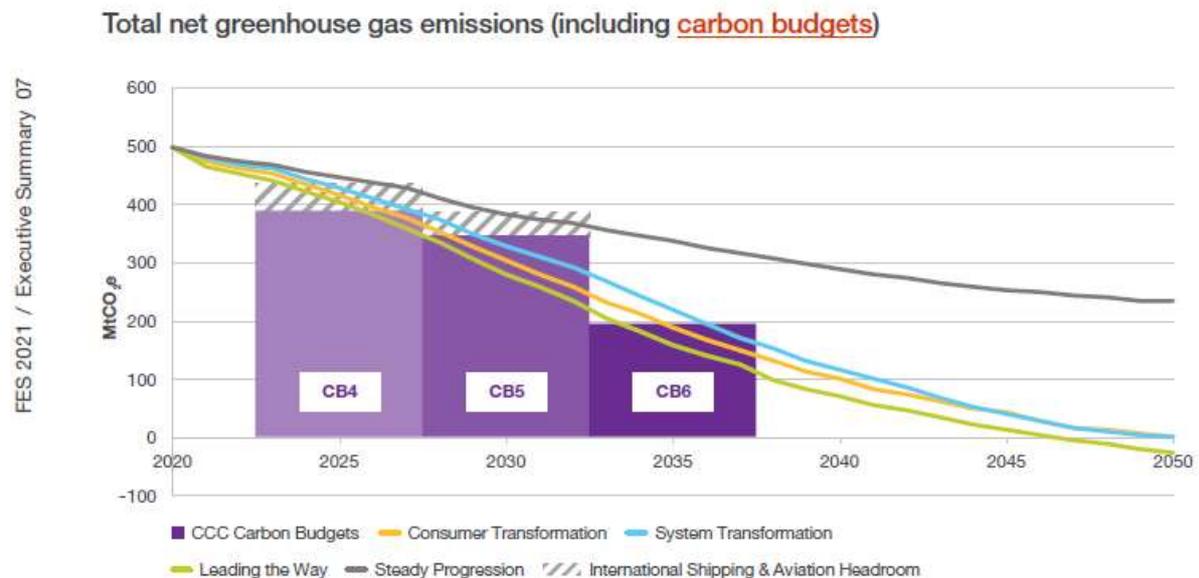
So, for a second time, it looks as though no assessment of long-term electricity needs has been made to justify the Government's nuclear ambitions.

In 2005 the Government's Energy White Paper predicted that by 2020 electricity consumption would increase by 15%. In fact, it decreased by 16%. Current projections expect demand to continue falling by a further 11% by 2025. But after that, projections revert to the bad old days. Within ten years Government forecasters expect consumption to be 2% more than today. (11) It is quite possible that these forecasts will turn out to be wrong again. Here we argue that more emphasis should be placed on energy efficiency to reduce overall costs and help to promote climate justice by tackling the urgent, yet persistent, problem of fuel poverty.



New Nuclear

The Government claims its analysis suggests additional nuclear capacity beyond Hinkley Point C will be required. It is understood that the Government is committed to the construction of at least two new large-scale nuclear power plants beyond Hinkley, with a funding announcement for at least one being expected in October's comprehensive spending review. (12) In 2019 it was estimated that householders' energy bills could rise by about £6 a year if the regulated asset base model is used to fund just one new large nuclear power station. (13)



National Grid ESO's Future Energy Scenarios (FES) 2021 outline four different, credible pathways for the future of energy in Britain. Three of the scenarios see the country reach net zero by 2050, while the slowest of the four Steady Progression sees a 73% reduction in emissions by the middle of the century. The most ambitious scenario – Leading the Way – reaches net zero by 2047.

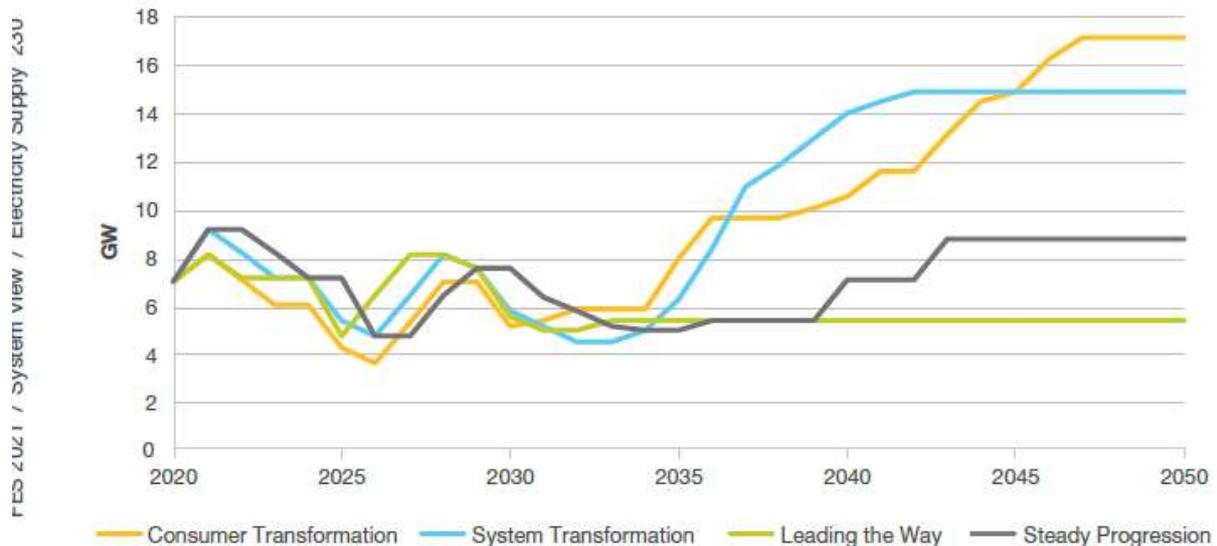
The Leading the Way scenario shows no growth in new nuclear after a few demonstration Small Modular Reactors in the 2030s.

The FES report points out that nuclear electricity production continues to decline throughout the 2020s as existing stations come off-line. This is offset to some extent by Hinkley Point C coming on stream around the end of 2026. But nuclear generation does not recover to current levels in any of the scenarios until after 2035.

In three of the scenarios the power sector reaches negative emissions before 2035. (14) Seven out of eight of the existing nuclear plants will be retired by then leaving only Sizewell B (2% of power) and Hinkley Point C, if it is completed by then (7%), so this outcome is not strongly dependent on a significant nuclear contribution.



Figure SV.35: Nuclear generation capacity



The only carbon emissions for the Government's proposed two new large nuclear reactors to save by the time they might come online in the mid-late 2030s at the earliest would be that saved by further electrification in the heating and transport sectors after 2035.

It also be noted that the embodied energy and resultant carbon emissions involved in building a plant like the proposed Sizewell C, will mean a net addition to the UK's carbon emissions. On the basis of an outdated carbon intensity forecast, EDF admits that it will take about 6 years (i.e. until 2040 if SZC is finished on schedule) to offset emissions from construction. Sizewell C would also be a net contributor to the UK's emissions because, unlike other low-carbon electricity sources, nuclear reactors require fuel that results in CO₂ emissions. So, while the emissions associated with renewables are essentially completed once the plant is online, a nuclear plant will effectively be emitting carbon throughout its life and beyond. (15)

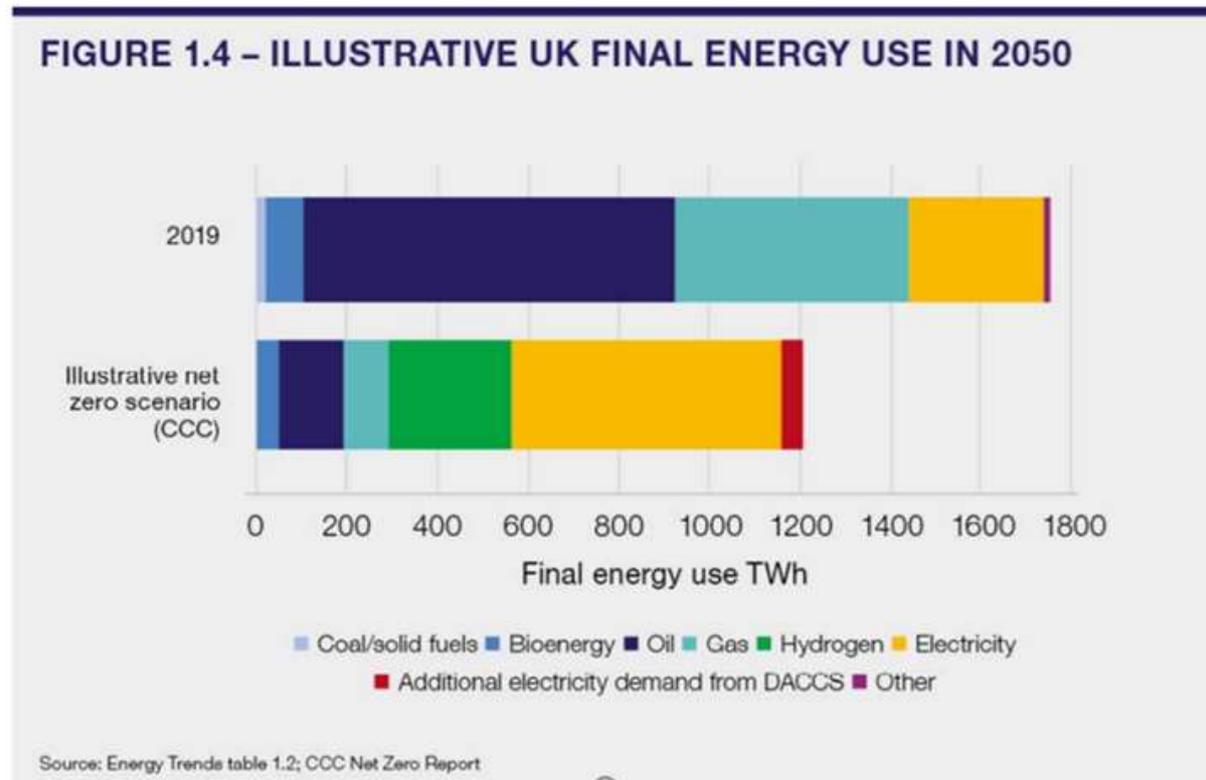
Decarbonising Heating and Transport

Electricity only meets around 18% of our final energy demand. So, to achieve our 2035 and 2050 climate targets we also need to focus on decarbonising our non-electrical supplies. Fossil fuels accounted for just over 79% of total energy supply in 2019.

The Government expects the electrification of heat and transport to lead to a doubling of electricity demand as forecast by the Climate Change Committee (CCC). But it has yet to define how reducing energy demand will contribute to achieving our climate ambitions. In fact, the Centre for Research into Energy Demand Solutions (CREDS) says existing policy instruments will only reduce energy demand by 5% by 2050. (16) In the short-term it needs to outline a detailed strategy with supporting policies to enable energy demand reduction to achieve rapid reductions in emissions, because it is not only the end point of net-zero emissions that matters but also the cumulative emissions on the pathway to it, as this determines the global temperature rise. Near term reductions in GHG emissions are therefore essential.



Residential buildings in the UK rely predominantly on heat produced from burning natural gas in boiler-based systems producing 15.2% of total national GHG emissions in 2019, a share which has been increasing steadily since the 1990s. A relative increase due largely to the faster rates of decarbonisation seen in the power and industrial sectors as compared to residential buildings.



The Government expects increased energy efficiency measures will lead to a reduction in final energy demand from around 1750 TWh in 2019 to 1200 TWh in 2050 – a fall of around 31% (as illustrated in the chart above). It claims that even with major improvements in overall energy efficiency, and increased flexibility in the energy system, demand for electricity is likely to increase significantly over the coming years and could more than double by 2050 as large parts of transport, heating and industry decarbonise by switching from fossil fuels to low carbon electricity.

The NPS consultation document says (para 3.3.3) “*even with major improvements in overall energy efficiency, and increased flexibility in the energy system, demand for electricity is likely to increase significantly over the coming years and could more than double by 2050 as large parts of transport, heating and industry decarbonise by switching from fossil fuels to low carbon electricity. The Impact Assessment for CB6 shows an illustrative range of 465-515TWh in 2035 and 610-800TWh in 2050.*”

But its advisor - the CCC - has been bad at forecasting electricity demand in the past. In 2008 it expected that electricity demand would continue to increase overall, but demand has actually dropped. The 2005 Energy White Paper was expecting that by 2020 electricity consumption

would have increased by 15%. In reality it has decreased by 16%. Current projections expect demand to continue falling by a further 11% by 2025. But after that, projections revert to the bad old days. Within ten years Government forecasters expect consumption to be 2% more than today. (17)

Research by CREDS shows that a 50% reduction is achievable through a combination of much more efficient technologies and social change, including more active travel, healthier diets and less waste. At present the government has no plan to achieve anything like this. (18)

Using energy more efficiency can significantly cut carbon emissions quickly and tackle the scourge of fuel poverty and the many physical and mental health problems caused by cold and damp homes A mass house retrofitting programme would need a large, skilled workforce in every part of the country. Heating our homes currently uses between 300 and 370 TWh per year. We can cut this by around half within the next 10 years, and by even more in the years following. (19)

A recent report by the UK Energy Research Centre (UKERC) notes that the UK needed to upgrade around 19,000 homes per week, compared to 3,800 seen in 2018–19; at current rates, this report suggests that the target, set out by the CCC, would take more than 700 years to reach. (20). The UK Government has set a goal of installing 600,000 heat pumps per annum by 2028 from the current base of 30,000. However, the policy instruments to deliver this have yet to be defined.

The transition to a net-zero economy means very high levels of investment to build out new energy supply infrastructure and invest in end-use, demand side technologies. Scenario analysis by CREDS shows that by implementing energy efficiency we can significantly reduce both investment levels and the cost of operating the energy system.

The CREDS Transform Scenario show how this can be achieved with no need to resort to building new nuclear power stations beyond Hinkley Point C. (21)

Figure 11: Power generation by scenario, 2010–2050.





Meeting Climate Targets the Fair Way

The Government's Committee on Fuel Poverty acknowledges that improving the efficiency of our homes makes them more affordable to heat and helps to ensure a fair transition to net zero. (22) Building expensive power stations without first carrying out a national retrofit programme will inevitably exacerbate inequality in this country – what you might call 'levelling down'. The Government has statutory fuel poverty target (for England), set in December 2014, which is to ensure that as many fuel-poor homes as is reasonably practicable achieve a minimum energy efficiency rating of Band C, by 2030. (23) Yet there is no single mention of fuel poverty in the NPS. Interim milestones were to upgrade as Band F and G properties as reasonably practicable to Band E by 2020 and to Band D by 2025. Regrettably the 2020 milestone was missed, and the Government's own Fuel Poverty Committee has said there is a high risk the 2025 target will be missed too. The Committee:

"...recognises the pressing need to address climate change and the importance of achieving the target of Net Zero carbon. The need for this to be a just transition which does not disproportionately impact fuel poor households is widely recognised. However, to date we have seen no detailed analysis which clearly shows how the fuel poor will be protected." (24)

Tackling climate change with a programme of heating electrification and the construction of expensive nuclear power stations without implementing a mass housing retrofit and fuel poverty programme will seriously exacerbate inequalities and does not represent a just transition.

Electric Vehicles

It is a similar story with transport. A recent report by the Institute for Public Policy Research's Justice Commission recommends making local public transport free to all users throughout the UK by 2030, with free bus travel by 2025 as a first step, as the fairest way of tackling transport emissions. (25)

The Government, on the other hand, remains focussed on electric vehicles. Its projections appear to suggest that most, if not all, of the 38 million vehicles currently on UK roads will be replaced by electric vehicles. But electrifying cars is not going to address traffic jams, urban sprawl, wasted space for parking and the health crisis caused by inactivity. Nor can electric vehicles completely solve air pollution problems caused by transport. According to the government's Air Quality Expert Group, particles from brake wear, tyre wear and road surface wear directly contribute to well over half of particle pollution from road transport. The key is to reduce the use of cars by getting people on to less-polluting forms of transport. (26)

Tackling the climate and air pollution crises requires curbing all motorised transport, particularly private cars, as quickly as possible. Focusing solely on electric vehicles is slowing down the race to zero emissions. Even if all new cars were electric now, it would still take 15-20 years to replace the world's fossil fuel car fleet, which is far too long. One way to reduce transport emissions relatively quickly, and potentially globally, is to swap cars for cycling, e-biking and walking – active travel, as it's called. Promoting cycling would be a far more effective



and quicker way of reducing carbon emissions than promoting electric vehicles. Active travel can contribute to tackling the climate emergency earlier than electric vehicles while also providing affordable, reliable, clean, healthy and congestion-busting transportation. (27)

CREDS has called on the government to devise a strategy allowing people to have a good standard of living without needing a car. The government is already spending £2bn to promote walking and cycling. (28) Many cities are devising active travel plans. The Greater Manchester Transport Strategy 2040, for instance, outlines the drive to make cycling a viable, safe and attractive travel choice for everyone as part of a more joined up approach to transport – and a genuine alternative to the car. It also establishes the Authorities ambition to make walking the obvious choice for shorter journeys, and working with the 10 district councils it is developing a new Greater Manchester Cycling and Walking Strategy. (29) Glasgow City Council has unveiled plans to build a city-wide network of active travel infrastructure for all parts of Glasgow which will add 270km of high-quality cycleways and improved footways along main roads in Glasgow. (30) Edinburgh is planning 85km of new protected cycle routes over the next five years. (31) The Scottish Government’s updated Climate Change Plan contains a new target to cut car kilometres by 20% by 2030. (32) The government has launched an experiment in Coventry to encourage people to ditch their cars in exchange for a £3,000 grant to be used on public transport. (33) Similar active travel plans and Low Traffic Neighbourhoods will be introduced across the UK placing a downward pressure on the number of vehicles and hence the electricity required to power them.

In 2017, National Grid inadvertently caused alarm by suggesting that electric vehicles could, hypothetically, add as much as 30GW to national peak electricity demand by 2050. That would have been a 50% increase on peak demand, if nobody agreed to use “smart” chargers that charged at off-peak times. (34) National Grid now it expects smart charging to keep the additional peak demand as a result of electric vehicles to be between 7 and 16GW.

A report by Redburn - a UK research and investment company – gives an alternative view on the impact of electric vehicles on electricity demand. This suggests the increase in demand as a result of the electrification of transport may be very limited and that electrification of cars will not dent the established trends towards reduced electricity consumption because ever more energy-efficient lighting and motors will offset any increases in electricity consumption due to EVs. (35)

National and Local Governments should also encourage the construction of a new generation of solar-powered charging stations across the UK. Gridserve plans to build a network of more than 100 solar forecourts to charge electric vehicles over the next five years. The first has opened at Braintree in Essex. (36) The West Yorkshire Combined Authority has opened the UK’s first solar-power Park and Ride Solar panels, together with a battery storage system will power the entire site including 26 electric vehicle charging points. (37) Scotland’s largest electric vehicle charging station has opened at the Falkirk Stadium. It generates over 30 per cent of the required electricity to power the facility from its own solar canopy made up of 1272 panels covering an area of over 2000 square metres. (38)



The Baseload Myth

Another argument used by the Government to justify new reactors is that nuclear capacity is required to provide a “baseload” of electricity to cope with variable supply and demand. It says nuclear technology is developing and opportunities for flexible use may grow as the energy landscape evolves. The role of nuclear power could be fulfilled by large-scale nuclear, Small Modular Reactors, Advanced Modular Reactors, and fusion power plants.

This justification – that we need nuclear power to provide baseload generation - is based on a myth. Michael Liebreich CEO of Bloomberg New Energy Finance says:

“Firm power which cannot be switched off when you don’t need it will be as much of a problem as variable power which cannot be switched on when you do. What is called for is flexibility, in huge quantities and of all types.” (39)

New nuclear plants are not flexible – they can’t balance the output from variable renewables like wind and solar. (40) Nuclear energy has the lowest flexibility and the worst response speed compared to all other power technologies. What is needed is flexible supply and demand side balancing systems, smart grids, and storage, including electrolytic ‘Power to Gas’ hydrogen production, using surplus renewables power, stored ready for conversion back to electricity when renewables inputs are low. (41)

As long ago as 2014, UBS Bank was forecasting that “Large-scale power generation ... will be the dinosaur of the future energy system: Too big, too inflexible, not even relevant for backup power in the long run”, as the cost of batteries declined. (42) Similarly, HSBC Bank was predicted that conventional generators would be the biggest losers from an upcoming energy storage boom. (43)

More recently, the Energy Networks Association has estimated that spare wind and solar electricity generated in the spring and summer months could generate between 60-80GW of renewable hydrogen. This would reduce the need for the total electricity generating capacity of wind farms from 500GW-600GW by 2050 to 140GW-190GW, a reduction of up to 75%. This is because it will ensure electricity generated by Britain's wind farms is used as efficiently as possible by avoiding surplus electricity going to waste. (44)

The Wartsila report “Front Loading Net Zero” concludes that:

“We have all the technologies that we need for net zero. The transition to 100% renewable energy systems is set to accelerate at an eye-popping rate. It’s no longer a question of if we’ll make the journey, but when we’ll arrive at a decarbonised future.” (45)

Towards 100% Renewables

According to trade body, Renewable UK, the cost of electricity from new onshore wind projects is now lower than the wholesale electricity price, and is forecast to get even cheaper. It is calling on the Government to double the UK’s onshore wind capacity by 2030 to 30GW would reduce consumer bills by £16.3 billion. Doubling capacity would not only lead to an annual saving of £25 for every household, it would also generate £45 billion of economic activity and create



27,000 full-time jobs in the sector, including its supply chain. The onshore wind sector could sustain as much as 70% UK content as well. In particular, Scotland is set to benefit from the growing onshore wind sector, with 17,000 of the new jobs set for there, while England would see 6,000, Wales 3,000 and Northern Ireland 1,000.

The UK needs to install 35GW of onshore wind by 2035 according to the Climate Change Committee in order to reach net zero. However, at the moment less than half of the annual capacity needed to reach this goal is being consented. As such, just over 600MW of capacity on average is being installed instead of the 1,250MW needed to stay on track. (46)

Offshore Wind

Wartsilla's latest modelling, sticks with the estimated need for electricity supply to double but suggests that to be cost optimal, the UK's new capacity needs to be met by wind energy, with 112 GW needed by 2035, which (including necessary battery storage and thermal balancing), would cover 77% of the annual power demand in the UK. With just 14 years to meet the 2035 target, Wartsila calculates that over 6 GW of new wind energy must be installed annually. That is almost three times the current pace of 2.1 GW per year and a significant increase on the UK's existing plans to install 40 GW of offshore wind by 2030. It is achievable for the UK to become the 'Saudi Arabia of wind', however, the shift cannot happen at the flip of a switch. New offshore wind can only grow as fast as the infrastructure that's built to harness its power.

The UK must also dramatically accelerate its focus on flexibility to manage the huge increase in variable renewables over coming decades. The modelling shows that the UK needs to install 18 GW of energy storage to affordably manage short-term fluctuations – plus almost 35 GW of thermal balancing power plant capacity and Power to Gas converters, to store renewable energy and manage longer-term peaks and troughs of supply and demand. (47)

Flexibility

Flexibility is the key to moving to an energy system based on 100% renewables.

Jonathan Marshall of the Energy and Climate Intelligence Unit says renewable energy solutions offer more flexibility than nuclear: *"If you look at the amount of money involved in building nuclear power stations, it's pretty easy to come up with something renewables-based that's as firm and more flexible."* (48)

Flexibility unlocks more renewable energy by balancing the intermittency of wind and solar power to ensure the power supply always matches demand. For example, when more power is generated than needed, you can store the surplus in batteries to be used later. The alternative is paying renewables to switch off, which is expensive and inefficient. On the other hand, investing in nuclear power could, according to Wärtsilä, entrench an inflexible grid while making renewables such as solar and wind less cost-effective. (49)

Similarly, a report in Nature Energy by Benjamin Sovacool, Andy Stirling, Gordon MacKerron and others says countries wishing to reduce carbon emissions should invest in renewables, abandoning any plans for nuclear power stations because they can no longer be considered a low-carbon option. The study provides evidence that it is difficult to integrate renewables and



nuclear together in a low-carbon strategy, because they require two different types of grid. Because of this, the authors say, it is better to avoid building nuclear power stations altogether. (50)

Baseload is not helpful in balancing a variable energy supply – it simply leads to further overproduction of energy at times when renewables can meet demand on their own. In a grid which has a large contribution from variable renewables, a flexible electricity supply which can be turned on and off quickly to fill the troughs when renewables aren't able to supply is what is needed. Nuclear power is a very poor fit for a 21st century grid system and acts against increasing renewable energy capacity. (51)

Lord Deben, Chair of the CCC says:

“By the time you get to the need for the next nuclear power stations, there will be alternative ways of doing this. If we get better at balancing the grid and the amount of baseload energy, the need becomes smaller. Nuclear isn't the best way of getting that base energy because you can't turn it on and off: you have to use it all the time.” (52)

Conclusions

- The Government has an unhealthy obsession with nuclear power. Against all the evidence it seems to believe that nuclear power can become competitive with renewables, yet experience tells us otherwise. It's nuclear pathway to achieving net zero will be too slow, too expensive. It will exacerbate fuel poverty, transport poverty and inequality, and is unlikely to achieve the required targets.
- The renewable industry is becoming increasingly confident that it could provide 100% of the UK's electricity supplies with the system balanced with flexibility, smart grids, storage, and international grid connections.
- There has been no obvious assessment which compares the cost of energy saving with the cost of energy generation. Assuming that electricity demand will double by 2050 and that vehicle numbers will remain the same is the wrong way to plan an energy strategy. More emphasis should be placed on energy efficiency and alternatives to individual vehicle ownership to reduce overall costs and help to promote climate justice.
- The idea that nuclear capacity is required to provide a “baseload” of electricity to cope with variable supply and demand is a myth. It would be perfectly feasible to devise a 100% renewable energy strategy with the system balanced with flexibility, smart grids, storage, and international grid connections.

-
1. Telegraph 17th Oct 2021 <https://www.telegraph.co.uk/news/2021/10/17/exclusive-government-fund-new-nuclear-power-station-part-net/>
 2. Times 17th Oct 2021 <https://www.thetimes.co.uk/article/out-of-gas-boilers-will-be-banned-by-2035-8lxhkgdkn>
 3. FT 16th Oct 2021 <https://www.ft.com/content/e6426194-21e6-49c4-9520-97c337b350fd>



4. Observer 16th Oct 2021 <https://www.theguardian.com/environment/2021/oct/16/treasury-leak-reveals-rift-between-johnson-and-sunak-over-costs-of-zero-carbon-economy>
5. BEIS 7th Oct 2021 <https://www.gov.uk/government/news/plans-unveiled-to-decarbonise-uk-power-system-by-2035>
6. Telegraph 4th Oct 2021 <https://www.telegraph.co.uk/politics/2021/10/04/boris-johnson-announce-plan-green-electricity-2035/>
7. “Low-carbon” Misses the Point: Arguments Favoring Nuclear Power as a Climate “Solution” are Fundamentally Misframed, by Amory Lovins, Counter Punch 6th Oct 2021, <https://www.counterpunch.org/2021/10/06/low-carbon-misses-the-point-arguments-favoring-nuclear-power-as-a-climate-solution-are-fundamentally-misframed/>
8. 56 Peer-Reviewed Published Journal Articles From 18 Independent Research Groups. <https://www.no2nuclearpower.org.uk/wp/wp-content/uploads/2021/04/100PercentPaperAbstracts-2021.pdf>
9. Front Loading Net Zero, Wartsila, Oct 2021 <https://www.wartsila.com/front-loading-net-zero>
10. A Corruption of Governance? A joint publication by Unlock Democracy and The Association for the Conservation of Energy, January 2012 <https://cdn.ca.emap.com/wp-content/uploads/sites/9/2012/02/ACE-Campaigns-MPs-misled-over-nuclear.pdf>
11. Energy in Buildings and Industry 29th March 2020 <https://eibi.co.uk/article/under-valued-energy-efficiency-provides-a-win-win-march-2020/>
12. Times 4th Oct 2021 <https://www.thetimes.co.uk/article/all-britains-electricity-to-be-green-by-2035-ns76tl7vm>
13. Telegraph 7th July 2021 <https://www.telegraph.co.uk/business/2021/07/07/consumers-face-higher-energy-bills-pay-new-nuclear-power/>
14. National Grid ESO, Future Energy Scenarios 2021 <https://www.nationalgrideso.com/future-energy/future-energy-scenarios>
15. How much Carbon would Sizewell C save? By Professor Steve Thomas & Alison Downes, Updated April 2021 <https://stopsizewellc.org/core/wp-content/uploads/2021/04/Sizewell-C-Carbon-Savings-updated-April-2021.pdf>
16. Letter from Nick Eyre to the Times 4th October 2021 <https://www.thetimes.co.uk/article/times-letters-pms-plan-for-electricity-to-be-green-by-2035-rvm6f8f09>
17. Energy in Buildings and Industry 29th March 2020 <https://eibi.co.uk/article/under-valued-energy-efficiency-provides-a-win-win-march-2020/>
18. Barrett, J. et al October 2021. The role of energy demand reduction in achieving net-zero in the UK. Centre for Research into Energy Demand Solutions. Oxford, <https://www.creds.ac.uk/publications/the-role-of-energy-demand-reduction-in-achieving-net-zero-in-the-uk/>
19. Climate Jobs: Building a Workforce for the Climate Emergency, Campaign Against Climate Change, Trade Union Group. https://www.cacctu.org.uk/sites/data/files/sites/data/files/Docs/buildings_climate_jobs.pdf
20. Rosenow, J., Lowes, R., Broad, O., Hawker, G., Wu, J., Qadrdan, M. and Gross, R. 2019. The pathway to net zero heating in the UK. A UKERC policy brief. London: UK Energy Research Centre (UKERC). <https://ukerc.ac.uk/publications/net-zero-heating/>
21. Barrett, J. et al October 2021. The role of energy demand reduction in achieving net-zero in the UK. Centre for Research into Energy Demand Solutions. Oxford,



- <https://www.creds.ac.uk/publications/the-role-of-energy-demand-reduction-in-achieving-net-zero-in-the-uk/>
22. Committee on Fuel Poverty Interim Report, July 2021
<https://www.gov.uk/government/publications/committee-on-fuel-poverty-interim-report-july-2021>
 23. Sustainable Warmth, Protecting Vulnerable Households in England, BEIS, February 2021
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/960200/CCS207_CCS0221018682-001_CP_391_Sustainable_Warmth_Print.pdf
 24. Committee on Fuel Poverty Annual Report October 2021
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1024398/Annual_Report_CFP_2021.pdf
 25. Politics.co.uk 14th July 2021 <https://www.politics.co.uk/news/2021/07/14/free-public-transport-would-help-meet-net-zero-targets/>
 26. BBC 11th July 2019 <https://www.bbc.co.uk/news/business-48944561>
 27. UK Energy Research Centre 6th May 2021 <https://ukerc.ac.uk/news/cycling-is-ten-times-more-important-than-electric-cars-for-reaching-net-zero-cities/>
 28. BBC 5th July 2019 <https://www.bbc.co.uk/news/uk-48875361>
 29. Transport for Greater Manchester <https://tfgm.com/strategy>
 30. Glasgow City Council 5th Oct 2021 <https://www.glasgow.gov.uk/index.aspx?articleid=27605>
 31. Highways News 11th October 2021 <https://highways-news.com/edinburgh-to-deliver-50-miles-of-protected-cycle-routes-over-the-next-five-years/>
 32. Update to the Climate Change Plan, Scottish Government
<https://www.gov.scot/publications/securing-green-recovery-path-net-zero-update-climate-change-plan-20182032/> para 3.3.17
 33. Independent 17th Oct 2021 <https://www.independent.co.uk/climate-change/news/coventry-cars-public-transport-payment-b1939852.html>
 34. Times 12th July 2018 <https://www.thetimes.co.uk/article/grid-ups-its-estimate-for-electric-cars-9kqp58wgb>
 35. Energy Post 6th Nov 2018 <https://energypost.eu/the-impact-of-electric-vehicles-on-electricity-demand/>
 36. Gridserve 6th Dec 2020 <https://www.gridserve.com/2020/12/06/gridserve-opens-uks-first-electric-forecourt/>
 37. Solar Power Portal 24th Sept 2021
https://www.solarpowerportal.co.uk/news/leeds_opens_uks_first_solar_power_park_and_ride
 38. Falkirk Herald 10th August 2020 <https://www.falkirkherald.co.uk/news/transport/scotlands-largest-electric-vehicle-charging-station-officially-opened-falkirk-2938118>
 39. Analysis: Does the UK 'require' new nuclear to reach net-zero emissions? Carbon Brief 26th July 2019
<https://www.carbonbrief.org/analysis-does-the-uk-require-new-nuclear-to-reach-net-zero-emissions>
 40. Brown, P. Nuclear Energy Now Surplus to Needs, Guardian 27th January 2020
<https://www.theguardian.com/news/2020/jan/27/weatherwatch-nuclear-energy-now-surplus-to-renewable-energy>
 41. Froggatt, A Survival of Utilities During the Transformations of the Power Sector, Chatham House 22nd August 2018 <https://www.chathamhouse.org/sites/default/files/publications/research/2018-08-21-flexFroggattQuiggin.pdf>



42. Will solar, batteries and electric cars re-shape the electricity system? UBS Global Research 20th August 2014 https://www.solareb2b.it/newsletter/ubs_storage_report.pdf
43. Renew Economy 1st October 2014 <https://reneweconomy.com.au/energy-storage-generators-biggest-losers-50615/>
44. Current 12th Oct 2021 <https://www.current-news.co.uk/news/renewable-hydrogen-best-option-to-circumvent-future-energy-supply-shortages-ena-finds>
45. Front Loading Net Zero, Wartsila, Oct 2021 <https://www.wartsila.com/front-loading-net-zero>
46. Current 13th Oct 2021 <https://www.current-news.co.uk/news/doubling-onshore-wind-could-reduce-bills-by-16-3bn-finds-renewableuk> and Business Green 13th Oct 2021 <https://www.businessgreen.com/news/4038587/renewable-energy-industry-urges-government-double-uk-onshore-wind-capacity>
47. Front Loading Net Zero, Wartsila, Oct 2021 <https://www.wartsila.com/front-loading-net-zero>
48. New Civil Engineer 4th Nov 2020 <https://www.newcivilengineer.com/latest/warning-against-sizewell-csvalue-for-money-as-nuclear-project-nears-green-light-04-11-2020/>
49. Forbes 30th November 2020 <https://www.forbes.com/sites/davidrvetter/2020/11/30/ditchnuclear-and-save-860-million-with-grid-flexibility-uk-told/?sh=5394dc4d1975>
50. Nature Energy 5th Oct 2020 <https://www.nature.com/articles/s41560-020-00696-3> and Good Men Project 21st Nov 2020 <https://goodmenproject.com/featured-content/nuclearpower-hinders-fight-against-climate-change/>
51. Farrell, J. Why coal and nuclear are not compatible with a renewable future, Institute for Local Self Reliance 16th October 2013 <https://ilsr.org/coal-nuclear-baseload-compatible-renewable-future/>
52. Lord Deben: Politicians have finally grasped the reality of climate change, Utility Week 23rd Sept 2019 <https://utilityweek.co.uk/lord-deben-politicians-finally-grasped-reality-climate-change/>