How much Carbon would Sizewell C save?

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1. Introduction

There were three main arguments for the programme of new nuclear reactors in the UK proposed in 2006.

- First, nuclear power was cheaper than other sources of low-carbon electricity and was therefore the most cost-effective way to meet our emissions targets
- Second, there was a need for base-load power stations that other low-carbon sources like renewables could not meet; and
- Third, even with a substantial renewables and energy efficiency programme, the UK could not reduce its carbon emissions sufficiently to meet its emissions targets.

The first two arguments have failed. In addition, the evidence that warming is increasing faster than expected has led to consensus that we are in a 'climate emergency' and need to decarbonise much more rapidly than previously expected putting a premium on measures that can be implemented quickly.

Assessing the contribution new nuclear power plants, such as SZC, could make to emissions reductions from power generation is therefore crucial to the case for new nuclear. In its Sustainability Statement,[3] EDF claims (emphasis added):

> *'The electrical output would provide a low carbon source for over 20% of the UK's homes and,* ***based on current grid intensity*** [average CO_2 emissions per kWh of electricity produced]*, offset approximately 7 million tonnes of CO_2 per annum by displacing the existing mix of more carbon intensive electricity from the National Grid. The development of the Sizewell C Project would therefore play a significant role in the UK's transition to a low carbon economy.'*

This statement is worthless because SZC will not be complete before 2034, by which time, the grid intensity will be far lower than now.

If new nuclear plants are not cheap and base-load capacity is not needed, the claim that nuclear power is essential if the UK grid is to be de-carbonised is the only remaining substantive argument for nuclear power. If nuclear capacity cannot be expanded sufficiently in the time-frame required, even assuming it can make a useful contribution to emissions reductions, it will be too late.

2. The UK government's 2050 target

On 27th June 2019, the UK government made its target for 2050 emissions legally binding:[4] *'The target will require the UK to bring all greenhouse gas emissions to net zero by 2050, compared with the previous target of at least 80% reduction from 1990 levels.' 'Net zero means any emissions would be balanced by schemes to offset an equivalent amount of greenhouse gases from the atmosphere, such as planting trees or using technology like carbon capture and storage.'*

The electricity sector will be key in meeting the CO_2 element of the target. It remains a large consumer of fossil fuels but decarbonising the two other key sectors, space heating, now largely met by natural gas, and vehicle transport now met by petroleum, will require an affordable low-

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[3] https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010012/EN010012-001959-SZC_Bk6_ES_V2_Ch26_Climate%20Change.pdf

[4] https://www.gov.uk/government/news/uk-becomes-first-major-economy-to-pass-net-zero-emissions-law

carbon electricity system. Electricity generation has the advantage of having affordable, well-proven low-carbon technologies already available. On these grounds, electricity is likely to be ahead of other sectors in decarbonising.

3. Arguments for and against new nuclear capacity in the UK

3.1. Cost

The UK Nuclear Industry Association claims that if construction cost risk could be reduced and financing models more advantageous to nuclear (implicitly by shifting risk from developers to consumers under the Regulated Asset Base model), the cost of existing projects, like Sizewell C (SZC) could reduce to £60/MWh. However, this would still be 50% more than the most recent offshore wind price bids, the largest potential power resource of the renewables.[5] The expectation is that the next round of offshore wind bids will produce even lower prices. By contrast, despite claims throughout the history of nuclear power that costs would soon start to fall, real costs have only ever risen and a real reduction in nuclear costs is therefore implausible.

3.2. Need for base-load power

Smart grids, dramatic improvements in electricity storage technologies and demand side measures have removed the need for base-load capacity. To be clear, while there is a level below which demand does not fall – the base-load – it is a non sequitur to assume that there needs to be a dedicated set of plants operating at full power round the clock – base load capacity - to meet it. It may make sense to run some plants on base-load, especially those that have very high fixed costs, but that is not the same as saying there is a need for base-load capacity. Five years ago, Steve Holliday, the then CEO of the UK's National Grid Company (NGC) said, 'The idea of large power stations for baseload is outdated.'[6] His argument was that in the past, electricity systems were built around base-load plant with mid-load and peaking plants added to meet the hour by hour fluctuations in electricity demand. Holliday claimed, '*the solar on the rooftop is going to be the baseload'*. Renewables will therefore be at the heart of the system with other capacity added to ensure security of supply. The function of grid supplied power will be to fill in the gaps when renewables are not available. Holliday warned that large nuclear plants do not fit well with such a system: '*If you have nuclear power in the mix, you will have to think about the size of these plants. Today they are enormous. You will need to find a way to get smaller, potentially modular nuclear power plants.*'

It was possible to reduce the output of Sizewell B (SZB), which is only two thirds the size of SZC, by 50% because it has two small turbines rather than one large one as is the case for all other large reactors worldwide and as will be the case for HPC and SZC.

3.3. Need for policies that can be rapidly introduced

The two most advanced nuclear projects, Hinkley Point C (HPC) and SZC were announced in 2009 and 2015 respectively but, on current projections, it will be almost two decades from these announcements before power is being produced (2027 in the case of HPC and 2034 in the case of SZC) and there is ample scope for further delay. As with costs, the nuclear industry has continually claimed that new projects would learn from past mistakes and lead-times for new projects would be much shorter. However, even in the unlikely event that the lead-time

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[5] https://www.niauk.org/wp-content/uploads/2020/06/Fortyby50_TheNuclearRoadmap_200624.pdf p 8.

[6] https://energypost.eu/interview-steve-holliday-ceo-national-grid-idea-large-power-stations-baseload-power-outdated/

could be halved, that would probably still be too long. In addition, while it seems possible to expand offshore wind with a large number of simultaneously constructed projects, it seems unlikely that more than a very small number of nuclear projects could be pursued at the same time. So on the criteria of meeting a 'climate emergency', nuclear power fails.

4. Carbon emissions associated with a nuclear power plant

While some assert nuclear power is zero carbon, this is false even though the routine operation of a nuclear power reactor does not directly produce CO_2 (there are some emissions from worker transport and back-up power facilities). Emissions of CO_2 occur in the fuel cycle – the various steps from mining of uranium to disposal of spent fuel - and are embodied in the inputs – the huge amount of material and labour, far larger than other forms of generation – to the construction of the plant. EDF also notes emissions from back-up diesel generators, a back-up CHP plant and from vehicle journeys during the operating life of the plant.

The main emissions from the construction phase are from the manufacture of the materials used, such as concrete and steel, with some emissions from worker and materials transport. Other forms of low carbon generation and energy efficiency require materials that will result in the production of CO_2 but the volumes of material are far lower than for a nuclear plant.

The fuel cycle[7] accounts for the vast majority of CO_2 emissions associated with operation of a nuclear plant. Many of these stages are not in the UK and will not be reflected in UK emissions, but given that climate change is a global problem, it would be wrong to discount these emissions simply because they do not occur on UK soil. Estimates of the carbon content of the fuel cycle vary massively depending on assumptions made on the quality and depth of the uranium ore deposits and on the composition of the national electricity system in which the highly electric intensive process of enrichment[8] takes place. Experience of reactor decommissioning is minimal and the final stage of the fuel cycle, disposal of spent fuel, has not been carried out yet anywhere in the world and is probably decades away from being demonstrated. It is therefore not possible to estimate the carbon content of decommissioning and disposal of spent fuel but it will not be zero.

In 2008, Sovacool[9] surveyed the various estimates of the CO_2 content of the nuclear fuel cycle finding a range of 1.4-288g of carbon dioxide equivalent per kWh (g CO_2e/kWh) with a mean value of 66g CO_2e/kWh. In 2012, Warner & Heath[10] carried out a similar survey and found a range of 4-220g CO_2e/kWh with a median of 13g CO_2e/kWh. If we assume SZC has a load factor of 85% and a capacity of 3340MW, the range of annual CO_2 emissions is 35,000-721,000 tonnes (t) of CO2 under Sovacool's range.[11] The range of subsequent estimates has not got

[7] Emissions occur in the mining of the ore, the processing of the ore to separate the uranium, the shipping of the ore to the location of enrichment, the shipping of the enriched uranium to the fuel fabrication plant, shipping of the fuel to the reactor, storage and cooling of the spent fuel for decades, packaging of the spent fuel ready for disposal, transport of the spent fuel to the disposal site and disposal and eventual sealing of the disposal site. The last two stages are not demonstrated and alternative options are possible.

[8] Only 0.7% of naturally occurring uranium is fissile, able to sustain a nuclear chain reaction, U235, with the majority the non-fissile U238. For the majority of reactor types the U235 content much be increased to 3.5-5% via process such as centrifuging to separate the lighter isotope from the heavier.

[9] B Sovacool, 2008, Valuing the Greenhouse Gas Emissions from Nuclear Power: A Critical Survey *Energy Policy* 36(8):2940-2953

[10] E Warner & G Heath, Life Cycle Greenhouse Gas Emissions of Nuclear Electricity Generation *Journal of Industrial Ecology*, **16**, S73, (2012)

[11] The molecular weight of carbon is 12 and CO_2 44, therefore 1t of carbon is equivalent 3.7t CO_2.

smaller. The Intergovernmental Panel on Climate Change (IPCC) assumes 12g CO_{2e}/kWh[12] and UK's Committee on Climate Change (CCC) estimated the carbon content as 6g CO_2e/kWh, at the lower end of Sovacool's and Warner & Heath's range.

As the world's uranium reserves are depleted, it might be expected that poorer quality ore at deeper depths will have to be mined increasing the emissions from this stage, although historically, this does not always appear to have been the case because much of the world has yet to be explored for uranium. The enrichment process will tend to lead to less emissions as electricity systems are decarbonised.

5. Electricity system operation

EDF suggests that nuclear and renewables such as wind and solar are 'complements', implying that when renewables are not available additional nuclear output can substitute for it. In its Sustainability Statement for SZC, EDF claims:[13]

> *'Whilst a range of technologies will be vital to achieving this* [decarbonising the UK electricity generation sector], *nuclear power will have an important role to play in providing a stable baseload of power, to complement other technologies such as wind and solar power.'*

This is highly misleading as both nuclear and renewables have inherent inflexibilities that make them a poor match. Physically and economically, nuclear power plants should run at full power whenever they can. The level of solar and wind available output is determined by the weather conditions although, unlike nuclear plants, renewable output can readily be reduced.

- This means that when demand is high and availability of renewables and nuclear is low – nuclear reactors break down or are on outage all too often – a large volume of flexible plant will be required.
- Equally, when demand is low and availability of nuclear and renewables is high, output of renewables will have to be restricted because of the physical inflexibility of nuclear plants.

This first happened in the UK in 2019 and is happening now with SZB running at 50% with only one of its two generators operating, an option not open to HPC or SZC as they would only have one large turbine per reactor.

As the capacity of renewables grows, this will be an increasing constraint on the UK electricity system.

Both nuclear and renewables impose extra system costs; for renewables, it is the reinforcement to the grid needed to bring power from off-shore windfarms and from windier areas to demand centres. For nuclear, it is because of the need to be able to maintain supplies if a generator breaks down generally met by 'spinning reserve', in other words a generator that can be switched on within seconds.

The large size of the proposed new reactors means spinning reserve will have to be much larger than now. At present, the largest turbines on the system – this determines the size of the spinning reserve needed - are the 600MW turbines at each of the seven AGR stations and at

[12] https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_annex-iii.pdf#page=7
[13] https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010012/EN010012-002235-SZC_Bk8_8.13_Sustainability_Statement.pdf p 1

the SZB PWR[14] as well as some fossil-fired stations like Drax. The EPR turbines will be more than 1600MW so the spinning reserve size will have to almost triple. Spinning reserve is generally met by fossil fuel generators that are hot and ready to operate or by gas turbines. Both options lead to the burning of fossil fuel.

Since 1990, the UK has tried to operate the British electricity power station system as a competitive market, although the proportion of wholesale power bought and sold at market-determined prices has always been relatively small, and generators with low running costs and high fixed costs do not fit easily into a system designed to produce competition on an hour-by-hour basis.

Nuclear plants are categorised as 'must run' because they are physically inflexible and should not be asked to vary their output on an hour to hour basis. For example, when the SZB plant was asked to reduce its output by 50 per cent, it was given at least a month's notice. So adding a must run, base-load plant to the system will mean that the utilisation of all plants that are not 'must run' will tend to be slightly reduced. Where these plants use fossil fuel - in practice natural gas as coal generation has essentially already been phased out - this reduction will reduce carbon emissions across the generation system.

The output of new nuclear reactors in the UK, including HPC, will inevitably be sold on 'take-or-pay' fixed price terms (so-called contract for difference), in other words, the plant owner will be paid the fixed purchase price for the power the plant could produce whether or not the output can be used. Off-shore wind and other large renewables will also be paid on take-or-pay terms, while smaller renewables, like solar panels and on-shore wind generate whenever available and are generally paid for under 'feed-in tariffs'. As the proportion of demand met by plants that are guaranteed a price and therefore not competing in the wholesale market increases, new arrangements to buy the power might have to be introduced. However, it is clear that the existing and committed renewable and new nuclear capacity was only possible because of the guarantee that all potential output would be sold at a guaranteed, fixed non-market price.

6. Carbon emissions saved

To calculate accurately the emissions reductions resulting from adding a nuclear plant to the generation mix would require complex simulations of the electricity system with and without the reactors. This would require accurate information on demand over the life of the plant as well as information on the timing and type of new capacity additions and capacity closures, at least until the electricity generation system is fully decarbonised, assumed to be by 2050 at the latest consistent with the UK government's legally binding commitment to bring all greenhouse gas emissions to net zero by then. It is unlikely that this data can be accurately forecast over the period required and a less precise but inevitably less accurate methodology may be required.

The higher demand is, all else being equal, the longer fossil fuel plants will have to continue to generate to meet demand and the larger the amount of carbon, SZC will save. UK governments of all complexions have consistently massively overestimated electricity demand growth in the 60 years since the Magnox reactor programme was started. At the time the nuclear programme was announced in 2006, it forecast an increase in demand of about 20 per cent by 2020. In fact

[14] Unlike other PWRs which have only one large turbine, Sizewell B has two medium-size turbines. At the time Sizewell B was built the UK turbine industry had no experience of supplying a large turbine so the more expensive but less risky option of using two medium-size turbines was chosen.

demand has fallen by about 20 per cent in that period and is continuing to fall. The UK government's commitment in July 2020 to spend £3bn on improving the energy efficiency of homes and public sector buildings[15] will reduce demand even more and will reduce the impact on electricity demand of measures to move space-heating from natural gas to electricity.

Similarly the quicker investment decisions are taken on low-carbon generation and on energy efficiency measures, the less fossil fuel plants will have to generate and the lower the carbon savings from SZC will be.

A July 2020 report from the UK NGC[16] claimed that in three out of four of its scenarios, 'net emissions from the power sector are negative by 2033'. Seven out of eight of the existing nuclear plants will be retired by then leaving only SZB (2% of power) and HPC, if it is completed by then (7%), so this outcome is not strongly dependent on a significant nuclear contribution in 2033.

If these scenarios are accurate, there will be no carbon emissions for SZC to save by the time it comes online and it will be a net contributor to the UK's emissions because, unlike other low-carbon electricity sources, nuclear reactors require fuel that results in CO_2 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. So once the existing fossil fuel generation has been phased out, far from reducing emissions, SZC, HPC and any other reactors built will be adding to them albeit some of these emissions will be in other countries notably the country the uranium is mined and the country where it is enriched if this is not at the UK Capenhurst facility.

7. EDF's Claims for SZC

EDF claims SZC will be online in 2034, producing 3340MW net power, contributing about 7 per cent of the UK's electricity and operating for 60 years. EDF forecasts that construction will begin in 2022 and will take 12 years.

7.1.Materials

EDF's Climate Change Statement for SZC[17] breaks down the carbon content of construction as: 5.74 million tonnes (Mt) of carbon equivalent (CO_2e) with 84% from the materials used, 4% construction activities, 5% materials transport and 5% worker transport. The carbon content of the materials and labour will take six years to be paid off by the output of SZC, if we assume EDF's average carbon reduction forecast, before SZC provides a net reduction in carbon emissions.

In its Sustainability Statement (p 83)[18] for Hinkley Point C, EDF states: 'Whilst the CO_2 emissions arising from construction are significant when considered in isolation, it is important to identify that these are very low by comparison to the benefit of generating low carbon electricity from the plant during its 60 year operation. Indeed calculations would demonstrate

[15] https://www.ft.com/content/a72ec4e9-9942-4794-a519-b42e28b36289
[16] https://www.nationalgrideso.com/document/173821/download
[17] chttps://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010012/EN010012-001959-SZC_Bk6_ES_V2_Ch26_Climate%20Change.pdf
[18] https://webarchive.nationalarchives.gov.uk/20191119152111/https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010001/EN010001-005331-8.14%20Sustainability%20Statement%201.pdf

that this embodied carbon during construction would be offset within as little as two months generation from HPC once operational.'

No calculations are given but under any plausible grid intensity, offsetting the construction emissions in two months is totally impossible.

EDF does not give the source or the details of the calculations of carbon content of construction so we have no basis for assessing the accuracy of their figures. It is worth noting that construction delays will inevitably increase the number of person hours of labour and the volume of materials, increasing the carbon content of construction. The poor record of the EPR design being built to time suggests a delay is very likely. The two EPRs under construction in Europe are now more than a decade late and even the two completed ones in China were four years late, an unprecedented delay for reactor construction in China.

7.2.Fuel cycle

EDF claims the emissions due to the fuel cycle of the plant will be 4.5g CO_2e/kWh, far less than the IPCC's central estimate of 12g, giving annual emissions of 1040t CO_2e. (EDF also confusingly uses 9-10g in some documents,[19] but their graphs are all based on just under 5g.) If the IPCC's estimate was used, the emissions would be 3160t, using Warner & Heath's median value would yield 3420t and Sovacool's mean 17370t. Over its lifetime, it would between emit 62,400t CO_2 on EDF's assumptions and 1.04Mt using the mean from Sovacool. EDF's calculations cannot be scrutinised as they have not been published; in the Development Consent Order application for HPC, EDF claimed a Life Cycle Assessment Study had concluded HPC's emissions would be 4.8g CO2e/kWh, but this study was never published despite being referenced as "available" in the DCO application.[20] EDF claimed it is commercially sensitive, and a Freedom of Information request by Stop Sizewell C confirmed that it had never been submitted to the Planning Inspectorate during the project's examination.

7.3.Other emissions during plant operation

EDF estimates that back-up generators, CHP plant and vehicle journeys produce 470,000t of CO_2 over the assumed 60 year life, or about 8,000t per year.

7.4.Emissions reductions

The forecast of the emissions that SZC will save depends on two main assumptions that determine grid intensity: the rate of growth of renewable capacity; and the evolution of demand. The more rapidly capacity of renewables grows, the quicker use of fossil fuel plant can be reduced. The lower demand is (and demand has fallen by 20% since 2005) the less the need to generate using fossil fuel plants.

Grid intensity

As new renewables come online replacing fossil fuels, the carbon emissions from UK electricity generation are falling and by the early 2030s, the mean emissions per kWh of electricity will have fallen from about 130g of carbon per kWh in 2020 to about 40g based on the UK government's 2018 figures from the Department of Business Energy & Industrial

[19] Eg, see pages 1 and 38 https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010012/EN010012-002235-SZC_Bk8_8.13_Sustainability_Statement.pdf
[20] https://webarchive.nationalarchives.gov.uk/20191119152111/https:/infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010001/EN010001-005331-8.14%20Sustainability%20Statement%201.pdf
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Strategy (BEIS).[21] EDF assumes a straight line reduction in carbon intensity to 2050 when the intensity will have fallen to 20g. However, the BEIS forecasts are out of date and, even when published, lacked credibility. EDF's extrapolation of grid intensity to 2050 takes no account of the UK government's legally binding commitment to make 'to bring all greenhouse gas emissions to net zero by 2050.'[22]

Given that electricity is widely seen as one of the easiest sectors to decarbonise and will probably be one of the first to do so, SZC will effectively cease to contribute to emissions reductions well before 2050 and will make a net addition.

On the basis of the outdated carbon intensity forecast, EDF claims SZC will reduce the UK's carbon emissions by 1Mt carbon in 2034 (excluding the contribution of construction to emissions).[23] EDF admits that it will take about 6 years (i.e. until 2040 if SZC is finished on schedule) to offset emissions from construction, stating *"it is conservatively estimated that GHG emissions from the construction of Sizewell C will be offset* ***within the first six years of operation*** *assuming the equivalent energy were otherwise to be generated by the anticipated mix of grid electricity generation sources."*

EDF claims SZC will have displaced a net 6.26Mt of CO_2 or an average of about 0.4Mt per year from 2034 onwards.

Electricity demand

For its electricity demand projections, EDF relies on the UK government's forecasts in its 2011 'Overarching National Policy Statement for Energy'.[24] This stated: 'Looking further ahead, the 2050 pathways show that the need to electrify large parts of the industrial and domestic heat and transport sectors could double demand for electricity over the next forty years.' This implies demand growth of nearly 2% per year. It is hard to understand why such an outdated forecast has been used. In the period 2011-19, far from rising by 18% as the government expected, electricity demand fell by 8% and in the first quarter of 2020, before lockdown slashed electricity demand even further, fell again by 1.4% allowing coal generation to be phased out almost completely. Historic experience suggests that following a deep economic recession as is now inevitable as a result of the Covid-19 pandemic, electricity demand will recover much more slowly than the economy as new energy efficient businesses replace old, less efficient businesses that failed in the recession. Even allowing for the electrification of transport and space heating, the 2011 demand forecast for the period appears far too high.

8. Sizewell C Project Uncertainties

EDF's financial position is very poor and a French government rescue plan, Opération Hercule, has been underway since early 2019. What the shape of the rescued company will be and what activities will have to be sacrificed to ensure the surviving elements are financially viable is

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[21] BEIS (2019) Updated Energy and Emissions Projections 2018 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/794590/updated-energy-and-emissions-projections2018.pdf

[22] https://www.gov.uk/government/news/uk-becomes-first-major-economy-to-pass-net-zero-emissions-law

[23] https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010012/EN010012-001959-SZC_Bk6_ES_V2_Ch26_Climate%20Change.pdf

[24] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/47854/1938-overarching-nps-for-energy-en1.pdf

not clear. China General Nuclear's participation in the SZC project has also raised concerns about national security.

EDF has stated that it is unable to finance SZC and so the plant will only go ahead if the UK government approves EDF's suggested method of finance, the Regulated Asset Base (RAB) model. Under this, ownership of the plant would be expected to be held by institutional investors such as pension funds who would provide the investment funds. A consultation on this method was launched in July 2019 and since January 2020, there have been continual rumours that publication of the result of the consultation was imminent but by August 2020, nothing had appeared. Even if the government approves the RAB model, it is far from clear that investors will be willing to invest in a nuclear project, especially if any of the project risk falls on them rather than on consumers.

There is also scope for delay, and even under EDF's figures, the later the plant is commissioned, the lower the savings over its lifetime will be. EDF's assumed commissioning date of 2034 is dependent on construction start in 2022 and given the large number of steps needed before construction can start and the delays likely to be caused by Covid-19 constraints, this looks unrealistic. For example, in 2009, when HPC was at about the same point as SZC is now, EDF was claiming HPC would start generating in 2017. EDF's most recent estimate forecast the earliest completion date as 2025 but with a significant risk it will be delayed till 2027 well before the pandemic struck. The impact of Covid-19 on construction activity makes the 2025 date implausible and puts in doubt even the 2027 forecast. There is clearly ample scope, with most construction at HPC still to take place, for even further delays at HPC as has happened with the EPRs at Olkiluoto and Flamanville, both now more than a decade late. The repeated claim that EDF will learn from past mistakes and, for SZC, things will go smoothly is threadbare.

Precisely when, and whether SZC's construction emissions can be paid off will depend on electricity demand growth and the construction rate of renewables but, at best, any saving will be very small.

9. What will the net emissions from Sizewell C be?

For all the major assumptions needed – demand, grid intensity, CO_2 content of the fuel cycle - EDF has chosen figures that provide a very favourable outcome for climate change emissions. If we substitute more realistic figures for demand, grid intensity and fuel cycle, SZC emerges as a net contributor to CO_2 emissions. We construct two alternative scenarios, one using somewhat higher assumption and one using assumptions that, on experience with HPC, are more realistic.

For construction emissions, we assume construction will overrun raising emissions by 25% and 50%. For the fuel cycle, instead of EDF's assumption of 4.5g CO_2/kWh, for the medium scenario, we use the IPCC assumption of 12g and for the high scenario, we use Warner & Heath's median of 13g. For the medium scenario, we assume that the net effect of lower demand growth, lower grid intensity and delays in completion of SZC is to halve the savings. For the high scenario, we assume the grid is decarbonised by 2033 so there will be no savings regardless of demand growth and completion date.

Table Net emissions savings from the whole life cycle of Sizewell C

Million tonnes

	EDF assumptions	Medium scenario	High scenario
Emissions			
Construction	5.7	7.2	8.6
Fuel cycle	0.1	0.2	0.2
Other operational	0.5	0.5	0.5
Savings			
Operation	12	6	0
Net savings	5.7	-1.9	-9.3

Source: EDF figures and authors' calculations

10. Conclusions

Given the collapse of arguments for new nuclear capacity on cost and the need for specific base-load generation, the only remaining substantive argument is that it is needed to reduce emissions from CO_2 from the electricity generation sector. Even if it would save emissions, the consensus of a 'climate emergency' needing quick action means that we need much quicker to implement measures than Sizewell C, which would not be generating until 2034 and would not make a net contribution, on EDF's admission taking account of emissions embodied in construction, until 2040.

EDF's forecasts for its UK nuclear programme in terms of timing and cost have invariably been hugely optimistic. This over-optimism extends to its forecasts of carbon reduction, which are based on a grossly inflated estimate of electricity demand growth and an unrealistically high CO_2 grid intensity by the earliest time Sizewell C can come on-line. More realistic assumptions on these factors suggest that, because of the expectation that the UK grid will be carbon-neutral by the mid-2030s, Sizewell C will make a net increase to UK emissions primarily because of the emissions content of the construction materials. Sizewell C has yet to start construction and with uncertainty about the method of finance and the risks it would place on consumers so the only sensible option is to abandon it now and focus on projects that can deliver quickly and cheaply.