Addressing EDF's case for the construction of Sizewell C

Three of the main arguments put forward by EDF for the construction of the Sizewell C nuclear power plant (SZC) are that: climate change has accelerated to such an extent that urgent measures are needed to build low-carbon generation sources like nuclear power plants; SZC would replace fossil fuel generation and therefore reduce emissions of greenhouse gases; there is a need, to preserve electricity system stability, to build some 'reliable base-load plants', implicitly nuclear capacity, because a system relying mainly on intermittent low-carbon sources like wind and solar would not be reliable.

1. The National Grid Company Scenarios[1]

To address the second two of these arguments, the scenarios published in July2021 by the UK National Grid Company (NGC) of energy demand up to 2050 are valuable. The government does not publish such detailed demand projections and its record of demand projections is so poor, invariably significantly over-forecasting demand, that it would be unwise to place much confidence in its projections. NGC operates the Great Britain electricity and gas transmission networks. Because of the expected substitution of fossil fuels by electricity and the option of replacing natural gas with hydrogen, the NGC scenarios cover all energy demand although we look mainly at the electricity sector. NGC is responsible for ensuring there is an adequate quantity of generating capacity to meet electricity demand and that it can also ensure grid stability whilst meeting government targets on environmental performance. It has comparable responsibilities for the network gas sector.

NGC produced four scenarios of energy demand and the composition of energy supply up to the year 2050, at which point, the government is statutorily obliged to achieve 'net zero' greenhouse gas emissions. In one scenario, 'Steady Progression' this obligation is not met and we do not consider this scenario further. In the 'best' scenario 'Leading the Way', combination of strong demand reduction measures and supply side measures reducing fossil fuel use leads to net zero by 2047. In the 'System Transformation' scenario, the focus is on the supply side measures while in the 'Consumer Transformation' scenario, the focus is on the demand side. NGC includes new capacity and targets of new capacity that are current government policy, including SZC in some scenarios and demonstration Small Modular Reactors (SMRs) which are projected to be completed in the early 2030s.

In the Leading the Way scenario, SZC is not built and the only nuclear capacity built after the completion of Hinkley Point C is the demonstration SMRs, adding minimal capacity. In the Consumer Transformation scenario, SZC is also not completed but there is a significant expansion of nuclear power of about 11GW of SMRs between 2035 and 2050. In the System Transformation scenario, SZC is built and further nuclear capacity using large reactors, about 5GW, is completed by 2050 although much of this is needed to produce the large quantities of hydrogen needed in the scenario, with hydrogen replacing natural gas in the existing gas network.

[1] https://www.nationalgrideso.com/future-energy/future-energy-scenarios/fes-2021/scenarios-net-zero

2. The Status of the Sizewell C project

In 2013, the government identified five new build nuclear projects which it expected would lead to 16GW of capacity being completed by 2030. A further project, Bradwell B (2.2GW), was added in 2016 but no target time-frame has been identified for this. Of these, three, Wylfa, Moorside and Oldbury, have collapsed and will not be built and Bradwell B is in serious doubt leaving only Hinkley Point C and SZC. Hinkley Point C is under construction but has already slipped by about four years from the expected completion date of 2023 forecast when a Final Investment Decision was taken. It is therefore unclear whether even it will be online by 2030. First consultations on the planning process for SZC began in 2013. In 2019, EDF forecast a Final Investment Decision (FID) for it would be taken in 2021 with plant completion in 2034.[2] No other dates were given but this implied construction start (first structural concrete) in about 2028.

In 2021, EDF said the FID might not be taken until 2023 while the government only has a target to reach FID for one large nuclear project, not specified which, during the term of this government, i.e., by 2024. EDF has not stated whether the delay in getting to an FID will affect the completion date.

The poor financial state of EDF led it to acknowledge they could not finance the plant and a new financing mechanism, the Regulated Asset Base (RAB) model, bringing in financial institutions as financiers and owners, would be needed. A public consultation on RAB by the government began in June 2018 but by September 2021, no decision had been taken on whether RAB would be approved for SZC. EDF has claimed it has alternative ways available for financing SZC if RAB is not approved but it is unwilling to specify what these are and there must be a strong probability that if RAB is not approved, SZC will not be financeable. EDF has been talking to potential investors for more than two years but despite EDF's claims of significant investor interest, no investors have publicly expressed even an interest much less a commitment in investing in SZC and several of the leading potential financiers have explicitly said they would not invest.

Those advocating SZC using RAB often use the Thames Tideway water project, also financed using RAB, as the model. However Thames Tideway is a very different project in several respects. The cost of SZC is expected to be at least five times that of Thames Tideway and the technology, the EPR, is massively more complex than Thames Tideway, essentially a 25km tunnel. Thames Tideway was designated an essential facility so the issue was not whether to build it but how to finance its construction whereas SZC is just one of many ways the need for new generating capacity could be met so it is not essential. Those paying for Thames Tideway are those that will use it, Thames Water consumers, whereas all consumers will have to pay for SZC even if they have specifically opted for a supplier that does not buy nuclear power. 12 consortia of financial institutions competed for the contract to build and own Thames Tideway whereas it is clear it will not be easy to put together even one consortium for SZC.

[2] https://www.edf.fr/en/the-edf-group/dedicated-sections/investors-shareholders/reference-documents

When the FID was taken, in 2014, the government wrote[3]:

> 'Over the past 5 years, Defra Legal Advisers along with the Commercial Law Group and colleagues in Litigation have negotiated a way through many of the obstacles that threatened the project. They have also developed a novel and unique legislative and regulatory framework, which underpins the model that has been used for delivering this infrastructure project and has reduced the expected cost to Thames Water's customers significantly.'

It seems likely that a similar amount of work establishing a 'legislative and regulatory framework' for SZC would be required. Given that government has yet to take a decision on whether to approve RAB for SZC, it is logical to assume this work has yet to start and even meeting the government target of an FID by 2024 will be hard to meet.

There is thus ample scope for delay in reaching FID for SZC and a significant risk that the project will not go ahead either because government does not approve RAB or investors willing to meet the terms offered for a RAB do not materialise.

3. Existing nuclear plant

The UK has seven operating nuclear power plants, about 8GW, (an eighth, Dungeness B, was closed in summer 2021) with two (Hunterston B and Hinkley Point B) to be closed in 2022, two (Heysham 1 and Hartlepool) to be closed in 2024 and two (Heysham 2 and Torness) to be closed in 2030. These closure dates are more likely to be brought forward than extended because of the more rapid than expected deterioration of the graphite moderator. Sizewell B, using a different technology, is expected to operate till at least 2035. Some argue this imminent reduction in nuclear capacity strengthens the case for SZC.

There is uncertainty about the completion date of Hinkley Point C and EDF's most optimistic opening date for the first unit is 2027 with the second following about a year later. Experience elsewhere with EPR technology suggests it would be unwise to rely on EDF's forecast completion dates but by end 2030, assuming Hinkley Point C is complete by then nuclear capacity will have fallen to about half the current level. NGC shows no concern about this loss of nuclear capacity but if it were to cause problems, SZC will be completed far too late to be of any assistance.

4. Urgency

In August 2021, the Secretary General of the United Nations, Antonio Gutierrez, stated that: 'As today's IPCC report makes clear, there is no time for delay and no room for excuses.'[4] So there is wide and authoritative agreement that action on reducing greenhouse gas emissions is urgent. However, the issue is whether the SZC project would constitute urgent action. The SZC planning process began seven years ago yet even on EDF's optimistic forecast of its completion date, the plant will not be online and able to reduce emissions before 2034.

In addition, the record of nuclear technology and in particular the EPR technology proposed for SZC being built on time is appalling while EDF's record is poor and deteriorating. It is

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[3] https://www.gov.uk/government/news/thames-tideway

[4] https://www.un.org/climatechange?gclid=CjwKCAjwx8iIBhBwEiwA2quaq_7x3sjIjv9QkFyHVMdewN9rYvpyTK_b1WgO0Khk8uUlcs9egLkYFBoCJcMQAvD_BwE

more than three decades since EDF completed a reactor on time in France (see Table) and more than five decades since a reactor was completed on time in the UK. The six EPRs worldwide on which construction has started are all several years late, including the Hinkley Point C plant with the notorious Flamanville and Olkiluoto projects still not complete after 14 and 16 years of construction respectively.

Given the collapse of three (Moorside, Wylfa and Oldbury) of the five nuclear projects the government projected would be in service by 2030 and the serious doubts over the Bradwell B project, SZC cannot be seen as a door-opening project that would open the way to a large number of nuclear projects using large-scale reactors like the EPR.

Table EDF's nuclear construction record 1990-2001

	Model	Construction start	Commercial Operation	Construction time months	Delay months
Flamanville 3	EPR	12/07	2023/24	192	132
Civaux 2	N4	4/91	4/02	132	72
Civaux 1	N4	10/88	1/02	159	99
Chooz B 2	N4	12/85	9/00	177	117
Chooz B 1	N4	1/84	5/00	196	136
Golfech 2	P4	10/84	3/94	113	53
Penly 2	P4	8/84	10/92	98	38
Cattenom 4	P4	9/83	1/92	100	40
Cattenom 3	P4	6/82	2/91	104	44
Golfech 1	P4	11/82	2/91	99	39
Penly 1	P4	9/82	12/90	99	39

Source: https://pris.iaea.org/PRIS/home.aspx

Therefore if urgent action is needed, the priority must be to focus on energy efficiency measures and low-carbon generation technologies that can be deployed rapidly and which do not have a history of long delays.

5. Replacing fossil fuels

Key issues in determining what emissions reductions would be achieved by SZC, which, for these purposes, we assume will be completed by 2034 as forecast by EDF, although given the slippage in when an FID will be taken and the record of construction delays with the EPR, this date must be regarded as highly optimistic.

In all three of NGC's scenarios that achieve net zero by 2050, the electricity sector achieves net negative emissions by 2032 in the 'Leading the Way' and 'Consumer Transformation' scenarios and by 2034 in the 'System Transformation' scenario. So in all three scenarios, SZC would be completed too late to save emissions and would not even be able to compensate for the carbon emissions produced by its construction, for example through the making of steel and concrete. It would also not be able to offset the emissions resulting from the fuel cycle, for example in the mining and processing of uranium.

6. System Stability

NGC states it aims to be able to operate the electricity system carbon free by 2025. Nowhere in its scenarios does it talk of the need for 'reliable base-load plant' and the lack of large new nuclear beyond Hinkley Point C in its scenarios reinforces the impression that large base load

capacity is not needed for it to be confident it could achieve system stability. NGC also shows no concern about the availability and cost of storage capacity, mainly batteries, that would be needed to accommodate intermittent renewable sources.

7. Conclusions

EDF is ambiguous on the urgency for the construction of SZC. It has continually emphasized that there is an urgent need for SZC yet when pressed on whether there was still a strong case for SZC if it could only be completed significantly after 2035, it claimed the project was still supported.[5] EDF's claims that an urgent decision is needed to go ahead with the SZC project is not defensible even if the 2034 target completion date could be met. The lead time including the steps needed to reach start of construction and the construction period itself for nuclear plants is too long and too uncertain for any reliance to be placed on new nuclear capacity to meet climate change targets. SZC would also be completed too late to even off-set the emissions generated in its construction, much less replace fossil fuels. The company responsible for ensuring adequate generating capacity and grid stability appears unconvinced of the need for new capacity and in two out of the three scenarios that achieve Net Zero by 2050, SZC is not required.

[5] John Rhodes at the Planning Inspectorate hearing on August 26