Written evidence submitted by Greenpeace

Greenpeace is an international environmental organization with a longstanding interest in a clean energy system, publishing analyses and evidence for at least 3 decades.

- **What role can, or should, nuclear power play in achieving net zero and UK energy security?**

None. There is no need for new nuclear. A suite of studies has shown that nuclear is not essential to maintaining security of supply whist rapidly decarbonising the electricity system. Nor is there strong evidence that new nuclear would be cost-effective. These studies are:

a) Imperial College Energy Futures Lab[1]. The model used[2] real world weather data to indicate the levels of wind and solar power generation on an hour-by-hour basis. New nuclear was not on the cost effective pathway to system decarbonisation

b) Energy Systems Catapult for Good Energy[3]. The modelling used hour-by-hour data to demonstrate adequate supply in the Zero Carbon Britain scenario. Which shows that a system based on high flexibility, with high renewables deployment and innovation can deliver a secure zero-carbon electricity system with no need for new nuclear beyond the Hinkley Point C

c) energy consultancy LCP Energy[4] for the energy company SSE[5]. The carbon intensity of GB power system approaches near zero in the 2030s. The high renewables scenario, replacing new nuclear – including the proposed Sizewell C – with offshore wind and other technologies to deliver security of supply, meant that there was a system cost benefit of £7.3bn between 2021 and 2050

d) University College London model for Claverton Energy Group[6] did detailed modelling of the entire heat, power and transport system. The model automatically tried a huge variety

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[1] https://www.imperial.ac.uk/news/223373/uk-offshore-wind-target-must-least/

[2] Imperial College used Whole-electricity System Investment Model (WeSIM), described as "a comprehensive system analysis model that is able to simultaneously balance long-term investment decisions against short-term operation decisions, across generation, transmission and distribution systems, in an integrated fashion"

[3] https://www.goodenergy.co.uk/business/exclusive/renewable-nation

[4] LCP Energy describes the modelling as ''used by both industry and policymakers. It is the primary power market forecasting tool used by BEIS to assess the impact of changes to energy policy. It is also used by National Grid". https://www.lcp.uk.com/energy/

[5] https://insight.lcp.uk.com/acton/attachment/20628/f-d32a3b26-13a3-4334-9d7f-0cb5634e5b9d/1/-/-/-/-/Net%20zero%20without%20breaking%20the%20bank%20-%20LCP%20SSE%20report%202021%20.pdf

[6] Sizewell C – more expensive than renewable energy, June 2022

https://claverton-energy.com/baseload-power-generators-such-as-nuclear-power-plant-are-not-needed-in-an-all-renewable-future-and-their-use-would-simply-increase-costs.html

of different mixes of wind, solar, nuclear, and 12 other variables concluding that nuclear increases costs without increasing reliability

A detailed analysis by LUT University of the UK energy system to be published this Autumn is expected to conclude similarly.

This kind of analysis is not isolated to the UK system. The study of 100% renewables systems has rapidly and recently grown into a major research field across the world in recent years[7] a new analysis has concluded. It says that exploring opportunities such as energy storage, electrification of transport and industry implying power-to-X and hydrogen-to-X leads to "The main conclusion of most of these studies is that 100% renewables is feasible worldwide at low cost".

Government has presented modelling[8] which purports to show that new nuclear is needed to be cost-effective (although note, it does not support anything like the scale of Government's recent target of 24GW). However, this modelling is not very transparent, and on some issues seems to make extremely pessimistic assumptions about storage technology costs[9]. This pessimism is in keeping with a sustained trend of government taking a dim view on the future costs of green hydrogen. One expert analyst described the assumptions as 'jaw-dropping' and that 'the UK is projecting costs for hydrogen vastly greater than anywhere else in the world'. To state the obvious, the cheaper that storage of low-cost renewable power becomes through technologies like green hydrogen, the less economically attractive nuclear becomes.

Clearly, governments might choose to make new nuclear a part of their energy mix, but there is no necessity. Given the intractable issues such as nuclear waste, link to nuclear weapons proliferation, risk from terrorists or malign actors there are very strong reasons not to, and instead work towards a future with 100% clean energy.

Faced with a barrage of bad news about costs and necessity of nuclear power, its supporters often argue that it is low carbon and 'needs to be part of the mix'. There are 2 reasons why this is wrong:

1. There are good reasons for thinking nuclear is not cost-effective – see above – and we know that **there is a limit to what ordinary people are prepared to pay**. So all money that is spent by government on things that might not be as cost-effective as alternatives makes the job of delivering net zero harder. As Amory Lovins of Rocky Mountain Institute in USA has described it for over a decade[10]:

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[7] On the History and Future of 100% Renewable Energy Systems Research, July 2022 https://ieeexplore.ieee.org/document/9837910

[8] https://www.gov.uk/government/publications/modelling-2050-electricity-system-analysis

[9] https://100percentrenewableuk.org/government-rubbishes-hydrogen-in-bid-to-boost-new-nuclear-power#_ftn7

[10] https://rmi.org/nuclearwhyeventhinkaboutit/

> "Nuclear power actually retards climate protection because it is so expensive and slow to deploy that you ultimately get less climate solution per dollar and per year. Each dollar spent on a new nuclear reactor yields 10 to 40 times less carbon savings per year, and two to 10 times less per dollar based on relative prices and deployment rates as compared to the same dollar spent on efficiency and renewables"

2. There is a significant **distraction effect** of nuclear power on energy strategy. A count of civil servants working in BEIS on the different policy areas[11] shows that there are more civil servants working on nuclear than there are working on renewable power and clean heating combined. And whilst both renewables and clean heating (like heat pumps) are big ticket emissions reductions technologies that will be essential to the UK journey to zero emissions, nuclear, as explained above, is not. Yet staff (and presumably ministerial) time is being occupied by nuclear. It is also thrown into sharp relief by the commitment of £400mn in the Net Zero Strategy for heat pumps versus (seemingly) several billions to deliver Sizewell C. Money, time and bandwidth is siphoned off to deliver a bit-part, optional technology, whilst essential items like renewables and heat pumps that need policy and cash support to scale at speed are not getting the attention they need.

- **What are the main challenges to delivering the UK Government's commitment to bring at least one large-scale nuclear project to final investment decision by the end of this Parliament?**

A FID for a nuclear plant before the end of this Parliament in practice means Sizewell C (SZC) because no other project is sufficiently advanced. Government has already shown a reckless desire to steamroller legitimate concern around SZC construction, in over-ruling the Planning Inspectorate's recommendation to refuse planning consent for SZC. The concerns leading to PI refusal related to impact on the nationally important nature reserve, and on the absence of clean water necessary during construction and operation. In pressing ahead, the government are gambling with the well being and environment of the local area.

Given high energy prices likely to be present through this decade, there will be the challenge of persuading the broader public that a new levy on bills for SZC – 'a nuclear tax' - makes good sense compared to (cheaper) renewables.

It also seems that govt expects about 60% of the cost to be paid for by private investors. However finding investors for an industry that is notorious for cost-overruns and delays could be hard unless cost and risk is dumped on taxpayers. Some major investors are clearly wary[12], and the unwillingness to invest will likely only be overcome with high, guaranteed

[11] https://www.theyworkforyou.com/wrans/?id=2020-10-08.100928.h&s=nuclear+speaker%3A24910#g100928.q0
[12] https://www.independent.co.uk/climate-change/news/sizewell-nuclear-power-station-environment-suffolk-b1805631.html

returns paid for by the taxpayer (or bill payer) and construction, operational and market risks substantially transferred to the consumer. Needless to say, liability for serious accident already sits with the public as it is unlikely a nuclear power station would ever be built if constructors carried that risk.

Approval for SZC would depend on a positive value for money assessment, which given the evidence above may prove to be challenging. Presumably the government will get round this by releasing a very poor quality VfM assessment only after contracts have already been signed. Thus any critique was rendered irrelevant - as was the process with Hinkley Point C despite evident shortcomings[13]. Although questioned repeatedly on the matter, there is no commitment of government to release the Value for Money Assessment before contracts are signed for SZC. All taxpayers should be concerned that if, once again, the VfM assessment is a joke, it'll be too late to change anything.

- **How important is the finance model to ensuring a successful nuclear project, and is the regulated asset base (RAB) model the best one to deliver this?**

All the financing models associated with new nuclear including RAB require transfers of large amounts of risk to the public, which, depending on the structure of agreement, includes covering for project mismanagement or technological failure on the part of the builders. As the National Infrastructure Commission says[14]:

> *"This makes projects appear cheaper as consumers are effectively financing the projects at zero interest. At least some of the risk associated with construction costs also sit with consumers, a further hidden cost, since consumers are not paid to hold these risks in the way investors would be"*

A RAB requires a strong, well informed regulator to tackle excessive transfer of risk to the public and excessive returns. The RAB calculations involve estimating fairly opaque future scenarios, such as construction times or problems (which affect cost) and prevailing economic conditions. But the likely regulator (Ofgem) has admitted it has allowed double digit returns to a very low risk business in power distribution[15] even after 2 decades of regulatory experience. The prospect of Ofgem – or any other regulator – getting nuclear right with a one-off project seems remote, as generally commercial developers know much more about real project costs than regulators. As the Energy and Climate Intelligence Unit put it[16]

> *"Vastly more complicated than the CfD system, the RAB model has long been criticised for opacity, with governments and regulators struggling to keep up with specialist consultants and accountants constantly pushing for minor rule changes to favour asset owners."*

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[13] For example the comparison with a renewables approach had a cost range of offshore win £81-132/MWh and it was already clear to those close to this industry it was way too pessimistic. Thrown into sharp relief by the following years auction prices of £57.50/MWh https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/556917/3_-_Value_for_Money_Assessment.pdf

[14] https://www.theguardian.com/business/2019/jul/27/despite-hinkley-new-plan-nuclear-hardly-better-than-old-one

[15] https://www.theguardian.com/business/2019/oct/03/energy-network-firms-allowed-to-make-bigger-than-expected-profits-ofgem-admits

[16] https://eciu.net/blog/2018/where-next-for-uk-nuclear

A mechanism similar to the RAB was used to finance the Vogtle nuclear power station in South Carolina, which collapsed and will not be built. Notwithstanding this, those payments for the nuclear power station that will never generate power still make up about **18% of customers' bills**[17]

The NAO has also said that using a RAB model for nuclear new build could help achieve a strike price of £63.50 and £67.50, although these low prices are only possible because of large levels of risk transferred to the public purse, a subsidy not required for the major forms of renewable generation. Note that even these prices, with their massive transfer of risk not required by other generators, are not low enough to put new nuclear power on the cost-effective pathway to decarbonisation as modelled by Imperial College.

That a RAB or similar mechanism represents a bad value for money, covering up a poor technology, with unbounded risks for consumers is not just an analysis from Greenpeace. Writing about RAB proposals, the Economics Editor of the Guardian points out[18]

> *"no financing model can disguise the core truth about nuclear – the technology is hideously expensive….. the UK shouldn't rush to tie itself to an expensive nuclear future and should instead back renewables, notably wind and solar, to continue becoming cheaper."*

And even more bluntly, the Economics Editor of the Times[19]:

> *"[the RAB] might avoid a re-run of Hinkley saddling consumers with rip-off bills decades out, but only at the price of leaving them exposed to construction risk. ….Under the proposed RAB scheme, energy bills will increase to pay for nuclear power stations before they start generating. In short, we'll be paying upfront for EDF's routine screw-ups."*

- **What practical steps can the UK Government take to support the nuclear industry in developing a range of nuclear technologies, including small modular reactors?**

Greenpeace does not think the Government should be supporting the nuclear industry.

Indeed the Government risks making similar strategic mistakes as it did with Hinkley Point C (HPC). The Cameron and May Governments allowed themselves to be drawn into commitments that would be politically embarrassing to retreat from, and dug themselves into a hole from which they could not climb out. As the National Audit Office (NAO) put it:

> "In September 2016, HM Treasury highlighted how the value-for-money case for HPC had weakened. But it concluded that the legal, reputational, investor and diplomatic ramifications of not proceeding meant it was, on balance, better to continue."

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[17] Section 18 https://www.worldnuclearreport.org/The-World-Nuclear-Industry-Status-Report-2018-HTML.html#fig28

[18] https://www.theguardian.com/business/nils-pratley-on-finance/2019/jul/23/lets-face-it-nuclear-power-is-hideously-dear-and-far-from-ideal

[19] https://www.thetimes.co.uk/article/sinking-nuclear-raft-needs-scuttling-p0qmqs28b

By talking up nuclear and putting in place regulatory arrangements that will be difficult to undo, innovation in storage and renewables could well leave nuclear as stranded assets and government will not be able to pull back. Government has already committed itself very fully, and very questionably, to new nuclear. It should not be taking further 'practical steps' to embed itself.

It is now 14 years since a proper, transparent case (a case which can now be seen as largely untrue) was made for new nuclear power compared to the alternatives in delivering a reliable and efficient zero carbon power system.

On small modular reactors there is nothing relevant demonstrated and they largely remain conceptual designs. Conventional nuclear reactors are large because of economies of scale. A reactor that produces 3 times as much power as an SMR does not need 3 times as much steel or 3 times as many workers. This inherently makes the economics of SMRs more challenging to begin with.

The proposition for SMRs is supposedly that 'mass manufacture' will bring the costs down. However, this may not happen - on extensive deployment of conventional reactors the learning rate[20] in the USA and France, the two countries with the highest number of conventional nuclear plants, was **negative** meaning prices went up as more were built. There is not yet any empirical evidence to show cost falls with SMR deployment. Further, extensive use of the same reactor design also opens up the prospect of fleet-wide design flaws requiring repair, and so requiring them all to be offline simultaneously. For example, French nuclear production is being affected by the same safety problem in multiple reactors.

The most advanced SMR being developed in the West has encountered familiar problems - delays and cost escalations, and funders pulling out when first estimates of cost turned out to be overly optimistic. There is no objective reason to think either Rolls Royce or any other consortium will be immune to these problems.

- **What would the likely cost be to the taxpayer of the UK Government supporting the development of a new nuclear power station at Wylfa?**

The cost would need to be considerable because both possible candidates for a conventional nuclear reactor have such poor records. One type is EDF's EPR reactor (as being built at Hinkley) and the other the AP1000 of Westinghouse. The actual cost is hard to assess as it depends on the risks transferred and costs of power after construction, both of which are unknown.

EPR - The poor delivery record of the EPR in France[21] for example, at 5.8 times original budget and 3.5 times as long to build as originally projected. Lengthy delays in Finland. One of the 2 EPRs built in China has now been offline for over a year because of fuel assembly

[20] Rate at which prices fall for every doubling of capacity installed

[21] https://www.lemonde.fr/les-decodeurs/article/2019/06/24/epr-de-flamanville-visualisez-comment-le-cout-et-la-duree-du-chantier-ont-triple-depuis-2007_5480745_4355770.html

problems[22]. This shows that the EPR not only experiences construction issues but also operational ones, which raises risks for investors (and potentially consumers if risks of malfunction are dumped on them).

Westinghouse's AP1000 - There are media reports that the government is courting Westinghouse in order to build its AP1000 reactor at Wylfa. The AP1000 has been an economic disaster where construction has been attempted. There have been 2 stations in the West, both in South East USA. Westinghouse, the owner of the AP1000 technology, filed for bankruptcy protection in the US in 2017 after big cost overruns at its nuclear projects in South Carolina and Georgia. It nearly brought Westinghouse's owner, Japanese giant Toshiba, to its knees forcing a fire sale of assets. This was largely because of the complexity of the AP1000 technology, which would be replicated if construction was attempted in the UK. In fact, one of the reactors being constructed in the US has been abandoned even though construction was 40% complete - it still didn't make financial sense to complete it. A mechanism similar to the proposed Regulated Asset Base (RAB) model was used to finance it and those payments, for a nuclear power station that will *never* generate power, still make up about 18% of customers' bills[23].

August 2022

[22] https://www.nuclearpolicy.info/news/an-imminent-radiological-threat-to-the-site-and-to-the-public-nfla-questions-whether-taishan-1-reactor-design-planned-for-hinkley-point-c-and-sizewell-c-is-fatally-flawed/

[23] Section 18 https://www.worldnuclearreport.org/The-World-Nuclear-Industry-Status-Report-2018-HTML.html#fig28