Nuclear Industry Association Response to Environmental Audit Committee's 'Small modular reactors in the transition from fossil fuels' Inquiry.

The Nuclear Industry Association (NIA) welcomes the chance to respond to the Environmental Audit Committee's inquiry into 'Small modular reactors in the transition from fossil fuels'.

The NIA is the trade association and representative body for the civil nuclear industry in the UK. We represent around 270 companies operating across all aspects of the nuclear fuel cycle.

Due to the diversity of our membership, our views in this submission will cover high-level, industry-wide matters. Our members may choose to make their own detailed submissions.

Executive Summary

Nuclear is essential to the UK's electricity mix, currently supplying around 15% of electricity demand and nearly a half of our low-carbon electricity. The current fleet has saved more than 1bn tonnes of carbon emissions over its lifetime, more than any other clean energy assets in British history. New nuclear power, including Small Modular Reactors (SMRs) and gigawatt -scale nuclear, is essential to meeting the Government's decarbonisation targets and increasing the UK's energy security by providing firm, domestic, clean power.

SMRs are flexible in their output and can provide baseload electricity when variable technologies are not providing high enough output, or, in periods of high renewable generation, can load follow by diverting to hydrogen or producing synthetic fuel for aviation and shipping. Building a fleet of SMRs will help mitigate similar events such as the recent energy crisis, making the UK less reliant on imported energy from foreign sources.

We recommend that the Government:

- With GBN, chooses SMR designs, assigns them sites and awards them funding by Spring 2024.
- Takes a fleet deployment approach to fully realise the potential of SMRs for fast and cost competitive deployment, and to build up the UK's own industrial manufacturing capabilities, to capture maximum value from the SMR programme.
- Adopts a principles-based, rather than menu-based, siting policy to expedite SMR fleet deployment, and imposes a Net Zero duty on all relevant regulators, including the Planning Inspectorate, to expedite project consents.
- Clarifies that the Regulated Asset Base funding model will be available to SMRs.

Note on Definitions: The NIA considers SMRs to be smaller versions of existing light-water cooled nuclear reactor technology, in line with the UK Government. When we refer to SMRs, we are not referring to Advanced Modular Reactors (AMRs), which use alternative coolants and fuels, and are often optimised for high-temperature operation. These technologies hold immense potential, particularly for industrial decarbonisation, but this response focuses on primarily light water SMRs.

Timelines for SMR delivery

- **What has prevented SMRs from being established in the UK, given that the technology and fuel sources already exist, and the Government has already financially supported R&D?**
  1. The long gap between new build has had a significant impact on workforce availability and the industrial capabilities of the UK supply chain to make components for nuclear reactors, impacting the capability to rollout SMRs. The Government must take a fleet

deployment approach to new nuclear to justify the investment necessary to rebuild our supply chain and workforce capability.

2. There are important regulatory changes that also need to be made to ensure that we can deploy clean energy sources as quickly as possible. Current planning and siting policies act as a barrier to establishing SMRs in the UK and achieving the goals of becoming energy independent and reaching Net Zero.
3. At present, it will take longer to complete planning, licensing, and consenting processes than it will to build an SMR. The current 'menu' of available sites determined for large scale technologies in 2011 is also a barrier for the deployment of SMRs as multiple sites will be required to make the modular, factory-build concept cost-effective.
4. We understand that a new EN-7 is in development, and rapid consultation on this should be a key priority for Government to provide clarity on siting and planning and encourage new generation technology.
5. As part of this, the Government should adopt a new, principles-based siting approach for SMRs, where developers must show that their chosen sites meet a set of published criteria, rather than developers having to choose from a set list of specific sites identified in Strategic Siting Assessments (SSAs). Prescriptive lists will not provide the necessary speed or flexibility to facilitate the required deployment of SMRs.
6. The regulatory bodies involved in the planning, permitting, licensing and consenting processes must be properly resourced to deliver new local infrastructure and make timely decisions on new build projects.
    a. The Government can facilitate the deployment of new nuclear by placing a Net Zero duty on all relevant regulators involved in the planning process, including the Planning Inspectorate, to ensure regulation is proportionate to the urgent need for more clean energy.
    b. Planning consent for nuclear projects must accelerate dramatically if the UK is to meet its ambition for nuclear to provide 25% of its electricity supply from 24 GW of capacity that the Government set out in its British Energy Security Strategy.
    c. NIA analysis indicates that the speed of planning consent must rise approximately 50% from 0.4 GW/year from 2008 to 2023 to 0.6 GW/year between 2023 and 2050 to reach this goal.
    d. From 2008 to 2023, 6.4 GW of nuclear capacity received planning consent, however, an additional 16.4 GW must receive consent before 2050 to reach our 24 GW goal.

- **How realistic are the current targets for SMRs (Final Investment Decision by 2029, deployment mid-2030s)? How should the Government's targets be revised, if at all?**

7. Final Investment Decisions by 2029 for deployment by the 2030s are eminently realistic and could be brought forward if the Government ensures swift and efficient regulatory assessment of reactor designs and provides rapid clarity on siting allocation within the Great British Nuclear (GBN) technology selection process, on the funding models that will be available to SMRs, and on the certainty of orders for multiple units to justify investment in factories for modular fabrication.
8. To accelerate the deployment of SMRs, the UK must fully maximise the value offered by the current workforce, existing sites, and capabilities available within the industry. A number of the sites designated in 2011 as suitable for gigawatt-scale reactors should be used for the first wave of SMR projects.
9. The UK should look beyond the existing suite of designated nuclear new build sites for second wave SMR deployment and beyond. For example, retiring or retired coal power plants and gas-fired power plants could be repurposed to allow for the deployment of SMRs. These brownfield sites would have existing grid connections and communities

around them with a history of industrial employment, both of which are attractive factors to consider.

a. The US Department of Energy found that 157 retired coal sites were potential candidates for the transition in the US.
b. 80% of those were amenable to siting advanced reactors, and 22% amenable to Light Water Reactors (LWRs). 125 retired sites, with 64.8 GW coal capacity, could therefore be backfitted with advanced reactors.[1]
c. A further 237 operating sites were also identified by the Department of Energy with 80% of those conducive for siting advanced reactors, and 40% for LWRs.

SMR regulation and financing

- **How should SMRs and larger gigawatt scale reactors be balanced to help the UK meet its net-zero targets and targets to decarbonise the national grid?**

10. After GBN selects its chosen SMR partners, the UK will still need a minimum of 16GW more nuclear capacity to meet the 24 GW ambition for new nuclear. Large-scale reactors and Advanced Modular Reactors (AMRs), as well as SMRs, will be required to meet this target and to achieve the wider decarbonisation of the UK economy beyond the electricity grid.
11. The UK should pursue further large-scale nuclear after Sizewell C, in tandem with the deployment of SMRs, because we have an urgent and overriding need for baseload power and energy security. We should take advantage of the fact that large-scale designs are proven and operational, and that project risks are now understood across the whole length of construction.
12. The UK should also use large- and small-scale reactor projects to develop the common skills and industrial base needed for all nuclear developments. Large- and small-scale programmes should be mutually reinforcing.

- **What best practice and previous experience, including from other countries, can guide policy, allowing the UK to take advantage of the benefits of SMRs while also making them competitive?**

The current one-by-one approach that has been taken to deploying new nuclear is not enough to meet the Government's aim for deploying 24 GW of nuclear capacity by 2050 and is not suitable for the deployment of SMRs. This approach does not allow for capturing the benefits of replication and supply chain activation that come from having multiple projects proceed in close succession.

13. Successful international nuclear programmes have taken a fleet deployment approach to nuclear project, and we would encourage the UK Government to do the same. This is the key proven way to bring costs down. France in the 1970s and 1980s, and South Korea from the 1980s, built reactors in 5-7 years when they built in large fleets, ordering and deploying multiple units of the same design on each site, and across multiple sites. The French reactors built in that era were the cheapest in the Western world.[2]
14. Fleet deployment is also essential to the deployment of SMRs which are based on the modularisation concept with factory production of components. It has been said that no one would build a factory to make a single car, and the same is true of SMRs.
15. The fleet approach drives ambition for a pipeline of domestic and international projects, achieves greater cost and schedule reduction, and creates a long-term work stream allowing UK manufacturers to develop a sustainable manufacturing infrastructure.

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[1] https://www.energy.gov/ne/articles/doe-report-finds-hundreds-retiring-coal-plant-sites-could-convert-nuclear.
[2] https://www.sciencedirect.com/science/article/pii/S0301421516300106.

a. The fleet approach taken by Ontario Power Generation (OPG) in Canada at its Darlington Nuclear site has allowed for sharing of common infrastructure such as cooling water intake over the four SMR units, reducing overall project costs.

16. For early stage SMR deployment specifically, we strongly recommend that the Government and GBN consider the example of OPG in Ontario, Canada, who have ordered the first commercial SMR in the Western world for deployment at their Darlington site.

    a. OPG started out their SMR selection process with the nuclear development roles already defined: OPG would be the customer, developer, funder, operator, and site licensee of the project.
    b. The funding model was similar to the Regulated Asset Base model that the UK has recently adopted: OPG sells electricity at regulated rates to households and businesses. The provincial government authorised them to add a small amount onto bill to fund capital investment in the SMR project.
    c. OPG started off with the intention that the winner of the competition would deploy one unit at a specific site, Darlington, with the further option for units 2-4 on the same site, if good progress was made.
    d. They took an “off-ramp” rather than “on-ramp” approach: the winner was on a path to deployment unless things did not work out, in which case OPG would exit. It was not that the winner kept having to prove themselves at various stages to keep progressing. The “off-ramp” approach provide much more certainty and was thus much more investable.
    e. They took a “business development” rather than “procurement” approach to the selection, as they wanted to develop the vendor offers to suit their needs and ensure delivery confidence rather than focus on price. For First-of-a-Kind reactor designs, they viewed building a strong understanding of vendor capabilities, and the vendor building a strong understanding of the developer requirements, as more important and more reliable than initial prices quoted.

- **How effective are existing financial models (e.g., Contracts for Difference, Regulated Asset Base) for SMRs? Should new financial models be considered for SMRs?**

17. We welcome the use of the RAB model to finance new nuclear projects and believe that the Government should continue to work with industry on developing its approach to financing SMRs. This should be done alongside the work on siting and GDA requirements for the deployment of SMRs.
18. The Government should also be prepared to take “cornerstone” equity stakes in SMR projects to build private sector confidence in projects and to lower the cost of capital of those projects, which is the greatest element in the ultimate price of the electricity paid for by the consumer.
19. The Government should also ensure that nuclear power is included in the forthcoming UK Taxonomy. The finance sector looks to Governments for assurance on which low carbon technologies are a safe investment for them, thus the inclusion of nuclear in the taxonomy is important to illustrate that nuclear power is a good investment.

- **What is the overall benefit or cost to the public purse from the UK’s adoption of SMR technology in its generating mix?**

20. There are many benefits to having new nuclear, including SMR, as part of the UK’s generating mix, including:
    - **The provision of grid stability and lower total system costs** driven by the reliable and dispatchable nature of nuclear. In a study recently commissioned by Rolls-Royce SMR, Aurora Energy Research found that deploying a fleet of Rolls-Royce SMR

power stations would reduce wholesale prices by up to 13% and reduce price volatility in the energy system.[3]

- **Socio-economic Benefits**. There are significant socio-economic benefits associated with nuclear new build projects, which has been highlighted by the Hinkley Point C project. For every £1 spent by Hinkley Point C, £2.50 of local regional value is generated. As of April 2023, spending in the South-West had topped £5.3 billion as a direct result of the project and investment in local infrastructure and community support has reached £139 million.[4] SMR projects could be expected to have a proportional impact. The Rolls-Royce SMR programme is forecast to create 40,000 regional UK jobs by 2050 and generate £52bn in economic benefit.[5]
- **Skilled workforce**. Nuclear power stations are valuable local employers and contribute tens of millions of pounds per year in wages, which is ploughed back into the local economy. Each nuclear sector employee contributes an average of £102,300 in gross valued added to the economy, almost twice as high as the national average.[6]
- **UK Industrial Capabilities**: SMRs offer the chance to rebuild high-value industrial capabilities that the UK has lost. For example, reactor pressure vessels, coolant circulators, boilers and turbines for nuclear power stations were once manufactured in the UK. We cannot do any of this today, but we could with a major new SMR programme. Companies like Sheffield Forgemasters, for instance, now owned by the Ministry of Defence, could make reactor pressure vessels for SMRs.

Delivery process

- **How does the current SMR technology design competition impact on the delivery of SMRs to commence generating capacity on time and on budget?**

21. The GBN SMR technology design competition has been a very welcome step for the UK to catch up with international competitors, however, the delivery of new nuclear must continue at pace. For this to happen, GBN will need to be funded and resourced adequately and strategic decisions will need to be made on the roles of the Project Developer and the Nuclear Operator.
22. The winners of the SMR competition should be announced as soon as possible, with sites assigned and awards made to those winners in the spring of 2024.
23. We must also ensure that those companies who are not selected by GBN but are interested in deploying their technologies in the UK have a route to market. The Government should use the forthcoming consultation on advanced nuclear technologies to clarify the "route to market" for technologies not selected by GBN to ensure that the companies remain interested in the UK and the energy sector remains open to new generation technology.

- **What benefits might accrue, and what issues might arise, if the Government were to select more than a single design to commission?**

24. The trade off is that supply chain investment and development is more diffuse if there are multiple designs commissioned, but there is less risk from potential problems in any one design.
25. It is possible to rollout a successful nuclear programme choosing either route.
    a. In the 1970s, the French decided to standardise on American-based Westinghouse Pressurised Water Reactor design and deployed more than 30

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[3] https://www.rolls-royce-smr.com/press/report-outlines-benefits-of-integrating-rolls-royce-smrs-into-the-uk-s-energy-mix.
[4] https://www.edfenergy.com/sites/default/files/hpc_socio_economic_report_2023_-_compressed.pdf.
[5] https://www.rolls-royce.com/innovation/small-modular-reactors.aspx#section-why-rolls-royce-smr.
[6] https://www.niauk.org/wp-content/uploads/2023/01/Delivering-Value_Economic-Impact-Civil-Nuclear.pdf.

units of this type. They then developed the technology into their own French design. The French fleet was delivered rapidly and cheaply, and to this day gives the French some of the cleanest power in Europe and billions of euros in revenue from export power to neighbouring countries.

   b. In the 1970s and 1980s, South Korea built American, French, and Canadian reactor designs, before deciding to standardise on Westinghouse's American Pressurised Water Reactor design. The Korean nuclear programme again was delivered in good time and budget and is a vital source of energy security for a country that has almost no fossil fuel deposits of its own.

26. If GBN selects multiple designs to commission, it should follow the Korean example and order multiple units of all of them. GBN should consult with the supply chain and order enough units in total to justify UK companies investing in capital intensive capabilities, such as the fabrication of reactor pressure vessels.
27. As a condition for contracting with GBN, vendors should be required to maximise UK content, starting with the use of UK nuclear fuel, which is our most mature supply chain capability. Where it is not realistic to achieve UK content in a particular area, GBN and its technology partners should publish medium-term localisation strategies, involving joint ventures and other partnerships between foreign suppliers and UK industry.
28. To aid this, GBN should strongly consider standardising on the single most successful SMR design after the initial deployment phase. This will concentrate investment efficiently on the required capabilities, allowing swifter introduction of UK content and more competitive exports.

- **What are the advantages and disadvantages of a prototype SMR being required to be delivered by a winning competitor ahead of installation of the initial SMR?**

29. The prototype approach is not appropriate for the deployment of SMRs. Prototypes are most effective when the goal is to prove that the technology itself works, not that it is commercially viable. We already know that the kind of water-cooled reactor technology incorporated in SMRs works. What we do not know yet for certain is which designs will be the most commercially competitive once the full cost and risks of construction are established. Building prototypes will not provide these answers.
    a. In the 1950s and 1960s, the UK built the 32 MWe Windscale Advanced Gas-Cooled Reactor (AGR), a prototype of the technology that is used in most of the UK's existing nuclear power stations. This prototype did not mitigate against very substantial First of a Kind construction problems encountered in the commercial deployment of 660 MWe AGR designs.
30. Requiring a single prototype to be deployed also does not fit with the modular construction concept that the UK is seeking to establish. The delivery of a protype SMR would also be a costly exercise as the fleet deployment approach is required to control costs and gain speed by repetition of activities.
31. A further disadvantage of requiring a prototype SMR is that this requirement does not address other key barriers faced by SMR developers, namely the siting of multiple units of the designs.

- **What export opportunities for the UK arise from the winning SMR design or designs?**

32. There is an enormous export opportunity for the UK in SMR deployment. Countries all over the world are showing unprecedented interest in nuclear energy deployment, and many of those countries have smaller grids or lesser financing capabilities that would only be suited to SMR technology.

33. Rolls Royce SMR has estimated that there is the potential to generate an export market of £250bn by 2050 from the SMR programme.[7]
34. We would urge the Government to develop UK manufacturing capabilities to build whatever SMR designs are chosen, UK or foreign. That way the export opportunity will not be confined to UK-flagged reactor designs, but to any design in which the UK has built up competitive industrial capacity.
35. This way, the UK supply chain can not only provide UK content for UK projects, but also potentially win orders for SMR projects globally.

Further Information

The NIA is happy to provide more context, or any clarifications desired on the content of our response and to ask our members where appropriate for additional information that may be useful.

Please contact Lauren Rowe, Policy Analyst for the NIA, at Lauren.Rowe@niauk.org to do this.

[7] https://www.rolls-royce.com/innovation/small-modular-reactors.aspx#section-why-rolls-royce-smr.