Department for Energy Security & Net Zero

Alternative Routes to Market for New Nuclear Projects

Closing date: 12 April 2024 (extended from 4 April)

January 2024

Any enquiries regarding this publication should be sent to us at: nuclearconsultation@energysecurity.gov.uk

Ministerial foreword

The UK's energy market has reached a critical juncture. We need a stronger, more reliable supply to meet increasing demand – one which doesn't leave us dependent on foreign energy imports. But we also know how important it is to reduce carbon emissions and maintain our status as a world leader in the fight against climate change.

Nuclear power, as one of the most reliable, secure, low-carbon sources of home-produced energy, is a solution to both challenges. And that is why this government is making nuclear a central pillar of our future energy mix, with ambitions to deliver up to 24GW of capacity by 2050 – enough to meet around a quarter of the country's projected demand.

We have already begun laying the groundwork, starting with support for the construction of Hinkley Point C and – subject to final approvals – Sizewell C. Together, those two plants could power 6 million homes for six decades. Last year, we also launched a new arms-length body, Great British Nuclear, to manage and spearhead our nuclear renaissance, and deliver a long-term pipeline of projects beyond Hinkley Point C and Sizewell C.

Now, at the start of 2024, we have published the *Civil Nuclear Roadmap to 2050*, our most ambitious civil nuclear strategy in decades, which will provide guidance and direction to the sector. We are also consulting on a policy for siting new nuclear power stations.

But to continue leading the way in nuclear innovation, we must give Advanced Nuclear Technologies (ANTs) all the support they need to reach market too. That means building on our world-class capability in areas such as fuels, regulation, and research, and unlocking investment in the wide range of small and advanced reactors currently under development. It also means going beyond the support of Great British Nuclear and enabling different routes to market.

This consultation is about putting the UK at the forefront of ANTs and creating an environment which encourages innovation. We therefore want to hear from you about what we can do to help the advanced nuclear sector work with regulators, access land and develop a business model that drives investment.

We want to understand fully the industry's perspective on a programme of work that will be of immense importance to Britain's future. So, we look forward to your contributions.

Andrew Bowie MP

Minister for Nuclear and Renewables

Introduction

Government believes that expanding new nuclear deployment in the UK will help us achieve our energy security and net zero goals. That is why government has announced a major shift in the UK's nuclear objectives, setting an ambition to deploy more nuclear power in the next three decades than we built over the previous seven.

This comes at a time when new technologies are creating new opportunities for the sector. The adoption of modern methods of off-site manufacturing and construction, which is already revolutionising other sectors, has the potential to reduce the costs and risks of nuclear deployment. In parallel, we are seeing a renewed interest in nuclear technologies that have a long heritage but have not previously been deployed commercially or at scale – potentially introducing much greater variety to an industry that has traditionally been dominated by light-water reactors.

Government wants the UK to be at the forefront of this new wave of technologies. That is why we have:

- established a £385m Advanced Nuclear Fund (ANF) to support the development of both Small Modular Reactors (SMRs) and Advanced Modular Reactors (AMRs);
- launched Great British Nuclear (GBN), a new public body that will support the UK's nuclear industry by providing better opportunities to build and invest;
- through GBN, launched a process to select those small modular reactor (SMR) designs best able to deploy in the UK by the mid-2030s, potentially releasing billions of pounds of private and public investment;
- committed up to £300 million investment to produce High Assay Low Enriched Uranium (HALEU) in the North West, supporting jobs and industry;
- alongside this document, launched a consultation on a new approach that would open up more siting opportunities and facilitate longer term market development (an approach could support ANTs as well as traditional technologies);
- agreed with the Nuclear Decommissioning Authority (NDA) that it will periodically publish a prospectus stating which of its land holdings will soon become available for reuse and, where there is commercial interest in available land, the NDA and the government will run fair and transparent processes to lease or option land, with the assumption being that sites go first to new nuclear projects, where that is feasible and represents value for money;
- announced our intention to streamline planning, environmental permitting and regulation to speed up new power stations, while maintaining our world-class regulatory framework; and
- created new options for early engagement between the nuclear industry and the regulators, ensuring regulators are aware of innovations in the sector and vendors can build in regulatory requirements by design.

And we want to go further. This consultation aims to explore what steps can be taken to enable different routes to market for these new Advanced Nuclear Technologies (ANTs). It will also explore the uses for ANTs and potential benefits that they can provide to the UK economy.

ANTs are a collective term for the wide range of innovative small and advanced reactors under development in the nuclear sector, including SMRs, AMRs and Micro Modular Reactors (MMRs). ANTs are smaller in size, both in terms of power output and land footprint, than large Giga Watt (GW)-scale reactors.

Due to the amount of electricity they generate and their relatively low operating costs, large-scale nuclear reactors have dominated new nuclear development in the developed world for decades. However, such projects have complex infrastructure, high upfront capital costs and lengthy construction schedules, meaning they are prone to cost overruns and delays.

ANTs seek to address these challenges by:

a. Reducing the size and scale of each individual reactor unit, thereby lowering the capital cost and making them easier to finance; and

b. Using modern construction techniques (factory manufacture/fabrication and onsite assembly) to reduce overall construction length, leading to a lower cost of capital.

Due to their size, modularity, and replicability, ANTs have the potential to be cheaper than traditional nuclear, particularly those built after the First of a Kind (FOAK) project. Nth of a Kind (NOAK) will likely offer increased value for money as technology risks are reduced, translating into reduced cost of capital.

Additionally, through the use of novel coolants, fuels and passive safety systems, AMRs have the potential to improve thermal efficiency and generate higher temperatures.

ANTs could represent a transformative leap in the field of nuclear energy and government recognises the strategic importance of embracing modular manufacturing. The economic ripple effects could be substantial, fostering job creation and bolstering local industries. ANTs could also provide a versatile range of applications – from producing localised power to supporting specific industrial processes – and could enable a more targeted approach to energy delivery. As a result, ANTs introduce a range of decarbonisation opportunities, from grid electricity through to industrial heat, as well as in entirely new industries such as the production of hydrogen and synthetic fuels.

Chapter 1 of this document outlines the potential uses for ANTs, exploring the benefits that they could bring to the UK energy landscape. We are seeking views on the potential role for government in enabling these new uses, as well as testing which uses could be most appropriate for the UK.

Chapter 2 looks at the UK’s internationally recognised regulatory regime. Efficient and effective regulation is a vital enabler of new nuclear projects, ensuring public confidence in our nuclear sector and supporting investment. It is therefore essential that our regulatory processes are both streamlined and robust. This chapter outlines the UK's regulatory pathways, detailing the processes that must be successfully undertaken to enable the safe operation of a nuclear plant. It also evaluates the appropriateness of the current regulatory pathway for ANTs and details new options for early engagement between the nuclear industry and the regulators, ensuring regulators are aware of innovations in the sector and vendors can build in regulatory

requirements by design. It also considers the vital roles that security, safeguards, and waste management play in the nuclear sector.

Chapter 3 discusses how we can support private developers and help them bring projects forward to complement the work being undertaken by Great British Nuclear (GBN). We are keen to hear from developers about what government can do to support investment and enable routes to market for good projects. This chapter also explores the financial enablers for getting nuclear power on the grid, and how government can best support financing and funding ANTs. It outlines the business models that may be most suitable for ANTs, as well as exploring the option of privately funded projects and what government's role should be in these.

Chapter 4 sets out the funding support that government currently provides for innovation in the sector and seeks views on how government can further support R&D in the sector.

Government sees great national opportunities in the nuclear sector, and we are seeking responses to support us in developing the policies that will allow this industry to thrive.

Government welcomes consultation responses from the nuclear industry, including technology vendors, developers, the supply chain, and industrial consumers of heat and power, alongside the whole spectrum of the public realm, including local communities, local government, the Devolved Administrations, science, academia, the financial sector, and members of the public.

Government particularly welcomes views from local communities. Government would appreciate hearing about local interests, any opportunities that could benefit your community, and if you have any concerns to share. Government is committed to supporting local communities, both those which host nuclear installations and beyond.

The responses received will shape our approach to this crucial and potentially transformative part of our energy system, enabling government to put the right policies in place to ensure nuclear energy plays a key role in our net zero future.

Contents

Consultation details

Why are we consulting?

Government is strongly committed to a range of nuclear technologies and wants to see both large-scale and Advanced Nuclear Technologies contribute to UK energy security and climate change targets. Government is seeking to increase diversity across the pool of nuclear technologies available in the UK and to strengthen the UK's nuclear sector supply chain.

This consultation aims to understand how government can support investment in advanced nuclear technologies and enable high value projects to be taken forward. It seeks to examine how government and the nuclear industry can go further and considers what steps need to be taken to enable the different routes to market for new technologies. There is space to further explore the role of nuclear energy for new uses, such as industrial decarbonisation, low carbon heating, and production of hydrogen and synthetic fuels. The evidence received from the consultation will help shape future policy and ensure that the UK's nuclear programme is as comprehensive and inclusive as possible.

Consultation details

Issued: 11 January 2024

Respond by: Midnight 12 April 2024 (extended from 4 April)

Enquiries to:

Alternative Routes to Market Consultation Team
Department for Energy Security and Net Zero
55 Whitehall
London
SW1A 2HP
United Kingdom

Tel: 020 7215 5435
Email: nuclearconsultation@energysecurity.gov.uk

Consultation reference: Alternative Routes to Market Consultation

Audiences:

Government wants to hear from members of the public, industry, non-governmental organisations, interested public bodies and organisations, and nearby states.

Territorial extent:

This consultation relates to Great Britain. The scope of this consultation is Great Britain only as we are not currently seeking views on how advanced nuclear technologies could be deployed in Northern Ireland, given the Single Electricity Market (SEM) on the Island of Ireland is a separate electricity market to Great Britain. Decarbonising the economy is, however, of interest

to governments across the UK and we will continue to engage with the devolved administrations as proposals are developed.

How to respond

Responses should be provided online where possible at:

energygovuk.citizenspace.com/energy-markets/alternative-routes-to-market

Alternative, responses can be submitted via the email or postal address below:

nuclearconsultation@energysecurity.gov.uk

Alternative Routes to Market Consultation Team
Department for Energy Security and Net Zero
55 Whitehall
London
SW1A 2HP
United Kingdom

When responding, please state whether you are responding as an individual or representing the views of an organisation.

Your response will be most useful if it is framed in direct response to the questions posed, though further comments and evidence are also welcome.

Related documents

This consultation was published alongside the *Civil Nuclear Roadmap to 2050* and *A new National Policy Statement for new nuclear power generation: consultation on the new approach siting beyond 2025*.

The *Civil Nuclear Roadmap to 2050* can be found here:
www.gov.uk/government/publications/civil-nuclear-roadmap-to-2050

A new National Policy Statement for new nuclear power generation: consultation on the new approach siting beyond 2025 can be found here:
www.gov.uk/government/consultations/approach-to-siting-new-nuclear-power-stations-beyond-2025

Confidentiality and data protection

Information you provide in response to this consultation, including personal information, may be disclosed in accordance with UK legislation (the Freedom of Information Act 2000, the Data Protection Act 2018, and the Environmental Information Regulations 2004).

If you want the information that you provide to be treated as confidential, please tell us, but be aware that we cannot guarantee confidentiality in all circumstances. An automatic

confidentiality disclaimer generated by your IT system will not be regarded by us as a confidentiality request.

We will process your personal data in accordance with all applicable data protection laws. See our privacy policy.

We will summarise all responses and publish this summary on GOV.UK. The summary will include a list of names or organisations that responded, but not people's personal names, addresses or other contact details.

Quality assurance

This consultation has been carried out in accordance with the government's consultation principles.

If you have any complaints about the way this consultation has been conducted, please email: bru@energysecurity.gov.uk.

Chapter 1: Exploring New Uses

Beyond baseload

1. Government expects that one of the primary uses of Advanced Nuclear Technologies (ANTs) will be to generate baseload power, providing a cost-efficient and reliable source of electricity to the National Grid. However, modern innovations in both manufacturing methods and reactor technology have created new opportunities for the use of nuclear energy. ANTs, which include both Small Modular Reactors (SMRs) and Advanced Modular Reactors (AMRs), may be able to serve the electricity grid more flexibly than traditional nuclear. Moreover, ANTs unlock a range of additional applications in energy sectors beyond grid electricity.

2. This chapter identifies the potential new uses of nuclear energy – beyond providing baseload power – and explores how government could facilitate more of these potential uses to help achieve our energy security and decarbonisation objectives.

3. Potential new uses of nuclear include:

   a. **Flexible electricity generation**: on-grid power servicing a different system purpose to traditional baseload nuclear by altering power output in response to demand.

   b. **Industrial heat and power**: heat and power to industrial consumers to support existing and new manufacturing and processing sectors, such as chemicals, pulp and paper, food and drink or data centres.

   c. **Hydrogen and synthetic fuels:** nuclear energy for industry could also help produce other energy products such as hydrogen, ammonia, and synthetic fuels.

   d. **District heating**: supply of heat to buildings via local heat networks.

   e. **Other proposed uses**: additional uses could include transportable heat and power, civil marine propulsion, or reusing legacy nuclear materials.

Question 1: Are there any uses for nuclear energy (beyond those in this document) that you believe government should be considering? If yes, please explain what they are.

Flexible electricity generation

4. Electricity demand is not even, with large variations through the day and across seasons. It is National Grid's responsibility, as the electricity system operator (ESO), to balance supply and demand, drawing on the distinct types of generating asset connected to the grid.

5. Although Nuclear Power Plants (NPPs) can flex their electricity output, they perform better over their lifecycle in economic terms when generating consistent, stable output. NPPs therefore have traditionally provided baseload power to the grid, with other generating assets (typically gas power stations) providing dispatchable or flexible power. Flexible power is a

vital component of the electricity system as it enables the ESO to balance supply and demand in real time.

6. The UK is expected to need an estimated four-fold increase in clean electricity generation by 2050, driven in part by the forecast doubling in demand for electricity as heat and transport are electrified[1].

7. Current modelling suggests that Renewable Energy Sources (RES), particularly wind and solar, are likely to produce most of the UK's electricity by 2050[2]. However, this needs to be supported by low carbon 'firm power' which could be provided by nuclear. This firm power ensures the market benefits from a secure, low-carbon electricity supply. In future, NPPs that can also make short notice alterations in power output could take on the role of peaker plants, providing electricity to the grid to meet fluctuations in supply and demand and offsetting variable RES output.

8. The novel features of ANTs create opportunities to operate more flexibly than traditional nuclear. Firstly, many ANT designs propose coupling with a Thermal Energy Storage (TES) system. This allows the operator to store heat energy when demand on the grid is low. When demand is higher, the heat can be released into steam turbines to generate electricity in addition to the power that the reactor would generate at the same time.

9. Secondly, ANTs could regulate power output to the grid via 'co-generation', enabling a NPP to switch between supplying power to the grid when electricity demand is high and transferring energy as heat and electricity to alternate uses (e.g., hydrogen or synthetic fuel production) when grid demand is low.

10. Government welcomes the opportunity for nuclear to play a more flexible role in our electricity system. This new system role for nuclear could be an important complement to more variable sources of low carbon power, providing the ESO with an additional tool to help reliably manage the network.

11. Government welcomes views on this potential uses of nuclear energy – whether this is a useful option for the network, whether there are barriers to investment in flexible nuclear power projects (and what those barriers are), and whether the existing nuclear policy, regulatory and planning frameworks are suitable for these new uses for advanced nuclear.

Question 2: To what extent do you agree that advanced nuclear can be a valuable energy source when combined with a Thermal Energy Storage System or for co-generation? Please provide an explanation for your response.

Industrial heat and power

12. Energy is about more than just grid electricity, and we will need to decarbonise across the energy sector to achieve net zero by 2050. ANTs could provide low carbon heat and power to a wide range of energy-intensive industries. A significant portion of energy demand

[1] Energy White Paper: Powering our net zero future, 2020 https://assets.publishing.service.gov.uk/media/5fdc61e2d3bf7f3a3bdc8cbf/201216_BEIS_EWP_Command_Paper_Accessible.pdf
[2] Energy and emissions projections: Net Zero Strategy baseline, 2021 https://www.gov.uk/government/publications/energy-and-emissions-projections-net-zero-strategy-baseline-partial-interim-update-december-2021

in industry is for heat for industrial processes; ANTs may have promise as a direct source of heat for application in such processes.

13. We are keen to understand what more government could do to help realise the exciting opportunities introduced by ANTs for the decarbonisation of industry.

Question 3: To what extent do you agree that advanced nuclear could be a valuable energy source for large scale industry. Please provide an explanation for your response.

Question 4: In your opinion, what further measures should government take to enable industrial applications of advanced nuclear? Please provide an explanation of the type of support required.

14. A significant portion of industrial heat demand is challenging to electrify, particularly at higher temperatures. The higher temperature output of some AMRs (e.g. ~700 – 950°C for High Temperature Gas Reactors as opposed to ~300°C for conventional light-water reactors) could support the supply of heat to hard-to-electrify sectors.

15. We would like to hear from potential industrial end-users of nuclear heat and/or power to understand their energy needs, their views on using advanced nuclear as a reliable, low carbon energy source, and their views regarding government's role to support this use of nuclear energy.

16. To provide high temperature heat to industry, a nuclear plant will need to be sited near to the industrial end-user. Alternatively, a long-distance heat network could be used to transport nuclear heat, albeit at lower efficiency due to heat loss. The UK's planning, licensing and environmental permitting regimes would therefore need to allow for this. Deployment of nuclear plants near to industrial end-users would also need to satisfy the siting criteria set out in the nuclear NPS, including population density and locational characteristics. Alongside this document, government has published more detail on the proposed criteria for siting NPPs in *A new National Policy Statement for new nuclear power generation: consultation on the new approach to siting beyond 2025*. We welcome responses to that consultation.

Hydrogen and synthetic fuels

17. A particularly important industrial process for which ANTs show promise is hydrogen production. Low carbon hydrogen production is a critical part of the UK's strategy for achieving net zero. Hydrogen can support the decarbonisation of the UK economy, providing a pathway to reduce emissions from industry, power, transport, and potentially heat. Low-carbon hydrogen has a broad range of possible uses, including as a heat source for industrial processes or as a feedstock for chemicals production and transport fuels, to provide long duration energy storage, and as a replacement for natural gas. The UK Low Carbon Hydrogen Standard included nuclear-enabled hydrogen production amongst the various production pathways that have the potential to deliver low carbon hydrogen[3].

[3] UK Low Carbon Hydrogen Standard, 2023 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1151288/uk-low-carbon-hydrogen-standard-v2-guidance.pdf

18. There are multiple low-carbon hydrogen production methods which could utilise heat and/or electricity from nuclear. The higher temperature outputs of some AMRs relative to traditional nuclear could unlock more efficient production routes for hydrogen, with the potential for associated cost savings from these efficiency gains. Hydrogen is a feedstock for other valuable chemicals, including synthetic fuels that could be crucial to decarbonising transport sectors that are challenging to electrify. Production of these chemicals also requires heat input (e.g. 350 – 500°C for ammonia production via the Haber-Bosch process). ANTs could therefore be an energy source for large-scale production of these chemicals.

Question 5: To what extent do you agree that advanced nuclear could be a valuable energy source for hydrogen and synthetic fuel production? Please explain your answer.

District heating

19. District heating is an important part of the plan to accelerate the decarbonisation of heating homes and workplaces while reducing bills. District heating involves distributing heat from a centralised energy source via a network of pipes (the 'heat network') connecting industrial and residential buildings in a locality.

20. There is significant global experience with using nuclear plants to supply heat networks; in 2019, 56 reactors supported district heating. Current examples include the Beznau NPP in Switzerland, which, though primarily used to generate electricity, has been providing heat to a network of c.20,000 people since 1984. There are also nuclear plants supporting heat networks in the Czech Republic, Slovakia and Hungary.

21. Analysis from Energy Systems Catapult demonstrates that heat from thermal power plants (including nuclear) can be a cost-effective solution for decarbonising domestic heating and hot water production in the UK via heat networks. There are some examples of district heating networks in the UK. However, nuclear energy has not been used in district heating in the UK to date.

22. ANTs may be well suited to supplying heat networks. Firstly, ANTs are potentially suitable for siting in a broader range of locations. In the future, this may allow siting closer to the heat demand, thereby reducing infrastructure costs for the transmission network. Secondly, ANTs are a better match for the energy requirements of existing heat networks in the UK, given their smaller energy output relative to large-scale nuclear plants. Finally, deployed in arrays of multiple units per plant, ANTs could allow for a more flexible response to seasonal heat demand changes, e.g. switching some units to other applications in the summer (co-generation). The safety, security, and environmental protections of operating a NPP will remain crucial.

23. However, for nuclear to be used efficiently to supply heat networks, the nuclear plant must be situated relatively close to the end-users. Traditionally, nuclear plants in the UK have been situated in sparsely populated coastal areas where they have easy access to cooling water, and because remote locations provide security and other operational benefits. If nuclear plants are to supply heat networks, we will need to consider how plant location can satisfy the UK's robust planning, environmental permitting and nuclear safety and security regimes.

24. Any proposed new nuclear plant will need to satisfy the siting criteria set out in the nuclear NPS, including population density and locational characteristics. Alongside the *Civil Nuclear Roadmap to 2050* and this consultation, we have published *A new National Policy Statement for new nuclear power generation: consultation on the new approach siting beyond 2025*, which sets out our proposed criteria for siting NPPs.

25. Government has awarded grant funding to public and private sector organisations to support new low-carbon heat networks, via programmes such as the Green Heat Network Fund (GHNF). At present, none of the participating projects involve nuclear-sourced heat. Government is interested to hear from heat network operators and innovators to understand their thoughts on advanced nuclear as a potential energy source for district heating.

Question 6: To what extent do you agree government should explore the opportunity of using nuclear plants to provide district heating to help decarbonise our domestic and commercial buildings? Please provide an explanation and include suggestions on mitigating any potential barriers.

Other potential uses

Transportable heat and power

26. Advanced nuclear innovation has opened the opportunity to use nuclear to decarbonise temporary and/or mobile heat and power needs. Diesel generators are generally relied upon in remote communities and where there is a short-term need for heat and power that cannot be supported by fixed grid infrastructure. Examples of this type of energy use include remote mining sites or provision of power in the wake of natural disasters. Some developers and vendors of ANTs are considering the potential of transportable nuclear reactors to provide a reliable, low-carbon solution.

27. There are two mobile nuclear concepts: very small-scale reactors (sometimes called Micro Modular Reactors) that aim to replicate the service provided by containerised diesel generators and can be transported by lorries; and ship based SMRs that can be delivered to where they are needed. Transportable reactors are not without precedent: the US deployed the MH-1A to the Panama Canal Zone from 1968-1976.

28. However, transporting whole reactors creates new vulnerabilities, both during transport and when deployed in dispersed and/or remote areas. This raises significant challenges with respect to safety, security, and nuclear safeguards.

Maritime propulsion

29. There are vendors developing reactor designs for merchant maritime propulsion. Although the military has used nuclear to drive ships since the dawn of nuclear power (the first pressurised water reactors were developed for marine propulsion by the US navy), only a very limited number of non-military nuclear vessels have been in service. International shipping is an important source of greenhouse gas emissions and government has committed to decarbonise UK shipping by 2050[4]. Nuclear propulsion may have potential in the longer-term to help support the decarbonisation of international shipping.

[4] *Decarbonising Transport – A Better, Greener Britain*, Department for Transport, Crown Copyright 2021, p37.

30. Nuclear-powered merchant ships would need to engage with multiple regulatory regimes globally. The UK has implemented the Merchant Shipping (Nuclear Ships) Regulations 2022 (SI 2022/1169), which provide a regulatory framework for any UK commercial nuclear-powered ships and foreign commercial nuclear-powered ships visiting UK waters. This instrument implements the requirements of Chapter VIII in the Annex to the International Convention for the Safety of Life at Sea, 1974 and gives effect to the provisions of the Code of Safety for Nuclear Merchant Ships, which was adopted by the International Maritime Organization (IMO) Resolution A.491(XII).

31. Government is interested in gathering views on the uses of nuclear energy for merchant maritime propulsion.

Re-using legacy nuclear materials

32. Some AMR designs are for fast spectrum reactors. A feature of fast spectrum reactors is that they can consume more material than conventional ‘thermal spectrum’ reactors. In addition, they have the potential to transmute some of the long-lived radioisotopes found in spent fuel to reduce the length of time the final product is radioactive.

33. As a result, nuclear waste management has been proposed as a potential market for these fast spectrum AMRs. It is unlikely that these reactors would generate electricity competitively compared to other low-carbon generators; the value proposition is that they will help reduce nuclear waste management costs.

34. However, developing these reactors would require new reprocessing and fuel fabrication facilities and would generate secondary waste that presents new hazards and would still require disposal. Even if such a concept were proven for the treatment of radioactive waste, it would not be suitable for a significant part of the UK’s legacy waste, much of which is in the form of vitrified high-level waste for which the only management route is geological disposal.

35. Government’s policy for managing the UK’s most hazardous radioactive waste, spent fuel and nuclear materials (should they be declared as waste) is deep geological disposal. This was recommended by the independent Committee on Radioactive Management following an extensive examination of potential options. Deep geological disposal is recognised internationally as the best available option for managing higher activity waste and spent fuel and is being pursued in several countries. Transmutation was one of many options considered by the committee but was dismissed as there was ‘no proof of concept and the cost would be disproportionate to benefits received.’

36. Government policy for the management of higher activity radioactive waste and spent fuel (should it be declared as waste) requires the Nuclear Decommissioning Authority (NDA) to continue to consider alternative management options that could become viable for parts of the UK’s radioactive waste inventory in the future, and it produces regular reports on alternative management routes for higher activity wastes.

37. Based on these considerations, government is not minded to support ANT technologies as a means of treating radioactive waste, spent fuel and nuclear materials.

38. As outlined in the *Civil Nuclear Roadmap to 2050*, the safe and secure management of civil separated plutonium is a priority for the government. All civil separated plutonium in the UK has been consolidated at the Sellafield site. Whilst critical high hazard risk reduction

activities are prioritised at Sellafield, we will not support advanced nuclear technologies requiring use of that plutonium for fuel as part of our nuclear ambitions.

Question 7: What do you think are the opportunities and challenges associated with other potential uses for nuclear power? Please explain your answer.

Chapter 1 Question Summary

Question 1: Are there any uses for nuclear energy (beyond those in this document) that you believe government should be considering? If yes, please explain what they are.

Question 2: To what extent do you agree that advanced nuclear can be a valuable energy source when combined with a Thermal Energy Storage System or for co-generation? Please provide an explanation for your response.

Question 3: To what extent do you agree that advanced nuclear could be a valuable energy source for large scale industry. Please provide an explanation for your response.

Question 4: In your opinion, what further measures should government take to enable industrial applications of advanced nuclear? Please provide an explanation of the type of support required.

Question 5: To what extent do you agree that advanced nuclear could be a valuable energy source for hydrogen and synthetic fuel production? Please explain your answer.

Question 6: To what extent do you agree government should explore the opportunity of using nuclear plants to provide district heating to help decarbonise our domestic and commercial buildings? Please provide an explanation and include suggestions on mitigating any potential barriers.

Question 7: What do you think are the opportunities and challenges associated with other potential uses for nuclear power? Please explain your answer.

Chapter 2: Regulating Advanced Nuclear

Regulation across the UK

39. Regulation is a crucial enabler of new nuclear projects. Robust, clear and efficient regulation is vital for ensuring public confidence in our nuclear sector and in supporting investment and enabling good projects to progress quickly and safely. The International Atomic Energy Agency (IAEA) has recognised the UK as having a mature regulatory framework that could be emulated by other countries[5].

40. Government will always ensure that we have a robust and rigorous nuclear legislative and regulatory regime. At the same time, we recognise that if regulation is to be an enabler of, and not a barrier to, good projects, it needs to be efficient and effective. Good regulation is a matter of quality, not quantity. If we are able to streamline regulatory processes without watering-down vital protections, we should do so.

41. That is why government is taking steps to accelerate planning approvals and launching a 'smarter regulation challenge' to work with industry to adapt regulatory approaches and reduce unnecessary red tape. This chapter sets out the current regulatory framework, efforts we are already undertaking to improve it (including a new approach to giving project developers opportunities to engage with regulators at an early stage) and invites views as to how it can be further improved.

Our current regulatory framework

42. The UK has a well-established, long-standing regulatory framework for nuclear activities regulated by the Office for Nuclear Regulation (ONR) and the national environmental regulators – the Environment Agency (EA), Natural Resources Wales (NRW) and the Scottish Environment Protection Agency (SEPA) – collectively known as 'the regulators'. It also includes requirements administered by government, such as the requirement for developers to justify the benefits of working with ionising radiation or the requirement for site licence holders to have adequate arrangements to meet their nuclear liabilities in accordance with international agreements.

43. The UK's approach to nuclear safety aims to maintain high standards of nuclear operations, radiological safety, and environmental protection within a robust regulatory framework. This requires a strong safety culture characterised by learning and continuous improvement.

44. The UK is a signatory to key international legal instruments relating to nuclear and radiological safety. These conventions provide an effective and credible legal framework agreed by the international community, which the UK values and has played a key part in formulating. The UK recognises the IAEA's safety standards as the primary standards against which its safety framework is measured. In 2019, the IAEA's Integrated Regulatory Review Service (IRRS) reviewed the work of the ONR and the other bodies involved in radiological

[5] https://www.iaea.org/newscenter/pressreleases/iaea-mission-says-united-kingdom-committed-to-enhancing-safety-sees-areas-for-further-improvement

protection in the UK and determined that 'The ONR has a mature regulatory framework that could be emulated by other countries' regulatory authorities to improve their understanding and implementation of IAEA safety standards in the oversight of nuclear and radiation safety'[6].

45. The pace of advanced nuclear innovation means that we are considering whether the existing regulatory framework can accommodate new technologies and new uses of nuclear. Government has been working closely with the regulators on this topic for some time. In 2017, government provided up to £12m funding to the ONR and EA for a programme to develop their capability and capacity to regulate Advanced Nuclear Technologies (ANTs). This funding allowed the regulators to invest in technical training on new design concepts, to support the Advanced Modular Reactor (AMR) Feasibility and Design Initiative, and to review and update regulatory guidance documents: the Technical Assessment Guides (TAGs), Safety Assessment Principles (SAPs), and Security Assessment Principles (SyAps). Government funding has also allowed the regulators to modernise the Generic Design Assessment (GDA) process, to support the GDA Entry Process for ANTs[7] and to build relationships with overseas counterparts in order to make use of overseas regulatory evidence within the UK framework.

46. This chapter considers the current regulatory landscape for ANT projects, and its suitability and adaptability to the advanced nuclear innovation currently unfolding in the UK. This includes seeking opportunities to enhance and refine the landscape to regulate new designs and new uses of nuclear energy. The aim is not only to review our existing system but also to gather diverse perspectives on how it can better support and facilitate the development and deployment of ANTs in the UK.

Regulatory pathways

47. Navigating the regulatory landscape for new Nuclear Power Plant (NPP) development involves completing numerous steps to demonstrate that the NPP will be safe, secure and can manage its waste, non-proliferation, and environmental obligations. Reactor designs and projects progress through the regulatory paths illustrated in Figure 1, all of which involve scrutiny of reactor design, site suitability, environmental impacts, and organisational capabilities.

6 https://www.iaea.org/newscenter/pressreleases/iaea-mission-says-united-kingdom-committed-to-enhancing-safety-sees-areas-for-further-improvement

7 https://www.gov.uk/government/publications/entry-to-the-generic-design-assessment-for-advanced-nuclear-reactors

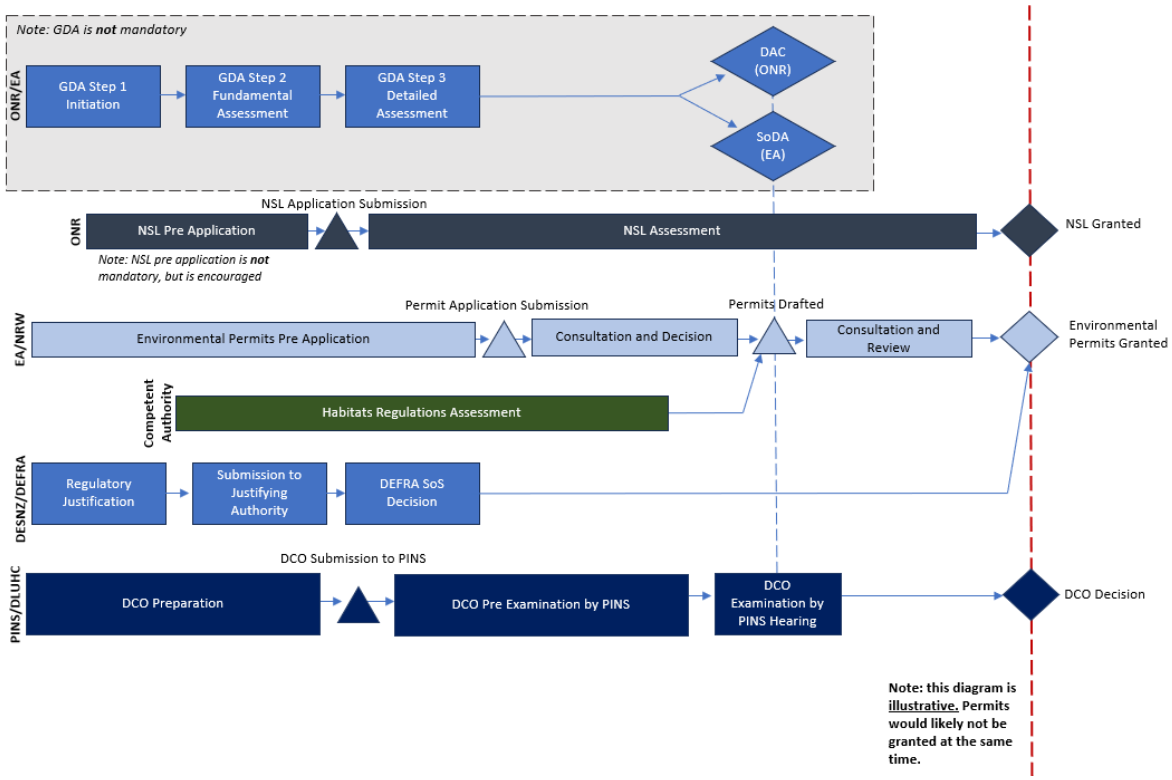

Figure 1: Different Stages in the regulatory pathway up to licensing and permitting

Regulatory principles

48. The UK has a goal setting, non-prescriptive nuclear regulatory framework. The onus is on the regulated party to set out claims, arguments and evidence to demonstrate that the prescribed nuclear activities can be carried out safely, securely and in ways that manage environmental impacts. The key principle for the ONR's regulatory framework is the requirement to reduce risks are reduced As Low As Reasonably Practicable (ALARP). This is a fundamental requirement and applies to all activities within the scope of the Health and Safety at Work etc. Act 1974 (HSWA). The EA and NWR use a similar As Low As Reasonably Achievable (ALARA) principle while also asking companies to demonstrate they will use the Best Available Techniques (BAT). Demonstration of ALARP requires duty holders to evaluate risks and to make an explicit justification that the costs of further risk reduction would be grossly disproportionate to the safety benefit.

Nuclear Site Licensing

49. Nuclear Site Licensing (NSL) is a structured, statutory process. It is undertaken for a specific site, with a corporate body. NSL assesses a prospective licensee's capability to carry out specified nuclear activities, prescribed under Nuclear Installations Act 1965, at the specified location. A licence may be granted when ONR is satisfied that the licence applicant's safety and security documentation provide assurance that the organisation can conduct the proposed activities within Licence Conditions. The licence is specific to the licensee and does not automatically transfer with a new site owner. The licence is also for specified activities, so additional prescribed activities could not be carried out without relicensing the site to accommodate the introduction of the new activities.

Environmental Permitting

50. A prospective nuclear operator will need to apply for and be granted environmental permits to conduct specified activities at a prospective site. For all nuclear sites, this includes a radioactive substances activities permit. If a nuclear operator intends to conduct activities with radioactive materials (which requires an environmental permit) then they must already have a NSL which covers those activities or be a tenant on licensed land.

Generic Design Assessment

51. GDA is a voluntary, comprehensive process conducted by the nuclear regulators to review the safety, security, and environmental protection aspects of new reactor designs on a generic basis, in advance of site or operator specific proposals. The benefit of GDA is that, compared with statutory regulatory processes, it allows regulators to identify key design issues early in the process, thereby reducing financial and regulatory risks. In this way it helps developers give investors confidence that a design will meet the statutory requirements. The GDA Requesting Party is not required to be the prospective operator.

Applicability to advanced nuclear

52. The regulatory framework and regulatory principles are flexible and technology neutral. As such much of the framework can be applied to any nuclear installation regardless of technology type or size and where regulatory effort is scaled proportionate to the risks and hazards. However, government is aware that the regulatory and planning systems were designed with large Nuclear Power Plants built with traditional civil engineering in mind. Therefore, some aspects of the regulatory pathways may not be best suited to ANTs, for instance to the innovative manufacturing and build processes, or to the potential new uses of nuclear energy enabled by ANT innovation. Government is therefore keen to hear views to ensure the regulatory pathways are suitable for all scales of nuclear development, and for a wider range of uses as set out in Chapter 1.

Question 8: To what extent do you agree that the current regulatory pathways cover new uses? Are there any areas that are not covered? Please explain your answer.

53. As set out in the *Civil Nuclear Roadmap to 2050*, government is taking steps to streamline and enhance the efficiency of nuclear regulation across all nuclear technologies (large-scale reactors, SMR and AMR) while maintaining rigorous levels of nuclear safety, security, and environmental protection. Whilst all these initiatives will drive improvements in the planning and regulatory systems, we know there is more to do. We have some of the best technical and regulatory expertise in nuclear in the world, so we are launching a smarter regulation challenge for industry to help us drive efficiencies in the deployment of new projects. Government is interested to hear about smarter regulation opportunities and ideas from consultees, and also whether ANT innovation and/or new uses of nuclear energy opens further opportunities for regulatory streamlining or efficiency.

Question 9: What, if any, are the main opportunities and challenges for streamlining regulation while maintaining high standards of safety, security and environmental protection? Please explain your answer.

Planning and smarter regulation

54. The Planning Act 2008 requires applicants to obtain a Development Consent Order (DCO) for projects which are a Nationally Significant Infrastructure Project (NSIP). The NSIP definition covers large electricity generating plants, including nuclear power stations. A DCO is the means by which such developments obtain planning permission; the application made by the developer is examined by the Planning Inspectorate (PINS), which then submits a report to the Secretary of State of the Department for Energy Security and Net Zero (DESNZ), who takes the decision. DCOs are only required when a nuclear plant (or total output from the planned number of units) exceeds a certain electrical output (50MW in England and 350MW in Wales). In England, NPPs under 50MW are assessed by the Local Planning Authority (LPA). In Wales, Welsh Ministers have had powers to grant consent to generating stations with an output of between 10MW and 350MW. The Planning Act does not apply to Scotland. Scottish planning is devolved and so the Scottish Authorities are responsible for taking planning decisions. Energy policy is, however, a reserved matter which means that all decisions about power stations there are taken under the Electricity Act 1989.

55. Government recognises that the NSIP system needs reform. Whilst it has been successful in its original aim of making nationally significant planning decisions as fair and as efficient as possible, supported by National Policy Statements, many decisions are being delayed and the process is struggling to cope with increased volumes and increased complexity. For that reason, a number of changes are already underway.

Fast-tracking the consenting process

56. The Department for Levelling Up, Housing and Communities (DLUHC) is bringing forward operational reforms to support faster consenting with an emphasis on delivering proportionate examinations for all projects; strengthening pre-application advice and introducing a fast-track consenting timeframe for projects that meet quality criteria; improve system-wide capacity and capability, including through greater community and local authority engagement; developing skills and training; and extending proportionate cost recovery by PINs and key statutory consultees to support effective preparation and examination of NSIPs and build resilience into the system.

57. Government is already:

a. Increasing the number of NSIP Inspectors, which has already increased by 70% since Spring 2023, with a further increase by Spring 2024.

b. Providing £2.7 million of funding to local authorities through our Innovation and Capacity fund. This will deliver 22 projects, enhancing the ability of local authorities to engage in the DCO process.

c. Providing £5.6 million additional funding for reform of the digital transformation of the PINS processes, increasing productivity, speed and the transparency of NSIP application handling

d. Reforming environmental assessment. Through the Levelling Up and Regeneration Act 2023, we have legislated to introduce Environmental Outcome Reports (EOR) to replace the EU systems of Strategic Environmental Assessment (SEA) and Environmental Impact Assessment (EIA). EOR will

streamline the environmental assessment process, placing the government's environmental commitments at the centre of decision making.

e. Improving capacity and capability of statutory nature conservation bodies in the planning system through the introduction of cost-recovery, allowing services resourcing to meet demand. This will be accompanied by performance monitoring arrangements that ensure bodies are held accountable for performance. These bodies are also undertaking workforce planning to better understand how to overcome a challenging recruitment market.

Strengthening National Policy Statements

58. In line with recommendations from the National Infrastructure Commission (NIC)[8] and Electricity Networks Commissioner[9], government has published and laid before Parliament an Overarching National Policy Statement for Energy[10] (including nuclear energy) and a suite of NPSs for technologies such as renewables, networks, and oil and gas pipelines. The Overarching National Policy Statement for energy introduces a new policy presumption of 'Critical National Priority' for consideration into the planning system; once designated, this will apply to all low carbon energy infrastructure including nuclear power. The concept of Critical National Priority does not remove any of the current requirements to assess all negative impacts and weigh these up in the planning balance, following the well-understood mitigation hierarchy. Critical National Priority makes it clear that where a decision is a closely balanced one, and some residual impacts remain which cannot be mitigated, the urgent priority for this infrastructure will normally be assumed to outweigh such impacts.

59. But more is needed. As set out in the Autumn Statement, government is raising its ambition and focussing as an urgent priority on electricity networks. This was set out in the report by the Electricity Networks Commissioner and in the government's response: the Transition Acceleration Action Plan[11].

60. Government is committed to a more strategic approach to spatial planning that will enable industry certainty over where new infrastructure will be, increasing efficiency in the system and resulting in cheaper transmission costs for generators and consumers of electricity. This will include the production of a Strategic Spatial Energy Plan (SSEP), designed to bridge the gap between government policy and Network Development Plans. Under this proposal, government targets across the whole energy system would be spatially mapped across Great Britain over several years. This plan would then act as a reference case from which individual plans (for example, the Centralised Strategic Network Plan; Hydrogen and CO_2 network plans, regional strategic plans) could be produced.

61. Such reforms are vital to the nuclear industry: the grid is the backbone of the system and if there are backlogs and delays to new connections, the new nuclear generating plant will not be able to make the much-needed contribution to a secure, low carbon electricity system.

[8] https://nic.org.uk/studies-reports/infrastructure-planning-system/delivering-net-zero-climate-resilience-growth/
[9] https://www.gov.uk/government/publications/accelerating-electricity-transmission-network-deployment-electricity-network-commissioners-recommendations
[10] https://www.gov.uk/government/collections/national-policy-statements-for-energy-infrastructure
[11] https://www.gov.uk/government/publications/electricity-networks-transmission-acceleration-action-plan

A new approach to siting

62. There are also changes that can be made to the planning system for the nuclear industry in particular.

63. Government is proposing to amend the threshold for NSIPs in England to bring all nuclear reactors, regardless of energy output, into the national planning process for the first time. At present, any projects to deploy reactors with a generating output of less than 50MW would in theory progress through local planning routes unless they specifically applied to be treated as Nationally Significant Infrastructure. However, government recognises that ANTs are needed alongside traditional nuclear in order for us to meet our ambition to have deployed up to 24GW by 2050, and that considerations around nuclear safety and security, environmental impacts and operational requirements are similar for both ANTs and GW-scale power stations.

64. Government will produce a new National Policy Statement for new nuclear power generation. *A new National Policy Statement for new nuclear power generation: consultation on the new approach to siting beyond 2025*, published alongside this document, sets out the possible routes for such projects to be considered by the Secretary of State. Government will gather public views on those proposals through the responses to that consultation.

Reforming the planning process and launching a smarter regulation challenge

65. In addition to the reforms already underway, government is considering what further changes are needed to the Planning Act 2008 itself to ensure that more innovative designs of nuclear power station, such as those which may provide high grade heat for industrial processes are captured by the NSIP definition.

66. Nuclear DCO applications are complex and involve large volumes of materials; there were over 40,000 pages of documentation provided as part of the Environmental Statement in respect of the recent Sizewell C (SZC) application. Such high regulatory burdens could be a barrier to speedy and efficient decision-making.

67. This can in part be addressed by the reforms described above, especially with the focus on earlier and more constructive engagement at the pre-application stage, involving the Applicant, PINS, and the Statutory Environmental Bodies. However, government is keen to go further in ensuring the process is proportionate. We are looking closely at recent changes to EU law in respect of how Environmental Assessment and habitats requirements apply to essential low-carbon energy infrastructure, and considering a range of options to ensure our own home-grown system works more efficiently while retaining the key elements of environmental protection and engagement with local communities.

68. However, we want to do even more so, as set out previously, we are launching a new smarter regulation challenge for industry to help us identify further opportunities to streamline smarter regulation and drive efficiencies in the deployment of new projects. Government is keen to understand gaps and overlaps between planning and permitting and could support a streamlining approach to create process efficiencies. Government strongly believes that there are better ways of achieving the right outcomes than requiring ever-increasing amounts of documentation and ever longer planning processes.

Question 10: Following government's streamlining work to date, do you agree the next phase should focus on improving the efficiency of existing processes? Please explain your answer.

Legislation

69. In addition to licensing, environmental permitting and development consent, nuclear projects and companies involved in those projects are subject to a broad suite of nuclear and non-nuclear specific legislation.

70. Vendors and prospective developers should familiarise themselves with the legal obligations in these areas: nuclear and wider energy legislation, health and safety legislation, environmental and radiation legislation, company law, siting legislation, export control legislation and security and non-proliferation legislation. A non-exhaustive list of potentially relevant legal instruments is summarised below in Figure 2.

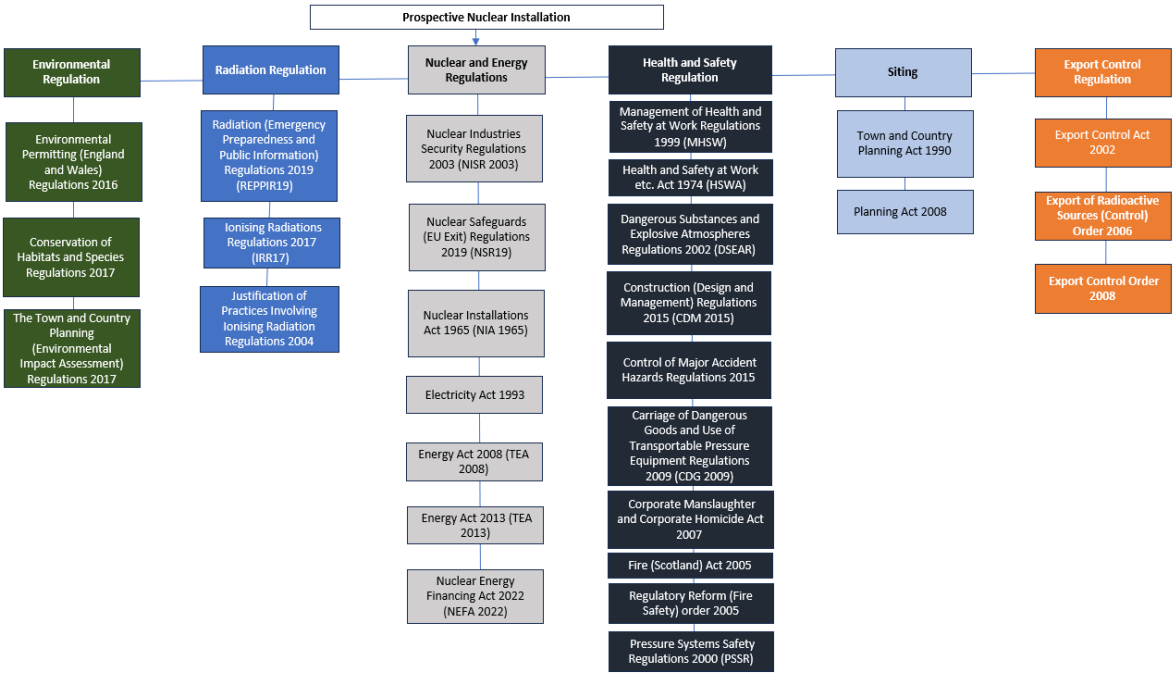

Figure 2: Non-exhaustive list of legislative instruments relevant to nuclear installations

71. Government's view is that ANTs and new uses of nuclear are accommodated with the existing legal landscape.

Question 11: To what extent do you agree that advanced nuclear technologies and new uses of nuclear are accommodated within the existing legal landscape? Please explain your answer.

Early engagement with the regulators

72. Government and the regulators encourage prospective vendors and project developers to engage with the regulatory system as early as possible. This helps regulators build an awareness of innovations in the sector and supports vendors and developers to build in regulatory requirements by design earlier in the process. Government is supportive of fostering these relationships and has previously provided funding for regulatory engagement, for example through the AMR Feasibility and Development Initiative.

73. The regulators have been designing an optional framework for early engagement between the regulators and industry so that pre-regulatory engagement is more widely available to the sector. Government envisages that industry may wish to access this prior to

applying for GDA or statutory Nuclear Site Licensing. The regulators will launch an initial version of this service in 2024 with the intention of continuous review to ensure the approach meets the user's needs. This early engagement service will consist of three tiers of engagement for the vendor or project developer to choose from. These engagements will be funded by the vendors or development company on a cost recovery basis via a charging agreement with the regulators.

74. This engagement approach could include the following:

a) **One Day Engagement** – Single engagement events for regulators to present on UK regulatory processes and expectations, including the regulatory approval route options. The vendor / development company could present on their proposals and there could be a two-way question and answer session.

b) **Multi-day Technical Engagement** – Technical engagements would allow the regulators to deepen their understanding of the technology and allow for a more detailed discussion on the safety, security, and environmental aspects of the proposed development. Technical engagements with the vendor would be conducted through a staged approach:

   i. Initial contact and preparation;

   ii. Main technical engagement (consisting of potentially ten sessions of 2-4 hours); and

   iii. A close-out session.

c) **Preliminary Design Review** – A preliminary design review would enable the regulators to provide tailored guidance to vendors, so that vendors can identify gaps in regulatory expectations and develop plans to resolve these gaps. Vendors would have the opportunity to respond to regulators comments and discuss solutions with the regulators. This approach could include:

   i. An introductory session;

   ii. A design familiarisation session for the regulators;

   iii. Several submissions from the vendor; and

   iv. A summary report from the regulators.

Question 12: What are the opportunities and the challenges of the proposed engagement approach? Please explain your answer.

Securing safe nuclear operations

Security

75. The UK's domestic security regime, which addresses cyber, physical and personnel security, is recognised internationally as being world leading. Central government departments work collaboratively with the ONR, the Security Services and the civil nuclear industry itself to ensure that the posture adapts to emerging threats in an effective way to

ensure the in-built security of the current and future nuclear infrastructure. Government actively supports the IAEA in building security capability globally and collaborates closely with international partners to ensure our approach to security continues to reflect best practice.

Managing radioactive waste and spent nuclear fuel

76. The UK is developing an integrated waste management approach that will ensure we use the most effective waste management approaches for the distinct types of waste that we have to deal with, both now and in the future.

77. It is important that developers of ANT plan at the outset for how they will manage and dispose of the spent fuel and radioactive waste from their technologies. This means having arrangements in place for conditioning the waste and spent fuel into a suitable form for packaging and storage before it can be disposed of. It is government policy that the most hazardous radioactive waste and spent fuel, should there be no further use found for it, is disposed in a Geological Disposal Facility (GDF).

78. A process is well underway to identify a site that has suitable geology and the support of a local community in which to develop a GDF. It is expected that a GDF will be operational in the 2050s. Until then, radioactive waste and spent fuel can be stored safely and securely in specially designed storage facilities.

79. Waste and spent fuel from ANTs will need to undergo a disposability assessment by Nuclear Waste Services to ensure it is suitable for disposal.

Nuclear safeguards

80. Nuclear safeguards are a fundamental component of the global nuclear non-proliferation regime and are underpinned by the Treaty on the Non-Proliferation of Nuclear Weapons. They consist of accounting, inspection, and verification processes which enforce international commitments that civil nuclear material is not diverted from peaceful uses to nuclear weapons or other nuclear explosive devices.

81. The UK is a strong advocate and supporter of non-proliferation and the international nuclear safeguards system. We have our own robust domestic nuclear safeguards regime that ensures all our international nuclear safeguards obligations are met. ONR is the UK’s safeguards regulator, and part of the UK’s system of accounting for, and control of, nuclear materials. Consideration of nuclear safeguards at the early design phases has significant advantages, such as reducing costs, and allowing for smoother international export, as nuclear safeguards are essential for a successful civil nuclear industry both in terms of operations and trade.

82. As an active member of the IAEA, the UK is contributing to the work of the IAEA in facilitating the safe and secure deployment of SMRs and other advanced reactors through various initiatives. This includes participation in the IAEA’s Nuclear Harmonisation and Standardisation Initiative (NHSI), which is finding common ground among regulators, designers, operators, and other stakeholders to support the safe and secure deployment of advanced reactors, including SMRs. Through the UK's nuclear safeguards support programme (part of the Member State Support Programmes for IAEA Safeguards), the UK also contributes expertise and advice for the further development of efficient and effective techniques and methods for the application of nuclear safeguards, as part of the diverse and evolving use of nuclear technology.

Question 13: Are there new or additional nuclear safeguard challenges associated with ANT innovation and/or new uses of nuclear energy? Please explain your answer.

Chapter 2 Question Summary

Question 8: To what extent do you agree that the current regulatory pathways cover new uses? Are there any areas that are not covered? Please explain your answer.

Question 9: What, if any, are the main opportunities and challenges for streamlining regulation while maintaining high standards of safety, security and environmental protection? Please explain your answer.

Question 10: Following government's streamlining work to date, do you agree the next phase should focus on process efficiencies? Please explain your answer.

Question 11: To what extent do you agree that advanced nuclear technologies and new uses of nuclear are accommodated within the existing legal landscape? Please explain your answer.

Question 12: What are the opportunities and the challenges of the proposed engagement approach? Please explain your answer.

Question 13: Are there new or additional nuclear safeguard challenges associated with ANT innovation and/or new uses of nuclear energy? Please explain your answer.

Chapter 3: Bringing projects to market

Supporting private investment

83. Government recognises that to deliver our nuclear ambitions will require progress on all fronts. We have launched GBN to help achieve up to 24GW of nuclear generating capacity by 2050. We recognise, however, that our task will be easier if GBN's work is complemented by privately led projects, and that many of the uses highlighted in chapter 1 are demand-led and require industry to take the lead. It is therefore vital that we create a policy environment that enable routes to market for private developers.

84. We know a number of technology vendors are looking to commercialise their products and, as set out in this document and the accompanying *Civil Nuclear Roadmap to 2050*, we are already taking a number of steps that will help support investment, as set out in the Introduction to this consultation.

85. We are keen to hear views on what the market can deliver in relation to the key building blocks of a nuclear project (for instance developer capability), and what further policy action could be put in place to support commercial deployment of ANTs. We are also interested in market views on the role of GBN in relation to the development of ANTs - beyond their existing role driving the SMR Programme.

86. The rest of this chapter is focused on investment challenges, and the mechanisms government has already introduced to support nuclear investment.

Question 14: What else should government do to ensure that new nuclear projects can be brought to market? Please explain your answer.

Investment challenges

87. One key area where we know industry needs government support is in developing a business model. Nuclear new build projects possess unique challenges that translate into financial risks and adversely impact investor and developer appetite. Compared to non-nuclear generation projects, nuclear projects are typically characterised by:

a. High upfront capital investment costs and back-loaded decommissioning and waste disposal costs. These costs are especially uncertain for Advanced Nuclear Technologies (ANTs).

b. Long construction periods with a history of delays and cost overruns.

c. Complex but necessary safeguarding, permitting, and licensing regimes.

88. ANTs represent a new approach to nuclear technology and, whilst there are more than 80 designs and concepts[12], none have been commercially deployed anywhere in the world[13]. Some projects are now underway, but no commercial unit is expected to deploy until the late 2020s at the earliest. For example, the GE-Hitachi SMR being built for Ontario Power Generation in Canada has a target deployment date of 2029. This means that ANTs face financing risks associated with First of a Kind (FOAK) technology.

89. This section examines how government can support vendors and developers in financing and funding ANTs. Financing is defined as the means by which the upfront capital investment is raised (e.g. equity; debt), while funding is the revenue stream which repays the finance (e.g. sales). We are particularly interested in views on how government can support ANTs being brought to market without GBN support and/or government capital.

90. The rest of this chapter distinguishes between projects that aim to sell electricity to the grid and direct, private arrangements between energy intensive consumers and producers.

Revenue Support Mechanism

91. This section covers government funding models to support nuclear projects providing grid electricity, with a focus on Revenue Support Mechanisms. Large energy projects that aim to sell electricity to the grid invariably require long-term certainty regarding the price of the electricity they sell. This has been instrumental in enabling the development of the UK's large and successful renewable sector and we believe it is also true of nuclear projects. This is not unique to energy projects; government funding models are an established tool for helping projects in many technology sectors overcome investment risks, enabling the markets to bring forward capital needed to finance high-cost infrastructure.

92. Government legislates to enable funding models where they are needed. Legislation typically allows the contractual terms and conditions to be negotiated between a project developer and government or a specified non-departmental public body. A key part of government funding models is the Revenue Support Mechanism. This is the mechanism that gives investor certainty on the return they could make if the project is delivered and operates successfully.

Contracts for Difference and Regulated Asset Base

93. Contracts for Difference (CfDs), under which developers receive a guaranteed strike-price or generated electricity, have underpinned the renewables transition. The CfD model has supported the development of Hinkley Point C.

94. Under the CfD model, developers receive a guaranteed strike price for generated electricity. They only receive payments when the plant is operational.

[12] https://www.iaea.org/topics/small-modular-reactors

[13] Small nuclear plants have been deployed (e.g., in China and Russia) but it is not clear that these are modular, i.e. that they use factory-built components that are manufactured offsite and assembled onsite, which is the element of SMRs that is revolutionary and expected to reduce time and cost.

95. Whilst many ANTs have smaller designs with faster construction times than GW-scale technologies, the risk profile on all new nuclear projects may make it more difficult for developers of nuclear projects to secure private investment through a CfD.

96. An alternative approach to a Revenue Support Mechanism is the Regulated Asset Base (RAB), which has been used successfully in other sectors, for example in the development of the Thames Tideway Tunnel. A process by which RAB could be applied to new nuclear projects was established by the Nuclear Energy (Financing) Act 2022 (NEFA)[14].

97. Like the nuclear CfD model, the nuclear RAB model has the potential to reduce the cost of private finance for new nuclear projects by sharing risk between investors and consumers. Unlike the CfD model, the RAB model also allows the generating company to receive payments during construction. For this reason, the RAB may be better suited to projects that carry a high degree of cost and schedule risk during the construction phase.

98. The RAB model also has the potential to reduce the costs of capital compared to a CfD by providing for consumers to share construction risks and providing investors with a return during construction. This should benefit consumers through lower bills.

99. Government has published detailed guidance on the operation of the nuclear RAB model, covering procedure and criteria for designation[15], nuclear RAB revenue stream regulations[16] and development costs and nuclear RAB model[17].

Other potential structures

100. Government is aware of several other potential structures, some of which were considered by the Expert Finance Working Group on Small Reactors in 2018[18]. These include a Power Purchase Agreement (PPA), the Mankala model used in the Finnish electricity sector, and the Exceltium model established between 2005 and 2010 to address the increasing energy prices in France.

101. Government is not currently considering introducing a new Revenue Support Mechanism beyond CfD and RAB. However, government will consider any evidence brought forward during this consultation on whether different structures and Revenue Support Mechanisms may be suitable.

Question 15: What, if any, structures do you think are appropriate for advanced nuclear technologies? Please explain your answer.

Beyond first-of-a-kind

102. Government funding models are tools to help investors manage risk, enabling infrastructure projects with high upfront capital costs to be financed at lower cost than would be the case in their absence. This should ultimately reduce costs to consumers. It is also the

[14] https://www.legislation.gov.uk/ukpga/2022/15/contents/enacted
[15] https://www.gov.uk/government/publications/nuclear-regulated-asset-base-rab-model-statement-on-procedure-and-criteria-for-designation
[16] https://www.gov.uk/government/consultations/revenue-stream-for-the-nuclear-regulated-asset-base-rab-model
[17] https://www.gov.uk/government/publications/development-costs-and-the-nuclear-regulated-asset-base-rab-model
[18] https://www.gov.uk/government/groups/expert-finance-working-group-on-small-reactors

case that investment risk should decline as technologies mature and developers learn and implement efficiencies.

103. As government evaluates the potential business model for ANTs, we need to consider how the model could adapt as the market develops and later iterations of a design benefit from the learning and experience of successful deployment. Future projects should be less risky (as problems are ironed out and risks better understood) and quicker (as the manufacturing and construction processes become more familiar). It is therefore possible that later projects will need less government support. Government is seeking views on how to design a business model for ANTs that is adaptable to the reduced investment risk we expect to see as SMRs and AMRs prove themselves.

Question 16: What are some key areas government should consider in a potential business model to bring a first-of-a-kind project to market? Please explain your answer.

Question 17: How do you think the support required for projects should differ for later, nth-of-a-kind projects compared with a first-of-a-kind project? Please explain your answer.

Privately Financed and Funded Projects

104. This section considers the role that government may have in mitigating financial risks arising from privately financed and -funded projects. 'Privately financed' means that all the up-front capital is raised privately, whilst 'privately-funded' refers to arrangements where the stream of revenue used to pay down the finance (i.e. to compensate investors) is via a private contract between an energy consumer and an energy producer (e.g. an industrial consumer buying heat and power from the operator or a nuclear plant).

105. The lower absolute cost of SMRs and AMRs means it may be possible for a developer to raise the necessary capital to finance a private nuclear project. This may take the form of a major user of heat and/or power building and operating a nuclear plant, but we think it is more likely that there will be a separation between the owner/operator of the plant and the consumer of the heat or power it generates. In either case, risk will largely sit with the investors. Government welcomes privately financed projects and believes that, when investors have the appetite to take on investment risk, they should be able to do so.

106. Nonetheless, there are certain financial risks that the private sector cannot fully mitigate. One area of risk to taxpayers is nuclear insolvency. Were a nuclear plant to become insolvent and the operator to cease trading, government might be required to step in to ensure the safe closure and decommissioning of the site. This would impose costs on taxpayers and therefore it is right for government to take steps to minimise the risk of insolvency. Revenue Support Mechanisms provide some protection against insolvency but would not be applicable where a project was entirely privately funded.

107. Government believes that private contracts cannot provide the same level of financial security as a Revenue Support Mechanism backed by government: for example, even where an offtake agreement were signed between an energy consumer and a nuclear plant, a private offtake agreement could not protect the nuclear plant from the consumer itself becoming insolvent. In addition, many industrial operations/factories have shorter lifespans than nuclear plants.

108. For this reason, government will need to be satisfied that any nuclear plant is on a sufficiently sound financial footing for the lifespan of the plant and that any projects with nuclear risks can demonstrate that public risks are effectively managed, even where government itself is not a party to the contract.

Question 18: What financial risks sit with government and cannot be transferred to private actors? What is the minimum protection that government will need to provide to mitigate financial risks to taxpayers? Please explain your answer.

Question 19: How should government mitigate insolvency risk at privately funded nuclear plants? How can this be achieved without imposing undue costs on taxpayers? Please explain your answer.

Question 20: What support infrastructure, or other enablers, would help bring projects to market, in addition to those highlighted above? Should government introduce measures to help private developers bring projects to market? Please explain your answer.

Negotiating with government

109. Government anticipates that in most circumstances a prospective nuclear project will likely need to negotiate with government. This could be to negotiate a public funding model/Revenue Support Mechanism as we have seen with recent new nuclear projects like Hinkley Point C. Or it may be that developers need to negotiate with government about how taxpayers will be protected in privately financed and -funded projects. Government welcomes views on the need for such negotiations and what the process for starting and carrying out negotiations could be.

110. Government is keen to enable the market to bring forward projects so that they may support the UK's decarbonisation and energy security objectives and so we are wary about setting so high a hurdle that it acts as a barrier to good projects. However, government also believes that a reasonably high bar should be set for projects seeking to enter these types of negotiations because of the risks that may fall to taxpayers.

111. The experience of nuclear projects to date demonstrates that, for government to enter substantive negotiations with a project, the project must have a reasonable level of maturity. This allows government to have a better sense of a project's prospects of success, the key challenges that need to be addressed and likely levels of government support required.

112. The Nuclear Energy (Financing) Act 2022, and *The Nuclear RAB model: statement on procedure and criteria for designation*[19] set out a potential model we could consider adopting or adapting for future ANT project negotiations. The Act and *The Nuclear RAB model: statement on procedure and criteria for designation* specify the process and criteria by which the Secretary of State would designate a nuclear company under subsection (1) of the Act in the case of projects seeking to negotiate a RAB. Only once a project has met the criteria and been designated would it be appropriate for government to enter substantive negotiations with the project developer.

[19] https://www.gov.uk/government/publications/nuclear-regulated-asset-base-rab-model-statement-on-procedure-and-criteria-for-designation

113. We welcome views on the criteria that should apply to projects seeking to negotiate with government.

Question 21: To what extent do you agree that government will always need to put measures in place to protect citizens, consumers, and taxpayers, even where a nuclear project is entirely privately financed? Please explain your answer.

Question 22: To what extent do you think companies wishing to negotiate with government should be tested against suitability criteria before entering negotiations? Please explain your answer.

Question 23: What do you think the criteria should be to warrant entering negotiations with government? Please explain your answer.

Chapter 3 Question Summary

Question 14: What else should government do to ensure that new nuclear projects can be brought to market? Please explain your answer.

Question 15: What, if any, structures do you think are appropriate for advanced nuclear technologies? Please explain your answer.

Question 16: What are some key areas government should consider in a potential business model to bring a first-of-a-kind project to market? Please explain your answer.

Question 17: How do you think the support required for projects should differ for later, nth-of-a-kind projects compared with a first-of-a-kind project? Please explain your answer.

Question 18: What financial risks sit with government and cannot be transferred to private actors? What is the minimum protection that government will need to provide to mitigate financial risks to taxpayers? Please explain your answer.

Question 19: How should government mitigate insolvency risk at privately funded nuclear plants? How can this be achieved without imposing undue costs on taxpayers? Please explain your answer.

Question 20: What support infrastructure, or other enablers, would help bring projects to market, in addition to those highlighted above? Should government introduce measures to help private developers bring projects to market? Please explain your answer.

Question 21: To what extent do you agree that government will always need to put measures in place to protect citizens, consumers, and taxpayers, even where a nuclear project is entirely privately financed? Please explain your answer.

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Question 23: What do you think the criteria should be to warrant entering negotiations with government? Please explain your answer.

Chapter 4: Supporting future technology

Research & Development

114. Government is committed to innovation in Advanced Nuclear Technologies (ANTs) and has launched over twenty Research and Development (R&D) programmes since March 2018 to develop advanced nuclear and associated technology, reduce risk and encourage private sector investment. Government recognises that R&D is crucial to enable success in new nuclear and government's aim is to enable R&D across the sector.

115. The 2020 Energy White Paper and the Ten Point Plan for a Green Industrial Revolution established a £385m Advanced Nuclear Fund (ANF) to support the development of both Small Modular Reactors (SMRs) and Advanced Modular Reactors (AMRs). Part of this fund is for the Advanced Modular Reactor Research, Development and Demonstration programme (AMR RD&D). The Net Zero Innovation Portfolio (NZIP) was also established to accelerate the commercialisation of innovative clean energy technologies, including nuclear technologies through the 2020s and 2030s. Government's overall aim is to enable an AMR Demonstration by the early 2030s.

116. The AMR RD&D programme is focussed on High Temperature Gas-cooled Reactor (HTGR) technology. Government's intention is to prove HTGR technology and build the evidence base for regulation of the First of a Kind (FOAK) and potential future fleet deployment. The preference for HTGRs is for this programme only. Focussing government's RD&D funding on one technology family is intended to deliver a higher impact compared to spending more diffusely across the AMR sector. Government has chosen to focus on HTGRs because the UK has unique experience operating gas reactors at scale and because the temperature of HTGR heat output opens the broadest range of potential industrial applications. However, government continues to support the development of the full spectrum of ANTs and welcomes private sector R&D in other technology types.

117. The AMR RD&D Programme focusses on High Temperature Gas Reactors (HTGR). A key criterion, against which the projects are continuously monitored, is value for money, including an assessment of *additionality*. The Programme is set up with a phased-approach: funding, planning and approvals decisions are made between each phase; these would include an assessment of the current state-of-the-market. If a private/commercial entity could provide a solution that met the Programme aims, objectives, and market needs, then future phases would no longer be necessary.

118. Government is also committed to R&D for innovative and advanced fuel manufacture and fuel performance demonstration, for example Tri-Structural Isotropic (TRISO) Coated Particle Fuel (CPF), which has been deployed previously in test and demonstration reactors, in particle qualification programmes, and is currently undergoing development ahead of qualification by fuel developers.

119. Previous funding through the Advanced Fuel Cycle Programme (AFCP) and current CPF programme funding has focussed on the Uranium Dioxide (UO_2) kernel variant. There is a benefit of continuing to scale up the process for UO_2 kernels, coated particles, and compacts for this programme – which will also provide a diversity of choice and value for money, in the global CPF market. The focus on High – Assay Low Enriched Uranium, (HALEU) UO_2 will

complement uranium oxycarbide (UCO) products that are being developed in the US and will provide diversity to the market as well as a faster scale-up process.

120. Government is committed to building on our existing support for the sector and welcomes views on what further support we can offer.

Question 24: What further steps should government take to support R&D for Advanced Nuclear Technologies? Please explain your answer.

Infrastructure and supply chain

121. As the ANT sector grows, government anticipates that there will be an increase in demand for the advanced nuclear supply chain. The UK already has a wide range of nuclear R&D facilities held by the National Nuclear Laboratory (NNL) and other Public Sector Research Establishments (PSREs), academia and the private sector. These facilities support academic and laboratory-based nuclear R&D, with the UK being highly regarded globally for the quality of our nuclear research. This is one of the reasons why there is so much inward investment interest in conducting ANT R&D in the UK. However, government recognises that as the advanced nuclear sector progresses and advanced reactors climb the Technology Readiness Level (TRL) scale this may require new types of R&D infrastructure. Government is interested in gathering views on facilities, capabilities, and supply chain capacity that may be needed to support the growth of ANTs and to what extent they are currently in place in the UK.

122. It is likely that the scale of experimentation, such as the build of prototypes or demonstrators, will grow beyond the capacity of the UK's current R&D facilities. It is also the case that, as technologies move closer to commercialisation, the R&D they need to conduct will involve radioactive materials, for instance to conduct criticality experiments. This type of experimentation would constitute prescribed nuclear activities under the Nuclear Installations Act 1965 and must therefore be conducted at a regulated nuclear installation. Although companies can invest in their own nuclear licensed sites for R&D, this is costly and has a high regulatory burden.

123. In other sectors, government has seen benefits result from co-locating similar businesses, creating a fertile breeding ground for ideas, and so driving innovation. For example, the East London Tech City attracted numerous technology companies from international conglomerates to disruptive start-ups and became a centre for the FinTech industry. Government is interested in views in whether similar agglomeration benefits could be seen in the ANT sector.

Question 25: To what extent do you agree that there are current or future gaps or constraints in the UK R&D landscape for Advanced Nuclear Technologies, either for that high TRL R&D and demonstration or earlier stage R&D? Please explain your answer.

Question 26: To what extent do you agree that there are current or future gaps or constraints in the UK supply chain for Advanced Nuclear Technologies? Please explain your answer.

Chapter 4: Question summary

Question 24: What further steps should government take to support R&D for Advanced Nuclear Technologies? Please explain your answer.

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Question 26: To what extent do you agree that there are current or future gaps or constraints in the UK supply chain for Advanced Nuclear Technologies? Please explain your answer.

Consultation questions

1. **Are there any uses for nuclear energy (beyond those in this document) that you believe government should be considering? If yes, please explain what they are.**
2. **To what extent do you agree that advanced nuclear can be a valuable energy source when combined with a Thermal Energy Storage System or for co-generation? Please provide an explanation for your response.**
3. **To what extent do you agree that advanced nuclear could be a valuable energy source for large scale industry. Please provide an explanation for your response.**
4. **In your opinion, what further measures should government take to enable industrial applications of advanced nuclear? Please provide an explanation of the type of support required.**
5. **To what extent do you agree that advanced nuclear could be a valuable energy source for hydrogen and synthetic fuel production? Please explain your answer.**
6. **To what extent do you agree government should explore the opportunity of using nuclear plants to provide district heating to help decarbonise our domestic and commercial buildings? Please provide an explanation and include suggestions on mitigating any potential barriers.**
7. **What do you think are the opportunities and challenges associated with other potential uses for nuclear power? Please explain your answer.**
8. **To what extent do you agree that the current regulatory pathways cover new uses? Are there any areas that are not covered? Please explain your answer.**
9. **What, if any, are the main opportunities and challenges for streamlining regulation while maintaining high standards of safety, security and environmental protection? Please explain your answer.**
10. **Following government's streamlining work to date, do you agree the next phase should focus on process efficiencies? Please explain your answer.**
11. **To what extent do you agree that advanced nuclear technologies and new uses of nuclear are accommodated within the existing legal landscape? Please explain your answer.**
12. **What are the opportunities and the challenges of the proposed engagement approach? Please explain your answer.**
13. **Are there new or additional nuclear safeguard challenges associated with ANT innovation and/or new uses of nuclear energy? Please explain your answer.**
14. **What else should government do to ensure that new nuclear projects can be brought to market? Please explain your answer.**
15. **What, if any, structures do you think are appropriate for advanced nuclear technologies? Please explain your answer.**

16. **What are some key areas government should consider in a potential business model to bring a first-of-a-kind project to market? Please explain your answer.**

17. **How do you think the support required for projects should differ for later, nth-of-a-kind projects compared with a first-of-a-kind project? Please explain your answer.**

18. **What financial risks sit with government and cannot be transferred to private actors? What is the minimum protection that government will need to provide to mitigate financial risks to taxpayers? Please explain your answer.**

19. **How should government mitigate insolvency risk at privately funded nuclear plants? How can this be achieved without imposing undue costs on taxpayers? Please explain your answer.**

20. **What support infrastructure, or other enablers, would help bring projects to market, in addition to those highlighted above? Should government introduce measures to help private developers bring projects to market? Please explain your answer.**

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22. **To what extent do you think companies wishing to negotiate with government should be tested against suitability criteria before entering negotiations? Please explain your answer.**

23. **What do you think the criteria should be to warrant entering negotiations with government? Please explain your answer.**

24. **What further steps should government take to support R&D for Advanced Nuclear Technologies? Please explain your answer.**

25. **To what extent do you agree that there are current or future gaps or constraints in the UK R&D landscape for Advanced Nuclear Technologies, either for that high TRL R&D and demonstration or earlier stage R&D? Please explain your answer.**

26. **To what extent do you agree that there are current or future gaps or constraints in the UK supply chain for Advanced Nuclear Technologies? Please explain your answer.**

27. **Please add any comments or reflections which have not been covered in the previous questions.**

28. **The Public Sector Equality Duty (PSED) requires government to have due regard to the need to eliminate unlawful discrimination, harassment, victimisation, and other conduct prohibited by the Equality Act 2010, advance equality of opportunity between people who share a protected characteristic and those who do not and foster good relations between people who share a protected characteristic and those who do not.**

Protected characteristics include age, gender reassignment, being married or in a civil partnership, being pregnant or on maternity leave, disability, race, religion or belief, sex, and sexual orientation.

Do you have any views about the implications of the policy measures explored in this consultation on people with protected characteristics? If you have identified any positive or negative impacts in the consultation, please provide any relevant evidence.

29. **The Environment Act 2021 sets out a legal duty for government ministers to have due regard for the Environmental Principles Policy Statement (EPPS) when making policy.**

    Do you have any views about the implications of the policy measures explored in this consultation on environmental protection? If you have identified any positive or negative environmental impacts in the consultation, please provide any relevant evidence.

Glossary

Advanced Modular Reactors (AMRs): A broad category of advanced nuclear reactors, the reactors use novel and innovative fuels, coolants, and technologies to generate low carbon electricity, and take advantage of the same modular-build principles as SMRs.

Advanced Nuclear Fund (ANF): A fund with up to £385 million dedicated to supporting the investment of the next generation of nuclear technologies.

Advanced Nuclear Technologies (ANT): Refers to innovative approaches in nuclear energy, it encompasses a wide range of nuclear reactor technologies under development including SMRs, AMRs, and MMRs.

Advanced Fuel Cycle Programme (AFCP): A programme focusing on advanced fuel manufacturing.

As Low As Reasonably Practicable (ALARP): A principle in nuclear safety that suggests efforts to reduce risk should be continued until the incremental sacrifice in doing so is disproportionate to the value of the incremental risk reduction.

Base Load: The consistent, stable supply of electricity to the national grid, typically provided by traditional nuclear power plants.

Contracts for Difference (CfD): A funding model in which developers receive a guaranteed strike-price for generated electricity based on their estimate of the cost of building and operating a specific project.

Decarbonisation: The process of reducing or removing carbon dioxide (CO_2) and other greenhouse gas emissions into the atmosphere.

District Heating: A system that distributes heating from an energy source via a network of pipes (the ‘heat network’) connecting industrial and residential buildings in a locality.

Fast Spectrum Reactors: A category of nuclear reactors in which the fission chain reaction can be sustained by fast neutrons.

FOAK (First of a Kind): Refers to the first commercial deployment of a new technology or reactor design.

Great British Nuclear (GBN): GBN is an arms-length body responsible for helping drive the delivery of new nuclear projects.

Generic Design Assessment (GDA): A voluntary process conducted by the nuclear regulators to review the safety, security, and environmental protection aspects of new reactor designs on a generic basis, in advance of site or operator specific proposals.

Geological Disposal Facility (GDF): A highly engineered facility designed to isolate and contain radioactive waste deep underground in a suitable geological formation, ensuring that no harmful quantities of radioactivity reach the surface.

Micro Modular Reactors (MMRs): MMRs are a subset of SMRs and AMRs with smaller generating capacity.

Nth-of-a-Kind (NOAK): Subsequent deployments of a technology that has been proven and is considered less risky.

Nuclear Decommissioning Authority (NDA): A government body responsible for managing and cleaning up the UK's former nuclear sites and land safely, securely and with cost effectiveness.

Nuclear Site Licence (NSL): A requirement under the Nuclear Installations Act 1965 (NIA 1965) for installing and operating nuclear reactors in the UK.

Office for Nuclear Regulation (ONR): The UK's independent nuclear regulator responsible for assessing and granting nuclear licenses.

Power Purchase Agreement (PPA): A contract where a generator sells electricity or heat directly to an industrial consumer for a fixed price and duration.

Pulp and Paper: An industrial sector that produces paper products and uses wood as a raw material.

Regulated Asset Base (RAB): A funding model treating a nuclear project as a regulated asset, enabling consumers to share construction risks and providing investors with a return during construction.

Revenue Support Mechanism: A mechanism that gives investor certainty on the return they could make if the project is delivered and operates successfully.

Small Modular Reactors (SMRs): Compact nuclear reactors designed to generate electricity with a smaller footprint compared to traditional nuclear power plants.

Spent Fuel: Nuclear fuel that has been used in a reactor and is no longer efficient in sustaining a nuclear chain reaction.

Synthetic Fuels: Man-made fuels often produced using hydrogen, carbon dioxide, and heat.

Technology Readiness Level (TRL): A method for estimating the maturity of technologies, with higher levels indicating more mature technologies.

Thermal Energy Storage (TES): A technology that stores thermal energy for later use.

Thermal Spectrum Reactors: A reactor that has been arranged in such a way to optimally ‘cool’ the neutrons so they can cause fission.

This consultation is available from: www.gov.uk/government/consultations/alternative-routes-to-market-for-new-nuclear-projects

If you need a version of this document in a more accessible format, please email alt.formats@energysecurity.gov.uk. Please tell us what format you need. It will help us if you say what assistive technology you use.