Written evidence submitted by the Dalton Nuclear Institute, University of Manchester[1]

Dalton Nuclear Policy Group

The Dalton Nuclear Policy Group is part of the Dalton Nuclear Institute [1] at The University of Manchester. The nuclear research community at The University of Manchester is the most advanced nuclear research capability in UK academia, hosting amongst others:

- The Beam; a collaborative, cross-disciplinary nuclear and social research network.
- The Radioactive Waste Management Research Support Office; supporting research to underpin the implementation of a UK Geological Disposal Facility.
- The Henry Royce Institute Hub; leading the UK national institute for advanced materials, which includes research into nuclear materials.

The Dalton Nuclear Policy Group regularly lends its expertise to contribute to Government consultations and calls for evidence, and regularly releases position papers on the effective delivery of nuclear energy in the UK. The views of the Dalton Nuclear Policy Group shared in this call for evidence response are developed in more detail in these position papers:

- Nuclear Energy for Net Zero: A Strategy for Action [2]
- Siting Implications of Nuclear Energy: A Path to Net Zero [3]
- Delivering Advanced Nuclear: The Role of Government [4]

Question 1: What role can, or should, nuclear power play in achieving net zero and UK energy security?

The appropriate roles of nuclear energy in achieving net zero and UK energy security have been developed through a succession of UK Government enactments and publications over the last several years. The roles comprise Three Waves:

1. Gigawatt-sized Light Water Reactors for electricity generation, such as the two reactors being built at Hinkley Point C (HPC) and those projected at Sizewell C (SZC).
2. Small Modular Reactors, again for electricity generation, such as the projected 470 MWe Rolls Royce design.
3. High Temperature Gas-cooled Reactors (HTGRs), whose main purpose will be the provision of high temperature heat to facilitate the production of hydrogen, and the decarbonisation of hard-to-decarbonise industries such as steel and glass manufacture.

This programme, and the reasons behind it, are described in Dalton Nuclear Institute's Nuclear Energy for Net Zero [2], but in short, it is very doubtful whether net zero could be

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achieved without the use of nuclear energy, particularly as nuclear is the only low carbon energy source which delivers firm power and heat, and is not dependent on the effectiveness of downstream processes (such as carbon capture and storage) to achieve low carbon performance.

The planned wave of HTGRs is the subject of a programme intended to commission a demonstration reactor by the early 2030s [4]. This Third Wave of reactors will aim to use the high temperature heat they produce to make hydrogen and other chemical products for hard-to-decarbonise industries. Wales should have an interest in HTGRs for two reasons:

1. It could provide the site for the demonstration reactor, with Trawsfynydd as an obvious candidate.
2. HTGRs sited in Wales could have a crucial role in decarbonising Welsh industries, particularly steel and other metals.

As an example for decarbonising Welsh industries, plans such as those of the South Wales Industrial Cluster [5] depend on shipping out captured carbon dioxide for underground storage elsewhere. An alternative using nuclear hydrogen would simply eliminate the generation of carbon dioxide. Clearly much assessment would be involved, but the potential advantages would be significant. A wide range of HTGR sites are being contemplated, so, both for supplying hydrogen into Wales and exporting it to England, consideration of several Welsh sites would be appropriate.

The consideration of the roles of nuclear energy in addition to firm electricity generation is being hindered by the absence of Government estimates on the possible size and geographical drivers of HTGR programmes to provide heat, especially for hydrogen generation. As indicated above, this energy requirement could have real significance for reactor development in Wales.

Question 2: What are the main challenges to delivering the UK Government's commitment to bring at least one large-scale nuclear project to final investment decision by the end of this Parliament?

This response was written just as SZC was given development consent, and so one challenge has been removed, and this should be shortly followed by the adoption of the Regulated Asset Base (RAB) funding mechanism (see below). This makes it more likely that the project to build a replica of HPC can go ahead, but on the other hand, the re-nationalisation of EDF (70% of HPC funding) may make the flow of French capital into SZC more problematic. The ongoing Government misgivings on Chinese funding also raises doubts on the other 30% of funding. While it is not impossible that one of the other projects (aside from SZC) could be revived under the next Government, it is not at all obvious how a commitment could be made on such a scheme before the last possible UK election date of January 2025.

Question 3: How important is the finance model to ensuring a successful nuclear project, and is the regulated asset base (RAB) model the best one to deliver this?

The existence of a financial model which assures an equable split of risk and return between the project entity and the Government is essential to the success of any nuclear energy project. The RAB model appears to deliver such a division, and its suitability should be tested by its adoption for the SZC project.

It is important to note that, to a large extent, 'the taxpayer' and 'the electricity consumer' are essentially the same people. Any financial model needs to provide an equable risk/return balance for the project, and consciously establish what is the split of any public burden between consumers and taxpayers. This balance will be different for the Three Waves of nuclear technology and, in particular, the relatively immature Third Wave is likely to require greater public sector support.

Question 4: What practical steps can the UK Government take to support the nuclear industry in developing a range of nuclear technologies, including small modular reactors?

Nuclear can only play a full role in net zero through extension of the nuclear energy market - from the current provision of firm electrical generation to the potentially much larger market of low carbon heat for industry, transport, and other applications, as signalled by the intended Third Wave of HTGR reactors. This potentially much enlarged market would lead to the prospect of a large number of reactors, with the associated requirement for many new reactor sites.

The UK Government should develop an integrated framework for delivery of nuclear energy in the UK to ensure the whole lifecycle is understood. The present role of the Nuclear Decommissioning Authority (NDA) is to deal with the legacy waste from the nuclear sector. It presents a 'Single-use' vision of sites rather than a dynamic system where Site 'Re-use' is part of the overall philosophy; the UK Government should integrate the NDA mission into this framework, supporting waste management and site clearance for reuse. Current knowledge of stakeholder views and values on nuclear matters is largely based on knowledge gained by the BNFL National Stakeholder Dialogue [6] which was conducted two decades ago. This should be brought up to date by a similar stakeholder study, drawing on the observations gained by the BEIS Public Dialogue on Advanced Nuclear Technologies [7].

Despite positive endorsement and favourable levelised costs of electricity, the large capital costs (dominated by the costs of financing) and long lead-times of new nuclear plants have meant that they have not been delivered by the market. Government action is clearly needed to deliver successful nuclear projects. Given that large numbers of reactors will likely be needed to achieve a net zero energy future in coming decades, effective facilitation by Government is urgently needed. Part of this role is communicating clearly future estimates of demand for nuclear energy to enable the sector to plan accordingly. Government has a role in providing certainty to the market with any decisions and future competitions they hold. Any decisions and commitments should be clear, and given the long lead-time for nuclear projects, assurance should be provided that whatever support is provided will be consistent over many years.

Competitions (such as the currently running AMR RD&D Programme [8]) have been a favoured tool of Government for encouraging R&D into new nuclear systems in recent years. Government must be careful to ensure that the competition format does not impact the effectiveness of any future nuclear fleet by being too frequent, or for too narrow a scope. The UK is following the EU in developing a taxonomy for assessing the sustainability of new endeavours. Nuclear energy is a sustainable energy source, and as such it is important that the UK assesses the sustainability benefits and drawbacks of all energy generators fairly within its upcoming taxonomy.

Question 5: What would the likely cost be to the taxpayer of the UK Government supporting the development of a new nuclear power station at Wylfa?

This will depend on the reactor(s) chosen and the financial model applied. The projected cost to the taxpayer would inevitably be a major parameter to be examined in any Wylfa nuclear power station project.

Question 6: What is the potential economic impact for Wales of a new nuclear power station at Wylfa?

Similarly, as the number of reactors, size and output of a Wylfa station are matters for speculation, then the economic impact will vary greatly, and would be a major parameter in the decision to go ahead with any scheme.

However, any nuclear station would be a significant and long-lasting infrastructure project, bringing jobs through construction, supply chain and decades of operation. A plant such as the proposed AP1000 development currently envisaged by Bechtel and Westinghouse would bring several thousand construction jobs over a 4-5 year period, along with hundreds of operational jobs which would endure for the likely 60+ years of operation. In addition, there would be positive economic effects in the local community from the secondary impact of these salaries in North Wales, and from the local development of businesses supporting the site throughout its life.

A challenge to any new project will be to ensure the maximum local content of work from the supply chain during construction, commissioning, and operation of the plant. Support in advance from Government, industry and skills providers, working together, can help to ensure many of the necessary skills are available within the local workforce.

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References

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