Written evidence from the Institution of Mechanical Engineers to the UK House of Commons Environmental Audit Committee inquiry on Small Modular Reactors in the transition from fossil fuels

6th November 2023 – information correct when written

About the Institution of Mechanical Engineers

The Institution of Mechanical Engineers (IMechE) represents 112,000 engineering professionals and students in the UK and across the world. The Engineering Policy Unit (EPU) of the IMechE informs and responds to UK policy developments by drawing on the expertise of our members and partners.

This response has been prepared by the EPU with input from the IMechE's Nuclear Power Committee. It has been informed by the Institution's 2014 Policy Statement on Small Modular Reactors, our 2017 report on Nuclear Power and our 2022 report 'Engineering a Net Zero Energy System'.[1,2,3]

Timelines

What has prevented SMRs from being established in the UK, given that the technology and fuel sources already exist, and the government has already financially supported R&D?

1. In 2014 the IMechE called for government to develop a clear pathway for engaging the nation in future emerging SMR markets.[4] In 2017 we again recommended that the development of SMRs was communicated in a clear 'roadmap',[5] something done in competitor countries like Canada.[6,7] However, a clear plan did not materialise, with some sources blaming the lack of progress on arguments over financing within government.[8] Whatever the underlying reasons, the significant inconsistency across Whitehall on the role of nuclear generally has led to the same for SMRs. A single cross-Whitehall (including advisory group) consensus agreement and resulting vision would significantly reduce the barriers to entry for SMRs.
2. Some of the structural elements required for SMR deployment due for development by Great British Nuclear (GBN) have not been in place. These include the lack of a developer organisation and operator other than EDF Energy. The single operator approach creates a challenge for projects wishing to deploy and a lack of developer organisation suggests low investment appetite.

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

3. The ongoing GBN competition provides a good opportunity to achieve the target of deployment by the mid-2030s, provided that timescales are adhered to.
4. Industry have confidence in their ability to deliver, with Rolls Royce claiming that their first SMR can be operating by 2031,[9] as once SMRs pass through regulatory stages, in theory they should be relatively quick to assemble and operationalise.
5. The government's Generic Design Assessment (GDA) may present a barrier to some designs being deployed by the mid-2030s, as only one SMR (Rolls-Royce SMR) has formally started the

process that normally takes 4-5 years to complete. Other vendors have submitted applications to start the GDA and must be suitably supported in order to make the assessment process as efficient as possible.

6. In addition to the GDA, there are multiple other potential barriers to SMR deployment by the mid-2030s that the government should establish plans to mitigate, or risk encountering later in development.
    a. Nuclear site licensing, the Development Consent Order process, and environmental permitting are all separate assessment processes that prospective bidders will face. These could all lead to delays in achieving the mid-2030s target. Site planning and ground investigation could be carried out by government early in the process to shorten deployment timescales.
    b. High resourcing requirements will be required for the building, installation, commissioning and running of each SMR. Additionally, sudden pressure on a currently low-demand supply chain could lead to issues and ultimately a rapid increase in market rates and salaries and ultimately the final price of any developed SMR.
    c. New SMRs will require new infrastructure to supply the National Grid.

SMR regulation and financing

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

7. SMRs have the potential to be a positive contributor to grid decarbonisation, but as they are in their infancy in terms of development in the UK it is unlikely that they will contribute significantly towards decarbonising the grid by 2035 in line with the current target.
8. As the UK has already approved four gigawatt-scale reactor designs for new build in the UK (all of which have passed the GDA),[10] it is likely that these will be more likely to contribute towards this 2035 target if these are selected to move forward.
9. As well as contributing to baseload electricity generation, SMRs, once developed, could be used to provide clean power to remote locations, to complement variable renewable energy, and to provide other useful services to the wide energy system, for example, district heating or hydrogen production. As these roles are significantly different to those filled by larger gigawatt scale reactors, both technologies will be important.

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

10. Publication of a clear roadmap for SMRs and how they will fit in alongside plans for larger gigawatt scale reactors is essential to increase confidence in the government's plans for the future of nuclear in the UK. This could follow Canada's example.
    a. The Science, Innovation and Technology Committee's 'Delivering nuclear power' report is correct to say that the government's clear target of a total of 24 GW of nuclear generating capacity by 2050 provides an end goal for the nuclear sector over the coming decades, however that government must provide a detailed plan in how this will be achieved. This should include how SMRs are expected to contribute towards this target and what role the current competitions for SMR development

play.[11] The IMechE flagged in its 2022 report on a Net Zero Energy System that the 24 GW target is nearly double the capacity in current planned scenarios, backing up this need for a transparent plan.[12]

b. Fleet deployment and commitment to a programmatic approach of multiple builds is a key point where the UK can learn from historic experience in Japan, South Korea and France in particular and should be included in any plan published. These countries deployed many reactor units in a relatively short period of time and as a result the overall cost per unit was reduced.

11. The UK is leading the world on policies that enable nuclear to support end-use decarbonisation through its inclusion in the Hydrogen Business Model, Renewable Transport Fuels Obligation and the proposed UK sustainable aviation fuel mandate. These policies provide nuclear with access to the hydrogen, aviation and transport sectors for the first time. As raised previously, strong cross-Whitehall collaboration between departments is essential for the SMR opportunity in these markets to be realised, leading to secure and resilient decarbonisation of sectors where emissions are hard to abate, while supporting UK jobs and investment in SMR technologies.
12. A higher degree of standardisation and de-compartmentalisation of the nuclear industry would help to accelerate the deployment of SMRs in the UK. This could follow best practice from France, where a single site owner (rather than a commercial/government split) exists, with construction, operation and decommissioning occurring on the same site. This contrasts with the UK system, in which decommissioning is exclusively managed by the Nuclear Decommissioning Authority (NDA) and its subsidiaries on their own licensed sites, which creates compartmentalisation in the nuclear industry.

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

13. As SMRs currently represent a first-of-a-kind model, the government will likely have to take on a high level of risk to ensure private investment.
    Therefore, a Regulated Asset Base (RAB) model may be suited to roll out initial SMR projects, to share the risk with private investors and get initial units running. If successful, future projects could then be supported by a model that shifts the risk back onto private investors, which due to the lower costs of SMRs when compared with larger nuclear projects should be attractive once the benefits have been demonstrated.
14. In 2018, the IMechE responded to a BEIS consultation on the RAB model for nuclear. Regarding SMRs, we stated that RAB could discriminate against small projects such as SMRs by having a long and complex process similar in time to that of a CfD. However, RAB could be a viable financing model if RAB licences could be agreed for more than one station at a time, which could take advantage of the ability to roll out SMRs quickly.
15. When considering the financing of SMRs, Deloitte point out that the level of risk transfer may not be as high for SMR development, as less capital is needed than for larger projects and the assembly and manufacturing methods of some designs may make their construction more predictable. Additionally, costs should be easier to manage on SMR projects, due to the factory manufacturing of components, the standardisation of design (that will improve through learning) and reduced construction time. These features and production through multi-unit plants should help SMRs overcome diseconomies of scale issues that have plagued large reactor construction projects. A streamlined RAB model could be employed for SMRs that take these factors into account.[13,14]

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

16. In 2014 the IMechE called for the UK Government to include within the UK's nuclear sector strategy a pathway for engaging the nation in future emerging SMR markets. Although the government has so far not delivered a plan to match this recommendation, the global SMR markets are still relatively open with only a few major players. If the UK can follow through on its promise to deliver SMRs by the mid-2030s, then it will be possible for the UK to become a leader in this technology. The export opportunities of both power generated from an SMR fleet and also expertise in the technology and supply chains could result in a significant share of the potentially large global SMR market in which the UK could still be a first-mover. However, action must be taken quickly so export opportunities are not missed, given progress being made in competitor nations.[15,16]
17. As well as export opportunities, the potential for job creation in the UK from developing SMR projects is huge, with Rolls-Royce stating in 2020 that 40,000 jobs are expected by 2035 from their project alone.[17] This relies on the UK developing a coherent plan, including how the supply chains and skilled workforce to deliver such projects and take up these jobs will be developed.
18. The benefit or cost to the public purse from nuclear projects is difficult to judge, reflected by the National Audit Office's (NAO) report on the funding method for the Hinkley Point C project.[18] The NAO judged that the project will be significantly more expensive for UK energy users than if the government had funded the project at lower financing levels, although whether the project ultimately offer value for money will not be known for decades. The government should take this into account when developing a financing method for SMRs, while also considering that deployment of multiple SMR units will present different levels of risk to projects like Hinkley Point C.

Delivery process

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

19. The current SMR competition provides a good opportunity to deliver SMRs by the mid-2030s, if timelines are adhered to and the process is clear and transparent.
    Given that over 70 SMR designs exist globally, narrowing down the field of potential suppliers at this stage is positive. Progress being made in other countries could threaten the UK's ability to secure SMR export opportunities, so the UK must use this competition to act quickly and decisively.
20. Negotiations with bidding companies must provide a level of support that is significantly large to justify the commitment from companies, in both financial and regulatory senses. The inclusion in the GBN competition of building developer and operator capability is positive and should remove future hurdles that organisations will face. Combined with the initiation of the Nuclear Skills Taskforce, these aspects should increase delivery certainty of SMRs on the noted timescales.[19]

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

21. 'First of a kind' build for a commercial SMR would be high in cost and risk.[20] Therefore, selecting more than one design to commission will increase the upfront cost to government. However, increasing the number of players in the UK SMR field may put the government at an advantage in the future when negotiating contracts with developers. As pointed out in the Science, Innovation and Technology Committee's Delivering Nuclear Power Report, previously successful financing models for renewable projects (using the CfD model) have been facilitated by competition between potential operators, which the selection of multiple designs would allow for.[21]
22. If only one design is selected, leading to the creation of one standardised fleet, any issues of failures in units would have a large impact. Unforeseen issues could then be present in the whole SMR fleet if there was no variety in design. However, selecting a single and successful design should come at a lower initial cost than selecting multiple designs, and enable economies of scale to be generated quickly, further reducing costs.
23. The government has already provided extensive support to Rolls-Royce SMR and has recently awarded Westinghouse Electric Company grants to develop nuclear fuels. Considering this, the fact that this competition is being run provides an inherent implication that more than one design will be selected. On balance, we believe this is the correct approach, as it will increase the chances of SMR deployment in the UK. As the UK is unlikely to be the first nation to deploy SMRs, ensuring that the UK quickly builds skills and experience in SMR deployment is essential and would still allow it to take a strong position in the emerging international market. Selecting more than one design will facilitate this and aid greater skills and knowledge development in the entire sector and supply chain, rather than just supporting one organisation that may look to self-perform and actually drain the UK-based skills as a result.

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

24. As the SMR technologies included in the current GBN competition are already proven, the production of prototypes is not necessary. Test rigs will be required to prove certain aspects, but overall prototyping does not make sense economically. The lack of a public acceptance issue for SMRs means that proving safety and effectiveness through a prototype is not needed and may actually be detrimental and define SMRs as immature technologies in the eyes of the public, which as stated is incorrect.
25. The modularisation approach of SMRs means that any investment to build must be underpinned by a commitment to build multiple reactors. Adding uncertainty by requiring the production of prototypes ultimately will delay the roll-out of an SMR fleet and increase the chances of SMRs not meaningfully contribute to the UK's net zero commitments.

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

26. The potential international SMR market is large and there is space within it for significant UK export opportunities, due to the relatively small number of countries developing the technology. These include energy export opportunities if a sufficiently large fleet of SMRs was developed. The IMechE's 2021 report on nuclear fusion 'Fusion Energy: A Global Effort- A UK

Opportunity' outlined that between 2040 and 2060 the potential market for nuclear energy is massive, which SMRs could support if developed.[22]

27. This will rely on the support of UK-based SMR developers and an investment in a 'British supply chain', which if done sufficiently could allow to export capacity to global civil nuclear programmes. Additionally, the UK skills pipeline will require development to take full advantage of any opportunities presented by SMRs.
28. Rolls-Royce have consistently flagged export opportunities of SMR deployment abroad, while competitors in the US have done similar based on NuScale Power technology.[23] A large number of countries in Europe and beyond may seek to phase out coal power stations, and if SMR plants can be delivered on time, the UK could take advantage of this and Russia's decreasing global standing.[24]

29. It is also worth noting that while supporting UK-based SMR developers will provide many advantageous export opportunities, supporting non-UK technologies to be built in the UK could also generate significant advantages. For example, if an international developer secured a project to build SMRs in the UK, then there is real potential for the UK supply to move to third markets where the particular technology may also be deployed. This supports the suggestion to back more than one SMR supplier through the GBN competition, and to not necessarily limit this to UK-based suppliers.

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