Infrastructure Review – Evidence submission

About You

1. **What is the name of your organisation?**

Nuclear Industry Association.

2. **Do you represent a particular interest group? If so, who?**

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

3. **Which sectors are you particularly interested in?**

Our main focus is the energy sector, specifically civil nuclear power. Our comments below are based on lessons from civil nuclear projects, but we will indicate where they are more widely applicable.

4. **What are your contact details for any follow-up?**

Please contact Laila Ahmed, Head of Policy for the Nuclear Industry Association, at Laila.Ahmed@niauk.org for further information.

Headline Questions

1. **How can we improve estimates of costs, benefits, and timescales to completion for major projects?**

The headline ambition for the nuclear sector is to build up to 24 GW of new nuclear power by 2050. The UK currently has 6 GW of operational nuclear power, of which 5 GW will retire within the next five years. Another 3.2 GW has entered nuclear construction at Hinkley Point C, with 3.2 GW at Sizewell C in the early phases of construction.

- To ensure good cost estimates and timely delivery in major projects such as nuclear projects, the UK will require:
    - Certainty of design of major projects before construction begins
    - Fresh experience in major construction management
    - Efficient supply chain capabilities, particularly in capital-intensive precision manufacturing capabilities
    - A skilled and productive workforce
    - Certainty of competitive, long-term financing for major capital spending
- A programmatic approach for the construction of nuclear power plants is required for the fastest and most cost-effective deployment of up to 24GW of nuclear power to the grid by 2050.
    - By a programmatic approach, we mean setting out what new reactors we will build, where we will build them, who will build them, how we will pay for them, and in what order we will build them. By this approach, we also mean undertaking multiple projects at once rather than a one-by-one approach.
- A programme provides clarity of scale, timeframes, and consideration of the public policy requirements to underpin delivery, resulting in the highest levels of efficiency and effectiveness.
    - A programme of projects allows the fixed costs of designing a project to be spread across many replica projects, rather than all borne by a single project. A programme also provides an incentive to be patient and finish design work before construction begins, as the design can be applied across multiple projects. Starting construction before design maturity is achieved is a major cause of cost overruns.
    - A programme allows construction management experience to be built up on the first project, and then retained, refined, and improved on subsequent projects.
    - A programme provides the size of order book necessary for companies to invest in better plant and equipment with certainty that they can get a return on their investment. A single project is rarely enough to achieve this.

    - Similarly, a programme provides the career prospects necessary to draw in new, often younger workers into the sector, with the promise of good work for many years, even decades. A single project will struggle to achieve this. The programme also creates an order book that allows companies to justify investment in training, re-skilling and other professional development of the workforce to improve retention and productivity.
    - A programme is always more expensive in gross terms, but almost always cheaper in per unit terms, than a single project, so access to secure, long-term competitive financing is essential to capture the benefits described above.
- The UK has never had a programmatic approach to nuclear: we have never built a nuclear power station that was a true replica of another station built in this country, and for the last 40 years we have had higher costs and higher deployment times than other countries, notably France and South Korea, that pursued a programme approach.
- Hinkley Point C could and should be the start of a programme, but it is to date the only nuclear project that has reached nuclear construction in the last 25 years, so it has had to bear the start-up costs of a programme, on a single project:
    - Hinkley Point C has had to contend with a First-of-a-Kind regulatory system that resulted in 7,000 design changes from the similar reactor design built in France. These changes put back the achievement of design maturity and added costs.
    - Hinkley Point C has had to restore UK nuclear project management experience, which has naturally withered since the last nuclear power station, Sizewell B, was completed in 1995.
    - Hinkley Point C has had to single handedly revive a dormant UK nuclear new build supply chain, which was utterly dormant.
    - Hinkley Point C has had to contend with a shortage of skilled workers arising from a generational lay-off of new nuclear construction in the UK.
    - Hinkley Point C has had to be financed with no public sector risk sharing during construction, something which the UK had never attempted before for new nuclear construction, and which resulted in very high borrowing costs.
- Fundamentally, it is crucial to deploy a fleet of reactors and a series of parallel projects with overlapping construction periods, rather than taking a one-by-one approach which is more costly and lengthy. This ensures continuous improvement, application of lessons learned, and retention of key capabilities. It also provides the demand to keep workforces mobilised and to strengthen our project management expertise.
- Government public investment in Sizewell C, a replica of Hinkley Point C, and the UK Civil Roadmap sets out the beginning of a programmatic approach. The Roadmap targets two Final Investment Decisions (FID) on nuclear projects in 2024-2029, and FID on 3-7 GW of nuclear capacity over the next three Parliaments. This is a start, but more detail is required.
- We can look to the examples of the approaches taken internationally to rapidly commission multiple new nuclear reactors simultaneously, which has resulted in cost and schedule delivery (see Q3 under *Current and future major projects*).

2. Does the Civil Service have access to the skills it needs for the successful delivery of major projects? If not what is needed?

No comment.

3. How can we ensure greater transparency and regular reporting of project data to improve delivery?

No comment.

4. **How can government plan for changes in the external environment, including inflation, rising interest rates and other factors?**

- If the Government is prepared to take public equity stakes in major infrastructure projects, such as nuclear projects, it can use its substantial long-term borrowing capability to fix long-term investments at low interest rates or wait until interest rates fall to refinance investments at lower rates.
- The best guard against the inevitable effects of inflation are to wherever possible, order multiple units of any technology, including nuclear, to achieve per unit cost reductions.
    - The Czech Republic has just raised their tender for a large-scale nuclear power plant from 1 to 4 units, because they found that vendors would offer prices 25% lower per unit on a 4-unit order.

5. How can projects contribute more to UK economic goals, including supporting UK supply chains, jobs, and skills?

Nuclear projects already contribute an immense amount to UK economic goals and provides jobs particularly in communities that need them:

- At Hinkley Point C:
    - 64% of the value of contracts are going to UK based companies
        - 3,700 UK businesses are involved in the project
    - 22,000 people across the UK are working on the project and more than 1,100 apprentices have been trained on the project
    - £5.3 billion has already been spent in the South-West of England alone[1]
- Analysis of the nuclear sector commissioned by the Nuclear Industry Association for Oxford Economics has shown that a full-time nuclear worker contributes on average about £102,300 in Gross Value Added per year, nearly twice the national average:
    - 85% of nuclear jobs are outside of London and the Southeast.
    - 56% of nuclear jobs are in rural areas, versus 21% of the population.
    - 40% of nuclear jobs in England, and 48% of nuclear jobs in Scotland, are in the most deprived 25% of local authorities.
- The nuclear sector contributes a range of benefits to the UK economy: generating £6.1 billion in GDP for the UK economy, supporting tens of thousands of jobs, and generating a substantial stream of £4.5 billion in tax revenues for the Exchequer each year.[2]
- When the indirect impact of the sector's activity is considered, the GDP figure more than doubles to £16.1 billion.[3]
- Providing such value depends upon the coordinated efforts of a broad range of firms spanning numerous civil nuclear activities and their supply chain.
- The civil nuclear sector is estimated to have a GVA multiplier of 2.6. So, for every £1 million it directly contributed to UK GDP, it supports another £1.6 million elsewhere in the economy through its expenditure.
- The spending of wages by the sector's employees (and those within its supply chains) creates further economic activity in the consumer economy. Our research shows that wage-financed consumer spending generated a £5.9 billion contribution in total to GDP in 2021.[4] Induced consumption, attributable to the civil nuclear sector, supports almost 70,000 jobs.

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[1]Hinkley Point C (2023), *Socio-Economic Impact Report 2023*. Available at https://www.edfenergy.com/sites/default/files/hpc_socio_economic_report_2023_-_compressed.pdf. Accessed: 13 February 2024.
[2]Nuclear Industry Association (2023), *Delivering Value: The Economic Impact of the Civil Nuclear Industry*. Available at https://www.niauk.org/delivering-value//. Accessed: 22 January 2024.
[3]Ibid.
[4]Ibid.

To further increase the value to the UK of nuclear projects:

- The UK must match the speed at which other countries are embracing emerging energy technologies, including the next generation of nuclear technologies to enable the parts of the supply chain that need intervention to compete with overseas alternatives.
- The UK should use the Great British Nuclear SMR selection process to encourage maximum UK content:
    - If GBN selects multiple SMR technologies, it should order multiple units of all of them. GBN should consult with the supply chain and order enough units in total to justify UK companies investing in capital intensive capabilities such as the fabrication of reactor pressure vessels.
    - As a condition for contracting with GBN, vendors should be required to maximise UK content, starting where possible with the use of UK nuclear fuel, which is our most mature supply chain capability.
    - Where it is not realistic to achieve UK content in a particular area, GBN and its technology partners should publish medium-term localisation strategies, involving joint ventures and other partnerships between foreign suppliers and UK industry.
    - To aid this, GBN should standardise on the single most successful SMR design after the initial deployment phase. This will concentrate investment efficiently on the required capabilities, allowing swifter introduction of UK content and more competitive exports.
- Although the GBN Small Modular Reactor selection has been welcomed, it is critical that we keep companies interested in deploying their technologies in the UK who are not selected in the current process. The government should clarify the route to market for technologies that are not selected by GBN and should consult the investor community to inform the development of the appropriate business models to finance advanced reactors.
- Providing optionality for deploying a range of projects will also provide the demand to keep our workforces mobilised, to train more people, to invest in more capacity and better capabilities, and to strengthen our project management expertise.

6. **How can the machinery of government be improved to support the delivery of major capital projects?**

No comment.

Current and future major projects

1. **What projects or initiatives do you think should be prioritised for the future development of UK infrastructure, and why?**

The delivery of further projects that will realise the UK's stated ambition for getting 24GW of nuclear power to the grid by 2050. Hinkley Point C, in construction, and Sizewell B, which will continue in operation, account for just 4.4 GW of this capacity.

- The government must deliver on its commitment to bringing Sizewell C to Final Investment Decision (FID) this Parliament. Sizewell C will be the first genuine replica nuclear power station built in the UK, so it is essential for introducing a proper programme approach.
    - Like Hinkley Point C, it will produce enough clean electricity for 6 million homes, or 7% of total UK electricity, for 80 years from a tiny patch of land. Like Hinkley Point C, it will drive billions of investment into the UK economy and sustain tens of thousands of skilled, well-paid, unionised jobs
- The Government should also pursue further large-scale nuclear, potentially at Wylfa on Anglesey in North Wales:

    - Wylfa is the best site for new nuclear in all of Europe, and the community is strongly supportive.
    - The site has been prepared for large-scale construction by the previous Horizon Nuclear Power project, which would accelerate construction timelines and cut costs.
    - Large-scale nuclear would be the largest inward investment in Welsh history, generated enough clean power for all of Wales and, like Hinkley Point C and Sizewell C, create thousands of jobs in areas that need them.

- The Government should complete the SMR competition and guarantee the winners orders for reactors at specific sites.
    - SMRs will allow the UK to maximise investment and clean power generation at its existing nuclear sites, many of which are too small for large reactors.
    - SMRs could also unlock benefits of modern modular construction methods, helping to improve construction certainty by increasing off-site fabrication.
    - SMRs offer an opportunity for UK industry to make nuclear components that they do not have the capability to make for large-scale reactors.
- To facilitate this necessary infrastructure to help enable low carbon projects and deliver the capacity needed for the future, the UK Government should:
    - Impose a Net Zero Duty on relevant regulators and use the Critical National Priority status conferred on low carbon generation to accelerate planning approvals.
        - The UK has approved 6.5 GW of new nuclear in the 16 years since the Nationally Significant Infrastructure Projects planning system was brought in. It will need to approve 17.5 GW of new nuclear in the next 20 years to hit our current ambitions, more than twice the rate.
    - The regulatory bodies involved in the planning, permitting, licensing, and consenting processes of new nuclear projects must be properly resourced to deliver new infrastructure and make timely decisions on new build projects.

2. Are there specific technological advancements or innovations that you believe can significantly benefit infrastructure delivery?

No comment.

3. What can we learn from the experience and approach taken by other nations in terms of accelerating infrastructure projects?

- Continuous fleet deployment is the cheapest and fastest way to deploy new nuclear capacity. This model has been successfully used by France and South Korea, who built cheap fleets of large-scale reactors on this basis.
    - The French started and finished 48 GW of nuclear in 1971-1987, 3 GW per year. By 1987, they also had a further 10 GW under construction.
    - More than 80% of the reactors built were replicas of reactors built previously.
    - Those projects were delivered more cheaply and consistently than any others in the Western world.
    - Those projects also sustained an unprecedented speed of construction, peaking when the maximum number of units were underway at once.

        - On New Year's Day 1980, France had 34 large-scale reactors under construction at once. It finished 6 reactors that year, all in less than 6 years' construction time.

- The UK can also learn from the Korean example, as relayed by the Nuclear APPG in its 2023 report, Made in Britain: The Pathway to a Nuclear Renaissance:
    - "In the 1970s, South Korea had no nuclear power stations. Today, South Korea has 26 GW of nuclear domestically, 3 GW more under construction, and 5 GW exported successfully to the UAE. The country followed a clear pathway that the UK should emulate.
    - "First, the Korean Government made a strategic decision to deploy nuclear power for energy security. The country then ordered American, French and Canadian-designed reactors, insisting that Korean industry work closely with foreign partners to build up their skills and experience. They chose to standardise on the American design and, with a technology transfer agreement, adapted it into their own Korean design.
    - "At the same time, they meticulously developed the capability of Korean industry to make every critical component required in their reactor design, to fabricate their own nuclear fuel, and to maintain the workforce necessary to do so. Korea always built multi-unit projects to capture the benefits of replication, and their nuclear industry has not stopped building in 50 years."
- South Korea has sustained one of the best continuous cost reductions in nuclear power deployment.[5]
- The UK must build multiple units of any reactor design it chooses to capture the benefits of replication, and it must continue building reactors to keep the supply chain active and efficient.

Procurement and supply chains:

1. How can we enable more efficient local supply chains?

- The Government should ensure that it takes decisions on bolstering support for new generation technologies and projects without delay, to retain and continually build appetite for the UK market, which will in turn encourage greater supply chain investment in the energy industry.
- To help rebuild the domestic supply chain and justify the major investment in plant and equipment, the Government must insist that UK content, including UK front-end fuel cycle services, is maximised in the deployment of new nuclear and place a sufficiently large number of orders to facilitate the necessary investments.
- A thorough analysis of the supply chain must be undertaken to identify areas supply gaps and where there are areas of competing demand in different regions.
- The nuclear supply chain will go where it is required, including for projects which also provide off-grid applications of nuclear beyond electricity production, including but not limited to heat generation, low-carbon hydrogen production and desalination for electrolysis.
- An example of such a project includes Sizewell C's construction of a heat powered Direct Air Capture (DAC) demonstration plant to capture CO2 from the atmosphere directly.

Future reforms, funding, and investment

[5]Lovering et al (2016), *Historical Construction Costs of Global Nuclear Power Reactors.* Available at https://www.sciencedirect.com/science/article/pii/S0301421516300106. Accessed: 13 February 2024.

1. **What do you see as the main obstacle to the private sector investing more significantly to help improve UKs infrastructure?**

The main obstacle to greater private sector investment in nuclear is the lack of certainty on government support for specific nuclear projects. Given the timescales, capital intensity and heavy regulation associated with nuclear projects, private sector investors want to know what risks the Government is sharing and mitigating:

- There is significant liquidity in the private market for financing nuclear power stations and there is also growing appetite from across the financial community to do so. Private investors are drawn to the prospect of diversifying their portfolios of sustainable infrastructure projects that support net zero and climate change goals.
- However, any deviation from existing government policy on nuclear deployment and the signals that the markets have received from the recently published UK Civil Nuclear Roadmap would diminish the interest and confidence from private investors. It is especially important that UK does not backtrack on this after signing the Declaration to Triple Nuclear Energy at COP28.
- Furthermore, the UK's Green Taxonomy and the Green Financing Framework act as regulatory parameters which guide investors on which low-carbon technologies are deemed as good, safe investments.
    - Analysis by the United Nations confirms that nuclear has the lowest lifecycle carbon, lowest land use, and lowest impact on ecosystems of any electricity source.[6]
- As such, it is imperative that the government incorporates nuclear in the UK taxonomy in line with the scientific evidence on nuclear's green credentials and level the playing field with other low carbon technologies, to provide the necessary indication and assurance to private investors that nuclear is a green investment.
- Without drawing in the opportunity for private pools of capital to finance existing and future nuclear projects, the UK will not be able to fulfil a crucial and sizeable portion of its net zero and energy security goals.

2. **Are there regulatory changes or policy recommendations that you believe would be beneficial to accelerate investment and delivery?**

- We believe the following regulatory changes and policies would support investment into nuclear projects and expedite delivery:
    - A clear statement that Government is willing to take a "cornerstone" minority equity stake in future nuclear projects to reduce the cost of borrowing and give confidence to private sector investors.
    - Incorporate nuclear in the Green Taxonomy to raise capital for new nuclear projects. The nuclear industry and investors await the launch of the Green Taxonomy Consultation. It is vital that following its launch, any future government sets out clear timelines for how and when the outcomes of the consultation will be implemented and adhered to.
    - Apply a Net Zero Duty on all relevant regulators to ensure proportionality in the planning system to facilitate and expedite the delivery of low carbon energy projects.
    - Instruct the Office for Nuclear Regulation (ONR) to maximally leverage in whole or in part the outcomes of assessments and reviews of reactor designs done by regulators in the International Nuclear Regulators Association (including Canada, France, the Republic of Korea and the United States among others) with similarly high standards. Similarly, instruct

[6]United Nations Economic Commission for Europe (2022), *Carbon Neutrality in the UNECE Region: Integrated Life-cycle Assessment of Electricity Sources*. Available at: https://unece.org/sites/default/files/202208/LCA_0708_correction.pdf. Accessed 23 January 2024.

the ONR to leverage operational data from any reactor designs that have already entered service so that UK regulators are not 'marking the homework of' other regulators.

- Full implementation of a siting approach for advanced nuclear technologies based on developers showing that their chosen sites meet a set of published criteria, rather than developers having to choose from a set list of specific sites identified in Strategic Siting Assessments to support a fleet roll-out approach and to encourage greater supply chain investment.

3. What do you see as the main alternative funding models* available to the sector to fund stations and their surrounding city developments?

- We believe that the Contracts for Differences (CfD) scheme will continue to have an important role to play in the deployment of new nuclear, along with the Regulated Asset Base (RAB) model and welcome both models being made available for all future projects. The RAB model will play an essential role in the development of future large-scale nuclear projects, particularly given the capital intensity and deployment timescales involved in these projects.
- The Government should continue to work with industry and the market to identify appropriate alternative funding models for projects, including for smaller scaler Advanced Modular Reactors (AMRs), SMRs and Micro Modular Reactors.

4. Are you aware of best practice approaches and case studies that have used alternative models with successful outcomes?

Potential funding models may include, but not be limited to, examples that include the use of development corporations, private sector investment, and co-location of other infrastructure.

- The Mankala model is applied in Finland, where several companies, who may be electricity consumers themselves, jointly establish a non-profit limited company for a common purpose, such as TVO, which operates the 3.5 GW Olkiluoto nuclear power plant. Each shareholder of TVO is obliged to pay the costs incurred during construction and operation of a nuclear power plant in proportion to their ownership, and likewise they are entitled to the electricity produced based on proportion of ownership. This model spreads the risk across a broad enough asset base to support it, allowing the financing of major infrastructure.
- This type of model, where several companies pool risks and rewards, may be effective for the application of advanced, high-temperature nuclear reactors for industrial decarbonisation. These reactors are intended to be co-located with heavy industries that consume large amounts of heat and power, to provide them with constant, reliable clean energy directly. A single industrial customer is unlikely to be able to finance a nuclear project itself, but a cluster of interested industrial users, could be viable.

Additional

1. Are there any other issues you would like to raise that are relevant to the Review's Terms of Reference?

The UK must take decisions urgently on a new nuclear programme or it will fall behind other countries trying to attract investment into their own nuclear programmes. The UK is looking at deploying up to 24 GW of new nuclear, but Europe as a whole is considering approximately 90 GW of new nuclear, and 90 GW of life extension work to existing nuclear plants.

There is unprecedented interest worldwide in deploying new nuclear energy, because of its energy security and net zero benefits, and because of the high-quality industrial jobs it creates:

- The Nuclear Industry Association has calculated that 78% of the world economy by Purchasing Power Parity backs new nuclear, including established and emerging economies such as the United States, France, Canada, South Korea, Sweden, China, India, Brazil, Argentina and Indonesia.

- 25 countries, including the United States, France, Canada, Sweden and South Korea, who have more than 250 GW of nuclear capacity combined, endorsed a declaration at COP28 calling for tripling nuclear energy worldwide by 2050.

- In Europe, a large number of countries are issuing specific tenders or pursuing defined programmes for new nuclear capacity:

    - In February 2022, President Emmanuel Macron announced that France would build at least 6, and likely up to 14, new large-scale reactors. France awarded the first contracts for construction of these new plants just 20 months later, in November 2023.

        - By contrast, the UK has taken 13 years to get Sizewell C through planning consent, permitting, and associated legal challenges.

    - Poland has signed contracts for 3 new large-scale reactors and is actively pursuing a second project for multiple additional large-scale reactors.

        - Polish industrial and energy consortia are advancing plans to build large-scale reactors and potentially dozens of SMRs.

    - Bulgaria plans to build 2 new large-scale reactors.

    - Romania is pursuing building 2 new large-scale reactors.

    - The Czech Republic has tendered for 4 new large-scale reactors and will decide on a vendor in April 2024.

    - The Netherlands has awarded contracts for feasibility studies for 2 new large-scale reactors.

    - Vattenfall in Sweden is considering options to build a new large-scale reactor or several SMRs at its Ringhals site.

- The UK is known for being slow and uncertain in making decisions about new nuclear: we must reverse this perception and press on decisively with a fleet of new projects if we are to achieve the mission of becoming a clean energy superpower with long-term, well-paid unionised jobs for the coming generations.

- Further life extensions for the UK's existing nuclear power stations (5.9 GW) are also critical for the UK's short-term energy security, but they are not a substitute for investment in new nuclear plants.

    - With the exception of the 1.2 GW-plant Sizewell B, life extensions would, at best, secure some of our existing nuclear output until the early 2030s. These nuclear power stations are already the most productive low carbon assets in British history and have outperformed their initial design expectations by a long way, thanks to careful management from EDF. Their designs are such, however, that they cannot be extended indefinitely, and they must be replaced.

    - Given the timescales for nuclear development, it is imperative that the UK take decisions swiftly on replacements to minimise any gap in baseload electricity capacity caused by past policy delays and procrastination.