The submission of the Nuclear Institute in response to the Invest 2035: The UK's Modern Industrial Strategy Consultation, November 2024

About the Nuclear Institute

Nuclear energy is an essential part of the UK's clean energy mix, making it critical that the industry has the right standards and people to support future growth and success.

The Nuclear Institute is the only professional membership body dedicated to the nuclear sector. Representing over 4,000 professionals at all levels across the nuclear industry, from new build and operations to decommissioning, we maintain the Nuclear Delta, the independently defined standard for Nuclear Professionalism and our community is a source of subject expertise. We are licensed by the Engineering Council, Science Council and Society for the Environment to charter and register those working in these disciplines.

The professional engineering community is working together to address the global challenges of sustainability, ethics and equity, diversity and inclusion. Jointly, and individually, we are committed to innovating and improving across these societal challenges, within our organisations, and ensuring our members recognise the importance of these responsibilities alongside core professional competencies. As a self-regulated profession, we recognise the importance of public confidence that engineering is safe, sustainable and inclusive to all in society.

The NI is made up of our HQ Team, our Board of Trustees (BoT), Committees plus our communities; a thriving network of Regional Branches, the Nuclear Institute Young Generation Network (YGN), Special Interest Groups, Expert Forums, and our volunteer network.

Further organisational information can be found on the NI website: nuclearinst.com

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Sector Methodology

1. How should the UK government identify the most important subsectors for delivering our objectives?

The UK government should look long term, identify its goals for the UK and then the subsectors that would enable the goals to be met. 2050 is a rational timeframe to set out a vision of what success would look like.

The UK government should utilise a simple theory of change model based on the premise of desired outcomes which should recognise; increased economic growth and the capacity to support the needed enablers of industrial growth including low carbon power, integrating technologies and a secured source of components, services and fuels required to deliver this.

In effect, secured and reliable power is a base vector and component for enabling multiple sectors to grow and capture economic growth and value. Clean and secure reliable power can have a "gearing" effect on attracting additional investment for example in meeting the needs of major technology & service provides for example Data Centres, Transportation and supporting Industrial to decarbonise.

Government should consider and recognise the above as a mechanism to stimulate investment in regions which traditionally were home to foundation industries such as the North-East, North West, Midlands and South Wales. It would seem reasonable that priority be given to those sub sectors that contribute to multiple objectives including; stimulating economic growth, attracting further inward investment in enabled sectors, regional development, direct support and future access to technologies and export markets stimulated by Net-Zero.

Hence under the 'clean energy' banner, it would be reasonable to expect developments in nuclear power and nuclear defence applications to be given a degree of priority and governmental focus. By providing secure energy supplies, this is an enabler for economic growth across many sectors. That this will need development of UK supply chains will provide the UK with a lasting industrial capability and UK designed reactors appear to be attractive, opening up an export potential across many nations. Data science, the widespread adoption of artificial intelligence (NB. the UK is the #3 adopter across the world behind the USA and Singapore) and development of workplace robotic capabilities (cobots etc), would support many potential economic growth sectors.

2. How should the UK government account for emerging sectors and technologies for which conventional data sources are less appropriate?

As described in the answer to Q1, Government should create an environment which supports lower cost of clean energy to be attractive to innovators and emerging businesses sectors. UK government needs to emerge as a leader in creating and stimulating foundation industries in global markets that are largely recognised today with a view to whether it wishes to be a leader. This can create an attractive location for innovation. Government should recognise regions which are likely to see the development of foundation industries and consider an integration of this into a skills and academic

environment. This could potentially be recognised through targeted investment into education pathways in these regions. early adopter or late arriver as regards emerging sectors and technologies. As the green paper indicates, careful selection of emerging sectors and technologies based on the UK strengths and skill set is likely to provide the greatest chance of success and economic benefit.

3. How should the UK government incorporate foundational sectors and value chains into this analysis?

Covered this in response to Q1, whereby foundational sectors that play a broad role in driving economic growth would be indicated as meriting a degree of priority. Hence, the use of 'systems thinking' is important in maximising the return for the effort committed in developing UK capability.

Sectors

4. What are the most important subsectors and technologies that the UK government should focus on and why?

On the assumption that success for the UK would be to achieve net zero by 2050 with a thriving contributing industry plus growing exports, a model of what is required to achieve this should be created. Nuclear power has a key role due to its low carbon, always on capabilities.

The UK require tens of Gigawatts (GW) of reliable and "dispatchable" generation to ensure supplies can be maintained. The principal credible options here are carbon capture and storage (CCS), hydrogen manufacture and storage, and nuclear.

CCS has yet to be demonstrated on a large scale. It would rely on the ongoing availability of natural gas (as UK supplies diminish rapidly), so it would require ongoing gas imports.

Hydrogen manufacture and storage for use as a natural gas replacement would incur very large changeover costs (for pipelines, domestic appliances, industrial process equipment, and storage facilities). The hydrogen would itself be manufactured by electrolysis – which would consume more electricity – and its storage would be difficult because of its small molecular size and consequent motility. Efficiencies and losses mean that it will always be cheaper to the end-user to supply electricity directly rather than generate hydrogen from electricity and supply it nationally via pipelines.

Nuclear electricity is proven technology, and it is capable of flexing to meet supply requirements, so it is a "good fit" with renewables.

Nuclear is an obvious best candidate to provide reliable and dispatchable base load assurance to the UK National Grid. By the 2030s, the UK will have only ~4.5 GW of nuclear generation available (Sizewell B and Hinkley Point C), rising to ~7.7 GW when Sizewell C becomes available. Current UK electricity demand is typically in the range 25 to 40 GW, so nuclear generating capacity can and should grow significantly – this is a "no regrets" option.

In response to currently known economic demands and the current geopolitical situation, the nuclear sector should continue to be a focus on the basis that it provides clean and reliable base load energy and underpins the UK's credibility on the international stage in defence terms. Other sectors like AI/ data science, wider adoption of drone technologies, Civil reactors for marine propulsion, space reactors, digital technology, simulation modelling and other advanced manufacturing techniques are also worthy of focus and attention, being areas where the UK is starting from an elevated standpoint.

In considering the question for Nuclear Energy, specifically the opportunities derived from the new flexibility offered by Small Modular Reactors (SMRs) and Advanced Modular Reactors (AMRs), it appears

that in many cases other subsectors and technologies can be directly supported. There're several UK data centre projects at different stages of development. Data centres need 24/7 power and because of AI these data centres require hundreds of megawatts of electricity. Already the tech giants Microsoft, Google and Amazon are recognising that SMRs/AMRs provide a solution.

Some designs of AMR produce high temperature heat which can be used in a number of industries that require that high temperature heat. Hydrogen production can be at much lower cost in this way compared to electrolysis. This is an example of how the potential for Small and Advanced is connected to other technologies and can encourage co-location and investment in both.
There are other examples, but data centres and hydrogen production have surplus heat. Data centre heat is sometimes used for greenhouses. The future of greenhouses is artificial sunlight and robots to tend the crops, all managed by a smart AI system. With electricity to power the systems and surplus heat from datacentres could we see winter production of food, an example of interlinked

The UK has an opportunity to create growth by addressing the global market for SMRs and AMRs. Traditional thinking with nuclear power has to be set aside. End users are now increasingly considering reactor plant as new energy sources which happen to be nuclear.
NetZero, data centres, energy security are the main drivers to generating the many SMR and AMR offerings that continue to emerge in response to market demand. Product offerings range from less than 5MW in the case of micro reactors to 470MW with the RR SMR. In recent years these offerings have been refined to target different markets.

The window of opportunity for the UK to capture economic value is closing. Canada has been early to recognise the fit of SMRs for those towns and cities that are not connected to the grid, replacing fossil fuel powered plant in off-grid applications, some UK companies in the current absence of enabling activity in the UK have now focussed their efforts on this market.
In North America, Terra Power hope to have their first unit operational by 2030 and are seeking to locate their units (with storage capability) on many historically coal powered plant sites in the USA. Several SMR/AMR developers, with different sizes of plant, are targeting data centres. Some are combined power and high temperature heat supply. The numbers forecast can be high with some companies saying 10,000 and one micro reactor company believing that 100,000 per year might not be enough.
The annual production demands of a successful large SMR/AMR provider are difficult to scale with precision but this is not a problem requiring this at this moment, it may be approaching 10 per annum , for the small say 100 per year and for the micro 1000 per year (replacing diesel generators). From a UK perspective the large unit could be the RR SMR. There are possibilities for a UK small SMR/AMR and micro reactor but these need to be accelerated if the UK wishes to be part of that market (NB there are other routes such as becoming the European manufacturer for a US plant)

Barriers include the grid infrastructure's current limitations to integrating large-scale nuclear projects and planning delays for new reactors. The government should prioritise infrastructure investment, especially to support electrification, while providing clear planning guidelines for nuclear development. Ensuring that nuclear energy continues to be at the core of the UK's long-term net-zero energy policy will further remove these barriers and encourage greater industry growth.

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5. What are the UK's strengths and capabilities in these sub sectors?

The UK is a proven and internationally respected safe and secure operator of nuclear facilities, has a pedigree and base capability in design and manufacturing of required systems and is one of a very limited number of nations with a strong nuclear fuel capability. This is recognised and held in high esteem globally and is a strength and is supported by strong regulation and the application of the same through the ONR.
The UK supply chain to create new nuclear infrastructure may be fragile and lack capacity and cost effectiveness to compete on a global stage. This is a weakness. The UK's research and development capabilities are strong, suggesting that it can make a significant contribution to the other factors listed above and, the energy with which AI is being adopted in the UK places it well to make further ethical use to stimulate economic growth across most sectors.

6. What are the key enablers and barriers to growth in these sub sectors and how could the UK government address them?

Siting - One of the challenges that subsectors will face is that the location of these nuclear power plant will not be on previously designated 'nuclear licensed sites'. The key issues of new locations are nuclear safety, nuclear security and co-location to the client and customer base that these can enable. Government should expedite the conclusion of it's response to the Alternate Routes to Market Consultation which closed in April 2024 and ensure this is consistent with Industrial Strategy.
Skills and Workforce – a increased capacity is recognised as needed in support of the nuclear sector requiring a mix of academics, blue- and white-collar workers and emphasis on hands on skills and experiences that are important. This is not a problem that is unique to Nuclear and should be considered in the context of the Industrial Strategy. This should be seen as an opportunity to integrate policy interventions with regional and industrial regeneration and growth. For example by Skills attraction to tan area due to excellent opportunities in emerging and enabled sectors.
Confidence - The UK nuclear sector has been plagued by a lack of clarity or strategic direction from government. This has affected the willingness of investors to commit significant funds in preparing to construct new nuclear facilities and the supporting supply chains. It is unreasonable to expect supply chains to invest in capabilities for a nuclear renaissance that has been intrinsically tied directly to Government funding . Absolute Clarity and commitment from government as regards the Uk nuclear new build programme would help attract investors and encourage the supply chain to prepare for and invest in a more certain future.
Cost effectiveness- For industry to invest in innovation to deliver increasingly cost competitive offerings including designs, skills and supply chains a renewed commitment to a nuclear roadmap and scale of global ambition is required. This can stimulate increased heavy UK industrial content and leadership to ensure the benefits of public investment are maximised and to aid energy security. This may require some sharing of innovation risk, perhaps through easier access to existing facilities or enhanced facilities including, High Value Manufacturing Catapult, Digital Catapult and other Innovation facilities within the UK.
Enabling Private Investors and Innovative Business Models- A commitment to a roadmap will also encourage private sector investment in the industry including into new nuclear power stations and end user infrastructure. This will minimise the call on the public purse and further improve the sustainability of the industry.
Developer Capacity – It will be difficult to attract private investment and accelerate industrial growth in an environment where it is perceived the Government is reluctant to enable innovative business

models which are less reliant on direct centra- control and funding to flourish. Government should recognise that an "end user demand lead model" has the potential to lower cost and risk and accelerate its aim and objectives and support this as appropriate.

Business Environment

7. What are the most significant barriers to investment? Do they vary across the growth-driving sectors? What evidence can you share to illustrate this?

The most significant barrier to investment is confidence that the nuclear industry can deliver and consistent commitment to a plan from UK Government. This is evidenced by the failure of the Horizon and NuGen projects, the continued difficulty in reaching a final investment decision for Sizewell C and the continued deferment and delay in GBN in delivering outcomes against previously communicated timescales.
A lack of a clear strategy and consistency of support for nuclear developments from government has

undermined business confidence outside the arena of Defence and Decommissioning. There have also been unrealistic expectations around the degree of risk that private businesses might be expected to take to capitalise nuclear developments. The UK experience with the Hitachi UK Advanced Boiling Water Reactor is testament to this. A clear strategy, consistent narrative, and in the ambitious approach by government would encourage more courage from potential investors. Other sectors relating to data science and non-nuclear technologies have lower entry barriers (cost and time) and can realise benefits in shorter time scales.
In the nuclear sector the main inhibitor is the reluctance of companies to commit investment.
Prior to the construction of Hinkley Point C the Nuclear Industry Council (NIA) in association with the Nuclear Industry Council initiated an assessment of the UK readiness for building new nuclear plant. The investigation into manufacture found that whilst EDF were looking for support (and enthusiasm) from the supply chain by them demonstrating their capability then most companies were limiting their investment in resources and capital expenditure, waiting to receive an order.
Fast forward to today when automation and digitisation are needed to be globally competitive then there will be an even greater challenge for manufacturers as some in the nuclear sub sector will not be familiar with any form of volume production hence the investment needs will be higher. This then has to be put into the context of any UK SMR/AMR developer requiring a team of globally competitive suppliers if they are themselves to become globally competitive.
The traditional model of the developer seeking bids from multiple UK suppliers for each piece of supply breaks down and the developer needs to find suppliers who are more partners or team members who will commit for the long term in a joint determination to be globally competitive. Some of what would be deemed 'best athlete' suppliers may baulk at the prospect due to lack of knowledge or inability to fund the necessary investment.

Business Environment – People and Skills

8. Where you identified barriers in response to Question 7 which relate to people and skills (including issues such as delivery of employment support, careers, and skills provision), what UK government policy solutions could best address these?

The government has sponsored the Nuclear Skills Task Force, which has many good ideas, but has gained only limited traction yet and has in effect scaled a problem with little perceived ability and support to enact a solution. To attract people into economic growth areas, people need to be confident

that these areas will prosper, with certainty of employment into the future, and career paths that are interesting and meaningful.
Because, traditionally, significant nuclear facilities tend to be built away from major population centres, this allows the economic benefit of employment and training to be felt in more rural areas where employment might be limited and salaries lower. The potential to co-locate and invest in educational and skills pipelines is noted in the response to Q6.
The skills landscape for the nuclear subsector is likely to be different in 5 years. The future skills map for the nuclear subsector (and those linked to its success) should be mapped so that providers can build the appropriate training plans in areas of end user demand.

9. What more could be done to achieve a step change in employer investment in training in the growth-driving sectors?

Certainty and commitment as described in Q7 and recognition of a demand lead model. If the UK government can deliver these, in a manner by which businesses can maintain profitability and avoid the high risks associated with 'crash out' costs (e.g. Redundancies because commitments were not delivered on), this would provide a better environment for employer investment in capability development and engagement with skills providers.
The Nuclear Skills Academy Derby established 2023 is an excellent example of demand stimulating need in response to a long-term confidence and this being met by Academia, Industry, and Innovators (IUK) in collaboration.

More could be done to incentivise employer investment in workforce development. The government could introduce tax credits or subsidies for nuclear companies that invest in training programmes and apprenticeships. Collaborating with educational institutions and industry bodies like the Nuclear Institute to develop industry-relevant curricula, which also recognises Nuclear Professional Standards, would align training more closely with sector needs. This would help ensure that employers actively invest in upskilling the workforce required to support the growth of the nuclear sector.

Business Environment - Innovation
10.Where you identified barriers in response to Question 7 which relate to RDI and technology adoption and diffusion, what policy solutions could best address these?

The UK has a reputation for scientific innovations and developments that it subsequently fails to take full economic advantage of. The RDI community would benefit from a more integrated and synergistic approach, that may speed up the rate of RDI. Regulators need to identify pro-innovation approaches and play their full role in enabling innovations' but this is a minor issue in the UK where regulators are believed to be receptive of justified innovation.
A specific vision and strategy for RDI to deliver economic growth and enhanced focus on innovation missions in collaboration with industry may be required to enable and encourage industry co-investment in programs beyond what could be considered a narrower centrally funded approach driven through academia, associated councils, and national labs.

The nuclear sector faces challenges when it comes to innovation, particularly in the areas of long-term affordable funding and overcoming regulatory hurdles. Government support for late-stage R&D, especially in new reactor technologies like Small Modular Reactors (SMRs), is essential. Policies

promoting and financially supporting public-private collaborations and expanding the nuclear innovation ecosystem would facilitate quicker technology adoption, enabling the sector to stay competitive and advance the UK's net-zero targets.

i. UK Government R&D Funding: https://www.gov.uk/guidance/innovation-funding-and-suppor t
ii. Small Modular Reactors (SMRs): https://www.world-nuclear.org/information-library/nuclear-fuel-cycle/nuclear-power-reactors/small-nuclear-power-reactors.aspx

11.What are the barriers to R&D commercialisation that the UK government should be considering?

This is partly answered in Q10, where it is suggested that the balance across the research and innovation pipeline between academia and industry may need consideration. Noting significant sums of money can be expanded for research that may be of fundamental value but does not answer a market problem and lead to direct scale up. Government needs to consider the above and how its innovation agency, Innovate UK may be better enabled to support its objectives. Where the R&D is being undertaken by commercial organisations, it needs to be need-driven with sight of a business case.

The primary barriers to R&D commercialisation in the nuclear sector include the high cost of scaling technologies from concept to commercialisation, regulatory delays, and the lack of sufficient capital. The UK government should streamline the regulatory approval processes for new nuclear technologies, such as SMRs, and develop tailored funding mechanisms that help underpin commercial-scale projects. This will provide the financial backing necessary for the nuclear sector to commercialise new innovations more efficiently.

iii. Nuclear Regulatory Process: https://www.onr.org.uk/new-reactors/index.htm
iv. Commercialisation of R&D: https://www.gov.uk/government/publications/commercialising-innovation

Business Environment - Data
12.How can the UK government best use data to support the delivery of the Industrial Strategy?

Data, data science and AI are likely to be pivotal to the delivery of the industrial strategy. It allows levels of analysis to be conducted that have not impossible before and provide the tools for an 'evidence based' industrial strategy, as opposed to one based on narrow perspectives, bias or perception. Policy initiatives that are directly linked to acceleration of the delivery of industrial infrastructure should be considered. For example in the Nuclear sector there are a number of organisations looking to use Data and Machine Learning to mitigate costs of Decommissioning and lost capacity due to outage. The Nuclear Institute has over 200 companies who engage as a community through to share best practice in this area one of its Special Interest Groups. Government should consider how it could encourage communities such as this to engage in reducing cost and accelerating the delivery of wealth creating infrastructure in support of its objectives.

The nuclear sector could benefit from enhanced data-sharing, particularly in areas such as safety, reactor performance, and predictive maintenance. The UK government should work with nuclear institutions, such as the Nuclear Institute, to develop data-sharing protocols that encourage

collaboration while maintaining strict security. Additionally, the application of advanced AI and data analytics could significantly optimise nuclear operations and support long-term project planning.

v. Data Sharing in Nuclear Industry: Nuclear and atomic data for energy and non-energy applications | IAEA
vi. AI in Nuclear Energy: Artificial Intelligence for Accelerating Nuclear Applications, Science and Technology | IAEA

13.What challenges or barriers to sharing or accessing data could the UK government remove to help improve business operations and decision making?

Cyber security and secure networks may need to be improved with more cyber skills in the workplace and support to smaller businesses to access and deliver requirements in this arena. The policies and regulations around competition and large companies with government contracts – this would allow smaller businesses to access a wider marketplace across the UK and the world.

Confidentiality concerns, security risks, and proprietary technologies are key barriers to data-sharing in the nuclear sector. The government could establish secure, sector-specific platforms that enable data exchange among trusted industry players, balancing transparency with the need for security. Ensuring clear guidelines on intellectual property rights and data protection within collaborative projects would further facilitate smoother data-sharing and improve decision-making processes across the sector.

vii. AI in Nuclear Energy: The Future of Nuclear Power in the UK: Challenges and Opportunities | Energy Futures Lab | Imperial College London

Business Environment - Infrastructure

14.Where you identified barriers in response to Question 7 which relate to planning, infrastructure and transport, what UK government policy solutions could best address these in addition to existing reforms? How can this best support regional growth?

Planning permission processes do introduce significant delays in infrastructure developments in the UK, including within the nuclear industry. These can also be complicated by the involvement of multiple different regulatory frameworks. One example of this is the work to site a UK Geological Disposal Facility, that has been through several near identical cycles of development, of which none so far have delivered the output required. A national infrastructure development plan that identified technologies and sites that were pre-approved or may be driven by a single entity should be considered.

Nuclear projects frequently face significant delays due to planning and infrastructure constraints. The Nuclear Institute can advocate for more streamlined planning processes for nuclear power plants, particularly in regions where critical infrastructure investments are required. Government support for upgrading the grid and facilitating projects like SMRs in key regions would enable nuclear energy to better contribute to local and regional energy needs.

viii. Planning for Nuclear Power Plants: https://www.gov.uk/government/collections/national-policy-statements-for-energy-infrastructure
ix. Infrastructure Investment: https://www.gov.uk/government/publications/national-infrastructure-strategy

15.How can investment into infrastructure support the Industrial Strategy? What can the UK government do to better support this and facilitate co-investment? How does this differ across infrastructure classes?

A lack of clear strategy and commitment to deliver that strategy has been evident over the last decade. A better understanding of the infrastructure that is needed to support the industrial strategy, and clear and assured incentives to do so would help. This is particularly prevalent in sectors like the nuclear sector that require large capitalization. Uncertainty, and a lack of consistency are hugely harmful to the willingness of commercial organisations to invest in infrastructure.

Long-term, stable investment in nuclear infrastructure is critical for the sector's growth. This includes waste management facilities, grid connections, and other supporting infrastructure. The Nuclear Institute recommends the creation of specific financing mechanisms to support such infrastructure projects, such as long-term contracts, government-backed bonds, or public-private co-investment schemes. These policies would help de-risk large nuclear projects and ensure sustained growth in the sector.

x. UK Infrastructure Investment: https://www.gov.uk/government/publications/national-infrastructure-strategy
xi. Public-Private Partnerships: https://www.pppknowledgelab.org/countries/united-kingdom

Business Environment - Energy

16.What are the barriers to competitive industrial activity and increased electrification, beyond those set out in response to the UK government's recent Call for Evidence on industrial electrification?

This is partially addressed in previous answers. The response to the previous Alternate Routes to Market Consultation is directly relevant to this and notably Government should expedite this with direct reference to PPA and Siting Policy.

Barriers include the grid infrastructure's current limitations to integrating large-scale nuclear projects and planning delays for new reactors. The government should prioritise infrastructure investment, especially to support electrification, while providing clear planning guidelines for nuclear development. Ensuring that nuclear energy continues to be at the core of the UK's long-term net-zero energy policy will further remove these barriers and encourage greater industry growth.

xii. UK Net Zero Strategy: Net Zero Strategy: Build Back Greener - GOV.UK (www.gov.uk)

17.What examples of international best practice to support businesses on energy, for example Purchase Power Agreements, would you recommend to increase investment and growth?

See above. Q16.

Business Environment - Competition

18.Where you identified barriers in response to Question 7 which relate to competition, what evidence can you share to illustrate their impact and what solutions could best address them?

In the nuclear sector, regulatory barriers often lead to lengthy project timelines and increased costs through delays. Approval processes for new reactor designs can take years, which limits the pace of innovation and

risks making new technologies obsolete by the time they are approved. International examples, such as Canada's streamlined licensing process for SMRs, demonstrate that a more flexible and adaptive regulatory framework could boost competitiveness, accelerate deployment, and promote a dynamic nuclear market.

i. Canadian Nuclear Safety Commission: Small Modular Reactor Readiness project overview (cnsc-ccsn.gc.ca)
ii. Impact of Regulatory Barriers: Nuclear Energy Agency (NEA) - First Triennial Report of the WGIP Benchmarking on Inspection Practices (oecd-nea.org)

19.How can regulatory and competition institutions best drive market dynamism to boost economic activity and growth?

In the USA, the US Nuclear Regulatory Commission has recently been made subject to regulation that requires it to be agile and to promote nuclear developments. A series of reports by Sir Patrick Vallance and Professor Dame Angela McLean (entitled the 'Pro-innovation Regulation of Technology) point to challenges with regulatory fragmentation (i.e. Where regulators in different sectors take different positions on the same innovation for no apparent reason) and opportunities for regulators to be more proactive in playing their role in the systems thinking underlying economic growth.

The regulatory framework for nuclear energy should be adapted to encourage innovation while maintaining stringent safety standards. The Nuclear Institute recommends promoting a regulatory environment that encourages competition in emerging nuclear technologies like SMRs and fusion energy. This could be facilitated through pilot schemes or regulatory "sandboxes" where innovative solutions can be tested in a controlled, low-risk environment.

xiii. Regulatory Sandboxes: https://www.ofgem.gov.uk/publications/regulatory-sandbox
xiv. Fusion Energy: https://www.iter.org

Business Environment - Regulation

20.Do you have suggestions on where regulation can be reformed or introduced to encourage growth and innovation, including addressing any barriers you identified in Question 7?

The UK has 92 statutory regulators with the nuclear industry having multiple of itself (ONR, EA, SEPA, NRW, DNSR etc etc). This provides for inconsistencies and the potential for regulatory requirements conflicting or causing confusion. It would be worth considering integration of the parts of regulatory bodies that regulate the nuclear industry into a single UK nuclear regulator. This would drive greater

holistic decision-making, consistency and predictability, but would also place greater onus on the regulator to help identify the 'sweet spots' where different regulatory requirements conflict.

Reforms are needed in the approval processes for new nuclear technologies, such as fusion reactors or advanced fission reactors. The Nuclear Institute could recommend streamlining the regulatory pathways for licensing these technologies, incorporating adaptive regulations that evolve with technological advancements. Additionally, regulations that incentivise the use of low-carbon nuclear technologies in industrial applications would further encourage growth and innovation.

xv. Nuclear Technology Regulation: https://www.onr.org.uk/new-reactors/index.htm
xvi. Low-Carbon Technologies: https://www.gov.uk/government/publications/clean-growth-strategy

Business Environment – Crowding in Investment

21.What are the main factors that influence businesses' investment decisions? Do these differ for the growth-driving sectors and based on the nature of the investment (e.g. buildings, machinery & equipment, vehicles, software, RDI, workforce skills) and types of firms (large, small, domestic, international, across different regions)?

Investment decisions in the nuclear sector are heavily influenced by government policy, long-term contracts, and public perception of nuclear energy. The Nuclear Institute urges the UK Government to maintain a clear and consistent pro-nuclear policy framework, alongside financial incentives such as loan guarantees for large infrastructure projects. This would help reduce the investment risks associated with nuclear and promote greater private sector involvement.

i. UK Nuclear Policy: https://www.gov.uk/government/publications/nuclear-sector-deal
ii. Loan Guarantees: https://www.gov.uk/government/publications/uk-guarantees-scheme

Business Environment – Mobilising Capital

22.What are the main barriers faced by companies who are seeking finance to scale up in the UK or by investors who are seeking to deploy capital, and do those barriers vary for the growth-driving sectors? How can addressing these barriers enable more global players in the UK?

This is addressed in Q6 and Q7 with regards to a perceived failure to encourage private development and investment to proceed outside the envelope of direct control. Government should look towards how it might engage directly with relevant private investors and developers. It may be perceived that in some sectors the funding models of trade bodies may dictate that these are bodies are strongly lobbied by more established sector parties and this could stifle innovative business models and silence the voice of new entrants.

The long development timelines and high regulatory standards in the nuclear sector present significant challenges to scaling up. Tailored financing mechanisms are required, and the Nuclear Institute suggests that government-backed financing or risk-sharing schemes be introduced to support smaller nuclear companies or innovative projects like SMRs, which are key to the sector's growth.

xvii. Financing Nuclear Projects: https://www.world-nuclear.org/information-library/economic-aspects/financing-nuclear-energy.aspx
xviii. Risk-Sharing Schemes: https://www.gov.uk/government/publications/uk-guarantees-scheme

23.The UK government currently seeks to support growth through a range of financial instruments including grants, loans, guarantees and equity. Are there additional instruments of which you have experience in other jurisdictions, which could encourage strategic investment?

Government bonds specifically allocated to clean energy, with nuclear energy as a key beneficiary, could incentivise further investment in the sector. Tax incentives or direct grants for R&D projects, particularly in fusion energy or advanced nuclear reactors, would encourage private investment in high-tech, innovative nuclear solutions.

xix. Clean Energy Bonds: https://www.gov.uk/government/publications/green-finance-strategy
xx. R&D Tax Credits: https://www.gov.uk/guidance/corporation-tax-research-and-development-rd-relief

Business Environment – Trade and International Partnerships

24.How can international partnerships (government-to-government or government-to-business) support the Industrial Strategy?

The nuclear industry depends on strong international collaboration for research, regulatory alignment, and supply chain management. The Nuclear Institute could recommend leveraging existing international partnerships, particularly with leading nuclear nations like France and Japan, to share best practices on safety, waste management, and technological innovation. These partnerships are critical for driving the UK's nuclear industry forward. International collaboration through a modular approach to regulation could help reduce timescales by allowing companies to focus only on the modules that vary by regulatory requirements specific to individual countries.

i. UK-Japan Nuclear Collaboration: The Hiroshima Accord - GOV.UK (www.gov.uk)

25.Which international markets do you see as the greatest opportunity for the growth-driving sectors and how does it differ by sector?

This is addressed in Q 2, 3 & 4 in respect of sectors and demand. Multiple nations have committed to nuclear new build within their future energy mix. Addressable markets in the near term are most likely in Europe, North America, Canada and in due course Pacific Nations.

Place

26.Do you agree with this characterisation of clusters? Are there any additional characteristics of dimensions of cluster definition and strength we should consider, such as the difference between services clusters and manufacturing clusters?

Clusters should be considered through the paradigm of a concentration of expertise and also through the ability to attract end users. For example the potential application of Small and Advanced Nuclear or it's use to power energy intensive industries through direct heat, ability to generate hydrogen as a source of stored energy or as is more economically viable synthetic liquid fuels. It is increasingly likely and being evidenced that some future nuclear applications will be linked with other industries, and identifying where and how this is likely would be an important part in enabling developments in areas where clustering would be practicable.

Nuclear sites, particularly regions around existing or planned reactors (e.g., Hinkley Point, Sizewell), act as natural industry clusters that spur local economic growth. The Nuclear Institute can argue that investment in these clusters, supported by clear infrastructure and planning policies, will enable these areas to benefit from nuclear-related activities and generate more jobs.

27.What public and private sector interventions are needed to make strategic industrial sites 'investment-ready'? How should we determine which sites across the UK are most critical for unlocking this investment?

This is addressed in previously.

28.How should the Industrial Strategy accelerate growth in city regions and clusters of growth sectors across the UK through Local Growth Plans and other policy mechanisms?

Nuclear energy provides the stable, clean energy needed to support industrial clusters. The Nuclear Institute could advocate for region-specific nuclear projects in areas needing economic regeneration. Supporting local supply chains around nuclear clusters will boost local economies and promote a more robust industrial growth model.

i. Local Supply Chains: https://www.gov.uk/government/publications/local-industrial-strategies-policy-prospectus

29.How should the Industrial Strategy align with devolved government economic strategies and support the sectoral strengths of Scotland, Wales, and Northern Ireland?

Nil return.

Partnerships and Institutions

30.How can the Industrial Strategy Council best support the UK government to deliver and monitor the Industrial Strategy?

The representative nature of any Industrial Strategy Council will be key in its effectiveness to supporting delivery and monitoring the industrial strategy. This should include direct access and engagement with important voices who may bring diversity of thought to bear i.e. not populated by people who know each other rather than by those who can make the greatest contribution on the ground or who have the most innovative and open-minded thought processes. Hence, getting a membership that inspires and innovates is going to be key. This should not be dominated by Government process.

31.How should the Industrial Strategy Council interact with key non-government institutions and organisations?

In my opinion, the ISC needs to be given a very clear and appropriate remit. It then needs to be allowed to perform its function in a manner that is not constrained unnecessarily. It may be wise for government to also encourage the ISC to act as a challenge function to unpick undo conservativism or

narrow thinking. Regularly and extensively allowing interactions to be undertaken and relationships to be built ensuring a better outcome for all involved. Interactions should be based on honesty, respect, trust, dynamism, growth, locality, experience, 360 degree look around, broad scanning across the sectors, nations and globally.

The Nuclear Institute, along with other industry bodies such as the Nuclear Industry Association, should be regularly engaged in the formulation and evaluation of industrial strategy policies. Their expert insights into the technological, regulatory, and workforce needs of the nuclear sector are essential for ensuring nuclear energy remains central to the UK's industrial growth and energy strategy.

32.How can we improve the interface between the Industrial Strategy Council and government, business, local leaders and trade unions?

Through honesty, respect, trust, dynamism, growth, locality, experience, all on the same page and no gain for any parties.

Theory of Change

33.How could the analytical framework (e.g. identifying intermediate outcomes) for the Industrial Strategy be strengthened?

Addressed previously in respect to desired outcomes and using the right outcomes both UK wide and locally as local outcomes will be different to UK wide, engage not just the people you have mentioned in the paper but committees, organisations such as institutes and bodies, education, infrastructure and service providers, and most critically end users of the same.

34.What are the key risks and assumptions we should embed in the logical model underpinning the Theory of Change?

The' Theory of Change' may be strengthened by super imposing a 'systems thinking' approach, and by remembering that we're dealing with people (and therefore culture is important) and academic and commercial institutions who will require certain enablers to be in place before they're likely to invest To support an industrial strategy.

35.How would you monitor and evaluate the Industrial Strategy, including metrics?

As described in earlier Qs'.

The industrial strategy should be founded on clear baselines and objectives from the start. An overall economic growth target will help, along with a clear indication/evaluation as to how each sector and sub sector would contribute to that. Delivery of each contribution would then contribute one means of evaluation. Supply chain capacity to deliver the industrial strategy, and whether the organisations we want to drive the industrial strategy have the certainty and confidence to be willing to do so (and invest) would be another measure.

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