

Industrial strategy: government and industry in partnership

The UK's Nuclear Future



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Ministerial Foreword

The UK's heritage, experience and accumulated knowledge of civil nuclear energy is second to none. The UK was the first country successfully to develop, deliver and safely operate nuclear power stations, meeting all the scientific, technological and industrial challenges that this involved. We can now look back on nearly sixty years of successful and, above all, safe exploitation of low-carbon nuclear power which has also enhanced our energy security.

Nuclear power is, and will continue to be, a key part of our low-carbon energy mix alongside renewable generation and Carbon Capture and Storage. All of these technologies are important in tackling climate change and diversifying our supply, contributing to the UK's energy security and growth.

This is an ambitious *Strategy*. It covers a number of challenges and opportunities, near and long-term. That includes: continuous improvements in safety; successfully delivering the first wave of new nuclear power stations; ensuring effective waste management and decommissioning plans are in place; driving down the costs of nuclear power to benefit domestic and industrial consumers; establishing effective collaborations at home and overseas on R&D and innovation.

The timing of this *Nuclear Industrial Strategy* comes at a watershed in the development of nuclear power in the UK, and indeed globally. The first new nuclear power station to be built in the UK for decades, having recently secured planning approval, is a clear prospect provided the agreement offers value for money for consumers and is consistent with the Government's policy of no public subsidy for new nuclear. More should follow. This will help satisfy our future energy needs and contribute to the essential decarbonisation of our energy system. New markets are emerging overseas, some with little or no experience in civil nuclear power and could therefore benefit from the UK's outstanding expertise and technologies.

Crucial to this *Strategy* – and the others that have been completed or are in preparation – is the need for partnership between Government and industry. The research community is also a key partner because of the significant engineering and scientific challenges that have to be addressed for new nuclear systems and their legacy. This partnership approach requires long-term planning and commitment – many decades rather than merely several years. So this *Strategy* is the beginning of a new approach and a new commitment. For it to be a genuine and productive partnership, Government and industry will need to contribute time and resource.

The Government will contribute funding for research and development, innovation, skills, and through support for centres like the Nuclear Advanced Manufacturing Research Centre. Government will also draw in direct expertise by utilising the National Nuclear Laboratory to advise on current and future commercial opportunities in the global nuclear market. Businesses of all sizes will stand to benefit from near

market innovation support run by the Technology Strategy Board, or other industrial investment schemes run directly by Government or its partners.

Industry's contribution can take many forms, and the industry's own Vision Statement – published with this *Strategy* – usefully indicates what that might be. We welcome that, as well as the development of those ideas into more specific proposals as part of this *Strategy* and through the work of the Nuclear Industry Council. We particularly welcome industry's recognition of the need to take steps now to improve its competitiveness and capabilities to win a major share of the UK's nuclear new build programme. In order to grow domestic and global market share, effective collaboration along supply chains will be essential, involving larger companies at the top and Small and Medium Enterprises further down those supply chains, as well as properly utilising inward investment. In the area of domestic and global decommissioning, historic issues provide real challenges, but also huge opportunities for UK businesses to deliver the best possible solutions for the safety and security of future generations. The Nuclear Decommissioning Authority, with UK Trade and Investment, will help businesses in the UK promote their capabilities internationally.

Effective collaboration over the long term, starting now, will enable the UK to tackle the challenges and exploit the opportunities for growth and jobs that lie ahead.



A stylized, cursive signature of Rt Hon Vince Cable MP in black ink.

Rt Hon Vince Cable MP

**Secretary of State for Business,
Innovation and Skills**



A cursive signature of Rt Hon Edward Davey MP in black ink.

Rt Hon Edward Davey MP

**Secretary of State for Energy
and Climate Change**

Nuclear Industry Association Foreword

Nuclear energy has become a mainstay of Britain's energy mix since its inception sixty years ago and it makes a significant contribution to the country's need for secure, clean and affordable electricity. In that time the British nuclear industry has developed a highly skilled workforce and capable supply chain across the whole nuclear business, and earned an enviable reputation for high quality, safe and reliable operations.

The UK is once more at the forefront of a global revival of interest in nuclear activities, and well positioned to reap the very considerable dividends that will result from a resurgent nuclear sector - taking advantage of and building upon our deep experience and expertise across the whole sector.

I warmly welcome this *Nuclear Industrial Strategy* as evidence of the fruitful partnership between Government and industry in setting the direction of travel for the UK to achieve its ambitions to be a leading nuclear nation. Having that clarity of vision and determination to succeed will help bring substantial rewards and benefits to the country's energy, industrial and economic future, and provide the platform from which to showcase the industry's qualities and capabilities to the rest of the world.

I welcome and applaud the Government's firm commitment to the important part that nuclear will continue to play in the energy mix, and pledge the industry's strongest endeavours to delivering a successful and prosperous nuclear future.



A handwritten signature in black ink, appearing to read 'John Hutton'.

Rt Hon Lord Hutton of Furness

**Chairman
Nuclear Industry Association**

“The nuclear industrial strategy sets out the path we must take to build UK capability in the civil nuclear sector and exploit our strengths. This is simply the start of what I hope will be a productive long term partnership. Government stands fully behind industry to grow this country’s work share and exploit the considerable growth opportunities that civil nuclear offers in the next two decades and beyond”.

Rt Hon Michael Fallon, Minister for Business and Enterprise



“The Government is determined to deliver a secure nuclear future. Nuclear power is an important part of our energy mix now, and will continue to be in the future.

“New nuclear power stations will provide heat and light to support our endeavours, delivering investment, jobs and growth, up and down the country. At the same time we must ensure the way we deal with decommissioning and waste continues to be an example to the rest of the world.

“This strategy is a vision for the long-term. We will work with the industry, educators and the science community to realise the vast potential that nuclear power has to offer. I am determined to deliver a policy defined by principle and driven by purpose.”

Rt Hon John Hayes, Energy Minister

Executive Summary

The *Nuclear Industrial Strategy* (the *Strategy*) is part of a series of industrial strategies across a number of sectors to be published by Government and co-created with industry. These strategies will establish a consistent, long-term approach to the deployment of Government and industry resources to grow commercial opportunities, stimulating economic growth and job creation.

The *Strategy* sets out the Government's clear expectation that nuclear will play a significant role in the UK energy mix in the future. The Government sees the domestic new build and wider nuclear market as an essential platform to further enhance the UK nuclear commercial base and grow global market share.

The *Strategy* builds on the review undertaken last year to respond to the House of Lords 2011 report¹ on the UK's nuclear R&D capabilities. That response included a *Nuclear Industrial Vision Statement* detailing industry's own ambitions for the UK to become once again a 'top table' nuclear nation; a *Long-term Nuclear Energy Strategy* which underlines the increasingly significant role that nuclear energy can play in the UK's energy mix up to 2050 and beyond; an *R&D Roadmap* detailing what R&D is required for different future scenarios; and an overview of the UK's current nuclear *R&D Landscape*. The *Nuclear Supply Chain Action Plan*², published in December 2012, focuses on near-term opportunities predominantly in the nuclear new build sector and is a forerunner to this *Strategy*.

New nuclear power is essential to meeting the Government's objective of delivering a secure, sustainable and low-carbon energy future. The UK has everything to gain from becoming the number one destination to invest in new nuclear. That is why Government and industry are taking action now.

Huge opportunities lie ahead. Over the coming decades, the nuclear industry is set for a global expansion. Around £930 billion investment is planned globally to build new reactors³ and £250 billion decommissioning those that are coming off-line⁴. Added to this is a significant potential market of extending the life of existing nuclear reactors, enhancing their efficiency – another area of UK experience.

In the UK, industry has set out plans to deliver around 16 GW of new nuclear by 2030. That broadly translates into at least 12 new nuclear reactors at five sites

¹ House of Lords Select Committee on Science and Technology, 3rd Report of Session 2010-2012, Nuclear Research and Development Capabilities. ISBN 978 0 10 847395 1

² The Nuclear Supply Chain Action Plan – URN 12D/436

³ The World Nuclear Supply Chain: Outlook 2030, WNA, Sep 2012, ISBN: 978-0-9550784-6-0

⁴ A Review of the UK's Nuclear R&D Capability, commissioned by the TSB, 2008

currently earmarked for development: Hinkley Point, Sizewell, Wylfa, Oldbury and Moorside. This is a significant programme of new build in the UK. Delivering it will be a challenge, given the high levels of capital investment required. But Government is committed to finding a way that will enable investors to deliver a programme of new build and is reforming the electricity market system to make this possible. A clear framework for future development was set out in the 2008 White Paper⁵ and much of the planned reforms to the electricity market are now in place, or underway. These arrangements will enable nuclear to be brought forward.

In response to this significant opportunity for economic growth, the sector is looking to transition from one currently dominated by the operation and life extension of reactors built over 20 years ago, as well as decommissioning and clean up of existing facilities, to one that also includes significant new generation. On 19th March the Government granted development consent for construction of the first nuclear power station in the UK since 1995. The £12-14 billion project at Hinkley Point, Somerset, to be constructed and operated by EDF Energy, will generate around 3.2 GW of clean energy, enhance our energy security and bring major investment to our economy supporting jobs and driving growth. Hinkley, the Government hopes, will be the first of five new sites to be developed by 2030. The market will be able to bring forward more after that. The second significant station is scheduled for Wylfa in North Wales to be developed by Hitachi and Horizon Nuclear Power. The Government is working with EDF Energy and Hitachi to assist them in being able to make a final investment decision, ensuring that a good deal is secured for consumers, the company, and UK industry. In the case of Wales the UK Government is joined to this end by the Welsh Government to help facilitate build plans.

The UK's strategy to clean up its existing nuclear facilities is being delivered by the Nuclear Decommissioning Authority (NDA) through the established decommissioning supply chain. This is an existing UK market worth around £3 billion a year. The skills, capabilities and capacity needed for this decommissioning work are significant in their own right. The addition of constructing new stations, together with providing the long term infrastructure needed to support them, and building an important UK nuclear export sector, means a new concentrated strategic approach is needed to ensure requirements are met across the whole sector. The supply chain and skills for the sector as a whole going forward will largely be developed from this existing base. The *Strategy* draws from the NDA's own strategy where necessary, as all aspects of the nuclear sector must work together to ensure the country's aspirations are met safely, to time and to budget. To achieve this, skills coordination is being managed through the Nuclear Energy Skills Alliance.

The *Strategy* outlines the key actions and approach needed to realise the vibrant, diverse and strategically cohesive sector that Government and industry wishes to see

⁵ Meeting the Energy Challenge: A White Paper on Nuclear Power. BERR (2008) URN 08/525

develop. It seeks to provide industry with the confidence to further invest in a nuclear future by:

- Recognising the challenges and capturing opportunities in the home market;
- Enhancing the UK's innovation and R&D landscape;
- Government engagement to attract domestic and inward investment in nuclear projects and assistance to help firms penetrate overseas markets; and
- Ensuring the UK has the necessary skills for the future.

Vision, Milestones and Key Actions

Together, Government and industry have a clear and ambitious vision to ensure the development of a vibrant UK nuclear industry that is an area of economic and strategic national strength, providing the UK with a safe, reliable and affordable supply of low-carbon electricity.

Nuclear energy is clean, secure and reliable. The Government is clear on the important role nuclear has to play in the energy mix and is working to ensure that the market can and will bring new nuclear power forward. The Government's Carbon Plan⁶ to reduce UK CO₂ emissions to 2050 aims for there to be competition between different forms of low carbon electricity generation. Although there are no set targets, within 3 of the 4 key scenarios in the Government's Carbon Plan nuclear energy is shown to deliver a much larger amount of generation than that available now, with the potential to deliver between 16 GW and 75 GW of the UK's electricity needs. The 75 GW from nuclear energy is part of a scenario where total installed capacity in the UK is around 160 GW by 2050. Nuclear could contribute roughly 40-50% to the energy mix under this scenario, compared with nearly 20% today.

The size of the UK's nuclear new build programme will therefore largely depend on industry's ambition, the success of the initial new build programme, subsequent reduction in cost through experience, growth in investor confidence, and realising economies of scale.

The following diagrams, based largely on industry's own *Vision Statement*, set out milestones towards delivering key objectives. The Government fully supports this approach and will work with industry to see this vision delivered through the Nuclear Industry Council (NIC).

⁶ DECC, Carbon Plan, 2011

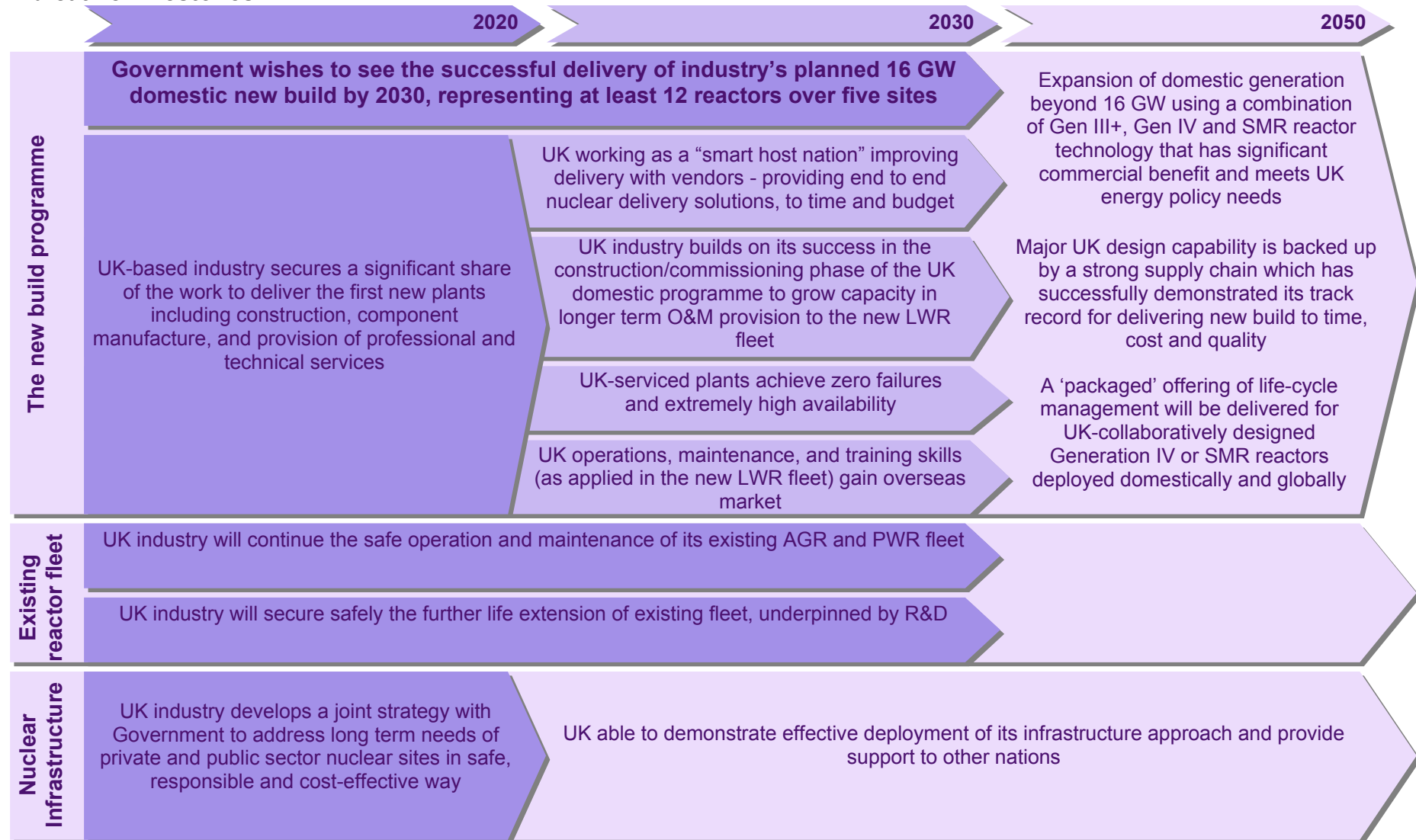
The Home Market

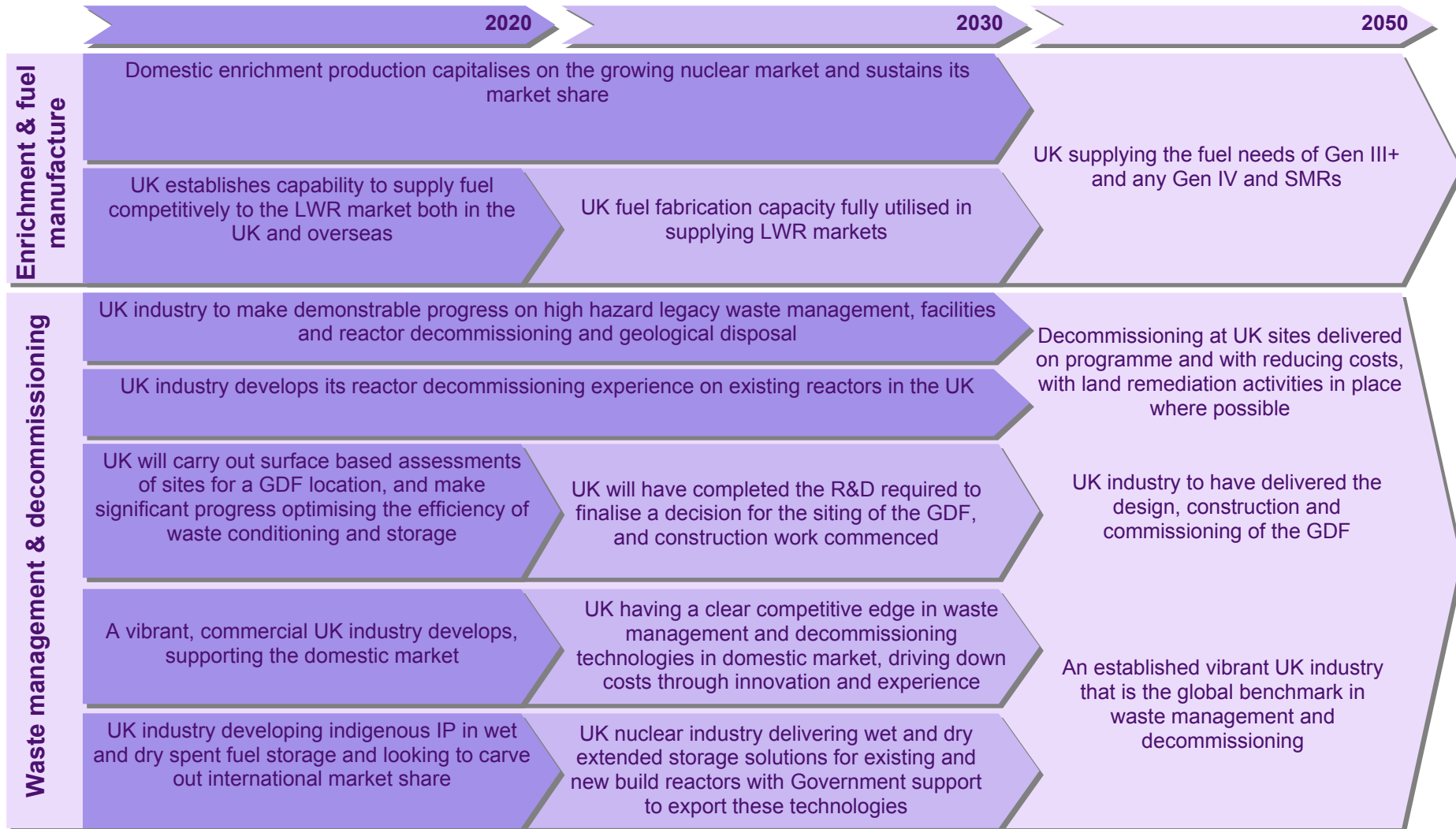
Objectives

- To have a domestic nuclear market that maximises UK commercial opportunities, delivering growth by providing a platform to build sustainable exports as well as a secure supply of energy in the long-term;
- To provide the long term infrastructure required to support both the public and private sector parts of industry in a safe, responsible and cost-effective manner;
- To have clear direction and co-ordination across public procurement, R&D, and skills development;
- For the home market to become the showcase that demonstrates UK's overall nuclear excellence to the international market.



Indicative Milestones





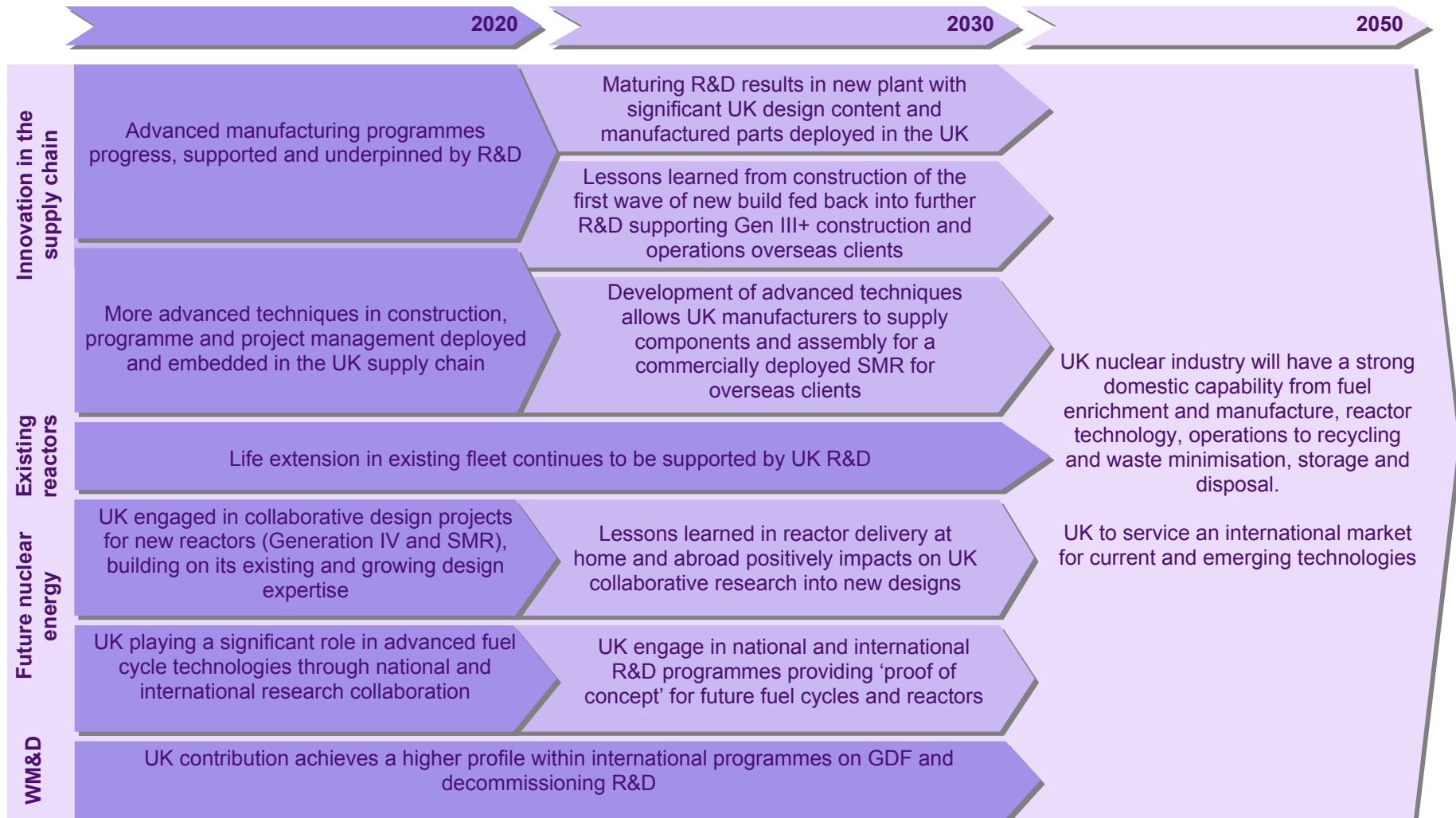
Building a Future: Innovation and R&D

Objectives

- To have a joined up approach to nuclear R&D across government, industry and academia, which serves to benefit the UK economy and ensure security of supply.
- For the research base to be underpinned by world-leading facilities which are fully utilised by both national and international customers and which conduct a programme of fission-related research whose scale is consistent with the UK's nuclear aspirations.
- To be a respected partner contributing significantly to appropriate international research programmes undertaken with selected international collaborators.
- To have the right level of nuclear innovation and R&D to ensure near-term as well as long-term commercial success in domestic and global markets.



Indicative Milestones



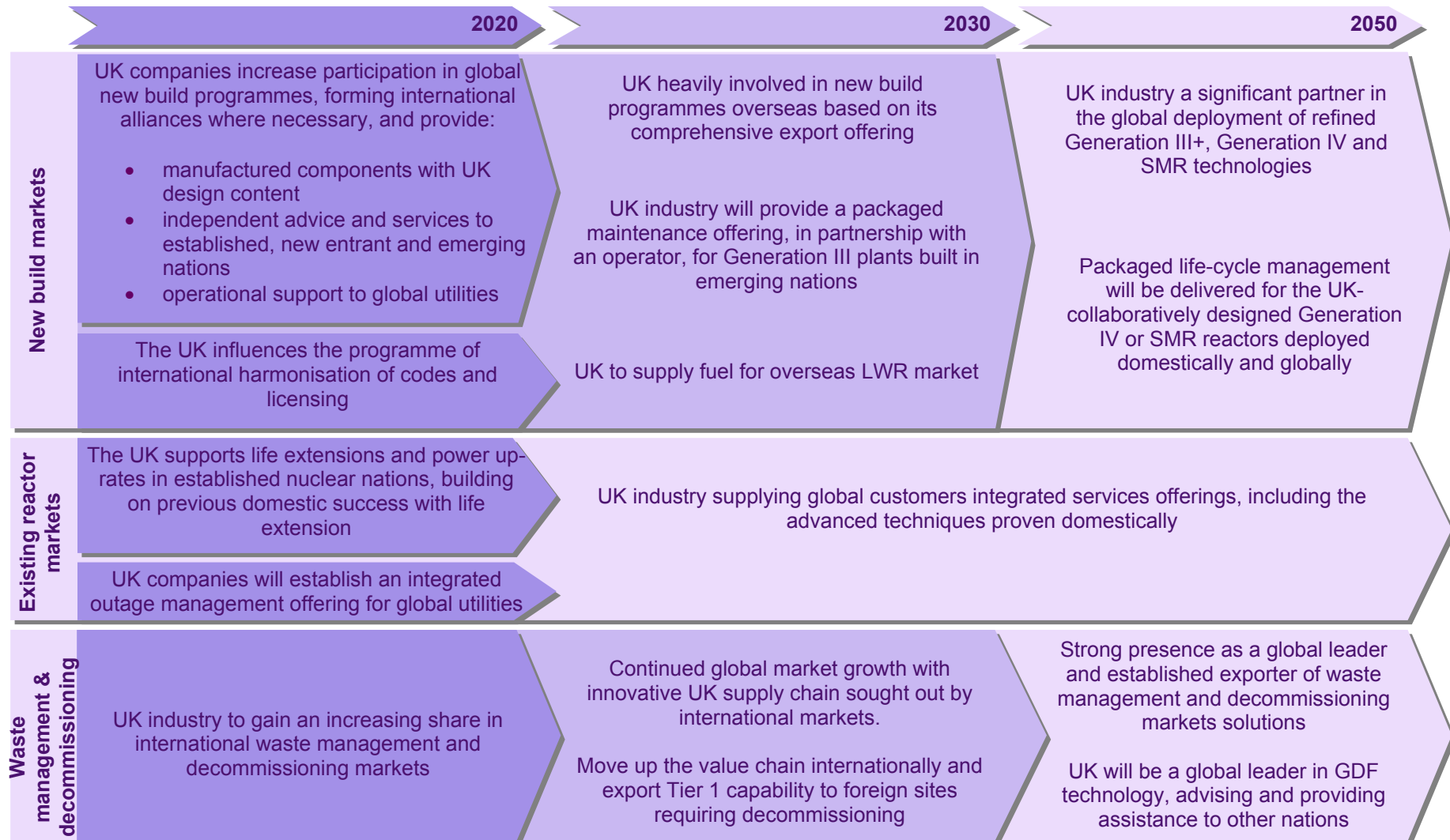
Forging a Stronger International Presence

Objectives

- To be a 'top table' nuclear nation, working in international partnerships leading the direction of future technology advances across the fuel cycle;
- To be a key partner of choice in commercialising Generation III+, IV and Small Modular Reactor (SMR) technologies worldwide;
- To have a supply chain that is integrated with the global market, and providing design, construction, manufacturing, professional services, skills, training and educational services across the complete civil nuclear fuel cycle from front end design through to decommissioning;
- To establish the UK industry as a global leader in waste management and decommissioning, securing a significant share of high value contracts globally.



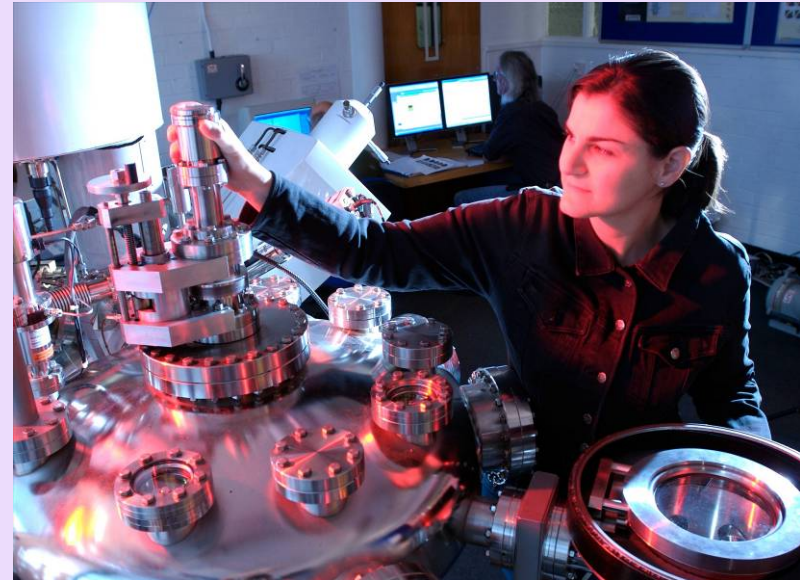
Indicative Milestones



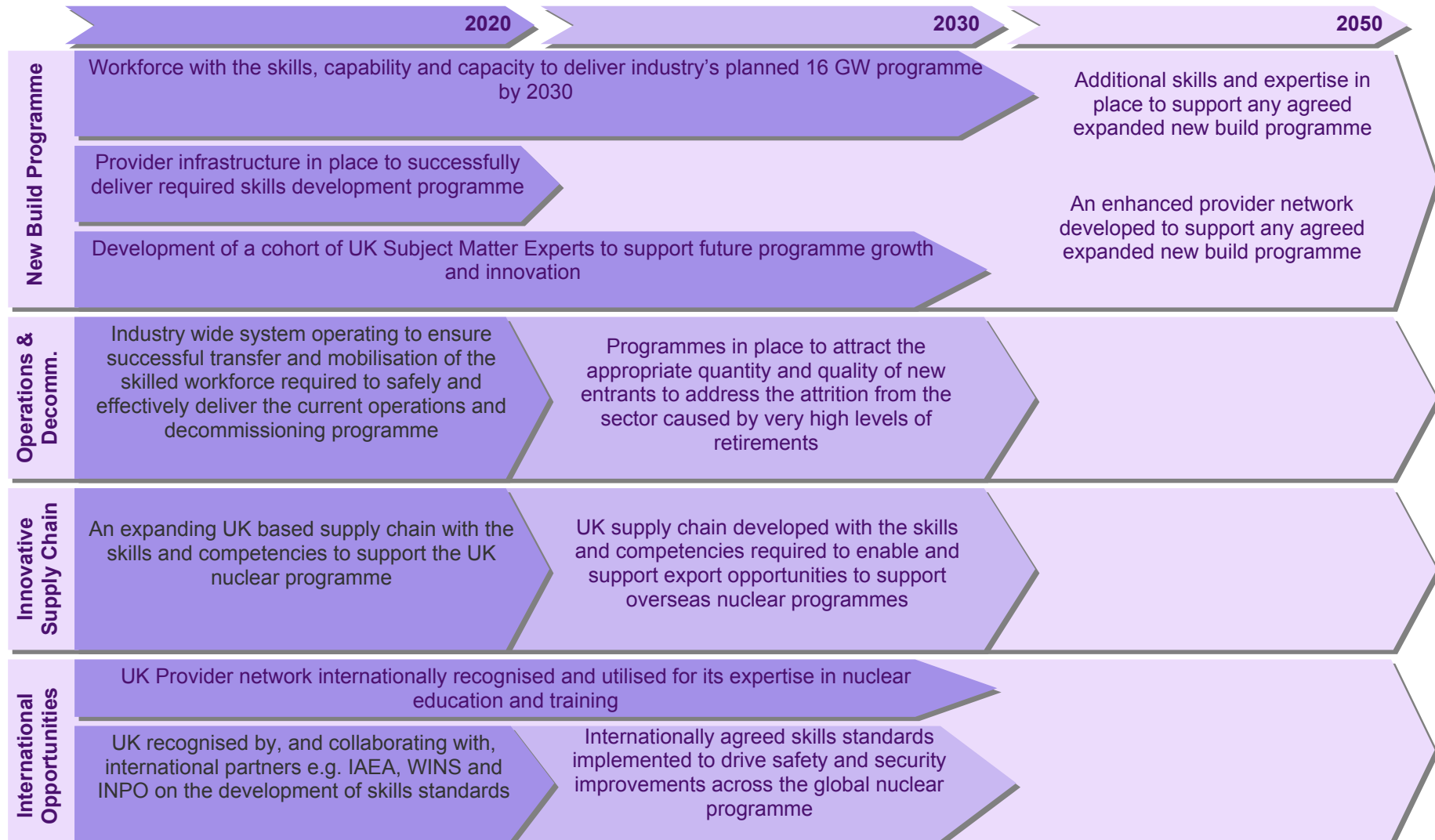
Investing in the Right Skills

Objectives

- For industry to be supported by a workforce with the skills, capability and capacity required to successfully deliver current and future UK nuclear programmes with the highest standards of nuclear professionalism, safety and competitiveness;
- To have a supply chain with the skills and expertise to compete on a global basis for contracts;
- For the UK nuclear industry and its approach to skills and workforce development to be recognised as an example of international best practice.



Indicative Milestones



Key Actions

Key actions together with individual measures specific to this *Strategy* are indicated in the tables below.

The Home Market		
Action	Owner	Initial Success Measure and Timescale
<p>Establishment and successful operation of the Nuclear Industry Council:</p> <p>NIC will be responsible for delivery and development of this <i>Strategy</i>.</p>	Govt & Industry	Reviews of progress at each NIC meeting. The frequency and mechanisms for doing so at a more detailed level to be agreed by NIC
<p>Establishment of a Procurement and Infrastructure Client Group:</p> <p>NDA, EDF Energy and Government (including MoD) will establish a Procurement and Infrastructure Client Group to improve procurement and infrastructure delivery and operational efficiency across the nuclear market.</p>	NDA, EDF Energy and Govt	<ul style="list-style-type: none"> • Group formed in 2013 • Advances made to simplify market access for supply chain companies in the UK • Decisions taken on large infrastructure
<p>Access to finance for nuclear supply companies:</p> <p>Government will commission a research project to investigate the specific challenges and barriers for SMEs in the nuclear sector in accessing finance, and consider possible solutions.</p>	Govt	Research project complete in 2014

The Home Market		
Action	Owner	Initial Success Measure and Timescale
<p>Nuclear energy cost reduction programme: To assess the scope for reducing the cost of nuclear decommissioning, new build and operation, through incremental advancements and potential innovation leaps.</p>	Govt & Industry	<ul style="list-style-type: none"> • Taskforce created by 2nd NIC meeting with project scope set out for NIC. • Short-term actions defined over 2013. • Ongoing programme of work with timetable to be agreed by the NIC.
<p>Technical Advisory Panel (TAP) for the nuclear regulator: Office for Nuclear Regulation (ONR) will create a permanent Technical Advisory Panel. This will ensure that the UK regulator receives the best advice and remains at the leading edge in technical knowledge in order to fully understand the safety aspects and implications across the sector. This is essential to underpin a growing and innovative domestic sector.</p>	ONR	TAP created by Q2 2013
<p>Regulating for the future: Government will work with ONR to ensure resources are available to safely regulate new build and decommissioning activities taking into account potential range of nuclear generation.</p>	Govt & ONR	Scoping exercise complete by Q2 2014 to identify potential short and long term actions.
<p>Public engagement and awareness: Government with the Health Protection Agency (HPA) and the NIC will work with universities, research institutes and others on programmes that improve understanding of radiation and how it is used in society and managed within the nuclear industry.</p>	NIC	Initiative underway by Q4 2013

Enhancing Research, Development and Innovation		
Action	Owner	Initial Success Measure and Timescale
<p>Nuclear Innovation and R&D Coordination:</p> <p>The UK will establish a co-ordinated approach to nuclear R&D. Government will establish:</p> <ul style="list-style-type: none"> • Nuclear Innovation and Research Advisory Board (NIRAB) to ensure that public R&D programmes are aligned to support industrial and energy policy, and to maximise synergy across different aspects of the nuclear sector, including fusion and the NDA portfolio. • Nuclear Innovation and Research Office (NIRO) hosted within the National Nuclear Laboratory (NNL). It will respond to NIRAB recommendations and provide advice to Government, its organisations and industry on R&D / innovation opportunities (including commercial) and programmes. 	Govt & Industry	NIRAB and NIRO created in 2013
<p>Future nuclear energy systems R&D:</p> <p>Government will keep under review the level of public nuclear R&D expenditure to ensure it effectively directs, and where possible accelerates, the pace and direction of commercial opportunities, including:</p> <ul style="list-style-type: none"> • Future reactor designs and their fuel cycles that may be required to deliver nuclear power (anywhere between 16 and 75 GW) by 2050 in the UK and take advantage of the global nuclear market. • The feasibility of launching a Small Modular Reactor (SMR) R&D programme that would enable the UK to be a key partner of any new reactor design for the global market. 	Govt	Funding routes explored and commercial justification for R&D programmes underway in FY 2013/14

Enhancing Research, Development and Innovation		
Action	Owner	Initial Success Measure and Timescale
<p>Phase 3 of the NNL Central Laboratory:</p> <p>Government will work with NNL and NDA to conclude an assessment about commissioning of Phase 3 of the NNL Central Laboratory at Sellafield. If commissioned the facility will support domestic and overseas decommissioning challenges. It could also to reduce costs and improve safety, together with programmes focused on domestic and international new build future nuclear R&D programmes.</p>	Govt	Q3 2013
<p>National Nuclear Users Facility:</p> <p>Government to invest £15m through UK Research Councils in equipment and access to Culham, NNL and Dalton Cumbrian Facility to facilitate active research for academia, national laboratories and industry.</p>	Govt	Investment made in both FY 2012/13 and 2013/14.
<p>Supporting nuclear innovation</p> <p>The Government is supporting manufacturing innovation through the Nuclear Advanced Manufacturing Research Centre (Nuclear-AMRC), the Manufacturing Advisory Service and funding for skills. NIC will play a key role in raising awareness of these initiatives and others that are developed over time.</p>	Govt & Industry	Delivered and ongoing

A strengthened international presence		
Action	Owner	Initial Success Measure and Timescale
<p>Inward Investment Strategy: UKTI to develop a strategy to increase the level of investment over time for all parts of the nuclear supply chain, including partnerships with existing UK-based companies to help with market access and knowledge transfer. NIC will be consulted.</p>	Govt	Review progress at Q3 2013
<p>Export Strategy: UKTI to work with NIC, the Nuclear Industry Association (NIA) and other parts of the industry to develop an export strategy, involving other parts of government, including the Foreign and Commonwealth Office (FCO) and ONR to increase the level of nuclear exports of goods and services, within our non-proliferation obligations. This will include industry agreeing a clearer unified offer from the UK to markets overseas ('UK Plc').</p>	Govt & Industry	Nuclear Export Strategy to be written by Q4 2013
<p>International Profile: Government and industry to raise the profile of the UK nuclear industry internationally. This will include making effective use of the UK's waste management and decommissioning knowledge, skills development activity and new build capability in the global market, with the NDA, NNL, National Skills Academy for Nuclear (NSA Nuclear) and ONR to share and leverage their experience internationally, and in doing so facilitate export by UK companies.</p>	Govt & Industry	Formulation of a stronger approach to start by Q3 2013 Further detail and commitments in the Export Strategy

A strengthened international presence		
Action	Owner	Initial Success Measure and Timescale
<p>Increasing UK presence and impact in international fora:</p> <p>Government and industry will commit to:</p> <ul style="list-style-type: none"> • Greater engagement with International Atomic Energy Agency (IAEA) where appropriate • Coordinated approach to engagement with the Nuclear Energy Agency (NEA) • Industry participation in international reactor 'owner groups' • Increased coordinated involvement in EU discussions and programmes, particularly on nuclear R&D via NIRO. 	Govt & Industry	Starting FY 2013/14
<p>Government to enhance strategic relationships with key nations in order to help realise the opportunities identified in this Strategy:</p> <p>For example with the US, France, South Korea, China, India, Japan, to boost trade and future technology development.</p>	Govt	Starting FY 2013/14
<p>Jules Horowitz Reactor:</p> <p>Government, represented through NNL, will join the Jules Horowitz Reactor (JHR) research project. This will provide a radiation testing environment to take forward the UK's future nuclear R&D programmes in the development of nuclear fuels and materials. This complements the enhanced nuclear facilities that exist or are being created in the UK.</p>	Govt	Agreement signed Q1 2013

Investment in the right skills		
Action	Owner	Initial Success Measure and Timescale
<p>Nuclear Skills Development:</p> <p>Government sets out further detail on the approach to skills delivery for the nuclear market in this <i>Strategy</i>. This details how skill gaps will be identified and subsequently resolved by Government and industry working together, with a common Skills Delivery Plan overseen by the Nuclear Energy Skills Alliance and whole industry labour market data provided by a Nuclear Workforce Model.</p>	Govt & Industry	Q2 2013

Partnership in Delivery

Government and industry will work together to achieve the objectives and actions outlined above. NIC will oversee that by providing strategic direction, and the associated work, including the *Nuclear Supply Chain Action Plan*. It will also identify further actions in the evolution of this programme of work. The *Strategy* marks a new approach, particularly in looking at energy policy and industrial policy and how they both relate to each other for maximum UK economic growth.

The UK Government will also work with the Devolved Administrations in implementing the *Strategy*. That includes opportunities to stimulate economic growth and job creation, such as extending the life of existing nuclear power stations, as well as waste management and decommissioning. In the case of Wales, this will also extend to new build.

A new legislative framework to promote investment through Electricity Market Reform (EMR) is being enacted by the Energy Bill, currently before Parliament, and through the Strategic Siting Assessment (SSA) and Generic Design Assessment (GDA) process amongst other initiatives. Industry, too, is already working to improve capability and competitiveness. However, where further work is needed and gaps exists, Government and industry will work together to address them.

Government's contribution of providing effective supporting infrastructure is a substantial one. This has made the UK one of the best nuclear markets in which to invest. Government will look to industry to step forward and make the most effective

use of these opportunities, essentially fulfilling the commitment given in the *Nuclear Industrial Vision Statement* to

“Strive to be competitive, and make significant and growing contributions to domestic programme delivery across the entire nuclear sector”.

Many short term actions are already underway. That includes actions in the *Nuclear Supply Chain Action Plan*, the NDA Strategy, the Nuclear Energy Skills Alliance Delivery Plan and other aligned programmes. NIC will oversee implementation and the development of key performance indicators (KPIs) to monitor progress. This will include:

- Domestic business activity KPIs: e.g. value of UK domestic civil nuclear turnover, the number of UK firms involved in new build, number of jobs, products and services delivered to time, to budget and to quality;
- Research KPIs: activity undertaken, utilisation of national facilities and commercialisation of output including number of patents registered;
- KPIs on strengthened international presence: e.g. number and value of UK civil nuclear exports, size and numbers of overseas markets;
- Investment in the right skills: e.g. age profile of the workforce and/or the number of key vacancies, companies able to expand.

Setting the Scene

The need for a Nuclear Industrial Strategy

The UK has developed considerable expertise across the full nuclear fuel cycle over the past 60 years. For the past two decades, the focus of the industry has been on operating and extending the life of existing reactors, supplying enrichment and new fuel services, reprocessing of spent fuel, and decommissioning the sites and facilities associated with the UK's nuclear history. As a result there is mature capability across these areas. There are also long-term plans in place to operate and extend existing reactors and deal with waste management and decommissioning.

There has been no new civil nuclear station built in the UK since the mid 1990s, although UK firms have been involved in equipment supply and professional services to projects overseas. The market-led nature of the sector means there has not been a national strategy for ensuring that the UK is knowledgeable in future fission generation technologies that may be required to ensure security of supply in 30 or 40 years. Government and industry recognise this needs to change.

This *Strategy* aims to build upon the strengths that already exist across the sector and increase our economic standing in these areas. That includes developing stronger capability in building the future fleet of domestic and global reactors now and in the future. The *Strategy* therefore also covers related areas of procurement, access to finance, international collaborations and skills and capability development.

The UK nuclear market has been gearing up for new build for the last few years. That is why the Government published the *Nuclear Supply Chain Action Plan* in December last year, following extensive consultation with industry. That *Plan* is a forerunner to this *Strategy*, focussing on specific near-term actions, particularly the UK's new build programme. The *Strategy* has a broader and more long-term remit, and aims to stimulate growth across the sector in domestic and global markets.

How to read this document

This *Strategy* draws from several programmes of work from the last year that have seen Government and industry jointly review the whole nuclear sector in the UK. The result is a clear picture of where the nuclear sector is now and where it wants to be in the future. This picture covers the following:

- **Current view:** UK capabilities are assessed in the *NIA Capability Report*⁷ and the *Review of the Civil Nuclear R&D Landscape*⁸ in the UK.
- **Near-term:** Near-term actions needed to take advantage of existing opportunities in the sector, particularly in new build, are identified in the *Nuclear Supply Chain Action Plan*.⁹
- **Long-term opportunities:** The future vision for the sector is clearly articulated by industry in the *Nuclear Industrial Vision Statement*¹⁰ and by Government in the *Long-term Nuclear Energy Strategy*.¹¹
- **Long-term R&D:** R&D required to ensure long-term security of supply and commercial benefit in the UK are identified for a range of future scenarios in the *R&D Roadmap*.¹²

Further details of the scope and purpose of each document and how they link together are given in Table 1 and Figure 1. The implementation of the recommendations of each of these documents will be in close alignment with this *Strategy*.

Table 1: Overview of underpinning documents

Document	Scope and Purpose
Ad Hoc Nuclear R&D Advisory Board - Summary of the Recommendations and Work of the Board	Summarises the work of the Advisory Board and highlights its recommendations for the future.
Government Long-term Nuclear Energy Strategy	Sets out the Government's vision for the future of nuclear energy in the UK, outlining the increasingly significant role that nuclear energy can play in the UK's energy mix up to 2050 and beyond. Details the existing Government policy in place to facilitate market uptake.

⁷ NIA Capability Report, 2012

⁸ A Review of the Civil Nuclear R&D Landscape in the UK – URN BIS/13/631

⁹ The Nuclear Supply Chain Action Plan – URN 12D/436

¹⁰ Nuclear Industrial Vision Statement - URN BIS/13/629

¹¹ Long-term Nuclear Energy Strategy - URN BIS/13/630

¹² Nuclear Energy Research and Development Roadmap: Future Pathways - URN BIS/13/632

Document	Scope and Purpose
Nuclear Industrial Vision Statement	An industry-authored document articulating industry's own vision for the UK nuclear industry in domestic and global markets out to 2050, and what is required to enable this.
Nuclear R&D Landscape Review	An assessment of current civil nuclear R&D capability within the UK, looking at Government policies that give rise to research needs, existing funding sources that support R&D programmes, and the capability of the research base in the UK to meet the demands of Government and the private sector.
Nuclear R&D Roadmap	Analyses several scenarios in which nuclear power has a varying contribution out to 2050 and examines the necessary R&D activities required to facilitate its deployment. Its purpose is to identify what the UK needs to do, and when, to be able to make informed decisions about future technologies and in doing so keep a variety of energy options open.
Nuclear Supply Chain Action Plan	Details the near-term, priority actions to help industry position itself for opportunities already present in the sector, including in the domestic nuclear new build programme over the next several years.
NIA Capability Report	An update of the 2006 report assessing the capability of the UK supply chain to deliver a 16 GW new nuclear programme.
NDA Strategy ¹³	The NDA's strategy to deliver safe, sustainable and publicly acceptable solutions in addressing the UK's civil nuclear legacy. It is reviewed at least every five years as required by the Energy Act 2004.

¹³ Strategy, Effective from April 2011, NDA (<http://www.nda.gov.uk/strategy/>)

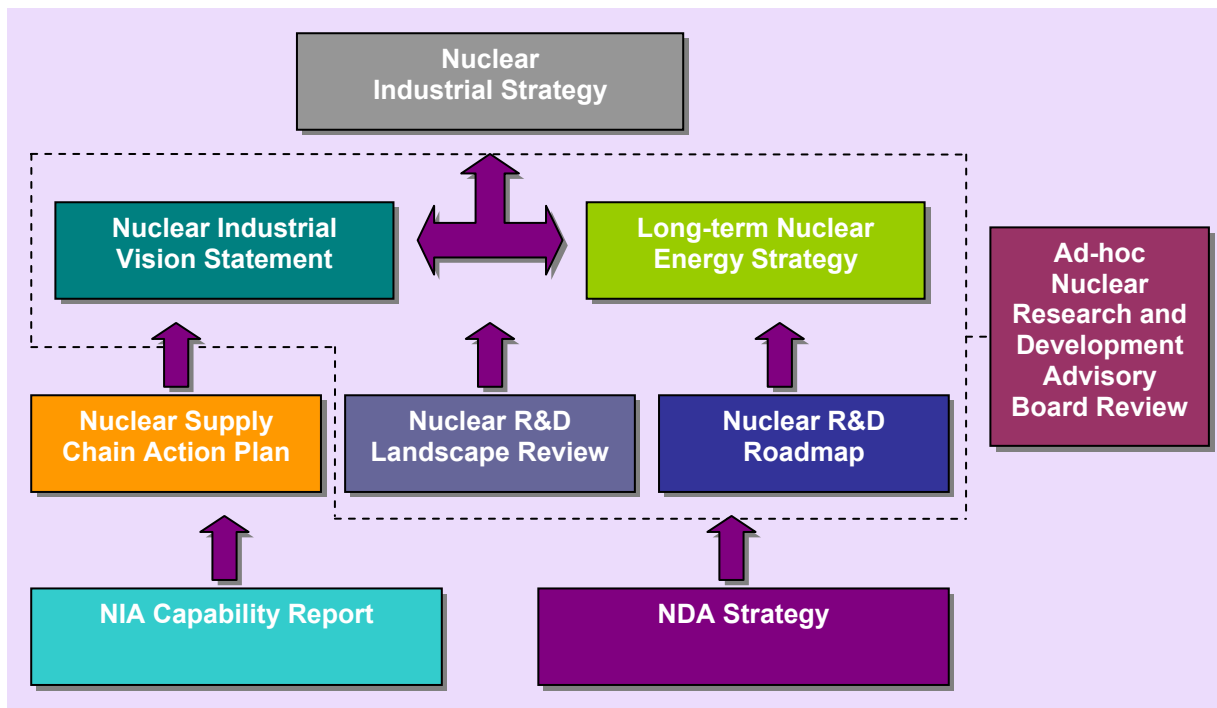


Figure 1: Work streams underpinning the *Nuclear Industrial Strategy*

Several of the above mentioned work streams respond to the 2011 House of Lords Science & Technology Select Committee inquiry into the UK's Nuclear R&D capabilities.¹⁴ The inquiry found that there was a need for Government to review its approach to nuclear R&D in order to ensure maximum value was being delivered for industry, energy policy and the public. The Government review¹⁵ was led by Government Chief Scientific Adviser, Sir John Beddington, chairing an Ad Hoc Nuclear R&D Advisory Board made up of academic and industry leaders. This *Strategy* represents the Government's overall response to the Advisory Board's recommendations.¹⁶

¹⁴ House of Lords Select Committee on Science and Technology, 3rd Report of Session 2010-2012, Nuclear Research and Development Capabilities. ISBN 978 0 10 847395 1

¹⁵ Government Response to 14 (see <http://www.parliament.uk/business/committees/committees-a-z/lords-select/science-and-technology-committee/news/nuclear-government-response/>)

¹⁶ Ad Hoc Nuclear Research and Development Advisory Board - Summary of the Recommendations and Work of the Board - URN BIS/13/628

Analysis of the Market Opportunities

The current domestic nuclear market

The nuclear sector in the UK currently employs around 40,000 people,¹⁷ with a total commercial turnover estimated at approximately £4 billion.¹⁸

The majority of employment and commercial turnover is in the operation, decommissioning and clean up of nuclear sites. Since the Energy Act 2004, decommissioning and clean-up of 19 of the UK's civil nuclear sites has been directed by the NDA. NDA expenditure in the UK is approximately £3 billion per year, with £1.6 billion of this spent in the supply chain, supporting 3500 companies. Up to £1 billion per year of NDA's annual expenditure is offset by revenue from generation and reprocessing.¹⁹ Waste management and decommissioning is therefore a strong and assured market in the UK. Government is clear it wants to see the domestic decommissioning market act as a springboard for companies to grow their share of the global decommissioning and waste management market. The NDA is therefore working with UKTI and will assist firms in that direction.

The UK has continuously been generating electricity from nuclear power stations since 1956, and has a distinguished operational safety record – one to be proud of. This has and will continue to require partnership working between the regulator and industry to ensure safety is by far the top priority. EDF Energy owns and operates 15 of the 16 current generating reactors in the UK, with the NDA owning and Magnox Ltd operating the 16th. These reactors together account for around 10 GW of installed generating capacity and contributed 19% of total electricity generation in the UK in 2011. While the contribution of the existing nuclear fleet will decline as plants come to the end of their operational lives, EDF Energy have recently reiterated their intention to seek to extend the operational lives of their Advanced Gas-Cooled Reactor (AGR) fleet by an average of seven years and by 20 years for Sizewell B. In December 2012, EDF Energy announced that having completed the necessary technical, safety and economic evaluation and received the relevant external consents, the decision was made to extend the lives of Hinkley Point B and Hunterston B power stations by 7 years. That decision means that those plants will be operational until 2023.

EDF Energy has a total annual supply chain spend of approximately £650m on its generating fleet in the UK, the vast majority of the associated work being delivered by UK suppliers. The UK's nuclear operations and maintenance industry has technical expertise, established integrated relationships between regulator, operator, academia

¹⁷ NIA Capability Report, 2012

¹⁸ K-Matrix, Low Carbon and Environmental Goods and Services data (2010-11). Note all figures include the supply chain.

¹⁹ NDA Business Plan 2012-2015

and supporting industries that place it at the forefront of global operational excellence.

Commercial exports in 2010/11 were approximately £240 million,²⁰ mainly within the subsectors of plant operations, decommissioning of nuclear sites and nuclear safety engineering services. This figure does not include the additional sizeable contribution from other areas like financial, legal, education and training, technical or fuel cycle services.

The future market at home and abroad

Opportunities for UK companies in the global nuclear market are considerable. In the decommissioning sector, as increasing numbers of older reactors come off line in the UK and worldwide, and as decommissioning of these progresses, this market will grow in significance for those specialist decommissioning companies able to apply expertise to global clients. The global decommissioning market is estimated to be worth £50 billion per annum by 2020, with between 82 and 145 reactors retired by 2030, mostly in Europe.²¹

Other areas of specialist nuclear services are required in the area of plant life extensions and new build. Increasingly, global operators are able to demonstrate that existing reactors can have their operational lives safely extended and to increase the efficiency of existing plant. There are many UK companies ideally equipped to provide products and services to aid this market demand.

Many nations have plans to develop nuclear energy as this provides them with a degree of greater energy security and insurance against the rising cost of fossil fuels. Based on these current plans, global investment is estimated to be in the order of £930 billion, with significant international procurement expected to be around £25 billion a year to 2025.²²

Government wants to see UK industry gaining a significant share of the growing new build, reactor operations and decommissioning markets at home and abroad. An important measure of the success of this *Strategy* will be the share of these markets that UK-based companies can win, and the associated jobs.

The domestic new build programme

Industry has set out plans to construct around 16 GW of new nuclear power stations in the UK by 2030, equating to an investment of around £60 billion through the

²⁰ K-Matrix, Low Carbon and Environmental Goods and Services data (2010-11) Note all figures include the supply chain.

²¹ Nuclear Technology Review 2008, IAEA

²² The World Nuclear Supply Chain: Outlook 2030, WNA, Sep 2012, ISBN: 978-0-9550784-6-0

delivery of at least 12 reactors on five sites. The Government is working with developers to help achieve that.

Government wants UK industry to secure a significant proportion of this investment, and industry itself believes that it can build on current capabilities and strengths in order to achieve this aim. To do this industry needs to strive to be competitive and overcome significant skills and capacity challenges now and in the longer term. Neither Government nor industry can afford to be complacent and underestimate these challenges; the initiatives outlined in this *Strategy* and the *Nuclear Supply Chain Action Plan* aim to assist industry in its ambitions.

Recent analysis by Oxford Economics and Atkins suggests that with policy interventions and actions taken by organisations and firms involved in new build, the UK supply chain has the potential to capture around 60% of the overall value of investment in a 16 GW programme over the period to 2030²³, providing it is delivered to the right drumbeat. As illustrated in Figure 2 below, this would be equivalent to around £35 billion in gross output and over £15 billion in Gross Value Added (GVA).²⁴ Combined with indirect and induced effects, gross UK output and GVA are estimated at over £80 billion and £37 billion respectively.²⁵

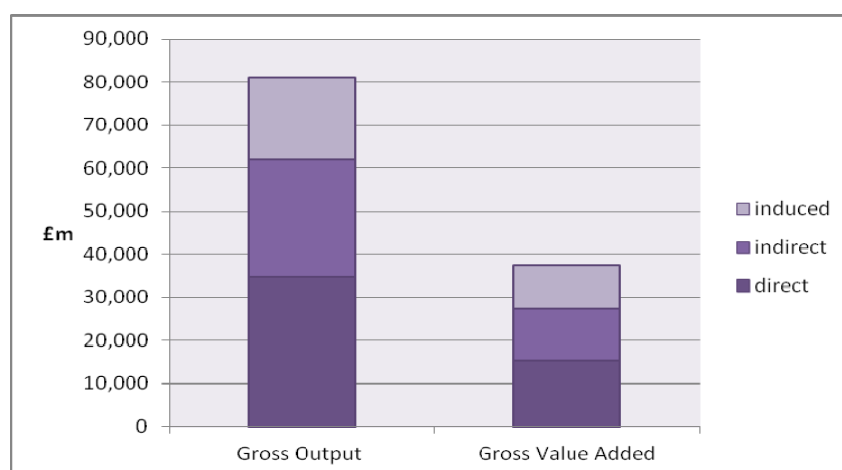


Figure 2: Estimated UK Gross Output and GVA from a 59% UK share of a 16.5GW New Build Programme 2012-2030, 2012 Prices

²³ The Economic Benefit of Improving the UK's Nuclear Supply Chain Capabilities, Oxford Economics and Atkins, 2013

²⁴ These estimates are “gross” in the sense that they do not take into consideration the fact that nuclear new build activity may displace other economic activity in the UK economy and thus the “net” impact is likely to be smaller. Estimates of net impacts, accounting for displacement effects, are detailed in the full report.

²⁵ ‘Indirect’ impacts are created as the supply chain demands products and services from the wider economy. ‘Induced’ impacts are created as the employment supported by the programme leads to further consumer spending effects, and are not included. Induced impacts can be found in the full report.

Many parts of the UK nuclear industry are competitive and are serving global customers, especially in the area of professional services. But there are some aspects where present capability in the UK's new build manufacturing supply chain are not as strong as in other areas, as highlighted in the recent *NIA Capability Report* and supply chain analysis undertaken by Oxford Economics and Atkins. UK businesses need to develop sufficient capability and strive to be ever more competitive to win future contracts domestically and abroad. This will take commitment on the part of industry once a confirmed market is visible. Assistance is available with measures already in place supported by the Government and additional ones contained in this *Strategy* will follow and help to underpin the environment necessary for this capability and competitiveness to be developed.

Barriers to new entrants to the nuclear sector are high compared to other industries. Stringent procurement requirements must be fulfilled, and there is a relatively high up front cost to develop this credibility. This is made more difficult for most companies through a lack of recent domestic civil new build experience. In some areas this can be aided by UK businesses forging international partnerships to share experience. For others it might be drawing upon decommissioning experience, some overseas civil work, or work in the domestic defence sector.

In order for UK industry, especially manufacturers, to invest in people, equipment and capability, industry and their shareholders have to have confidence that the UK domestic new build programme will take place and at a drumbeat that they can access and deliver to. Industry has made clear that they need clarity around project timescales and requirements from developers and that developers themselves need a market that enables investors to bring forward large nuclear infrastructure projects. The Government hears this and some of the actions in the *Nuclear Supply Chain Action Plan* are designed to tackle just these issues. However where remaining confidence is required the Government would hope that the NIC is able to ensure concentration is maintained on ensuring the right things are developed to provide nuclear project certainty.

As well as developing capability and competitiveness, capacity needs to be ensured over the course of the new build programme. In order to project demand, the number of jobs a 16 GW new build fleet could create has been estimated in the *NIA Capability Report*. It estimates that a total of 30,000 jobs could be supported at peak.²⁶ The figures used in the NIA report form a common basis to feed into the Nuclear Workforce Model from which skills bodies will work towards preparing for the new build programme.

The Oxford Economics and Atkins report utilised an alternative methodology to calculate the number of gross jobs that a 16 GW new nuclear build programme could

²⁶ NIA Capability Report 2012, NIA assume new build is complete by 2027 and Oxford Economics and Atkins assume it is finished by 2030.

support across the supply chain. The analysis suggests that at the peak of activity and with the UK supply chain capturing around 60% of the programme value, up to 41,000 jobs could be supported throughout the supply chain.²⁷ The scope of the analysis and methodologies used by the two reports differ in some key areas, with Oxford Economics and Atkins assuming 16.5 GW of new build and a longer indicative build profile.

The current nuclear workforce is ageing, with up to 70% of its highly skilled workers forecast to retire by 2025.²⁸ When coupled with the scale of industry's new build ambitions and the length of time since the last new build project in the UK, it is clear that action must be taken now to identify current and future skills gaps and address these. A comprehensive approach to identify and address skills gaps is laid out in the Skills section of this *Strategy*. The Government also understands however that whilst skill gaps can be forecast, until there is confidence in a significant nuclear new build programme, delivering a vibrant ongoing future for the industry, that it will be impossible to attract large number of recruits into the sector, or to maintain them once in.

In the longer-term, beyond 2030, the shape of the nuclear market globally becomes less clear, but what is a possibility is that the introduction of different reactor technologies and fuel cycles could be a factor. The time needed to commercialise nuclear technology means that for future markets industry alone will not invest in this area. However, if the UK wants to be an active player in the future then it needs to act now, requiring Government backing, working closely with industry, in the development of future technologies with international partners that have potential commercial opportunities. The area of future nuclear fission energy systems, in much the same way as fusion, is driven by international collaborative R&D, and so the UK would need and want to be a part of this.

Building on Strong Foundations

Government has refreshed policy to facilitate new nuclear build in the UK. This has been done through, for example, its streamlined GDA and SSA processes. Both of these, together with other measures are designed to ensure that once projects have planning permission and funding in place they can be delivered swiftly and to budget.

Electricity Market Reform represents the biggest change to the electricity market since privatisation. It will transform the UK's electricity sector, while working with the market and encouraging competition. EMR will also deliver the investment needed to maintain security of supply, meet our renewables and decarbonisation targets, and

²⁷ As with the Gross Output and GVA impacts reported above this estimate of additional employment is "gross" and does not take account of potential displacement effects on the wider economy.

²⁸ Power People, The Civil Nuclear Workforce 2009-2025, Renaissance Nuclear Skills Series 1, 2009, Cogent

minimise consumer bills. EMR will put in place two key mechanisms – Contracts for Difference (CfDs) and the Capacity Market. These mechanisms will ensure that low carbon electricity generation is an attractive investment opportunity and that the UK electricity sector can deliver a secure, affordable supply to consumers. CfDs specifically, will provide stable and predictable incentives for companies to invest in low-carbon electricity generation.

Government is also ensuring that decommissioning of the UK's existing nuclear facilities takes place. That will be done in a way that the programmes of work deliver the skills and capacity needed to support not only the decommissioning programme but also the potential new build and plant life extension programme. The decommissioning forward plan is detailed in NDA's strategy.²⁹

Government has in recent years taken a number of steps and provided substantial funding to help industry take advantage of existing market opportunities. This has included:

- £66m funding for nuclear R&D (2010-11).³⁰ This includes R&D into nuclear fusion which attracts significant gearing funding from Europe and international programmes and where the UK is a global player.
- £9 billion spent by NDA in the supply chain dealing with decommissioning since 2005.
- Establishment of the Nuclear-AMRC in 2009 to provide a focal point for the UK civil nuclear manufacturing industry. The aim of the Nuclear-AMRC is to help companies access the domestic and global market, to develop capability and competitiveness through process manufacturing innovation and R&D, driving up quality and reducing cost. The initial support was followed by additional investment of £37.1m in 2012. This public funding has been matched with additional industry and European funding. The Nuclear-AMRC is also part of the Manufacturing Catapult attracting additional TSB funding and support.
- TSB Nuclear Feasibility and Near to Market Nuclear Innovation Support: £18m funding, including £3m from NDA's R&D portfolio for projects identified in 2012. This builds on £2m to industry through the Technology Strategy Board (TSB) for nuclear feasibility studies in 2010.
- Via the Skills Funding Agency, UK Commission for Employment and Skills (UKCES) and Research Councils, Government has made a number of investments in support of the nuclear skills agenda including:
 - National Skills Academy for Nuclear
 - £6.5m capital on flagship training centres
 - £3.5m Skills Academy set up and operational costs

²⁹ Strategy, Effective from April 2011, NDA (<http://www.nda.gov.uk/strategy/>)

³⁰ A Review of the Civil Nuclear R&D Landscape in the UK – URN BIS/13/631

- £2m on 'Transformational Growth' programme in the Supply Chain
- £1m Expansion into Manufacturing for Nuclear
- Cogent SSC: £1m Employer Investment Fund including:
 - The Nuclear Workforce Tool being developed with the Nuclear Energy Skills Alliance
 - The Nuclear Island
 - Nuclear Industry Training Framework
- £10.5M support from the Engineering and Physical Sciences Research Councils (EPSRC) for the training of nuclear PhDs through the Nuclear First Centre for Doctoral Training and the Nuclear Engineering Industrial Doctoral Centre.

These individual actions alone, however, will not deliver the vibrant, diverse and strategically cohesive sector that Government and industry wishes to see develop. The overarching, co-ordinated thinking this requires is a fundamental part of this *Strategy*.

The Home Market

The UK Government and industry has a clear vision for the UK nuclear industry:

- **To have a domestic nuclear market that maximises UK commercial opportunities, delivering growth by providing a platform to build sustainable exports as well as a secure supply of energy in the long-term;**
- **To provide the long term infrastructure required to support both the public and private sector parts of industry in a safe, responsible and cost-effective manner;**
- **To have clear direction and co-ordination across public procurement, R&D, and skills development;**
- **For the home market to become the showcase that demonstrates UK's overall nuclear excellence to the international market.**

The success of this *Strategy* will be based in the first instance on the strength of the home market. We need to deliver the proposed new build fleet safely to time and budget, whilst continuing to operate our existing reactors and keep on track with our decommissioning programme.

Government and industry must work together to achieve this, and ensure that the infrastructure and supporting mechanisms are in place. NIC provides the platform for that long term partnership, and the forum for identifying and exploiting opportunities.

It will be vital for UK industrial capabilities to be developed further in order to win a significant share of the domestic market, and the economic growth and new jobs that go with that. It will also be necessary to put in place more effective mechanisms to enable UK-based companies to compete in procurement processes, ensuring that such processes are transparent.

Larger infrastructure projects will attract global players, but we also need to ensure that capable SMEs are aware of the commercial opportunities and can gear up to exploit them. Access to finance will therefore be an important factor in SME success.

As noted already, the UK has an outstanding record in safety, and the regulatory regime has played a key role in that as well as industry's rigorous safety culture. That will be carried forward as an inherent part of the UK's nuclear future, and therefore designed to apply the highest standards to future nuclear generating systems. Local engagement will also be important, and we will build on the existing

fora to help deliver community benefits in the form of new business opportunities and jobs. Local engagement will also be important for improving understanding of the nuclear industry, which has a direct bearing on dealing with legacy issues.

Government and industry do not underestimate the challenge of a long-term solution to waste management – it remains a top priority.

The Nuclear Industry Council

Government's close engagement with industry over the last year, particularly on the *Nuclear Supply Chain Action Plan* and the *Nuclear Industrial Vision Statement*, showed strong business support for a permanent forum to agree actions to stimulate economic growth and tackle any barriers to achieving that, in dialogue with Government. The establishment of NIC was a direct response to that.

NIC consists of senior members from industry, the research community and Government Ministers. The overall aim of NIC is to ensure continued commercial growth of the UK nuclear industry and it will provide leadership to the entire civil nuclear sector including the implementation of this *Strategy* and development of future proposals.

The objectives of NIC are:

- To act as the **leading engagement body** between the UK nuclear industry and Government, as well as providing a forum for dialogue between different parts of the industry.
- To develop and maintain a single, **coherent strategy and vision** for the civil nuclear industry in the UK to guide decision-making in Government and business and, as part of this, to demonstrate the commitment of both sides to the successful delivery of a vibrant UK nuclear new build, operations and decommissioning programme.
- To agree and oversee the implementation of **work programmes** to strengthen the capability and competitiveness of the UK nuclear industry at home and internationally.
- To **work with the research community**, through the Nuclear Innovation Research Advisory Board (see *Building a Future: Innovation & R&D* section later) and industry to underpin those actions needed to realise industry and Government's long-term vision for the sector.

For an effective partnership, it will be essential for industry to match the contribution Government is making by seconding in industry members to help run NIC, with companies sharing the opportunities between them.

Nuclear Energy Cost Reduction Programme – driving down costs

Providing competitively priced and reliable energy, primarily through market mechanisms, lies at the heart of the UK's energy policy, as reiterated in the Government's *Long-term Nuclear Energy Strategy* published alongside this document. A significant challenge for the nuclear industry is the initial capital cost of nuclear new build and decommissioning. Safety will always take priority over cost, but there is a role for industry, with Government, to explore ways of reducing the up front capital cost and risk associated with nuclear new build. Technologies generally enter the market at a price that reflects some of the development cost and then this reduces over time. Nuclear needs to follow this same path in order to become a truly commercially attractive option over the long-term.

The UK's new build and decommissioning programmes provide an excellent opportunity for those involved to look carefully and critically at costs and explore ways of achieving maximum safety and reliability of operations in the most cost-effective way.

Government will work with the NIC to establish a taskforce with developers, the NDA and industry that will define and run a Cost Reduction Programme. Organisations linked to Government such as NNL, the Nuclear-AMRC, TSB and Research Councils may also play a role supporting this work. The details and exact scope of the Cost Reduction Programme will be developed with industry following publication of this *Strategy*.

The establishment of a Cost Reduction Programme whilst not compromising safety could have two core elements: looking at the costs *between* projects, whether decommissioning or new nuclear, and *long-term* cost reductions through the introduction of new technology designs that also improve safety and efficiency. Cost reduction relating to current projects is an area that is more for the individual developer, or contract manager, but in order to improve costs overall a Cost Reduction Programme would require cooperation from clients on lessons learnt within projects on a confidential basis.

The Programme will not only focus on technical innovation but also 'softer' aspects such as waste management arrangements, aspects of the planning and regulatory regimes, programme/project management, as well as a fleet approach to construction of new stations.

Separately, the costs of nuclear have the potential to be further reduced, whilst still driving up safety, through the development of small factory-built modular reactors with minimised on-site construction and easier decommissioning processes. The aim would be to develop viable approaches that could enable nuclear infrastructure to proceed on a project finance basis in time.

Procurement

Procurement pipelines

Under the Energy Act, the NDA has obligations to promote competition for the services it requires. It recognises that its procurement activities are part of this wider strategic aim.

Publishing future procurement opportunities gives greater certainty about future requirements so industry has confidence to make long term investment decisions and time to prepare and develop supply chain capabilities. In November 2012, Government published pipelines worth £84 billion in 18 sectors improving the visibility of upcoming contracts and helping suppliers better respond to UK demand.³¹ Under the construction and infrastructure pipeline³² there are already £1.33 billion worth of decommissioning projects running up to 2015.

However, publishing forward pipelines is not enough: procurement should be a well-anticipated event as part of a continuing dialogue with the market. That will ensure readiness to deliver. The NDA's Supply Chain Development Strategy was created with the help and support of the market³³. Its objective is:

“To ensure the optimum use of the supply chain available to the NDA estate to enable a safe, affordable, cost effective, innovative and dynamic market for clean up and decommissioning”.

The Supply Chain Development Strategy has four key principles, supported by a range of specific positive interventions and actions:

- Open, transparent, timely and consistent communications at all levels
- Optimise supply chain processes
- Optimise supply chain relationships and
- Explore synergies with other nuclear clients and other industries

The Site License Companies (SLC) who operate the NDA's sites are required to interpret the Supply Chain Development Strategy and ensure that they have appropriate ways of delivering and supporting the objective and the principles. NDA is uniquely positioned to take a strategic view of supply chain issues across the estate and reviews the impact of the Supply Chain Development Strategy periodically, amending and reprioritising actions to:

- Reflect the views of the market;

³¹ <https://online.contractsfinder.businesslink.gov.uk>

³² <http://data.gov.uk/dataset/government-construction-pipeline>

³³ <http://www.nda.gov.uk/strategy/criticalenablers/supplychain/index.cfm>

- Changes of Government policy;
- Performance and business need.

The *Nuclear Supply Chain Action Plan*³⁴ sets out a series of actions to provide greater clarity about the forward pipeline of both public and private procurement contracts in the nuclear sector. It includes a commitment by the NDA and the majority of its key contractors to use Contracts Finder³⁵ to provide details of major contracts. UK industry needs to make effective use of this tool.

In December 2012, the Government launched Energy for Growth, using its position as the UK's largest energy consumer to unlock investment in the renewables market whilst also making substantial cost savings for the public sector. Although the pilot is for non-intermittent power such as biomass and energy from waste, the Department for Business, Innovation and Skills (BIS) will work with the Government Procurement Service to consider the application of Energy for Growth to other energy sectors, including nuclear.

Small and Medium Enterprises (SME) access to NDA contracts

The NDA is committed to meeting Government's SME procurement obligations. That includes a formal SME target and action plan which commits to see 20% of supply chain spend delivered by SMEs by the end of the current Parliament. NDA is also a member of a number of pan-Government committees aimed at delivering value via agendas such as the Growth and SME Agenda.

In addition, the NDA has appointed its own SME champion to work alongside other Government departments. As part of this work, NDA and the Small Business Research Initiative (SBRI) are exploring ways of encouraging procurement from SMEs. SBRI is an initiative which matches business ideas to Government challenges through a simple procurement process. This helps deliver innovative solutions to specific public sector needs by engaging a broad range of companies in competitions for ideas that result in Government development contracts. NDA R&D framework contracts have seen an increase in SME participation, and in particular through the NDA funding of decommissioning feasibility projects as part of the wider TSB innovation call.

Procurement & Infrastructure Client Group

A Procurement and Infrastructure Client Group will be formed. It is currently expected that it will consist of NDA, EDF Energy, Government (including MoD) with other developers or clients joining as necessary. The Group will have two principle areas of focus:

³⁴ The Nuclear Supply Chain Action Plan – URN 12D/436

³⁵ <https://online.contractsfinder.businesslink.gov.uk/>

1. **Procurement:** The Group will look at streamlining market access arrangements for UK-based supply chain companies. It will, for example, cover a common approach to suppliers registering their interest through a single portal for tender registrations, common pre-qualification approaches and information about upcoming work. By working together it should be possible to reduce costs, improve market access and help to ensure efficient use of the supply chain, avoiding bottle necks and potential project delays. The Client Group focusing on procurement will therefore work to develop indigenous nuclear capabilities and enable suppliers to have the long-term confidence to develop skills in partnership with clients.
2. **Infrastructure:** The Group will also take a strategic approach to the challenges for the nuclear market on large infrastructure, and how this might be delivered and maintain programmes of new nuclear, operations and decommissioning. The Client Group would then send the right signals to enable industry investment to meet client needs. Output of the Client Group and its broad areas of discussion would be fed into the NIC.

The Client Group will also work with Government to ensure that Building Information Modelling (BIM) is able to be implemented by developers and driven through all the relevant levels of the supply chain where appropriate. Government, through the BIM for Nuclear Programme, will support the clients in this approach in helping to raise efficiency and quality in the supply chain.

Case study - Building Information Modelling for the Nuclear Industry

BIM is a collaborative way of working, underpinned by digital technologies which unlock more efficient methods of designing, creating and maintaining assets. BIM embeds key product and asset data and 3D computer models that can be used for effective management of information throughout a project lifecycle – from earliest concept through to operation. It has been described as a game-changing information and communication technology (ICT).

In 2011, Government announced its intention to require collaborative 3D BIM on its publicly procured projects by 2016. This has helped to ensure the UK is now recognised by its peers as one of the leading nations in the exploitation of BIM technology. In November 2012, Government and industry set out how it will take advantage of this leading role in the BIM Strategy.³⁶

In the nuclear industry, at a strategic level BIM offers the capacity to address many challenges, including waste reduction, value creation, transparency and improved productivity, with all parties involved having access to the same data..

A specific working group focused on facilitating adoption of BIM in the nuclear sector has been set up by Government ('BIM4Nuclear') and is already developing initial work from the NNL, NDA and EDF Energy.

“The nuclear industry has regulatory requirements for continuous safety reviews; the need for up to date integrated information to inform these reviews is paramount for their safe and efficient operations. In the past considerable time was expended trawling through reams of data trying to find salient information. The introduction of BIM across the project lifecycle will provide the framework for capturing and integrating data to inform safety reviews, subsequent decision making and opportunities for efficient delivery.”

Joe Gallagher Director URS

Access to Finance

Government is aware that SMEs in general face difficulties accessing finance and has put in place a number of interventions to address that. The difficulties faced by SMEs are deep-rooted, so the impact and reach of Government's intervention needs to be stepped up. Government has therefore announced it is creating a 'Business Bank'.

SMEs and midsized businesses in the nuclear industry will face common access to finance challenges. In addition, they are likely to face difficulties associated with projects that have very long lead times and few clients. This is true whether it is in

³⁶ <https://www.gov.uk/government/publications/building-information-modelling>

new build, decommissioning or operation and maintenance support. The result of this is uncertainty.

As part of this *Strategy*, we will commission research to investigate whether SMEs seeking to operate in the nuclear sector face unique challenges on accessing finance. This research will be conducted during 2013/14. NIC will be invited to advise on the scope of the project, as well as consider the strength of the evidence, and any solutions proposed as a result of it. The research will provide a basis on which to assess whether SMEs in the nuclear sector are making full use of available access to finance schemes, and whether there is a case for looking at more bespoke Government support, including through the Business Bank, Green Investment Bank or other channels that might better meet their needs.

UK's World-Renowned Nuclear Regulation

Having an effective and reputable regulatory regime and safety record is essential for the UK's use of nuclear energy. Disseminating awareness of that regime overseas, together with UK industrial expertise, especially to new nuclear countries, will be important longer-term to ensure nuclear power is used safely and in accordance with non-proliferation obligations. The Government is embarking on a series of initiatives to maintain this position to provide for a multitude of future scenarios, including significant growth in the UK nuclear power market.

The Energy Bill currently before Parliament includes provisions to put the ONR on a statutory footing. This will enable the ONR to retain the best of current practice whilst creating a modern independent regulator based on the better regulation principles of transparency, accountability, proportionality, targeting and consistency. The ONR will build on its current strengths as a world-class regulator. It will be better placed to respond quickly and flexibly to current and future regulatory challenges while retaining its focus on the protection of people and society from the hazards of nuclear generation.

Technical Advisory Panel

The UK regulator needs to retain a leading edge in technical knowledge in order to fully understand safety across the sector. The importance of this has been reiterated over the past two years. ONR convened two short-term technical advisory panels to assist the Chief Inspector in his work on both the lessons learned from Fukushima and aircraft risk to nuclear installations. These panels consisted of technical experts nominated by a range of stakeholders and have proved to be very successful.

Building on this experience and the recommendations of the House of Lords report, the ONR are now in the process of setting in place a standing Chief Nuclear Inspectors Technical Advisory Panel with a broad-based membership. The ONR will seek the Panel's views on a wide range of regulatory issues including significant reports and any appeals received relating to regulatory decisions. Additionally, this Panel will provide technical advice and commentary to the Chief Nuclear Inspector on the adequacy and balance of ONR's research programme.

The arrangements that ONR will put in place for the Panel will ensure that, in line with the House of Lords Select Committee's recommendation, the Panel's advice is independent and transparent, and it provides suitable external review without impinging on ONR's regulatory duties and responsibilities.

The ONR intend to have the Panel in operation from Spring 2013 and that it will meet half yearly.

Regulating for the long-term

Given the significant scope for nuclear power in the long-term generation mix, it is essential that the framework needed to provide effective and efficient regulation remains adaptable to changing circumstances.

Government will therefore work with the UK's nuclear regulators to identify potential obstacles and opportunities to regulating anywhere between 16 and 75 GW of nuclear generation, together with ongoing waste and decommissioning, by 2050. This will include consideration of the skills, resources and framework that will need to be developed to provide sufficient adaptability as the nuclear sector itself develops.

This work will commence with a scoping exercise over the next year to identify any potential short term actions and longer term pathways.

International harmonisation

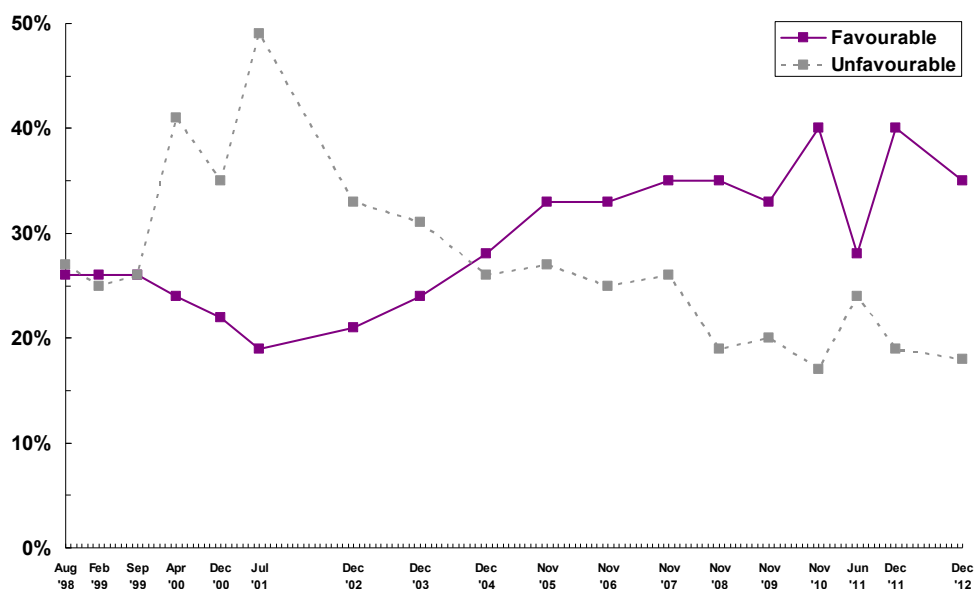
Regulation of nuclear safety is a national responsibility, with a number of different regulatory approaches being taken across the world. All of these systems, however, aim to achieve high levels of nuclear safety in a way that is consistent with the standards and principles set out by the IAEA.

Whilst we do not believe that standardisation of rules and procedures would be appropriate across the many varied national regulatory frameworks, our regulators have demonstrated the benefits of close working and harmonisation of principles with other regimes. This has been demonstrated recently through the close working and information sharing of the Multinational Design Evaluation Programme (MDEP) supported by the NEA. It has also been shown at a more practical level with the good international cooperation in the GDA programme, where the UK, France, Finland and USA cooperated on identifying a number of important issues relating to new nuclear reactor design.

As reactors become more global in their design, deployment and operation, it will be important for national regulators to continue to seek to harmonise their development of the key principles and to work together to share best practice and information without impinging on their independent competencies.

Engagement with the Public

UK public opinion of nuclear power has been studied over a number of years. A graphic of recent opinion polling is given below:



Source - Ipsos MORI, Base: All adults aged 16+ (nationally representative quota sample of 1,046)

Figure 3: Public Opinion of the Nuclear Sector

As the chart shows, there is a mixed picture about the acceptance of nuclear power. There is, however, a split in support between the sexes. Ipsos MORI polling in December 2012 showed that 55% of men versus 30% of women are supportive of nuclear power.³⁷

Government, industry, regulators and others have all worked over recent years to constructively engage with the public to help address concerns, particularly as part of the new nuclear programme and long-term decommissioning choices. It is important to continue to help improve the public understanding of risks and of radiation, as well as the benefits of the use of nuclear. It will be important to engage with the public more consistently in this area to put risk into perspective.

Government will continue to work with universities and others to establish an independent initiative that engages the public with nuclear power, as well as its management within the nuclear industry. Any engagement undertaken in this way must be fully transparent and independent if it is to be credible with the public. The

³⁷ Ipsos MORI polling, fieldwork dates 7-13 December 2012, 1046 nationally representative quota sample

best means of taking this forward will be considered, but is likely to include the academic community and others such as the Health Protection Agency to explore the type of programmes that would best improve understanding of radiation in society and the nuclear industry more specifically.

The UK nuclear industry itself is committed to its role in better communication with the public, through, for example, more interaction with communities through visitors' centres, school visits and promotion of careers available. NIC may wish to consider developing and enhancing these programmes with the UK industry.

Local Community Engagement

Government's overarching role is to establish a competitive market-based framework to meet future energy needs and create a level-playing field for industry. At local level, growth policies aim to help all parts of the country achieve their full economic potential. Particular benefits need to accrue to communities that host nuclear facilities, and provide the supportive environment business needs to flourish. The *Nuclear Supply Chain Action Plan* sets out an action for both the Government and Welsh Government (with support from the NDA) to oversee the formation of Strategic Delivery Forums at a local level, to demonstrate commitment to the industry and to maximise local and regional employment and supply chain opportunities. The UK Government stands ready to work with the Scottish Government on areas of mutual interest as regards waste management, decommissioning and nuclear power station extensions.

The Government will facilitate bringing together local and national public sector representatives with developers, education and business partners with the objective to:

- maximise local and regional employment and supply chain opportunities arising from new nuclear and NDA developments in the area;
- address obstacles that would prevent local people finding employment, particularly for the long term unemployed.

The Welsh Government

The Welsh Government through the First Minister's Energy Wales programme recognises that energy is one of the key sectors that will bring jobs and growth to Wales. It has well established support structures in place to assist businesses and individuals to take advantage of the opportunities that nuclear development creates. Working in partnership with the Welsh Office, Energy Wales Programme, Anglesey Energy Island Programme, and the education sector team in the Welsh Government we will facilitate access to additional support available within the UK.

The Welsh Government has also invested significant funding into delivering the right infrastructure such as business parks, Construction and Energy Centres of

Excellence for future students, R&D programmes through the Low Carbon Research Institute and Enterprise Zones.

Case Study: Anglesey Energy Island

The Anglesey Energy Island Programme is a collective effort between several stakeholders within the public and private sector working in partnership to put Anglesey at the forefront of energy R&D, production and servicing, bringing with it potentially huge economic rewards.



Harnessing a rich mix of energy streams, including nuclear, wind, tidal, biomass and solar, together with associated servicing projects provides major potential to achieve economic, social and environmental

gains. The programme could contribute £2.5 billion to the Anglesey and North Wales economy over the next 15 years.

For more information - www.anglesey.gov.uk/business/energy-island/

West Cumbria Strategic Forum (WCSF)

Since its inauguration on 1 November 2004, where the Government signed a memorandum of agreement with West Cumbria Partners that included the NDA and West Cumbria local authorities, the WCSF's aim has been for West Cumbria to:

- be globally recognised as a leading nuclear, energy, environment and technology business region, building on its nuclear assets, its technology and research strengths;
- be a strong, diversified and well-connected economy, with a growing, highly skilled population, and high employment;
- project a positive image to the world, and be recognised by all as an area of scientific excellence, outstanding natural beauty and vibrant lifestyle, which attracts a diverse population;
- provide opportunities for all its communities, where geography is not a barrier to achievement and where deprivation, inequality and social immobility are reduced.

In 2008, the West Cumbrian Spatial Masterplan 'Britain's Energy Coast' (BEC) was launched setting out the strategy for regeneration of the area. This was supplemented with the launch of the West Cumbria Economic Blueprint: Realising the Potential of Britain's Energy Coast in June 2012. Thus safeguarding West Cumbria's economic prosperity and its aim is to create a sustainable economy in Cumbria, taking into account the threats and opportunities that nuclear decommissioning brings to an area so heavily dependent on the nuclear industry.

Case Study: Britain's Energy Coast, West Cumbria

BEC is a dynamic one-stop-shop for economic development. Delivering business support includes: energy innovation; funding for physical and skills-related regeneration projects; managing a high quality business property service, such as Westlakes Science & Technology Park, assets in Lillyhall and workspace in Workington and Blencathra near Keswick.

Their aim is to create an entrepreneurial environment where businesses can grow; helping to stimulate wealth and jobs that directly benefit the West Cumbrian community and aid Britain's response to the pressing challenges of climate change and energy security.

For more information - www.britainsenergycoast.co.uk

Hinkley Strategic Delivery Forum (HSDF)

Since its inauguration in September 2012, the HSDF creates the means to co-ordinate and maximise the effective use of existing Government resources to support growth. The agenda is driven and owned by the local authorities and respective business and educational leaders but fully utilises the collective support from Government departments, the developer and key stakeholders to ensure local employment opportunities and growth can be maximised.

HSDF considers:-

- local economic and employment growth opportunities;
- that those currently unemployed and long term unemployed will receive appropriate training and access to employment opportunities;
- maximise local business and supply chain opportunities;
- local training and skills development opportunities;
- a co-ordinated approach to enable long term sustainable growth through redeployment once the main construction phase is completed;
- ways to provide appropriate business support to ensure that local business can grow sustainably alongside new business in the area.

These local delivery forums provide an excellent means of bringing together public and private sector interests to present a coherent offer to business, including inward investors. They also provide a means by which local supply chains can be developed, and skills capabilities enhanced, to meet the exacting standards required for entry into the nuclear market. It will be important that local forums develop realistic assessments of local and regional business capabilities, and tap into opportunities for improving that, as well as skills, such as through national

competitive schemes (e.g. Advanced Manufacturing Supply Chain Initiative (AMSCI), TSB competitions).

Geological Disposal

Government remains firmly committed to geological disposal as the right policy for the long-term safe and secure management of higher-activity radioactive waste.

Our preferred approach for the location of a suitable site is based on volunteerism and partnership working with willing communities, an approach supported by evidence from other countries.

The Government will continue to ensure that the case for hosting a Geological Disposal Facility (GDF) is drawn to the attention of communities, while also considering possible improvements to the site selection process.

Building a Future: Innovation & R&D

The UK Government and industry has a clear vision for the UK nuclear industry:

- **To have a joined up approach to nuclear R&D across government, industry and academia, which serves to benefit the UK economy and ensure security of supply.**
- **For the research base to be underpinned by world-leading facilities which are fully utilised by both national and international customers and which conduct a programme of fission-related research whose scale is consistent with the UK's nuclear aspirations.**
- **To be a respected partner contributing significantly to appropriate international research programmes undertaken with selected international collaborators.**
- **To have the right level of nuclear innovation and R&D to ensure near-term as well as long-term commercial success in domestic and global markets.**

Innovation and R&D are central to nuclear achieving a growing contribution to the UK's energy mix, which could be between 16 and 75 GW up to 2050³⁸ as well as ensuring commercial opportunities can be realised in global markets.

At the same time as progressing new nuclear build, the UK must continue operating its existing fleet, decommissioning its existing facilities and currently generating reactors as they come off line. Innovation and R&D in the supply chain is crucial for UK companies to increase competitiveness and secure contracts, as well as maintaining the highest standards of safety and driving down costs. Government will continue to support this through a variety of initiatives and partnership with industry.

The UK needs to ensure it has the right public bodies, infrastructure and funding in place to assist R&D and innovation across the full spectrum of Technology Readiness Levels to meet our short and long term commercial goals and national energy security needs. Strategic co-ordination in defining programmes will be necessary to achieve long-term R&D aims.

³⁸ DECC, Carbon Plan, 2011

This section outlines the strategic approach Government, in partnership with industry, is taking to innovation and R&D across the sector both in the near and long term. It aims to address several of the recommendations from the Ad Hoc Nuclear Research and Development Advisory Board.

The UK's current R&D landscape

The UK has established a reputation for performing world-leading research in science and technology, both in industry and academia. We played a pioneering role in bringing civil nuclear energy to market 60 years ago, and are now conducting world-leading R&D to decommission and clean up our historic facilities, overseen by the NDA. We are also at the cutting edge of R&D into nuclear fusion technology, and fully engaged with international collaborations through the UK national fusion laboratory at the Culham Centre for Fusion Energy (CCFE).

To gain a clear picture of the UK's current R&D activities, the Government Chief Scientific Advisor conducted a *Review of the Civil Nuclear R&D Landscape in the UK*.³⁹ Government funding in civil nuclear for 2010/11 totalled £66 million.

Total fission (£29m)	Total BIS (£18.1m)	EPSRC (£11.7m)
		STFC (£2.6m)
		NERC (£1.8m)
		TSB (£2.0m)
	Total DECC (£10.9m)	NDA ⁴⁰ (£10.9m)
Total fusion (£33m)	Total BIS (£33.0m)	EPSRC (£33.0)
Total other (£4m)	Total DH (£3.7m)	HPA (£1m)
		FSA (2.7m)
	Total Defra (£0.3m)	EA (£0.3m)

Table 2: UK Government Expenditure on Nuclear R&D 2010/11

This level is low compared to some international competitors and negligible for research into future generations of fission reactors and their associated fuel cycle.

In addition to the Government contribution, industry continues to fund R&D. EDF Energy, for example, currently invests around £30 million per year in UK nuclear research to support its existing fleet. NNL and AMEC also invest in R&D for future nuclear energy technologies but industry cannot be expected to fully fund this with

³⁹ A Review of the Civil Nuclear R&D Landscape in the UK – URN BIS/13/631

⁴⁰ NDA also funds nuclear R&D in the UK indirectly through the overall budgets provided to SLCs who may undertake R&D in order to meet their contractual obligations to NDA. The collated estimates for R&D spend by the SLCs in 2010/2011, as reported to the House of Lords in June 2012 was £121.3m.

commercialisation likely to be 25 years away as the returns are too far off resulting in the classic market failure situation.

The *Landscape Review* concluded the current policy landscape needs to evolve to fit the growth in domestic and global ambition for nuclear power, as well as meet the challenges of decommissioning the legacy.

Supporting Innovation in the Nuclear Industry

Nuclear Advanced Manufacturing Research Centre

Nuclear-AMRC is a prime example of successful industry-academia partnership combining industry expertise and university innovation. The Nuclear-AMRC work with companies to improve capability and performance along with general development of the nuclear supply chain. The Centre provides an opportunity for companies to place their employees outside of normal work constraints to enable them to look at situations from fresh angles, drawing upon experiences of other sectors and solutions that they have applied.

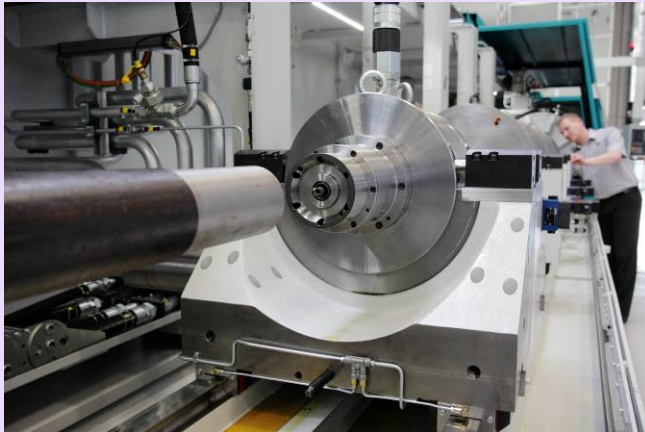
The key to success is that Nuclear-AMRC members are the manufacturers themselves, and are dedicated to helping UK businesses become suppliers of choice to the global civil nuclear industry. Through its Fit for Nuclear programme⁴¹ and other initiatives, the Nuclear-AMRC work with manufacturers to gain clarity and knowledge on nuclear codes and standards, helping them to meet the demanding requirements of this industry – often seen as a barrier to entry for new suppliers. This support is complemented by the necessary training and skills development which ensures companies are able to comply with the strict requirements of the nuclear industry.

The Nuclear-AMRC is part of the TSB-funded High Value Manufacturing Catapult which helps to provide the Centre with some of its capability and resources. In October 2012 BIS announced a Regional Growth Fund award of £37.1 million to the Nuclear-AMRC that is in addition to any funding flowing through it as part of the Catapult network. This will support the Nuclear-AMRC's large-scale programme of supplier development working with the Manufacturing Advisory Service and manufacturing research in partnership with key industrial members. The programme focuses on the civil nuclear new build industry, but has broad applicability across the nuclear value chain including decommissioning and other industries in the energy sector.

⁴¹ <http://namrc.co.uk/work-with-us/f4n/>

Case Study: Developing Commercial Techniques - Automatic deep-hole drilling

High-value steel components used in nuclear reactor internals require precisely machined holes of a depth up to 500 times their diameter. The current industry limit for a single hole is around 300 times diameter, in a process which is slow, requires a lot of manual intervention, and has a high scrap rate.



Improving this deep-hole drilling capability was identified as a core research focus by the Nuclear-AMRC's industrial partners, led by Rolls-Royce. Improved drilling techniques can be applied in oil and gas, chemical and other sectors, as well as nuclear manufacturing.

Researchers at the Nuclear-AMRC are now developing new techniques to drill holes of up to 8m depth with a single cut in a wholly automated

process. With funding from BIS and the European Regional Development Fund, the centre has acquired one of the largest deep-drilling machines in the UK, a TBT ML700. The research is being conducted by a postgraduate engineer from the University of Sheffield studying at the EPSRC-funded Industrial Doctorate Centre in Machining Science, with sponsorship from Rolls-Royce.

The Technology Strategy Board

BIS conducts most of its innovation support through the TSB. Following its independent review in 2009⁴², the TSB has supported a number of initiatives relating to innovation in the civil nuclear sector. In 2010, recognising the importance of developing networks, supply chains and improving communications within the sector, the TSB appointed NNL as the delivery partner for the nuclear group of its Energy Generation & Supply Knowledge Transfer Network (KTN). Their remit is to create an integrated and dynamic network of business, technology, academic and policy stakeholders delivering strategic and effective knowledge exchange to advance the nuclear sector. Currently the nuclear group has around 450 members and is open to new members.

⁴² A Review of the UK's Nuclear R&D Capability, commissioned by the TSB, 2008

In 2010, the TSB launched a competition for funding collaborative feasibility projects, aimed primarily at stimulating the interest and engaging SMEs in the sector. The competition was heavily oversubscribed, receiving over 90 applications, from which 20 innovative projects across a range of technologies from instrumentation to manufacturing were supported. More than 60% of these technologies are being taken further, either through additional public sector funding, private financing or directly by the organisations themselves.

In 2012, the TSB led a competition in partnership with the Department for Energy and Climate Change (DECC), NDA and EPSRC to support innovation in the civil nuclear industry supply chain. Key drivers for the programme were to help SMEs move their technology innovations closer to commercialisation. That requires working with organisations already established in the sector, encouraging the transfer of technology and knowledge from academia to industry (through funding knowledge transfer partnerships) and attracting new businesses to the nuclear sector. The total value of the funded programme was over £31 million, with the public sector contributing around £18m. The portfolio of projects, announced alongside the publication of this *Strategy*, has brought together over 60 different organisations in the supply chain focusing on innovation in advanced manufacturing and construction, materials, condition monitoring and decommissioning and waste management.

Innovation in Action Case Study: LaserSnake



Currently under development by UK SME OC Robotics, LaserSnake combines two highly innovative technologies, advanced robotics and lasers, to create a safe and cost effective solution for the multi-million pound nuclear decommissioning market. The project will deliver a robust, re-usable robot controlled laser-cutting technology that can be applied both in-air and underwater in confined and

hazardous spaces to dismantle vessels, support structures, flasks and pipe work.

An initial successful feasibility study into the development of LaserSnake was funded by the TSB and the project has recently received additional co-funding of £6m from TSB, DECC and NDA to develop the technology to a full-scale demonstration phase, which could lead to the UK being world leading in this technology area.

Led by OC Robotics, the project consortium comprises NNL, The Welding Institute, ULO Optics and Laser Optical Engineering. The technology is already attracting significant market interest in the UK and overseas and has considerable spin-off potential in other sectors including the petrochemical, military and construction industries.

Looking ahead, TSB recognises the nuclear sector as one of its priority areas, with key themes linked to innovation opportunities in nuclear new build, maintenance and decommissioning as well as understanding and quantifying the potential for the UK in associated technologies such as Small Modular Reactors. During 2013-14, the TSB will work with industry to review and quantify the innovation and business opportunities that SMRs offer the UK and how they align with TSB's investment strategy. Subject to the outcomes of the review, consideration will be given to supporting initial feasibility studies in this area.

Coordinating R&D and Innovation

The Nuclear Innovation Research Advisory Board

The Government spends around £30 million each year on nuclear fission R&D, the majority of which is channelled through the Research Councils. As the UK looks to increase its commercial opportunities in the nuclear market, more effective coordination of R&D is needed. That was also the message of the House of Lords Science & Technology Select Committee in 2011. The recommendations of that committee have shaped our thinking in this area.

When it comes to waste management and decommissioning the NDA Research Board coordinates R&D and is supported by the Nuclear Waste Research Forum. Similarly, the Radioactive Waste Management Directorate (RWMD) Technical Advisory Panel coordinates R&D for geological disposal, CCFE for fusion energy and RCUK for the Research Councils. These play a valuable role in themselves, but none of them are able to provide a holistic approach.

To address this situation, the Government will set up a Nuclear Innovation Research Advisory Board comprising of Government scientific advisors, academic experts, the Research Councils, TSB, NDA, and business leaders. It is envisaged the NIRAB will have a Chair independent from Government.

NIRAB's primary focus will be advising on the level, approach and coordination of nuclear innovation and R&D that will keep future nuclear energy options open and where commercial opportunities might reside, either within the domestic or global market. It will do this by providing a forum to bring together current nuclear R&D funders and discuss the best way forward. It has the potential to adopt a more directional and strategic approach with any future additional Government R&D funding in areas outside of the remits of existing streams, for example involving international collaboration to develop SMRs, or Generation IV systems.

The NIRAB will not take over from the autonomy or governance of existing organisations carrying out nuclear R&D, such as the NDA, TSB, CCFE and Research Councils. They will still have the ultimate say in the way their budgets are spent. But it is expected the NIRAB will help to provide a UK-wide overview to inform and influence these decisions. Its membership will contain individuals from these existing bodies and so will help to ensure that this is a two-way process and that synergies with existing and future programmes on waste management, decommissioning,

future fission fuels, fusion and defence are captured and opportunities maximised.

The full details of the NIRAB can be developed with its members at a later date, but the core aspects would be that it is independent, with an independent chair and would report to the Government as well as feed its views publicly into NIC. NIC will provide an additional mechanism for industry and the wider research community to voice their views on the success of NIRAB's approach and the innovation and R&D programmes they believe should be supported. The Government believe this will represent the best way to bridge public and private research on areas of mutual interest and ensure the most efficient use of public and private resources.

In summary, the remit of the NIRAB will be:

- To initially act as a forum that will bring together the research funders with academia and industry to enable effective coordination of nuclear research across the fuel cycle, ensuring maximisation of opportunity and efficiency;
- To make the case for additional areas of nuclear innovation and R&D, the commercial merits of this, and develop business cases to justify any increase in nuclear R&D spend;
- To oversee the delivery of nationally strategic nuclear innovation and R&D programmes where accountability and budget are not under the control of existing funders, e.g. the Research Councils, NDA or TSB. This would follow a successful business case for future nuclear energy R&D;
- To provide advice to Ministers, Government Departments, Government Agencies and industry on policy and technical issues where it is important to take a UK-wide holistic view;
- To oversee a regular review of the status of UK nuclear innovation and R&D;
- To advise the R&D community on Government policy and industry's priorities;
- To speak on behalf of the R&D community on universal issues, e.g. sector communications, promoting UK facilities, and where relevant to promote UK industry.

The Nuclear Innovation Research Office

The NIRAB will be an important development to ensure the UK is on a path to an effective nuclear R&D environment that ensures future energy options are kept open and commercial opportunities able to be realised. But in order to be able to truly deliver, it will require an underpinning structure of people whose job it is to deliver the NIRAB's strategic approach.

NIRAB's work will be developed and taken forward by the Nuclear Innovation Research Office. Government will look to the UK National Nuclear Laboratory to host the NIRO given it is best positioned to work with industry, academia and the public sector. The NIRO will be run separately to NNL's commercial business directorates and the Government hopes that industry will wish to second its own people into the

office for significant periods of time to work alongside NNL staff. The NIRAB will effectively form the executive arm of the NIRO.

The remit of the NIRO will be as described for the NIRAB, but more specifically:

- To aid the coordination and development of nuclear innovation and R&D programmes, including representing and coordinating UK involvement in international R&D programmes;
- To provide the secretariat function to the NIRAB;
- To regularly review the status of UK nuclear innovation and R&D by:
 - Updating the *Landscape Review* every 3 years;
 - Maintaining and updating the *Nuclear R&D Roadmap*;
 - Performing a gap analysis through comparison of actions and progress against industrial and energy *Strategy* and *Roadmaps*;
 - Work with the Nuclear Energy Skills Alliance and other skills organisations to ensure where appropriate R&D is supporting the skills development agenda.
- Together with the NIRAB, to provide advice to Government, its organisations, universities and industry on R&D programmes, particularly outside of decommissioning, and level of funding to support specific agreed objectives as set out by Government and industry;
- To explore how funding can be secured, not only from Government, but also from the private sector, EU and other international organisations and programmes related to future nuclear energy systems.

The Future for the National Nuclear Laboratory

In addition to providing support to NIRO, the Government acknowledges the importance of NNL and its wider contribution, for example, in supporting the UK nuclear decommissioning programme and current generating estate. Increasingly, the NNL has also developed roles in technological advances in nuclear maintenance and operations, new build and markets outside of the civil nuclear field. The Government is also aware of the important role that NNL has been playing working with the Nuclear-AMRC to help identify areas of manufacturing commercial opportunity for UK manufacturers as well as assisting Government and industry in helping to understand the commercial opportunities in the global market from the development of new approaches and technology. Alongside this the NNL is also playing an active role in seeking to grow the number of commercial contracts it has with private clients overseas, helping to boost our nuclear exports.

The Government places high value on the role of NNL and the initiatives that they have undertaken and would like to now provide the platform for NNL to consolidate current successes and expand these approaches, including being able to act as a national lab for both UK Government and industry. Following a strategic review of

NNL, we will therefore be re-stating NNL's mission to give particular emphasis on its role in supporting UK national programmes across the civil nuclear sector. Current contractual arrangements for running NNL will continue for now but will not be replaced when they come to an end (due April 2014). Thereafter NNL will retain its company structure under Government ownership and leadership of its Board, and will continue to provide a wide range of high quality services to public and private sector customers. Over the coming months the NNL will be seeking strategic partners to help it to deliver its amended mission statement and objectives from 2014 onwards.

Future Nuclear Energy Technologies R&D

The first step in growing the contribution of nuclear energy in the UK is delivering the planned fleet of new reactors. Innovation is important to this in lowering costs through improved techniques, and Government is supporting this as mentioned above.

However, beyond the planned fleet, the reactor and fuel cycle technologies that could be deployed globally may be different. A variety of potential future technologies are already the subject of international R&D, some of which may help to meet the UK's ambitions in the domestic market or for customers overseas. Exactly what will be most applicable is not yet clear, but the UK does not want to foreclose its options or potential commercial benefits through inactivity in the near term. This is the recommendation of the Ad-Hoc Nuclear R&D Advisory Board and also the view of industry as stated in the *Nuclear Industrial Vision Statement*.

In identifying the most credible Generation IV technologies for market deployment, Government and industry want to engage further with global R&D programmes, adding value from within the UK. This would enable UK industry to gain a greater share of the future Generation IV reactor and fuel cycle global market, valued about £8 billion/yr globally when deployed commercially in approximately 25 years time.

To do this, as recommended by the Ad-Hoc Nuclear R&D Advisory Board and outlined in the *R&D Roadmap*, Government will need to define long-term R&D programmes of national strategic importance on future nuclear energy systems. These will focus on helping to deliver commercial opportunities for companies in the UK as well as ensure the effective delivery of our domestic energy programme. Government will therefore investigate the best way to progress this, seeking advice from the NIRAB.

The key reasons for embarking on these programmes are:

- To ensure domestic and global commercial opportunities can be realised by companies in the UK, both in the short and long-term;
- To maintain the UK's high technical skill base across the full fuel cycle, providing high value career opportunities at home and overseas;
- To enable the UK to keep the range of nuclear options open for various nuclear energy scenarios in the future. This will enable the UK to make informed

decisions on future UK energy policy and continue to support UK international policy objectives enabling a low carbon global economy whilst ensuring non-proliferation objectives are maintained and enacted;

- To ensure the availability of qualified and suitably experienced nuclear regulators to ensure safety of nuclear at home and overseas through international cooperation;
- To ensure that the UK continues to be a credible player in Europe and internationally enabling us to attract funding from European and international funds as well as enable us to shape programmes to ensure the right technological solutions for society are found that consider the whole fuel life-cycle;
- To ensure the UK maintains energy security and affordability;

Government will build on work DECC has recently commissioned with NNL and the Dalton Nuclear Institute to review the necessary R&D programmes that would be needed to maintain a skill base for future nuclear energy systems across the fuel cycle in the near term.

Part of this skill base is reprocessing and recycling of spent fuel. Industrial scale reprocessing of spent fuel in the UK is expected to conclude towards the end of this decade, and the NDA has assessed that further such business is unlikely to be forthcoming in the medium term. If nuclear power expands in the UK and if Generation IV systems become commercially adopted by utilities then reprocessing is likely to be needed in future decades. However, the technologies for reprocessing and recycling Generation IV fuels could be and are likely to be different from those used today. With the phase-out of existing reprocessing in the UK there is a concern that relevant skills, which the UK currently has world leading expertise, may be lost and will be difficult to rebuild if they are required again in the longer-term.

DECC is presently funding research, including taking part in international collaborations, to ensure that R&D skills are maintained and that the UK has a good knowledge of likely future reprocessing and recycling technologies. In support of its mission the NDA also continues to fund research and activities to maintain nuclear reprocessing skills.

The advice received from NDA regarding maintaining reprocessing and recycling skills will feed into R&D programmes into future reactor systems and associated fuel cycle technologies that will be taken forward through NIRO. Therefore there will need to be alignment of the technologies being considered by NDA and NIRO, and this will be achieved via NIRAB. Similarly, advice Government receives from NDA regarding plutonium management, for which they are accountable, would need to be communicated with NIRAB who would consider if there are any synergies and ensure there is no duplication of work in other programmes.

The information gained from the existing work mentioned above will enable Government to establish what the requisite level of funding is that would enable the UK to take a leading position in key niche areas, influence international developments and exploit commercial opportunities.

Developing the UK's R&D Facilities

R&D excellence requires world-leading facilities to be available to industry and academia to address the priorities identified in the Nuclear R&D Roadmap. The Government, academia and industry have, over previous decades, developed an enviable R&D facility base, including laboratories for active research, and centres for high-performance computing, such as at Edinburgh and Daresbury in Cheshire, which UK Research Councils fund. Both physical testing and virtual modelling and simulation will be fundamental to future advances in nuclear technology including both fuels and reactors. It is crucial that these assets continue to develop and remain at the leading edge, and for this to occur, future investment from the public and private sectors will be needed.

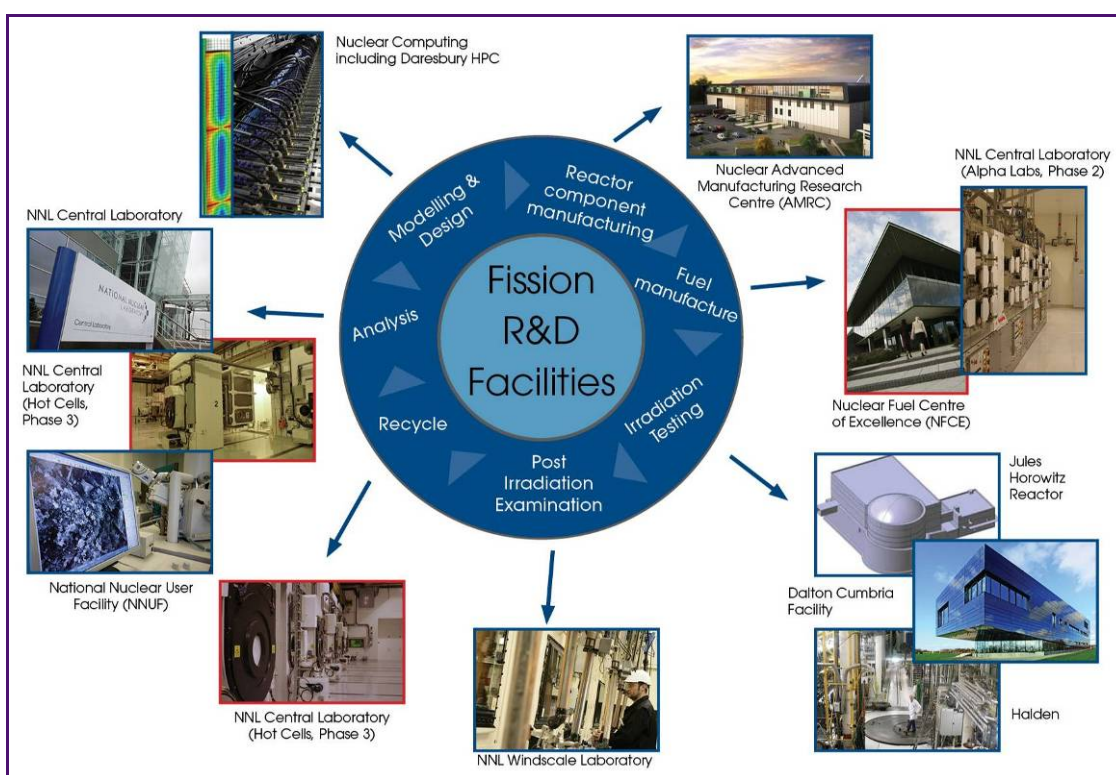


Figure 4: UK's public nuclear fission R&D facilities⁴³

Figure 4 above shows how current and proposed public R&D facilities, either UK based or that the UK has access to, can support industry and academia across the fuel cycle. In addition to those pictured there are a variety of other facilities within universities and companies that add to a national capability, which are described further in the *R&D Landscape Review*.

⁴³ Images outlined in red are facilities currently being proposed.

Commissioning of Phase 3 of NNL's Central Laboratory at Sellafield

The Government and industry recognise the benefits to domestic programmes and international R&D collaborations that would arise from the full commissioning and operation of Phase 3 of NNL's Central Laboratory at Sellafield. In addition to its use for future energy systems, the Phase 3 facility may potentially reduce the cost of decommissioning existing facilities at Sellafield by around £500m, representing a considerable long-term saving to the taxpayer. The facility also aims to be a means to develop high-end nuclear R&D skills, with access for academic researchers funded by EPSRC on research grants assessed and awarded through EPSRC's normal peer review routes. This year Government will therefore work with NNL and NDA to conclude an assessment about commissioning the facility.

National Nuclear User Facility

A National Nuclear User Facility (NNUF) will be supported to expand greatly nuclear research involving the most advanced methods for the handling, testing and inspection of radioactive materials. Academic access will be enhanced for both industrial focused work and improving our understanding of how nuclear systems behave under the extreme conditions found in nuclear reactors and across the fuel cycle.

The NNUF will capitalise on our world leading expertise in materials for both nuclear fission and fusion. It will be centred at the three complementary hubs of the Central Laboratory of NNL, CCFE and Dalton Cumbrian Facility, University of Manchester. By upgrading these facilities and strengthening the links between existing research groups, this new investment builds on previous substantial UK and European investment at these facilities. Programmes will be funded by EPSRC on research grants assessed and awarded through EPSRC's normal peer review routes.

The NNUF will be established with £15 million provided over three years from 2012/13. This is part of the EPSRC investment in Advanced Materials – one of the Eight Great Technologies in which the UK is or can be global leaders. The goal is to address key underlying materials problems that must be solved to facilitate the design and safe operation of future reactor fuel cycle and waste technologies and to capture strategic intellectual property for future nuclear systems. Potential stakeholders include universities and NNL undertaking related research and also the nuclear supply chain.

NDA R&D Strategy

NDA has key obligations with regard to R&D as set out in the Energy Act 2004. These are to promote, and where necessary, fund generic R&D in relation to its core mission of decommissioning. The R&D strategic objective is

“To ensure that delivery of the NDA's mission is technically underpinned by sufficient and appropriate R&D”

NDA's R&D strategy is that, where possible, R&D is undertaken by the SLCs and their supply chain as an integral part of the delivery of the decommissioning plans. Where necessary, NDA will directly maintain a strategic R&D programme. Overall strategic coordination of R&D in this area is maintained by NDA.

The NDA strategic R&D programme focuses on targeted, estate-wide R&D needs, risks and opportunities to

- Inform and develop strategy
- Encourage innovation
- Develop and maintain key technical skills

There are synergies with other organisations in the UK and overseas in this area that NDA identify and try to encourage through collaborative investment e.g. with TSB. NDA's role on the NIRAB will ensure the requirements and activities of R&D in this space are accounted for in the national picture.

Opportunities from UK Support for Nuclear Fusion

The UK has a recognised world leading status in fusion research (RCUK International Review of Energy Research 2010). CCFE is the main centre of UK fusion research with the operation of JET (Joint European Torus), the only device in the world capable of fusion, under contract from EURATOM. Success here has positioned the UK to be a major participant in the operation of the International Thermonuclear Experimental Reactor (ITER), under construction in the south of France. The EU roadmap projects fusion to generate electricity in the 2040s.

It is significant that the UK's fusion programme:

- Attracts foreign investment (around 2/3rds of CCFE'S £80m funding for fusion studies comes from Europe);
- Is directly supporting industry now - ITER has already provided around €200 million of business to the UK, with much more available - possibly up to €1 billion. Some contracts have been directly assisted by the CCFE, e.g. CCFE is helping a major UK engineering company develop part of a Tritium breeding blanket for ITER.
- CCFE plans to host the European-funded design centre for the first electricity producing fusion reactor, Demonstration Power Plant (DEMO), after the closure of JET in the 2020s. This will represent a huge opportunity for UK industry to be involved in the delivery of this reactor, intended to lead directly to a commercial reactor design.
- Benefits from strong international links and collaboration. Plans are underway to collaborate with other countries on JET operations (including funding) and bring in funding in other areas. There are already strong links with other ITER partners,

Japan, India, Russia, South Korea and China, which is aggressively pursuing fusion electricity well before 2040.

- Develops skills and capabilities in a new generation of scientists and engineers.

Synergy between fission and fusion

Within the nuclear energy R&D sector there are common technologies that support the development of both fusion and fission energy systems.

Both fusion and fission national laboratories (CCFE and NNL) recognise the importance of working together in technical areas of common interest. In particular materials science and neutronics have been identified as two key areas to focus on. The joint vision for CCFE and NNL in these technical areas is to develop a coherent understanding of the existing national capability and future requirements including those in academia and industry. This approach will enable efficient and effective investment in capability and infrastructure to avoid duplication or gaps.

CCFE and NNL will establish a series of technical workshops, involving academia and industry, to develop an integrated R&D capability in the areas of materials and neutronics. These will review the state-of-the-art in materials and neutronics research and assess how recent and expected developments in experimental techniques and computational capability can be exploited to maximum effect. This work will build on the *Nuclear R&D Roadmap* and existing strategy for fusion research and result in a number of position papers clarifying the research needs and capability requirements. Each laboratory will continue to focus on supporting its nuclear energy research objectives whether fission or fusion, but by working together a seamless capability can be developed that optimises the use of public sector resources, for example the NNUF that is described above.

Forging a Stronger International Presence

The UK Government and industry has a clear vision for the UK nuclear industry:

- **To be a 'top table' nuclear nation, working in international partnerships leading the direction of future technology advances across the fuel cycle;**
- **To be a key partner of choice in commercialising Generation III+, IV and Small Modular Reactor technologies worldwide;**
- **To have a supply chain that is integrated with the global market, and providing design, construction, manufacturing, professional services, skills, training and educational services across the complete civil nuclear fuel cycle from front end design through to decommissioning;**
- **To establish the UK industry as a global leader in waste management and decommissioning, securing a significant share of high value contracts globally.**

The potential commercial opportunities for the industry are immense if UK firms are able to grow their share of the global nuclear market across new build, fuel, operations, maintenance, decommissioning and waste handling. 65 reactor units are currently under construction internationally, and current proposals indicate a total of 317 new reactors coming on line by 2030⁴⁴. The World Nuclear Association (WNA) estimates that on current plans the value of this nuclear new-build is in the order of £930 billion, with significant international procurement expected to be approximately £25 billion per year through to 2025.⁴⁵ Approximately £310 billion will be for equipment purchases, with the balance consisting of design, engineering, project management, commissioning, and other professional consulting services, areas in which UK firms excel. Analysis undertaken in support of this *Strategy* suggests that, with current capability, significant market share could be captured by UK firms in markets around the world⁴⁶, totalling £8 billion by 2025 (equating to on average approximately £600m per year in tangible exports, or products in the new build market), as shown in Table 3 – (note: there are several underlying assumptions on

⁴⁴ WNA reactor database as of 1/1/13 (<http://world-nuclear.org/info/reactors.html>)

⁴⁵ The World Nuclear Supply Chain: Outlook 2030, WNA, Sep 2012, ISBN: 978-0-9550784-6-0

⁴⁶ The economic benefit of improving the UK's nuclear supply chain capabilities, Oxford Economics and Atkins, 2013

market sizes and UK perceived market capture that are further detailed in the reference study⁴⁷. The values are therefore indicative).

Table 3: Potential new build global market capture by UK industry by 2025

Region	Number of New Plants	Potential Market Size (billion)	Percent Captured	Exports (billion)
North America	12	£13	2.5%	£0.33
Latin America	3	£3.3	5.0%	£0.17
Western Europe	11	£12	5.0%	£0.6
Eastern Europe & Central Asia	48	£52.2	2.5%	£1.31
Africa	1	£1.1	10.0%	£0.11
Middle East and South Asia	39	£42.4	10.0%	£4.24
Southeast Asia and Pacific	6	£6.5	1.0%	£0.07
Far East	101	£109.7	1.0%	£1.1
Total	221	£240.2	--	£7.91

Commercial exports in 2010/11 were approximately £240 million, mainly within the subsectors of plant operations, decommissioning of nuclear sites and nuclear safety engineering services.⁴⁸ This figure does not include the additional sizeable contribution from other areas like financial, legal, education and training, technical or fuel cycle services.

Added to the global new build market highlighted above, there are opportunities for the UK in asset management of existing plant and a large and growing decommissioning market. According to IAEA (2008) projections, between 82 and 145 reactors will have been retired by 2030, mostly in Europe⁴⁹. The total civil nuclear global market could be £50 billion per annum by 2020.

The *Nuclear Industrial Vision Statement* shows industry's level of ambition. The actions presented in this section all have the objective of expanding our global influence, resulting in benefits for the UK supply chain both at home and abroad. A stronger international presence will also mean that the UK will direct rather than follow the direction in which global technology advances. Government is clear that UK industry cannot achieve all its goals in isolation, especially as globalisation gathers pace and there must be forging of international alliances, at a national,

⁴⁷ The economic benefit of improving the UK's nuclear supply chain capabilities, Oxford Economics and Atkins, 2013

⁴⁸ K-Matrix, Low Carbon and Environmental Goods and Services data (2010-11) Note all figures include the supply chain.

⁴⁹ Nuclear Technology Review 2008, IAEA

industrial and academic level. Following this *Strategy* Government and industry will look to this being advanced by the NIRO in partnership with the NIC.

A Unified Export Approach

UKTI has recognised that the global civil nuclear market offers a significant commercial opportunity for UK companies. Revealed Comparative Advantage (RCA) analysis,⁵⁰ which measures the extent to which the UK specialises in exporting nuclear goods and services relative to other countries, indicates where the UK is “punching above its weight” as an exporter. The analysis reveals that the UK has considerable strength in consultancy, R&D and decommissioning.

UK companies can provide a significant contribution to overseas civil nuclear programmes including provision of legal, regulatory, financial, engineering/technical and scientific services, programme management, plant and equipment supply, education and training programmes, full fuel cycle capability, asset management and decommissioning and waste management expertise. However, in areas such as design and new build, the UK needs to work to improve its capability and maximise the value it can obtain from the overseas markets, as well as at home. One such activity that industry has already raised that will contribute to this aim is engagement with international reactor owners groups.

What is the Government doing already?

Over the past five years UKTI has significantly increased the resource it devotes to promoting the UK's civil nuclear capability. Most of the activity has been focussed on the new build market in response to the growing number of countries either expanding or seriously considering new build civil nuclear power programmes. However, given the UK civil nuclear industry is recognised as one of the global leaders in nuclear regulatory safety, plant life extensions, maintenance, waste management and decommissioning, UKTI is considering how it can specifically promote these sub sectors with industry and how industry on its part can provide more coherent comprehensive packages to overseas clients.

Current UKTI activities to promote export by the UK civil nuclear industry include:

- Building strong government to government relationships with potential overseas customers and highlighting UK industry strengths as part of that process;
- International promotion - using a programme of inward and outward missions, seminars, promotional material and attendance at international exhibitions and conferences, articulate the UK civil nuclear offer and facilitate introductions for UK companies to key decision makers;

⁵⁰ K-Matrix, Low Carbon and Environmental Goods and Services data (2010-11) Note all figures include the supply chain.

- Assessing and pursuing High Value Opportunities (HVOs). This programme aims to identify, prioritise and deliver support in pursuit of major projects and contracts offering huge opportunities for British business. For the purposes of this programme, UKTI are looking at large scale projects with a face value in excess of £500 million. Currently UKTI has two existing civil nuclear HVOs, and is adding several new civil nuclear projects to the programme;
- Providing relevant diplomatic support for specific UK bids;
- Promoting UK industry attendance at the IAEA's annual general conference provides a unique opportunity to promote UK civil nuclear expertise to a truly global audience of 2,500 Ministers, policy makers, senior officials, regulators and industry representatives. UKTI has regularly organised a UK stand, trade mission and side seminar event at the event in the past and is considering repeating this in 2013. This also presents an opportunity to explore wider opportunities for UK companies to engage with the IAEA e.g. through technical assistance programmes.

The NDA also has a well established international relations strategy supporting UK industry that complements the activity conducted by UKTI. This includes:

- Gaining access to international good practice from relations with counterpart organisations in other countries;
- Influencing technical legislative developments;
- Maintaining good relations with overseas communities.

NDA and its SLCs were early signatories to the Government Procurement pledge. The Pledge includes a number of activities including support to UK industry abroad. In the last 12 months NDA has hosted or supported a number of missions including Japan, China, South Korea and Canada. These typically include visits to NDA sites and focused workshops, including some exclusively for SMEs. NDA and its SLCs routinely support overseas visits and conferences such as the recent one to the US where NDA helped showcase UK SMEs.

NDA's SME action plan includes a commitment to one overseas mission per year. Additionally, NDA has agreed to work with UKTI to develop a strategy for further NDA support to significant overseas decommissioning and waste management opportunities for both large firms and SME companies.

International Skills Development Collaboration

The National Skills Academy for Nuclear is working in collaboration with the IAEA and FCO on skills development initiatives with a focus on security skills and has a Collaboration Agreement with the Institute of Nuclear Power Operations. NSA Nuclear, Cogent SSC, The UK Human Performance Forum (sub group of the UK Safety Directors Forum) and INPO are now working on the development of jointly agreed skills standards the first of which is the Human Performance Practitioner Training Standards.

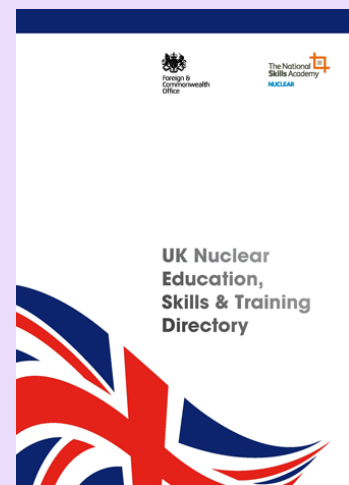
The Skills Academy and UK nuclear industry have developed in collaboration with the World Institute of Nuclear Security a competence framework for managers with nuclear security accountabilities, to be implemented world-wide.

An international training offering - UK Nuclear Education, Skills and Training Directory

Recently, NSA-Nuclear has produced a *UK Nuclear Education, Skills and Training Directory*. Funded by FCO, the *Directory* showcases the very best of nuclear provision offered by UK universities, Further Education Colleges as well as private companies specialising in nuclear skills development, education and training. The publication covers a wide range of education, training and services that are relevant to the nuclear industry including apprenticeships, degree courses, continuing professional development as well as information about the nuclear R&D capability of each of our leading Universities.

For more information see

<https://www.nuclear.nsacademy.co.uk/providers/uk-nuclear-education-skills-and-training-directory>



Strengthening our export approach – developing an Export Strategy

Recognising that many of these activities have been established independently over time, along with the continued growth of the international market, UKTI is now looking to strengthen its nuclear export work through a more coordinated approach that better highlights the UK's considerable strengths to overseas customers. In 2013, UKTI will agree with industry a civil nuclear export strategy with market priorities and

the plan to develop specific campaigns, to ensure nuclear export campaigns are focussed on those overseas opportunities that offer the best prospects for the UK nuclear industry.

This export strategy will draw upon research commissioned by UKTI on the global nuclear markets for both new build and waste management / decommissioning sectors. This research will add to existing information by combining knowledge of UK capability, competing capability, global opportunities, and status of these opportunities. As part of the HVO programme it will identify key export markets that are well-matched with UK capability as well as the maturity of those markets. The export strategy will present a flexible approach to each market, taking into account market maturity and client need i.e. countries that require full infrastructure investment and advice all the way through to mature industries that require specialist or niche services.

Relevant trade associations, companies, and other intermediary bodies will be consulted as part of the process of drafting the export strategy, which will be agreed by the summer.

Some of the specific initiatives in the new export strategy will include:

- More efficient coordination with Government Departments and Government bodies by building on existing strong relationships. UKTI will work closely with DECC, BIS, ONR, NDA, FCO and UK Export Finance, to support commercial opportunities through positively responding to global interest in the UK's approach. This will cover nuclear new build including electricity market reforms, nuclear regulation, the licensing regime for new reactor technologies (GDA) and our advanced decommissioning programme.
- UKTI will work with industry to identify and develop relationships with strategically important international partners for the UK nuclear supply chain, including nuclear vendors. This will build upon and expand existing programmes of engagement in several markets including the US, South Korea, China, Japan, France and Russia.
- UKTI will look to build on its recent "packaged solutions" approach by facilitating industry-led discussions to encourage a more co-ordinated and integrated "UK Plc" offer to target promising overseas markets. In developing such an approach, industry will need to make a strong overall commitment to fulfil their stated ambitions in the *Nuclear Industrial Vision Statement*. These include packaged operations and maintenance offerings (both services and components) for both new and emerging reactor technologies, as well as comprehensive professional services offerings for new entrant countries. UKTI will look to industry to drive forward such initiatives.

In support of a more joined-up approach to promotion of UK industry, NDA supports the concept of a single suitable database maintained by industry on behalf of Government departments. This would support the overseas export agenda in its use by Government departments in the UK and abroad. The database would contain

company information on capability, capacity, accreditation, bids and awards. This could be hosted by UKTI or NNL as part of their new expanded role.

Case Study – A “UK Plc” approach at the Annual Showcase

UKTI has developed an annual Civil Nuclear Export Showcase event to promote the UK civil nuclear industry to a global audience. The latest Showcase took place earlier this year and covered UK experience and capability in both new build and decommissioning. 98 International delegates attended representing 20 countries.

Presentations are made at the Showcase by a wide range of UK industry and Government stakeholders including the ONR, NDA and DECC. The Showcase is an excellent example of where industry and wider Government can work together to highlight the breadth of UK civil nuclear expertise available to support overseas nuclear programmes. The next Showcase is planned for January 2014.

In addition, NDA and UKTI are in early discussions on the potential to adapt the NDA's National Supply Chain event to include decommissioning and waste management export.

A Unified Inward Investment Approach

The UK nuclear market is attractive to a number of overseas investors, both from a new build developer investment perspective and also from firms specialising in certain areas of the supply chain. UKTI is active in helping all forms of investors understand the domestic market and where they might like to consider investing. On the whole assistance is directed at areas of the market where there are not existing investors or indigenous capability. UK industry is looking to partner with established overseas suppliers on the advice of nuclear developers to help promote knowledge transfer of specific reactor designs.

Encouraging targeted smart inward investment the UK nuclear sector can be strengthened overall. UKTI will look to get advice from the NIA and the NIC on specific areas where the UK supply chain would benefit from inward investment.

Current inward investment activity

A range of assistance from UKTI is available to companies to help with joining the UK nuclear supply chain from overseas or other sectors through any or all stages of their investment journey. This includes discussions around a company's UK strategy and planning; help with finding the right location; guidance during the set-up phase; and ongoing support to help the company grow. In addition to support at a national level there is local support from Local Enterprise Partnerships (LEP) which reflects the regional clustering of the nuclear sector in the UK. The assistance extends to improving the ability to meet industry and local regulations and quality standards.

UKTI has organised a number of seminars and networking events to promote the opportunity for foreign owned companies to invest in the UK, either alongside sector events or as standalone events held at an embassy. These events enable UKTI and partners to convey key messages to potential and existing investors, to build the pipeline of inward investment projects and provide a platform for high level bi-laterals with decision makers to promote partnerships and joint ventures.

International Programmes and Commercial Opportunities from R&D

Much of the technology advancement that needs to occur to commercialise the next generations of reactors will be achieved through international collaborations, whether it be through research programmes or joint industrial ventures with international supply chains. The UK does not want to go it alone. For the UK to fully exploit opportunities and realise its vision to be at the 'top table' of nuclear nations, there is a need to increase its international presence and, where appropriate, establish long term, strategic partnerships.

Small Modular Reactors

The future of nuclear needs to be based in a context where the cost of nuclear energy generation is reduced and a format where nuclear developments can become project financeable over time. A long-term approach that could aid this development would be the commercialisation of SMRs once they have a track record of being delivered to time and budget with a greatly reduced on-site construction risk.

There is a global race to bring the first commercial SMR to market. Building on our reactor design and fuel cycle heritage, the UK has an opportunity to make our mark on this global market through partnership and collaboration with US companies and the US Government.

The US Department of Energy (DOE) is backing a programme to accelerate the commercial deployment of SMRs. Their goal is to bring the technology to the home market and license it for commercial operation, using that as a springboard to the global market. Government and industry will investigate the feasibility of entering this market in partnership with the US DOE. We would like to see UK industry involved in a range of capabilities across the SMR design and become strategic partners in core areas in delivering SMRs in the future across manufacturing, professional services, operations and the maintenance aftermarket. At the same time the UK will keep under review the potential for SMRs within the domestic market and the contribution they could make to the energy mix. The potential advantages of UK engagement in an SMR development programme are clear:

- SMRs could play an important role in a long-term nuclear energy Cost Reduction Programme by reducing the unit cost of nuclear power. This could be achievable though moving away from onsite construction to much greater in-factory manufacture and minimal onsite assembly. In the UK we can capitalise on existing and developing high value manufacturing capabilities by industry involved at the Nuclear-AMRC;

- Support of the aftermarket of SMR fleets in the UK and globally through in-life service support drawing on remote monitoring capabilities;
- Offering complete SMR solutions with international partners into markets from the UK.

Through the NIRO, Government and TSB, working with industry, will investigate the areas of commercial opportunity in more detail, developing the business case.

Increased input to EU discussions and programmes on Nuclear R&D

The Government commits to further increasing its presence and impact into international fora. This will involve the development of a strategic approach to engaging internationally, with the NIC, NIRAB and NIRO playing an active role.

At an EU level, Government will develop and implement broader strategic relationships with nuclear interested countries through a programme of coordinated and proactive engagement. The aim will be to shape EU policy to enable nuclear power to continue to have a role in the energy mix and harness economic opportunities, whilst respecting non-proliferation obligations. The UK needs to have representation on key committees to shape specific R&D programmes to align with the UK strategy.

The Government will also continue to engage with the Commission, Council and Parliament in the negotiation of the next EU Nuclear R&D budget to 2020 as an important basis for international collaboration.

Jules Horowitz Reactor

Government will join the JHR research project. The reactor, being constructed in France, should be operational by 2018 and has the potential to provide the UK with a valuable radiation testing facility to develop future advanced nuclear fuels, and carry out research into material ageing, nuclear fuel behaviour and safety. Access to this facility will also open up material research related to the space industry.

The UK has considerable capability and revealed comparative advantage in the manufacture of nuclear fuel and is well placed to lead the development of future fuels for reactors both in the UK and internationally. Building on the irradiation and modelling facilities that exist in the UK, membership of and access to this test reactor will facilitate the development of new fuel types which are fully qualified for commercialisation. These advanced fuels could be more efficient Generation III, SMR and Generation IV fuels.

It is proposed that UK membership of the JHR would be represented through NNL, with delegation to the JHR steering board to influence the development of research programmes conducted at the facility, as well as assisting in the running of bespoke experiments. As part of a committed UK nuclear future energy R&D programme the membership of this facility has significant benefits enhancing the role of facilities that exist in the UK.

Investing in the Right Skills

The UK Government and industry has a clear vision for the UK nuclear industry:

- **To be supported by a workforce with the skills, capability and capacity required to successfully deliver current and future UK nuclear programmes with the highest standards of nuclear professionalism, safety and competitiveness.**
- **To have a supply chain with the skills and expertise to compete on a global basis for contracts.**
- **For the UK nuclear industry and its approach to skills and workforce development to be recognised as an example of international best practice.**

Skilled professionals are the lifeblood of the nuclear industry. In 2012, the industry boasted a dynamic skilled workforce of around 40,000 employees, an increase of 7.5% on 2011 figures.⁵¹ This displays a well-established quality skills base supporting the sector particularly in; the nuclear fuel cycle, reactor materials and component performance, decommissioning and management of radioactive waste and world-leading nuclear safety expertise.

Nevertheless employers are reporting current skills deficiencies. Working closely with industry, the members of the Nuclear Energy Skills Alliance (the Skills Alliance)⁵² have identified key skills areas where there is a risk of skills shortages, these include:

- Project and programme management
- Construction project management
- Steel fixing
- High integrity welding
- Safety case authorship
- R&D
- Site/ construction supervisors

⁵¹ NIA Capability Report 2012

⁵² Cogent Sector Skills Council, Construction Skills, ECITB, National Skills Academy for Nuclear, Senta Sector Skills Council, Dalton Nuclear Institute, BIS, DECC, Welsh Government.

- Apprenticeships and higher level apprenticeships

The Skills Alliance members have also identified general workforce capability priorities, namely:

- Educating new entrants on the basic requirements for working on nuclear sites in the UK and promoting awareness and understanding of the nuclear industry;
- The flexibility and mobility of the workforce and supply chain;
- The ability to demonstrate supply chain competence;
- Trained and qualified craft and technician personnel.

There is a high demand for high level Science, Technology, Engineering & Mathematics (STEM) skills in the nuclear industry (as identified in initial findings from the Perkins Review discussed later). These are reported as being in shortage and a priority across the whole UK economy so competition for resource is fierce. In theory, the supply of high level STEM adequately meets demand, however, with almost 40% of STEM graduates choosing to work in non-STEM roles⁵³ there is scope for action to increase the attractiveness of STEM roles across industry and promote collaborative action between industry and Government to raise supply, accelerate Suitably Qualified Experienced Personnel (SQEP) status where possible, and enhance knowledge transfer from Subject Matter Experts to the next generation.

On new nuclear build projects, construction, site preparation and engineering construction make up around 60% of the workforce.⁵⁴ To deliver each build to time and to budget, it is therefore essential that the construction and engineering construction workforce has the necessary skills and competences for working on a nuclear site. To achieve this, a new qualification, the Triple Bar for new nuclear, has been developed. The Construction Industry Training Board (CITB) and Engineering Construction Industry Training Board (ECITB) are working with the industry to support the development of the relevant skills and competences to support the nuclear new build programme using their levy fund as appropriate.

Driving forward world class innovation, long term decommissioning opportunities and a new nuclear build programme of up to 16 GW, not only demonstrates the potential for tremendous economic growth and attractive career opportunities across the country covering the full sector skills spectrum, it also articulates the scale of workforce requirements to deliver this. The *NIA Capability Report* highlights impressive direct employment impacts peaking at approximately 30,000 before dropping off into the operational phase under a 16 GW scenario.⁵⁵ Figure 5 shows

⁵³ UKCES (2011) Supply of and demand for high level STEM skills.

⁵⁴ Next Generation, Skills for New Build Nuclear, Cogent, NSAN, Skills Alliance, March 2010

⁵⁵ NIA Capability Report 2012.

the profile of workforce requirement for new build the NIA calculate based on their assumed programme.

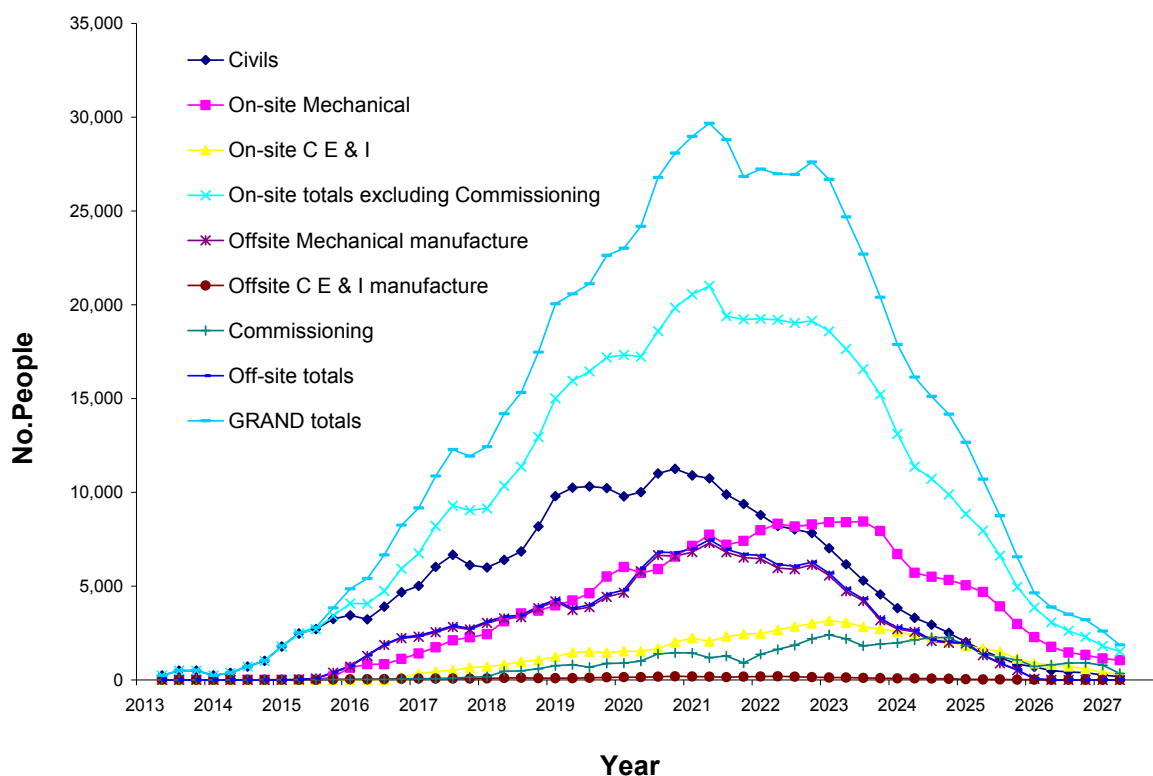


Figure 5: Workforce projection - NIA assumed programme

The NIA figures form a common basis from which skills bodies will work towards preparing for the new build programme. Oxford Economics and Atkins’ alternative methodology suggests a gross jobs impact of 30,000 – 41,000, comprising 14,000 – 19,000 direct jobs and 16,000 – 22,000 indirect jobs. The Oxford Economics and Atkins projection based on different assumptions can be found in their report.⁵⁶ The scope of the analysis and methodologies used by the two reports differ in some key areas, with Oxford Economics assuming 16.5 GW of new build and a longer indicative build profile.

Meeting the requirements for these roles will be challenging, and this is exacerbated by the demographics of the workforce and the length of time since the last new build

⁵⁶ The economic benefit of improving the UK's nuclear supply chain capabilities, Oxford Economics and Atkins, 2013. ‘indirect’ impacts are created as the supply chain demands products and services from the wider economy. ‘Induced’ impacts are created as the employment supported by the programme leads to further consumer spending effects and are not included – they can be found in the full report. Impacts are gross, not net.

project. Approximately 53% of workers in the sector are over 45 years old, resulting in significant attrition of skills and expertise over the next decade.

This issue is particularly acute among management roles and Subject Matter Expert roles, with nearly 70% of those workers due to retire by 2025.⁵⁷ Among professional roles, retirement rates are lower but remain substantial at around 50%. Analysis by members of the Skills Alliance indicates that approximately 1,000 additional recruits in professional engineering and project roles are needed per annum to replace those leaving the industry. Taken together with the need for between 10 and 15 years for leading expertise to develop, this highlights the scale of the challenge in the nuclear sector and the strategic approach needed to address it.

Furthermore, other parts of the energy sector face similar problems and there will be competition for the same skills and experienced people. A very significant source of existing nuclear engineering, technical and manufacturing capability is currently also employed in the defence sector. BIS will therefore engage proactively with MoD on future resource planning to mitigate the effect of pressure from the civil nuclear programme on the defence nuclear skills base.

However, with some of the finest facilities, research resources and academics in the world, the UK is well-placed to grow its world class skills and knowledge base for the future of the nuclear industry. The Government will continue working closely with industry, national labs, NSA Nuclear and academia, building upon the suite of measures introduced to ensure the UK nurtures its world-leading talent and develops industry excellence. This will offer exciting and rewarding careers, with multiple entry points at all levels across the sector. The education and training programmes available include: vocational qualifications for technicians and apprentices, undergraduate courses in nuclear engineering or nuclear options in generic engineering degrees, masters and doctorate programmes, continuing professional development, specialised training for companies in meeting the required regulations and quality standards for the nuclear industry and a suite of nuclear awareness programmes. These programmes need to be complemented through research activities that enable hands-on work with nuclear materials; this can be achieved by utilising the facilities within our national laboratories.

Government and industry have a clear vision and comprehensive skills strategy for the nuclear industry, detailing clearly how skills gaps will be identified and addressed by Government and industry working together, supporting the effective delivery of the nuclear programme and leading to the creation of jobs, career opportunities and economic growth in the UK.

⁵⁷ Power People, The Civil Nuclear Workforce 2009-2025, Renaissance Nuclear Skills Series 1, 2009, Cogent

A Strategic Approach to Developing Nuclear Skills

Figure 6 below details the high level strategic approach for developing nuclear skills starting from Government working with industry identifying future demand and skill gaps through to a final resolution process.

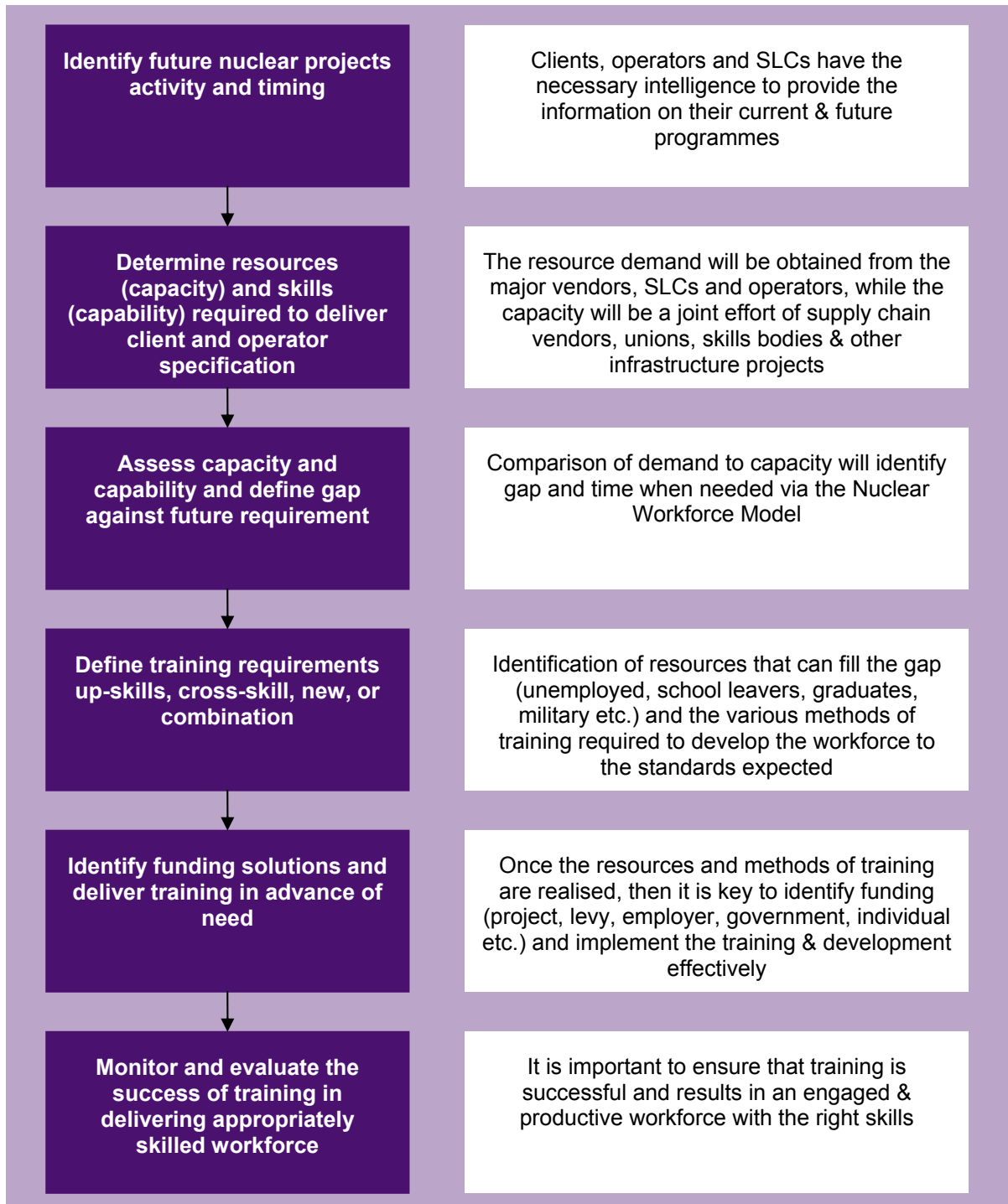


Figure 6: The strategic approach to developing nuclear skills

The Skills Challenges to be Addressed

To effectively take forward this *Strategy* it is essential to fully understand the detail of the skills and workforce requirement for the planned UK nuclear programme. This skills requirement needs to be set in the context of other major infrastructure and energy programmes that will be seeking a workforce with similar skills and requirements. Carrying out a comprehensive demand and supply analysis will enable the identification of gaps where skills, education and training interventions are required. Work has already been undertaken to articulate the demand requirements via the Cogent Renaissance series and the *NIA Capability Report*. Further work is now needed to analyse this against the supply and availability of skills, developing forecasts based on different scenarios.

Government and the UKCES have provided funding for the development of a Nuclear Workforce Model to carry out this labour market analysis. This model is being managed by Cogent SSC on behalf of the nuclear industry and the workforce requirement data will be provided by employers (owners, operators, developers). All the partners of the Skills Alliance will provide the data and support the analysis and interrogation of the outputs of the Nuclear Workforce Model to enable effective planning and deployment of resources. The NIC will articulate the overall UK nuclear programme and the pace of development - the Nuclear Workforce Model will then be used to map out the skills and workforce requirement for the different scenarios articulated.

The efforts to provide the engineering skills required by the nuclear industry will take place at the same time as the UK economy generally seeks more engineering skills. The BIS Chief Scientific Adviser, Professor John Perkins, has been looking at the broader issue of engineering skills in the UK and his analysis has concluded "it would benefit the economy to substantially increase the supply and the quality of engineers entering the labour market". Further detail on this is given in the case study below.

The need to challenge outdated perceptions of engineering may well have an extra emphasis for the nuclear sector. Over recent years, sector focus has been on operations and decommissioning only. There has not been recruitment of the large numbers of engineers seen in earlier decades and consequently teachers and parents may not fully understand the type and range of career opportunities available within the nuclear sector. Recent NSA Nuclear initiatives such as: the Energy Foresight programme in secondary schools, teachers from industry in primary schools and the Nuclear Bursary Award programme have started to address this challenge but further work is needed to build on this. That could include opportunities to participate in the joint programme between BIS and industry known as See Inside Manufacturing (SIM). The SIM programme seeks to provide opportunities for young people, as well as their teachers and career advisors, to 'get behind the scenes', visit modern manufacturing companies and discover for themselves the excellent opportunities that exist in manufacturing.

Perkins Review of the Skills Pipeline

Professor John Perkins CBE, the Chief Scientific Adviser for BIS, is looking at the issue of engineering skills supply in the UK on behalf of the Secretary of State for Business. Based upon initial analysis of demands/supply constraints, job market trends for rising skill levels, data on skills gaps and structural supply issues, his review has concluded that it would benefit the economy to substantially increase the supply and the quality of engineers entering the labour market, ensuring they have the right mix of skills as sought by employers.

The analysis has highlighted six strategic aims:

1. Changing the perception of engineering making it much more accurate and positive, challenging outdated negative views of the profession.
2. Addressing the diversity issues in engineering including the 'gender gap' (only 9% of professional engineers in the UK being women), thereby reaching out to the widest possible talent pool.
3. Encouraging sponsorships and strengthening industrial links to students, thereby making engineering courses more attractive and increasing students' employability.
4. Helping engineers who have left the profession and wish to rejoin it and others who wish to convert to it.
5. Provision of the appropriate education to support engineering careers. Increasing the number of students with the right educational background (i.e. a strong grounding in maths and physics), providing modern educational infrastructure, and giving accurate careers advice.
6. Encouraging and supporting the provision of more engineering apprenticeships, particularly higher level apprenticeships.

What are Government and Industry doing already?

Significant work has already commenced in line with the strategic approach set out in Figure 6 on ensuring the skills and workforce challenges are addressed and this work will be built on and further developed to ensure success.

The industry is well supported by having one overarching expert skills body wholly dedicated to the skills needs of the nuclear programme, the NSA Nuclear working in partnership with the four expert skills bodies that specialise in the 'pillars' that

underpin that nuclear programme: Construction – Construction skills/CITB; Engineering Construction - ECITB; Engineering and Manufacturing – Semta SSC and science based industries - Cogent SSC. These skills bodies have come together with BIS, DECC and Welsh Government to form Skills Alliance. Following the work of the Ad-Hoc Nuclear R&D Advisory Board, the membership of Skills Alliance has been expanded to incorporate higher education via the Dalton Nuclear Institute. This move will ensure that the R&D and higher level skills issues identified by the Ad-Hoc Nuclear R&D Advisory Board can be taken forward collaboratively.

The Skills Alliance is a collaborative forum where the partners work together to:

- Input research, data and labour market intelligence into the Nuclear Workforce Model; and
- Develop a common Nuclear Skills Delivery Plan to implement mitigations to address the industry's skills requirements and skills pinch points identified via the Nuclear Workforce Model.

The Skills Alliance is structured as a formal programme board, chaired by NSA Nuclear, with each skills body leading on the working group of its area of expertise. This enables real clarity of purpose and ensures appropriate and coordinated engagement with industry at each stage of the nuclear programme. The Skills Alliance partners will take forward the skills recommendations made in the *Nuclear Supply Chain Action Plan* and in the Ad-Hoc Nuclear R&D Advisory Board reports published alongside this *Strategy*.

By all partners working collaboratively, with industry, in support of this *Strategy* it will be possible to:

- Maximise the use of UK resources;
- Ensure the highest standards of nuclear professionalism across the workforce;
- Create opportunities for skilled personnel from other high hazard industries to consider nuclear careers;
- Develop clear career pathways to enable progression and development;
- Ensure the development of an integrated skills pipeline for R&D and Subject Matter Experts so key capabilities are maintained working in collaboration with NNL;
- Agree and communicate industry wide skills standards and expectations via the Nuclear Industry Training Framework to drive performance improvement striving to achieve the highest standards of global excellence;
- Plan skills interventions and investments based on sound and robust labour market intelligence for the breadth of the nuclear programme;
- Support UK companies to develop the required skills to enable them to access export opportunities;

- Maximise the impact, effectiveness and added value of all investment (Government, employer, levy, individual) in skills, training, education and workforce development for the sector.

Skills for nuclear manufacturing

The Nuclear-AMRC is working in collaboration with the new NSA Nuclear Manufacturing to help ensure that the nuclear manufacturing supply chain has the skills required to compete in the global market. They are developing an industry-led programme of skills and training services, focused on:

- Training and skills for nuclear new-build.
- Up-skilling the existing trained manufacturing workforce.
- Attracting more talented people into the manufacturing workforce and developing generic engineering and specific nuclear manufacturing skills.

This collaborative approach optimises the strengths of the three partner organisations of the National Skills Academy for Nuclear Manufacturing, namely:

- Nuclear-AMRC (leading on technology, product and process development and knowledge transfer)
- NSA Nuclear (leading on nuclear-specific skills and behaviours and nuclear professionalism)
- Semta (leading on advanced manufacturing skills and qualifications and training planning)

The Nuclear-AMRC also has close links with the new University of Sheffield AMRC Training Centre, due to open in autumn 2013.

Skills for decommissioning

Decommissioning provides skilled employment for thousands of people and will continue to do so for many decades ahead as newer power stations close and enter the decommissioning phase.

- There are approximately 400 graduates and apprentices currently in various stages of training across the NDA estate at any one time, with 150 joining annually.
- There has been £19 million invested in training centres in England, Scotland and Wales with a world-class facility in West Cumbria.
- The NDA has invested directly in the recruitment and employment of 130 apprentices in the supply chain via its Community Apprenticeship Scheme.
- 18,000 people are directly employed throughout the UK at the NDA sites and offices in a wide range of capabilities from support staff through to highly qualified technical, managerial and scientific staff.

Due to remote locations, the NDA sites are often the largest employer in the local area and sometimes the only one offering skilled industrial job opportunities. Sellafield in West Cumbria is the NDA's largest site and employs in excess of 10,000 people, over 50% of the economically active population of the nearest town, Whitehaven.

NDA RWMD has responsibility to develop and maintain an effective organisation and secure resources to deliver geological disposal.

Skills for construction

The ECITB is the national training organisation for the engineering construction industry. It invests some £30 million annually in the industry, of which around 20% is directly in support of the nuclear sector. Key projects include enhancement of project and programme management qualifications, site supervisor training and development of new qualifications for high integrity welding.

Case Study: £7m Britain's Energy Coast Construction Skills Centre

BEC in partnership with Nuclear Management Partners, BEC Campus and Lakes College, have invested in a new construction skills centre to equip hundreds of people with the skills needed to deliver a wide variety of construction projects. The BEC Construction Skills Centre is a flagship development for West Cumbria - a crucial symbol of a commitment to help ensure local young people are equipped with the necessary skills to work on the wide range of construction projects set to take place in the coming years.



The centre will be run by Lakes College on their existing site, and will have state of the art teaching spaces and workshops for up to 600 students. They will be able to study electrical installation and joinery; high specification and exotic welding and fabrication, plus courses and skills around renewable energy technologies including solar photovoltaic and solar thermal hot water systems.

Industrial schemes

Industry is also working to play its part in addressing the nuclear skills challenge through its current provision of a range of graduate and apprentice schemes. Individual companies run their own programmes, whilst several also participate in sector-wide initiatives that are funded by multiple partners, such as the '*nucleargraduates*' scheme.

Continued commitment by companies to such schemes and industrial uptake of direct funding provision from Government through initiatives such as the Employee

Ownership of Skills and the Growth & Investment Fund (GIF) will be a key part of meeting the skills challenges outlined here.

Case Study: National Nuclear Gateway

The NSA Nuclear has gained approval via GIF for a National Nuclear Gateway project, funded by the UKCES and matched against nuclear employer investment. The project aims to deliver transformational growth in the UK nuclear industry by equipping businesses and their supply chain with the fundamental skills at the right level and the right time to deliver the planned nuclear programme in the UK from 2015 onwards. The two year funded project will ultimately result in an enhanced offer of skills related products and services to the nuclear industry in the UK to enable this to happen.

Case Study: Centres for Doctoral Training (CDT)

EPSRC has set up two centres to supply PhD level nuclear researchers to underpin Government's Energy policy, based on an interdisciplinary and industrially partnered approach.

The Nuclear Engineering CDT has been operational since 2006 and is centred at the University of Manchester. The centre works closely with the Universities of Sheffield, Strathclyde, Surrey, Lancaster, Leeds and Imperial College London. The centre develops vocationally oriented research engineers through intensive, broad based training delivered in collaboration with companies. The centre works very closely with the nuclear industry and has projects sponsored by, amongst others, Rolls-Royce, EDF Energy, Sellafield Ltd and NNL.

The Nuclear First CDT began in 2009 and is run by the Universities of Manchester and Sheffield. The centre is primarily academic in focus but works closely with NNL, AMEC, The Welding Institute, NDA, and other nuclear industry organisations. The centre studies strategic nuclear materials, radioactive wastes, radionuclides in the environment, radiation effects, radiochemistry and other nuclear-relevant materials science.

Case Study: £8m Energy Skills Centre at Bridgwater College

The Energy Skills Centre at Bridgwater College, a flagship of NSA Nuclear, was officially opened in January 2011 housing engineering subjects as well as science, low carbon and nuclear related education and training. Facilities include; a 550m² two storey high Realistic Work Environment, complete with 3.2 tonne full traverse overhead gantry crane, an engineering workshop and a welding and fabrication workshop, as well as labs for instrumentation and control, computer aided design, electrical and electronics, engineering maintenance, CNC manufacturing, materials testing and a science lab. On the roof there is an outdoor training area with a 6kW wind turbine, photovoltaic skills and other 'green' technologies.

The Centre is supported by many high profile and interested parties: including, EDF Energy, NDA and NSA Nuclear. Further industry sponsorship has been provided by EnergySolutions and the Kier Group. Sedgemoor District Council has also supported the project through the donation of the land on which the Centre is built.

Taking the Skills Strategy Forward

- Employers, via existing fora, will continue to take the lead in terms of identifying the detail of the future nuclear programme and its associated resource requirements. Where there are synergies with the existing programme or decommissioning programmes these will be considered.
- Skills Alliance partners will continue to up-date and deliver the priorities in the Skills Delivery Plan.
- NSA Nuclear and NNL will collaborate to address the development of Subject Matter Experts and R&D capabilities to meet future requirements.
- The impact and return on investment of all this work will be reviewed and monitored on an on-going basis and reported to the Nuclear Industry Council.

This collaborative work between Government, industry and the skills bodies is an effective 'industrial partnership' which will be fully utilised to ensure a streamlined approach to skills development, education and training for the sector. Linkages will also be made to other developing industrial partnerships such as manufacturing to ensure access to the most appropriate funding mechanisms to support the breadth of the nuclear programme.

The Way Forward

This *Nuclear Industrial Strategy* and the supporting documentation signals the Government's firm commitment to seeing the delivery of new nuclear power generation in the UK and the role of nuclear energy in the UK energy mix out to 2050 and beyond. This *Strategy* and its policies also show the Government's unwavering commitment to the UK nuclear industry and our combined desire to see industry's vision for its future realised.

The UK's nuclear future can only be achieved if safety continues to be paramount and the nuclear legacy continues to be dealt with effectively, providing a base for decommissioning firms in the UK to grow their global ambitions. Nuclear power must also prove its economic worth in competition with alternative sources of energy as the *Strategy* makes clear.

This *Strategy* is the first for the nuclear sector and is not the end point, it should be seen as the start of a longer-term, better coordinated partnership. It sets out ambitions that will evolve over time in response to market and technology developments, and will be dependent upon Government and industry shouldering their share of the partnership. The Nuclear Industry Council needs to play a central role in cementing that partnership, and working with the research community.

There are a number of important elements in this *Strategy* which will deliver success, including:

- The creation of the Nuclear Industry Council itself as a forum to bring businesses together with Government to prioritise the areas of most significant need for commercial success
- The establishment of more effective nuclear innovation and research coordination mechanisms to maximise the use of public resources, aligned with the private sector to deliver industry's commercial aspirations as well as maintain energy options for the UK
- The acknowledgement that there are core commercial opportunities in which Government with industry will look to realise in some key areas of nuclear innovation in both current and future reactor designs as well as the development of modular manufacturing methods and future fuel systems

The Nuclear Industry Council will wish to consider how best it can review progress with the implementation and development of the *Strategy*, as well as defining success measures.

Glossary

AGR	Advanced Gas-Cooled Reactor
AMSCI	Advanced Manufacturing Supply Chain Initiative
BIM	Building Information Modelling
BIS	Department for Business, Innovation and Skills
CCFE	Culham Centre for Fusion Energy
CfD	Contracts for Difference
CITB	Construction Industry Training Board
CDT	Centres for Doctoral Training
DECC	Department for Energy and Climate Change
DEMO	Demonstration Power Plant
ECITB	Engineering Construction Industry Training Board
EMR	Electricity Market Reform
EPSRC	Engineering and Physical Sciences Research Councils
FCO	Foreign and Commonwealth Office
FSA	Food Standards Agency
GDA	Generic Design Assessment
GDF	Geological Disposal Facility
GVA	Gross Value Added
HPA	Health Protection Agency
HVO	High Value Opportunities
IAEA	International Atomic Energy Agency
ICT	Information and Communication Technology
IP	Intellectual Property
ITER	International Thermonuclear Experimental Reactor
JET	Joint European Torus
JHR	Jules Horowitz Reactor
KPI	Key Performance Indicators
KTN	Knowledge Transfer Network
LEP	Local Enterprise Partnerships
LWR	Light Water Reactor
MDEP	Multinational Design Evaluation Programme
MoD	Ministry of Defence

NDA	Nuclear Decommissioning Authority
NEA	(Organisation for Economic Cooperation and Development) Nuclear Energy Agency
NERC	Natural Environment Research Council
NIA	Nuclear Industry Association
NIC	Nuclear Industry Council
NIRAB	Nuclear Innovation and Research Advisory Board
NIRO	Nuclear Innovation and Research Office
NNL	National Nuclear Laboratory
NNUF	National Nuclear User Facility
NSA Nuclear	National Skills Academy for Nuclear
Nuclear - AMRC	Nuclear Advanced Manufacturing Research Centre
ONR	Office for Nuclear Regulation
PIE	Post Irradiation Examination
PWR	Pressurised Water Reactor
RCA	Revealed Comparative Advantage
RWMD	Radioactive Waste Management Directorate
SBRI	Small Business Research Initiative
SIM	See Inside Manufacturing
SLC	Site Licence Company
SMEs	Small and Medium Enterprises
SMR	Small Modular Reactor
SQEP	Suitably Qualified Experienced Personnel
SSA	Strategic Siting Assessment
STEM	Science, Technology, Engineering & Mathematics
STFC	Science and Technology Facilities Council
TAP	Technical Advisory Panel
TRLs	Technology Readiness Levels
TSB	Technology Strategy Board
UKCES	UK Commission for Employment and Skills
US DOE	United States Department of Energy
UKTI	United Kingdom Trade & Investment
WNA	World Nuclear Association

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