Nuclear Skills Strategy Group

Working in partnership to deliver skills leadership

Nuclear Workforce Assessment 2021

A scenario-based approach to nuclear workforce planning

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1 Foreword

I am delighted to introduce this newly updated Nuclear Workforce Assessment (NWA), which once again provides a comprehensive forecast of skills supply and demand across the nuclear sector – including new build, current operations, decommissioning, research and development and defence activities. Our Nuclear Workforce Assessment includes within it a number of different analyses. It explores total demand of skills for the workforce. It compares this to the current supply i.e. our existing workforce. Within this analysis we can start to explore characteristics of the workforce such as age and gender, to examine how diverse our workforce is. The report and data also allow us to examine our trainee population, i.e. apprenticeships and graduates, and examine the rate of their intake compared to attrition of our workforce.

While the UK's pathway to a low carbon and sustainable energy system is yet to be fully mapped out, there is a renewed optimism and commitment for nuclear as part of a future energy mix and with this comes opportunities and challenges for our sector in acquiring these skills. The nuclear sector has always provided high quality jobs, bringing economic growth to remote areas of our country. However, there will be increased competition for skills resource from other sectors recruiting for similar skills. Our ability to identify required skills and proactively plan a healthy pipeline to ensure they are ready when required, will be a key strategic capability for our sector and one where the NSSG can really add value.

Finally, I'd like to acknowledge the hard work of the NSSG members in providing the all-important data and for shaping this report together with the NSSG support team in enabling it.

Corhyn Parr, CEO of Nuclear Waste Services and Chair of the Nuclear Skills Strategy Group

2 Context

Since the publication of our last Nuclear Workforce Assessment (NWA) in 2019, the nuclear sector has experienced a series of changes that are set to have a long-lasting impact upon both the nature and makeup of our workforce. The Nuclear Sector Deal, launched in 2018, is being refreshed to recognise that the UK nuclear sector will be a major contributor to Net Zero and to national security, by delivering economic recovery and sustainable growth through innovative approaches. The NWA provides us with a crucial evidence base to support this ambition, forecasting skills supply and demand across the sector.

Recognising that the exact makeup and nature of civil new build is far from settled, this NWA 2021 has retained a scenario-based approach. Additionally, there is further work to be undertaken to develop accurate workforce profiles for some of the new build projects (in both civil and defence). Consequently, there will be further adaptations to the data sets that underpin the analysis in this document. The approach taken to workforce assessment must be agile and flexible. This report is both partial and a snapshot, but the databases, analysis and modelling will be used to continuously update the picture, as new and refined information comes to hand. We are working with the Nuclear Sector Deal team to agree a range of viable scenarios for future forecasting, and as refined workforce models are provided to us, we can update the scenarios with the latest data.

There is always a lag in the provision of data, and consequently to analysis and output. This year is no exception, as organisations have waited for updated internal plans. At the time of writing there are further updates to workforce profiles due. However regular NWA reports and outputs are important for historical trending.

Current work on the Nuclear Skills Landscape Review has identified opportunities for strengthened use of the analysis underlying the nuclear workforce assessment. The NWA has several use cases, and one of these is to help to prioritise action within the sector to address any skills risks that are identified. Demand signals identified in the NWA can be combined with qualitative judgements of skill availability, in order to produce skills risks heat maps.

Alignment of the NWA to other sectors' labour market intelligence that maps wider infrastructure and manufacturing projects, will allow us to better understand the challenges of skills for nuclear in a wider industrial context. Current development around workforce planning within the defence sector, will help us to better understand the opportunities (and challenges) for transferable skills.

So, whilst the production of this report represents a key milestone, we recognise that it also represents the start of a future phase of work on Labour Market Intelligence (LMI).

Contributing organisations

The skills required to meet this workforce demand, include 'skills for nuclear' - all-important trade, generic engineering and project management skills - as well as more specialised 'nuclear skills'. Through working with the sector, and its wider supply chain, we can bring prosperity to our regions through the opportunities that the nuclear sector can bring.

The NSSG will use this report and associated analysis to help ensure our sector and its supply chain have the skills they need to succeed; and to help embed a reformed system of technical and vocational education to boost STEM (science, technology, engineering and maths) and digital skills. The NSSG, working across the sector, will also strive to ensure that the benefits that a career in our nuclear sector can bring, are open to all.

The NWA utilises directly acquired planning data for the main client organisations, as well as a modelled supply chain workforce profile, based on spend.

The Nuclear sector consists of four key organisations - Department for Business, Energy and Industrial Strategy (BEIS), Ministry of Defence (MoD), Nuclear Decommissioning Authority (NDA) and EDF - that drive the current spend on nuclear in the UK. The NDA and MoD alone annually spend £3.4bn and £5.2bn, respectively. These organisations invest in the supply chain, academia, R&D establishments, innovation groups, skills organisations, Local Enterprise Partnerships (LEPs), business clusters and unions, to deliver significant socioeconomic benefits across the whole nuclear lifecycle.

The civil nuclear sector supports and operates across the Union, with 32 nuclear licensed sites in England, ten in Scotland, and two in Wales. The nuclear landscape is evolving, and today's landscape will continue to change with new technologies and policy developments

Ministry of Defence

The Government's policy to maintain a nuclear deterrent as part of its national security strategy has been in place since 1969, and was last endorsed in 2021 by Government, with the Integrated Review confirming the renewal of the UK's Trident deterrent. The UK's world-leading nuclear defence programme underpins our national security and makes a significant contribution to the economy through jobs, skills, research and development, and exports. The MoD spends around £5.2bn a year with UK nuclear industry, with the Defence Nuclear Enterprise (DNE) employing 30,000 people and has delivered a Continuous At-Sea Deterrent (CASD) for more than 50 years.

NDA

The largest UK Nuclear Sector Employer is the NDA, a non-departmental public body of the Department for Business, Energy and Industrial Strategy, formed in 2004 whose current mission is to decommission the UK's 17 earliest nuclear sites safely, securely and cost-effectively. Over the next six years, a further eight Advanced Gas-cooled Reactor sites will come under the NDA's remit for decommissioning. The NDA manages the Nuclear Liability of £124.3bn through the decommissioning, processing, packaging and safe long-term storage of wastes, leaving sites ready for re-purpose. The NDA has 16,500 employees across the group, comprising of Sellafield Ltd, Magnox Ltd, Nuclear Transport Solutions and Nuclear Waste Services. The planned annual spend for the NDA was £3.4bn for 2020/2021. The NDA looks to increase value for money for the taxpayer, enhance performance, and deliver increased value an improved confidence in nuclear decommissioning and waste management expertise of the UK

EDF

EDF is the UK's largest producer of zero carbon electricity and meets around one-fifth of the country's demand. EDF is leading the UK's nuclear renaissance with the construction of the first new nuclear power station in a generation at Hinkley Point C in Somerset and has plans for a new power station at Sizewell C in Suffolk. Together, if Sizewell C is approved, the two power stations will be able to produce enough zero carbon electricity to meet around 14% of the UK's energy demand – the equivalent of 12 million homes. Hinkley Point C has so far created over 11,700 job opportunities, 750 apprentices and the UK-wide supply chain has spent over £3.2bn in the South West alone since 2016. On behalf of the UK Government, EDF will also be responsible for defueling all seven of the UK's existing AGR stations which will be offline by 2030. To prepare for the dramatic change in the UK's nuclear landscape over the coming decade, EDF has launched a new way of delivering technical support across Nuclear Generation, Hinkley Point C and Sizewell C - the Technical Client Organisation (TCO). Over time, the TCO will help develop and maintain EDF's UK-based technical capacity and expertise.

BEIS

In addition to the industrial organisations identified above, it is important to note the role of the Department for Business, Energy and Industrial Strategy

In June 2019, the Government wrote into UK legislation a requirement to achieve net zero greenhouse gas emissions by 2050. In response to this, BEIS set out the UK's strategy for energy through publication of the Energy White Paper and the Prime Minister's 10-Point-Plan for a Green Industrial Revolution. Recognising the key attributes of nuclear, these publications collectively commit to:

1. Aiming to bring at least one large-scale nuclear project to the point of Final Investment Decision (FID) by the end of this Parliament, subject to clear value for money and all relevant approvals.

2. Providing up to £385 million in an Advanced Nuclear Fund for the next generation of nuclear technology, aiming, by the early 2030s, to develop a Small Modular Reactor (SMR) design and to build an Advanced Modular Reactor(AMR) demonstrator: a. Up to £215 million into SMRs. b. Up to £170 million for a research and development programme on AMRs. c. Invest an additional £40 million in developing the regulatory frameworks and supporting UK supply chains.

3. Aiming to build a commercially viable fusion power plant by 2040, already providing: a. £222 million for the visionary STEP programme (Spherical Tokamak for Energy Production) b. £184

million for new fusion facilities, infrastructure and apprenticeships to lay the foundations of a global hub for fusion innovation in the UK (Note that skills for fusion technology are not considered in this report).

Whilst some of programmed activities are already built into resource planning, and have therefore been directly fed into the NWA, others are still to be confirmed, assessed or quantified. This has created some ambiguity in predicting future workforce demand profiles.

Key messages, skills challenges and opportunities

- The scale of future energy demand is unknown and so three scenarios have been developed to manage the uncertainty, including the explicit modelling of an SMR workforce. Outside of the NWA, new scenarios can be implemented comparatively easily within a Dynamic Workforce Model
- Even in the absence of a civil new build programme, a substantial replacement demand exists, driven in part by an ageing workforce
- Previous assessments have been in a position to assume locations for civil new build in addition decommissioning sites and the UK regions in which defence operates. As expectations have changed, outside of the south west and south east (for Hinkley Point C and Sizewell C) the location of further sites, particularly clusters of SMRs is now difficult to predict. Consequently, this assessment has not focused on geography. This is not to say that geography won't be an important feature in the near future as potential sites become identified. The nuclear industry has provided considerable socio-economic benefits in the areas in which it operates. The extension of those will be an important consideration.
- The overall participation of women in the industry remains stubbornly pinned at around 20% (Defence 16.6% - Civil 23.7%). The opportunity to rebalance comes mainly from young people entering the workforce for the first time (around 25% of the inflow within the available data). Experienced hires, at least in the available recruitment data, have a gender balance no better than the existing work force. The exact cause of this is not known, but clearly recruits are being drawn from a pool which is likely to be male dominated to begin with. Since analogous industries also tend to suffer from gender imbalances, this may be limiting the opportunity to use recruitment to improve the balance in this sector
- It remains important to focus attention on high-level skills, which are lower in numbers but play an important role

The information contained within this latest NWA will continue to support evidence-based planning for future interventions and activities the sector will need to meet its skills needs. The NSSG uses this data and other associated research to help drive a risk-based approach to skills, ensuring mitigating actions are focused on most significant skills risks.

3 Introduction

The NSSG collects workforce data from a range of major nuclear employers every 18 – 24 months, covering, roles, role levels, age, trainees, gender, recruitment and leavers. Together with modelled data to reflecting supply chain and future new build options, this forms a data set that can produce a range of cross-tabulated analyses. Whenever more reliable data is available, the basis dataset will be updated.

Nuclear LMI serves several purposes with different demands. These range from more detailed data monitoring of the demographic profile of the current workforce, to providing a long range but less granular picture of the overall demand envelope, covering many years. It fills in gaps in national data and helps to identify areas of skills concern.

The Nuclear Workforce Assessment is a summary of the same data, generally at a high level, designed to show the principal trends at a point in time.

The NWA 2019 was the first to look at a range of feasible scenarios for civil electricity generation over the next two decades, rather than a fixed set of sites that followed the National Policy Statements for energy infrastructure, published in 2011. This report continues with that approach but, develops the model to better reflect the range of small and large-scale reactor technologies. Calculations for the workforce implications for three scenarios are presented, consistent with the government's most recent policy and funding announcements. They cover one or two large-scale projects in addition to Hinkley Point C, together with several SMRs

In the October 2021 budget and spending review, the government announced £1.7 billion of direct government funding to enable a large-scale nuclear project to the point of final investment decision during the current parliament. Sizewell C is the most advanced project still to take its final investment decision

Geography is an important factor in the nuclear sector, not least because of its historical role in bringing high-wage, highly skilled jobs[1] to more remote areas. The socio-economic impact of future developments will be vital contribution in economic recovery following the combined impact of the UK's exit from the European Union and the Covid-19 pandemic.

Until recently, new nuclear projects were confined to submarine construction and the construction of large-scale plants at locations adjacent to existing operations. To that extent, and beyond the supply-chain at least, geography was well-defined.

Now the picture has changed with a large role for SMRs and a great reliance on manufacturing and off-site fabrication. Until more information becomes available about the likely distribution of manufacturing centres for SMRs determining skills demands geographically is difficult.

Methodology

Data has been collected, as in previous reports, directly from the site licence companies (SLC). The supply chain is more disparate and is represented by modelling as described previously.

Current Workforce

Data was requested for the existing workforce by resource code, level, age and gender. The workforce in training was collected by discipline (grouped by apprenticeship, or degree) and by gender.

Recruitment

Recruitment data was requested by six Function areas, grouped for staff by source (internal staff, external experienced hires, apprenticeship or degree) and for trainees by graduate or apprenticeship.

Where the data was collected by gender, the gender identification options offered were Female, Male and non-Binary.

[1] Over 50% are employed at level 5 or higher. Median civil salary ~£45,000 in 2017 (NIA Activity Report 2017)

Leavers

Workforce data for leavers was collected for the first time in this collection round, using the same format as for the existing staff (resource code, level, age and gender).

Workforce projections

Existing estate civil and defence data suppliers provided forward projections for the period 2022 to 2042. In some cases, this involved extrapolation from 2021 levels.

Forecasts for civil new build used a dynamic workforce tool designed for this purpose. Reactor unit workforce data to drive the model takes two forms. For giga-watt scale plant of the type currently under construction at Hinkley Point C, data is informed by consultation with the developers although its accuracy within the report remains the responsibility of the author. For Small Modular Reactors, no equivalent reactor unit workforce profile is currently available, so these are included in the model in the form of the initial estimates of Appendix 8.

The Dynamic Workforce Model

The **Dynamic Workforce Model** allows pre-defined new build workforce units to be placed on a timeline. Represented at the top level as a Causal Loop Diagram, the model keeps track of workforce occupations and levels as the units are adjusted in time. This allows for rapid recalculation of evolving expectations. Charts a) to h) shows test profiles added and moved, at different levels of segmentation.

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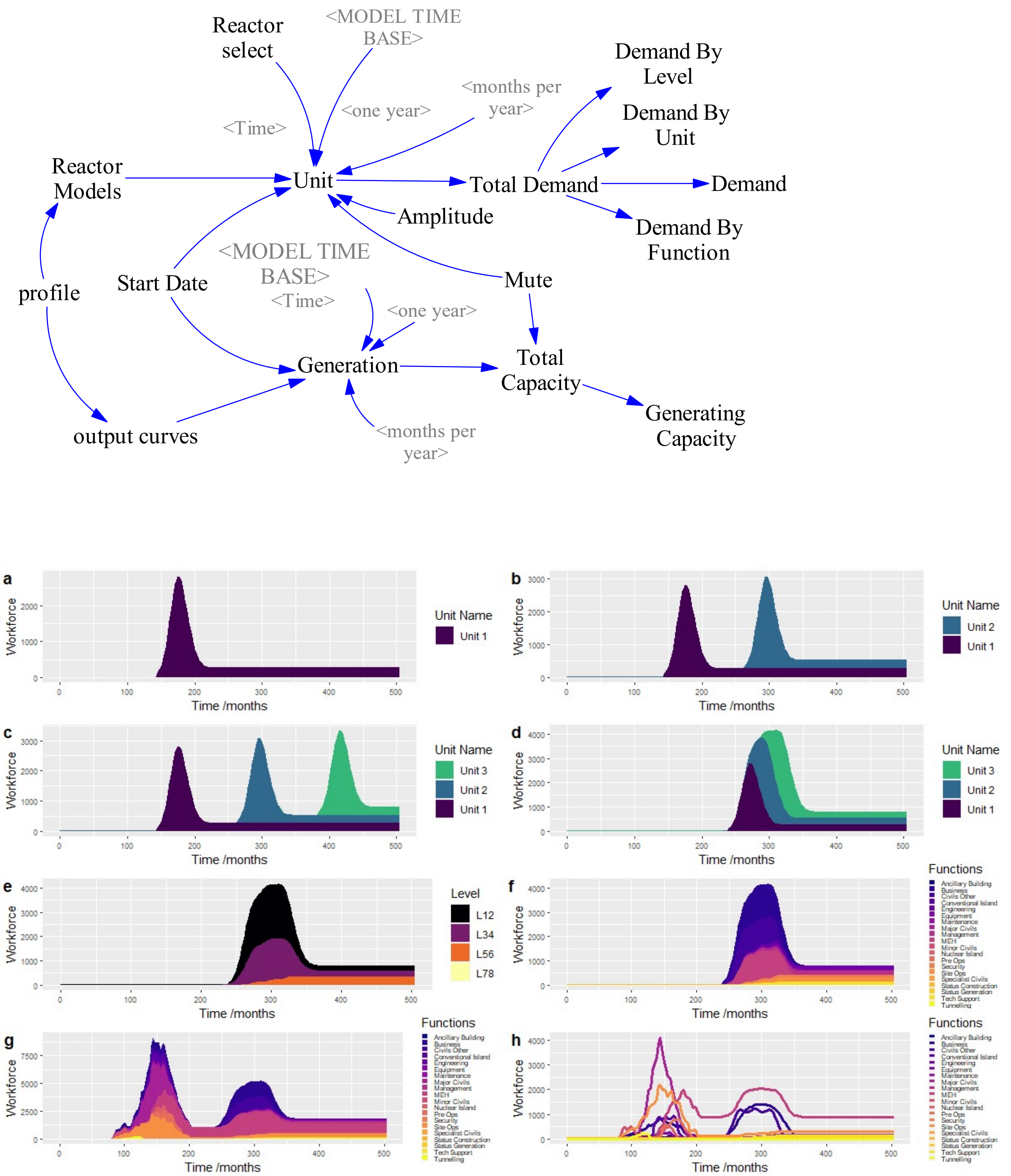

Figure 1 The Dynamic Workforce Model to allow different scenarios to be quickly recalculated

The Demand

As in previous analyses, the total demand is formed from the sub-sectors, defence, decommissioning, fuel processing, electricity generation and the civil electricity new build programme. In 2021 several possibilities are emerging for the continuation of the new build programme beyond the completion of Hinkley Point C, with widely different workforce requirements. Based on public statements from government and industry that point to, a) the intention to progress with Sizewell C, b) openness in government to the possibility of a third large-scale plant, and c) an ambition to develop a fleet of Small Modular Reactors, the following plausible scenarios are proposed in order to explore the range of demand envelopes that can be expected.

Three scenarios

The three civil new build scenarios considered are:

- High (18.4 GWe – 19.9 GWe)
- Medium (9.6 GWe – 10.2 GWe)
- Low (3.2 GWe)

(Final generating capacity will depend on technology and SMR reactor sizes)

In each case the start date is taken to be the date of first nuclear concrete on site (FNC), or J0 for EDF projects.

The assumed timelines are:

High (18.4 GWe - 19.9 GWe)		**Medium (9.6 GWe - 10.2 GWe)**		**Low (~6.4 GWe)**	
Reactor	**FNC/J0**	**Reactor**	**FNC/J0**	**Reactor**	**FNC/J0**
HPC	2019	HPC	2019	HPC	2019
SZC	2023	SZC	2023	SZC	2023
Generic LS	2025	SMR 1	2030		
SMR 1	2030	SMR 2	2032		
SMR 2	2031	SMR 3	2034		
SMR 3	2032	SMR 4	2036		
SMR 4	2033	SMR 5	2038		
SMR 5	2034	SMR 6	2040		
….		SMR 7	2042		
SMR 22	2051	SMR 8	2044		

Table 1 Key dates for construction within the three scenarios

Figure 2 shows the likely development of generating capacity for each of the scenarios.

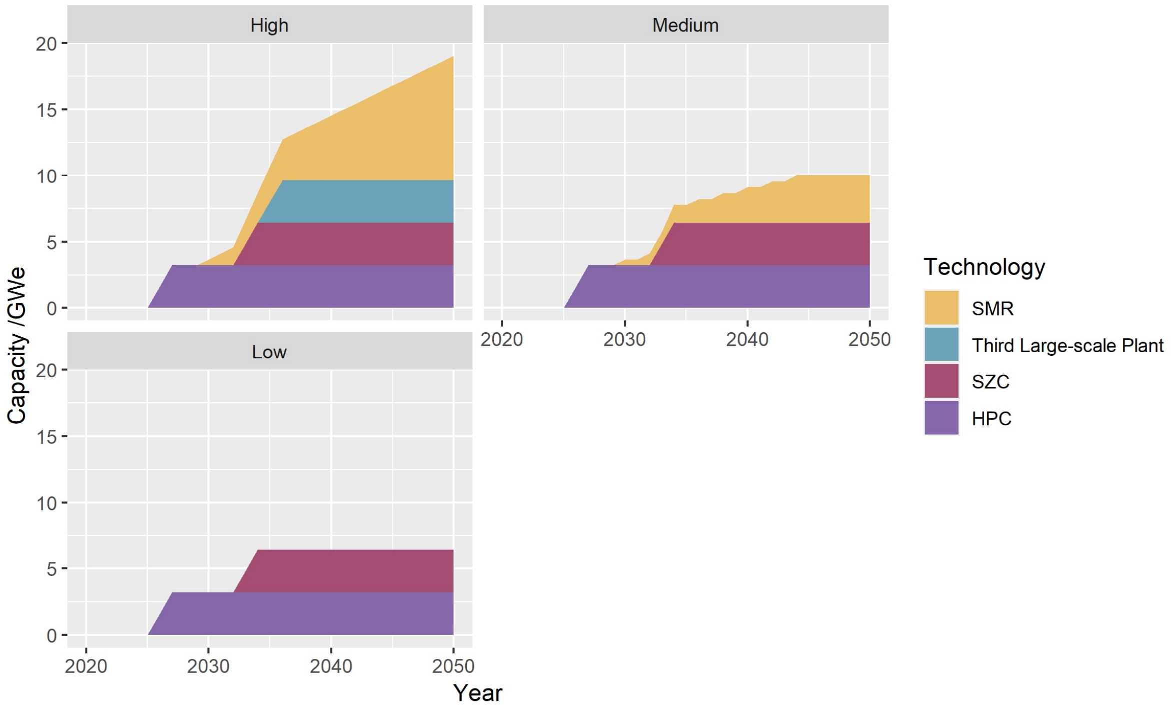

Figure 2 Civil electricity generating capacity under the three scenarios

The Nuclear Timeline

The overall demand for nuclear skills is determined by a combination of nuclear projects spanning the decommissioning of existing facilities, the development of future technologies, the construction of new civil power generation and the implementation of defence programmes. Some of these, particularly decommissioning and submarine construction, have well established timelines. Others await commercial and governmental decisions.

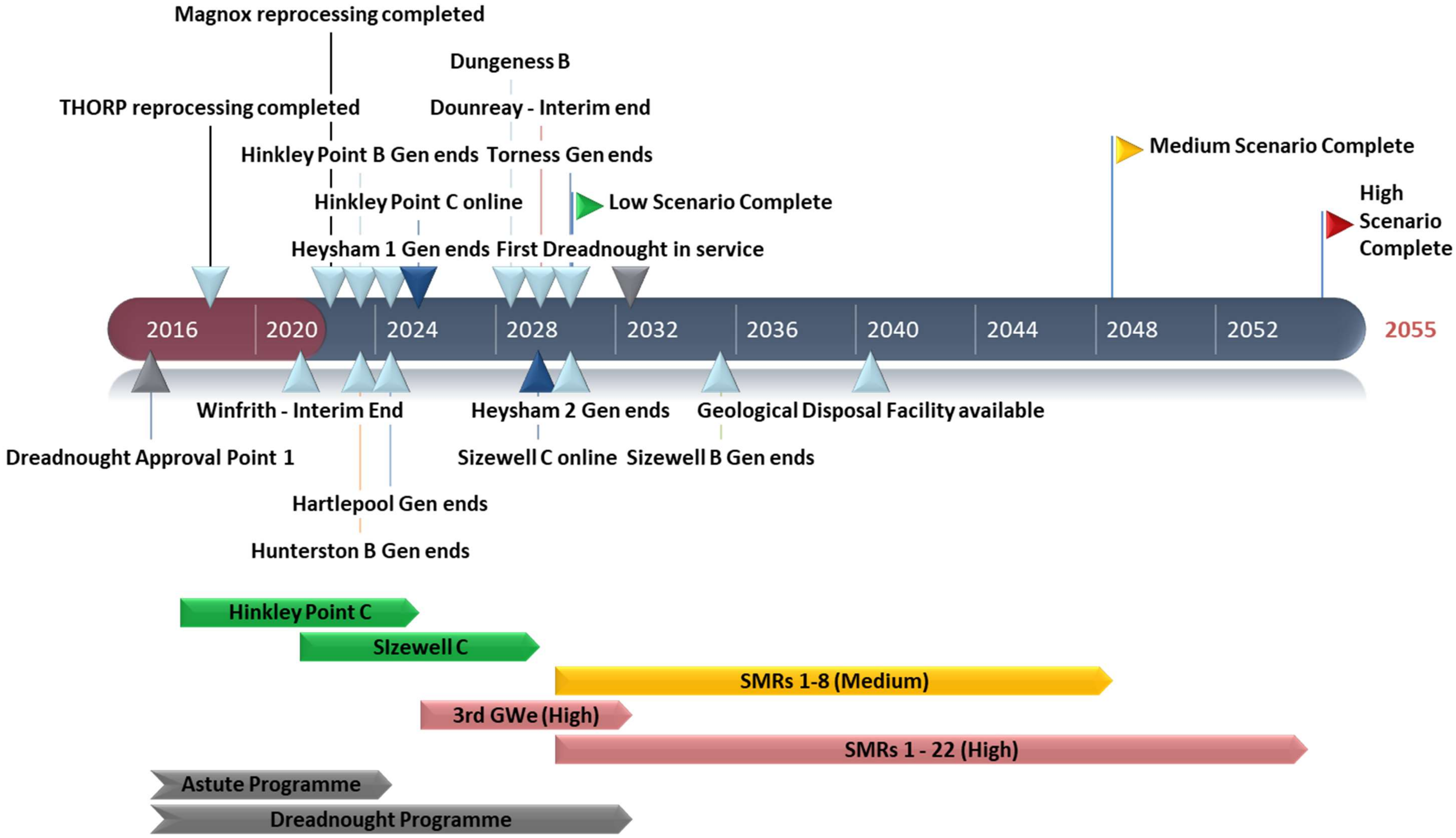

Figure 3 Nuclear timeline

The timeline is an estimate of significant nuclear milestones extending beyond the net-zero greenhouse gas emission target date of 2050. It includes three civil new build scenarios described below.

Baseline inflow requirement

Before discussing the skills demand for the three scenarios, it is useful to establish a baseline. Figure 4 shows the replacement demand for current civil and defence activities in the absence of any new major projects. Even with a contracting industry (Figure 4a – demand line) a sizable replacement inflow is required. In the short-term, around 3200 new workers would enter the industry each year (Figure 4b), decreasing to between 2200 and 2500 per year in the medium and longer term.

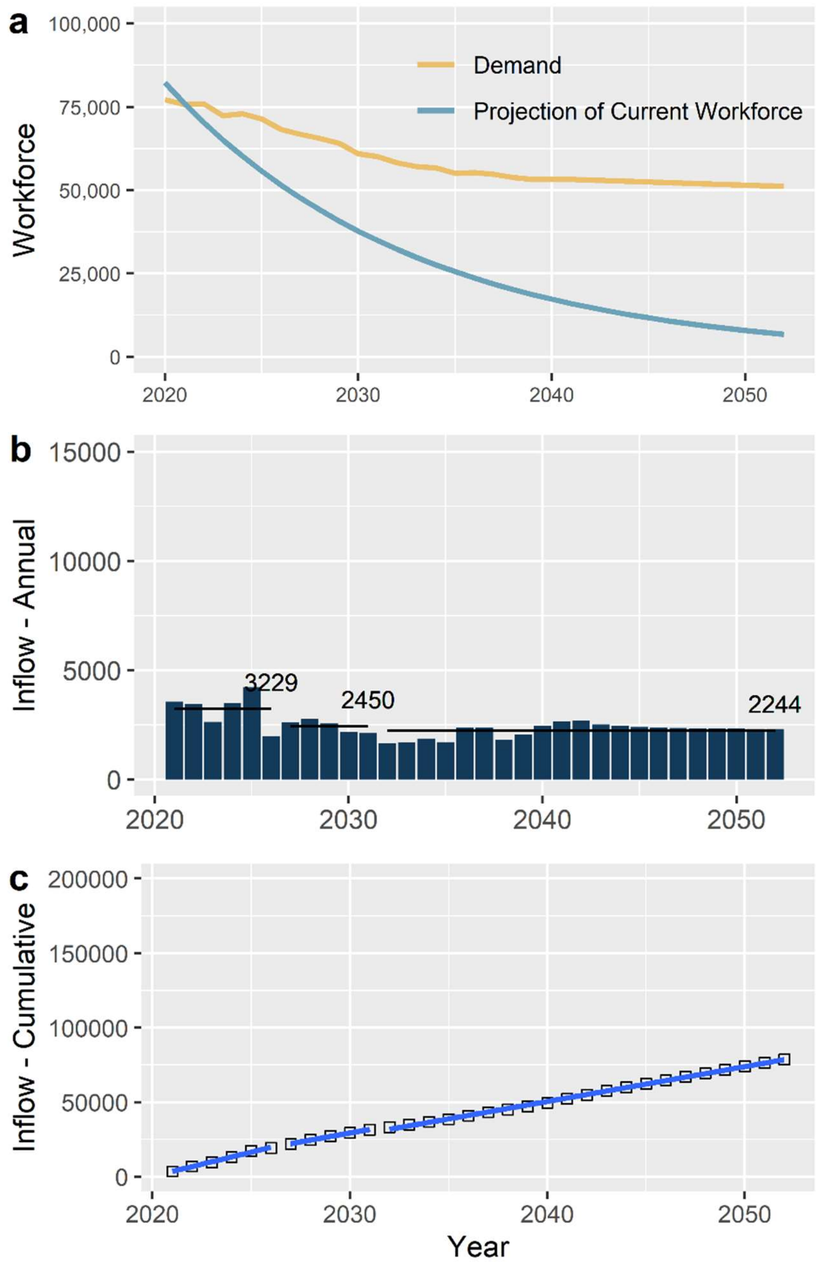

Figure 4 Baseline replacement demand covering only existing decommissioning, operations and necessary support activities

Over the period to 2040 a total of 50,000 FTEs will need to join the industry for some period, even in the baseline case (Figure 4c).

High Scenario (~ 19 GWe by 2050)

The most ambitious scenario is formed from three gigawatt-scale reactors (Hinkley Point C, Sizewell C and a third, to be specified. These are followed by twenty-two Small Modular Reactors (of between 400 MWe and 470 MWe). Sizewell C is assumed to pass the first nuclear concrete milestone in 2023, with the third large-scale plant reaching the same point in 2025. SMR construction begins in 2030, and a new unit beginning construction every two years.

Figure 5a shows the forecast profile of the existing estate. At 2042 a vertical dotted line marks the point beyond which the existing estate forecast has been extended by a linear extrapolation to match the time axis of the new build model.

The new build component itself is shown in Figure 5b, where the construction and operational components are separated out. Occupations and levels are also handled within the model but are not shown in these summary charts.

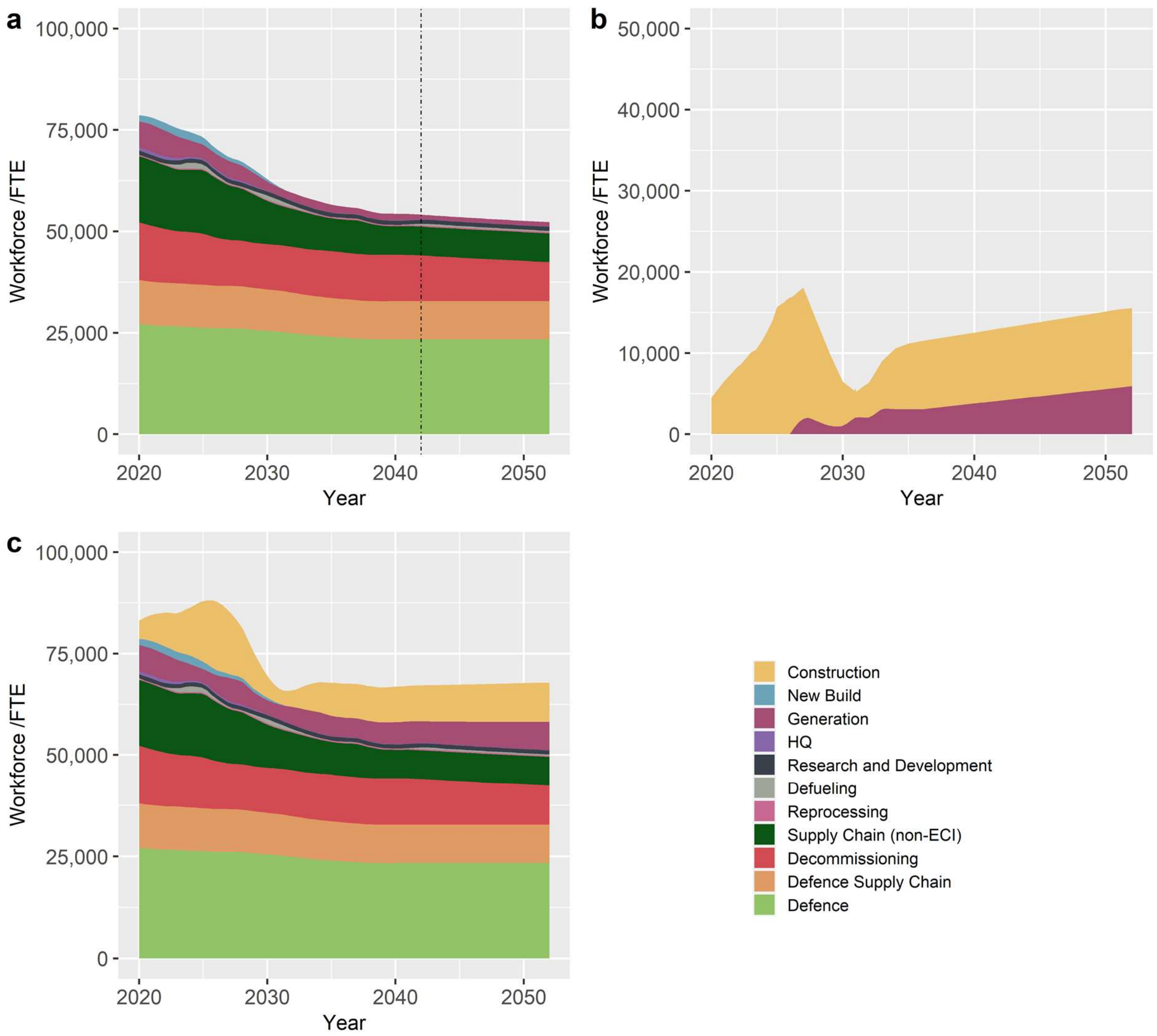

Figure 5 High Scenario demand profile formed from the existing estate and a new civil generation scenario

Figure 5c shows total forecast demand with the new build forecast added to the existing estate. Figure 6 shows the same data but mapped to the site type rather than activity.

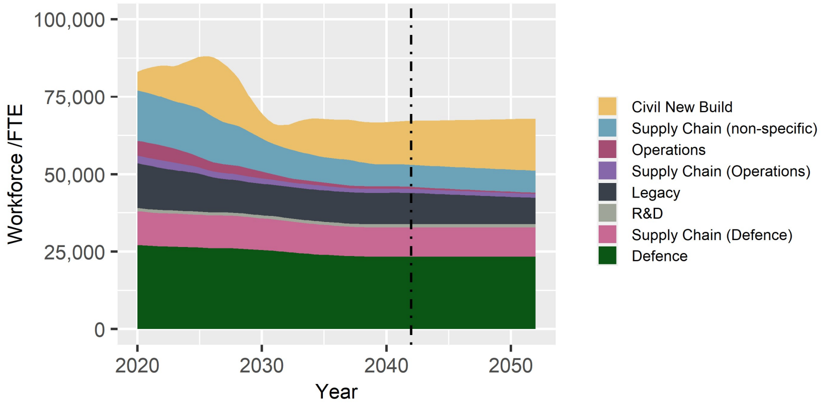

Figure 6 High scenario showing the separation of Civil New build (construction and operations) from Defence and Legacy activities

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Inflow required to meet HIGH scenario demand profile

Demand and the projection of the current workforce for the high scenario are shown in Figure 7a. The calculated year on year inflow to meet demand is shown in Figure 7b.

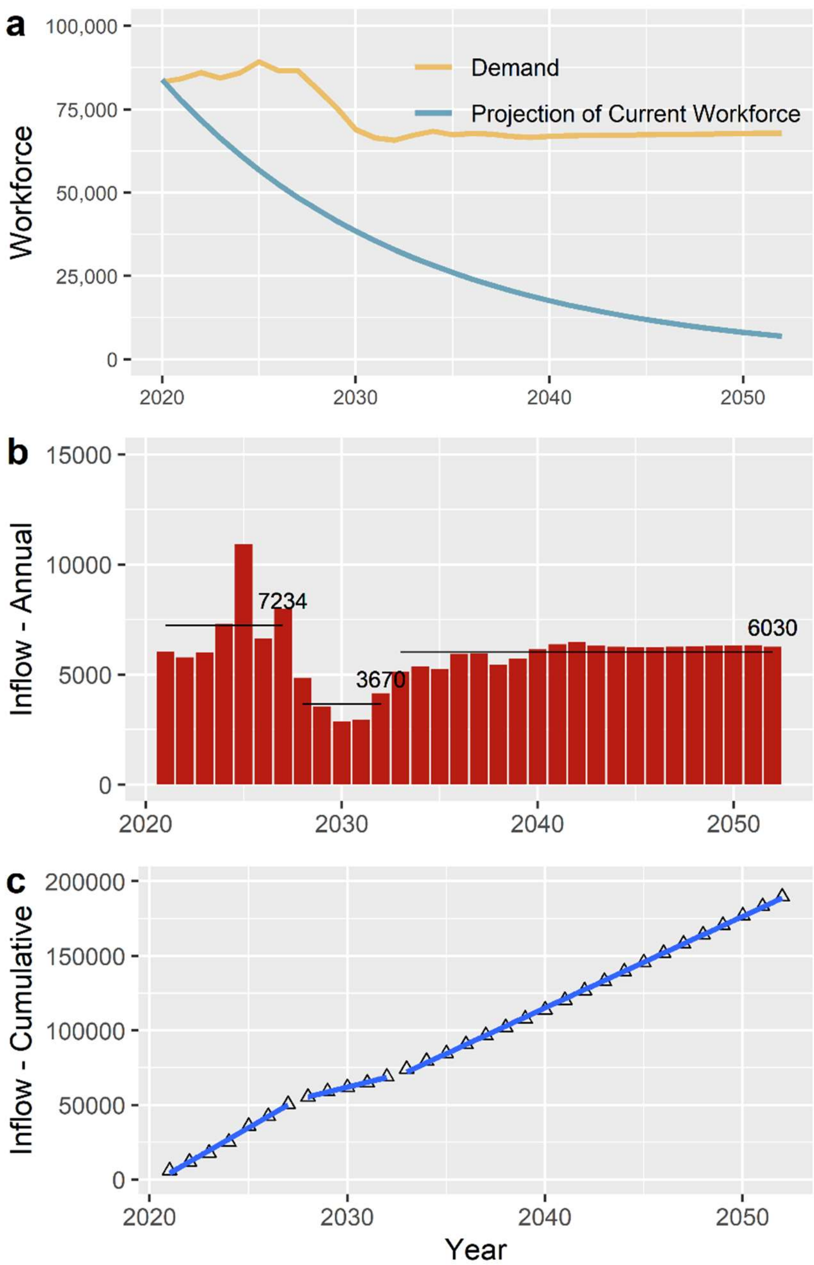


Figure 7 High Scenario. a) Demand and Internal Workforce projection, b) Required inflow to meet demand curve, c) Cumulative inflow to meet demand curve

The High scenario implies a net inflow into the industry of an average of 7234 full time equivalents each year between 2021 and 2027, covering replacement demand, expansion operation demand, and an itinerant construction workforce. This is ~2.2 times the expectation in the baseline. After completion of Hinkley Point C and Sizewell, the inflow falls to an average of 3670 FTEs per year from 2028 to 2032, before increasing again to meet the demand for SMR fabrication and installation beginning in 2030.

It should be noted that the skills required will be different in each of these phases. The first will include a high number of civil construction workers, while beyond 2030 there will be a shift to a greater demand for manufacturing skills.

Medium Scenario (~ 10 GWe)

The medium scenario assumes Hinkley Point C, Sizewell C and 8 Small Modular Reactors. Demand peaks around 2025 and again between 2033 and 2038, before falling back after 2042

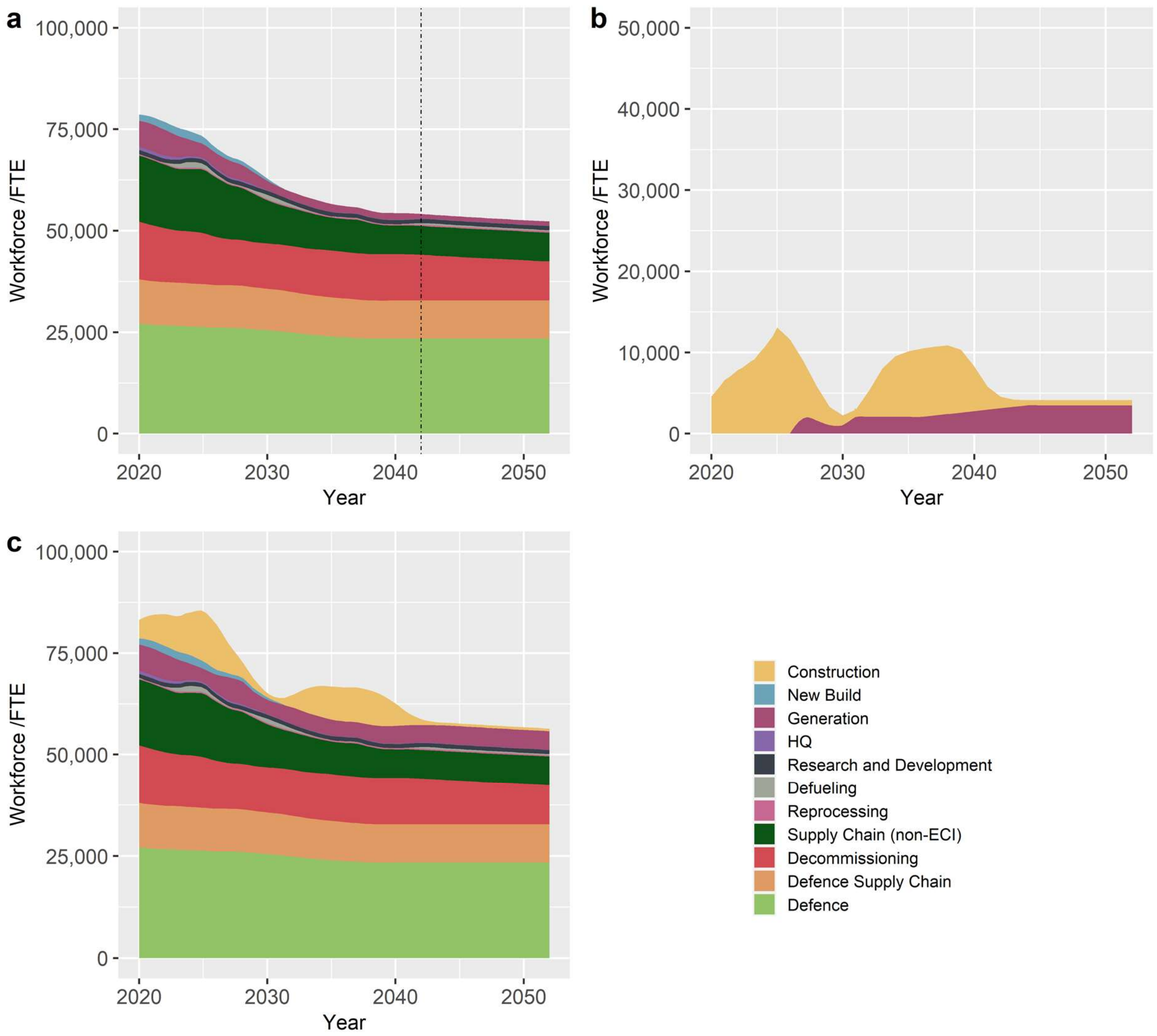


Figure 8 Medium Scenario demand profile formed from the existing estate and a new civil generation scenario

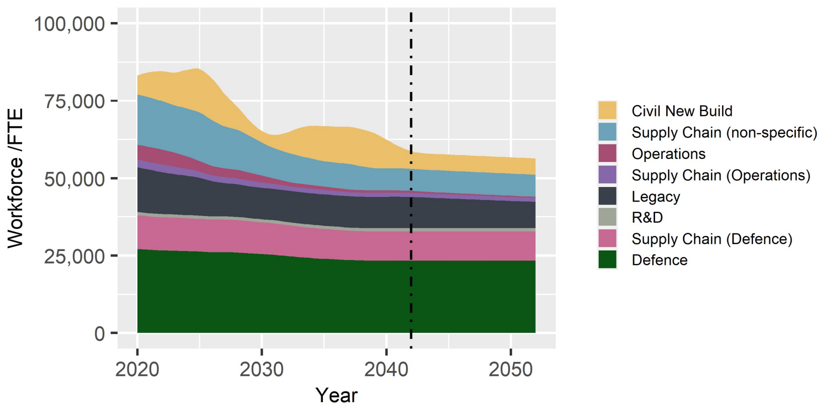


Figure 9 Medium scenario showing the separation of Civil New build (construction and operations) from Defence and Legacy activities

Inflow required to meet MEDIUM scenario demand profile

Demand and the projection of the current workforce for the high scenario are shown in Figure 10a. The calculated year on year inflow to meet demand is shown in Figure 10b.

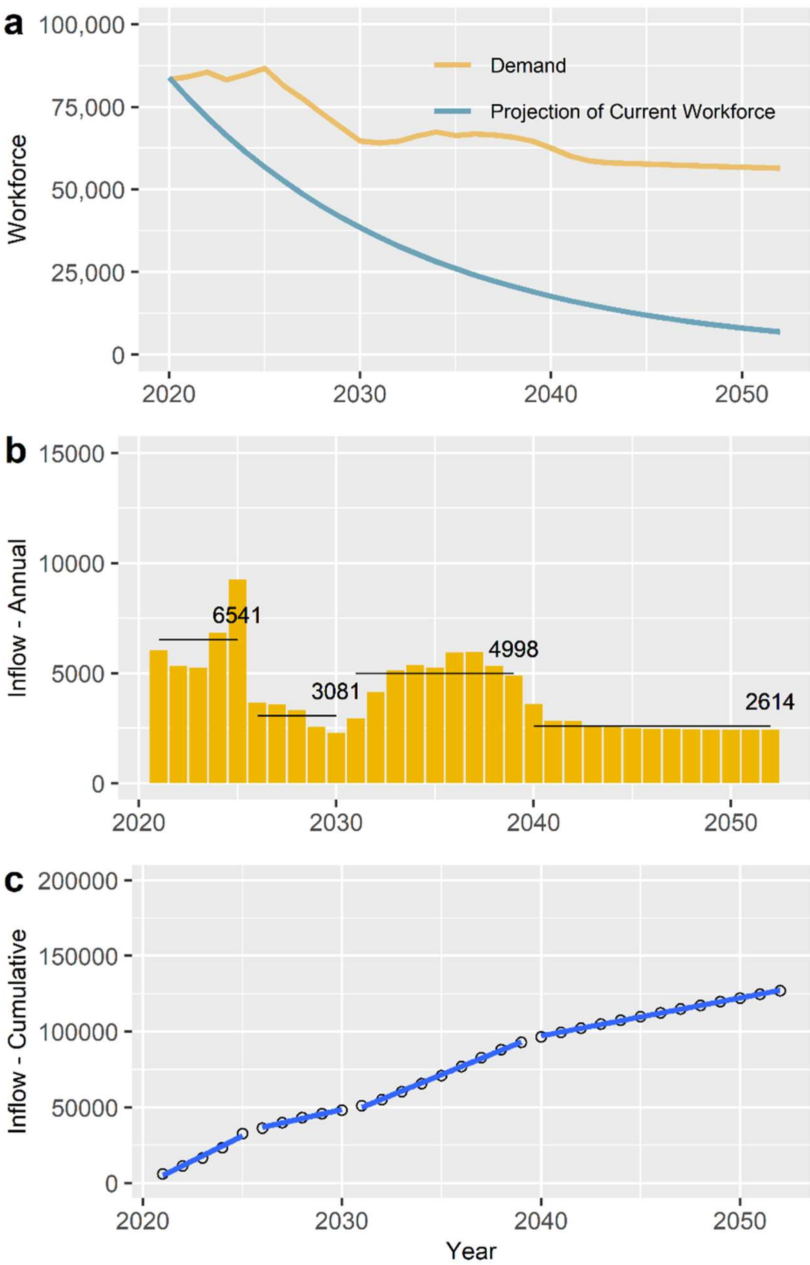


Figure 10 Medium Scenario. a) Demand and Internal Workforce projection, b) Required inflow to meet demand curve, c) Cumulative inflow to meet demand curve

The medium scenario shows four distinct demand phases. The first, from 2021 to 2025, with an inflow of 6541 FTEs per year is twice that of the baseline.

By 2040 a total of around 100,000 FTEs need to be brought into the industry (Figure 10)

Low Scenario (~ 6.4 GWe)

The low scenario assumes that new build is confined to Hinkley Point C and Sizewell C.

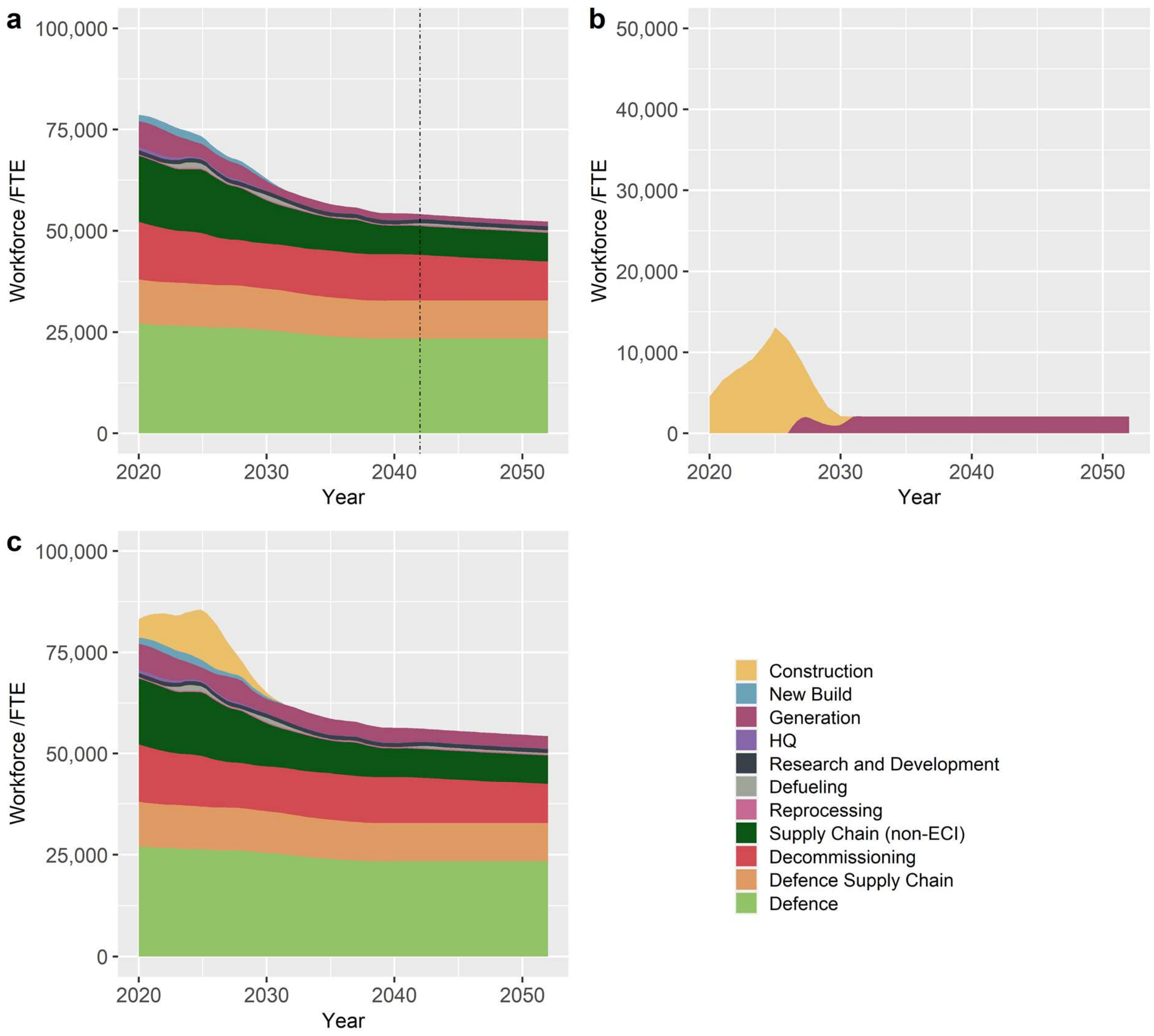


Figure 11 Low Scenario demand profile formed from the existing estate and a new civil generation scenario

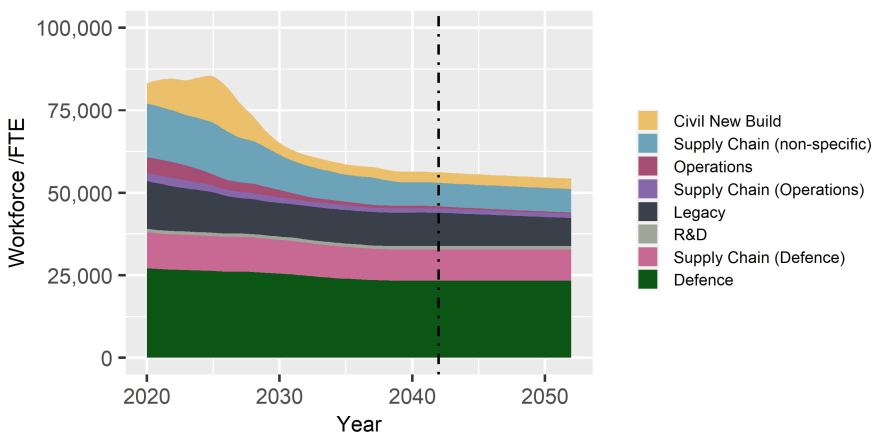


Figure 12 Low Scenario stratified to particulalry distinguish Defence, Legacy, Operations and Civil New Build

Inflow required to meet LOW scenario demand profile

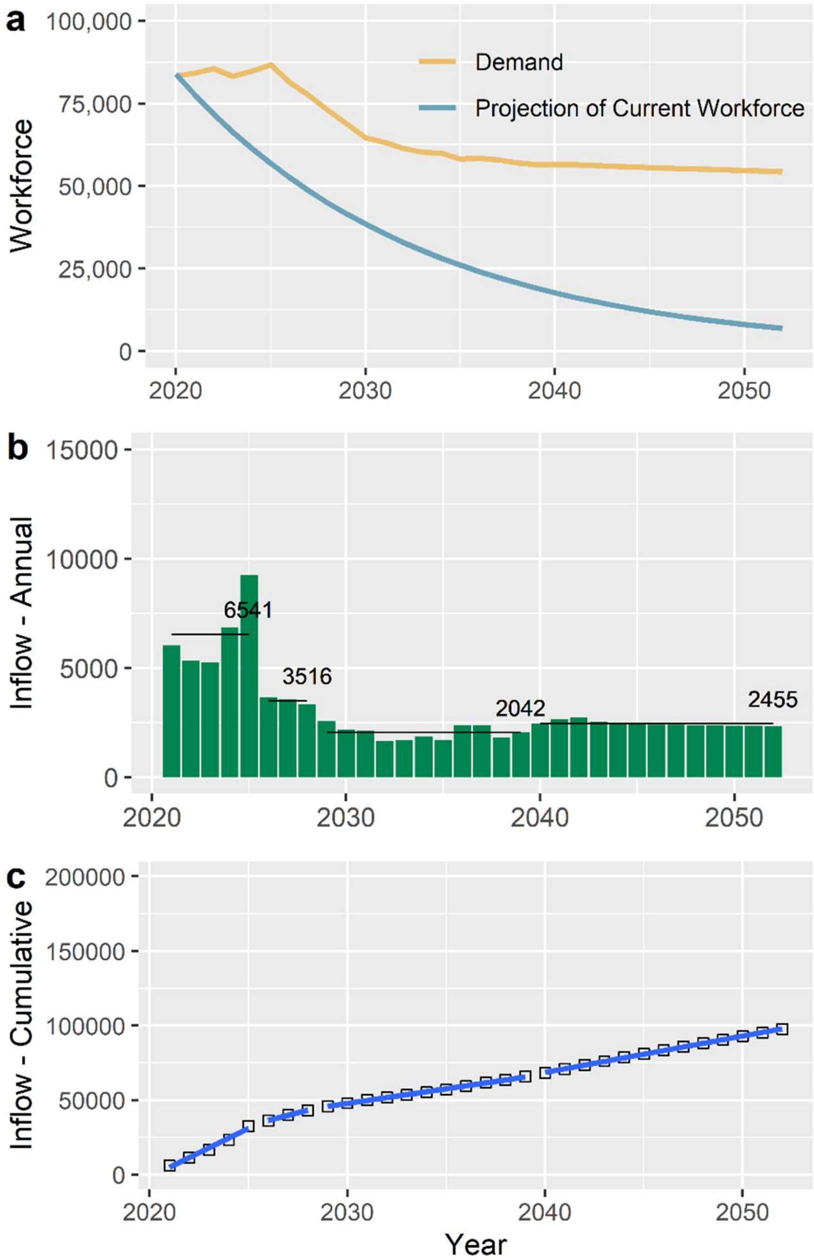


Figure 13 Low Scenario. a) Demand and Internal Workforce projection, b) Required inflow to meet demand curve, c) Cumulative inflow to meet demand curve

Since the first phase from 2021 to 2025 is the same as the medium scenario, the inflow for that period is also just over 6500 FTEs per year, and again around twice the inflow of the baseline scenario. The demand profile suggests a brief three-year period at 3500 FTEs per year, before settling to a long-term recruitment replacement of 2000 to 2500 FTEs per year, similar to the baseline.

Section Summary: Demand

- Three scenarios have been considered with a mix of large scale and SMR covering High (18.4 GWe – 19.9 GWe, Medium (9.6 GWe – 10.2 GWe) and Low (3.2 GWe)
- Baseline required inflow (no civil new build): 3200 per annum to 2026, decreasing in the longer term. Equates to 50,000 cumulative by 2040
- High required inflow: 6000 – 7200 per annum, except for a short period before 2030. Equates to over 100,000 cumulative by 2040
- Medium required inflow: 6500 per annum to 2025 with three distinct phases thereafter. Equates to ~100,000 cumulative by 2040
- Low required inflow: 6500 per annum to 2025. Equates to ~65,000 cumulative by 2040

Meeting the Demand

Replenishing and developing the workforce

The workforce inflows needed to realise the programmed demand will be met by recruitment of experienced hires, who already have much of the experience and knowledge necessary, and trainees (apprentices and graduates) who are part of a programme of developing new talent, and, finally, through reskilling and promotion of existing people in the organisation.

Fragile Skills

In many cases, an increased demand for skills can easily be met by the availability of those skills in the employment market. In these areas, no particular intervention is required, unless supply becomes more challenged. Where the supply against a particular demand is more challenging, we label these as ‘fragile skills’. Work is on-going to identify fragile skills throughout the industry, using heatmaps (Appendix 1) that combine the degree to which nuclear activities have a critical demand for the skill (and the immediacy of that demand), with the extent to which skills are available in the labour market in the right time frame. Skills currently viewed as of particular concern are:

Nuclear Construction Workforce

- Civil Engineers
- Pipe welders
- Pipe fitters
- Mechanical fitters
- Construction trade supervisors
- Electricians
- NDT Technicians
- Plate welders
- Engineering Construction Welders
- Engineering Project Managers
- Logistics
- Project Quantity Surveyor
- Chargehand Riggers
- Lifting Supervisors
- Engineering Construction Ops Cabling
- Lifting supervisors
- Project planners/managers Schedulers

Nuclear operations and decommissioning

- Control and instrumentation engineers
- Cyber Security Specialists
- Mechanical Engineers
- Project planners/managers
- Safety Case Authors
- Reactor operators
- Nuclear Engineers

Subject Matter Experts

Subject Matter Experts are defined as previously: Personnel with authority in a specific work area developed through 10 or more years' experience of the subject. Typically, they will have high-level authority to sign off plans-for-work and documents verifying safe completion. They are likely to hold the highest technical knowledge for that subject in the organisation. SMEs do not necessarily have the highest educational qualification or hold senior managerial positions. In some organisations, these are known as 'Heads of Profession', in others 'Professional Leads' or 'Intelligent Customer'. The key is those individuals where loss of a Subject Matter Expert's knowledge would cause a serious disruption to the organisations work programme.

Table 2 shows the number of Subject Matter Experts most recently reported. A more detailed breakdown can be found in Appendix 2. The total is around 7% lower than the figure reported in NWA 2019.

The data are provided by NSSG members, and so exclude academics and SMEs within the wider supply chain. We have previously estimated that this represents approximately three-quarters of the true figure.

Function	SMEs
Business Functions	131
Engineering	118
Operations	78
Project and Programme Management	48
Science Technical Health Safety & Environment	105
Trades	2
Total	482

Table 2 Subject Matter Experts by Function

The Structure and Gender Balance of the Existing Workforce

The following sections summarise data covering the current workforce, trainees embedded within the reporting organisations, and recruitment of new staff, and trainees.

Gender balance is particular focus as part of a broader efforts to improve Equality, Diversity and Inclusion (EDI). However, it needs to be seen in the context of the workforce structure more generally, and so in the following sections data is presented alongside other workforce structural measures such as age and level.

The gender balance and the opportunities to improve it need to be understood by viewing both the fraction of women in a particular grouping, and the weighting of that group. Figure 14 shows the workforce by age in terms of the whole workforce distribution (Panel A), and the fraction of each age band populated by women (Panel B). For example, Women under 20 years (Civil and Defence combined) form 29.3% of that age band (Panel B – All), but the age band as a whole is only 1.6% of the workforce (Panel A – All). So, while a better than average gender balance in younger age groups is a positive sign, generally it has little impact on the headline figure of 20.0%.

At the other end of age range, the age bands 50-54 and 55-59 are under 20.0% female, while accounting for 27% of the workforce between them.

Age and the Retirement Pipeline

The nuclear workforce is generally regarded as ageing. Across both sectors over a third of the workforce (35.2%) is aged 50 or over, with 8.1% aged 60 or over. In Panel A of Figure 14 the peak in the civil workforce between ages 50 and 59 is clear

Figure 14 Age. Panel A shows the age distribution for the whole workforce as a percentage of the total. Panel B shows the participation of women within age bands Total population: 49739

STEM and non-STEM Occupations by Gender

The balance between women working in STEM fields and non-STEM field workforce shows that in technical fields the female workforce is lower at 14.1%.

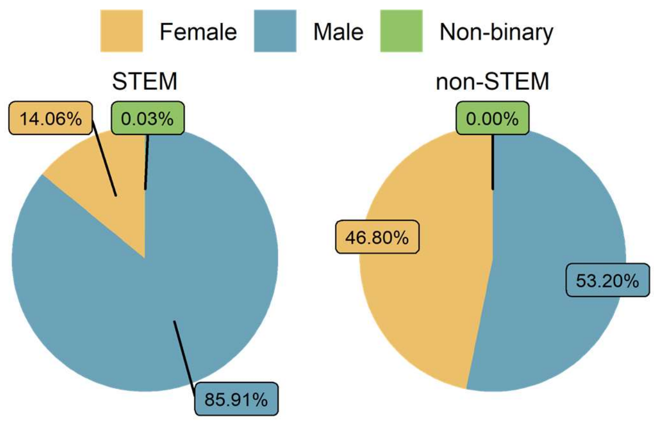


Figure 15 Female participation in STEM and non-STEM areas

This report shows the first data for those leaving roles in a 12 month period, and gives some indication of the rate of staff turnover, and how the rate changes with age and gender. Only data from the Civil sector was available.

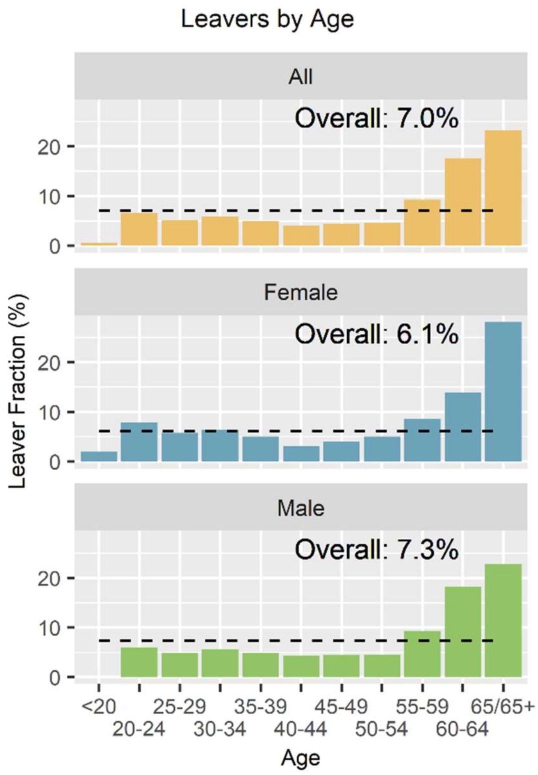


Figure 16 Fraction of the workforce leaving within the preceding 12 months (Civil Only). Total population: 1761

Overall 7% of the staff in organisations reporting (a population of close to 25,000) left posts. Since the destination of leavers is not known, this does not necessarily mean that 7% were lost to the industry. Clearly in the age bands 55-59 and above, the majority of attrition is due to retirement. Below 55 the attrition rate falls to 4.8%, but again the rate lost to the the industry will be lower.

A significant difference is evident between Males (7.3%) and Females (6.1%), reflecting fewer women in the retirement age band 55+ (Figure 14).

Role Level

Figure 17 Workforce by Role Level. Total population: 49739

Figure 17 shows the distribution of the workforce by role level. Women are better represented at level 1 and levels 3 and 4. As reported in NWA 2019, there is a notable worsening of the gender balance at levels 7 and 8, and among Subject Matter Experts. Levels represent the experience required for a role/educational level and as such can be an indicator of seniority. Higher proportions at level 3 in the civil sector reflect administrative roles. Work to achieve gender balanced recruitment must consider all types of role (STEM and non-STEM) and at all levels.

Function

Figure 18 Workforce by Function. Total population: 49739

Largely unchanged from previous reports, and consistent with the better gender balance in non-STEM areas, the business function supports over 40% female workers (Figure 18, Panel B) in civil and defence sectors, but accounts for under 20% of the workforce (Figure 18, Panel A). Engineering is particularly low at 7.5% while forming over one third of the workforce (34.5%).

Training

Data for those employed in training roles that form the internal pipeline are shown in Figure 19, Figure 20 and Figure 21, including gender balance by Level, Type (Framework, Standard or Degree) and mapped to Function. Overall, 27.4% of trainees were female (19.9% Defence, 31.3% Civil).

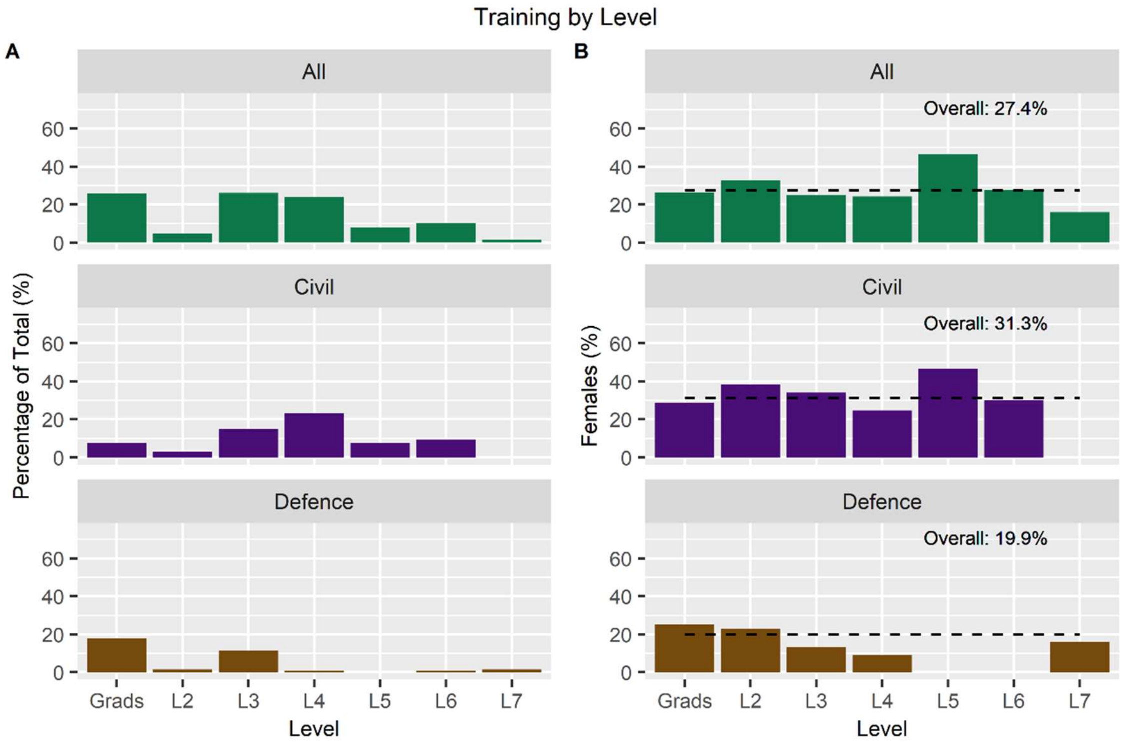


Figure 19 Training by Level. Total population: 1583

Most civil sector trainees are at graduate and levels 3 and 4. Defence shows a large fraction of graduates and level 3 trainees. Overall, 27.4% of trainees are female, more balanced than the general workforce, but it should be borne in mind that this pipeline is much smaller than workforce it feeds into, and that the percentage margin is not large. Trainees in the Civil Sector at 31.3% is higher than for (civil) recruitment discussed below.

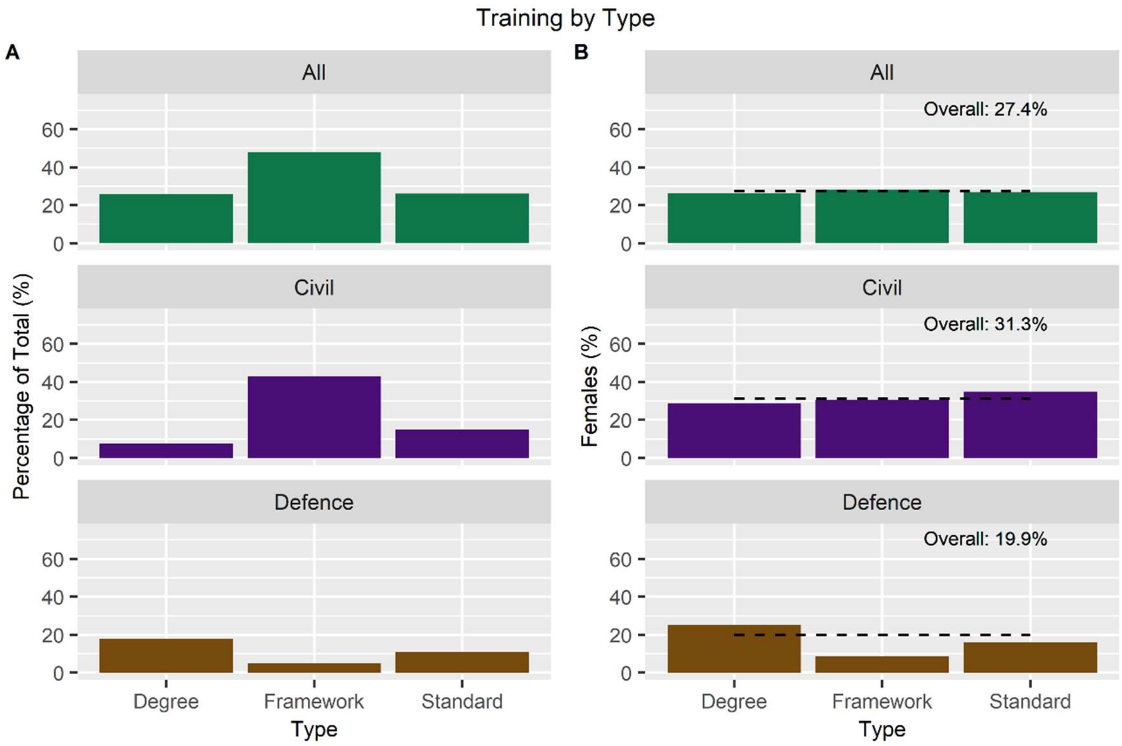


Figure 20 Training by Training Type (Apprenticeship or Degree). Total population: 1583

Figure 20 shows current trainees by Apprenticeship (Frameworks and Standards) and Degree. Apprenticeships represent over 70% of all trainees. Interestingly the gender balance in the Defence sector is better for graduates than for those following an apprenticeship route. This may be related to roles and their historical gender biases. For the Civil sector there is little variation between the different routes.

Figure 21 Training mapped to Function. Total population: 1583

Figure 21 shows the distribution of trainees by function, with nearly half engaged in engineering activities. The most area gender balanced areas are business, project management and operations in line with the workforce generally.

More information on apprentices and particular frameworks and standards is available in the Nuclear Apprenticeship Survey 2020-21[2]

Recruitment

Recruitment is not only the route to meeting demand, but ultimately it determines how quickly, and to what limit, the workforce is able to become more diverse. Data received for this report shows females made up 29.6% of all recruitment, reduced somewhat from 33% in 2019. It should be noted that the sample is limited to a subset of civil recruitment, and so is likely to be subject to some variation.

Recruitment by Function

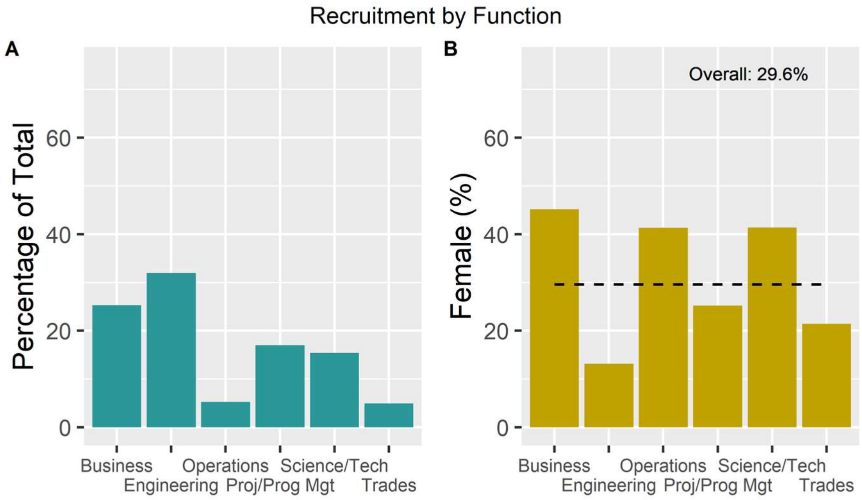


Figure 22 Recruitment by Function

Figure 22 shows civil recruitment across functions. Business and Engineering account for over half of all recruitment and represent opposite ends of the gender balance spectrum (Figure 22b).

[2] https://www.nssguk.com/media/2723/nuclear-apprenticeship-survey-2020-21-final.pdf

Recruitment by Source

Figure 23 Recruitment by source

Figure 23 shows that recruitment from outside of nuclear (which is the majority of that reported) shows a marginally poorer gender balance than from within. This is offset to some extent by new workers (apprentices and graduates) but is, if anything working against improving the balance. This is perhaps not surprising, since many experienced-hires will have come from other engineering industries that have also historically been male dominated.

Gender

The gender balance of the workforce is an important aspect of wider considerations of equality and diversity. A target of 40% female participation in the workforce was set in the government strategy document, “Sustaining Our Nuclear Skills” (2015), continued in the Nuclear Sector Deal and remains an important measure.

Rebalancing gender depends on workforce turnover. It is only through the replacement of leavers with balanced recruitment that the make-up of the workforce can change at all. Attrition, expansion and female recruitment rates all contribute to the rate at which the gender balance improves. But gender balance in recruitment, also sets an upper limit for the long-term position. If the rate never exceeds 35%, for example, the long term established workforce cannot exceed 35% either.

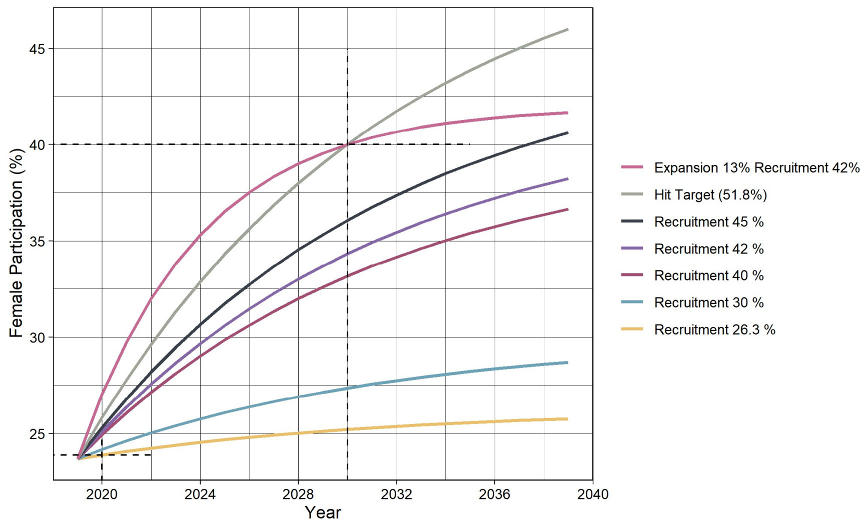


Figure 24 Projections of future gender balance based different recruitment rates, assuming an attrition rate of 7%

Figure 24 shows a range of projections based on different recruitment rates, and assuming 7% attrition. Only those curves with female recruitment above 40% will cross the 40% target line.

Progress towards the 40% target faces two limits currently: 1) the rate of turnover (attrition/expansion) and 2) the gender balance in recruitment. The low value of the former (7%) means that that opportunity in any one year is quite small. The latter is the (current) long-term ceiling. Although apprentice recruitment is 38.7% and in training it is 27.4%, among experienced hires the level is only 26.9% (see Table 3 Summary of Gender data for a summary of the key gender statistics).

Area	Group	Female Fraction
Current Workforce	Civil	23.7%
	Defence	16.8%
	All	20.0%
STEM Status	non-STEM	46.8%
	STEM	14.1%
	All	20.0%
Leaver fraction	All	7.0%
	Female	6.1%
	Male	7.3%
Degree	Female	26.4%
Framework	Female	28.3%
Standard	Female	26.9%
Apprenticeships Combined	Female	27.8%
All trainees	Female	27.4%
Recruitment	Apprenticeship	38.7%
	Graduate	33.3%
	Staff	26.9%
	All	29.6%

Table 3 Summary of Gender data

Section Summary: Meeting the Demand

- More than a third of the workforce (35.2%) is aged 50 or over, with 8.1% aged 60 or over
- 482 Subject Matter Experts recorded (~650 including academics and the supply chain). Reduced
- Women in the workforce remaining pinned at 20% (Defence 16.8%, Civil 23.7%)
- In the STEM workforce 14% are female
- 7% of the of the civil workforce for which data was provided left posts
- In training 27.4% are female, above that for the main workforce
- In recruitment 29.6% are female

Conclusion

The pressing need to develop and implement technologies that in combination will meet the net zero greenhouse gas emissions target, creates a wealth of nuclear skills challenges and opportunities. Ongoing defence demands are long-term and well planned in their own right, but overlap with an evolving civil picture.

The nuclear workforce remains for now predominantly male, and with more than a fifth of the workforce over 55. A more diverse workforce is a priority not only in terms of gender. Efforts are underway to gather consistent and accurate ethnicity data across a range of organisations.

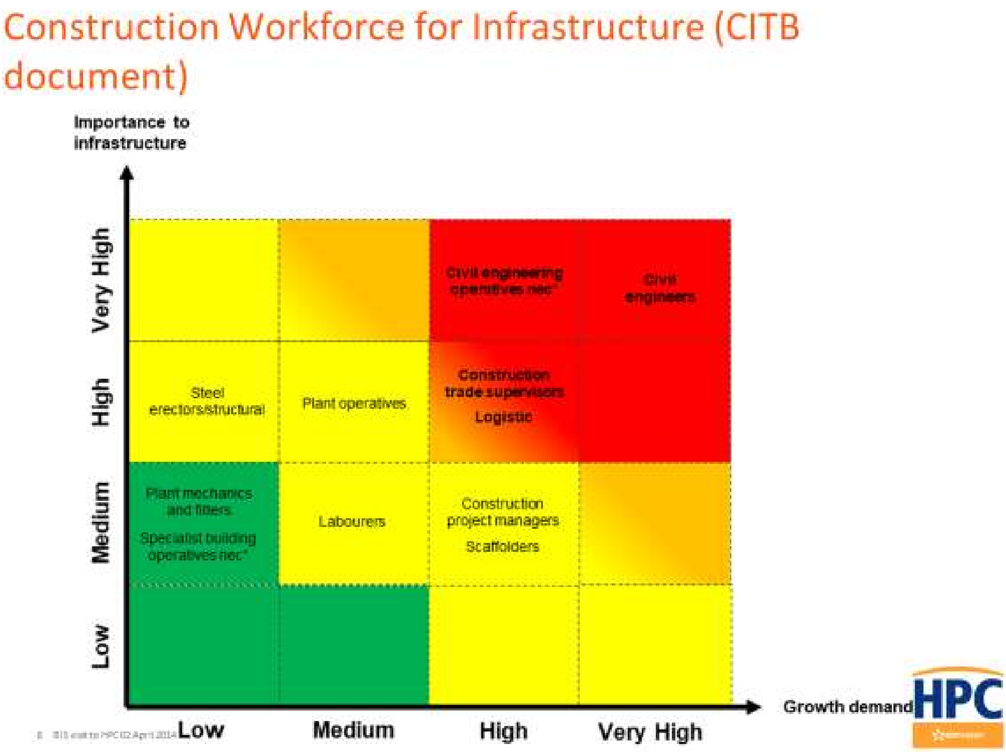
Despite an active and developing programme led by Women In Nuclear, movement towards a more gender balanced workforce is inevitably difficult without considerable expansion. Turnover is only 7.5% per year, and three-quarters of that is of experienced hires that are likely to come from industries with a similar gender profile. Apprenticeship and Graduate recruitment show that there has certainly been a shift from the historical trend in the number of women entering the industry at the start of their careers. Nevertheless, at 38.7% and 33.3% respectively, work remains to be done to get close to the target of 40% female participation.

Expansion of the workforce provides one the best opportunities to develop a more diverse workforce, and will be essential in providing the increase in reliable low-carbon power generation needed to meet the net zero target. This report considered three scenarios, including the first incorporation of an SMR workforce. While a more accurate analysis will require the input of SMR developers, both in terms of establishing workforce levels and defining key skills, this still provides a useful and unique insight into the likely required workforce demand.

In the short and medium term, the inflow into the industry will need to increase by between 1.25 and 2.5 times the baseline (replacement) demand. However, fragile skills present a challenge that is independent of increases in total demand. These are occupations for which shortages have the capacity to delay work, and for which it may also prove difficult to source additional supply from the wider employment market, without careful monitoring and appropriate interventions.

Appendix 1

Example Heat Map



Appendix 2

Subject Matter Experts

Function/Resource code	SMEs
Business Functions	**131**
Executive & Strategy	59
Commercial Contracts	14
Human Resources	10
Health and Safety - Occupational Health	7
Training	6
Commercial Procurement	5
PR and Comms	5
Administrators	4
Finance	4
Business Security	3
IT and Telecoms	3
Human and Organisation Capability	3
Trading	2
Modelling & Analysis	2

Knowledge Management	2
Emergency Planning	1
Legal	1
Engineering	**118**
Other Engineers (including non-specific)	32
Nuclear Safety Case Preparation	28
Maintenance Engineers	21
Control and Instrumentation Engineers	11
Regulation Site Inspection	11
Mechanical Engineers	5
Civil and Structural Engineers	3
Electrical Engineers	2
Design Engineers (Mechanical)	2
Construction Engineers	1
Nuclear Criticality and Shielding	1
Commissioning Engineers	1
Operations	**78**
Generation	58
Process Engineers	9
Waste Management	5
Decommissioning	3
Post Irradiation Examination	2
Nuclear Materials Accountancy and Control	1
Project and Programme Management	**48**
Project Management	23
Programme Management	14
Project Planning and Control	10
Construction Management	1
Science Technical Health Safety & Environment	**105**
Health and Safety - Radiological Protection	19
Operational Research	17
Industrial Health & Safety	12
Environmental Science Geology Hydrology and Modelling	12
Physicists	9
Chemists	9
Material Science	8
Health and Safety Regulation	7
Quality Assurance	5
Analytical Sciences	2
Chemical Engineers	2
Research Facility Operators	2
Fuel Scientists	1
Trades	**2**
Supervisors	2
Total	**482**

Appendix 3

Retirement pipeline

Age	Fraction
65 and Over	1.7%
60-64	8.1%
55-59	21.2%
50-54	35.2%
45-49	47.2%
40-44	57.1%
35-39	68.3%
30-34	80.0%
25-29	91.7%
20-24	98.4%
19 and Under	100.0%

Table 4 Retirement pipeline - cumulative age distribution

Age	Female	Male	Non-binary
65 and Over	0.6%	2.0%	0.0%
60-64	4.4%	9.0%	0.0%
55-59	14.6%	22.9%	0.0%
50-54	27.6%	37.1%	0.0%
45-49	41.1%	48.7%	16.7%
40-44	52.3%	58.3%	16.7%
35-39	64.3%	69.3%	33.3%
30-34	77.0%	80.8%	58.3%
25-29	89.4%	92.3%	66.7%
20-24	97.7%	98.6%	66.7%
19 and Under	100.0%	100.0%	100.0%

Table 5 Retirement pipeline - cumulative age distribution by gender

Appendix 4

Sites Supplying Workforce Data

Site	Organisation
Defence NW	Defence
Defence Scotland	Defence
Defence SE	Defence
Defence SW	Defence
DSRL	DSRL
Barnwood	EDF
Dungeness B	EDF
East Kilbride	EDF
Hartlepool	EDF
Heysham 1	EDF
Heysham 2	EDF
Hinkley Point B	EDF
Hunterston B	EDF
Sizewell B	EDF
Torness	EDF
Hinkley Point C Ops	HPC Client
LLWR	LLWR
Berkeley Site	Magnox
Chapelcross Site	Magnox
Dungeness A	Magnox
Harwell Site	Magnox
Hinkley Site	Magnox
Hunterston Site	Magnox
Magnox Support Office - OTC	Magnox
Oldbury Site	Magnox
Sizewell A Site	Magnox
Trawsfynydd Site	Magnox
Winfrith	Magnox
Wylfa Site	Magnox
NNL Chadwick	NNL
NNL Culham	NNL
NNL Preston	NNL
NNL Sellafield	NNL
NNL Stonehouse	NNL
NNL Windscale	NNL
NNL Workington	NNL
Risley	Sellafield Limited
Sellafield Limited	Sellafield Limited
Sizewell C	SZC Client

Table 6 Sites Supplying Workforce data

Appendix 5

Sites providing Leaver Data

Leaver_Sites
Barnwood
Berkeley Site
Chapelcross Site
DSRL
Dungeness A
Dungeness B
East Kilbride
Hartlepool
Harwell Site
Heysham 1
Heysham 2
Hinkley Point B
Hinkley Point C Ops
Hinkley Site
Hunterston B
Hunterston Site
LLWR
Magnox Support Office - OTC
NNL Chadwick
NNL Culham
NNL Preston
NNL Sellafield
NNL Stonehouse
NNL Windscale
NNL Workington
Oldbury Site
Risley
Sellafield Limited
Sizewell A Site
Sizewell B
Sizewell C
Torness
Trawsfynydd Site
Winfrith
Wylfa Site

Table 7 Sites providing leaver data

Appendix 6

Sites providing recruitment data

Site	Organisation
DSRL	DSRL
Hinkley_Point_C_Ops	HPC Client
LLWR	LLWR
NNL Chadwick	NNL
NNL Culham	NNL
NNL Preston	NNL
NNL Sellafield	NNL
NNL Stonehouse	NNL
NNL Windscale	NNL
NNL Workington	NNL
nucleargraduates	nucleargraduates
Risley	Sellafield Limited
Sellafield Limited	Sellafield Limited

Table 8 Sites providing recruitment data

Appendix 7

Principal UK Nuclear Sites 2020

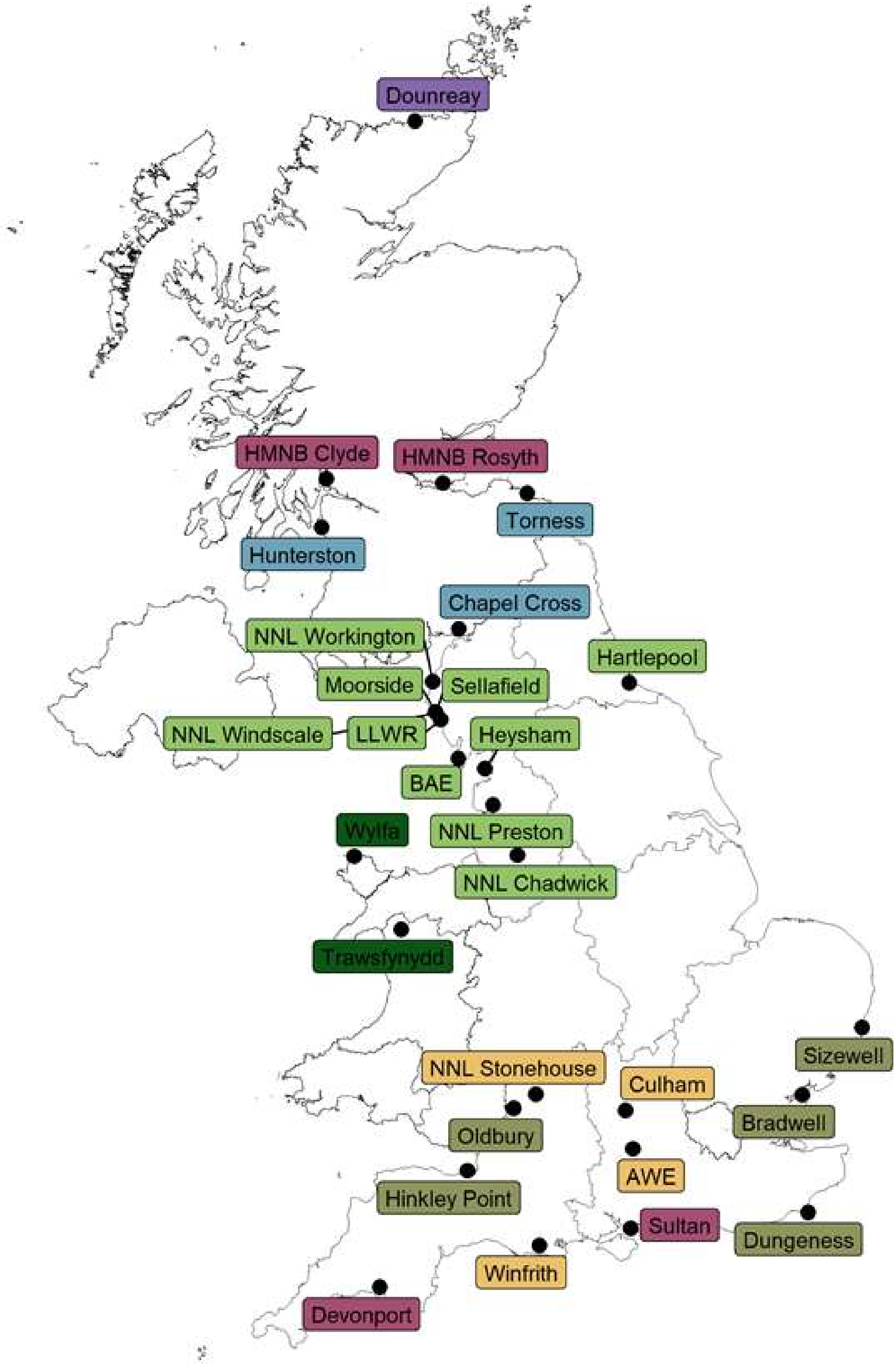


Figure 25 Nuclear sites with data with directly represented data. The extended supply chain is modelled from planned spend profiles. One large-scale generating plant is under construction at Hinkley Point with a second similar project expected at Sizewell (Sizewell C)

Appendix 8

SMR Model Version 1

There is currently a lack of specific SMR workforce information. This situation will improve, but in the meantime the following working assumption models have been used, based on industry-based assumptions. The location of the skills (at site or within a manufacturing plant) is not defined here.

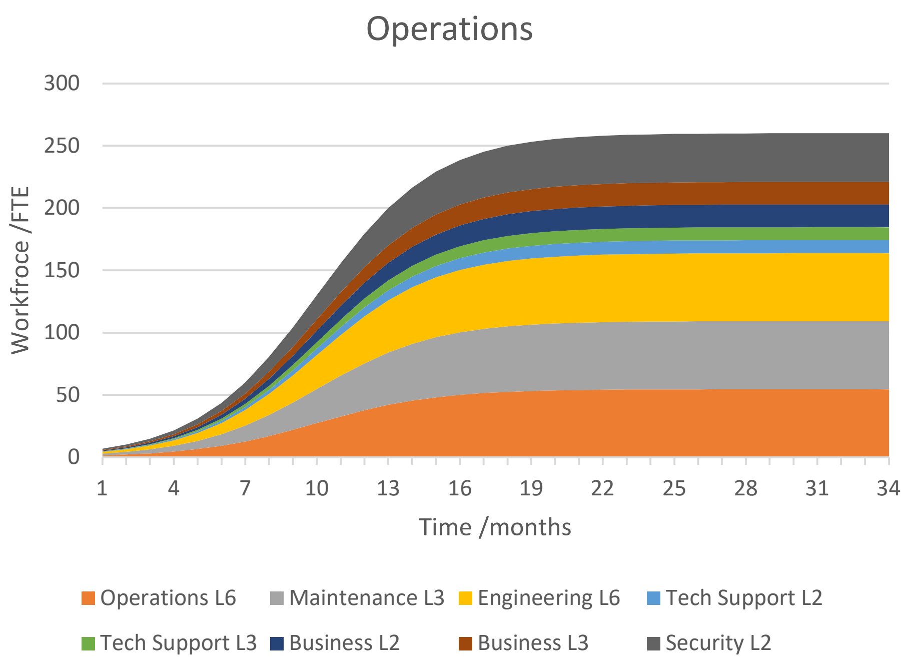


Figure 26 SMR models used in the Dynamic Workforce Model