Economic Insight

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ECONOMIC IMPACT ASSESSMENT OF MAGNOX SITES

A report for the Nuclear Decommissioning Authority

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1. Executive summary

The Nuclear Decommissioning Authority (NDA) asked Economic Insight to conduct an assessment of the economic impact of the 12 Magnox sites on their local economies. As set out in this document, we find that there are considerable differences in terms of the current impacts of sites, and there are good reasons to believe there will be variation in the future impact of sites.

The UK civil nuclear sector is a key contributor to the delivery of a modern industrial strategy: supporting clean growth, improved productivity and a lasting contribution to host communities, delivered by a highly skilled workforce deploying skills and technology which are valued around the world. This was recognised recently by Government through the Nuclear Sector Deal, agreed in June 2018. The NDA was established to ensure that the UK's civil nuclear legacy sites are decommissioned safely, securely, cost-effectively, and in ways that protect people and the environment. As set out in the Energy Act (2004), the NDA has a statutory function of supporting activities that benefit the social or economic life of communities living near sites. Furthermore, the NDA has set itself a strategic objective to support the maintenance of sustainable local economies for communities living near its sites, and where possible to contribute to regional economic growth objectives.

To support the NDA in meeting its socio-economic objective, it asked Economic Insight to conduct an economic impact assessment of the 12 Magnox sites. In particular, the aim of the study is to better understand both the current and potential future impact of sites on their local communities. This work will help the NDA in prioritising the socio-economic support that it gives to local areas.

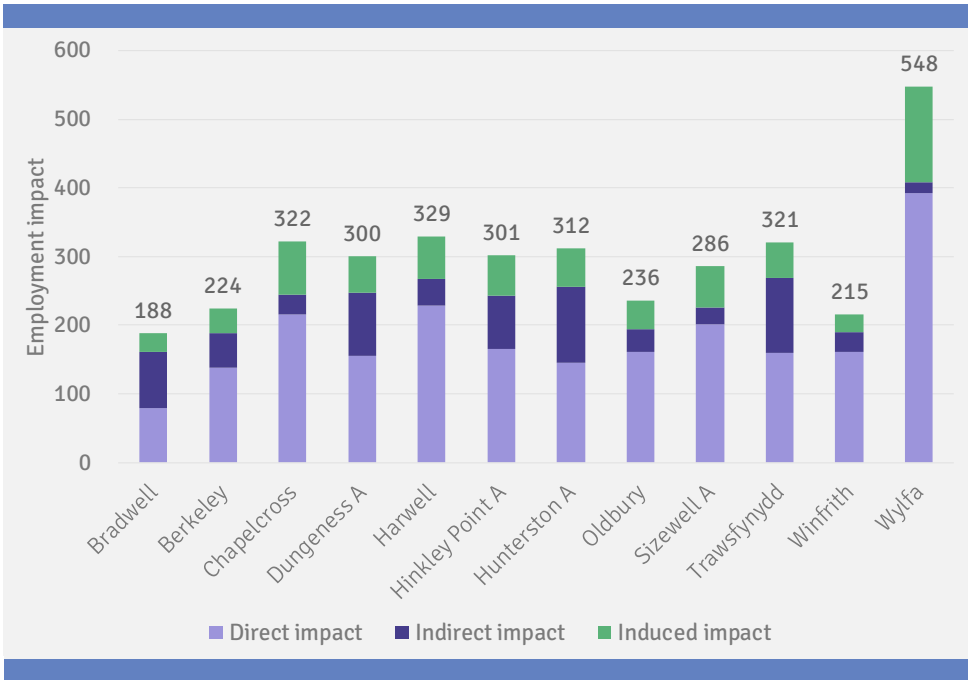
In the sections below, we summarise our key findings.

The Magnox sites currently make sizable, but varying, contributions to their local economies in terms of employment, GVA, and tax receipts

Based on data provided by the NDA and Magnox, and our in-house model of the UK economy, we have estimated the current economic impact of the Magnox sites on their local economies in terms of employment, Gross Value Added (GVA) and tax receipts. We have included direct, indirect (supply chain), and induced (wage) effects.

The following figure shows our estimate of the employment supported by each site in its local area (defined here as the local authority district in which the site is located, and those adjacent to it).[1]

Figure 1: Employment effects within each site's local authroity district and those adjacent



Source: Economic Insight analysis

A similar pattern is observed in terms of the relative magnitudes of the local impacts of sites when measured in terms of GVA and tax receipts. For example, the highest local GVA impact comes from Wylfa (£39m), and the lowest from Bradwell (£12m).

We find that the main channel through which local impacts arise is through direct employment at the sites. This is because:

- The sites provide jobs for people living in the local areas; and employees subsequently support further jobs and economic activity through spending their wages – which are above national averages – in local areas. The majority of employees live in the local authority district that their site is located in, or those adjacent to it. As such, employment effects are relatively concentrated in the local economies.

- Whereas, Magnox sites purchase a relatively small amount of their inputs from local suppliers (although it can equate to hundreds of thousands of pounds). The sites' supply chains typically consist of UK companies located elsewhere in the country, with a small proportion of inputs coming from abroad. As such, the impact of sites on their local economies that arise through supply chains (the indirect impact in the above figure) is smaller in comparison to the impact arising through direct employment (which in turn leads to induced impacts, as shown in the above figure). Some sites have more notable indirect employment effects on

[1] There is no single 'best' geographic definition of a site's local area. We have focussed on sites' local authority districts and those adjacent to them. This reflects: the spread of where employees live; where suppliers are based; and the availability of data.

their local area because there are significant numbers of on-site contractors. For example, Bradwell has about the same number of direct employees as on-site contractors.

The operational phase that a site is in affects the scale of economic activities at the site, and therefore its contribution to the local economy. Furthermore, it could reasonably be expected that the sites would have had a greater economic impact whilst they were operational.

The Magnox sites currently account for a relatively small, but not insignificant, proportion of economic activity in their local economies

To put the above figures into context, we have calculated the sites' contribution to economic activity in their local areas. Total jobs supported by a site in its local authority district range from 0.1% (Oldbury) to 1.9% (Wylfa) of all jobs in the site's local authority district. Sites account for a slightly higher proportion of GVA in their local authority districts because they undertake relatively high value work. Wylfa makes the largest GVA contribution relative to its local authority district, at 3.9%.

Our evaluation of the strength of local areas, and their dependence on sites, gives an initial indication of where socio-economic support may be most impactful

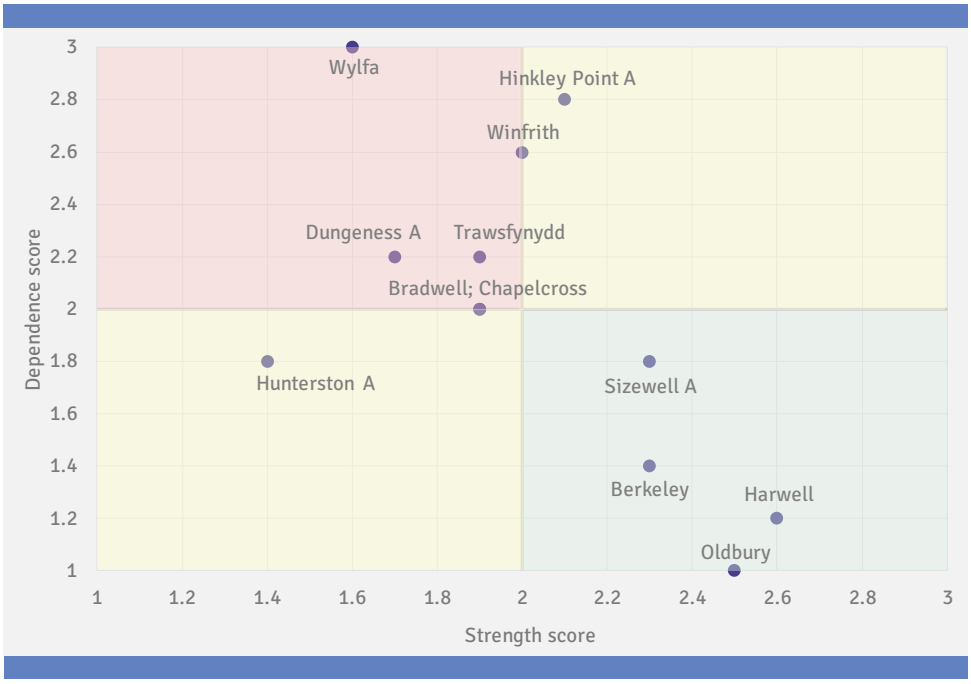
Further to quantifying the current economic impacts, we have assessed the current strength of sites' local economies, and their dependence on the activities at the sites. This provides an evaluation of the current importance of the sites to their local economies – and an indication of the relative impact that would arise if sites ceased their operations now.

As detailed subsequently in our report, we have assessed the sites' local areas on a variety of metrics that reflect the strength of the area and its dependence on the site. For example, in terms of strength, we quantify aspects such as the local areas employment rate and productivity per capita. For dependence, we assess aspects such as the proportion of economic activity that is accounted for by the site.

Local areas that are currently stronger and less dependent on their Magnox site may warrant less support from the NDA, compared to those areas that are less strong and more dependent on their Magnox site.

The results of our evaluation of the strength and dependence of the local areas of sites are illustrated below. The top left quadrant of the figure includes the sites whose local economy is relatively more dependent on its Magnox site, and relatively less strong. Whereas, sites in the bottom right quadrant appear relatively stronger and relatively less dependent on their Magnox site. This analysis does not take into account future developments such as nuclear new builds.

Figure 2: Summary of strength and dependence score for Magnox sites



Source: Economic Insight analysis

Turning to the future impact of sites, the downturn in activity will impact local individuals, communities, businesses, and governments

Consistent with the current impact of sites, the main channel through which downturn will affect local economies is through direct employment – and as such this is the aspect we focus on. However, we also note the range of other impacts that can arise, such as: the breakdown of local communities; physical and mental health issues; and a decline in local business activity.

Downturn in site activity presents employment risks, but there are a number of factors that we expect to – at least in part – mitigate any negative effects

Whilst the profile of labour demand from the Magnox sites varies over the next decade, in the second half of our forecast period we expect there to be minimal direct employment at the sites. This means that there is a risk of negative socio-economic impacts. We have assessed both supply and demand factors to evaluate the potential risk at each site. In particular:

- We expect the reduced demand for labour from the Magnox sites to be partly mitigated by employment opportunities at currently active adjacent sites and nuclear new builds. These alternative employers are often relatively large compared to the Magnox sites. The presence of a current or future adjacent site varies across Magnox sites. Of course, the extent to which these sites may provide employment opportunities to ex-Magnox staff will depend on factors such as role similarity and the availability of open positions.

- In addition to demand from other nuclear sites, the demand for staff that would otherwise be employed at the Magnox sites will depend on the strength of local economies and the extent to which employment opportunities are available in sectors that require similar skills to nuclear decommissioning. For example, the

Harwell science and innovation campus near the Harwell site may provide demand for the skills of Magnox employees.

- In relation to supply factors, we find that retirements among the current cohort of Magnox employees is likely to partly mitigate negative demand. That is, a large proportion of current Magnox staff are expected to retire over our forecast horizon. In addition, the level of local migration, and training and education available, will affect the supply of labour in the local economies.

To 'trade-off' the positive and negative factors for each site we have undertaken both a qualitative and quantitative comparison. Broadly, our analysis suggests that Bradwell, Chapelcross, Harwell and Winfrith will be most 'at risk' of negative employment effects (in terms of the absolute number of current staff that may not have an employment opportunity for prolonged periods of time in the local nuclear sector). Hinkley Point A, Oldbury, Berkeley and Wylfa appear relatively insulated, due to their adjacent active and new build sites.[2] It should be recognised that any forward-looking analysis is subject to an inherent degree of uncertainty, and the assumptions used should be fully stress tested before the results are used to inform policy.

Prioritising socio-economic support is challenging, but we offer some initial thoughts and recommendations

As is set out above and in the rest of this report, we provide a range of approaches and metrics to compare the current and potential future economic impact of Magnox sites on their local economies. The main challenge we foresee going forward is using this and other evidence to prioritise 'where' and 'how' the NDA provides support. In the final chapter of this report, we provide our initial thoughts in relation to:

- identifying specific objectives which may help guide the prioritisation process;
- forms of support that could be considered; and
- a discussion of practical approaches to prioritisation.

[2] It is important to note that the conclusions drawn here are based on the analysis of alternative employment opportunities in the nuclear sector exclusively (active and new build sites). Whereas, we note that Magnox employees will likely possess skills that are transferrable to other sectors/industries.

2. Background and methodological approach

This chapter sets out the background to this report, and the methodological approach that we have taken. In turn, we discuss: the NDA and its socio-economic objective; the Magnox sites; the aims and objectives of this report; and our methodological approach.

2.1 The NDA and its socio-economic objective

The NDA was established in 2005 as a Non-Departmental Public Body (NDPB), under the Energy Act (2004), to ensure that the UK's civil nuclear legacy sites are decommissioned and cleaned up safely, securely, cost-effectively and in ways that protect people and the environment. Its clean up mission covers 17 sites, which include the first fleet of nuclear power stations, research centres and fuel-related facilities.

The NDA's role is strategic; it establishes the overall approach, allocates budgets, sets targets and monitors progress. It does not have overall hands-on role in cleaning up the sites, and instead delivers its mission primarily through six Site Licence Companies (SLCs) – each of which manages one or more of the 17 sites in the NDA's estate.

In addition to ensuring the effective decommissioning of sites, the Energy Act (2014) gives the NDA a range of supplementary functions. These include supply chain development, research and development, skills, stakeholder engagement, and of most relevance to this project, supporting activities that benefit the social or economic life of communities living near sites.

The NDA has recognised its statutory socio-economic function through successive strategies. Indeed, in its 5-year strategy, effective from April 2016, the NDA sets itself a specific objective to:

> "support the maintenance of sustainable local economies for communities living near our sites and, were possible, contribute to regional economic growth objectives."[3]

Historically, much of the NDA's socio-economic activity has been in the form of funding support. This was delivered either by the NDA or via SLCs, to which increasing amounts of funding and decision-making responsibility has been delegated. In 2016/17, the NDA Group as a whole (including SLCs) spent about £20m on over 200 projects – the NDA itself spent about £3m directly.

The NDA's ability to contribute to the socio-economic agenda is not limited to funding though, and it is this theme that the NDA intends to pursue over the current strategic period. The priorities of employment, education and skills, economic and social infrastructure and economic diversification, however, remain unchanged.

2.2 Magnox sites

Magnox Ltd, which is owned by Cavendish Fluor Partnership, is the SLC for 12 sites in the NDA's estate. It is responsible for managing the sites through their lifecycles; and in particular, overseeing all aspects of defuelling and decommissioning.

As is illustrated below, the Magnox sites are distributed across the UK, and often located in remote coastal areas of the country.

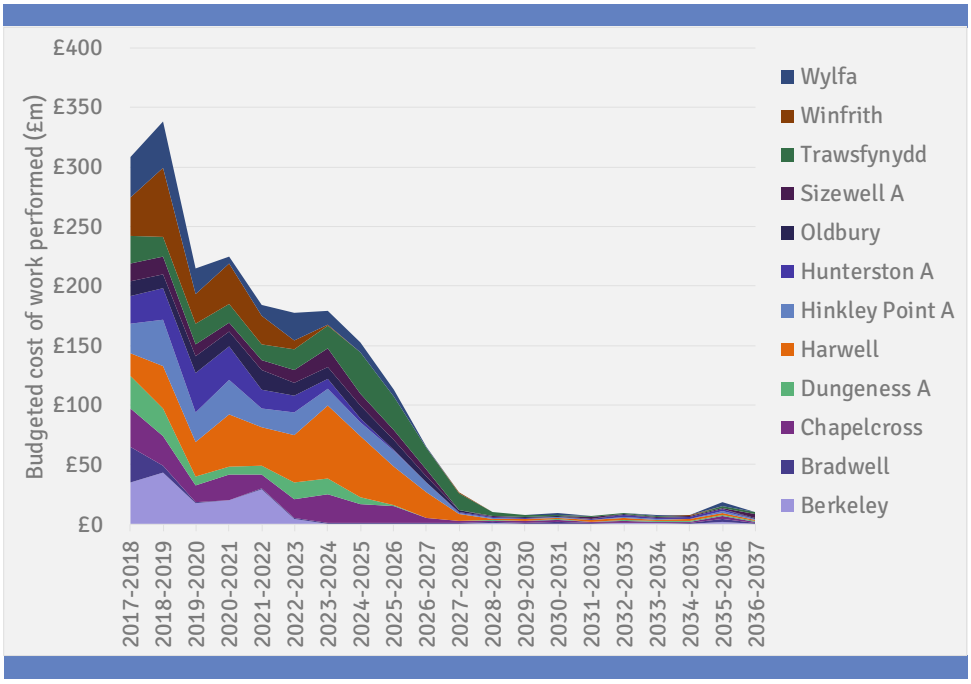
[3] *'Strategy, effective from April 2016', Nuclear Decommissioning Authority, 2016.*

Figure 3: Location of Magnox sites

Source: Economic Insight analysis

Furthermore, there is significant variation across the sites in terms of their size, complexity, and stage of decommissioning. Most sites (if not all) will enter the care and maintenance phase, in which only limited activities take place on the sites, within the next 10 years. As is shown in the following figure, the level of activity across all 12 Magnox sites is projected to significantly reduce over the next decade.

Figure 4: Level of projected activity across Magnox sites (as at September 2017)



Source: Economic Insight analysis of data supplied by the NDA

2.3 Aims and objectives of this work

To support the NDA in meeting its socio-economic objective, it asked Economic Insight to conduct an economic impact assessment of the Magnox sites on their local economies. In particular, the NDA wanted to gain a better understanding of both:

- the current economic contribution of the Magnox sites to their local communities; and
- how well placed each community is to deal with the planned downturn and site closure.

In addition to understanding the purely 'economic' impacts, given its socio-economic role, the NDA also wanted to gain a better understanding of the 'social' impacts of activities related to the sites.

Ultimately, our work is designed to support the NDA in choosing how to allocate resources to socio-economic activities, and prioritise between different sites and projects.

2.4 Methodology

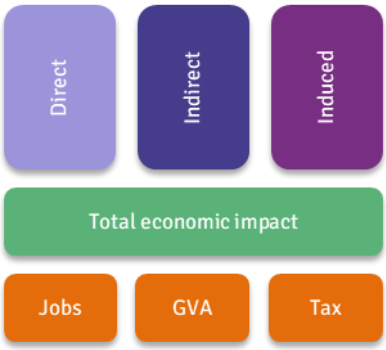
The NDA is in a unique position, and to meet the above objectives we developed a bespoke approach. As is set out briefly below, our work is split into two sections: assessing the current impact of sites; and considering the potential future impact of downturn. Our evaluation relies on detailed site-level analysis, using data from a variety of sources including the NDA, Magnox Ltd, the Office of National Statistics (ONS) and the Ministry of Housing, Communities and Local Government (MHCLG).

2.4.1 Assessing the current contribution of site activities to local economies

To understand the **current** contribution of sites to their local economies we have first undertaken economic impact modelling; and then subsequently more broadly considered the 'strength' and 'dependence' of local areas.

More specifically, we estimate three types of economic impact:

Illustration of economic impact framework



- **Direct effects** are the immediate impacts that arise from the operations of the NDA sites, and include aspects such the number of staff employed by Magnox and the immediate 'value' created by the activities undertaken at the sites.

- **Indirect effects** arise through supply chains that support the NDA sites. Suppliers buy inputs from their suppliers, and their suppliers buy inputs from others, and so on, creating further economic impacts that can 'ripple through' the local economies.

- **Induced effects** arise through employees at the NDA sites and the companies in the supply chains spending their wages in the economy, creating further impacts – which again 'ripple through' the wider economy.

These types of economic impact are quantified using three metrics:

- jobs / employment;
- gross value added (GVA), a measure of the local contribution to GDP; and
- tax receipts.

To quantify the impacts, we use a combination of data supplied to us by Magnox and our in-house model of the UK economy. Further details of this modelling approach are given in the appendix.

It should be noted that, whilst we have taken steps to ensure our analysis is as robust as possible, estimating impacts necessarily relies on assumptions and the precision of estimates can vary. In particular, we typically have greater confidence in estimates of direct impacts, as these tend to rely more closely on raw data from Magnox.

As the focus of our work is on the local impact of the Magnox sites, we concentrate on quantifying impacts that arise within the local authority district that each site is located in, and those adjacent to it – rather than nationally or internationally.

In addition to these quantitative estimates of the economic impact of Magnox sites, we more qualitatively assess the 'strength' and 'dependence' of sites and their local economies. This allows us to take into consideration a wider range of factors, including 'social' aspects.

Our evaluation of strength and dependence is designed to support the NDA's decision making. For example, an area of low strength and high dependence on the NDA site is likely to benefit more from additional support compared to an area of high strength and low dependence.

We define strength and dependence as follows.

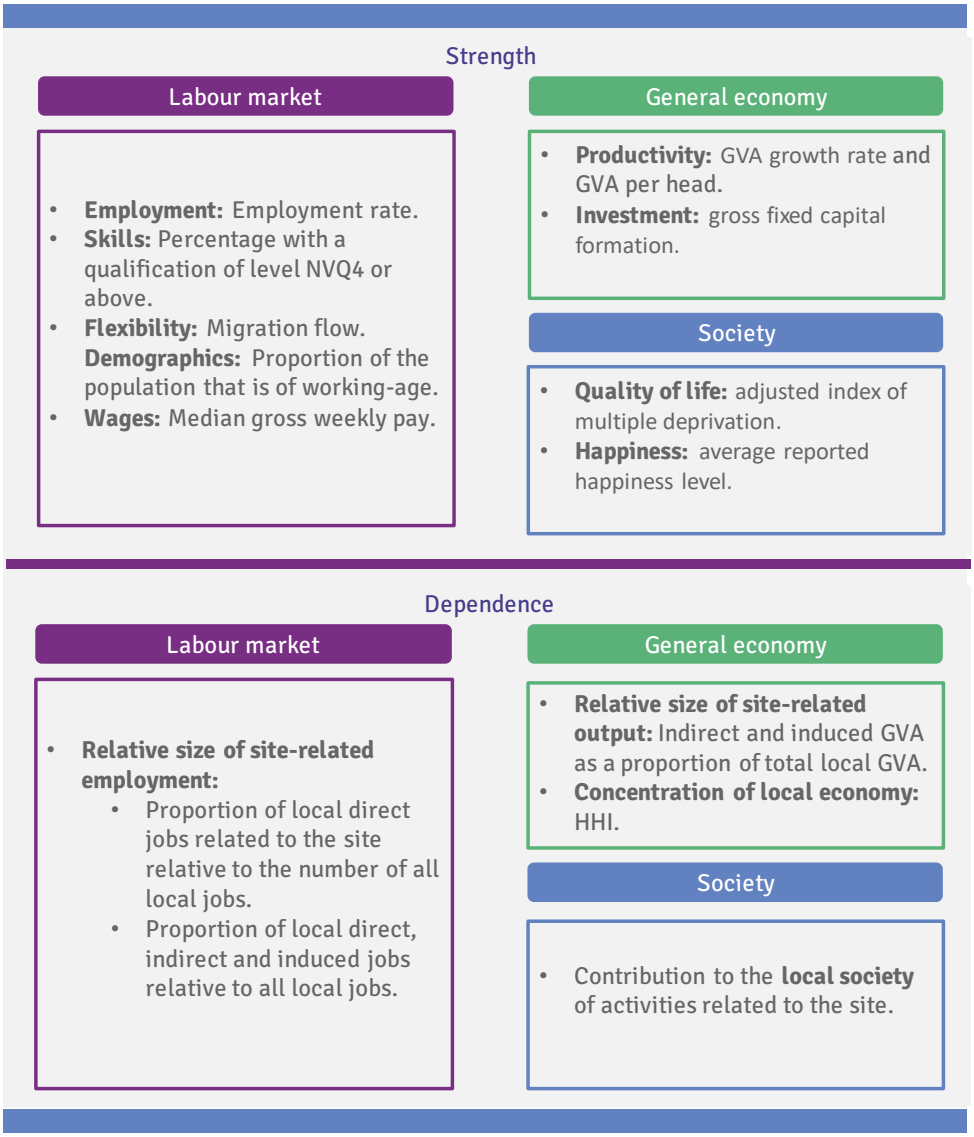
- **Strength**. By 'strength' we mean how well the area is currently performing socio-economically. All else equal, a stronger area is likely to be better able to deal with

'shocks' – including changes in demand such as from reduced activity at the NDA site.

- **Dependence**. By 'dependence' we mean how much the local area depends on the NDA site. That is, to what extent would the ceasing of operations at the NDA site affect the local socio-economic area.

For both strength and dependence, we have specified a number of measures; and for each measure, a number of metrics – as detailed in the figure below. As can be seen, measures cover the local: labour market; general economy; and society.

Figure 5: Measures and metrics used to assess strength and dependence



Source: Economic Insight

Each metric has been assigned a score on a high-medium-low scale. These scores are relative to the 12 sites. For example, the sites with the highest GVA per head will receive a 'high' score, and those with the lowest will receive a 'low' score. The scores are then aggregated to create overall measures for strength and dependence.

2.4.2 Assessing the future impact of downturn on local economies

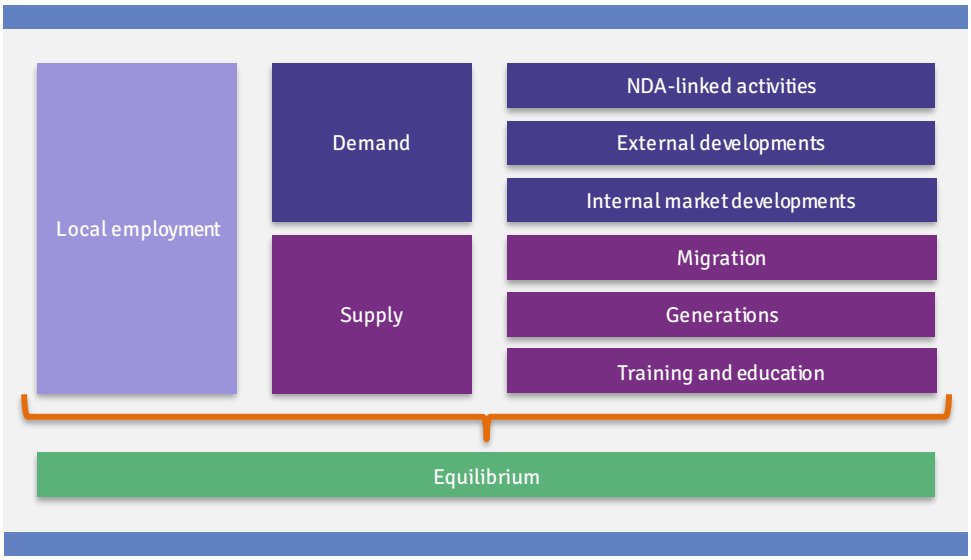
The second part of our analysis consists of estimating how site downturn will affect local economies, identifying those most 'at risk', and providing recommendations in relation to potential mitigating strategies.

To assess the impact of downturn and site closure, we compare the future situation in which the decommissioning process winds down, with a hypothetical situation in which the current level of activity continues. Our approach to this is based around a conceptual framework of dynamic labour supply and demand. In particular, to understand the effects of downturn on local employment, we consider factors that will affect the supply and demand for labour over time – and how an equilibrium level of employment (and unemployment) is determined.

This forward-looking aspect of our project focuses on the employment effects of downturn. This is because: (a) as is detailed later in our report, local impacts from Magnox sites mainly arise through the employment channel; and (b) employment is a more 'tangible' measure of impact (compared to output or GVA) and reflects the distribution of impact across individuals.

The factors that we consider within our conceptual framework are set out in the figure below.

Figure 6. Conceptual framework of dynamic labour supply and demand



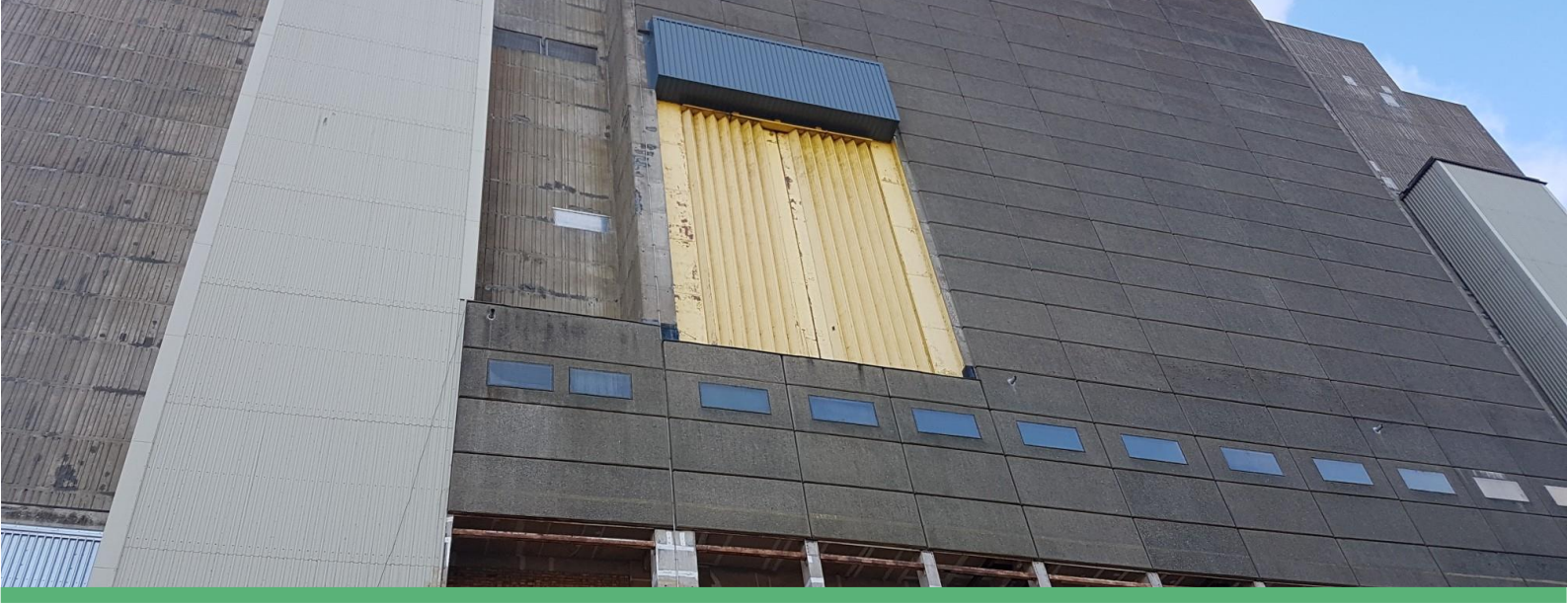
Source: Economic Insight

We focus on a period of 20 years, because this covers sites entering the care and maintenance phase, along with a decade or so afterwards i.e. a reasonable amount of time for effects to arise.

Our evaluation of future impacts consists of three main aspects:

- We first identify and present evidence in relation to the determinants of future local labour supply and demand.
- Secondly, we 'qualitatively' compare the identified evidence across the sites by assigning a traffic light system.

- Finally, to facilitate further comparison of the relevant factors, we quantitatively model the extent to which there may be 'over-supply' of labour in the local areas in the future.



3. Current contribution of site activities to local economies

This chapter presents our findings in relation to the current contribution of Magnox sites to their local economies.

In summary:

- The Magnox sites make quantifiable contributions to their local economies in terms of employment, GVA, and tax receipts. The main channel through which local impacts arise is through direct employment at the sites. On-site contractors (particularly at some sites) also contribute significantly to local employment. The sites provide jobs for people living in the local areas, and employees subsequently support further jobs and economic activity through spending their wages – which are above national averages – in local areas. The majority of employees live in the local authority district that their site is located in, or those adjacent to it. As such, employment effects are relatively concentrated in the local economies. In total, the sites support hundreds of jobs in their local economies.

- The Magnox sites purchase goods and services from national supply chains. Only a small proportion of inputs are purchased from abroad, but also only a small proportion are purchased from local suppliers (although this can equate to hundreds of thousands of pounds). As such, the impact of sites on their local economies that arise through supply chains is smaller in comparison to the impact arising through direct employment and on-site contractors. Notably, the sites purchase a large proportion of their inputs from a small number of suppliers, which will give rise to impacts elsewhere in the country.

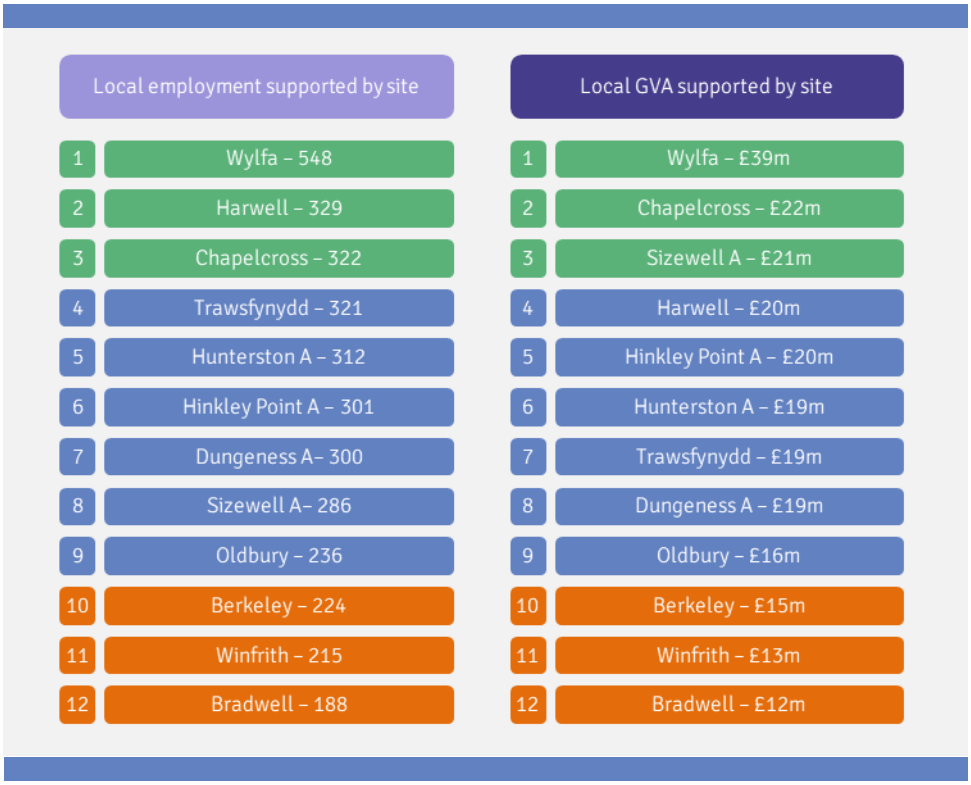
- Whilst the employment effects of sites are relatively concentrated on their local economies, they account for a small (but not insignificant) proportion of local jobs. The sites support a slightly larger proportion of local GVA – owing to the fact that the sites conduct relatively high value activities. Sites also support a small proportion of local government tax receipts.

- Further to quantifying the current economic impacts, we have assessed the current strength of the local economies within which sites are based, and their

dependence on the activities at the sites. This provides an evaluation of the current importance of the sites to their local economies – and an indication of the relative impact that would arise if sites ceased their operations now. In the next chapter, we evaluate sites in terms of their future impact, taking account of the anticipated profile of downturn.

The figure below provides a summary of the estimated employment and GVA impacts of the sites on their local economies (defined as the local authority district in which the site is located, and those adjacent to it). Sites are ranked from highest to lowest, and the top three and bottom three highlighted in green and orange respectively.

Figure 7: Summary of current employment and GVA impacts[4]



Source: Economic Insight analysis

In relation to the relative strength and dependence of local economies, please refer to Figure 28 on page 46. However, in brief:

- the local economies of Wylfa, Dungeness A, and Trawsfynydd have relatively high dependence and low strength; whereas
- the local economies of Sizewell A, Berkeley, Harwell, and Oldbury have relatively low dependence and high strength.

The following sections of this chapter set out the evidence and our calculations of the current impact of sites in terms of employment, GVA, and tax receipts. The final section of this chapter more broadly evaluates the strength and dependence of sites and their local economies.

[4] *Employment figures based on data from January 2018. GVA calculated from 2016/17 data.*

3.1 Current employment contribution

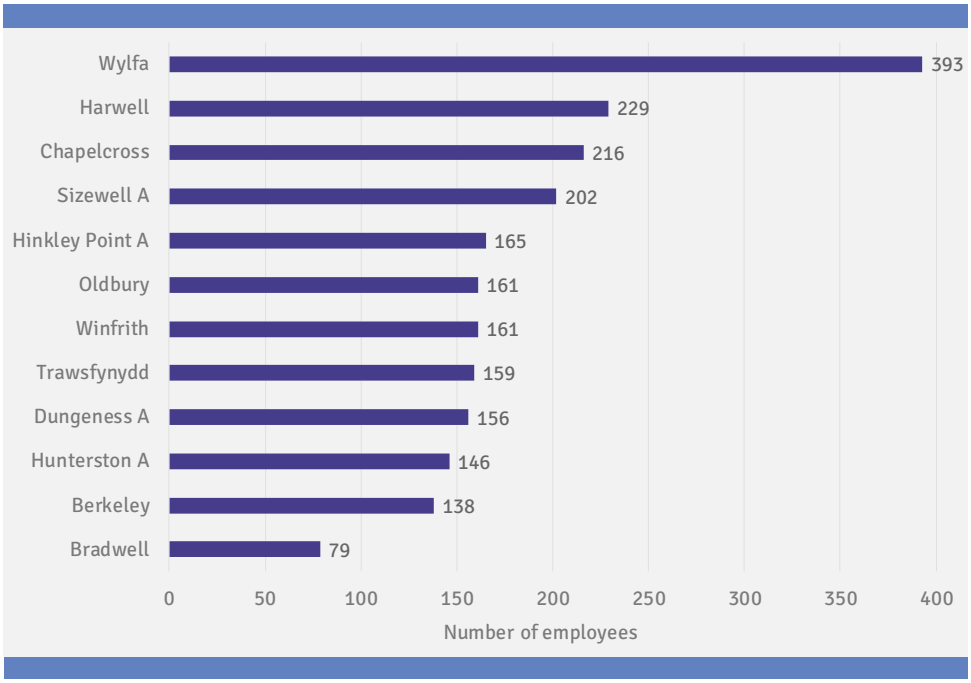
We first present statistics in relation to the number of employees at each site, and their age, income and where they live. We then present our estimates of knock-on employment effects of the sites.

3.1.1 Direct employment effect

As of January 2018, Magnox directly employed about 2,400 staff across the 12 sites. In this section we focus on only staff directly employed by Magnox, whereas in later sections we also consider on-site contractors.

As is shown below, the number of Magnox employees at each site varies significantly – with Bradwell employing the fewest (79) and Wylfa employing the most (393). Employee numbers reflect both the magnitude of the stations; but also importantly, the phase of decommissioning they are in. Bradwell, for example, is following an accelerated decommissioning programme and is expected to become the first reactor site in the UK to enter the care and maintenance phase. All else equal, a larger workforce will result in a greater economic impact – however, as we explore subsequently, sites differ across a range of factors which mean the magnitude of impacts are not necessarily purely a function of size.

Figure 8: Number of employees at each site (Jan 2018)



Source: Economic Insight analysis of data supplied by the NDA

Putting the above figures in perspective, and as is shown in the following table, each site contributes a relatively small proportion of the total jobs in the local authority district in which it is located. Except for Wylfa, which directly accounts for about 1.8% of jobs in Anglesey, all sites directly account for less than 1% of jobs in their local authority district.

Table 1: Site direct employment as a proportion of jobs in the local authority district in which the site is located

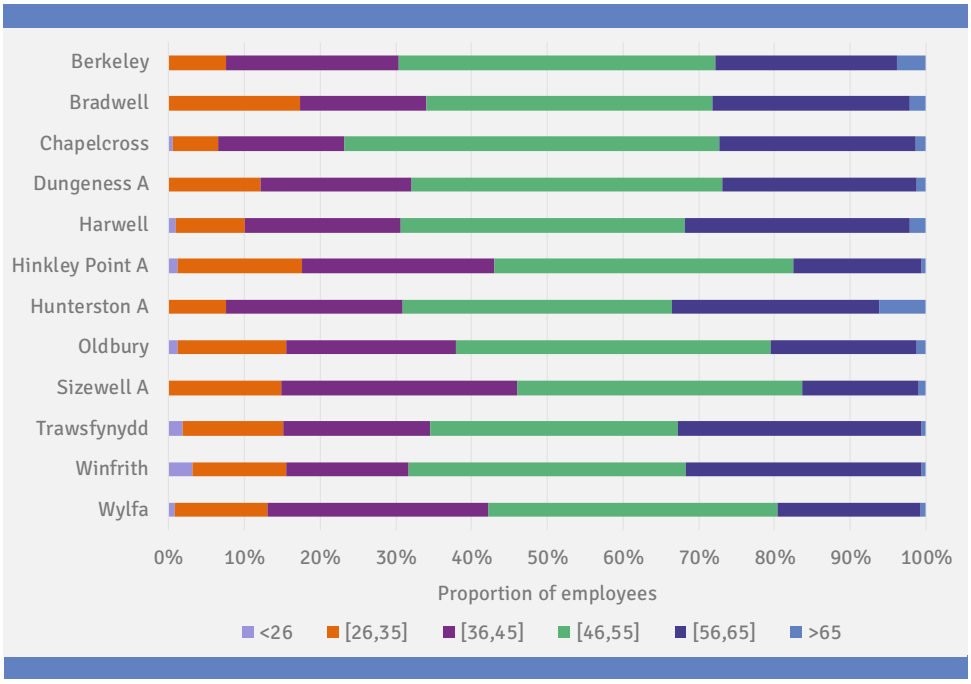
Site	Local authority district in which the site is located	Site direct employment as a proportion of jobs in local authority district
Berkeley	Stroud	0.11%
Bradwell	Maldon	0.21%
Chapelcross	Dumfries and Galloway	0.25%
Dungeness A	Folkestone and Hythe	0.19%
Harwell	Vale of White Horse	0.08%
Hinkley Point A	West Somerset	0.25%
Hunterston A	North Ayrshire	0.23%
Oldbury	South Gloucestershire	0.04%
Sizewell A	Suffolk Coastal	0.22%
Trawsfynydd	Gwynedd	0.17%
Winfrith	Purbeck	0.14%
Wylfa	Isle of Anglesey	1.33%

Source: Economic Insight analysis of ONS data and data supplied by the NDA

3.1.2 Employee age

Staff at the sites tend to be older than the average UK employee. As discussed further in chapter 4, this can have opposing implications for the future economic impact of sites (older employees are closer to retirement, but may find it harder to find new employment). As can be seen by the figure below, the age profile of staff is relatively consistent across sites.

Figure 9: Age of employees at each site



Source: Economic Insight analysis of data supplied by the NDA

3.1.3 Employee income

The average salary of staff at the sites is also above the national average. In particular, the average annual salary for a UK worker in 2017 was £29,009,[5] whilst the average salary of staff at the Magnox sites was £45,419 in 2017. Staff at the sites can therefore be expected to have a greater economic impact compared to the average UK worker.

There is some variation in the average salary across sites. This will affect the extent of knock-on effects that arise because of employees spending their wages – as we subsequently estimate.

3.1.4 Where employees live

Most employees tend to live in the local authority districts surrounding the site that they work at, although some commute longer distances. This is important because where staff live will, in part, determine where induced effects arise.

The table below shows the proportion of a site's employees that live in the same local authority district in which the site is located; and the proportion that live in the same or one of the adjacent local authority districts.[6] These statistics are a measure of 'how local' staff live, but it should be recognised that they will be partly dependent on size and borders of local authority districts. Based on the proportion of staff that live in the site's local authority district or those adjacent, the least concentrated sites appear to be Berkeley, Oldbury and Winfrith.

[5] *As of the Annual Survey of Hours and Earnings (ASHE) published by the ONS.*
[6] *The adjacent local authorities are all local authorities that share a geographic border with the local authority in which the site is located.*

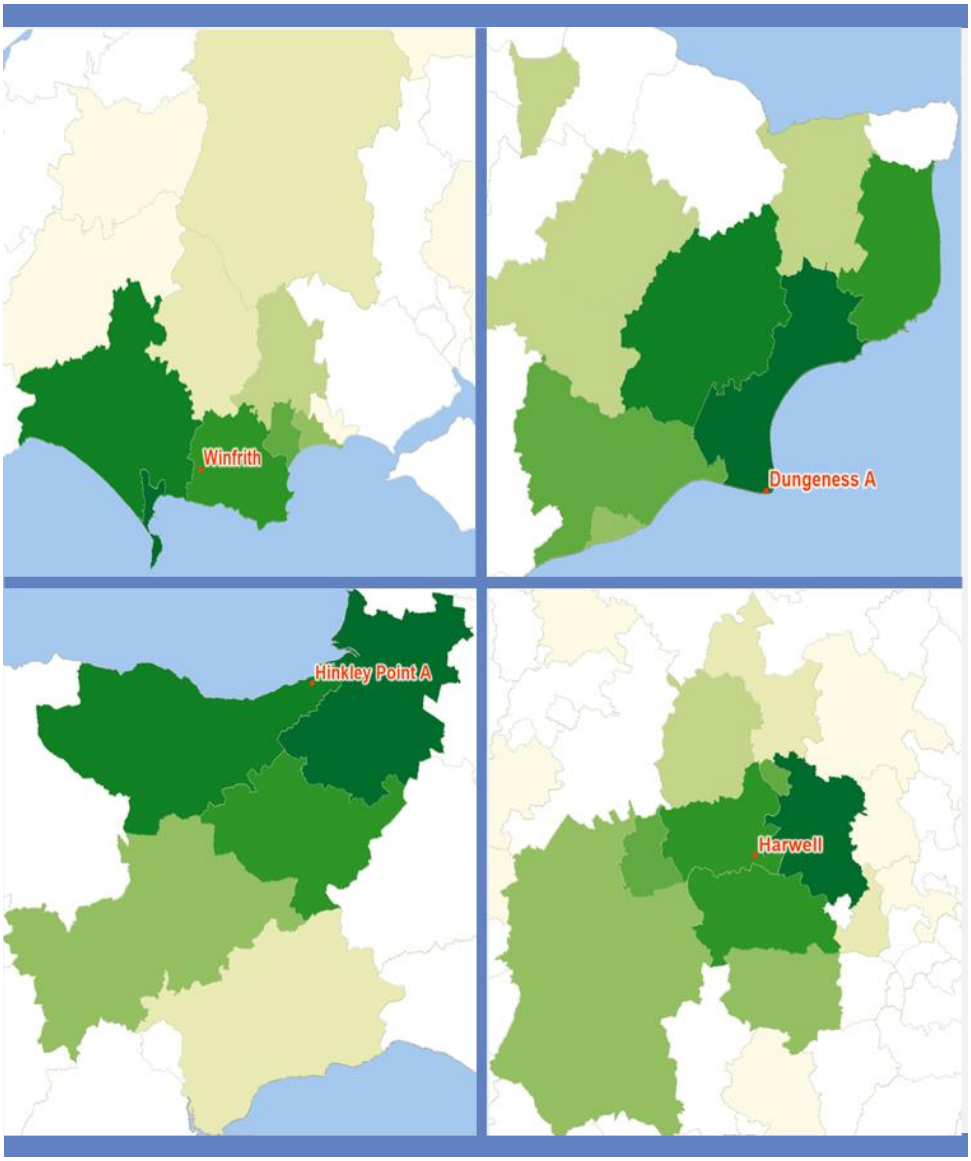
Table 2: Residence of site direct employees

Site	Proportion of site employees that live in the local authority district that the site is located in	Proportion of site employees that live in either the local authority district that the site is located in or an adjacent one
Berkeley	50%	62%
Bradwell	73%	82%
Chapelcross	82%	99%
Dungeness A	60%	90%
Harwell	26%	80%
Hinkley Point A	25%	94%
Hunterston A	74%	84%
Oldbury	43%	57%
Sizewell A	63%	81%
Trawsfynydd	92%	95%
Winfrith	18%	52%
Wylfa	91%	99%

Source: Economic Insight analysis of NDA and ONS data

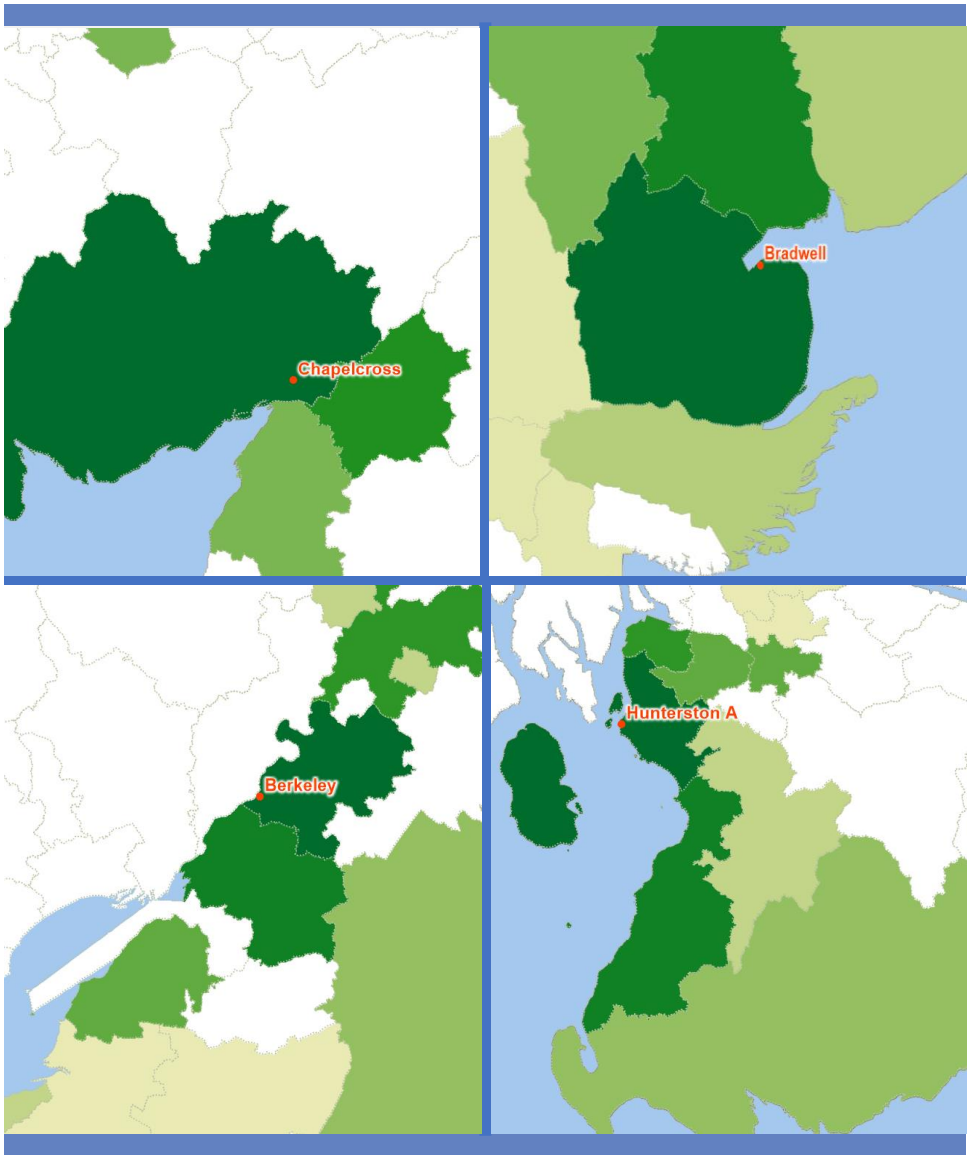
In the following figures, we show the concentration of a site's employees in the site's local and adjacent local authority districts. A darker shade is a reflection of a higher concentration of the site's employees in the local authority district. The mapping shows that for some sites, such as the case of Winfrith, which is located at close proximity with an adjacent local authority district, that the concentration of employees is higher in the adjacent local authority district (West Dorset) than the local authority district in which the site is located (Purbeck).

Figure 10: Staff location for Winfrith, Dungeness A, Hinkley Point A, and Harwell sites



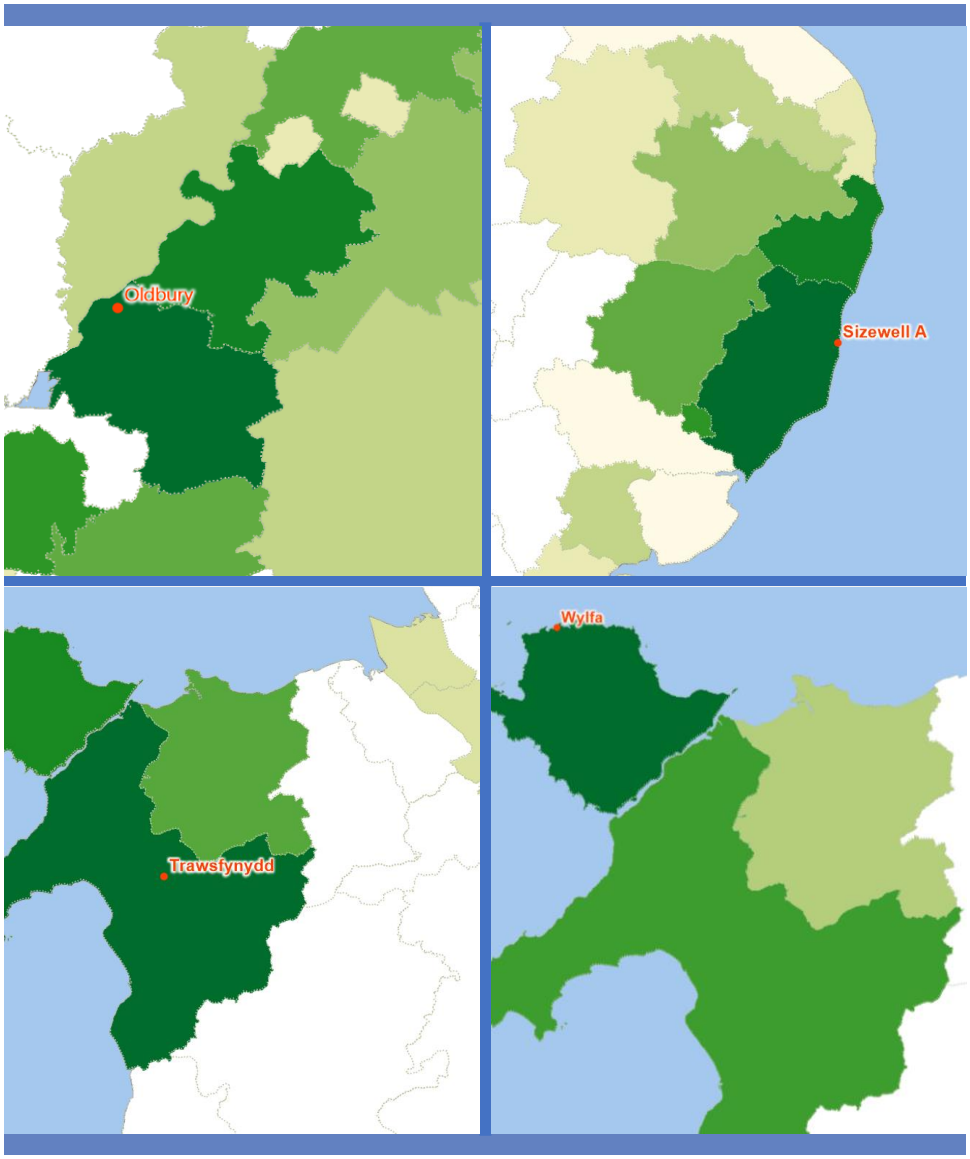
Source: Economic Insight analysis of data supplied by the NDA
Note: The darker shading reflects a higher concentration of employees in the local authority district. Note, the shadings are relative to the number of site employees, and are not comparable across maps e.g. the darkest green represents a different number of employees across the different maps.

Figure 11: Staff location for Chapelcross, Bradwell, Berkeley, and Hunterston A sites



Source: Economic Insight analysis of data supplied by the NDA
Note: The darker shading reflects a higher concentration of employees in the local authority district. Note, the shadings are relative to the number of site employees, and are not comparable across maps e.g. the darkest green represents a different number of employees across the different maps.

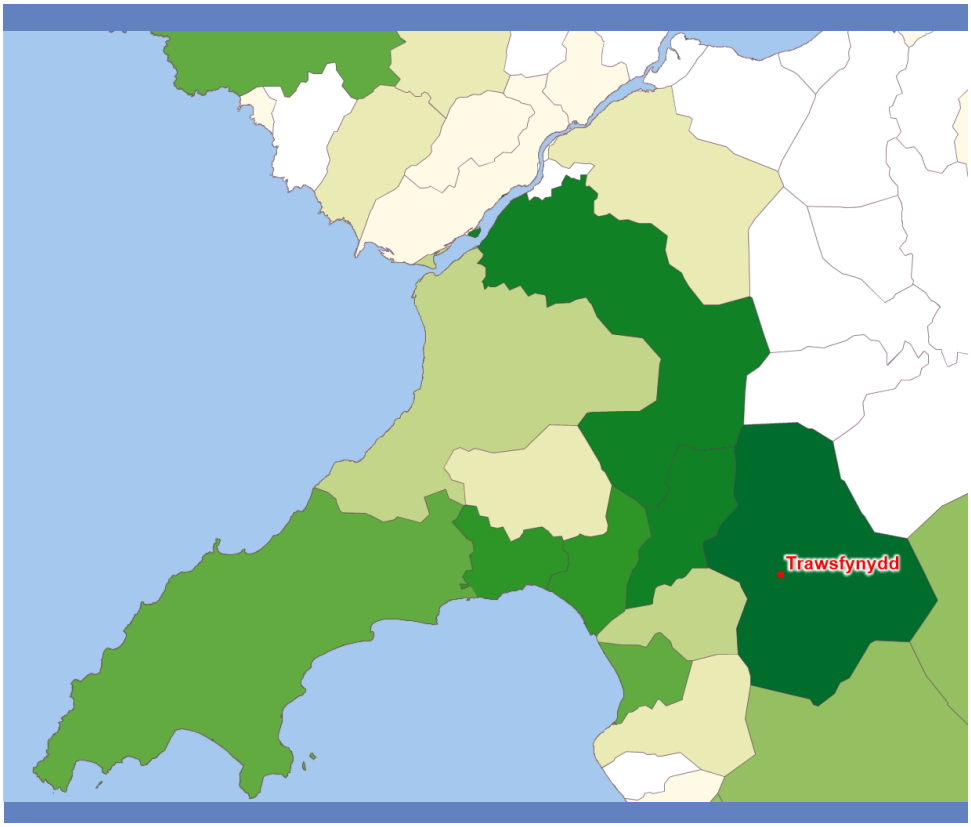
Figure 12: Staff location for Oldbury, Sizewell A, Trawsfynydd, and Wylfa sites



Source: Economic Insight analysis of data supplied by the NDA
Note: The darker shading reflects a higher concentration of employees in the local authority district. Note, the shadings are relative to the number of site employees, and are not comparable across maps e.g. the darkest green represents a different number of employees across the different maps.

As can be seen in table 2, employees are highly concentrated in Trawsfynydd's local authority district. We have looked more closely at the concentration of employees, and as can be seen below staff are relatively highly concentrated around the site; and much less concentrated around, for example, Bangor which is in the most northernly part of Gwynedd.

Figure 13: Staff location for Oldbury, Sizewell A, Trawsfynydd, and Wylfa sites



Source: Economic Insight analysis of data supplied by the NDA
Note: The darker shading reflects a higher concentration of employees.

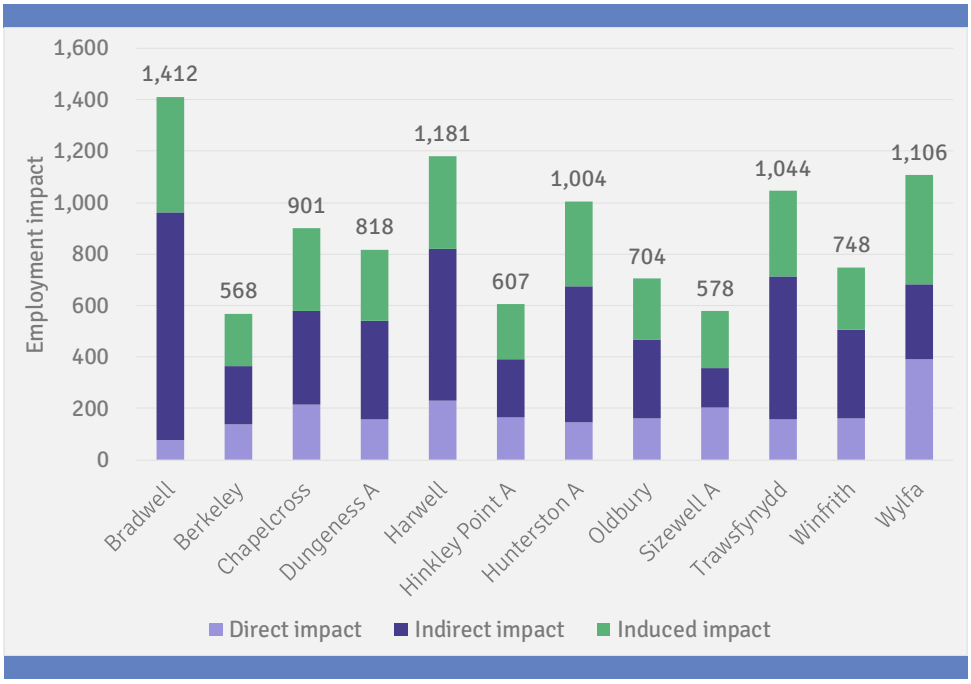
3.1.5 Indirect and induced employment

In addition to the direct employment effects, the sites also have impacts on the economy through:

- indirect employment effects, which arise through supply chains; and
- induced employment effects, which arise through employees of the NDA sites and their suppliers spending wages.

At a national level, these indirect and induced impacts are significant compared to the number of staff directly employed by sites. As can be seen in the figure below, the multiplier effects are larger than the direct employment effects.

Figure 14: Total employment effects at the national level



Source: Economic Insight analysis of data supplied by the NDA

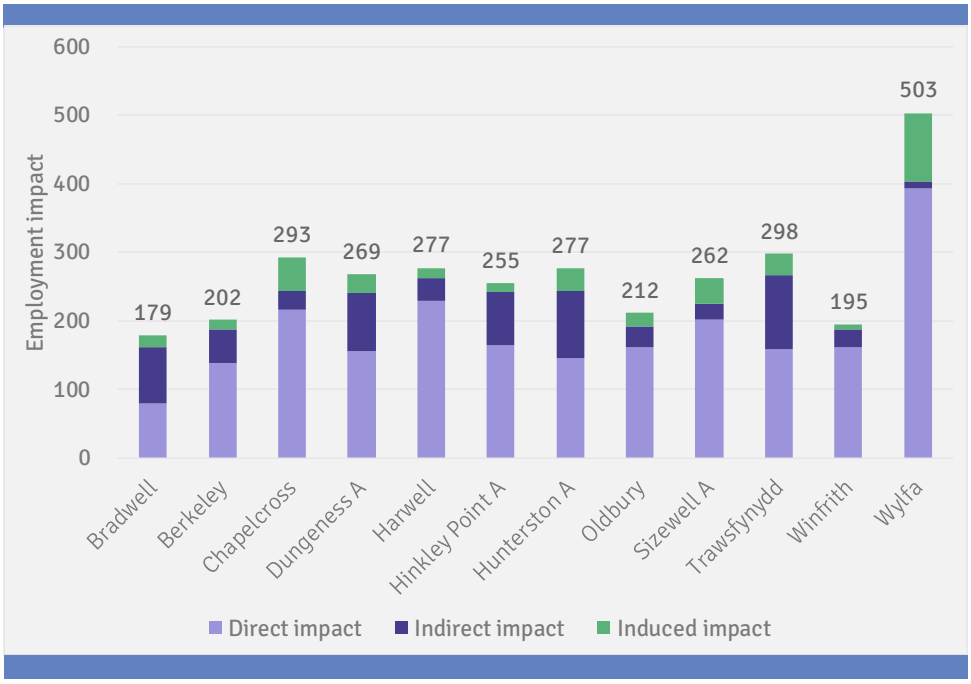
The relative magnitude of the knock-on effects varies considerably across sites. Most notably, whilst Bradwell accounts for the fewest direct employees, it contributes the largest knock-on employment effect. This is a result of it having the largest supply chain of all the sites (by a significant margin), as is detailed later in this report.

The indirect and induced effects shown above arise throughout the whole economy, whereas our focus is on the local impact of sites. The two figures below show that only a proportion of the knock-on effects arise in sites' local economies – defined first as the local authority district in which a site is located, and secondly including adjacent local authority districts as well. As can be seen:

- The indirect employment effect is significant for some sites. This is particularly true for the sites that have a large proportion of on-site contractors, such as Bradwell, Trawsfynydd, and Hunterston A. The contribution of suppliers (other than those that provide on-site contractors) to local employment impacts is relatively small because the majority of suppliers are not local to the sites (see further details in section 3.2.2).

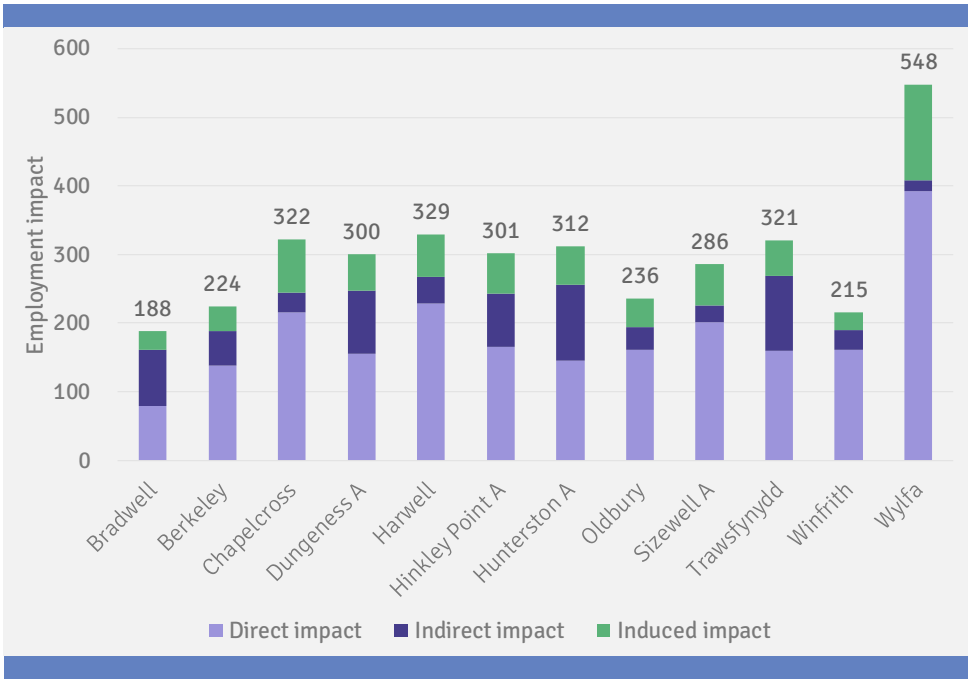
- Local employment is also supported by induced impacts. This is primarily because staff of the sites live in the local areas, and spend part of their wages there – thus supporting local jobs. The relative size of the induced impacts largely turns on the proportion of site staff that live in the local area, but will also be affected by wages rates and the presence of suppliers (whose employees are likely to spend wages locally). We understand that whilst on-site contractor by definition work in the area, they may not live there permanently (e.g. do not stay in the area during weekends).

Figure 15: Employment effects within each site's local authority district



Source: Economic Insight analysis

Figure 16: Employment effects within each site's local authroity district and those adjacent



Source: Economic Insight analysis

Every job at a Magnox site supports other jobs in the local economies. The table below specifies employment multipliers, which show the equivalent number of local jobs supported by each Magnox job. For example, the figures in the right-hand column suggest that for every 10 jobs at a Magnox site, between another 3 to 14 jobs are supported in the site's local authority district and those adjacent to it.

Table 3: Local employment multipliers

Site	Employment multiplier within the site's local authority district	Employment multiplier within the site's local authority district plus those adjacent
Berkeley	2.3	2.4
Bradwell	1.5	1.6
Chapelcross	1.4	1.5
Dungeness A	1.7	1.9
Harwell	1.2	1.4
Hinkley Point A	1.5	1.8
Hunterston A	1.9	2.1
Oldbury	1.3	1.5
Sizewell A	1.3	1.4
Trawsfynydd	1.9	2.0
Winfrith	1.2	1.3
Wylfa	1.3	1.4

Source: Economic Insight analysis

The following table puts the local employment figures into context of total employment with the local authority districts. As can be seen, the total number of jobs supported by the sites in their local areas are a small proportion of all jobs in the local areas. As can be expected, because direct employment at Wylfa accounts for the largest proportion of jobs in a site's local authority district, and a large proportion of employees live in Anglesey, Wylfa supports the largest proportion of jobs in sites' local authority districts.

Table 4: Local employment supported by sites as a proportion of the total number of jobs in an area[7]

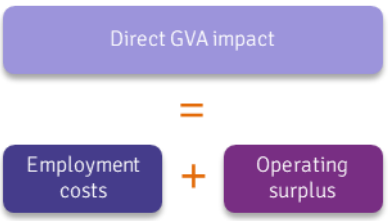
Site	Jobs supported by the site in its local authority district as a proportion of total jobs in the area	Jobs supported by the site in its local authority district and those adjacent as a proportion of total jobs in the area
Berkeley	0.64%	0.06%
Bradwell	0.33%	0.06%
Chapelcross	0.41%	0.08%
Dungeness A	0.56%	0.11%
Harwell	0.38%	0.05%
Hinkley Point A	1.50%	0.13%
Hunterston A	0.59%	0.11%
Oldbury	0.13%	0.02%
Sizewell A	0.44%	0.15%
Trawsfynydd	0.44%	0.14%
Winfrith	0.93%	0.09%
Wylfa	1.86%	0.58%

Source: Economic Insight analysis of ONS data and data supplied by the NDA

[7] *Total number of jobs is measured by job density, which is defined as 'the number of jobs in an area divided by the resident population aged 16-64 in that area'.*

3.2 Current GVA contribution

The economic impact of sites can also be quantified in terms of GVA, which is a measure of contribution to GDP. In the sections below, we detail: the direct GVA effects of sites; sites' supply chains (which determine knock-on impacts); and our quantification of the indirect and induced impacts.



3.2.1 Direct GVA effect

Direct GVA is the economic value created by the activities that are undertaken at a specific site. It is equal to the sum of employment costs and operating surplus (where operating surplus is defined as income, less all operating costs other than those related to capital i.e. excluding depreciation charges. This captures the value that operations at a site are adding on top of the inputs that are bought from suppliers.

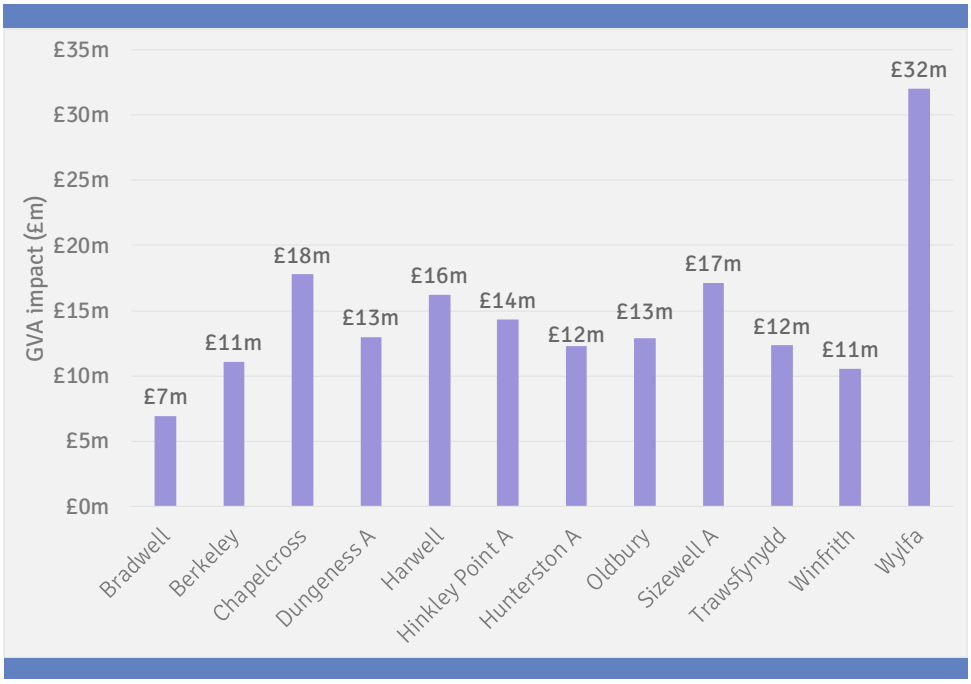
More specifically, the site-level components of direct GVA have been calculated as follows:

- Employment costs are estimated as the sum of site-level wages and salaries, 'scaled up' to the same proportion that wages and salaries are to total employment costs at the Magnox Ltd level. This means that, for example, social security and pension costs are included within our estimate of employment costs.
- Operating surpluses are assumed to be proportional to employment costs, and equal to the ratio at the Magnox Ltd level. We understand that profit is not accounted for at the individual site level, and therefore this is a reasonable approximation to make.

The definition of direct GVA impact should be kept in mind when considering the local impact of sites. For example, a larger operating surplus (all else equal) will not benefit the local economy. Rather, benefits to the local economy are felt through direct employment (one component of direct GVA), and the knock-on effects through local suppliers (as estimated separately).

The figure below shows that the direct GVA impact differs considerably across sites. Wylfa directly contributes the most to national GDP – estimated at £32m per year. Whereas, Bradwell directly contributes the least, at an estimated £7m per year. The variation between sites is driven by the wage bill. That is, as Wylfa has by far the largest number of employees (and an average wage not too dissimilar from the majority of other sites), it has the largest estimated direct GVA impact.

Figure 17: Direct GVA impact



Source: Economic Insight analysis of data supplied by the NDA

These direct impacts are assigned fully to where each site is located.

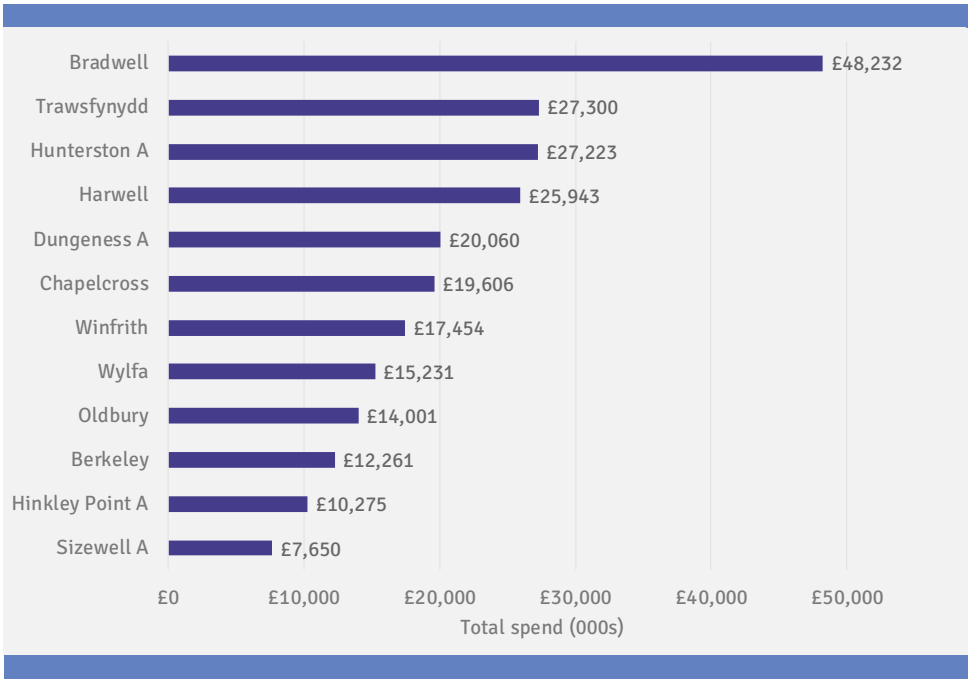
3.2.2 Supply chains

The knock-on GVA impacts of activities at sites are partly determined by supply chains i.e. 'what' inputs are purchased from other organisations, and 'where' suppliers are based. This sub-section focuses on the supply chains of the Magnox sites. The next sub-section quantifies the indirect and induced GVA impacts.

The 12 sites purchase a significant amount of goods and services from suppliers within the UK. Based on our analysis of supplier data, we calculate that only between 0% and 4% of each site's spend was with international suppliers. As such, the vast majority of knock-on impacts that arise through supply chains can be expected to accrue to the UK.

The figure below shows that the value of goods and services purchased from UK suppliers by the different sites varied significantly in 2016/17. For example, Bradwell had the highest value of purchases at about £48m – six times more than Sizewell A, which had the lowest value of purchases. This, in turn, is a function of the level of activity at the Magnox site and the funding it receives.

Figure 18: Each site's spend with UK suppliers 2016/17

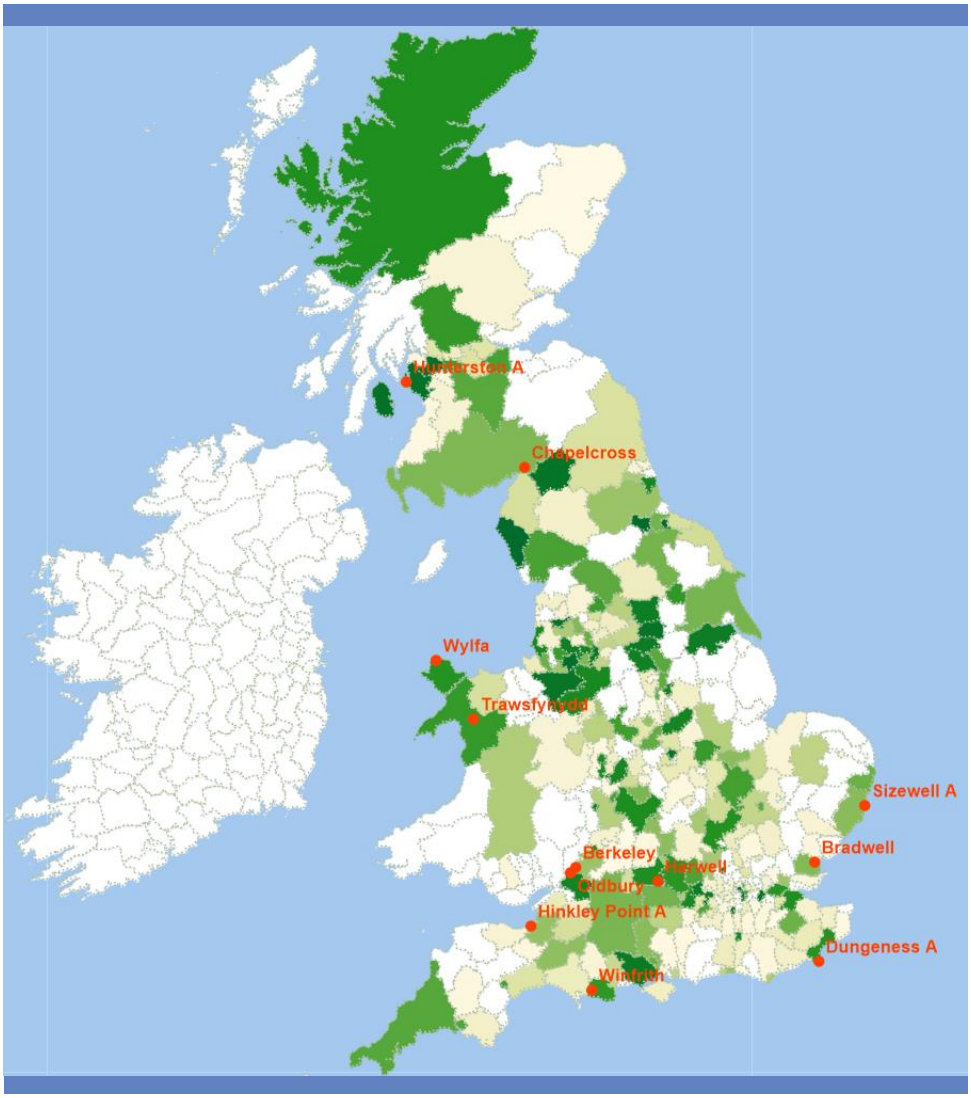


Source: Economic Insight analysis of data supplied by the NDA

The suppliers that sites purchase goods and services from are spread across the UK, but only a small proportion of spend is with local suppliers. The following figure shows how the total value of purchases of all 12 sites is distributed across local authority districts (the darker the green shading the greater the 12 sites collectively spend with suppliers based in the local authority district). As can be seen, those areas that receive the highest spend from sites are often not in the local vicinity of sites.

The map to the right shows the distribution of spending with suppliers by the 12 Magnox sites combined across local authority districts in the UK. The darker shade reflects a higher spending in the local authority district.

Figure 19: Total UK spend by the 12 sites by local authority district 2016/17



Source: Economic Insight analysis of data supplied by the NDA
Note: The darker shade reflects a higher spending in the local authority district.

This suggests that sites (individually and collectively) may have significant economic impacts on local areas other than those in which they are situated. For example, the five local authority districts that receive the highest spend from the Magnox sites collectively, as set out in the following table, do not have Magnox sites located within them. Spend is attributed to the location of the supplier recorded in the data provided to us (which in some cases appears to the be 'local' office of the supplier, rather than always its head office).

Table 5: Top five local authority districts by total spend of the 12 Magnox sites (2016/17)

Local authority district	Spend by the 12 Magnox sites in the local authority district
Copeland	£22m
Darlington	£20m
Middlesbrough	£17m
Lambeth	£15m
Warrington	£14m

Source: Economic Insight analysis of data supplied by the NDA

Although a relatively small proportion of a site's spend is within the local area, it can still equate to hundreds of thousands of pounds. The following table shows how much each site spent in its local authority district and adjacent ones, along with the proportion of each site's total spend. As can be seen, Hunterston A spends the most (in absolute terms) within its local authority district and those surrounding it. Whereas, Berkeley and Hinkley Point A spend the least.

Table 6: Each site's spend with suppliers in their local authority districts and those adjacent 2016/17

Site	Spend in the local authority district that the site is located in	Spend in either the local authority district that the site is located in or an adjacent one
Berkeley	£29,000 (0.24%)	£34,000 (0.28%)
Bradwell	£56,000 (0.12%)	£56,000 (0.12%)
Chapelcross	£93,000 (0.47%)	£525,000 (2.68%)
Dungeness A	£479,000 (2.39%)	£590,000 (2.94%)
Harwell	£330,000 (1.27%)	£546,000 (2.10%)
Hinkley Point A	£1,000 (0.01%)	£47,000 (0.46%)
Hunterston A	£1,002,000 (3.68%)	£1,694,000 (6.22%)
Oldbury	£119,000 (0.85%)	£164,000 (1.17%)
Sizewell A	£17,000 (0.22%)	£17,000 (0.22%)
Trawsfynydd	£236,000 (0.86%)	£412,000 (1.51%)
Winfrith	£151,000 (0.87%)	£189,000 (1.08%)
Wylfa	£403,000 (2.65%)	£586,000 (3.85%)

Source: Economic Insight analysis of data supplied by the NDA
Note: figures in parentheses are the relevant proportion of a site's spend with UK suppliers.

The sites' spending is relatively concentrated by sector and supplier. The figure below shows the 10 SIC sectors were most spending occurred. For each site, we show the percentage of its spending across the 10 SIC sectors. For most sites, the highest

proportion of spending (usually between 30% to 40%) was on suppliers in the architectural and engineering services or construction services. This is relevant for calculating knock-on impacts that arise through supply chains, because different industries generate different levels of GVA and employment.

Figure 20: Site spend by SIC group 2016/17

	Berkeley	Bradwell	Chapelcross	Dungeness A	Harwell	Hinkley Point A	Hunterston A	Oldbury	Sizewell A	Trawsfynydd	Winfrith	Wylfa
Architectural and engineering services; technical testing and analysis services	11%	21%	9%	7%	21%	6%	43%	5%	10%	30%	40%	38%
Construction	10%	12%	41%	30%	4%	10%	4%	6%	30%	29%	10%	18%
Electricity, transmission and distribution	1%	0%	2%	2%	1%	5%	3%	0%	3%	2%	1%	2%
Employment services	15%	11%	7%	8%	3%	20%	11%	5%	3%	14%	7%	2%
Machinery and equipment n.e.c.	2%	2%	3%	11%	2%	3%	16%	2%	5%	4%	2%	8%
Office administrative, office support and other business support services	9%	6%	9%	10%	12%	20%	3%	18%	23%	3%	10%	9%
Other professional, scientific and technical services	10%	12%	5%	21%	24%	25%	14%	6%	9%	12%	9%	6%
Rail transport services	0%	0%	0%	0%	1%	0%	0%	52%	0%	0%	0%	0%
Security and investigation services	0%	0%	0%	0%	20%	0%	0%	0%	0%	0%	0%	2%
Waste collection, treatment and disposal services; materials recovery services	38%	34%	11%	3%	7%	6%	2%	2%	1%	2%	16%	8%

Source: Economic Insight analysis of data supplied by the NDA
Note: darker shades represent higher proportions.

In addition to the consistency between sites in terms of what they purchase, there is also a high degree of consistency in terms of suppliers. Put another way, the 12 sites often buy from the same suppliers. As can be seen below, suppliers such as Capital Business Services Ltd, LLW Repository Ltd and Hertel Ltd are among the main suppliers for many of the sites.

Figure 21: Site spend by supplier 2016/17

	Berkeley	Bradwell	Chapelcross	Dungeness A	Harwell	Hinkley Point A	Hunterston A	Oldbury	Sizewell A	Trawsfynydd	Winfrith	Wylfa
Actavo (UK) Limited	0%	0%	0%	7%	15%	0%	10%	5%	23%	0%	0%	0%
Balfour Beatty Civil Engineering Limited	6%	5%	2%	5%	8%	12%	2%	0%	0%	0%	0%	0%
Capita Business Services Ltd	7%	9%	0%	0%	0%	0%	0%	4%	3%	13%	6%	1%
Direct Rail Services Ltd	0%	10%	1%	1%	5%	10%	1%	0%	0%	0%	0%	0%
Hertel (UK) Ltd	0%	0%	0%	0%	1%	0%	0%	0%	0%	16%	0%	16%
Interserve (Facilities Management) Ltd	14%	10%	7%	8%	2%	19%	7%	0%	0%	2%	7%	6%
James Fisher Nuclear Ltd	4%	24%	1%	3%	6%	2%	1%	1%	1%	1%	33%	2%
LLW Repository Ltd	0%	0%	0%	0%	0%	0%	34%	0%	1%	2%	13%	1%
Nuvia Ltd	0%	0%	40%	3%	0%	9%	2%	0%	0%	6%	8%	0%
Radwise Ltd	2%	1%	1%	1%	0%	2%	1%	0%	2%	0%	0%	1%

Source: Economic Insight analysis of data supplied by the NDA
Note: darker shades represent higher proportions.

We note that the supplier Radwise Ltd is located in North Ayrshire, the same local authority district where Hunterston A site is located, which is one of the sites that has a relatively higher proportion of spending within its local economy as per Table 6.

For some suppliers, the sales to Magnox sites comprise a considerable proportion of total revenues, such as the case of Nuvia Ltd where sales to Magnox sites comprise around 11% of their total revenues.

3.2.3 Indirect and induced GVA

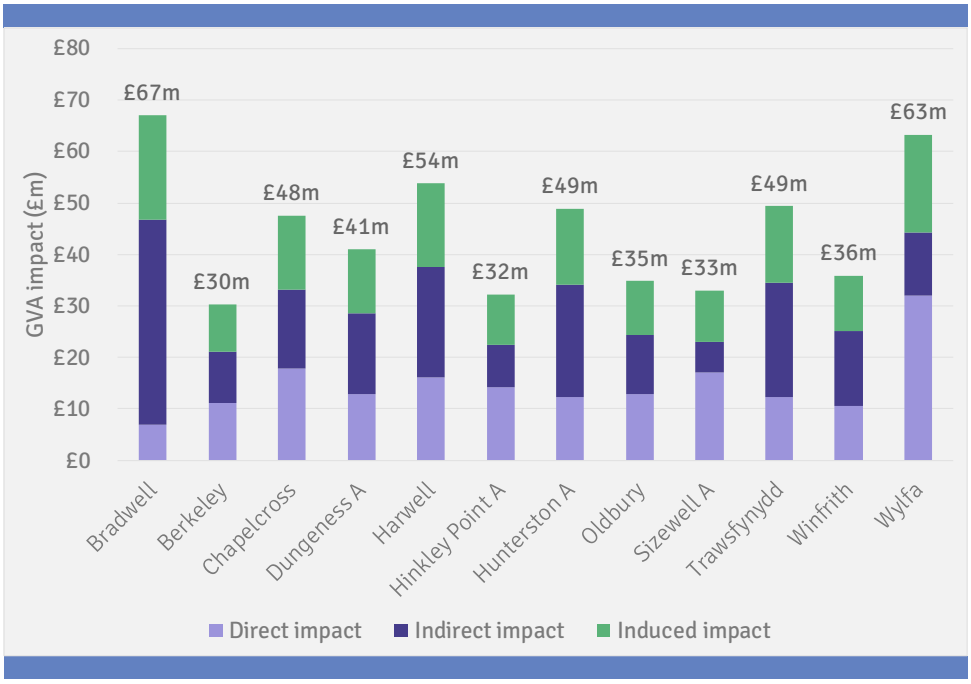
Similar to the sub-section on the indirect and induced employment effects, this sub-section quantifies knock-on impacts in terms of GVA.

As is shown in the following figure, the Magnox sites have significant national knock-on effects when measured in terms of GVA. In particular:

- Given their substantial supply chains, the sites give rise to significant indirect impacts. The size of these effects depends on how much each site purchases from suppliers, and also what type of inputs are bought. For example, construction services typically generate greater value that administration services, and therefore the 'mix' of inputs each site purchases will determine its knock-on effects. Notably, given the relative size of its supply chain spending, Bradwell contributes the largest indirect impact.

- Induced effects, that arise through employees of both the Magnox sites and their suppliers, are also significant.

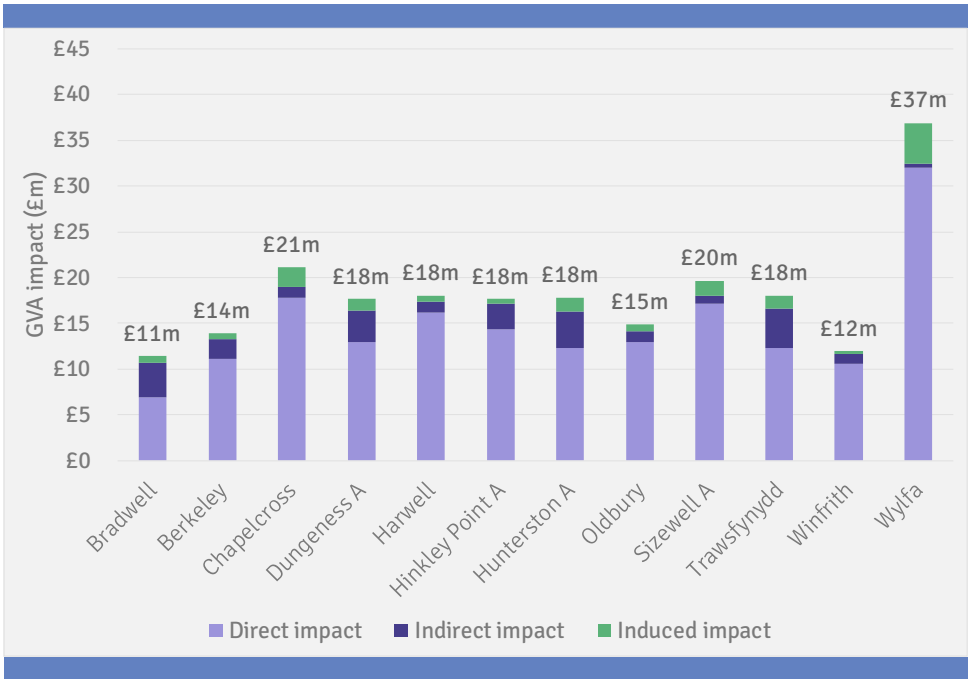
Figure 22: Total GVA impact at the national level



Source: Economic Insight analysis of data supplied by the NDA

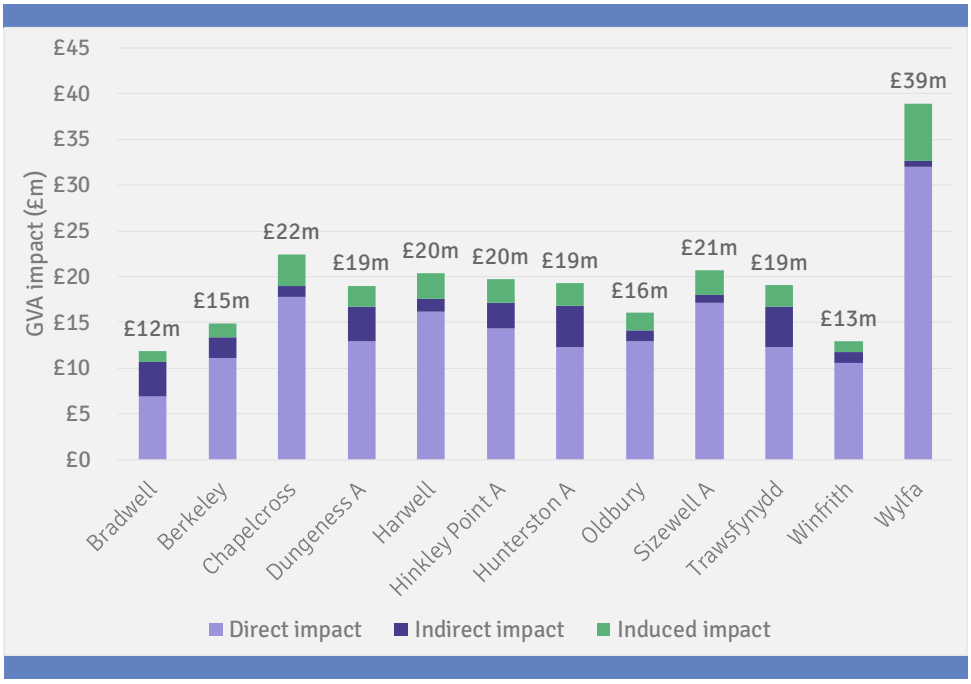
As with the employment effect, only a proportion of the national GVA effects arise in the sites' local areas. The figures below show the GVA impact of sites on their local authority districts and those adjacent.

Figure 23: GVA effects within each site's local authority district



Source: Economic Insight analysis of data supplied by the NDA

Figure 24: GVA effects within each site's local authroity district and those adjacent



Source: Economic Insight analysis of data supplied by the NDA

The following table puts the total GVA impacts of the sites in the context of total GVA within local areas. As can be seen, whilst the proportions are small, they are often not insignificant. For example, Wylfa and Hinkley Point A contribute 3.9% and 2.6% of their local authority district's GVA respectively. Notably, the sites contribute a greater proportion of GVA than employment – this is because the jobs are relatively high value and above average productivity.

Table 7: Total GVA impact of site as a proportion of local GVA

Site	Total GVA impact of site as a proportion of GVA of its local authority district	Total GVA impact of site as a proportion of GVA of its local authority district plus those adjacent
Berkeley	1.0%	0.1%
Bradwell	0.5%	0.1%
Chapelcross	0.7%	0.1%
Dungeness A	0.8%	0.2%
Harwell	0.5%	0.1%
Hinkley Point A	2.6%	0.2%
Hunterston A	0.9%	0.1%
Oldbury	0.2%	0.0%
Sizewell A	0.6%	0.2%
Trawsfynydd	0.8%	0.2%
Winfrith	1.4%	0.1%
Wylfa	3.9%	1.2%

Source: Economic Insight analysis of ONS data and data supplied by the NDA

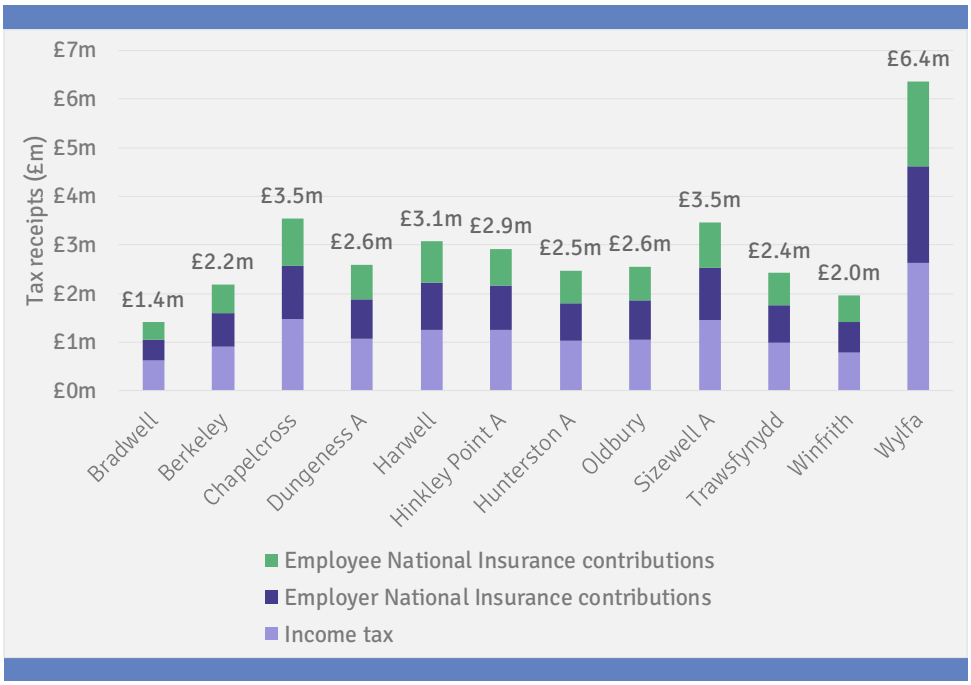
3.3 Current tax contribution

The current impact of Magnox sites can also be measured in terms of contribution to tax receipts. Below, we discuss the impact of sites on both national and local taxes.

3.3.1 National taxes

Through direct employment at the Magnox sites, income tax and national insurance contributions will be raised. The figure below shows the estimated revenues HMRC receives from these employment taxes. The relative magnitudes of the receipts from different sites is driven primarily by the number of employees, and to a lesser extent average wages.

Figure 25: Employment tax receipts



Source: Economic Insight analysis of data supplied by the NDA

In addition to employment taxes, central government will also receive:

- VAT from employees of Magnox sites and their suppliers when spending their wages; and
- Corporation Tax from Magnox Ltd and its suppliers in relation to any profit that is made.

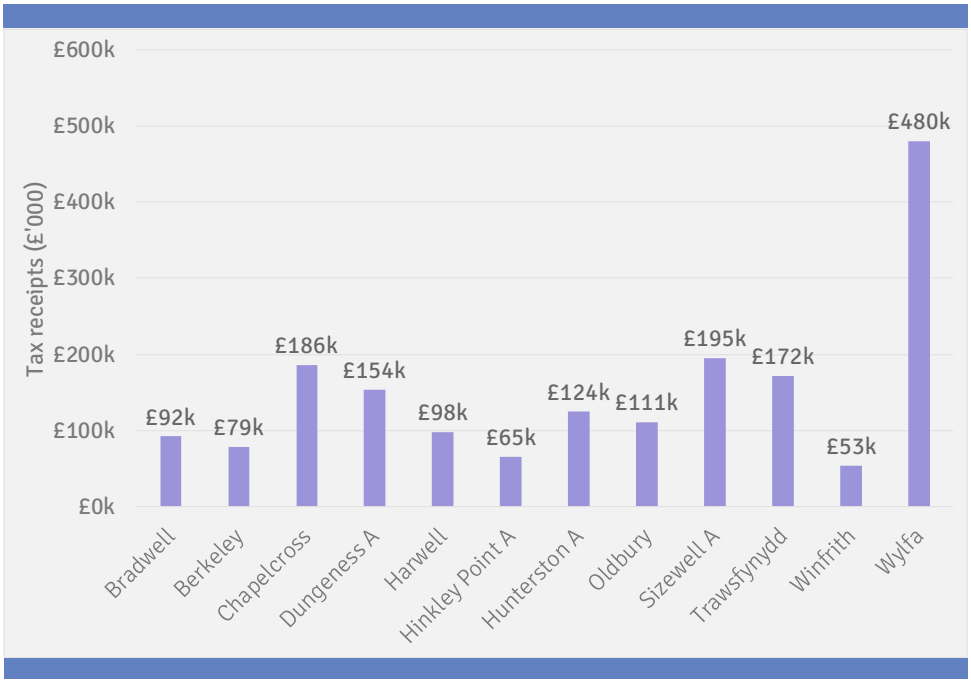
3.3.2 Local taxes

Activities at the Magnox sites will result in local tax receipts in the form of Council Tax and business rates (non-domestic rates). Whilst national taxes support all local economies (e.g. through welfare spending and healthcare), these local taxes are used by local authorities to fund services in their area. That is, these local taxes may have a more 'direct' local impact than national taxes.

The figures below show the estimated amount of council tax that is raised from individuals directly employed by the Magnox sites – firstly for the local authority

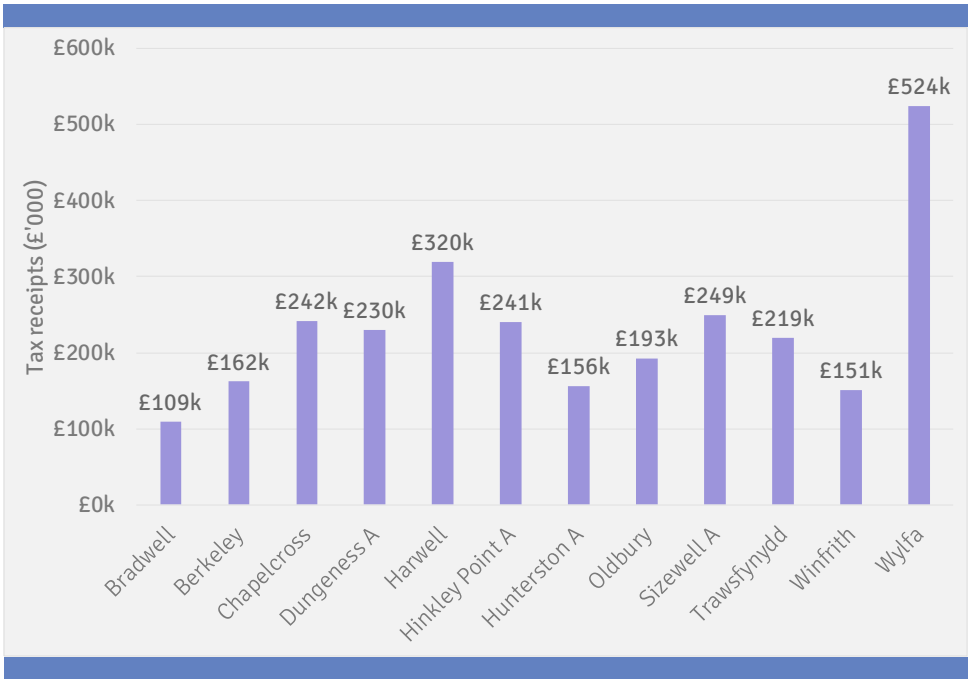
district that the site is located in, and then including adjacent local authority districts as well.

Figure 26: Council tax receipts from direct employees who live in the local authority district in which the site is located



Source: Economic Insight analysis of data supplied by the NDA

Figure 27: Council tax receipts from direct employees who live in the local authority district in which the site is located plus adjacent ones



Source: Economic Insight analysis of data supplied by the NDA

The table below shows these Council Tax receipts relative to local authority districts' total tax receipts. As can be seen, employee's Council Tax payments only account for a

small proportion of their local authority districts' total Council Tax receipts – as would be expected given the size of the workforces relative to total populations.

Table 8: Council tax receipts from direct employees relative to local authority districts' total tax receipts

Site	Council tax receipts from direct employees who live in the local authority district in which the site is located as a proportion of that local authority district's total Council Tax receipts	Council tax receipts from direct employees who live in the local authority district in which the site is located plus adjacent ones, as a proportion of those local authority districts' total Council Tax receipts
Berkeley	0.24%	0.03%
Bradwell	0.11%	0.04%
Chapelcross	0.33%	0.07%
Dungeness A	0.25%	0.07%
Harwell	0.12%	0.05%
Hinkley Point A	0.30%	0.10%
Hunterston A	0.26%	0.06%
Oldbury	0.08%	0.02%
Sizewell A	0.26%	0.11%
Trawsfynydd	0.27%	0.09%
Winfrith	0.16%	0.05%
Wylfa	1.39%	0.53%

Source: Economic Insight analysis

In addition to Council Tax paid by employees, the Magnox sites will further contribute to local authority funding through business rates. As of April 2013, local councils in England keep 50% of the business rates that they receive and pay the rest to central government, which in turn redistributes it between councils based on their needs. Additionally, local councils get to keep 50% of any growth in business rates above those projected.

The business rates paid by Magnox sites in the financial year 2017/18 are shown in the following table. Note that Wylfa received a rebate in 2017/18 and therefore is not included in the table.

Table 9: Magnox sites business rates 2017/18

Site	Business rate
Berkeley	£ 237,737
Bradwell	£ 215,929
Chapelcross	£ 184,500
Dungeness A	£ 58,385
Harwell	£ 518,799
Hinkley Point A	£ 58,346
Hunterston A	£ 389, 664
Oldbury	£ 126,344
Sizewell A	£ 58,242
Trawsfynydd	£ 202,095
Winfrith	£ 57,652

Source: Economic Insight analysis of data supplied by the NDA

In the following table, we show what percentage of local authority districts' business rates receipts are from Magnox sites. The proportions are generally below 1% of total business rates received, although there is some variation.

Table 10: Proportion of the site's local authority district total business rates coming from the site[8]

Site	Proportion of local authority district's total business rates coming from the site
Berkeley	0.88%
Bradwell	1.53%
Chapelcross	0.41%
Dungeness A	0.21%
Harwell	0.91%
Hinkley Point A	0.44%
Hunterston A	0.94%
Oldbury	0.09%
Sizewell A	0.09%
Trawsfynydd	0.55%
Winfrith	0.58%

Source: Economic Insight analysis of data supplied by the NDA and UK local government finance statistics

[8] Note that the latest data available for business rates received by local authority districts is as of the financial year 2016/17, whereas the business rates paid by the sites are as of the financial year 2017/18.

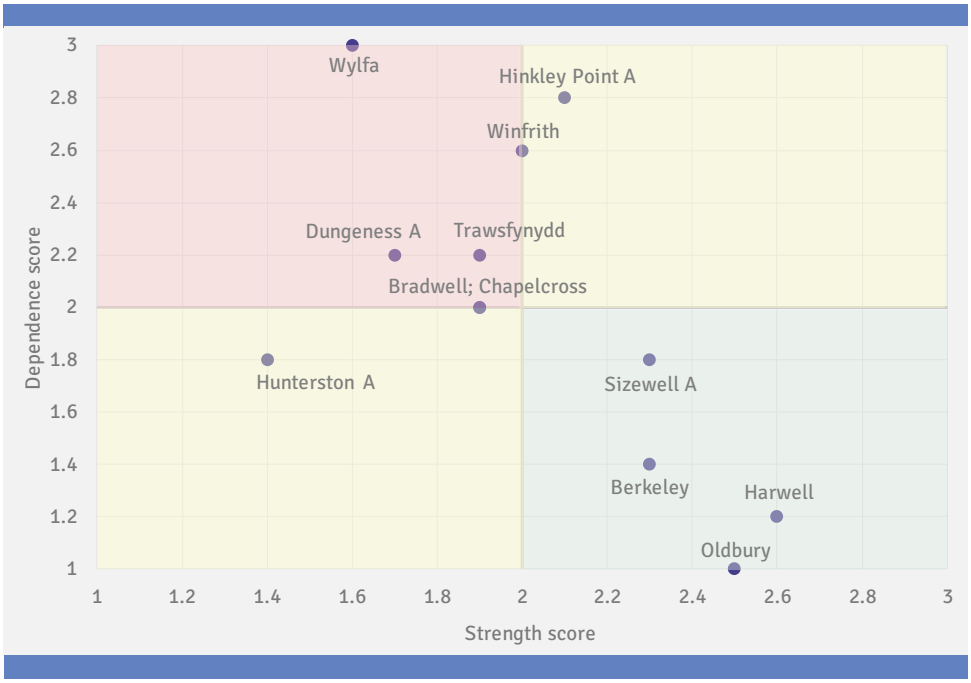
3.4 Evaluation of strength and dependence of local economies

In this section we assess the **current** socio-economic strength of the local economies in which the sites are located as well as their dependence on the sites' operations.

As was set out in section 2.4, we assess the labour market, general economy and society of the local authority district in which each site is located. For these three domains, we look at a number of metrics that reflect the current level of socio-economic activity in a local area, and assign the sites a score based on their relative distribution with respect to other local authorities in the UK for strength metrics and with respect to each other for dependence metrics. Once equally weighted and aggregated, each site has a score between 1 (low) and 3 (high) for strength and dependence.

The figure below shows how the local economies of each of the sites performs in total on the strength and dependence domains. The top left quadrant of the figure includes the sites whose local economy is: relatively more dependent on their Magnox site; and relatively less strong. Sites that fall into this quadrant may require greater support from the NDA to mitigate the effects of downturn. The local economies of the sites in the bottom right quadrant appear relatively stronger and relatively less dependent on their Magnox site, and may therefore require less support. The local economies of the sites that fall into the other two quadrants (or that fall exactly between quadrants) could be seen as 'medium priorities'.

Figure 28: Summary of strength and dependence score for Magnox sites



Source: Economic Insight analysis

The top left quadrant of the figure includes the sites whose local economy is: relatively more dependent on their Magnox site; and relatively less strong.

Notably, the local economies of the following sites fall into the 'high dependence, low strength' quadrant:

- **Wylfa**. The Isle of Anglesey was scored as having relatively low strength due, in particularly, to: low GVA per head (the lowest among the 12 sites); low average wages; a low proportion of the population that is of working age; and a low

migration flow. It was scored as having relative high dependency due mainly to the proportion of local employment and GVA that it contributes.

- **Trawsfynydd**. Gwynedd was scored as having low strength and high dependence due in particularly to low average earnings and a relatively high industry concentration in the local economy.

- **Dungeness A**. Low GVA growth and a low proportion of the population being of working age contributed to Folkestone & Hythe being scored as having low strength.

Whereas, the local economies of the following sites fall into the 'low dependence, high strength' quadrant:

- Sizewell A;
- Berkeley;
- Harwell; and
- Oldbury.

It should be noted that this analysis is based only on an evaluation of the current strength and dependence of local economies – we take a more forward-looking view in the next chapter. Furthermore, the criteria that we have selected and the equal weighting we have applied are based on judgement, and alternative well-reasoned choices could give different results. Nevertheless, the above figure gives an indication of the relative strength and dependence of the local economies of the sites.

In the following sections, we present the metrics for strength and dependence, and how each of the sites perform against them.

3.4.1 Strength of the local economies

The following figure shows the score that is assigned to each of the sites for the measures of strength. The steps for assigning strength scores are as follows:

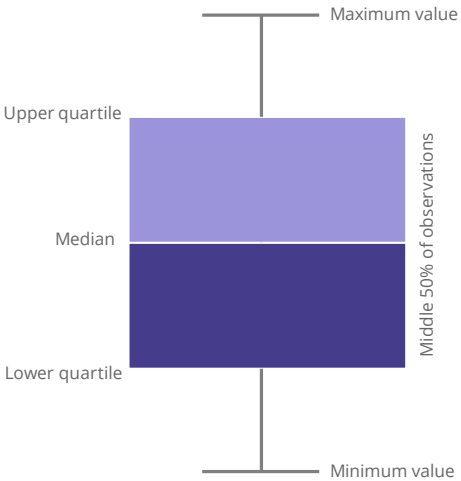
- Firstly, we look up the value for the metric (for example, employment rate) for the site based on the local authority district in which it is located.
- Secondly, we calculate the lower and upper quartile values for the metric across the local authority districts in England, Wales and Scotland.
- Thirdly, we assign the site a value 1 if its value is below the lower quartile, a value 3 if its value is greater than the upper quartile, and a value 2 if its value is between the lower and upper quartile values.

Note that a higher score is a reflection of stronger economic performance in the local authority district where the site is located.

Figure 29: Summary of scores across strength metrics for Magnox sites

Site / metric	Berkeley	Bradwell	Chapelcross	Dungeness A	Harwell	Hinkley Point A	Hunterston A	Oldbury	Sizewell A	Trawsfynydd	Winfrith	Wylfa
Employment rate	3	2	2	2	3	3	1	2	2	2	3	2
Proportion with NVQ4 or above	2	1	2	2	3	3	2	2	2	2	1	2
Migration flow	2	2	1	2	3	3	1	2	2	2	3	1
Proportion of working age	2	1	1	1	2	1	2	2	1	2	1	1
Median gross weekly pay	2	3	1	2	3	1	2	3	3	1	2	1
GVA growth rate	2	1	3	1	2	2	1	3	2	2	1	2
GVA per head	2	2	2	2	3	2	1	3	2	2	2	1
Gross fixed capital formation	3	2	2	1	3	2	2	3	3	1	2	1
Adjusted IMD	3	2	2	2	3	2	1	3	3	2	2	2
Average reported happiness	2	3	3	2	1	2	1	2	3	3	3	3

Source: Economic Insight analysis



In the following sub-section, we look at the distribution[9] of the local authority districts in England, Scotland and Wales across each of the metric, and point out where each of the sites' local authority district located relative to the distribution. Specifically, for each of the metrics, we present a box and whisker plot[10] and highlight the sites that are located in local authority districts that have values above or below the upper and lower quartile values of the metric – see opposite illustration.

3.4.1.1 Labour market

Employment

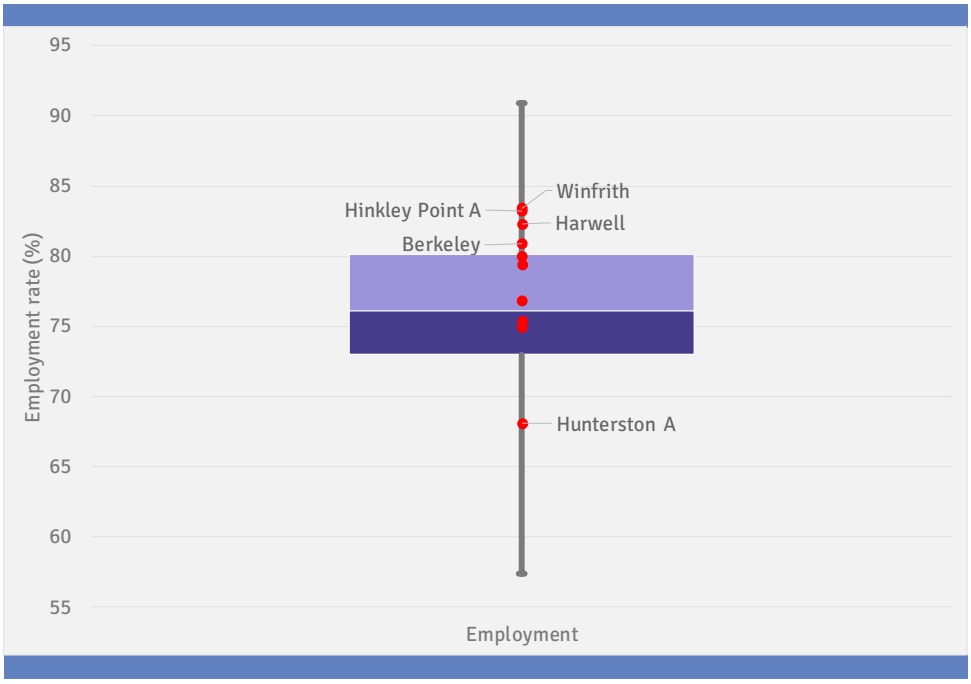
For the employment domain we look at the employment rate, which is the number of people employed as a percentage of the economically active population (employed plus unemployed individuals).

Generally, the higher the level of employment within a local area the stronger it is.

As the figure below shows, the local authority districts in which Winfrith, Harwell, Berkeley, and Hinkley Point A sites are located have an employment rate that is above the upper quartile value of employment rate for local authority districts in England, Scotland, and Wales. While Hunterston A, located in the North Ayrshire local authority district has an employment rate that is below the lower quartile value of employment rate for the other local authority districts.

[9] Note that we use the latest available data for each of the metrics.
[10] A box and whisker plot shows statistic summary of the data: maximum, minimum, median, upper quartile, and lower quartile. The box identifies the upper and lower quartile values, the line that divides the box shows the median value. The 'whiskers' go from each of the quartiles to the minimum or maximum values.

Figure 30: Distribution of employment rates in UK local authority districts



Source: Economic Insight analysis of ONS data

Skills

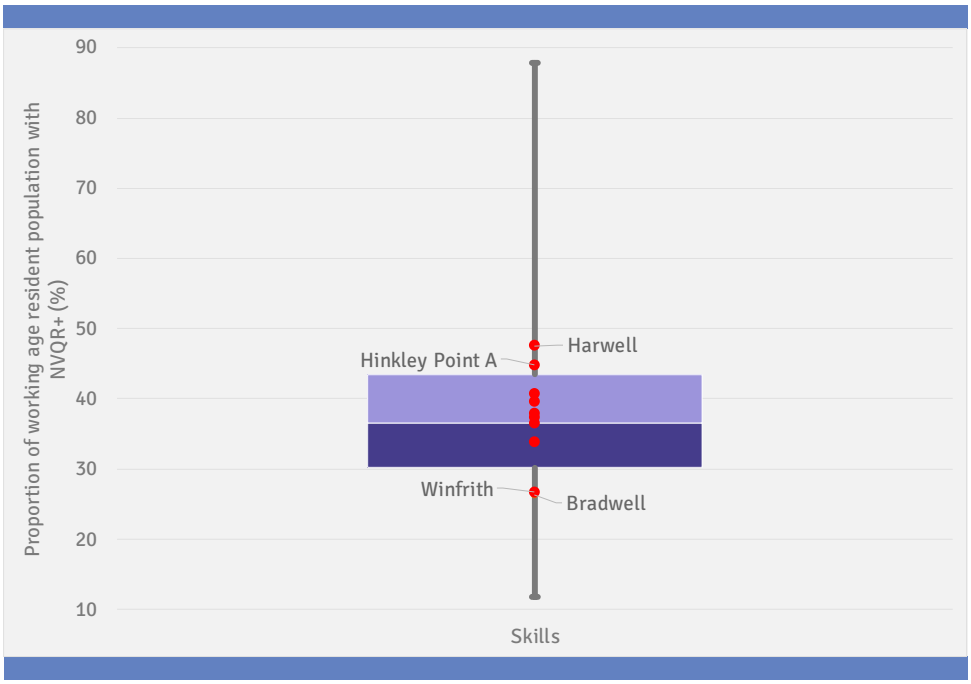
For the skills domain, we look at the percentage of working-age population within a local authority district with a qualification of level NVQ4[11] or above.

Generally, a more highly qualified population is more productive and better able to find employment opportunities.

As the box and whisker plot below shows, West Somerset (Hinkley Point A) and Vale of White Horse (Harwell) local authority districts have a large proportion of highly qualified working-age population, whereas Maldon (Bradwell) and Purbeck (Winfrith) lie in the lower quartile of the distribution for the local authority districts in England, Wales and Scotland.

[11] *For example, HND, Degree, and Higher Degree level qualifications or equivalent.*

Figure 31: Distribution of proportion of working-age resident with qualification level NVQ4+ in UK local authority districts



Source: Economic Insight analysis of ONS data

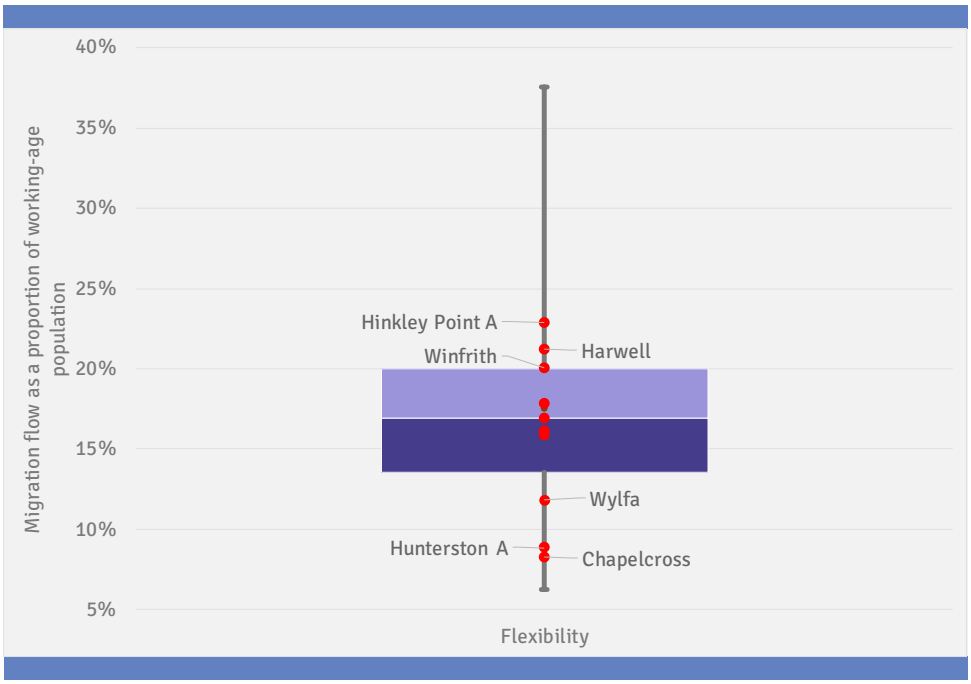
Flexibility

For the flexibility domain, we look at the migration flow (inward plus outward) both internal and international migration as a proportion of the working-age population.

Generally, a more flexible and adaptable labour market is better able to deal with changes in the labour market conditions, and is therefore stronger.

The figure below shows that, in general, sites located in local authority districts in Wales and Scotland have lower proportions of migration flow in comparison with sites located in England.

Figure 32: Distribution of proportion of migration flow to working-age population in UK local authority districts



Source: Economic Insight analysis of ONS data

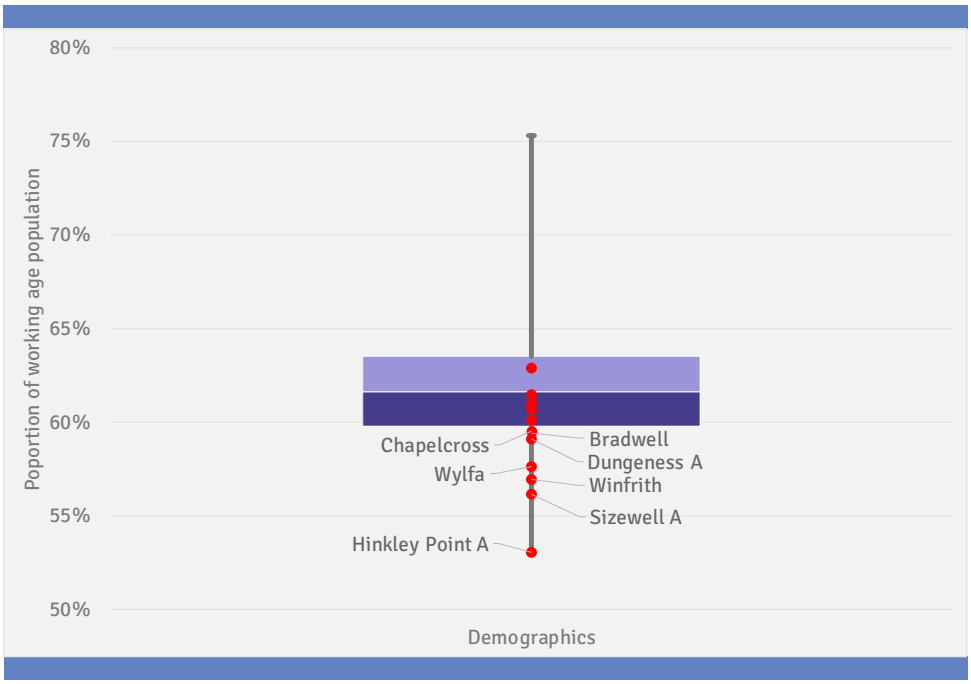
Demographics

For the demographics domain, we look at the proportion of the local authority district's population that is of working-age.

Generally, a higher proportion of working-age individuals in the population translates into a higher level of economic activity.

The figure below shows that more than half of Magnox sites are in local authority district that have a proportion of working-age population that is below the lower quartile value for local authority districts in England, Scotland and Wales.

Figure 33: Distribution of proportion of working-age population of UK local authority districts



Source: Economic Insight analysis of ONS data

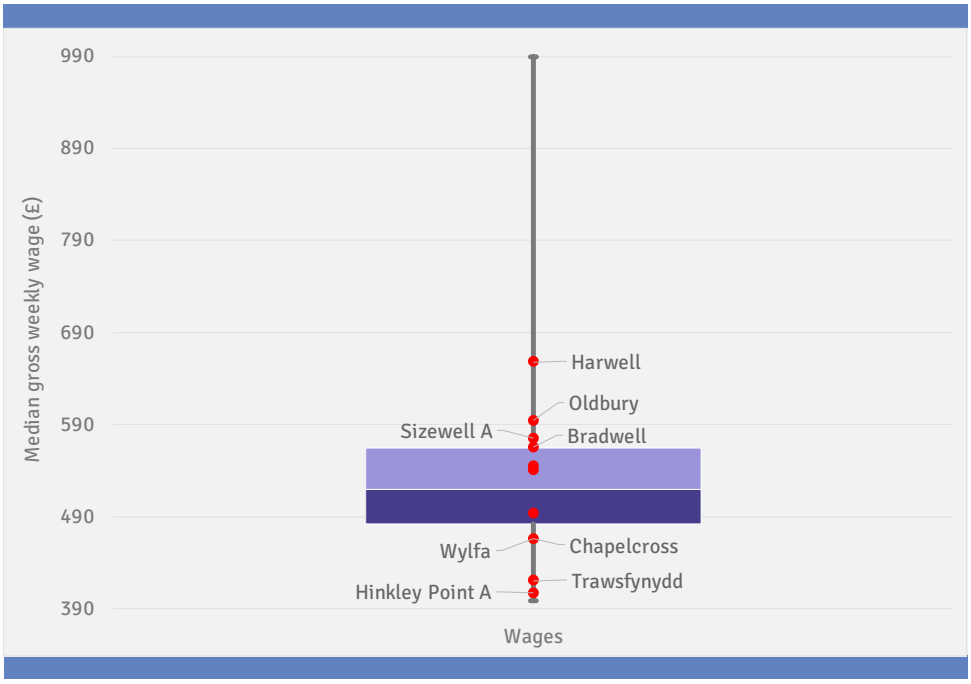
Wages

For the wages domain, we look at the median gross weekly pay for full-time employee jobs in the local authority districts.

Generally, a higher local wage level is consistent with a stronger economy.

We note from the graph below, that the Vale of White Horse local authority district, where the Harwell site is located, has the highest level of median gross weekly pay (in comparison with other sites), which is consistent with the local authority district having the highest percentage of working-age population with NVQ4+ as per Figure 31.

Figure 34: Distribution of weekly gross median pay across UK local authority districts



Source: Economic Insight analysis of ASHE data

3.4.1.2 General economy

Productivity

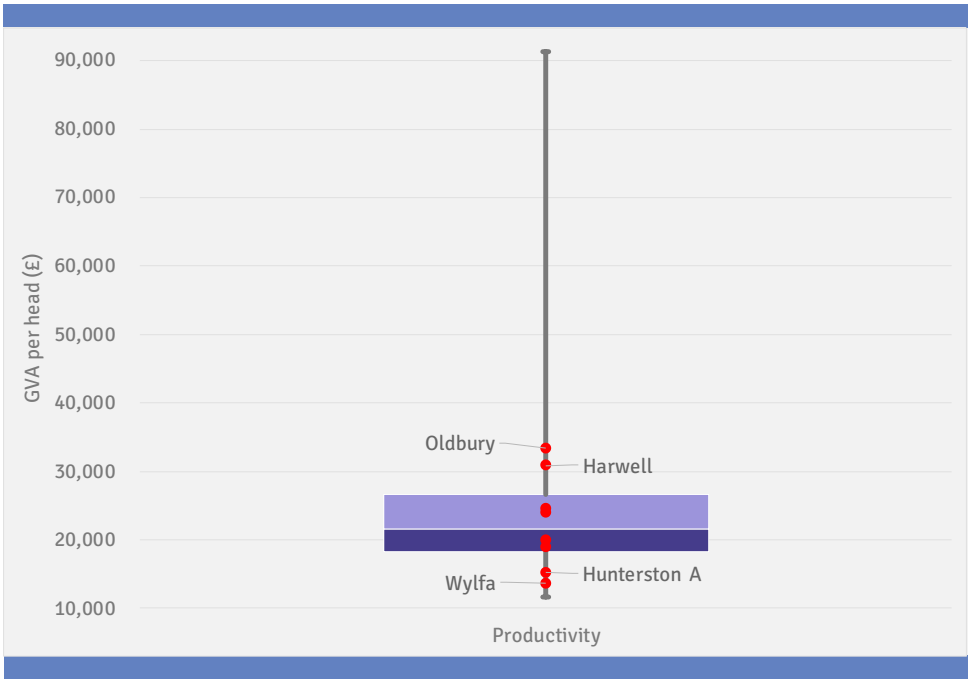
To assess productivity levels in a local economy, we look at GVA per head and GVA per head growth rate in a local authority districts.[12]

Generally, a stronger economy is consistent higher growth and higher levels of productivity.

We note from Figure 35 that Vale of White Horse (Harwell) and South Gloucestershire (Oldbury) have the highest GVA per head values in comparison with local authority districts of other sites, consistent with the two local authority districts also having the highest median gross weekly pay as per Figure 34, constant with economic theory that suggest more productive economies also have higher wage levels.

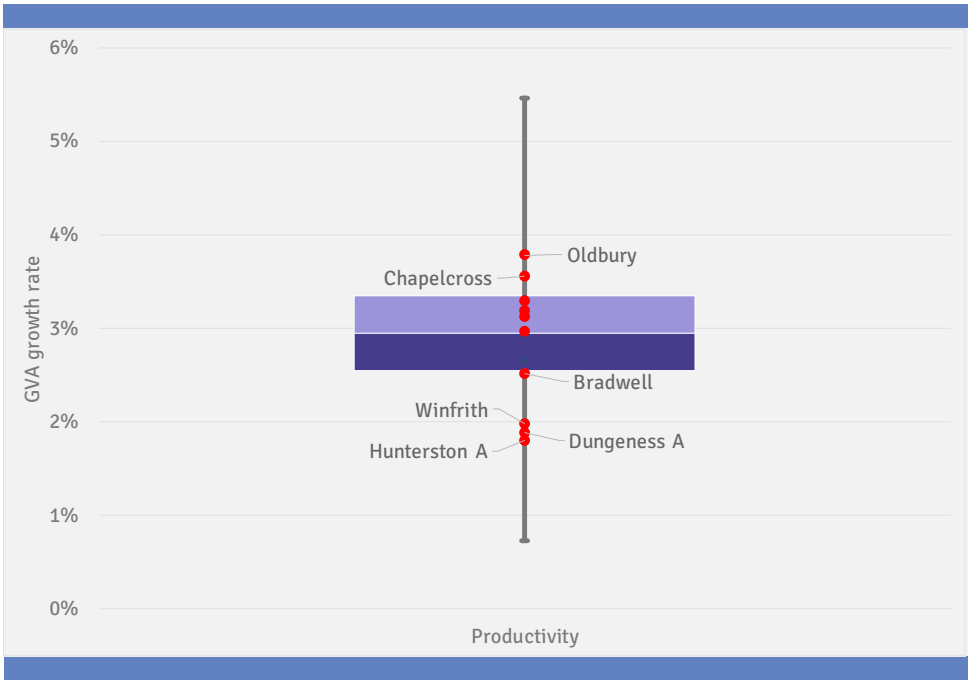
[12] *For GVA growth rate, we took the average growth rate across the years 1998-2016, to capture the 'trend' in economic growth in the local authority.*

Figure 35: Distribution of GVA per head across UK local authority districts[13]



Source: Economic Insight analysis of ONS data

Figure 36: Distribution of GVA growth rate across UK local authority districts



Source: Economic Insight analysis of ONS data

[13] *Note that GVA per head in City of London and Camden are outliers and have been excluded in looking at the distribution of values.*

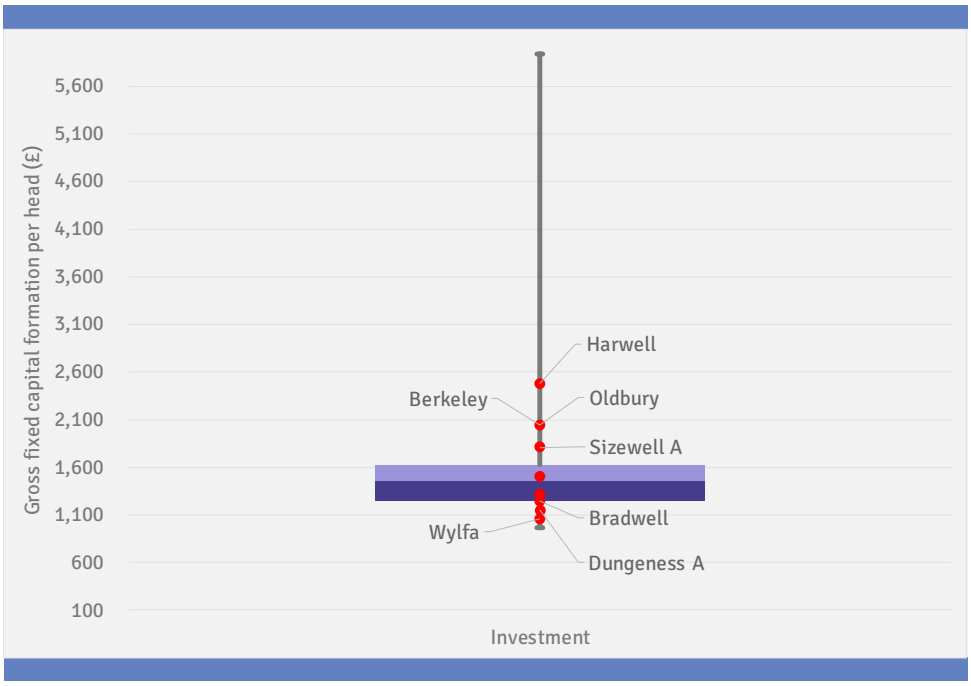
Investment

For investment levels, we look at gross fixed capital formation per head in NUTS2[14] areas in the UK, and assign local authority districts values based on the NUTS2 area in which they are located.

Generally, the greater the level of investment in an area, the stronger is the economy.

Consistent with high GVA per head and wage levels, the graph below shows that the local authority districts for Harwell and Oldbury also have a high level of gross fixed capital formation per head in comparison with other sites.

Figure 37: Distribution of investment levels across UK local authority districts



Source: Economic Insight analysis of ONS data

3.4.1.3 Society

Quality of life

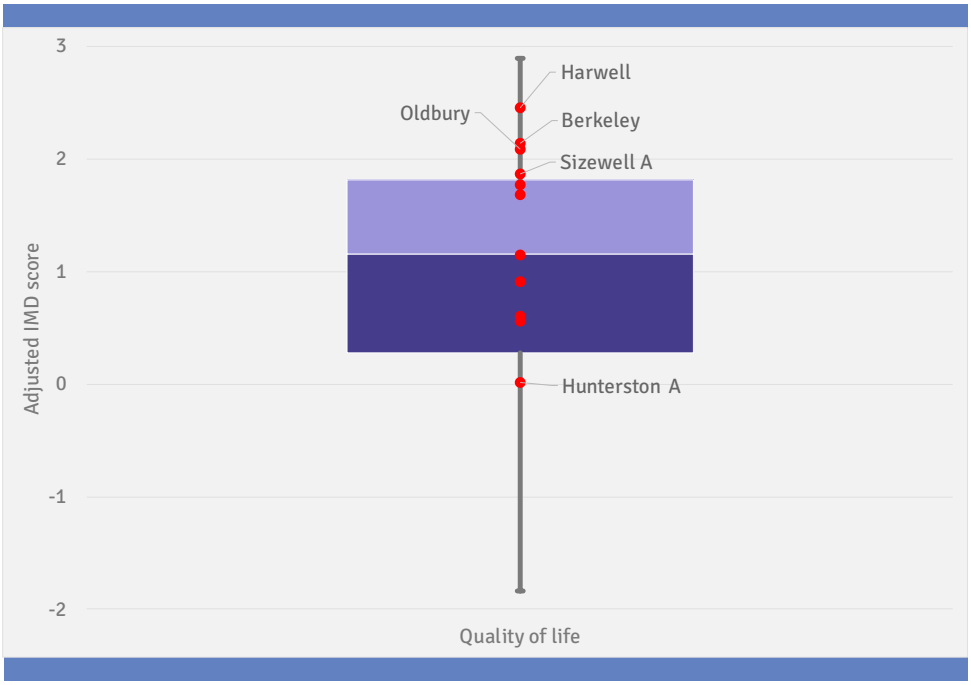
The metric that we look at here is an adjusted Index of Multiple Deprivation (IMD), which measures the relative deprivation of local areas in the UK. The IMD assess deprivation across the following domains: employment, education, health, income, crime, barriers to housings and services, and environment. As slightly different approaches are used to calculate IMD metrics in the different countries of the UK, we have calculated an adjusted measure which standardises the metrics, based on accepted practice. We implicitly associate a lower level of deprivation with a higher quality of life.

A higher quality of life is a sign of a stronger socio-economic area.

[14] Data for investment levels is not available at the local authority level, and NUTS2 is the most granular geographic level for which investment data is available.

As per the graph below, North Ayrshire (Hunterston A) is the only site located in a local authority district that has a quality of life measure below the lower quartile value, consistent with North Ayrshire also having an employment rate below the lower quartile value as per Figure 30.

Figure 38: Distribution of quality of life measure[15] across UK local authority districts



Source: Economic Insight analysis of devolved government statistics

Happiness

The metric for happiness is average reported happiness level such that a value of 10 is equivalent to feeling 'completely happy' yesterday, and a value of 0 equivalent to being 'not happy at all' yesterday.

The higher reported happiness level, the stronger an area can be considered socio-economically.

Figure 39 below shows that most Magnox sites are located in local authority districts that report high level of happiness. On the other hand, Harwell and Hunerston A are in local authority districts that have average reported happiness level below the lower quartile.

[15] *The quality of life measure we calculate is based on the standardised values of the IMD scores.*

Figure 39: Distribution of happiness levels across UK local authority districts

Source: Economic Insight analysis of ONS data

3.4.2 Dependence of the local economy on the site operations

In this section we look at the extent to which local economies are dependent on the site's socio-economic operations and activities. That is, we look at the economic and social contribution of the site to the local area to assess how the downturn of operations at the Magnox sites may impact the local economy if it were to take place 'now'. As with strength, we look at each of the site's contribution to the local economy in three different domains: the labour market; the general economy; and society. The steps for assigning dependence scores are as follows:

- Firstly, we calculate the value for the metric.
- Secondly, we calculate the lower and upper quartile values across the values for the 12 Magnox sites for each of the metrics.
- Thirdly, we assign the site a value 1 if its value is below the lower quartile, a value 3 if its value is greater than the upper quartile, and a value 2 if its value is between the lower and upper quartile values.

Note that in the case of dependence, a higher score is a reflection of a higher dependence of the local authority district on the site operations.

The figure overleaf shows the dependence score across each of the metrics for the 12 Magnox sites.

Figure 40: Summary of scores across dependence metrics for Magnox sites

Site / metric	Berkeley	Bradwell	Chapelcross	Dungeness A	Harwell	Hinkley Point A	Hunterston A	Oldbury	Sizewell A	Trawsfynydd	Winfrith	Wylfa
Proportion of local direct jobs related to the site relative to the number of all local jobs	1	2	2	2	2	3	2	1	2	1	3	3
Propotion of local direct, indirect and induced jobs relative to all local jobs	1	2	2	2	1	3	2	1	2	2	3	3
Direct, indirect and induced GVA as a proportion of total local GVA	1	2	2	2	1	3	2	1	2	2	3	3
Sum of the squares of the proportion of GVA from each industry	2	2	2	2	1	3	1	1	2	3	2	3
Contribution to social activities in local area	2	2	2	3	1	2	2	1	1	3	2	3

Source: Economic Insight analysis

In the following, we present the metrics for each of the three domains and discuss how Magnox sites perform against them.

3.4.2.1 Labour market

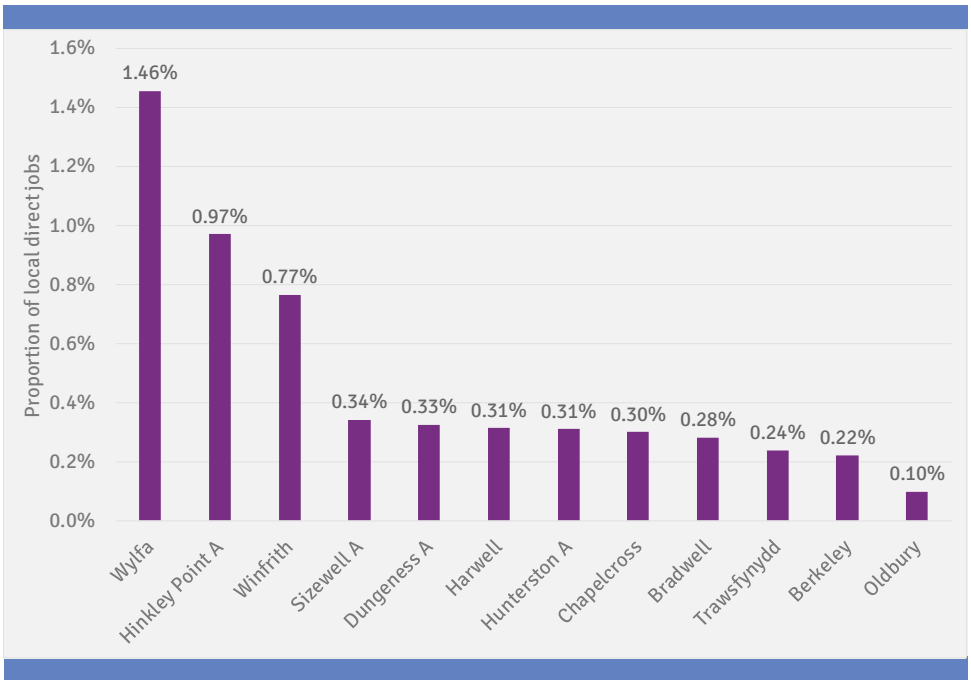
Employment

To assess the dependence of the local labour market on the site, we look at the relative size of site-related employment in the local area.

The greater the proportion of local jobs related to the site the more dependent the local area is likely to be on the site.

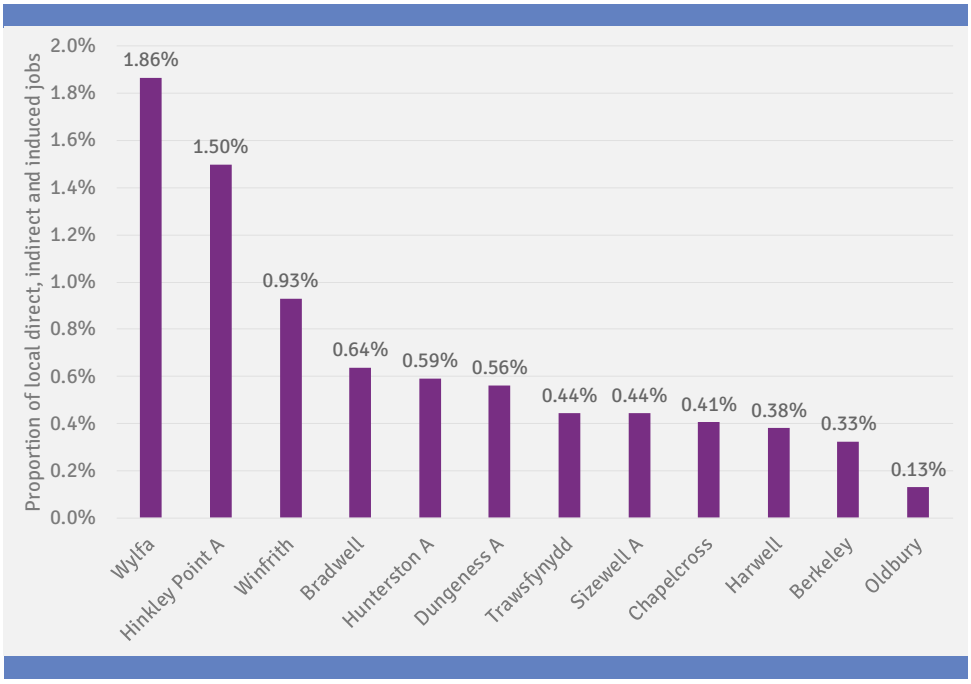
Figure 41 and Figure 42 below show that, in general, a site's direct as well indirect and induced contribution to employment in the local labour market is relatively small – although not insignificant. Still, there is some variation across sites, with Wylfa creating the largest proportion of employment in a local authority district in comparison with other sites, and Oldbury creating the smallest relative proportion.

Figure 41: Proportion of local direct jobs related to the site relative to the number of all local jobs



Source: Economic Insight analysis

Figure 42: Proportion of local direct, indirect and induced jobs relative to all local jobs



Source: Economic Insight analysis

3.4.2.2 General economy

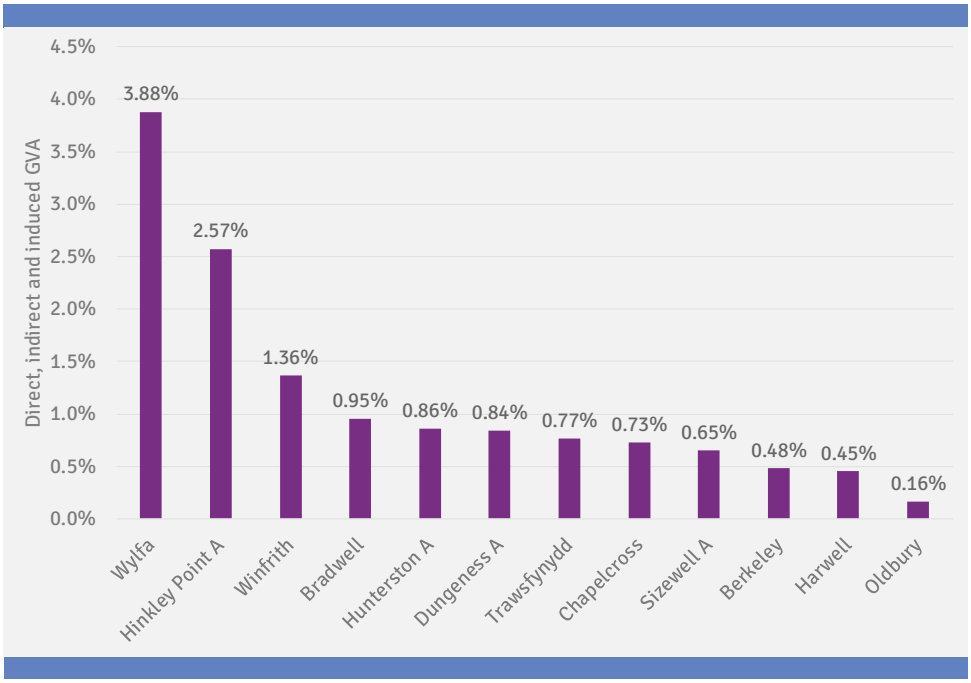
Output

For a measurement of the size of output in a local economy, we look the total GVA impact of sites (direct, indirect and induced) as a proportion of total GVA in the local authority district.

The greater the proportion of local output related to the site the more dependent the local area is likely to be on the site.

Consistent with the findings from the previous section showing the contribution of sites to the local labour market, Figure 43 below also shows that Wylfa has the highest proportional contribution to GVA, and Oldbury the smallest.

Figure 43: Direct, indirect and induced GVA as a proportion of total local GVA



Source: Economic Insight analysis

Concentration of local economy

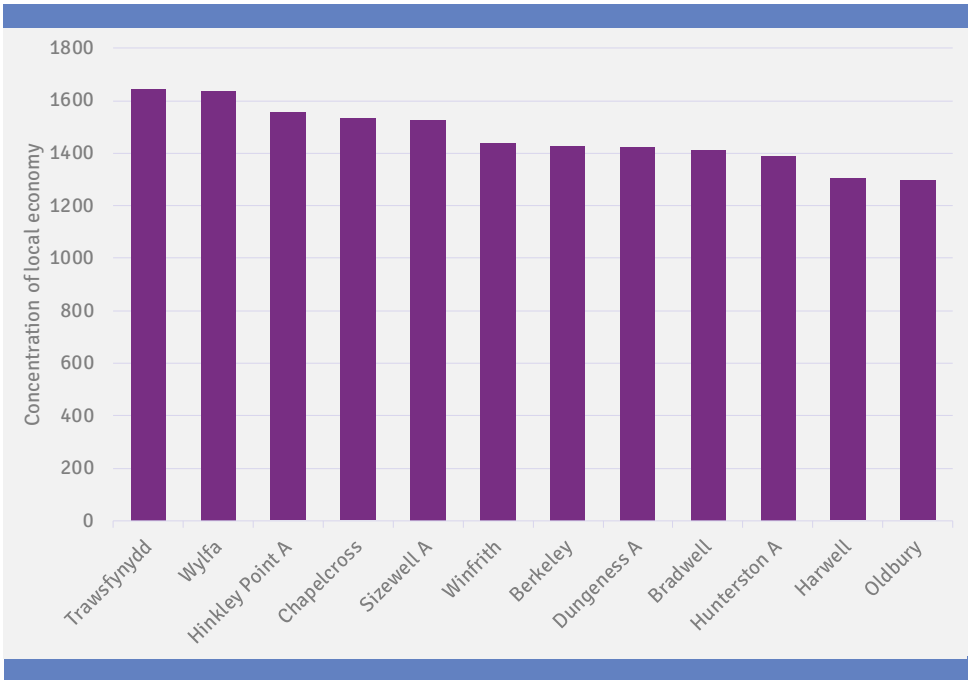
Additionally, we look at the concentration of economic activities in the local authority district where the site is located. The metric is the Herfindahl-Hirschman Index (HHI) – a measure of market concentration. The HHI value ranges from 0 to 10,000 where the higher the value of the index, the more concentrated is the market.

The more heavily concentrated an area's economy, the less able it is likely to be able to adapt to changes.

Figure 44 below shows that the local authority district where Trawsfynydd (Gwynedd) and Wylfa (Isle of Anglesey) are located are the most heavily concentrated local authority districts in comparison with local authorities where the rest of the sites are located. Oldbury (South Gloucestershire) is located in a local authority district that is relatively more diversified. It should be noted that the sites' local authority

districts can all be considered 'moderately concentrated' markets.[16] That is, an HHI value of less than 1,500 is a competitive market; a value greater than or equal to 2,500 is highly concentrated market; and a value between 1,500 and 2,500 is a moderately concentrated market.

Figure 44: Sum of squares of the proportion of GVA from each industry in the local economy



Source: Economic Insight analysis

3.4.2.3 Society

Socio-economic contribution of the sites to the local economies

Besides the site direct economic contribution to the local area, they also contribute to the wider society through various activities and donations. Examples of these contributions include:

- opening up of new study centres;
- donations to local charities; and
- helping in diversifying the local economy.

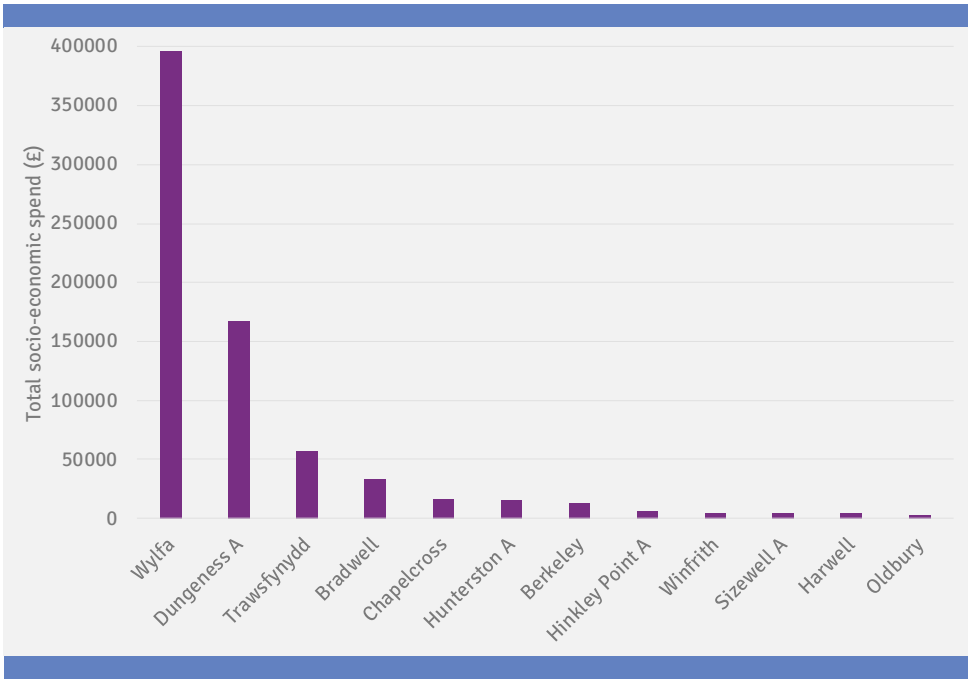
These types of activities are also important for a comprehensive overview of the role that a site plays in a local economy.

The more social activities provided and facilitated by the site, the greater the local society is likely to depend on it.

[16] *Generally, an HHI value of less than 1,500 is considered a highly competitive market; a value greater than or equal to 2,500 is highly concentrated market; and a value between 1,500 and 2,500 is a moderately concentrated market.*

In the following, we look at the size of the sites' social contribution to the local areas, as per the socio-economic spend by each of the sites. Figure 45 shows that Wylfa's contribution to social activities is largest and Oldbury is smallest.[17]

Figure 45: Relative size of social activities



Source: Economic Insight analysis

We note that the above is an imperfect measure of the site's contribution to society where a £1 spend does not necessarily have the same impact across sites. Additionally, there are other alternative ways that the site can contribute to the social cohesion and participation that are not necessarily captured by the total spending figures in the chart above. Examples include the activities that the employees of the sites organise between each other (such as football matches or other group activities) that boost the general sense of belonging in the society.

[17] *See the NDA socio-economic spend report 2016/17: https://www.gov.uk/government/publications/socio-economic-spend-report-2016-to-2017/socio-economic-spend-report-201617#total-spend*

4. Impact of future downturn on local economies

Building on our assessment of the current impact of sites, this chapter assesses what the potential future impact of downturn may be. In summary:

- Downturn at the Magnox sites will impact local individuals, communities, businesses, and governments. Whilst we focus on the future employment effects of downturn, it should be noted that downturn could have prolonged effects in relation to: the physical and mental health of employees; the family and friends of employees; and the wider community.

- Consistent with the current impact of sites, the main channel through which downturn will affect local economies is through direct employment – and as such this is the aspect this chapter focuses on. As per our conceptual framework, we assess both supply and demand factors that will determine the level of employment in sites' local economies in the future.

- Whilst the profile of labour demand from the Magnox sites varies over the next decade, in the second half of our forecast period we expect there to be minimal employment. This means that there is a risk of negative socio-economic impacts. There are, however, instances of potential increased activity at sites in the near-term – and therefore increased demand for labour, which will come with associated positive economic impacts.

- We expect the reduced demand for labour from the Magnox sites to be partly mitigated by employment opportunities at currently active adjacent sites and nuclear new builds. These alternative employers are often relatively large compared to the Magnox sites. The presence of a current or future adjacent site varies across Magnox sites. Of course, the extent to which these sites may provide employment opportunities to ex-Magnox staff will depend on factors such as role similarity and the availability of open positions.

- In addition to demand from other nuclear sites, the demand for staff that would otherwise be employed at the Magnox sites will depend on the strength of local

economies and the extent to which employment opportunities are available in sectors that require similar skills to nuclear decommissioning.

- In relation to supply factors, we find that retirements among the current cohort of Magnox employees is likely to partly mitigate negative demand. That is, a large proportion of current Magnox staff are expected to retire over our forecast horizon. Given that wages in the nuclear sector are, in general, higher than UK average wages, it can be reasonably argued that Magnox retired employees will have high pensions. In addition, the level of local migration and training and education available will affect the supply of labour in the local economies.

- To 'trade-off' the positive and negative factors for each site we have undertaken both a qualitative and quantitative comparison. Broadly, this suggests that Bradwell, Chapelcross, Harwell and Winfrith will be most 'at risk' of negative employment effects (in terms of the absolute number of current staff that may not have an employment opportunity for prolonged periods of time in the local nuclear sector). Hinkley Point A, Oldbury, Berkeley and Wylfa appear relatively insulated, due to their adjacent active and new build sites. It should be kept in mind, however, that there is uncertainty around decommissioning dates and whether new builds will go ahead.

Whilst there appears to be differences in the risk of negative impacts from downturn across the Magnox sites, we note that there is inherent uncertainty in relation to forecasting future impacts. For example, it may be that Magnox staff have highly demanded skills sets, and any negative employment effects are minimal and short-lived. Nevertheless, our analysis provides an indication of where the NDA may wish to focus its attentions to minimise negative socio-economic impacts – as we explore in more detail in the next chapter.

The rest of this chapter is structured as follows:

- we first outline the range of potential impacts that may arise from site downturn;
- we then assess a number of separate drivers of the future supply and demand of local labour; and
- then finally, we draw the above evidence together in both qualitative and quantitative frameworks.

4.1 Range of potential impacts

Future downturn at the Magnox sites may affect a range of individuals in a range of different ways. The main focus of this chapter is on the employment effects on Magnox staff because: (i) the majority of economic impacts arise through the direct employment channel, rather than through knock-on supply chain effects; and (ii) many of the other effects of downturn are closely related to employment effects. However, we briefly discuss a range of other types of effects.

Further to the immediate employment effect of site closure, evidence suggests that individuals may also experience the following effects.

- **Long-term wage scaring**. The loss of a job may damage an individual's long-term future wage prospects. That is, aside from the immediate loss of income resulting from being unemployed, an individual may experience lower levels of income

even once they find another job, compared to if they were in continuous employment. This could arise, for example, because time out of employment results in lower levels of experience, or due to negative signals of being unemployed for a period of time.[18] To help mitigate this impact, the NDA allocates resources to prepare / teach Magnox employees with the skills that are in demand in the labour market. This is, to eventually aid workers with re-entering the labour market.

- **Employment vulnerability in future recessions**. Similar to above, those that have been made unemployed before may be more susceptible to losing their job again if a recession occurs. This is consistent with the 'last in, first out' principle.[19]

- **Health problems**. A number of studies have found increased occurrences of health problems resulting from job losses. This includes both mental and physical conditions. Issues noted in the literature include depression, poor self-esteem, and anxiety. Negative health effects have been found to be more prevalent in older workers.[20] Relatedly, for Magnox sites, Figure 9 shows the age profile for employees at each of the sites.

In addition to effects on those who lose their jobs, site downturn can also have implications for other individuals and local societies. For example:

- **Partner well-being.** Besides the direct impact of job loss on the individual's mental health, evidence shows that it also impacts the partner's mental wellbeing. The negative experience might as well increase the probability of divorce by a statistically significant degree.[21]

- **Children well-being.** The effects of job loss extend well beyond the individual and may even have an impact on children's performance in schools. This is also argued to have a ripple effect on the performance of other students in the classroom, where the larger the number of people suffering from a job loss in a community, the lower the scores of all students in that community.[22]

- **Breakdown of local communities.** The closure of sites can result in the weakening and breakdown of local communities. For example, this can arise through social activities that were indirectly facilitated by the site ceasing, or individuals moving out of an area.

Finally, we note other channels and groups of individuals that may be affected by future site downturn.

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[18] See for example 'Advanced manufacturing skills tracking survey: A report investigating the post-closure resettlement patterns of the former Atmel workforce'. Centre for Urban and Regional Development Studies, Dawley, 2008.
[19] See for example 'Lasting or latent scars? Swedish evidence on the long-term effects of job displacement'. Journal of Labour Economics, Elliason and Storrie, 2006.
[20] See for example 'Job loss is bad for your health: Swedish evidence on cause-specific hospitalization following involuntary job loss'. Social Science & Medicine, Elliason and Storrie, 2009; and 'Serious health events following involuntary job loss in New Zealand meat processing workers'. International Journal of Epidemiology, Keefe et al., 2002.
[21] See for example 'The impact of job loss on family dissolution'. Journal of Population Economics, Doiron and Mendoila, 2012.
[22] https://childandfamilypolicy.duke.edu/news/long-shadow-unemployment/

- **Local businesses**. Local small businesses that are dependent on the site's operations or the spending of the site's employees (for example, a local supermarket) are also likely to be impacted in terms of revenues due to the decreased demand – and subsequently their employment. As shown in the previous chapter though, local businesses are primarily affected through Magnox employees spending their wages, rather than Magnox itself purchasing goods and services from local suppliers. We therefore expect that the impact of downturn on local businesses to be focused on consumer-facing companies, such as restaurants and shops.

- **Housing markets**. In the case that employees choose to migrate as a result of site downturn, demand for housing will decrease in the local area. If there is a large movement of people from a concentrated area, this could have an effect on average local house prices. However, given the scale of employment effects relative to the size of local authority district populations and the fact that only a small proportion of staff may migrate, we do not envisage any significant house price effects.

- **Local councils**. Local councils can be impacted through the reduction in tax revenues, as we explored in the previous chapter. Changes in tax revenues will largely be a function of migration, which we expect to be small compared to the population.

As can be seen from the above discussion, most of the impacts of downturn arise through the direct employment channel. Therefore, the rest of this chapter explores factors that will determine the extent of future employment effects.

4.2 Future labour demand

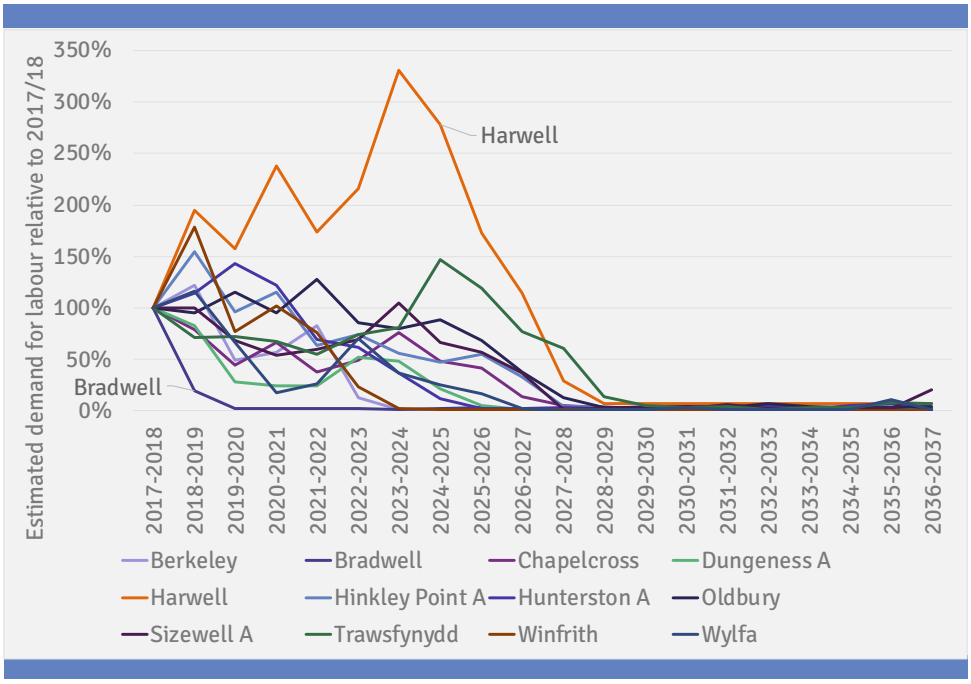
As per our framework, in the sub-sections below we consider three sources of demand for local labour: Magnox site activities; other large local employers; and the general economy.

4.2.1 Magnox site activities

The level of activity at the Magnox sites will decline over the next 20 years, and this will have significant impacts on the demand for staff relative to current employment numbers. It is currently expected that most, if not all, sites will have entered the care and maintenance phase within the next decade. At such a stage in the decommissioning process, required staff levels are very low.

The figure below shows our estimate of labour demand from each site, relative to 2017/18. These estimates are based on the relative budgeted cost of work performed in each year relative to 2017/18. As can be seen, Bradwell is expected to be the first site for which demand for labour falls to minimal levels. Whilst for Harwell, we expect demand for labour over the next decade to generally be above current levels, after which it will also fall to minimal levels.

Figure 46: Estimated labour demand from Magnox sites



Source: Economic Insight

Taken alone, sites that experience sooner and more significant reductions in labour demand would be expected to have a greater adverse impact on local economies. However, we recognise that future activity levels are uncertain, and could potentially be varied to mitigate any adverse effects.

4.2.2 Other large local employers

The effects of downturn are likely to be partly dependent on currently active adjacent nuclear sites, nuclear new builds, and other energy/industrial sites. New or existing sites in the local area may mitigate the negative effects of a Magnox site closure – by providing employment alternatives and supporting supply chains. Whereas, the closure of an adjacent nuclear site may increase the negative effects of a Magnox site closure – by increasing the number of unemployed people looking for similar jobs and harming local supply chains (this is discussed further below).

The implications of the other large local employers on the effects of Magnox site downturn will generally depend on the following.

- **Role similarity**. The more similar the roles are at another nearby site, the greater the relevance that site is to the effects of downturn. The current presence or future establishment of a site that requires similar roles will likely mitigate the effects of downturn. That is, staff from the Magnox site would have an alternative employer demanding similar skills to their previous job – and may employ those made redundant. The closing down of another site that employed individuals with similar roles to those at the Magnox site would likely increase the negative effects of downturn. This is because there would be more people looking for the same jobs, thus lowering the probability that an individual is re-employed after redundancy.

- **Physical proximity**. The closer another large employer is to the Magnox site, the greater the influence (either positive or negative) it will have on the effect of downturn.

- **Size**. The larger another local employer is the greater the influence it will have on the effect of downturn.

- **Overlap of supply chains**. If a new large local employer is established that has a similar supply chain to the Magnox site, it would likely mitigate any supply chain effects (although given the national, rather than local, nature of supply chains, this is likely to be a relatively inconsequential factor).

- **Timings**. The relative time at which a new site opens (or an old one closes) compared to downturn activity at the Magnox site will influence the effects of downturn.

- **Level of uncertainty**. For the purpose of evaluating future impacts, it is important to take into consideration how certain or uncertain future developments are expected to be e.g. how likely a proposed nuclear new build is to be built.

The following sections provide details of the evidence we have collected regarding other large local employers.

4.2.2.1 Current adjacent nuclear sites

As specified in the following table, there are four Magnox sites that have current active adjacent nuclear sites. We understand that the presence of an active adjacent site may partly mitigate the effects of downturn at the Magnox site. This is because some of those being made redundant from the Magnox site may be re-employed by the adjacent site. In particular, there are skills overlaps between active and decommissioning sites e.g. civil engineering skills.

Notably, the four sites are expected to shut down during the 20-year period we are analysing – although Sizewell B is only expected to close right at the end of this time period. We understand that the skills required for decommissioning 'B sites' is very similar to decommissioning Magnox sites, and therefore the active sites shutting down may increase demand for current Magnox staff. We note that precisely when sites close may differ in reality compared to current plans.

Table 11: Details of currently active adjacent nuclear sites

Magnox site	Active adjacent site	Expected shutdown of adjacent site	Current employment at adjacent site
Dungeness A	Dungeness B	2028	750 (550 EDF employees plus 200 contractors)
Hinkley Point A	Hinkley Point B	2023	755 (535 EDF employees plus 220 contractors)
Hunterston A	Hunterston B	2023	770 (520 EDF employees plus 250 contractors)
Sizewell A	Sizewell B	2035	770 (520 EDF employees plus 250 contractors)

Source: EDF Energy website

In addition to adjacent sites, others that are further away may also influence the impact of downturn. As is shown in the following figure, there are other NDA sites, and other active plants that are 'near' Magnox sites – although generally not within the local authority district of the Magnox site, or those adjacent.

Figure 47: Map of Magnox sites, other active nuclear sites, and other NDA sites

Source: Economic Insight analysis

We also note the existence of the Harwell science and innovation campus, which currently houses over 200 organisations and over 5,500 staff. We understand that it would provide significant opportunities for science and engineering staff from the Harwell site.

4.2.2.2 Nuclear new builds

Further to existing nuclear power stations, there is a pipeline of nuclear new builds that may mitigate some of the negative effects of Magnox site downturn. The UK Government's 2011 energy national policy statement confirmed that eight sites are suitable for new nuclear power stations by 2025: Bradwell; Hartlepool; Heysham; Hinkley Point; Oldbury; Sizewell; Sellafield; and Wylfa.[23] Of most relevance to the Magnox sites, Table 12 below details the current plans for new nuclear power plants that would be adjacent to the Magnox sites.

We anticipate that an adjacent nuclear new build will have mitigating effects to Magnox site downturn by increasing demand for local jobs, and increasing demand in

[23] *'National Policy Statement for Nuclear Power Generation (EN-6), Volume I of II', Department for Energy and Climate Change, July 2011.*

local supply chains (although this latter effect may be smaller). We understand that during the construction phase the skills of Magnox employees will be less relevant than during the operational phase of new sites.

We note that the level of certainty to which plans will be carried out vary.

Table 12: Details of nuclear new builds

Magnox site	Adjacent new build	Current development stage	Construction start date	Start-up date
Bradwell	Bradwell B	Proposed		
Hinkley Point A	Hinkley Point C	Planned	2019	2026
Oldbury and Berkeley[24]	Oldbury B	Planned		Late 2020s
Sizewell A	Sizewell C	Planned		
Wylfa	Wylfa Newydd	Planned	2019	2025

Source: Economic Insight review of publicly available information

Notably, these sites are expected to be significant employers, compared to the Magnox sites currently. For example:

- **Hinkley Point C**: There are currently 1,700 workers on site, during peak time this will reach 5,600 workers, and around 900 workers will work there full-time.
- **Oldbury B**: 4,000 workers during construction time, 9,000 workers at peak of construction, and 850 permanent jobs.
- **Sizewell C**: 5,600 construction workers, and 900 full-time employees.
- **Wylfa Newydd**: 8,350 construction workers and 850 permanent jobs.

[24] Due to the proximity of Oldbury and Berkeley, we consider Oldbury B to be of relevance to both sites.

4.2.2.3 Other energy/industrial sites

Table 13 below details a number of other energy and industrial site developments that we have identified that may influence the effects of Magnox site downturn.

Table 13: Other energy / industrial sites

Magnox site	Nearby site	Details
Wylfa	Orthios biomass plant	The planned plant is expected to generate 500 permanent jobs, and a further 1,200 during the construction phase by 2019.
Bradwell	Tilbury Power Station	The proposed coal-fired power station is expected to create 1,500 jobs during construction and up to 100 'highly-skilled' jobs when operational.
Dungeness A	Kent CHP	The biomass power plant created around 300 jobs during construction phase (the expected operation date is summer 2018) and is expected to create 25 full-time jobs once operational in summer 2018.
Hinkley Point A	West Somerset Tidal Lagoon	This project is still in negotiation phase and is expected to create between 60 to 100 jobs once operational.
Oldbury	Seabank 3	The proposed power plant is expected to create 800 jobs during construction period and 40 full time jobs once operational.
Chapelcross	Beatrice	The offshore wind project is expected to support more than 21 years of employment once operational in 2019.

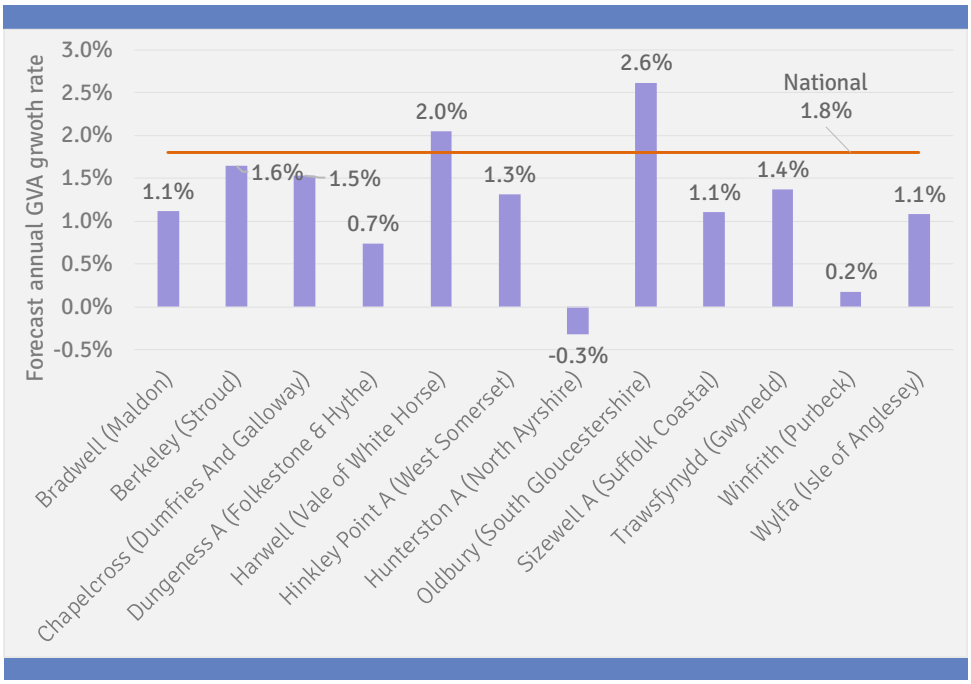
Source: Economic Insight review of publicly available information

4.2.3 General economy

Further to the specific sources of labour demand discussed above (which are closely related to employment at Magnox sites), we consider labour demand from the local economies more generally. This is relevant because a faster growing local economy is likely to generate more jobs that could absorb any negative employment effects arising from site downturn – both in terms of ex-Magnox employees and those whose jobs are supported through knock-on effects.

The figure below shows Economic Insight's central forecast for annual GVA growth across the sites' local economies (here defined as the local authority district in which they are located) over our forecast period, compared to the expected growth rate for the country as a whole. Notably, the area around the Oldbury site is expected to experience the strongest growth, whilst the areas around Dungeness A, Hunterston A and Winfrith are expected to grow at the slowest rate (the area around Hunterston A may even experience negative growth).

Figure 48: Central forecasts of average annual GVA growth in sites' local economies (local authroity district) 2017-2037



Source: Economic Insight

These forecasts are for local authority districts, and the extent of growth can vary significantly at more disaggregated levels. For example, growth may be concentrated around a large town within a local authority district. However, due to a lack of data this is difficult to determine in practice – in part, because economic activity is difficult to assign to specific geographic locations. Furthermore, at very granular levels economic forecasts become incredibly uncertain.

These forecasts do not explicitly include the impact of site downturn, or any significant changes in local policy. It should also be noted that these forecasts come with a high degree of uncertainty. Accurately predicting UK growth rates even a few years in advance is challenging, and doing so for local authority districts over a 20-year period is even more challenging. As such, we place less weight on these predicted growth rates compared to the other evidence presented in this chapter which is subject to less forecast error.

Another way to consider labour demand from the general economy is to look at the sectoral composition of sites' local economies. This can provide an insight into why local economies are expected to perform a certain way, 'where' employment demand may come from, and how relevant it is to the job prospects of those affected by Magnox sites.

In general, the prospects for low skilled manufacturing jobs are less positive than those for high skilled services jobs. Furthermore, there are certain industries that are expected to experience significant growth over the coming decades, such as IT/tech, healthcare, and green energy.

The following figure shows the sectoral breakdown of the site's local authority districts. However, it should be noted that the available data is at relatively aggregated levels, and it is challenging to draw firm conclusions from it.

Figure 49: Sectoral breakdown of the site's local authority districts (proporiton of GVA, 2016)

	Bradwell (Maldon)	Berkeley (Stroud)	Chapelcross (Dumfries And Galloway)	Dungeness A (Shepway)	Harwell (Vale of White Horse)	Hinkley Point A (West Somerset)	Hunterston A (North Ayrshire)	Oldbury (South Gloucestershire)	Sizewell A (Suffolk Coastal)	Trawsfynydd (Gwynedd)	Winfrith (Purbeck)	Wylfa (Isle of Anglesey)
Agriculture, mining, electricity, gas, water and waste	3%	6%	8%	8%	4%	20%	11%	3%	8%	10%	6%	6%
Manufacturing	14%	24%	14%	6%	7%	5%	15%	15%	5%	7%	13%	11%
Construction	15%	8%	5%	8%	8%	7%	8%	8%	7%	6%	6%	7%
Distribution; transport; accommodation and food	21%	16%	21%	21%	15%	22%	18%	16%	27%	20%	16%	24%
Information and communication	2%	4%	3%	2%	12%	1%	1%	7%	11%	2%	2%	1%
Financial and insurance activities	3%	1%	2%	5%	2%	1%	2%	6%	1%	3%	1%	2%
Real estate activities	17%	13%	14%	18%	17%	17%	11%	10%	17%	14%	22%	18%
Professional and administrative services	9%	9%	6%	10%	14%	5%	8%	17%	6%	4%	9%	5%
Public administration; education; health	13%	15%	23%	18%	17%	16%	21%	16%	14%	29%	17%	22%
Recreation, other services and household activities	4%	4%	4%	5%	4%	6%	5%	2%	3%	5%	7%	4%

Source: Economic Insight analysis of ONS data

4.3 Future labour supply

As per our conceptual framework, the following sub-sections present evidence in relation to three aspects of future labour supply: generations; migration; and training and education.

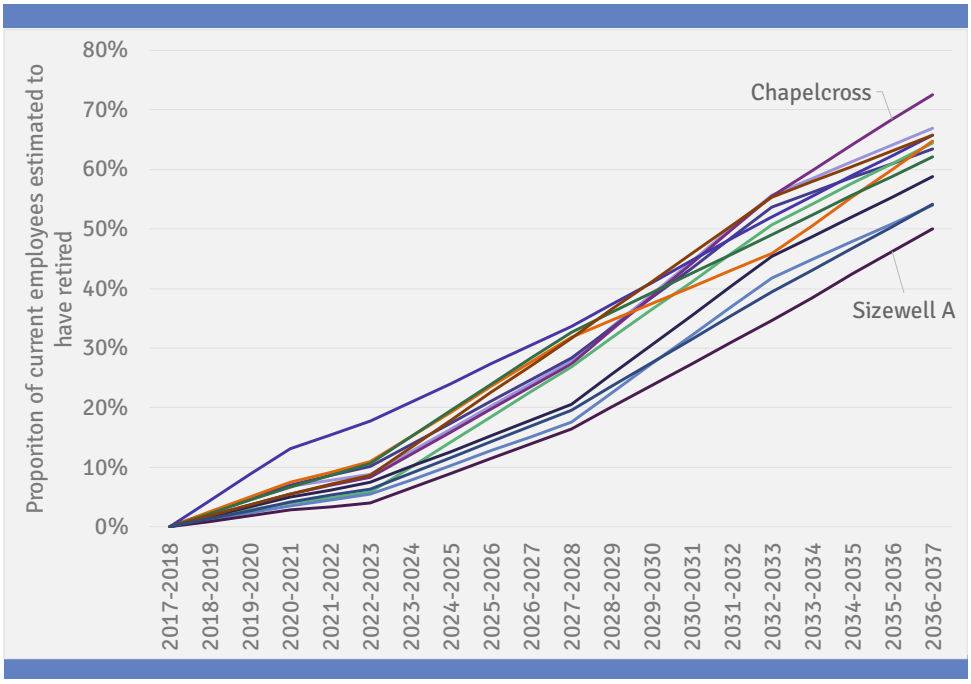
4.3.1 Generations

The age of current Magnox employees is highly relevant to the future impact of sites. As noted in section 3.1.2, Magnox workers tend to be older than the average UK worker, and this can have two opposing implications on the future impact of site downturn.

On the one hand, older workers are closer to retirement, and therefore any negative employment effects of redundancy will be felt over a shorter time period. That is, if an older employee was made redundant and never found another job, they would have less time to wait until retirement compared to a younger employee.

As is shown in the flowing figure, we estimate that a large proportion of current Magnox staff will have retired by the end of our forecast period. In particular, we estimate that over 70% of current staff at Chapelcross will have retired by 2036/37, but only about 50% of staff at Sizewell A.

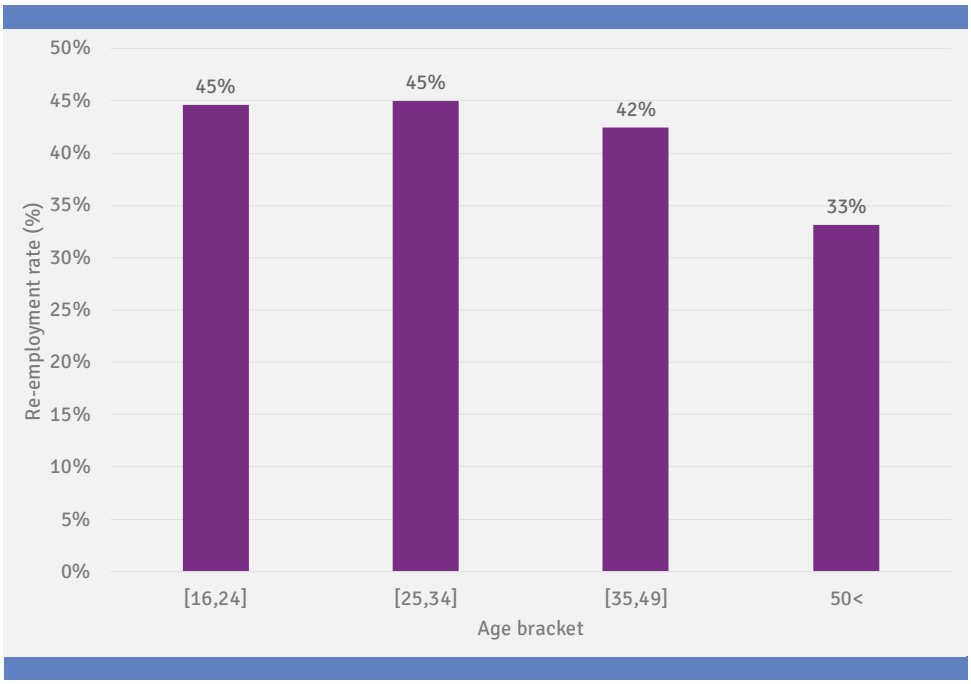
Figure 50: Estimated proportion of current employees that will have retired



Source: Economic Insight

However, on the other hand, evidence suggests that older workers are less likely to find another job after redundancy, and therefore the size of the negative employment effect may be greater for older employees. Data from the ONS, as illustrated below, shows that, on average, individuals that are 50 or older are 9 percentage points less likely to get re-employed compared to individuals in the age group 34-49.

Figure 51: Proporiton of people made redundant that are re-employed within three months, by age



Source: Economic Insight analysis of ONS data

This observation is well established in the literature, both within the UK and further afield. For example, a report by the OECD that discuss statistical evidence on re-employment rates in 14 countries concludes that older people (55-64 years) are less likely to be re-employed within a year of redundancy than prime-aged people (35-44 years) in all 14 countries examined.[25]

A number of hypotheses are put forward as to why this may be the case:

- Raterink (2012) suggests that older individuals have a lower preference for re-entering employment – in part due to apprehension about being able to fit in to a new role – and that unemployment benefits are usually higher for older people who have a longer labour market history.[26]

- Konle-Seidl (2017) discusses employer discrimination as a potential different explanation for the low re-employment rate of older people.[27]

It is also widely accepted that re-employment rates are lower among less well educated and lower skilled workers. We understand that on average, Magnox workers are at the higher end of the education and skills ranges, but there is variation within the workforce.

There are potential wider socio-economic impacts that an ageing population can have on society. Naturally, an ageing population will have increased demand for care and

[25] Quintini, G. and Venn, D., 2013. Back to work: re-employment, earnings and skill use after job displacement. Final report, OECD, October.
[26] Raterink, M., 2012. Re-employment rates of older workers: the effect of birth cohort. Business in the Community (BITC) International Longevity Centre-UK (ILC-UK); Prince's Initative for Mature Enterprise (PRIME), 2015. The missing million: pathways back into employment.
[27] Konle-Seidl, R., 2017. Retention and re-integration of older workers into the labour market: What works? (No. 17/2017). IAB-Discussion Paper.

health services. The literature suggests that an ageing population will also likely to put downward pressure on economic growth and upward pressure on pensions paid by the Government[28]. One way in which the society is able to respond to the ageing population is through addressing the potential barriers to later life learning, which would enhance productivity and build 'mental capacity and resilience'[29].

4.3.2 Migration

Another key labour supply factor is the extent to which local migration takes place. It is relevant for two reasons:

- Firstly, if those who lose their job are highly mobile, they may move out of the local area to find new work. This will both reduce local unemployment and be a positive employment outcome for the individual.

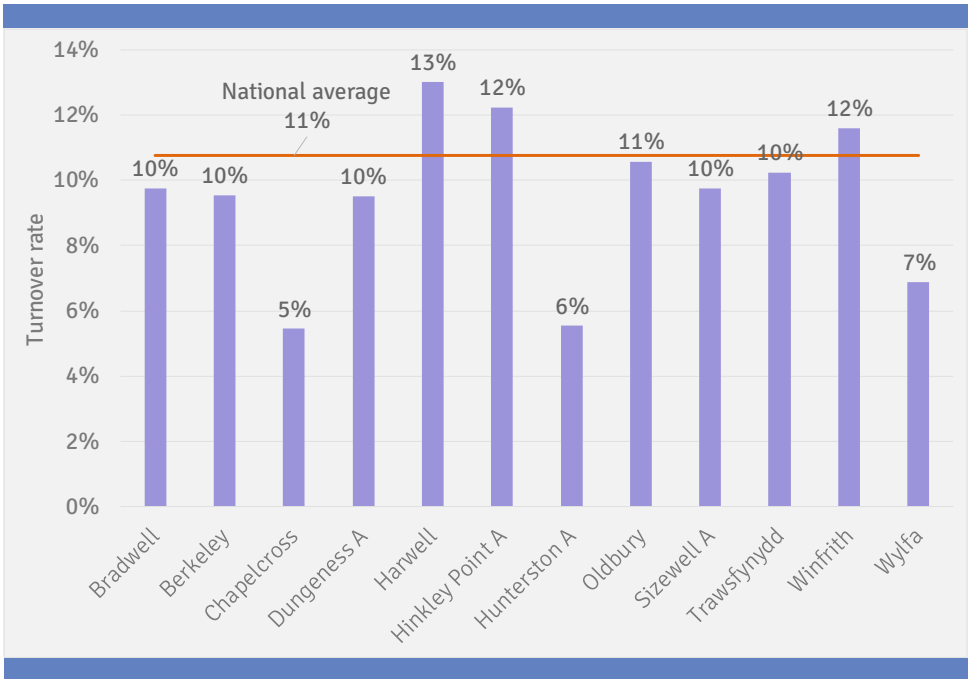
- Secondly, if there is a high migration rate, a local area may be more flexible in general, as discussed previously. As such, it may be that other individuals – those whose employment is not directly supported by a Magnox site – move to balance supply and demand of labour.

We understand from conversations with the NDA and Magnox that generally staff are hired from sites' local areas. This means that staff are less likely to move out of the area if made redundant, compared to if they moved to the area in the first place for the job at the Magnox site. However, it does not preclude them from moving away.

The figure below presents Economic Insight's central forecast for the turnover rate (inflows plus outflows, divided by average population) for the sites' local authority districts over the forecast horizon. As can be seen, the local authority districts of Chapelcross, Hunterston A, and Wylfa experience much lower levels of migration.

[28] *Nerlich, C. and Schroth J., 2018. The economic impact of population ageing and pension reforms. ECB Economic Bulletin, Issue 2 / 2018*
[29] *Leeson, G., Nanitashvili, N. and Zaloznik, M., 2016. Future of an Ageing Population.*

Figure 52: Turnover rate of sites' local authority districts (2016)



Source: Economic Insight

4.3.3 Training and education

Whilst the existing Magnox staff may supply their labour in other markets that require similar skills to their existing role, the provision of training and education can broaden the available opportunities. Indeed, re-skilling is often a fundamental aspect of re-employment after the closure of a large employer.

The extent to which training and education is currently available in local economies is not easy to quantify. Furthermore, the extent to which it will be available in the future is uncertain – and could be dependent on, in part, the actions that the NDA takes to mitigate negative socio-economic effects.

We note that the NDA and Magnox have made certain investments to support education and skills in the Magnox sites' local areas. For example, based on the NDA's latest available socio-economic spending report:[30]

- The NDA has committed £2m to support Grŵp Llandrillo Menai (the College Group comprising Coleg Llandrillo, Coleg Meirion-Dwyfor and Coleg Menai). The colleges offer a range of qualifications, including degrees, in a wide number of subjects such as Construction, Automotive Engineering and Building Services. The funding helps young people gain the right skills to take up opportunities in and around Snowdonia – which includes the Trawsfynydd site.

- Magnox has committed to spend nearly £100,000 on the Môn Communities First project, which provides support for individuals from deprived areas in Anglesey – which includes the Wylfa site. The programme offers training courses to improve basic skills, obtain qualifications and supports individuals into employment.

[30] *Sourced from the NDA's Socio-economic spend report 2016/17.*

4.4 Qualitative comparison of supply and demand factors

To evaluate the above supply and demand factors together, we first 'qualitatively', and then in the next section 'quantitatively', compare them. That is, there are both positive and negative factors in terms of the future employment impact for each site. In effect, what we want to do is 'trade-off' the positive factors with the negative factors.

The figure below presents our qualitative comparison of the supply and demand factors that can be directly compared within the group of sites. That is, we have omitted factors such as training and education and the availability of employment options outside the nuclear sector, because comparisons between sites are not feasible on these factors. We have also omitted the profile of site downturn, as ultimately all sites will reduce their activities to minimal levels. As detailed further subsequently: red is used as a negative indicator; grey as neither positive or negative; and green as a positive.

Figure 53: Qualitative comparison of supply and demand factors

	Current active adjacent nuclear site	Nuclear new build	Future economic growth	Existing staff retiring	Migration
Berkeley					
Bradwell					
Chapelcross					
Dungeness A					
Harwell					
Hinkley Point A					
Hunterston A					
Oldbury					
Sizewell A					
Trawsfynydd					
Winfrith					
Wylfa					

Source: Economic Insight

As can be seen, no site has all green indicators, or all red indicators, and therefore it is not easy to determine which are most at risk and least at risk. We partly address this with the quantitative labour market modelling below.

Red, grey and green indicators have been applied in the above qualitative comparison as follows:

- Current active adjacent nuclear site: green if it does; red if it doesn't.
- Nuclear new build: green if there is one planned and it is of high certainty; grey if there are proposals, but they are uncertain (Bradwell); and red if there is no expected new build.
- Future economic growth: green if 0.8ppt or more above national rate; red if 0.8ppt or more below national rate; grey otherwise.

- Existing staff retiring: green if 65% or more retired before end of forecast period; red if 55% or less retired before end of forecast period; grey otherwise.
- Migration: green if turnover rate 14% or more; red if 8% or less; grey otherwise.

4.5 Labour market modelling

To quantify the potential employment effects from site downturn, we have forecasted the potential 'over-supply' of labour from current Magnox employees. More specifically, we have:

- **Estimated the annual supply of labour provided by the cohort of staff currently employed by the Magnox sites**. This takes account of the fact that many of the employees at each site will retire over the forecast horizon.

- **Estimated the annual demand for labour provided by the cohort of staff currently employed by the Magnox sites**. This includes demand from the Magnox sites, currently active adjacent sites, and adjacent new build nuclear sites.

- **Subtracted the estimated supply from the estimated demand**. This results in a forecast of over-supply for the current cohort of Magnox staff in relation to employment within the nuclear sector. Put another way, this predicts when there will likely be more staff seeking employment in the local nuclear sector compared to the demand for staff in the local nuclear sector.

Our modelling focuses on factors that affect employment within the nuclear sector because these are more certain. For example, we know that there are adjacent active nuclear sites to some of the Magnox sites that could provide alternative employment. We are less certain about how the relative job prospects outside of the nuclear sector vary by site.

Our estimates should be interpreted with caution. A range of assumptions (detailed subsequently) are required to calculate the forecasts and they therefore come with a degree of uncertainty. However, the forecasts do provide a way to trade-off the supply and demand factors, and they highlight 'where' and 'when' there may be negative employment effects from site downturn. More attention should be paid to consecutive periods of high over-supply, rather than specific figures in individual years.

Of course, any over-supply of labour for the local nuclear sector may be met by demand from local economies, or from further afield. These estimates are therefore not an estimate of unemployment, but give an indication of the number of current staff that may be 'at risk' of having to seek employment outside the nuclear sector.

The two figures on the following pages show our central estimates of over-supply of labour in absolute terms (i.e. number of individuals) and as a proportion of current employment at the site-level. We discuss notable observations subsequently, along with the results of sensitivity analysis.

Figure 54: Forecast labour over-supply (number of employees)

	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022	2022-2023	2023-2024	2024-2025	2025-2026	2026-2027	2027-2028	2028-2029	2029-2030	2030-2031	2031-2032	2032-2033	2033-2034	2034-2035	2035-2036	2036-2037
Berkeley	0	0	36	29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bradwell	0	108	128	126	123	121	118	111	105	103	97	88	81	70	69	62	59	53	42	47
Chapelcross	0	42	112	61	120	91	26	77	83	136	146	139	126	110	102	86	81	71	51	53
Dungeness A	0	0	32	37	35	0	0	26	45	43	36	29	21	14	7	0	0	0	0	0
Harwell	0	0	0	0	0	0	0	0	0	0	90	134	127	121	115	107	97	86	75	65
Hinkley Point A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hunterston A	0	0	0	0	0	0	0	17	26	21	15	11	3	1	0	0	0	0	0	0
Oldbury	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sizewell A	0	0	0	11	0	0	0	0	0	23	89	80	72	65	50	50	42	35	27	0
Trawsfynydd	0	42	38	41	58	24	7	0	0	0	11	80	89	86	80	79	70	66	53	49
Winfrith	0	0	31	0	27	109	136	130	123	115	108	101	94	86	79	71	66	63	58	54
Wylfa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Source: Economic Insight analysis
Notes: Figures over 50 are highlighted in beige; over 75 in orange; and over 100 in red.

Figure 55: Forecast labour over-supply (percentage of current employees)

	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022	2022-2023	2023-2024	2024-2025	2025-2026	2026-2027	2027-2028	2028-2029	2029-2030	2030-2031	2031-2032	2032-2033	2033-2034	2034-2035	2035-2036	2036-2037
Berkeley	0%	0%	46%	37%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Bradwell	0%	79%	93%	91%	89%	88%	85%	80%	76%	74%	70%	64%	58%	51%	50%	45%	42%	39%	30%	34%
Chapelcross	0%	19%	52%	28%	55%	42%	12%	35%	38%	63%	68%	64%	58%	51%	47%	40%	37%	33%	24%	25%
Dungeness A	0%	0%	21%	24%	22%	0%	0%	17%	29%	28%	23%	18%	14%	9%	4%	0%	0%	0%	0%	0%
Harwell	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	39%	58%	56%	53%	50%	47%	42%	38%	33%	28%
Hinkley Point A	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Hunterston A	0%	0%	0%	0%	0%	0%	0%	11%	18%	15%	10%	8%	2%	0%	0%	0%	0%	0%	0%	0%
Oldbury	0%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Sizewell A	0%	0%	0%	5%	0%	0%	0%	0%	0%	11%	44%	39%	36%	32%	25%	25%	21%	17%	13%	0%
Trawsfynydd	0%	26%	24%	26%	37%	15%	4%	0%	0%	0%	7%	50%	56%	54%	50%	49%	44%	41%	33%	31%
Winfrith	0%	0%	19%	0%	17%	68%	84%	81%	76%	72%	67%	63%	58%	54%	49%	44%	41%	39%	36%	34%
Wylfa	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Source: Economic Insight analysis
Notes: Figures over 25% are highlighted in beige; over 50% in orange; and over 75% in red.

As can be seen from the figures:

- Bradwell, Chapelcross, Harwell and Winfrith have long periods of high over-supply of labour. These sites do not have adjacent active sites, and there are no 'certain' nuclear new builds. Notably, there are plans for Bradwell B, but we understand this is still only at the proposal stage and therefore hasn't been included within the modelling.

- On the other hand, Hinkley Point A, Oldbury, Berkeley and Wylfa appear insulated from potential negative employment effects due to new builds and adjacent sites (see further sensitivity analysis below).

- On a proportional basis, over-supply appears less significant at Harwell due to its relative number of employees.

- Over-supply generally reduces over time, due to current staff reaching retirement age.

Notable assumptions used for our 'central' estimates include:

  - 10% of jobs at adjacent sites will be available for Magnox staff. This takes account of natural turnover of staff.
  - The employment level of adjacent sites remains constant over the forecast period, at current rates.
  - 50% of jobs at nuclear new builds will be available for Magnox staff.
  - The employment level at new builds is assumed to remain constant at its operational level from the year in which construction is expected to begin.
  - Hinkley Point C, Oldbury B, and Wylfa Newydd will be built, with construction starting in 2019, 2021, and 2019 respectively.

In addition to our central estimates, we have also undertaken sensitivity analysis to explore how our results change if different assumptions are made. The results of this analysis are as follows.

- Reducing the assumed proportion of jobs at nuclear new builds that will be available for Magnox staff from 50% to 25% introduces sometimes significant over-supply from staff at Wylfa. However, the periods are less prolonged than for Bradwell, Chapelcross, Harwell and Winfrith.

- Reducing the assumed proportion of jobs at adjacent sites that will be available for Magnox staff from 10% to 5% marginally increases the estimated over-supply of staff from Dungeness A, Hunterston A and Sizewell A. However, the over-supply remains less than that around Bradwell, Chapelcross, Harwell and Winfrith.

The results can be seen in section 6.3 in the appendix.

The sensitivity analysis therefore suggests that the risk of unemployment does depend on precisely how many jobs at current and new sites could be taken by Magnox staff. But, there are four sites that do not have adjacent active sites or planned new builds for which the risk is more likely to be significant.

5. Conclusions and recommendations

This chapter provides a conclusion to our analysis, and presents recommendations for going forward.

As is set out in chapter 3, the sites currently make sizable, but varying, contributions to their local economies. We presented a number of ways of quantifying the economic impacts, including both in absolute and relative terms. Furthermore, we assessed the current strength of local economies and their dependence on Magnox sites. In Chapter 4, we take a forward-looking approach and assess the potential future impact of site downturn on the local employment. As such, our work provides a range of evidence which can be used to inform the NDA's decisions regarding its socio-economic mission.

The main challenge we foresee going forward is using this, and other evidence, to prioritise 'where' and 'how' the NDA provides support to sites' local economies. In the sections below, we provide our initial thoughts in relation to: identifying specific objectives; forms of support; and practical approaches to prioritisation.

5.1 Identifying specific objectives

As is set out in this report, there are multiple ways of quantifying the impact of sites on their local economies – and these different approaches can imply different priorities. As such, identifying specific socio-economic objectives may help guide the prioritisation process.

Due to the fact that all resources are scarce, implicit trade-offs between supporting different initiatives or groups of individuals have to be made. One aspect to consider is whether it is desirable to support as many people as possible (however measured), or to support those most in need (which is also subject to measurement choice). For example, whilst two options for supporting two different local economies may result in the same immediate employment impact, one area many be more deprived, and therefore it could be judged that any employment is more valuable to it.

Relatedly, the local economies of sites could be treated as individual entities, and support could be focused on those that could gain the most, or are most in need.

Alternatively, individual support initiatives could be evaluated and prioritised, which may result in a different allocation of resources.

Furthermore, specificity around 'where' local communities are may support prioritisation decisions. For example, the wider a local area is defined, generally the larger the benefits, but the less 'local' it is to a site.

Such implicit trade-offs are hard to make, and can be hard to specify in advance. Therefore, whilst it may not be possible to define more specific objectives, a greater appreciation of the above types of issues and trade-offs may make the prioritisation process smoother and more efficient.

5.2 Forms of support

Here, we provide some 'food for thought' in relation to the forms of support that could be provided to support local economies. These include both activities that may mitigate the immediate effects of downturn (e.g. unemployment) and the subsequent 'symptoms' (e.g. poor health).

- **Skills development**. One approach to limit any negative employment impacts is to support individuals in finding a new job by increasing the range of jobs that the individual may be suitable for. Specifically, by supporting the development of new skills that are valuable in the workplace. Initiatives could be tailored to what jobs are likely to be prevalent in the local area, or what jobs require skills that are already similar to those possessed by those being displaced. The benefits from supporting younger and lower skilled individuals may be greater.

- **Support new or existing businesses**. Another approach could be to support the creation of new jobs, either with existing businesses or new businesses. Support could be tailored with the objective of: diversifying the local economy; furthering the specialisation in energy; and/or fostering high value or high growth sectors. Such support may be less 'direct' in terms of who it supports. For example, those displaced may not be guaranteed that they will benefit from the newly available jobs.

- **Strategic placement of new facilities**. Related to the above, it may be possible for jobs to be directly created through establishing new NDA-related facilities in areas in which job losses may occur. Whilst a location close to an existing NDA site may not be the most efficient choice on a standalone basis, taking into account the mitigating effects on site downturn may mean the choice on the whole is efficient.

- **Relocation support**. As an alternative to supporting job matching or the development of new jobs in a local area, support could be given to individuals to relocate to other areas of the country. This, of course, comes with dangers of creating further negative effects for a local area – such as losses for local businesses.

- **Transport**. Similar to the above, support could be used to help individual access jobs from further away. For example, this could include helping develop new public transport routes.

- **Healthcare support**. Support could target the physical and mental health issues that could arise from loss of employment. This could have further positive effects on re-employment rates.

The effectiveness of each of these forms of support can be expected to vary, and be dependent on both the initiative's specification and the group it is designed to support.

5.3 Practical approaches to prioritisation

Finally, drawing on our experience of advising both public and private sectors clients, we discuss some practical approaches to prioritising the allocation of resources.

First and foremost, we note that having a deep understanding of 'how' impacts arise, 'who' they affect, and 'how' options can support them is critical to making the best prioritisation decisions. As the main impacts of Magnox sites occur through the direct employment channel, it is highly important to understand the existing skills mix and how this aligns, or could align in the future, with roles outside of Magnox.

With the available information, we discuss two high-level practical approaches that can be used to make prioritisation decisions.

- **Scorecard**. Consistent with our approach of evaluating the strength and dependence of local economies, options can be prioritised through creating a scorecard. This involves specifying a range of metrics that options will be evaluated on, along with a scoring and weighting approach. Those options with the highest aggregate score are chose. The approach involves judgement in its design, but then is an objective way to trade-off the pros and cons of different options.

- **Facilitated panel evaluation**. Recognising the fact that it can be hard to specify a range of metrics, scoring and weighting, a 'facilitated panel evaluation' approach can be more effective. This approach involves a selected panel of individuals being provided with the same evidence and, with the support of a facilitator, making prioritisation decisions through workshops. This approach allows for the for the fact that information on options is often 'incomplete', and relies on the expert judgement of individuals to assess the evidence as a whole.

6. Appendix

6.1 Sites' local authority district and those adjacent to it

The table below specifies the local authority district that each Magnox site is located in, along with the adjacent local authority districts.

Table 14: Sites' local authority districts

Magnox site	Site's local authority district	Adjacent local authority districts
Berkeley	Stroud	South Gloucestershire Cotswold Gloucester Tewkesbury
Bradwell	Maldon	Rochford Colchester Chelmsford Braintree
Chapelcross	Dumfries and Galloway	Carlisle Scottish Borders South Ayrshire East Ayrshire South Lanarkshire
Dungeness A	Folkestone & Hythe	Canterbury Dover Ashford Rother

Harwell	Vale of White Horse	Oxford South Oxfordshire West Oxfordshire West Berkshire Swindon Cherwell
Hinkley Point A	West Somerset	Taunton Deane Sedgemoor Mid Devon North Devon
Hunterston A	North Ayrshire	Inverclyde Renfrewshire East Renfrewshire East Ayrshire South Ayrshire
Oldbury	South Gloucestershire	Wiltshire Bath and North East Somerset Bristol, City of Stroud Cotswold
Sizewell A	Suffolk Coastal	Waveney Mid Suffolk Babergh
Trawsfynydd	Gwynedd	Ceredigion Isle of Anglesey Conwy Denbighshire
Winfrith	Purbeck	Poole East Dorset West Dorset North Dorset
Wylfa	Isle of Anglesey	Gwynedd

6.2 Literature review of previous studies related to site closures

This section sets out a summary of previous studies related to site closures. The first paper, by the former Department for Business, Innovation and Skills, is itself a literature review of studies related to site closure. We have also reviewed a number of relevant papers that do not feature in the aforementioned literature review.

6.2.1 'Feasibility Study: The economic impact of industrial plant closure in the UK, with an emphasis on energy intensive industries', Department for Business, Innovation and Skills, 2014

This paper is based on a literature review of studies related to the economic impacts of plant closure, with a focus on energy-intensive industries in the UK.

52 studies, published between 1972 and 2012, were included in the in-depth review. The literature was primarily related to plant closures in the UK, with half a dozen in Australia, a small number relating to Nordic countries (Sweden, Norway and Denmark) and two studies relating to the US. The vast majority of studies used regions as a functional economic area within which to understand the impact of plant closures, with some consideration of national impact and implications. For most studies, impacts were identified and examined post-closure, with a range of 6 months to 10 years post-closure used to measure impact. A small number of studies predicted future impact of a plant closure less than 6 months after the closure.

In order to systematically analyse the literature, the authors developed an analytical framework, which consisted of the following.

- Impacts can be identified in terms of five '**economic actors**'. Specifically:
  - investment capital (such as from shareholders and directors);
  - fixed capital (land, buildings, machinery, etc.);
  - employees;
  - suppliers; and
  - loans, taxes and payments (including fiscal flows to creditors, HMRC, and local authorities).
- Impacts can arise though three core '**impact domains**':
  - income (e.g. dividends for shareholders, wages for employees, taxes for governments);
  - employment; and
  - place / community.
- Impacts can be considered as taking place over three **time periods**:
  - immediate;
  - adaption (generally up to around 12 months after closure); and
  - longer term.

The findings of the paper in relation to employees, supply chains, taxes, and policy implications are detailed below.

Employee effects

In relation to employment effects of plant closures, the authors conclude that the papers reviewed illustrate:

- Strong evidence of mostly negative impacts on income and employment for dismissed workers, with some evidence of long term wage scarring.
- Some evidence of long term increased vulnerability of dismissed workers in future economic downturns.
- Negative income and employment impacts are most acute and long lasting for older workers.
- Dismissed workers that do not find new employment are more likely to report health problems compared to those who do find work.
- Reemployment rates for dismissed workers are heavily influenced by the level of vacancies and economic growth in the regional economy.
- Over the longer term, changes to travel to work patterns for dismissed workers are more likely. The extent of this change is heavily dependent on local factors.
- New employment is often in a diverse range of sectors and is typically more likely to be on part-time or temporary contracts.
- Overall, employee impacts are highly segmented – even individualised – including costs and benefits, with outcomes highly dependent on the substantial contextual influence of (national, regional and local) labour markets.

More specifically, the paper identifies the following quantifications in the literature.

- Three months after the closure of the MG Rover plant in Longbridge, only a quarter of dismissed workers had found employment. In the adaption period, only 34% of dismissed workers were still unemployed and more than half were in full-time employment. Those that were still unemployed were likely to be: older; separated/divorced or single; report higher levels of anxiety; and report that health problems interfered with their ability to carry out normal tasks.
- Tomaney et al. (1997) found a reemployment rate of 44% with an average period of unemployment of just 19 weeks, following the closure of Swan Hunter shipyard in the North East of England in the mid-1990s. The highest proportions of unemployed were in the 50 to 59 age bands; close to half of all workers in these groups remained out of work in the long term.[31]
- Mason and Pinch (1991) considers two cases, each in the manufacturing sector, in which only 24% of workers remained unemployed 18 months after the plant closure. The majority of unemployed had previously operated in supervisory roles.

[31] *'Workers' experience of plant closure: the case of Swan Hunter on Tyneside. Discussion Paper No. 97/1', Tomaney et al., Centre for Urban and Regional Development Studies, 1997.*

- Shuttleworth et al. (2005) analyses the closure of the Harland and Wolff shipyard in Belfast in 2001. This study shows that 6 months following the closure 67% of workers had found alternative employment; one year later 80% of workers had found new jobs. The authors further note that there appeared to be a high degree of sustainability in these job outcomes (95% of those in employment at six months were still in employment at eighteen months).[32]

- Shuttleworth et al. (2005) also note than in Northern Ireland: nine months after the Coats Viyella factory closed in Lurgan in 1997 some 70% of the former employees were in work again. Significantly, over 50% had found work in other companies in the textile sector. Due to the fact that many nearby companies had unfilled vacancies, many former Coats Viyella employees were in a position to choose between several jobs.

- Dawley (2008) notes that in the case of the closure of Amtel in the North East of England in 2008, 17% of workers resettled outside of the region following the closure. A high share of relocating workers was in higher level occupations.[33]

Supply chain effects

The impact of plant closure on suppliers is established in a number of studies. This analysis is limited to negative impacts associated with short-term responses and adaption to plant closure. The analysis establishes that plant closure can result in immediate significant financial loss to suppliers, including the precipitation of job loss.

Tax effects

The impact of plant closure on loans, taxes and payments is a limited feature of studies examined within the literature. Impacts in terms of loss to Local Authorities as a result of reduced business rates are identified, along with increased social security payments, and in rare cases the costs associated with negative health impacts.

Regeneris (2005) quantifies the effect of the closure of the MG Rover plant in Longbridge in terms of: corporation tax; employer national insurance contributions; employee income tax and national insurance contributions; and additional benefits paid.[34]

Policy implications

In relation to employees, four main policy responses are identified in the literature:

- Addressing psychological issues of dismissed workers is important to prevent long term underemployed and unemployed.

- Continued effort and investment is required to increase the skill levels of workers in ways that are appropriate to the potential job opportunities available to them.

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[32] 'Redundancy, readjustment, and employability: what can we learn from the 2000 Harland and Wolff redundancy?', Shuttleworth et al., Environment and Planning, 2005.
[33] 'Advanced manufacturing skills tracking survey: A report investigating the post-closure resettlement patterns of the former Atmel workforce', Dawley, Centre for Urban and Regional Development Studies, 2008.
[34] 'Closure of MG Rover: economic impact assessment. Stage 2 report', Regeneris Consulting, 2005.

- Ongoing monitoring of strategic companies is noted as an important element of modern industrial policy for local economic development policy makers (as a means of anticipating. preventing and/or planning to mitigate job losses).

- Support for those with the lowest skill levels is also consistently identified as an important policy response.

Regeneration of the local economy through investment in new infrastructure and site development (to enable new forms of economic activity) is clearly noted as an important element of post-plant closure strategy. In this regard, three considerations are noted:

- Housing and neighbourhood policy must compliment economic development investment.

- Creation of high-tech jobs can have negative consequences (for example, increased commuting and labour market segregation).

- A balance between high tech job creation and other economic development policy is important.

6.2.2 'The economic impact of the operation and closure of a nuclear power station', Lewis, Journal of Regional Studies, 1986

This paper first discusses the economic impact that the Trawsfynydd nuclear power station has in terms of employment opportunities while operational, and second the potential unemployment effects after closure. The site is located within the Porthmadog and Ffestiniog 'Travel-to-Work-Area', where over 86% of the 600 staff resided.

The two sources of income to the local economy were the salaries of the plant's staff, and the plant's purchases of goods and services from local traders. It was noted that although local purchases were limited, they did comprise a significant portion of the total turnover of multiple local traders. The sum of the two sources was equal to £7.25m in 1984.

In the event of plant closure, the policy at the time gave workers three options: retire; redeploy at another power station in another area; or voluntary severance. In a survey completed by 45% of staff, less than 1% of respondents said that they would likely 'seek employment outside the area'. The choice of option depended more on the occupation in the power station than it did on age.

6.2.3 'Analyzing the Socioeconomic Impacts of Nuclear Power Plant Closures', Kayastha et al., Worcester Polytechnic Institute, 2016

This paper investigates the socio-economic impacts of nuclear power plant closures, based on four cases in the US. The authors analysed publicly available economic data and newspaper articles, and conducted interviews with nine local government officials and staff. The site closures took place between 1996 and 2012.

The economic impacts that were identified include:

- job losses of the utility workers;

- decreased tax contribution paid to the host community from the plant;
- lowered citizen expenditure;
- funding adjustments for schools leading to decrease in education quality; and
- changes to the town's economic outlook and morale.

The authors found that effect on local tax revenues was large, and that this had a number of significant implications. For example, evidence was found of increased residential taxes, lower local government spending, and public-sector redundancies.

Unexpected site closures were also identified as contributing to negative impacts. If a local community was not expecting a site to close, it had not made effective plans to deal with the consequences.

The paper also identified a number of social impacts, such as the loss of civic activities and changing demographics as a result of working age individuals (and their families) migrating.

6.2.4 'The impact of job loss on family mental health', Mendolia, 2001

This paper looks at the relationship between job loss and family mental well-being. The dataset used in the analysis is the sample of married/cohabitating couples from the first 14 waves of the British Household Panel Survey. The sample size is 2,521 households. The paper looks at cases of redundancy, which is allowed in the British legislation under three cases: 'total cessation of the employer's business (whether permanently or temporarily), cessation of business at the employee's workplace and reduction in the number of workers required to do a particular job.'

The author uses a dynamic panel probit specification to model the probability of poor mental health following a job loss. The panel model is used to control for individual-specific unobserved heterogeneity.

The results of the econometric estimation show that a husband's job loss due to redundancy increases the probability of poor mental health for both individuals, leading to significant negative effect on the family's well-being. Moreover, the model shows that in the case of the husband losing a job due to dismissal, only the man's probability of poor mental health will increase, the probability for the partner is statistically insignificant. Women are found to be particularly sensitive to the income shock, even if the household was receiving income support, the perception of the shock does not change for the woman.

The study also shows an inverse U relationship between age and mental health, and a positive relationship between the probability of poor mental health and the individual's level of education.

6.2.5 'Serious health events following involuntary job loss in New Zealand meat processing workers', Keefe et al, International Journal of Epidemiology, 2002

This paper looks at health consequences from involuntary job loss in New Zealand. The sample is a meat-processing plant that ceased operations in 1986 due to changes in the elected ruling government. The author uses another operational meat-processing plant as a 'control group' to compare with the redundancy group. It is argued that factory closure studies are well-placed to comment on the causal relationship between job loss and deteriorated health conditions, given that they have

the following characteristics: '(1) a large number of employees; (2) a similar number of controls in a similar factory; (3) high response rates; (4) data before the closure; (5) both self-reported and objective measures of health; (6) follow-up for ⩾5 (ideally 10) years, and; (7) minimal loss to follow-up.'

Mortality and hospital admissions were compared for the sample of two plants pre- and post-closure. Control variables included are sex, years of experience in meat work, ethnicity, age and year of hire.

The study shows that the risk of suicide was double among the redundancy group compared to the control group, but statistically insignificant. Additionally, deaths from external injuries such as car crashes were almost double among the redundancy group but also statistically insignificant.

However, the risk of self-harm doubled among the redundancy group post-closure and was statistically significant even after controlling for the various independent variables in the model.

6.3 Sensitivity analysis of labour market modelling

The figures on the following pages show the results of the labour market modelling under the two sensitivity scenarios tested.

Figure 56: Forecast labour over-supply (number of employees) – sensitivity scenario with proportion of new jobs available at adjacent nuclear new builds suitable for ex-Magnox staff at 25%

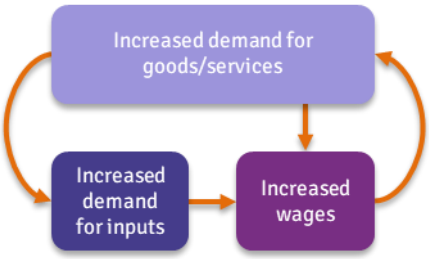
	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022	2022-2023	2023-2024	2024-2025	2025-2026	2026-2027	2027-2028	2028-2029	2029-2030	2030-2031	2031-2032	2032-2033	2033-2034	2034-2035	2035-2036	2036-2037
Berkeley	0	0	36	29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bradwell	0	108	128	126	123	121	118	111	105	103	97	88	81	70	69	62	59	53	42	47
Chapelcross	0	42	112	61	120	91	26	77	83	136	146	139	126	110	102	86	81	71	51	53
Dungeness A	0	0	32	37	35	0	0	26	45	43	36	29	21	14	7	0	0	0	0	0
Harwell	0	0	0	0	0	0	0	0	0	0	90	134	127	121	115	107	97	86	75	65
Hinkley Point A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hunterston A	0	0	0	0	0	0	0	17	26	21	15	11	3	1	0	0	0	0	0	0
Oldbury	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sizewell A	0	0	0	11	0	0	0	0	0	23	89	80	72	65	50	50	42	35	27	0
Trawsfynydd	0	42	38	41	58	24	7	0	0	0	11	80	89	86	80	79	70	66	53	49
Winfrith	0	0	31	0	27	109	136	130	123	115	108	101	94	86	79	71	66	63	58	54
Wylfa	0	0	0	94	58	0	2	36	59	107	101	82	68	44	35	21	7	0	0	0

Source: Economic Insight analysis
Notes: Figures over 50 are highlighted in beige; over 75 in orange; and over 100 in red.

Figure 57: Forecast labour over-supply (number of employees) – sensitivity scenario with Proportion of jobs that could be filled by current Magnox staff at 5%

	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022	2022-2023	2023-2024	2024-2025	2025-2026	2026-2027	2027-2028	2028-2029	2029-2030	2030-2031	2031-2032	2032-2033	2033-2034	2034-2035	2035-2036	2036-2037
Berkeley	0	0	36	29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bradwell	0	108	128	126	123	121	118	111	105	103	97	88	81	70	69	62	59	53	42	47
Chapelcross	0	42	112	61	120	91	26	77	83	136	146	139	126	110	102	86	81	71	51	53
Dungeness A	0	0	70	75	72	29	28	63	82	81	74	66	59	51	44	34	31	25	20	15
Harwell	0	0	0	0	0	0	0	0	0	0	90	134	127	121	115	107	97	86	75	65
Hinkley Point A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hunterston A	0	0	0	0	0	0	23	55	65	60	54	50	42	39	34	24	24	15	6	9
Oldbury	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sizewell A	0	0	22	49	37	15	0	11	26	61	127	118	111	103	88	89	80	73	65	21
Trawsfynydd	0	42	38	41	58	24	7	0	0	0	11	80	89	86	80	79	70	66	53	49
Winfrith	0	0	31	0	27	109	136	130	123	115	108	101	94	86	79	71	66	63	58	54
Wylfa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Source: Economic Insight analysis
Notes: Figures over 50 are highlighted in beige; over 75 in orange; and over 100 in red.



6.4 Input-output modelling

Input-output modelling is a standard technique to estimate the effects of economic activities on whole economies, geographic regions, and industries. It incorporates the interdependencies present in modern economies. For example, an increase in final demand for one type of product will cause an increase in demand for the inputs into production, and the wages earned by employees in related sectors will increase demand for other goods and services, thus further increasing demand for final outputs.

More specifically, economic impacts can be broken down into three channels:

- **Direct effects** arise as an immediate impact from the activities being studied. These include the value created by producing the final good or service, and the employment required to do so.
- **Indirect effects** arise through the supply chain. An increase in demand for a final output will also increase demand for its inputs, and the inputs to those inputs, and so forth.
- **Induced effects** arise as a result of increased wages to the employees of the organisation(s) producing the final output, and those in the supply chain.

Whilst standard accounting information can be used to calculate direct effects, input-output modelling quantifies the indirect and induced effects.

Typically, economic impact is measured in terms of:

- gross value added (GVA);
- employment; and
- tax receipts.

Our in-house input-output model has been developed to estimate the economic impacts of organisations / industries defined by the user, on geographic regions of choice. The basis of our model is the set of input-output analytical tables produced by the ONS for the UK as a whole. These tables show the flows of products and services in the economy, and are themselves based on the same underlying data that is used to produce estimates of Gross Domestic Product (GDP).

To reflect the regional differences in the economy, and to estimate localised economic impacts, our model adjusts the UK level data to reflect the regions we are focusing on. In particular, we use the location quotient approach that is consistent with that used by the ONS and advocated by academics specialising in input-output modelling. These location adjustment calculations are also based on data from the ONS.

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